Activity patterns of birds in the central Free State, South Africa

Volume II

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5 Species accounts: Passerines

5.1 Alaudidae: Larks, Sparrowlarks

Structural characteristics distinguishing larks from other passerines include the lack of an ossified pessulus in the syrinx and scutes covering the posterior surface of the tarsus instead of an unbroken lamina (Green 1985). The 96 species occur worldwide except in New Zealand and Antarctica; 31 species are found in southern Africa (Hockey *et al.* 2005) with approximately half of the species occurring in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b). Nine species were recorded at Glen. Based on SABAP1 distribution maps (Harrison *et al.* 1997b), the Eastern Long-billed Lark *Certhilauda semitorquata* and Large-billed Lark *Galerida magnirostris* could also potentially occur at Glen, but they were not recorded. In both cases Glen is on the edge of their respective distributions.

R492 Melodious Lark..*Mirafra cheniana*

The Melodious Lark is endemic to southern Africa, where it is primarily restricted to South African grasslands, preferring open climax grassland dominated by Red Grass *Themeda triandra* (Dean 1997e). Transformation of these habitats through land-use changes may impact this species negatively (Barnes 2000h). Consequently, it is close to qualifying for or is likely to become vulnerable to extinction in the near future and is classified as near-threatened (Barnes 2000h). There is no evidence of regular seasonal movements, but numbers vary from year to year at specific localities (Tarboton *et al.* 1987; Present study), implying local movements (Dean 1997e).

The birds at Glen

All Melodious Lark records at Glen refer to birds in the grassland. The analysis distinguishes between displays, other vocalisations and birds seen only. Displays involved singing males, either in the air or from a perch, with the song consisting of various sounds interspersed with imitations of other bird species. The observer's influence on displays is assumed to be negligible. Other vocalisations were usually associated with nesting and were distinct from displays, but in contrast to the displays, it is likely that the observer's presence did have an influence on its occurrence on some occasions. Sight only records were often the result of birds being flushed, and was thus significantly influenced by the observer's presence. The bulk of the records consists of displays (88.5%), followed by birds seen only (7.1%) and non-display vocalisations (4.5%) (Table 5.1a). The 'seen only' data is not analysed specifically, but is used to assess the overall occurrence of the Melodious Lark. Data was recorded separately for each minute since the beginning of the study for displays, and since 2001/2 for other vocalisations and for birds seen only (Table 5.2). Figures start on page 567.

Table 5.1: R492 Melodious Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.885	5 055	114 612	4.4	displays	25.5	656	167	30
0.045	257	114 612	0.2	non-display voc.	10.5	656	69	4
0.071	403	114 612	0.4	seen only	22.1	656	145	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.667	4	1 188	0.3	displays	7.0	43	3	1
0.333	2	1 188	0.2	seen only	4.7	43	2	1

Table 5.2: R492 Melodious Lark: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
displays	beginning	17 201	547 500	3.1
non-display voc.	late winter 2001/2	182	345 105	0.1
seen only	late winter 2001/2	185	345 105	0.1

Annual occurrence of displays in the grassland: Overall, recorded on 25.5% of the days with an activity index of 30 (Table 5.1a). Normally recorded for 5–7 seasons each year, but during nine seasons in 2005/6 and only 3–4 seasons in 2000/1, 2002/3 and 2007/8 (Fig. 5.1; Fig. 5.2). Daily reporting rates ranged from 0.5 to 99.2% with 80.2% bird-days attaining relatively low reporting rates (Fig. 5.1). The years 1997/8, 1999/0 and 2001/2 stand out for having relatively high median daily reporting rates compared to other years, and together with 2004/5, these were the only years with high reporting rate days (Fig. 5.1; Fig. 5.2). Activity intensities were variable (Fig. 5.1).

Seasonal occurrence of displays in the grassland: Displays were restricted to spring, summer and autumn, occurring most frequently during late spring, summer and early autumn, and infrequently during early spring, mid-spring and late autumn (Fig. 5.1; Fig. 5.2). The occurrence of high reporting rate days was limited to different seasons in the four peak years mentioned above (Fig. 5.2). When the data for all years are combined, median daily reporting rates are similar for all seasons (Figs. 5.1).

Daily occurrence of displays in the grassland: Overall, activity occurred most frequently in the early mornings after sunrise and was approximately half as frequent during the rest of the day, except after sunset, when it was infrequent (Fig. 5.1). This pattern, however, is only applicable for low reporting rate days (Fig. 5.3). For intermediate and high reporting rate days, activity was very frequent throughout the day, except after sunset, when it was infrequent (Fig. 5.3). Seasonally, activity was recorded during all segments between sunrise and sunset from late spring to mid-autumn only; during other seasons, activity was limited to 1–2 early morning segments (Fig. 5.4). Segment combinations occurring during at least 5% bird-days included three combinations involving S1–S2 and another combination involving all 12 segments between sunrise and sunset (Fig. 5.5). The latter combination was restricted to early and mid-autumn (Fig. 5.5). Collectively these combinations accounted for a quarter of all bird-days (Fig. 5.5).

The first activity of the day was typically noted before mid-morning, occurring earlier on intermediate and high reporting rate days (usually before sunrise) than on low reporting rate days, with limited seasonal variability (Fig. 5.4; Fig. 5.6). The timing of the last activity of the day was highly variable, but it normally occurred later in the day (shortly before or after sunset) on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.4; Fig. 5.6).

Activity intensities differed markedly between low, intermediate and high reporting rate days, changing from being relatively low during all segments on low reporting rate days, to being relatively high during morning segments on intermediate reporting rate days, and, finally, to being high throughout the day (Fig. 5.3).

Median daily segment reporting rates were similar for all segments of the day for low reporting rate days, high in the early morning on intermediate reporting rate days, and high throughout most of the day on high reporting rate days (Fig. 5.3).

Early morning occurrence of birds heard during 2007/8: Not recorded in the drainage line and recorded infrequently in the grassland (Table 5.1b & c).

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Annual occurrence of non-display vocalisations in the grassland: Overall, recorded on 10.5% of the days with an activity index of four (Table 5.1a). Recorded for 0–4 seasons each year (Fig. 5.7). Daily reporting rates ranged from 0.5 to 12.7% with 85.5% of the days attaining relatively low reporting rates (Fig. 5.7). Compared to other years, activity was relatively high during 2001/2 and 2004/5, both years having relatively high annual frequency indices and median daily reporting rates (Fig. 5.7). Activity intensities were uniformly low (Fig. 5.7).

Seasonal occurrence of non-display vocalisations in the grassland: Recorded on a very limited number of days each season (if at all), except during mid-autumn, when it occurred more often (Fig. 5.7). Daily reporting rates reached intermediate and high values only during autumn, with the median daily reporting rate of mid-autumn higher than that of most other seasons (Fig. 5.7; Fig. 5.8). Activity intensities were consistently low for all seasons during which it was measured (Fig. 5.7).

Daily occurrence of non-display vocalisations in the grassland: Recorded throughout the day, except after sunset, and tended to be more frequent in the early morning after sunrise

(Fig. 5.7). Seasonally, activity occurred in many segments of the day during autumn, and in only 1–4 segments during other seasons (Fig. 5.9). The two bird-segment combinations occurring during more than 5 bird-days involved single segments S1 and S2, collectively accounting for only 15.9% bird-days (Fig. 5.10).

The first activity of the day most frequently occurred during the first half of the morning, particularly during autumn (Fig. 5.9). The last activity of the day tended to occur later on intermediate and high reporting rate days than on low reporting rate days, and it also occurred later during autumn than during other seasons (Fig. 5.9).

Activity intensities were low for all segments (Fig. 5.7). Daily segment reporting rates ranged from 5.6 to 50.0% with 91.4% of the values relatively low (Fig. 5.7). Median daily segment reporting rates were similar for all segments (Fig. 5.7).

Early morning occurrence of non-display vocalisations during 2007/8: None (Table 5.1b & c).

Combined data: Overall, encountered during 4–10 seasons each year, most frequently (n > 8 seasons) in 1997/8, 2001/2, 2002/3, 2004/5, 2005/6 and 2007/8 (Fig. 5.11). The seasonal data shows it to be most frequent (n = 10–11 years) in late spring, summer and early autumn and least frequent (n = 2–4 years) during winter and early spring (Fig. 5.11).

Discussion

The status of the Melodious Lark at Glen — *i.e.* whether it is resident or not — is difficult to determine because 'search effort' was not constant. To be sure, the data for the displays are accurate, but the presence of the observer influenced the occurrence of non-display vocalisations and for birds seen only. Yet in spite of these biases the data at hand do show that the birds occurred in the study area for at least 12 consecutive, or nearly consecutive, seasons at times (Fig. 5.11). At other times a number of seasons would go by without any records of the birds (Fig. 5.11). This may be due to local movements in response to environmental conditions, as suggested by Dean (1997e). The SABAP1 Zone 7 reporting rates show a summer centred peak (Dean 1997e) similar to that recorded at Glen (Fig. 5.11).

Although no nests have been discovered at Glen to date, the presence of displaying males and particularly the presence of recently fledged birds, confirms that breeding does in fact occur. The incidence of high reporting rate days for Melodious Lark displays was linked to good veld conditions — in particular, tall and reasonably dense stands of Red Grass *Themeda triandra* — stimulated by recent rainfall. This link between displays and rainfall is most clearly seen in Figure 5.2, which shows that high reporting rate days followed soon after (and during) 'good' rain seasons.

Note, however, that this was not the case in 2005/6 or 2006/7, when good rains occurred during autumn and late spring respectively (Fig. 5.2). In the case of 2006/7, limited rain fell subsequent to late spring and this presumably caused less than ideal conditions for the larks. 2005/6 was interesting in that its rainfall during early and mid-autumn was comparable to that of

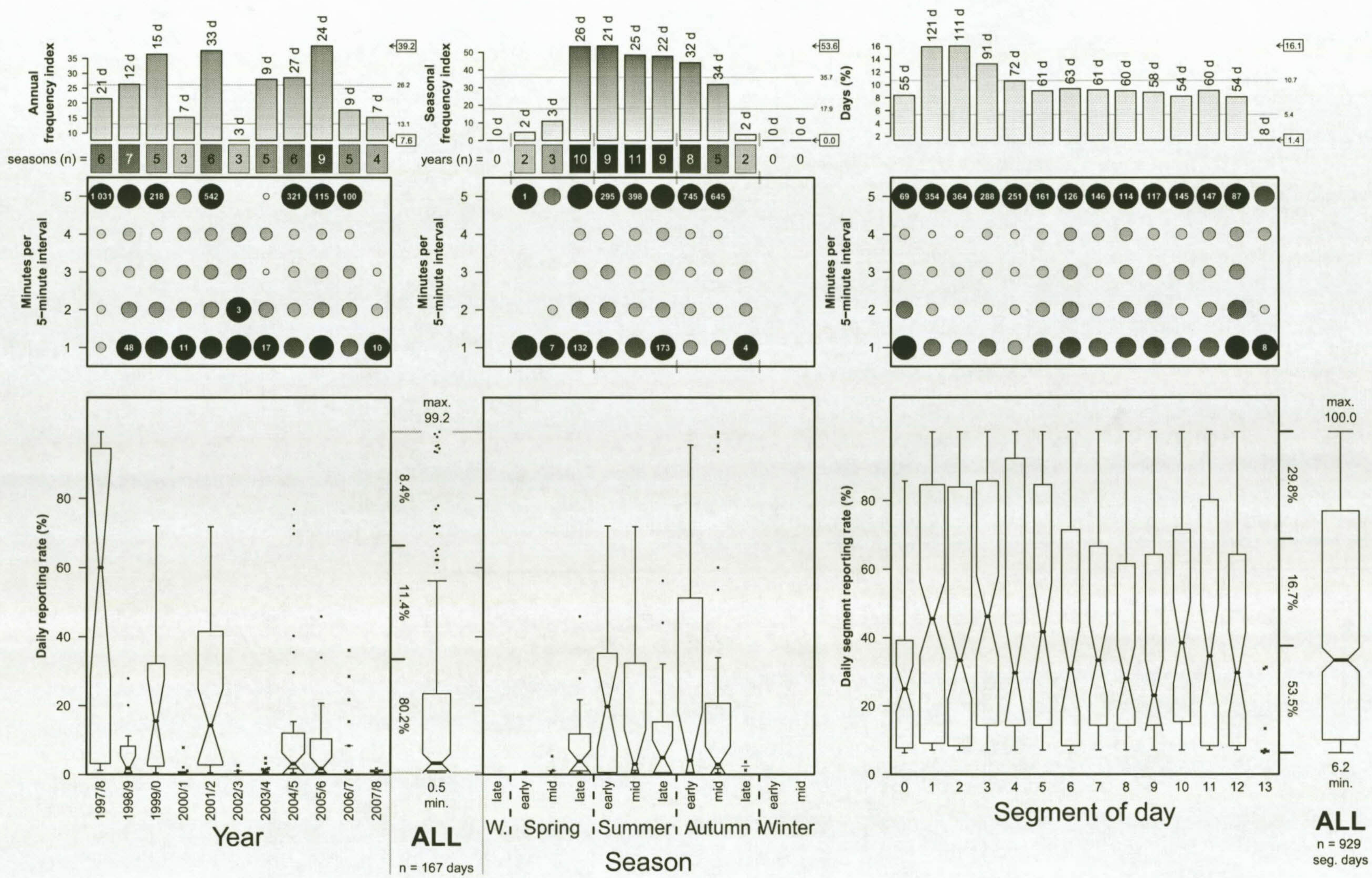

Figure 5.1: R492 Melodious Lark — displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

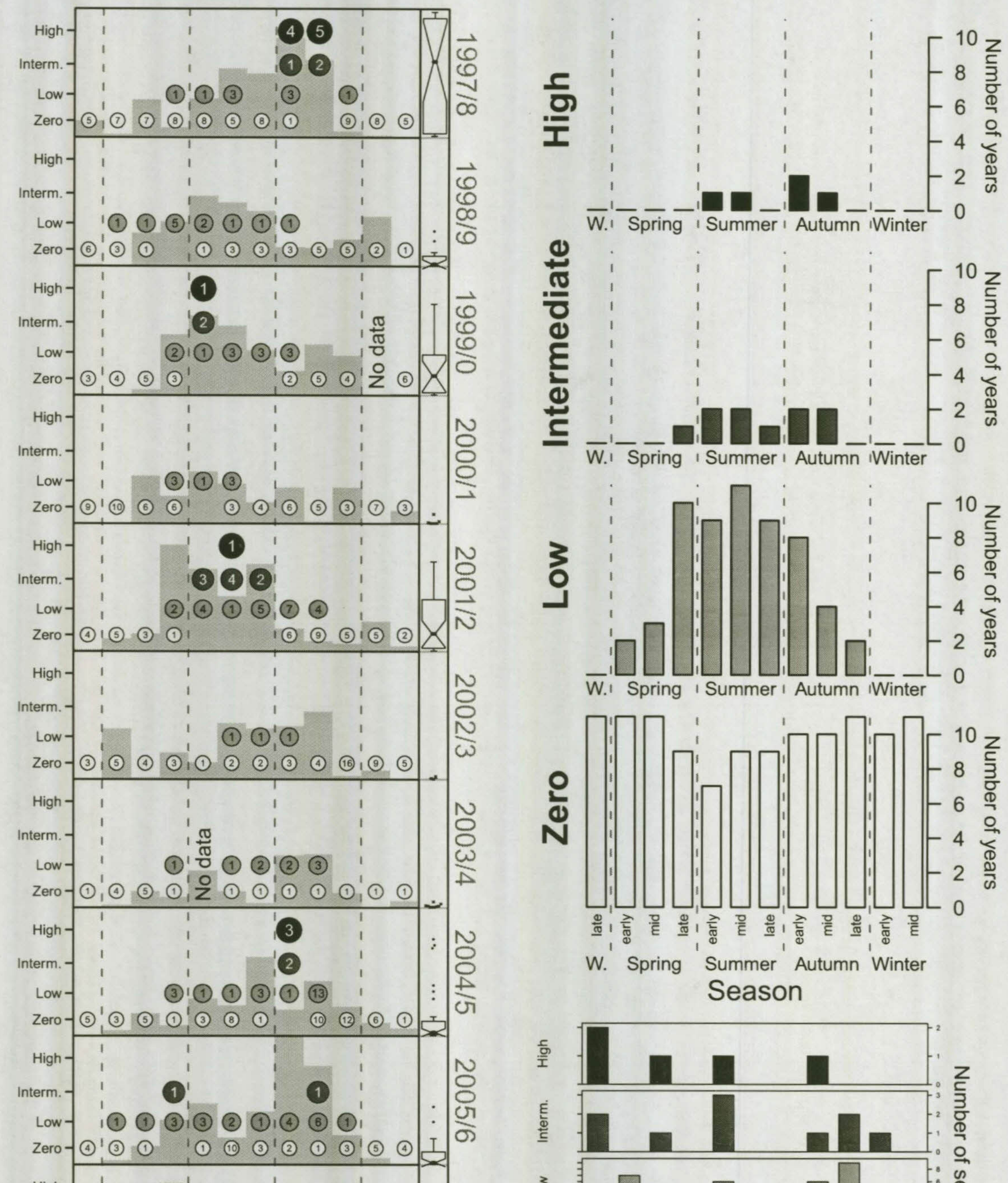

Figure 5.2: R492 Melodious Lark — displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

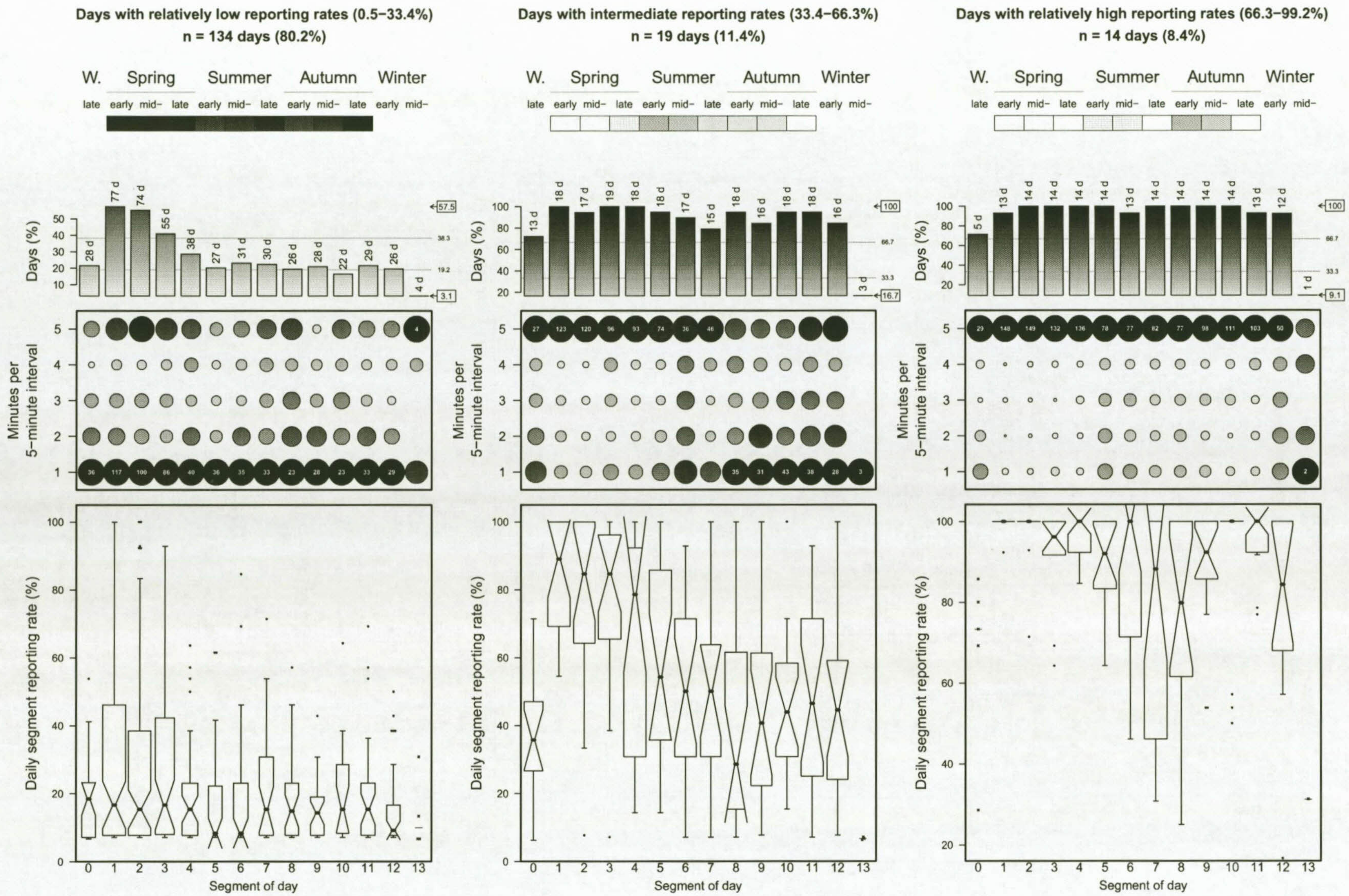

Figure 5.3: R492 Melodious Lark — displays: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

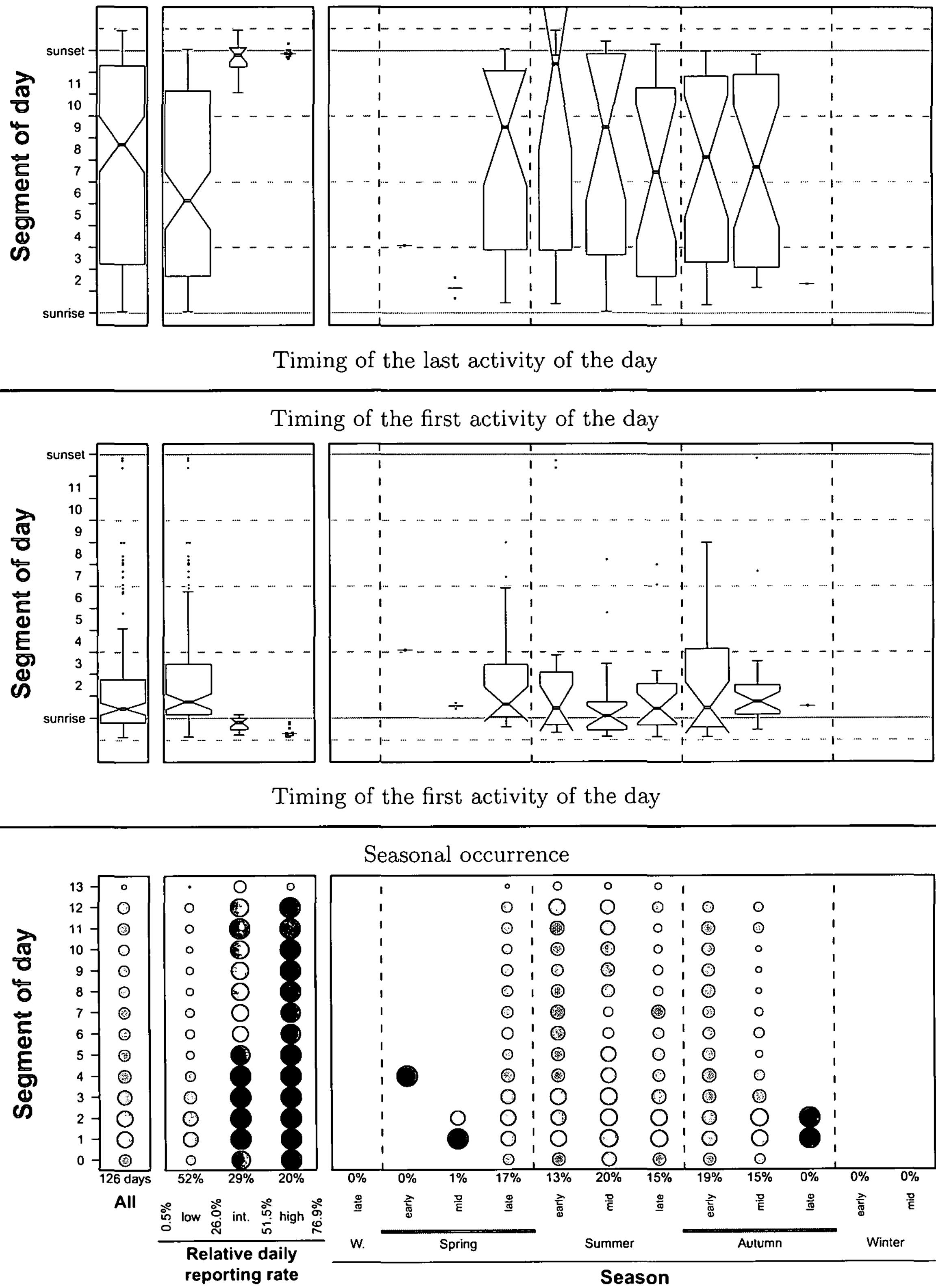

Figure 5.4: R492 Melodious Lark — displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

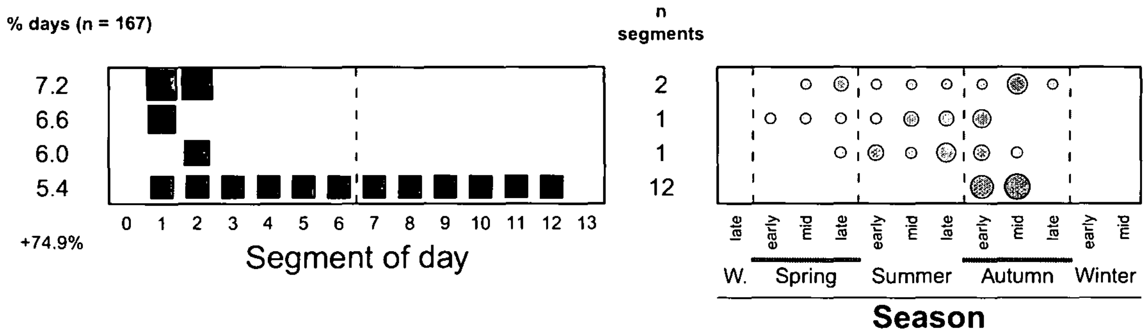

Figure 5.5: R492 Melodious Lark — displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

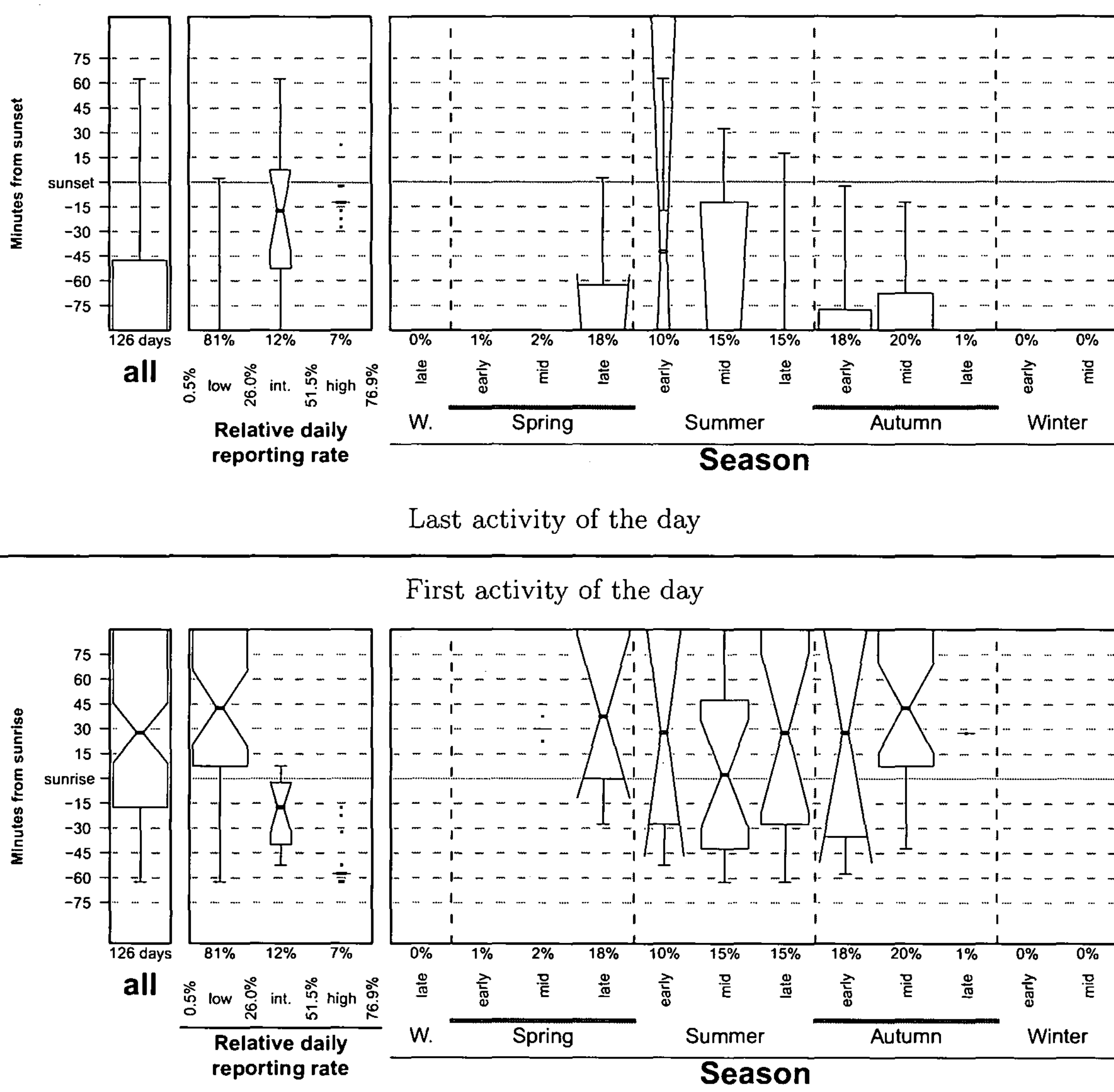

Figure 5.6: R492 Melodious Lark — displays: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

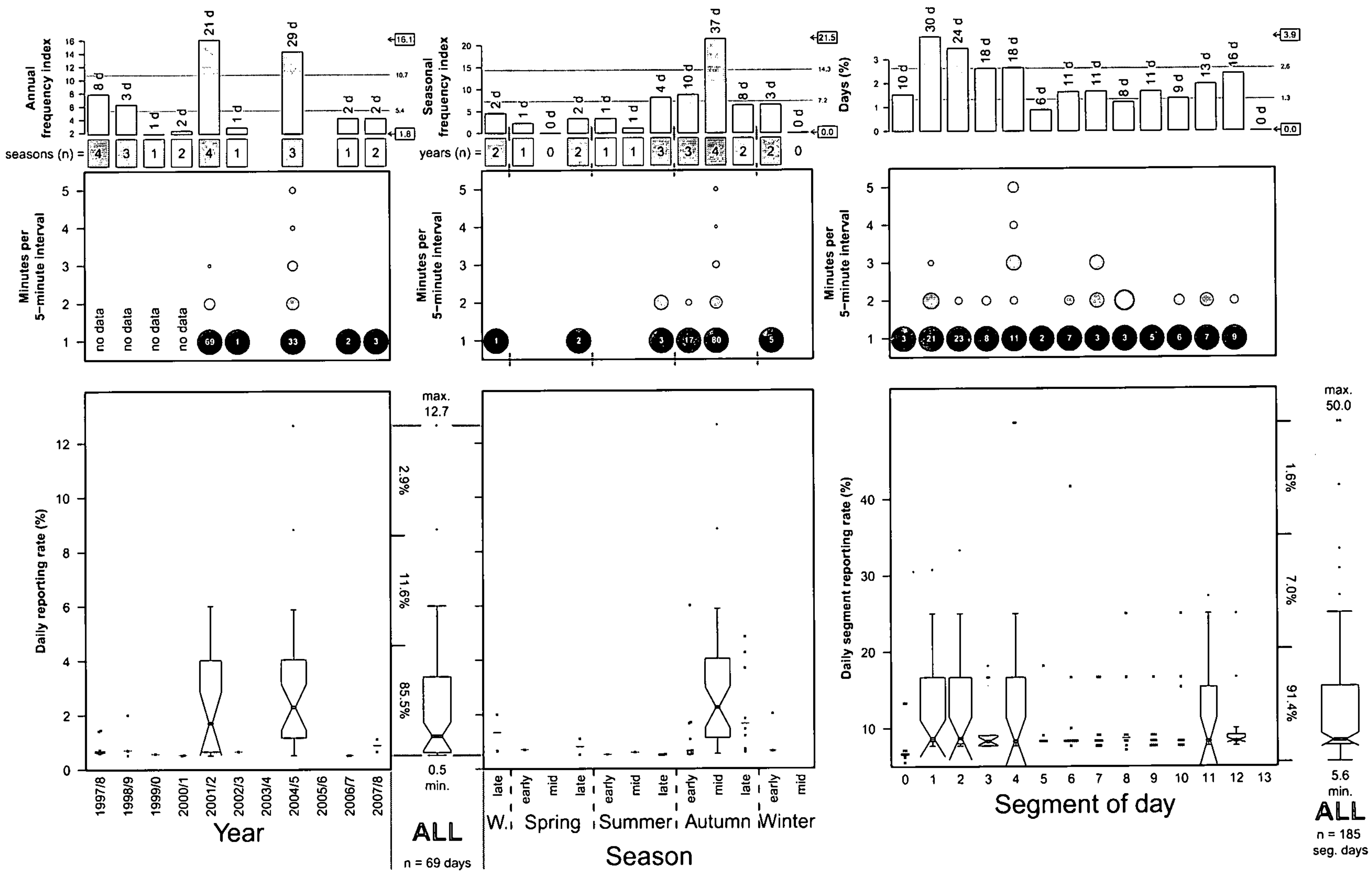

Figure 5.7: R492 Melodious Lark — non-display vocalisations: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

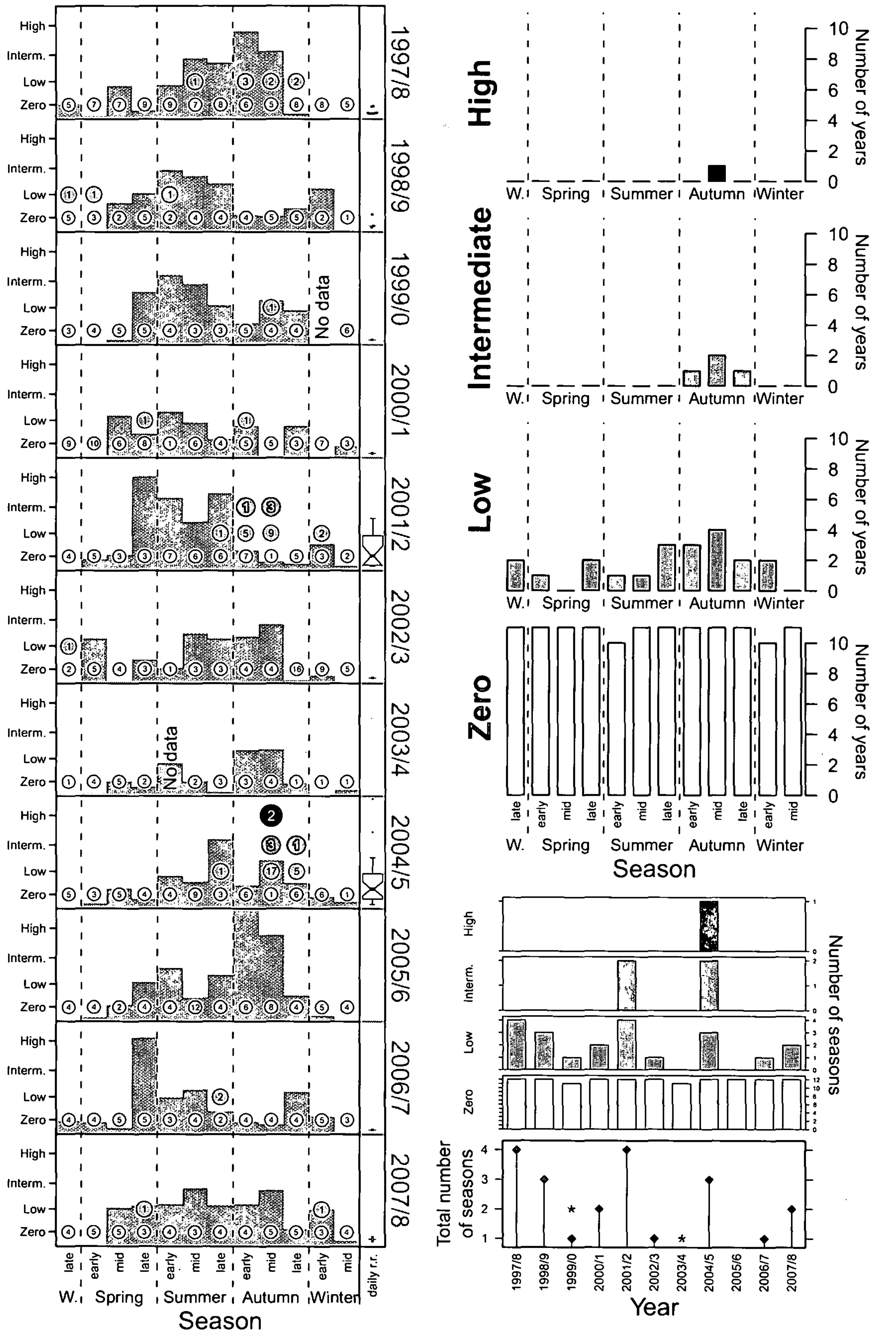

Figure 5.8: R492 Melodious Lark — non-display vocalisations: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

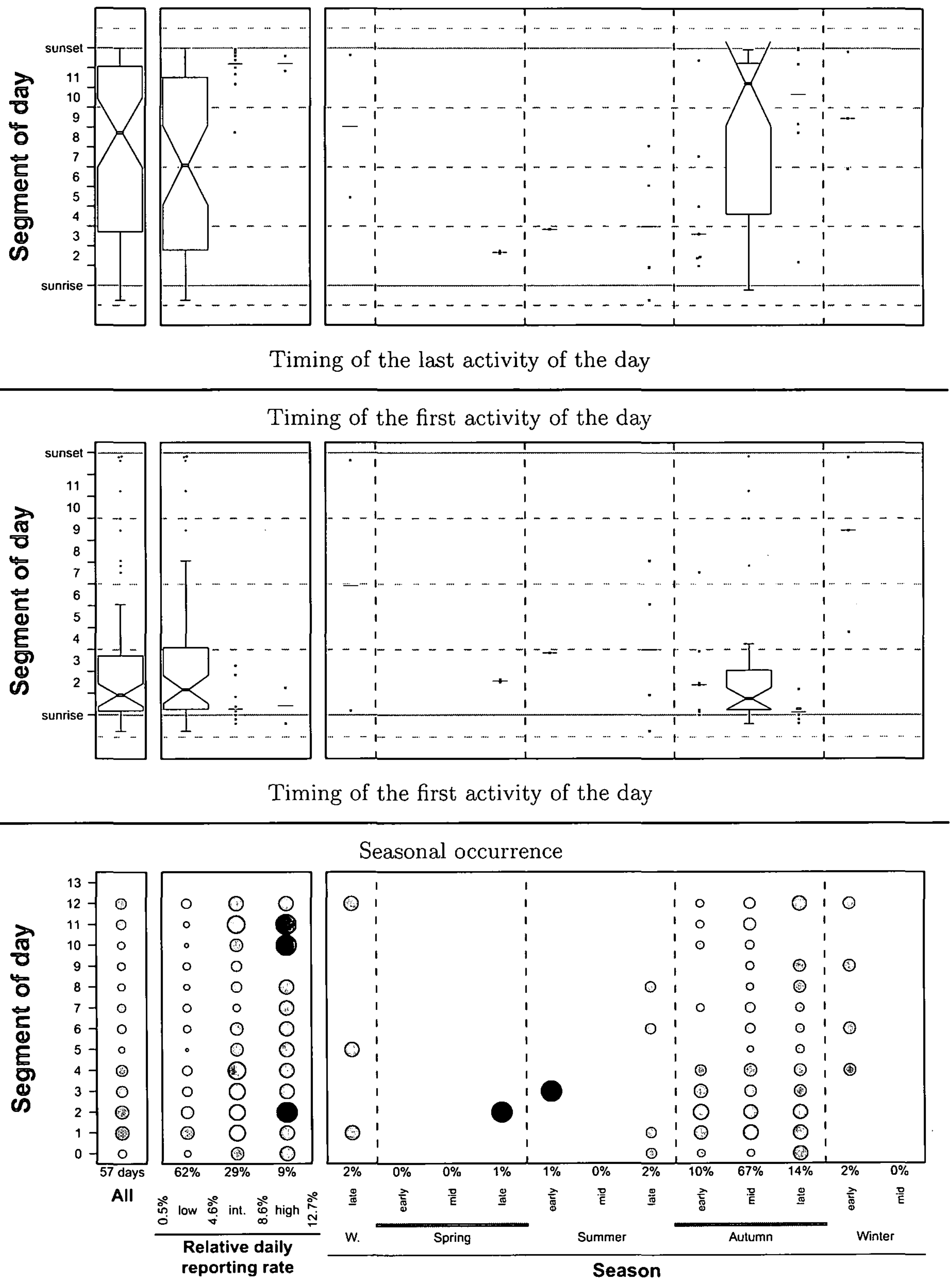

Figure 5.9: R492 Melodious Lark — non-display vocalisations: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

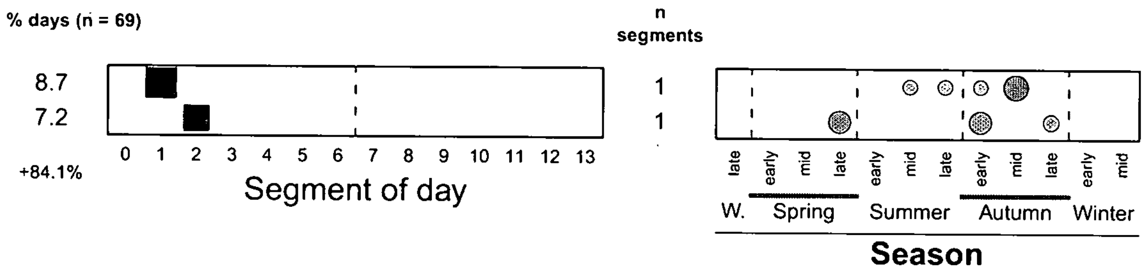

Figure 5.10: R492 Melodious Lark — non-display vocalisations: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

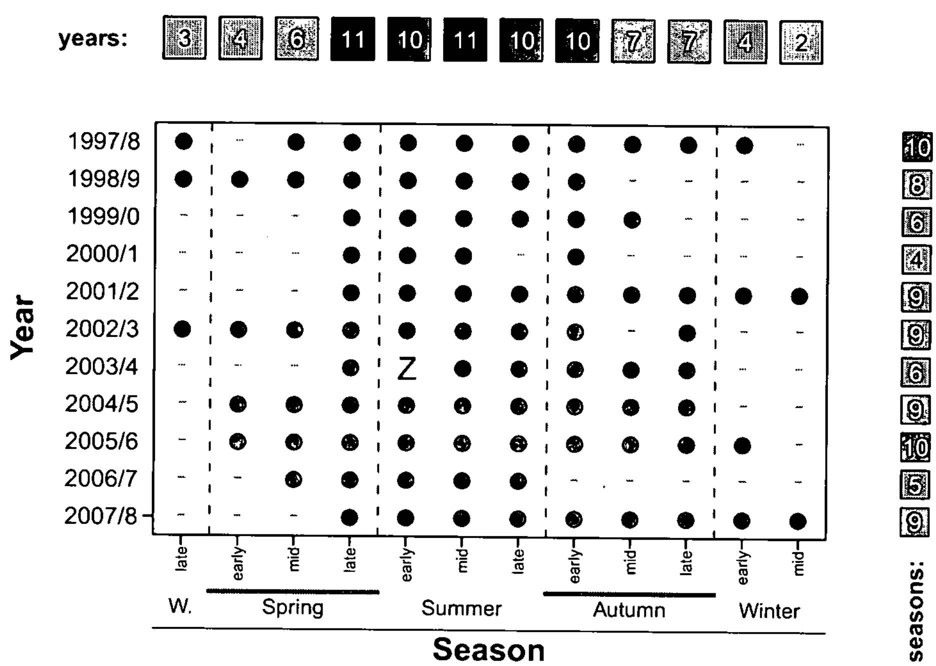

Figure 5.11: R492 Melodious Lark: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

1997/8, but in contrast to 1997/8 when display activity was very high, it was relatively low during 2005/6 (Fig. 5.2). This apparent discrepancy is most probably linked to the fact that 1997/8 experienced relatively good rains during mid- and late summer too, compared to 2005/6, when relatively little rainfall occurred prior to autumn (Fig. 5.2). Examination of habitat photos (not illustrated here) indicates that Red Grass came into prominence towards the end of early autumn 2005/6, compared to 1997/8 when this occurred earlier. This indicates that good veld conditions by and in themselves is not sufficient to stimulate high activity levels — these conditions also have to occur at the right time of the year.

Why are high activity levels not associated with good veld conditions which occur relatively late in the year (*i.e.* autumn)? A probable explanation is that it coincides with moulting. According to Dean (2005w), there is no data available on moult. However, during the present study, a number of birds were ringed at Glen and elsewhere, and their moulting status recorded.

While the data awaits detailed analysis, some preliminary findings are of interest here. Adults undergo a complete post-breeding moult, starting in mid-autumn with some birds still in moult by late winter. Primary moult may also be fairly rapid with up to five primaries actively growing at a time in one instance. This is likely to impair the flight capabilities of the bird to an extent that would make sustained flight displays prohibitive. Significantly, display activity was never recorded during winter and seldom in late autumn and early and mid-spring (Fig. 5.1). This general pattern is probably a reflection of the timing of moult, which, in turn, is probably dictated by circannual rhythms. This would explain why activity levels were so low during 2005/6 (Fig. 5.1), in spite of what seemed to have been excellent veld conditions.

R494 Rufous-naped Lark .... *Mirafra africana*

The Rufous-naped Lark is endemic to sub-Saharan Africa (Maclean 1985). Its southern African distribution is limited to the eastern and northern halves of the region, being conspicuously absent from the south-western parts (Dean 1997f). It occurs in a wide range of grassy habitats with suitable perches such as trees, bushes and fenceposts (Maclean 1985). Dean (1997f) attributed decreases in SABAP1 reporting rates for the cooler time of the year to birds "singing less and becoming less conspicuous" and concluded that "there is no convincing evidence of regular seasonal movements."

The birds at Glen

Records of the Rufous-naped Lark at Glen involved birds in the grassland as well as in the border between the grassland and the drainage line.

Distinction was made between two song types, which are here termed the perch and flight song respectively. The former, usually given by a bird perched on a fencepost, bush or tree, was accurately described by Maclean (1985) as a "clear whistled phrase of 4 notes, run together in pairs (sometimes sounds like 2 notes), rising then falling in pitch, *tiree-tiroo*." This was the activity noted most frequently (98.0%; Table 5.3a). The flight song consists of a "sustained series of rambling whistles, tweets and trills, sometimes with imitations" (Maclean 1985). Whereas the perch song may extend for minutes on end, the flight song was much shorter, seldom exceeding more than a few tens of seconds at a time. In addition to these two song types, individuals were also recorded when seen only, usually when flushed. Data has been recorded separately for each minute since mid-autumn 1997/8 for perch songs, and since 2000/1 for flight songs (Table 5.4). Figures start on page 580.

Annual occurrence of perch song in the grassland: Overall, recorded on 66.5% of the days with an activity index of 49 (Table 5.3a). Recorded for 8–11 seasons each year (Fig. 5.12; Fig. 5.13). Daily reporting rates ranged from 0.5 to 80.5% with half of the days attaining intermediate or high reporting rates (Fig. 5.12). Median daily reporting rates were particularly high during 1998/9 and 2005/6, and very low in 2000/1, the latter year also being the only year with no high reporting rate days (Fig. 5.12; Fig. 5.13). Activity intensities were also highest in 1998/9 and 2005/6 and lowest during 1997/8 (Fig. 5.12).

Table 5.3: R494 Rufous-naped Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.980	21 382	114 612	18.7	perch song	66.5	656	436	49
0.015	328	114 612	0.3	flight song	27.7	656	182	2
0.005	109	114 612	0.1	seen only	7.2	656	47	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.995	203	1 190	17.1	perch song	60.5	43	26	8
0.005	1	1 190	0.1	flight song	2.3	43	1	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.993	426	1 188	35.9	perch song	65.1	43	28	15
0.007	3	1 188	0.3	flight song	7.0	43	3	1

Table 5.4: R494 Rufous-naped Lark: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
perch song	mid-autumn 1997/8	59 638	500 520	11.9
flight song	late winter 2000/1	282	403 440	0.1

Seasonal occurrence of perch song in the grassland: Recorded during all seasons, but was relatively infrequent during mid-autumn, late autumn and winter (Fig. 5.12). Activity intensities were highest from late spring till mid-autumn (Fig. 5.12), with median daily reporting rates and the occurrence of high reporting rate days peaking during a similar period (not mid-autumn) (Fig. 5.12; Fig. 5.13). In addition, days with zero records were absent or infrequent from mid-spring to early autumn (Fig. 5.13).

Daily occurrence of perch song in the grassland: Overall, activity was most frequent in the early mornings and became progressively less frequent towards sunset, when it was still not too infrequent (Fig. 5.12). This general pattern is most applicable for low reporting rate days (Fig. 5.14). On intermediate reporting rate days, activity was frequent throughout the morning and became only slightly less frequent in the afternoon, and on high reporting rate days activity was frequent throughout the day, except after sunset (Fig. 5.14). The pattern also varied seasonally with activity mainly confined to the early mornings in late autumn, winter and early spring in contrast to other seasons when it occurred during all segments of the day (Fig. 5.15). The only segment combination to occur on at least 5% bird-days was activity during S0–S12, which accounted for only 5.3% bird-days, occurring mainly from late spring to early autumn (Fig. 5.16).

The first activity of the day typically occurred at dawn, slightly earlier on high and intermediate reporting rate days than on low reporting rate days (Fig. 5.15; Fig. 5.17). The timing of the first activity of the day varied seasonally, occurring later during autumn, winter and most of spring than during summer (Fig. 5.15; Fig. 5.17). The dawn chorus sequence varied in accordance with the timing of the first activity of the day (Fig. 5.17).

The last activity of the day frequently occurred earlier in the day on low reporting rate days than on intermediate or high reporting rate days (Fig. 5.15; Fig. 5.17). There is also a well-defined seasonal pattern with the timing of the last activity of the day least variable and occurring around sunset during early summer, becoming progressively earlier towards winter, when it typically occurred before mid-morning (Fig. 5.15; Fig. 5.17).

Activity intensities varied through the day and according to the relative reporting rate of the day (Fig. 5.14). For low reporting rate days, activity intensity was greatest in the early morning around sunrise (Fig. 5.14). On intermediate reporting rate days, the activity intensity was high during most of the morning, becoming less intense in the afternoon, and for high reporting rate days, the activity intensity remained high until about mid-afternoon (Fig. 5.14).

The patterns described above for the activity intensities apply broadly also to the daily variation of daily segment reporting rates (Fig. 5.14). In addition to a general increase in daily segment reporting rates, the daily pattern changes from relatively high values in the early morning only on low reporting rate days, to relatively high values for most of the morning on intermediate and high reporting rate days (Fig. 5.14). Similar contrasts are discernible between seasons with low and higher daily reporting rates (*cf.* Figs. 5.12 & 5.18).

Early morning occurrence of perch song during 2007/8: Although activity was recorded on almost the same number of mornings, the activity index of the grassland was nearly double that recorded in the drainage line (15 vs. 8; Table 5.3b & c). In addition, the median early morning reporting rate was much higher and the occurrence of high reporting rate mornings more frequent in the grassland (Fig. 5.19). It does seem, however, that the data collected in the drainage line gives a reasonable estimate of seasonality (Fig. 5.19).

The timing of the first activity of the day was similar between the two habitats, but at times it occurred later in the drainage line than in the grassland (Fig. 5.19). Activity intensities were similar before and after sunrise, but higher in the grassland than in the drainage line, particularly for intermediate and high reporting rate mornings (Fig. 5.19).

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Annual occurrence of flight song in the grassland: Overall, recorded on 27.7% of the days with an activity index of two (Table 5.3a). Recorded during either 4–6 seasons (2001/2–2004/5; 2006/7) or 9–10 seasons each year (Fig. 5.20; Fig. 5.21). Daily reporting rates ranged from 0.5 to 5.5% with 91.8% bird-days attaining low values (Fig. 5.20). Median daily reporting rates were similar for all years (Fig. 5.20). Activity intensities were largely similar for the years during which it was assessed (Fig. 5.20).

Seasonal occurrence of flight song in the grassland: Recorded during all seasons, but was relatively infrequent from mid-autumn to early spring (Fig. 5.20). Activity intensity was uniformly low (ignoring the seasons with low sample sizes; Fig. 5.20), with median daily reporting rates comparable for all seasons (Fig. 5.20).

Daily occurrence of flight song in the grassland: Overall, activity occurred throughout the day and tended to be slightly more frequent during the early to mid-afternoon (Fig. 5.20), a trend which was most evident for low reporting rate days (Fig. 5.22) and for the period from mid-spring to late summer (Fig. 5.23). The five bird-segment combinations occurring during more than 5% bird-days all involved single segments, which collectively accounts for a third of all bird-days (Fig. 5.24). The occurrence of the first as well as the last activity of the day was variable (Fig. 5.23).

Activity intensities tended to be higher during the early morning after sunrise than during other times of the day (Fig. 5.20). Daily segment reporting rates ranged from 5.9 to 33.3% with 86.9% of the values relatively low and median values similar for all segments (Fig. 5.20).

Early morning occurrence of flight song during 2007/8: Activity was very infrequent, occurring during one (late spring) and three mornings (mid-autumn to mid-winter) in the drainage line and grassland respectively (Table 5.3b & c).

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Combined data: Combining all the data — including birds seen only but not specifically discussed — it is clear that the Rufous-naped Lark is a resident, being recorded during almost all seasons each year (Fig. 5.25). Least frequently recorded during late autumn and early as well as mid-winter, but even then during at least seven years (Fig. 5.25).

Discussion

Dean (2005x) claimed that the Rufous-naped Lark male "sings year-round". However, earlier he explained decreasing SABAP1 reporting rates "for the winter months" as the probable result of "birds singing less and becoming less conspicuous" then (Dean 1997f). In addition, other authors note that the "Male sings primarily during early breeding season" (Ryan 2004a), and that the birds are "easily overlooked when not breeding" (Maclean 1985) or "calling" (Brewster 1996). Indeed, the birds are difficult to find when they are not singing, and the data from Glen indicates that singing behaviour is a seasonal phenomenon (Fig. 5.12; Fig. 5.13). Note in particular the frequent occurrence of days with zero records from mid-autumn to early spring (Fig. 5.13). It is suggested that this 'silent period' is linked to moulting.

Dean (2005x) mentions only one reference to moult: "In Botswana, in moult mid Dec." This is with reference to Hall (1956) who collected three males and one juvenile female; He simply stated that the birds were "in moult." At Glen, only two birds have been ringed to date, with an additional two birds ringed in Sandveld Nature Reserve (DJvN unpublished data). Considering these birds in chronological order, one of the adults at Glen showed no wing or tail moult, but was moulting body feathers in early summer. The Sandveld birds, ringed in early autumn, included an adult and a juvenile. The inner two primaries (P1 & P2) of the adult were new and those of the juvenile bird were growing. Neither of the two birds showed any body moult, but the juvenile was growing a new tail feather. The second adult from Glen, ringed during mid-autumn, was nearly halfway through its primary moult with P1 & P2 new and P3–P5 growing, while its inner two tail feathers on both sides were already replaced. In addition, it was in heavy body moult.

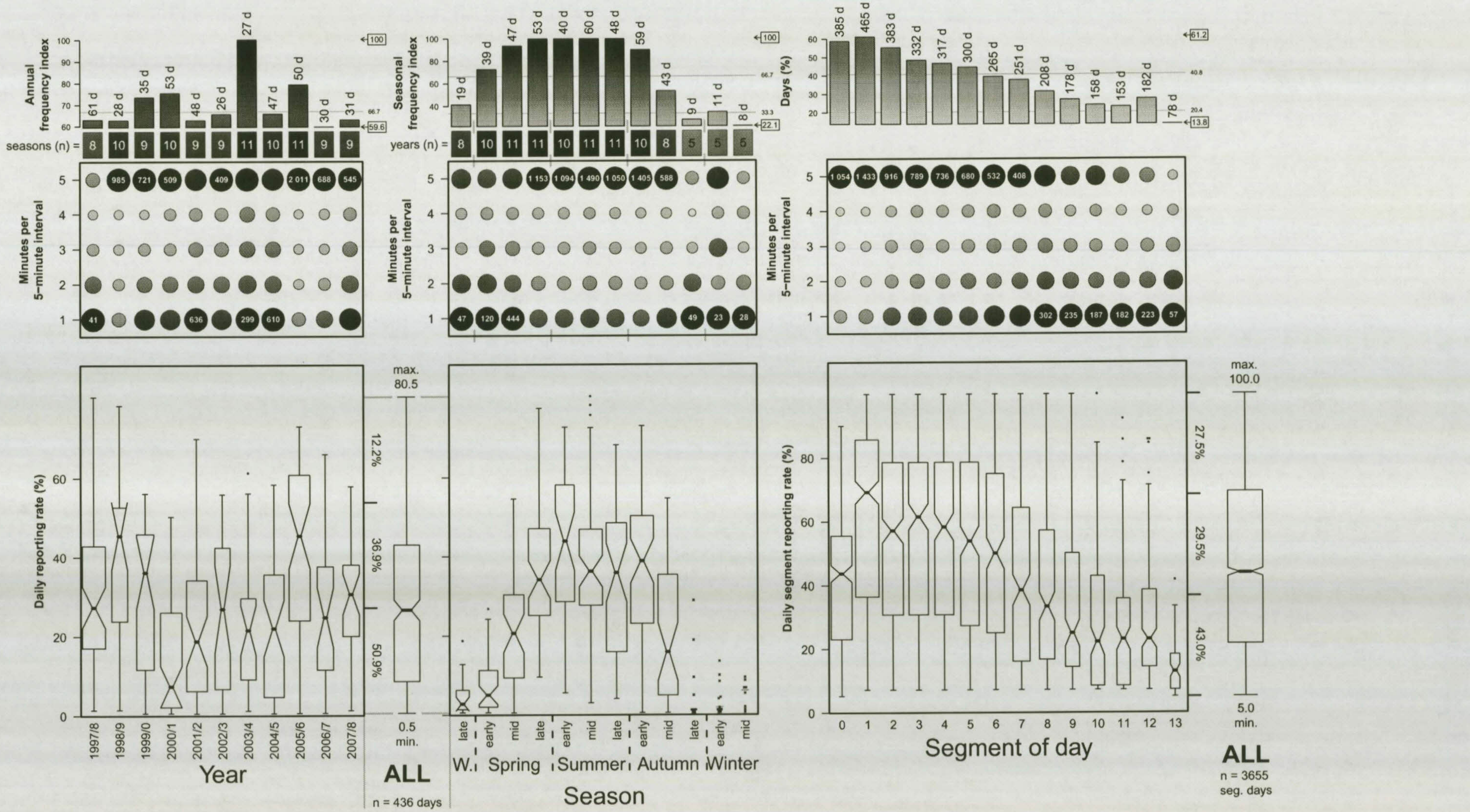


Figure 5.12: R494 Rufous-naped Lark — perch song: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

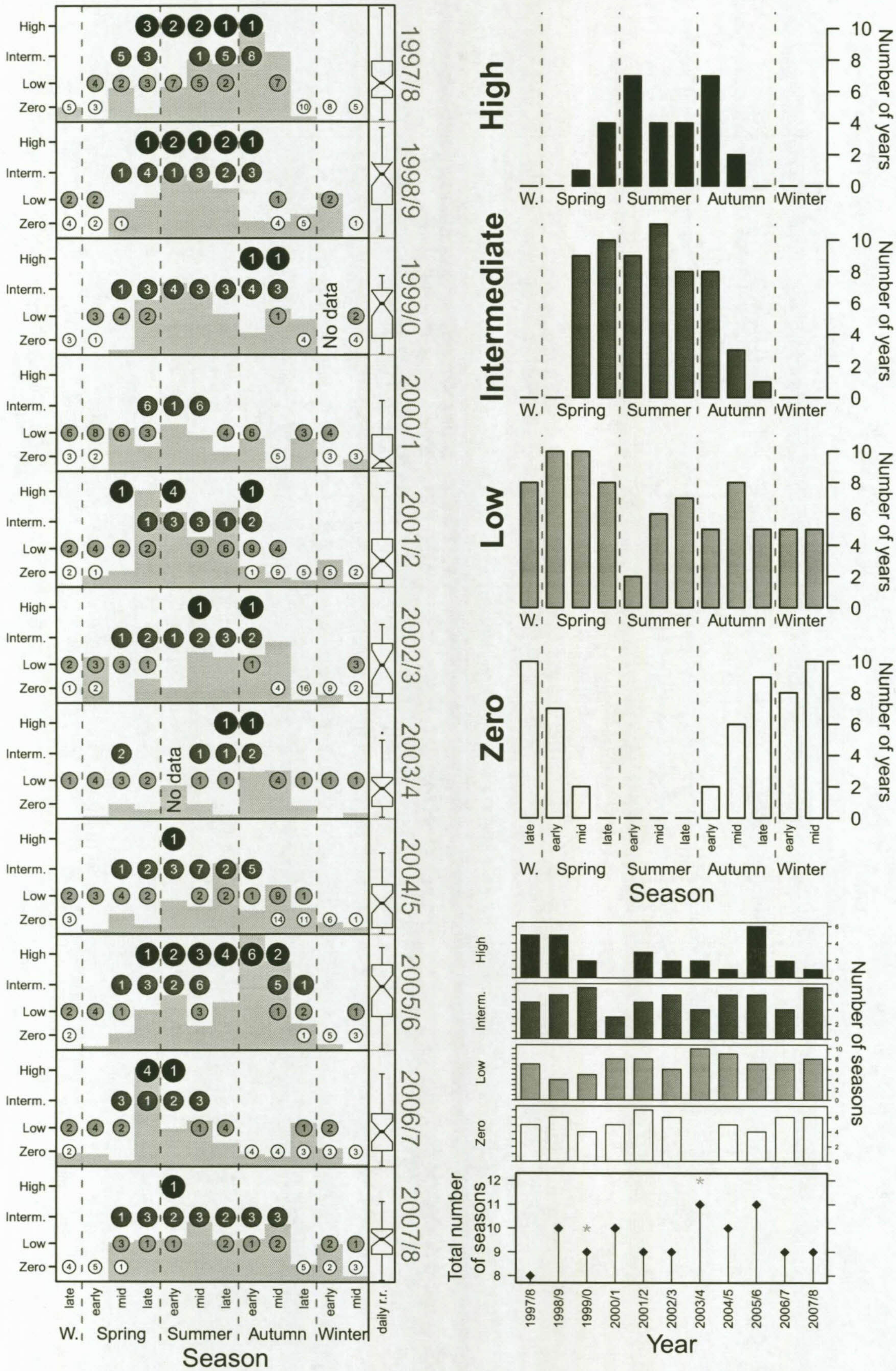


Figure 5.13: R494 Rufous-naped Lark — perch song: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

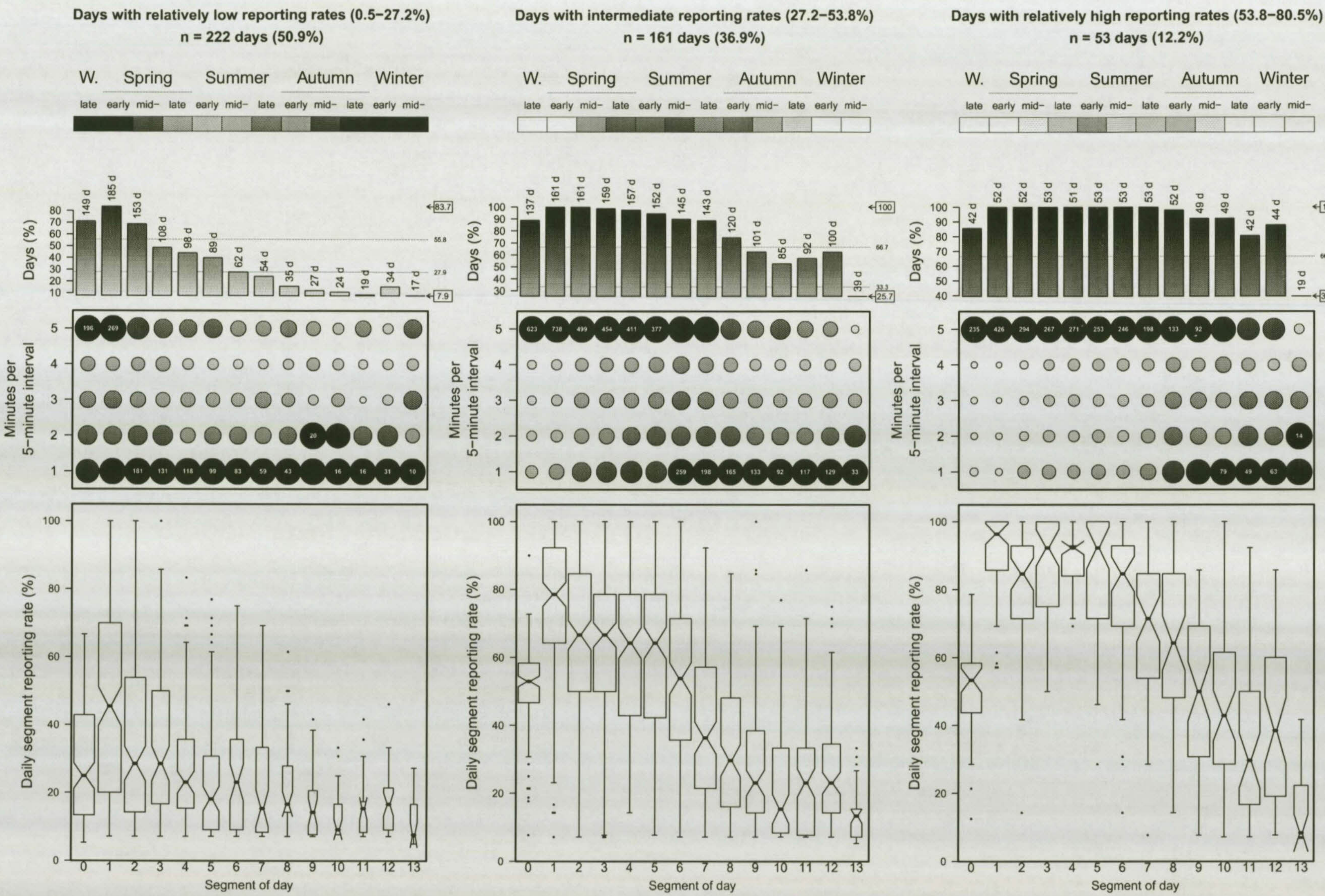


Figure 5.14: R494 Rufous-naped Lark — perch song: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

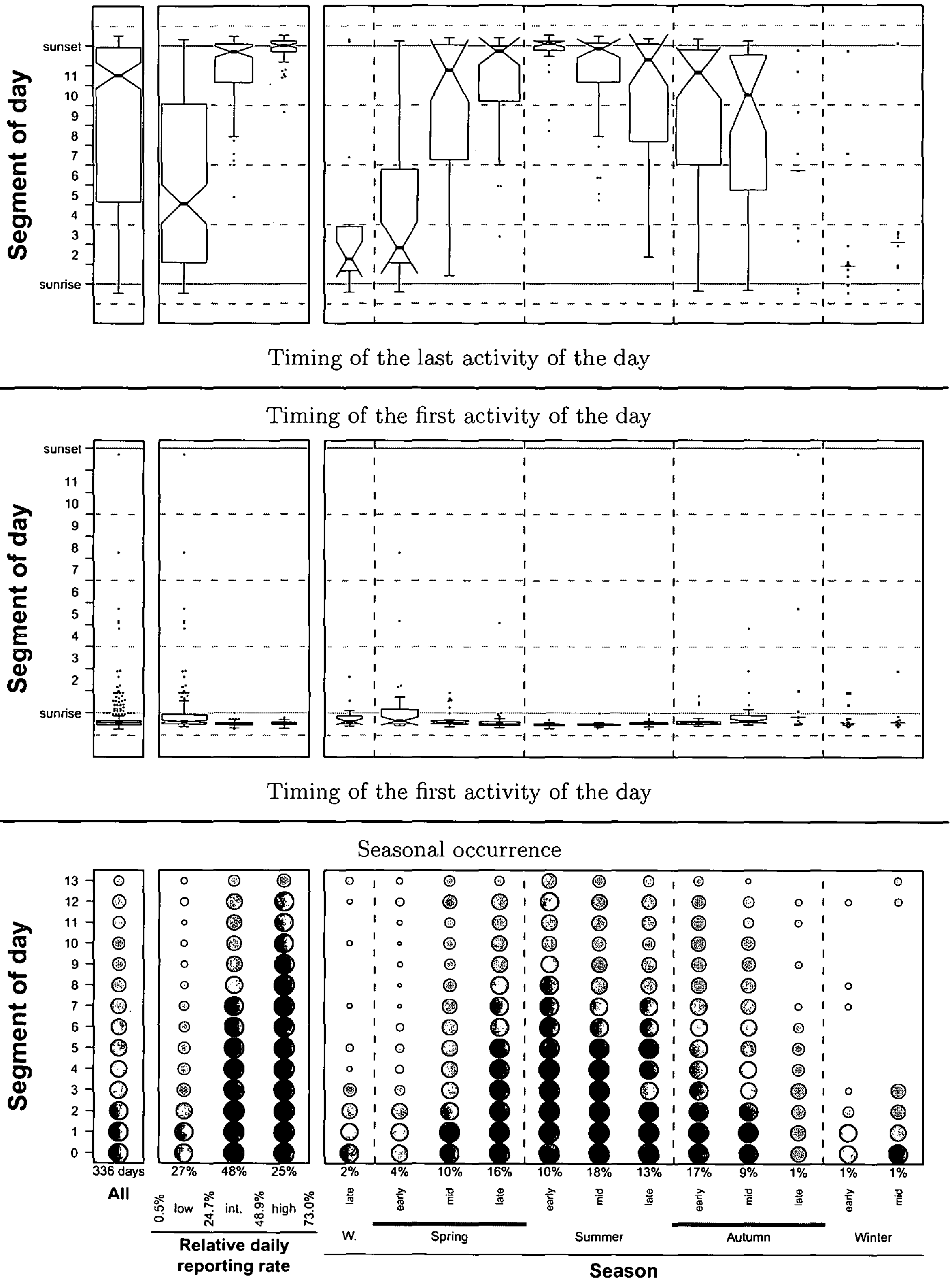


Figure 5.15: R494 Rufous-naped Lark — perch song: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

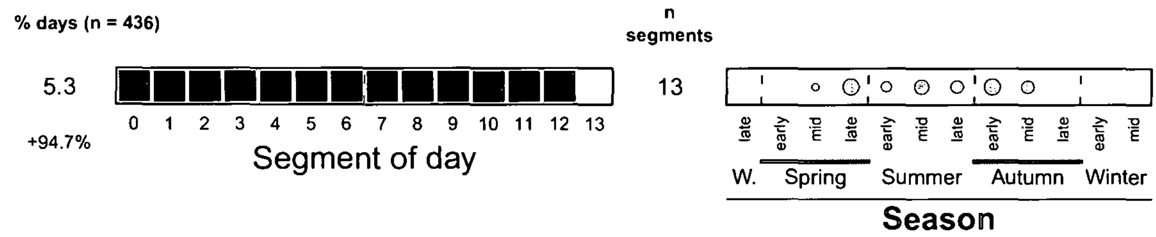
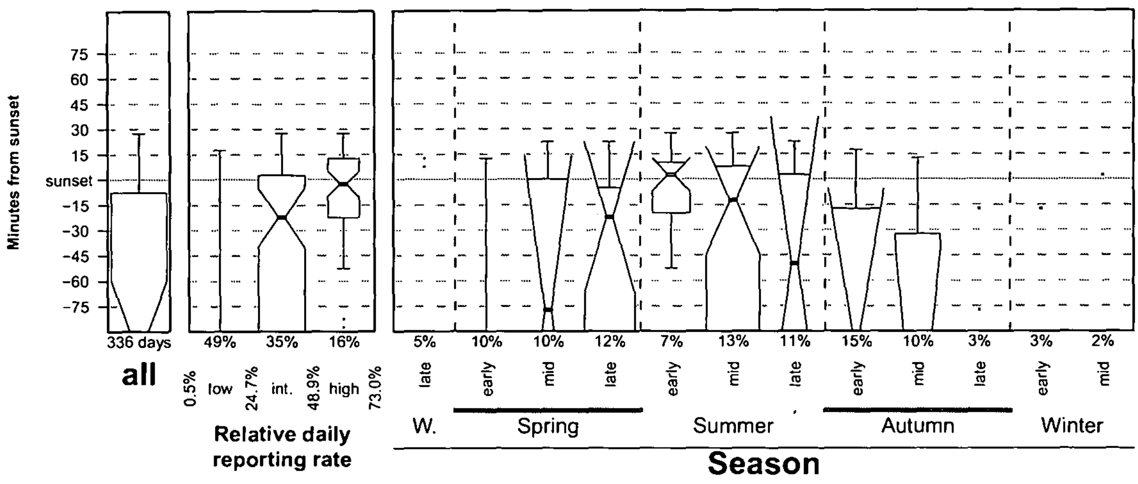


Figure 5.16: R494 Rufous-naped Lark — perch song: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

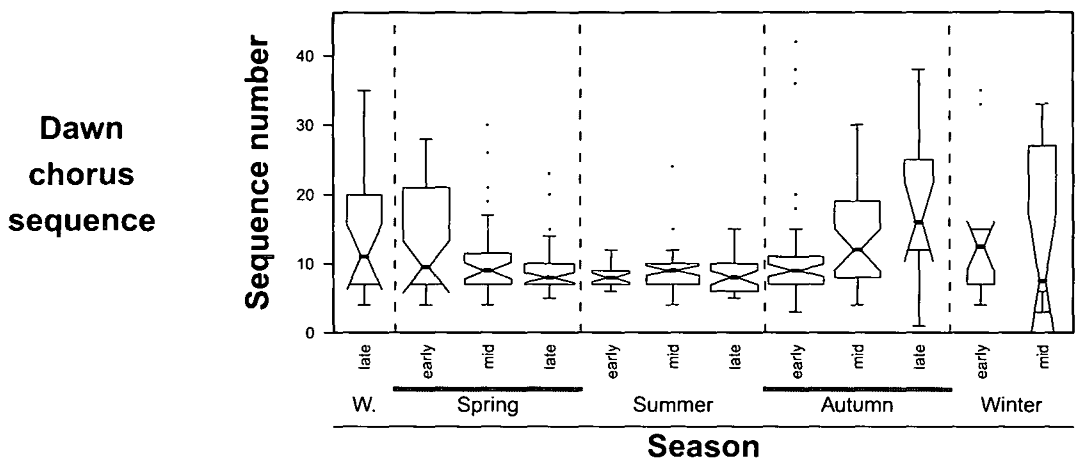
Although the sample size is small, the data do point to a complete post-breeding moult and it is suggested as the reason for the 'silent period' during the cooler times of the year (Fig. 5.12; Fig. 5.13).

During most years, the last occurrence of days with zero records in the beginning of the year was during late winter or early spring, coinciding with the relatively frequent occurrence of low reporting rate days (Fig. 5.13). The first occurrence of intermediate reporting rate days was during mid-spring each year, except in 2001/2 when a high reporting rate day occurred then and in 2000/1 when it first occurred during late spring (Fig. 5.13). This suggests a cue that triggers higher activity levels during mid-spring in most years. First considering rainfall, with the exception of 2004/5 the first rains occurred during late winter, but this mostly involved less than 5 mm per 30 days (Fig. 2.16). By contrast, the incidence of more rain varied from year to year (for example, more than 10 mm per 30 days: late winter, n = 2 years; early spring, 2 years; mid-spring, 6 years; late spring, 1 year; Fig. 2.16). It is not clear, therefore, to what extent rainfall influence the behaviour. However, mid-spring is per definition the season during which the increase in day-length peaks (Fig. 2.12). It is consequently suggested that day-length plays an important role in stimulating Rufous-naped Lark activity at the beginning of the breeding season, with rainfall possibly functioning as a secondary cue. Most breeding records in South Africa is from October to January [mid-spring to late summer] (Dean 2005x).



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

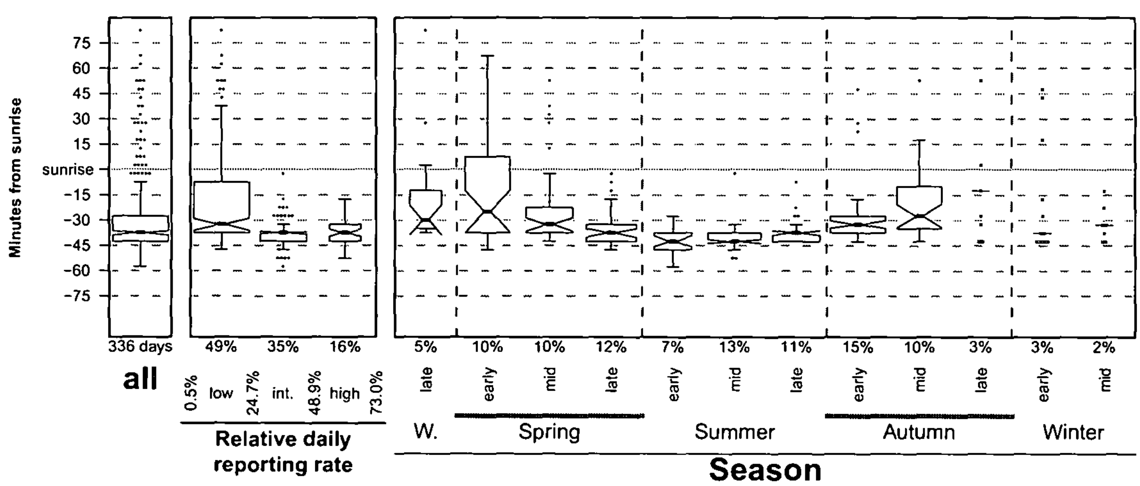


Figure 5.17: R494 Rufous-naped Lark — perch song: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

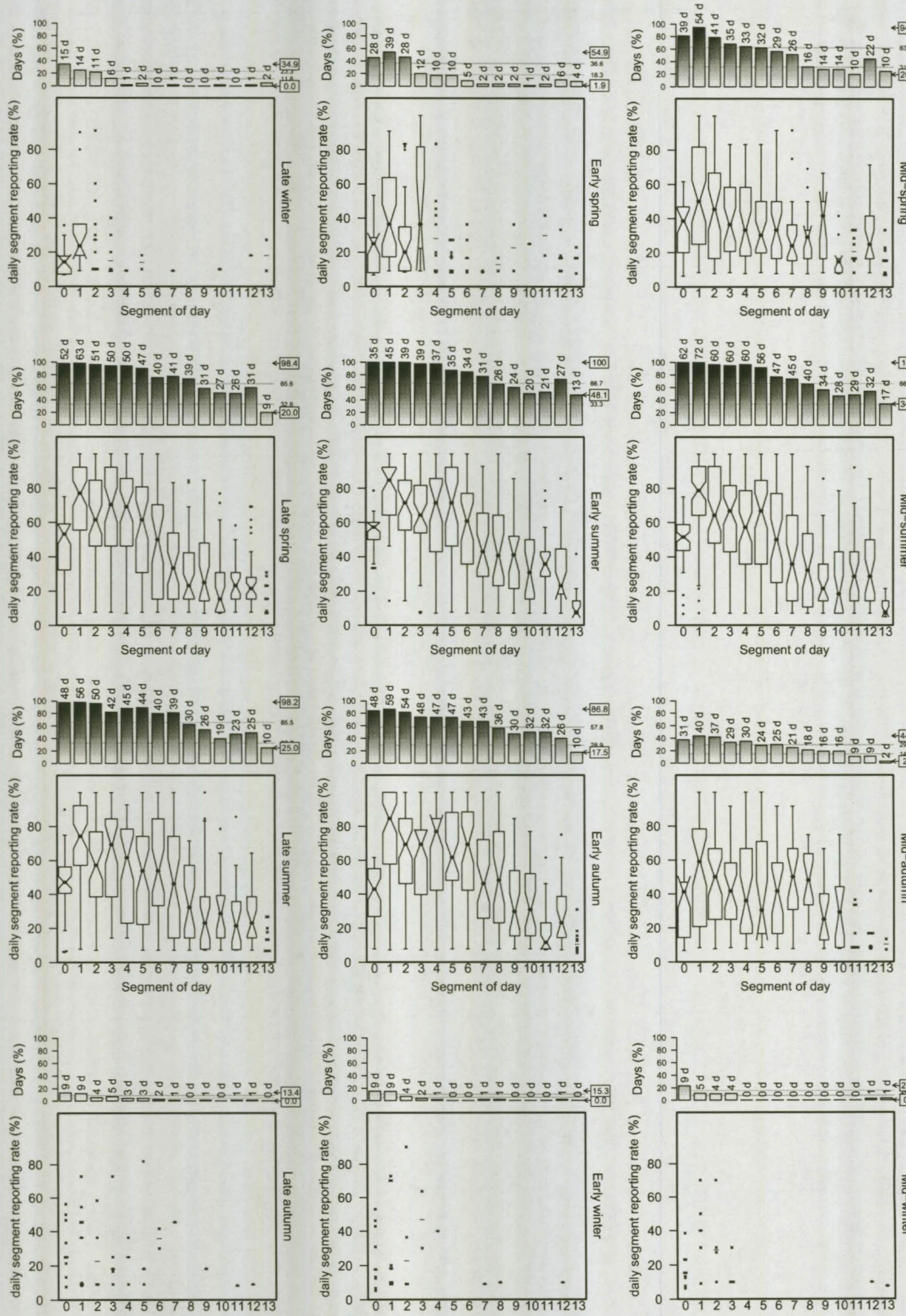
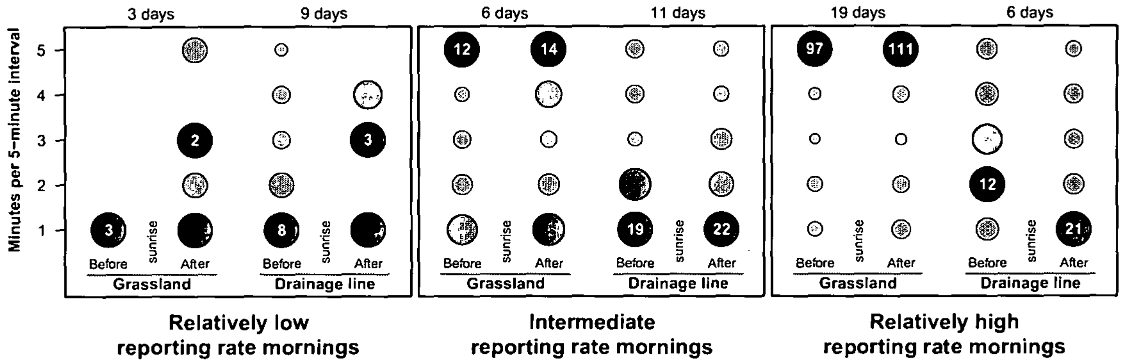
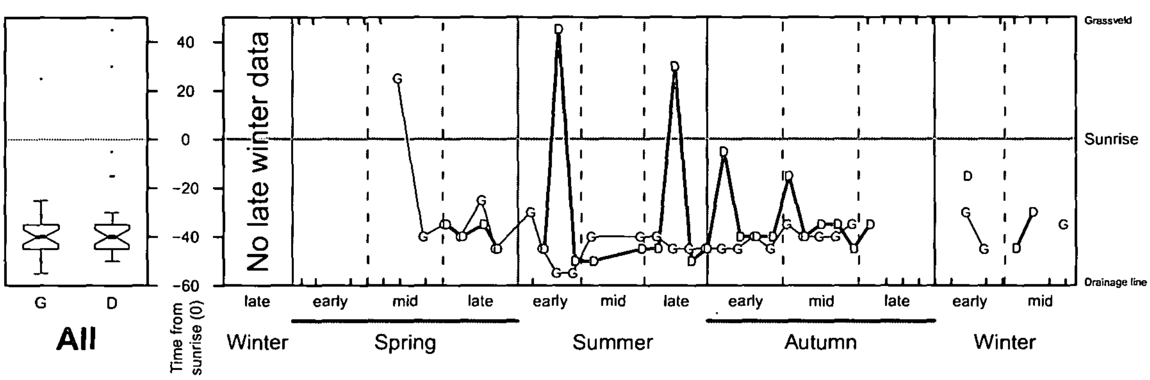


Figure 5.18: R494 Rufous-naped Lark — perch song: Seasonal fluctuations in daily occurrence in the grassland at Glen. See page 136 for more information on this seasonal detail figure.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

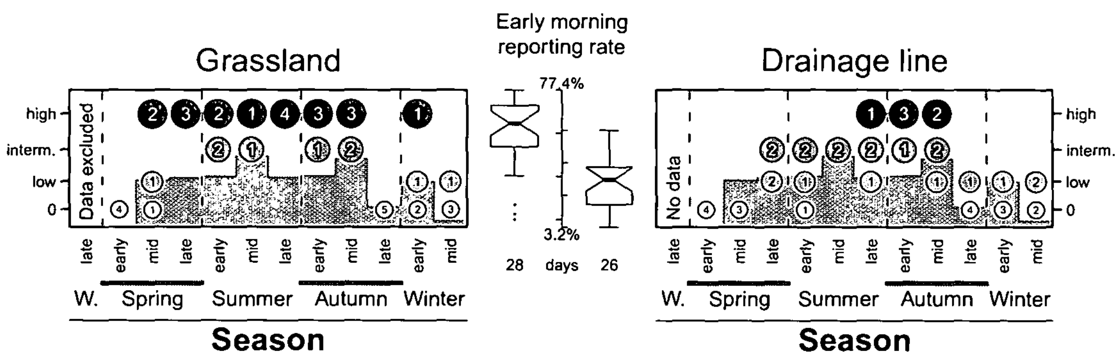


Figure 5.19: R494 Rufous-naped Lark — perch song: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

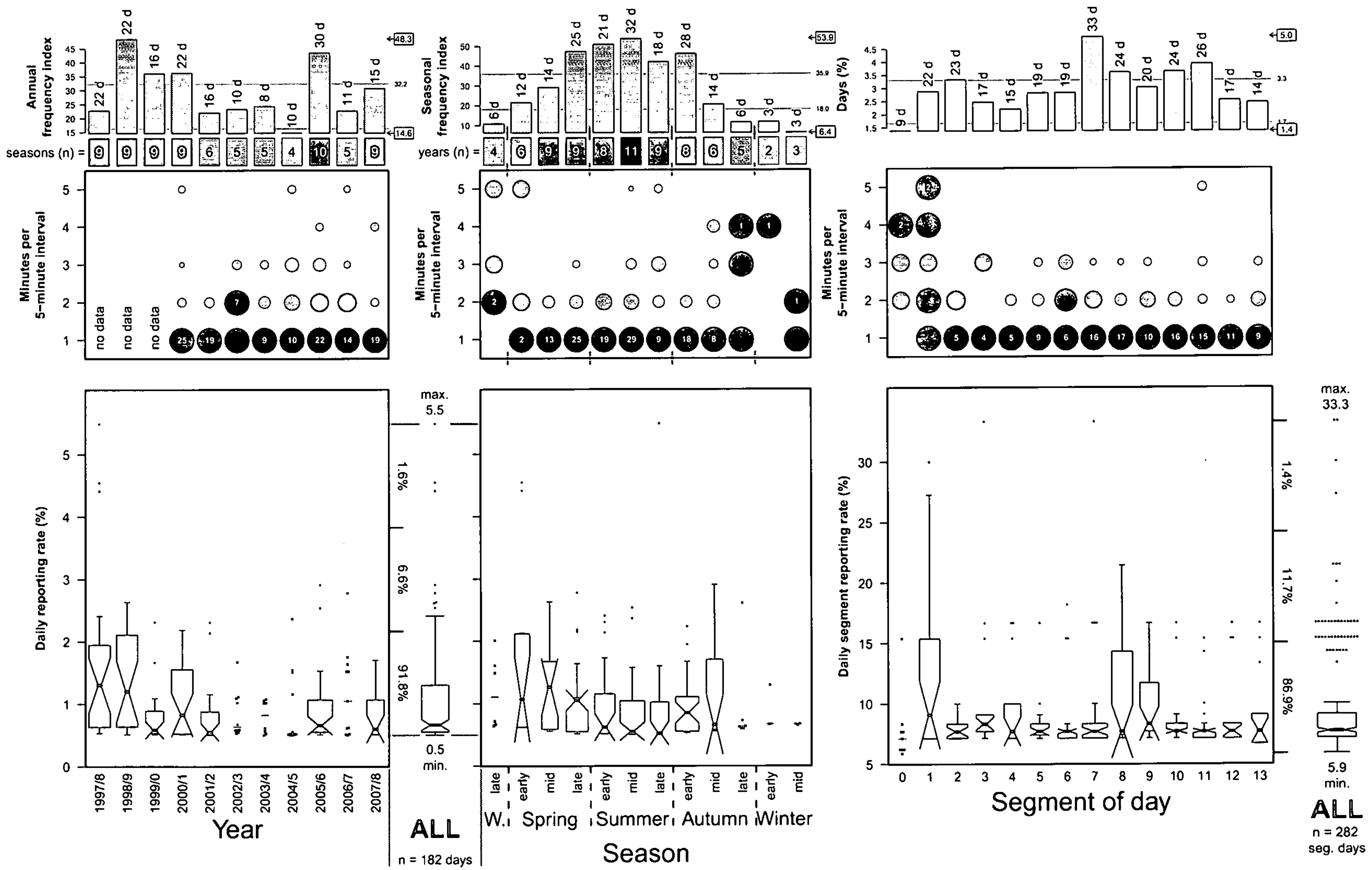


Figure 5.20: R494 Rufous-naped Lark — flight song: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

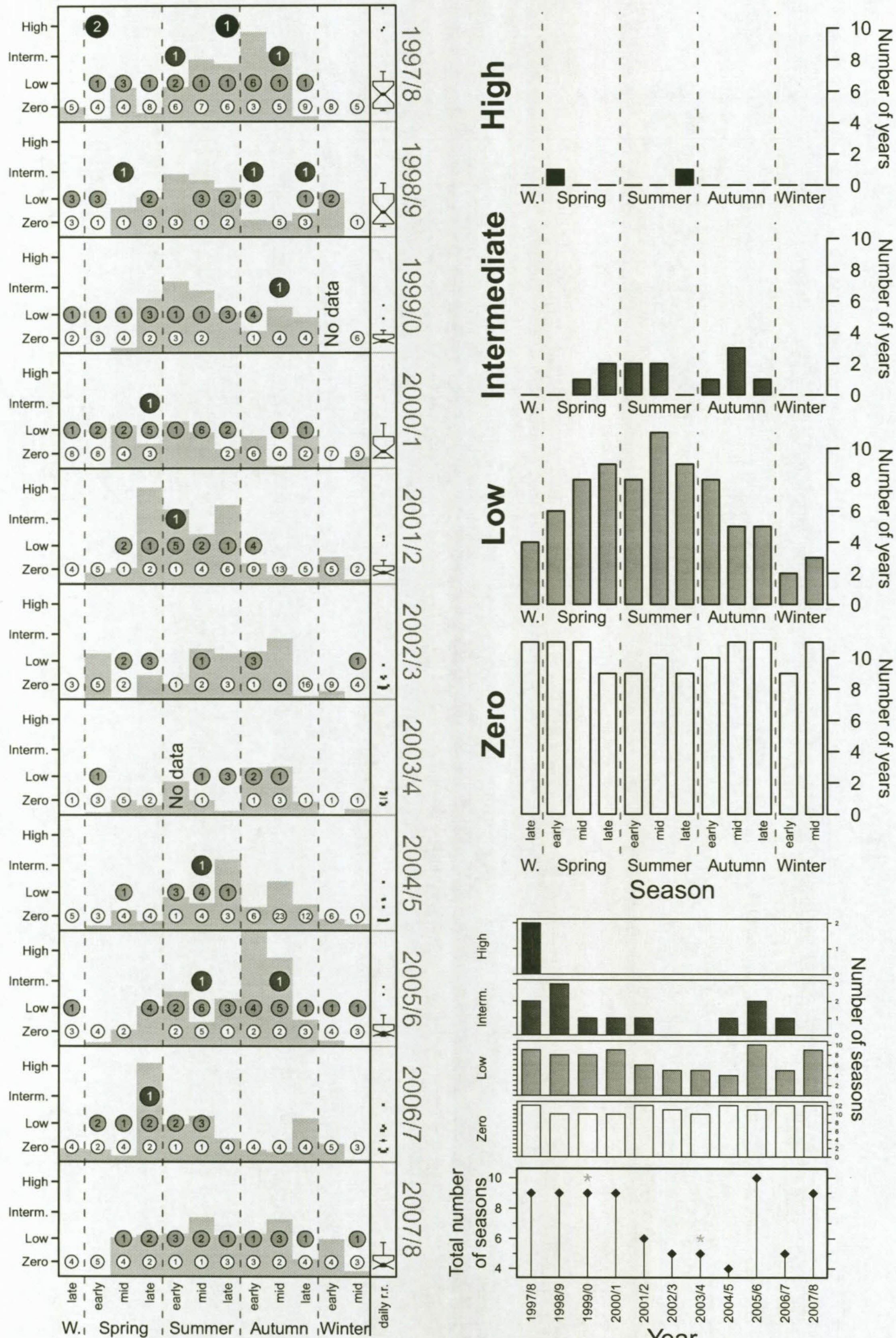


Figure 5.21: R494 Rufous-naped Lark — flight song: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

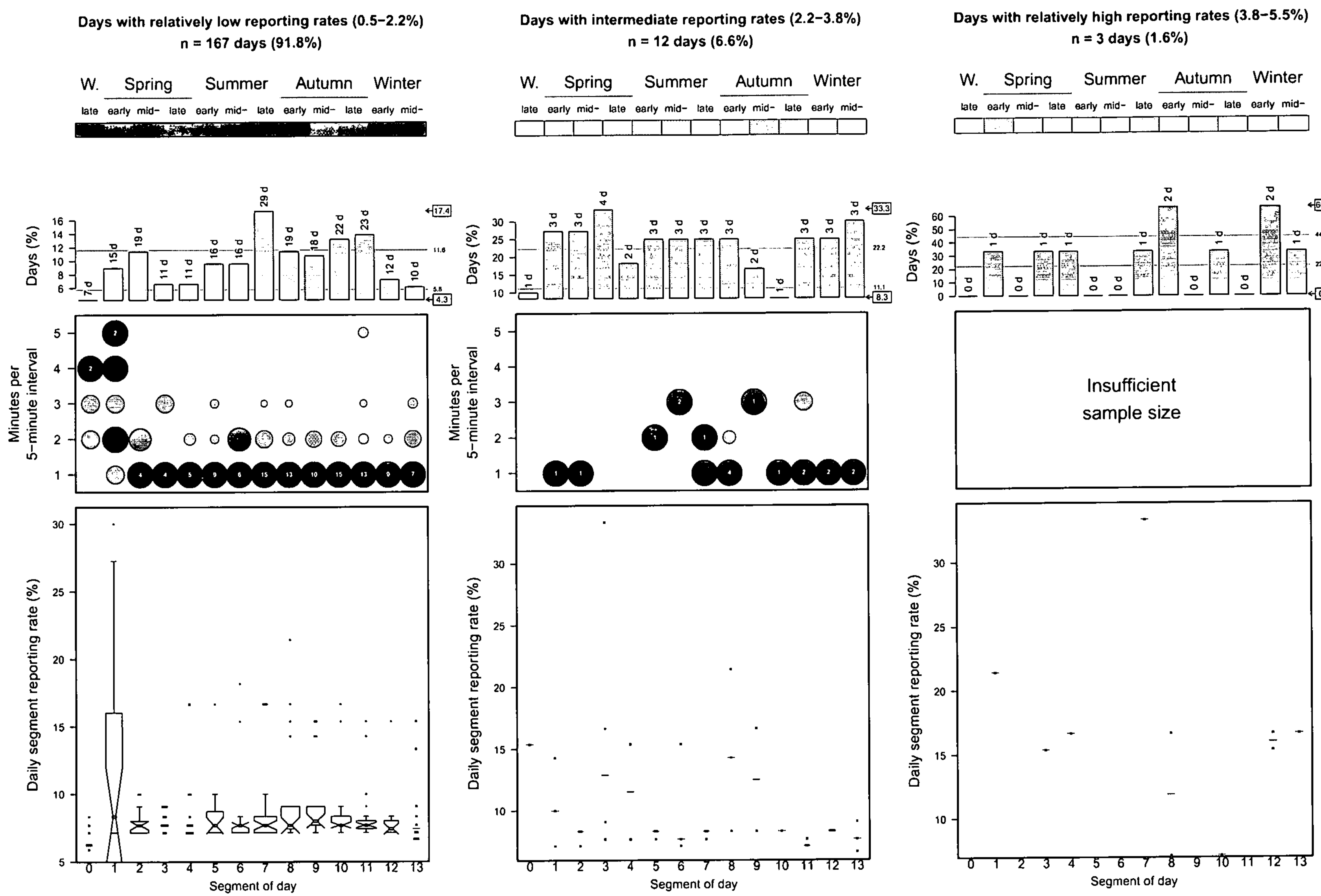


Figure 5.22: R494 Rufous-naped Lark — flight song: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

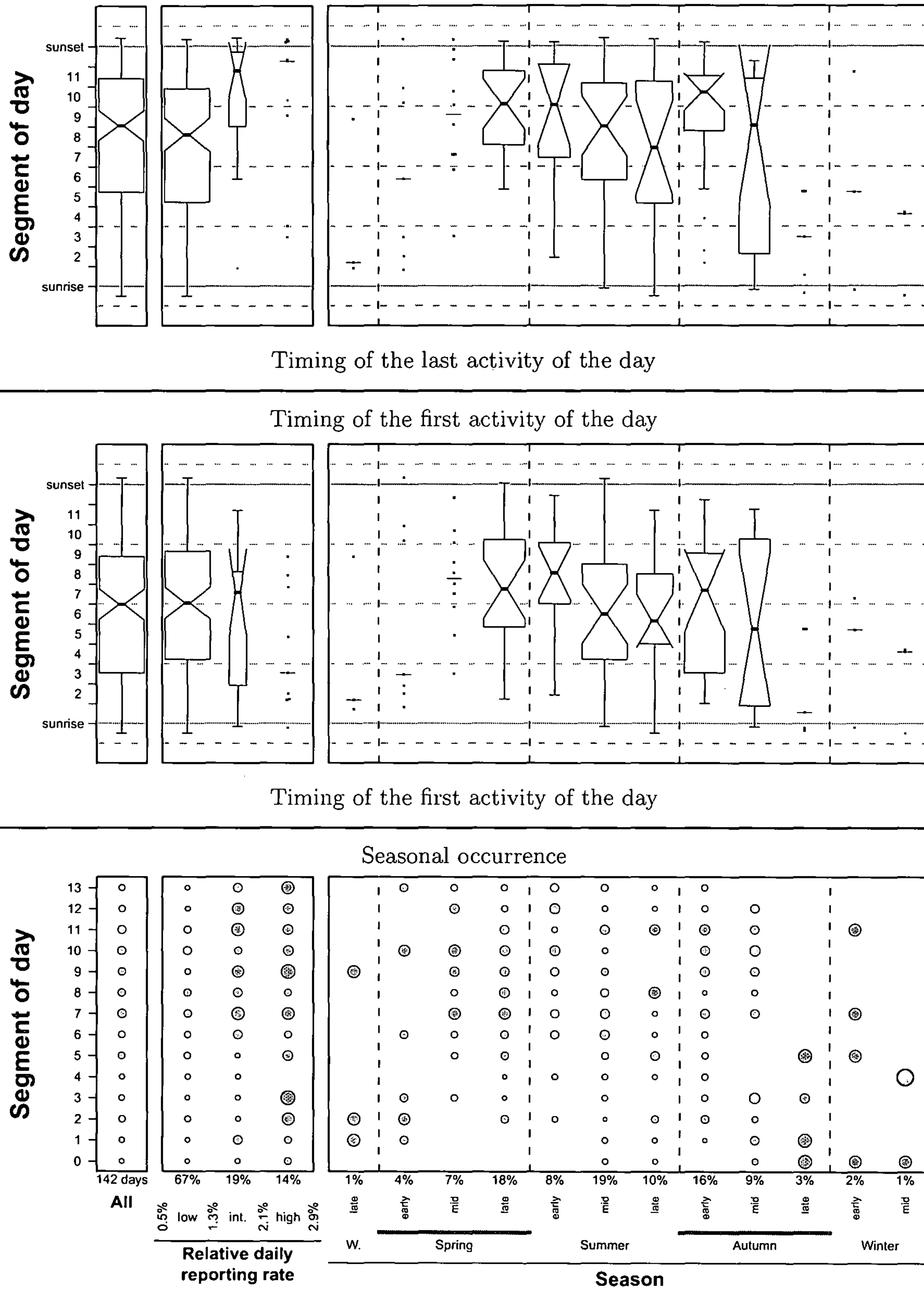


Figure 5.23: R494 Rufous-naped Lark — flight song: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

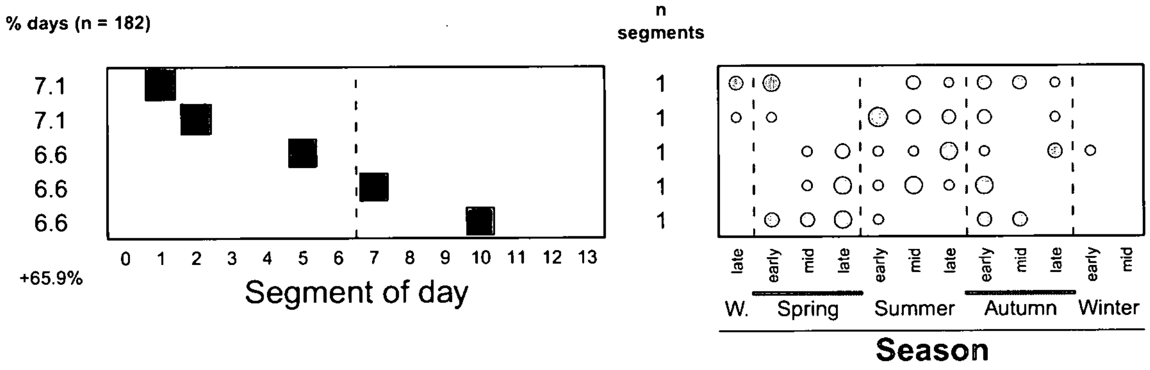


Figure 5.24: R494 Rufous-naped Lark — flight song: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

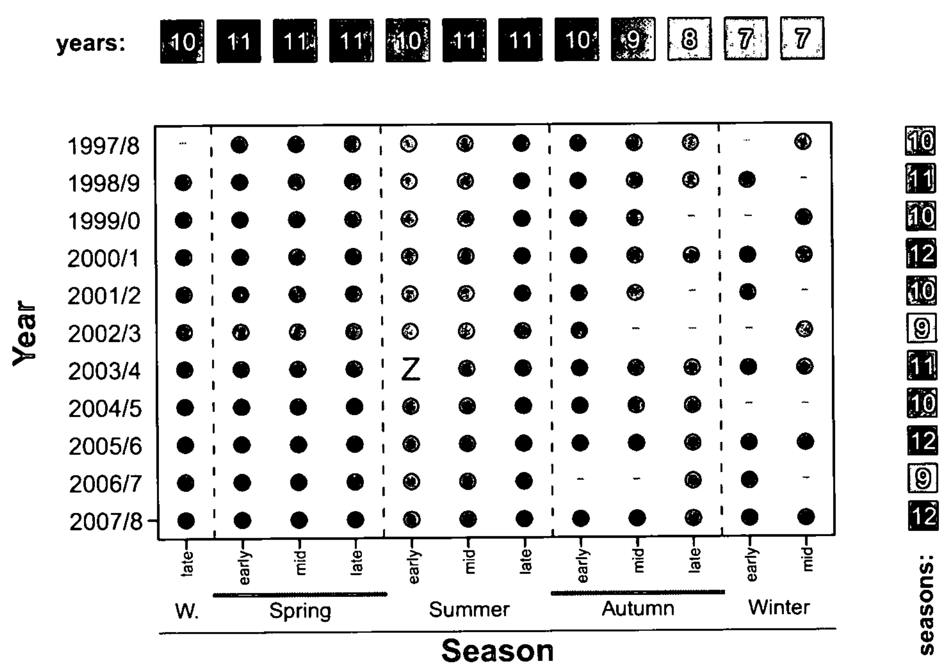


Figure 5.25: R494 Rufous-naped Lark: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

R495 Eastern Clapper Lark . . . . *Mirafra fasciolata*

From western Zambia (and probably also south-eastern Angola, Dean 2000) the distribution of the Eastern Clapper Lark extends southwards into Namibia, Botswana and South Africa, where the Free State forms part of its core distribution (Dean 1997g). It is primarily associated with grassland (Dean 1997g).

The birds at Glen

The behaviour of the Eastern Clapper Lark has been studied at Glen since 1999/0. The data presented in this thesis concern selected aspects of its vocal behaviour and represent a mere fraction of the total data-set, which include additional information on vocalisations, moult, breeding, feeding, thermoregulation, *etc.* The bulk of this data awaits computerisation and analyses. The present thesis considers only displays and song.

Males maintain territories throughout the year. However, they may wander into adjacent territories when food becomes scarce, typically during the cooler seasons of the year. They advertise their territories by means of displays, and often when one bird starts, others will join in. On rare occasions, usually associated with breeding, females may also display, albeit briefly and imperfectly.

A display involves the bird flying up into the air, clapping its wings together below its body, causing a clearly audible sound as it ascends (hence its name, *Clapper* Lark). Then, near/at the peak of its ascent a few metres up and towards the end of the wing clapping, a whistle ensues as the bird descends with wings held momentarily at a high dihedral. If one were to trace a bird during its ascend-clap — whistle-descend sequence, the trace would resemble an inverted 'V', or the Greek letter lambda, Λ. Strong wind may push a displaying bird backwards.

Displays occur from the ground or during sustained flight. When from the ground, it is usually only one display that occurs at a time, *i.e.* the ascend-clap starts from the ground and the whistle-descend ends on the ground. Sometimes the bird would not alight on the ground after the whistle-descend, but instead continue in low-level flight, sometimes performing another display or displays further on. The interval between displays from the ground varies from a few seconds to several minutes (Note that reference here to 'ground' also implies anthills, bushes and fences).

Displays during sustained flight start by the bird ascending fairly steeply, with or without displays on the way up, to an altitude of a few tens of metres, where it would start/continue displaying for a number of minutes. The interval between consecutive displays range from approximately 6 to 10 seconds. This is in contrast to the birds in the Kalahari Gemsbok National Park, where the interval between consecutive displays is about 15 to 30 seconds according to Maclean (1970c). A variation on the sustained flight displays occurs when displays are interspersed with vocal imitations of other birds. During these display sessions the intervals between consecutive displays are variable, and can be longer than a minute. Displays with or without imitations were analysed separately. If both display modes occurred during a particular 5-minute interval, it was recorded as displays with imitations. No distinction was made between flight and ground displays in the current analysis.

Song is usually given by a bird perched on a termite mound, karoid shrub, acacia bush or fence, and consists of various calls given in succession (often more than 30 calls per minute). The duration of the song is variable and can extend for many minutes. The first song of the morning typically occurred some time after the first displays.

All activities refer to birds in the grassland, with Table 5.5 summarising the 5-minute checklist data and Table 5.6 summarising the one-minute data-set. Figures start on page 599.

Table 5.5: R495 Eastern Clapper Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen. imit. = imitations.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.514	21 494	114 612	18.8	displays without imit.	76.2	656	500	43
0.062	2 591	114 612	2.3	displays with imit.	54.0	656	354	7
0.424	17 721	114 612	15.5	song	99.4	656	652	27
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.963	389	1 190	32.7	displays without imit.	69.8	43	30	13
0.037	15	1 190	1.3	song	18.6	43	8	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.551	592	1 188	49.8	displays without imit.	81.4	43	35	17
0.013	14	1 188	1.2	displays with imit.	14.0	43	6	2
0.436	468	1 188	39.4	song	95.3	43	41	11

Table 5.6: R495 Eastern Clapper Lark: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
displays – imitations	beginning	84 635	547 500	15.5
song	early summer 1999/0	33 791	429 075	7.9

Annual occurrence of displays (without imitations) in the grassland: Overall, recorded on 76.2% of the days with an activity index of 43 (Table 5.5a). Recorded during all, or nearly all, seasons each year (Fig. 5.26; Fig. 5.27). Daily reporting rates were variable and ranged from 0.5 to 72.6% with nearly half of the days reaching intermediate or high reporting rates (Fig. 5.26). Days with high reporting rates usually occurred during ≤ 3 seasons in most years, but during 5–6 seasons in 1999/0, 2001/2, 2005/6 and 2007/8 (Fig. 5.27). Activity intensity was high during all years (Fig. 5.26).

Seasonal occurrence of displays (without imitations) in the grassland: Based on the number of bird-years and the seasonal frequency index, activity frequency showed a bimodal seasonal pattern with the main peak occurring during spring, summer and early autumn, and a lesser peak during early and mid-winter (Fig. 5.26). Activity intensities indicated a similar trend (Fig. 5.26), as do the occurrence of zero record days (Fig. 5.27). However, intermediate and particularly high reporting rate days were largely limited to the period from mid-spring to early autumn (Fig. 5.27), coinciding with median daily reporting rates which were much higher during that period than during late autumn and winter (Fig. 5.26).

Daily occurrence of displays (without imitations) in the grassland: Overall, activity was most frequent in the early morning and relatively infrequent after mid-morning (Fig. 5.26). However, this general pattern is most applicable to low reporting rate days only (Fig. 5.28). On intermediate reporting rate days activity was most frequent in the morning and less frequent, but still frequent, in the afternoon (Fig. 5.28). However, activity after sunset was infrequent (Fig. 5.28). For high reporting rate days, activity on the majority of days occurred during almost all segments, except after sunset, when activity was relatively infrequent (Fig. 5.28). Seasonally, activity was recorded during all segments from mid-spring to mid-autumn (not after sunset in mid-autumn) and mainly during the early mornings in late autumn, winter and early spring (Fig. 5.29). Only two segment combinations occurred during at least 5% bird-days, namely activity during S1 alone (mainly during winter), and activity during S0–S12 (mainly during summer and early autumn) (Fig. 5.30). Collectively these combinations accounted for 13.2% of all bird-days (Fig. 5.30).

The first activity of the day typically commenced before sunrise, often earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.29; Fig. 5.31). There is also a well-defined seasonal pattern with the timing of the first activity of the day being least variable and occurring earlier during spring and summer than during autumn or winter (Fig. 5.29; Fig. 5.31). The dawn chorus sequence followed a similar trend, except that during winter the sequence was lower than during summer (Fig. 5.31).

The last activity of the day occurred later on high and intermediate reporting rate days than on low reporting rate days (Fig. 5.29; Fig. 5.31). There was also a very strong seasonal pattern with activity ending in the late afternoon from mid-spring to late summer, and in the mornings during late autumn and winter (Fig. 5.29; Fig. 5.31).

During low reporting rate days, activity intensity was highest during the early mornings and became relatively low from midday onward (Fig. 5.28). On intermediate and high reporting rate days the activity intensity was still highest during the early morning (Fig. 5.28). However, it was high during the rest of the day too, except in the late afternoon and after sunset when it became relatively low (Fig. 5.28).

Median daily segment reporting rates peaked for low reporting rate days in S0–S1, in S0–S4 on intermediate reporting rate days, and S0–S5 on high reporting rate days (Fig. 5.28). Owing to a strong seasonal pattern in daily reporting rates (Fig. 5.26), it is not surprising to note that seasonal variation in the daily pattern (Fig. 5.32) reflects the daily patterns for low, intermediate and high reporting rates (Fig. 5.28). Compare, for example, the activity during winter (Fig. 5.32) with that of days with low reporting rates (Fig. 5.28); or, the activity during summer (Fig. 5.32) with that of days with intermediate and high reporting rates (Fig. 5.28).

Early morning occurrence of displays (without imitations) during 2007/8: Activity was recorded slightly more frequently in the grassland than in the drainage line (Table 5.5b & c), and the median early morning reporting rate was also higher in the grassland (Fig. 5.33). The seasonal pattern in the drainage line partially matched that recorded in the grassland (Fig. 5.33). More specifically, high reporting rate mornings occurred from mid-spring to early autumn in both habitats, but only low reporting rate mornings occurred subsequently in the drainage line compared to the high reporting rate mornings during late autumn and early winter in the grassland (Fig. 5.33). The timing of the first activity of the day was comparable between the two habitats (Fig. 5.33).

Activity intensities were comparable between pre- and post-sunrise times in the grassland, but not in the drainage line, where the activity intensities after sunrise were typically lower than that measured before sunrise (Fig. 5.33). Moreover, whereas pre-sunrise activity intensities were comparable between the habitats, post-sunrise activity intensities were typically lower in the drainage line than in the grassland (Fig. 5.33).

Annual occurrence in the grassland of displays with imitations: Recorded on 54.0% of the days with an activity index of seven (Table 5.5a). Noted during 9–11 seasons in all years except 2006/7 when recorded during only six seasons (Fig. 5.34; Fig. 5.35). Daily reporting rates ranged from 0.5 to 19.3% with 81.9% bird-days attaining low reporting rates (Fig. 5.34). Median daily reporting rates were similar for all years and days with high reporting rates limited to 2005/6 and 2006/7 (Fig. 5.34; Fig. 5.35).

Seasonal occurrence in the grassland of displays with imitations: The seasonal data indicate a bimodal pattern with a primary peak period centred more or less on spring and summer and a secondary peak period on mid-winter (Fig. 5.34; Fig. 5.35). This pattern is most clearly seen in the seasonal fluctuation of the median daily reporting rates (Fig. 5.34) and the seasonal occurrence of days with zero records (Fig. 5.35).

Daily occurrence in the grassland of displays with imitations: Overall, activity was infrequent before sunrise, most frequent in the early morning after sunrise and slightly less frequent after mid-morning (Fig. 5.34). This general pattern is reflected for both low and intermediate reporting rate days (Fig. 5.36). Activity occurred during all, or almost all, segments of the day from mid-spring to early autumn, in contrast to most other seasons when activity was largely limited to the early morning and particularly to the time after sunset (Fig. 5.37). The two bird-segment combinations occurring during at least 5% bird-days were limited to single segments S2 and S13, which combinations collectively accounted for 13.6% bird-days (Fig. 5.38).

The first activity of the day typically commenced during the course of the morning, often earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.37). The timing of the first activity of the day was less variable from mid-spring to late autumn than during winter and early spring (Fig. 5.37).

The last activity of the day generally occurred later on intermediate and high reporting rate days than on low reporting rate days, but the seasonal pattern was variable with only mid-winter, late winter and early spring having median values after sunset (Fig. 5.37).

Overall, daily segment reporting rates ranged from 6.2 to 80.0% with 83.8% of the values relatively low and median daily segment reporting rates similar for nearly all segments of the day (Fig. 5.34; Fig. 5.36).

Early morning occurrence of displays with imitations during 2007/8: Only recorded in the grassland where it occurred during six mornings (Table 5.5b & c).

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Annual occurrence of song in the grassland: Overall, recorded on 99.4% of the days with an activity index of 27 (Table 5.5a). Noted during all seasons of every year (Fig. 5.39; Fig. 5.40). Daily reporting rates ranged from 0.6 to 55.8% with two thirds of the bird-days attaining low reporting rates (Fig. 5.39). The median daily reporting rates of 2006/7 and 2007/8 were low compared to those of 1997/8, 1998/9 and 2002/3–2005/6 (Fig. 5.39). High reporting rate days occurred during 1997/8, 1998/9, 2001/2, 2002/3 and 2005/6 (Fig. 5.40). Activity intensities were slightly higher during certain years than during others (Fig. 5.39).

Seasonal occurrence of song in the grassland: Activity intensity is highest during spring and wanes during summer to reach its minimum level in mid-autumn (Fig. 5.39). Median daily reporting rates, however, show a definite peak centred on early winter (Fig. 5.39).

Daily occurrence of song in the grassland: Overall, activity was most frequent in the early morning with a secondary peak in the late afternoon around sunset (Fig. 5.39). This general pattern is similar for low, intermediate and high reporting rate days (Fig. 5.41), as well as for the respective seasons (Fig. 5.42). No segment combinations occurred during more than 5% bird-days.

The first activity of the day always occurred in the morning, typically before sunrise, and often earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.42; Fig. 5.43). There is also a well-defined seasonal pattern with the timing of the first activity of the day being least variable and occurring earlier during late autumn, winter and early spring than during other times of the year (Fig. 5.42; Fig. 5.43). This pattern matches partially the fluctuations in the dawn chorus sequence, particularly the autumn and winter part of the pattern (Fig. 5.43).

The last activity of the day frequently occurred around sunset, typically after sunset on intermediate and high reporting rate days (Fig. 5.42; Fig. 5.43). Although the median values for all seasons fall within the first 15 minutes after sunset, the values for late autumn, early and mid-winter and early spring were least variable and mostly after sunset (Fig. 5.42; Fig. 5.43).

The daily pattern of activity intensity was similar for low, intermediate and high reporting rate days, with highest values attained in the early morning and values higher than midday values in the late afternoon (Fig. 5.41).

The daily pattern followed by the median daily segment reporting rates was similar between low, intermediate and high reporting rate days with peaks in the early mornings and a lesser peak in the late afternoon (Fig. 5.41).

Early morning occurrence of song during 2007/8: Song was much more frequently recorded in the grassland than in the drainage line (Table 5.5b & c). The median early morning reporting rate was also higher in the grassland (Fig. 5.44). The timing of the first activity of the day was often later in the drainage line than in the grassland (Fig. 5.44). Activity intensities were typically higher in the grassland than in the drainage line (Fig. 5.44).

Discussion

The following is a general review of the Eastern Clapper Lark's annual cycle at Glen, with particular emphasis on the activity of the males.

In late winter, the birds are in fresh plumage, having undergone a complete post-breeding moult a few months earlier. At this stage in the cycle they subsist mainly on grass seeds, including those of Red Grass *Themeda triandra*, Spear Grass *Heteropogon contortus* and *Aristida* spp. Displays, if they occur at all, are minimal (Fig. 5.27) and largely confined to the early mornings (Fig. 5.29). However, the incidence of aerial displays accompanied by imitations is particularly prevalent after sunset at this time of the year (Fig. 5.37).

Then comes the first significant rain of the year, usually during mid- or late spring (Fig. 2.16; Fig. 2.18). Invertebrate prey become more readily available and the birds are quick to exploit this source of food instead of grass seeds.

Singing occurs throughout the year, but is particularly intense during spring (Fig. 5.39). However, its daily occurrence is more limited (mainly early mornings and late afternoon) than during late autumn, early and mid-winter (Fig. 5.39; Fig. 5.42) .

Displays become more frequent from mid-spring onwards, occurring every day (Fig. 5.26), and more extensively during the day (Fig. 5.29). There is a striking similarity between the seasonal occurrence patterns during the first part of the year of Rufous-naped Lark R494 perch song and Eastern Clapper Lark R495 displays without imitations (*cf.* Figs. 5.13 & 5.27). As discussed on page 584, the pattern — involving the regular occurrence of the first annual intermediate reporting rate days during mid-spring — could be linked to an increase in day-length, which peak during mid-spring (Fig. 2.12), with rainfall as a possible secondary factor that influence the pattern.

Breeding may occur soon after the start of displays (and extend into autumn) with the female alone responsible for the incubation of the eggs. It also appears that she is the only one that takes care of the young if it is early in the breeding season (the male presumably too involved with displays and territorial defence), but with nests later in the season the male makes a significant contribution to the feeding of the young.

High activity levels of displays continue until a certain time of the year when all displays cease, usually during mid-autumn (note in particular the high incidence of days with zero records during that season in Figure 5.27). However, during 2000/1 and 2006/7 activity had already ceased in early autumn (Fig. 5.27). This is probably related to the fact that both years experienced poor rain during late summer (Fig. 2.16; Fig. 2.18). Indeed, the male observed during 2006/7 was already on a grass seed diet by late summer, which is unusual for that time of the year.

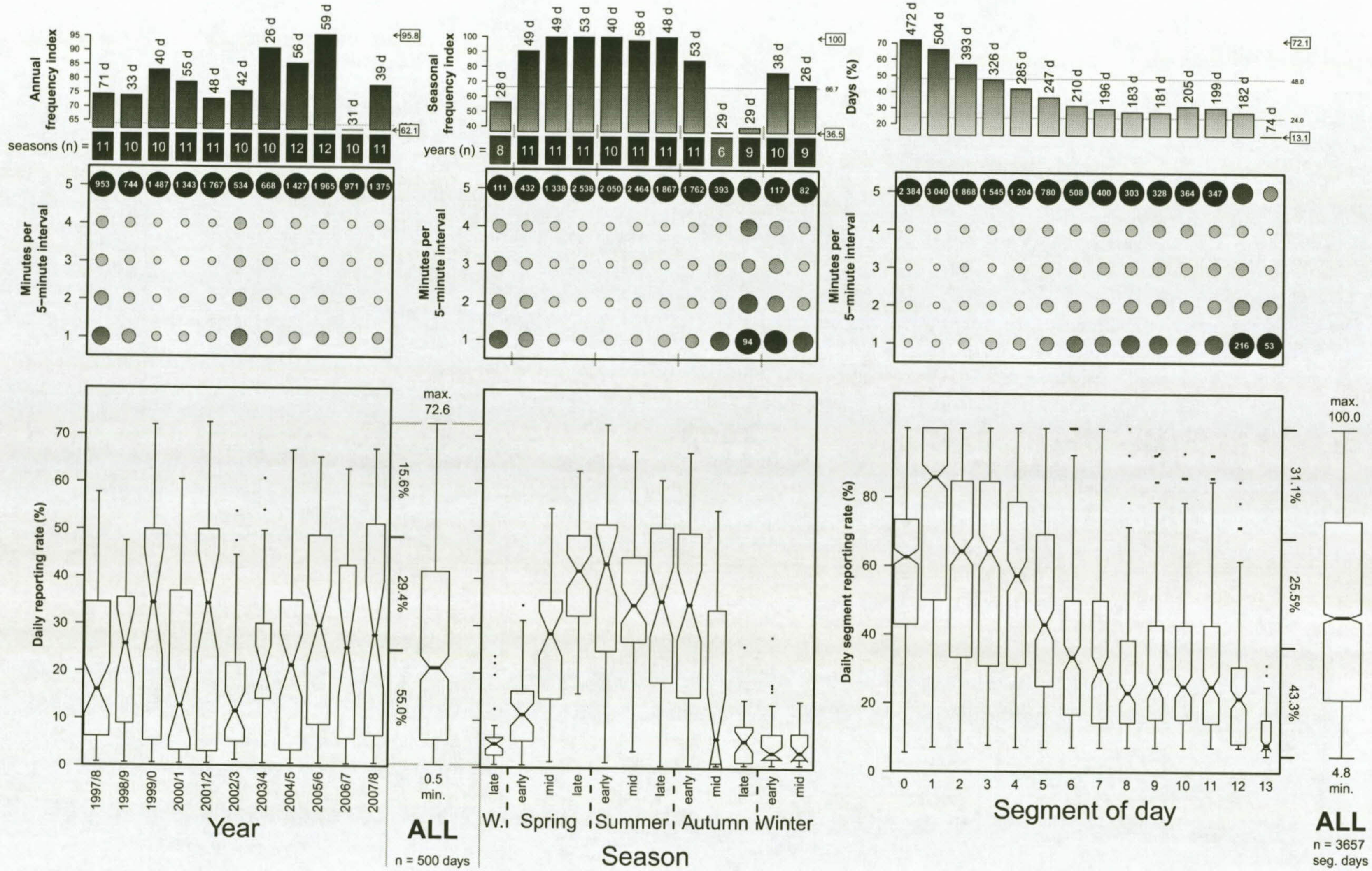


Figure 5.26: R495 Eastern Clapper Lark — displays without imitations: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

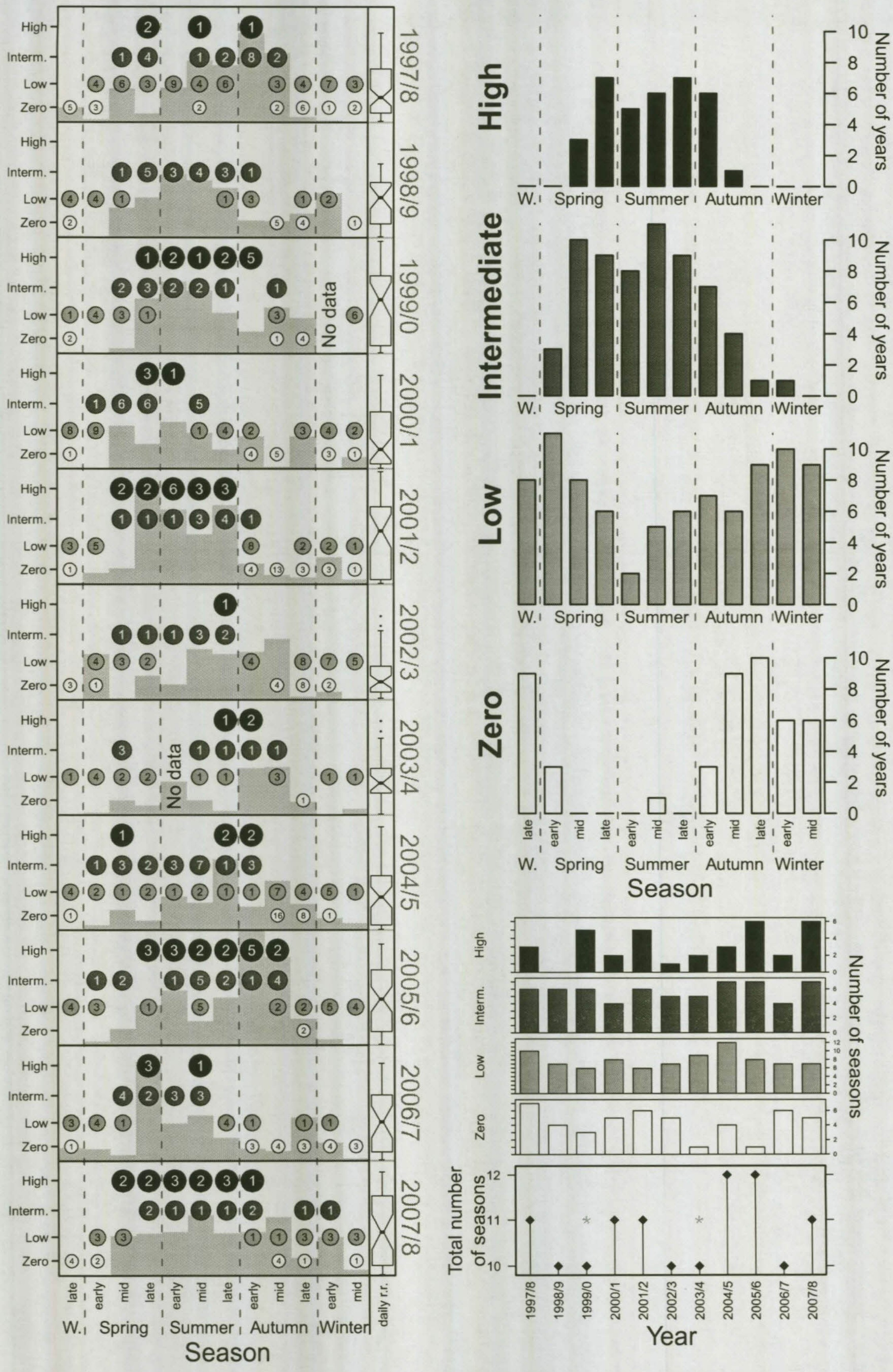


Figure 5.27: R495 Eastern Clapper Lark — displays without imitations: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

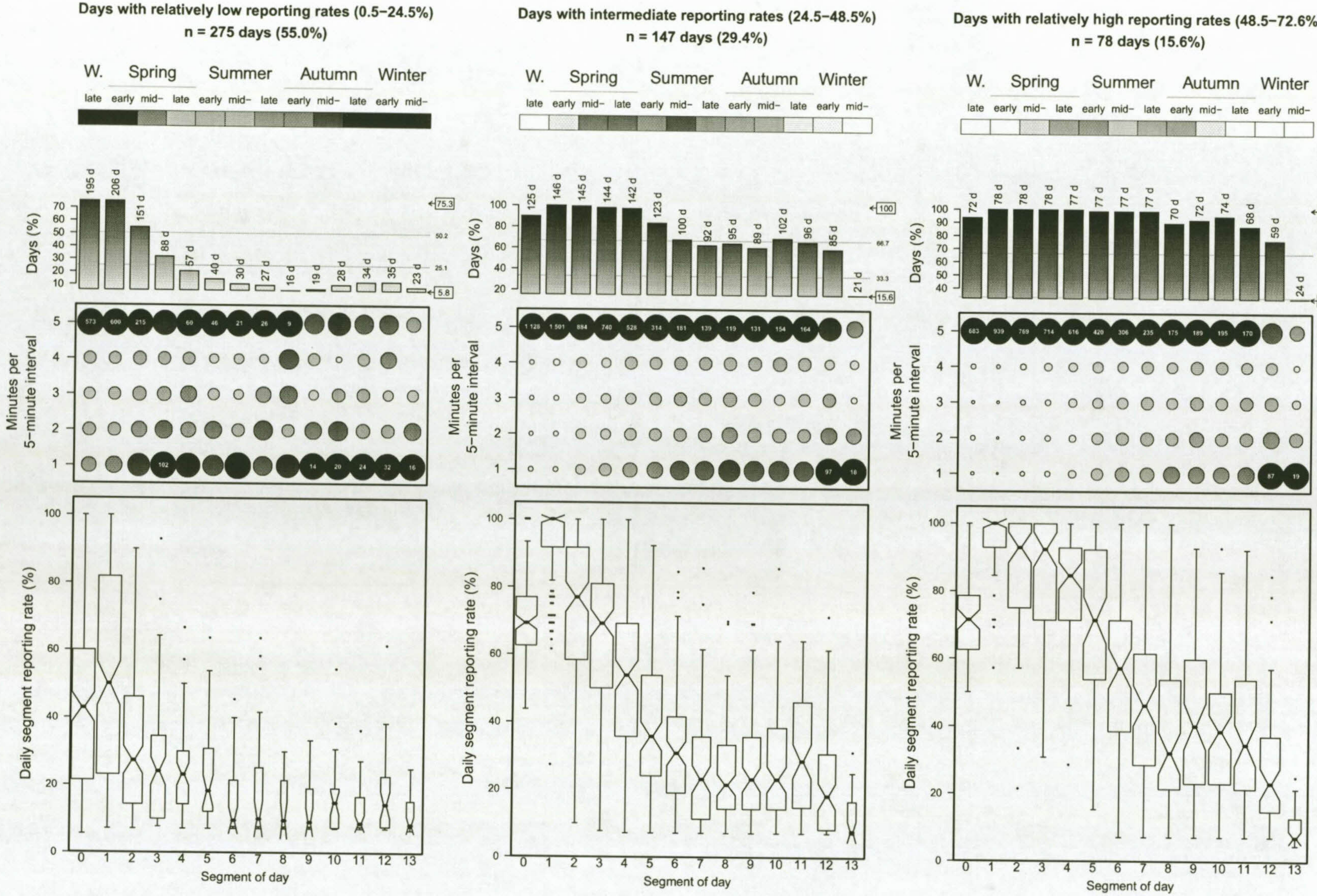


Figure 5.28: R495 Eastern Clapper Lark — displays without imitations: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

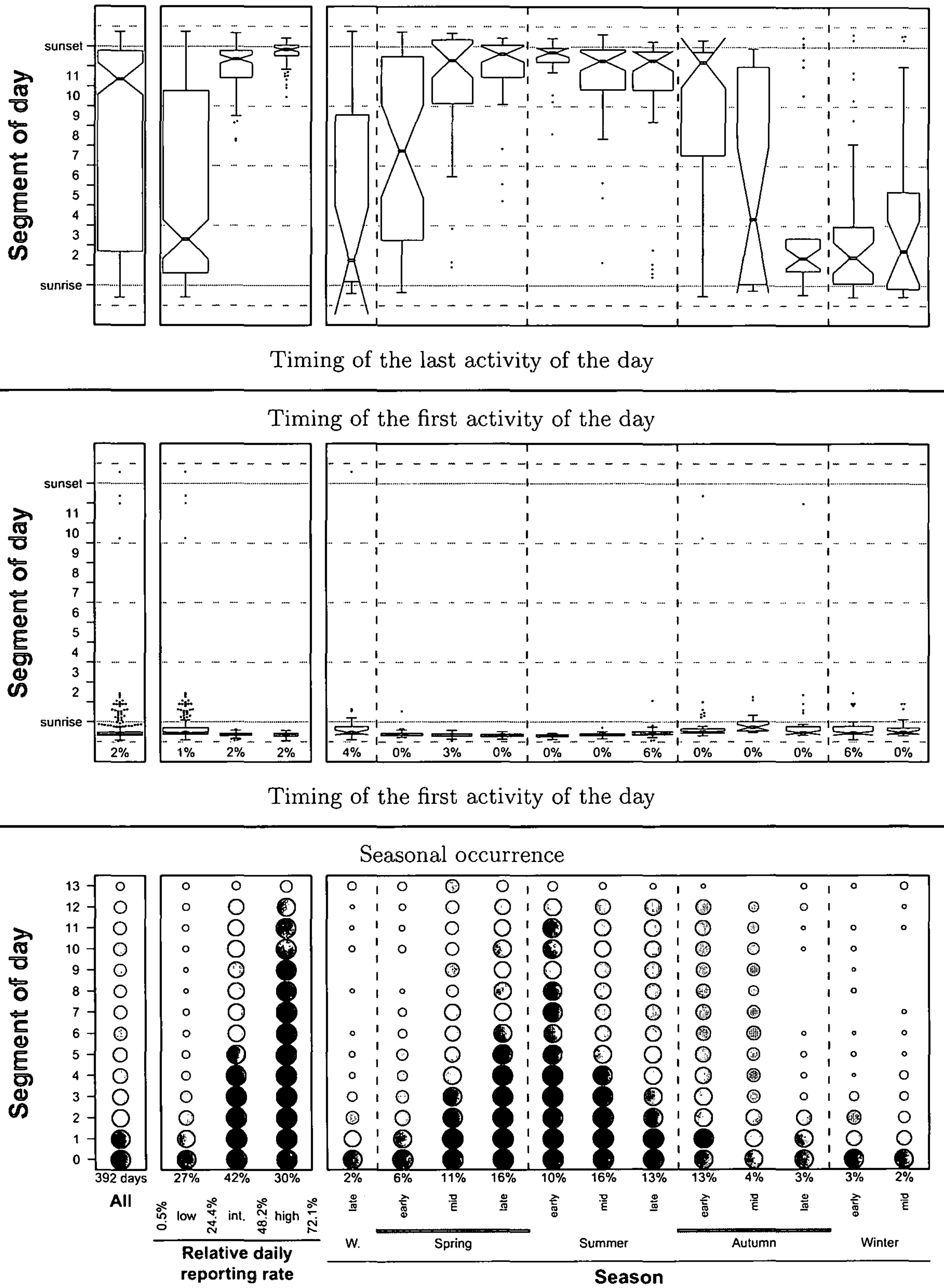


Figure 5.29: R495 Eastern Clapper Lark — displays without imitations: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

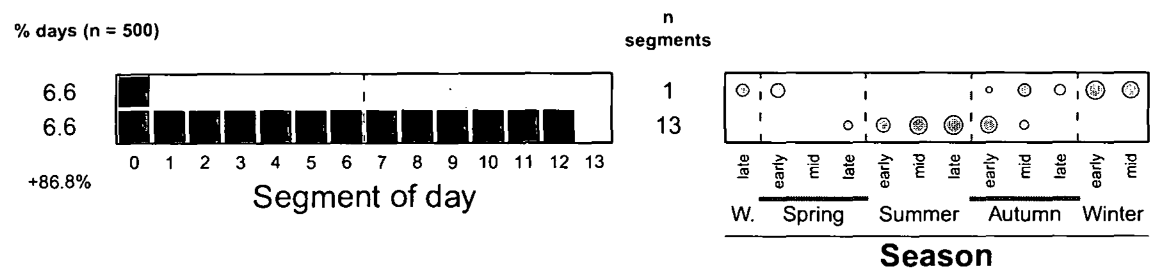


Figure 5.30: R495 Eastern Clapper Lark — displays without imitations: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

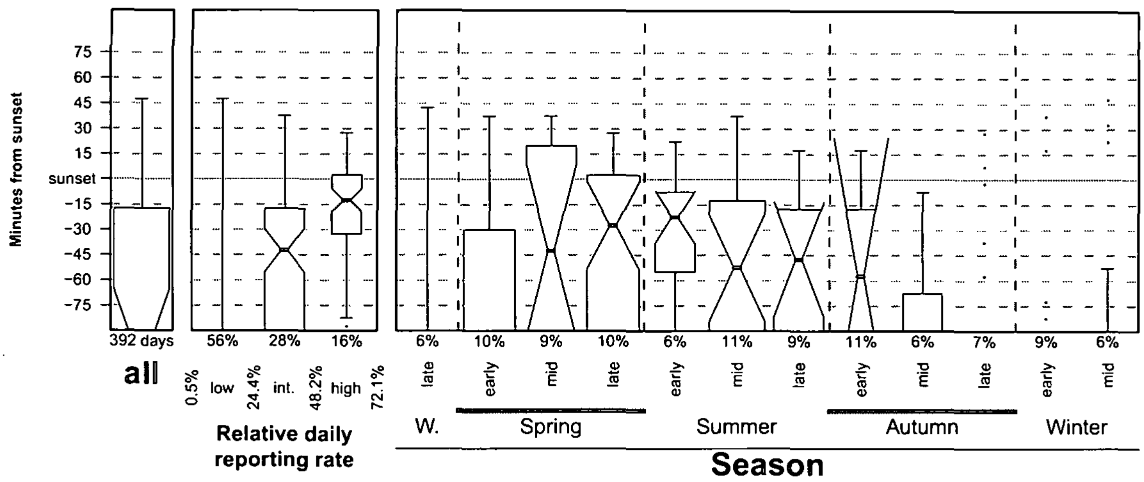
In 2003/4 and 2005/6 the first occurrence of days with zero records was only in late autumn (Fig. 5.27). This is also linked with rainfall. During 2003/4 — the driest year of the study, Fig. 2.13 — only limited rain had fallen by the end of summer (Fig. 2.16). Then nearly 72 mm fell during early autumn, and 74 mm during mid-autumn (Fig. 2.16). This probably caused the birds to display until the end of mid-autumn.

The year 2005/6 was unusual in that it was the only year with high reporting rate days occurring until mid-autumn (Fig. 5.27). Its rainfall was also unusual. It was the year with the highest rainfall during the study period (Fig. 2.13), with approximately half of the rain occurring in early and mid-autumn (Fig. 2.16; Fig. 2.18). This, no doubt, stimulated the birds to continue displaying until the end of mid-autumn (Fig. 5.27).

But why did the displays end at all during 2005/6? Conditions were good enough for the focal birds to successfully raise three chicks in mid-autumn of that year. More generally, why is the occurrence of days with zero displays so prevalent during mid- and late autumn (Fig. 5.27)? Food availability certainly plays a role — invertebrate prey become relatively scarce during autumn and winter, causing the birds to switch to grass seeds instead — but the seasonal occurrence of moult no doubt is an important factor too.

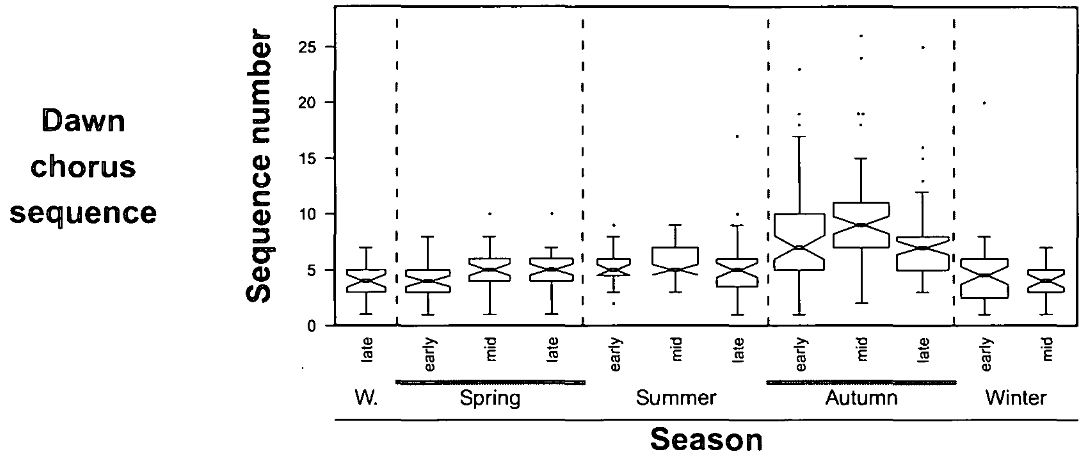
According to Ryan & Dean (2005), no data is available on the moulting of the Eastern Clapper Lark. However, over the years moult data have been collected for a large number of birds at Glen and elsewhere. In addition, field observations on moulting have also been made. The data-set awaits detailed analysis, but some preliminary results are relevant here. Adults undergo a complete post-breeding moult. Wing moult, which starts in early autumn or soon thereafter, is fairly rapid with the incidence of 3–4 primaries actively growing at a time common. All the tail feathers are dropped more or less simultaneously when the bird is approximately halfway through its primary moult. Thus, birds having a very short or no tail are sure signs that moult are well underway. The tail feathers are fully grown before the end of primary moult, and most birds have completed their moult before early winter.

Two of the consequences of the rapid moult in this species during autumn are that flight capabilities are impaired during moulting, and that the period of moulting is relatively short. The fact that days with zero displays occur every year during mid and/or late autumn (Fig. 5.27) also indicate a high degree of synchronisation between the birds. It is suggested that moult is triggered by shortening day-length, which is most rapid during mid-autumn (Fig. 2.12). After



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

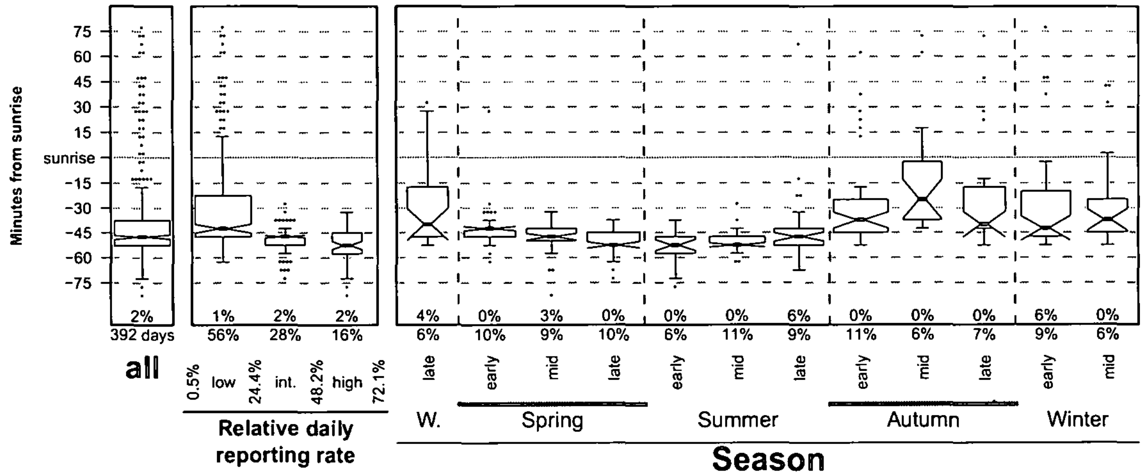


Figure 5.31: R495 Eastern Clapper Lark — displays without imitations: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

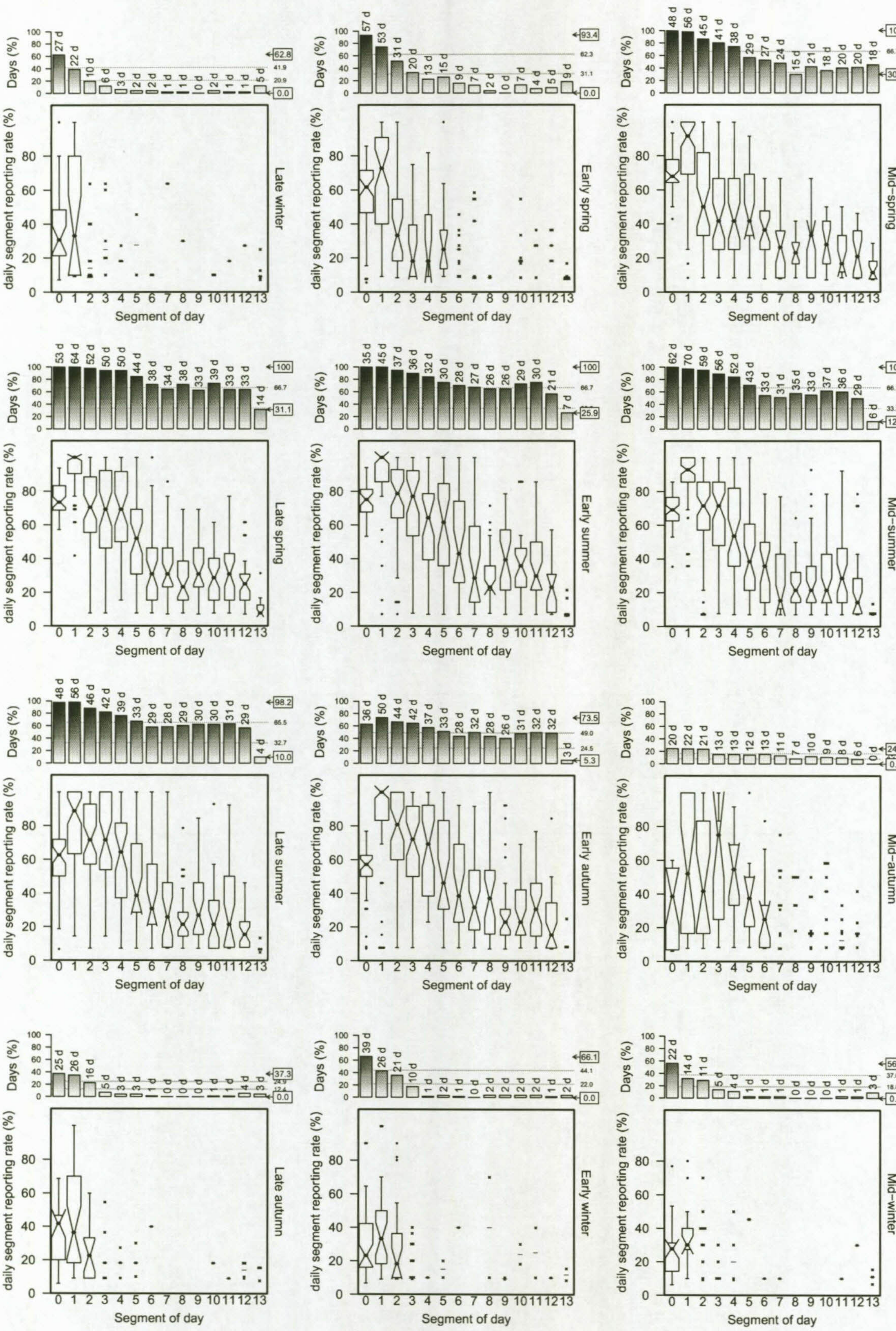
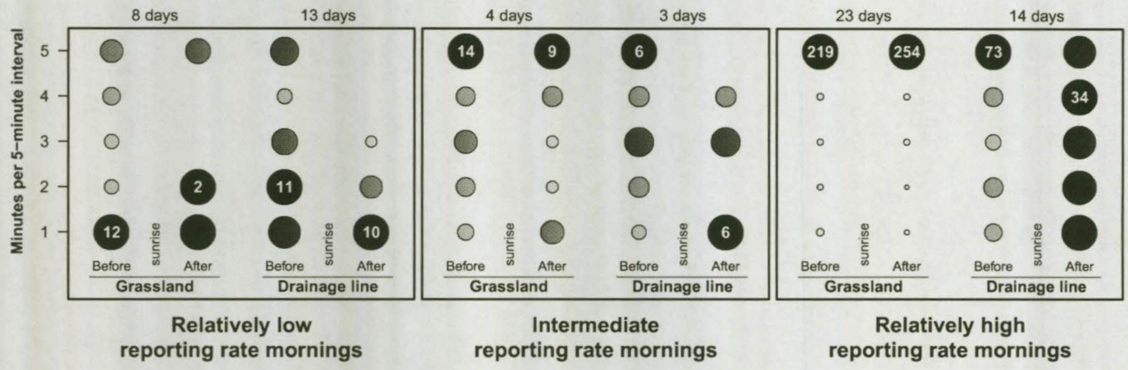
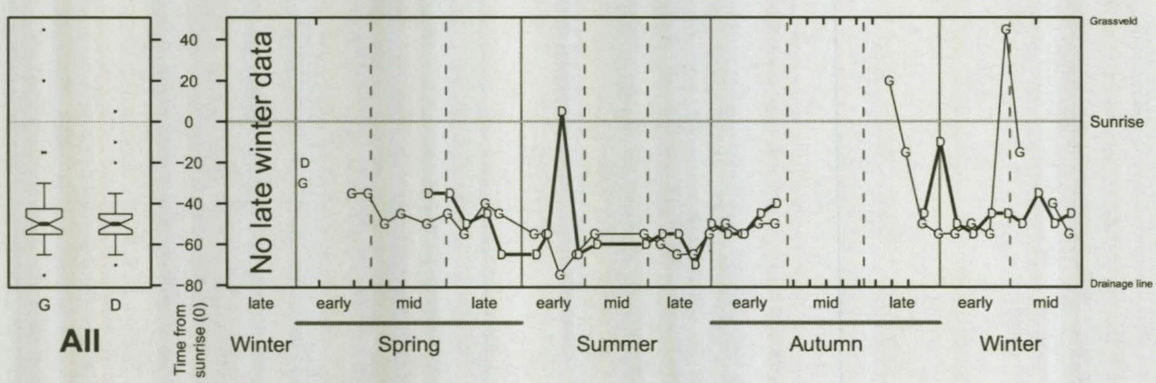


Figure 5.32: R495 Eastern Clapper Lark — displays without imitations: Seasonal fluctuations in daily occurrence in the grassland at Glen. See page 136 for more information on this seasonal detail figure.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

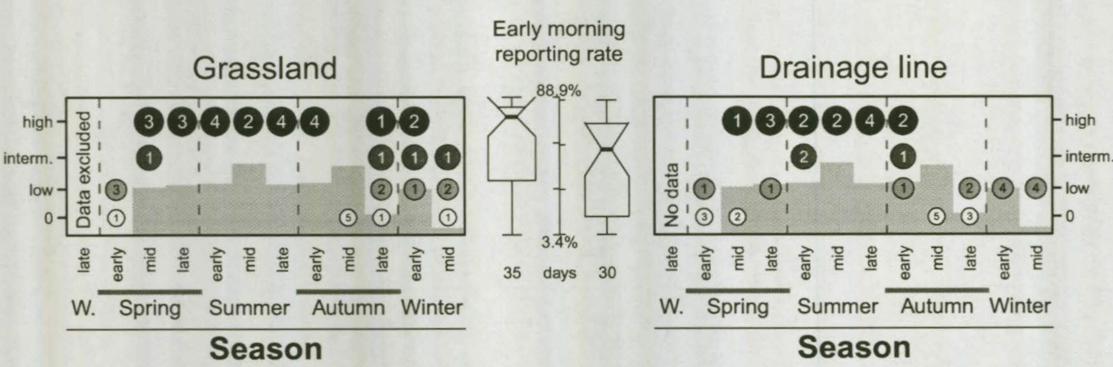


Figure 5.33: R495 Eastern Clapper Lark — displays without imitations: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

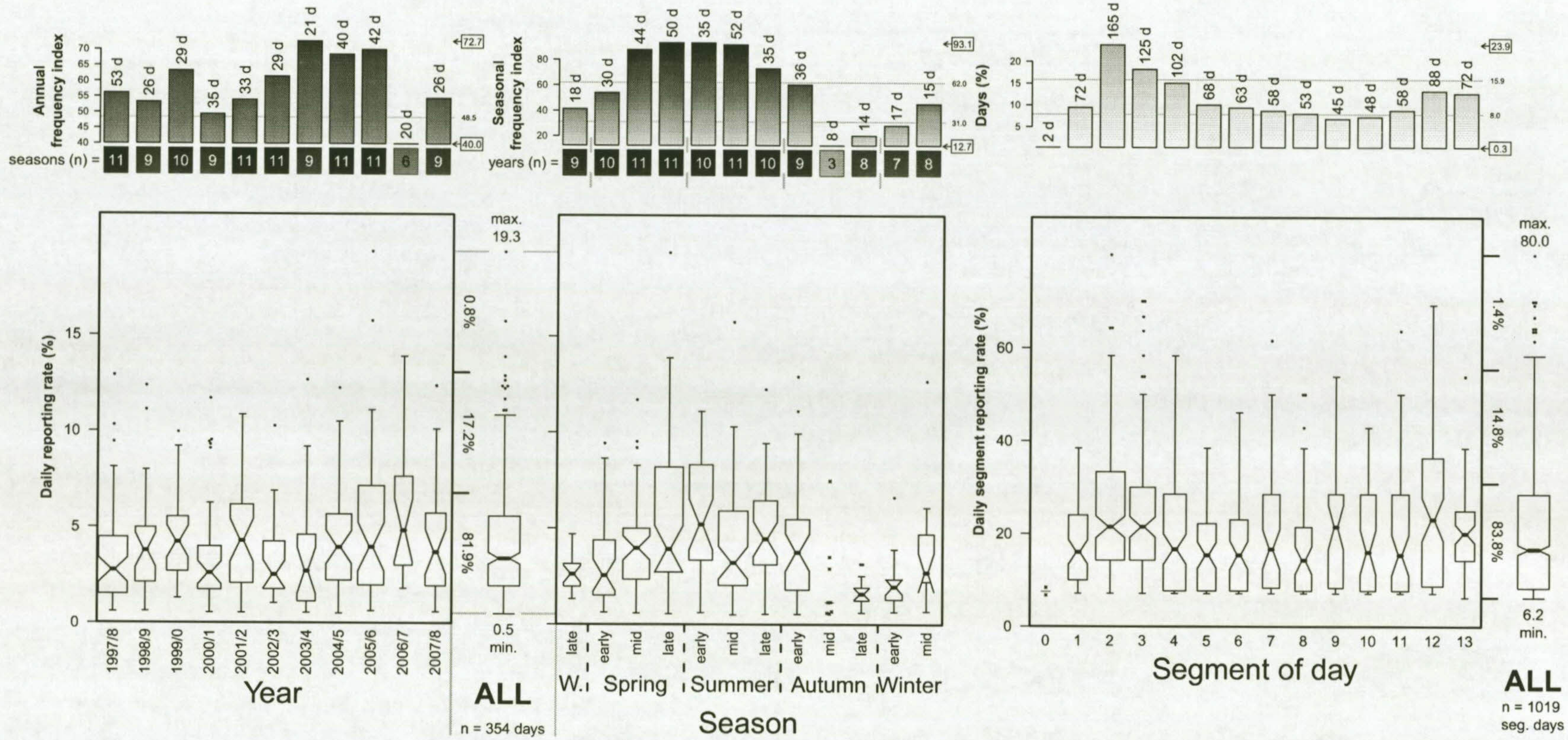


Figure 5.34: R495 Eastern Clapper Lark — displays with imitations: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

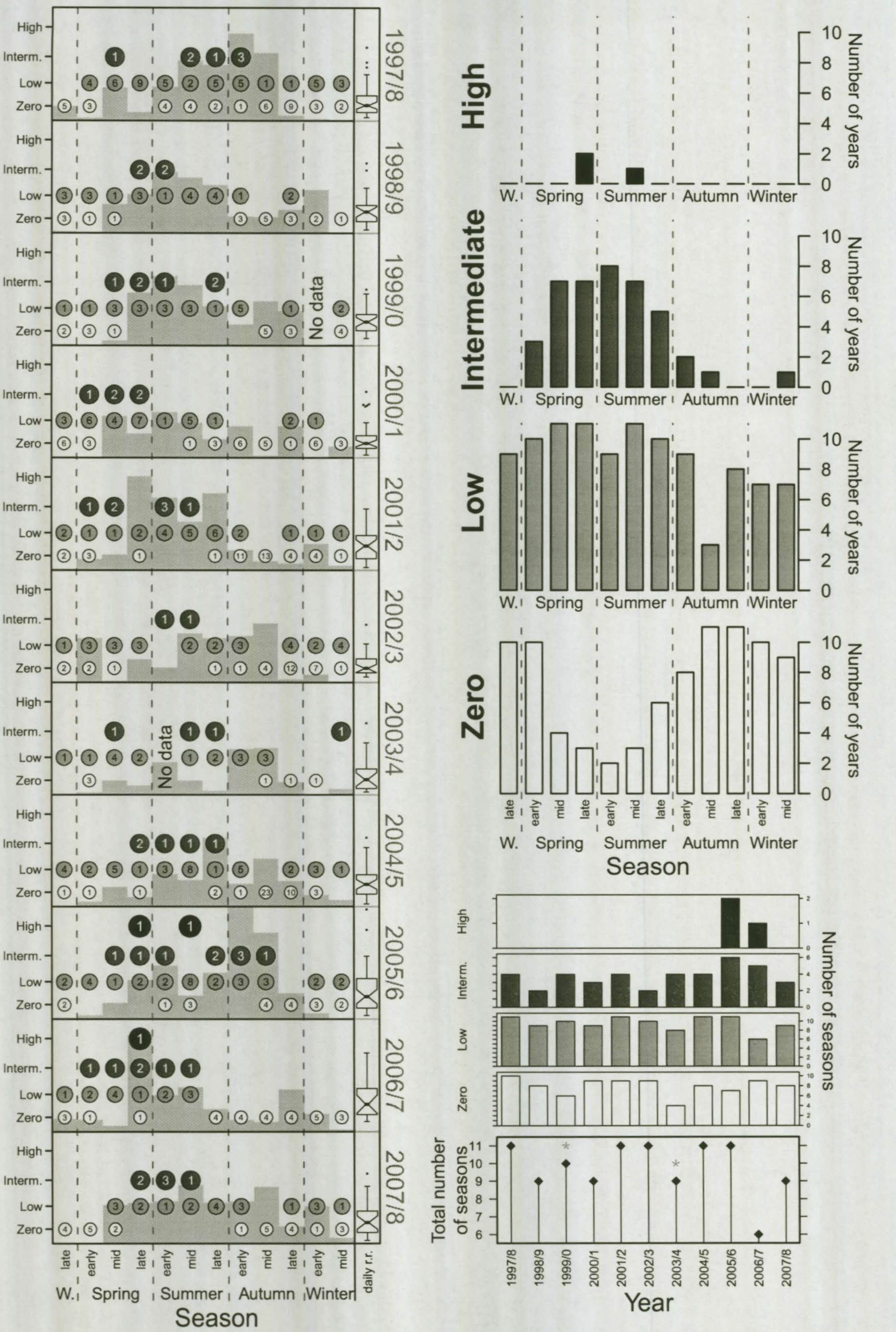


Figure 5.35: R495 Eastern Clapper Lark — displays with imitations: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

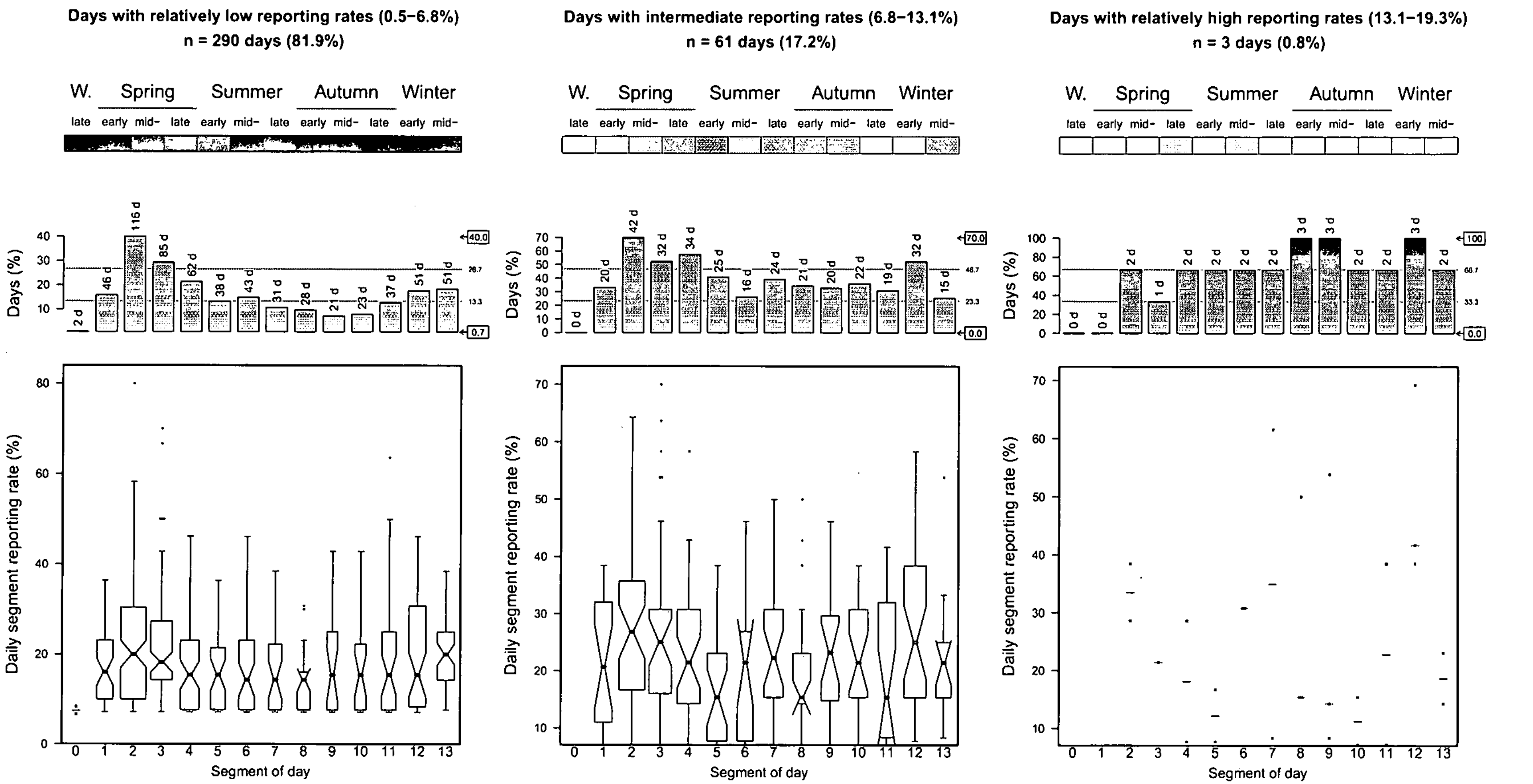


Figure 5.36: R495 Eastern Clapper Lark — displays with imitations: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

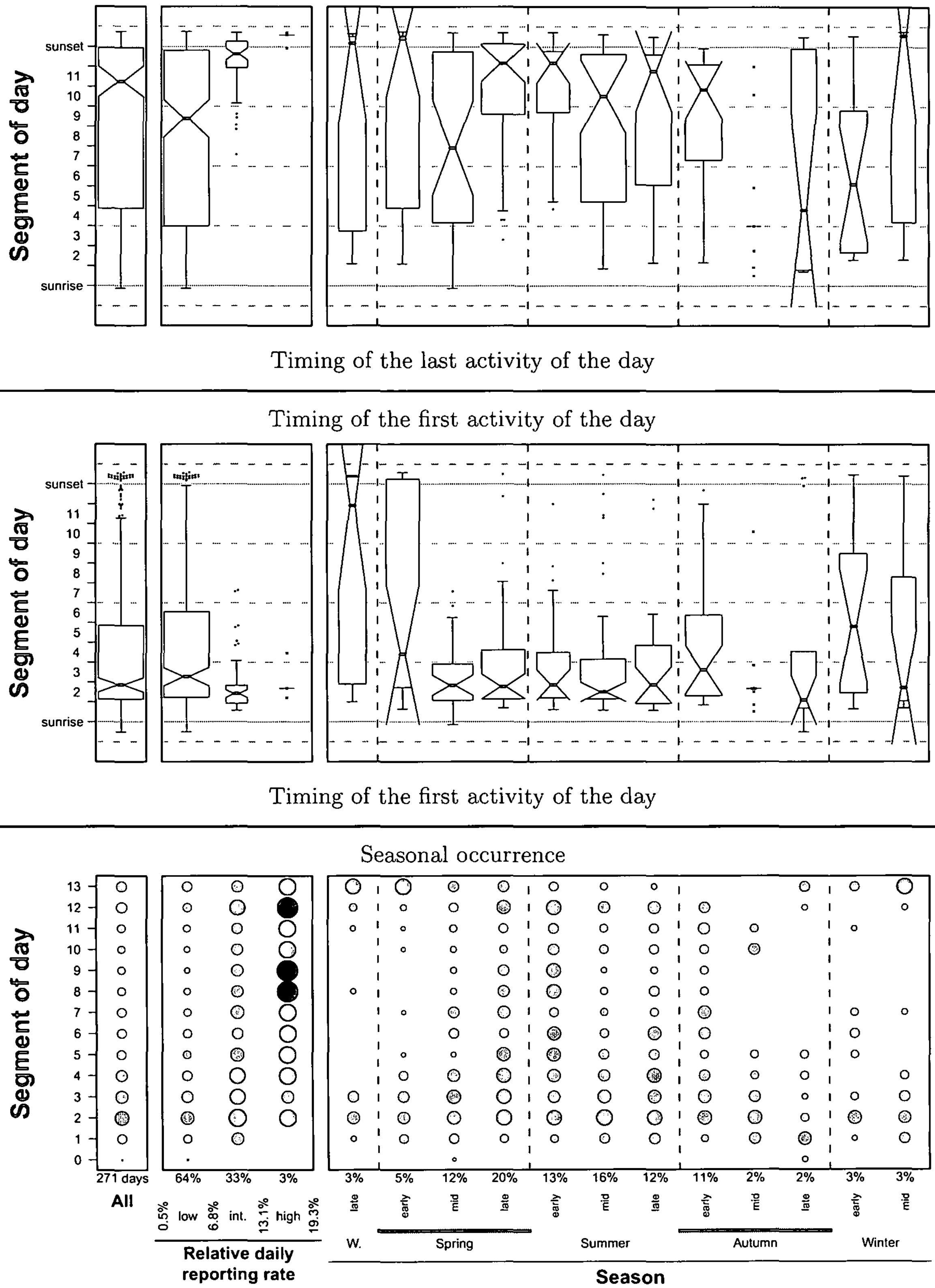


Figure 5.37: R495 Eastern Clapper Lark — displays with imitations: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

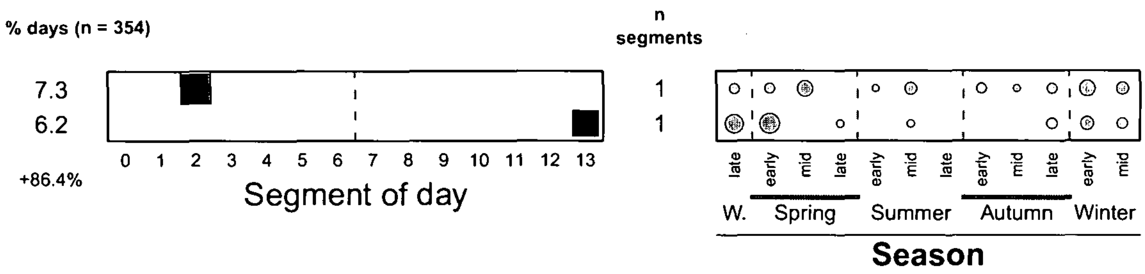


Figure 5.38: R495 Eastern Clapper Lark — displays with imitations: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

completion of the moult the birds start displaying once again (Fig. 5.27), only now it is largely limited to the early mornings until the rains of the next year (Fig. 5.29).

Regarding the SABAP1 reporting rates shown in Dean (1997g), it is noted that in most zones the reporting rates were lower during the cooler part of the year. These lower reporting rates probably represent post-moult activity. Dean (1997g), commenting on the SABAP1 data, wrote: "This is probably due to reduced detectability when the birds are not displaying and calling, and is unlikely to represent seasonal movements." It is agreed with Dean (1997g) that reduced detectability probably explains the lower SABAP1 reporting rates. However, the data from Glen shows that singing continues throughout the year, and is *more* prevalent during the post-moult period (Fig. 5.39; Fig. 5.42).

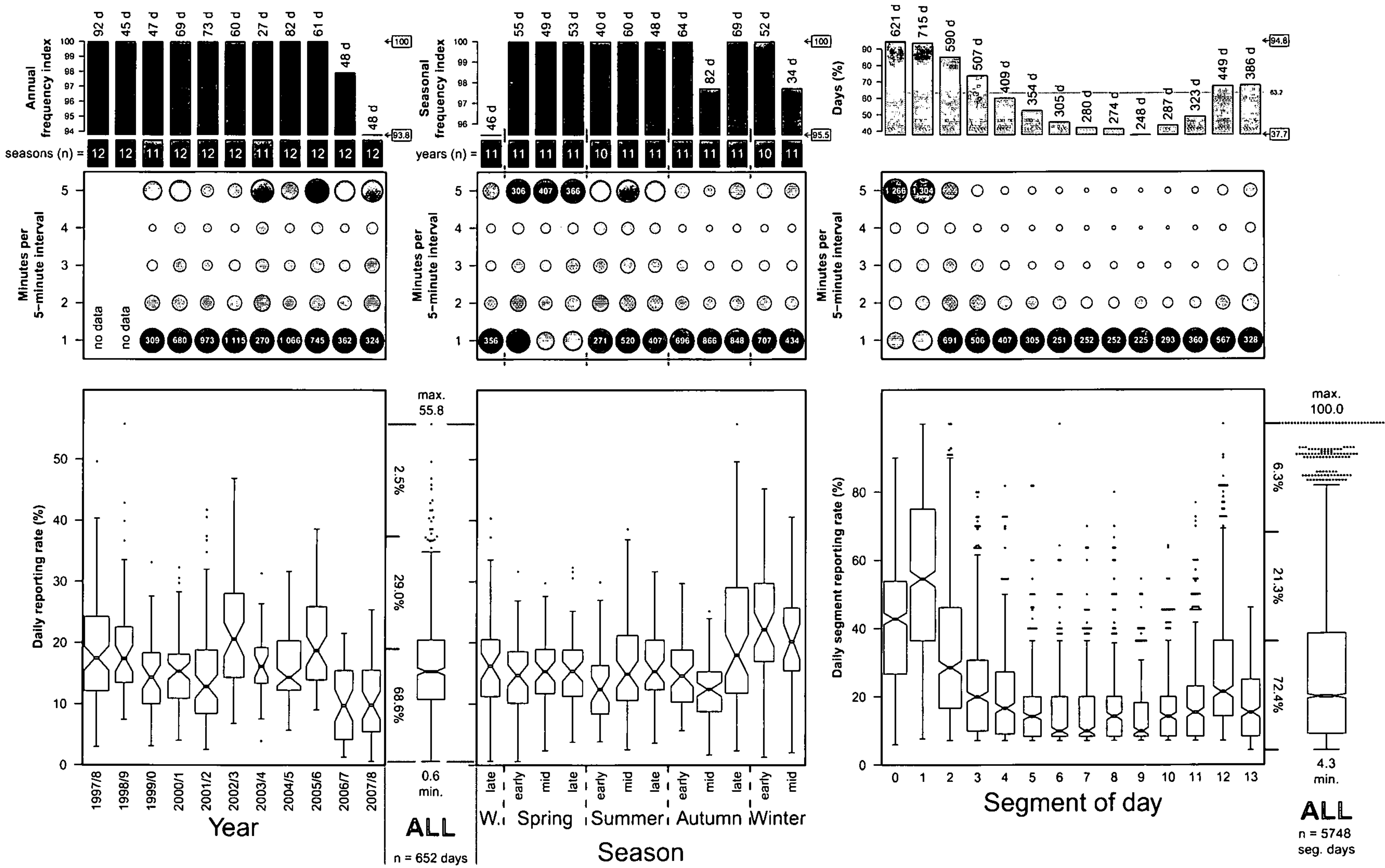


Figure 5.39: R495 Eastern Clapper Lark — song: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

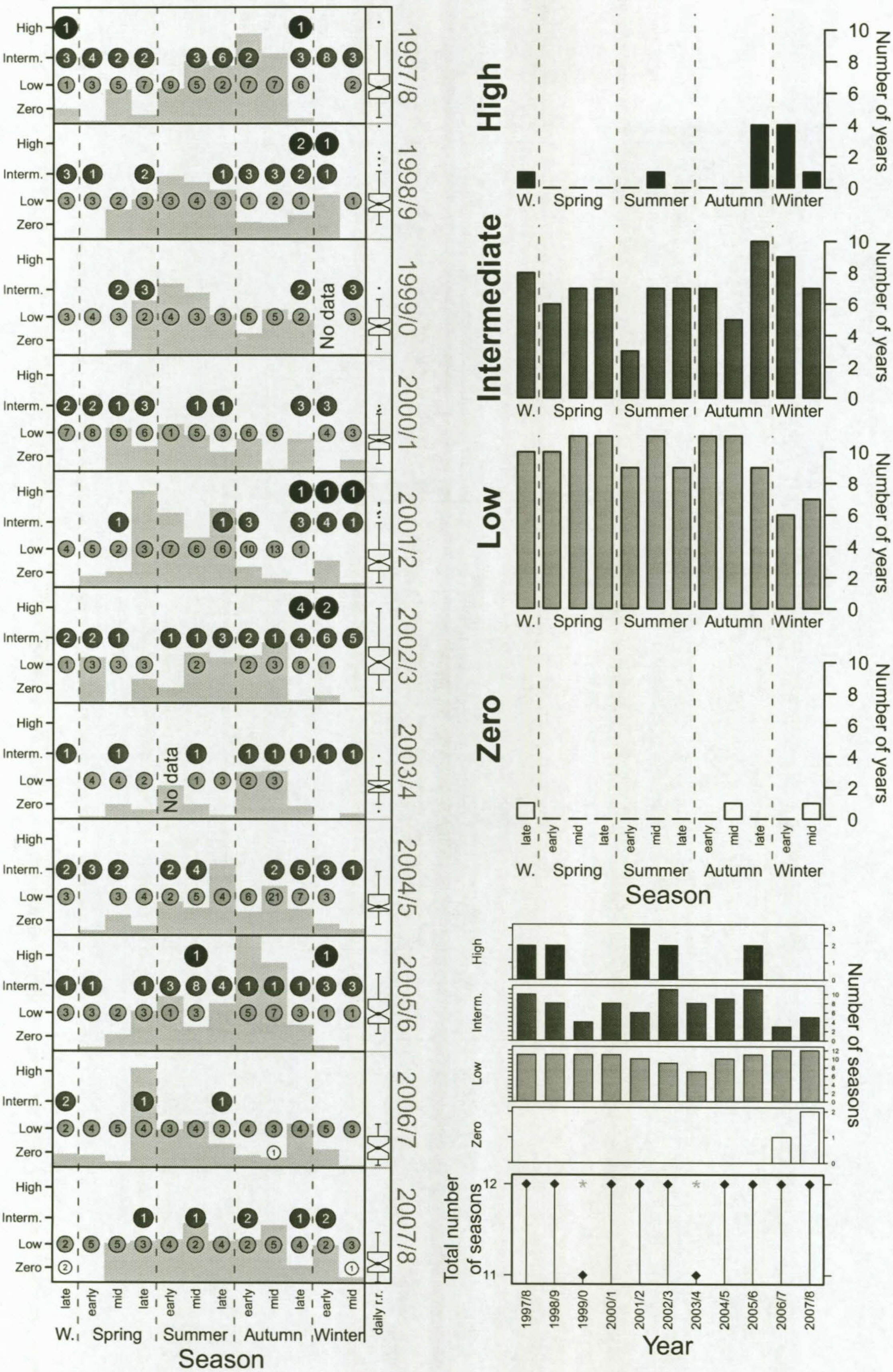


Figure 5.40: R495 Eastern Clapper Lark — song: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

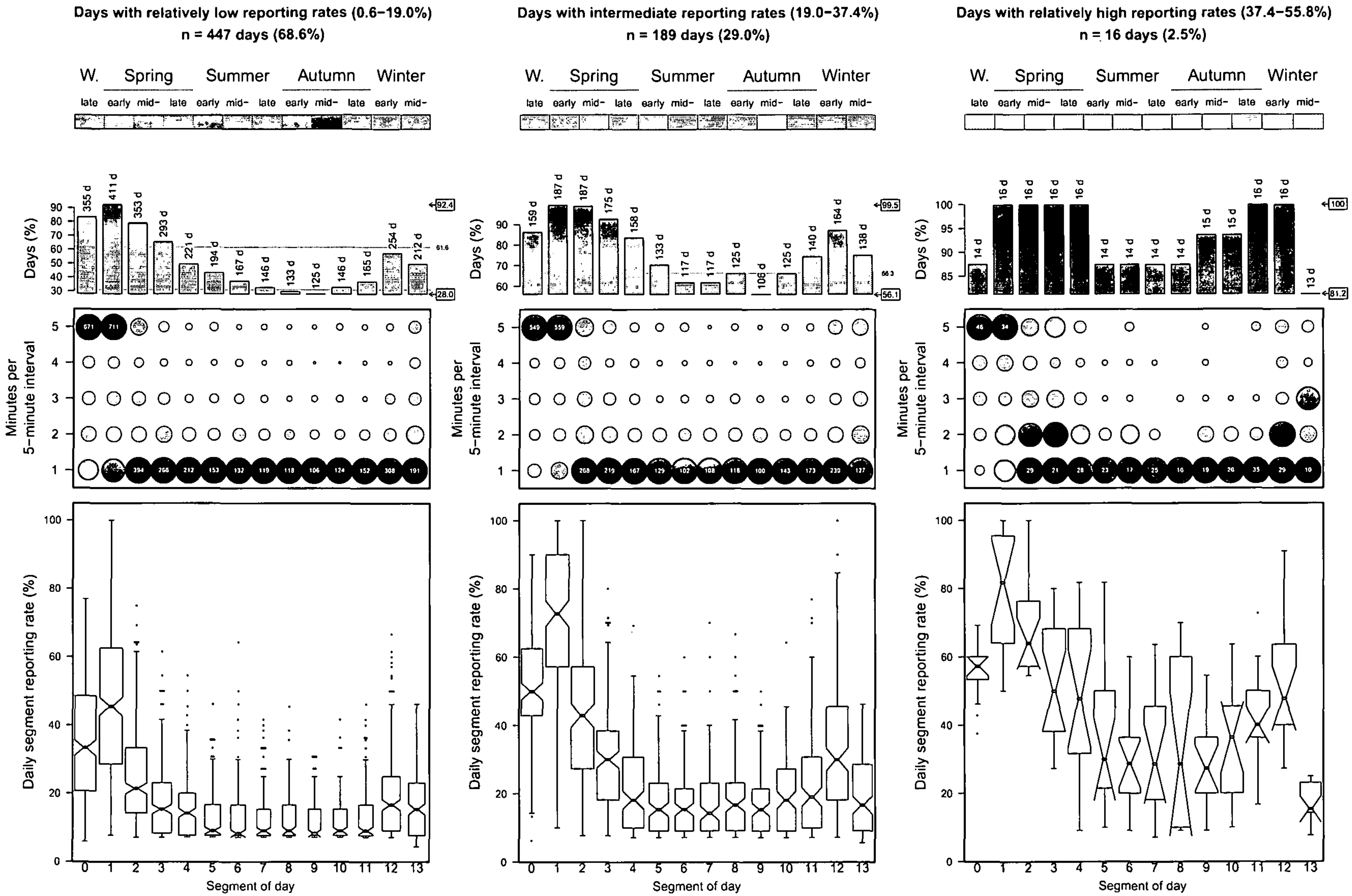


Figure 5.41: R495 Eastern Clapper Lark — song: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LJH figure.

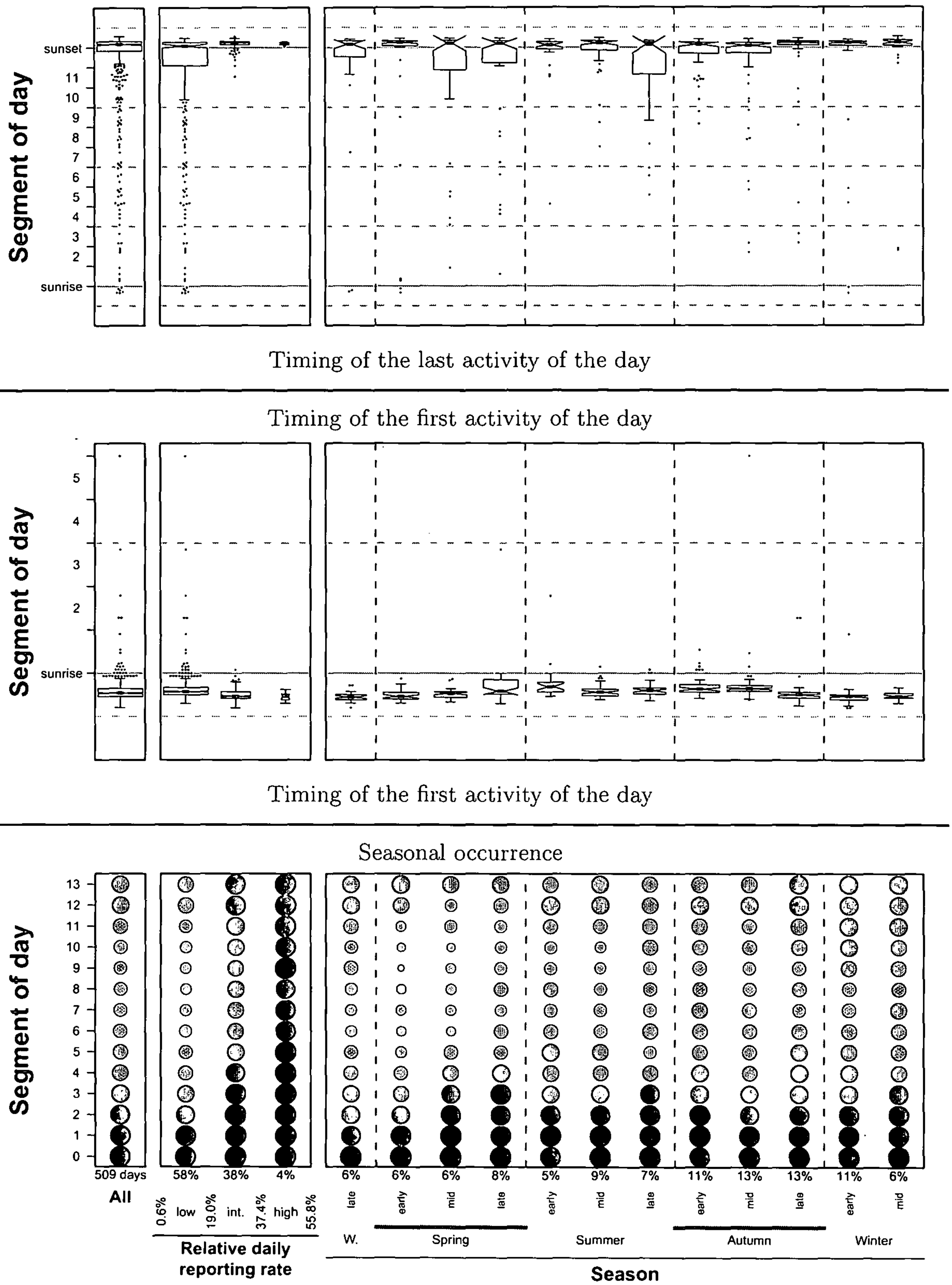
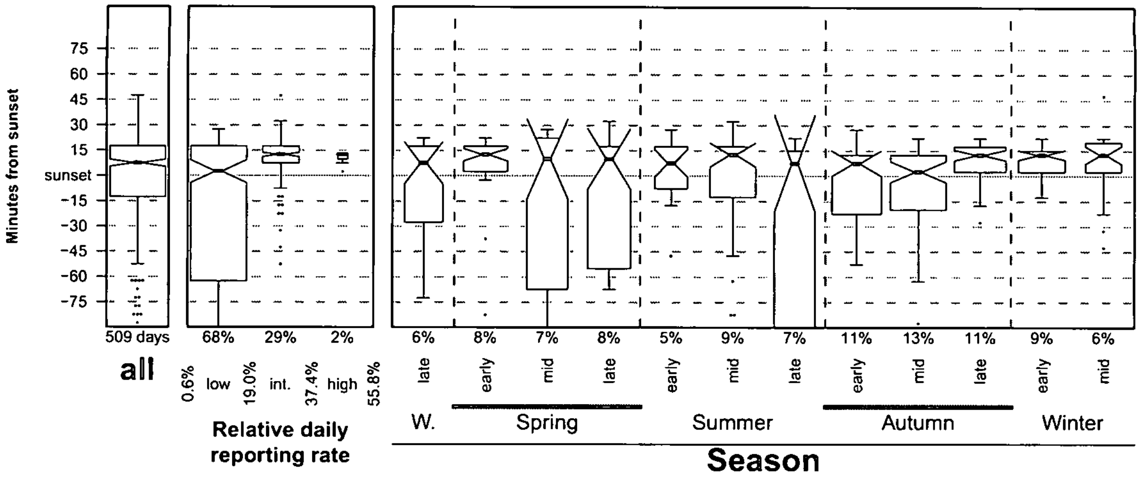
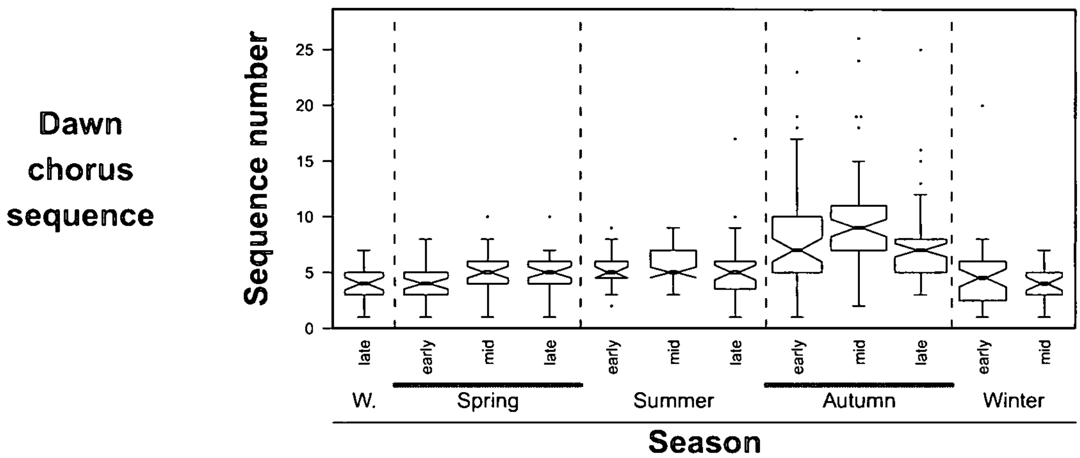


Figure 5.42: R495 Eastern Clapper Lark — song: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

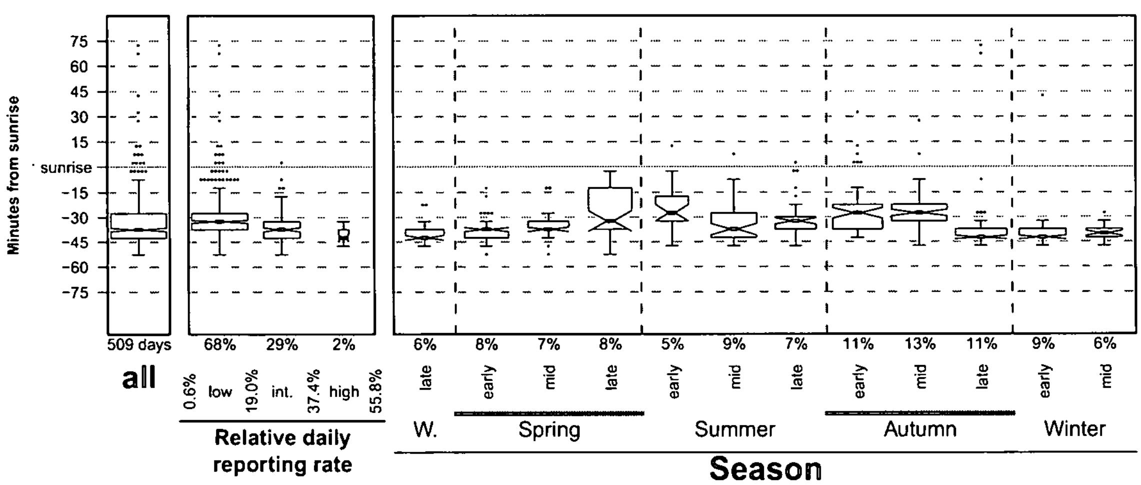
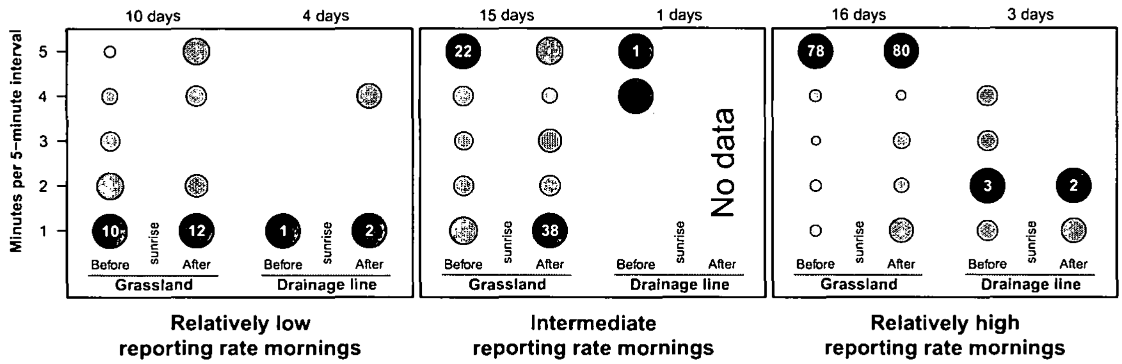
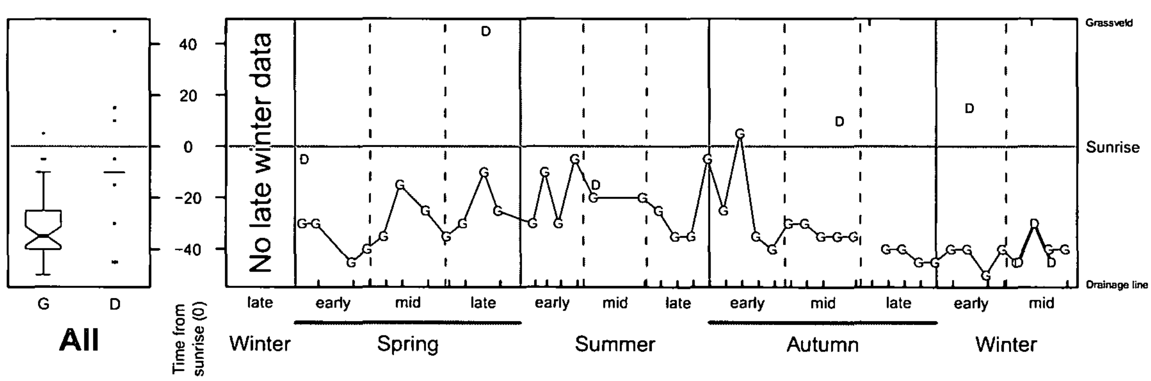


Figure 5.43: R495 Eastern Clapper Lark — song: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

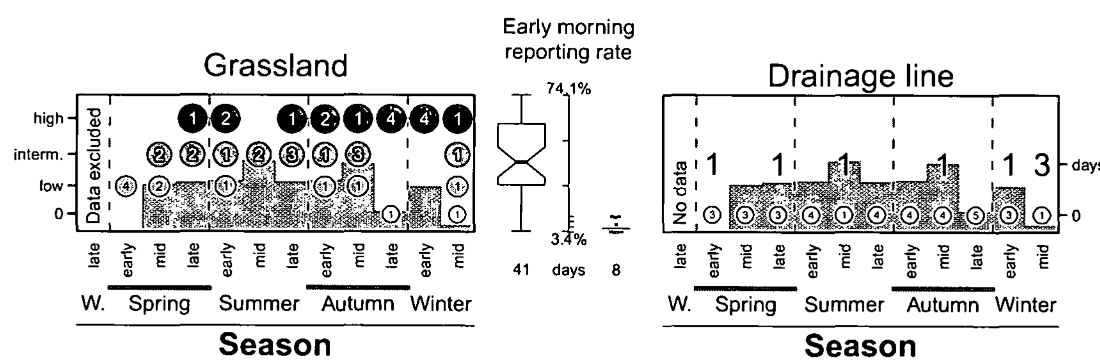


Figure 5.44: R495 Eastern Clapper Lark — song: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

R498 Sabota Lark .... *Calendulauda sabota*

The Sabota Lark is found from the western coastal areas of Angola (including Cabinda) (Dean 2000) south into Namibia, Botswana, south-western Zimbabwe, southern Mozambique (Parker 1999), Swaziland and South Africa, where it is largely absent from the eastern and far western parts; patchily distributed in the Free State, where absent from the east (Dean 1997h). It is associated with bushes and trees, including those found along drainage lines (Dean 1997h). It is a resident with some local movements in response to rainfall (Dean 1997h).

The birds at Glen

All records of the Sabota Lark were of birds being heard calling in the drainage line; but never recorded in the grassland. The calls are given either from the top of trees or while flying high up in the air.

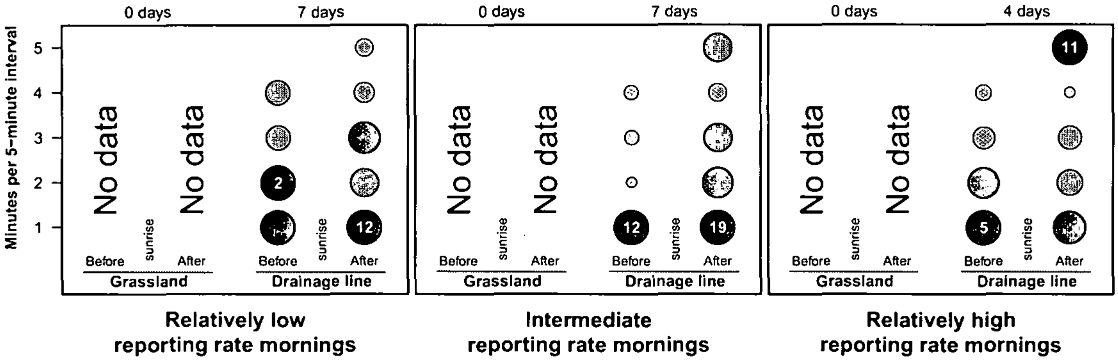
Recorded on 18 mornings with records limited to the period from mid-spring to early autumn and also recorded in mid-winter (Fig. 5.45). Intermediate and high reporting rate mornings were limited to summer and early autumn (Fig. 5.45). The first activity of the day often occurred within the last 25 minutes before sunrise (Fig. 5.45). Activity intensity was higher after than before sunrise (Fig. 5.45).

Discussion

The peak in Sabota Lark activity during summer (Fig. 5.45) coincides with the breeding season, which is mostly during November and December [late spring to mid-summer] (Dean 1971; Irwin 1981; Tarboton *et al.* 1987). The abrupt end of activity after early autumn is striking (Fig. 5.45) and probably signals the beginning of moult. This conclusion is partially based on a bird ringed in the Sandveld Nature Reserve during early autumn and which had started its primary moult (DJvN unpublished data). Furthermore, Hall (1956) noted that five males collected in north-eastern Botswana during the latter part of November [early summer] were "Finishing moult". Overall, the data seem to indicate that the Sabota Lark has a post-breeding moult. The abrupt end of displays in mid-autumn furthermore suggests that it is tightly controlled by day-length.

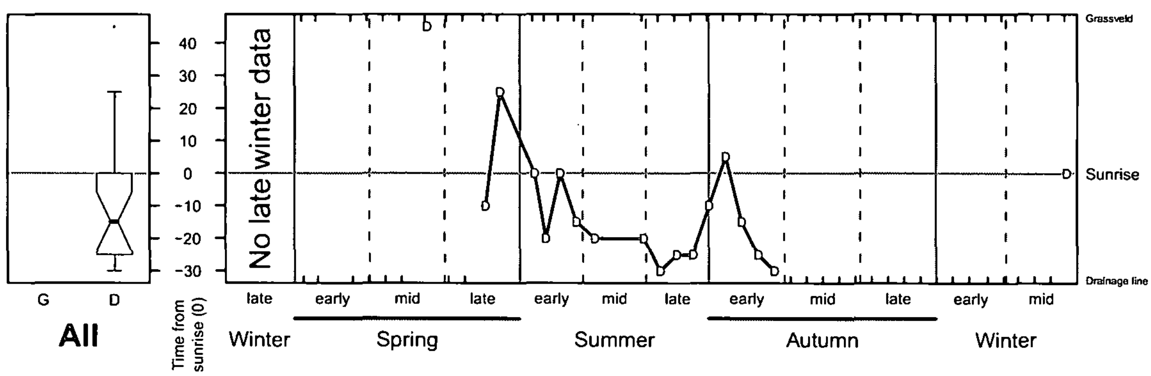
R506 Spike-heeled Lark .... *Chersomanes albofasciata*

The Spike-heeled Lark occurs in Angola (Dean 2000), Namibia, central and southern Botswana and South Africa where it is mainly absent from the north, east and far south (Dean 1997i) and with an isolated population in the Democratic Republic of the Congo (Ryan 2004b). The highly localised Beesley's Lark *C. beesleyi* of northern Tanzania was until recently considered a subspecies of the Spike-heeled Lark (Dean & Keith 1992; Ryan 2004b,c). Of the southern African larks, the Spike-heeled Lark probably utilises the widest range of climatic conditions, occurring from the Namib Desert to high-rainfall grasslands (Dean 1997i). Its preferred habitat includes sparse grassland and overgrazed areas (Maclean 1985).



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

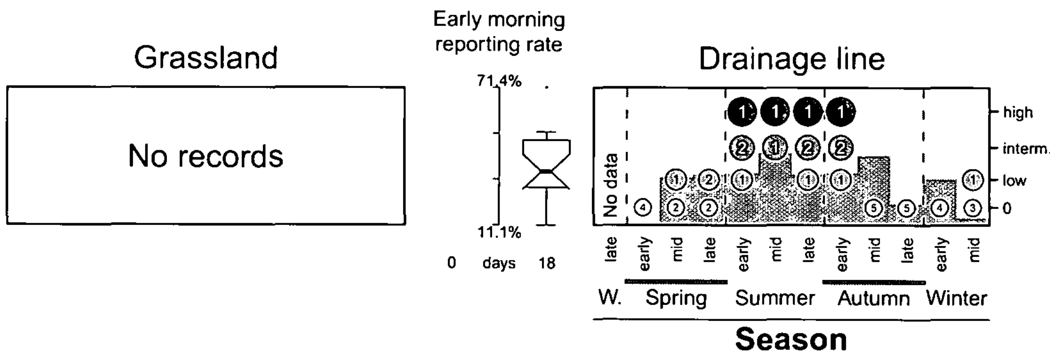


Figure 5.45: R498 Sabota Lark — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

The birds at Glen

The behaviour of the Spike-heeled Lark was studied at Glen from the summer of 1994/5 until the end of 1998/9 when they disappeared from the study area. Van Niekerk (2000) analysed the data of the first part of that study. Because the Spike-heeled Lark data until 1998/9 was recorded separately from the five-minute data-set considered in this thesis, the years 1997/8 and 1998/9 are excluded from the present analysis.

Spike-heeled Larks occur in groups that maintain territories throughout the year. They generally avoid areas with dense grass, frequenting areas with less dense grass and particularly the trampled area. At the beginning of the study in 1994/5 there were at least three groups in the study area, but during the last number of years only one group. The observations during the last few years involved a colour ringed female and accompanying male (unringed, but presumably the same individual).

Spike-heeled Larks are often vocal when in flight, and also on the ground. The male's display flight involves the bird flying up less than 10 meters into the air and starting calling near the top and as it descends down with outstretched wings. This appears to be similar to the display described by Maclean (1985), except that he gives the height as "to about 2 m".

The data is analysed separately for displays and all other encounters (mainly vocal records), with the latter category constituting the bulk of the data (99.0%; Table 5.7a). Data was collected for each minute since 1999/0 for displays and since mid-summer 2001/2 for other vocalisations (Table 5.8). Figures start on page 622.

Table 5.7: R506 Spike-heeled Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.990	3 698	114 612	3.2	birds present	72.3	656	474	8
0.010	39	114 612	0.0	all displays	4.7	656	31	1
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	31	1 188	2.6	birds present	48.8	43	21	1

Table 5.8: R506 Spike-heeled Lark: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
birds present	mid-summer 2001/2	2 434	327 075	0.7
all displays	beginning	38	547 500	0.0

Annual occurrence of non-display vocalisations in the grassland: Overall, recorded on 72.3% of the days with an activity index of eight (Table 5.7a). Recorded during all seasons each year, except 1999/0 when recorded during only nine seasons (Fig. 5.46; Fig. 5.47). Daily reporting rates ranged from 0.5 to 26.4% with 88.4% bird-days attaining low reporting rates (Fig. 5.46). The median daily reporting rates of 1999/0 and 2000/1 were higher than those of most other years, while the median daily reporting rates of 2003/4 and 2005/6 were higher than those of 2004/5 and 2006/7 (Fig. 5.46). Activity intensities were similar for all years (Fig. 5.46).

Seasonal occurrence of non-display vocalisations in the grassland: Recorded during virtually all seasons each year (Fig. 5.46). Activity intensities were similar for all seasons (Fig. 5.46). Median daily reporting rates followed a cyclical pattern with highest values in winter and lowest values in summer (Fig. 5.46).

Daily occurrence of non-display vocalisations in the grassland: Overall, most frequently recorded in the early morning and late afternoon before sunset (Fig. 5.46). This general pattern agrees with the pattern for low and intermediate reporting rate days (Fig. 5.48). Recorded during all segments of the day in all seasons, with activity most frequent in the early morning and late afternoon during most seasons (Fig. 5.49). Activity was also relatively frequent during midday in late spring (Fig. 5.49). No segment combinations occurred during more than 5% bird-days.

The first activity of the day occurred most frequently during the early morning, generally earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.49; Fig. 5.50). The median timing of the first activity of the day was around sunrise during all seasons, and was least variable during mid-winter and particularly late winter (Fig. 5.49; Fig. 5.50). The dawn chorus sequence followed a pattern similar to that shown by the timing of the first activity of the day (Fig. 5.50). The last activity of the day most often occurred in the afternoon, with the median values of all seasons in the late afternoon (Fig. 5.49; Fig. 5.50).

For low reporting rate days, activity intensities were low during all segments of the day (Fig. 5.48). The activity intensities for intermediate reporting rate days were still similar for all segments, but slightly higher than for low reporting rate days (Fig. 5.48).

Overall, daily segment reporting rates ranged from 5.3 to 90.0% with 95.4% of the data points relatively low (Fig. 5.46). For low reporting rate days the median daily segment reporting rate was similar for most segments, but for intermediate reporting rate days it was slightly higher during S1 (Fig. 5.48).

Early morning occurrence of non-display vocalisations during 2007/8: Recorded on nearly half of the mornings in the grassland but not at all in the drainage line (Table 5.7b & c).

Displays in the grassland: Recorded on 33 days and during all years (Fig. 5.51). Recorded during late winter, spring, summer and autumn with a peak period centred on late spring (Fig. 5.51). Heard during most segments and particularly frequent in the late morning and at midday (Fig. 5.51).

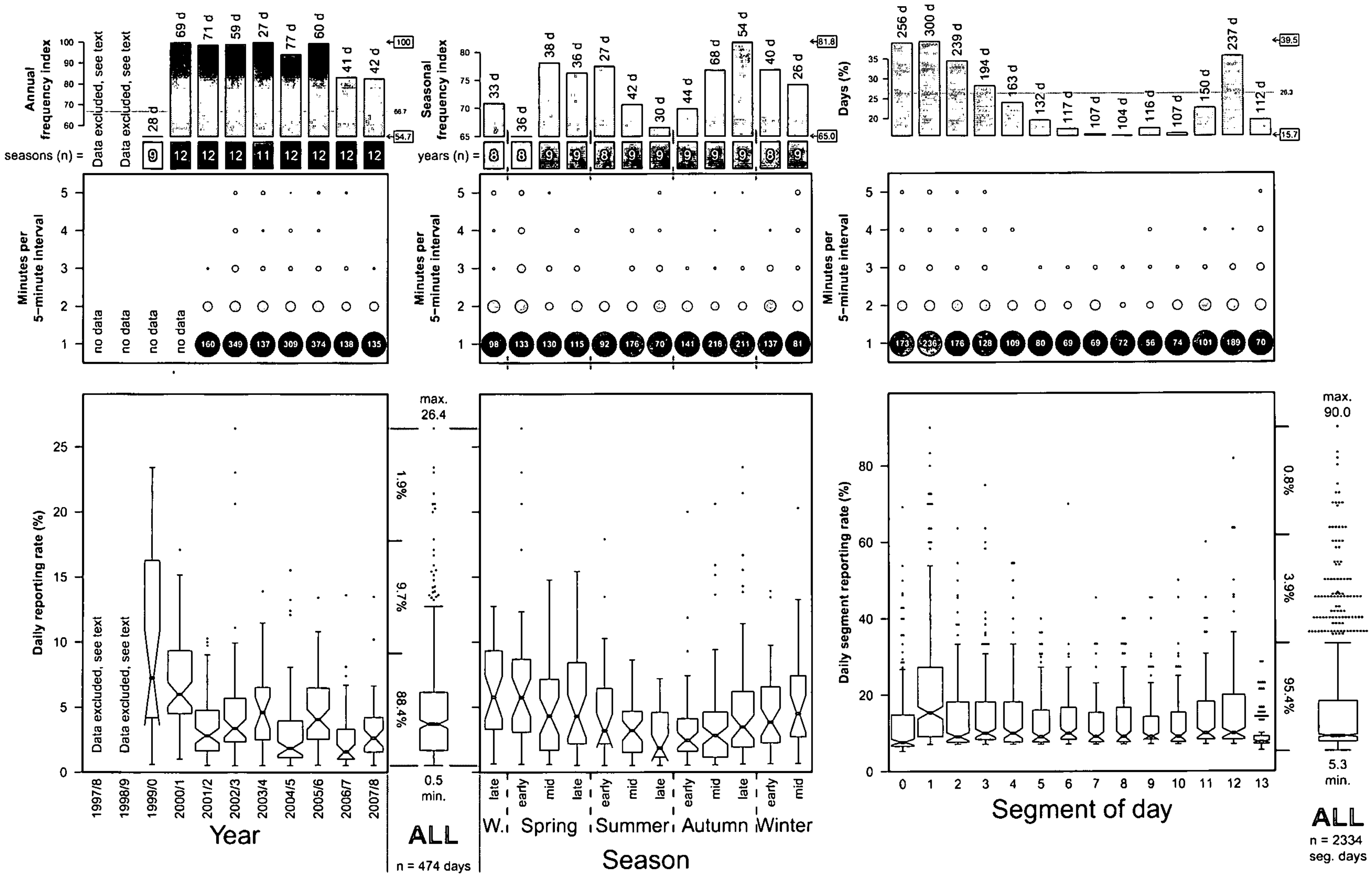


Figure 5.46: R506 Spike-heeled Lark — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

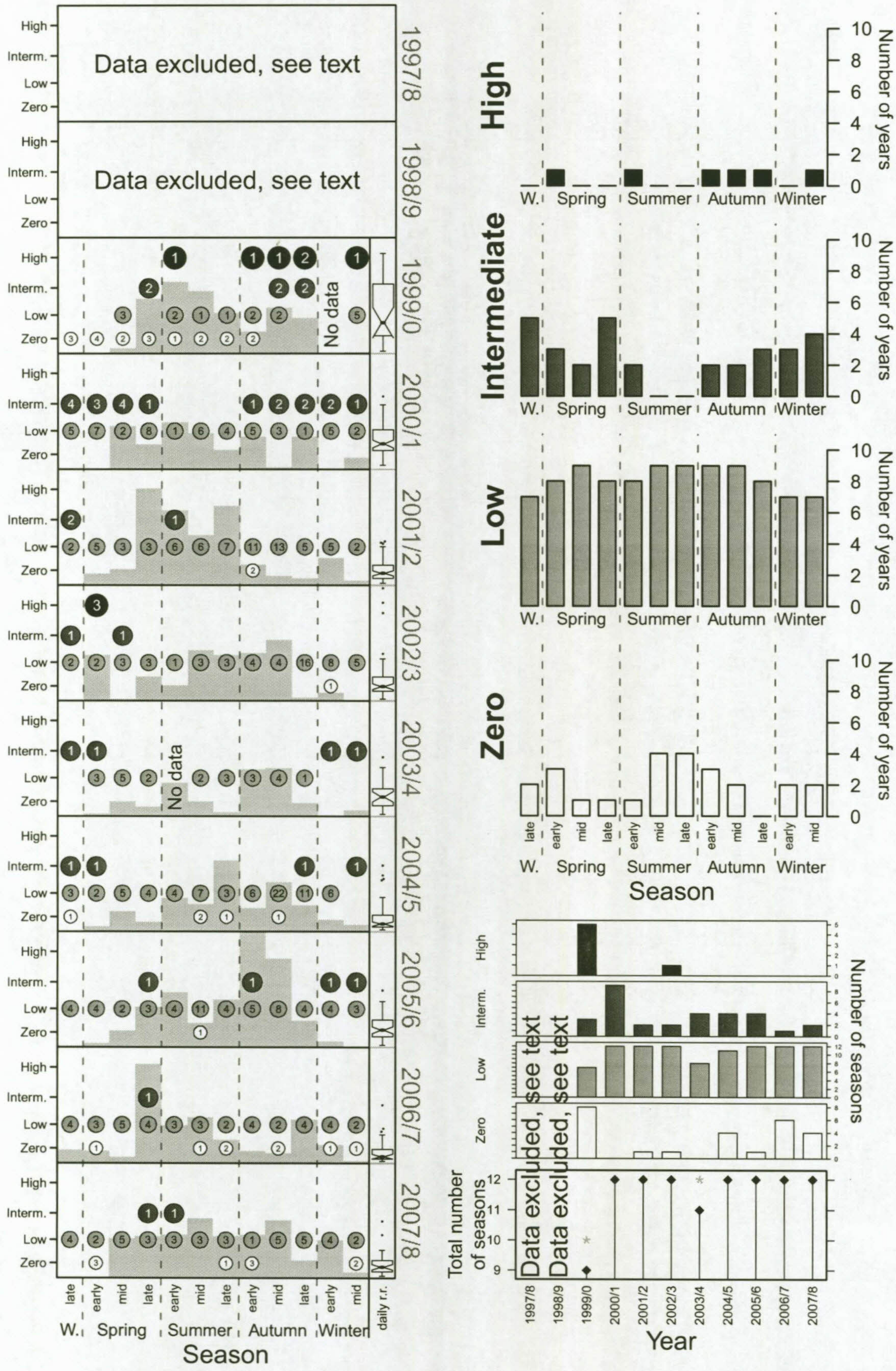


Figure 5.47: R506 Spike-heeled Lark — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

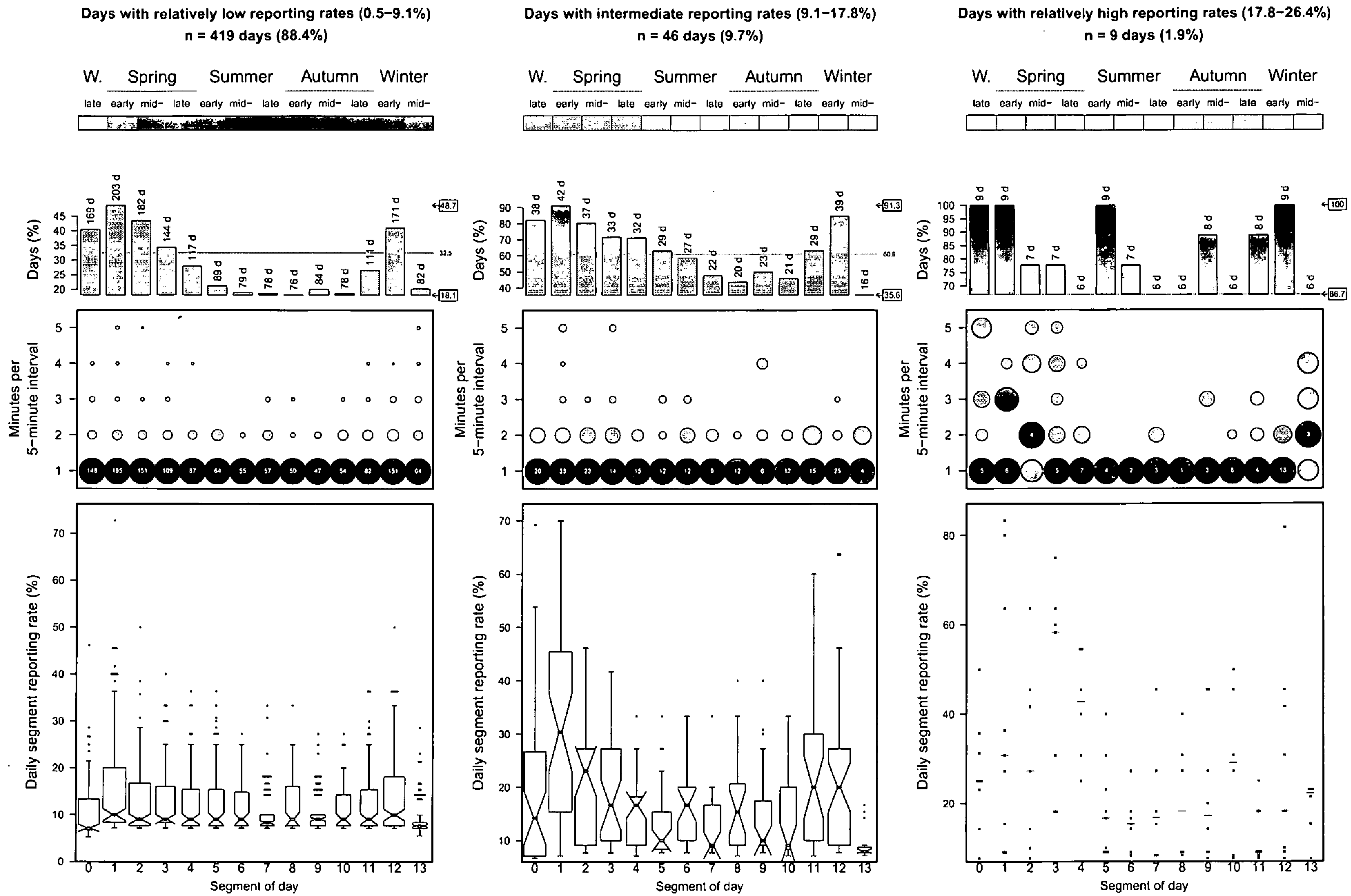


Figure 5.48: R506 Spike-heeled Lark — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

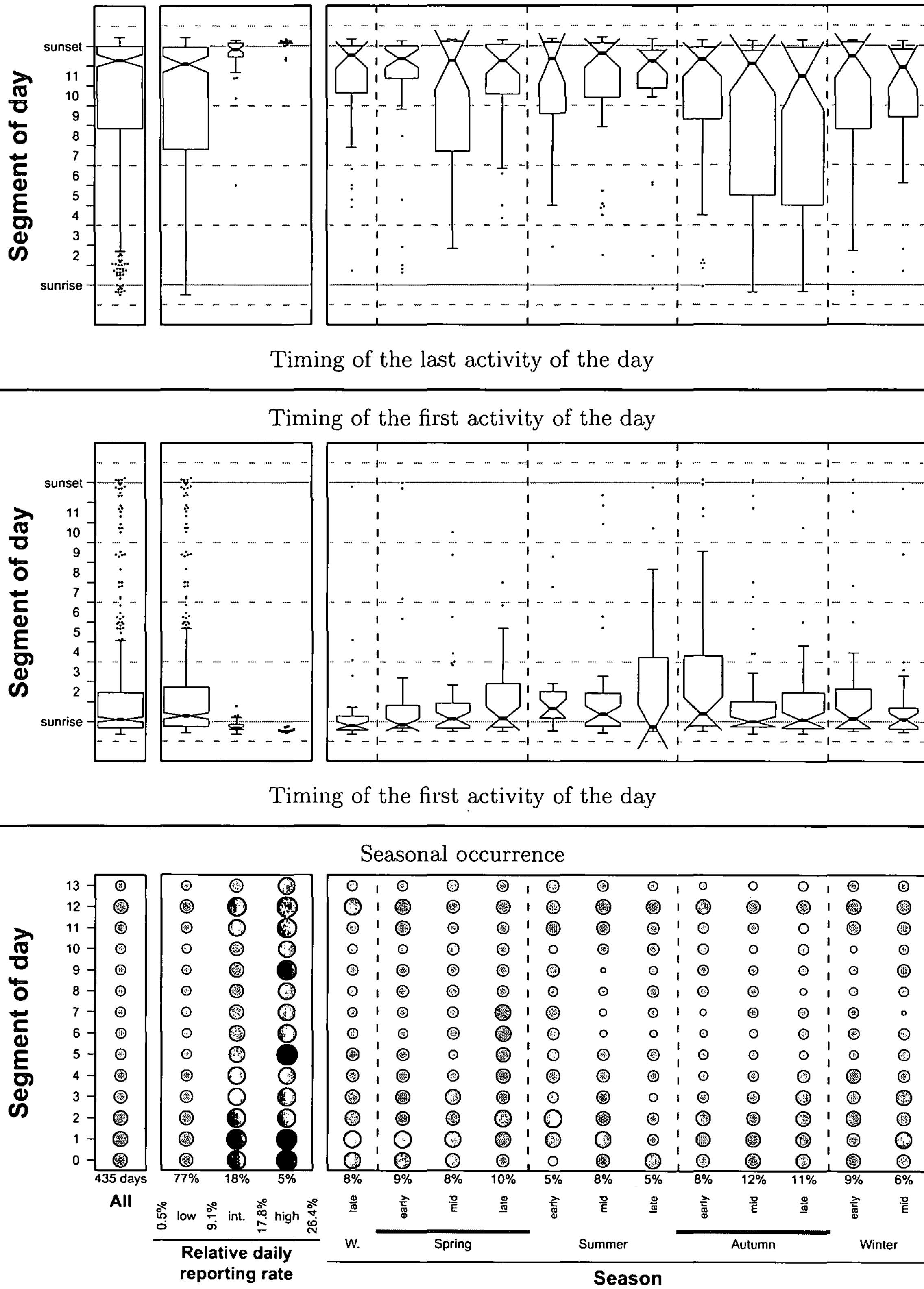
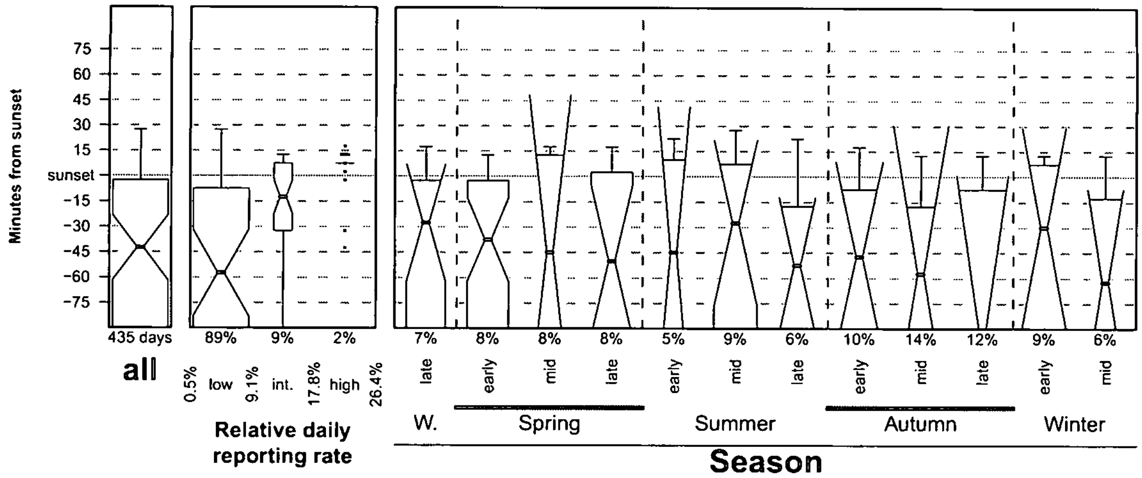
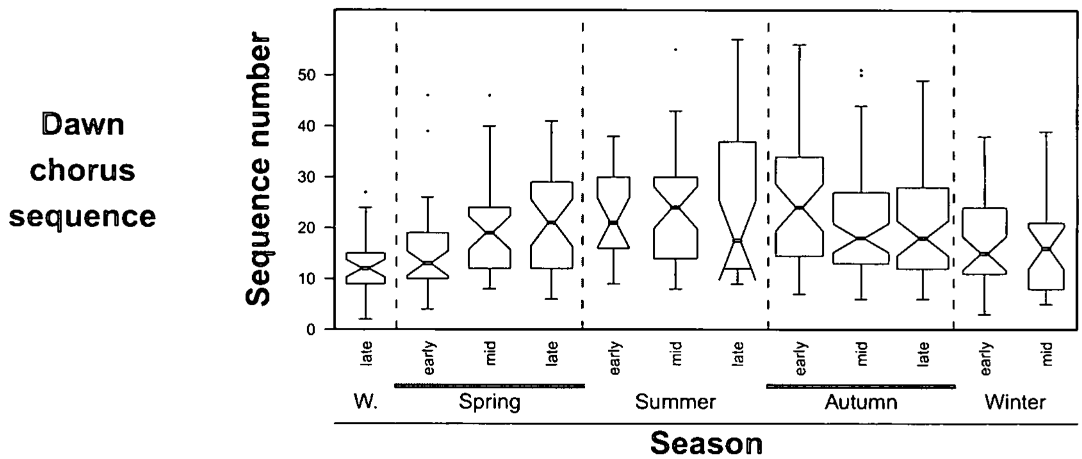


Figure 5.49: R506 Spike-heeled Lark — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

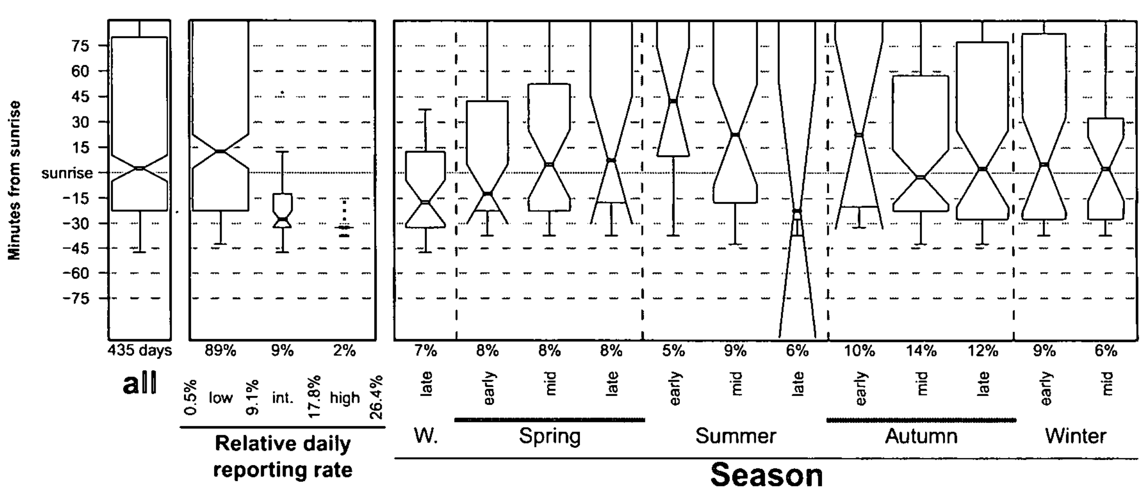


Figure 5.50: R506 Spike-heeled Lark — birds present: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

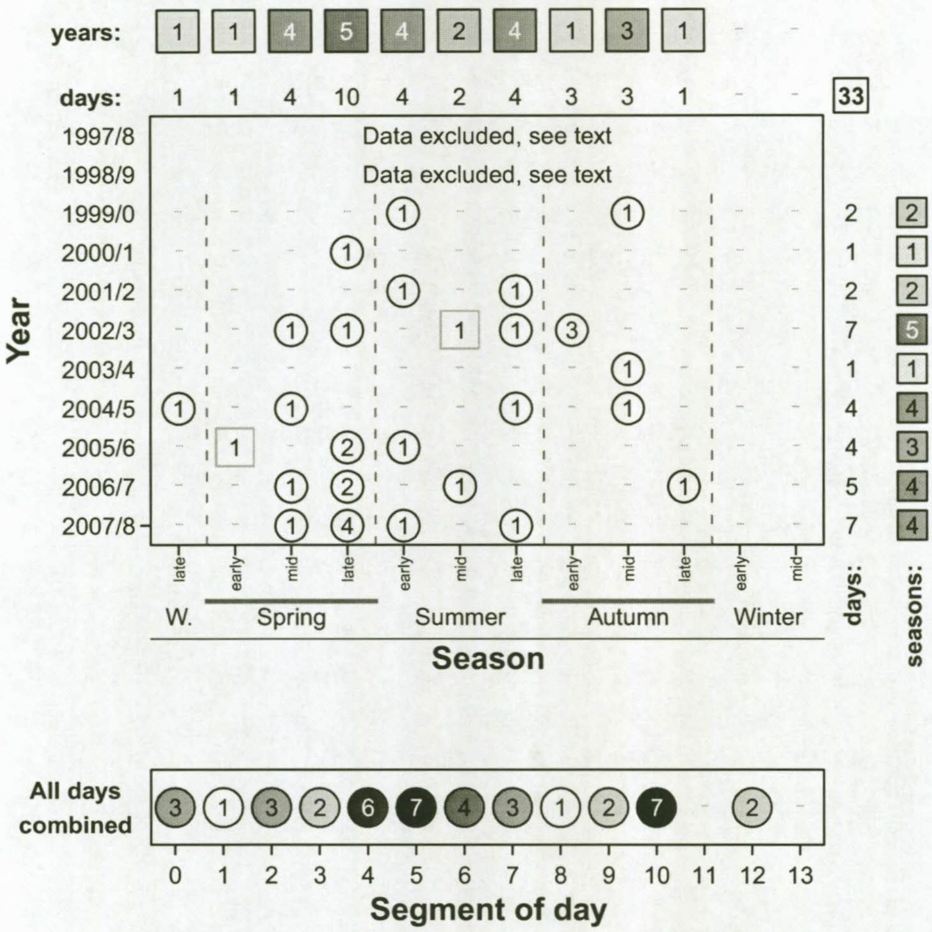


Figure 5.51: R506 Spike-heeled Lark — all displays: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Discussion

When the study on the Spike-heeled Lark was initiated in 1994/5 there were at least three groups present in the study area (Van Niekerk 2000), but by mid-winter 1998/9 the last bird was gone. They returned soon thereafter with the first birds noted again in mid-spring 1999/0. Since then there was mostly only one group in the area, at least during the last number of years. In addition to these changes in numbers, there were also significant inter-annual fluctuations in daily reporting rates of non-display vocalisations (Fig. 5.46). These fluctuations in numbers and daily reporting rates are at least partially explainable by changes in habitat, which, in turn, are influenced mainly by rainfall and grazing by cattle. The following two paragraphs describe a possible scenario.

The year in which the study on the Spike-heeled Larks was initiated and when the birds were most abundant, 1994/5, was the driest year since 1972/3 (Fig. 2.13). This caused veld conditions that suited the larks well. The result of above average rainfall during the following three years (1995/6, 1996/7 and 1997/8; Fig. 2.13) was that conditions for the larks deteriorated, leading to their disappearance by the end of 1998/9. The latter year and the year following (1999/0) both experienced slightly less than average rainfall, while 2000/1 was again a relatively dry year

(Fig. 2.13). This led to more favourable conditions for the larks, resulting in birds colonising the area afresh in 1999/0 and 2000/1.

Then came 2001/2 with good rains during late spring and summer (Fig. 2.16), causing field conditions for the larks to deteriorate, hence the generally lower daily reporting rates during 2001/2 compared to 1999/0 and 2000/1 (Fig. 5.46▪□). The next three years (*i.e.* 2002/3, 2003/4 and 2004/5) all experienced below average rainfall (Fig. 2.16), which apparently benefited the birds initially, leading to a slight increase in daily reporting rates during 2003/4 (Fig. 5.46▪□). However, after 2003/4 (the driest year since 1972/3, Fig. 2.13) conditions were such (too dry for too long?) that activity dropped in 2004/5 (Fig. 5.46▪□). The dry conditions of the previous years were alleviated in 2005/6, which year had the highest rainfall since 1996/7 (Fig. 2.13), causing a general increase in the daily reporting rates (Fig. 5.46▪□). However, activity dropped once again in 2006/7 (Fig. 5.46▪□), a year with below average rainfall (Fig. 5.46▪□), presumably because the habitat became unsuitable after the good rains of 2005/6.

Median daily reporting rates followed a reasonably well-defined seasonal pattern in spite of inter-year fluctuations (Fig. 5.46▪□□▪). Moreover, the median daily reporting rate pattern is similar to that indicated by SABAP1 Zone 7 reporting rates in Dean (1997i), both data-sets showing higher values during the cooler times of the year. Dean (1997i) suggested the possibility that the pattern in the SABAP1 data "may indicate some seasonal movement away from particularly arid areas in winter," referring to SABAP1 Zone 2s pattern which indicated "a reduction in reporting rates during winter." This idea, however, is contradicted by the work of Willoughby (1971) on the biology of larks in the central Namib Desert, his study area being situated on the lower Kuiseb River in Namibia, which falls well into Zone 2 of SABAP1. After more than a year's work there, Willoughby (1971) concluded that the Spike-heeled Lark is a "sedentary species that remain constantly in the Namib, and do not wander far."

It turns out that the period of least activity coincides with moult. The only published information on Spike-heeled Lark moult (see Dean 2005y) appears to be that of Willoughby (1971). In addition to a diagram Willoughby (1971) summarised his findings thus:

> "*Spike-heeled Lark.* The fragmentary data indicate that moulting may occur throughout the year, which is consistent with the evidence that reproduction may occur at any time of year. It appears likely that an individual experiences a post-nuptial body moult beginning when the gonads start to regress after a period of sexual activity, followed immediately by, or merging into, a complete moult. ... It is safe to say that there is little or no synchrony in either gonadal or moult cycles among individuals of the particular population sampled."

However, contrary to his summary, Willoughby's (1971) "fragmentary data" illustrated in his diagram indicated that wing moult was basically *limited* to the period from December to the beginning of May [summer and autumn]. Fragmentary or not, closer to home the moult data from more than 150 birds from Glen and elsewhere in the Free State indicate a similar pattern, *i.e.* primary moult during summer and autumn (DJvN unpublished data). This follows on breeding, which is mainly from August to December [spring to mid-summer] according to Maclean (1985). Summer and autumn, of course, correspond to the period of least activity at Glen (Fig. 5.46□▪).

It is suggested, therefore, that the patterns observed at Glen and those shown by the SABAP1 data reflect moult related changes in conspicuousness more than they reflect changes in densities, and by extension movements.

That is not to say that movements do not occur. Movements do occur, but are of a nomadic rather than seasonal nature. The study at Glen indicates that the birds are capable of colonising new areas with suitable habitat, and that they are resident in such areas as long as suitable conditions prevail. Perhaps such birds could be termed 'resident nomads' or 'nomadic residents'.

Judging from the annual fluctuations in activity at Glen (Fig. 5.46) it appears that it is the overall annual rainfall (wet vs. dry years) that affects the birds the most. What is surprising, however, is that dry and wet years may *both* lead to greater levels of activity, or to lower levels of activity. It all depends on the broader context in which it occurs, *i.e.* the rainfall in previous years. In this regard it is ironic to read the most recent published statement on the movements of the Spike-heeled Lark in southern Africa:

> "**Movements:** Resident, possibly nomadic. Sedentary in higher-rainfall parts of range; may be locally nomadic in more arid areas [in reference to Dean (1997i)]". (Dean 2005y)

The irony is that it is high rainfall which often causes the habitat to become *unsuitable* (tall, dense grass), which, in turn, drives the larks to nomadism in search of better situations. In arid areas, by contrast, the habitat is more likely to remain stable for longer periods, hence Willoughby's (1971) resident Spike-heeled Larks in the Namib Desert.

R507 Red-capped Lark .... *Calandrella cinerea*

The Red-capped Lark is endemic to sub-Saharan Africa (Ryan 2004d). Widespread in southern Africa but relatively scarce in Namibia and southern Mozambique (Dean 1997j; Parker 1999). The Free State forms part of its core distribution in South Africa (Dean 1997j). It prefers disturbed habitats such as overgrazed grassland and ploughed fields (Earlé & Grobler 1987; Maclean 1985). The southern African population consists of resident, migratory and nomadic components, but details on movements are unclear (Dean 1997j). Earlé & Grobler (1987) suggested that they are "Probably nomadic to some extent" in the Free State while De Swardt (2000) considered them to be a "common resident" in Soetdoring Nature Reserve.

The birds at Glen

Red-capped Larks were mainly recorded as birds heard in flight — often moving on a north-west to south-east axis — less often as birds seen in the trampled area. Al the data are combined with the analysis based on a year starting in late summer. Figures start on page 632.

Annual occurrence of birds in the grassland: Recorded on 53.5% of the days with an activity index of three (Table 5.9a). Recorded for 8–12 seasons each year, most frequently in 1999, 2000, 2006 and 2007, and least frequently in 1998 and 2003 (Fig. 5.52). With the exception of one day in 2006 (19.5%), daily reporting rates ranged from 0.5 to 9.0% with 96.6% bird-days attaining low reporting rates (Fig. 5.52). Yearly median daily reporting rates were generally similar. However, the daily reporting rate upper quartile of 2006 was markedly higher than those of other years (Fig. 5.52).

Table 5.9: R507 Red-capped Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 120	114 612	1.0	birds present	53.5	656	351	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	19	1 188	1.6	birds present	23.3	43	10	2

Seasonal occurrence of birds in the grassland: The number of bird-years per season indicate a bimodal pattern with the first peak period during autumn, winter and early spring (n = 9–10 bird-years), and a lesser peak centred on mid-summer (n = 8 bird-years) (Fig. 5.52). The seasonal frequency index showed a similar trend (Fig. 5.52). The incidence of days with zero activity was least frequent during late autumn and early winter and most frequent during spring (Fig. 5.53). Median daily reporting rates were slightly higher during early and mid-winter than during late spring and early and mid-summer (Fig. 5.52).

Daily occurrence of birds in the grassland: Overall, activity was most frequent in the late afternoon before sunset with a secondary peak in occurrence centred on mid-morning (Fig. 5.52). Activity was very infrequent in the late morning and early afternoon (Fig. 5.52). This overall pattern is the result of complimentary seasonal patterns. Generally speaking, activity was most frequent in the late afternoon before sunset during summer and autumn, and most frequent during mid-morning from mid-winter to mid-spring (Fig. 5.54). This pattern corresponds with the occurrence of bird-segment combinations occurring on more than 5% bird-days: Activity during S12 only was basically limited to summer, autumn and early autumn, and activity during S3 or S4 was particularly frequent during late winter and early spring (Fig. 5.55).

Overall, the first activity of the day usually occurred sometime between sunrise and midday, but on the few intermediate and the one high reporting rate day it typically occurred before sunrise (Fig. 5.54). Seasonally, the timing of the first activity of the day was variable, least so from mid-winter till mid-spring. Median values were within the first half of the morning during late summer, autumn, winter and spring, and in the afternoon during early and mid-summer (Fig. 5.54).

The timing for the last activity of the day was very variable for low reporting rate days, but virtually limited to the period after sunset on intermediate and high reporting rate days(Fig. 5.54). Although values were variable within most seasons (remarkably constant in mid- and late summer), the median time of the last activity of the day was during the late afternoon in summer, autumn and early winter, and during the latter half of the morning from mid-winter to mid-spring (Fig. 5.54).

Daily segment reporting rates ranged from 5.6 to 72.7% with 95.7% of the values relatively low (Fig. 5.52). The median daily segment reporting rates were similar for all segments between sunrise and sunset (Fig. 5.52).

Early morning occurrence of birds during 2007/8: Not recorded in the drainage line in spite of records during ten mornings in the grassland (Table 5.9b & c).

Discussion

Most Red-capped Lark records at Glen involve birds on the move, *i.e.* the birds are not utilising the study area extensively. Occasionally a bird or two would feed in the trampled area, and during one specific year a small group of birds roosted regularly at a specific bare spot in the veld. Other than that, the birds were in transit. The daily regularity of these movements, specifically the high incidence of birds in the late afternoon before sunset (Fig. 5.52), is suggestive of movements to roosting areas. The seasonal occurrence of this behaviour is particularly interesting. Why does it peak so prominently during summer and autumn (Fig. 5.54)? As it turns out, this appears to coincide with moulting. There seems to be no published data on the moult of this species (see Dean 2005z). However, data from 12 Red-capped Larks in the Free State (none from Glen) suggest that primary moult occurs sometime between early summer and mid-autumn (DJvN unpublished data), implying post-breeding moult. The moult, therefore, appears to be relatively slow, *i.e.* the flight feather replacement is such that it does not impair flight too much, contra the situation in the Eastern Clapper Lark (see page 603).

How about breeding? According to Ryan (2004d) breeding is associated with the time just prior to the onset of rains or with the first rains itself. Given that the main rain period at Glen starts in late spring, it would imply that egg-laying usually occurs during the course of spring. In this regard it is perhaps significant to note that the occurrence of days with zero activity was most frequent during spring (Fig. 5.53), presumably because the birds are breeding then and are confined to the nesting area (no breeding has been recorded at Glen to date). Thus, breeding precedes moult as well as the summer and autumn occurrence of activity in the late afternoon. It is suggested, therefore, that the occurrence of birds in the late afternoon during summer and autumn (Fig. 5.54) represent family groups going to roost. As mentioned earlier, there was a small group of birds that regularly used a specific bare spot in the veld where they made shallow hollows for roosting. Others have noted similar behaviour (*e.g.* Ryan 2004d; R. J. Nuttall personal communication).

From late summer onward the incidence of late afternoon activity decreases, complemented by an increase in activity during the morning; by late winter/early spring activity peaked during the morning and was relatively infrequent in the late afternoon (Fig. 5.54). A possible explanation for this pattern is that it represents the gradual breaking up of family groups as the younger birds mature and become more independent.

The foregoing discussion assumed a resident population because of the neat complimentary nature of the data in Figure 5.54. How does this fit into the seasonal data of Figure 5.52? The

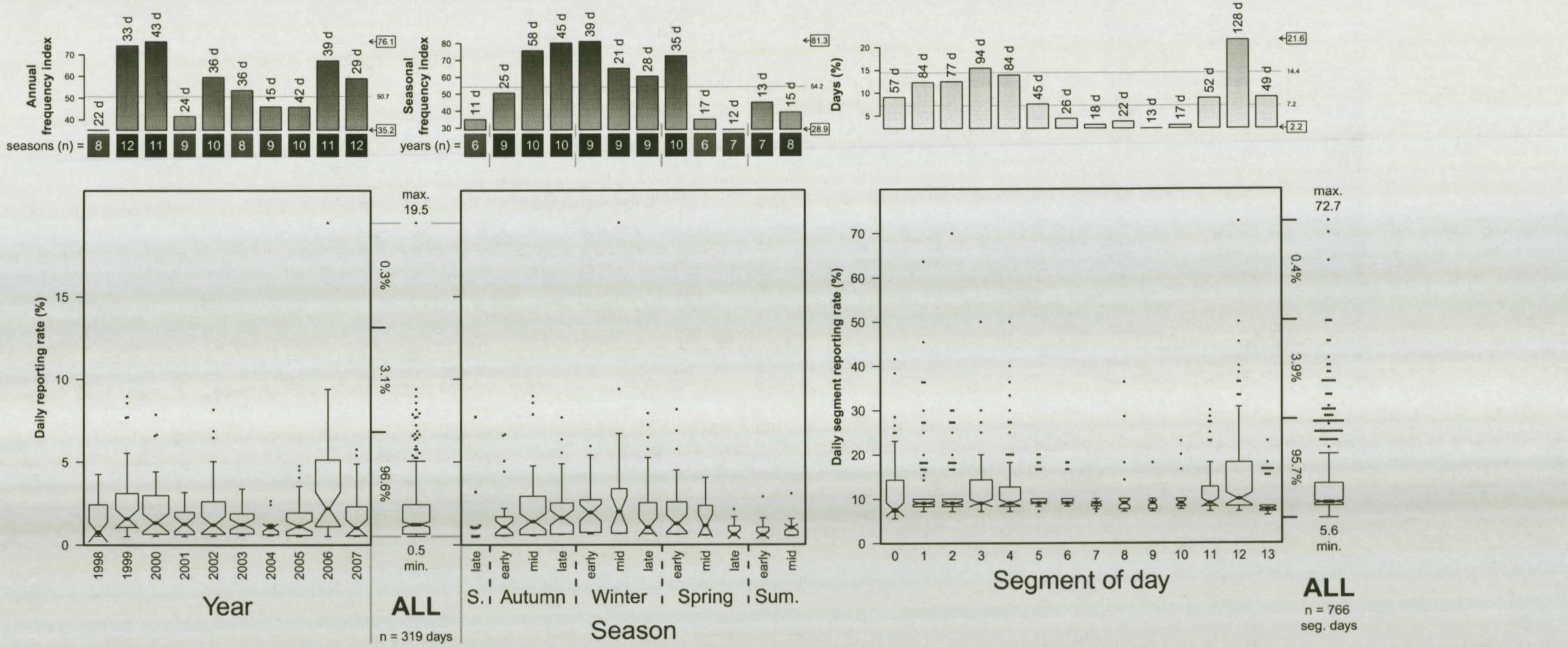


Figure 5.52: R507 Red-capped Lark — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

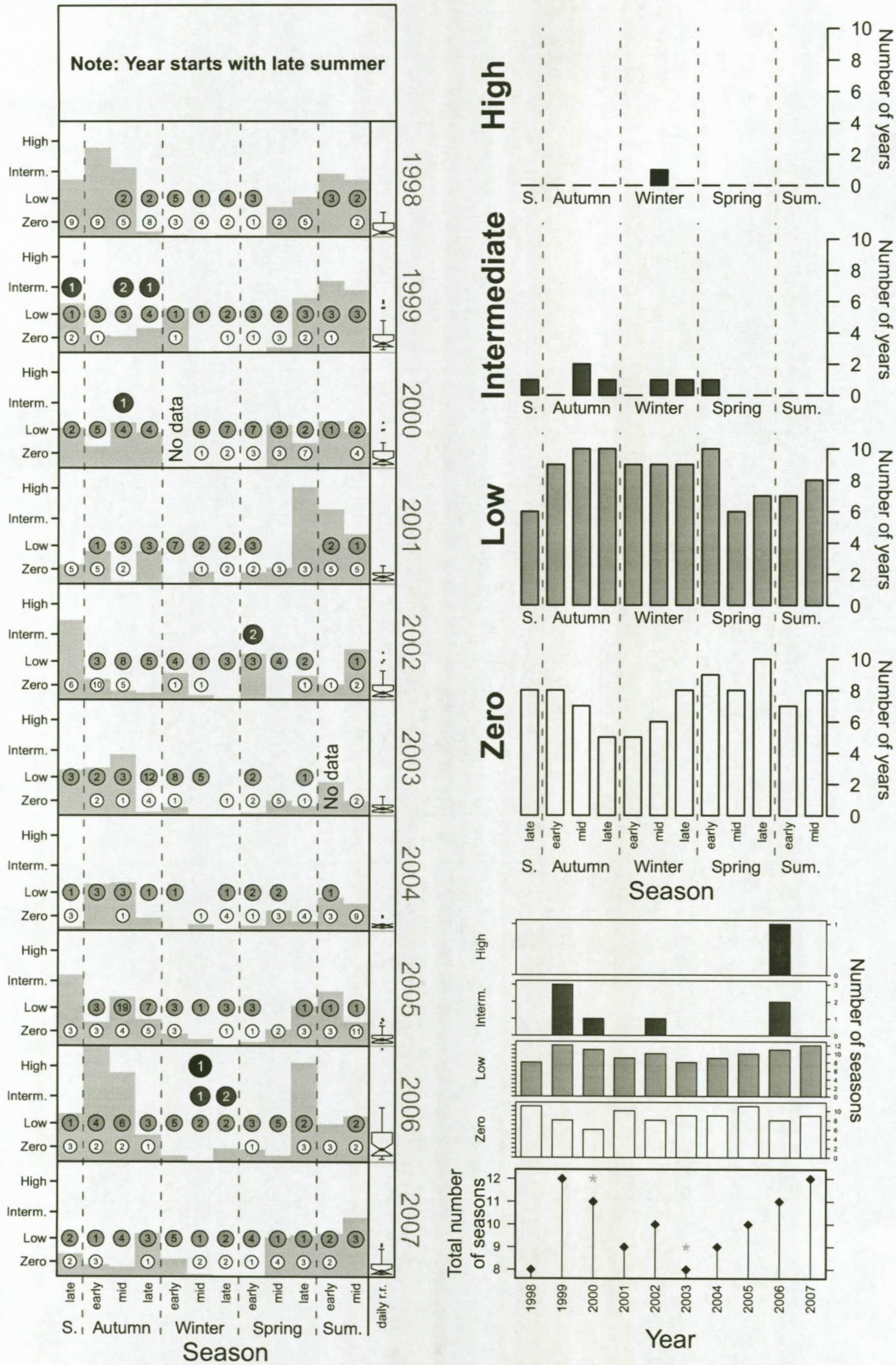


Figure 5.53: R507 Red-capped Lark — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

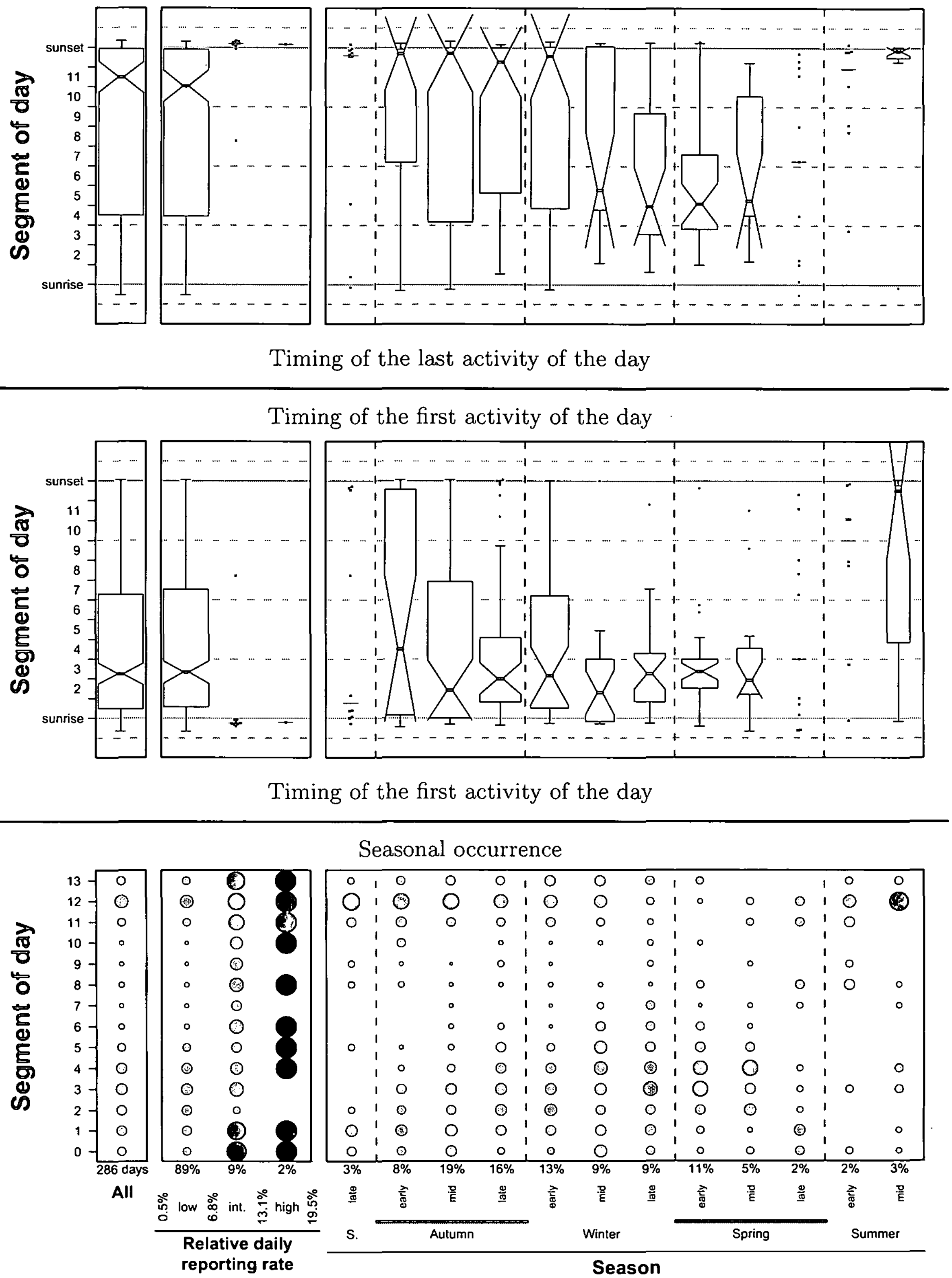


Figure 5.54: R507 Red-capped Lark — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

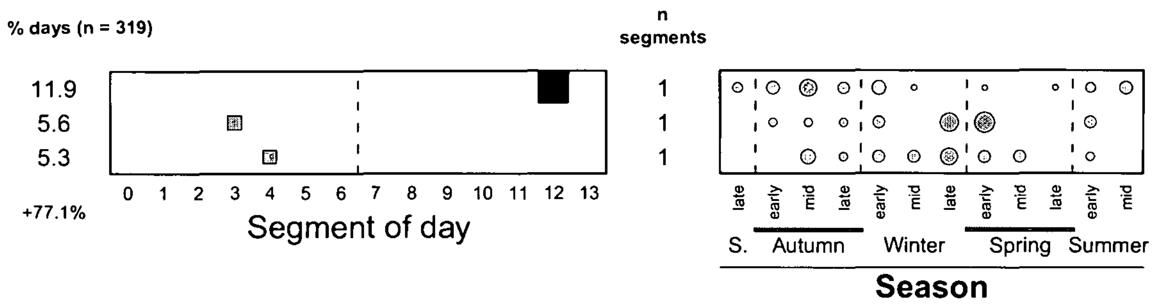


Figure 5.55: R507 Red-capped Lark — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

relative infrequent occurrence during mid-spring, late spring and summer is probably the result of breeding during which time the birds are presumably confined to the nesting area initially, and afterwards staying together as a family unit. It is also possible that the birds congregate into larger flocks at this time. Van Niekerk (2007), for example, found as many as 16 birds (both adults and juveniles) around a pool in a recently planted maize field during mid-summer. The increased activity during autumn, winter and early spring is possibly related to the disintegration of these family units or flocks, resulting in a more widespread occurrence of the birds, and hence greater chances of encountering some of them during the day.

The approach followed here in assuming a resident population is unique. Dean (1997j) thought that the seasonal patterns of the SABAP1 data — for Zone 7 similar to the data at Glen (Fig. 5.52) — "suggest that there may be movement into the karoid and grassland vegetation zones of South Africa and into Zimbabwe during winter, and a dispersal from these areas northward and westward into the northern Transvaal, Botswana and Namibia during summer." He then continued by noting that "It is clear that these are partial migrations" (Dean 1997j). Addition of this latter part probably relates to the SABAP1 data that clearly indicated that the birds are present year-round in most areas, including the Free State and Lesotho. To be fair, the SABAP1 seasonal distribution maps in Dean (1997j) do indicate that the birds are present in certain parts of the region at certain times only (*e.g.* Botswana; see also Brewster 1996). If it is furthermore assumed that reporting rate fluctuations imply actual fluctuations in density, then the data may "suggest" movement.

However, the data presented here implicate changes in detectability rather than changes in density as the main cause of seasonal fluctuations in reporting rates. That is not to say that inter-regional movements cannot be detected by reporting rates — it can. In his "Handbook of parametric and nonparametric statistical procedures", Sheskin (2007) wrote:

> "Specifically, an **outlier** is a score in a set of data which is so extreme that, by all appearances, it is not representative of the population from which the sample is ostensibly derived." (Bold in original)

Such an outlier occurred during mid-winter 2006 (Fig. 5.52). More specifically, Red-capped Larks were unusually common at Glen on 28 June 2006, with birds heard calling as they flew over the study area throughout the day. Unfortunately, the observer was too focused on his Eastern

Clapper Lark to count the Red-caps. An even more spectacular event occurred three years later when, on 24 June 2009, more than 50 Red-capped Larks flew over the study area between 6h55 and 7h35. That is 50+ birds in 40 minutes — highly unusual for Glen! On that morning sunrise was supposed to be at 7h16, but thick clouds and drizzle blocked it out completely. It was a cold front passing through, and all the birds were coming from the south-east. The temperature was not too cold, 5°C, but 200 km to the south-east it was white — snow-time in Lesotho. A closer look at the temperatures before, during and after 28 June 2006 revealed that a cold front passed through the area on that day too.

In the highlands of Lesotho, the Red-capped Lark is less frequently recorded during the cooler times of the year (Van Niekerk 2004). Two surveys, one in November and the other during April, indicated no major altitudinal shifts, only some movement from natural vegetation to fields (Van Niekerk 2004). Nevertheless, there can be little doubt that the two events recorded at Glen involved Lesotho birds fleeing the miserable weather in the Maluties at the time.

The daily reporting rate upper quartile of 2006 was higher than that of other years (Fig. 5.52), suggesting that the influx noted on 28 June 2006 was accompanied by more Lesotho birds before or after. A closer look at the daily reporting rates revealed that daily reporting rates were indeed relatively high before and after the influx (*cf.* Figs. 5.52 & 5.56). It is suspected, therefore, that days with relatively high reporting rates could also represent influxes associated with cold fronts. A check on the minimum and maximum temperatures from the weather station at Glen and the ten outlying points of 1999, 2000 and 2002 in Figure 5.52, indicated that four points were associated with what seemed to have been cold fronts (sudden sub-zero minimum temperatures) during late autumn, late winter and early spring. Some of the remaining six points were also associated with drops in temperatures, but these were during late summer, early and mid-autumn and probably related to rain. The three highest daily segment reporting rates in Figure 5.52 were also examined and proved to be cold front related too: S1, early spring 2002; S2, early autumn 2002; S12, 28 June 2006.

There may be more of the outliers that are associated with cold fronts, but suffice it to say that Red-capped Larks are definitely moving in response to adverse weather conditions, which in southern Africa is probably at its most severe in the highlands of Lesotho.

R508 Pink-billed Lark .... *Spizocorys conirostris*

The Pink-billed Lark occurs in southern Africa, western Zambia (Dean 1997k), and possibly also extreme south-eastern Angola (Dean 2000). In southern Africa recorded from a few scattered localities in Namibia and Botswana, with the bulk of the birds occurring in South Africa where approximately half of its southern African distribution overlaps with the Free State (Dean 1997k). On the South African highveld, it is usually associated with grassland (Earlé & Grobler 1987) where it is resident (Dean 2005aa).

The birds at Glen

Only recorded from the grassland (Table 5.10). There were usually only one or two pairs in the study area and breeding has been recorded. Distinction was made between alarm/flight calls and displays, both activities having an activity index of nine (Table 5.10a). Displays were recorded

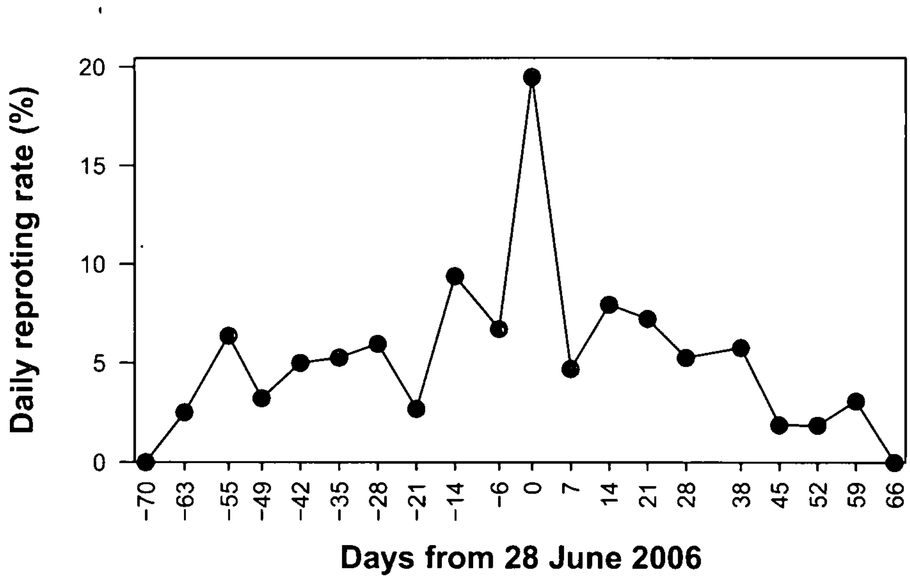


Figure 5.56: R507 Red-capped Lark. Fluctuations in daily reporting rates before and after 28 June 2006 at Glen. Most of these values are higher than what could be considered 'normal' (*cf.* Fig. 5.52). See text.

separately for each minute since 1998/9, and alarm/flight calls since 2001/2 (Table 5.11). Figures start on page 641.

Table 5.10: R508 Pink-billed Lark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.612	4 626	114 612	4.0	alarm/flight calls	75.5	656	495	9
0.388	2 928	114 612	2.6	displays	52.4	656	344	9
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.333	10	1 188	0.8	alarm/flight calls	23.3	43	10	1
0.667	20	1 188	1.7	displays	23.3	43	10	2

Table 5.11: R508 Pink-billed Lark: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
alarm/flight calls	late winter 2001/2	3 688	345 105	1.1
displays	late winter 1998/9	4 394	476 815	0.9

Annual occurrence of alarm/flight calls in the grassland: Overall, recorded on 75.5% of the days with an activity index of nine (Table 5.10a). Recorded during 9–12 seasons per year (Fig. 5.57; Fig. 5.58), with daily reporting rates ranging from 0.5 to 49.7% and 93.1% bird-days attaining low reporting rates (Fig. 5.57). The median daily reporting rate of 2002/3 was particularly high (Fig. 5.57) and its activity intensity was also slightly higher than that of other years (Fig. 5.57). The median daily reporting rates of 2003/4, 2006/7 and 2007/8 were the lowest of all years (Fig. 5.57). 1999/0 and 2002/3 were the only years with high reporting rate days (Fig. 5.57; Fig. 5.58). The incidence of days with zero records were relatively more common since 2001/2 (Fig. 5.58).

Seasonal occurrence of alarm/flight calls in the grassland: Recorded during 10–11 years in most seasons, the exceptions being late winter and mid-spring with eight and four years respectively (Fig. 5.57). Seasonal frequency indices were lower during late winter and spring than during other seasons (Fig. 5.57). Median daily reporting rates followed a seasonal trend with the highest value in late autumn and lowest in mid-spring (Fig. 5.57). This pattern coincides with the occurrence of high reporting rate days, which were limited to mid- and late autumn, intermediate reporting rate days which were limited to late summer, autumn and early winter, and the incidence of zero bird-days that was least frequent during late summer and autumn and most prevalent in spring (Fig. 5.58).

Daily occurrence of alarm/flight calls in the grassland: Overall, activity was most frequent around mid-morning and in the late afternoon before sunset (Fig. 5.57). This pattern is a reflection of the situation for low reporting rate days, because the activity for intermediate and high reporting rate days was more evenly spread throughout the day, except after sunset when it was relatively infrequent (Fig. 5.59). The seasonal patterns generally tend to be similar to that of low reporting rate days, except during late autumn when activity was relatively frequent throughout the day (Fig. 5.60). No bird-segment combinations occurred during more than 5% bird-days.

The first activity of the day most frequently occurred in the early morning, earlier on intermediate and high reporting rate days (frequently before sunrise) than on low reporting rate days (Fig. 5.60). The seasonal pattern was reasonably constant, except during late winter and spring when the timing of the first activity of the day was more variable than during other seasons (Fig. 5.60).

Activity tended to end later in the day on intermediate and high reporting rate days (typically around sunset) than on low reporting rate days (Fig. 5.60). Seasonally, the timing was least variable during late winter and early spring with median values after sunset, in contrast to the more variable nature of the other seasons with their medians in the late afternoon before sunset (Fig. 5.60).

Activity intensities were similar for all segments on low reporting rate days, but tended to be higher during the early to mid-morning on intermediate and high reporting rate days (Fig. 5.59).

Overall, median daily segment reporting rates ranged from 5.6 to 90.9% with 88.6% of the values relatively low, and median values similar for most segments (Fig. 5.57). A similar trend is evident for low reporting rate days, but for intermediate reporting rate days median values were relatively high in the morning (Fig. 5.59).

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Annual occurrence of displays in the grassland: Overall, recorded on 52.4% of the days with an activity index of nine (Table 5.10a). Recorded during 6–12 seasons per year, most frequently (n = 10–12 years) during 2000/1, 2001/2 and 2007/8 (Fig. 5.61; Fig. 5.62). Daily reporting rates ranged from 0.5 to 67.5% with 97.1% bird-days attaining low reporting rates (Fig. 5.61). Median daily reporting rates were particularly high during 1999/0 and 2002/3 (Fig. 5.61), and together with 2005/6 were the only years with intermediate (and high in 1999/0) reporting rate days (Fig. 5.62). Activity intensities were mostly comparable between the respective years (Fig. 5.61).

Seasonal occurrence of displays in the grassland: Recorded during 10–11 years from mid-summer to late autumn and less frequently in other seasons, particularly mid-spring when recorded during one year only (Fig. 5.61). Seasonal frequency indices also peaked from mid-summer to late autumn (Fig. 5.61). Median daily reporting rates followed a similar seasonal trend with a peak in late autumn and lowest values during spring (Fig. 5.61). This pattern coincides with the occurrence of high reporting rate days, which was limited to mid- and late autumn, intermediate reporting rate days which were limited to autumn, and the incidence of zero bird-days which were lowest during late summer and autumn, and most prevalent in winter and spring (Fig. 5.62).

Daily occurrence of displays in the grassland: Overall, activity was most frequent from before sunrise until mid-morning (Fig. 5.61). Seasonally the pattern changes from activity largely limited to the morning in late winter and spring, to activity relatively frequent in the late afternoon and later also in the early morning during summer, to activity most prominent around mid-morning in autumn and early winter, with activity becoming less frequent during mid-winter (Fig. 5.63).

The first activity of the day most frequently occurred in the early morning, earlier on intermediate and high reporting rate days (before sunrise) than on low reporting rate days (Fig. 5.63; Fig. 5.64). Seasonally, the timing was reasonably constant with median values limited to the early mornings in all seasons (Fig. 5.63; Fig. 5.64). The dawn chorus sequence reflects the occurrence of the first activity of the day (Fig. 5.64).

The occurrence of the last activity of the day was variable for low reporting rate days, but mostly around sunset on intermediate and high reporting rate days (Fig. 5.63; Fig. 5.64). Seasonally, the timing was least variable during late winter and early spring with median values in the morning, compared to the highly variable nature of the other seasons with their medians at various times of the day (Fig. 5.63; Fig. 5.64).

Activity intensities were slightly higher before sunrise than during other parts of the day (Fig. 5.61).

Daily segment reporting rates ranged from 5.3 to 100% with 88.8% of the values relatively low, and median values similar for the respective segments (Fig. 5.61).

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Combined data: Recorded during 9–10 seasons from 2002/3 to 2005/6, and during 11–12 seasons in all other years (Fig. 5.65). Recorded from mid-summer to mid-winter in all years and in 9–10 years from late winter to early summer, except during mid-spring when recorded during only four years (Fig. 5.65).

Discussion

Ryan (2004e) described the movements of the Pink-billed Lark as follows:

> "**Movements.** Nomadic in arid W [west], following rain events with other granivorous species. Largely resident or subject to local movements elsewhere in range. Localized population in NE [north-east] assumed to be entirely sedentary."

This is in contrast to earlier authors who claimed that it is a "Common nomad, numbers fluctuate greatly" in southern Africa (Maclean 1985, 1993) and even that the birds are "highly nomadic" in the Free State (Earlé & Grobler 1987). These statements about nomadism, however, most probably derive from Maclean's (1970c) work in the Kalahari. Ryan (2004e) clarified the situation by limiting nomadism to the birds of the "arid west". At Glen, the Pink-billed Lark is resident and sedentary (Fig. 5.65).

In spite of being resident, the general seasonal trend is for the least activity during spring and the most activity during autumn (Fig. 5.57; Fig. 5.58; Fig. 5.61; Fig. 5.62; Fig. 5.65). SABAP1 reporting rates show a very similar trend, which Dean (1997k) correctly attributed to "reduced conspicuousness rather than seasonal movements." In this regard, note the scarcity of the birds at Glen during mid-spring (Fig. 5.65). The prominence of the pattern suggests a strongly seasonal event in the annual cycle, and it is suspected to be moult. There seem to be no published data on the moult in the Pink-billed Lark (see Dean 2005aa). Data from a limited number of birds in the Free State are inconclusive — no spring records (DJvN unpublished data).

The Pink-billed Lark is an opportunistic breeder, breeding at any time of the year in response to rain, with a slight peak from April to July [late autumn and winter] (Tarboton 2001). In this regard it is notable that displays at Glen often start soon after or even during the first reasonable rains of the season (Fig. 5.62). This is generally not the case for other vocalisations (Fig. 5.58), which occurred more or less throughout the year (Fig. 5.57). Note, however, that activity levels were relatively low during the high rainfall years (*i.e.* 1997/8, 2001/2, 2005/6 and 2007/8) and reached their peak only during two below average rainfall years, 1999/0 and 2002/3 (Fig. 5.57; Fig. 5.61). In both these years activity peaked during autumn, well after the first rains of the season (Fig. 5.57; Fig. 5.61). It was also at these times that nests were found.

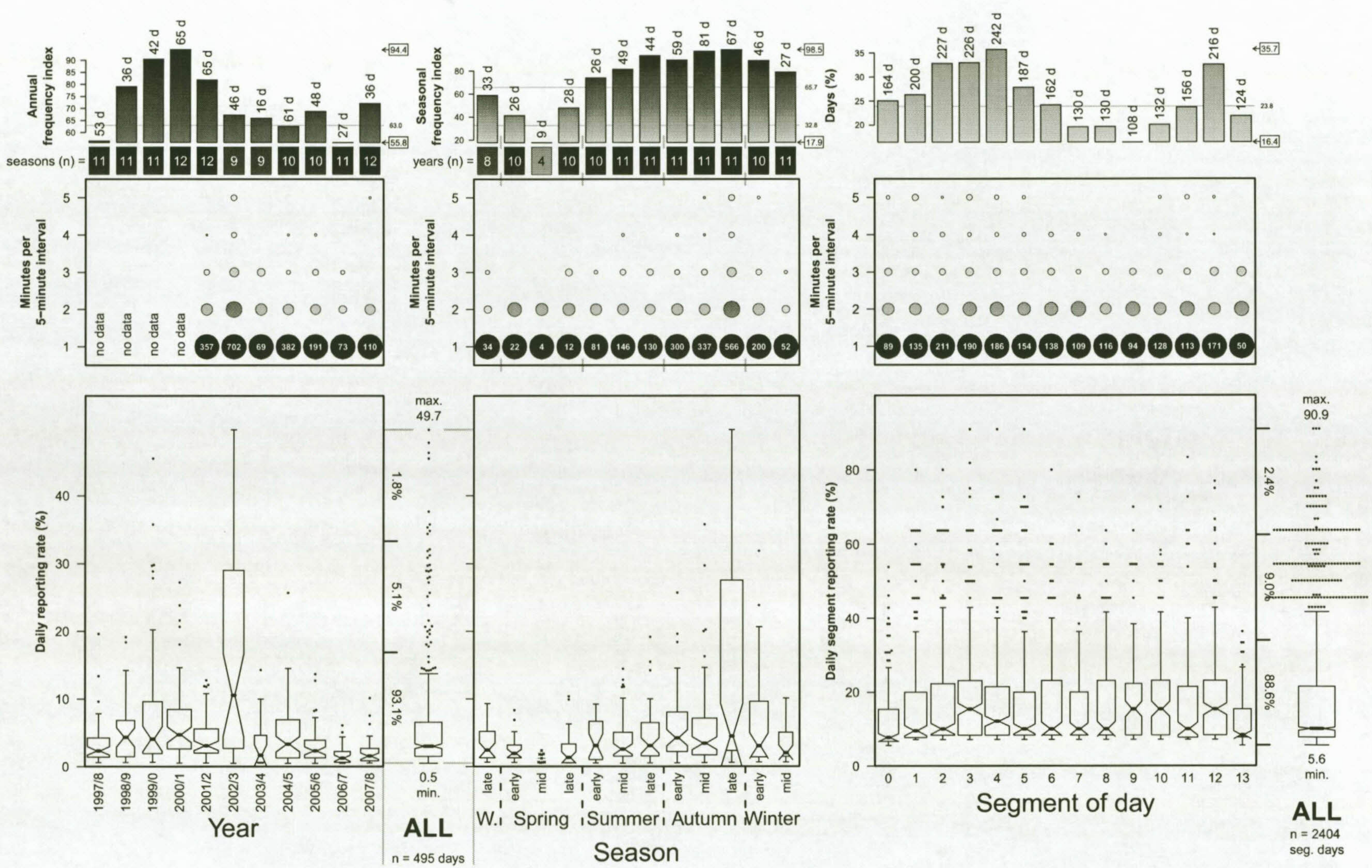


Figure 5.57: R508 Pink-billed Lark — alarm/flight calls: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

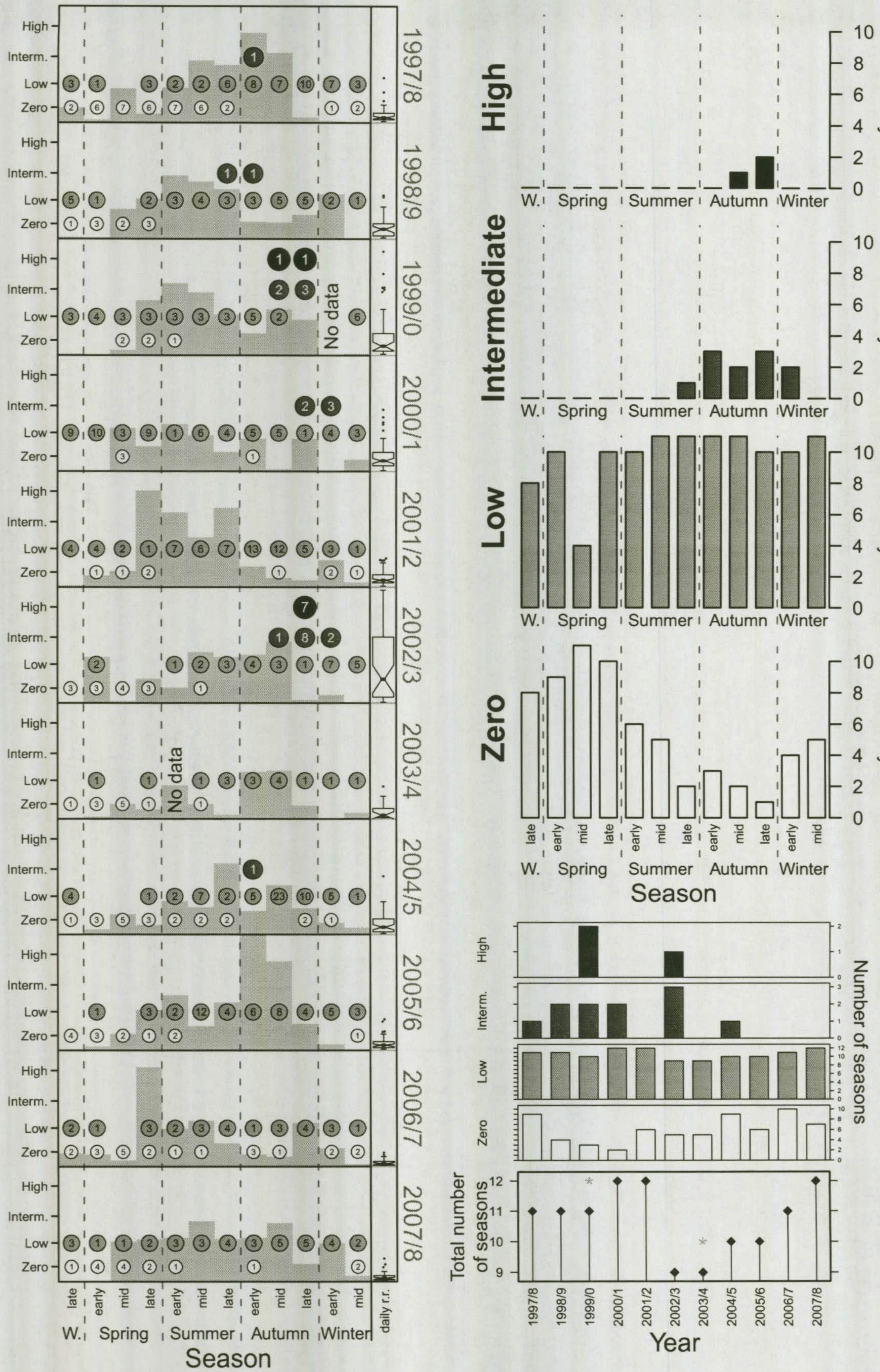


Figure 5.58: R508 Pink-billed Lark — alarm/flight calls: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

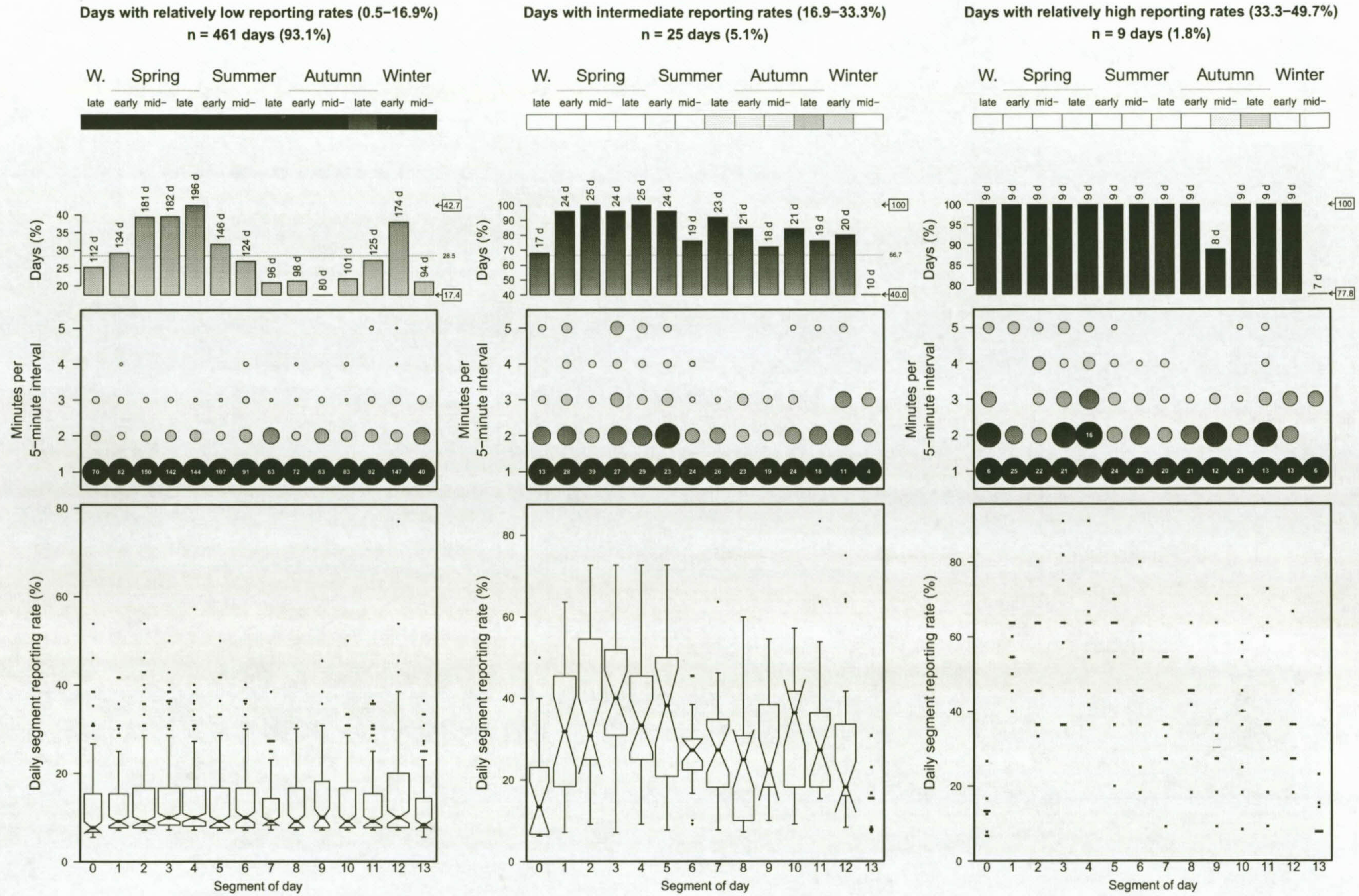


Figure 5.59: R508 Pink-billed Lark — alarm/flight calls: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

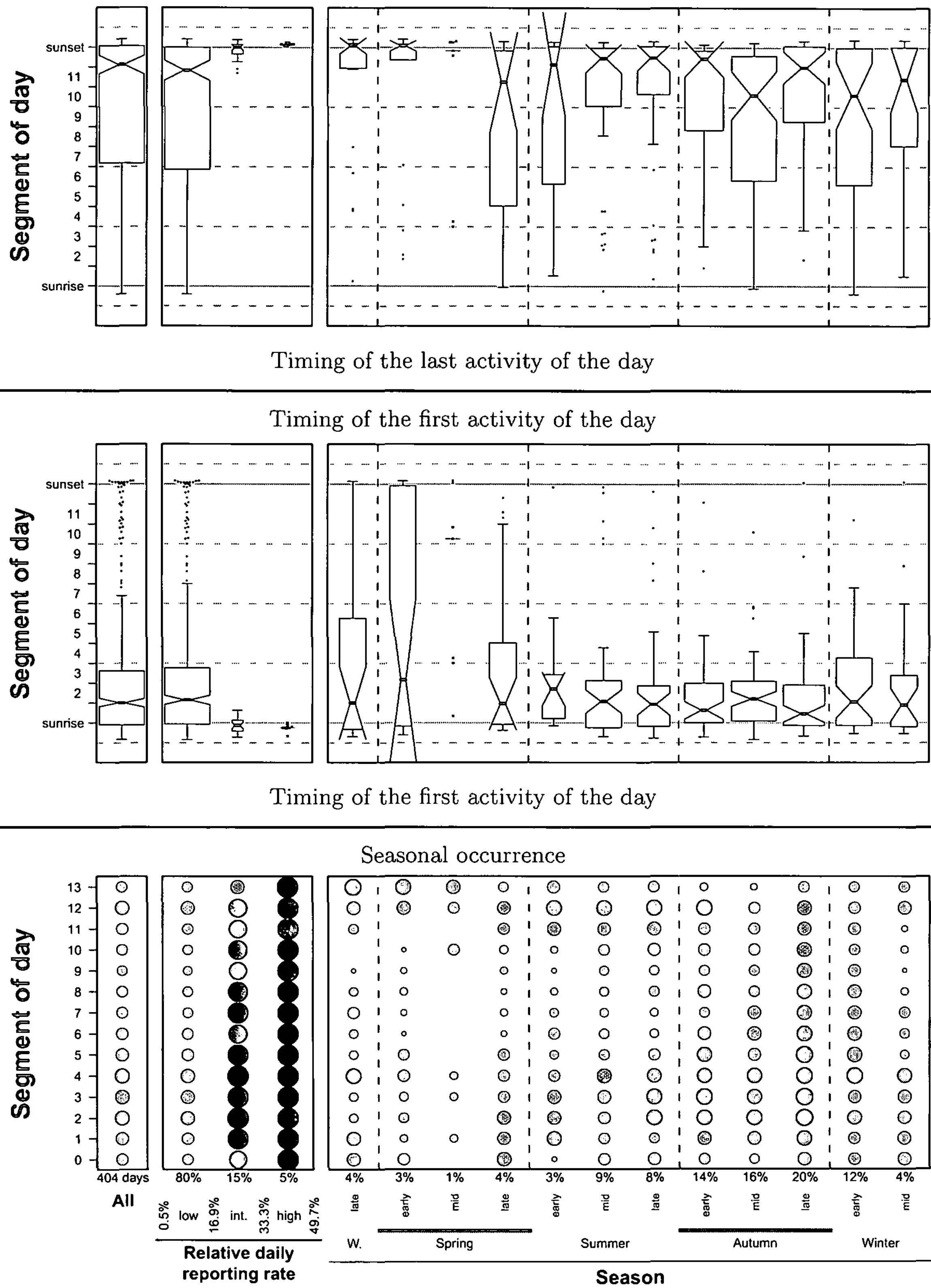


Figure 5.60: R508 Pink-billed Lark — alarm/flight calls: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

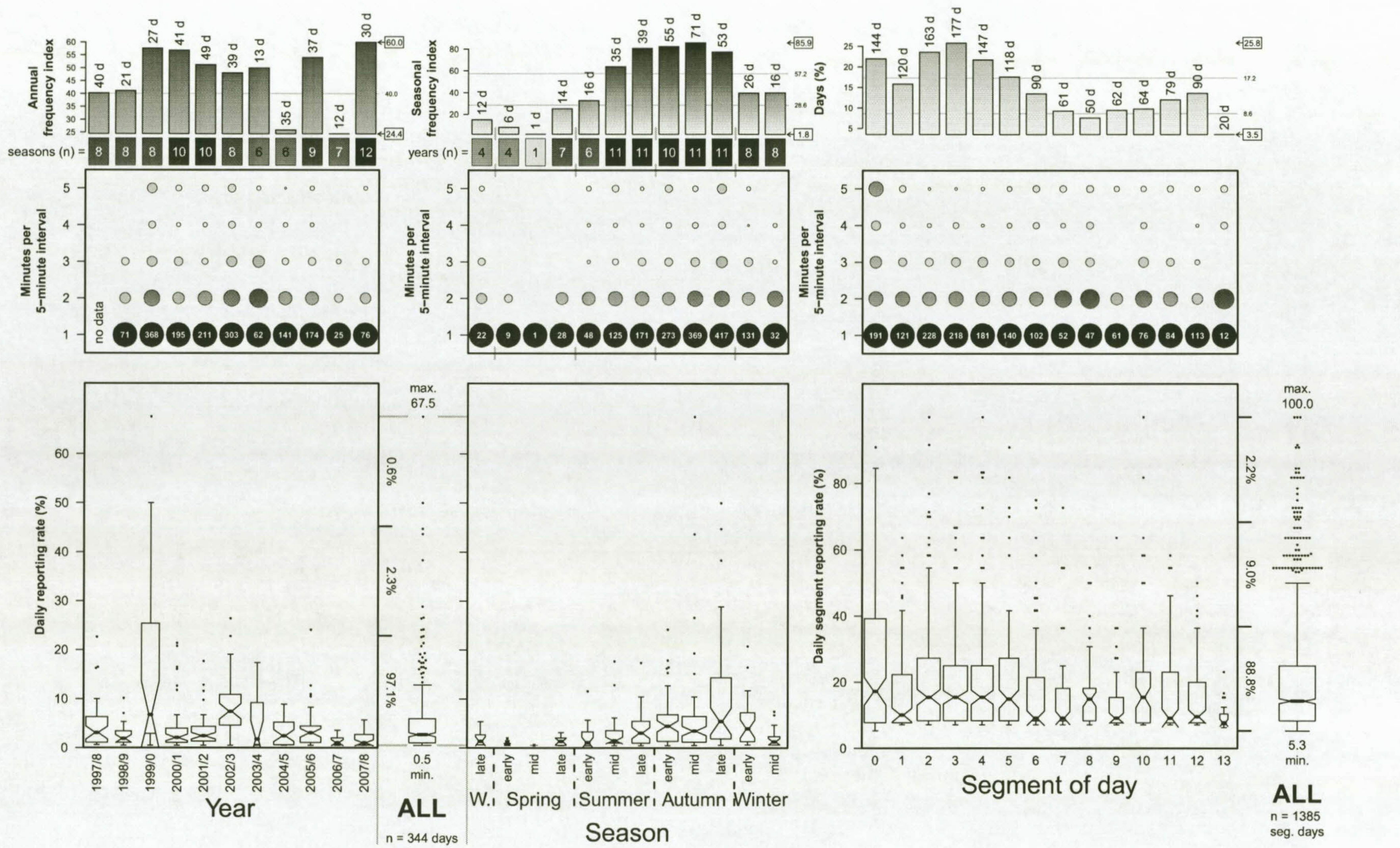


Figure 5.61: R508 Pink-billed Lark — displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

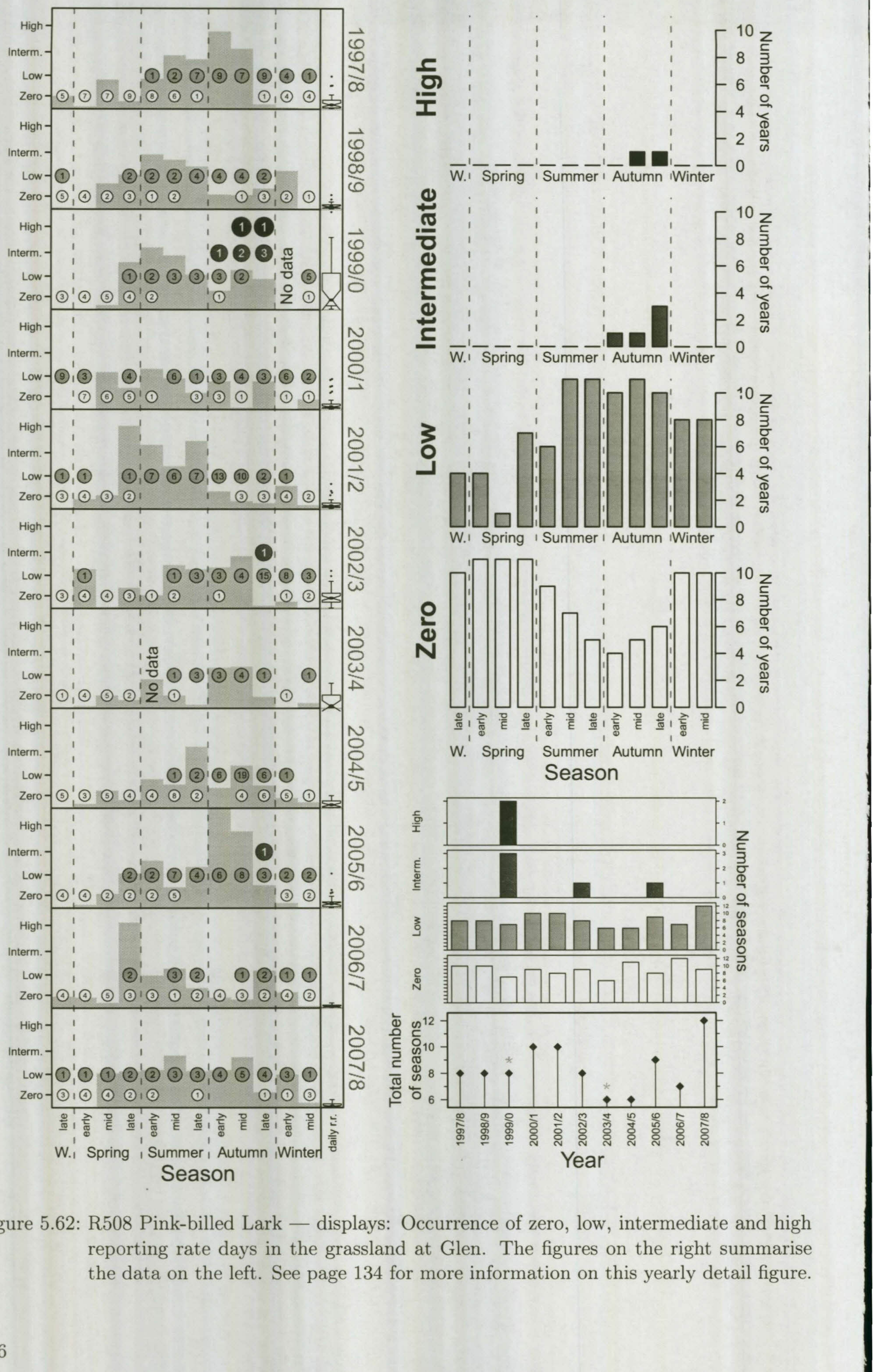
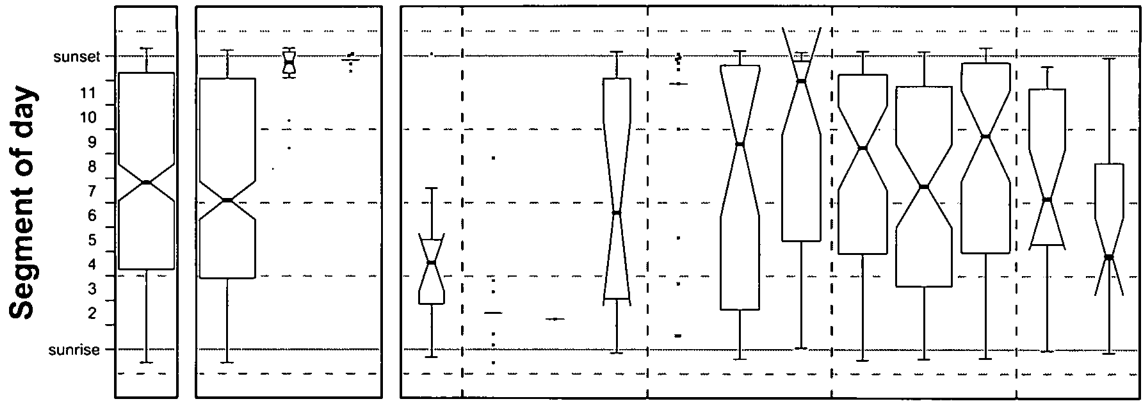
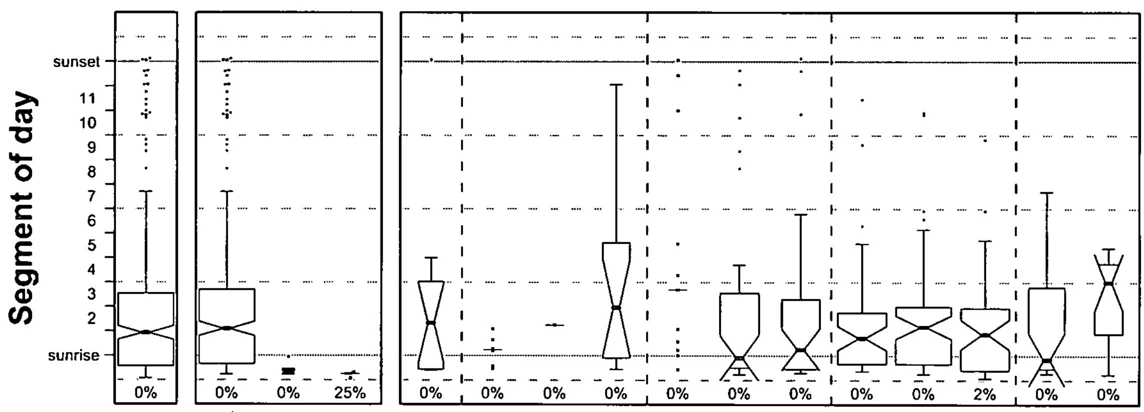


Figure 5.62: R508 Pink-billed Lark — displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.





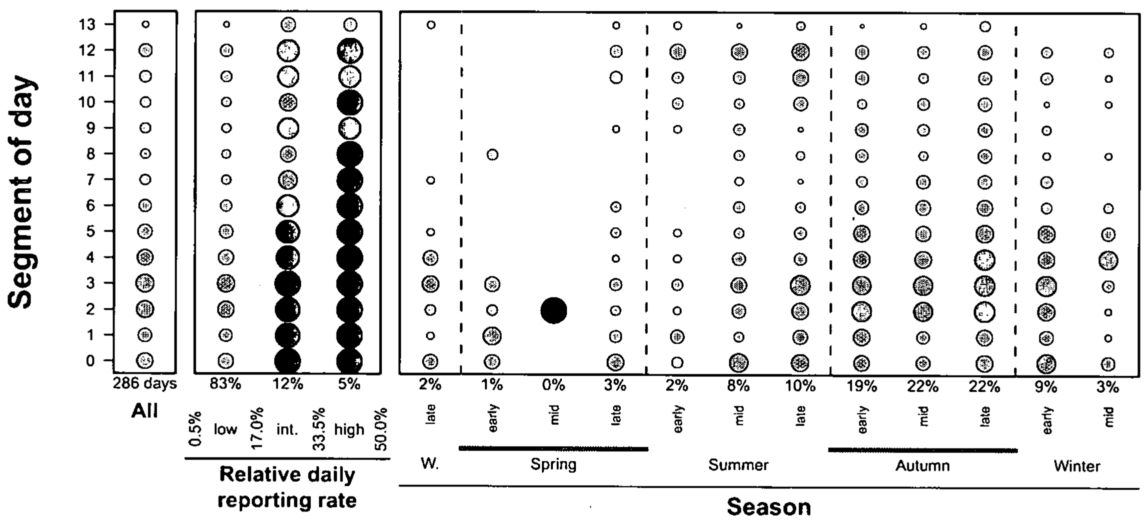
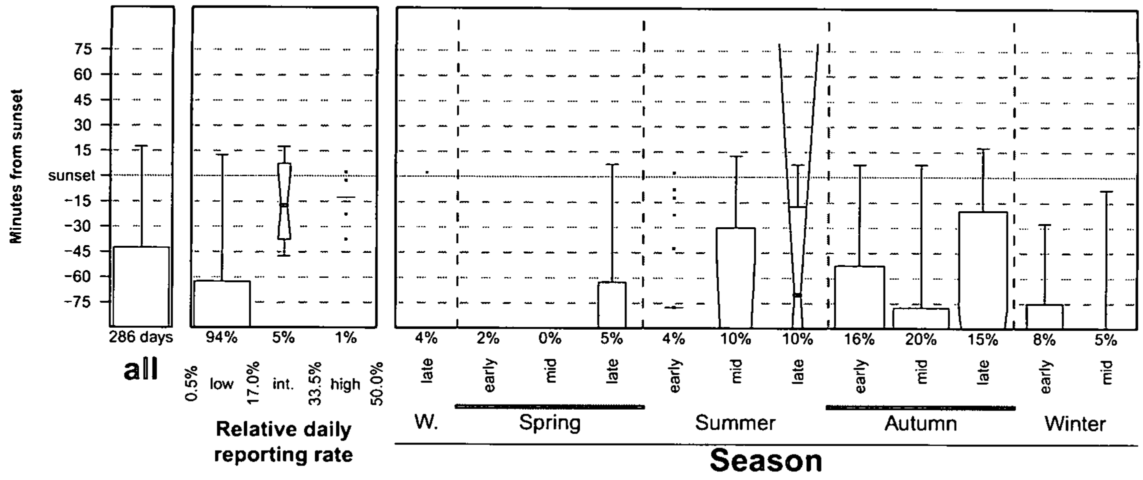
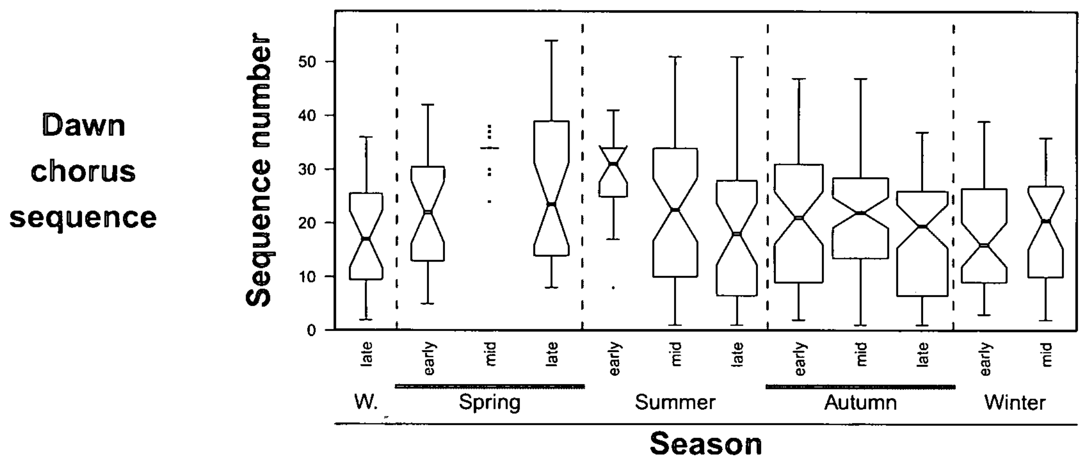


Figure 5.63: R508 Pink-billed Lark — displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

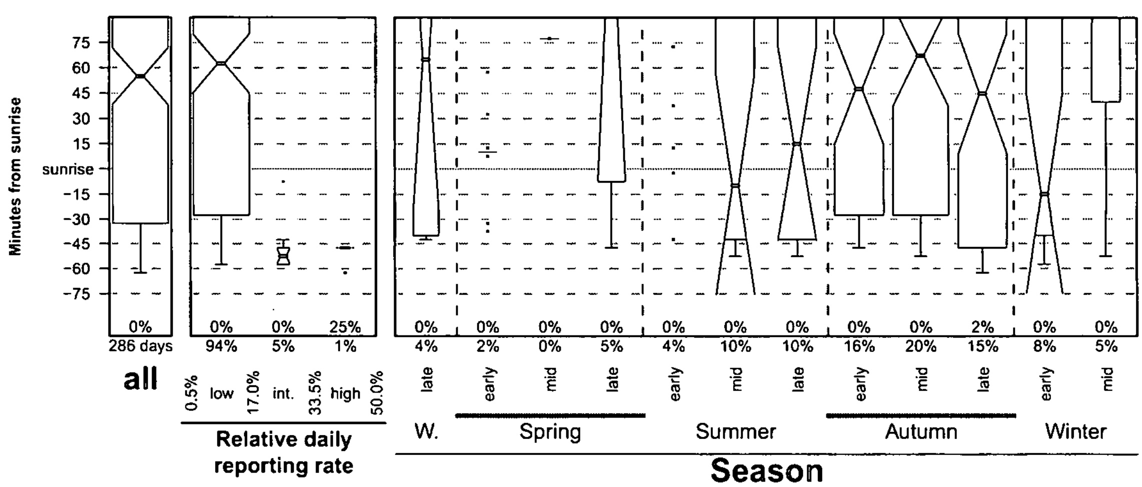


Figure 5.64: R508 Pink-billed Lark — displays: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

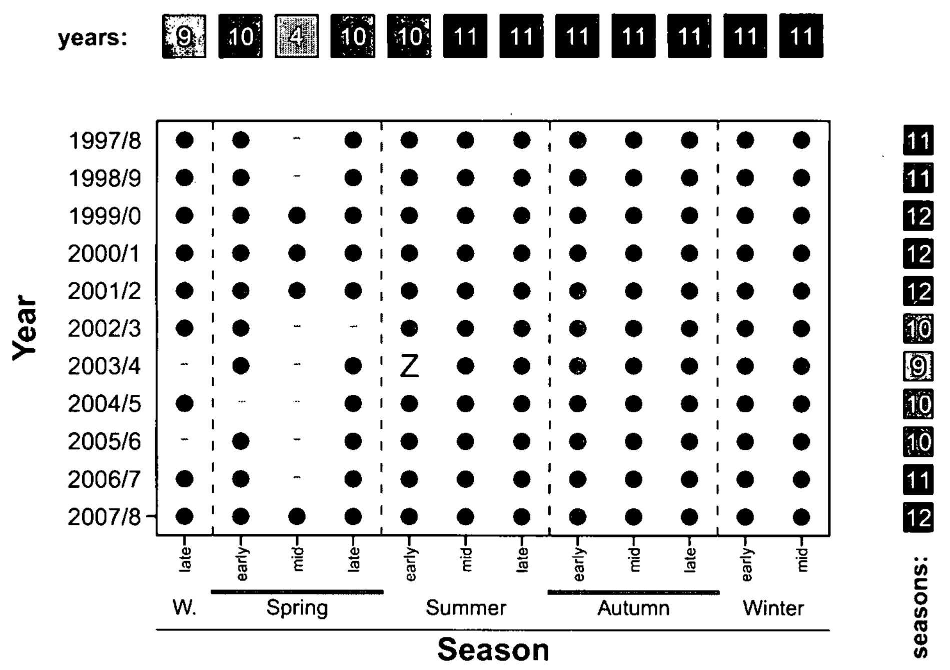


Figure 5.65: R508 Pink-billed Lark: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

R515 Chestnut-backed Sparrowlark .... *Eremopterix leucotis*

The Chestnut-backed Sparrowlark is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, it occurs mainly in northern Namibia, Botswana, Zimbabwe and in South Africa from the Free State north and north-eastward (Dean 1997l). Usually associated with bare areas such as burned grassland and fallow fields (Maclean 1985). The population includes resident, migratory and nomadic components, but details of movements unclear (Dean 1997l).

The birds at Glen

Due to inadequate views it was not always possible to distinguish between the Chestnut-backed Sparrowlark and Grey-backed Sparrowlark R516. Only positively identified birds are considered here.

Chestnut-backed Sparrowlarks were recorded as birds flying over the grassland, displaying and visiting the trampled area (infrequently); never recorded in the drainage line (Table 5.12). In the analysis, distinction is made between displays and the rest of the records, which consist mainly of vocal records (Table 5.12). The analysis is based on a year starting in late summer. Figures start on page 651.

Annual occurrence of birds in the grassland (excluding displays): Recorded on 16.8% of the days with an activity index of three (Table 5.12a). Two years stand out: 2000 and 2005. Whereas other years had mostly minimal daily reporting rates of approximately 0.5%, the median daily reporting rates of 2000 and 2005 were approximately 2% with a maximum of 12.8% in 2000 (Fig. 5.66). These two years also had the highest annual frequency indices, with that of 2000

Table 5.12: R515 Chestnut-backed Sparrowlark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.925	370	114 612	0.3	present (excl. displays)	16.8	656	110	3
0.075	30	114 612	0.0	displays	2.4	656	16	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 188	0.1	present (excl. displays)	2.3	43	1	1

much higher than that of 2005 (Fig. 5.66). In addition, recorded during nine seasons in 2000 compared to the four in 2005 (Fig. 5.66; Fig. 5.67).

Seasonal occurrence of birds in the grassland (excluding displays): Activity was most frequent during mid-autumn when recorded during seven years compared to the 0–5 bird-years of other seasons (Fig. 5.66). Median daily reporting rates were minimal for six seasons (*ca.* 0.5%), with higher values attained during mid- and late autumn and from mid-winter to early spring (Fig. 5.66).

Daily occurrence of birds in the grassland (excluding displays): Most frequently recorded from mid- to late morning; seldom before sunrise or after sunset (Fig. 5.66). Bird-segment combinations occurring on more than 5% bird-days were limited to single segments S3, S4 and S5, collectively accounting for a fifth of the bird-days (Fig. 5.68). Daily segment reporting rates ranged from 7.1 to 54.5% with median values uniformly low (Fig. 5.66).

Displays: Noted on 17 days spread over four non-consecutive years with all records limited to autumn and early winter (Fig. 5.69).

Discussion

It is known that Chestnut-backed Sparrowlark numbers can fluctuate greatly from year to year (Brewster 1991; Brewster 1996; Irwin & Lorber 1983; Maclean 1985). This was evidently the situation at Glen too (Fig. 5.66).

According to Earlé & Grobler (1987), the larks are "mostly nomadic" in the Free State. Campbell & Lack (1985) defined nomadism as the "term used to describe movements of species that do not normally revisit either breeding site or non-breeding areas." At Glen, there is a reasonably strong seasonal trend with birds relatively frequently recorded during autumn, particularly mid-autumn (Fig. 5.66), suggesting that the birds are not truly nomadic there.

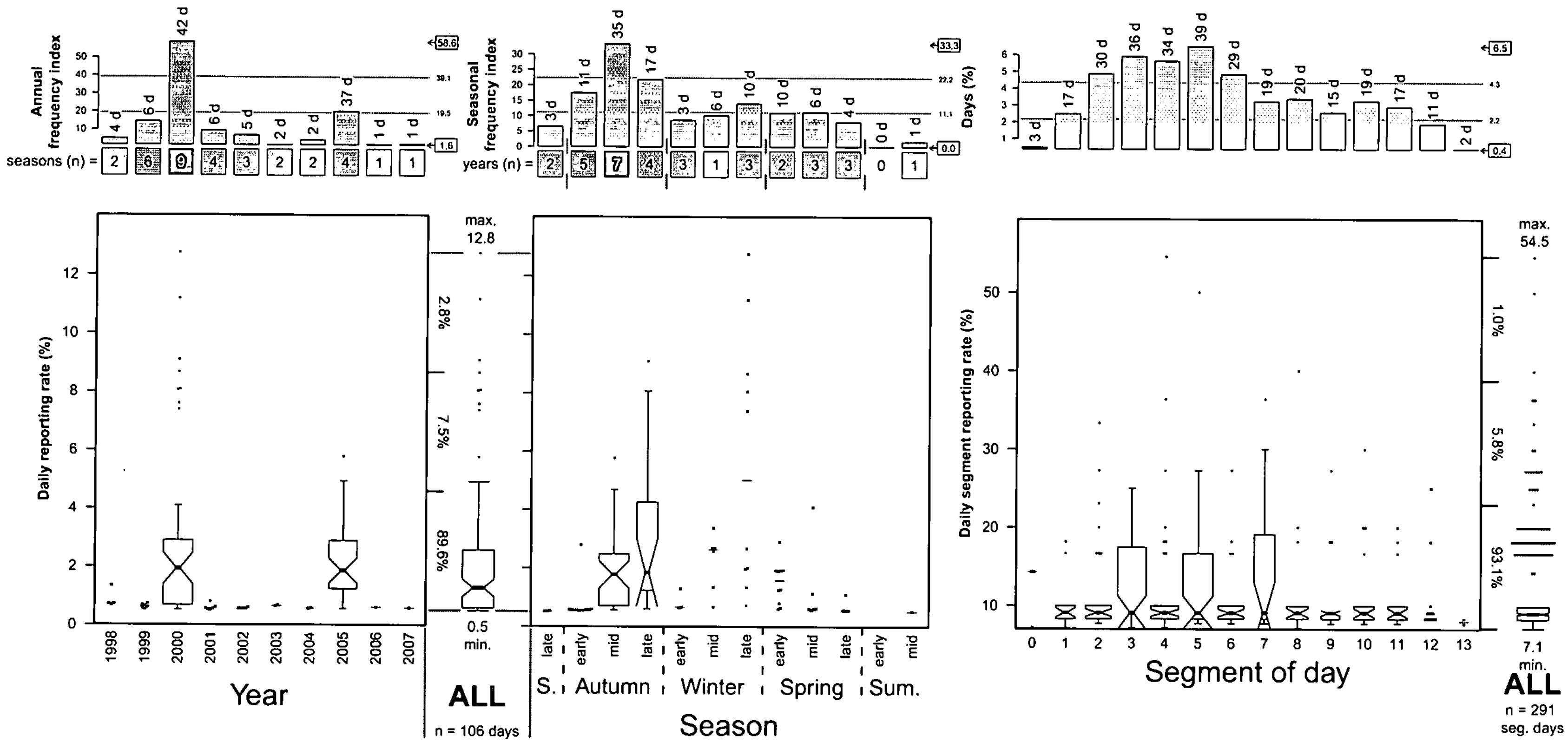


Figure 5.66: R515 Chestnut-backed Sparrowlark — present (excluding displays): Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

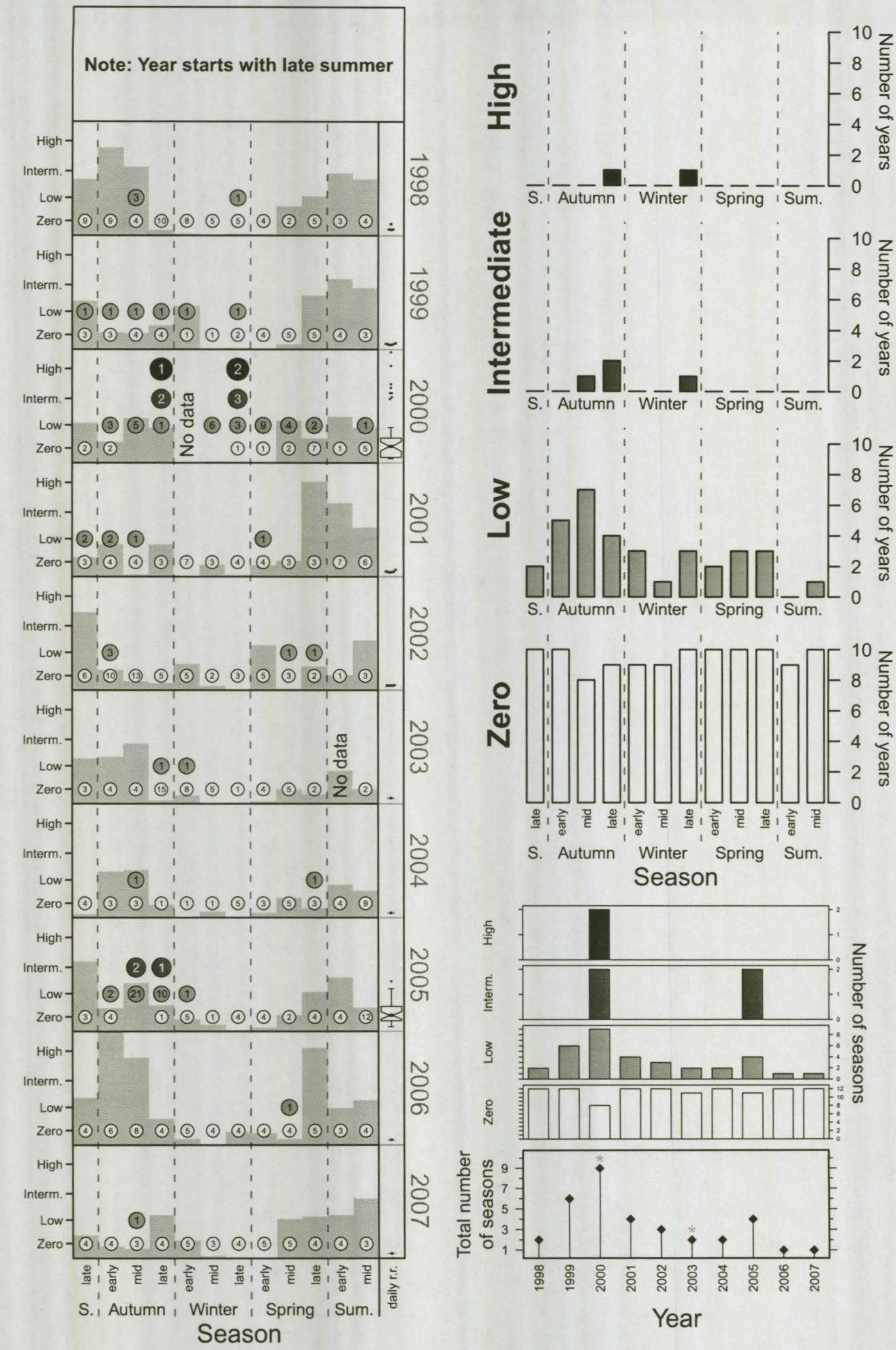


Figure 5.67: R515 Chestnut-backed Sparrowlark — present (excluding displays): Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

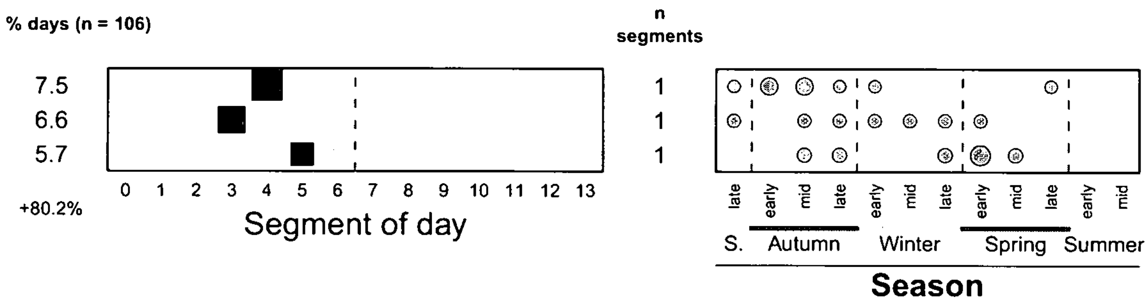


Figure 5.68: R515 Chestnut-backed Sparrowlark — present (excluding displays): Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

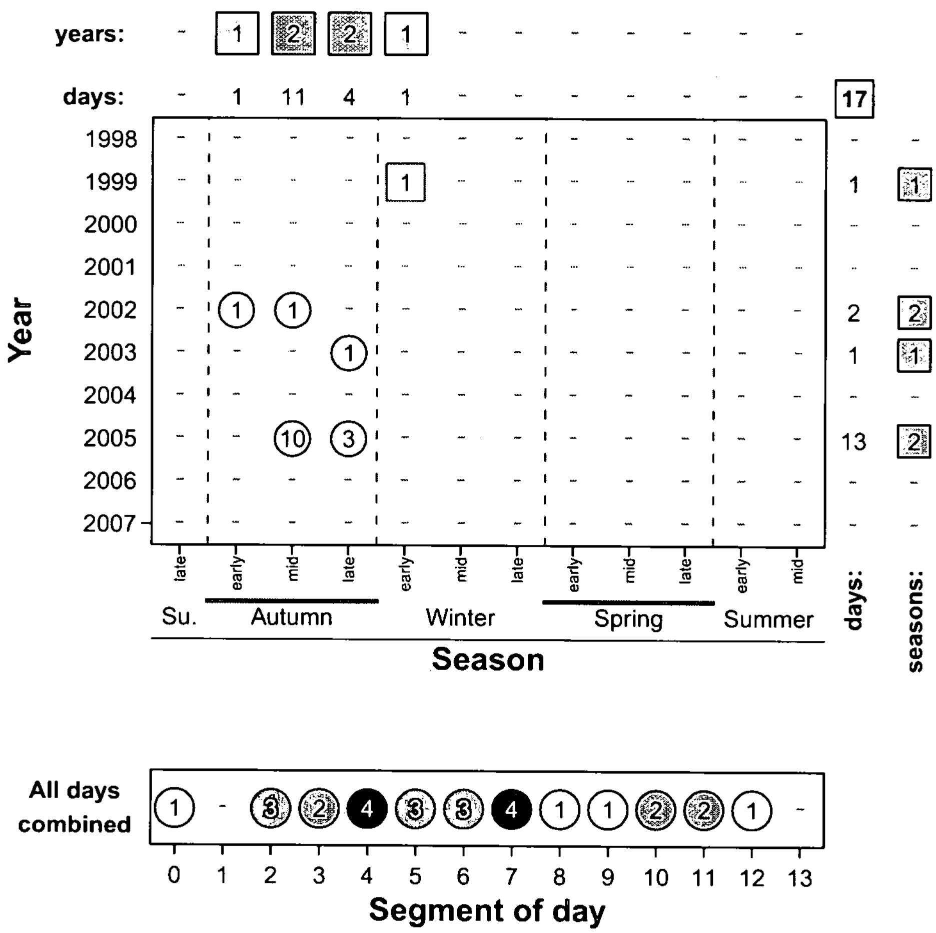


Figure 5.69: R515 Chestnut-backed Sparrowlark — displays: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

The timing of peak occurrence at Glen during autumn (Fig. 5.66), and in particular displays (Fig. 5.69), coincides with the end of the main rain period. This is similar to the situation in Zimbabwe (Irwin & Lorber 1983) and the former Transvaal (Chittenden & Batchelor 1977; Tarboton *et al.* 1987).

There appears to be no published data on the moult of Chestnut-backed Sparrowlarks (see Lloyd 2005b). In the Free State, an adult male was halfway through its primary moult and in full body moult in early summer, and another male in fresh plumage in late autumn (DJvN unpublished data). This suggests that moult occurs from the latter part of spring into summer, similar to the moult pattern of the closely related Grey-backed Sparrowlark R516 as determined by Willoughby (1971) in the central Namib. It is suggested that the absence of records during early summer at Glen signifies a time when primary moult and moult otherwise is such that the birds become less mobile, and hence less detectable. Significantly, the SABAP1 reporting rates illustrated in Dean (1997l) show a marked decrease centred on December and January [summer]. In addition, there is a distinct decrease in SABAP1 reporting rates during June/July [mid-winter], plus peaks centred on September [mid-spring] and April/May [late autumn/early winter] (Dean 1997l). The Glen data shows a similar trend (Fig. 5.66).

Thus, the birds moult in spring/summer, breed in autumn, and then become scarce in mid-winter, only to reappear in spring. — what are they doing in mid-winter? Moult, again? In truth, no-one can say for sure because we simply know too little about their moult. What we do know is that adults of the closely related Grey-backed Sparrowlark have a very rapid post-breeding moult involving body feathers and tertials (Willoughby 1971). Perhaps this is true also for the Chestnut-backed Sparrowlark, and the reason for the dip in reporting rates around mid-winter.

R516 Grey-backed Sparrowlark .... *Eremopterix verticalis*

The Grey-backed Sparrowlark occurs in Angola (Dean 2000), Zambia and southern Africa where it is largely absent from the eastern third of the region (Dean 1997m). In the Free State, it is largely confined to the western half of the province (Dean 1997m; Earlé & Grobler 1987), the study area being near the eastern limit of its range. It occurs in a variety of bare, sparsely vegetated or short grass habitats (Dean 1997m; Earlé & Grobler 1987; Maclean 1985). Movements do occur, but annual changes in detectability complicate the interpretation of data (Dean 1997m; Earlé & Grobler 1987).

The birds at Glen

Due to inadequate views it was not always possible to distinguish between Grey-backed Sparrowlarks and Chestnut-backed Sparrowlarks R515. Only positively identified birds are considered here.

Recorded as birds flying over the grassland, displaying and visiting the trampled area (infrequently). Never recorded in the drainage line (Table 5.13). The analysis is based on a year starting in late summer. Figures start on page 656.

Table 5.13: R516 Grey-backed Sparrowlark: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	Total	%	Activity	Days %	Total	n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.947	772	114 612	0.7	present (excl. displays)	12.7	656	83	9
0.053	43	114 612	0.0	displays	1.2	656	8	5
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	4	1 188	0.3	present (excl. displays)	9.3	43	4	1

Annual occurrence of birds in the grassland: Recorded on 12.7% of the days with an activity index of nine (Table 5.13a). Not recorded in 2005 or 2006. Based on the number of bird-seasons, annual frequency indices and daily reporting rates activity levels were exceptionally high during 2003 compared to other years (Fig. 5.70; Fig. 5.71).

Seasonal occurrence of birds in the grassland: Recorded during all seasons, for 4–5 bird-years during autumn and for 1–3 bird-years in winter, spring and summer (Fig. 5.70). However, median daily reporting rates were highest during winter (Fig. 5.70).

Daily occurrence of birds in the grassland: Overall, recorded relatively infrequently in the early morning and after sunset (Fig. 5.70). This general pattern is similar for low and intermediate reporting rate days (Fig. 5.72). No bird-segment combinations occurred during more than 5% bird-days.

Overall, daily segment reporting rates ranged from 5.9 to 91.7% with 86.7% of the values relatively low (Fig. 5.70). Except for the relatively low value of S13, the median daily segment reporting rates were similar for all segments (Fig. 5.70). This pattern was similar regardless of the relative magnitude of the daily reporting rate (Fig. 5.72).

Displays: Displays occurred only during autumn 2003.

Discussion

The seasonal pattern for the Grey-backed Sparrowlark is very similar to that of the Chestnut-backed Sparrowlark R516 (*cf.* Figs 5.66 & 5.70), and the explanation is probably the same too. See the discussion for the Chestnut-backed Sparrowlark on page 650.

In eastern Botswana, Brewster (1996) noted large flocks during a drought year, but not during a normal rain year. In the Free State Earlé & Grobler (1987) linked the high prevalence of the Grey-backed Sparrowlark during the early to mid 1980's to drought conditions prevailing at the

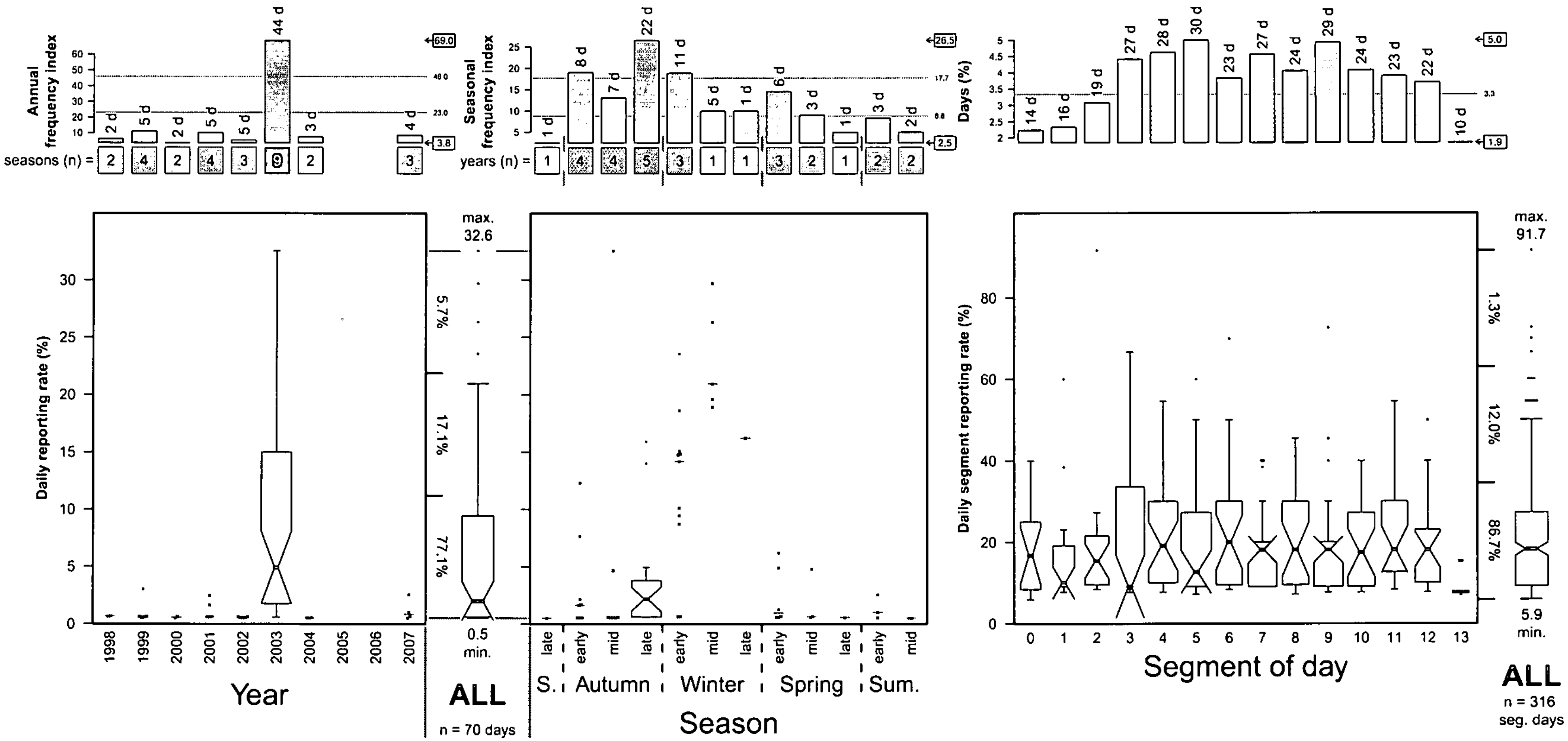


Figure 5.70: R516 Grey-backed Sparrowlark — present (excluding displays): Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

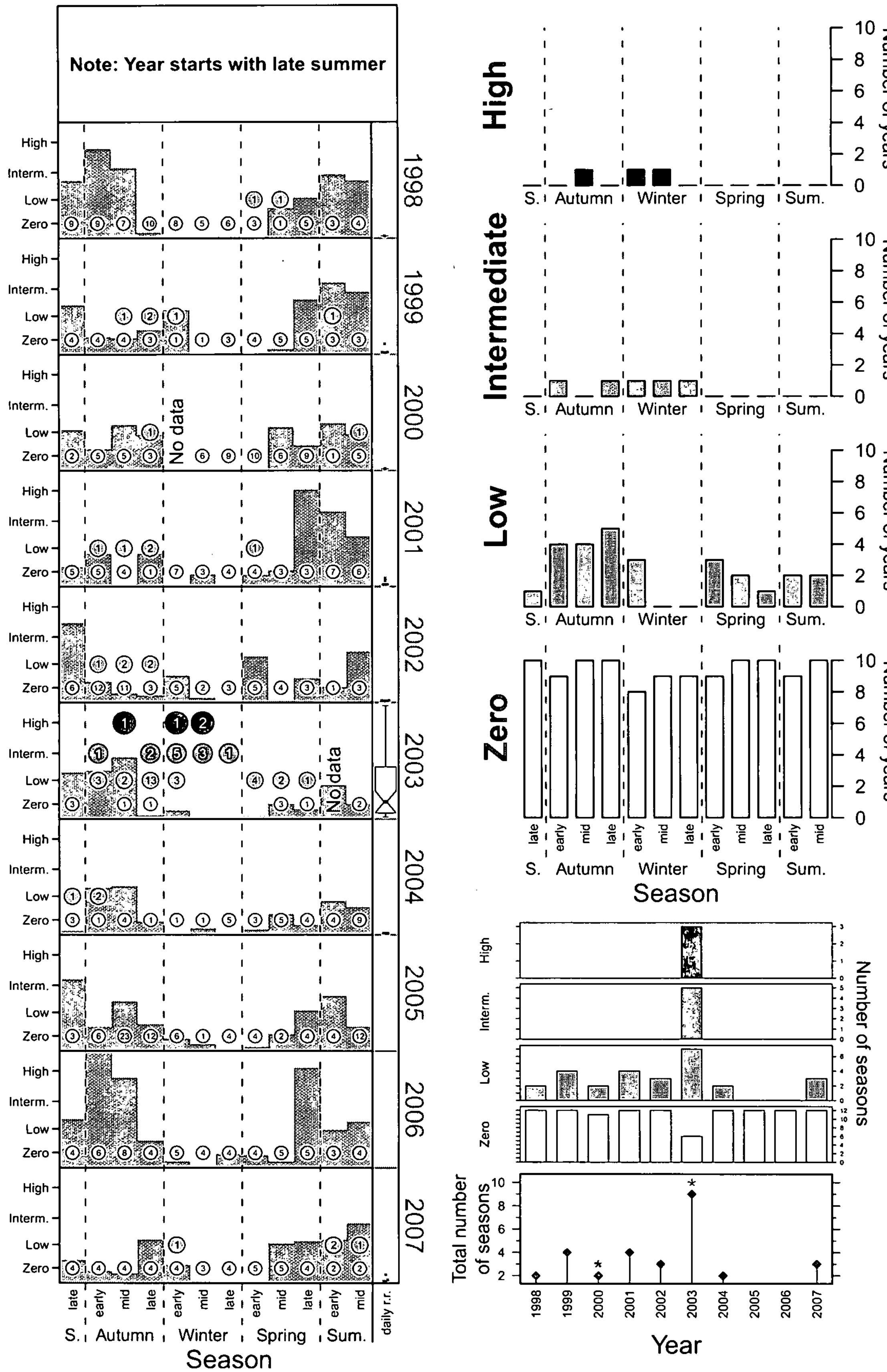


Figure 5.71: R516 Grey-backed Sparrowlark — present (excluding displays): Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

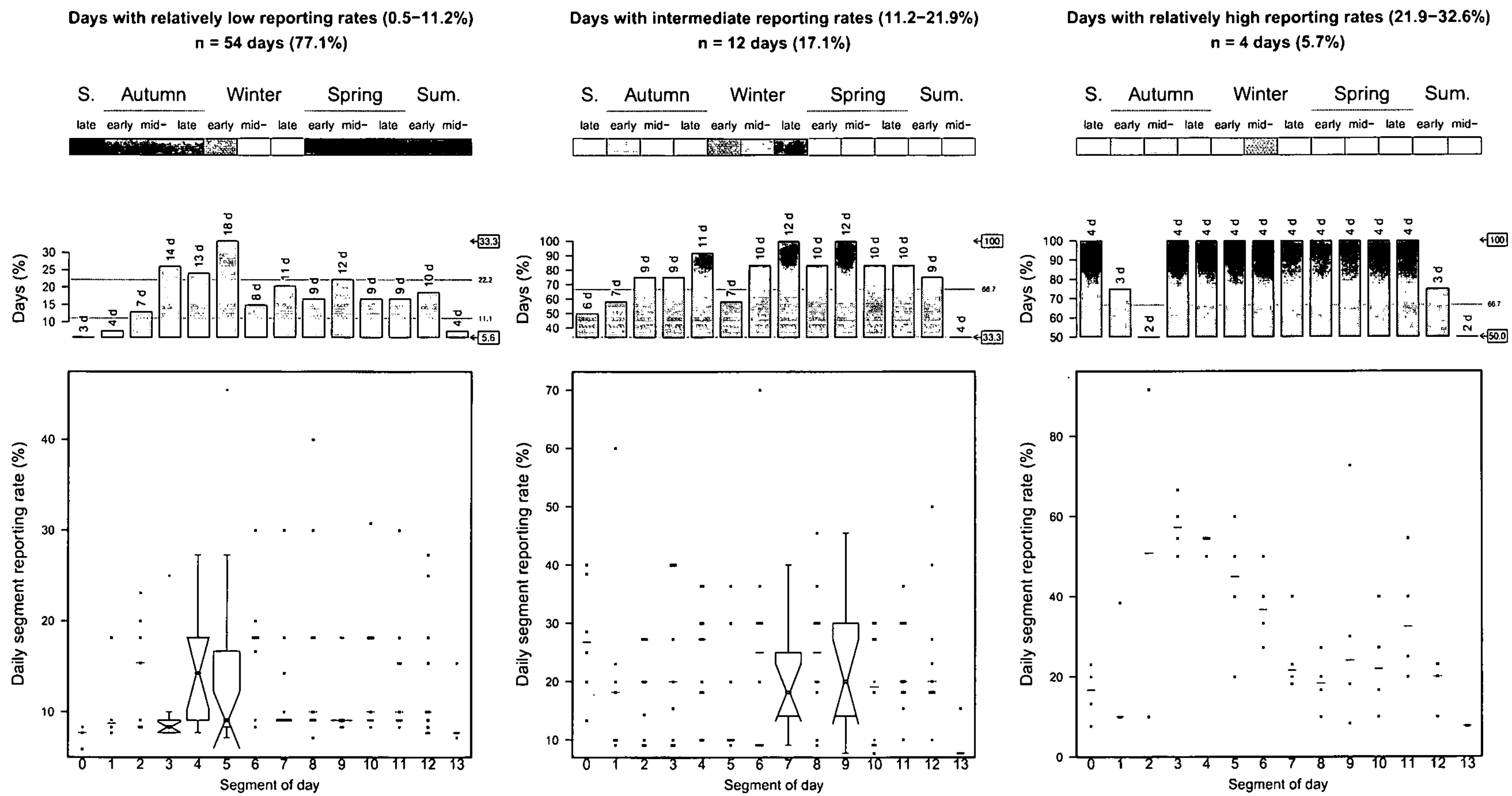


Figure 5.72: R516 Grey-backed Sparrowlark — present (excluding displays): Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

time (see also Figure 2.13). Significantly, the 2003 peak in activity occurred during the latter part of 2002/3 (Fig. 5.70■□), a year also with below average rainfall (Fig. 2.13).

5.2 Hirundinidae: Swallows, Martins

Hirundinids are highly specialised passerines that feed on aerial plankton, mainly flying insects but also other airborne invertebrates including spiders (Bryant 1985). The 74 species occur worldwide except in polar regions and most oceanic islands; 22 species occur in southern Africa, including four non-breeding migrants (Hockey *et al.* 2005). Thirteen species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b), with all except the Lesser Striped Swallow *Hirundo abyssinica,* Black Saw-wing *Psalidoprocne holomelaena* (both confined to the far eastern Free State) and Sand Martin *Riparia riparia* (scarce in the Free State) recorded at Glen.

R518 Barn Swallow . . . . *Hirundo rustica*

The Barn Swallow breeds throughout the Holarctic and migrates south to spend the non-breeding season in Africa, South America and southern Asia (Maclean 1985). The birds occurring in South Africa breed as far away as Russia (Rowan 1968). They occur throughout southern Africa where they forage over any habitat, but are more common in the wetter eastern parts of the region than in the drier west (Earlé 1997a; Parker 1999). They are highly gregarious and roost in their thousands or even millions, usually in reedbeds (Maclean 1985). In SABAP1 Zone 7, they occur mainly from October [mid-spring] to April [late autumn] (Earlé 1997a). Some birds rarely overwinter (Earlé 1997a).

The birds at Glen

Distinction was made between birds seen only and birds heard (and seen). The former category was most prevalent, comprising 72.4% of the grassland data-set (Table 5.14a). Figures start on page 662.

Table 5.14: R518 Barn Swallow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.724	3 735	114 612	3.3	birds seen only	46.6	656	306	12
0.276	1 424	114 612	1.2	birds heard	32.5	656	213	7
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.591	13	1 190	1.1	birds seen only	25.6	43	11	1
0.409	9	1 190	0.8	birds heard	7.0	43	3	3
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.864	19	1 188	1.6	birds seen only	23.3	43	10	2
0.136	3	1 188	0.3	birds heard	2.3	43	1	3

Annual occurrence in the grassland of birds seen only: Overall, recorded on 46.6% of the days with an activity index of 12 (Table 5.14a). Usually recorded during 6–7 seasons each year, but during eight seasons in 1997/8 and 2002/3 (Fig. 5.73; Fig. 5.74). The annual frequency indices were comparable for all years (Fig. 5.73). Daily reporting rates ranged from 0.5–48.6% with 88.9% bird-days attaining low reporting rates (Fig. 5.73). Daily reporting rates were particularly high during 2001/2, and although the median daily reporting rates of the two subsequent years were also high their values were more variable (Fig. 5.73). The years 2001/2 and 2002/3 represent the only years with high reporting rate days, while intermediate reporting rate days occurred only since 2001/2 (Fig. 5.73; Fig. 5.74).

Seasonal occurrence in the grassland of birds seen only: Arrival dates was variable and spanned a 99-day period from early spring to early summer (Fig. 5.75). The last birds of the year were mostly recorded at the end of mid-autumn or the beginning of late autumn (median date: 12 April), with a few exceptional records in early and mid-winter (Fig. 5.75). Recorded during 10–11 bird-years from late spring to mid-autumn and 2–5 bird-years during early and mid-spring and late autumn (Fig. 5.73; The winter records in Figure 5.75 refers to vocal records, see below). Intermediate and high reporting rate days were limited to the period from mid-summer to mid-autumn, while days with no records were least frequent during summer and early autumn (Fig. 5.74), corresponding with relatively high median daily reporting rates (Fig. 5.73).

Daily occurrence in the grassland of birds seen only: Overall, activity was slightly more frequent during mid-morning than during other parts of the day, and infrequent before sunrise and after sunset (Fig. 5.73). The mid-morning peak in activity is only applicable to low reporting rate days, while activities on intermediate and high reporting rate days were recorded during all or most segments between sunrise and sunset (Fig. 5.76). However, all the main seasons show a pattern of higher activity during mid-morning, with late summer and autumn additionally also showing a lesser peak in the late afternoon (Fig. 5.77). No bird-segment combination occurred during more than 5% bird-days.

The first activity of the day often occurred between sunrise and mid-morning, earlier on intermediate and high reporting rate days (soon after sunrise) than on low reporting rate days (Fig. 5.77). Seasonally, it occurred earlier during summer and early autumn than during late spring in particular (Fig. 5.77).

The last activity of the day usually occurred in the afternoon, later on intermediate and high reporting rate days (shortly before sunset) than on low reporting rate days (Fig. 5.77). The timing was least variable during late summer when it occurred mostly in the late afternoon, and it become earlier at the beginning and towards the end of the birds' stay (Fig. 5.77).

Overall, daily segment reporting rates ranged from 5.6 to 92.9% with 83.1% of the bird-segments attaining relatively low values (Fig. 5.73). Apart from the relatively low values for S0, median daily segment reporting rates were similar for all other segments (Fig. 5.73). This pattern mostly represents low reporting rate days, because median daily segment reporting rates on intermediate reporting rate days tended to be higher during the early morning and in the late afternoon (Fig. 5.76).

Early morning occurrence during 2007/8 of birds seen only: Activity was similar in the drainage line and in the grassland (Table 5.14b & c; Fig. 5.78).

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Annual occurrence of birds heard in the grassland: Overall, recorded on 32.5% of the days with an activity index of seven (Table 5.14a). Six years showed seven bird-seasons while the rest included only 4–6 (Fig. 5.79; Fig. 5.80). Daily reporting rates ranged from 0.5 to 25.0% with 84.5% bird-days attaining low reporting rates (Fig. 5.79). The median daily reporting rate of 2001/3 was particularly high, and together with 2004/5 the only years with high reporting rate days (Fig. 5.79; Fig. 5.80).

Seasonal occurrence of birds heard in the grassland: Recorded during all seasons except late winter, but was infrequent during spring and winter (Fig. 5.79). Recorded during almost all years in summer and early and mid-autumn (Fig. 5.79), coinciding with the least frequent occurrence of zero record days during these seasons (Fig. 5.80). Daily reporting rates were generally higher during early and particularly mid-autumn than during other seasons, with the few high reporting rate days also limited to these two seasons (Fig. 5.79; Fig. 5.80).

Daily occurrence of birds heard in the grassland: Overall, activity occurred slightly more frequently between sunrise and mid-morning than at other times, and was particularly infrequent before sunrise and after sunset (Fig. 5.79). This pattern is generally more obvious for low reporting rate days than for intermediate or high reporting rate days (Fig. 5.81). The patterns during the main seasons all showed a similar trend (Fig. 5.82). Bird-segment combinations occurring during more than 5% bird-days were limited to single bird-segments S2 and S3, which collectively accounted for 11.7% bird-days (Fig. 5.83).

The first activity of the day usually occurred in the morning, and tended to occur earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.82). Seasonally the time of first activity was frequently earlier in the morning during mid-autumn than during other seasons (Fig. 5.82).

The occurrence of the last activity of the day was variable on low reporting rate days, but on intermediate and high reporting rate days it was largely restricted to the late afternoon (Fig. 5.82). Seasonally the timing was variable, but it did tend to occur later in the day during early and mid-autumn than during other seasons (Fig. 5.82).

Overall, daily segment reporting rates ranged from 5.9 to 91.7% with 90.6% of the values relatively low (Fig. 5.79). Values were generally similar for most segments except S0 and S13, which had relatively low daily segment reporting rates (Fig. 5.79). There is a trend, however, for slightly higher values during S2/S3/S4 on intermediate and high reporting rate days (Fig. 5.81).

Early morning occurrence of birds heard during 2007/8: Activity was exceptional in both the drainage line and the grassland (Table 5.14b & c).

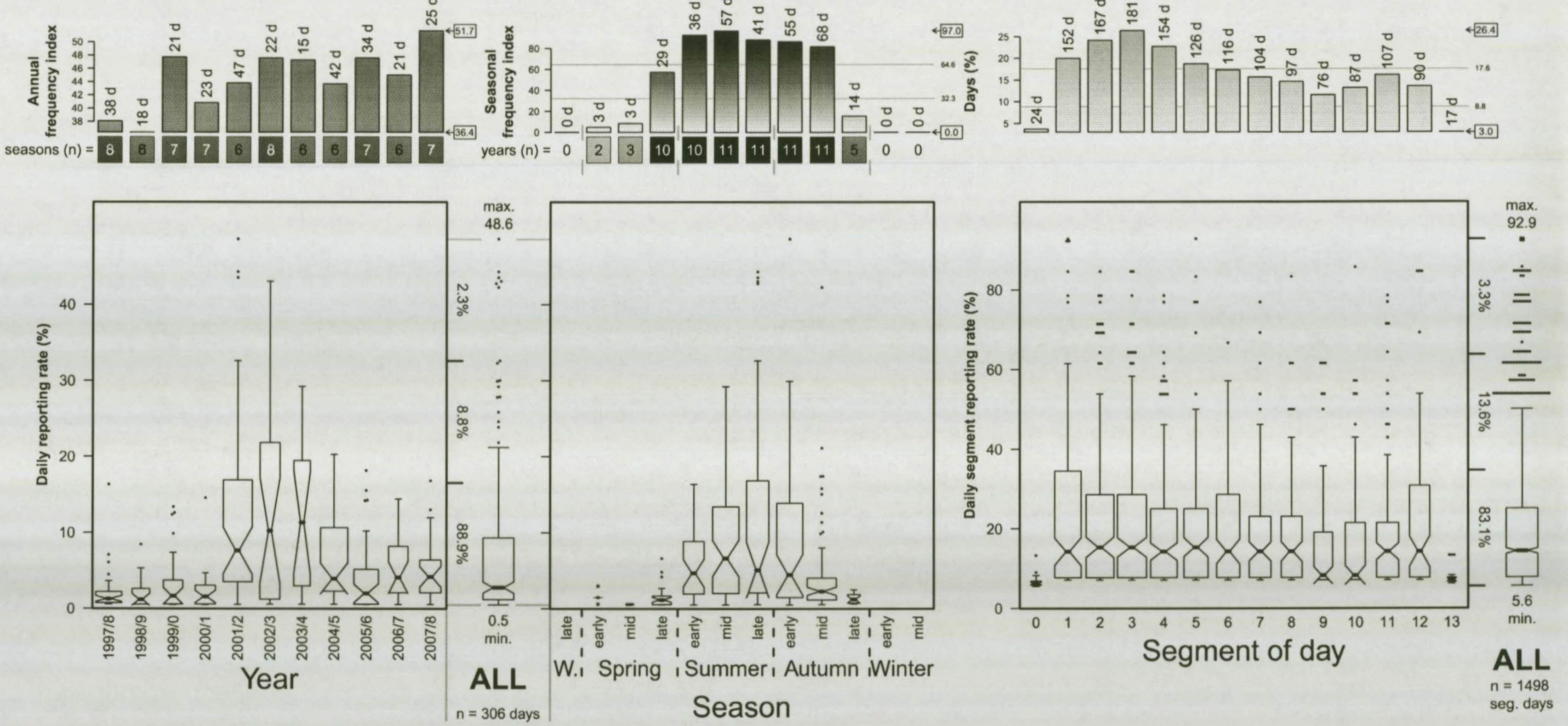


Figure 5.73: R518 Barn Swallow — birds seen only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

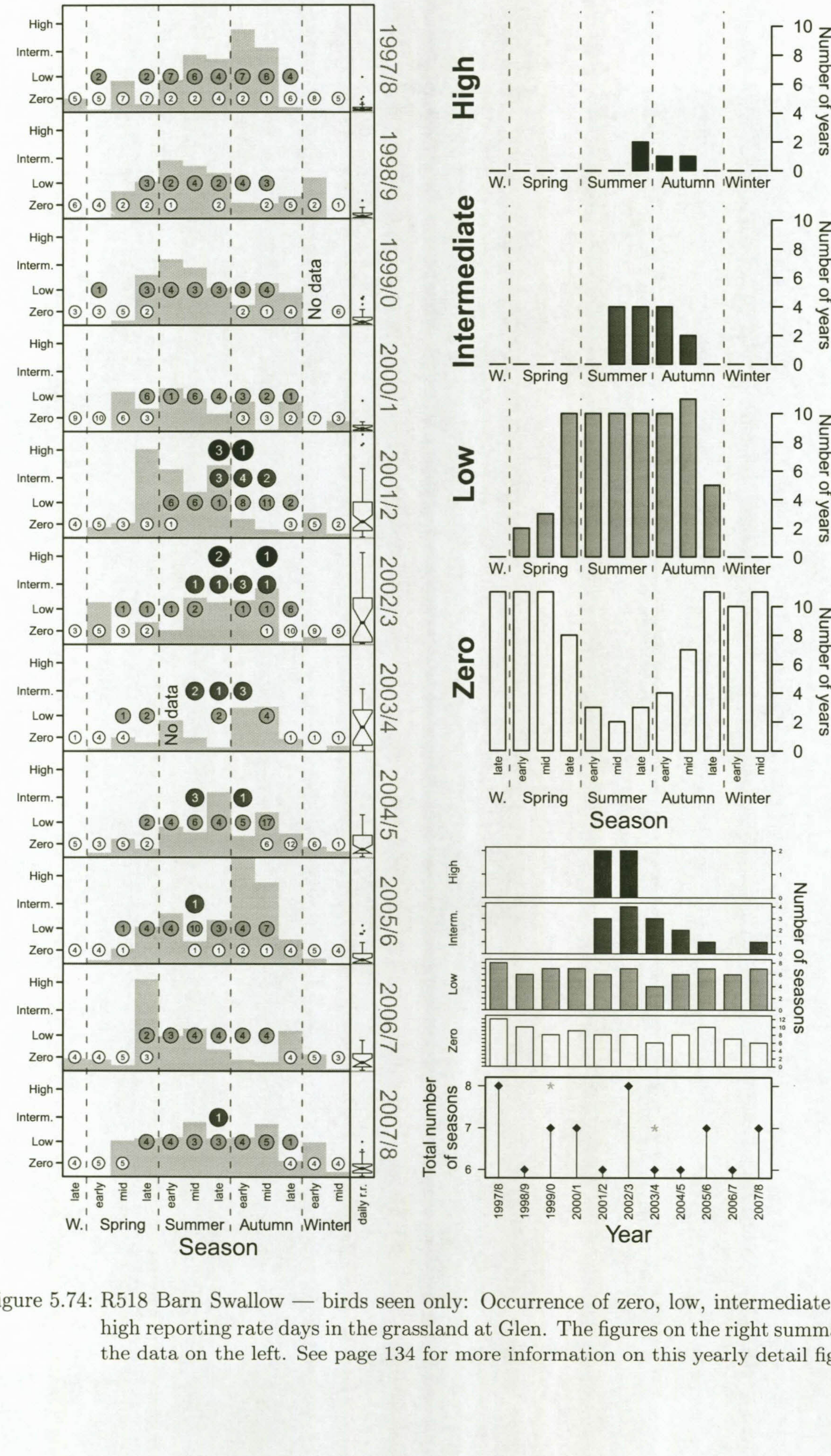


Figure 5.74: R518 Barn Swallow — birds seen only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

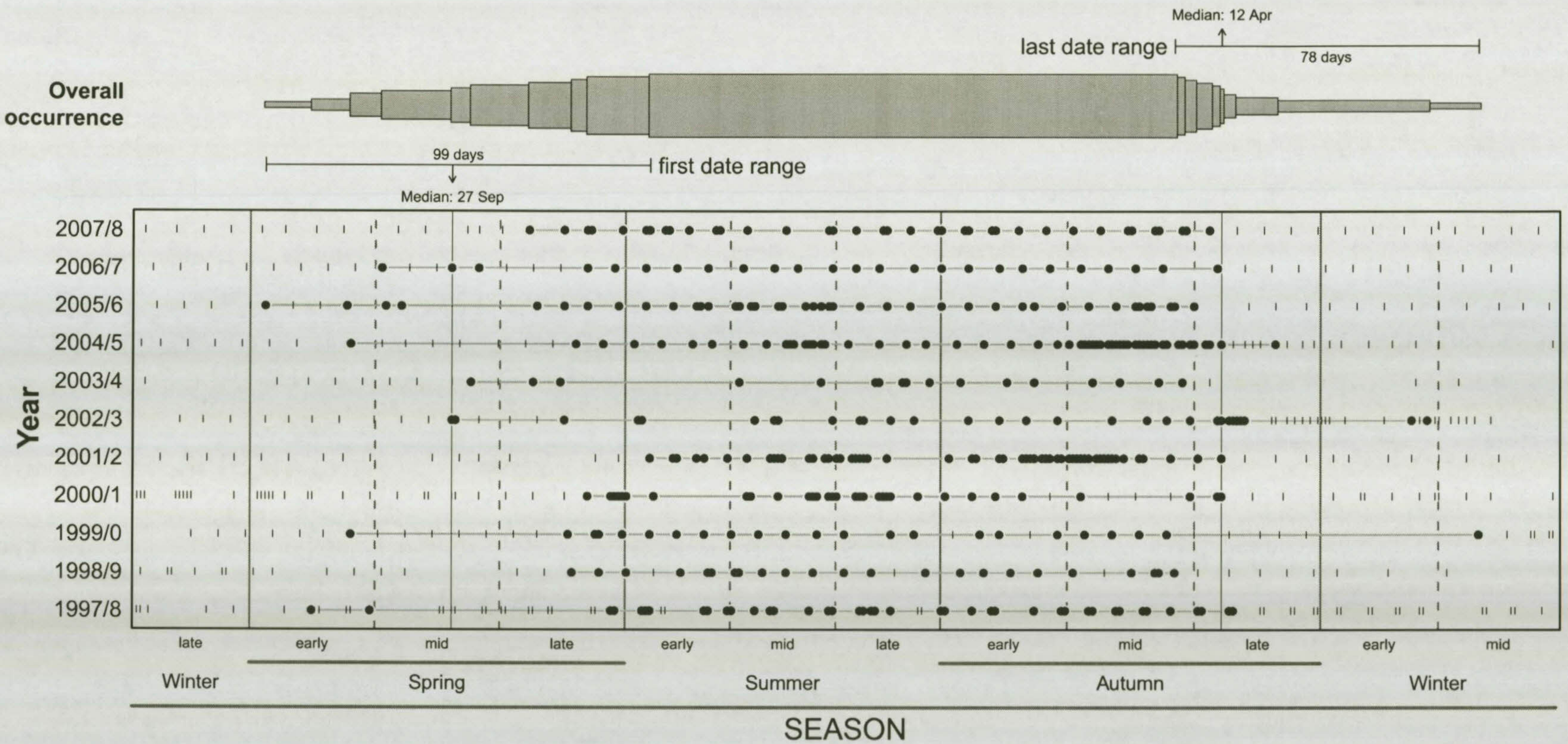


Figure 5.75: R518 Barn Swallow: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

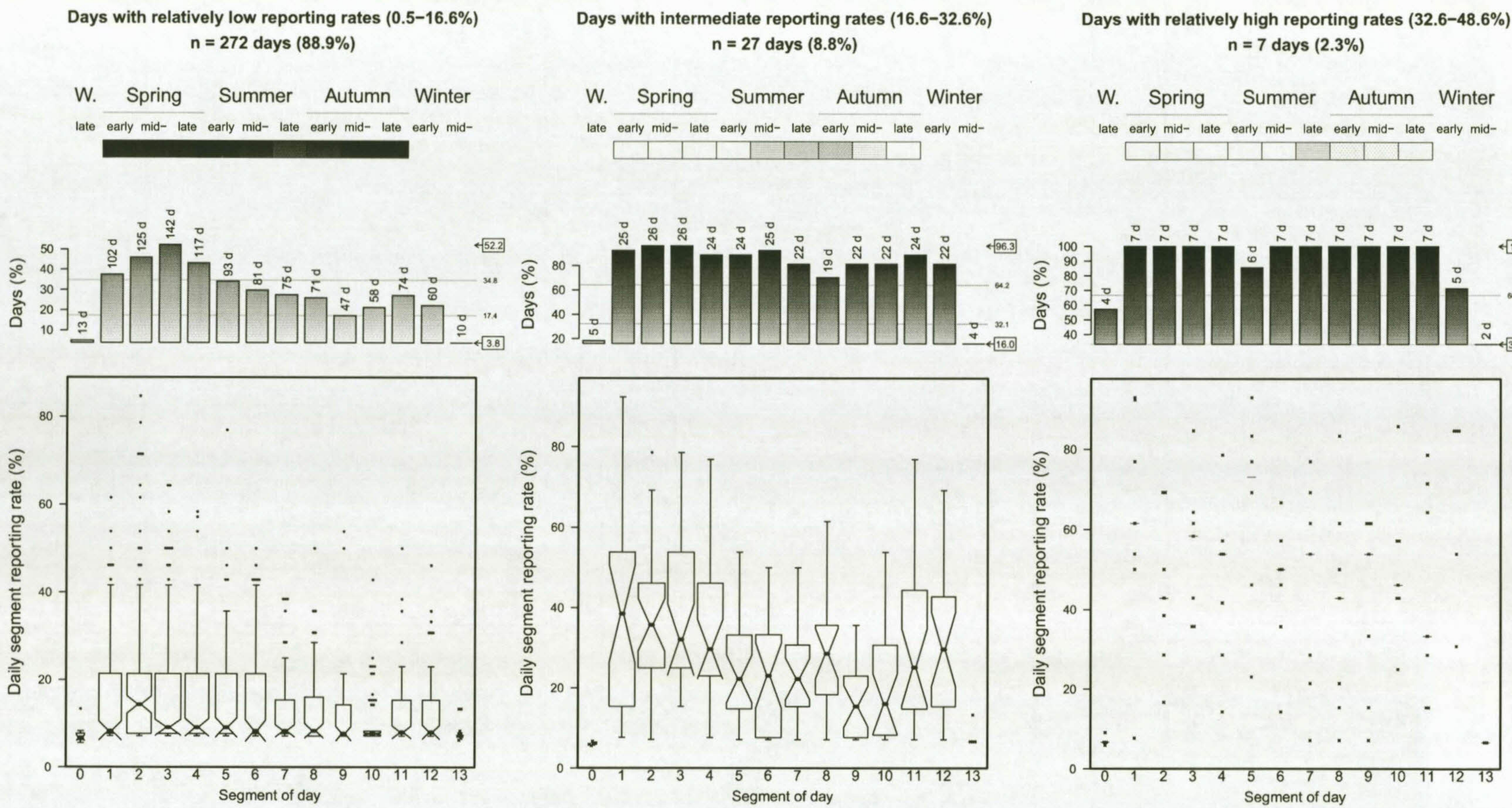


Figure 5.76: R518 Barn Swallow — birds seen only: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

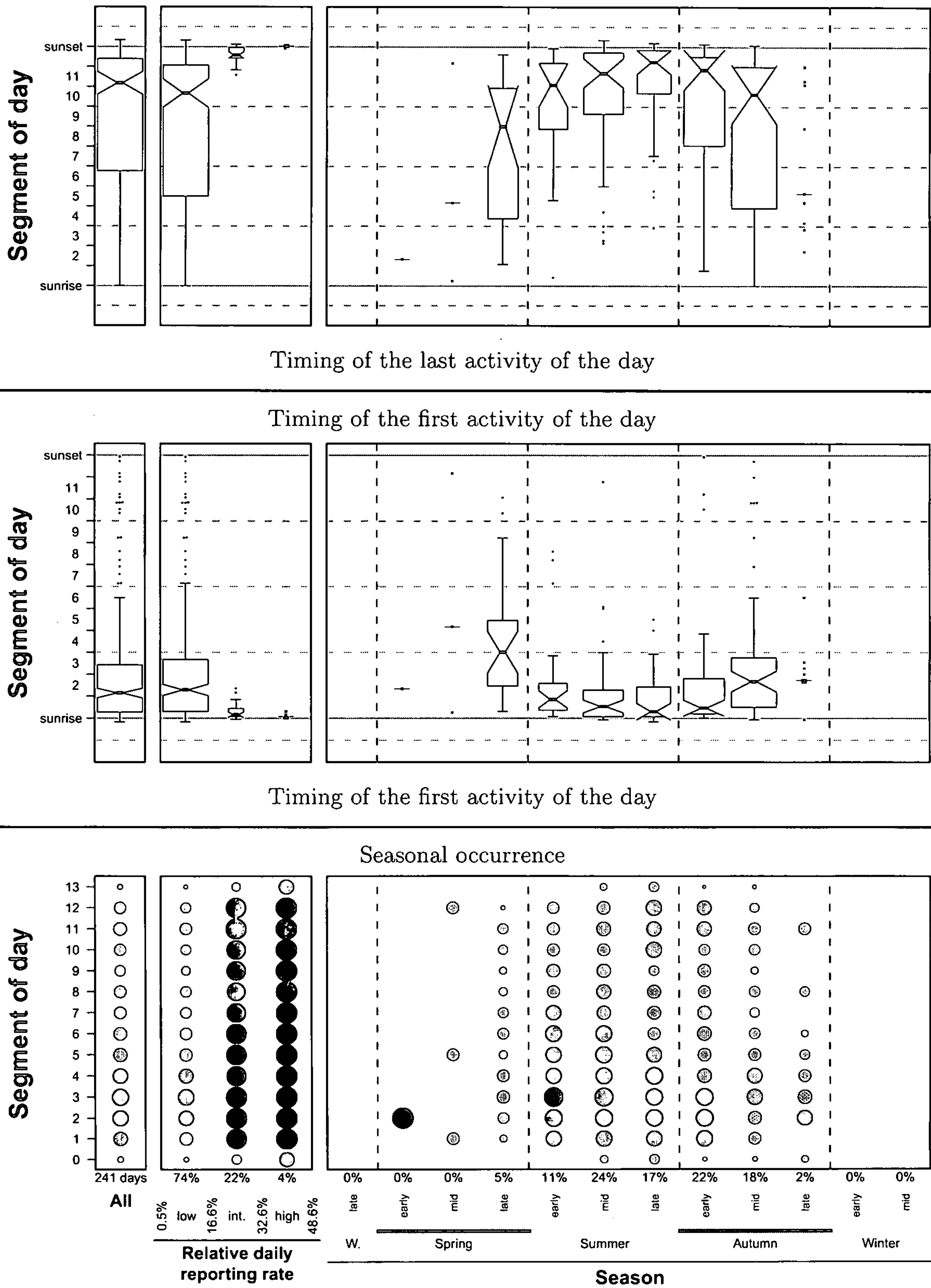


Figure 5.77: R518 Barn Swallow — birds seen only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

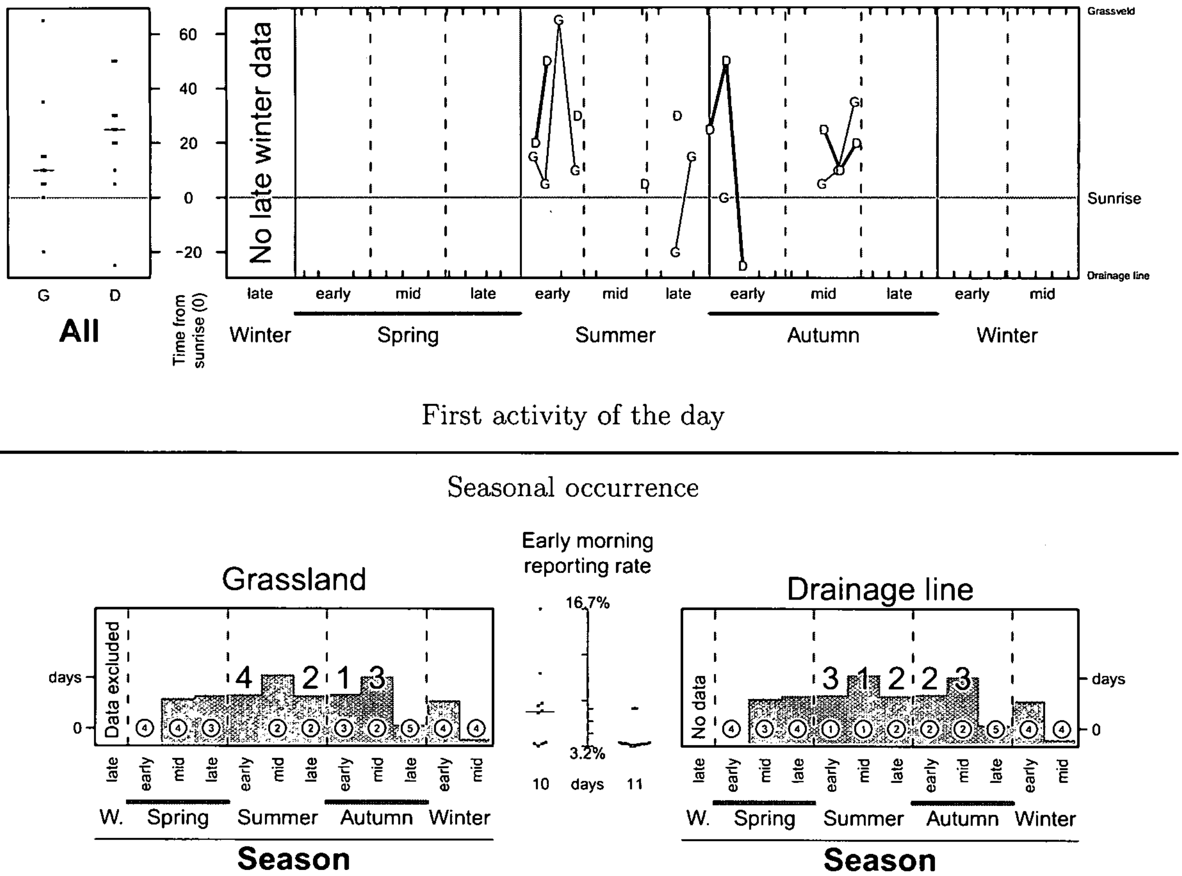


Figure 5.78: R518 Barn Swallow — birds seen only: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Top: Occurrence of the first activity of the day. See page 136 for more information on this early morning figure.

Discussion

The narrow window during which the last Barn Swallows were recorded towards the beginning of late autumn in most years (Fig. 5.75) indicates that the timing of migration is determined to a large degree by circannual rhythms. Both the timing and amount of rainfall probably also affected the Barn Swallow's occurrence and activity at Glen. The relatively high level of activity during 2001/2 (Fig 5.73; Fig. 5.79), as well as the relatively late arrival of the birds (Fig. 5.75), coincided with above average rainfall (Fig. 2.13). Yet similar increases in activity were not seen in other high rainfall years, *i.e.* 1997/8, 2005/6 and 2007/8 (Fig. 2.13; Fig 5.73; Fig. 5.79). Examination of the seasonal occurrence of rainfall during these years (Fig. 2.16) shows that the rainfall pattern of 2001/2 was unique, with relatively high rainfall occurring from late spring through summer compared to the other high rainfall years when most rain occurred either later in the year (1997/8 and 2005/6) or at relatively median and constant levels for a prolonged period (2007/8). Thus, it appears that good rains early in the year when the swallows arrive are important. 2006/7 also experienced good rains during late spring, but this was not accompanied with an increase in activity (Fig 5.73; Fig. 5.79), probably because there was

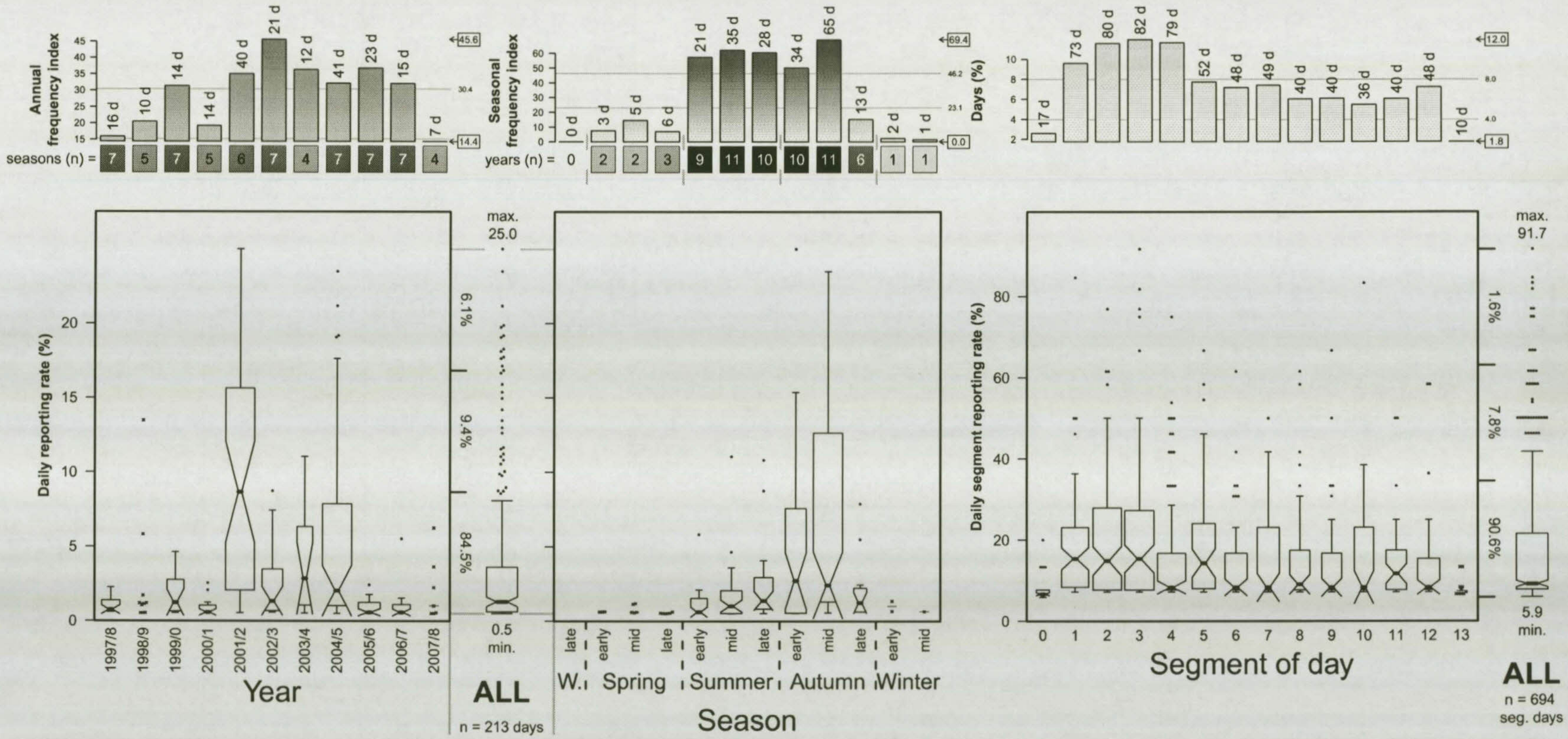


Figure 5.79: R518 Barn Swallow — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

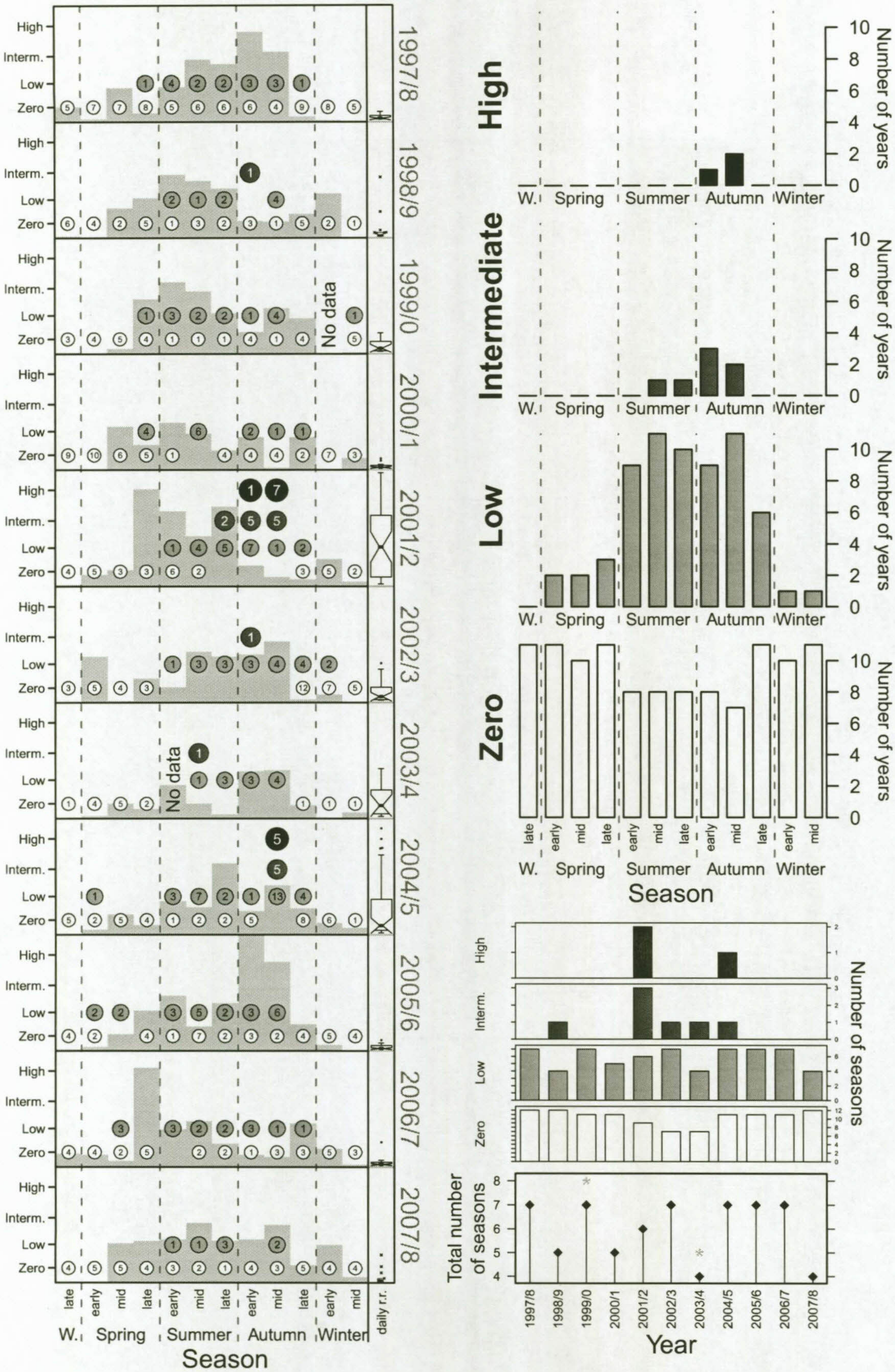


Figure 5.80: R518 Barn Swallow — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

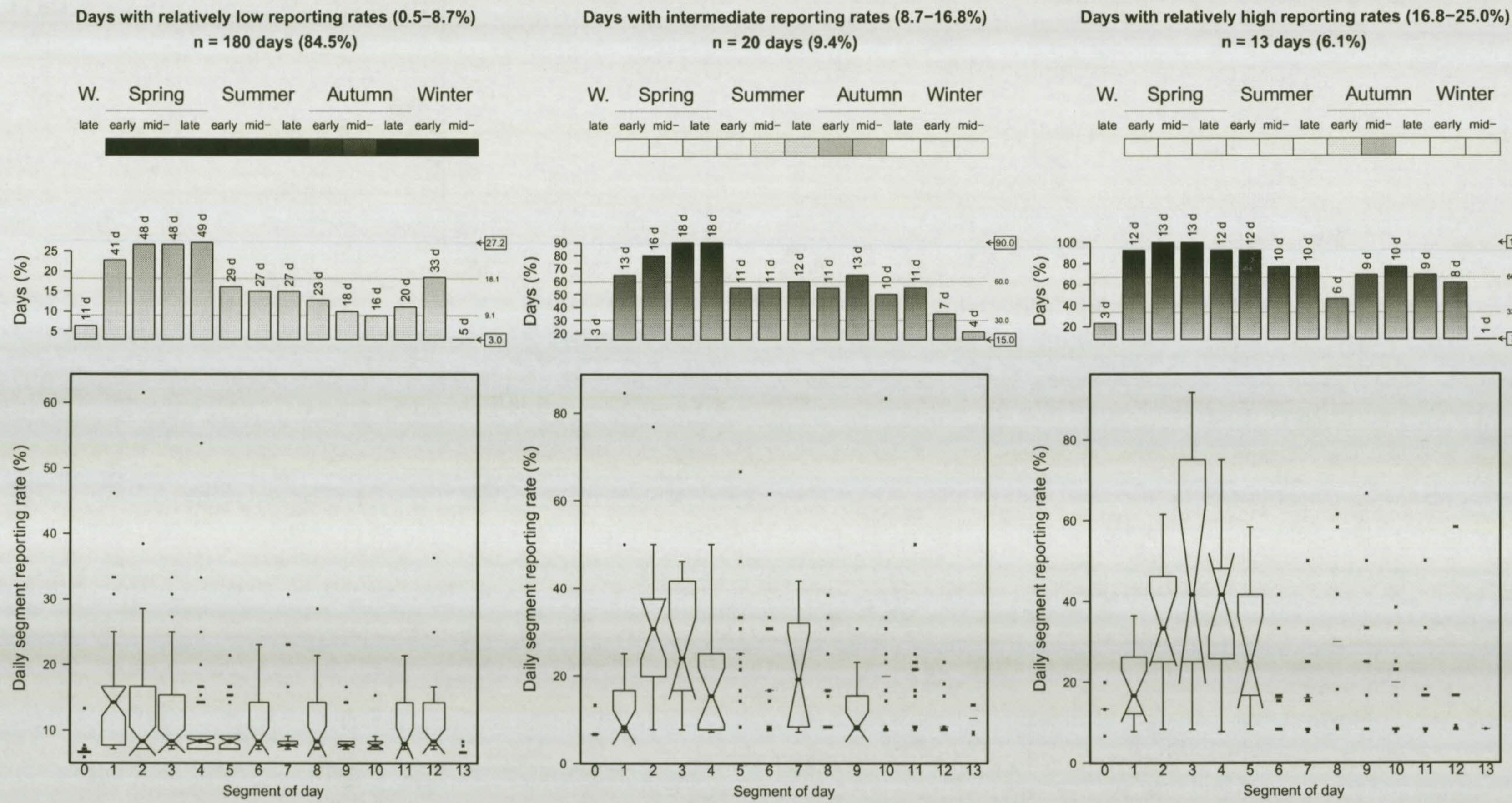


Figure 5.81: R518 Barn Swallow — birds heard: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

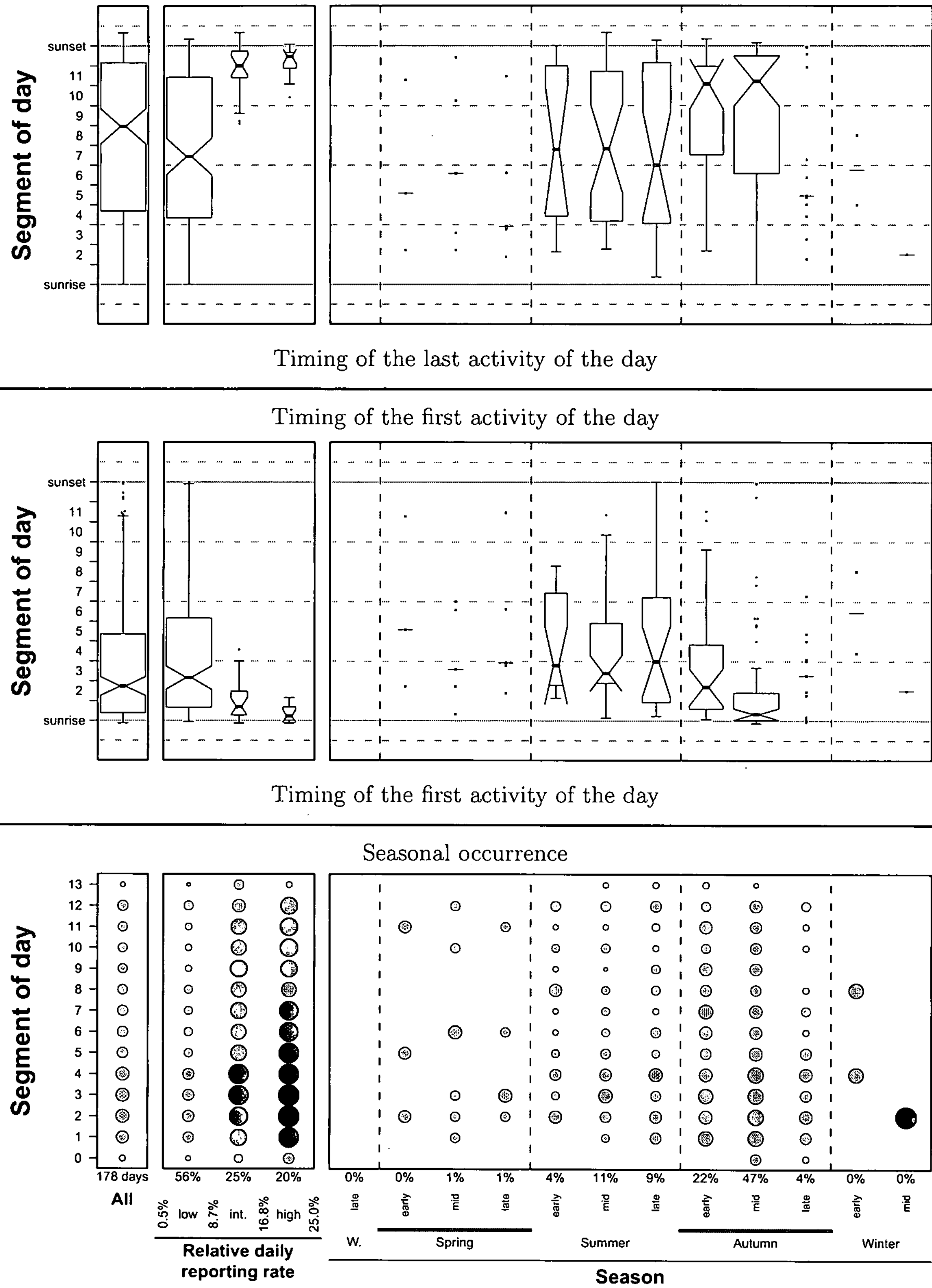


Figure 5.82: R518 Barn Swallow — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

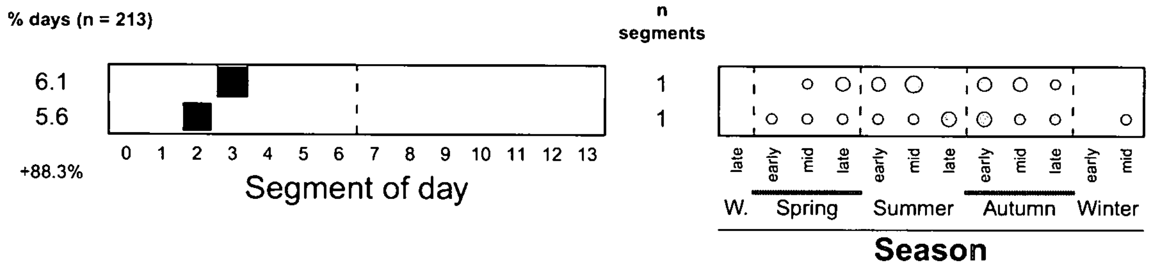


Figure 5.83: R518 Barn Swallow — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

no good follow-up rains during summer in that year (Fig. 2.16; Fig. 2.18).

R520 White-throated Swallow .... *Hirundo albigularis*

The White-throated Swallow is an intra-African migrant endemic to Africa south of the equator (Earlé 1997b). Most birds breed in South Africa, the remainder breeding in Namibia, Botswana and Zimbabwe (Earlé 1997b; Penry 1994); Absent from southern Mozambique (Parker 1999). It occurs in a variety of habitats, usually near water and often around man-made structures (Maclean 1985). They reach their breeding grounds in August or September [early to mid-spring] and depart again in April [late autumn], with few birds overwintering (Earlé 1997b).

The birds at Glen

White-throated Swallows were recorded as birds seen and/or heard as they foraged over the grassland and often associated with the zinc dam. Recently fledged birds are regularly found at the zinc dam where they wait on their parents to feed them — the birds must be breeding close to the study area. Figures start on page 674.

Annual occurrence of birds in the grassland: Overall, recorded on 47.9% of the days with an activity index of three (Table 5.15a). Recorded during nine seasons in six years and during 6–8 seasons in other years (Fig. 5.84; Fig. 5.85). Daily reporting rates ranged from 0.5 to 19.3% with 97.1% bird-days attaining low reporting rates and median daily reporting rates were similar for all years (Fig. 5.84).

Seasonal occurrence of birds in the grassland: A 23-day period in early spring (median date: 22 August) marked the arrival of the birds (Fig. 5.86). The last birds were usually recorded around the border of mid- and late autumn (median date: 9 April), but until the end of late autumn in 2001/2 and 2007/8 (Fig. 5.86). They were thus recorded during spring, summer and autumn (Fig. 5.84). Median daily reporting rates were similar for the respective seasons (Fig. 5.84), with the few intermediate and high reporting rate days limited to late summer and autumn (Fig. 5.85).

Table 5.15: R520 White-throated Swallow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	968	114 612	0.8	birds present	47.9	656	314	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	7	1 190	0.6	birds present	9.3	43	4	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	16	1 188	1.3	birds present	23.3	43	10	2

Daily occurrence of birds in the grassland: Activity occurred most frequently around mid-morning, with a secondary peak in the late afternoon before sunset (Fig. 5.84). Summer and autumn show a similar pattern (Fig. 5.88). Bird-segment combinations occurring during more than 5% bird-days were limited to single bird-segments S2, S3 and S4, which collectively accounted for 16.9% bird-days (Fig. 5.89).

The first activity of the day usually occurred in the morning, with the medians of seasons usually before mid-morning (Fig 5.88). The occurrence of the last activity of the day was variable (Fig. 5.88).

Overall, daily segment reporting rates ranged from 5.9 to 83.3% with 96.9% of the values relatively low (Fig. 5.84). Median daily segment reporting rates were similar for all segments (Fig. 5.84).

Early morning occurrence of birds during 2007/8: Activity was less frequent in the drainage line, occurring during only four mornings compared to the ten of the grassland (Table 5.15b & c).

Discussion

The narrow window of arrival of White-throated Swallows during early spring, as well as their departure towards the end of mid-autumn in most years (Fig. 5.86), indicate that the timing of migration in this species is fairly tightly controlled by changes in day-length. However, it is possible that the good rains of 2001/2 and 2007/8 (Fig. 2.13; Fig. 2.16) contributed to their late departure during these two years (Fig. 5.86).

R523 Pearl-breasted Swallow .... *Hirundo dimidiata*

The Pearl-breasted Swallow is endemic to Africa south of the equator (Earlé 1997c). In southern Africa it is concentrated in five areas including South Africa south of 32°S and north of 26°S, north-eastern Zimbabwe, northern Botswana and central Namibia (Earlé 1997c). It is a breeding visitor to the southern areas (including the Free State) during the warmer parts of the year (Earlé 1997c). At least some birds recorded in the Free State and adjacent Northern Cape are

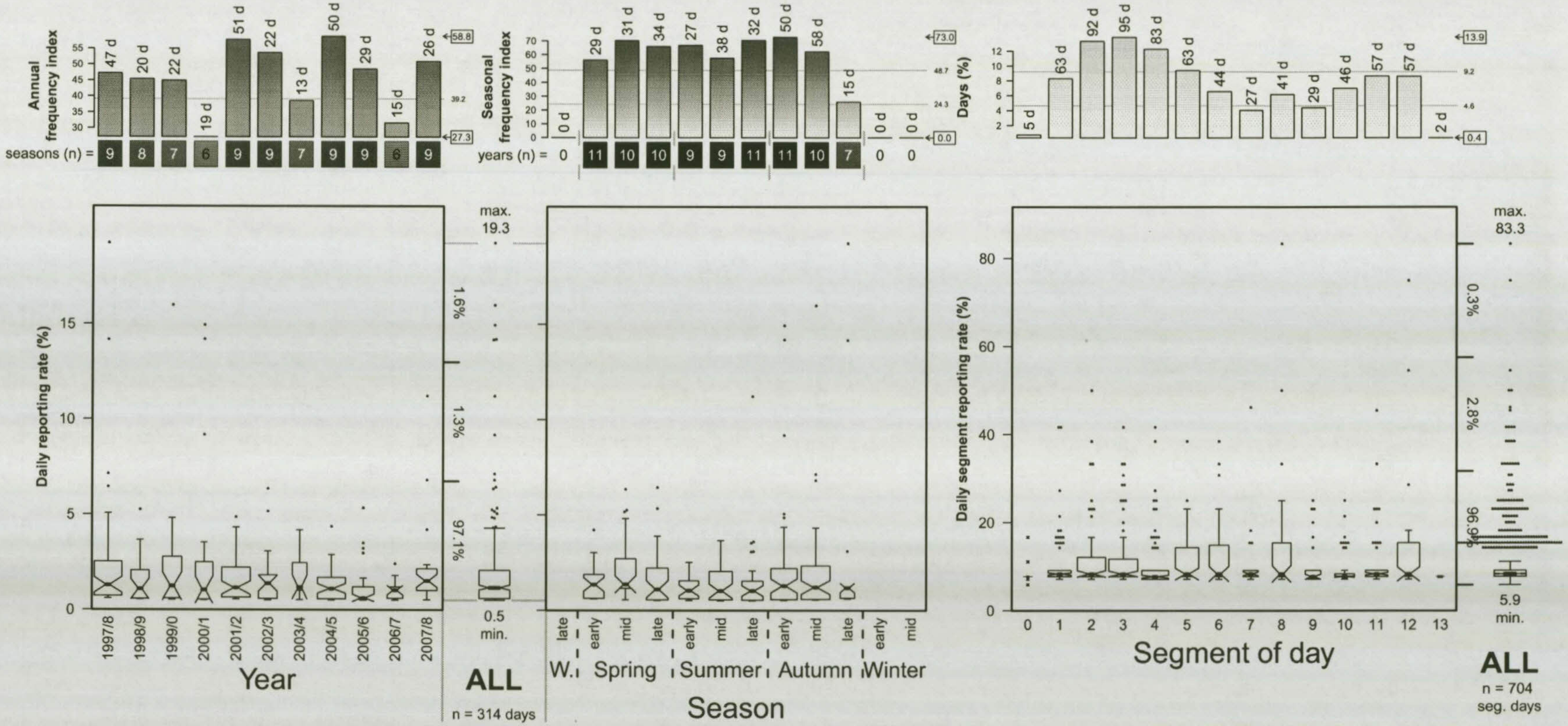


Figure 5.84: R520 White-throated Swallow — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

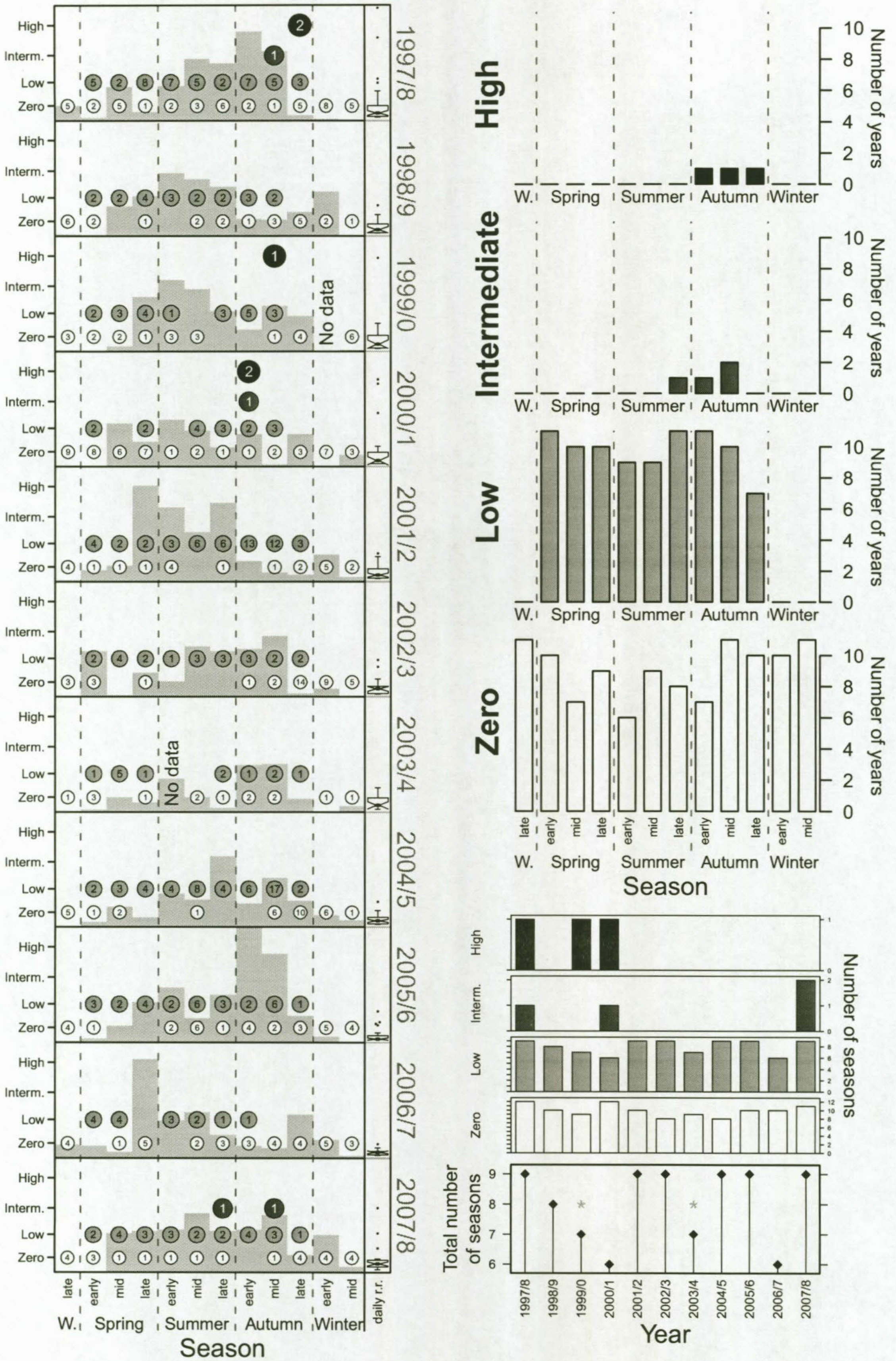


Figure 5.85: R520 White-throated Swallow — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

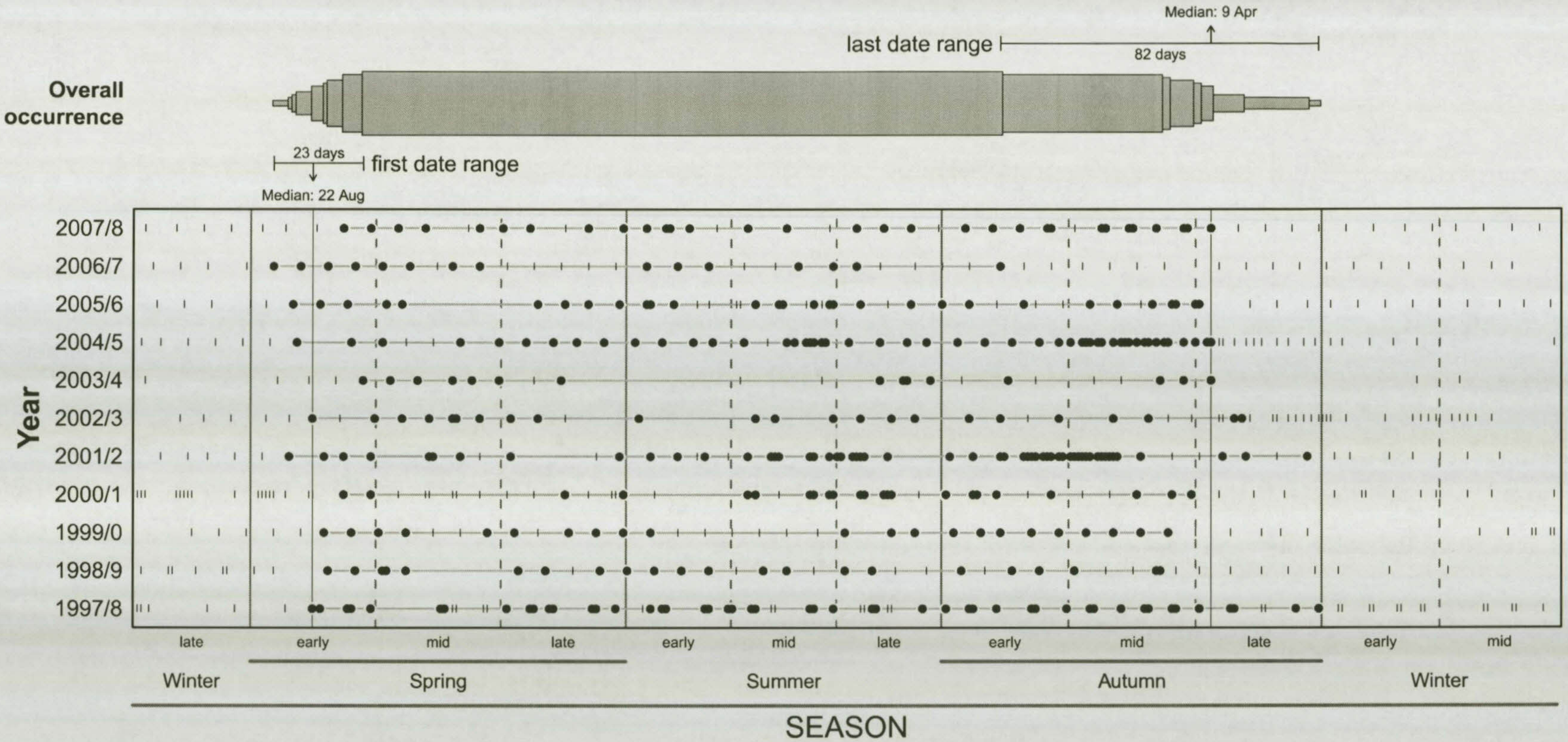


Figure 5.86: R520 White-throated Swallow: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

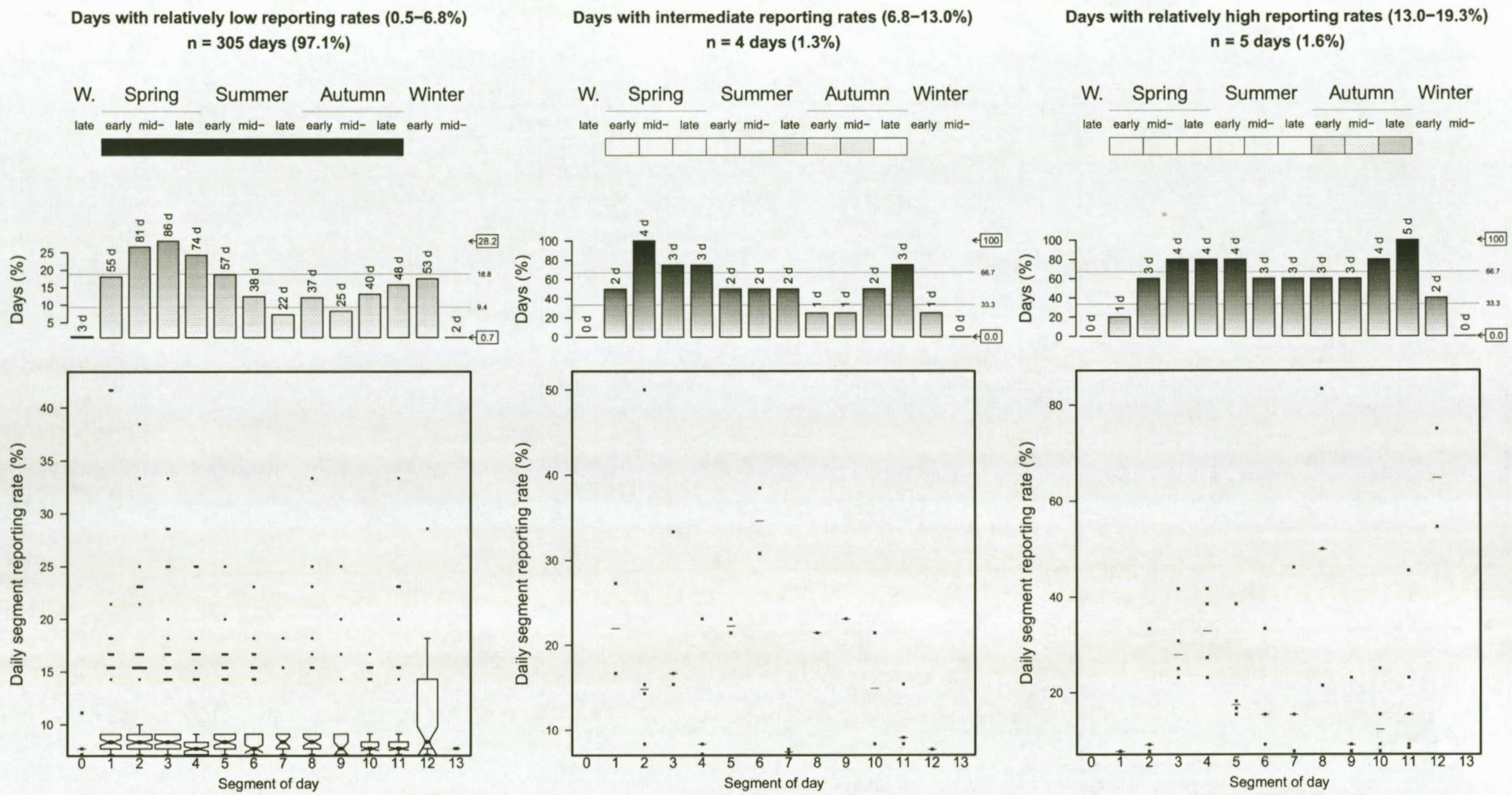


Figure 5.87: R520 White-throated Swallow — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

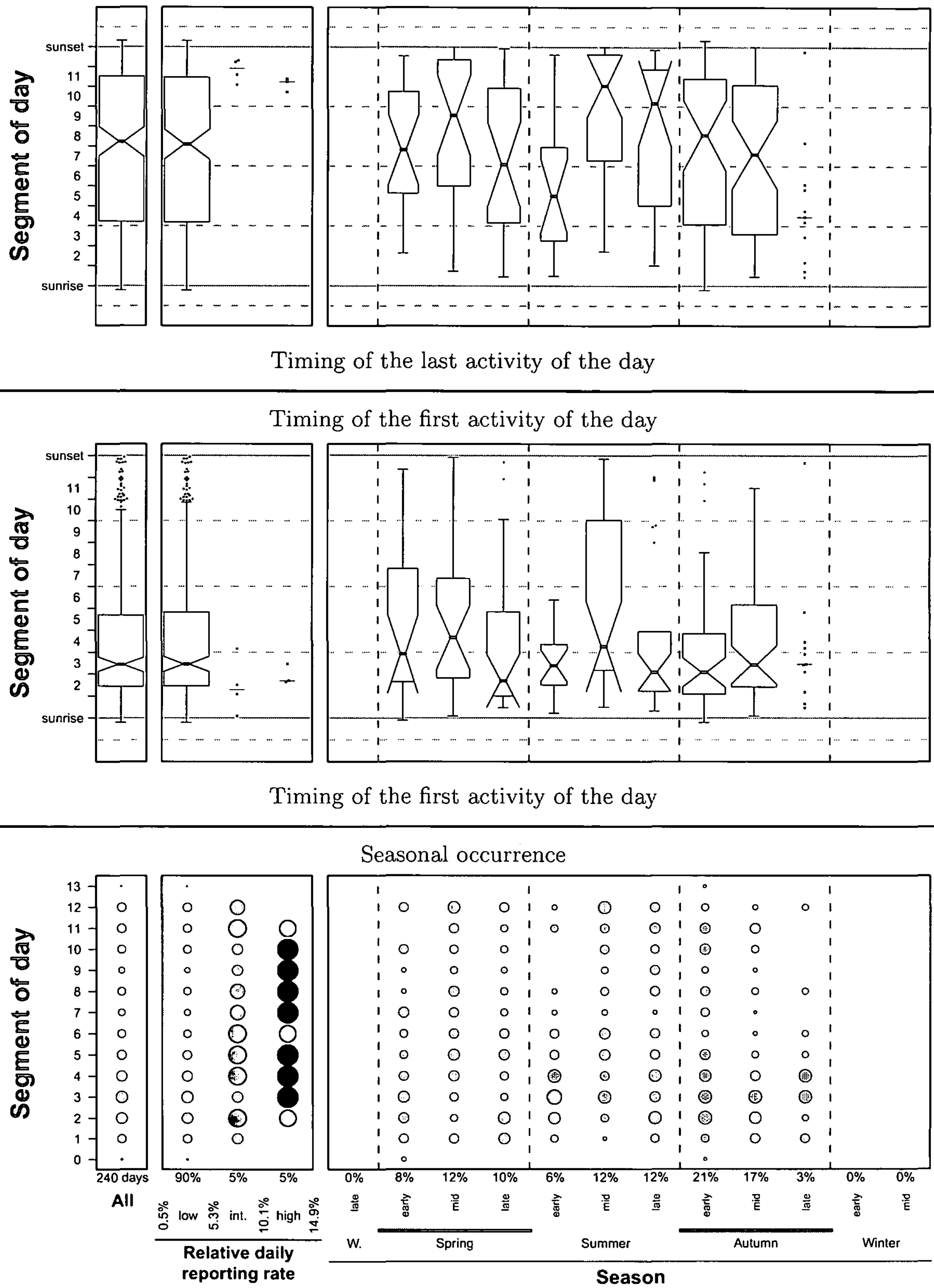


Figure 5.88: R520 White-throated Swallow — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

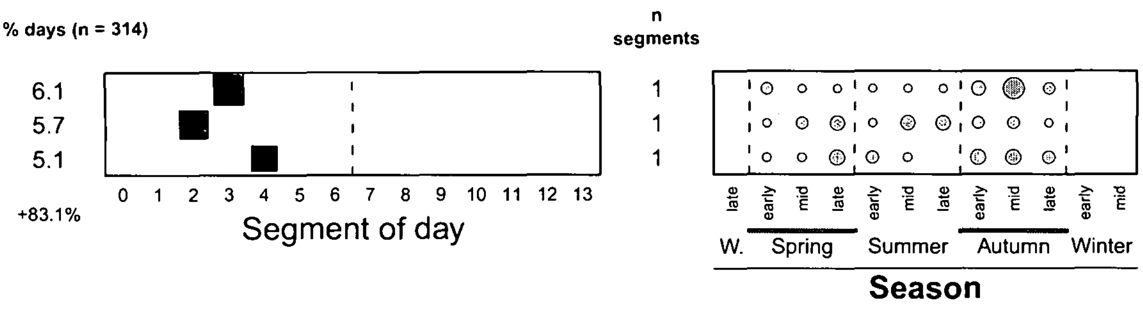


Figure 5.89: R520 White-throated Swallow — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

thought to represent southern birds on passage (Earlé 1997c), but breeding was recorded in the Hoopstad district (Earlé & Grobler 1987). It utilises a variety of habitats (Earlé 1997c).

The birds at Glen

When recorded in the grassland, the Pearl-breasted Swallow (singles or pairs) was often associated with cattle. The association with domesticated animals, including cattle and horses, has been noted before (Dean & MacDonald 1981; Spottiswoode 2005a). However, there appears to be no record of these birds in association with wildlife. They were seen to associate with African Buffalo *Syncerus caffer* during late spring 2007/8 in Mokala National Park, Northern Cape (DJvN personal observation).

A pair roosted regularly in the drainage line during 2007/8. A pair with three recently fledged young was found in the trampled area at the beginning of late summer 2006/7. Given a combined incubation and fledgling period of approximately 40 days (Spottiswoode 2005a; Tarboton 2001), it follows that egg-laying must have been during early summer.

Birds in the grassland: Recorded on 31 days spread over eight years; most frequently encountered during 1997/8 and 2007/8 (Fig. 5.90). Found between early spring and mid-autumn with most records during the beginning and end of that period (Fig. 5.90). Basically recorded throughout the day with peaks in the early morning after sunrise, at midday and in the late afternoon (Fig. 5.90).

Early morning occurrence of birds during 2007/8: Activity was most frequent in the drainage line where a pair (presumably the same birds) was evidently roosting. Recorded on 17 (39.5%) mornings in the drainage line compared to only two mornings in the grassland (Fig. 5.91). The latter two mornings occurred in early and mid autumn, which was similar to the occurrence of high reporting rate mornings in the drainage line that occurred during late summer and early autumn (Fig. 5.91). Except for two mornings when the first activity of the day occurred shortly after sunrise, it otherwise occurred before sunrise in the drainage line (Fig. 5.91). The first mentioned mornings occurred during low reporting rate mornings (Fig. 5.91).

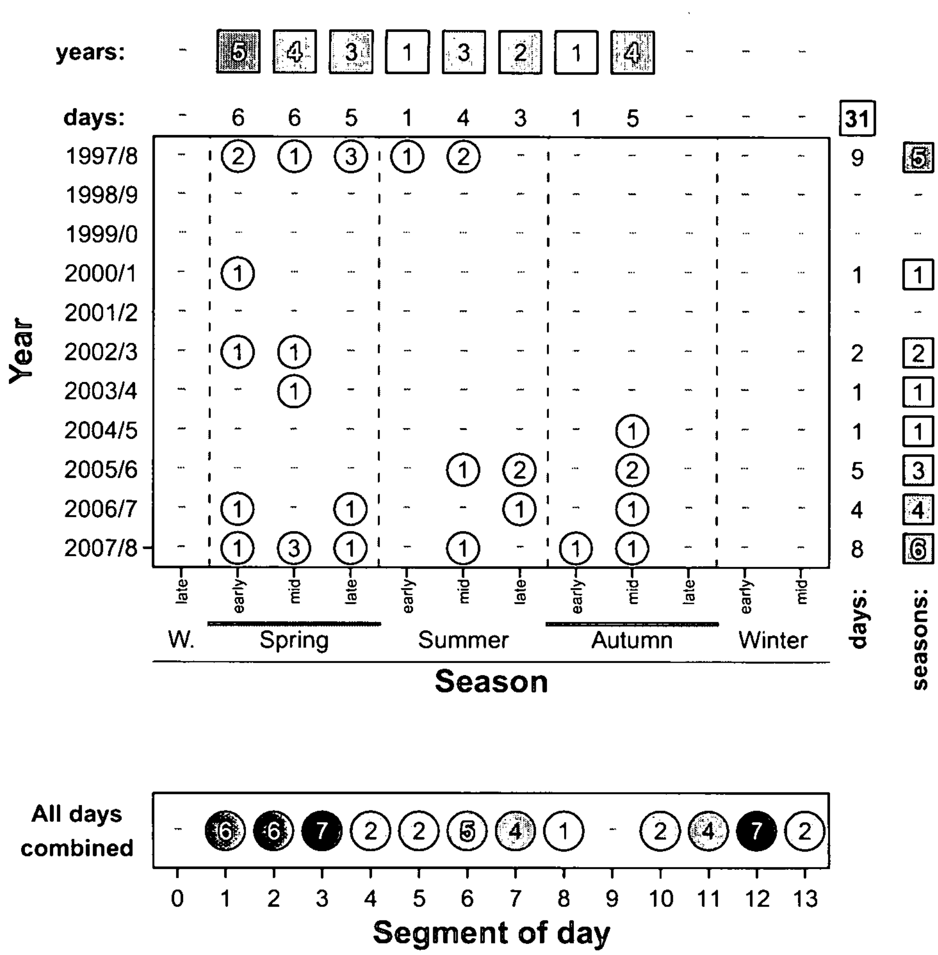


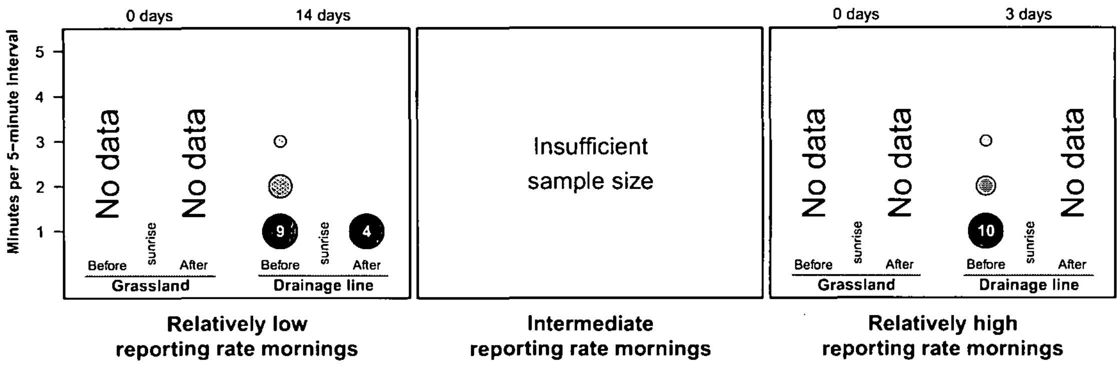
Figure 5.90: R523 Pearl-breasted Swallow — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Discussion

The relatively common occurrence of the Pearl-breasted Swallow during spring and mid-autumn at Glen (Fig. 5.90) supports the idea put forward by Earlé (1997c) that records in the Free State partially represent southern birds on passage. However, the birds are evidently also breeding in the Free State (Earlé & Grobler 1987; This study).

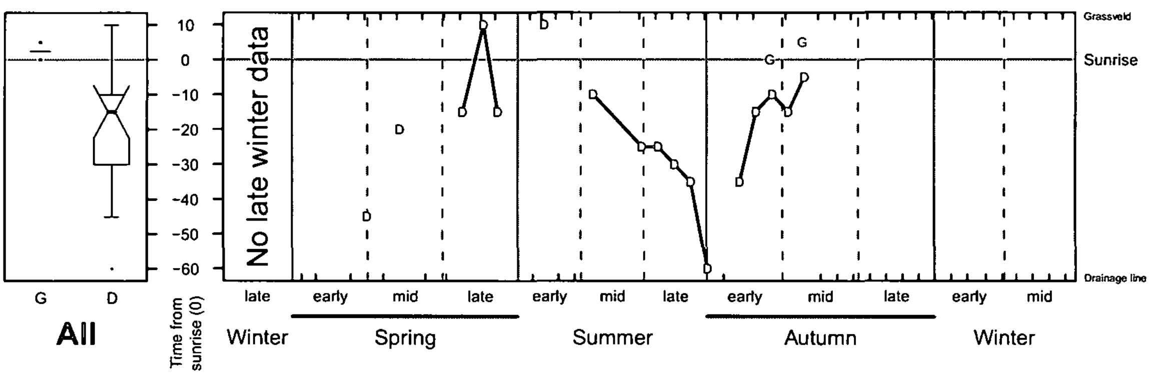
R524 Red-breasted Swallow .... *Hirundo semirufa*

The Red-breasted Swallow is endemic to sub-Saharan Africa (Maclean 1985). Two sub-species are recognised with the nominate breeding south of the equator and *H. s. gordoni* breeding in western and central Africa (Earlé & Brooke 1989). In southern Africa, they occur as breeding intra-African migrants, mainly in Zimbabwe, Swaziland and South Africa where the Free State represents the southern limit of their main range (Earlé 1997d). In SAPAP1 Zone 7, most birds arrive in September [early spring] and depart in March [mid-autumn] (Earlé 1997d). It occurs in open savanna and grassland with the availability of suitable nesting sites — including man-made structures such as culverts — probably dictating its abundance in many regions (Earlé &



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

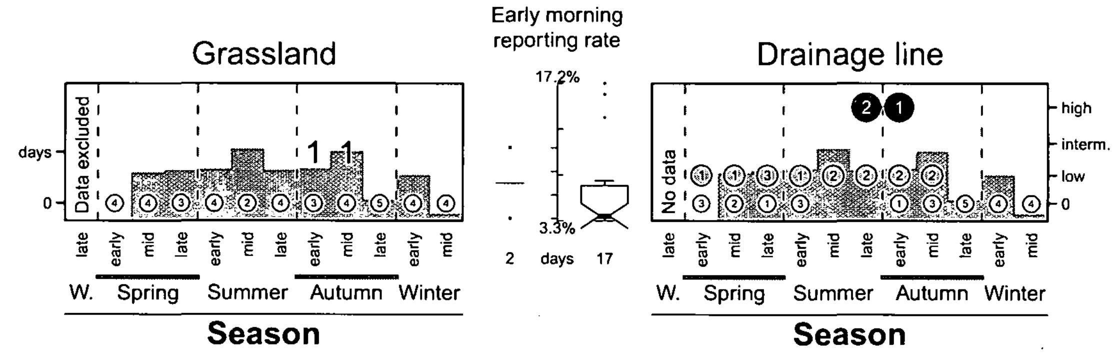


Figure 5.91: R523 Pearl-breasted Swallow — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Brooke 1989).

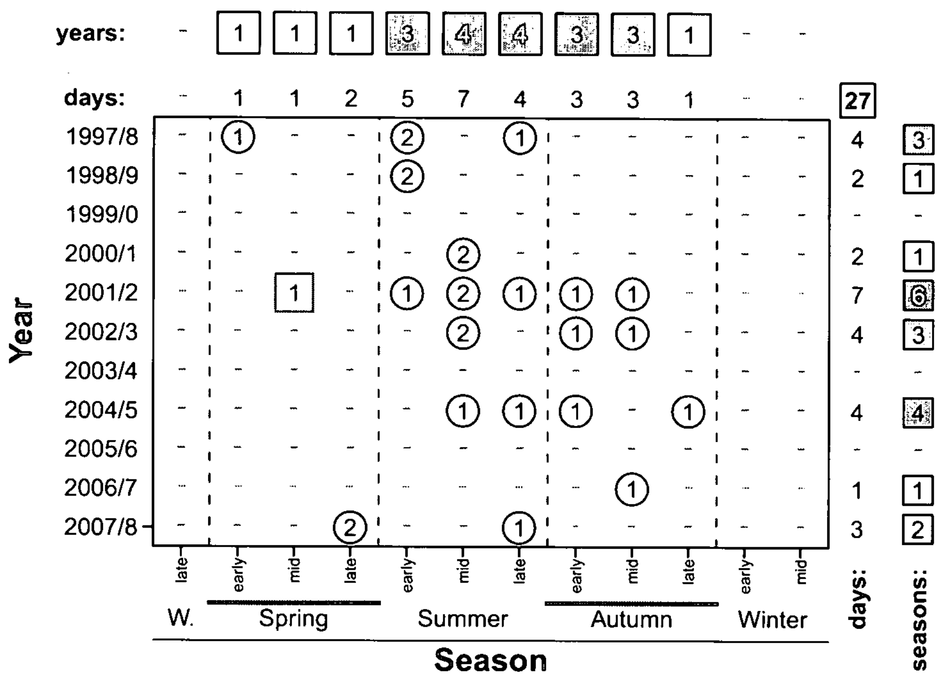
The birds at Glen

Red-breasted Swallows were mostly recorded as birds in flight with records limited to the grassland (not recorded during the early mornings of 2007/8 in the grassland or drainage line).

Recorded on 27 days spread over eight years, usually during 1–4 seasons per year but during six seasons in 2001/2 (Fig. 5.92). Recorded during spring, summer and autumn, most frequently (n = 3–4 bird-years) during summer, early and mid-autumn (Fig. 5.92). The timing of the first and last records varied from year to year (Fig. 5.93). Records are limited to the time from sunrise until mid-morning, and the late afternoon (Fig. 5.92).

Discussion

The peak in occurrence of Red-breasted Swallows during 2001/2 is probably linked to the good rains during that year and the fact that it came on the right time (late spring to late summer). See discussion on the Barn Swallow R518 on page 667 for more information in this regard.



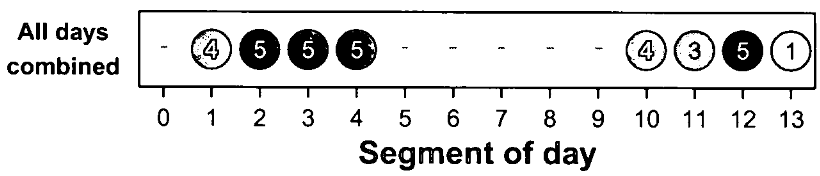


Figure 5.92: R524 Red-breasted Swallow — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

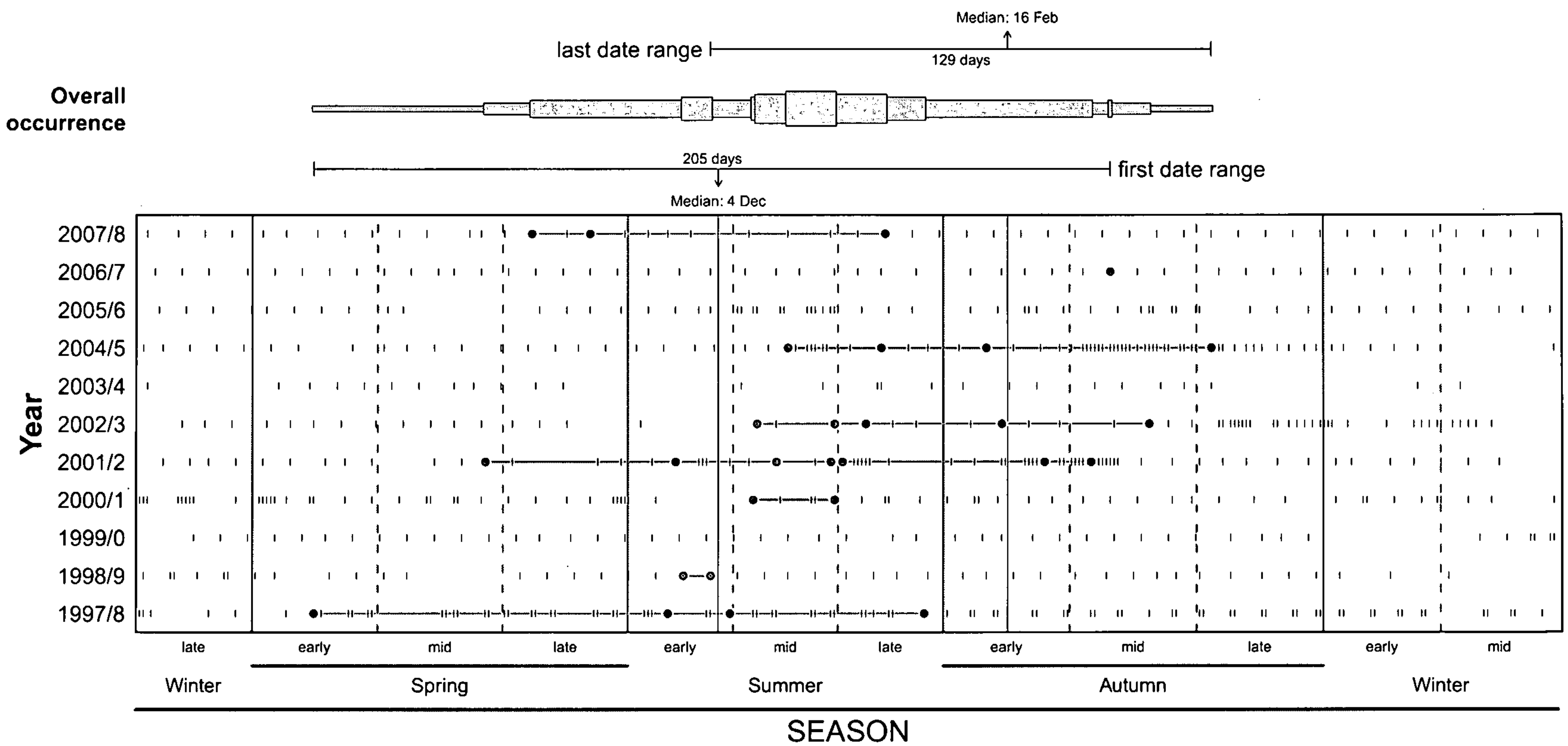


Figure 5.93: R524 Red-breasted Swallow: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

R526 Greater Striped Swallow .... *Hirundo cucullata*

The Greater Striped Swallow is endemic to Africa south of the equator, and in southern Africa it occurs as a breeding migrant (Maclean 1985). The bulk of the population breeds in South Africa — where it is widespread except in the north, north-east and dry west — but it also breeds in Lesotho, Swaziland, Zimbabwe, Botswana and Namibia (Earlé 1997f). In SABAP1 Zone 7 most birds arrive from September [mid-spring] and depart in April/May [late autumn], with some birds overwintering (Earlé 1997f). Found in a variety of habitats, including grassland (Earlé 1997f).

The birds at Glen

The Greater Striped Swallow roosts somewhere outside the study area and visits the area during the day. The majority of records involved birds heard, but no distinction is made in the analysis between vocal or sight records. Figures start on page 686.

Annual occurrence of birds in the grassland: Recorded on 58.5% of the days with an activity index of five (Table 5.16a). Noted during 7–9 seasons each year with the annual frequency index relatively high during all years (Fig. 5.94; Fig. 5.95). Daily reporting rates ranged from 0.5 to 16.4% with 88.0% bird-days attaining relatively low reporting rates (Fig. 5.94). The median daily reporting rate of 2003/4 was low compared to those of other years (Fig. 5.94).

Table 5.16: R526 Greater Striped Swallow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 907	114 612	1.7	birds present	58.5	656	384	5
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	17	1 190	1.4	birds present	27.9	43	12	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	8	1 188	0.7	birds present	11.6	43	5	2

Seasonal occurrence of birds in the grassland: Arrival of these intra-African migrants were limited to an 18-day period at the beginning of mid-spring (median date: 20 September; Fig. 5.96). Departure mainly occurred during the first part of late autumn or towards the beginning of early winter, but is was also recorded at the beginning of mid-winter in 2000/1 (Fig. 5.96). Overall, they were recorded during virtually all years from mid-spring to late autumn, and during only four years in early winter (Fig. 5.94). Median daily reporting rates were similar for most seasons (Fig. 5.94). Days with zero records were least frequent during late spring, summer and early autumn (Fig. 5.95).

Daily occurrence of birds in the grassland: Overall, activity was only slightly less frequent in the middle part of the day than in the early morning from after sunrise until mid-morning and in the late afternoon before sunset; Activity was infrequent before sunrise and after sunset (Fig. 5.94). This general pattern is most applicable to low reporting rate days; on intermediate reporting rate days the peak in the morning was more prominent (Fig. 5.97). The bimodal daily pattern was most prominent during summer and early autumn, while an activity peak in the morning was more prominent during mid- and late autumn (Fig. 5.98). No bird-segment combination occurred on more than 5% bird-days.

The first activity of the day usually occurred in the morning, earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.98). The median timing was only slightly earlier during late summer than during preceding seasons (Fig. 5.98).

The last activity of the day was usually in the afternoon and tended to occur later in the afternoon on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.98). Seasonally, the timing was least variable and latest during early and mid-summer when it often occurred in the late afternoon, compared to the beginning and end of the birds' stay when it often occurred earlier in the day (Fig. 5.98).

Overall, daily segment reporting rates ranged from 5.9 to 90.9% with 96.3% of the values relatively low (Fig. 5.94). Median daily segment reporting rates were similar for most segments (low for S0 and S13), but the upper quartile range was relatively high for S3 (Fig. 5.94). Whereas median daily segment reporting rates were largely similar for low reporting rate day segments, it was higher in the morning for intermediate reporting rate days (Figs. 5.98).

Early morning occurrence of birds during 2007/8: Recorded on 27.9% and 11.6% of the mornings in the drainage line and grassland respectively (Table 5.16b & c). The occurrence of activity in the grassland coincided with the occurrence of high reporting rate mornings in the drainage line during late summer and early autumn (Fig. 5.99). The timing of the first activity of the day was variable (Fig. 5.99).

Discussion

The narrow window of arrival of the Greater Striped Swallow (Fig. 5.96) indicates that the timing of its migration is under firm control of circannual rhythms.

The generally low daily reporting rate during 2003/4 (Fig. 5.94) is probably related to the fact that it was a very dry year.

R528 South African Cliff-Swallow . . . . *Hirundo spilodera*

The South African Cliff-Swallow is endemic to Africa south of the equator, occurring in southern Africa as a breeding migrant during the warmer seasons (Maclean 1985). Their breeding grounds are centred on the Free State and adjacent areas (except Lesotho), and it also occurs at scattered localities in Namibia, Botswana and Zimbabwe (Earlé 1997e). It forages over grassland, usually close to breeding sites under bridges (Earlé 1997e; Maclean 1985). They arrive on their breeding ground from August [early spring] and depart in April [late autumn], with a few records of birds overwintering (Earlé 1997e).

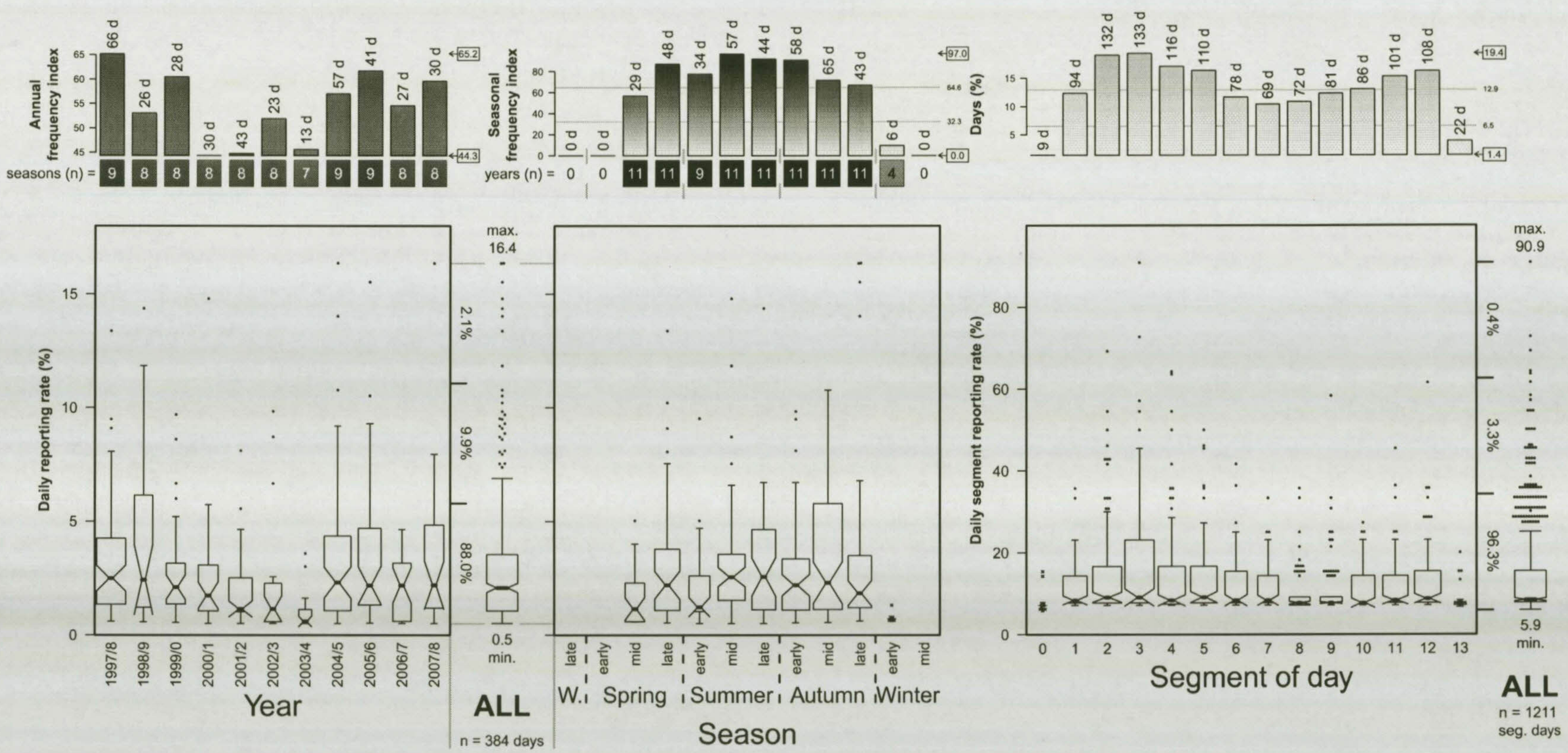


Figure 5.94: R526 Greater Striped Swallow — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

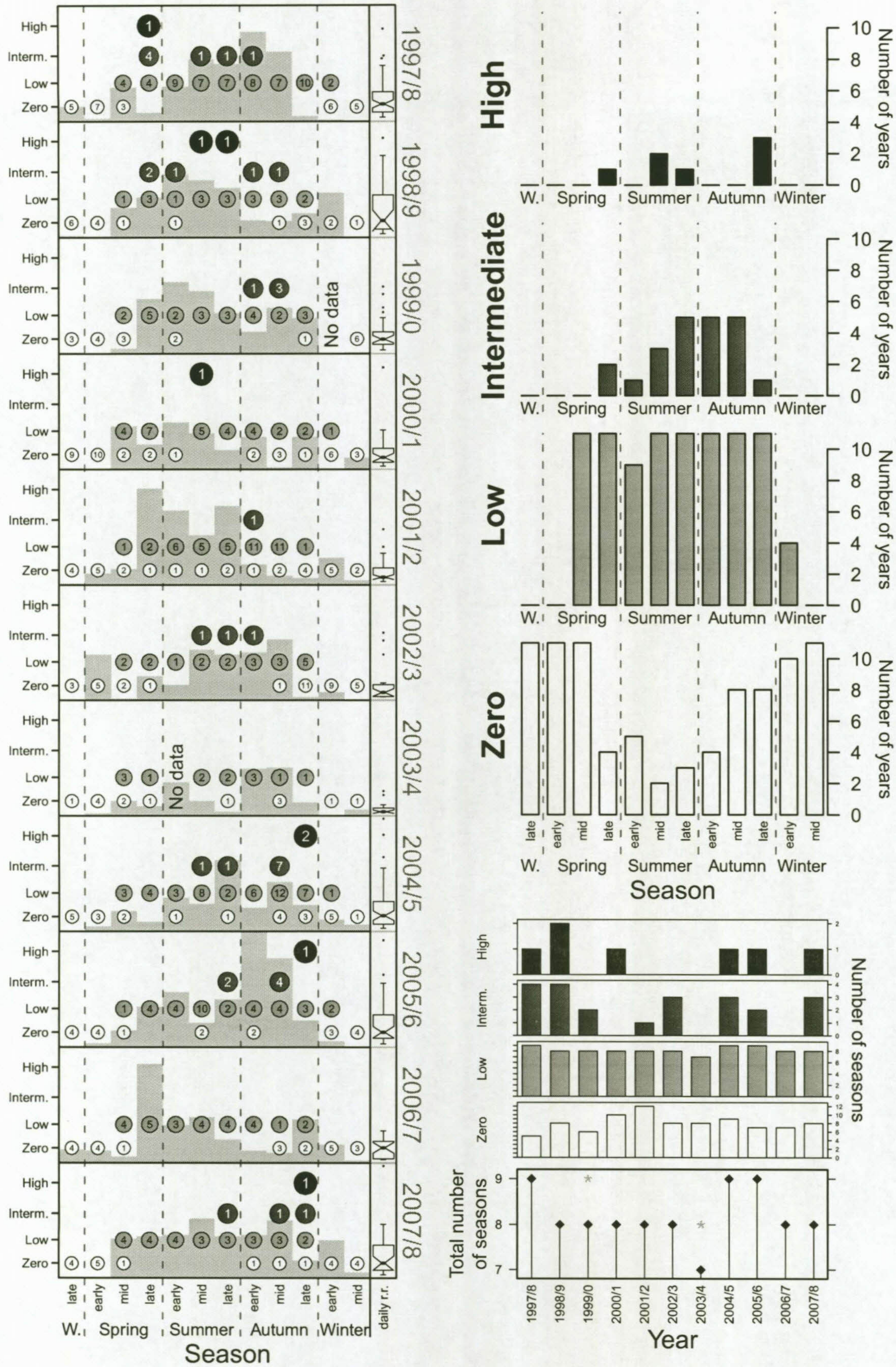


Figure 5.95: R526 Greater Striped Swallow — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

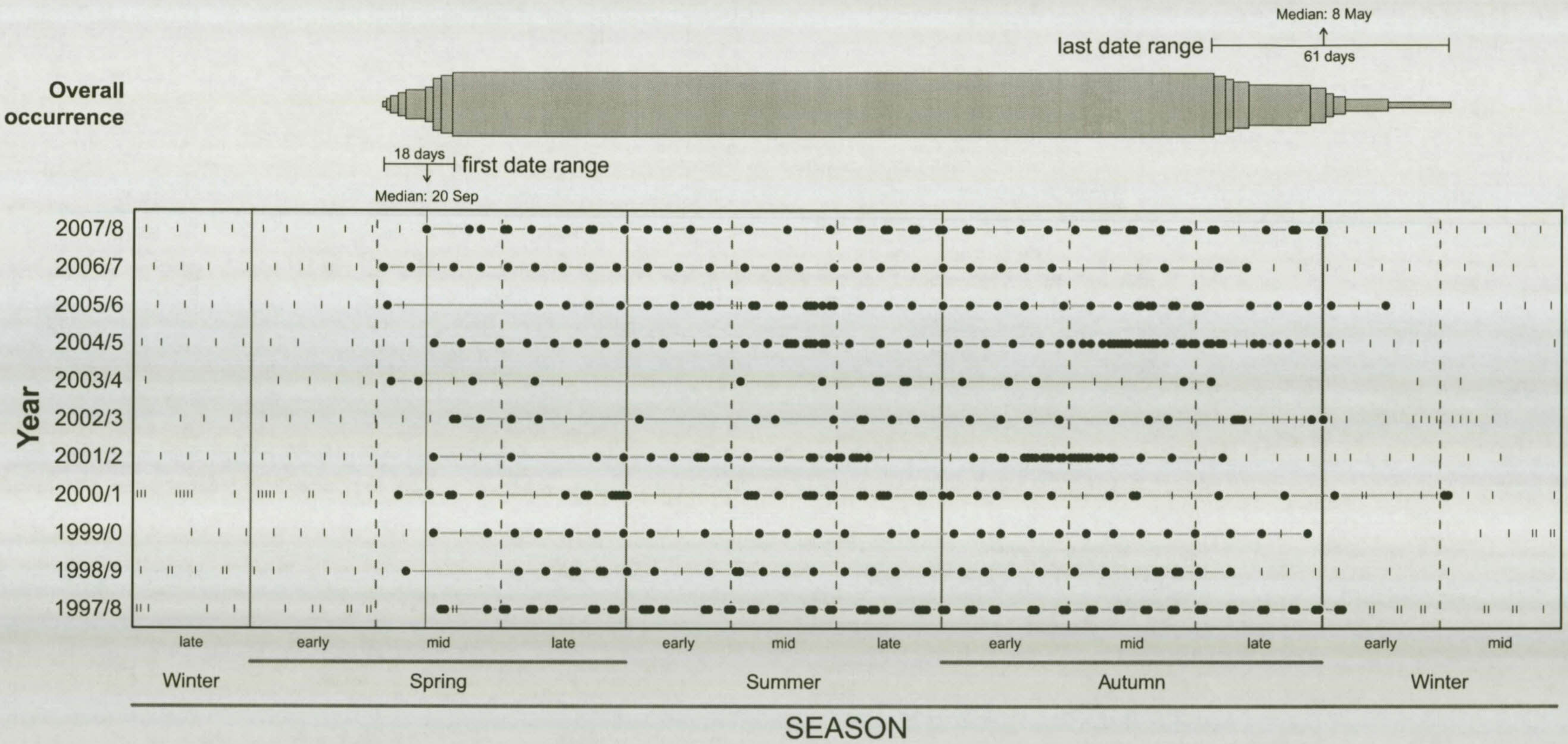


Figure 5.96: R526 Greater Striped Swallow: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

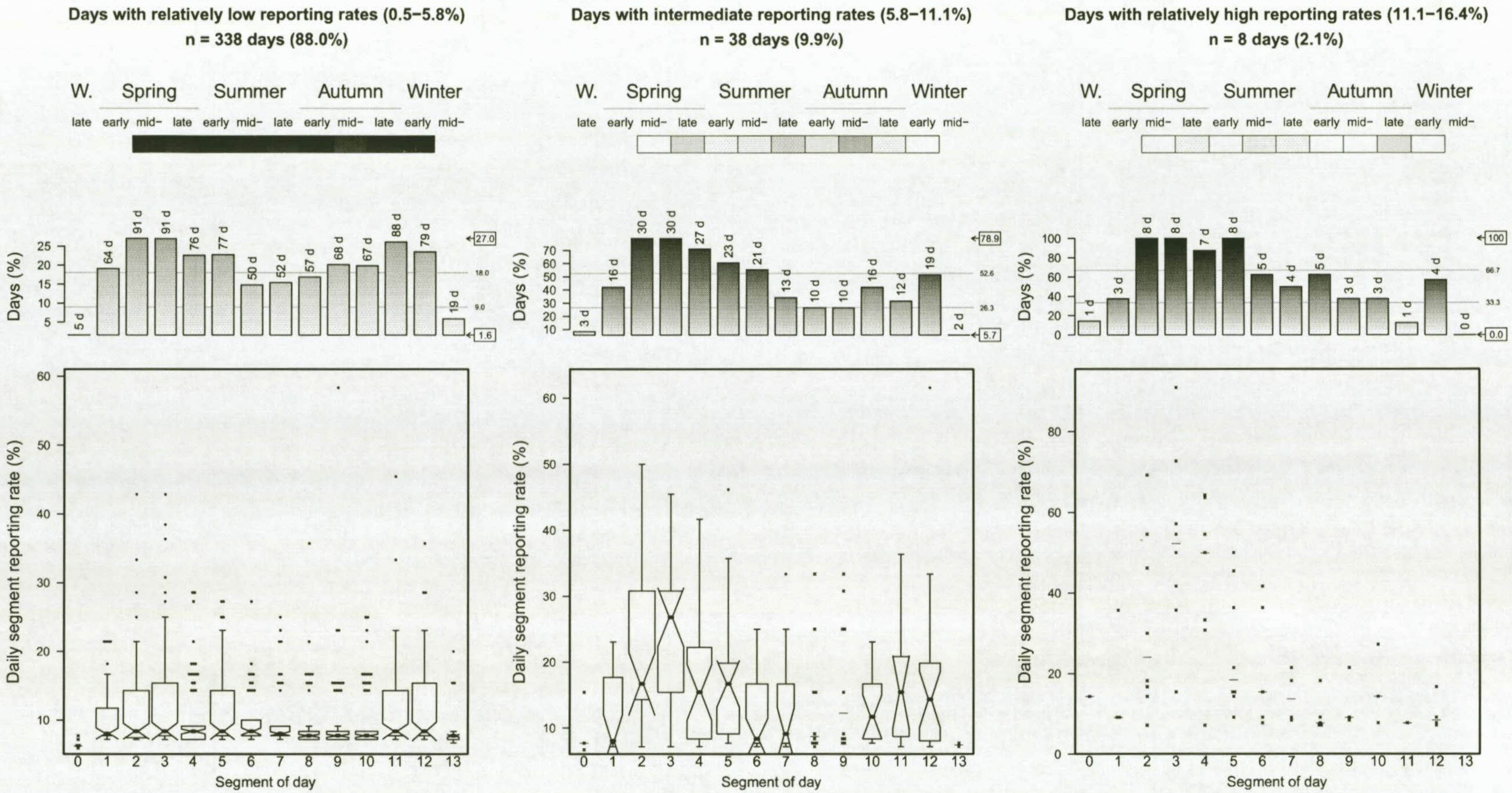
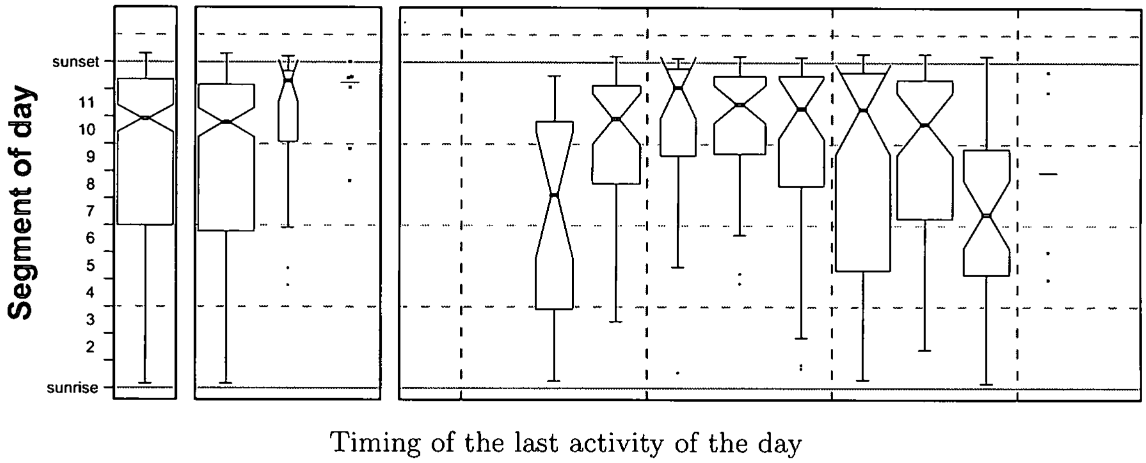
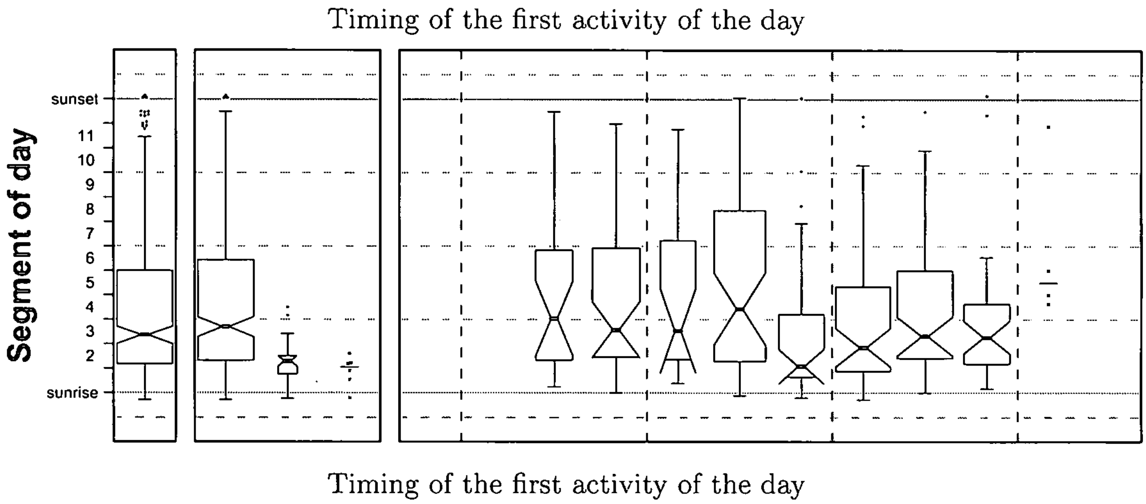


Figure 5.97: R526 Greater Striped Swallow — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.





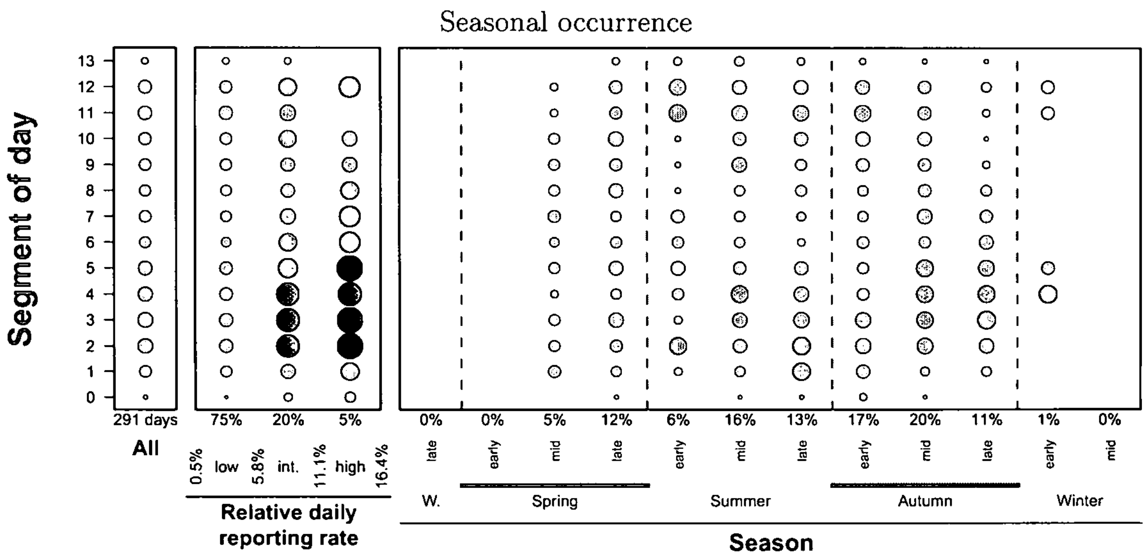


Figure 5.98: R526 Greater Striped Swallow — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

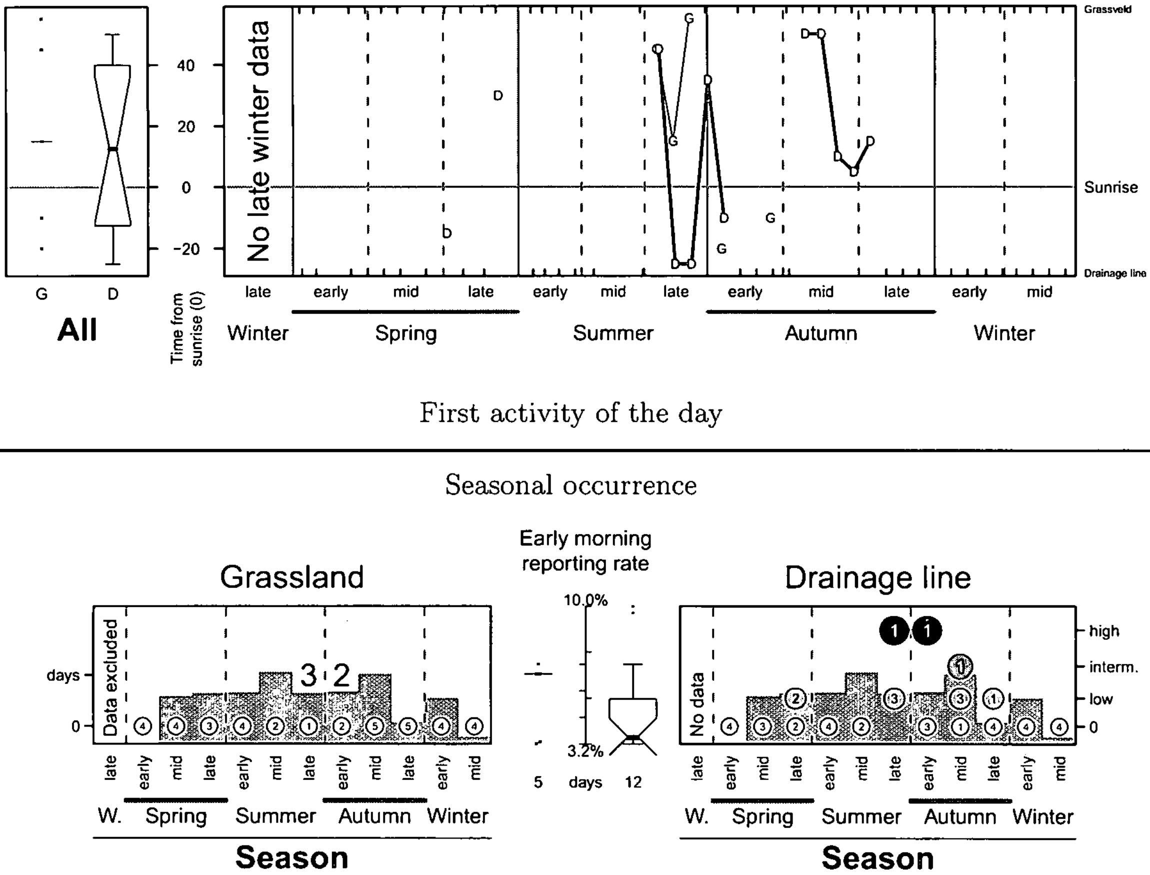


Figure 5.99: R526 Greater Striped Swallow — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Top: Occurrence of the first activity of the day. See page 136 for more information on this early morning figure.

The birds at Glen

South African Cliff-Swallows were recorded as birds perched on fences or in flight, often foraging over the grassland. Not recorded in the drainage line during the early mornings of 2007/8 when recorded during four mornings in the grassland (Table 5.17b & c). Figures start on page 693.

Annual occurrence of birds in the grassland: Recorded on 52.0% of the days with an activity index of nine (Table 5.17a). Noted during 7–10 seasons each year (Fig. 5.100; Fig. 5.101). Daily reporting rates ranged from 0.5 to 37.4% with 88.6% bird-days attaining relatively low reporting rates (Fig. 5.100). Median daily reporting rates were relatively high in 1997/8, 1998/9 and 2001/2, with the occurrence of high reporting rate days restricted to the first three years of the study (Fig. 5.100; Fig. 5.101).

Seasonal occurrence of birds in the grassland: The birds usually arrived during the latter part of early spring or the beginning of mid-spring (median date: 26 August; Fig. 5.102). Departure is often towards the end of mid-autumn with a median date of 2 April (Fig. 5.102). Overall, recorded

Table 5.17: R528 South African Cliff-Swallow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	3 147	114 612	2.7	birds present	52.0	656	341	9
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	6	1 188	0.5	birds present	9.3	43	4	2

during all seasons except mid-winter, but rarely during late autumn or winter (Fig. 5.100). Daily reporting rates tended to be higher during summer (Fig. 5.100), and days with zero records were particularly infrequent during summer and early autumn (Fig. 5.101).

Daily occurrence of birds in the grassland: Overall, activity was most frequent around mid-morning and became less frequent towards sunrise and sunset respectively (Fig. 5.100). Low and intermediate reporting rate days showed a similar pattern (Fig. 5.103). Activity was seasonally most frequent during midday in spring, but became more frequent earlier in the day in summer and earlier still in autumn (Fig. 5.104). No bird-segment combination occurred on more than 5% bird-days.

The first activity of the day usually occurred in the morning (Fig. 5.104). The median timing follows a seasonal pattern with activity tending to commence earlier during late summer and early autumn than during other seasons (Fig. 5.104).

The occurrence of the last activity of the day was variable for low reporting rate days, but for intermediate reporting rate days it normally occurred in the late afternoon (Fig. 5.104). Seasonally it was variable with the values of the respective seasons overlapping extensively (Fig. 5.104).

Overall, daily segment reporting rates ranged from 5.6 to 100% with 88.0% of the values relatively low (Fig. 5.100). Median daily segment reporting rates were similar for most segments (low for S0 and S13), but the upper quartiles of S5 and S6 was relatively high (Fig. 5.100). Whereas median daily segment reporting rates were largely similar for low reporting rate day segments, it was higher in the morning for intermediate reporting rate days (Figs. 5.103).

Discussion

The arrival and departure dates of South African Cliff-Swallows at Glen occurred during moderately restricted time frames (Fig. 5.102), suggesting that it is to some extent controlled by changes in day-length.

These swallows require mud to construct their nests and Earlé (1986) found that rainfall has a definite influence on the timing of breeding, directly by providing the necessary mud for nest construction and indirectly by causing a better food supply for some period. In this regard, it is

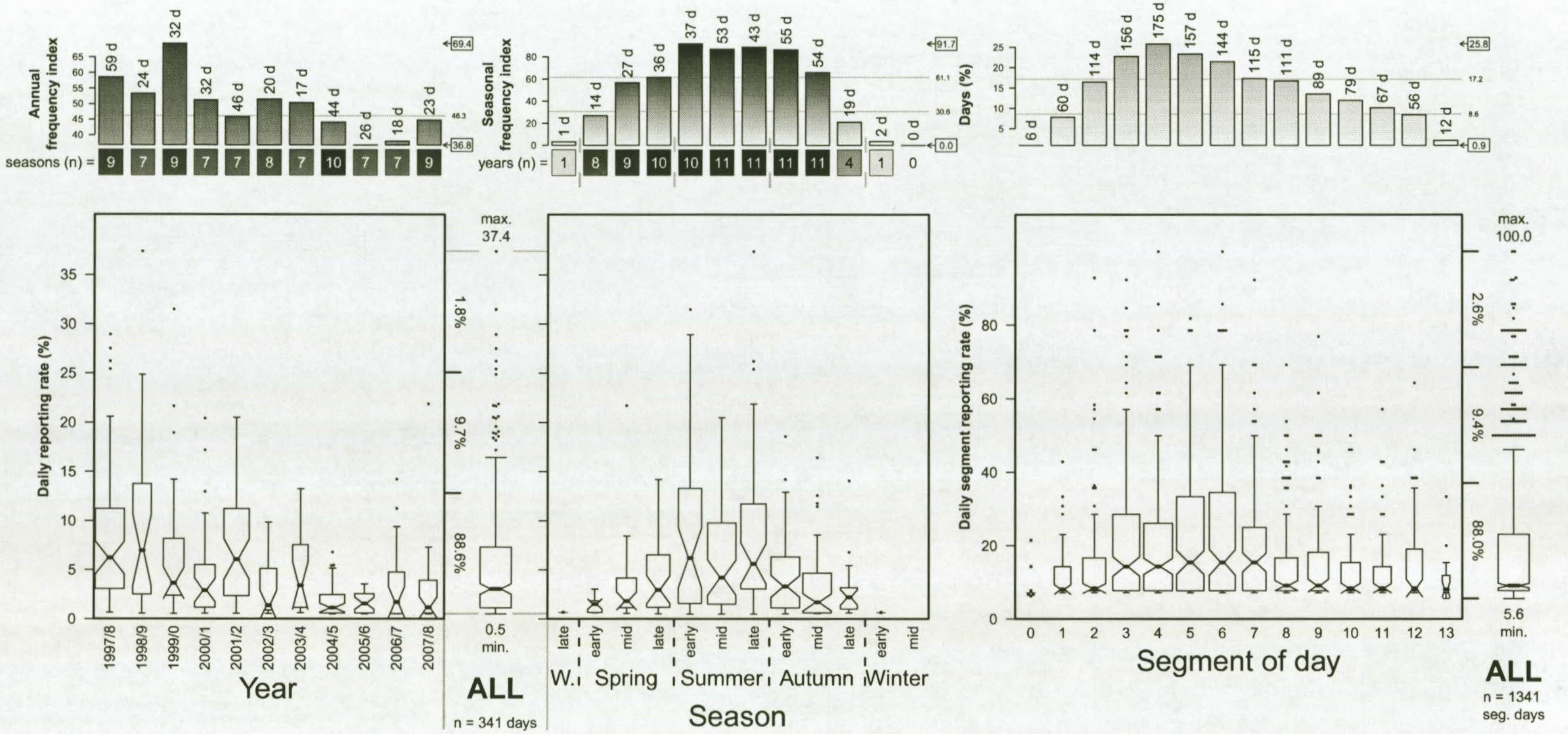


Figure 5.100: R528 South African Cliff-Swallow — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Figure 5.101: R528 South African Cliff-Swallow — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

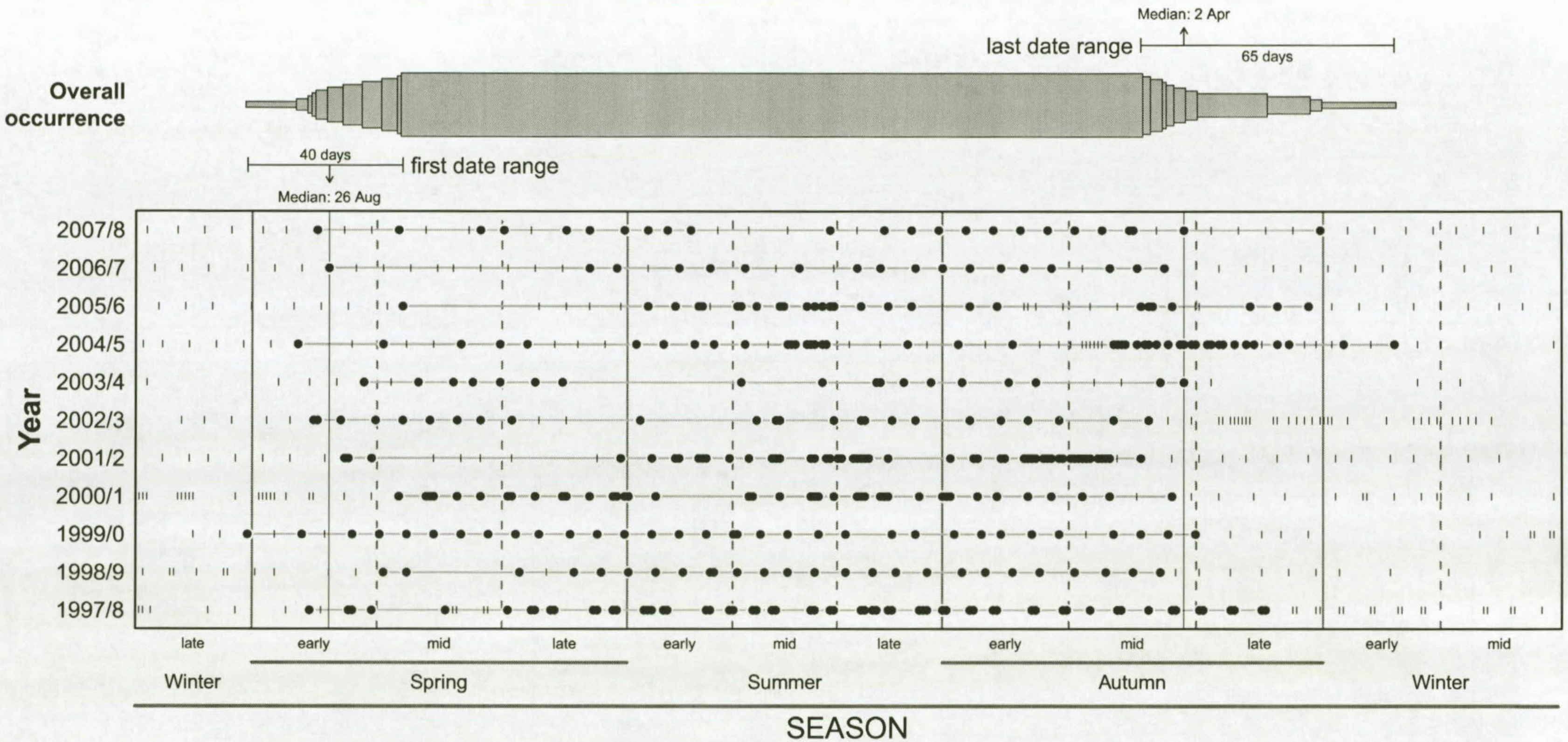


Figure 5.102: R528 South African Cliff-Swallow: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

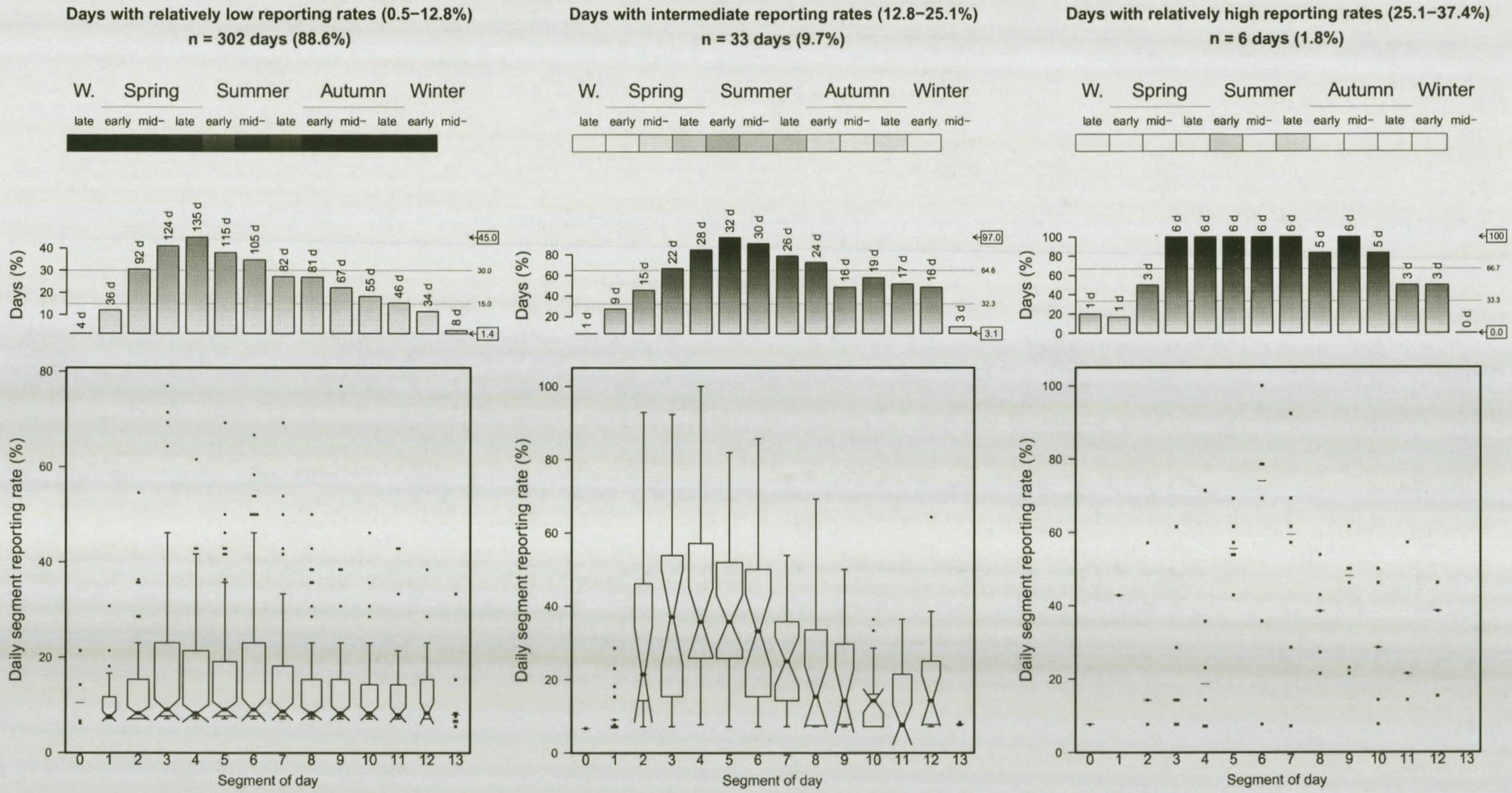


Figure 5.103: R528 South African Cliff-Swallow — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

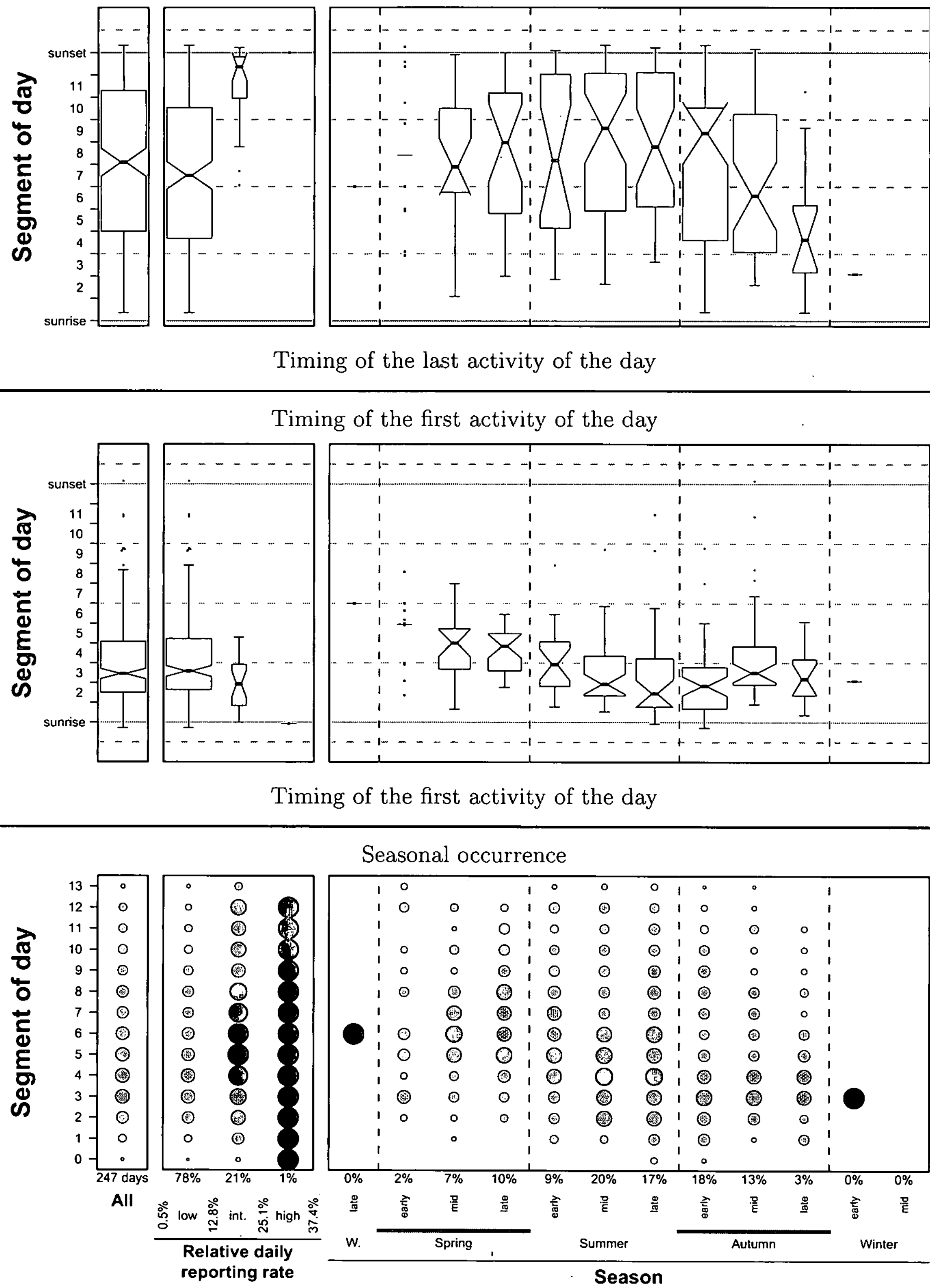


Figure 5.104: R528 South African Cliff-Swallow — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

noteworthy that daily reporting rates were somewhat higher during 1997/8, 1998/9 and 2001/2 than during other years (Fig. 5.100). The rainfall patterns of these years probably contributed to these higher values.

R529 Rock Martin .... *Hirundo fuligula*

The Rock Martin occurs in Africa and from the Middle East eastwards to Pakistan (Cramp 1998). In southern Africa it is widespread in South Africa, Lesotho, Namibia (except the north-east) and Zimbabwe (not in the eastern and central parts) (Earlé 1997g). Associated with rocky terrain and buildings, the population consists of resident and migratory components, but details about movements not yet resolved (Earlé 1997g). It is less common in the highlands of Lesotho during the cooler part of the year (Van Niekerk 2004).

The birds at Glen

Usually recorded as one or two birds, but as many as seven birds were recorded. Not recorded during the early mornings of 2007/8 in either the grassland or the drainage line (Table 5.18). The analysis below is based on a year starting in late summer. Figures start on page 699.

Table 5.18: R529 Rock Martin: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	136	114 612	0.1	birds present	11.9	656	78	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Annual occurrence of birds in the grassland: Recorded on 11.9% of the days with an activity index of two (Table 5.18a). Not recorded in 2004, only once in 1999, and during 3–7 seasons during the remainder of the years (Fig. 5.105). Daily reporting rates ranged from 0.5 to 4.0% with 84.0% bird-days attaining low reporting rates, and with median daily reporting rates similar for the respective years (Fig. 5.105).

Seasonal occurrence of birds in the grassland: Recorded during all seasons except mid-autumn and early summer, and most frequently during mid-winter, late winter and early spring when recorded during seven years (Fig. 5.105). Intermediate and high reporting rate days were limited to the period from mid-winter to early spring (Fig. 5.105).

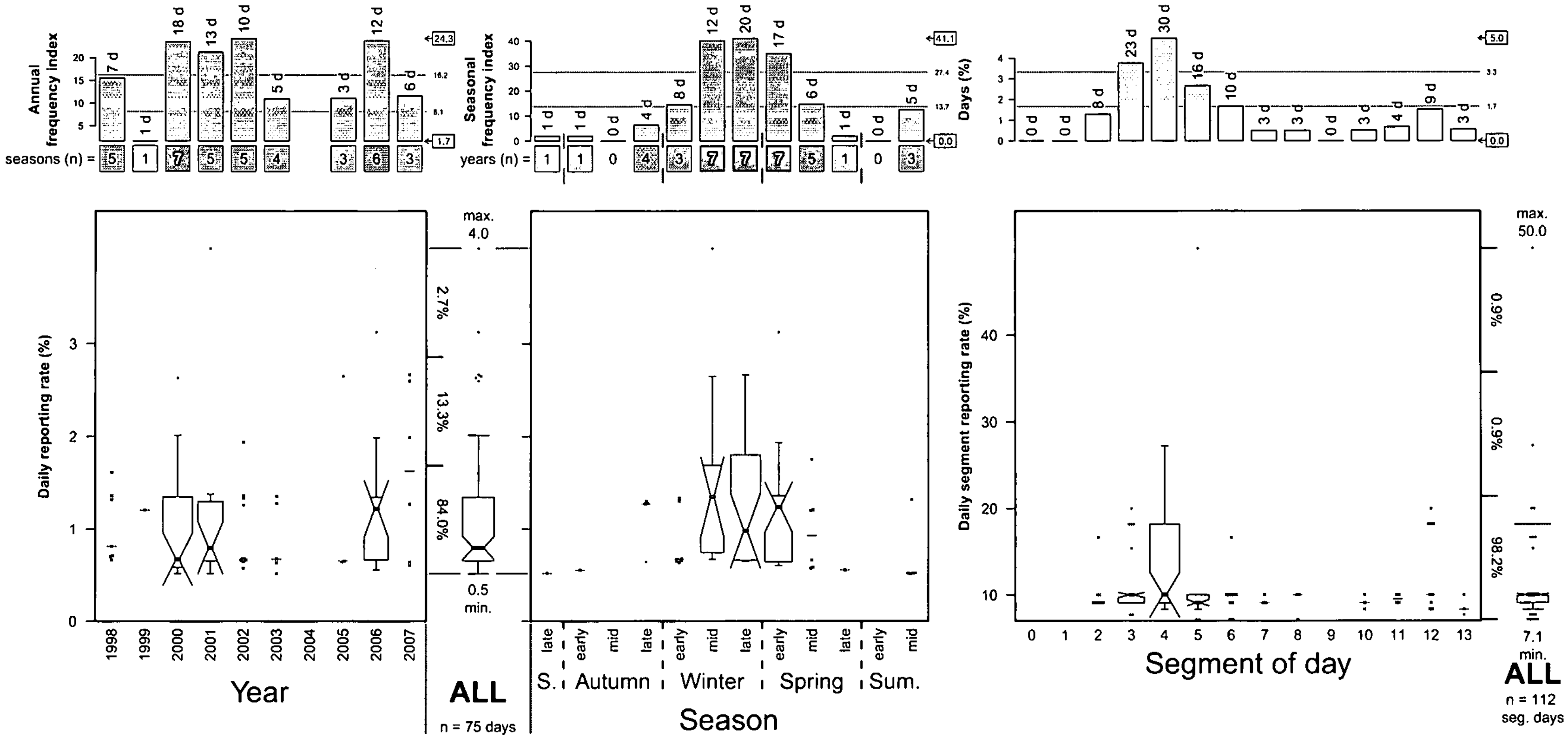


Figure 5.105: R529 Rock Martin — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Daily occurrence of birds in the grassland: Most frequently recorded at mid-morning and infrequently or not at all during other parts of the day (Fig. 5.105). Daily segment reporting rates ranged from 7.1 to 50.0% with 98.2% of the values relatively low (Fig. 5.105). Median daily segment reporting rates were similar for all segments (Fig. 5.105). Bird-segment combinations occurring during more than 5 bird-days were limited to single bird-segments S3–S6, collectively accounting for more than half of all bird-days (Fig. 5.106).

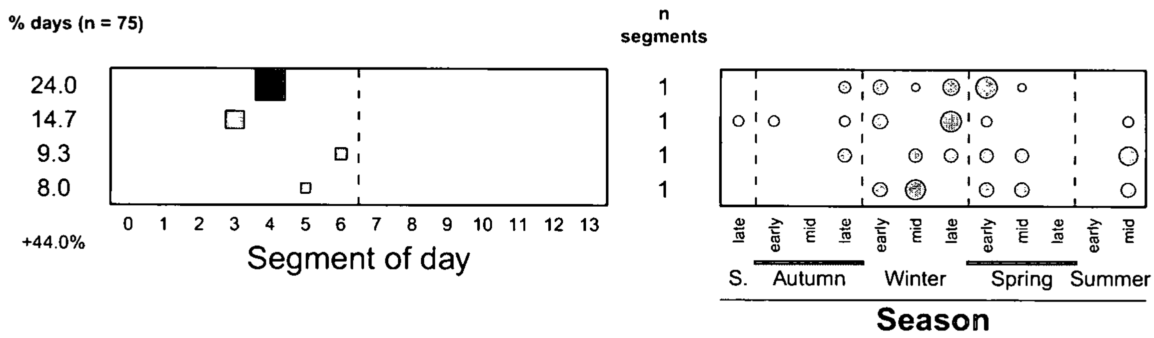


Figure 5.106: R529 Rock Martin — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

Discussion

At Glen, the Rock Martin is particularly frequent during the cooler part of the year (Fig. 5.105). There appears to be at least two possible explanations for this seasonality. Firstly, the birds recorded at the study site may involve local breeding birds that move around more widely during the non-breeding than the breeding season when they are presumably more confined to the nesting site. In one study, for example, it was found that adults with chicks foraged only in the immediate vicinity of the nest (Fry 1992). The closest breeding birds are probably at Glen village.

A second possibility is that at least some of the birds at Glen involve birds from further afield. The main source of these birds, it is suggested, are those from the Lesotho highlands where the birds are less common during the cooler times of the year (Van Niekerk 2004). Moreover, based on two surveys there, one during November/December [early summer] and the other during April/May [late autumn], Van Niekerk (2004) found evidence suggesting population shifts from higher to lower altitudes and from natural habitats towards rivers, possibly indicating that birds are moving out of the mountains via the lower lying river systems there. This would compliment their occurrence at Glen from late autumn to mid-spring (Fig. 5.105). There appears to be similar movements into the lower laying areas of KwaZulu-Natal during "winter" (Johnson & Maclean 1994).

R530 Common House-Martin .... *Delichon urbicum*

The common House-Martin breeds in the Palearctic and Asia with the entire western Palearctic and western Asian population migrating to sub-Saharan Africa to spend the non-breeding season there (Cramp 1998). In southern Africa it is most frequent in the eastern half and far southern parts of the region and infrequent or absent in the west, particularly in the Northern Cape (Earlé 1997h). It forages over a wide variety of habitats, including grassland (Earlé 1997h). In SABAP1 Zone 7 it was recorded from October to the first half of May [late spring to late autumn] with reporting rates peaking from January to March [late summer to mid-autumn] (Earlé 1997h). A similar peak period was noted in subsequent studies in the Lesotho highlands, probably reflecting passage migrants on their way north (Van Niekerk 2004).

The birds at Glen

Seen on nine days spread over seven years with most of the records from late summer to mid-autumn; once recorded in late spring too (Fig. 5.107). Most frequently recorded during late morning with single records in the late afternoon (Fig. 5.107).

Discussion

According to Moreau (1972), the Common House Martin appears in Africa only very exceptionally and sporadically, and far fewer birds are actually seen than would be expected given the millions that pour into the continent annually. The reason appears to be their habit of foraging at altitudes too high for the human observer to see them (Moreau 1972). In addition, they are thought to sleep on the wing while in their non-breeding quarters (Cramp 1998).

Subsequent to the present study, birds were seen regularly on telephone wires at Glen village during the early mornings in early and mid-autumn 2008/9. The question now is: If they sleep on the wing, would they return to the same place to rest each morning? Perhaps, but it is suggested that it is equally or even more likely that the birds roost somewhere in or around Glen village, probably in trees. Observations on birds coming to roost in Bloemfontein indicate that they regularly use the same set of trees over several nights (thanks to P. J. du Preez who discovered this roost), suggesting a degree of roost-site fidelity. Others have observed terrestrial roosts too (Curry-Lindahl 1963; Moreau 1972).

Despite regular sightings on telephone wires at Glen village, the birds were seen in the study area only once during 2008/9, in early autumn during S2, indicating that the birds may be present in the general area without being recorded in the study area. Nonetheless, they were seen in the study area only during certain times of the day, *i.e.* in the morning and again in the late afternoon (Fig. 5.107). A possible explanation for this pattern is that the birds seen in the morning involve those foraging at low altitudes after their initial morning rest at Glen village. The lack of observations after late morning is perhaps due to their high flying behaviour, yet two observations were made in the late afternoon (Fig. 5.107). These observations might have been birds foraging at lower altitudes before going to roost, perhaps in trees at Glen village.

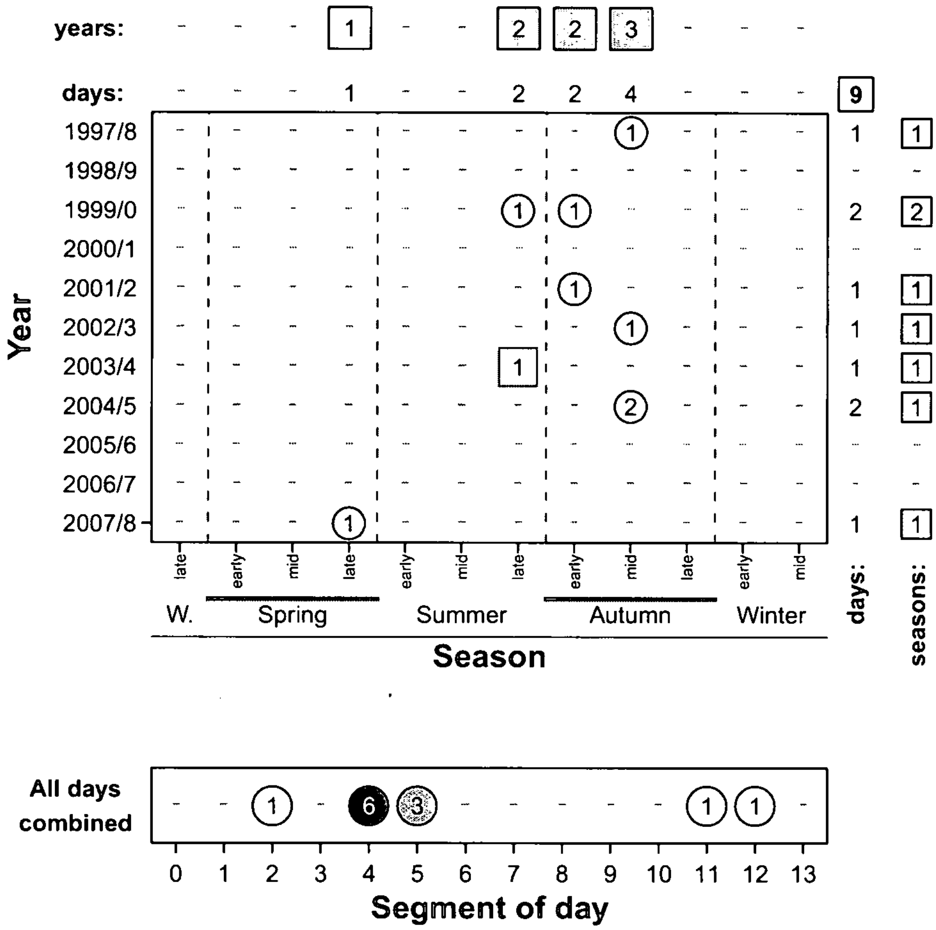


Figure 5.107: R530 Common House-Martin — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R533 Brown-throated Martin . . . . *Riparia paludicola*

The Brown-throated Martin occurs in Africa, southern Asia east to Taiwan and the Philippines (Cramp 1998). In southern Africa it is most widespread in South Africa, Lesotho and Swaziland, and less densely distributed in other countries (Earlé 1997i; Parker 1999). It is usually associated with water, but may forage over dryland habitats, including grassland (Earlé 1997i; Earlé & Grobler 1987). The population consists of resident, nomadic and short-distance migratory elements (Earlé & Tree 2005).

The birds at Glen

In the grassland, Brown-throated Martins were most often seen as singles or in pairs, less frequently three or four birds. The analysis is based on a year starting in late summer.

Seen on 28 days and in all years, except 2006 (Fig. 5.108). Usually seen during 1–3 seasons each year but during five seasons in 2003 (Fig. 5.108). Recorded in mid-summer once and from mid-autumn to mid-spring, usually during 2–3 years each season but during six years in late winter (Fig. 5.108). During the day, most frequently recorded around mid-morning and in the late afternoon before sunset (Fig. 5.108). Seen only once in the drainage line during an early morning observation in 2007/8.

Discussion

Brown-throated Martin influxes during the cooler part of the year are known for several regions, including Botswana (Penry 1994; Randall 1994), Zimbabwe (Earlé & Tree 2005), southern Mozambique (Lamm 1955) and the bushveld and lowveld regions of the former Transvaal (Tarboton *et al.* 1987). A similar situation appears to be true for Glen (Fig. 5.108). In SABAP1 Zone 7 reporting rates were slightly higher during the cooler seasons too (Earlé 1997i). Commenting on the SABAP1 reporting rates in general, Earlé (1997i) suggested that it may be "influenced by the dispersal of birds from breeding colonies outside the breeding season." Yet breeding is recorded in all months but mainly from June to September [mid-winter to mid-spring] (Tarboton 2001), *i.e.* it overlaps to some degree with the above mentioned influxes. The relatively frequent occurrence during late winter at Glen (Fig. 5.108) may suggest birds moving to breeding areas, but it is agreed with Earlé (1997i) that the seasonal movement patterns of the Brown-throated Martin require further investigation.

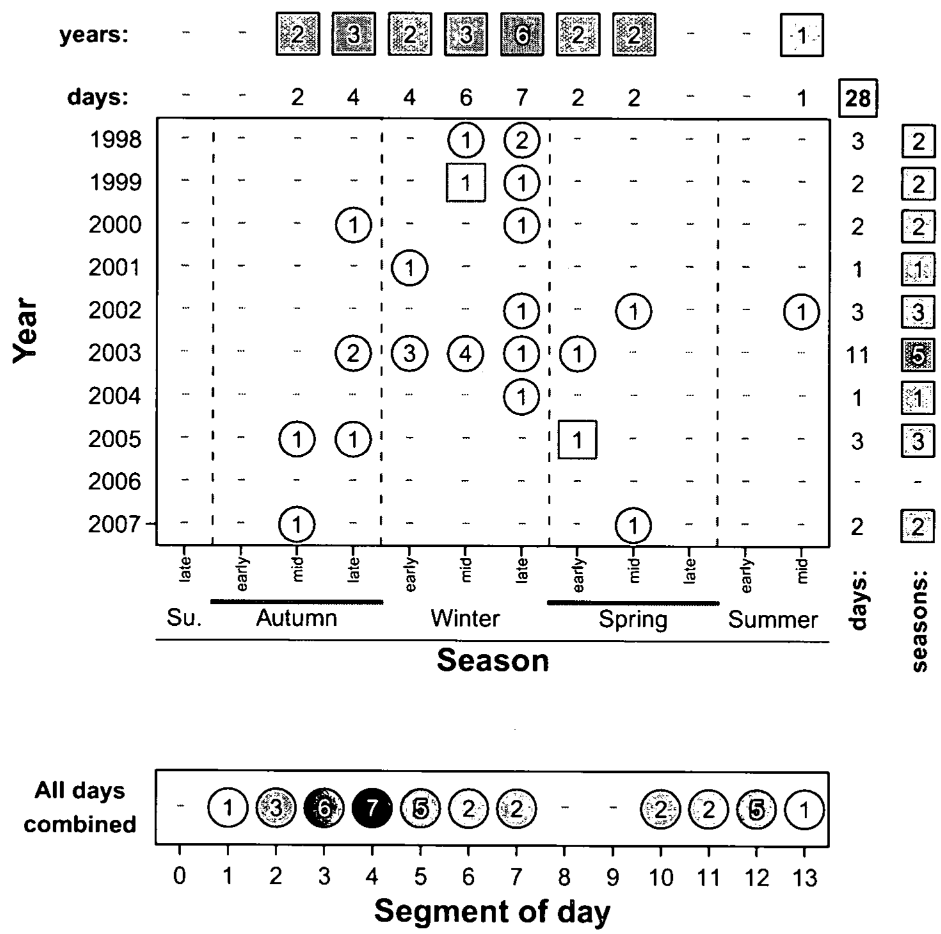


Figure 5.108: R533 Brown-throated Martin — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R534 Banded Martin .... *Riparia cincta*

The Banded Martin is endemic to sub-Saharan Africa, occurring in southern Africa mainly as a breeding intra-African migrant (resident at some localities) (Maclean 1985). It has a fragmented distribution in southern Africa with concentrations in the Western and Eastern Cape, the sour grasslands of South Africa and Swaziland, and a few other localities in Namibia, Botswana, Zimbabwe (Earlé 1997j) and southern Mozambique (Parker 1999). In the Free State, it is more frequent in the east (where some birds may overwinter), with early and late season records elsewhere in the province likely to represent birds on passage (Earlé & Grobler 1987). Found in open grassland and wetlands, often near streams or erosion features with vertical walls in which it breeds (Maclean 1985). In SABAP1 Zone 7 they mainly arrive in October [mid- to late spring] and depart in May [early winter] (Earlé 1997j).

The birds at Glen

Seen on 14 days spread over seven years with most records from mid-autumn to early winter (Fig. 5.109). Recorded during various times of the day, mainly in the early morning after sunrise and again around sunset (Fig. 5.109).

Discussion

The birds at Glen probably involve birds on passage, particularly birds heading north late in the season.

5.3 Dicruridae: Drongos

A total of 24 drongo species occur in Africa, Madagascar, southern Asia and Australasia with two species found in southern Africa (Hockey *et al.* 2005). Only the Fork-tailed Drongo occurs in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b).

R541 Fork-tailed Drongo .... *Dicrurus adsimilis*

The Fork-tailed Drongo is endemic to sub-Saharan Africa (Maclean 1985). Widespread throughout southern Africa except in the grassland areas of the highveld and the more arid areas in the west (Oatley 1997b; Parker 1999). It may occur in these less favoured habitats if alien trees such as eucalyptus is present (Oatley 1997b). The study area is situated on the edge of its distribution. Normally considered resident, but may move locally during "winter" (Dean 2005j; Maclean 1985).

The birds at Glen

The Fork-tailed Drongo is a breeding resident at Soetdoring Nature Reserve (De Swardt 2000); this is the nearest known breeding locality to Glen where they were encountered as single birds or in pairs in the grassland, sometimes associated with cattle. The analysis is based on a year starting with late summer.

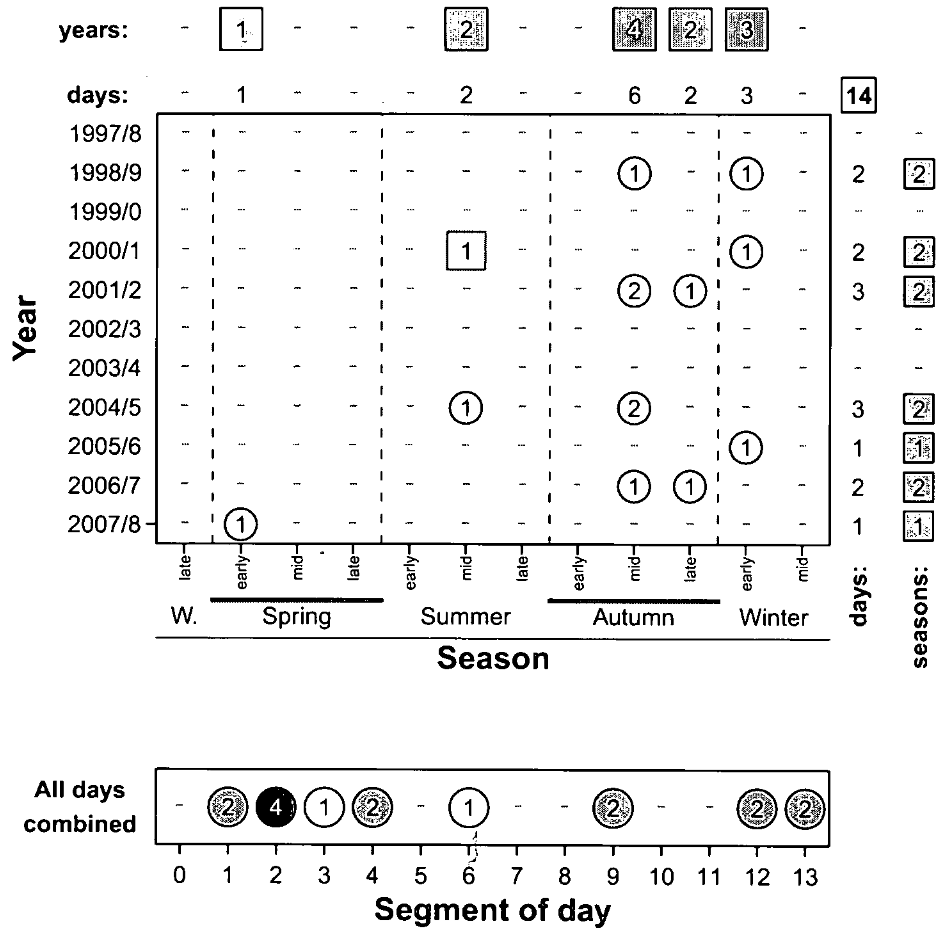


Figure 5.109: R534 Banded Martin — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Birds in the grassland: Overall, recorded on eight days spread over five years with all the records from late autumn to mid-spring (Fig. 5.110). Seen only during mid- to late morning and in the late afternoon before sunset (Fig. 5.110).

Birds in the drainage line: Encountered during transects on two consecutive days in mid-winter 2001.

Discussion

The observations at Glen probably represent local movements (see also Dean 2005j; Maclean 1985).

5.4 Corvidae: Crows, Ravens

Corvids represent 119 species that occur worldwide except in Antarctica, with four species found in southern Africa (Hockey *et al.* 2005). Three species occur in the Free State, but only the Pied Crow R548 is commonly found in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b), and was the only species recorded at Glen.

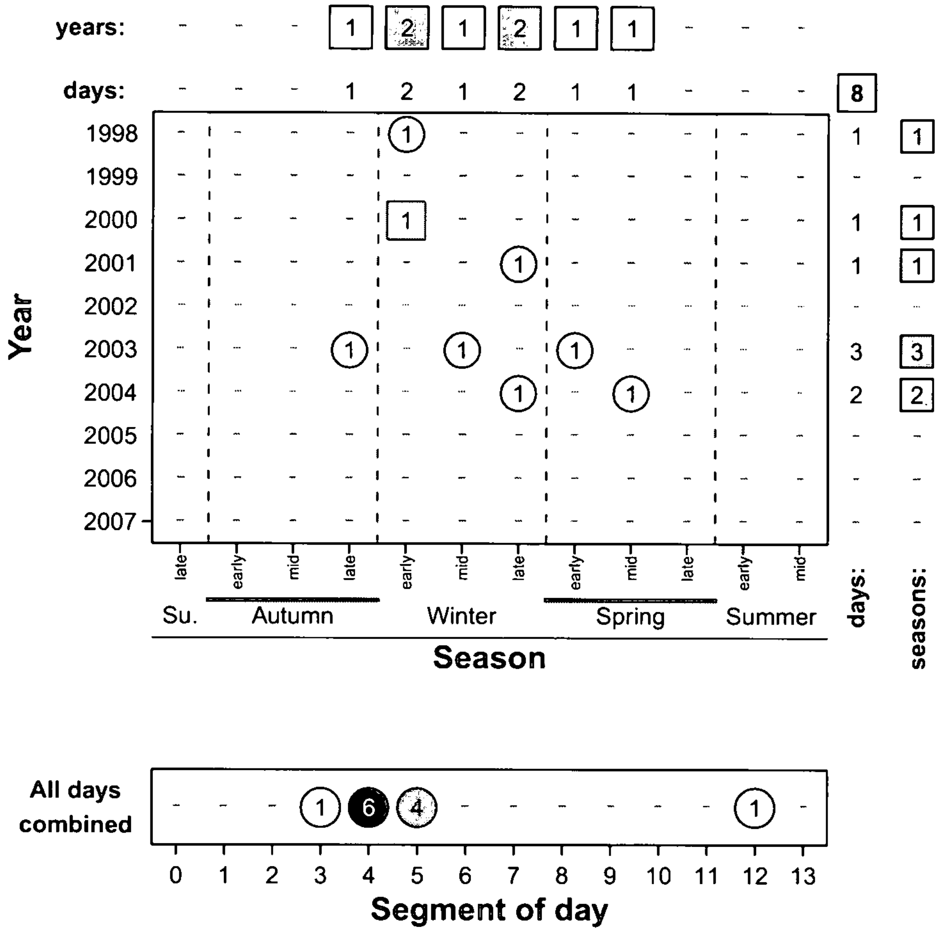


Figure 5.110: R541 Fork-tailed Drongo — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R548 Pied Crow . . . . *Corvus albus*

The Pied Crow occurs in sub-Saharan Africa, Madagascar and on Indian Ocean islands (Jenkins & Underhill 1997). It is widespread in southern Africa, but conspicuously absent from certain areas (Jenkins & Underhill 1997). In the Free State it is largely absent from the eastern third of the province and relatively scarce in the central parts (Earlé & Grobler 1987; Jenkins & Underhill 1997; Walker & Marx 1991). It occurs in a wide variety of habitats (Jenkins & Underhill 1997). Resident, but some local movements do occur, including adults that gather into flocks and dispersal of juveniles (Dean 2005k).

The birds at Glen

The Pied Crow was more common and even bred at Glen during the 1970's, but it became scarce during the 1980's (P. Goosen, personal communication). During the present study, recorded on only six days since 2004/5 (Fig. 5.111). These records involved 1–2 individuals flying high in the sky. Records limited to mid-spring, late spring, late autumn and early winter and in the day from S2 to S10 (Fig. 5.111).

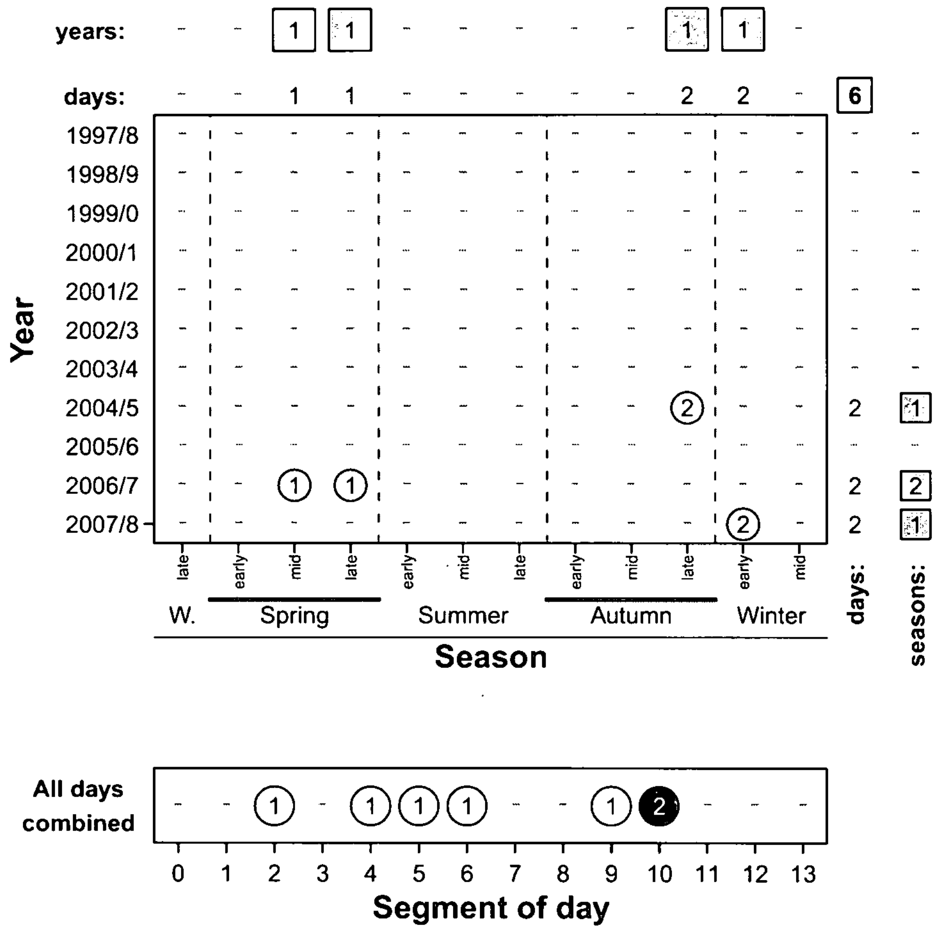


Figure 5.111: R548 Pied Crow — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Discussion

According to P. Goosen (personal communication) the Pied Crow were more common at Glen during the 1970s (when they even bred there) than in the 1980s. In fact, Marx *et al.* (1987) launched a crow census in the Free State during the mid-1980s based on an apparent decrease in numbers (see Walker & Marx (1991) for the results of that project).

The seasonal pattern observed at Glen (Fig. 5.111) is suggestive of regular seasonal movements, but such movements are currently unknown for this species. Its occurrence only since 2004/5 is interesting, because on CAR[1] route #31 there has been an increase in their reporting rate over the years too (DJvN unpublished data). Only time will tell if these trends would persist.

5.5 Paridae: Tits, Penduline-Tits

Sixty-two parid species occur in Africa, Eurasia and North America with eight species occurring in southern Africa (Hockey *et al.* 2005). Three species occur in the Free State (Earlé & Grobler 1987;

[1]CAR: Coordinate Avifaunal Roadcount. See Young *et al.* (2003).

Harrison *et al.* 1997b) of which only the Grey Tit *Parus afer*, being limited to the southern Free State, was not recorded at Glen.

R552 Ashy Tit .... *Parus cinerascens*

The Ashy Tit occurs in south-western Angola (Dean 2000), Namibia, Botswana, the central watershed of Zimbabwe and the northern, north-western and central parts of South Africa, with the Free State representing the south-eastern limit of its distribution (Harrison 1997b). These resident birds are habitat specialists, being closely associated with *Acacia* trees (Harrison 1997b). In the Free State, they are mainly confined to watercourses (Wiggins 2000).

The birds at Glen

The Ashy Tit was mostly confined to the drainage line. However, individuals did visit solitary acacias in the grassland from time to time, and a bird was even found in the trampled area where it was foraging on the ground.

In the analysis below distinction is made between birds heard only (presumably birds calling in the drainage line) and birds seen (and heard) in the grassland. The former category dominated in the grassland (Table 5.19a). Figures start on page 710.

Table 5.19: R552 Ashy Tit: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.881	304	114 612	0.3	drainage line bird heard	17.2	656	113	3
0.119	41	114 612	0.0	birds in the grassland	2.9	656	19	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	176	1 190	14.8	drainage line bird heard	65.1	43	28	6
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	3	1 188	0.3	drainage line bird heard	7.0	43	3	1

Annual occurrence of drainage line birds heard in the grassland: Recorded on 17.2% of the days with an activity index of three (Table 5.19a). Recorded during ten seasons in 2002/3, 6–7 seasons in 2001/2 and 2004/5–2005/6, and 3–5 seasons in all other years except 2003/4 when recorded during only one season (Fig. 5.112; Fig. 5.113). Daily reporting rates ranged from 0.5 to 13.6% with 96.5% bird-days attaining relatively low reporting rates (Fig. 5.112). Median daily reporting rates were similar for all years (Fig. 5.112).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons, but particularly frequent during autumn with a lesser secondary peak centred on mid-spring (Fig. 5.112). The median daily reporting rates for all seasons were less than 2% (Fig. 5.112).

Daily occurrence of drainage line birds heard in the grassland: Overall, most frequently recorded between sunrise and late morning with no activity noted after sunset (Fig. 5.112). Activity was seasonally also frequent in the late afternoon during certain seasons (Fig. 5.114). Bird-segment combinations occurring during more than 5% bird-days involved single segments S0–S4, collectively accounting for nearly half of all bird-days. These combinations occurred most frequently during autumn or early winter (Fig. 5.115).

The first activity of the day usually occurred during the morning (Fig. 5.114). The timing of the last activity of the day was more variable (Fig. 5.114).

Daily segment reporting rates ranged from 5.6 to 80.0% with 92.6% of the values relatively low (Fig. 5.112). Apart from a relatively low value before sunrise, the median daily segment reporting rate was similar for all other segments (Fig. 5.112).

Early morning occurrence of drainage line birds heard during 2007/8: Activity was much more frequent in the drainage line than in the grassland (65.1% vs. 7.0% bird-mornings; Table 5.19b & c). The median early morning reporting rate was higher in the drainage line too (Fig. 5.116). In the drainage line activity was virtually limited to late summer, autumn and winter (Fig. 5.116). Whereas the first activity usually occurred 20 or more minutes before sunrise in the drainage line, it always occurred after sunrise in the grassland (Fig. 5.116). Activity intensity tended to be higher before sunrise (Fig. 5.116).

Birds seen in the grassland: Recorded on 2.9% of the days with an activity index of two (Table 5.19a). Recorded during six years, most frequently in 2002/3 when encountered during seven seasons compared to the 0–3 bird-seasons of other years (Fig. 5.117). Not recorded during summer and encountered throughout the day (Fig. 5.117).

Discussion

The activity of drainage line birds measured in the grassland seems to be representative of the true activity in the drainage line, at least at a broad, overall level (Fig. 5.112; Fig. 5.113; Fig. 5.116).

According to Wiggins (2000) the Ashy Tit is most vocal during the breeding season, which in South Africa apparently peaks from October to November [mid-spring to early summer] (Tarboton 2001). At Glen, however, vocal activity was particularly frequent during autumn, with a much less extensive peak in mid- or late spring (Fig. 5.112; Fig. 5.116). A possible explanation for this pattern is as follows. There are two periods of high vocal activity, one associated with nesting — it is known that the male would sing throughout the incubation period and at least to the early nestling stage (Wiggins 2000) — and a second, more extensive, vocal period some time after breeding. In between these two periods is a silent period spanning summer, which is probably related to moult. Nothing is apparently known about the moult in this species (Dean 2005m), but other southern African *Parus* species are known to undergo a complete post-breeding moult (Hockey *et al.* 2005; Tarboton 1981). If the same were true for the Ashy Tit, it would mean that moulting occurs in summer. This, perhaps, explains the dearth of records of birds seen in the grassland (Fig. 5.117), as well as the infrequent occurrence of vocal activity

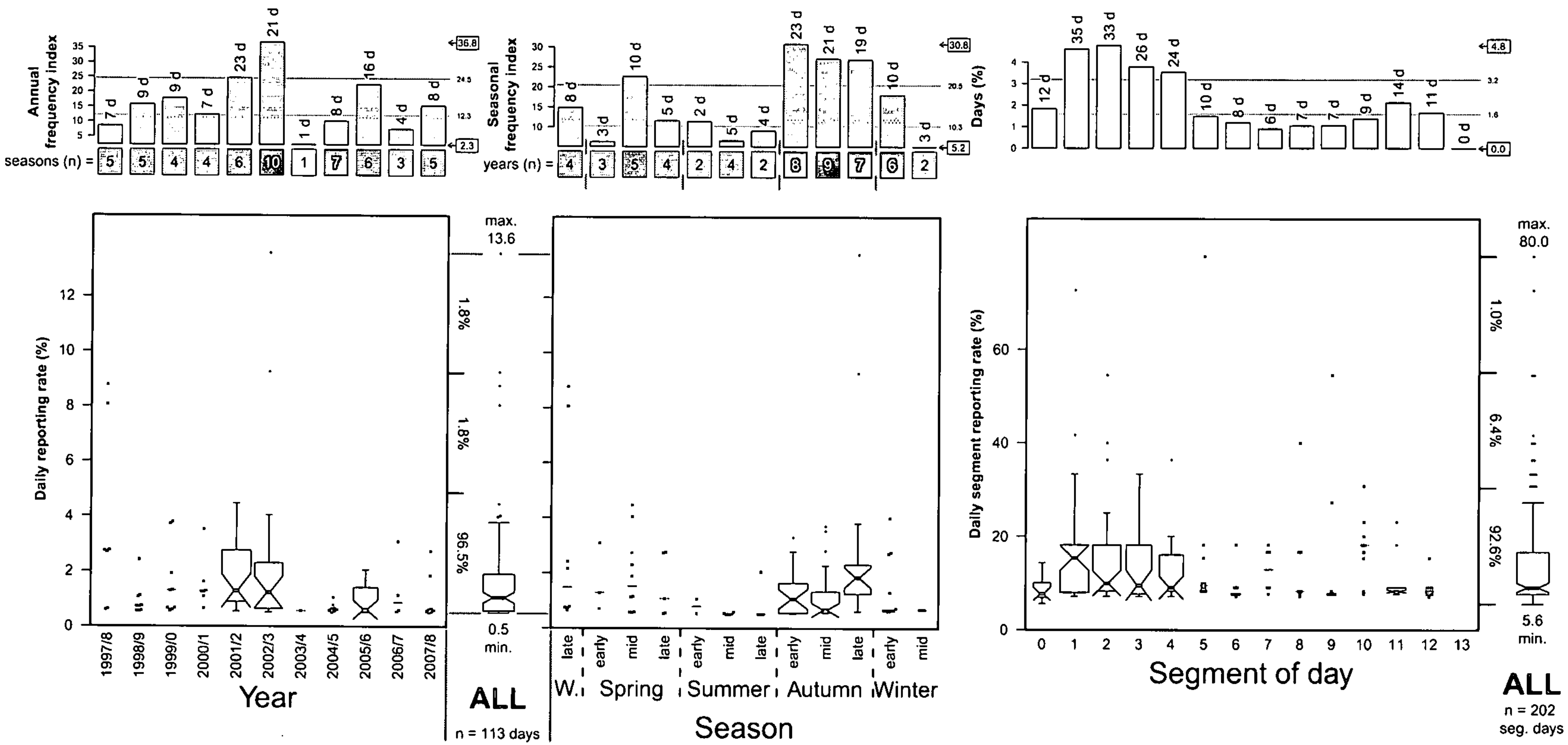


Figure 5.112: R552 Ashy Tit — drainage line bird heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

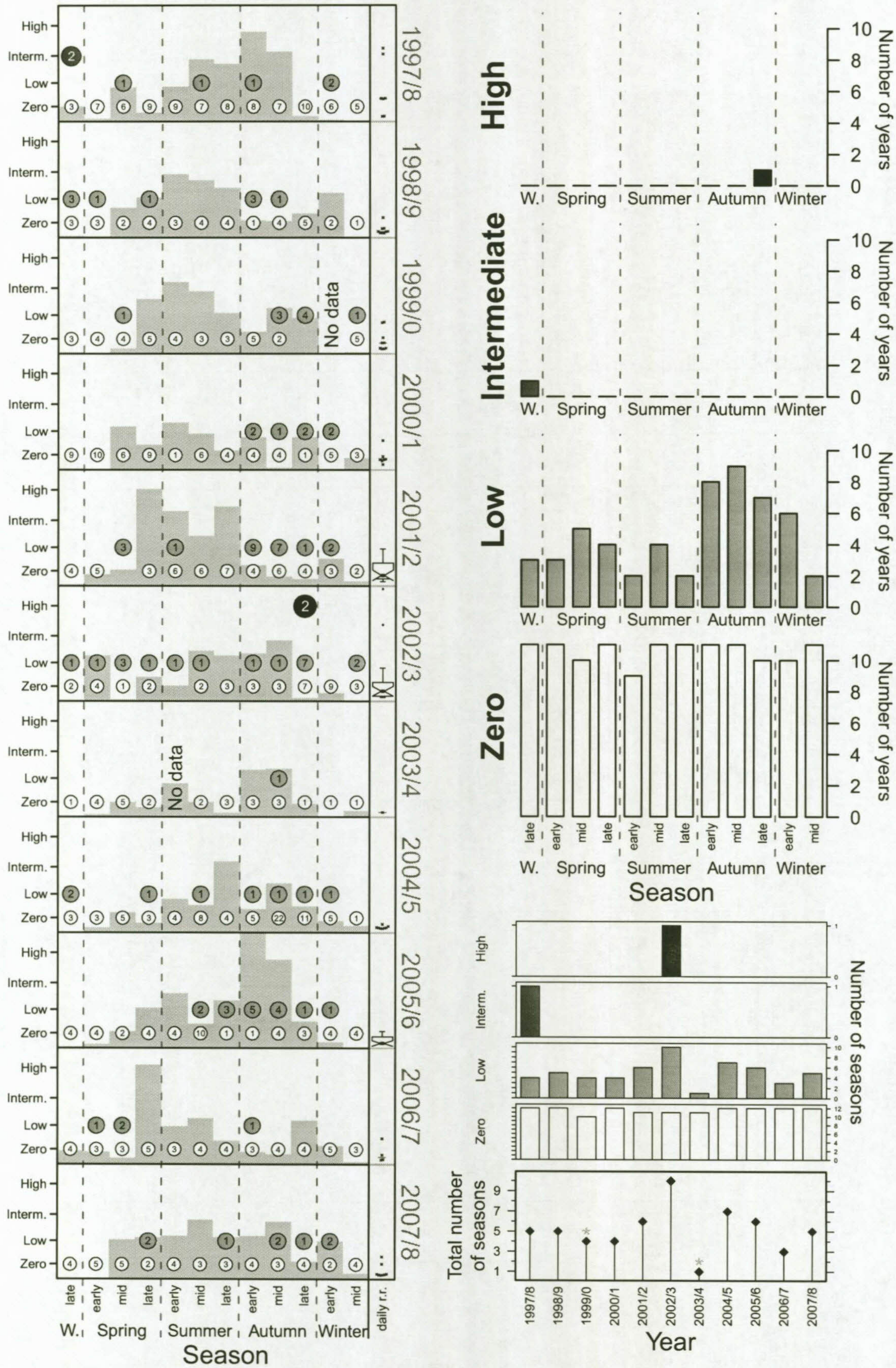


Figure 5.113: R552 Ashy Tit — drainage line bird heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

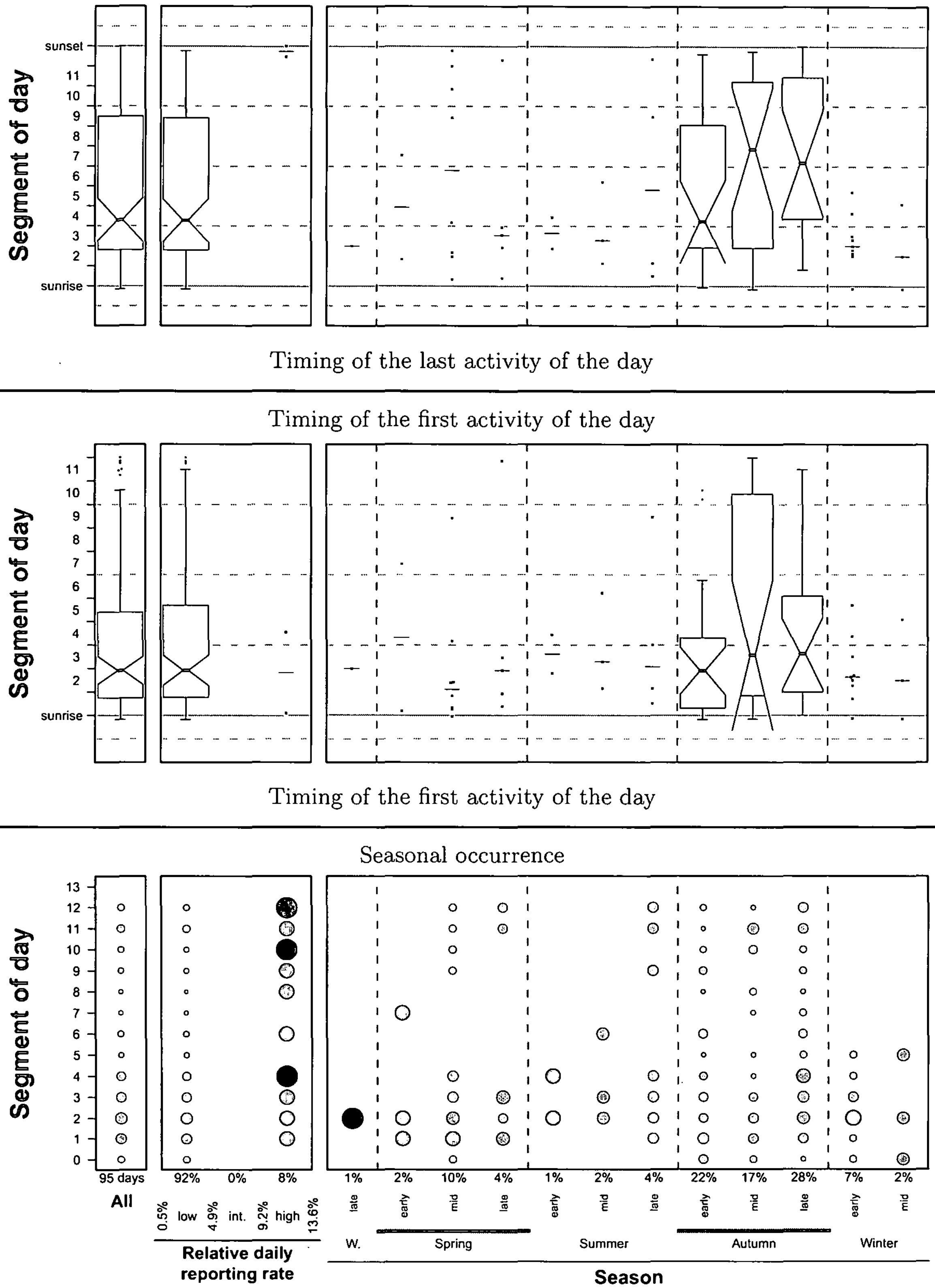


Figure 5.114: R552 Ashy Tit — drainage line bird heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

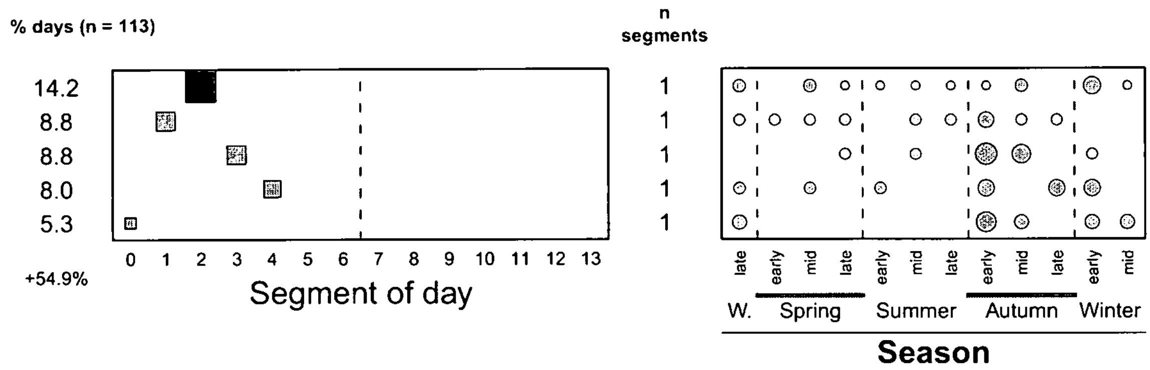


Figure 5.115: R552 Ashy Tit — drainage line bird heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

during that season (Fig. 5.112). The peak in activity during autumn (Fig. 5.112) would then follow on moult, and possibly represent a period when the birds forage more widely in the drainage line and beyond. The data further suggests that there is again a silent period before the next breeding season (Fig. 5.112; Fig. 5.116). Thus, the annual cycle appears to be vocal & breeding → moult & silent → vocal → silent.

Ashy Tit activity appears to be affected by rainfall too. Note that activity occurred during most seasons from early autumn 2001/2 to mid-winter 2002/3 (Fig. 5.113). Although activity was most frequent during the latter year (Fig. 5.112; Fig. 5.117), it followed on the abundant late spring and summer rains of 2001/2 (Fig. 5.113). A second peak period involved 2004/5 and 2005/6 (Fig. 5.112), and there, too, activity was recorded for a few consecutive seasons after good rains in late summer 2004/5 and early summer 2005/6, respectively (Fig. 5.113). It is possible that rainfall, perhaps specific rainfall events, also stimulated activity during other years, particularly during autumn (Fig. 5.112; Fig. 5.113).

R557 Cape Penduline-Tit .... *Anthoscopus minutus*

The Cape Penduline-Tit occurs in south-western Angola (Dean 2000), Namibia, Botswana, south-western Zimbabwe and South Africa (Barnes & Herremans 1997; Earlé & Grobler 1987). In the Free State it occurs marginally in the north, west and south, but also recorded from a few localities in the central parts of the province (Barnes & Herremans 1997; Earlé & Grobler 1987). It is associated with arid and semi-arid habitats where it appears to be resident (Barnes & Herremans 1997).

The birds at Glen

The high-pitched vocalisations of the Cape Penduline-Tit always betrayed their presence. Most often seen as pairs, but single birds and groups of up the 10 birds were also recorded. The larger groups were particularly frequent during early and mid-winter. Figures start on page 717.

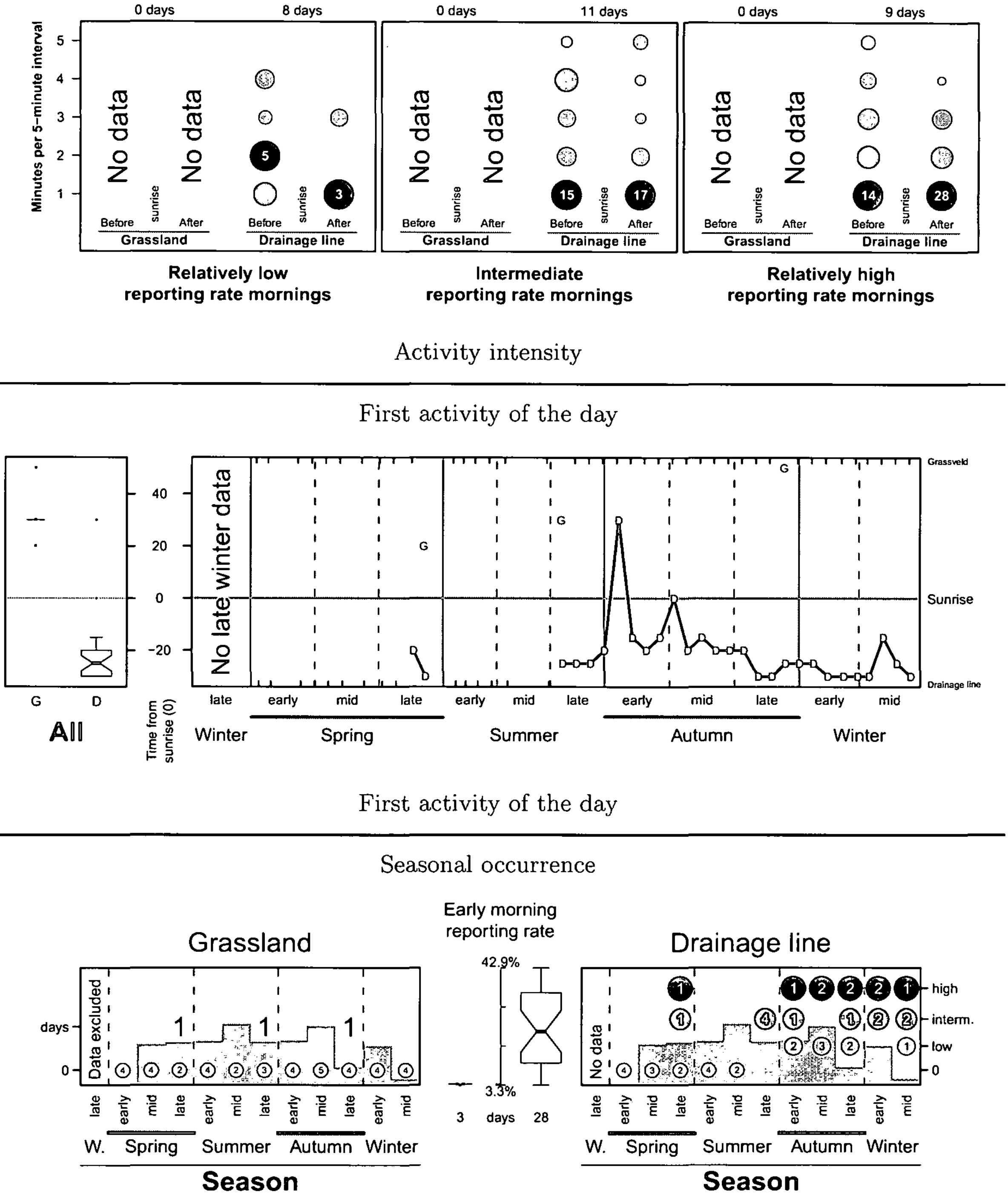


Figure 5.116: R552 Ashy Tit — drainage line bird heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

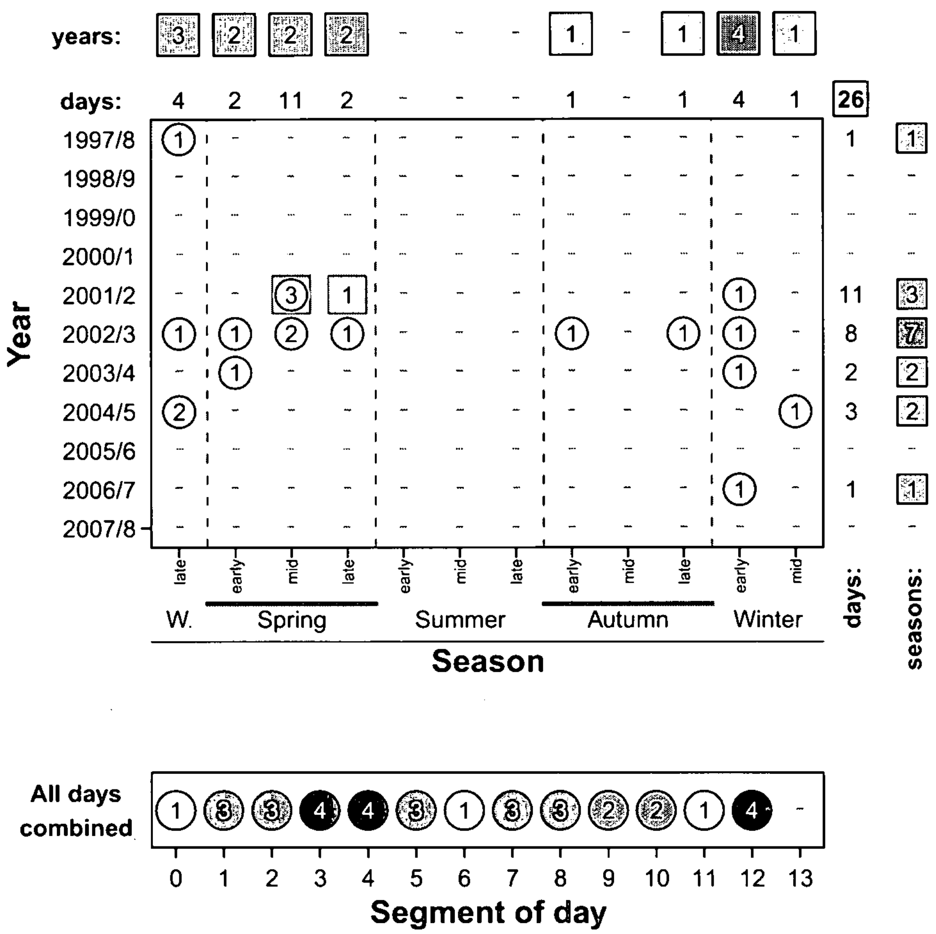


Figure 5.117: R552 Ashy Tit — birds in the grassland: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Table 5.20: R557 Cape Penduline-Tit: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	261	114 612	0.2	birds present	13.3	656	87	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 190	0.4	birds present	7.0	43	3	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	7	1 188	0.6	birds present	11.6	43	5	1

Annual occurrence of birds in the grassland: Recorded on 13.3% of the days with an activity index of three (Table 5.20a). Found during all years except 2000/1. Particularly frequent during 2001/2, 2003/4–2005/6 and 2007/8 when recorded during 7–8 seasons compared to the 0–4 bird-seasons of other years (Fig. 5.118; Fig. 5.119). Daily reporting rates ranged from 0.5 to 15.6%

with 95.4% bird-days attaining low reporting rates; The median daily reporting rate of 2003/4 was particularly high (Fig. 5.118).

Seasonal occurrence of birds in the grassland: Recorded during 4–5 years in most seasons from mid-spring to early winter, the exceptions being mid- and late spring and late autumn when recorded during 6–7 years (Fig. 5.118). Recorded during only 1–2 years in mid-winter, late winter and early spring (Fig. 5.118). Although the daily reporting rates of late spring tended to be higher than that of most other seasons, median daily reporting rates were similar for all seasons (Fig. 5.118).

Daily occurrence of birds in the grassland: Activity was slightly more frequent during the early morning after sunrise than thereafter, and did not occur after sunset (Fig. 5.118). The pattern varied seasonally (Fig. 5.120). Bird-segment combinations occurring during more than five bird-days were limited to five single morning segments, which collectively accounted for nearly half of all bird-days (Fig. 5.121).

The first activity of the day often occurred during the morning, while the occurrence of the last activity of the day was variable (Fig. 5.120).

Daily segment reporting rates ranged from 5.6 to 70.0% with 89.9% of the values relatively low; Median daily segment reporting rates showed limited variation amongst the segments (Fig. 5.118).

Early morning occurrence of birds during 2007/8: Activity was equally infrequent in the drainage line and the grassland (Table 5.20b & c).

Discussion

The Cape Penduline-Tit's breeding season varies regionally, and in arid areas the birds may breed opportunistically after rain (Maclean 1985). Moult occurs from October to May [mid-spring to early winter] (Austin 1978), which overlaps perfectly with the time of peak activity at Glen as shown in Figure 5.118. This also means that the time when the birds were least frequent at Glen (*i.e.* mid-winter to early spring) was when the birds were not moulting. A possible explanation for these patterns is that the birds wander more widely when they are moulting in order to satisfy their higher energy demands, perhaps searching for specific types of food.

According to Barnes & Herremans (1997), the Cape Penduline-Tit appears to be resident throughout its range, but, they add, "presumably it wanders in response to localised rainfall events." This presumption is now confirmed by the data from Glen. However, the relationship between the birds and rainfall is rather complicated. The discussion below is based on Figures 2.13, 5.118 and 5.119.

The study started towards the end of a wet cycle with above average rainfall recorded in 1995/6, 1996/7 and 1997/8, followed by the slightly below average rainfall of 1998/9 and 1999/0 and a very dry 2000/1. During this period the birds were recorded progressively less frequently, from four seasons in 1997/8 to zero in 2000/1. 2001/2 was again an above average rain year when the birds reappeared and were noted during eight seasons, but in the subsequent year, 2002/3,

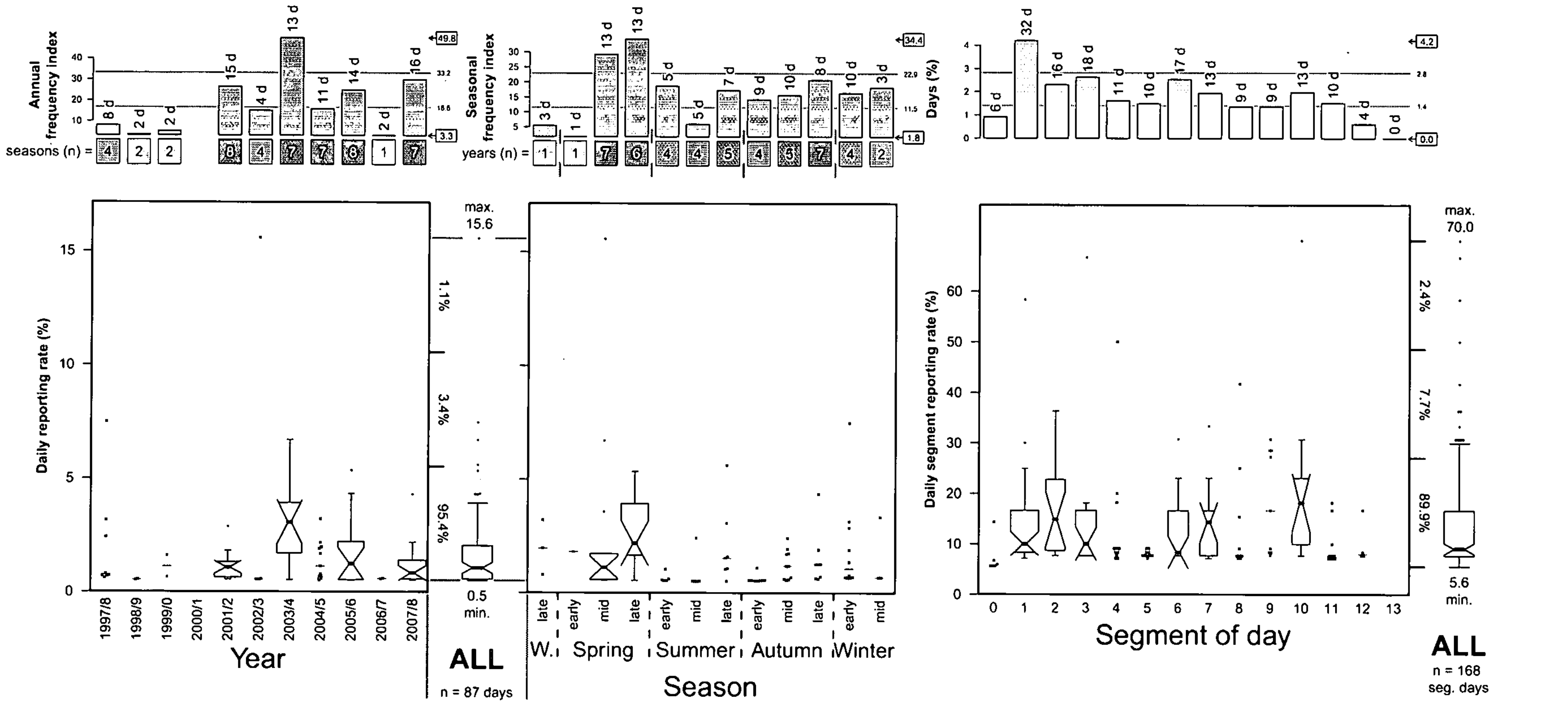


Figure 5.118: R557 Cape Penduline-Tit — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

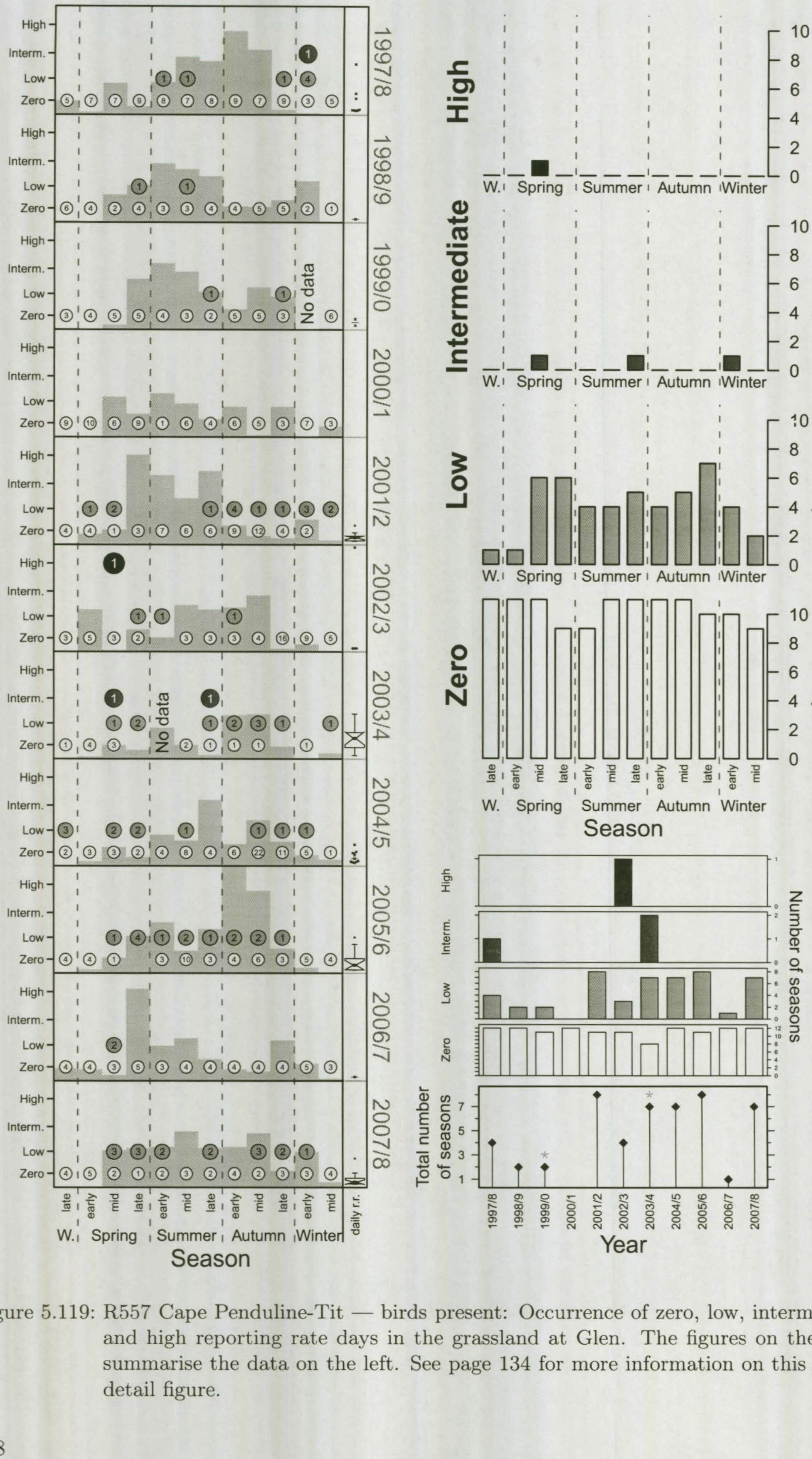


Figure 5.119: R557 Cape Penduline-Tit — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

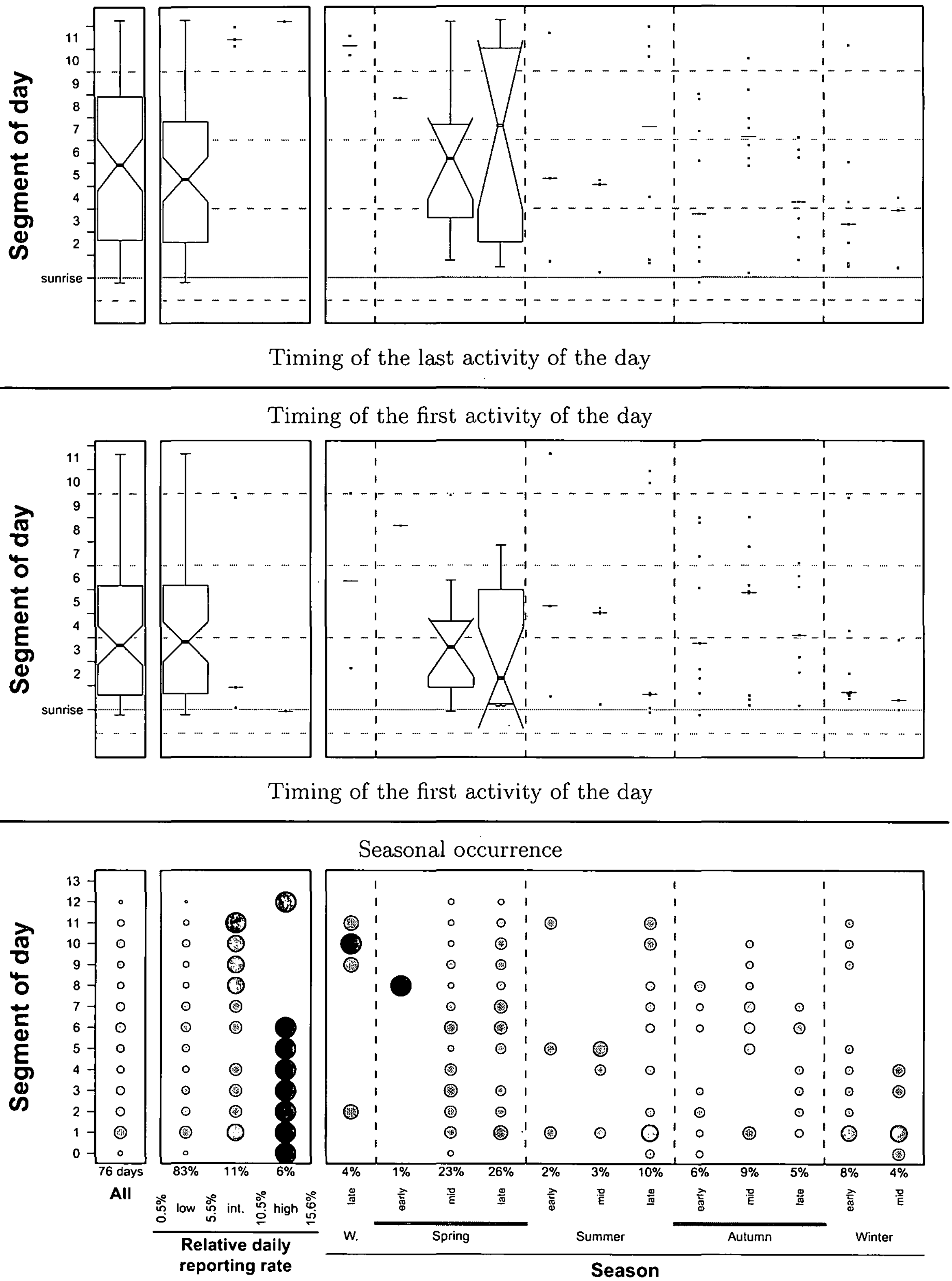


Figure 5.120: R557 Cape Penduline-Tit — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

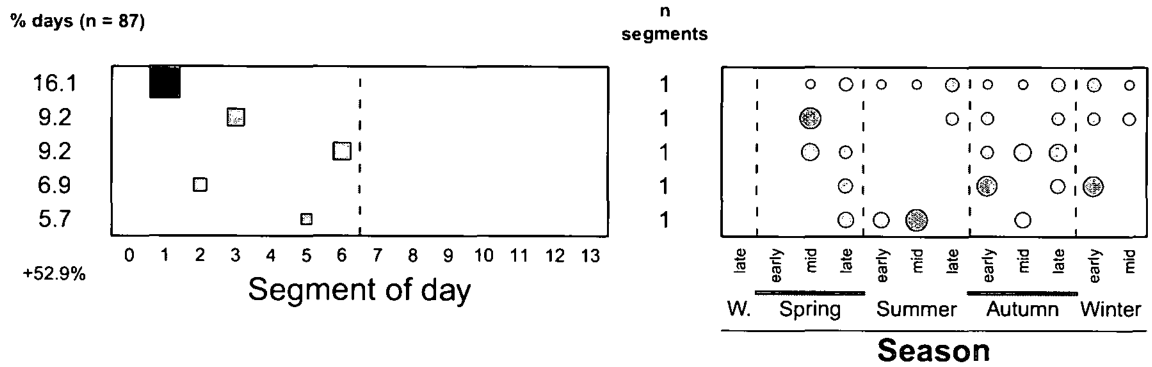


Figure 5.121: R557 Cape Penduline-Tit — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

they were recorded during only four seasons. Then, during 2003/4 (the driest year of the study) and 2004/5 (also a below average rainfall year) activity was noted during seven seasons in each year, and in the following year, 2005/6 (the wettest year of the study), activity was noted in eight seasons. After late autumn 2005/6 the birds were seen again in mid-spring 2006/7, and a year later when they reappeared with the first rains in mid-spring 2007/8. In the latter year, they were recorded during seven seasons.

The data suggest that the timing and duration of dry and wet years are important factors influencing the Cape Penduline-Tits at Glen. High rainfall can have a dual effect. Its immediate effect after a dry spell is to improve conditions for the birds (note in particular the reappearance of the birds in 2001/2), but the nature of the improvement could be such that the habitat becomes unsuitable for them in the year following the wet year. This is presumably what caused the crash in activity in 2006/7 and to a lesser extend in 2002/3. Dry years can reverse this effect and make the habitat more suitable again, and this is presumably what happened in 2003/4. Of course, droughts can render the conditions unsuitable too, as it probably did at the beginning of the study.

5.6 Pycnonotidae: Bulbuls, Nicators

Altogether 136 pycnonotid species occur in the Old World tropics and temperate regions with ten species occurring in southern Africa (Hockey *et al.* 2005). Three species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b) with the Dark-capped Bulbul *Pycnonotus tricolor* confined to the northern and eastern parts and the Sombre Greenbul *Andropadus importunus* to the extreme east of the province. Only the African Red-eyed Bulbul R567 is widespread in the province and the only species recorded at Glen.

R567 African Red-eyed Bulbul .... *Pycnonotus nigricans*

The African Red-eyed Bulbul occurs in south-western Angola (Dean 2000), marginally in the south of Zambia (Keith 1992), and in Namibia, Botswana, western Zimbabwe, Lesotho and

South Africa from the Free State northwards, westwards and southwards (Hart 1997). It is associated with arid and semi-arid habitats with a tree component and water (Hart 1997; Lloyd 2005a; Maclean 1985). They wander widely during the non-breeding season and during droughts (Brewster 1991; Hart 1997; Lloyd 2005a).

The birds at Glen

The African Red-eyed Bulbul was normally associated with the drainage line. However, they do enter the grassland at times, specifically the trampled area where they would drink water at the water manger. In the analysis below, distinction is made between the birds in these two habitats, with the bulk of the grassland data-set (97.9%) involving birds heard in the drainage line (Table 5.21a). Figures start on page 723.

Table 5.21: R567 African Red-eyed Bulbul: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.979	1 235	114 612	1.1	birds in drainage line	47.6	656	312	4
0.021	27	114 612	0.0	birds in the grassland	2.6	656	17	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	519	1 190	43.6	birds in drainage line	100.0	43	43	12
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	54	1 188	4.5	birds in drainage line	46.5	43	20	3

Annual occurrence of drainage line birds heard in the grassland: Recorded on 47.6% of the days with an activity index of four (Table 5.21a). Usually recorded during 9–11 seasons per year, but during only 6–7 seasons in 2003/4 and 2004/5 (Fig. 5.122; Fig. 5.123). Daily reporting rates ranged from 0.5 to 20.0% with 95.5% bird-days attaining low reporting rates; Median daily reporting rates were similar for all years and 20005/6 was the only year with a high reporting rate day (Fig. 5.122; Fig. 5.123).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons, but relatively infrequently (4–6 vs. ≥8 bird-years) in mid-spring, early summer and mid-winter (Fig. 5.122). The seasonal frequency index shows a peak centred on early autumn (Fig. 5.122) when the occurrence of zero record days were also least frequent (Fig. 5.123). Median daily reporting rates were similar for the respective seasons (Fig. 5.122).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity was most frequently recorded before sunrise and only infrequently from mid-morning onwards (Fig. 5.122). This general pattern is mainly a reflection of the situation on low reporting rate days, because on intermediate reporting rate days activity was most frequent before mid-morning, but also not too infrequent thereafter, except after sunset when no activity was recorded (Fig. 5.124). The frequent occurrence of activity before sunrise was particularly prominent during summer, early and mid-autumn (Fig. 5.125). Bird-segment combinations occurring during more than 5% bird-days were limited to four combinations involving early morning segments S0, S1 and S2 (Fig. 5.126). Collectively these combinations account for two-fifths of all bird-days and were most frequent during late winter or autumn, depending on the combination (Fig. 5.126).

The first activity of the day normally occurred during the early morning, earlier on intermediate reporting rate days (before sunrise) than on low reporting rate days (Fig. 5.125). The timing followed a seasonal pattern, being earliest and least variable during late summer and early autumn when the first activity typically occurred more than 15 minutes before sunset, and latest and most variable during winter and spring when it typically occurred in the early morning after sunrise (Fig. 5.125; Fig. 5.127). The dawn chorus sequence followed a very similar pattern (Fig. 5.127). The timing of the last activity of the day (Fig. 5.125) was much more variable than that of the first activity of the day.

Overall, daily segment reporting rates ranged from 5.3 to 66.7% with 85.6% of the values relatively low (Fig. 5.122). The median daily segment reporting rates of all segments was similar (Fig. 5.122; Fig. 5.124).

Early morning occurrence of drainage line birds heard during 2007/8: Activity was more frequent, and median early morning reporting rate higher, in the drainage line than in the grassland (Table 5.21b & c; Fig. 5.128). Moreover, whereas activity as assessed in the grassland showed a clear peak from mid-summer to mid-autumn, the activity in the drainage line was relatively high throughout the year (Fig. 5.128). The timing of the first activity of the day was remarkably constant between the two habitats, but occurred slightly earlier in the drainage line (Fig. 5.128). Activity intensity was higher before sunrise than thereafter (Fig. 5.128).

Birds seen in the grassland: Seen on a total of 18 days spread over six years, with most records from mid-winter to mid-spring (Fig. 5.129). Seen during most segments of the day (Fig. 5.129).

Discussion

In South Africa, African Red-eyed Bulbuls breed mainly from November to January [summer] (Lloyd 2005a). This is apparently followed by moult. The only published information on moulting is that the birds are in active moult from January to June [late summer to mid-winter] (Lloyd 2005a). Limited additional information from birds at Glen and elsewhere in the Free State indicate that primary moult starts towards the end of summer; no data for winter (DJvN unpublished data). It appears, therefore, that the peak in activity in the grassland from mid-summer into autumn (Fig. 5.122; Fig. 5.128), during which time activity is particularly frequent before sunrise (Fig. 5.125), coincides with moult.

The African Red-eyed Bulbul's dependence on water is well-known (Hart 1997; Lloyd 2005a; Maclean 1985), as is its wanderings during the non-breeding season and during droughts (Brewster 1991; Hart 1997; Lloyd 2005a). The relative scarcity of vocal activity at Glen during 2003/4

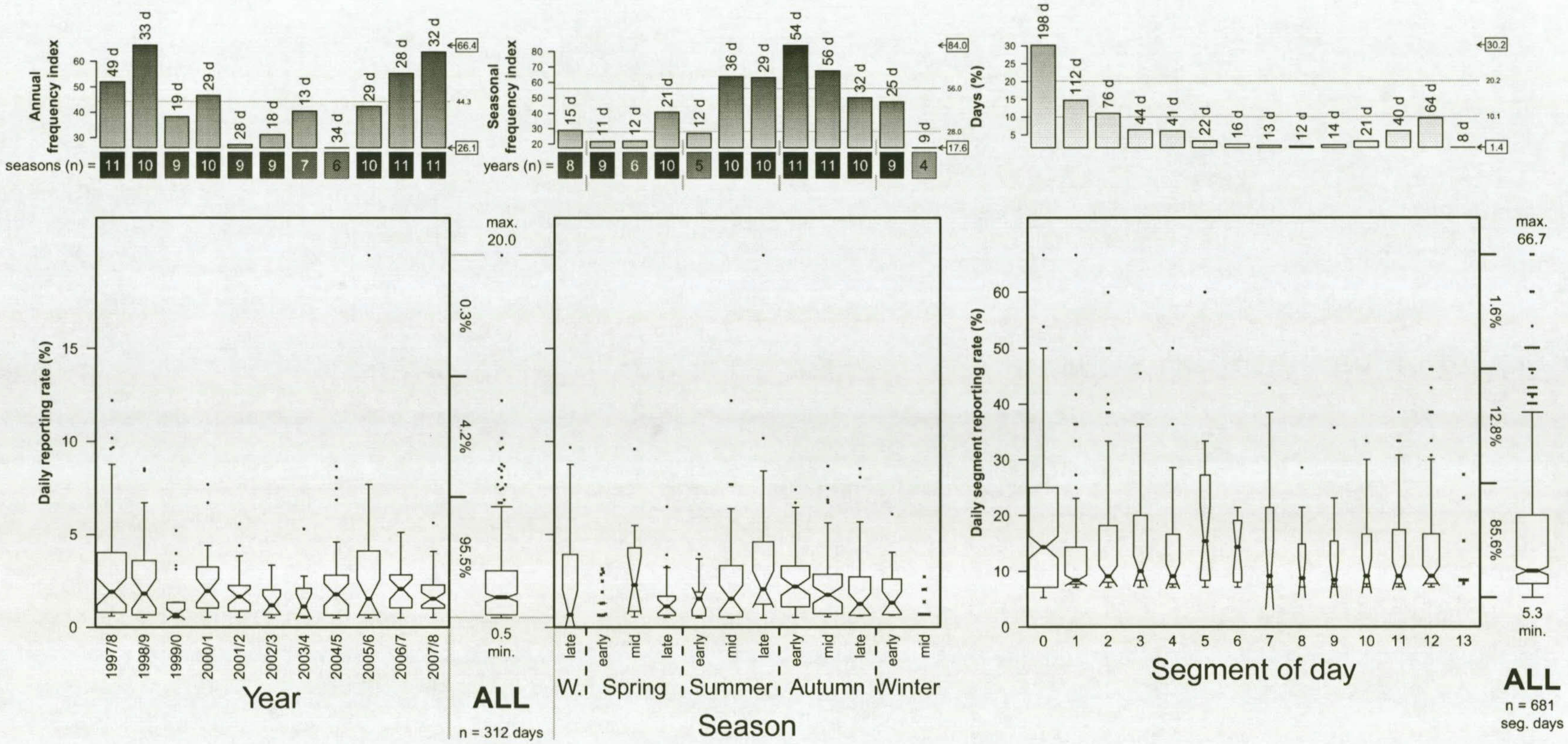


Figure 5.122: R567 African Red-eyed Bulbul — birds in drainage line: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

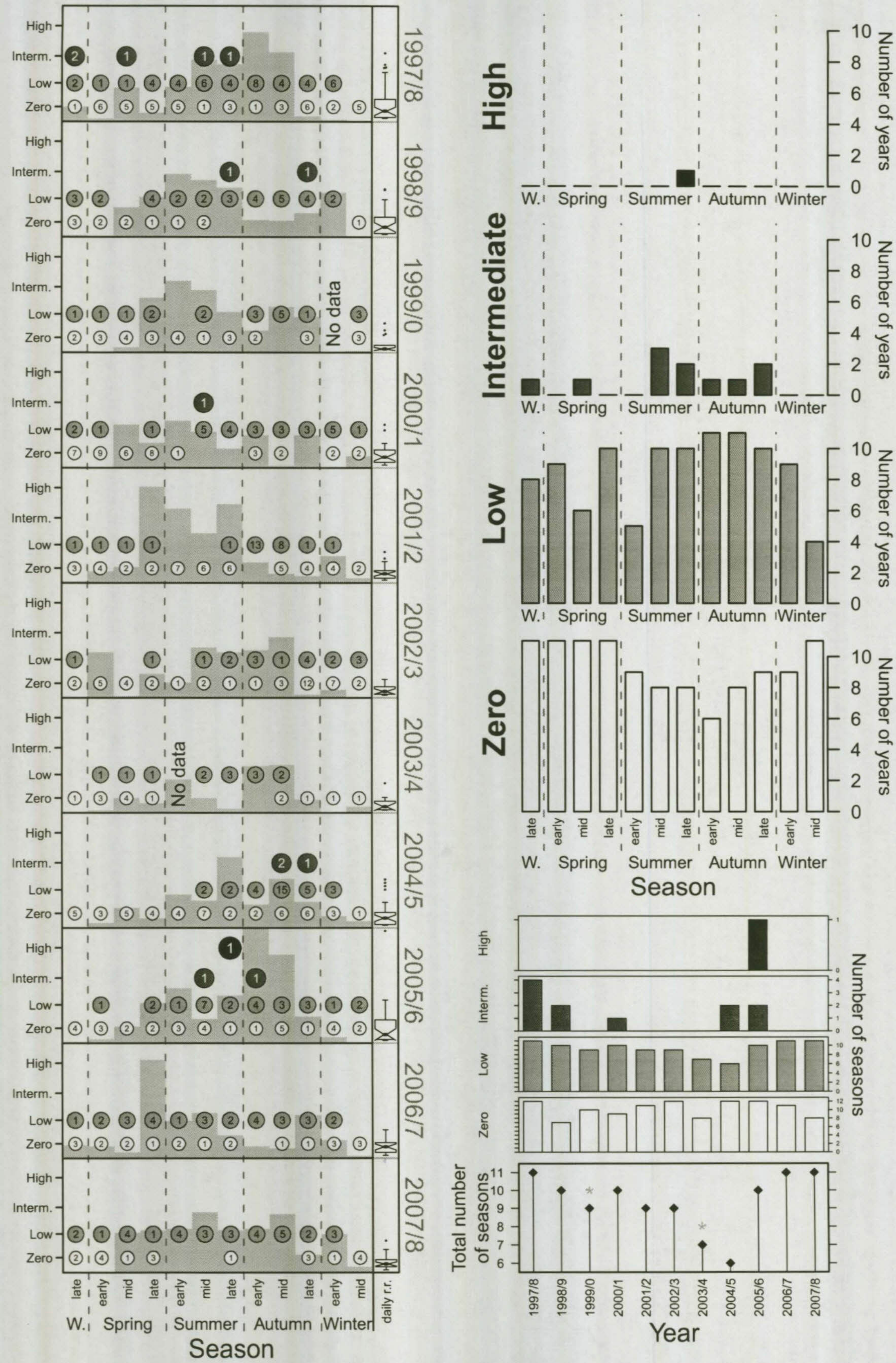


Figure 5.123: R567 African Red-eyed Bulbul — birds in drainage line: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

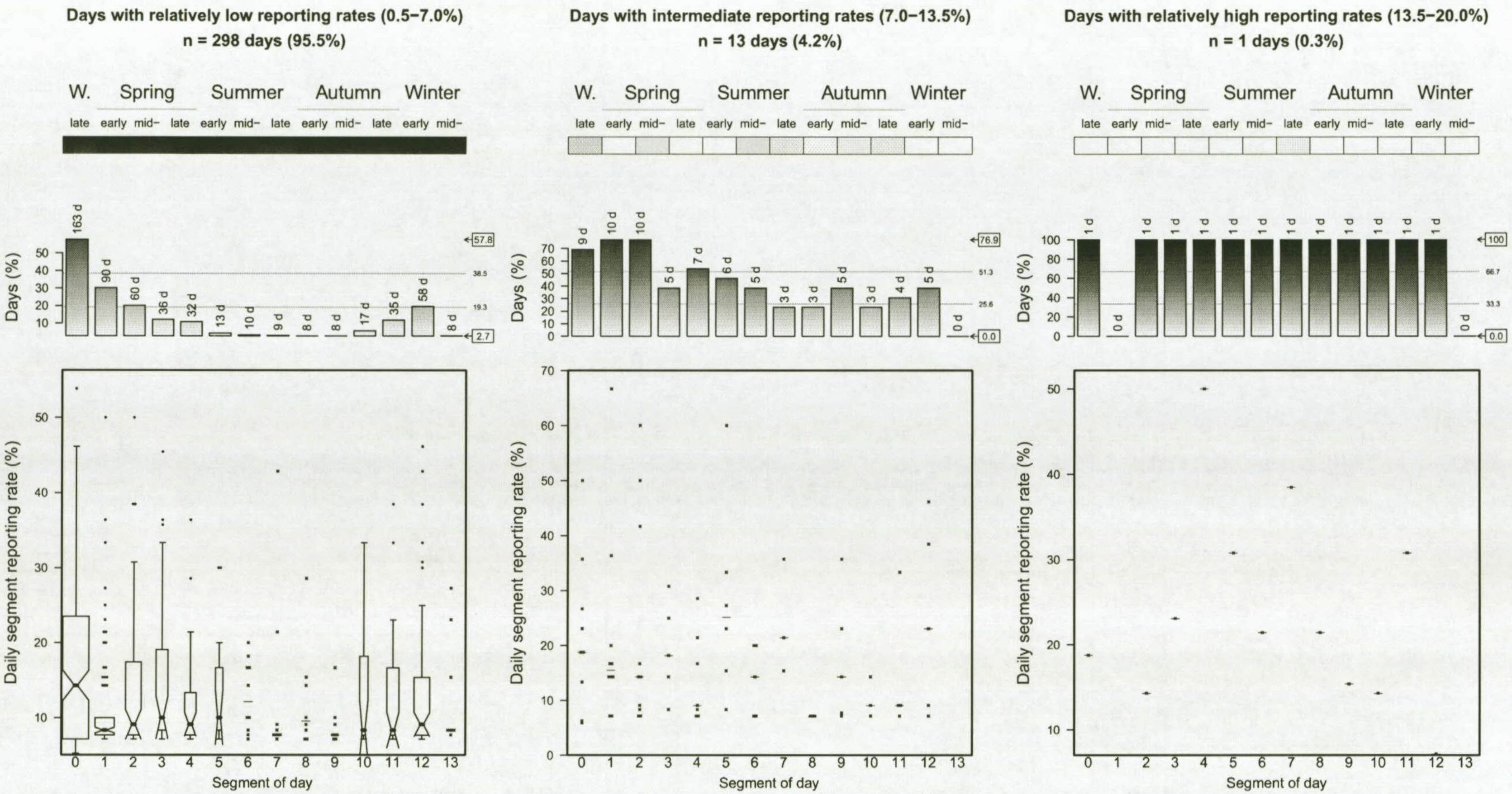


Figure 5.124: R567 African Red-eyed Bulbul — birds in drainage line: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

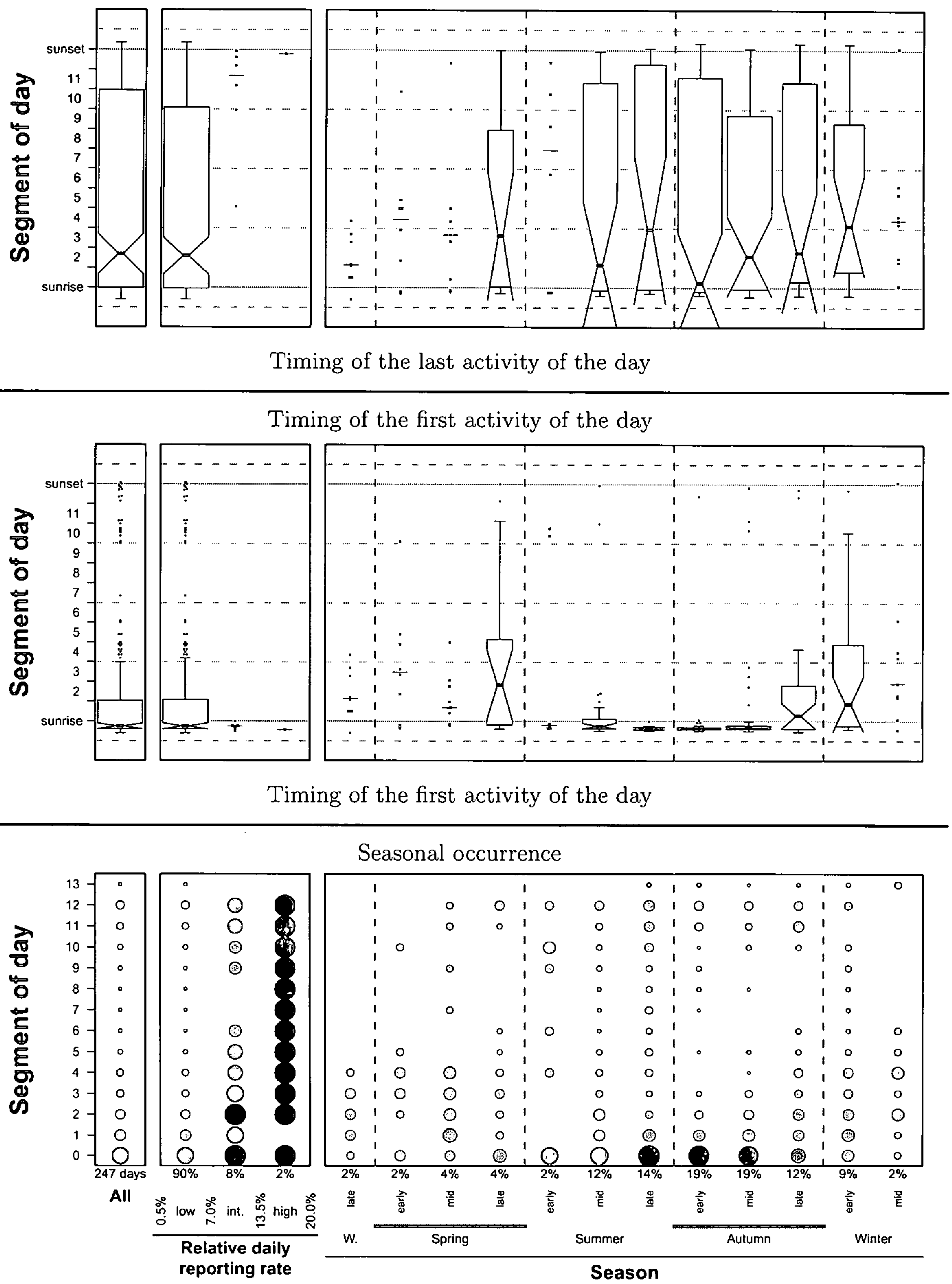


Figure 5.125: R567 African Red-eyed Bulbul — birds in drainage line: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

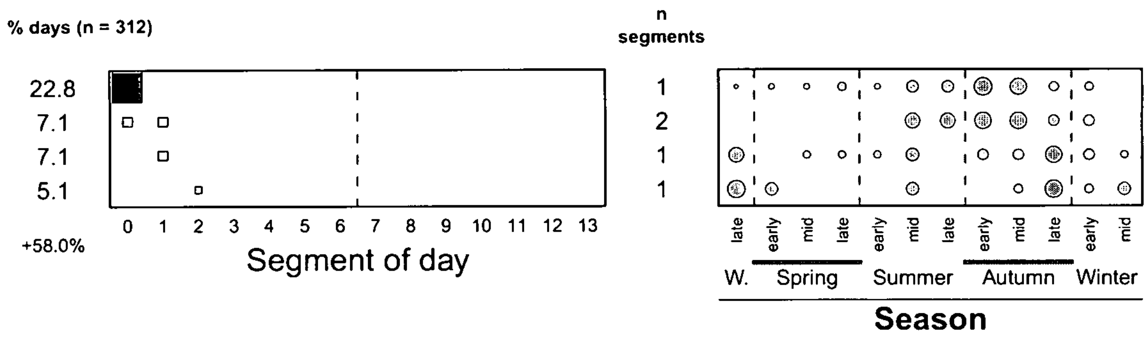
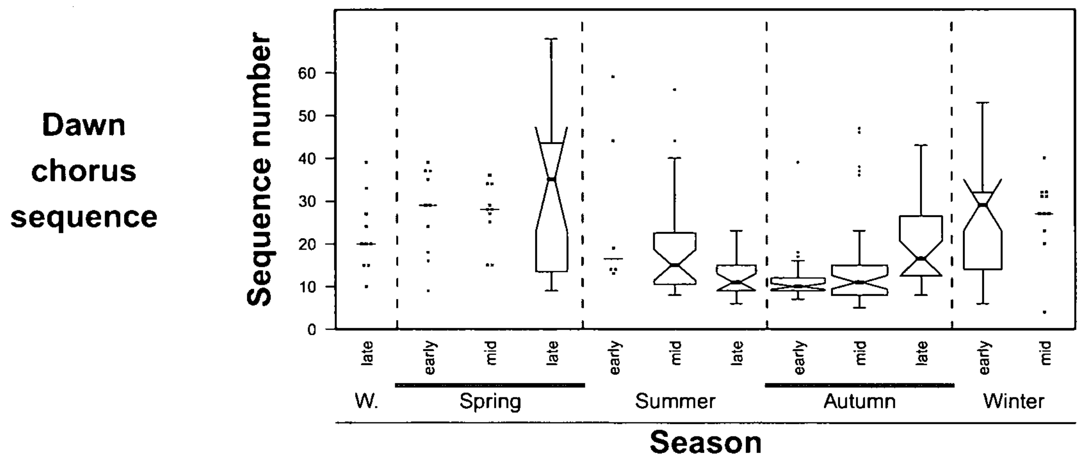


Figure 5.126: R567 African Red-eyed Bulbul — birds in drainage line: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.



Dawn chorus sequence

First activity of the day

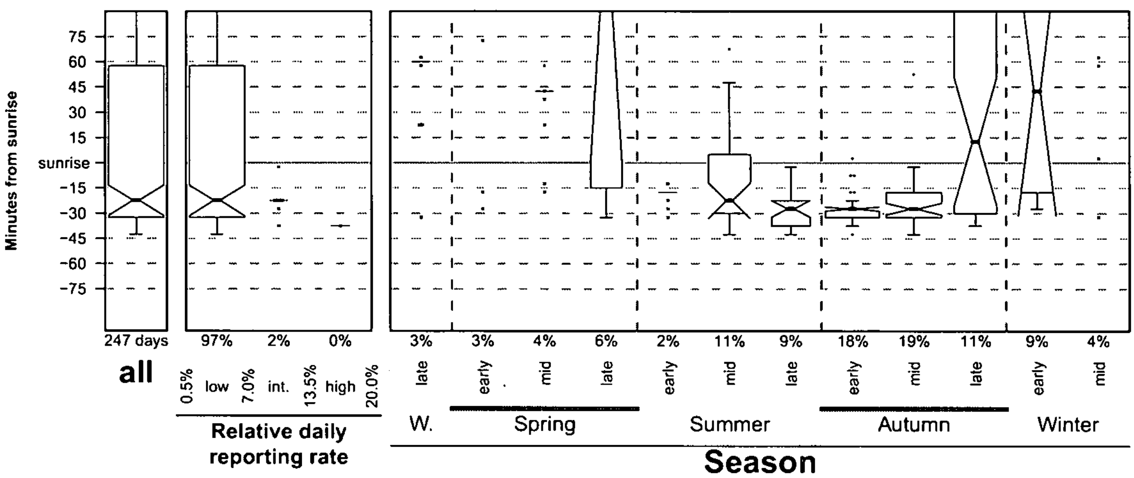


Figure 5.127: R567 African Red-eyed Bulbul — birds in drainage line: Details on the daily occurrence of the first activity of the day (bottom) and the dawn chorus sequence (top) in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

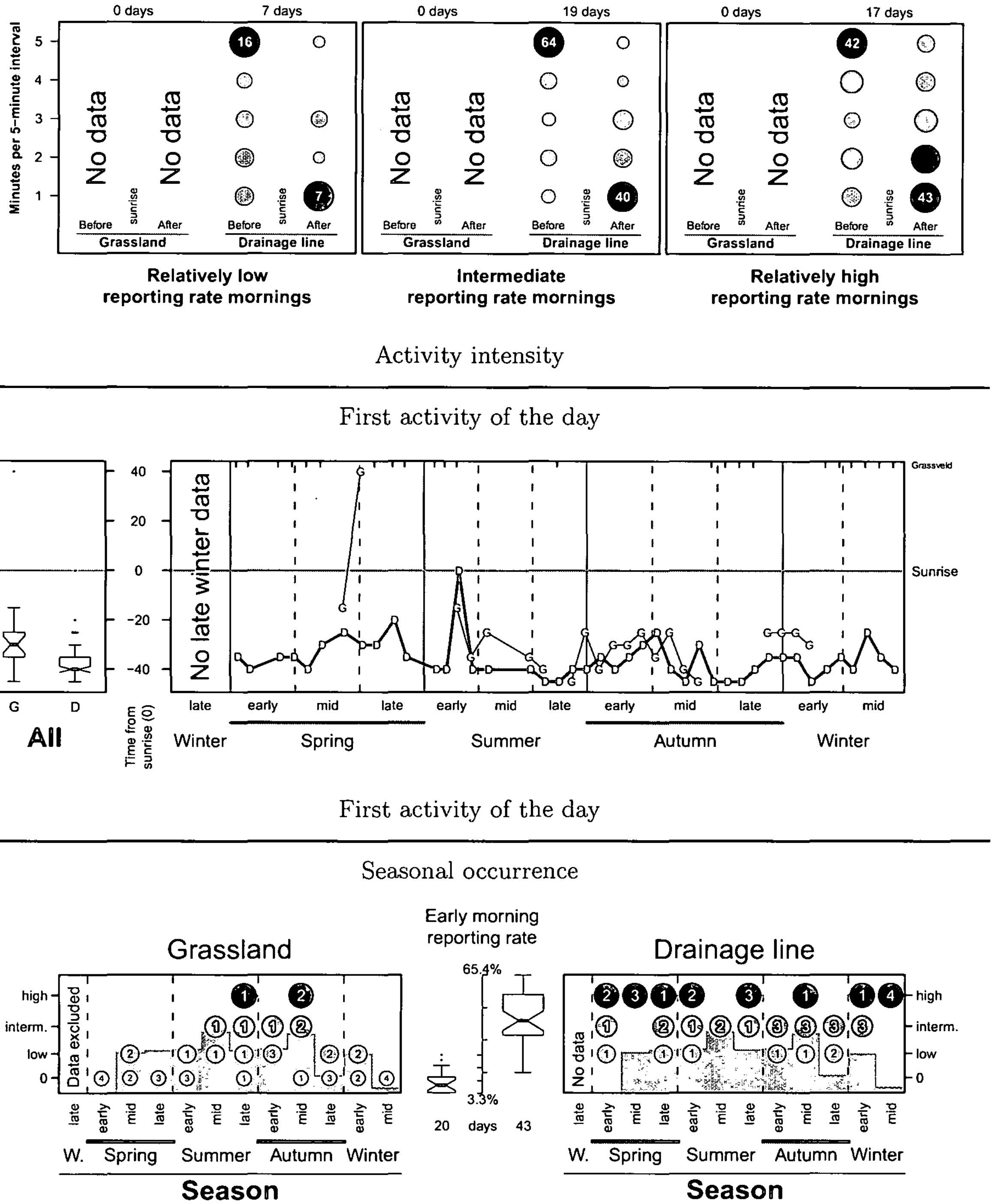


Figure 5.128: R567 African Red-eyed Bulbul — birds in drainage line: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

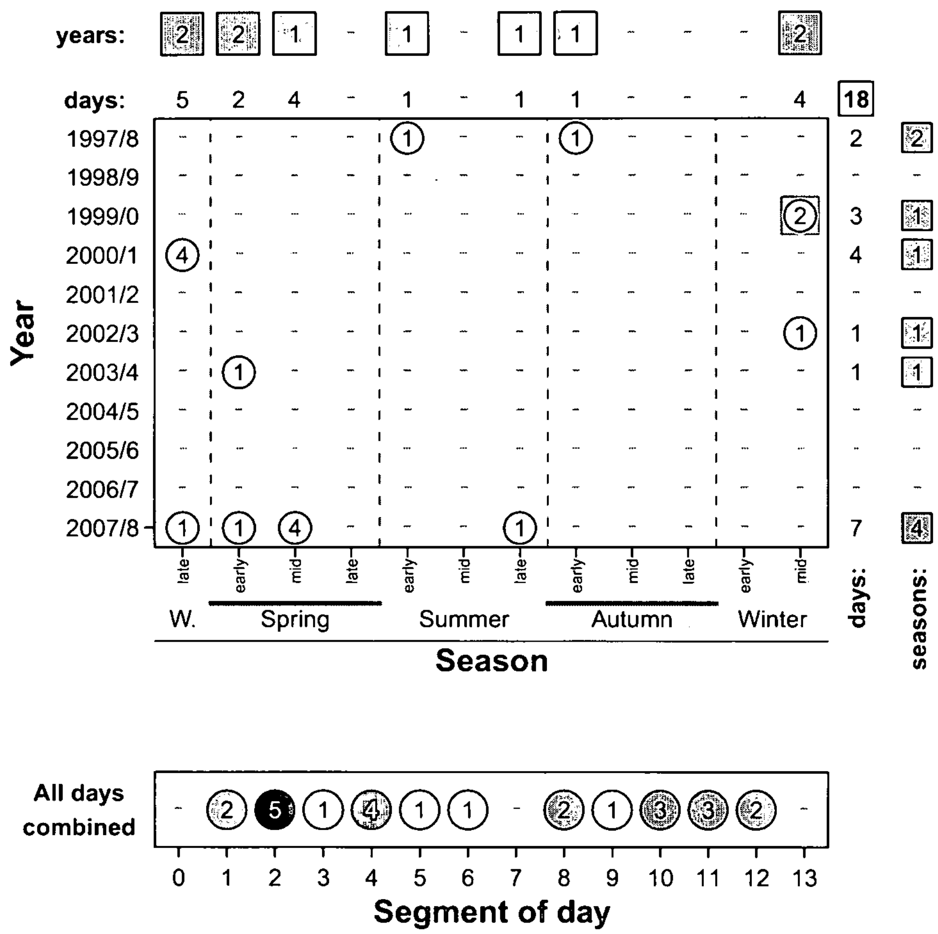


Figure 5.129: R567 African Red-eyed Bulbul — birds in the grassland: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

and 2004/5 (in terms of bird-seasons; Fig. 5.122) is probably related to the dry conditions at the time (Fig. 2.13). But does it represent fewer birds, reduced activity or perhaps both? Data collected during the early mornings of 2007/8 show a surprising contrast between the highly seasonal nature of vocal activity as measured in the grassland versus the relatively aseasonal nature of vocal activity in the drainage line itself (Fig. 5.128). Yet it is also to be noted that in 2007/8 activity was recorded in the grassland during all seasons, except mid-winter (Fig. 5.123). What is needed to resolve the issue is data in the drainage line during a drought year.

5.7 Muscicapidae: Thrushes, Robins, Chats, Old World Flycatchers

The 456 species of the Muscicapidae family occur worldwide except in Antarctica, with 55 species occurring in southern Africa (Hockey *et al.* 2005). Almost half of these species occur in the Free State, and half of them in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). Of the latter species, all except the Mountain Wheatear *Oenanthe monticola* (which occur in the mountains in the east) and the Familiar Chat *Cercomela familiaris* were recorded at Glen. In addition, an out of range Sentinel Rock-Thrush R582 was also recorded in the study area.

R577 Karoo Thrush .... *Turdus smithi*

The Karoo Thrush is endemic to southern Africa, occurring mainly in South Africa from the Free State westward, being replaced along the coast by the similar looking Olive Thrush *Turdus olivaceus* (Bonnevie *et al.* 2004; Bowie *et al.* 2003). The Karoo Thrush is associated especially with riverine *Acacia* woodlands and associated scrubby growth, and gardens (Bowie *et al.* 2003). It is mostly a resident species (Johnson 2005a).

The birds at Glen

Karoo Thrush records are limited to birds heard (seldom seen) in the drainage line. During the early mornings of 2007/8, activity was recorded on 11 mornings spread throughout the year.

Discussion

There appears to be no published information on moult in the Karoo Thrush (see Johnson 2005a). Limited data from Glen and Bloemfontein (DJvN) show that adults start moulting in mid-summer; no data for autumn or winter. Breeding occurs mainly from September to December [mid-spring to early summer] (Tarboton 2001).

R582 Sentinel Rock-Thrush .... *Monticola explorator*

The Sentinel Rock-Thrush occurs from Mpumalanga and western Swaziland south through the western and southern parts of KwaZulu-Natal, the eastern Free State, Lesotho (the core of its distribution), the southern Free State, Eastern Cape and further west to the Western Cape (Harrison 1997c). The study area at Glen is situated approximately 90 km outside its known range. Habitat preferences include rolling alpine grasslands and wetlands (Dean 2005ab; Van Niekerk 2004), and during the cooler parts of the year it may move down to grassland at lower altitudes (Tarboton *et al.* 1987).

The birds at Glen

As single male was seen in the grassland and trampled area on 20 and 27 May 2000 (early winter 1999/0). Its feathers were subsequently found in a hollowed out anthill; it had obviously fallen prey to a predator.

Discussion

Two sub-species of the Sentinel Rock-Thrush occur in southern Africa (Clancey 1980; Dean 2005ab). The distribution map in Dean (2005ab) shows that *M. e. tenebriformis* is thought to be limited to the highlands of Lesotho, the eastern Free State, KwaZulu-Natal and the southern parts of Mpumalanga, and *M. e. explorator* to the rest of the species' southern African range, including Gauteng, the northern parts of Mpumalanga as well as the southern Free State.

Clancey (1957) suggested that "*M. e. tenebriformis* is confined as a breeding bird to the high mountains of Basutoland, and winters in Natal, Zululand, southern Portuguese East Africa and adjacent regions." However, in their study on the birds of the Natal Alpine Belt, Brown & Barnes (1984) found that the "winter and summer counts for this species are exactly the same". The authors then continued by commenting on Clancey (1957): "Either the birds recorded wintering in the above-mentioned areas [referring to Clancey (1957)] are from some other region (*i.e.* not from the Lesotho highlands) or this winter movement only takes place in years of extreme cold and heavy snowfalls." Importantly, they noted that the years in which they counted the birds were particularly warm and dry, with light snowfalls that melted within a few days. They then added that the mild conditions might have resulted in atypical patterns of bird movements (Brown & Barnes 1984).

An analysis of SABAP1 data reveals the following regarding the seasonal changes in distribution in South Africa (see Fig. 5.130): 1) The proportion of QDGS in which the birds are recorded remain reasonably constant throughout the year in the Western and Eastern Cape, indicating that there are no major influxes (or outward movements) of birds in these areas; 2) Compared to the warmer months, there was a 3–6 fold increase in the proportion of QDGS during June, July and/or August in the southern Free State, eastern Free State, KwaZulu-Natal, southern Mpumalanga and Gauteng, suggestive of influxes of birds into these regions; 3) The percentage QDGS in the northern parts of Mpumalanga varied a bit but did show a slight peak in September.

Overall, the SABAP1 data suggest that influxes occur into the Free State and other parts of the species' range during the cooler times of the year (Fig. 5.130). It is likely that most of these birds originate from the highlands of Lesotho where they are less frequently reported in the cooler times of the year (Tarboton *et al.* 1993; Van Niekerk 2003, 2004). It is considered unlikely that the influxes involve birds from the Eastern Cape because SABAP1 data do not suggest a convincing seasonal trend for that province, which is in contrast to the occurrence of birds in the southern Free State where they are most widespread during the cooler times of the year and absent during the warmer months (Fig. 5.130). It is suggested, therefore, that the bird recoded at Glen during early autumn was from Lesotho. Significantly, a review of the temperatures from the weather station at Glen indicates that the individual's occurrence at Glen could have been related to cold fronts that passed through the area at that time. Similar movements were implied for the Red-capped Lark (see on page 635).

R587 Capped Wheatear .... *Oenanthe pileata*

The Capped Wheatear is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in Namibia, Botswana, Zimbabwe and South Africa from the central Free State northwards, westwards and southwards (Harrison & Herremans 1997); the study area at Glen is on the edge of its distribution. It occurs in open areas with bare ground, including those resulting from trampling or overgrazing (Harrison & Herremans 1997). The birds occurring in the Free State are mostly migrants or nomads — presumably from their breeding grounds elsewhere in southern Africa (see Harrison & Herremans 1997) — that may visit an area for a few months before disappearing (Earlé & Grobler 1987).

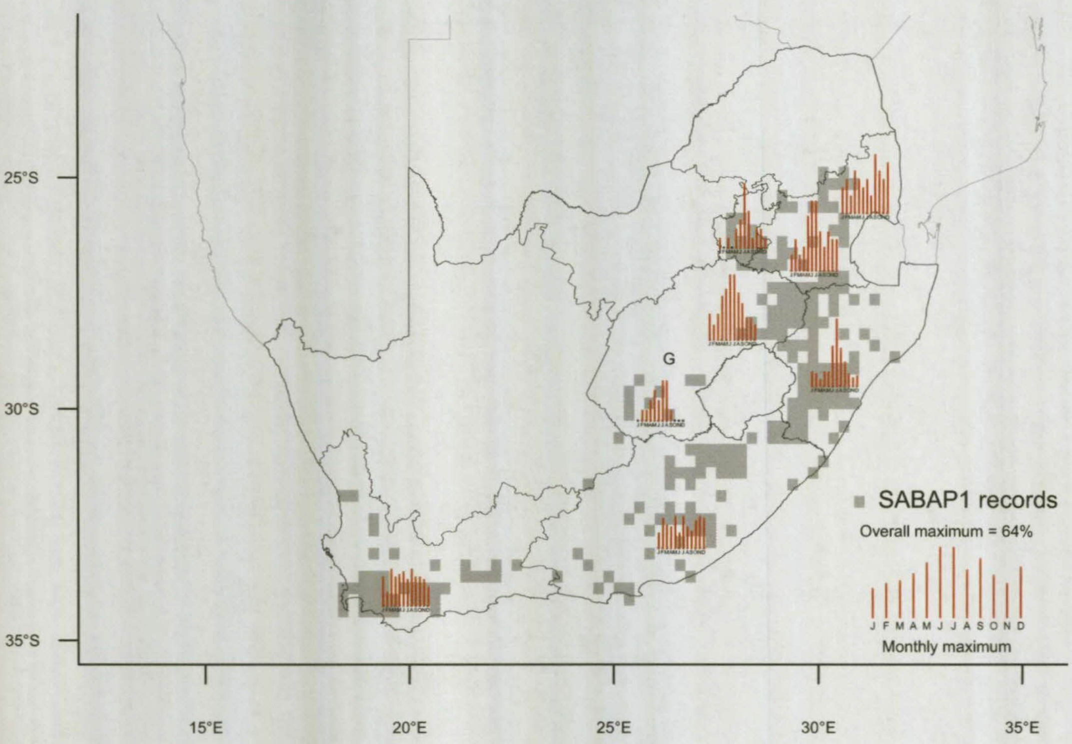


Figure 5.130: R582 Sentinel Rock-Thrush: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

The birds at Glen

Typically recorded as single birds (less often two) in the trampled area, often juveniles. Recorded on 40 days spread over six years, and in all seasons except early and mid-spring and late autumn (Fig. 5.131). Encountered during all segments of the day between sunrise and sunset (Fig. 5.131).

Discussion

The occurrence of the Capped Wheatear at Glen was typical of the birds in the Free State as described by Earlé & Grobler (1987): "... mostly a migrant or nomad visiting an area for a few months before disappearing".

Nothing is apparently known of the moult of southern African birds, with Dean (2005ad) citing moult data from southern Tanzania, western Zambia and the southern Democratic Republic of the Congo only. At Glen, an adult ringed in late summer 1994/5 was halfway through its primary moult.

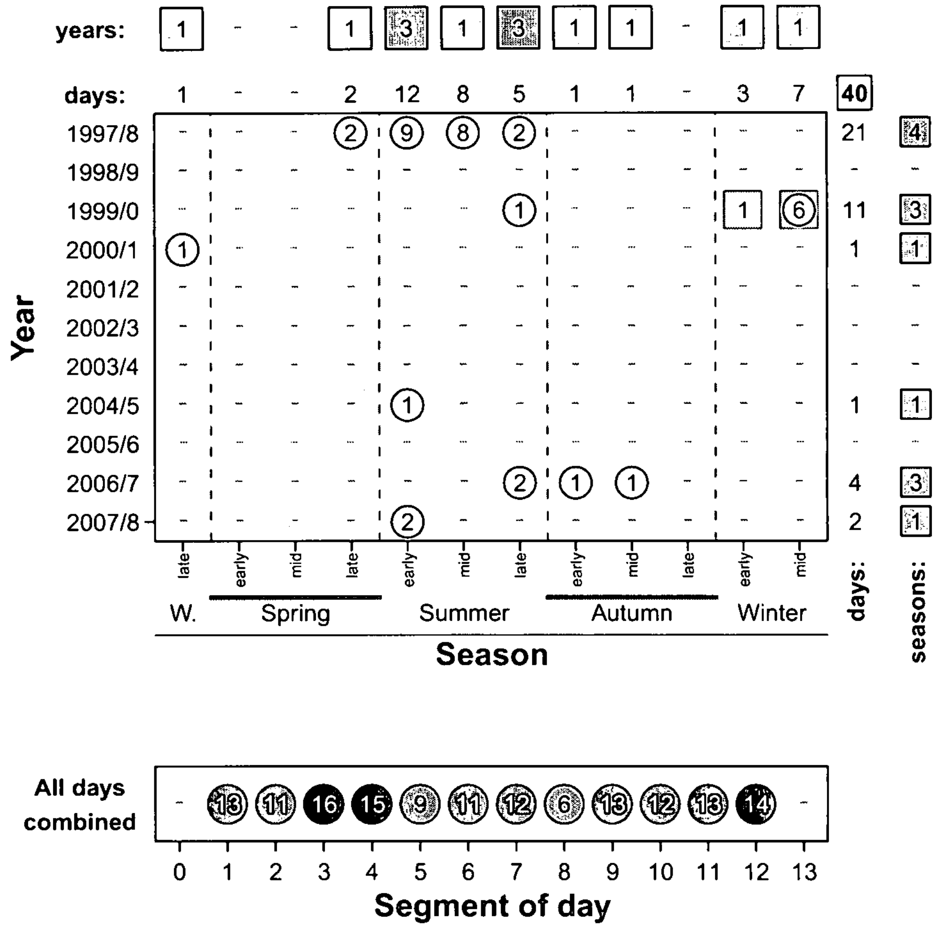


Figure 5.131: R587 Capped Wheatear — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R591 Sickle-winged Chat .... *Cercomela sinuata*

The Sickle-winged Chat is endemic to southern Africa, occurring from Lesotho west- and south-westwards into South Africa and southern Namibia (Harrison 1997d). Three subspecies have been described (Clancey 1958; Clancey 1980). *C. s. sinuata* and *C. s. ensifera* have continuous ranges (Harrison 1997d) and based on the taxa borders delineated by Dean (2005ae) the study site falls into the area occupied by the latter taxon. According to Harrison (1997d) the SABAP1 data "suggests a degree of isolation of the third subspecies *C. s. hypernephela* which is found in the Lesotho highlands and KwaZulu-Natal Drakensberg". Subsequently, Dean (2005ae) delineated the distribution of *C. s. hypernephela* so as to isolate it from the Free State and from records north of Lesotho.

However, there are good reason to believe that Sickle-winged Chats do not read — much less obey — the textbooks! The first problem is that Sickle-winged Chats penetrate KwaZulu-Natal only marginally, to the extent that they are listed under the "Rarer Species and Vagrants" heading of the Natal Bird Atlas, where it is stated that it "Occurs in ... Natal in winter" (Cyrus & Robson 1980; See also Clancey 1980). Brown & Barnes (1984) noted that they move only relatively short distances to lower altitudes when forced to do so by severe winter conditions, and, significantly, that it is recorded below the Alpine Belt only at these times. This could explain why their distribution in Natal terminates a short distance from the Lesotho border, as duly recognised by Harrison (1997d).

The second problem is that most Sickle-winged Chats seem to vacate the highlands of Lesotho each year for some months during the coolest times of the year (Tarboton *et al.* 1993; Van Niekerk 2004). Observations in southern Lesotho indicate that they do not simply move to lower altitudes locally (Van Niekerk 2004), and the absence of records in the lowlands of Lesotho (Harrison 1997d) militates against any suggestion that they spent the winter there. Furthermore, it is unlikely that the birds, most of them at least, move into Natal, for else they would appear their more regularly and extensively than is presently the case. It is suggested, instead, that they move elsewhere.

The birds at Glen

Sickle-winged Chats were recorded as single (rarely two) birds in the trampled area and sometimes in the path leading up to the zinc dam. The analysis is based on a year starting in late summer.

Found during all years except 2004, usually during 1–3 seasons per year but during six seasons in 1999 (Fig. 5.132). Records were limited to autumn, winter and early and mid-spring with a peak in occurrence centred on late autumn (Fig. 5.132). The timing of the first and last records each year was variable (Fig. 5.133). Encountered throughout the day (Fig. 5.132).

Discussion

From the data presented above it is clear that the Sickle-winged Chat is a seasonal visitor to Glen, occurring during the cooler part of the year (Fig. 5.132). This phenomenon is not unique to Glen. De Swardt (1999) observed these birds mainly between late April and September [late autumn to mid-spring] in Soetdoring Nature Reserve. In addition, he notes that many of the 45 Sickle-winged Chat specimens collected from 1989 to 1999 at various localities in the Free State dates from the period May to August. Moreover, analysis of SABAP1 raw data reveals that the birds are much more widely distributed in the Free State and the Northern Cape east of 22° E during the cooler months of the year (Fig. 5.134). In the Free State there are two peaks, a lesser one in May and the main peak in August (Fig. 5.134). This is complimented by a June to July peak in the eastern parts of the Northern Cape (Fig. 5.134). It is suggested that Lesotho birds moving through the Free State into the Northern Cape and back again cause this pattern.

The birds in the Eastern Cape show a bimodal pattern too, with peaks in March to May and October, and, importantly, low values from December to January (Fig. 5.134). The values during the cooler part of the year are also relatively high (Fig. 5.134). This pattern probably represents birds departing from Lesotho in March to May and returning to Lesotho during October.

The idea of Lesotho Sickle-winged Chats moving far beyond Lesotho's borders is a radical one. It is worth quoting the latest published statement on their movements:

> "**Movements & Migration:** Generally resident, with some local altitudinal movements; in Alpine Belt along Drakensberg Mt, descends to lower altitudes after heavy snowfalls in winter, and to Lesotho lowlands in severe winters [refers to Brown & Barnes (1984)]." (Dean 2005ae) (Bold in original).

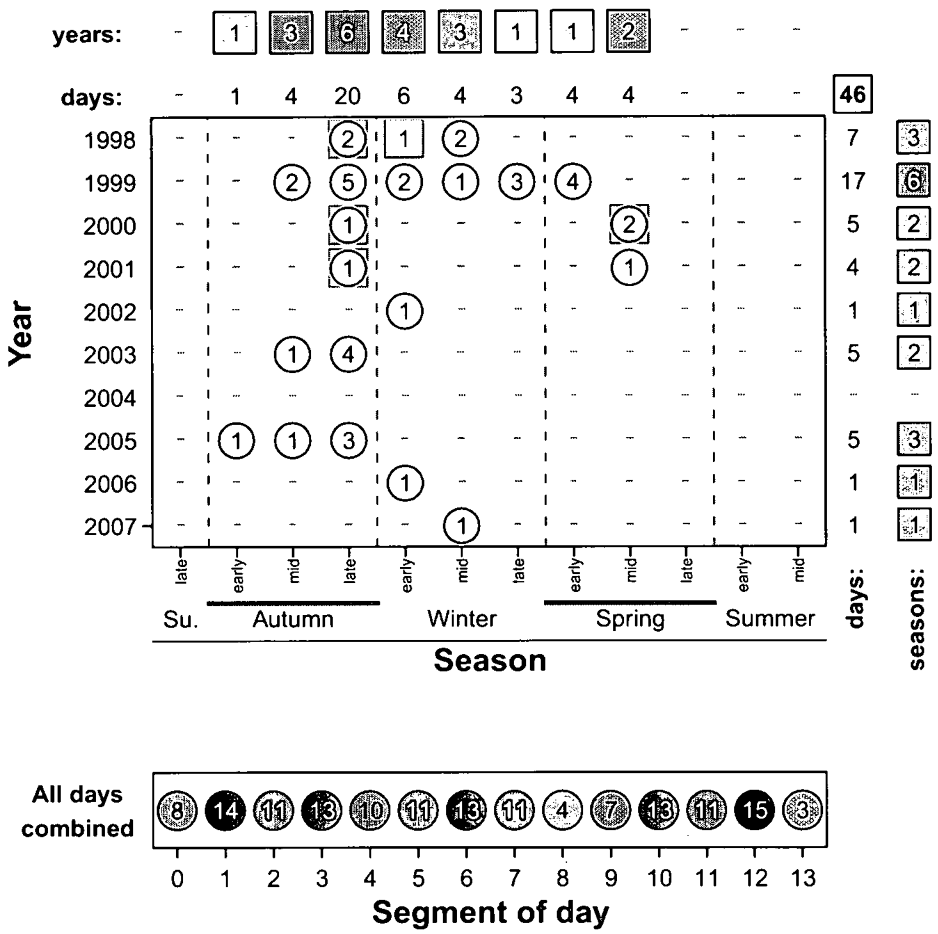


Figure 5.132: R591 Sickle-winged Chat — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

But how far west do the Lesotho birds actually go — Namibia? In the south-western part of the Northern Cape (*i.e.* west of 22° E and south of 30° S) there are two peaks, one in April and the other from September to October (Fig. 5.134). In between these periods the birds are relatively widespread in the north-western part of the Northern Cape (Fig. 5.134), suggesting passage movements through the more southerly areas. Interestingly, the April peak in south-western Northern Cape follows on a March peak in the Eastern Cape, a March – April peak in the eastern part of the Western Cape (*i.e.* east of 22° E), and an April peak in the western part of the Western Cape (*i.e.* west of 22° E) (Fig. 5.134). This is suggestive of movements between the Eastern Cape and the more westerly and north-westerly regions.

It is important to note that birds were recorded throughout the year in all the regions mentioned above, and that the patterns could have been influenced by local dispersal, perhaps after breeding. Furthermore, the total number of QDGS covered each month was not taken into account. However, the evidence for movement of Lesotho birds into the Free State, eastern Northern Cape and the Eastern Cape seem very convincing, and movements beyond these regions are worthy of serious consideration.

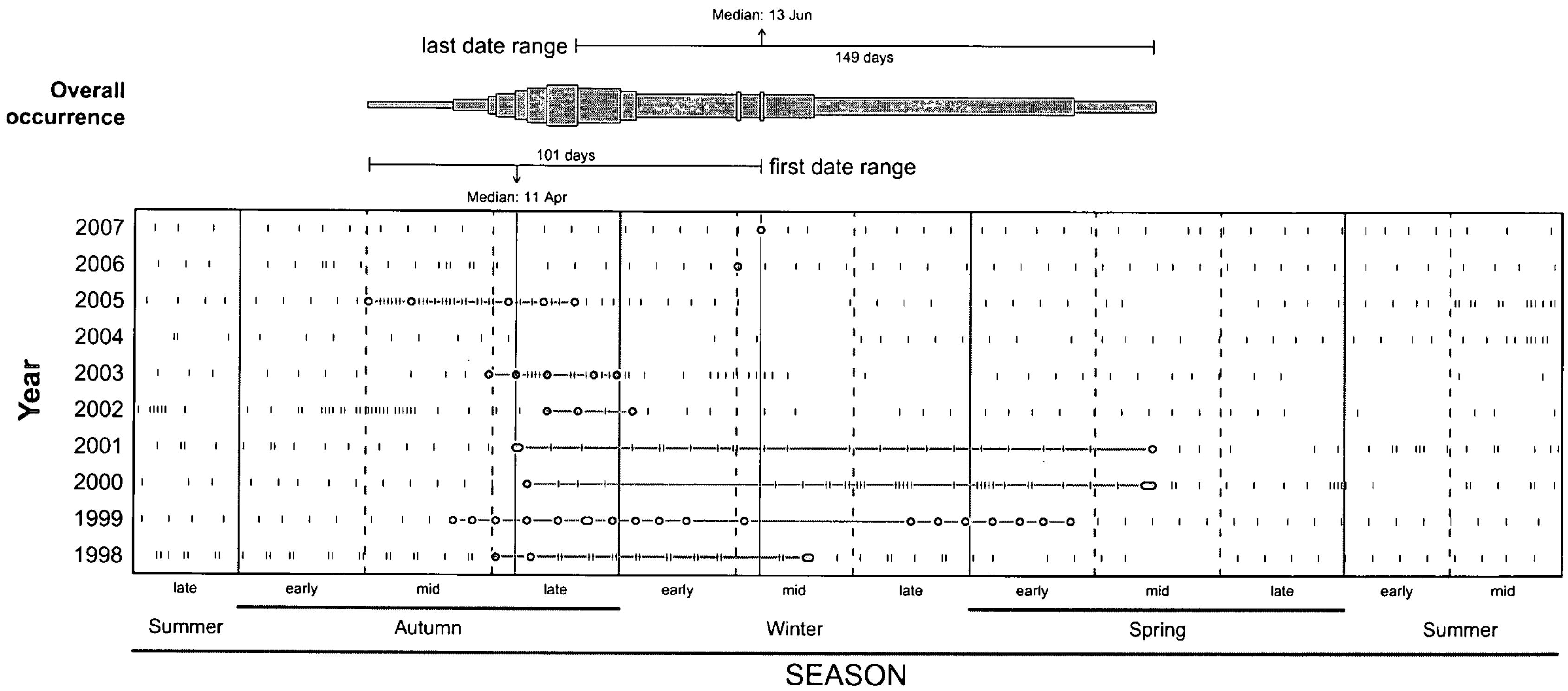


Figure 5.133: R591 Sickle-winged Chat: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

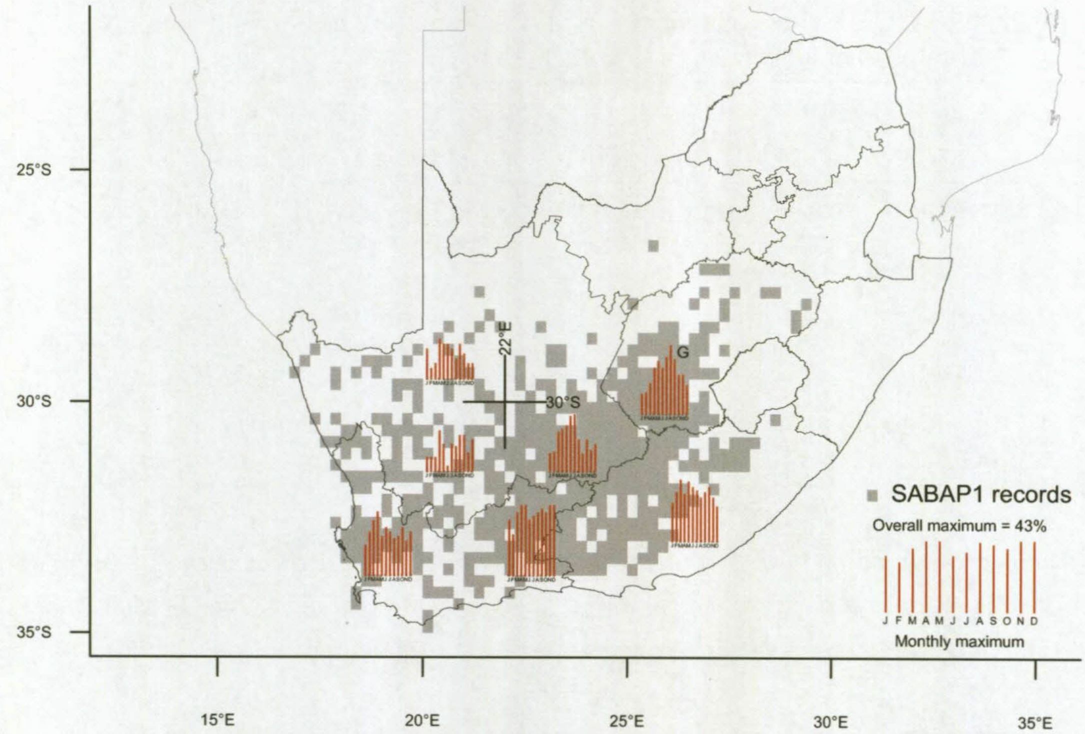


Figure 5.134: R591 Sickle-winged Chat: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

R595 Ant-eating Chat .... *Myrmecocichla formicivora*

The Ant-eating Chat is endemic to southern Africa, being widespread in Namibia, Botswana and South Africa (Harrison 1997e). It is found in a range of open habitats, including grassland, where it lives solitary, in pairs or in small groups (Maclean 1985). Resident, but is known to abandon an area for a year or more before returning (Dean 2005af) and dispersal takes place during "late winter and spring" (Earlé & Herholdt 1988).

The birds at Glen

At least one group occupied the grassland since the beginning of the study and breeding has been recorded. Only vocal records are considered in the analysis (Table 5.22a), and all records refer to birds calling in the grassland. Figures start on page 739.

Annual occurrence of birds heard in the grassland: Heard on nearly all days (99.7%) with an activity index of 25 (Table 5.22a). Daily reporting rates ranged from 0.6 to 76.0% with 82.9% bird-days attaining low reporting rates (Fig. 5.135■□). Median daily reporting rates were higher at the beginning of the study than subsequently (Fig. 5.135■□).

Table 5.22: R595 Ant-eating Chat: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	16 233	114 612	14.2	birds heard	99.7	656	654	25
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	2	1 190	0.2	birds heard	4.7	43	2	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	119	1 188	10.0	birds heard	65.1	43	28	4

Seasonal occurrence of birds heard in the grassland: Recorded during all seasons every year with median daily reporting rates peaking in mid- and late spring (Fig. 5.135), corresponding with the relatively frequent occurrence of intermediate reporting rate days (Fig. 5.136).

Daily occurrence of birds heard in the grassland: Overall, activity was frequent during all segments of the day, occurring during at least half of the days (Fig. 5.135). Yet, activity tended to be slightly more frequent in the early morning and late afternoon before sunset than during the middle part of the day (Fig. 5.135). This general pattern is only applicable for low reporting rate days (Fig. 5.137). On intermediate and high reporting rate days activity frequency was alike for all segments between sunrise and sunset, but infrequent before sunrise and after sunset (Fig. 5.137). The pattern for all seasons were for activity to be most frequent during the early morning and late afternoon, however, activity at other times of the day was also frequent, particularly during mid- and late spring and early summer (Fig. 5.138). No bird-segment combinations occurred during more than 5% bird-days.

The first activity of the day often occurred before sunrise, frequently earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.138; Fig. 5.139). There is a strong seasonal pattern with activity starting earlier in the day from mid-spring to mid-summer than during other seasons (Fig. 5.138; Fig. 5.139). The dawn chorus sequence followed a similar trend (Fig. 5.139).

The last activity of the day often occurred during the late afternoon, most frequently after sunset on intermediate and high reporting rate days (Fig. 5.138; Fig. 5.139). There was also a well-defined seasonal pattern with activity ceasing later during mid- and late spring, typically after sunset, than during other seasons, particularly early and mid-winter when activity after sunset was relatively infrequent (Fig. 5.138; Fig. 5.139).

Overall, daily segment reporting rates ranged from 4.8 to 100% with 80.0% of the values relatively low (Fig. 5.135). Median daily segment reporting rates were very similar for all segments, except S13 when it was relatively lower (Fig. 5.135). A similar trend is seen when only low and intermediate reporting rate days are considered, but the values for high reporting rate days were more variable, tending towards peaks in the early morning, midday and late afternoon (Fig 5.137).

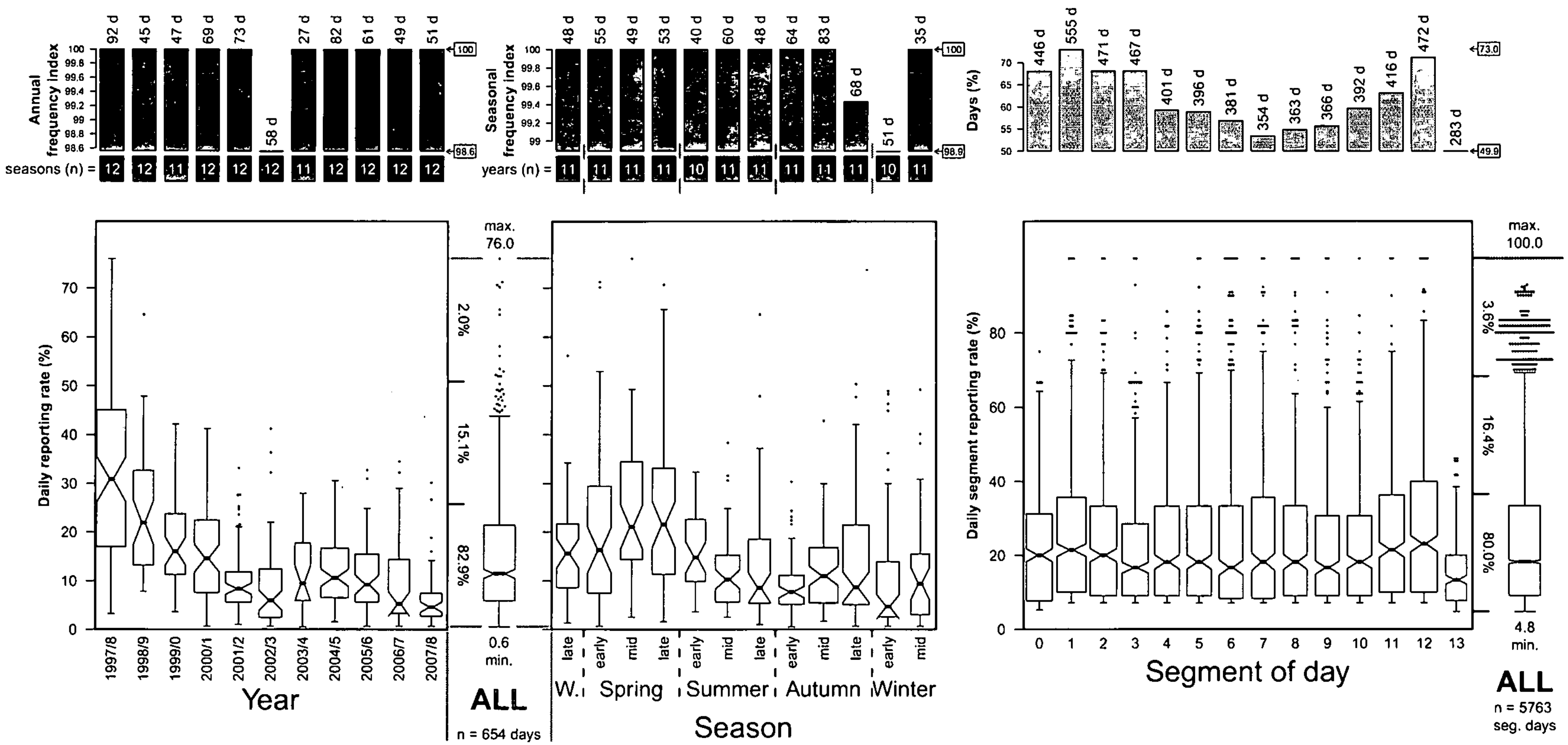


Figure 5.135: R595 Ant-eating Chat — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

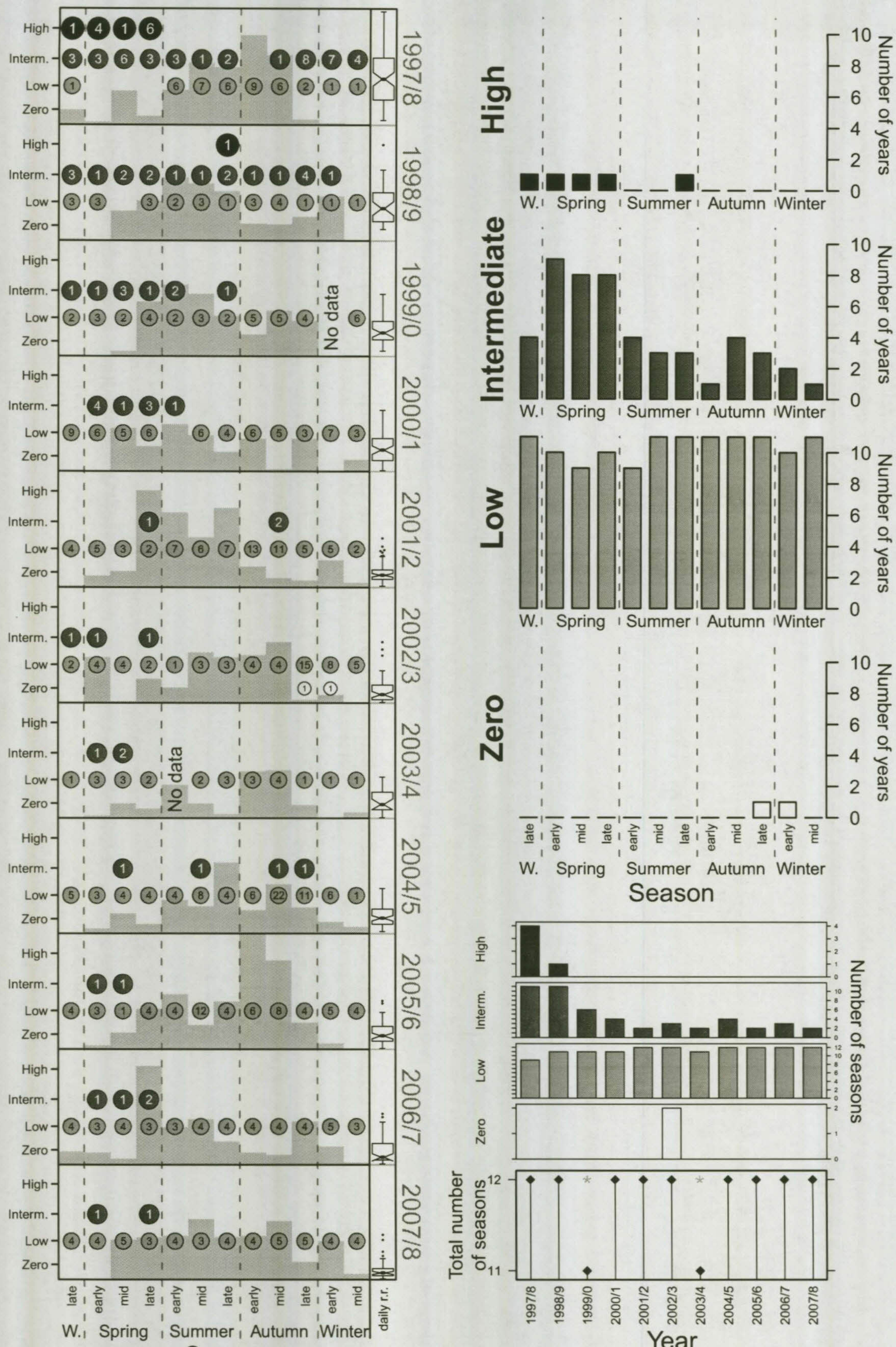


Figure 5.136: R595 Ant-eating Chat — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

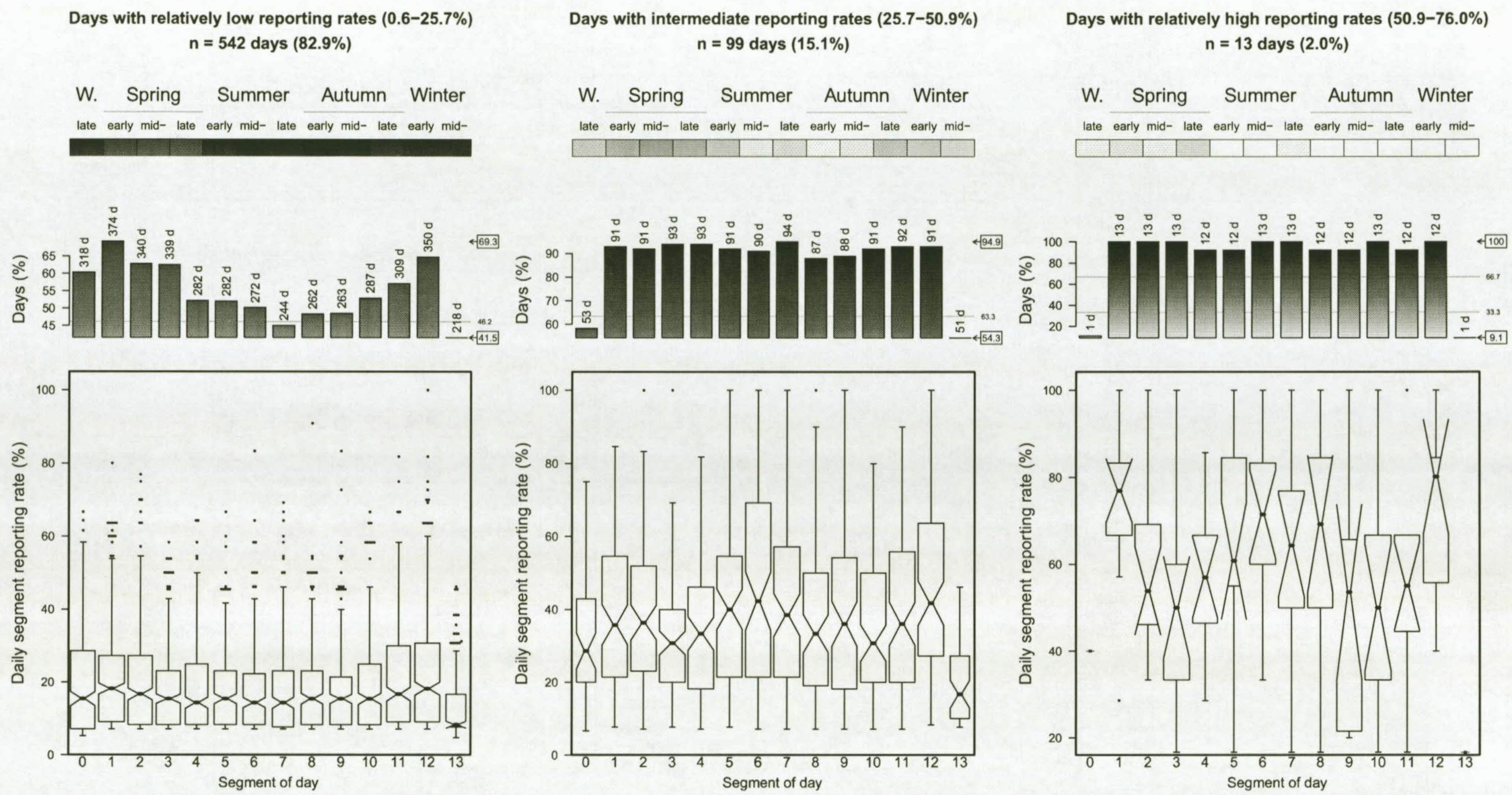
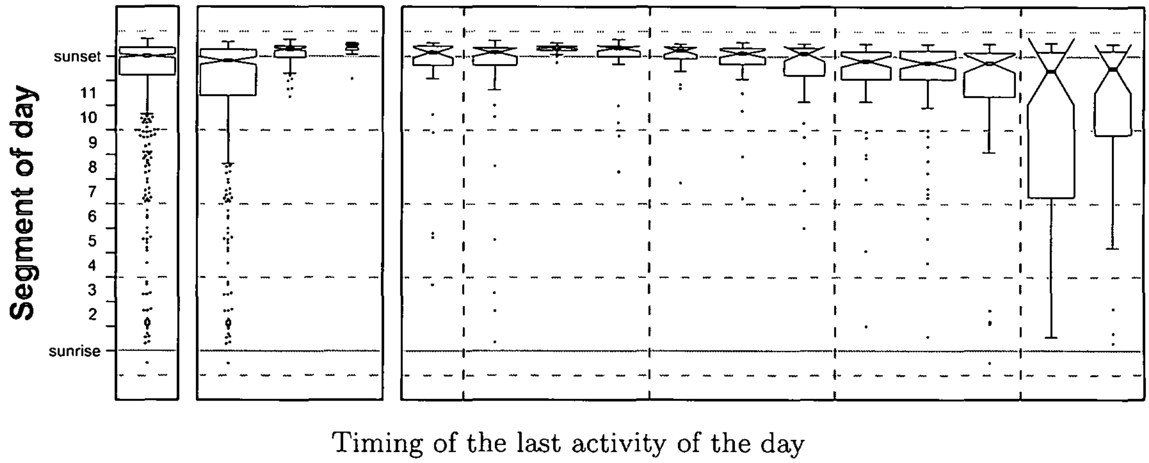
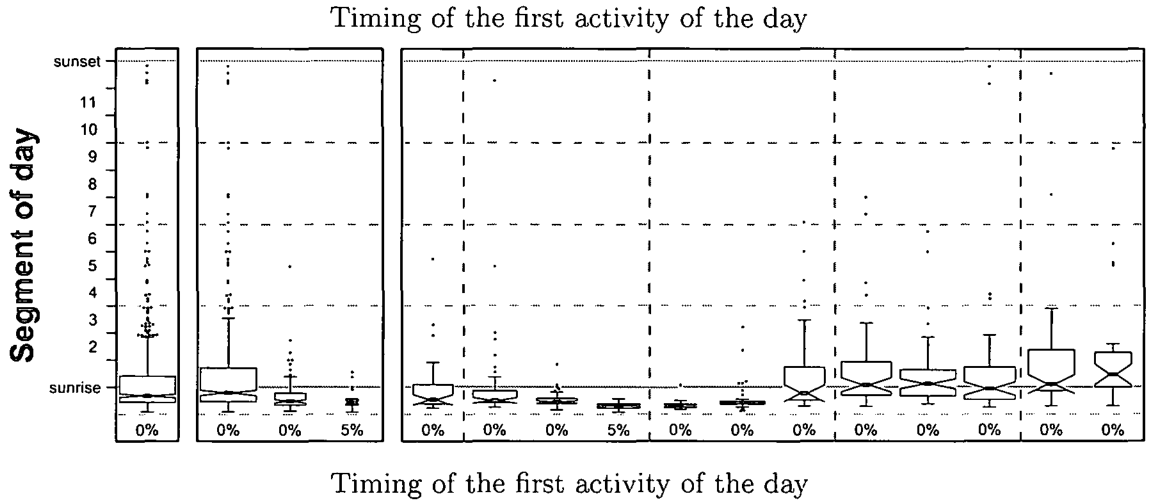


Figure 5.137: R595 Ant-eating Chat — birds heard: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.





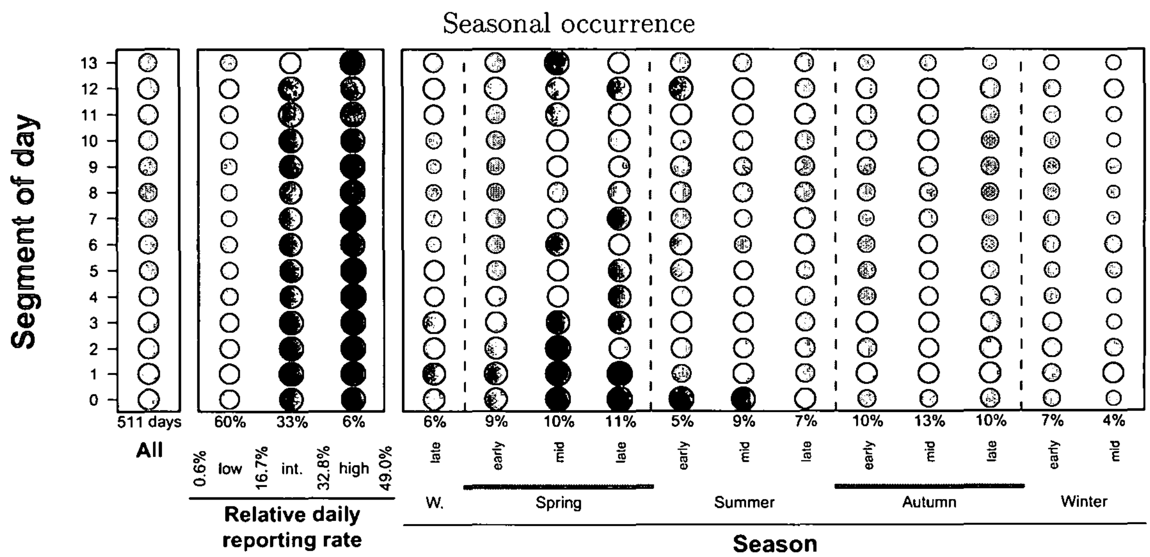
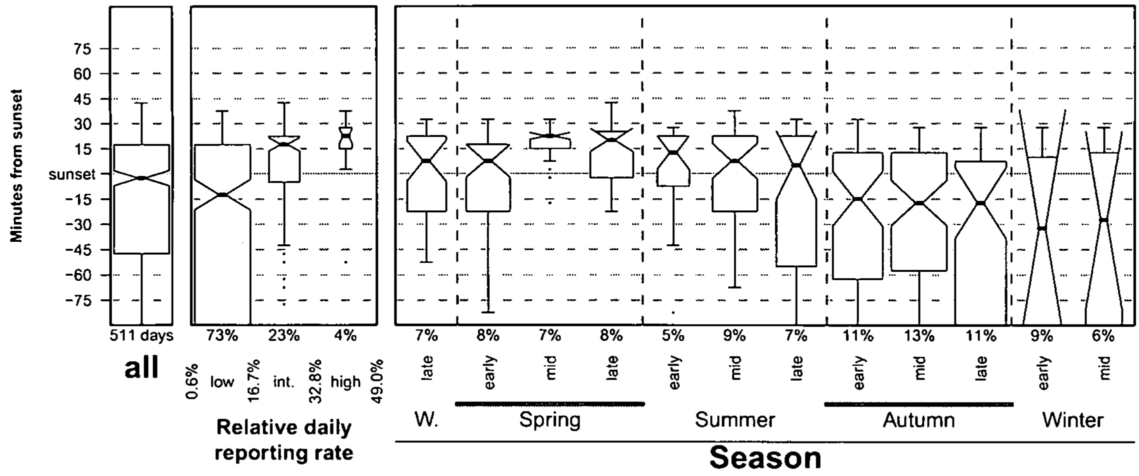
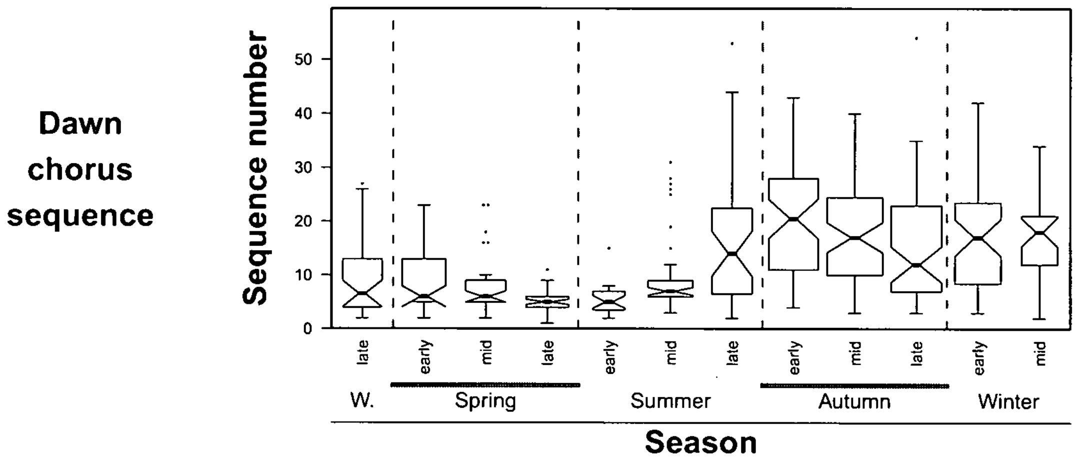


Figure 5.138: R595 Ant-eating Chat — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

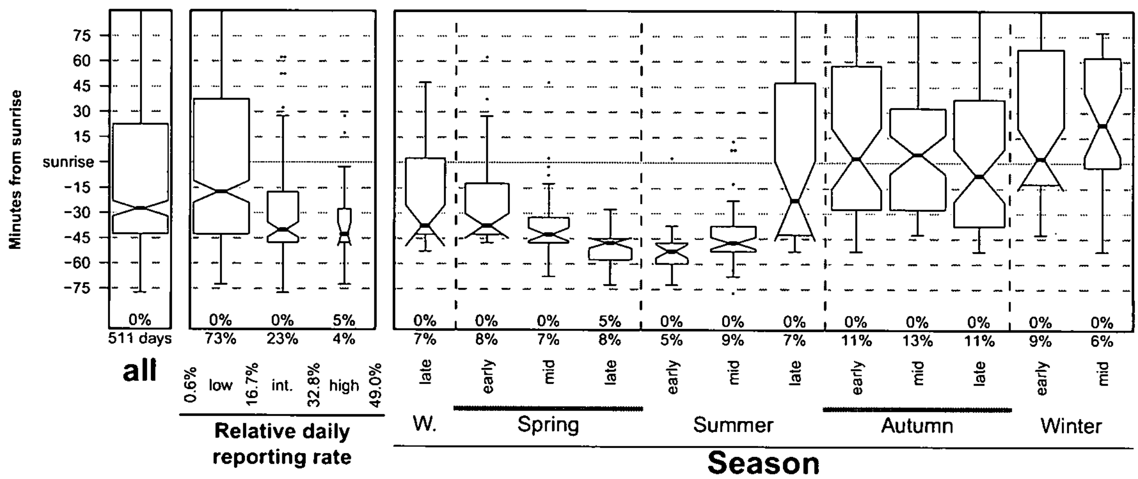


Figure 5.139: R595 Ant-eating Chat — birds heard: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

Early morning occurrence of birds heard during 2007/8: Activity was only rarely recorded in the drainage line (n = 2 mornings), in contrast to its occurrence in the grassland (n = 28 mornings) (Table 5.22b & c).

Discussion

Breeding in the Ant-eating Chat occurs mainly from September to November [spring and early summer], followed by a complete post-breeding moult from December to June [summer to mid-winter] (Earlé & Herholdt 1988). It appears, therefore, that the peak in vocal activity during spring and early summer coincides with breeding, and the decrease in activity in summer is probably related to moult (Fig. 5.135; Fig. 5.136; Fig. 5.138). In addition, it is noted that activity started earlier in the day during breeding (Fig. 5.138; Fig. 5.139).

The reasonably consistent occurrence of intermediate reporting rate days during spring (Fig. 5.136) possibly points to a recurring cue at that time of the year. The frequent occurrence of such days before the first significant rains each year (Fig. 5.136) suggests that rainfall is not a primary cue. One factor that remains constant from year to year is the cyclic change in day-length (Fig. 2.12). Furthermore, spring is defined as the season during which day-length increase are most marked (see page 85). It is suggested, therefore, that vocal activity of the Ant-eating Chat is positively affected by an increase in day-length during the earlier parts of spring, although other factors may also be involved because the pattern is somewhat variable (Fig. 5.136).

R596 African Stonechat .... *Saxicola torquatus*

Based on genetic studies, *S. torquatus* is considered by Dean (2005ac) to be one of six species within the *S. torquatus* complex. Members of this complex occur in the Palearctic, Asia and Africa (Cramp 1998), with *S. torquatus*, the African Stonechat, endemic to sub-Saharan Africa and Madagascar (Dean 2005ac).

In southern Africa it occurs in northern Botswana and adjacent Namibia, parts of Zimbabwe and southern Mozambique (Parker 1999), in Swaziland, Lesotho and South Africa where it is scarce or absent west of the Free State, except along the west coast (Harrison 1997f). It occupies a variety of habitats including high-altitude grasslands and moist open country with rank growth of grass and other plants, and cultivated fields (Harrison 1997f). Resident in some areas and a seasonal altitudinal migrant otherwise, with the possibility of migration between Zimbabwe and South Africa (Maclean 1985).

The birds at Glen

The African Stonechat was recorded in the grassland only. All records were of one or two birds, mostly seen only but also heard; all the data are combined for analysis. When present they possibly roosted in the *Rhus ciliata* bushes at the zinc dam, or at least that was were they were sometimes seen early in the morning or in the late afternoon. During the day they spent much of their time in the vicinity of the trampled area. The analysis is based on a year starting with late summer. Figures start on page 746.

Annual occurrence of birds in the grassland: Recorded on 26.8% of the days with an activity index of 11 (Table 5.23a). Usually recorded for 5–6 seasons each year, but during seven seasons in 2004 and 2–4 seasons in 2002, 2003 and 2007 (Fig. 5.140; Fig. 5.141). Daily reporting rates ranged from 0.5 to 35.0% with 77.4% bird-days attaining low reporting rates (Fig. 5.140). Median daily reporting rates were particularly high in 1998 and 2004, which were also the only years with higher reporting rate days (Fig. 5.140; Fig. 5.141).

Table 5.23: R596 African Stonechat: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 971	114 612	1.7	birds present	26.8	656	176	11
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	6	1 188	0.5	birds present	4.7	43	2	3

Seasonal occurrence of birds in the grassland: The birds usually arrive during late autumn (median date: 12 April) and depart in early spring (median date: 27 August; Fig. 5.142). Overall, recorded during late autumn, winter and early spring in most years and rarely in mid-autumn, mid-spring or late spring (Fig. 5.140). Days with no records were particularly infrequent during mid-winter (Fig. 5.141), but median daily reporting rates were similar between the seasons (Fig. 5.140).

Daily occurrence of birds in the grassland: Overall, activity was most frequent between sunrise and sunset (Fig. 5.140), but the pattern shows some seasonal variability (Fig. 5.143). Only one bird-segment combination occurred during more than 5% bird-days and involved S1 (Fig. 5.144). This accounted for only 6.3% of all bird-days and occurred relatively frequently in late autumn and mid-winter (Fig. 5.144).

The first activity of the day typically occurred during the first half of the morning and was reasonably constant between seasons (Fig. 5.143; Fig. 5.145). The occurrence of the last activity of the day was more variable, but the median values of all seasons were in the latter part of the afternoon (Fig. 5.143; Fig. 5.145).

Daily segment reporting rates ranged from 5.6 to 100% with 84.8% of the values relatively low (Fig. 5.140). Apart form relatively low values before sunrise and after sunset, the median daily segment reporting rates were similar for all other segments (Fig. 5.140).

Discussion

The African Stonechat is a regular seasonal visitor at Glen during the cooler times of the year (Fig. 5.140; Fig. 5.141). It is suggested that these birds come from Lesotho. This is based

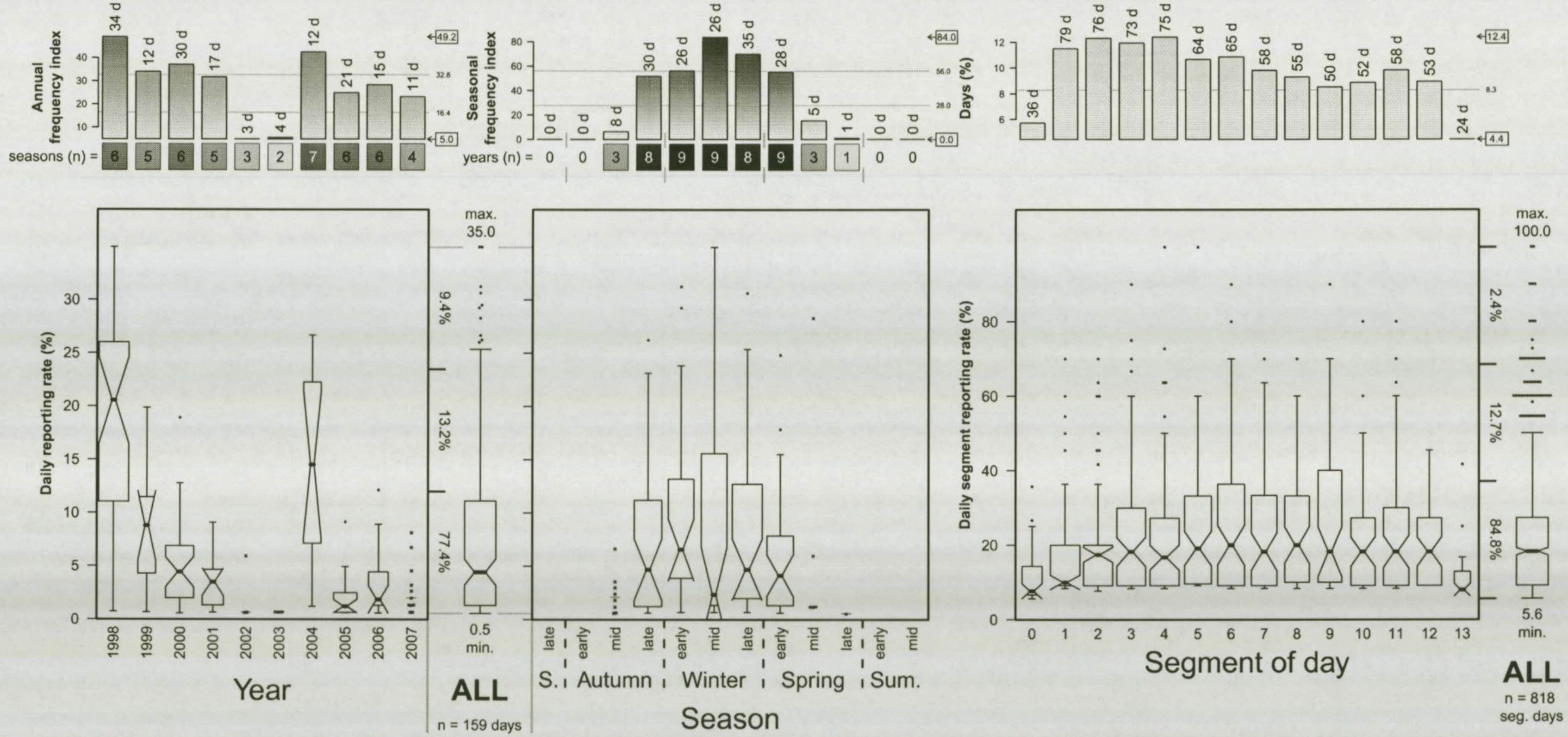


Figure 5.140: R596 African Stonechat — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

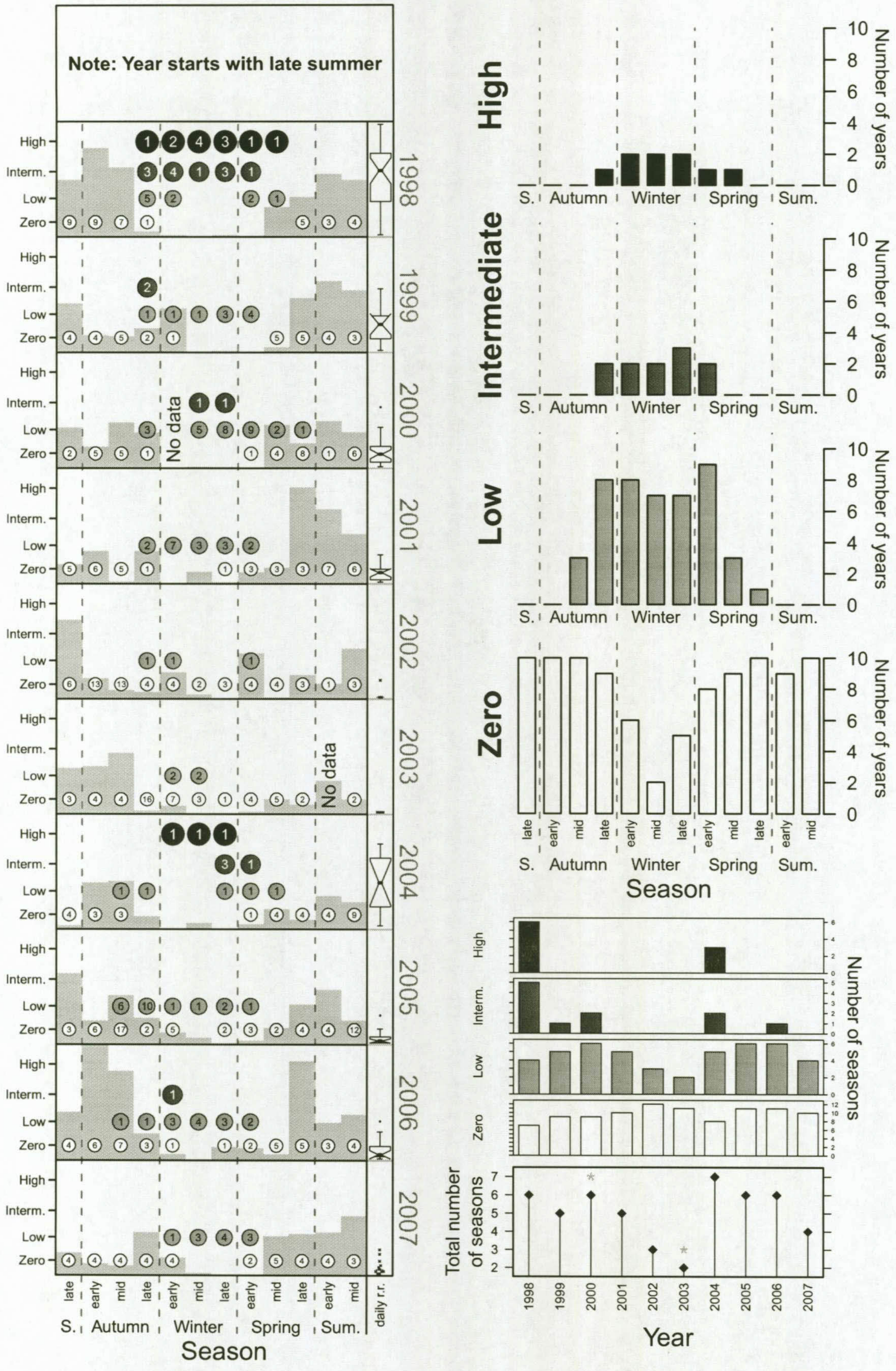


Figure 5.141: R596 African Stonechat — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

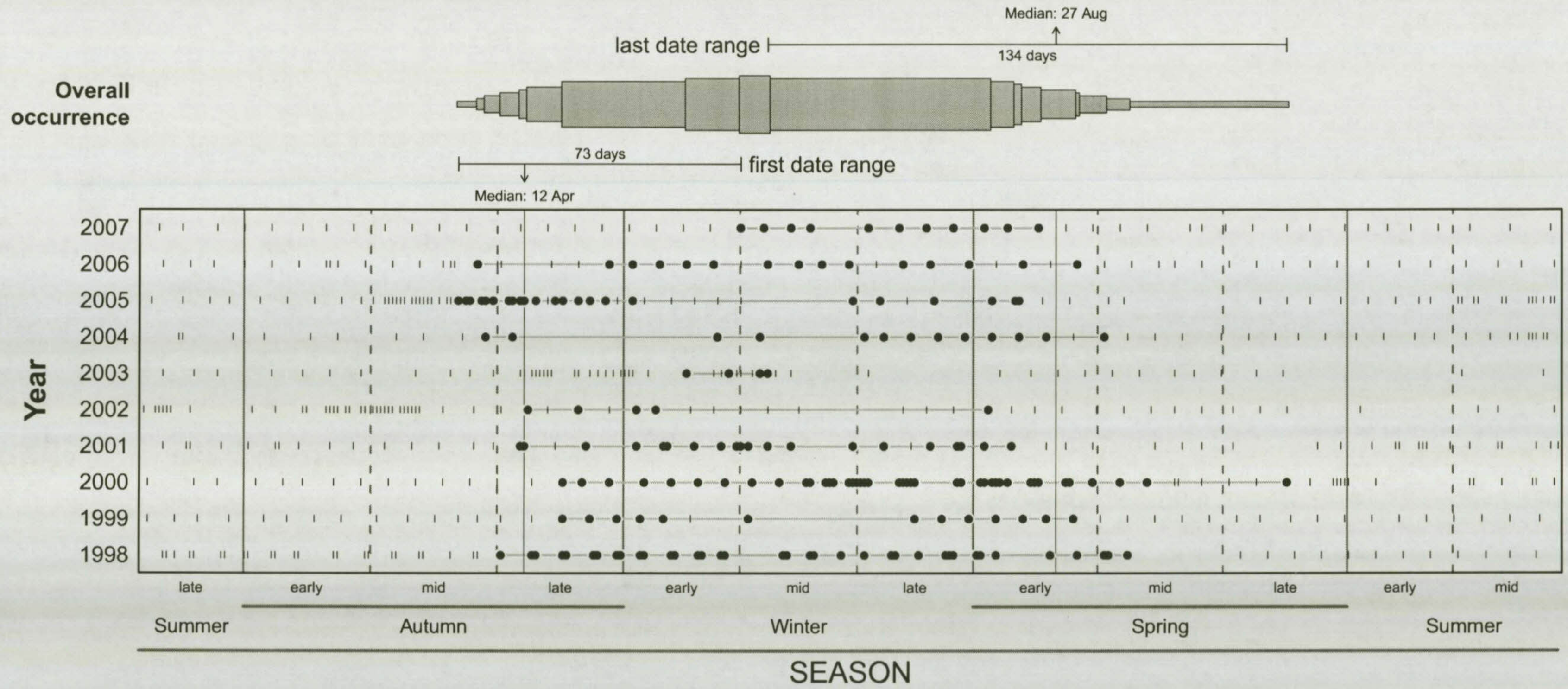


Figure 5.142: R596 African Stonechat: Arrival and departure dates in the grassland at Glen. See page 134 for more information on this migration figure.

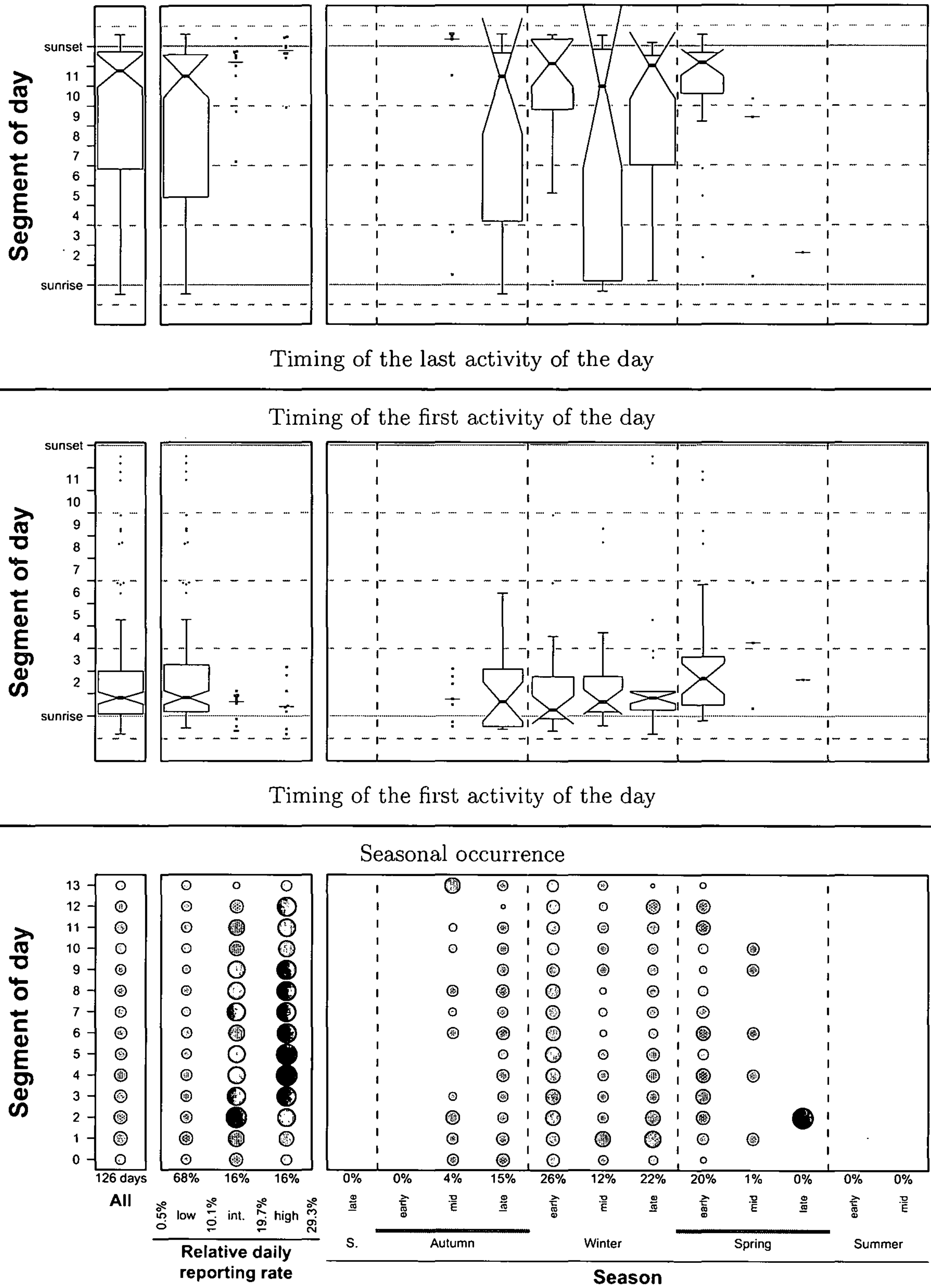


Figure 5.143: R596 African Stonechat — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

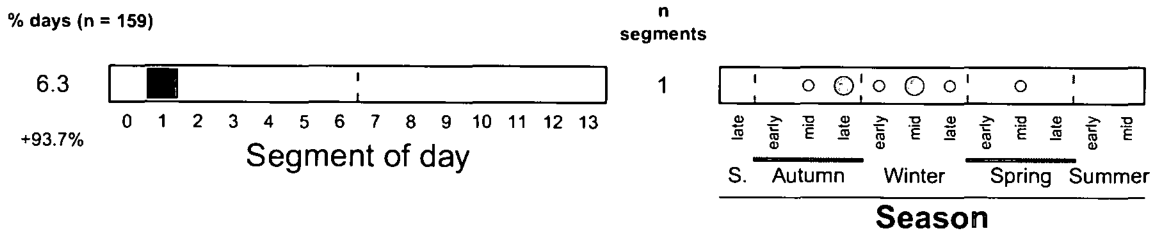


Figure 5.144: R596 African Stonechat — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

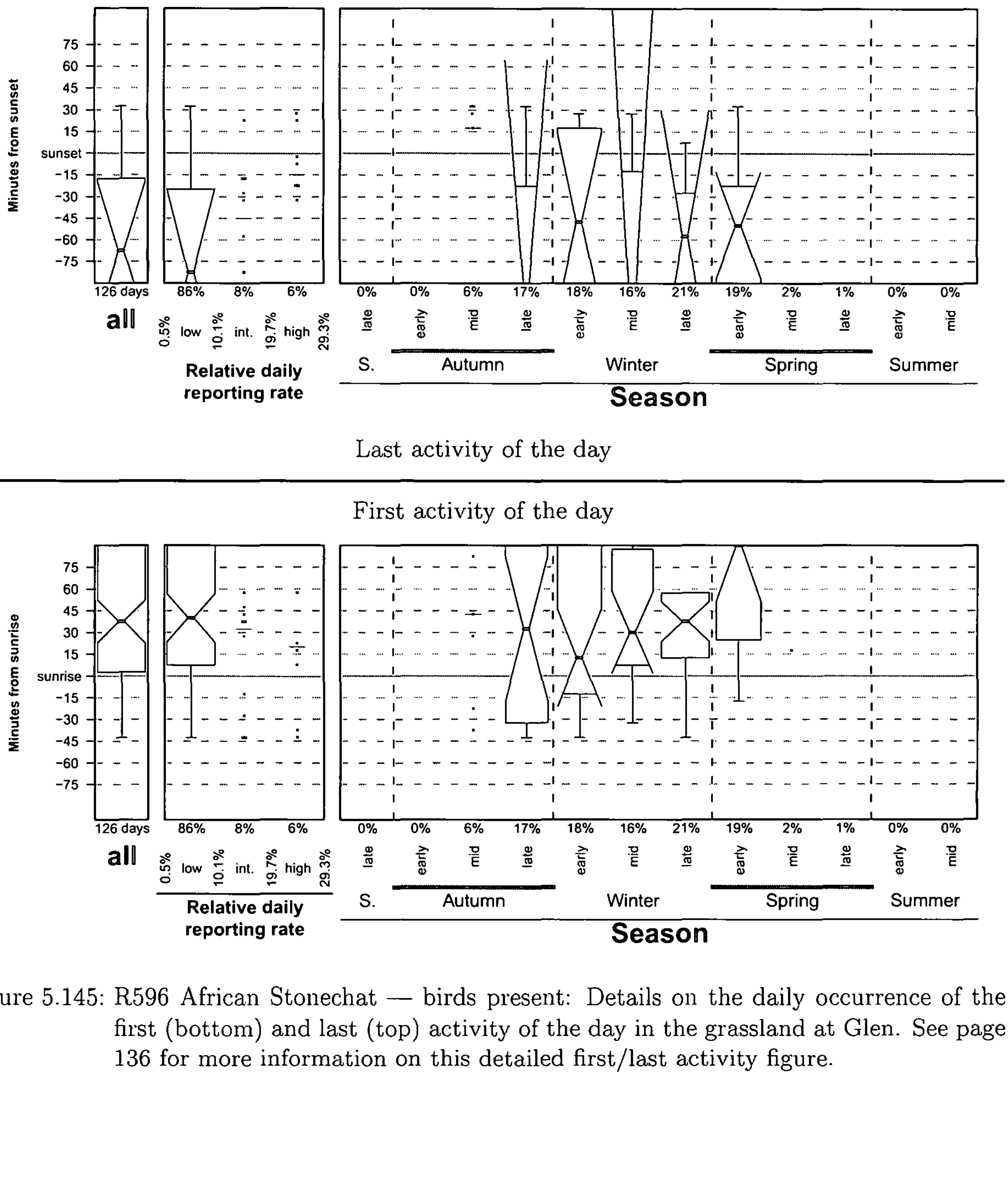


Figure 5.145: R596 African Stonechat — birds present: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

on the fact that the birds are common in the mountain kingdom during the warmer parts of the year, but scarce during winter (Van Niekerk 2004). It is a well-known seasonal altitudinal migrant (Harrison 1997f; Maclean 1985). The idea that Lesotho birds venture far beyond the mountains of that country is not new. Pearson (1992b), for example, noted: "*S. t. oreobates* Clancey: highlands of Lesotho, wintering at lower altitudes and reaching E Zimbabwe." (See also Maclean 1985, 1993). However, Dean (2005ac) recently summarised their movements as follow:

> "**Movements & Migrations:** Resident in most areas, but winter altitudinal migrant down Drakensberg to midlands and lowlands of KwaZulu-Natal [reference to Johnson & Maclean 1994]; possibly some movement between Zimbabwe and South Africa [reference to Maclean 1993]." (Bold in original).

But Johnson & Maclean (1994) also cited several authors (*i.e.* Bonde 1993; Cyrus & Robson 1980; Earlé & Grobler 1987; MacLean 1957) and pointed out that the African Stonechat is a regular altitudinal migrant on both sides of the Malothi massif, *i.e.* to KwaZulu Natal and the Free State. Based on the map in Dean (2005ac), the five African Stonechat sub-species listed for southern Africa each has continuous ranges over at least part of their respective ranges with between 1–3 other sub-species. Of particular interest to the present study is *S. t. stonei* whose range suggests that it is the sub-species to be found at the study area, and *S. t. oreobates* whose range mainly encompass Lesotho plus adjacent Natal and Eastern Cape according to the map in Dean (2005ac). The entry for the latter sub-species under the "Geographical Variation" section in Dean (2005ac) reads: "highlands of Lesotho, wintering at lower altitudes." It is suspected, however, that African Stonechats from Lesotho have extensive movements during the cooler parts of the year.

Harrison (1997f) noted that the SABAP1 "seasonal distribution maps clearly show a winter enlargement of the area of high reporting rate surrounding the highlands of eastern South Africa, indicating movement to lower altitudes where the birds were readily observed in more accessible areas." Lesotho most certainly count as a highland area in "eastern South Africa" too! In addition, a more detailed analysis of the SABAP1 raw data shows that the birds are more widespread during the cooler times of the year in the eastern parts of the Eastern Cape, in KwaZulu-Natal, Mpumalanga, the Free State and North West Province as well as in the eastern parts of the Northern Cape (Fig. 5.146).

How far do the Lesotho birds go during winter? This is a difficult question to answer because the birds are so widespread in South Africa; only ringing studies can answer this question for certain. However, it is predicted that such studies would reveal extensive movements way beyond the borders of Lesotho, perhaps as far east as southern Mozambique where their seasonal occurrence (see Parker 1999) is very similar to that found at Glen. Or how about the West Coast? Analysis of the SABAP1 raw data reveals a curious bimodal pattern in the south-central parts of the Northern Cape where the birds were most widely recorded from April to May and again in October (Fig. 5.146). This is suggestive of passage migrants commuting between the West Coast in the west and an unknown locality in the east, perhaps Lesotho.

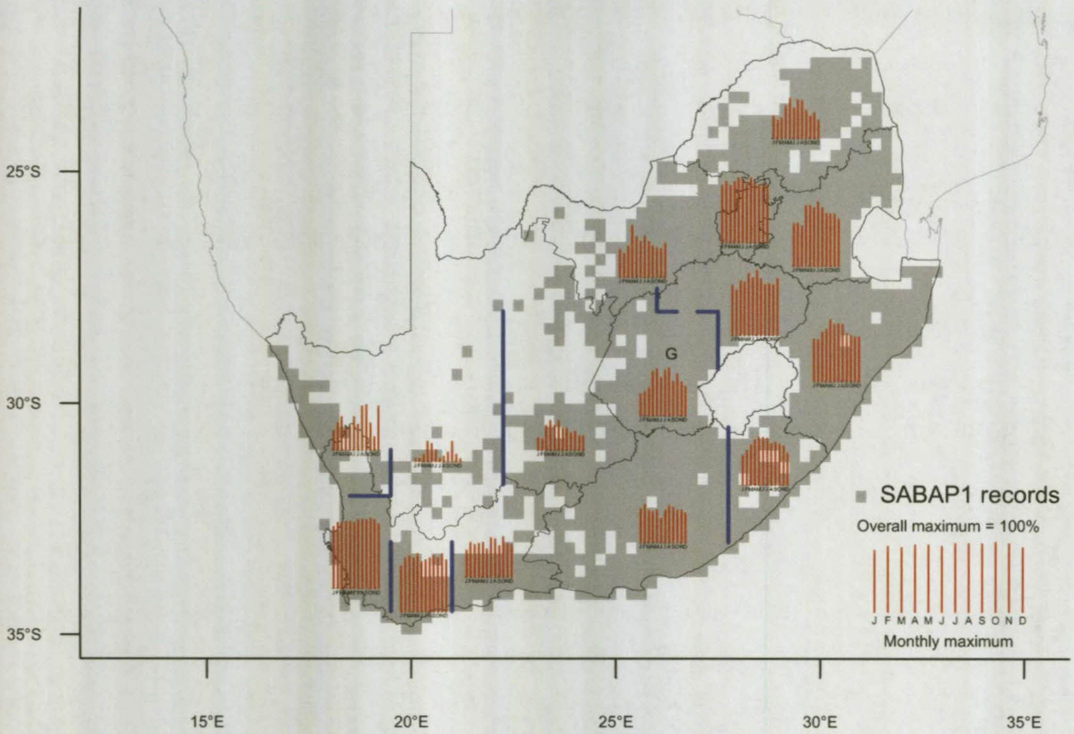


Figure 5.146: R596 African Stonechat: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

R601 Cape Robin-Chat .... *Cossypha caffra*

The Cape Robin is endemic to southern and eastern Africa (Oatley & Arnott 1998). In southern Africa it is mainly restricted to, and widespread in, South Africa, Lesotho and Swaziland, an isolated population also occurring in the eastern highlands of Zimbabwe (Oatley 1997c). Whereas its breeding habitat is restricted to Afromontane habitats (mostly forest-fringes) elsewhere in Africa, south of the Limpopo River they utilise a much greater variety of habitats, but always habitats with cover (Oatley 1997c). It is a known altitudinal migrant with many birds spending the non-breeding season within the breeding range of the species (Oatley & Arnott 1998; Oatley 1966). It is parasitized by the Red-chested Cuckoo R377 (Oatley & Arnott 1998; Steyn 1996).

The birds at Glen

All Cape Robin-Chat records refer to birds calling from within the drainage line. Figures start on page 755.

Annual occurrence of drainage line birds heard in the grassland: Heard on 19.5% of the days with an activity index of four (Table 5.24a). Usually recorded during 3–6 seasons each year, but during nine in 1997/8, 12 in 2002/3 and during only one season in 2006/7 (Fig. 5.147; Fig. 5.148). Daily reporting rates ranged from 0.5 to 13.1% with 86.7% bird-days attaining low reporting rates; The median daily reporting rate was particularly high in 2001/2 (Fig. 5.147).

Table 5.24: R601 Cape Robin-Chat: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	474	114 612	0.4	birds heard only	19.5	656	128	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	212	1 190	17.8	birds heard only	83.7	43	36	6
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 188	0.1	birds heard only	2.3	43	1	1

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons, mostly during 2–7 years per season but during nine years in mid- and late autumn (Fig. 5.147). In addition to relatively high seasonal frequency indices for these two seasons, they also were the only ones in which high reporting rate days were recorded (Fig. 5.147; Fig. 5.148). The median daily reporting rates of early and mid-autumn were slightly higher than those of other seasons (Fig. 5.147).

Daily occurrence of drainage line birds heard in the grassland: Overall, most frequently recorded during the early morning with a lesser peak in the late afternoon (Fig. 5.147). This general pattern is applicable to low reporting rate days only (Fig. 5.149). On intermediate reporting rate days there is no peak in the late afternoon (Fig. 5.149). The pattern varied seasonally with both peaks evident in some seasons, most notably autumn, and activity during the mornings only in other seasons (Fig. 5.150). Five bird-segments combinations occurred during more than 5% bird-days, all involving single bird-segments S0–S3 and S12 (Fig. 5.151). Collectively, these combinations accounted for half of all bird-days and three of the combinations were particularly frequent during autumn (Fig. 5.151).

The first activity of the day often occurred during the early morning, earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.150; Fig. 5.152). The timing was least variable and earliest during early and mid-autumn when it occurred mostly before sunrise compared to other seasons when it typically occurred after sunrise (Fig. 5.150; Fig. 5.152). The dawn chorus sequence fluctuated in accordance with the timing of the first activity of the day (Fig. 5.152). The occurrence of the last activity of the day was variable and it occurred throughout the day (Fig. 5.150).

Overall, daily segment reporting rates ranged from 6.2 to 60.0% with 85.7% of the values relatively low (Fig. 5.147). The median daily segment reporting rates were similar for all segments for low reporting rate days, but it was higher before sunrise for intermediate reporting rate days (Fig. 5.149).

Early morning occurrence of drainage line birds heard during 2007/8: Activity was commonly noted in the drainage line (n = 36 mornings) but rarely in the grassland (n = one morning) (Table 5.24b & c). In the drainage line, low and intermediate reporting rate mornings occurred throughout the year, but high reporting rate mornings were restricted to late autumn and early winter (Fig. 5.153). The first activity of the day frequently occurred more than 30 minutes before sunrise (Fig. 5.153). Activity occurred more frequently at higher intensities before sunrise than thereafter (Fig. 5.153).

Discussion

According to Oatley & Arnott (1998), the Cape Robin-Chat sings throughout the year at dawn and dusk. At first glance, the data collected in the grassland at Glen (note in particular Figures 5.148 & 5.150) seems to be contrary to that fact. However, as is clear from Figure 5.153 the data collected in the grassland was not representative of the early morning activity of birds in the drainage line. The data collected in preferred habitat shows that activity does occur throughout the year at dawn (no data available for dusk) (Fig. 5.153) .

Yet, activity in the drainage line is sometimes detected relatively frequently in the grassland too. It is clear that the abundant rains of 2001/2 stimulated high levels of activity, and that the effect was long-lasting with activity being recorded throughout 2002/3 compared to other years when activity occurred much less frequently (Fig. 5.147; Fig. 5.148). Activity was also relatively frequent during 1997/8 (Fig. 5.148), which was towards the end of a three year wet cycle (Fig. 2.13). The relatively infrequent occurrence of activity during the remaining wet years is probably related to the timing of the rain during those years. Much of the rainfall of 2005/6 occurred only in early and mid-autumn, which did stimulate some activity but nowhere near the levels recorded in 2001/2 (Fig. 5.148). The rainfall of 2007/8 was characterised not by exceptional precipitation in any one season, but rather by an intermediate amount over an extended period, which obviously did not inspire the robins (Fig. 5.148).

Why is it that the birds are more readily detected in certain years only? Is it because the resident birds are simply bolder then, or are birds from somewhere else involved too? According to Oatley & Arnott (1998), territories are maintained throughout the year: "Territory is not a seasonal phenomenon; breeding pairs live together in their territory from one year to the next." However, this is obviously not applicable to birds subjected to altitudinal migration. In Lesotho, for example, the birds are abundant during summer but scarce during winter, an obvious result of altitudinal migration (Van Niekerk 2004).

The activity burst during autumn 2001/2 (Fig. 5.148) was also the first time that drainage line activity was noted in the grassland since early winter (2000/1), and exceptional rainfall occurred in the intervening seasons, particularly during late spring and summer. Robin-chats were encountered during transects in the drainage line at that time, but no vocal activity was detected in the grassland until after the rains.

There is a definite peak in activity during mid- and late autumn (Fig. 5.147; Fig. 5.148;

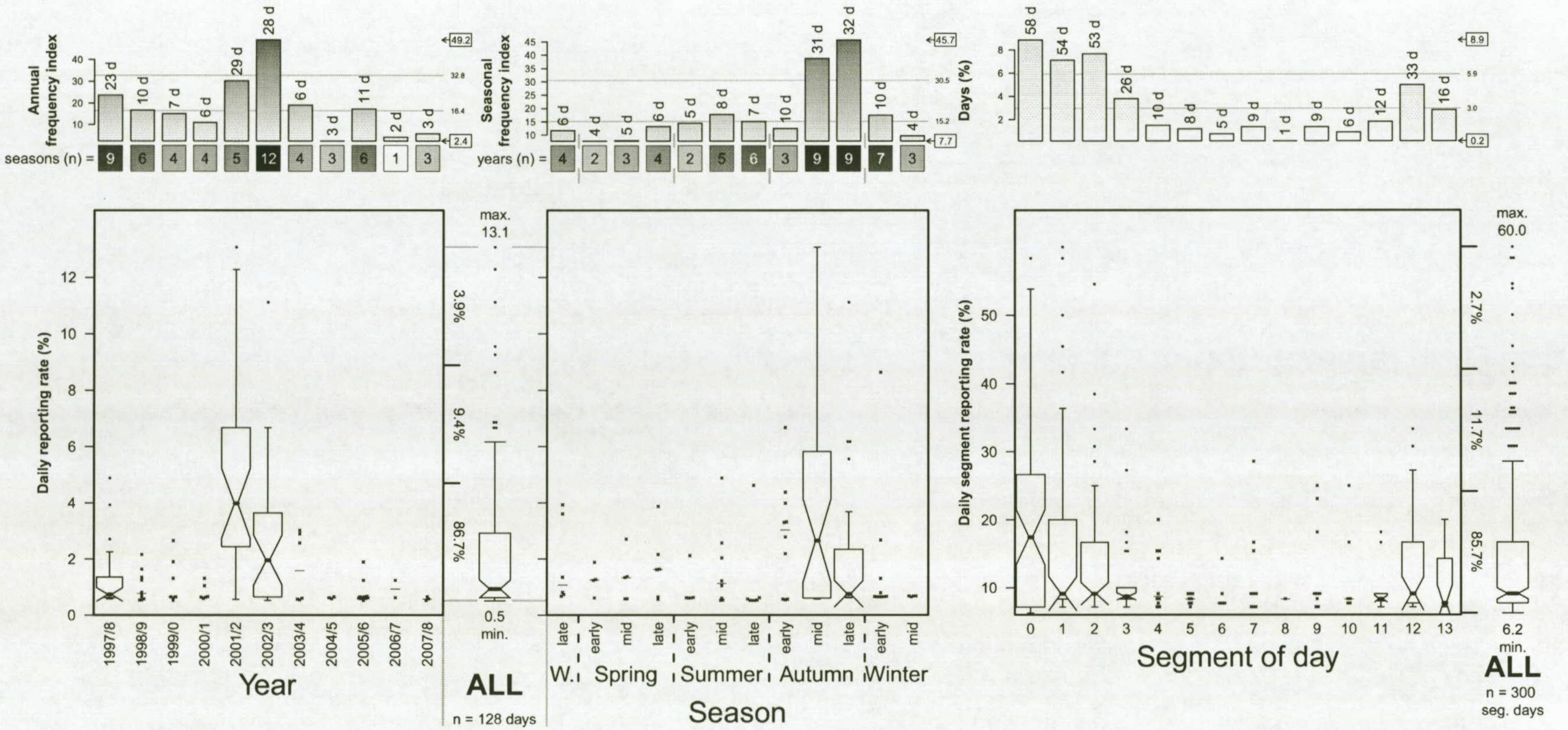


Figure 5.147: R601 Cape Robin-Chat — birds heard only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

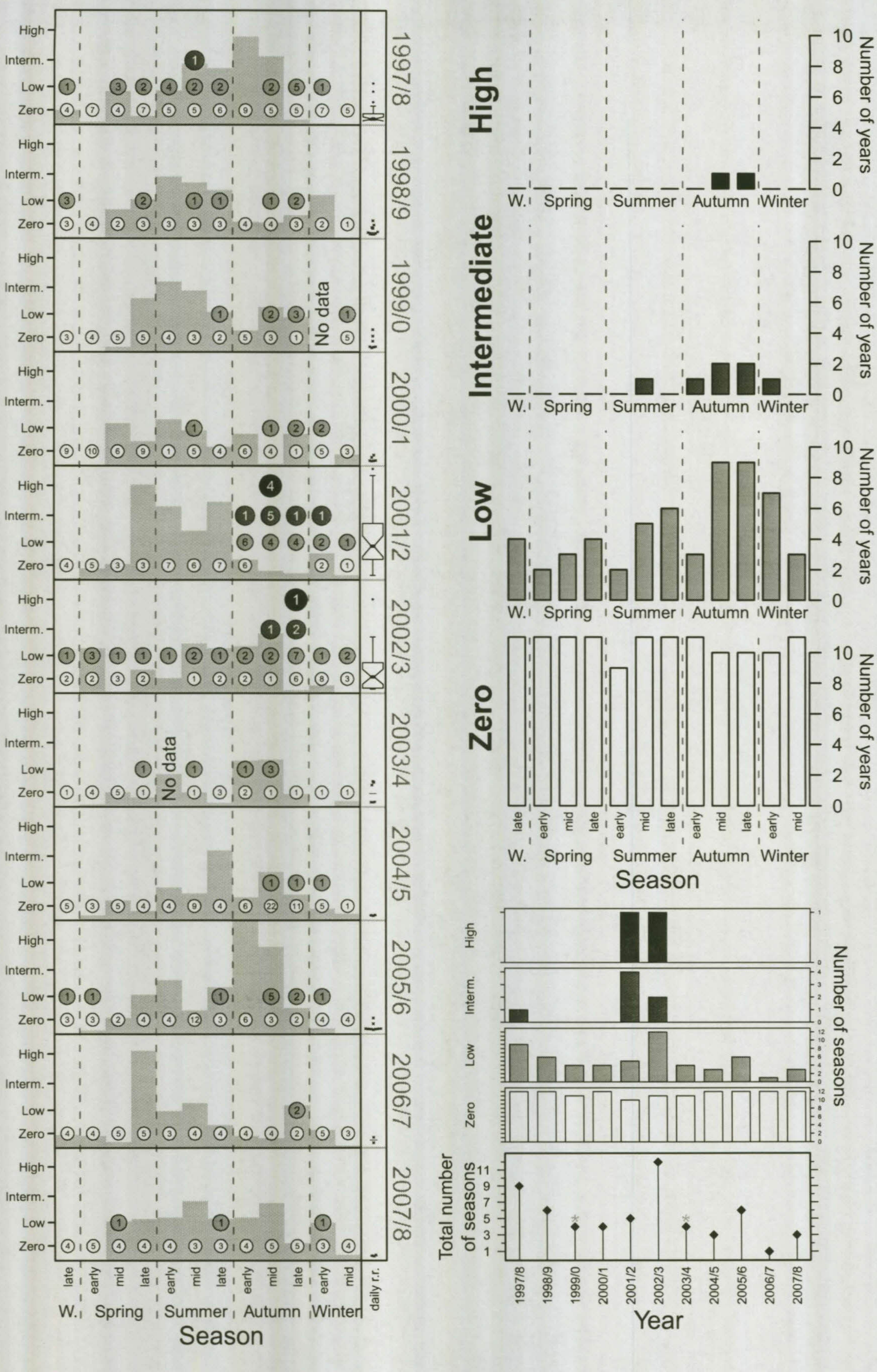


Figure 5.148: R601 Cape Robin-Chat — birds heard only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

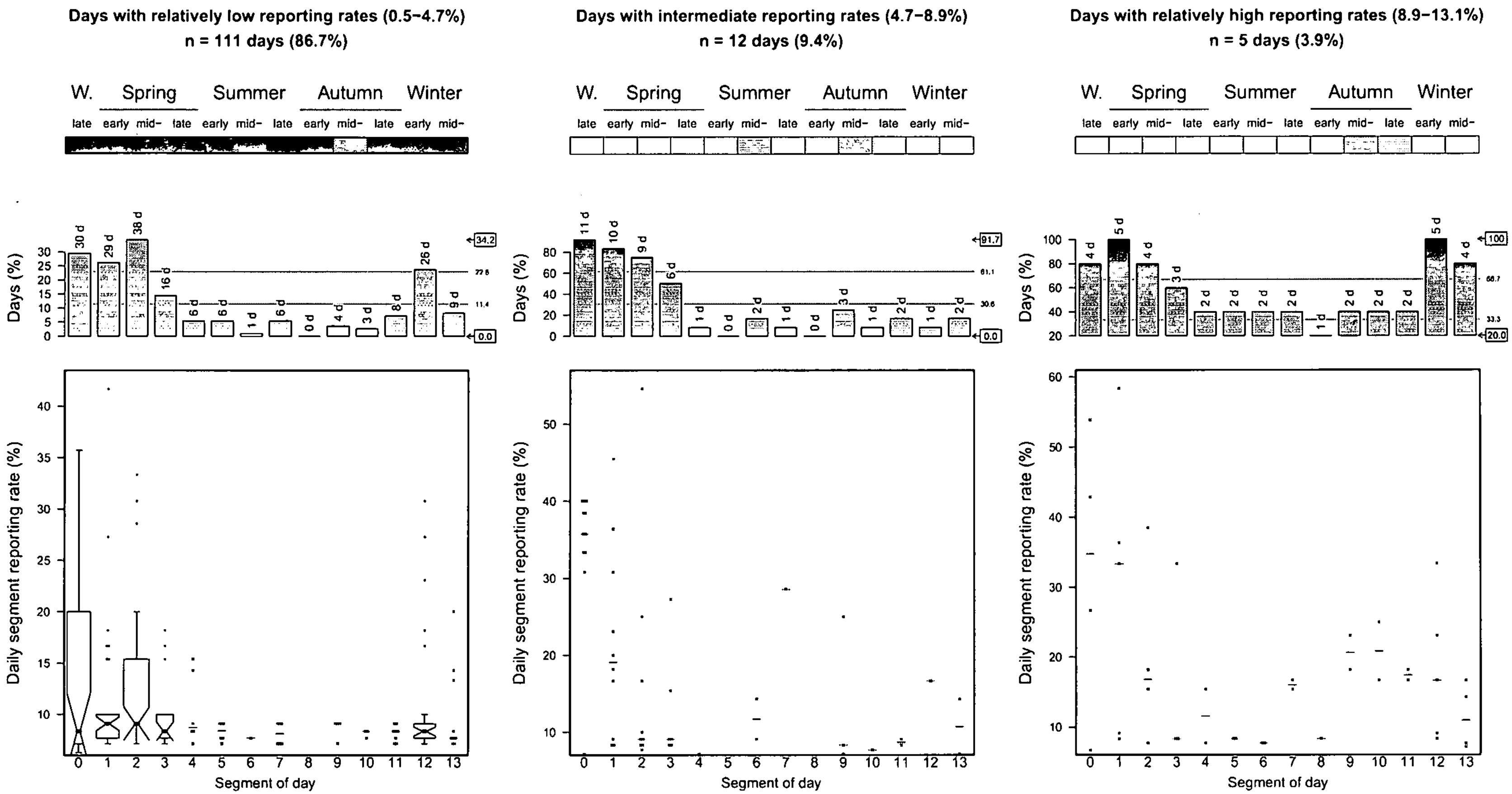


Figure 5.149: R601 Cape Robin-Chat — birds heard only: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

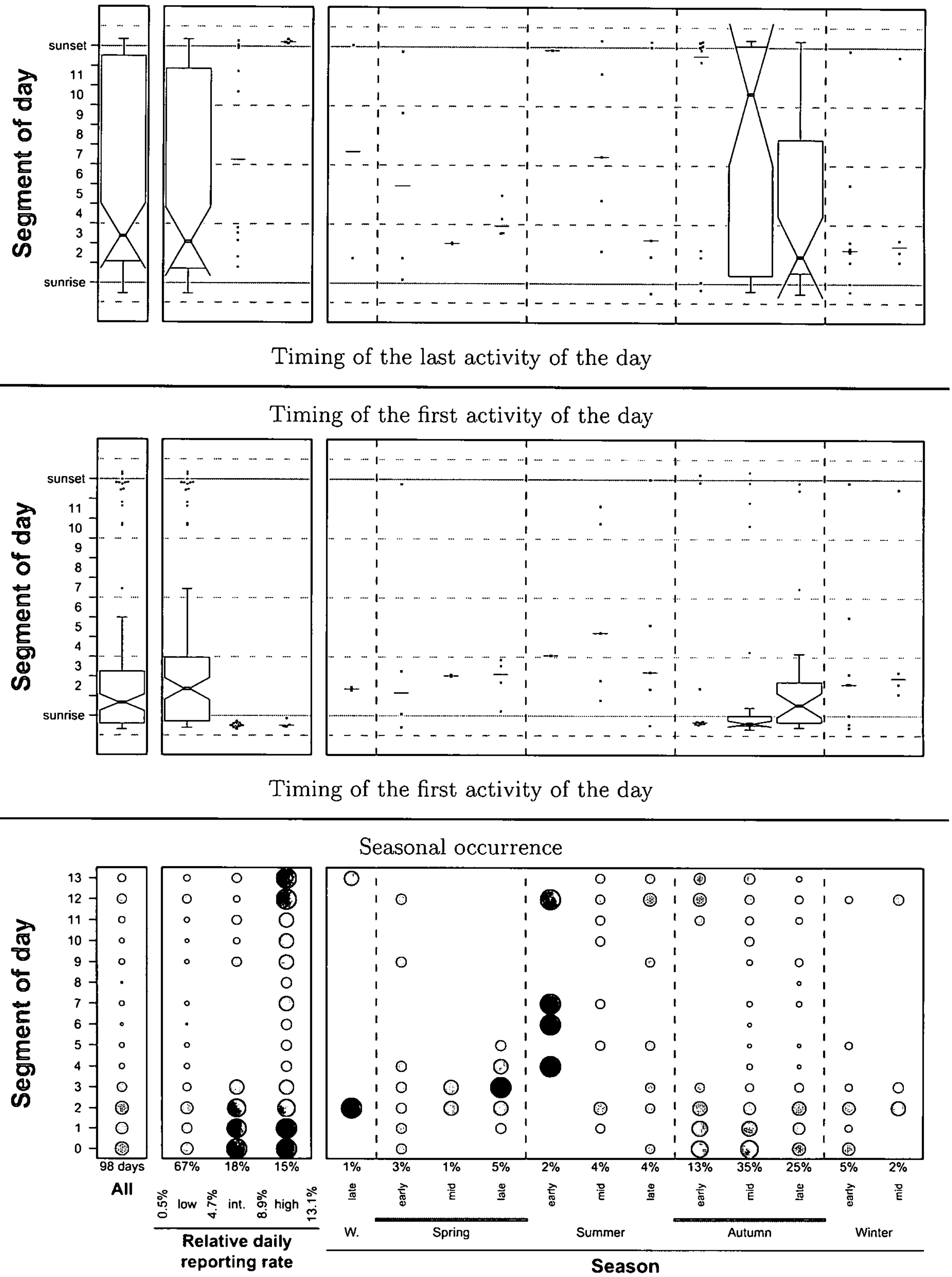


Figure 5.150: R601 Cape Robin-Chat — birds heard only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

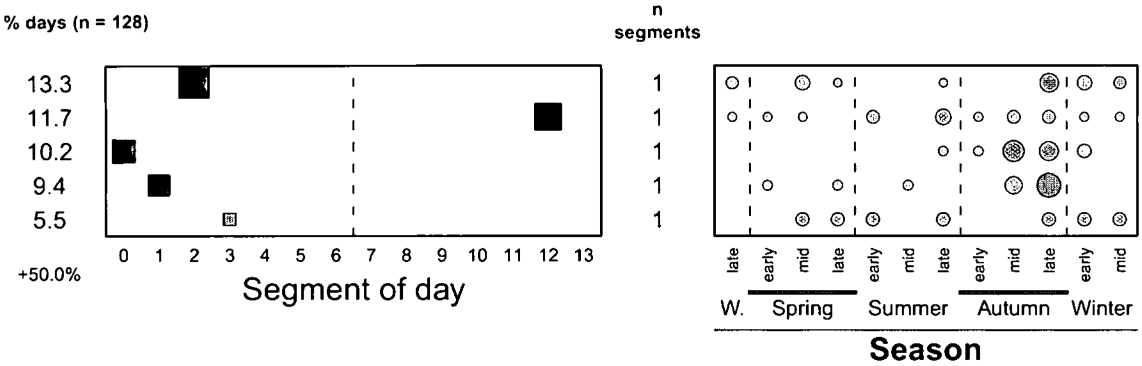
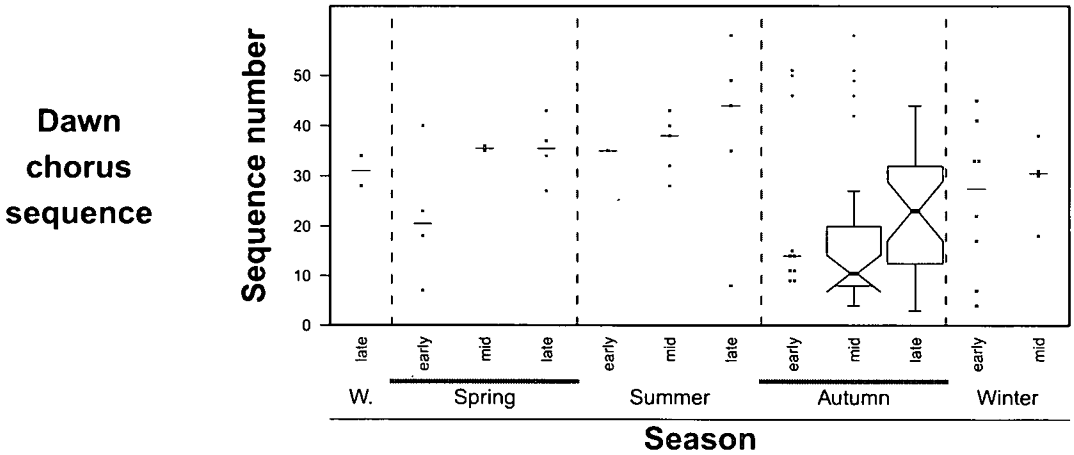


Figure 5.151: R601 Cape Robin-Chat — birds heard only: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.



Dawn chorus sequence

First activity of the day

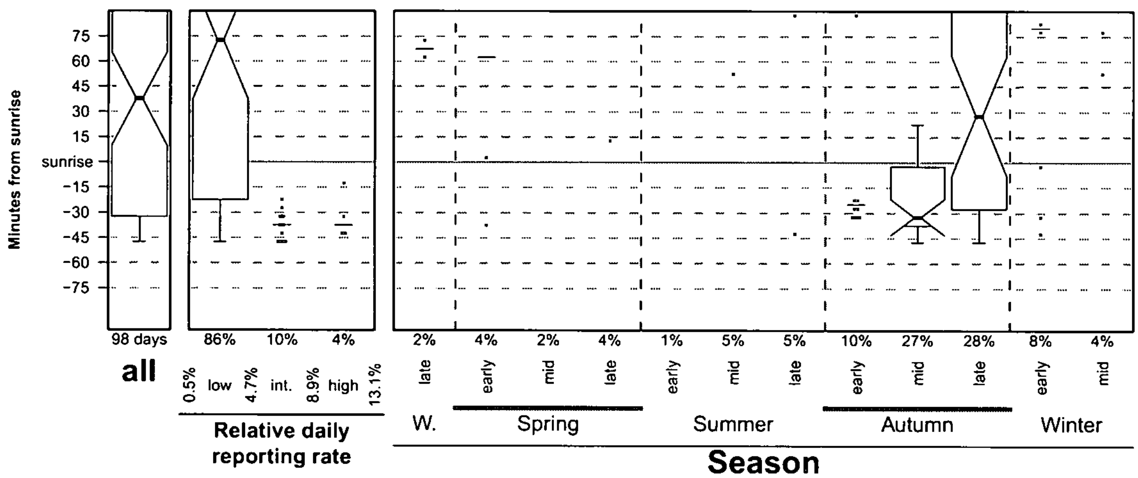


Figure 5.152: R601 Cape Robin-Chat — birds heard only: Details on the daily occurrence of the first activity of the day (bottom) and the dawn chorus sequence (top) in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

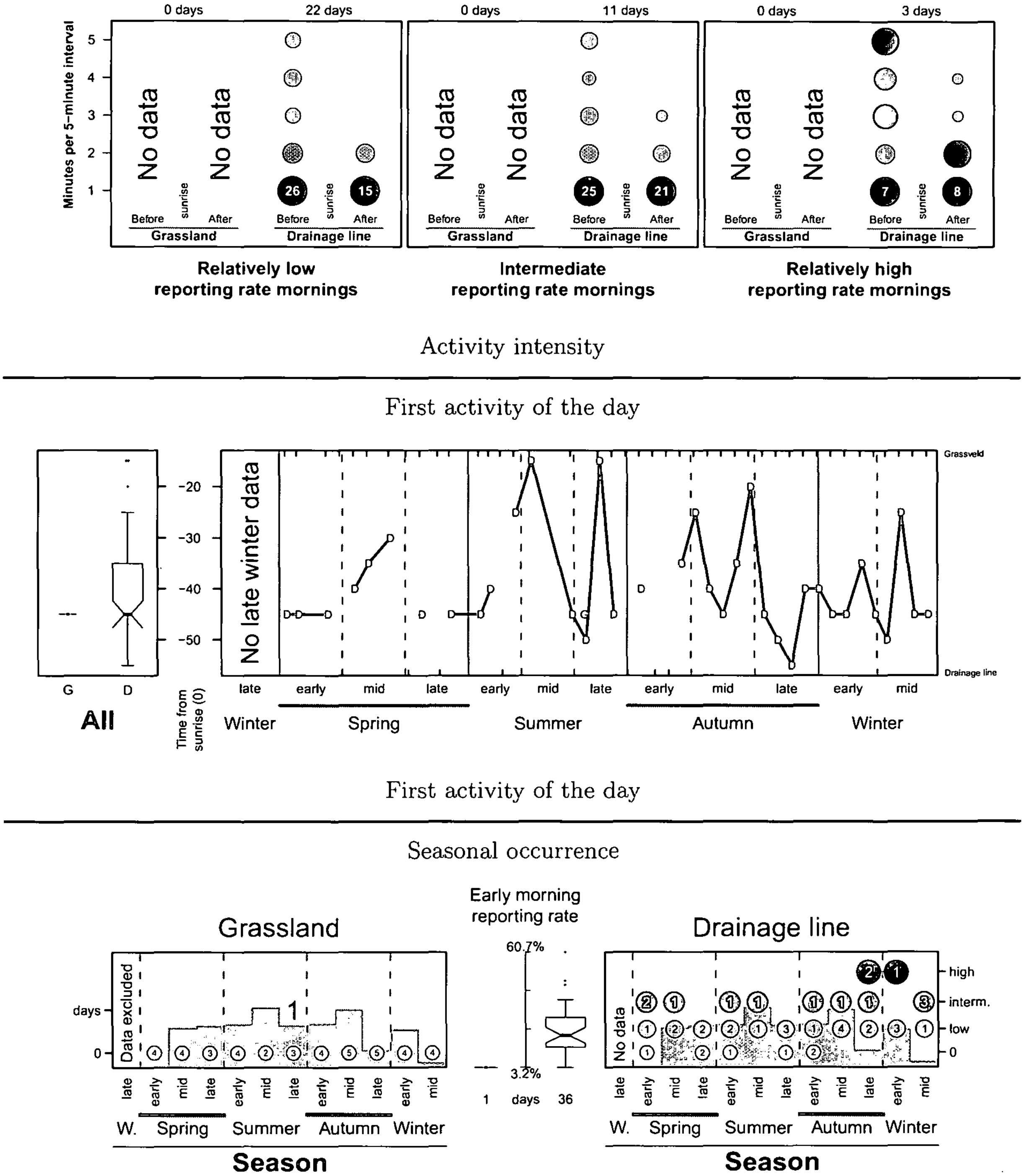


Figure 5.153: R601 Cape Robin-Chat — birds heard only: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Fig. 5.153). In the summer-rainfall areas of southern Africa, egg-laying peaks from October to December [mid-spring to mid-summer] (Oatley 1997c), and adult birds undergo a complete post-breeding moult which is usually completed in April [late autumn] (Oatley & Arnott 1998; Oatley 2005b; DJvN unpublished data). Therefore, it appears that the activity peak in autumn at Glen follows moult.

R614 Karoo Scrub-Robin .... *Cercotrichas coryphoeus*

The Karoo Scrub-Robin is endemic to southern Africa, occurring in the southern half of Namibia and in South Africa as far east as east-central Free State (Harrison 1997g). It is also found in the highlands of Lesotho (Van Niekerk 2004; DJvN unpublished data). Usually associated with scrub with some open ground (Harrison 1997g). Resident and sedentary (Harrison 1997g; Oatley & Arnott 1998).

The birds at Glen

Not recorded in the grassland or during the early mornings of 2007/8 in the drainage line. They do, however, occur in the eastern part of the farm dam's catchment where suitable habitat is available.

R615 Kalahari Scrub-Robin .... *Cercotrichas paena*

The Kalahari Scrub-Robin occurs from south-western and southern Angola (Dean 2000) southwards throughout most of Namibia, Botswana, western and southern Zimbabwe and South Africa where the north-western half of the Free State represents the south-eastern limit of its range (Oatley 1997d). The study area is situated at the south-eastern limit of its range. Important features of their habitat include bare ground and at least some elevated perches (trees, *etc.*) (Oatley 1997d). Sedentary, except where tall grass after good rains may necessitate local seasonal movements (Oatley & Arnott 1998).

The birds at Glen

Almost all Kalahari Scrub-Robin records were of birds calling in the drainage line. The exception was during early spring 2002/3 when a single individual was seen in the grassland and in the trampled area on three separate days. Only records of drainage line birds heard are considered further. Figures start on page 763.

Annual occurrence of drainage line birds heard in the grassland: In the grassland, heard on 12.7% of the days with an activity index of two (Table 5.25a). Recorded for 1–8 seasons per year, most frequently during 1998/9 and 2005/6 and least frequently in 2001/2 and 2006/7 (Fig. 5.154; Fig. 5.155). Daily reporting rates ranged from 0.5 to 11.7% with 95.2% bird-days attaining low reporting rates (Fig. 5.154). Median daily reporting rates were similar for all years with 2002/3 the only year with high reporting rate days (Fig. 5.154).

Table 5.25: R615 Kalahari Scrub-Robin: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.943	199	114 612	0.2	birds heard	12.7	656	83	2
0.057	12	114 612	0.0	birds seen only	0.5	656	3	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.995	428	1 190	36.0	birds heard	100.0	43	43	10
0.005	2	1 190	0.2	birds seen only	4.7	43	2	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 188	0.1	birds heard	2.3	43	1	1

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during 1–4 years from early winter to early summer (not recorded during mid-winter) and in 6–9 years from mid-summer to late autumn (Fig. 5.154). Median daily reporting rates were similar for all seasons (Fig. 5.154).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity was most frequently recorded in the early morning (S2) and in the late afternoon around sunset (Fig. 5.154). The pattern varied seasonally and includes activity most frequent in the late afternoon during early and mid-summer, and most frequent in the early mornings as well as late afternoon from late summer to mid-autumn (Fig. 5.156). Bird-segment combinations occurring during more than five bird-days were limited to activity during single morning (S1–S4) and late afternoon (S12–S13) segments (Fig. 5.157). Collectively these combinations account for more than half of all bird-days (Fig. 5.157). The timing of both the first and last activity of the day was variable (Fig. 5.156).

Daily segment reporting rates ranged from 5.9 to 54.5% with 93.8% of the values relatively low (Fig. 5.154). Median daily segment reporting rates were similar for all segments of the day (Fig. 5.154).

Early morning occurrence of drainage line birds heard during 2007/8: Activity was noted during all mornings in the drainage line, but during only one morning in the grassland (Table 5.25b & c; Fig. 5.158). In the drainage line, high reporting rate mornings occurred from early spring to early summer and again in early autumn, with exceptionally low levels of activity recorded during mid-summer (Fig. 5.158). The occurrence of the first activity of the day showed little variation, typically occurring at approximately 40 minutes before sunrise (Fig. 5.158). Activity intensities were sometimes higher before sunrise (Fig. 5.158).

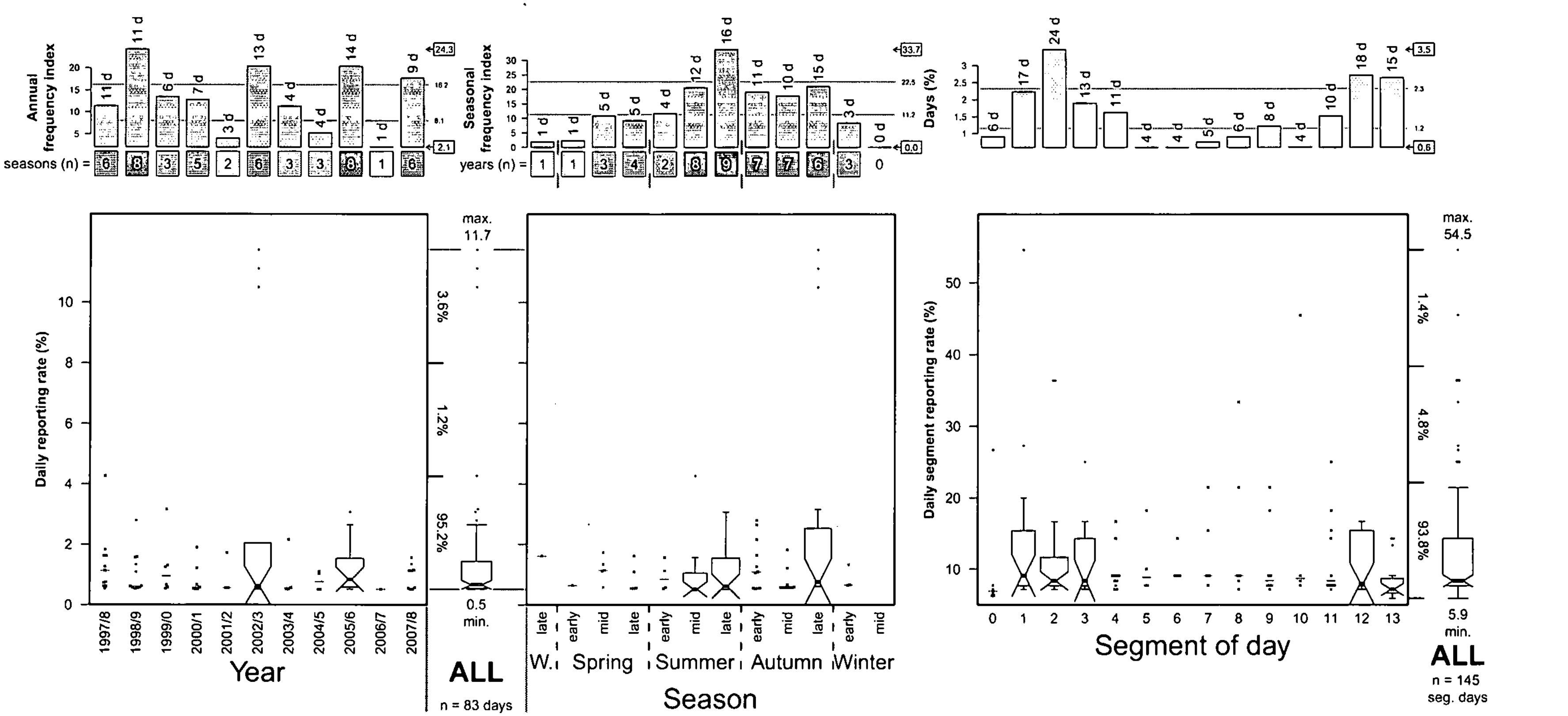


Figure 5.154: R615 Kalahari Scrub-Robin — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Figure 5.155: R615 Kalahari Scrub-Robin — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

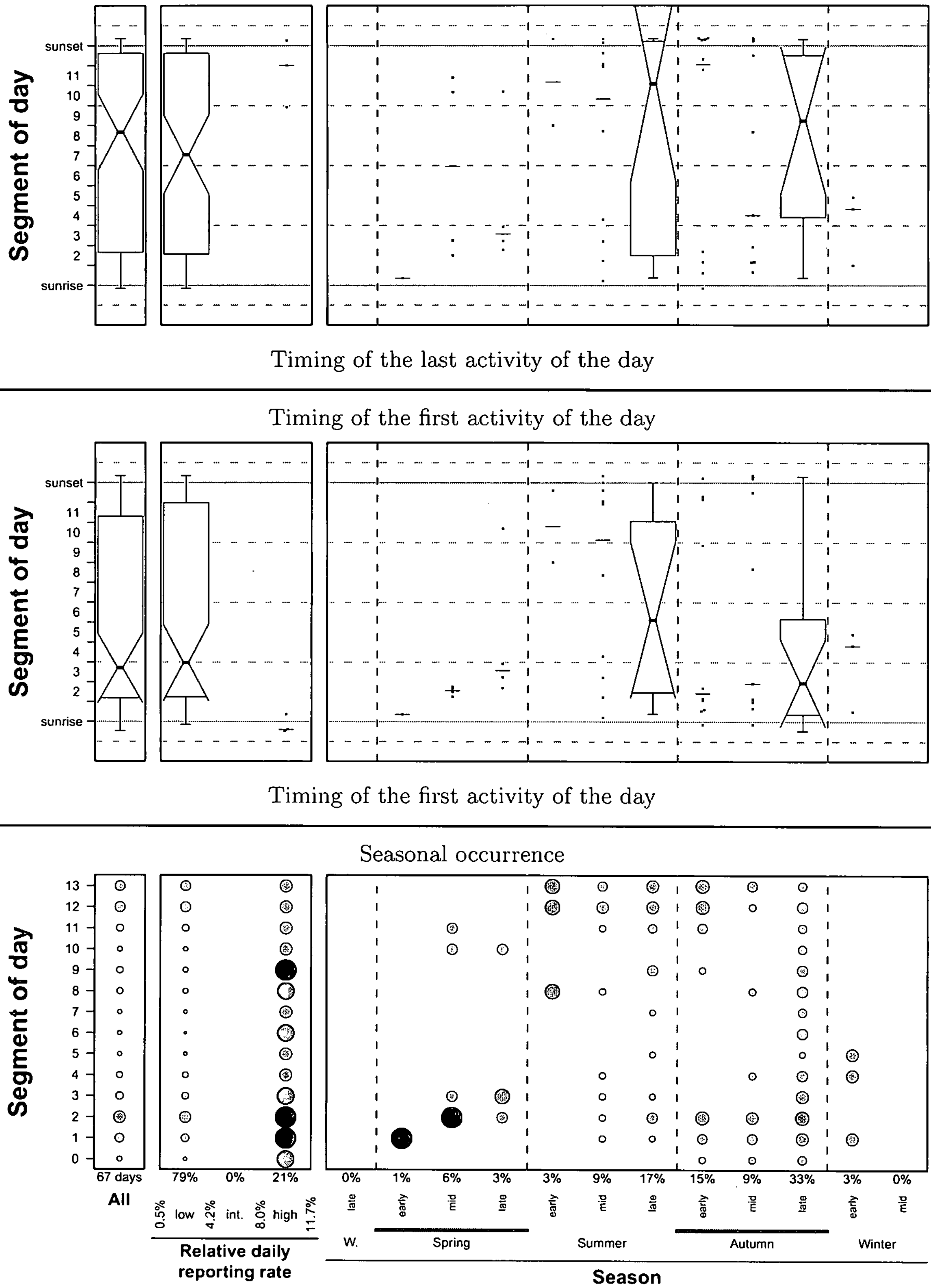


Figure 5.156: R615 Kalahari Scrub-Robin — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

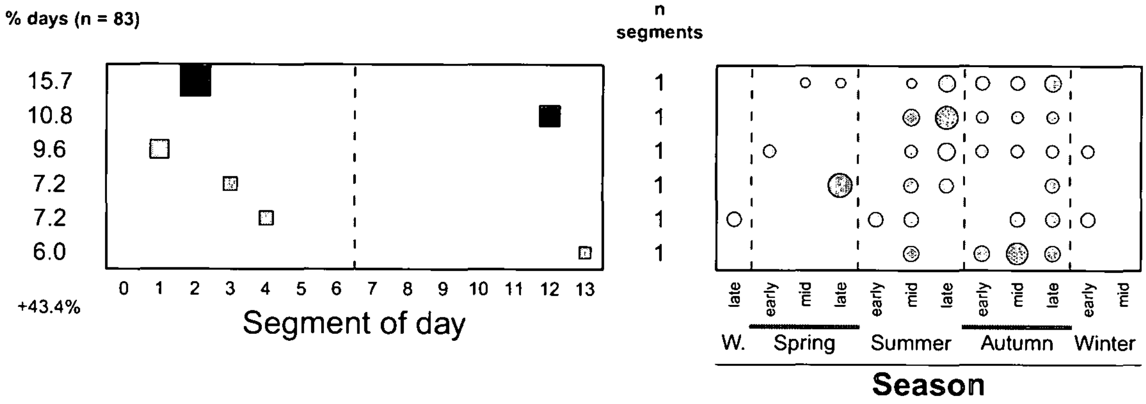


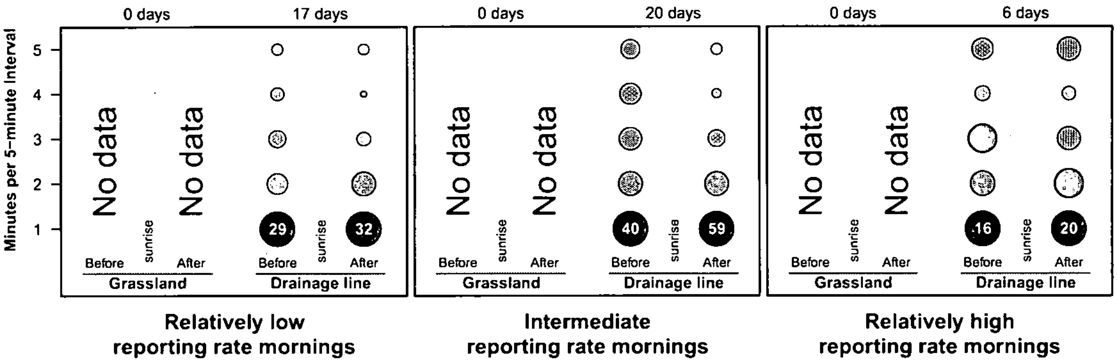
Figure 5.157: R615 Kalahari Scrub-Robin — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

Discussion

According to Oatley & Arnott (1998), rainfall is an important cue for breeding in the Kalahari Scrub-Robin. Significantly, in 2007/8 activity in the drainage line was first recorded in the grassland with the first rains of the season in mid-spring (Fig. 5.155), coinciding with a peak in early morning activity in the drainage line itself (Fig. 5.158). Note, however, that the early morning activity in the drainage line was rarely recorded in the grassland (Fig. 5.158). In fact, activity in the grassland was generally recorded later in the day (Fig. 5.156). This suggests diurnal behavioural changes which cause the birds to be become more detectable in the grassland. Perhaps the birds are more active on the outer parts of the drainage line later in the morning. There are probably seasonal changes in behaviour as well, because the birds were recorded during only six seasons in the grassland (Fig. 5.155) in spite of their resident status in the drainage line (Fig. 5.158).

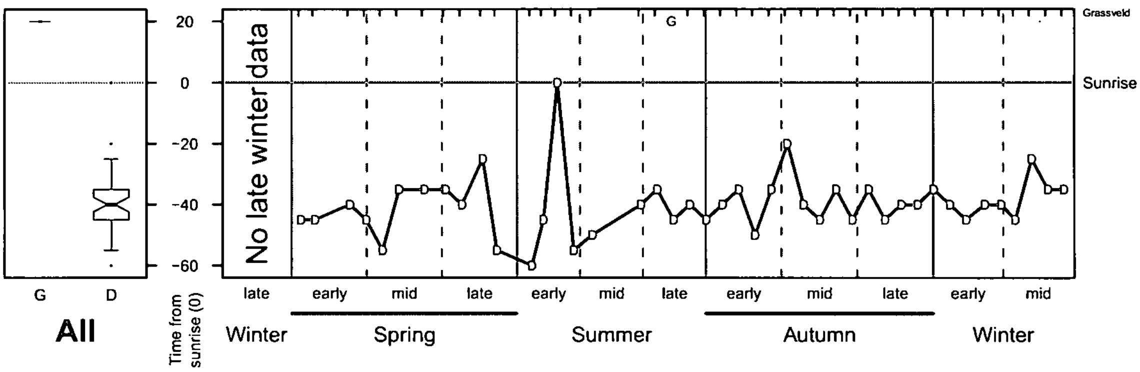
Figure 5.155 suggests that rainfall, perhaps specific rainfall events, could have stimulated activity in other years. Two notable exceptions include 2001/2 and 2006/7 during which activity was recorded in isolated seasons only, compared to other years when activity spanned at least two consecutive seasons. Strange as it may seem at first, it is suggested that rainfall also caused the abnormal occurrence of activity during 2001/2 and 2006/7. Oatley & Arnott (1998) suggested that local movements might occur when heavy rains lead to tall grass growth, thus rendering the habitat unsuitable. One feature that 2001/2 and 2006/7 have in common is that both years had exceptionally good rains during late spring (Fig. 2.18; Fig. 5.155). It is suggested that this caused habitat changes, which then led to reduced activity and/or local movements.

The drainage line data shown in Figure 5.158 suggests the following annual cycle. Breeding and accompanying vocalisations is associated with the earlier part of the main rain period and is followed by moult which dampens activity (mid-summer). This is followed in turn by a brief peak in activity (early autumn) after which activity returns to moderate levels. The peak in activity noted in the grassland from mid-summer to late autumn (Fig. 5.154) seems to follow on moult. The inference regarding post-breeding moult is based on a similar pattern observed in northern Botswana (see Oatley 2005c), two adults which started primary moult in mid-spring at



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

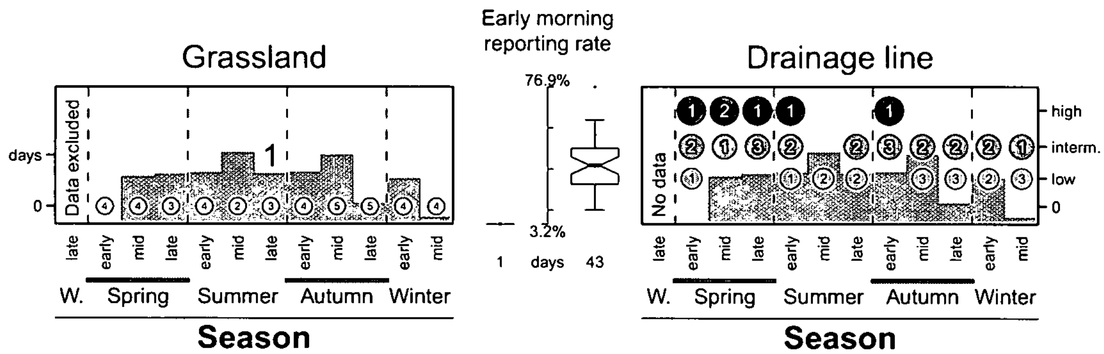


Figure 5.158: R615 Kalahari Scrub-Robin — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Glen (DJvN unpublished data), as well as the dampening effect that it have on activity in other species (*cf.* Eastern Clapper Lark R495, page 603).

> Note: The current classification of the Muscicapidae (Hockey *et al.* 2005) is different from that presented in Maclean (1985), whose order is followed here for practical reasons. Consequently, the family is continued on page 828.

5.8 Sylviidae: Leaf-Warblers, Babblers, Warblers

The taxonomy of this family is in a state of flux (Hockey *et al.* 2005). The approximately 576 species are, with one exception, found in the Old World only, with 44 species occurring in southern Africa (Hockey *et al.* 2005). Approximately half of these species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b), of which seven were recorded at Glen. Those not recorded include species inhabiting reedbeds (a habitat that does not occur in the study area), species limited to the eastern parts of the Free State or otherwise scarce species.

R621 Chestnut-vented Tit-Babbler .... *Parisoma subcaeruleum*

The Chestnut-vented Tit-Babbler occurs from south-western Angola (Dean 2000) and south-western Zambia (Hall & Moreau 1970) southward and is widespread in Namibia, Botswana, parts of Zimbabwe and in South Africa where it is absent from the east (including the eastern section of the Free State), except for an isolated population in the inland parts of KwaZulu-Natal (Berruti 1997a). It is associated with scrub and thickets, particularly indigenous *Acacia*, and is resident and apparently sedentary (Berruti 1997a).

The birds at Glen

The Chestnut-vented Tit-Babbler is restricted to the drainage line with all records in the grassland being of birds heard calling from within the drainage line. Figures start on page 770.

Annual occurrence of drainage line birds heard in the grassland: Heard on 11.9% of the days with an activity index of two (Table 5.26a). Activity was noted during 5–7 seasons per year during 1997/8–2000/1, 2005/6 and 2007/8, and during 3–4 seasons in all other years, except 2004/5 when recorded during only one season (Fig. 5.159; 5.160). Daily reporting rates ranged from 0.5 to 11.7% with 91.0% bird-days attaining low reporting rates; Median daily reporting rates were similar for all seasons except 2002/3, which had a relatively high value (Fig. 5.159).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons for at least one year per season, most frequently (n = 7–8 years) in late autumn and early winter (Fig. 5.159). Median daily reporting rates were similar for all seasons, with the occurrence of the few intermediate and high reporting rate days limited to autumn and early winter (Fig. 5.159; Fig. 5.160).

Table 5.26: R621 Chestnut-vented Tit-Babbler: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	189	114 612	0.2	birds heard only	11.9	656	78	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	567	1 190	47.6	birds heard only	95.3	43	41	14
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Daily occurrence of drainage line birds heard in the grassland: Overall, most frequently recorded between sunrise and late morning (Fig. 5.159). A similar pattern is evident for most seasons (Fig. 5.161). Bird-segment combinations occurring during more than five bird-days were limited to single bird-segments S1–S4 and S12, collectively accounting for nearly half of all bird-days (Fig. 5.162).

The first activity of the day was often in the early morning after sunrise, but later on the few late spring and early summer days (Fig. 5.161). The timing of the last activity of the day was variable, occurring at various times of the day (Fig. 5.161).

Overall, daily segment reporting rates ranged from 6.7 to 45.5% with 88.1% of the values relatively low (Fig. 5.159). Median values were similar for all segments (Fig. 5.159).

Early morning occurrence of drainage line birds heard during 2007/8: In contrast to the total absence of activity in the grassland, activity was noted on 95.3% of the mornings in the drainage line (Table 5.26b & c). Activity levels was particularly low during early and mid-spring (no data for late winter) (Fig. 5.163). The timing of the first activity of the day was variable during spring and early summer, but became remarkably constant after that, stabilising around 35 minutes before sunrise (Fig. 5.163). Activity at relatively high intensities occurred slightly more frequently after sunrise (Fig. 5.163).

Discussion

In spite of activity occurring throughout the year in the drainage line in the early mornings of 2007/8, no activity was recorded in the grassland then (Table 5.26b & c; Fig. 5.163). Activity was, however, recorded in the grassland later in the day in 2007/8 (Fig. 5.160; A check on the raw data reveals that activity was particularly frequent during S3 and S11; see also Fig. 5.161). It is possible that the birds become more detectable in the grassland because they venture into the more peripheral parts of the drainage line, and thus closer to the observer in the grassland, later in the morning.

According to Tarboton (2001), breeding occurs mainly from September to November [spring to early summer]. At Glen, limited data indicates that primary moult start as early as mid-summer

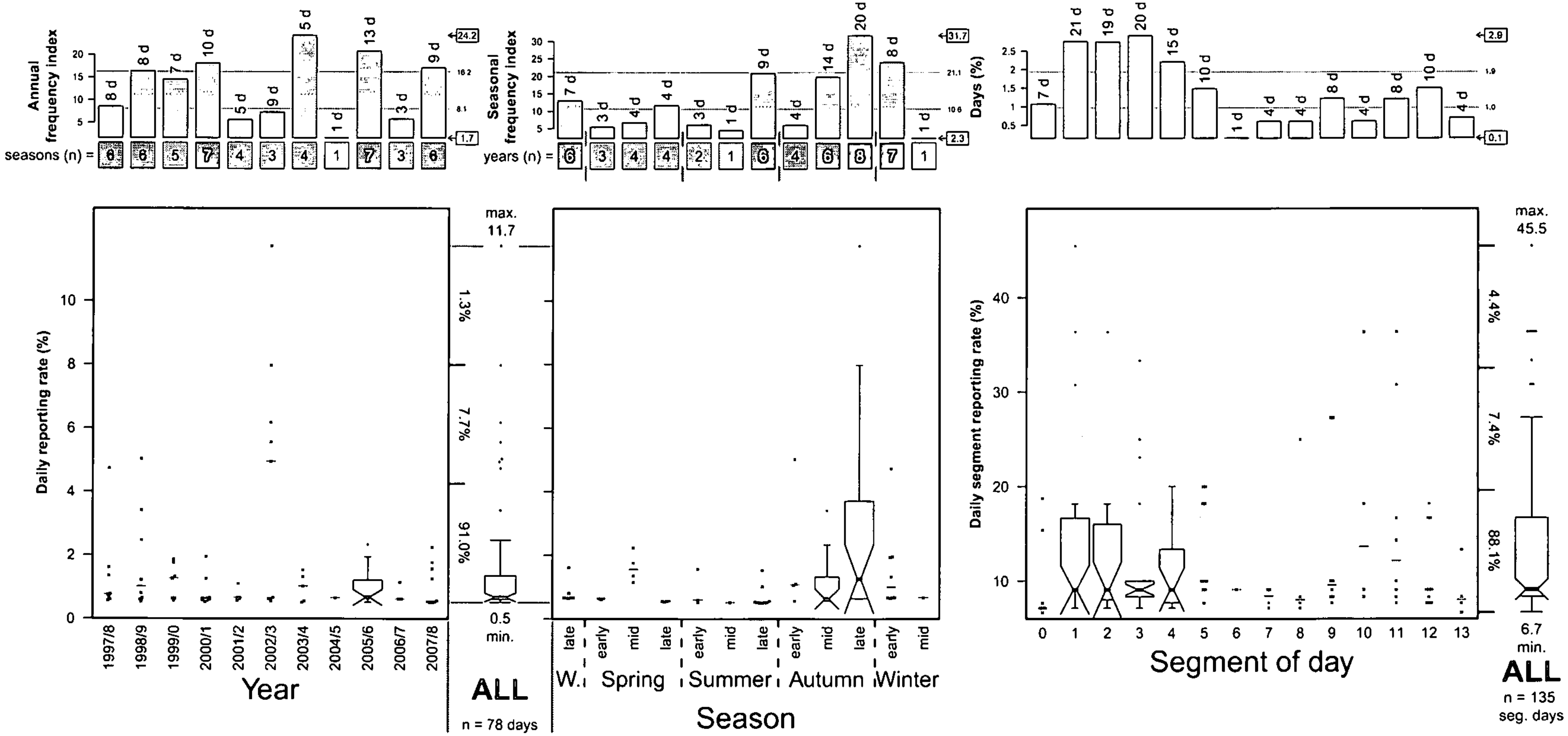


Figure 5.159: R621 Chestnut-vented Tit-Babbler — birds heard only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

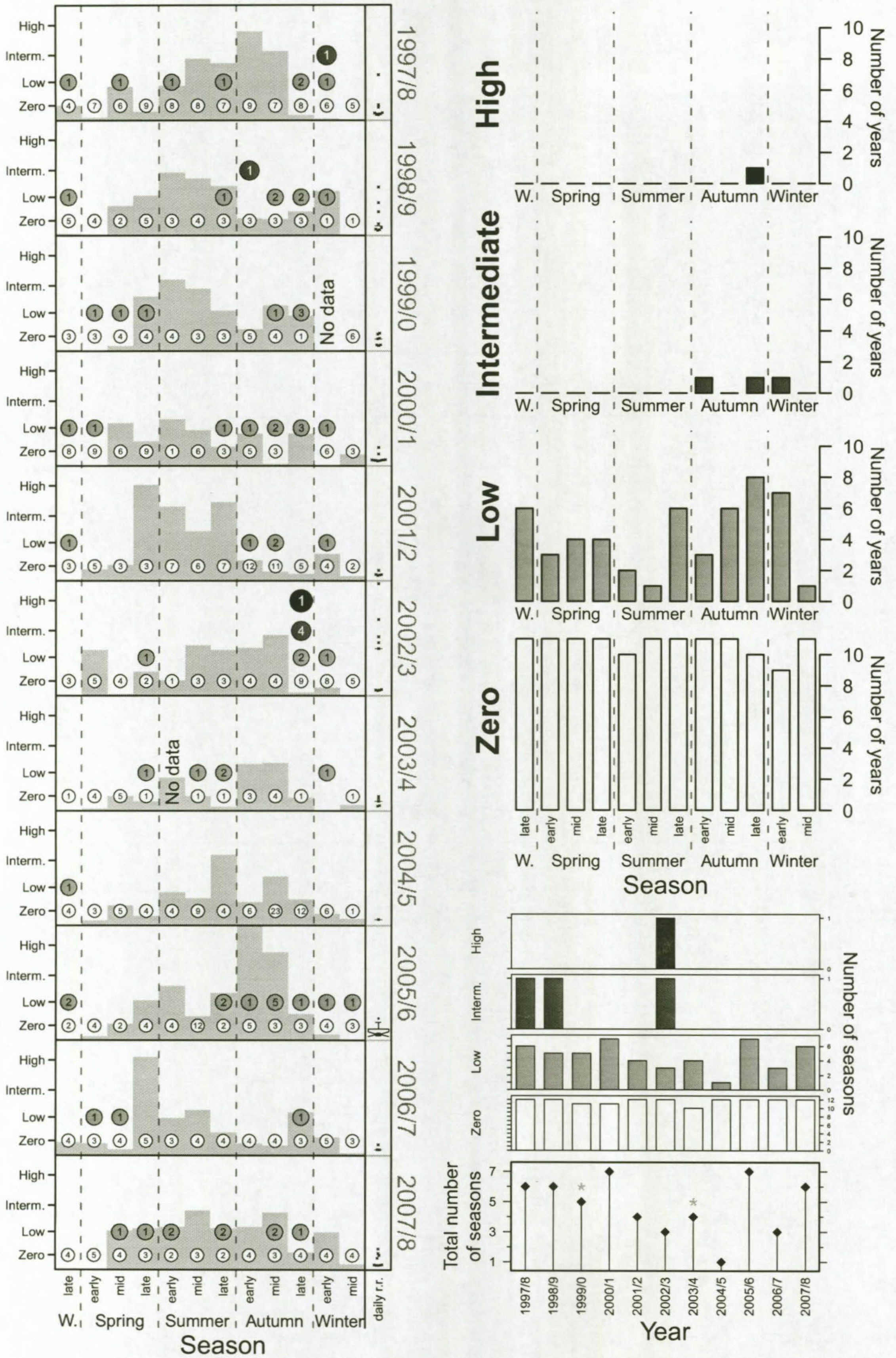


Figure 5.160: R621 Chestnut-vented Tit-Babbler — birds heard only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

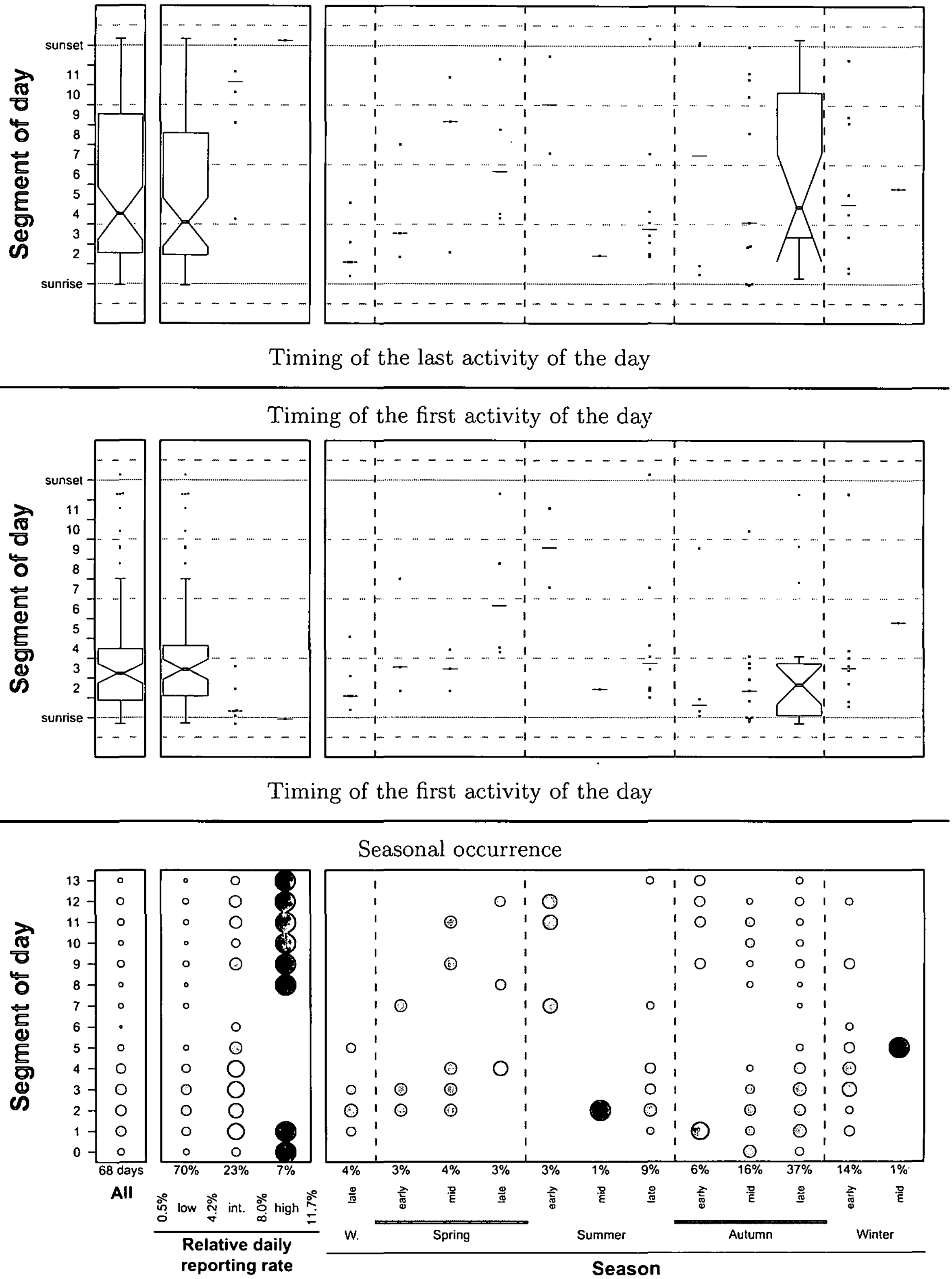


Figure 5.161: R621 Chestnut-vented Tit-Babbler — birds heard only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

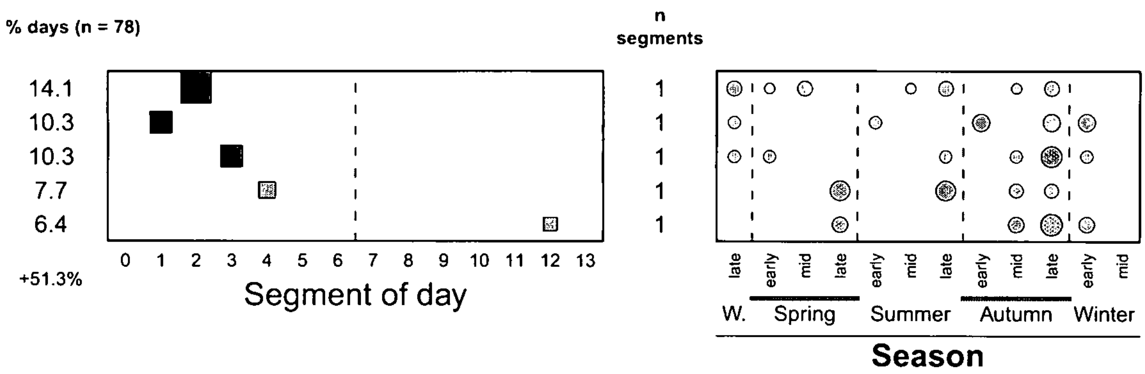


Figure 5.162: R621 Chestnut-vented Tit-Babbler — birds heard only: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

and lasts until about early winter (DJvN unpublished data), implying a post-breeding moult. This is in agreement with data from the Western Cape and Botswana (see Dean 2005q). The activity patterns in the drainage line (Fig. 5.163) suggest that activity peaks are associated with breeding as well as mid-autumn after relatively low activity levels in early autumn. These latter low levels may be related to moult. The relative frequent occurrence of activity during late autumn and early winter in the grassland (Fig. 5.159) seems to follow on moult.

R622 Layard's Tit-Babbler .... *Parisoma layardi*

Layard's Tit-Babbler is endemic to southern Africa, occurring from Lesotho and adjacent areas in the Free State westwards into western Namibia (Berruti 1997b). The study site is situated on the northern edge of its Free State distribution. In the Free State, they are often associated with *Olea* scrub on rocky outcrops or mountain slopes (Earlé & Grobler 1987). It is mainly a resident, but may move to lower altitudes during the cooler seasons (Dean 2005p; Van Niekerk 2004).

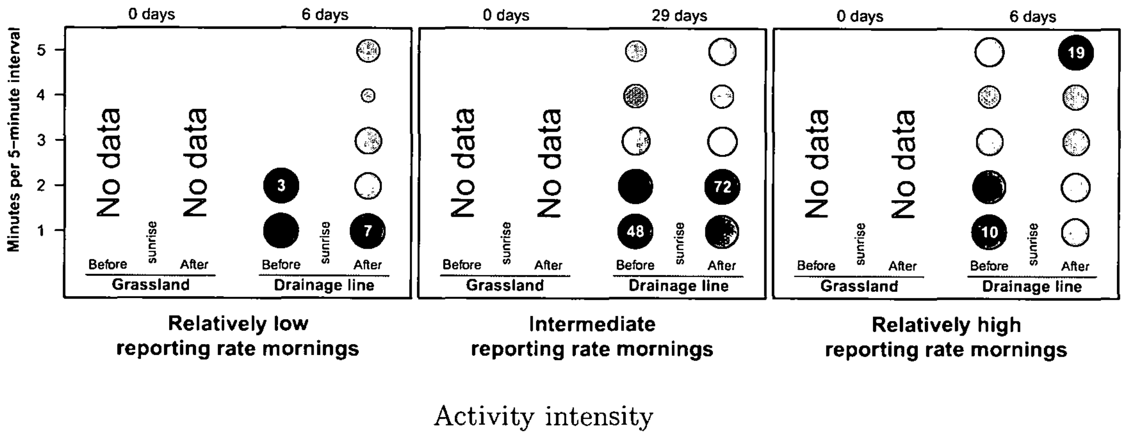
The birds at Glen

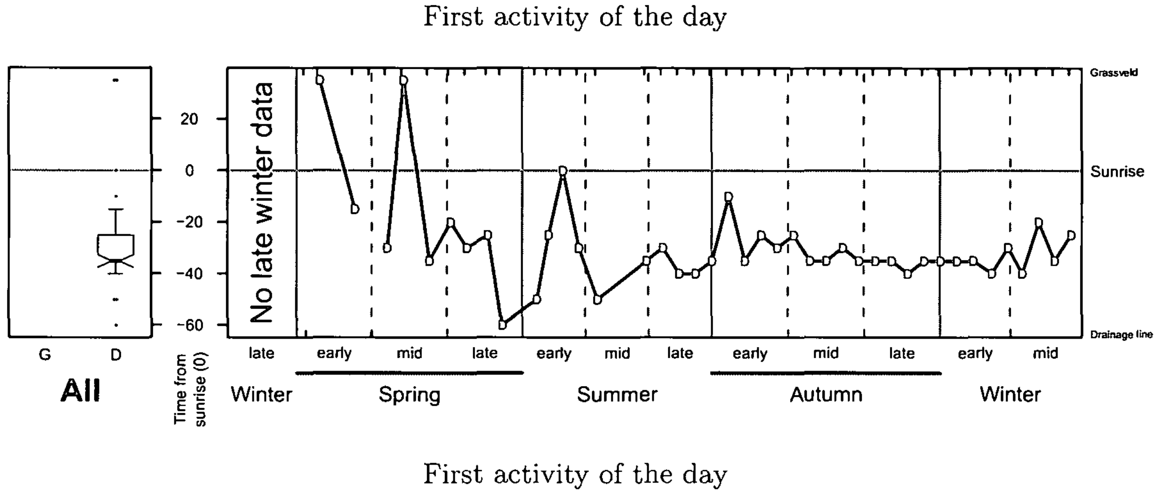
Individual Layard's Tit-Babblers were recorded on the mountain to the east during sporadic surveys there, most recently in mid-winter 2008/9.

In the grassland, a single individual was seen one morning before sunrise in one of the small acacias in the trampled area during early winter 2000/1. After a few minutes if flew in the direction of the drainage line.

Discussion

Four sub-species of Layard's Tit-Babbler are currently recognised (Dean 2005p). The range of *P. l. barnesi* is said to be the "Lesotho highlands and adjacent KwaZulu-Natal along Drakensberg", and across the Lesotho border a second sub-species, *P. l. subsolanum*, is said to occur from the Free State southward and westward (Dean 2005p). The remaining two sub-species occur along the west coast (*P. l. layardi*) and from the northern parts of the Northern Cape into Namibia (*P. l. aridicola*).





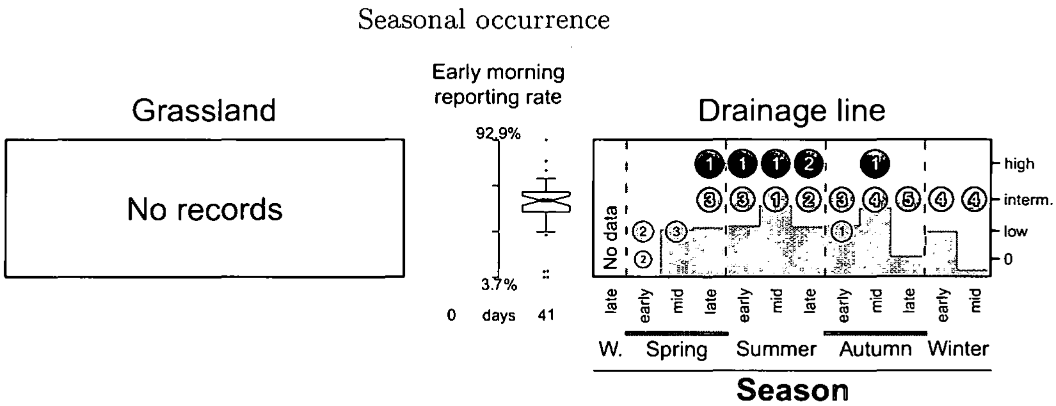


Figure 5.163: R621 Chestnut-vented Tit-Babbler — birds heard only: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Berruti (1997b) correctly noted that the latter three sub-species "appear to have continuous ranges" and that "the Lesotho highlands endemic, *P. l. barnesi*, is probably separated by altitude as it does not occur in the foothills (Bonde 1993)." We should add the Lesotho lowlands too: "Not found in foothills and lowland region" (Bonde 1993). Where then do the Lesotho birds go during winter? They are not recorded in the highlands then (Van Niekerk 2004). Furthermore, Dean (2005p) notes that the birds in the Karoo move from hillside habitat to lower-lying drainage lines during winter in some years. It is here suggested that the Lesotho birds move into the Free State and elsewhere when conditions in the Lesotho highlands demands it.

Significantly, an analysis of SABAP1 raw data reveals that the birds are more widespread during the cooler months of the year in the Free State, Northern Cape and Western Cape, but not the Eastern Cape where they were recorded from a similar number of QDGS during all months (Fig. 5.164). It is suggested that their more widespread occurrence in the Free State, at least, is due to an influx of Lesotho birds. The peaks in the Northern and Western Cape suggest a similar source.

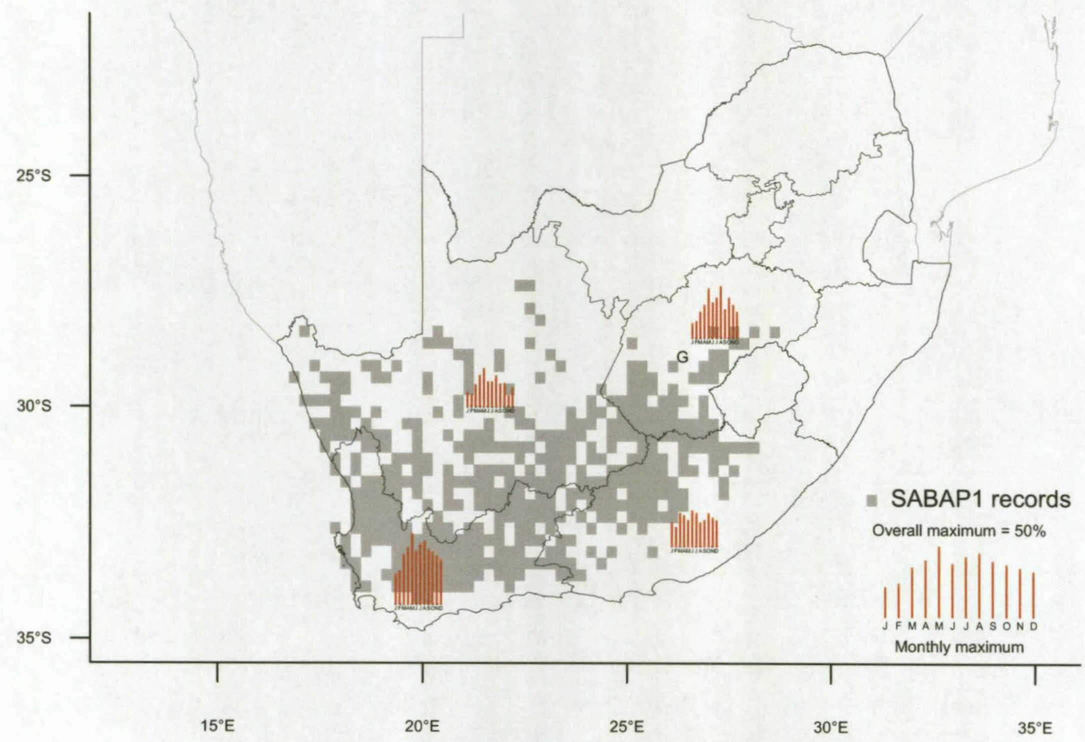


Figure 5.164: R622 Layard's Tit-Babbler: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

R625 Icterine Warbler .... *Hippolais icterina*

The Icterine Warbler breeds in the Palearctic with the entire population spending the non-breeding season in sub-Saharan Africa, mainly south of the equator (Cramp 1998). It reaches its southern limit in Natal and the Free State where it is infrequently recorded (Earlé & Grobler 1987; Herremans 1997b). The birds prefer taller stands of trees, particularly those with a well-developed shrub stratum (Herremans 1997b). In SABAP1 Zone 7, they were recorded from the end of November to the beginning of April [early summer to mid-autumn] (Herremans 1997b).

The birds at Glen

Recorded in the drainage line on two days a week apart, end of mid-summer and beginning of late summer 2007/8.

R643 Willow Warbler .... *Phylloscopus trochilus*

The Willow Warbler breeds in the Palearctic with all populations migrating to sub-Saharan Africa for the non-breeding season (Cramp 1998). It is one of the most common Palearctic passerines in southern Africa, occurring throughout the region, but only sparsely in the west (Herremans 1997c). It occurs almost anywhere where bushes and trees are found (Maclean 1985). In SABAP1 Zone 7 they were present from middle September to April [mid-spring to late autumn] (Herremans 1997c).

The birds at Glen

The Willow Warbler was mainly recorded in the drainage line and only rarely in the grassland (Table 5.27) where it was heard and seen in solitary *Acacia* trees, including those in the trampled area. The vast majority of the records involved birds heard and all the data are combined for analysis.

Table 5.27: R643 Willow Warbler: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	13	114 612	0.0	birds present	0.8	656	5	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	75	1 190	6.3	birds present	46.5	43	20	4
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 188	0.4	birds present	2.3	43	1	5

Birds in the grassland: Recorded on five days in four years during early spring (n = 1 year) and mid-autumn (n = 3 years), with records in the early morning after sunrise and in the early afternoon only (Fig. 5.165).

Early morning occurrence of birds during 2007/8: In contrast to the single record during mid-autumn in the grassland, the birds were recorded on 20 mornings in the drainage line from mid-spring to mid-autumn (Table 5.27b & c; Fig. 5.166). It was recorded on isolated mornings during early and late spring, but continuously from early summer to mid-autumn (Fig. 5.166). The timing of the first activity of the day was variable (Fig. 5.166), and activity intensities were often higher after sunrise than before sunrise (Fig. 5.166).

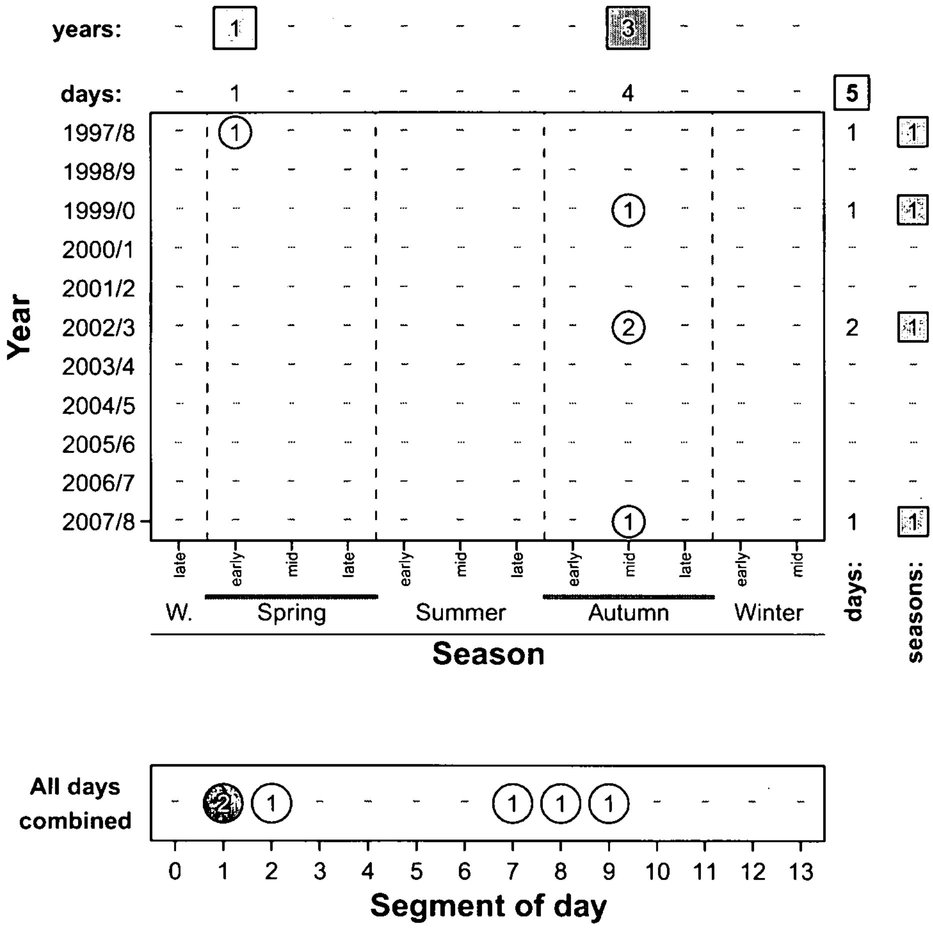
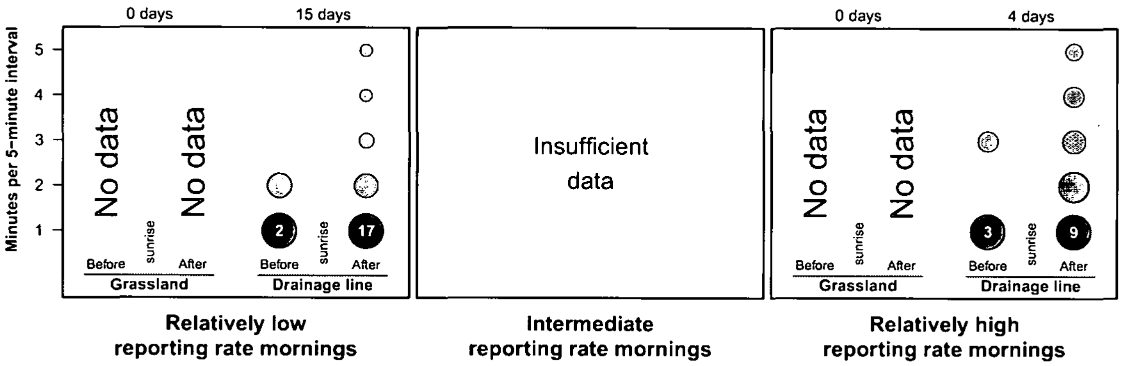


Figure 5.165: R643 Willow Warbler — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

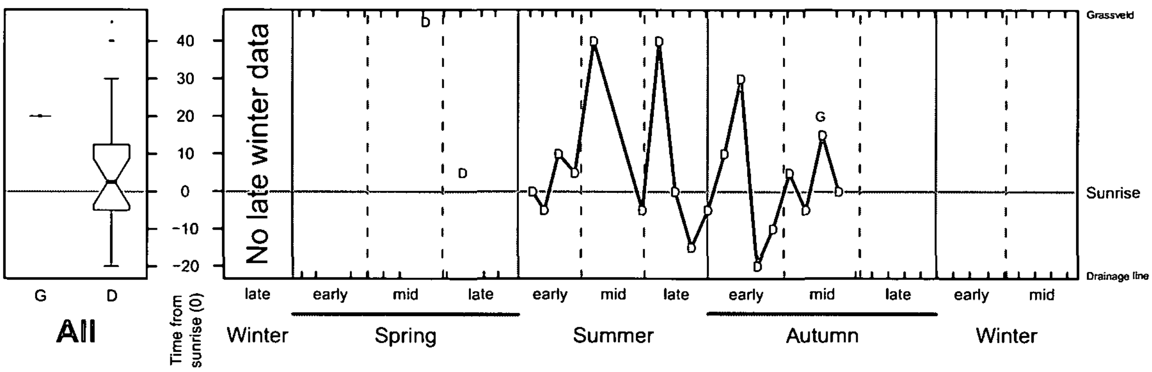
Discussion

Underhill *et al.* (1992) used SABAP1 data to show that the departure of the Willow Warbler is synchronised over southern Africa, with a mid-departure date in early April [mid-autumn]. Significantly, four of the five days during which the birds were recorded in the grassland were during mid-autumn (Fig. 5.165). These probably represent birds on their way north and explain their presence in the grassland. The abrupt end of activity in the drainage line (Fig. 5.166) further illustrates the point.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

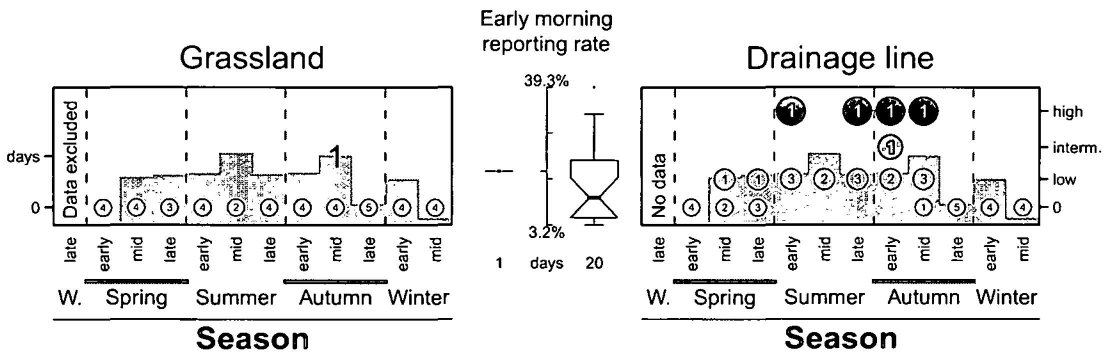


Figure 5.166: R643 Willow Warbler — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

The one early spring record in the grassland (Fig. 5.165) probably refers to a bird heading south. The same probably holds true for the single records during mid- and late spring in the drainage line (Fig. 5.166◘).

The moult in this species is well studied at both ends of its range, and Underhill *et al.* (1992) considered the scheduling of their moult in relation to breeding and migration. The Willow Warbler is one of a small number of bird species that undergo two primary moults each year, a post-breeding moult in the breeding area and a moult in the non-breeding area (Ginn & Melville 2007; Underhill *et al.* 1992). In South Africa, the latter moult occurs from December to February [mid-summer to early autumn] (Underhill *et al.* 1992). Thus, moult coincided partially with peak activity in the drainage line at Glen (Fig. 5.166◘).

R651 Long-billed Crombec .... *Sylvietta rufescens*

The Long-billed Crombec is endemic to sub-Saharan Africa (Harrison 1997h). It is widespread in southern Africa but conspicuously absent from southern Mpumalanga, the eastern Free State, Lesotho and the eastern parts of the Eastern Cape (Harrison 1997h; Parker 1999). It occurs in various types of woodland and scrubland habitats where it is resident (Harrison 1997h).

The birds at Glen

All Long-billed Crombec records refer to birds calling in the drainage line.

Drainage line birds heard in the grassland: Recorded on 24 (3.7%) of the days with an activity index of two (Table 5.28a). Since it was first recorded in 2000/1, activity was noted during six years, being particularly frequent in 2007/8 when recorded during six seasons compared to the 0–3 seasons of previous years (Fig. 5.167). Records were limited to the period from mid-spring to early winter when recorded during 1–2 years per season but during four years in late summer (Fig. 5.167). Heard throughout most of the day with a distinct peak in occurrence during the first half of the morning (Fig. 5.167).

Table 5.28: R651 Long-billed Crombec: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	59	114 612	0.1	birds heard	3.7	656	24	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	174	1 190	14.6	birds heard	65.1	43	28	6
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 188	0.4	birds heard	9.3	43	4	1

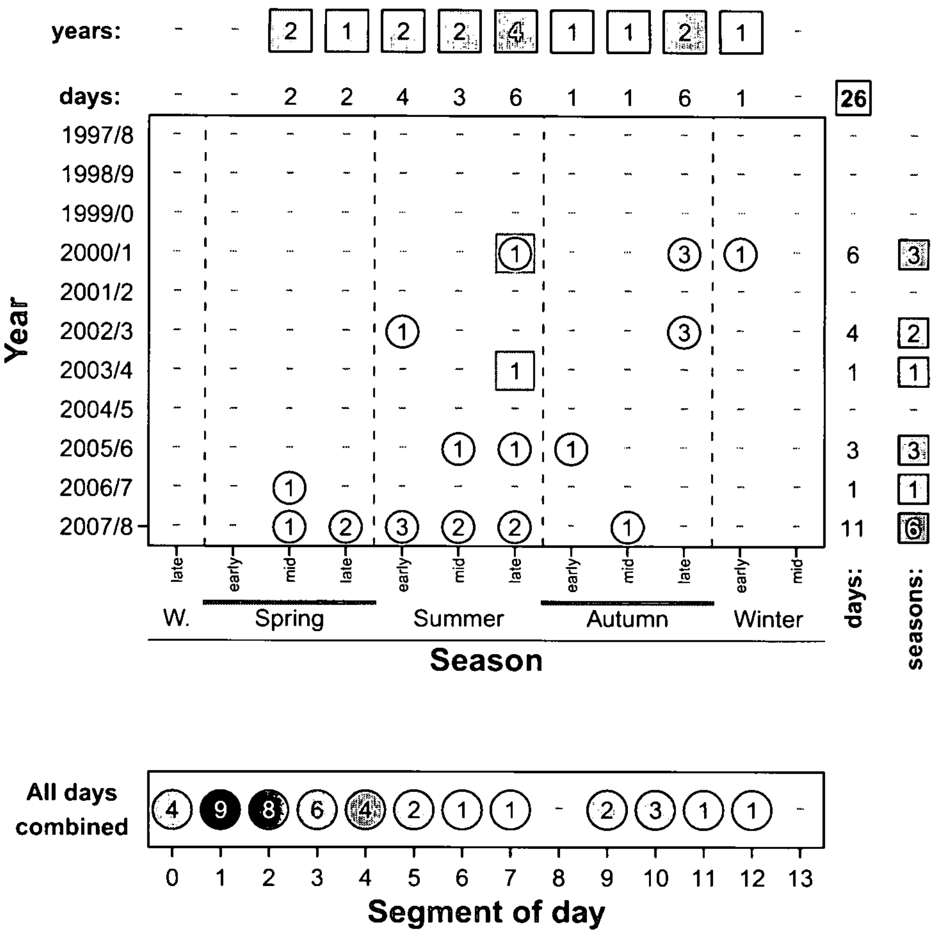


Figure 5.167: R651 Long-billed Crombec — birds heard: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Early morning occurrence during 2007/8 of drainage line vocalisations: Compared to the near absence of activity in the grassland when recorded on four mornings in early and late summer only, activity in the drainage line was noted on 28 mornings from mid-spring to mid-winter (Table 5.28b & c; Fig. 5.168). In addition, the activity index (6 vs. 1; Table 5.28b & c) and the median early morning reporting rate (Fig. 5.168) were higher in the drainage line than in the grassland. Activity peaked during late spring and early summer in the drainage line, followed by an abrupt drop in activity during mid-summer (Fig. 5.168). The timing of the first activity of the day was variable, but occurred mostly before sunrise in the drainage line (Fig. 5.168). Activity intensities were slightly higher before sunrise (Fig. 5.168).

Discussion

Activity as recorded in the grassland underestimated the activity in the drainage line during the early mornings of 2007/8 (Fig. 5.168). Yet activity was recorded in the grassland later in the day too (Fig. 5.167), presumably because the birds moved more to the edges of the drainage line then.

In the former Transvaal, egg-laying mostly occurs from October to January [mid-spring to

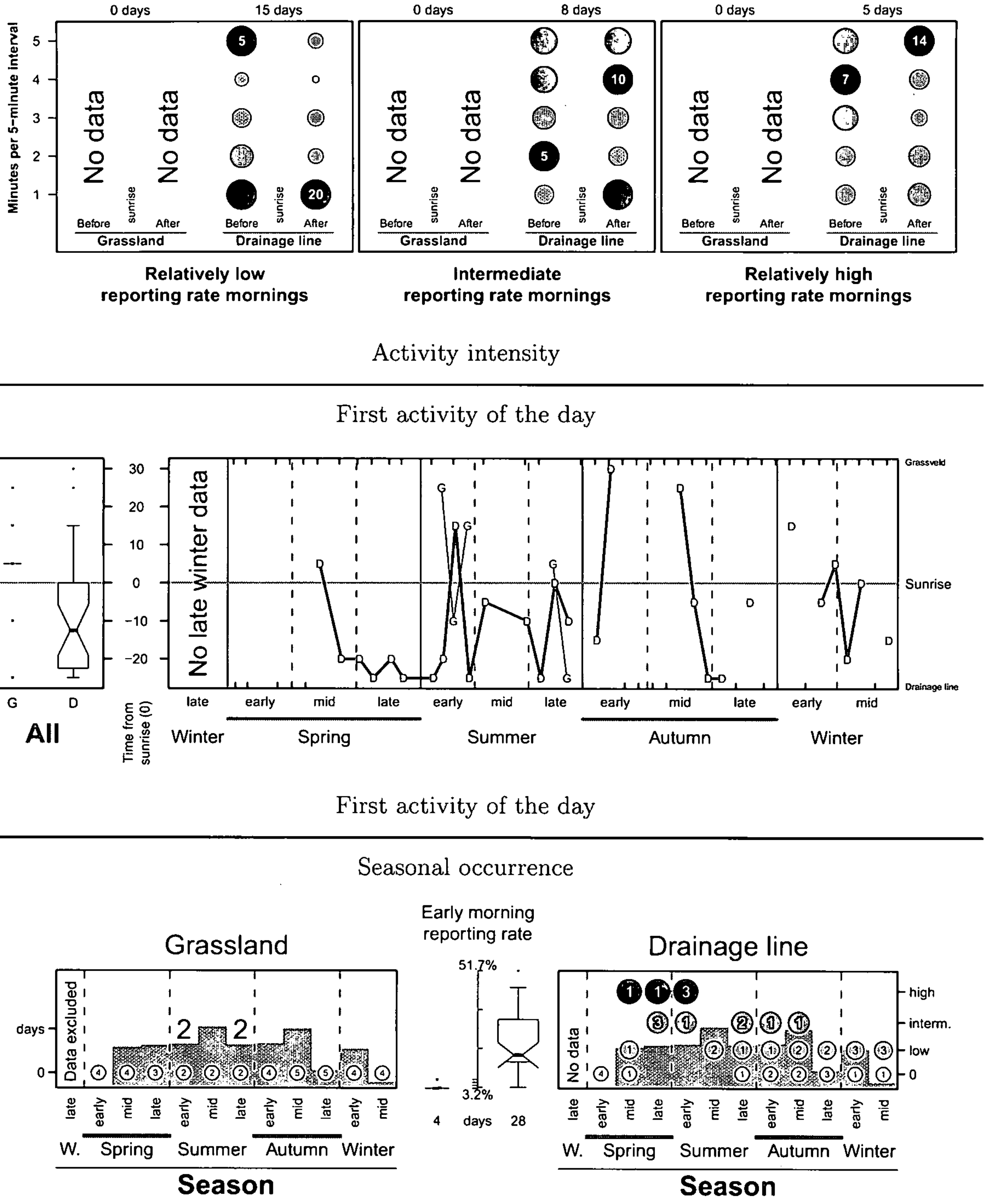


Figure 5.168: R651 Long-billed Crombec — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

late summer] (Tarboton *et al.* 1987). There is no published information on the moult of these birds in South Africa (Dean 2005n). However, of three adult birds ringed at Glen, one was in an early stage of primary moult in mid-summer, another was nearly finished in mid-autumn and the third bird ringed in late autumn had no active wing moult (DJvN unpublished data). This is suggestive of a post-breeding moult from about mid-summer to mid-autumn. It agrees with data from southern Zambia where the birds undergo a complete post-breeding moult from January to March [late summer to mid-autumn] (Dean 2005n). In northern Botswana and western Zambia moult is apparently earlier (Dean 2005n).

The activity in the drainage line at Glen (Fig. 5.168) peaked from late spring to early summer and is most probably due to breeding at that time. This was followed by a rather abrupt decrease in activity during mid-summer, presumably related to the start of moult. Activity levels subsequently increased, only to return to low levels from late autumn onwards.

R653 Yellow-bellied Eremomela .... *Eremomela icteropygialis*

The Yellow-bellied Eremomela is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in Namibia, Botswana, Zimbabwe and in South Africa in the north-east, the north and from the central Free State westwards (Berruti 1997c). It occurs in a variety of woodland and scrubland habitats (Berruti 1997c), preferring open karoo veld and *Acacia* scrub in the Free State (Earlé & Grobler 1987). It is a resident in the western half of the Free State (Earlé & Grobler 1987).

The birds at Glen

The Yellow-bellied Eremomela occurs in both the drainage line and in the grassland, but was recorded in the former habitat only during transects there, *i.e.* not during the 2007/8 early mornings when recorded on four mornings in the grassland (Table 5.29b & c). Figures start on page 784.

Table 5.29: R653 Yellow-bellied Eremomela: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	199	114 612	0.2	birds present	13.3	656	87	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	6	1 188	0.5	birds present	9.3	43	4	2

Annual occurrence of birds in the grassland: Recorded on 13.3% of the days with an activity index of two (Table 5.29a). Found during 2–4 seasons in most years, but during 6–9 seasons in 2002/3, 2004/5, 2005/6 and 2007/8 (Fig. 5.169; Fig. 5.170). Daily reporting rates ranged from 0.5 to 6.2% with 88.5% bird-days attaining low reporting rates (Fig. 5.169). Median daily reporting rates were similar for all years (Fig. 5.169).

Seasonal occurrence of birds in the grassland: Based on the number of bird-years, there appear to be two peak periods with one centred on spring and the other on autumn, while the seasonal frequency index peaked during mid-spring (Fig. 5.169). Median daily reporting rates were similar for all seasons, however (Fig. 5.169).

Daily occurrence of birds in the grassland: Overall, most frequently encountered in the early morning after sunrise (Fig. 5.169). There is some seasonal variability in this pattern with no early morning activity recorded during winter (Fig. 5.171). Four bird-segment combinations occurred during more than five bird-days and all involved single bird-segments S1–S4, collectively accounting for more than a third of all bird-days (Fig. 5.172). These combinations were largely limited to spring and autumn (Fig. 5.172).

The timing of the first activity of the day was variable, but the median values do show a seasonal trend with activity starting later in the day during winter (Fig. 5.171). The timing of the last activity of the day was variable (Fig. 5.171).

Daily segment reporting rates ranged from 6.2 to 58.3% with 92.0% of the values relatively low (Fig. 5.169). Median daily segment reporting rates were similar for all segments of the day (Fig. 5.169).

Discussion

Egg-laying in the Yellow-bellied Eremomela occurs mainly from September to November [spring and early summer] (Tarboton 2001). This period coincides with a time when the birds were most frequently recorded at Glen (Fig. 5.169). The birds apparently undergo a post-breeding moult, which in western Zambia and Botswana is from November to January [late spring and summer] (Dean 2005o; Hall 1956). This coincides with the time when the birds were relatively infrequently recorded at Glen (Fig. 5.169). Thereafter the birds became more frequent once again followed by a period in mid-winter when they were recorded only once (Fig. 5.169).

Note: The current classification of the Sylviidae (Hockey *et al.* 2005) is different from that presented in Maclean (1985), whose order is followed here for practical reasons. Consequently, the family is continued on page 833.

5.9 Cisticolidae: African Warblers

African warblers, of which there are 125 species, occur in sub-Saharan Africa, southern Europe, Asia, Australia and Madagascar, with 37 species occurring in southern Africa (Hockey *et al.* 2005). A total of 19 species have been recorded in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b), with seven species recorded at the study area at Glen. The Grey-backed Cisticola *Cisticola subruficapilla* was not recorded in the drainage line or the grassland, but they do occur on the slopes of the adjacent mountains in the east. Other Free State species not

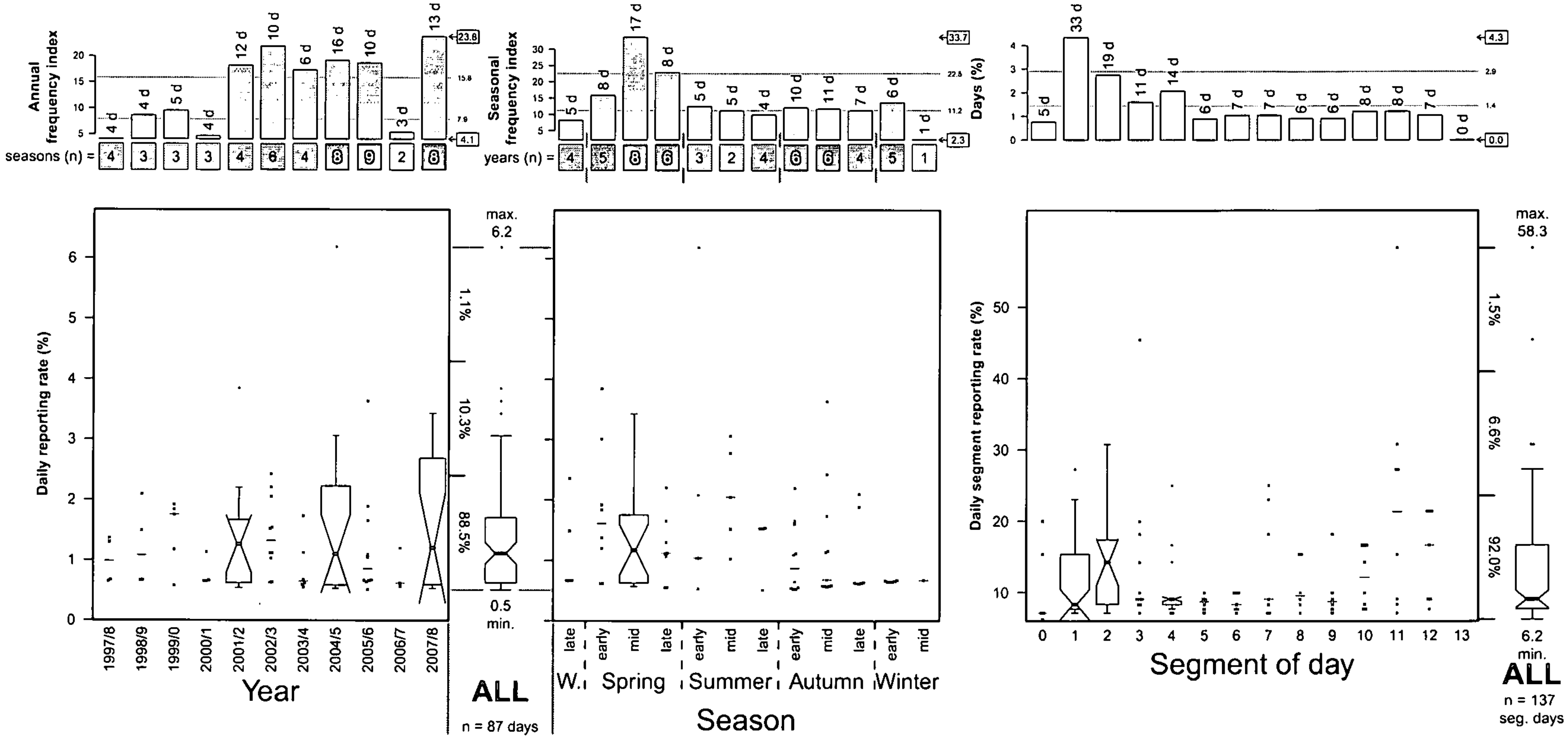


Figure 5.169: R653 Yellow-bellied Eremomela — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

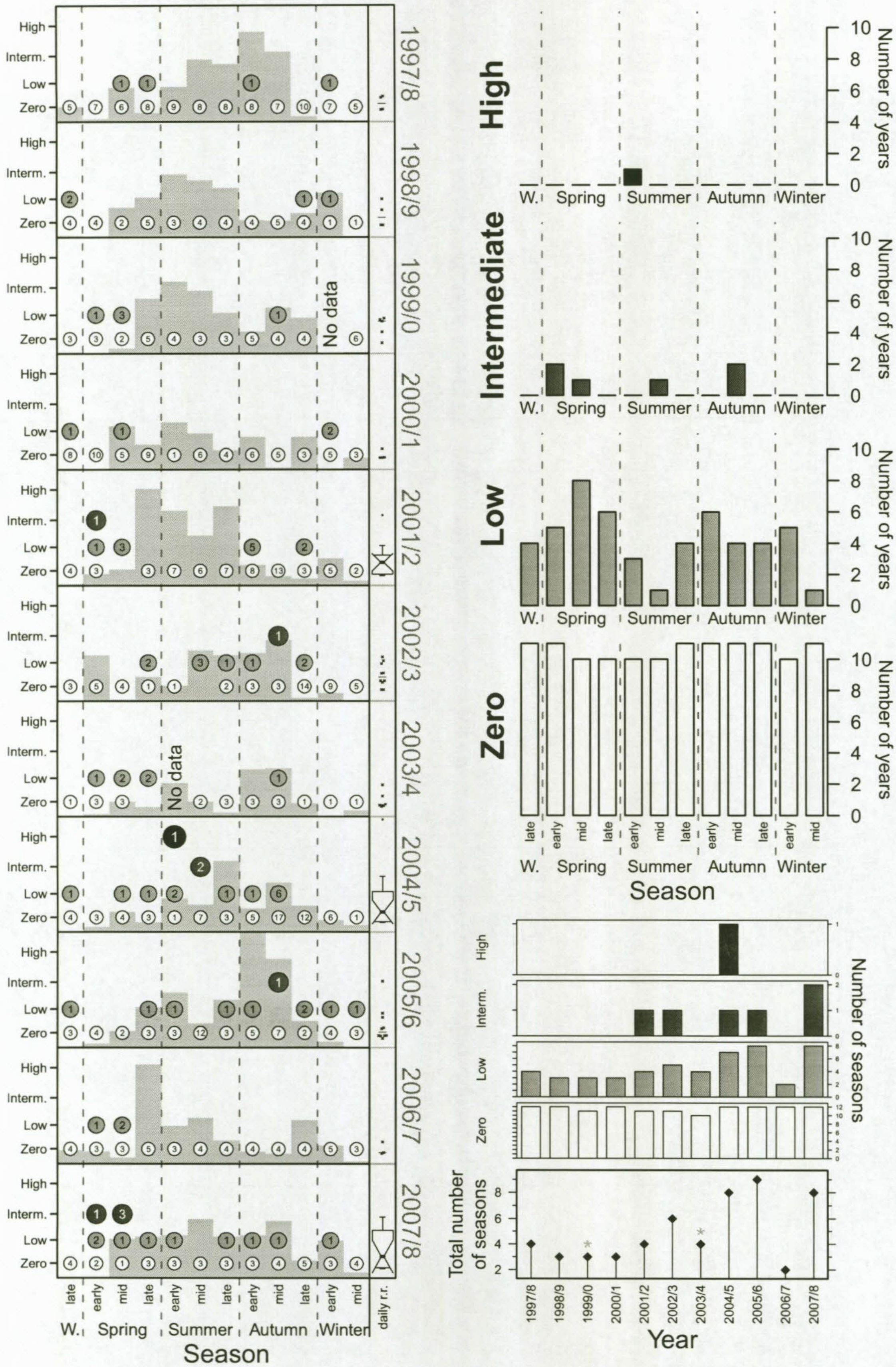
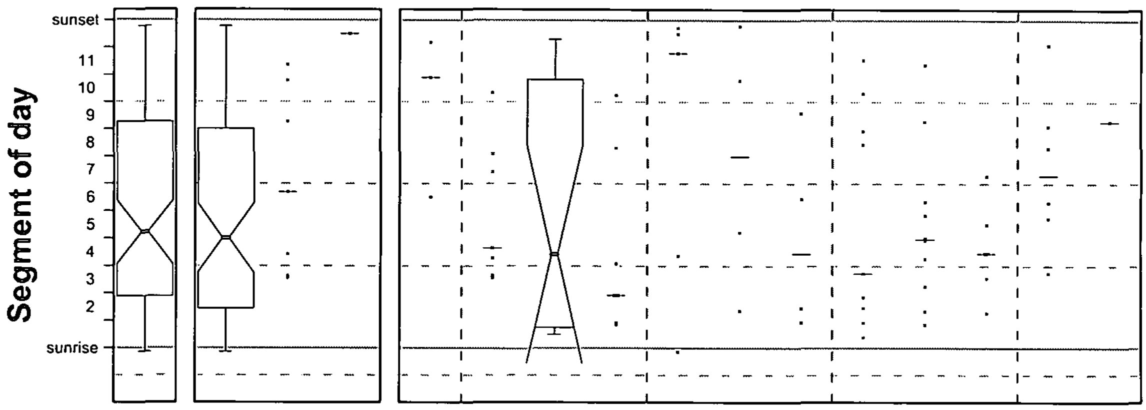
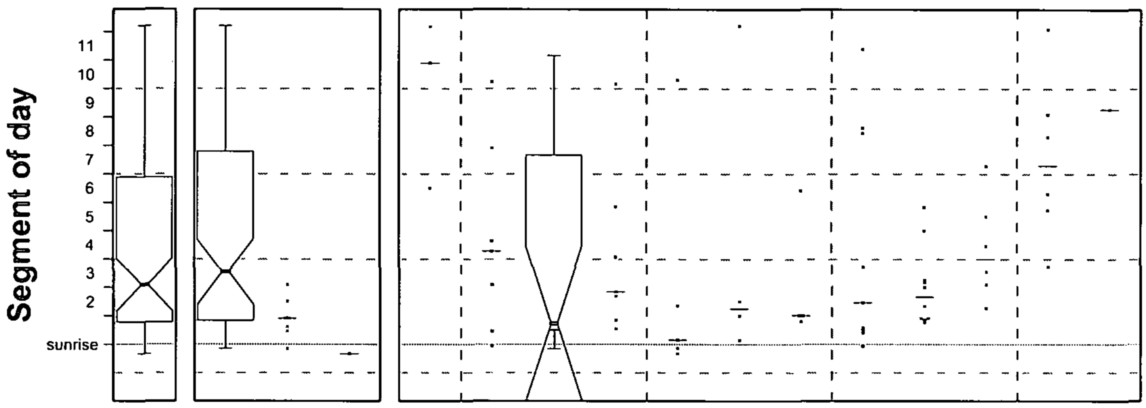


Figure 5.170: R653 Yellow-bellied Eremomela — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.



Timing of the last activity of the day

Timing of the first activity of the day



Timing of the first activity of the day

Seasonal occurrence

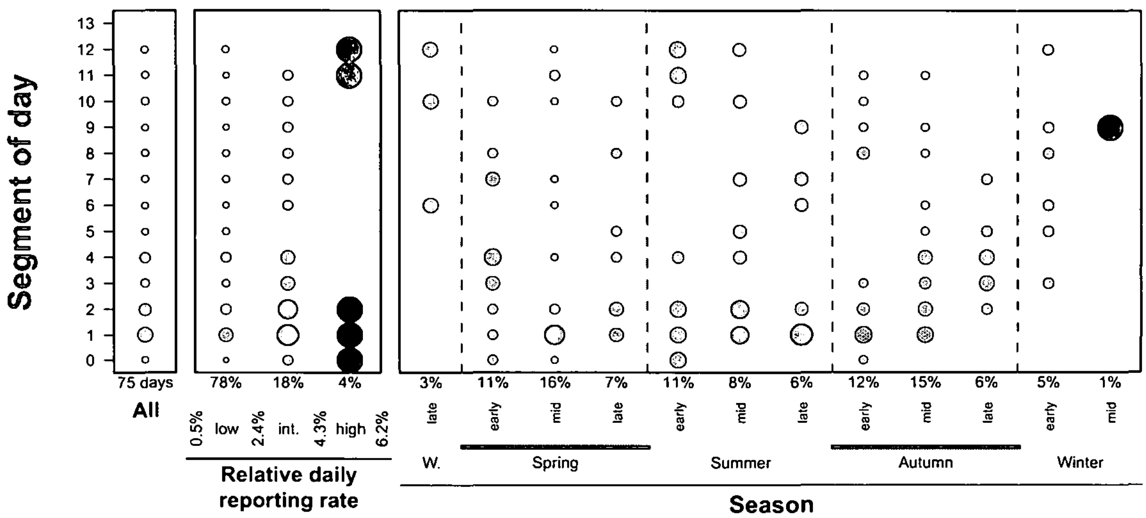


Figure 5.171: R653 Yellow-bellied Eremomela — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

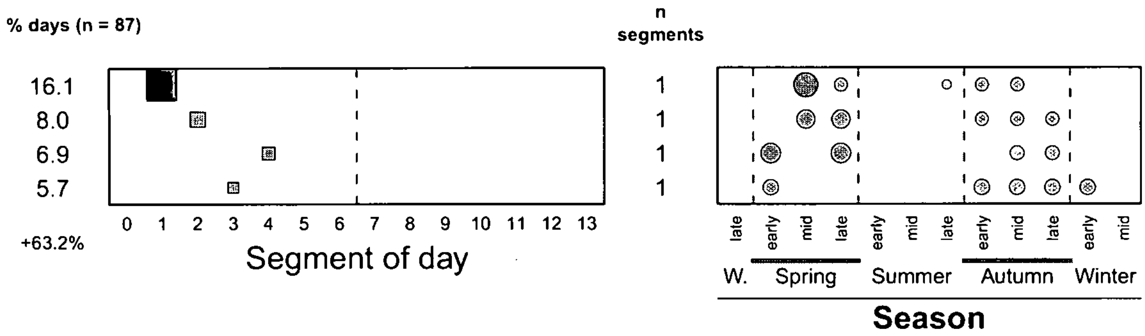


Figure 5.172: R653 Yellow-bellied Eremomela — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

recorded in the study area include the common Levaillant's Cisticola *Cisticola tinniens* which occurs in wetland habitats not found in the study area, the Namaqua Warbler *Phragmacia substriata* which is a habitat specialist occurring along the nearby Modder River, the Karoo Prinia *Prinia maculosa* which is uncommon in the central parts of the Free State, and eight other species which do not occur in the central parts of the province.

R664 Zitting Cisticola .... *Cisticola juncidis*

The Zitting Cisticola is the most widespread of all cisticolas, occurring in Africa, southern Europe and from southern Asia south to northern Australia (Cramp 1998). It is widespread in southern Africa, being particularly common in the southern parts and from a longitudinal line from the Free State eastwards (Berruti 1997d; Parker 1999). Habitat preferences include open grassland and cultivated fields (Earlé & Grobler 1987; Maclean 1985), often where it is moist (Penry 1994; DJvN personal observations). The temporal nature of its habitat may lead to local movements (Berruti 1997d).

The birds at Glen

All records of Zitting Cisticolas refer exclusively to birds displaying in the grassland. These displays usually took place over the denser stands of Red Grass *Themeda triandra*. Data was collected for each minute since 2001/2 (Table 5.30). Figures start on page 790.

Table 5.30: R664 Zitting Cisticola: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
all displays	late winter 2001/2	6 030	345 105	1.7

Annual occurrence of birds displaying in the grassland: Heard on 18.0% of the days with an activity index of 24 (Table 5.31a). Recorded during 2–6 seasons each year, most frequently during 2001/2 (Fig. 5.173☐; Fig. 5.174). Daily reporting rates ranged from 0.5 to 77.8% with only days during 2001/2 attaining values greater than 10%; high reporting rate days occurred during four seasons in that year (Fig. 5.173; Fig. 5.174). High activity intensities also tended to be more frequent during 2001/2 than during subsequent years (Fig. 5.173); no data for pre-2001/2 years (Table 5.30).

Table 5.31: R664 Zitting Cisticola: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	2 804	114 612	2.4	all displays	18.0	656	118	24
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 190	0.1	all displays	2.3	43	1	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Seasonal occurrence of birds displaying in the grassland: Based on the number of bird-years each season, activity was most frequent during late spring (n = 9 bird-years), followed by summer (7–8 bird-years), early and mid-autumn (6–4 bird years) and lastly late autumn when it was recorded during only one day (Fig. 5.173). Not recorded during winter, early or mid-spring (Fig. 5.173). High activity intensities occurred most frequently during late summer (Fig. 5.173). Although the median daily reporting rates were similar for all seasons, the upper quartiles of daily reporting rates were particularly high during summer (Fig. 5.173).

Daily occurrence of birds displaying in the grassland: Overall, activity was most frequent in the morning after sunrise and became progressively less frequent towards sunset (Fig. 5.173). This general pattern was most applicable for low reporting rate days (Fig. 5.175). On high reporting rate days activity occurred during most segments of the day (Fig. 5.175). Seasonally the trend was for activity to be most frequent during the morning, but in summer activity was frequent during other parts of the day too (Fig. 5.176). Three bird-segment combinations occurred during more than 5% bird-days and collectively they accounted for 21.2% of all bird-days (Fig. 5.177). Activity occurring during S1 or S2 alone was most frequent during early spring and early and mid-autumn, while activity during all 14 segments occurred most frequently during mid-summer and early autumn (Fig. 5.177).

The first activity of the day usually occurred during the first half of the morning after sunrise, but mostly before sunrise on high reporting rate days (Fig. 5.176). The data for the seasons are variable but median values were higher during the beginning of the year than later (Fig. 5.176).

The timing of the last activity of the day was variable, but on intermediate and high reporting rate days it typically occurred around sunset (Fig. 5.176). There is a lot of intra-seasonal variability (Fig. 5.176).

Activity intensities were similar for all parts of the day during low reporting rate days, but for high reporting rate days relatively high activity intensities were more frequent during the early morning after sunrise and around midday (Fig. 5.175).

Overall, daily segment reporting rates ranged from 6.7 to 100% with nearly half of the values intermediate or high (Fig. 5.173). The median daily segment reporting rates were similar for all segments between sunrise and sunset, and low during S0 and S13 (Fig. 5.175).

Early morning occurrence of birds displaying in the grassland during 2007/8: Heard only once in the drainage line (Table 5.31b).

Discussion

According to Maclean (1985), the Zitting Cisticola is a very common resident with some local movements. Subsequently, Berruti (1997d) pointed out that the transient nature of its preferred habitats "suggests that local movements are frequent." At Glen, the data points to a recurring seasonal pattern.

The data from Glen is based on displays only, because the Zitting Cisticolas were not seen at other times of the year, *i.e.* when they are not displaying. This is contrary to the situation for the Desert Cisticola R665 and Cloud Cisticola R666 that are present throughout the year (see their respective species texts from pages 794 to 811). It is acknowledged that the detectability of Zitting Cisticolas would be much less when they are not displaying. However, it is suggested that the total lack of any records — vocal or otherwise — during winter and early and mid-spring (Fig. 5.173) represent real absence. Assuming that this is true, it follows that the Zitting Cisticola is a seasonal visitor to the study area, usually arriving in late spring and staying until autumn in some years (Fig. 5.173; Fig. 5.174), where after they move elsewhere (Note that "elsewhere" does not necessarily imply a location far away — further study is needed in this regard).

The only other previous reference to regular seasonal movement seems to be that of Little & Brainbridge (1992). In their book on the *Birds of the Natal Drakensberg Park* they noted that it "appears that at least part of the population leaves the area during winter" (Little & Brainbridge 1992). The study at Glen is probably the first to show a total absence of the birds during an extended period each year. Admittedly, the area under consideration at Glen is relatively small, yet the recurring seasonal pattern demands an explanation. The following scenario is offered: During the non-breeding season (from the end of autumn until mid-spring) the birds are localised at suitable habitat patches. Then, towards the beginning of the main rain period the birds become more mobile in search of suitable breeding habitat, possibly triggered by the first rains of the season. However, displays do not start until late spring (Fig. 5.173; Fig. 5.174), presumably because of endogenous circannual factors linked to increasing day-length. The birds remain mobile throughout the main rain period but will settle in an area for as long as the conditions there remain favourable. It appears form Figure 5.174 that the conditions during 2001/2 were optimal with high levels of activity associated with good rains in late spring followed-up by more good rains in summer. Brewster (1996) likewise found that the birds were "More numerous than usual" during an above average rainfall year in eastern Botswana. Activity

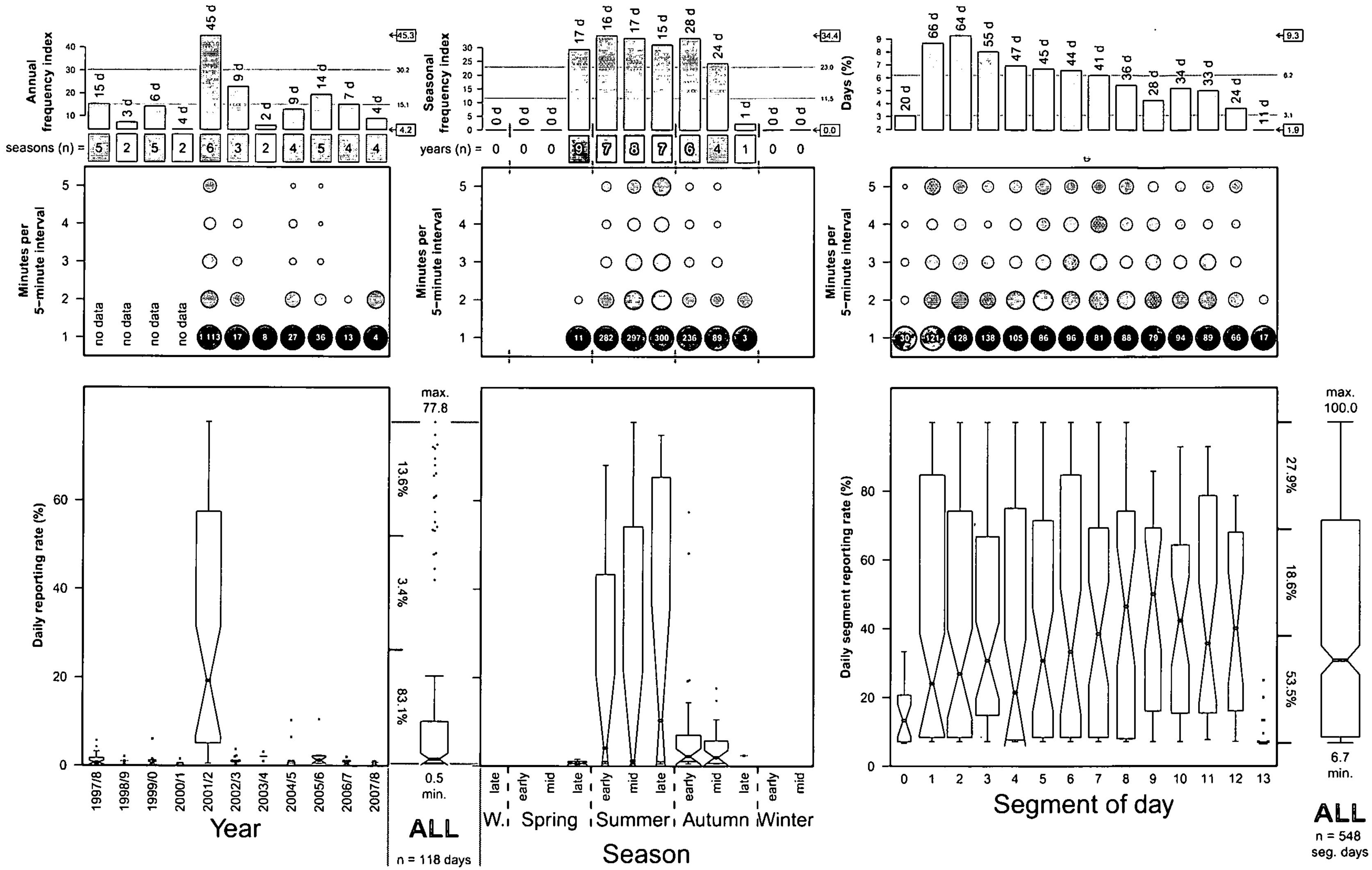


Figure 5.173: R664 Zitting Cisticola — all displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

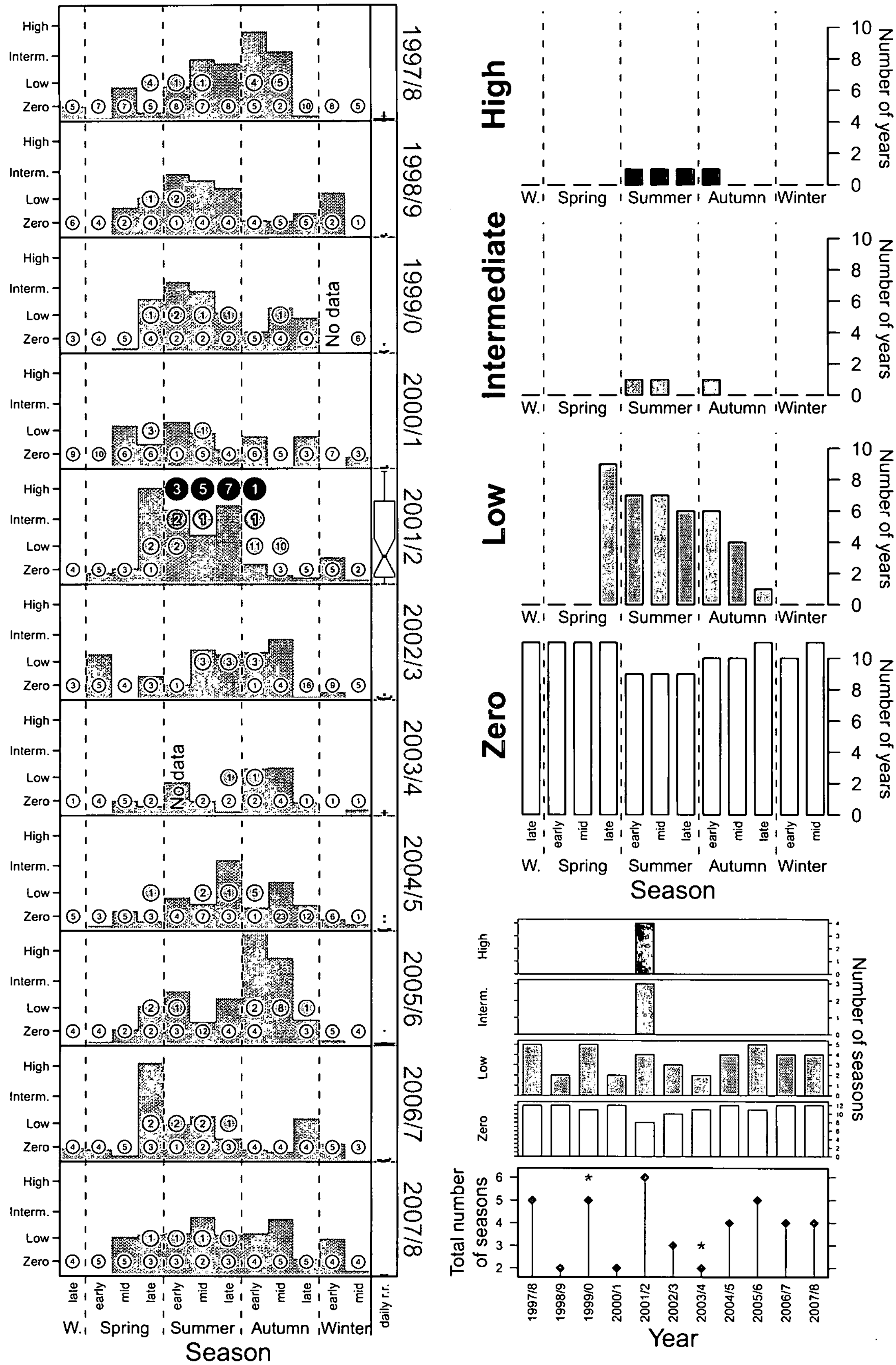


Figure 5.174: R664 Zitting Cisticola — all displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

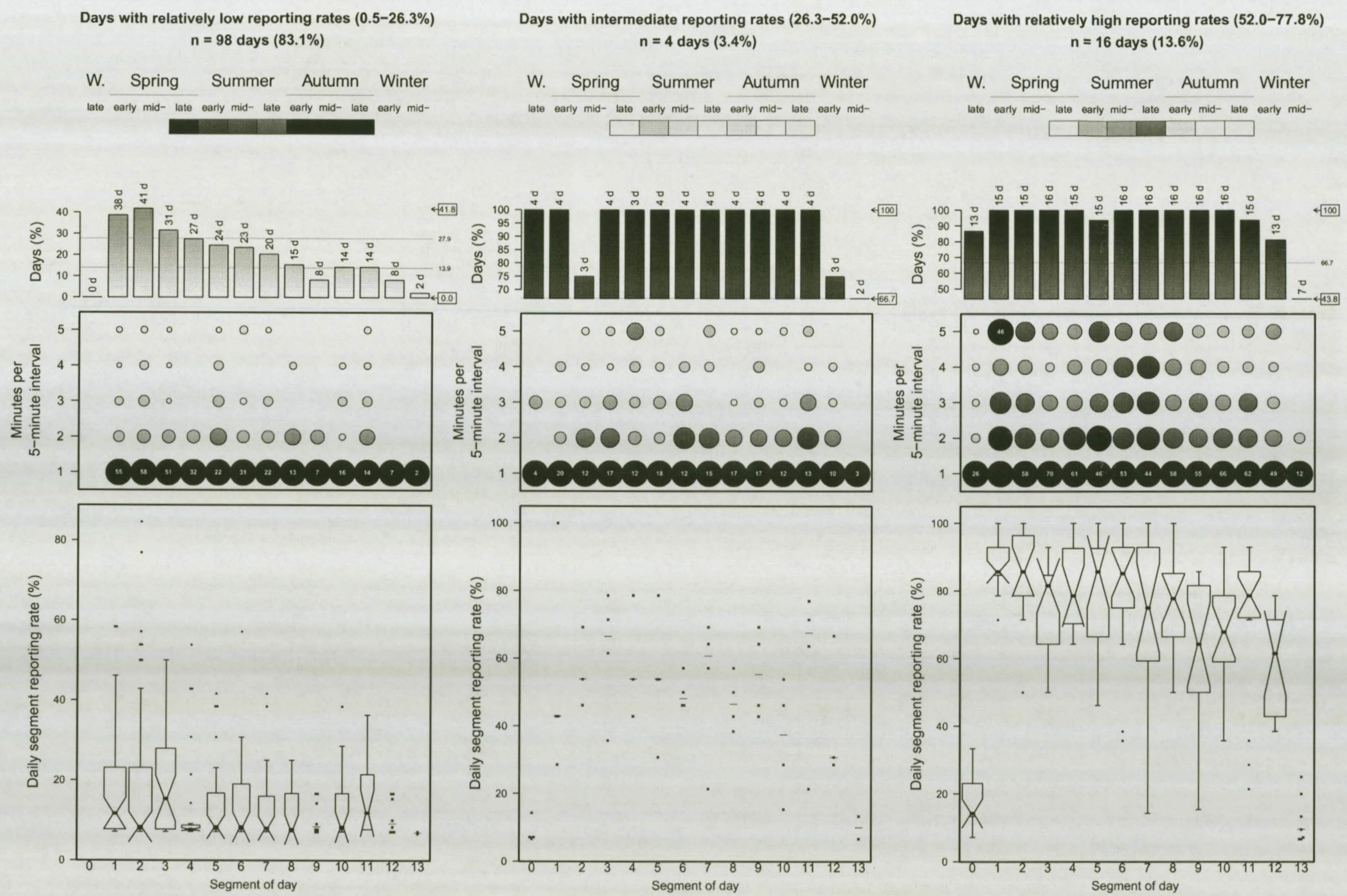


Figure 5.175: R664 Zitting Cisticola — all displays: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

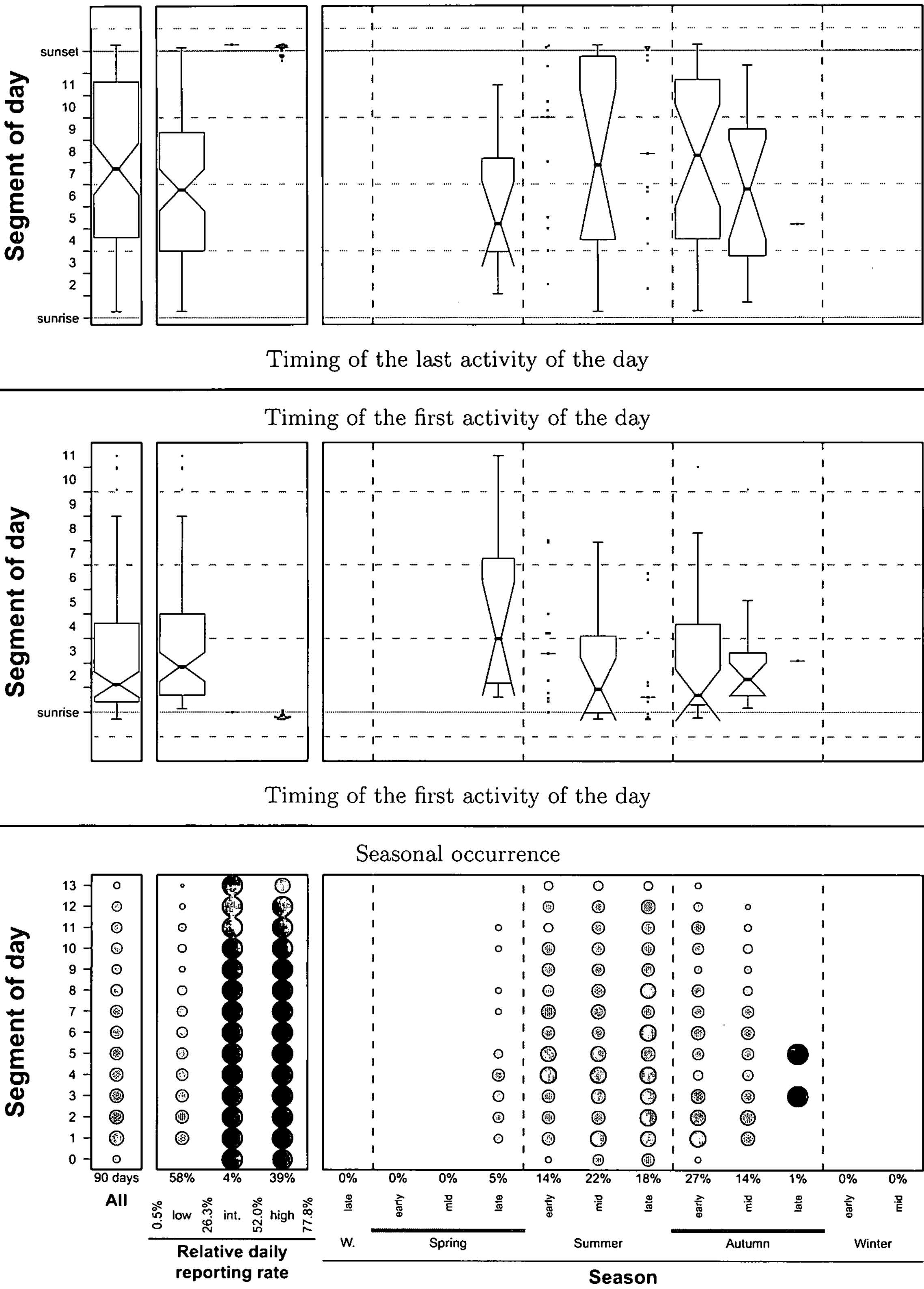


Figure 5.176: R664 Zitting Cisticola — all displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

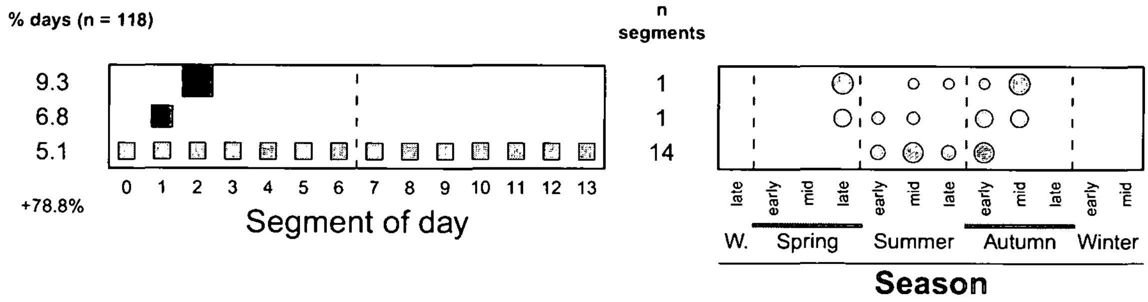


Figure 5.177: R664 Zitting Cisticola — all displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

during other years was also associated with rainfall (Fig. 5.174), but the circumstances were such that it did not lead to high levels of activity (Fig. 5.173; Fig. 5.174).

There is apparently no published information on the moult of the Zitting Cisticola in South Africa (Dean 2005s). Limited data from birds in the central and western Free State suggest that the birds undergo a complete post-breeding moult from autumn (no data for winter or spring) (DJvN unpublished data). This is in agreement with the situation in Malta (see Gauci & Sultana 1981) and probably the reason why activity becomes scarcer during the course of that season (Fig. 5.173).

R665 Desert Cisticola .... *Cisticola aridulus*

The Desert Cisticola is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, it is widespread in the northern half of Namibia, Botswana, Zimbabwe and South Africa from the Free State north and north-westwards (Berruti 1997e). In the Free State its habitat includes open grassland (Earlé & Grobler 1987). It is a resident subject to local movements dictated by environmental conditions (Berruti 1997e; Brewster 1996; Clancey 1991; Maclean 1985).

The birds at Glen

Recorded exclusively from the grassland with displays being the most dominant activity recorded (Table 5.32). Based on the regular occurrence of activity in certain parts of the field it appears that males are territorial. The data is first analysed in detail for displays followed by a combined analysis of displays, other vocalisations and sight records to assess the overall occurrence of the birds. Activity was recorded for each minute since 2001/2 (Table 5.33). Figures start on page 797.

Annual occurrence of birds displaying in the grassland: Activity occurred on 54.7% of the days with an activity index of 58 (Table 5.32a). Recorded during 5–10 seasons each year, least frequently during 2002/3 and 2003/4 (Fig. 5.178; Fig. 5.179). Daily reporting rates ranged from 0.6 to 81.5% with more than half of the bird-days attaining intermediate or high reporting rates (Fig. 5.178). Median daily reporting rates started off at a low in 1997/8 and increased in subsequent years, peaking in 2001/2 (Fig. 5.178). The next year, 2002/3, saw a drastic

Table 5.32: R665 Desert Cisticola: Numerical data summary of 5-minute checklists compiled in the study area at Glen. voc. = vocalisations.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.941	20 725	114 612	18.1	displays	54.7	656	359	58
0.049	1 070	114 612	0.9	non-display voc.	37.2	656	244	4
0.010	218	114 612	0.2	seen only	18.0	656	118	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.989	91	1 188	7.7	displays	51.2	43	22	4
0.011	1	1 188	0.1	non-display voc.	2.3	43	1	1

Table 5.33: R665 Desert Cisticola: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
displays	late winter 2001/2	22 589	345 105	6.5

decrease in reporting rates, followed by an increase which culminated in a peak during 2005/6; It decreased again in the years following (Fig. 5.178). High activity intensities were slightly more frequent during 2001/2 than in subsequent years (Fig. 5.178; not measured in pre-2001/2 years, Table 5.33).

Seasonal occurrence of birds displaying in the grassland: Recorded during all seasons (Fig. 5.178), with a well-defined peak period from late spring to mid-autumn, and activity very infrequent from late autumn to early spring (Fig. 5.178; Fig. 5.179).

Daily occurrence of birds displaying in the grassland: Except for the time before sunrise and after sunset when activity was relatively infrequent, activity was equally frequent throughout the day, both when all the data is considered (Fig. 5.178) and when the relative magnitude of the daily reporting rates are taken into account (Fig. 5.180). A similar pattern is evident for the main seasons of occurrence (Fig. 5.181). Four bird-segment combinations occurred on more than 5% bird-days, and all four involved S1–S12 with all possible combinations with and without S0 and S13 (Fig. 5.182). Collectively these combinations accounted for half of all bird-days and were basically restricted to late spring, summer and early autumn (Fig. 5.182).

The first activity of the day usually occurred during the first half of the morning on low reporting rate days and around sunrise on intermediate and high reporting rate days (Fig. 5.181; Fig. 5.183). There was also a well-defined seasonal pattern with activity starting earlier during summer (usually around sunrise) and progressively later in the day during seasons further away from summer (Fig. 5.181; Fig. 5.183). The dawn chorus sequence (Fig. 5.183) followed a similar pattern.

The timing of the last activity of the day was often after sunset on high reporting rate days, in the late afternoon on intermediate reporting rate days and earlier in the day on low reporting rate days (Fig. 5.181; Fig. 5.183). The seasonal pattern is for activity to end later during summer (usually around sunset) than during seasons further away from summer (Fig. 5.181; Fig. 5.183).

The activity intensity pattern changed from the relative infrequent occurrence of high intensities for all segments of low reporting rate days to relative high intensities centred on midday for high reporting rate days (Fig. 5.180).

Overall, daily segment reporting rates ranged from 5.3 to 100% with more than half of the bird-segments having intermediate and high values (Fig. 5.178). The median daily segment reporting rates for S0 and S13 were lower than those of the other segments (Fig. 5.178). In addition, on low reporting rate days the median daily segment reporting rate from S1 to S12 was similar to one another, but on intermediate reporting rate days they peaked during the late morning and on high reporting rate days they were generally high for most segments with the peak in the middle of the day not so well-defined (Fig. 5.180).

Early morning occurrence of displaying birds during 2007/8: In spite of activity occurring during half the mornings in the grassland, no activity was noted in the drainage line (Table 5.32b & c).

All activities combined: Recorded during 10–12 seasons in most years, the exceptions being 2003/4 and 2006/7 when recorded during 7–8 seasons (Fig. 5.184). Recorded during 11–10 years from mid-spring to late autumn, during 9–7 years in winter and during only five years in early spring (Fig. 5.184).

Discussion

Berruti (1997e) suggested that improved grass cover resulting from good rains is likely to trigger breeding in the Desert Cisticola. At Glen, where the birds are resident (Fig. 5.184), the occurrence of intermediate and high reporting rate days of displays corresponded with the main rain period (late spring to mid-autumn), and lower levels of activity appear to be associated with the first rains in some years (Fig. 5.179). In addition, the relatively high daily reporting rates attained during 2001/2 and 2005/6 coincided with high rainfall during those years (Fig. 5.178; Fig. 5.179). The consistent occurrence of intermediate and high reporting rate days only from late spring onwards, as well as the occurrence of low reporting rate days mainly from mid-spring (Fig. 5.179) suggests that the beginning of displaying activity may be closely linked to changes in day-length.

Is seems likely that the end of displays during mid- or late autumn (Fig. 5.179; note in particular the occurrence of zero record days), coincides with moulting. Data from the central and western Free State indicate that primary moult in adults occurs during autumn and early winter and

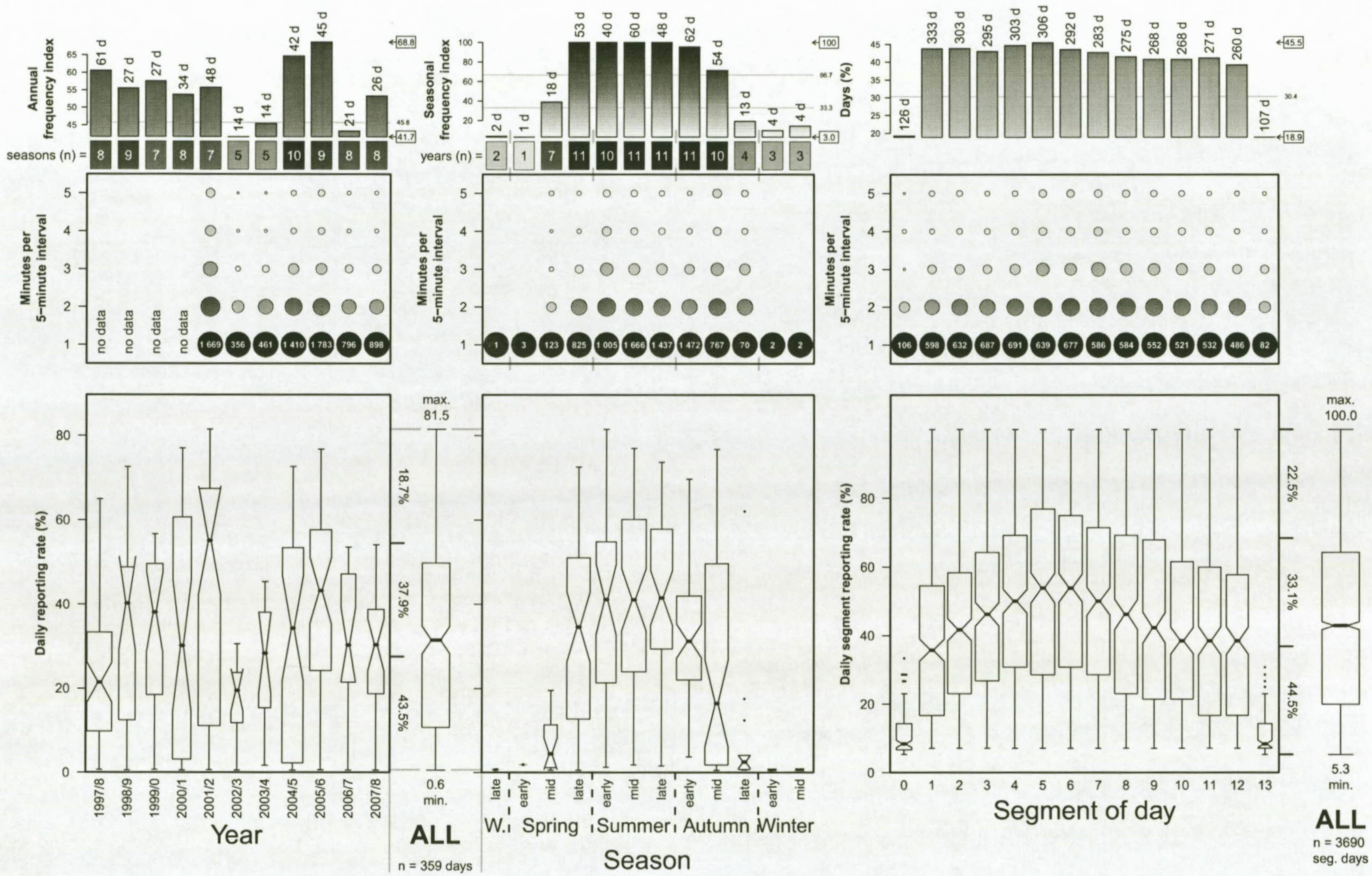


Figure 5.178: R665 Desert Cisticola — displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

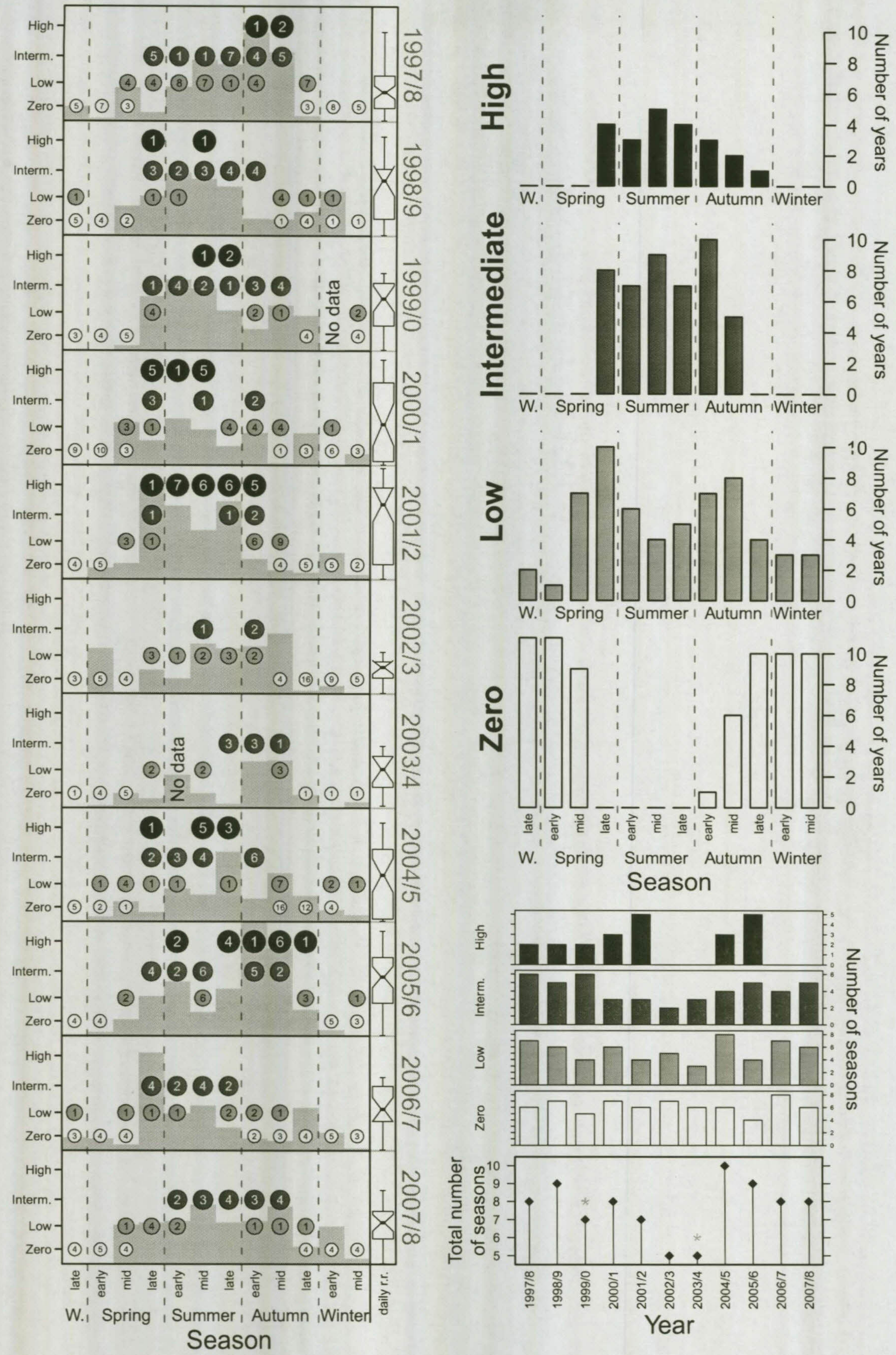


Figure 5.179: R665 Desert Cisticola — displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

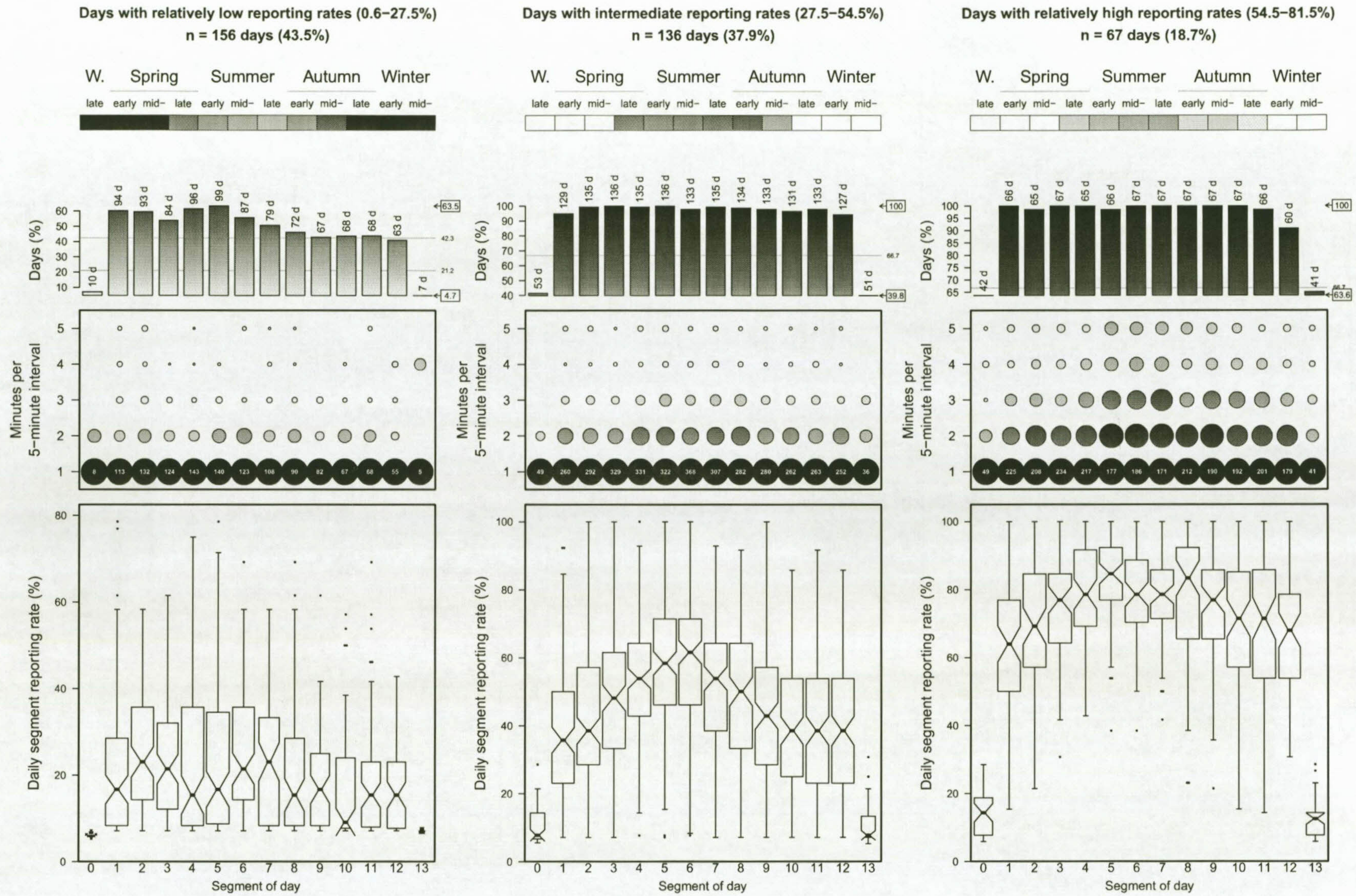
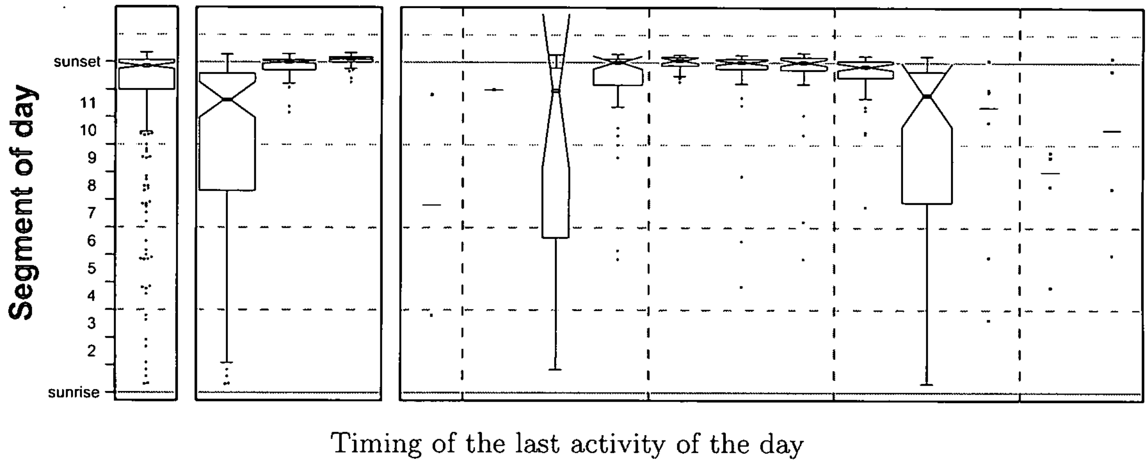
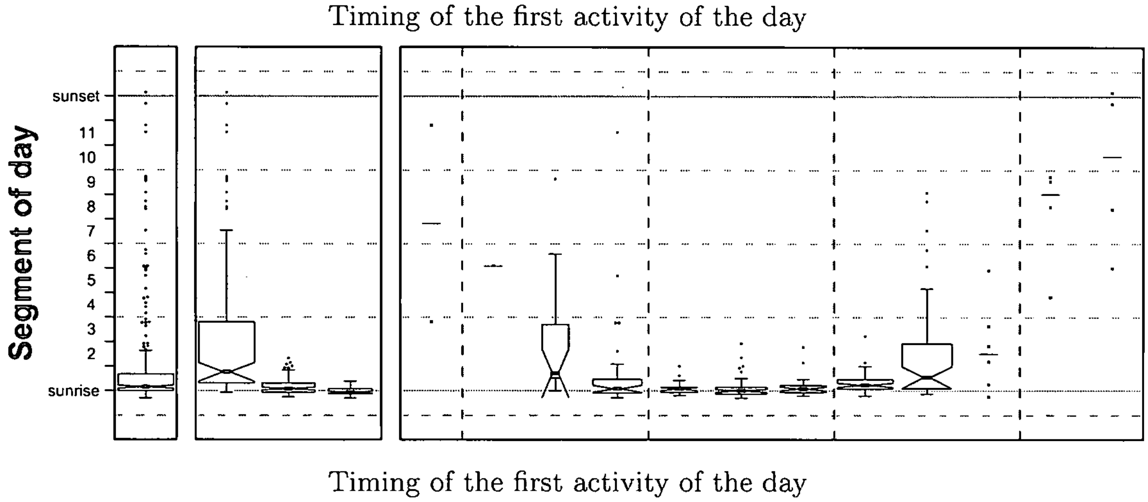


Figure 5.180: R665 Desert Cisticola — displays: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.





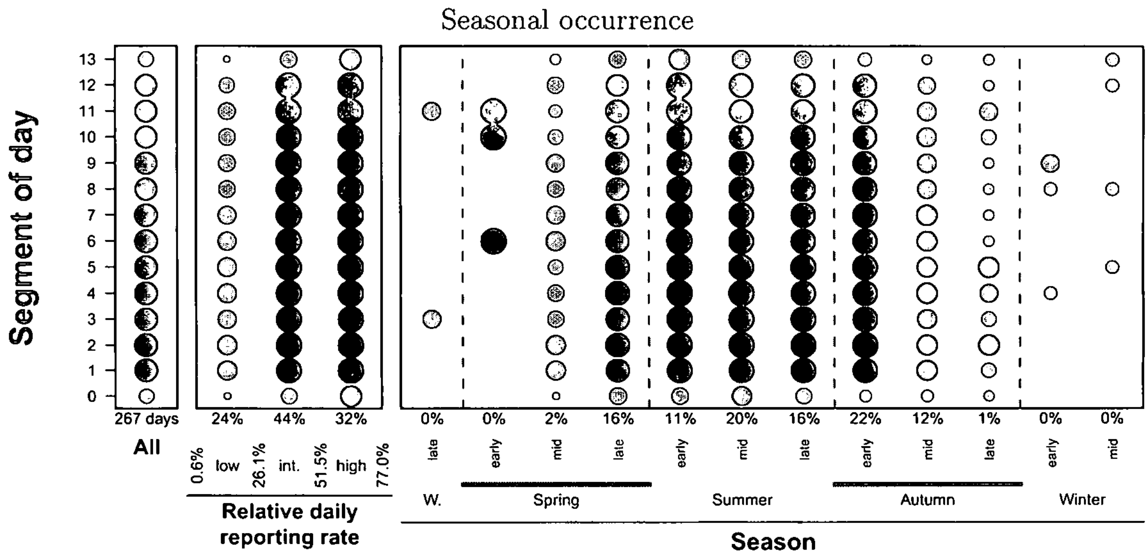


Figure 5.181: R665 Desert Cisticola — displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

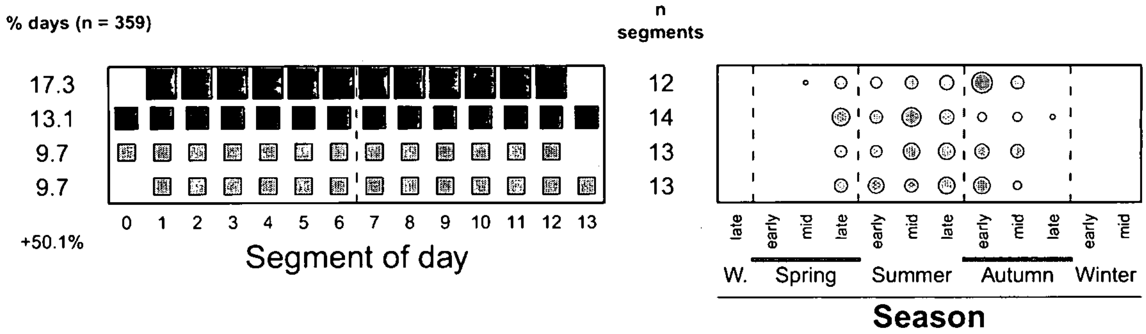


Figure 5.182: R665 Desert Cisticola — displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

no 'pre-breeding' moult (DJvN unpublished data). In western Zambia, however, 'pre-breeding' moult was recorded during October and November [mid-spring to early summer] (Dean 2005t).

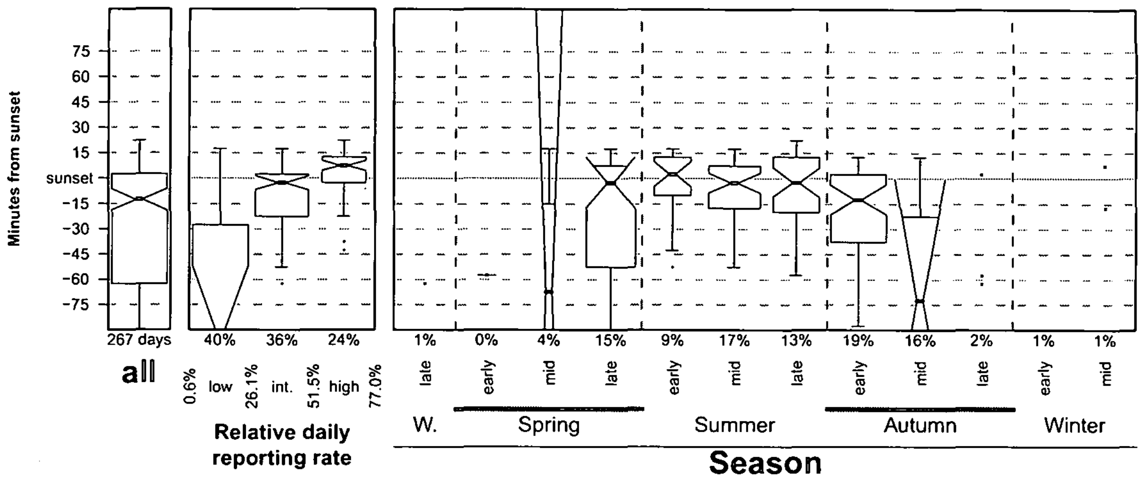
R666 Cloud Cisticola .... *Cisticola textrix*

In addition to isolated populations in Angola (Dean 2000) and Zambia, the Cloud Cisticola also occurs in southern Africa (Irwin 1997b) where its distribution is centred on the Free State (Berruti 1997f). It occurs in short grassland with bare ground between grass tufts and it is resident (Maclean 1985).

The birds at Glen

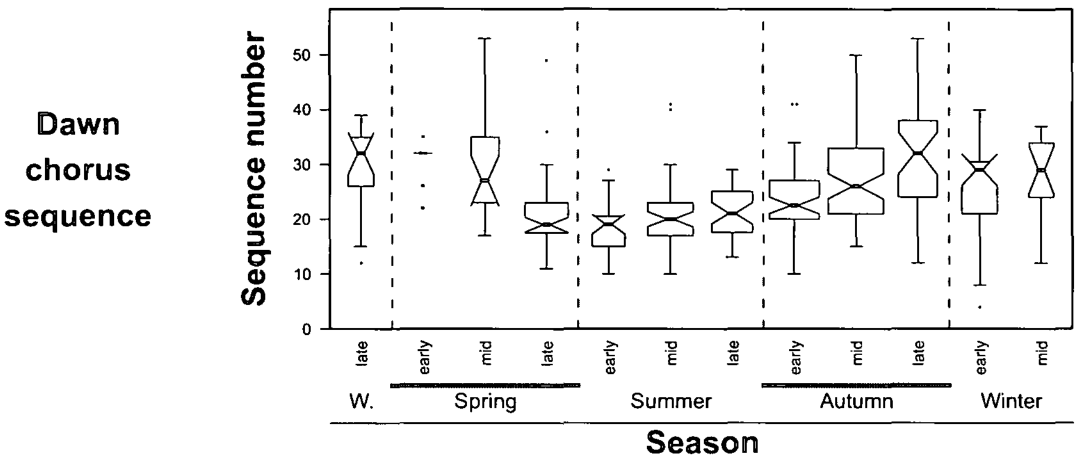
The Cloud Cisticola was restricted to the grassland with only a few records of grassland birds heard while conducting observations in the drainage line (Table 5.34b). The occurrence of displays is analysed in detail followed by a combined analysis of displays, other vocalisations and sight only records.

The display song is always given in high cruising flight and consists of a repeated song phrase. The latter consists of two or three components, here called *to*, *pi* and *chik*. The *chik* component was not specifically quantified during the study, but subsequent observations indicated that it is often three and less often four. Based on the consistent occurrence of the number of *to*'s and *pi*'s per song phrase — the *to*'s are always lower pitched than the *pi*'s — in particular parts of the study area, it appears that each male sticks to a particular combination throughout the season, and perhaps for life. A shorthand was developed by noting the number of *to* 's and *pi*'s, *e.g.* 3+2 was the most common version at Glen (and at many other places too): *to – to – to – pi – pi – chikchikchik*. The second most common combination was 4+0: *to – to – to – to – chikchikchik*. At least six additional combinations were noted (in order of frequency of occurrence): 3+0, 1+3, 4+2, 2+3, 2+2 and 3+1. Figure 5.185 shows the annual frequency indices of all of these combinations. The analysis combines all the data. Activity was recorded for every minute since 2001/2 (Table 5.35). Figures start on page 806.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

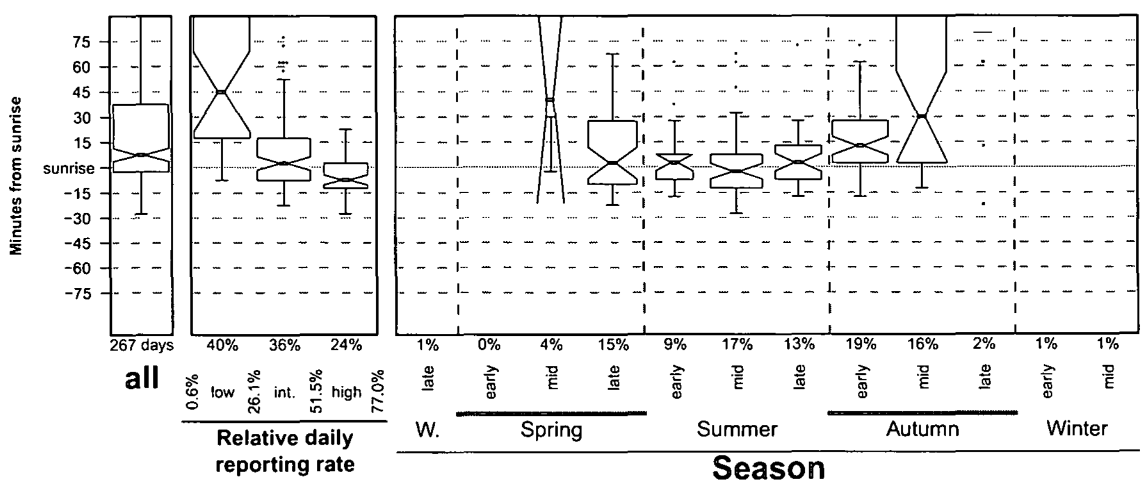


Figure 5.183: R665 Desert Cisticola — displays: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

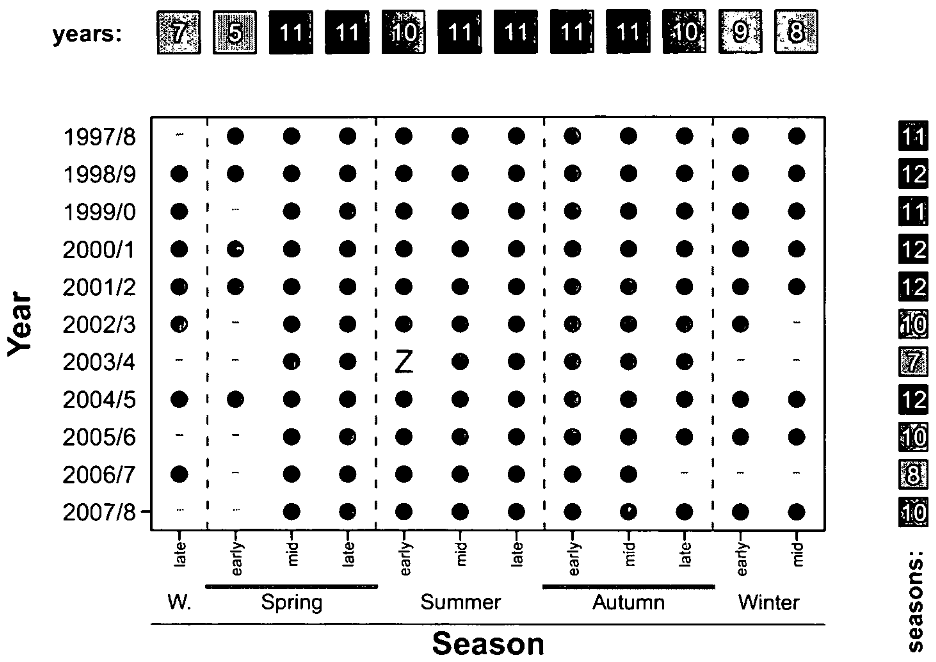


Figure 5.184: R665 Desert Cisticola: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

Annual occurrence of birds displaying in the grassland: Activity was recorded on 68.9% of the days with an activity index of 66 (Table 5.34a). Recorded during 8–12 seasons each year, most frequently during 2000/1–2002/3 and 2005/6 (Fig. 5.186; Fig. 5.187). Daily reporting rates ranged from 0.5 to 85.5% with more than half of all bird-days attaining intermediate or high reporting rates (Fig. 5.186). Daily reporting rates were extremely variable within and between years, with the highest median daily reporting rates during 1997/8 and 2005/6 and the lowest during 2000/1 and 2004/5 (Fig. 5.186). High activity intensities were particularly frequent during 2001/2, 2005/6 and 2006/7 (Fig. 5.186; Not measured in years prior to 2001/2, Table 5.35).

Seasonal occurrence of birds displaying in the grassland: Recorded during all seasons (Fig. 5.186), with daily reporting rates showing a well-defined peak period from late spring to late summer, and activity very infrequent or occurring at low levels from late autumn to early spring (Fig. 5.186; Fig. 5.187).

Daily occurrence of birds displaying in the grassland: Overall, activity was only slightly more frequent in the early morning than at other times of the day (Fig. 5.186). However, on low reporting rate days activity was markedly more frequent in the early morning after sunrise and became progressively less frequent towards mid-afternoon, in contrast to intermediate and high reporting rate days when activity was almost equally frequent throughout the day, except after sunset when it was less frequent (Fig. 5.188). All the main bird-seasons show a similar pattern (Fig. 5.189). Three bird-segment combinations occurred on more than 5% bird-days, and all three involved S1–S12 with combinations with and without S0 and S13 (Fig. 5.190). Collectively

Table 5.34: R666 Cloud Cisticola: Numerical data summary of 5-minute checklists compiled in the study area at Glen. voc. = vocalisations.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.422	29 679	114 612	25.9	All displays	68.9	656	452	66
0.305	21 486	114 612	18.7	3+2 displays	59.8	656	392	55
0.133	9 373	114 612	8.2	4+0 displays	42.5	656	279	34
0.048	3 352	114 612	2.9	?+? displays	9.8	656	64	52
0.045	3 142	114 612	2.7	non-display voc.	64.3	656	422	7
0.018	1 246	114 612	1.1	3+0 displays	11.9	656	78	16
0.015	1 058	114 612	0.9	1+3 displays	5.6	656	37	29
0.010	703	114 612	0.6	4+2 displays	5.2	656	34	21
0.003	207	114 612	0.2	2+3 displays	2.4	656	16	13
0.002	139	114 612	0.1	2+2 displays	3.0	656	20	7
0.000	13	114 612	0.0	other displays	1.1	656	7	2
0.000	7	114 612	0.0	3+1 displays	0.9	656	6	1
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.500	11	1 190	0.9	All displays	11.6	43	5	2
0.273	6	1 190	0.5	4+0 displays	7.0	43	3	2
0.227	5	1 190	0.4	3+2 displays	7.0	43	3	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.417	286	1 188	24.1	All displays	60.5	43	26	11
0.316	217	1 188	18.3	3+2 displays	58.1	43	25	9
0.251	172	1 188	14.5	4+0 displays	55.8	43	24	7
0.016	11	1 188	0.9	non-display voc.	18.6	43	8	1

Table 5.35: R666 Cloud Cisticola: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
All displays	mid-spring 2001/2	48 129	338 340	14.2
3+2 displays	mid-spring 2001/2	35 221	338 340	10.4
4+0 displays	late winter 2001/2	15 528	345 105	4.5
3+0 displays	late winter 2001/2	1 433	345 105	0.4
4+2 displays	beginning	1 123	547 500	0.2
2+2 displays	late winter 2001/2	188	345 105	0.1
1+3 displays	late winter 2003/4	119	233 075	0.1
other displays	late winter 2001/2	14	345 105	0.0
3+1 displays	beginning	13	547 500	0.0
?+? displays	early autumn 2001/2	10	306 390	0.0
2+3 displays	late winter 2001/2	1	345 105	0.0

these combinations accounted for nearly half of all bird-days and were largely restricted late spring, summer and early autumn (Fig. 5.190).

Whereas the first activity of the day usually occurred during the first half of the morning after sunrise on low reporting rate days, on intermediate and high reporting rate days it typically occurred before sunrise (Fig. 5.189; Fig. 5.191). There was also a well-defined seasonal pattern with activity starting mostly before sunrise from mid-spring to late summer and progressively later towards early and mid-winter when it started after sunrise (Fig. 5.189; Fig. 5.191). The dawn chorus sequence (Fig. 5.191) followed a similar trend.

The timing of the last activity of the day was variable for low reporting rate days, but on intermediate and high reporting rate days it typically occurred around sunset (Fig. 5.189; Fig. 5.191). The seasonal pattern is for activity to end around sunset from mid-spring to late summer and later during other seasons, particularly winter when it often occurred in the morning already (Fig. 5.189; Fig. 5.191).

Activity intensity was most frequently low on low reporting rate days, higher in the morning after sunrise than later in the day on intermediate reporting rate days and frequently high, particularly during the morning, on high reporting rate days (Fig. 5.188).

Overall, daily segment reporting rates ranged from 5.6 to 100% with only 38.8% of the values relatively low (Fig. 5.186). The median daily segment reporting rate for S0 and S13 was much lower than that of the other segments, particularly for intermediate and high reporting rate days (Fig. 5.188). On low reporting rate days the median daily segment reporting rates for S1–S3 were higher than those of afternoon segments (Fig. 5.188), but higher in the morning than in the afternoon on intermediate reporting rate days (Fig. 5.188). On high reporting rate days they were generally high for most segments and only slightly less during mid-afternoon (Fig. 5.188).

Early morning occurrence of displaying birds during 2007/8: In spite of activity occurring during 60.5% the mornings in the grassland, activity occurred during only 11.6% of the mornings in the drainage line (Table 5.34b & c).

All activities combined: The Cloud Cisticola was recorded during virtually all seasons of every year (Fig. 5.192).

Discussion

The Cloud Cisticola is a resident at Glen (Fig. 5.192), and generally considered so in the rest of its range (Dean 2005u; Maclean 1985). Berruti (1997f), however, noted that droughts, overgrazing and burning affect the habitat of these birds and "must prompt local movements." At Glen, circumstantial evidence suggests that at least some birds came from elsewhere. As mentioned earlier, it seems that each male sticks to a certain combination of *to*'s and *pi*'s, the most common variations being 3+2 and 4+0 (see page 801). However, from time to time new variations occurred as shown in Figure 5.185. It is possible that these represent birds from outside the study area.

The annual cycle of the Cloud Cisticola consists of a well-defined display period (presumably linked to breeding) centred on late spring and summer (Fig. 5.186), followed by a complete post-breeding moult from mid-autumn into winter (DJvN unpublished data) when displays are

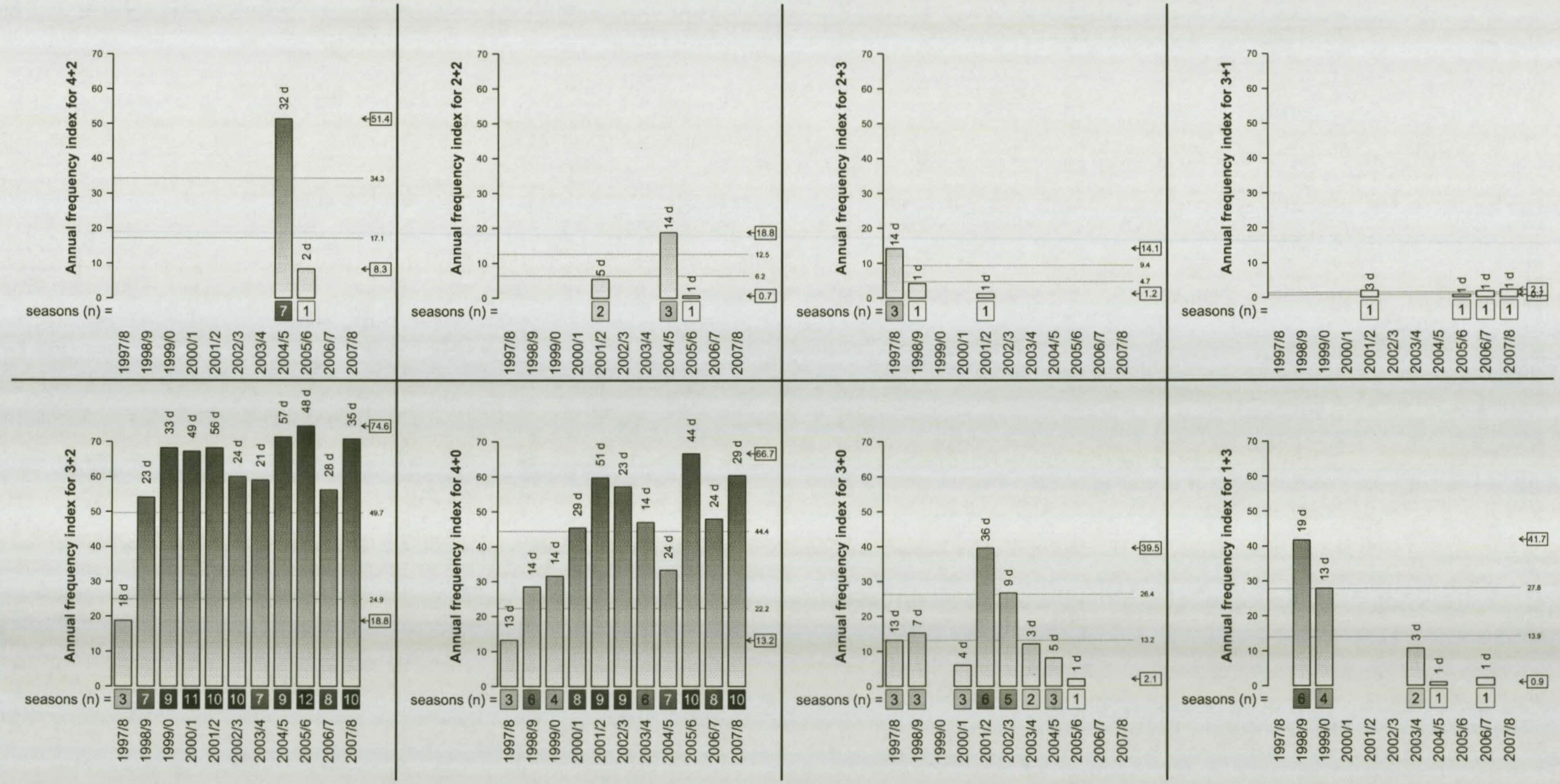


Figure 5.185: R666 Cloud Cisticola: Annual frequency indices of the eight song-phrase variations recorded at Glen. All the diagrams are drawn on the same scale.

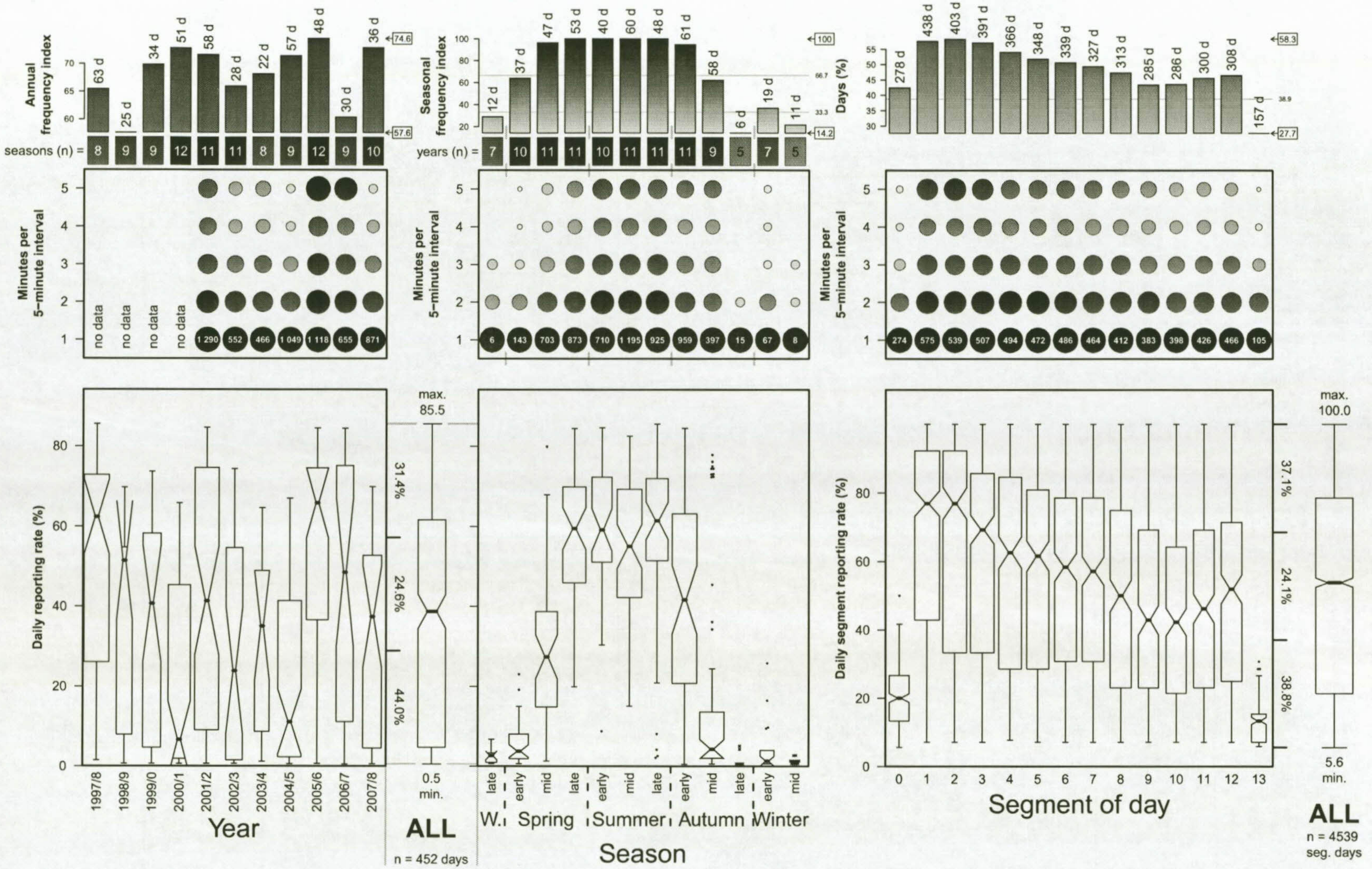


Figure 5.186: R666 Cloud Cisticola — all displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

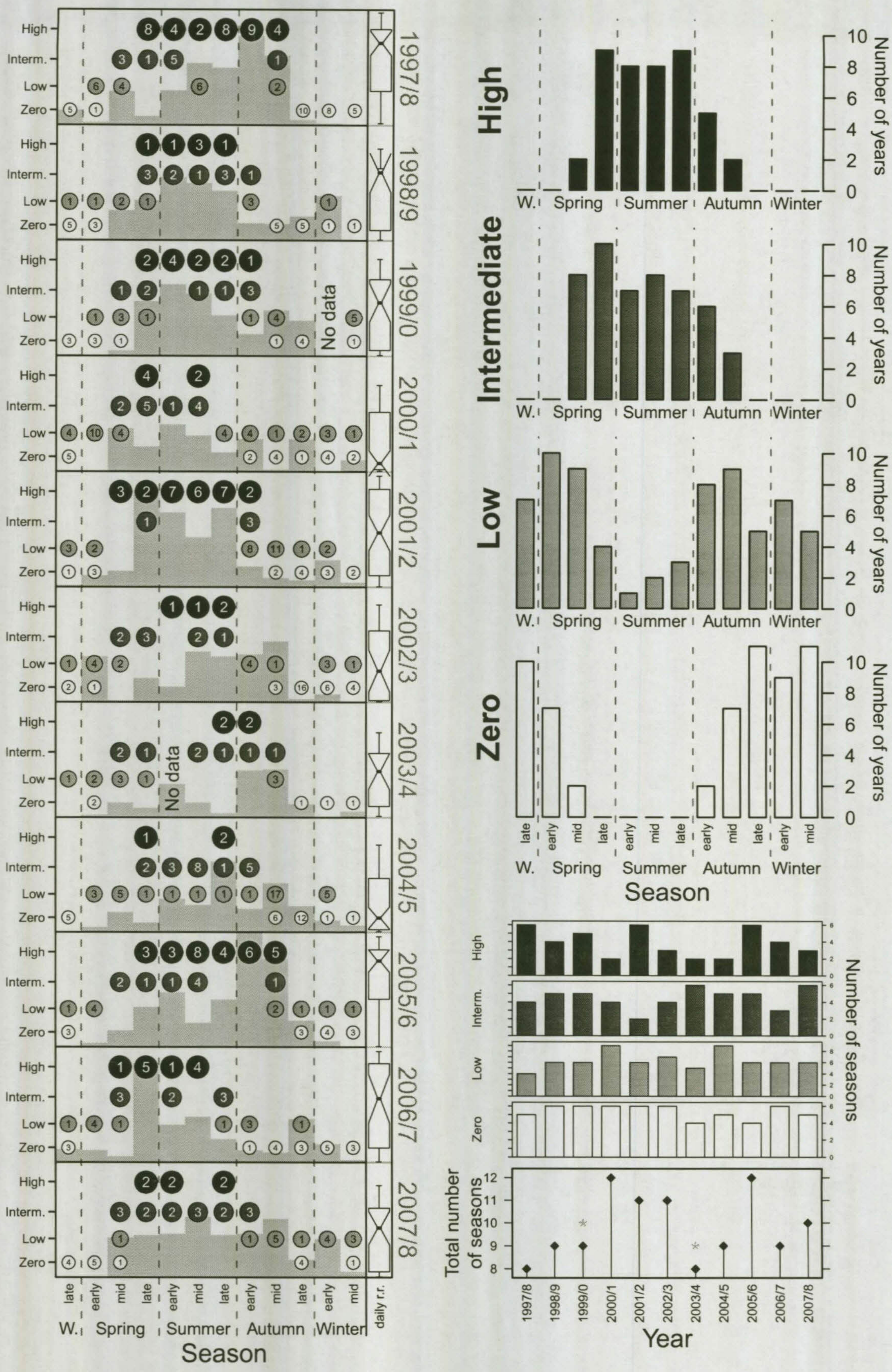


Figure 5.187: R666 Cloud Cisticola — all displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

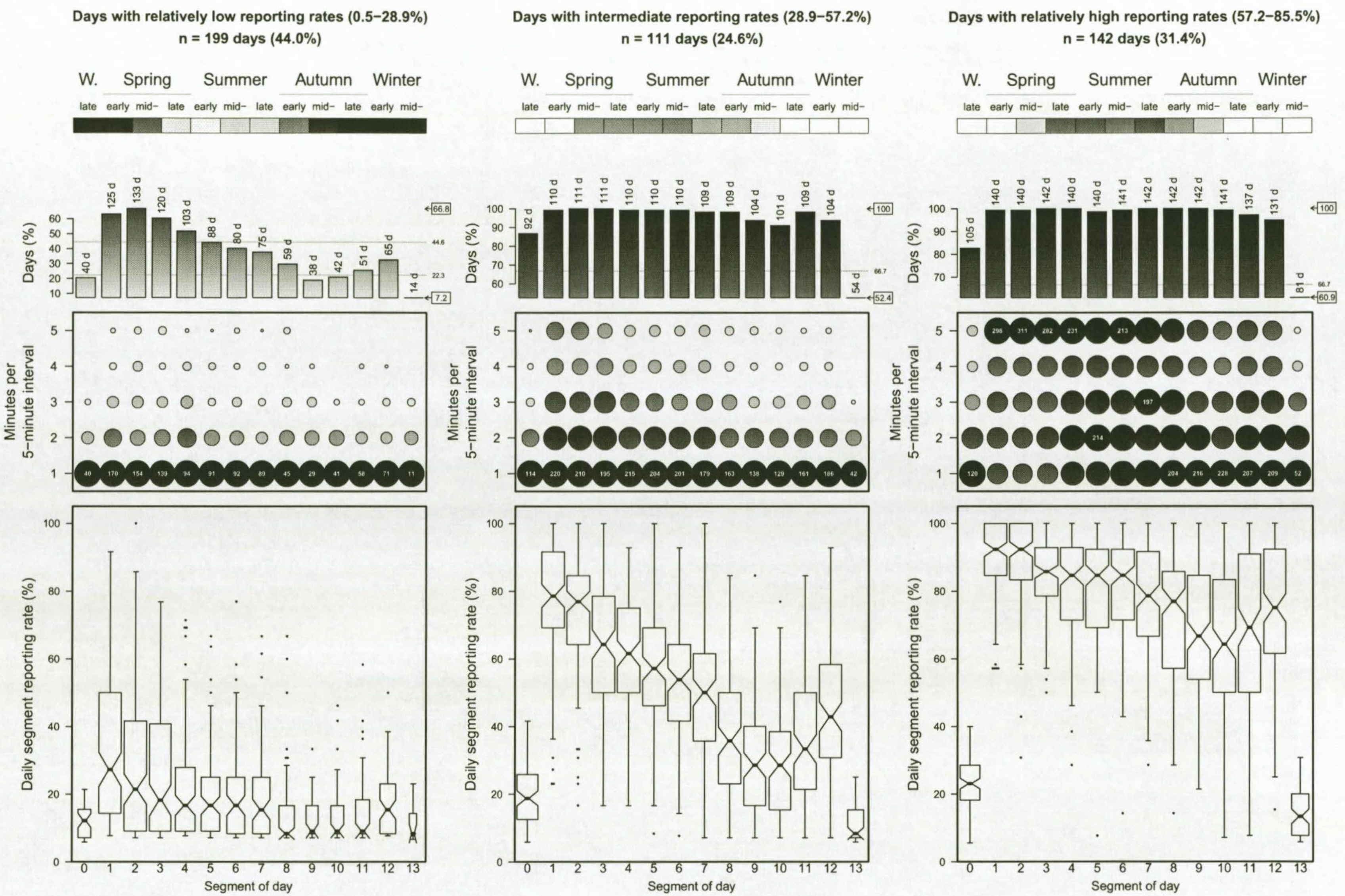


Figure 5.188: R666 Cloud Cisticola — all displays: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

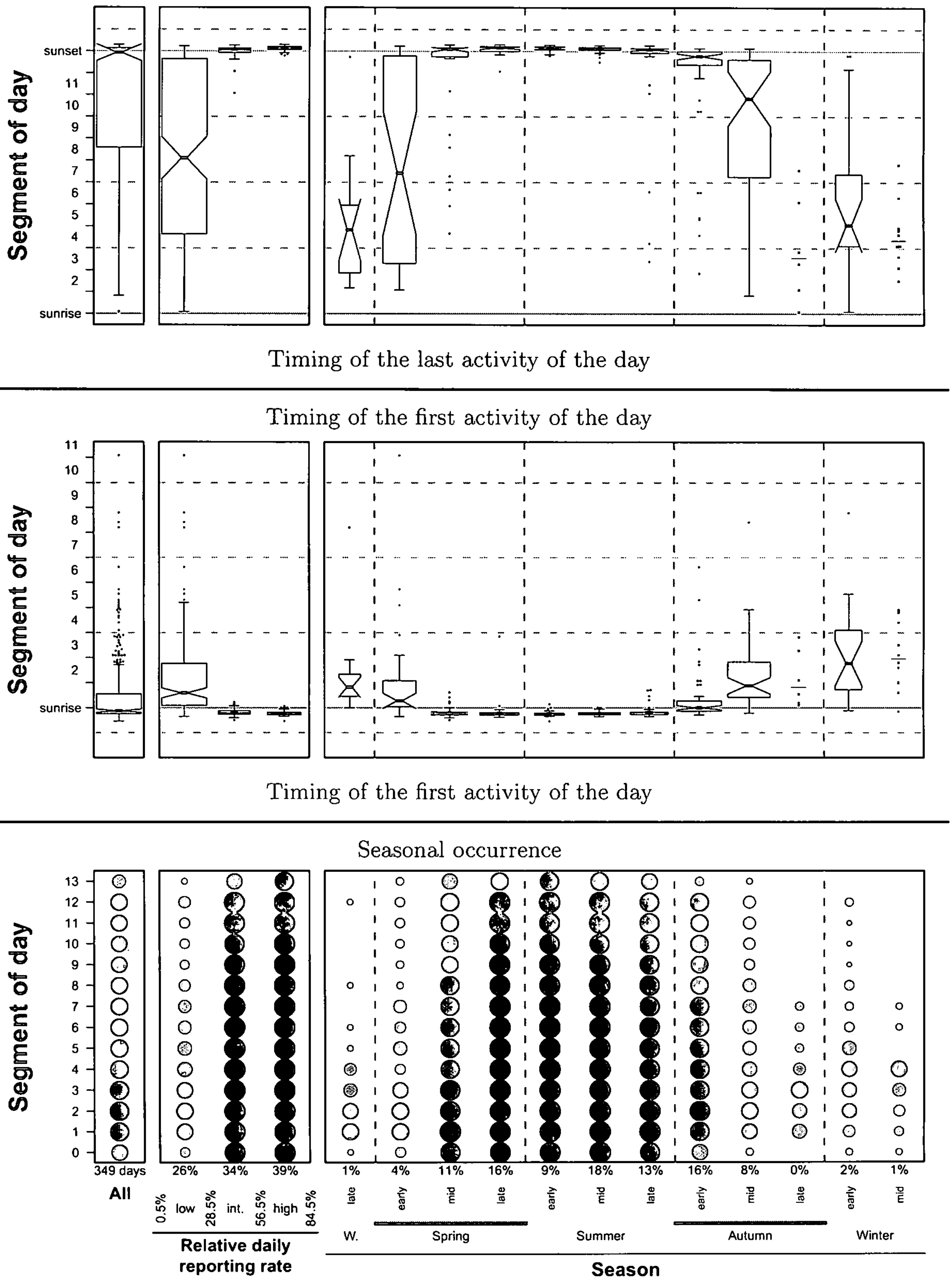


Figure 5.189: R666 Cloud Cisticola — all displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

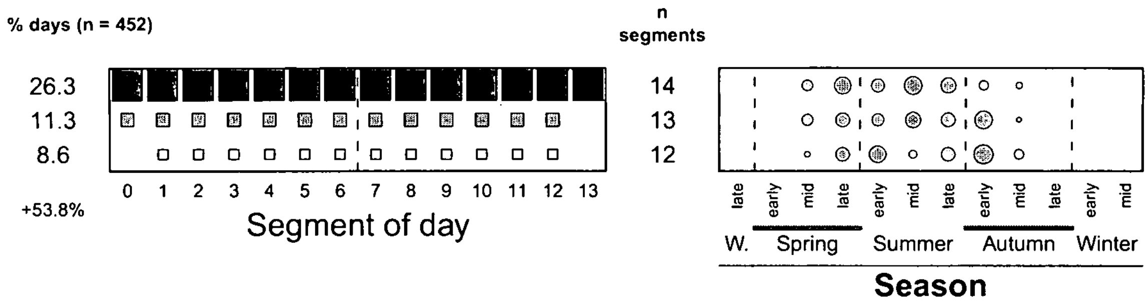


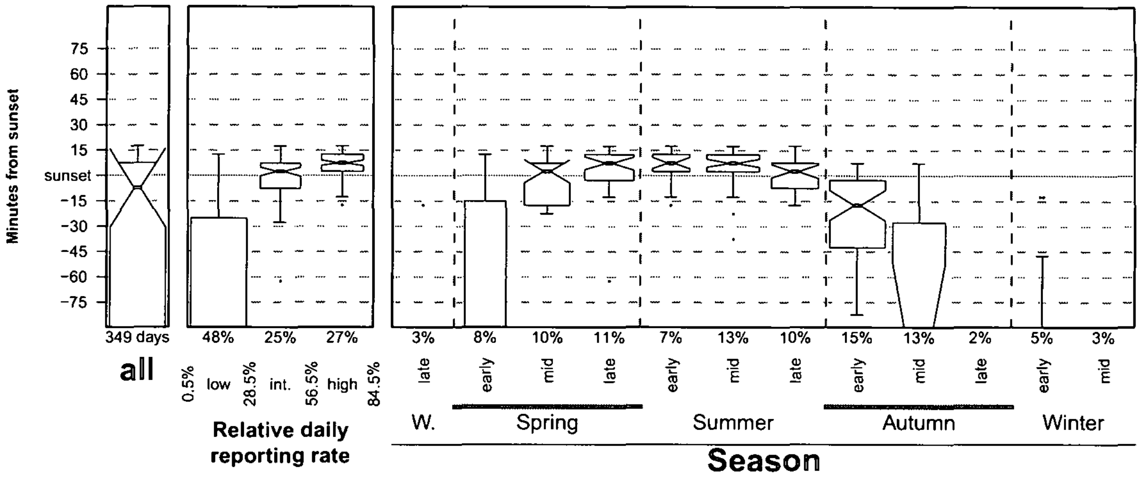
Figure 5.190: R666 Cloud Cisticola — all displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

infrequent (Fig. 5.186; Fig. 5.187). They are not completely silent during this latter period as they may be found sitting on the fence making all kinds of sounds, a kind of sub-song perhaps.

In the beginning of the year, the last occurrence of days with zero records was usually during late winter or early spring, with the occurrence of low reporting rate days particularly frequent during early and mid-spring (Fig. 5.187). The first occurrence of intermediate reporting rate days were during mid-spring, except in 2001/2 when only high reporting rate days occurred then and in 1998/9 and 2004/5 when it occurred in late-spring, together with high reporting rate days (Fig. 5.187). This suggests a common cue that stimulates higher levels of activity during mid-spring in most years. First considering rainfall, with the exception of 2004/5 the first rains occurred during late winter, but this mostly involved less than 5 mm per 30 days (Fig. 2.16). By contrast, the incidence of more rain varied from year to year (for example, more than 10 mm per 30 days: late winter, n = 2 years; early spring, 2 years; mid-spring, 6 years; late spring, 1 year; Fig. 2.16). It is not clear, therefore, to what extent rainfall influence the behaviour. However, mid-spring is per definition the season during which the increase in day-length peaks (Fig. 2.12). It is suggested that this plays an important role in stimulating Cloud Cisticola activity, with rainfall possibly functioning as a secondary cue.

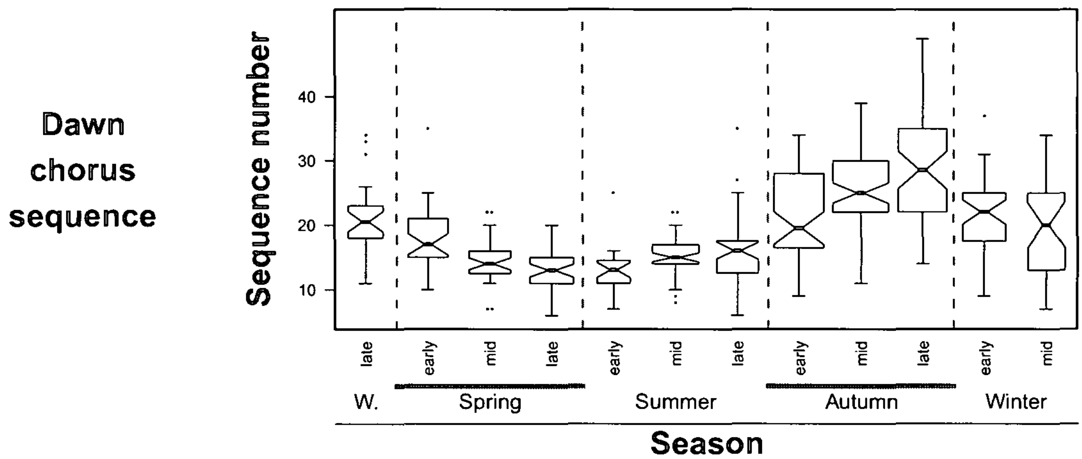
R667 Wing-snapping Cisticola .... *Cisticola ayresii*

The Wing-snapping Cisticola is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, it is recorded mainly in South Africa east of 26°E, Lesotho, Swaziland and from scattered localities in Zimbabwe (Berruti 1997g). In the Free State it is mostly found over the eastern half of the province (Berruti 1997g; Earlé & Grobler 1987), with the study area at the western limit of its range. It prefers short grassland that is slightly denser than that preferred by Cloud Cisticola R666, but like that species it also requires bare ground between tufts (Maclean 1985). Seasonal variation in detectability complicates the assessment of seasonal occurrence (Berruti 1997g). Generally considered to be resident, but changes in habitat caused by fire, overgrazing, *etc.* would lead to local movements (Berruti 1997g; Maclean 1985). It is a breeding summer visitor to the highlands of Lesotho (Van Niekerk 2004).



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

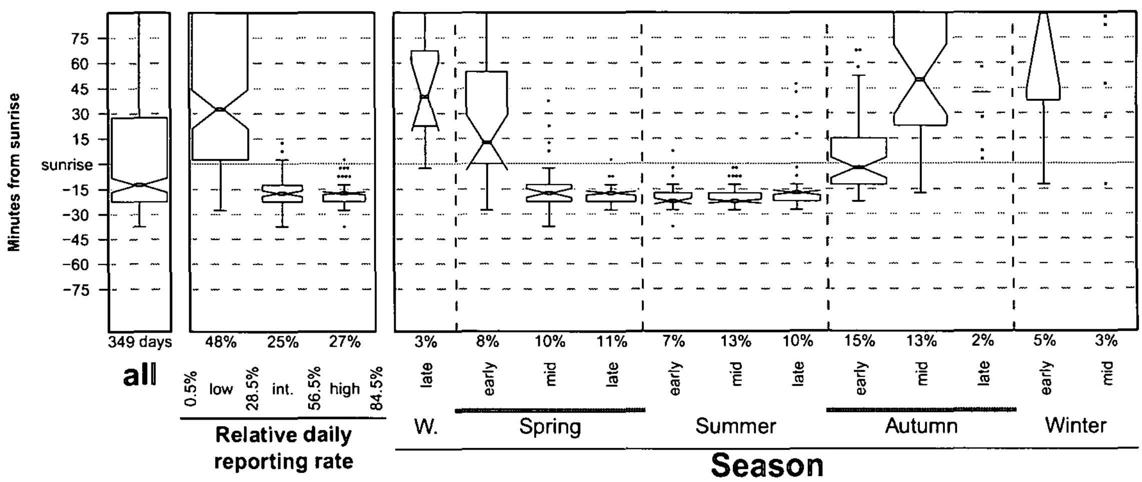


Figure 5.191: R666 Cloud Cisticola — all displays: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

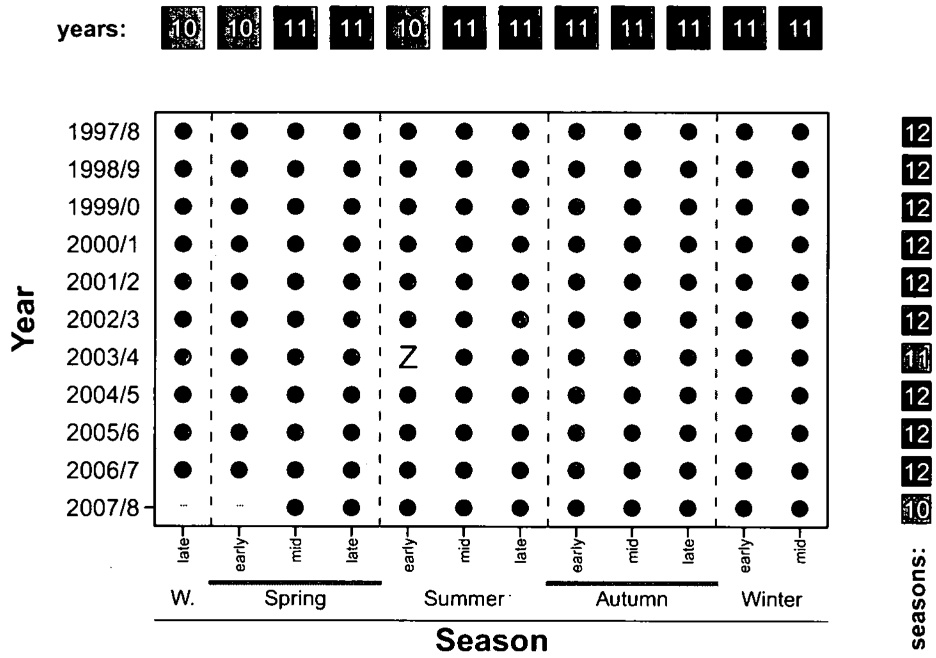


Figure 5.192: R666 Cloud Cisticola: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

The birds at Glen

A displaying bird was heard one day each during late summer 2003/4 and mid-summer 2004/5, on both occasions in the early morning.

R681 Neddicky.. *Cisticola fulvicapilla*

The Neddicky is endemic to Africa south of the equator (Irwin 1997a). In southern Africa, it is largely confined to the north, south and elsewhere east of 24°E (Berruti 1997h; Parker 1999). It occurs in a variety of habitats with a scrub/tree component (Maclean 1985) and is sedentary (Berruti 1997h).

The birds at Glen

The Neddicky was confined to the drainage line with records in the grassland referring to birds calling in the drainage line. Figures start on page 815.

Annual occurrence of drainage line birds heard in the grassland: Heard on 20.6% of the days with an activity index of six (Table 5.36a). Recorded for 5–6 seasons in most years, but during only 2–3 seasons in 1999/0, 2000/1 and 2001/2 (Fig. 5.193). Daily reporting rates ranged from 0.5 to 18.5% with 85.9% bird-days attaining low reporting rates (Fig. 5.193). The median daily reporting rate of 2005/6 was higher than that of most other years (Fig. 5.193). Only two years, *i.e.* 2001/2 and 2005/6, attained high reporting rate days (Fig. 5.193; Fig. 5.194).

Table 5.36: R681 Neddicky: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	752	114 612	0.7	birds heard only	20.6	656	135	6
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	278	1 190	23.4	birds heard only	74.4	43	32	9
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	13	1 188	1.1	birds heard only	23.3	43	10	1

Seasonal occurrence of drainage line birds heard in the grassland: Records are virtually limited to late spring, summer and early and mid-autumn (less frequent during the latter season; Fig. 5.193). Median daily reporting rates were similar for the respective seasons (Fig. 5.193). However, the few days with high reporting rates were restricted to late summer and early and mid-autumn with the incidence of days with zero records least frequent in early autumn (Fig. 5.194).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity was most frequent in the early morning and in the late afternoon before sunrise (Fig. 5.193), with low and intermediate reporting rate days indicating a similar trend (Fig. 5.195). Activity was most frequent in the morning and in the afternoon during the main bird-seasons (Fig. 5.196). Two bird-segment combinations occurred during more than 5% bird-days, involving single segments S1 and S12 which collectively accounts for 16.3% of all bird-days (Fig. 5.197).

The timing of the first activity of the day was variable, but tended to occur more frequently in the morning than in the afternoon (Fig. 5.196). The timing of the last activity of the day was also variable but often occurred closer to sunset on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.196).

Overall, daily segment reporting rates ranged from 5.6 to 69.2% with 89.9% of the values relatively low and median daily segment reporting rates mostly similar for the respective segments (Fig. 5.193; Fig. 5.195).

Early morning occurrence of drainage line birds during 2007/8: Activity was much more common in the drainage line than in the grassland (Table 5.36b & c; Fig. 5.198). Whereas activity was limited to summer and early and mid-autumn in the grassland, it occurred during all seasons except early spring in the drainage line (Fig. 5.198). Furthermore, the activity in the drainage line shows a well-defined early summer centred peak with high reporting rate days also occurring from early spring to early autumn (Fig. 5.198). The first activity of the day was usually before sunrise (Fig. 5.198), and activity intensities were slightly higher before sunrise (Fig. 5.198).

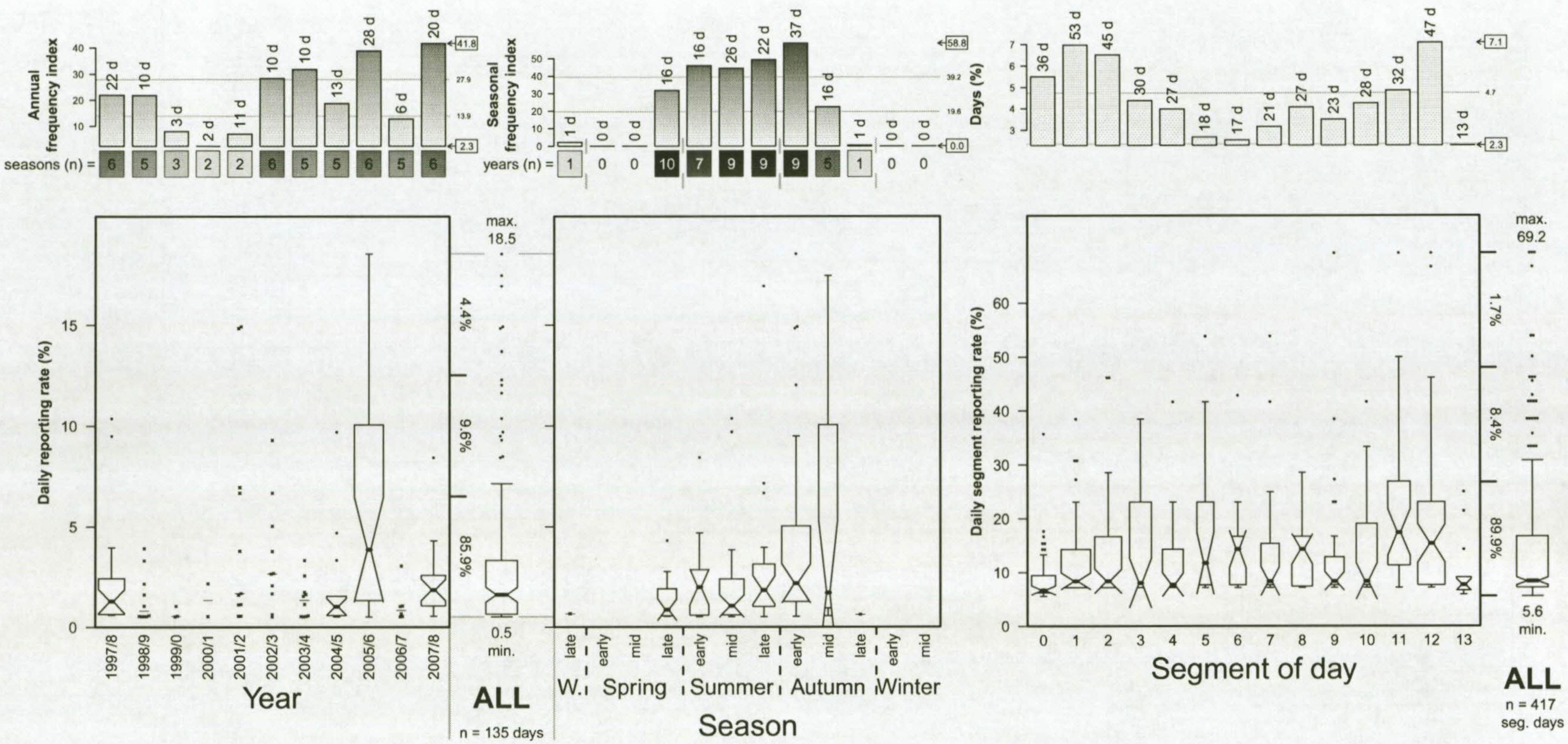


Figure 5.193: R681 Neddicky — birds heard only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

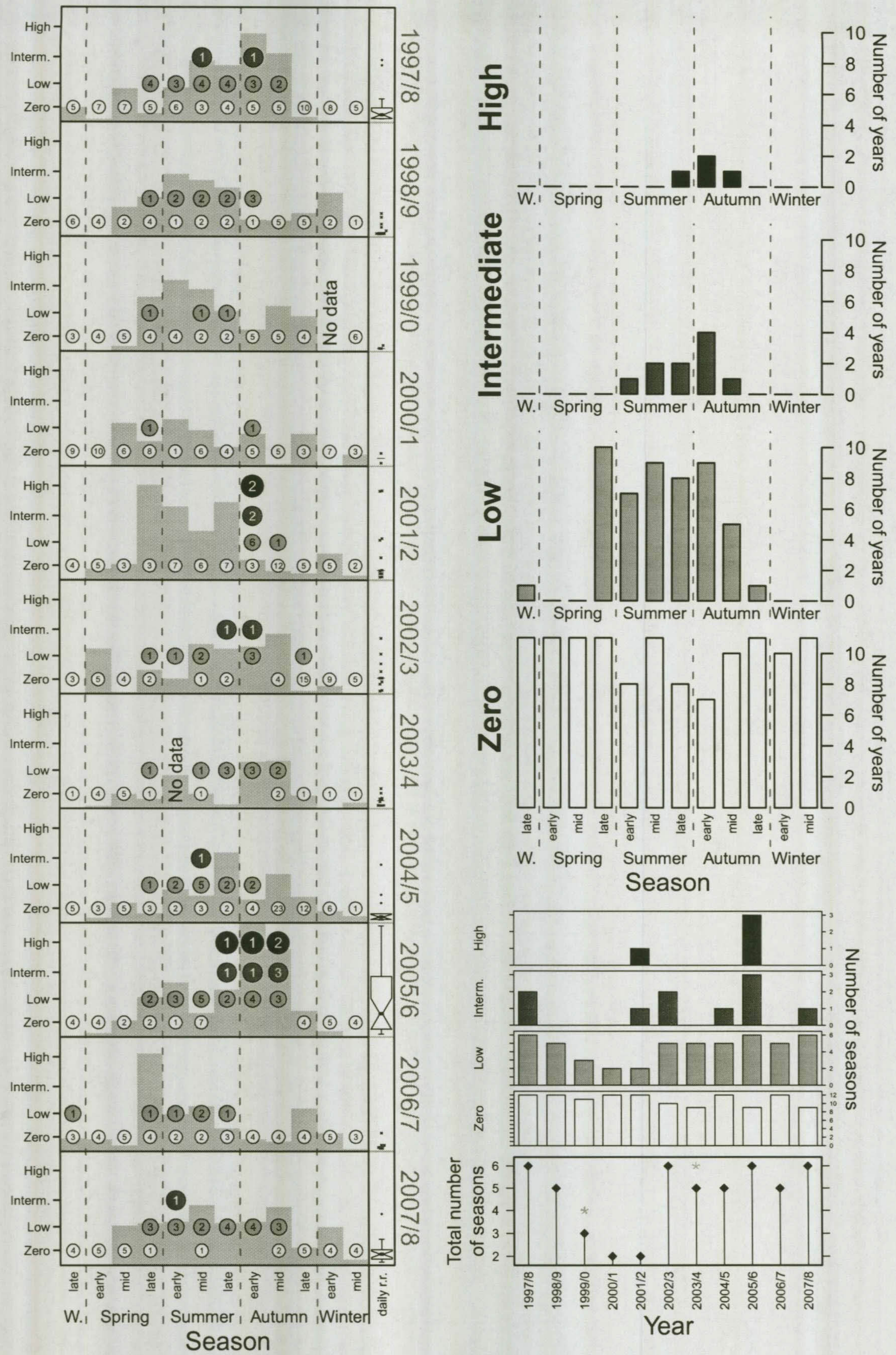


Figure 5.194: R681 Neddicky — birds heard only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

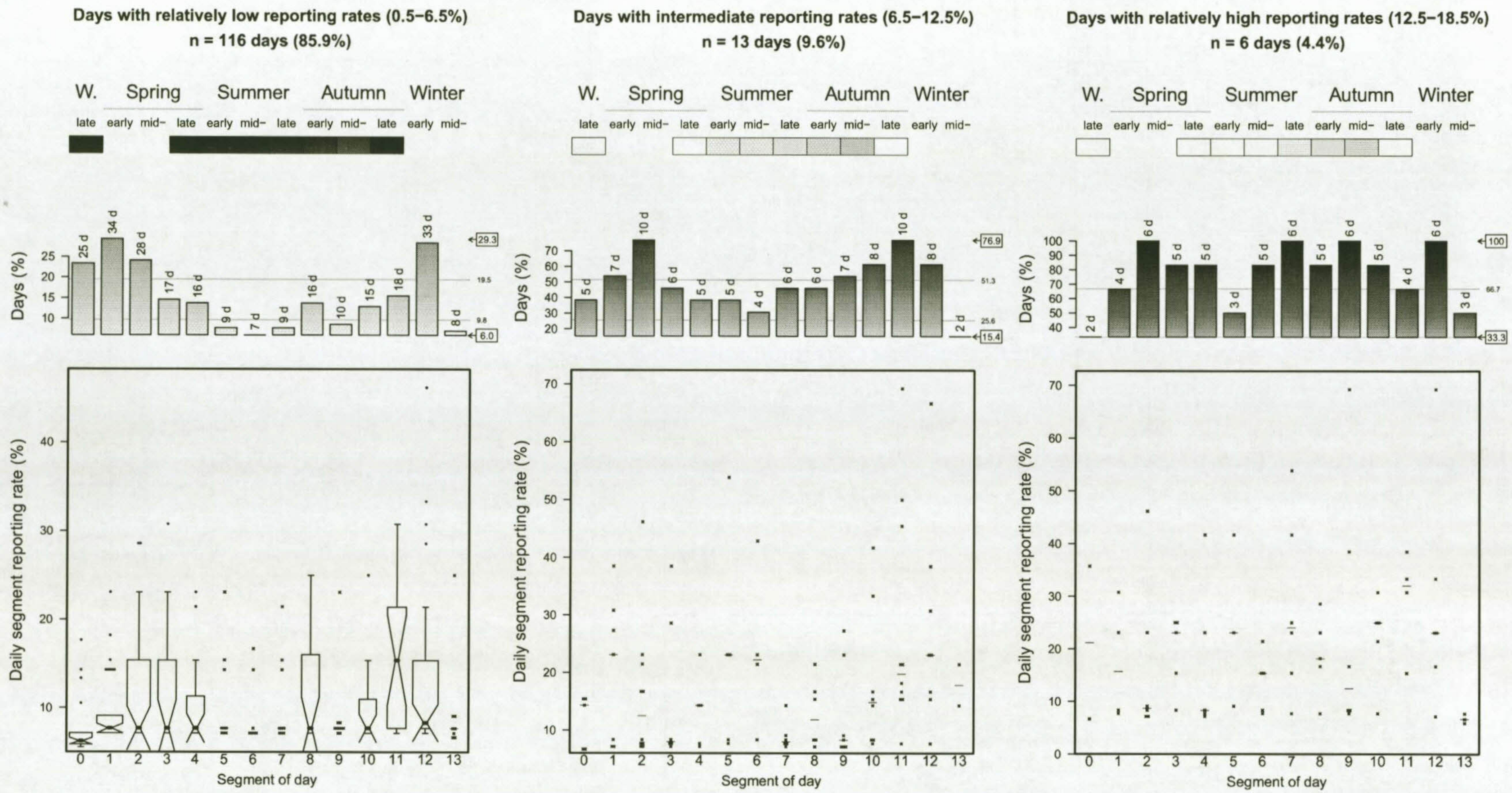
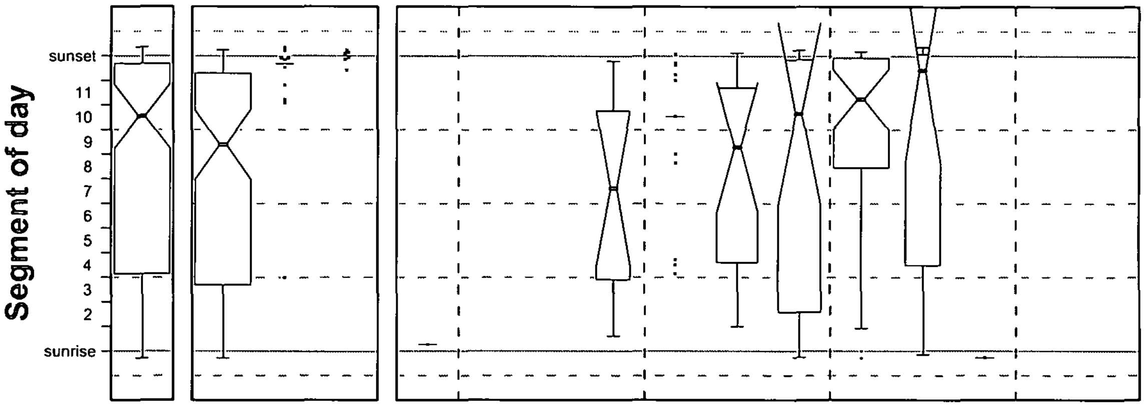
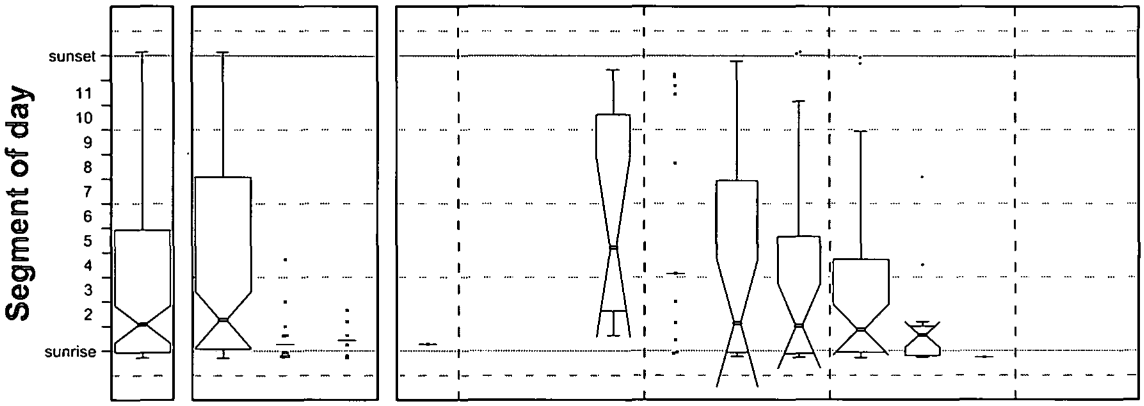


Figure 5.195: R681 Neddicky — birds heard only: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

Timing of the last activity of the day



Timing of the first activity of the day



Timing of the first activity of the day

Seasonal occurrence

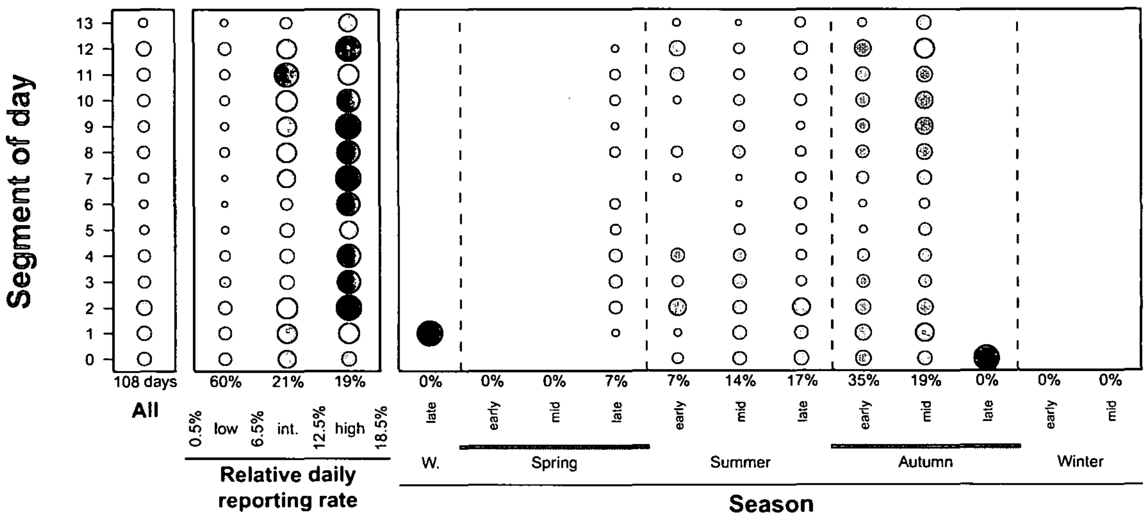


Figure 5.196: R681 Neddicky — birds heard only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

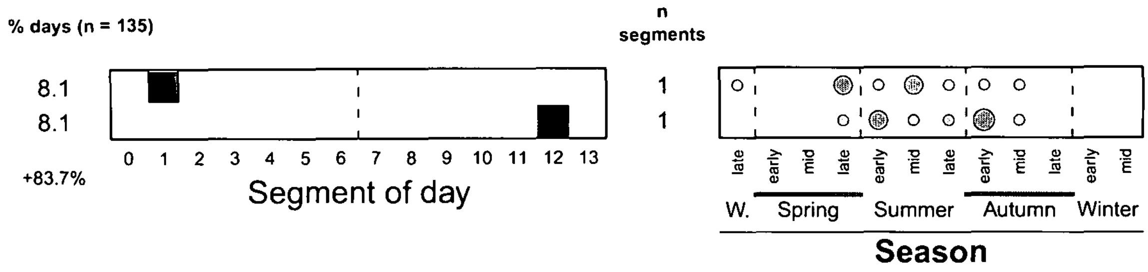


Figure 5.197: R681 Neddicky — birds heard only: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

Discussion

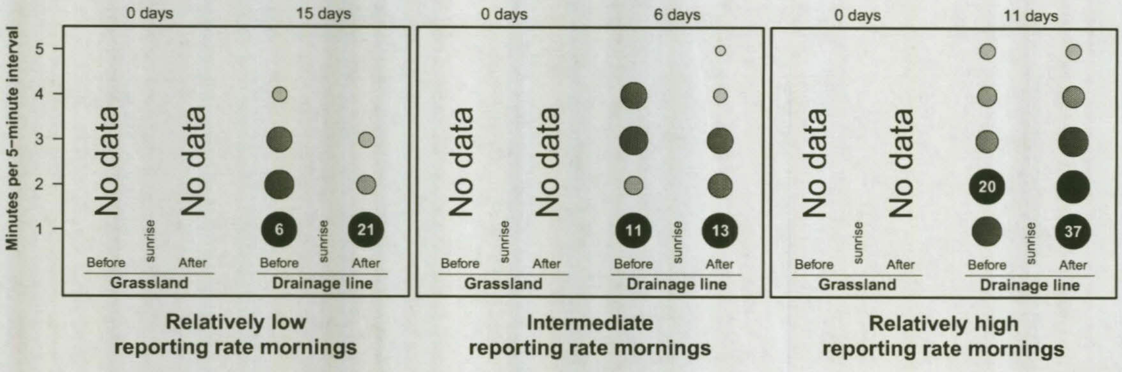
Although the actual levels of Neddicky activity in the drainage line was underestimated in the grassland (Table 5.36b & c), the grassland data nonetheless appear to give a reasonable approximation of the activity peaks in the drainage line (Fig. 5.198).

The birds appear to be resident in the drainage line (Fig. 5.198). In almost all years the first activity detected in the grassland was during late spring (Fig. 5.193; Fig. 5.194). Two exceptions include 2001/2 when activity was first recorded during early autumn after a spell of good rains that started in late spring (Fig. 5.194), and 2006/7 when activity was noted once in late winter and thereafter in late spring (Fig. 5.194). The relatively consistent occurrence of the first activity during late spring each year suggests the involvement of a recurring cue. Although late spring signals the start of the main rain period (see page 88), activity was not associated with reasonable precipitation occurring earlier in some years (*e.g.* 2002/3; Fig. 5.194). However, late spring is by definition the season following after the change in day-length has reached its peak (Fig. 2.12). It is suggested, therefore, that the start of activity is tightly controlled by day-length.

Breeding varies regionally, but in KwaZulu-Natal and the former Transvaal it occurs mainly from October to January [late spring and summer] (Maclean 1985). This corresponds to the period of peak activity at Glen, which extends into early autumn (Fig. 5.193; Fig. 5.194; Fig. 5.198). It appears that the end of vocal activity during the latter part of autumn (Fig. 5.193) coincides with moulting. One bird ringed during late autumn was in late primary moult and none of four birds handled during summer showed active moult (DJvN unpublished data). In the southern Western Cape, two apparent adults were in early primary moult during February [early autumn], and in western Zambia pre-breeding moult was finishing during November [early summer] (Dean 2005r).

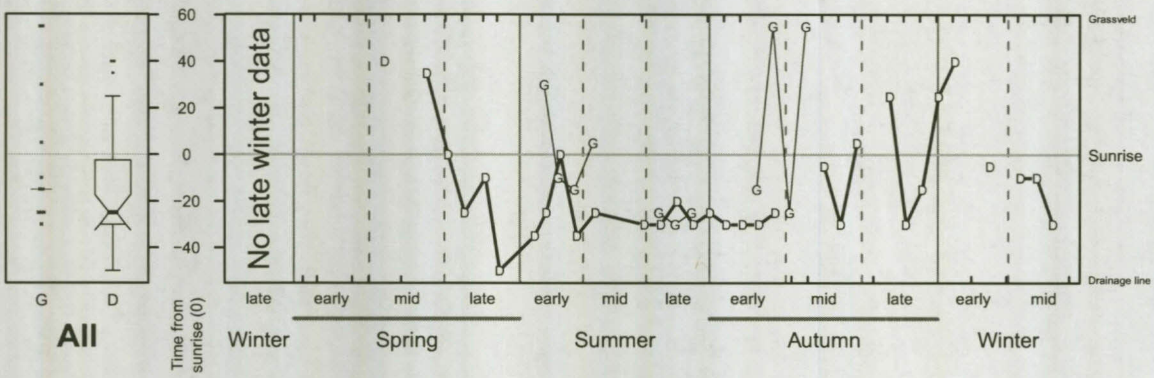
R685 Black-chested Prinia .... *Prinia flavicans*

The Black-chested Prinia occurs from southern Angola (Dean 2000) and south-western Zambia (Maclean 1985) southwards throughout Namibia, Botswana, south-western Zimbabwe and South Africa where the Free State represents the south-eastern limit of its distribution (Berruti 1997i; Maclean 1985). It occurs in a variety of habitats with a tree/bush/tall weed component, including



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

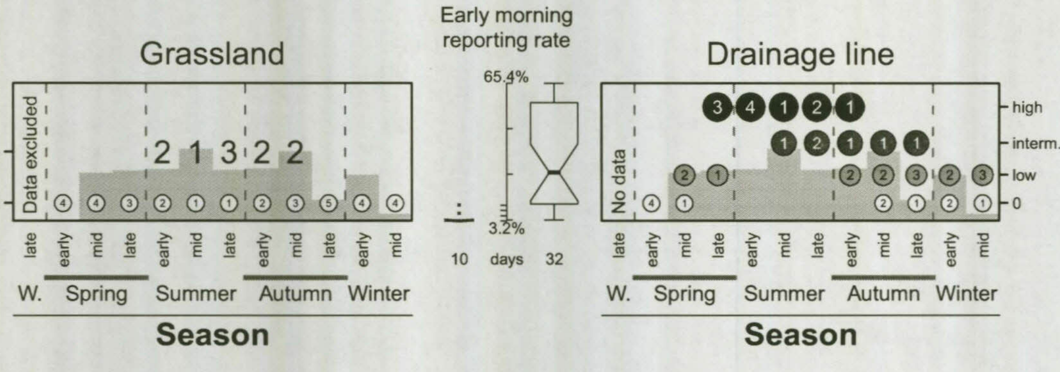


Figure 5.198: R681 Neddicky — birds heard only: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

those in dry watercourses (Maclean 1985). It is a resident in the Free State and in most other areas of its range (Berruti 1997i; Earlé & Grobler 1987).

The birds at Glen

The Black-chested Prinia is primarily a bird of the drainage line, but they were seen in the grassland as well. In the analysis below, distinction is made between drainage line birds (94.1%) and birds seen and/or heard in the grassland (5.9%; Table 5.37a). Figures start on page 823.

Table 5.37: R685 Black-chested Prinia: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.941	1 575	114 612	1.4	birds heard only	45.9	656	301	5
0.059	98	114 612	0.1	birds seen	8.5	656	56	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	271	1 190	22.8	birds heard only	90.7	43	39	7
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	8	1 188	0.7	birds heard only	11.6	43	5	2

Annual occurrence of drainage line birds heard in the grassland: Heard on 45.9% of the days with an activity index of five (Table 5.37a). Usually noted during 9–10 seasons each year, but during 11–12 seasons in 1997/8 and 1998/9, and during 6–8 seasons in 2003/4, 2005/6 and 2007/8 (Fig. 5.199; Fig. 5.200). Daily reporting rates ranged from 0.5 to 38.5% with 96.3% bird-days attaining low reporting rates (Fig. 5.199). The median daily reporting rate of 1997/8 was higher than that of all other years and it was also the only year with high reporting rate days (Fig. 5.199; Fig. 5.200).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons for 4–11 bird-years each season, with the number of bird-years as well as the seasonal frequency index following a bimodal pattern with the first (lesser) peak period in mid- and late spring and the second from mid-summer to late autumn (Fig. 5.199). The upper quartile ranges of daily reporting rates hint at a similar pattern, however, median daily reporting rates were similar for all seasons (Fig. 5.199). Days with zero records were relatively infrequent in late summer and early autumn (Fig. 5.200).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity tended to be more frequent in the early morning after sunrise than later in the day, and was particularly infrequent before sunrise and after sunset (Fig. 5.199). The pattern varied seasonally with peaks shifting from late morning in late winter to early morning during autumn (Fig. 5.201). No segment combinations occurred during more than 5% bird-days.

The first activity of the day often occurred during the morning, earlier on intermediate and high than on low reporting rate days (Fig. 5.201). The seasonal pattern was reasonably constant (Fig. 5.201). The occurrence of the last activity of the day was variable (Fig. 5.201).

Overall, daily segment reporting rates ranged from 5.3 to 92.9% with 92.2% of the values relatively low (Fig. 5.199). Median daily segment reporting rates were similar for all segments, except before sunrise when it was relatively lower than during other segments (Fig. 5.199).

Early morning occurrence of drainage line bird vocalisations during 2007/8. Much more commonly recorded in the drainage line than in the grassland (Table 5.37b & c; Fig. 5.202). Whereas activity in the grassland was limited to four seasons only, it occurred during all seasons except early spring in the drainage line (Fig. 5.202). Activity in the drainage line shows a well-defined peak with high reporting rate days occurring from late spring to late summer (Fig. 5.202). The timing of the first activity of the day was somewhat variable but frequently occurred more than 15 minutes before sunrise (Fig. 5.202). Activity intensities were very similar before and after sunrise (Fig. 5.202).

Birds in the grassland: Recorded on 8.5% of the days with an activity index of two (Table 5.37a). Recorded during 2–6 seasons each year (least frequently during 2001/2 and 2002/3), except in 2005/6 when not recorded (Fig. 5.203). Seasonally, records occurred during two discrete periods: late winter to early summer and early autumn to early winter (Fig. 5.203). Recorded during all segments between sunrise and sunset and only once after sunset (Fig. 5.203).

Discussion

Peak breeding of the Black-chested Prinia in the eastern parts of their range is from November to January [late spring & summer] according to Tarboton (2001). Activity peaked in the drainage line at Glen during the same period (Fig. 5.202). Their general absence from the grassland at these times (Fig. 5.203) can probably be attributed to birds that are confined to their nesting areas in the drainage line. Their absence during mid-winter (Fig. 5.203) is more difficult to explain.

The broadly similar bimodal seasonal patterns of birds seen in the grassland (Fig. 5.203) and drainage line vocalisations noted in the grassland (Fig. 5.199) probably coincide with their bi-annual moult. Adults undergo a pre-breeding moult from September to November [mid-spring to early summer] and a post-breeding moult from February to June [early autumn to mid-winter] (Herremans 1999). A limited sample of birds in the central Free State (mainly from Glen) indicates a similar pattern (DJvN unpublished data). The data suggest that the birds wander more widely during moulting.

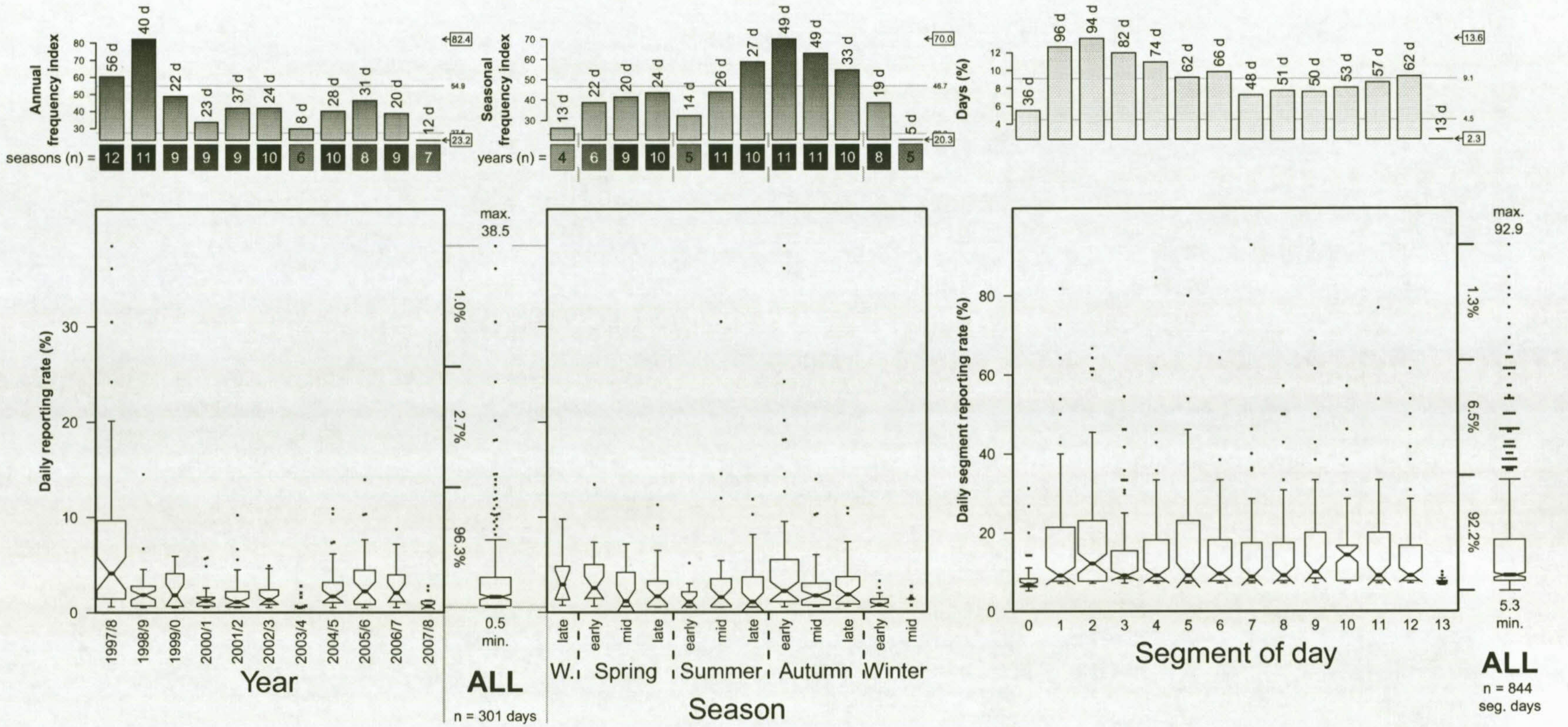


Figure 5.199: R685 Black-chested Prinia — birds heard only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

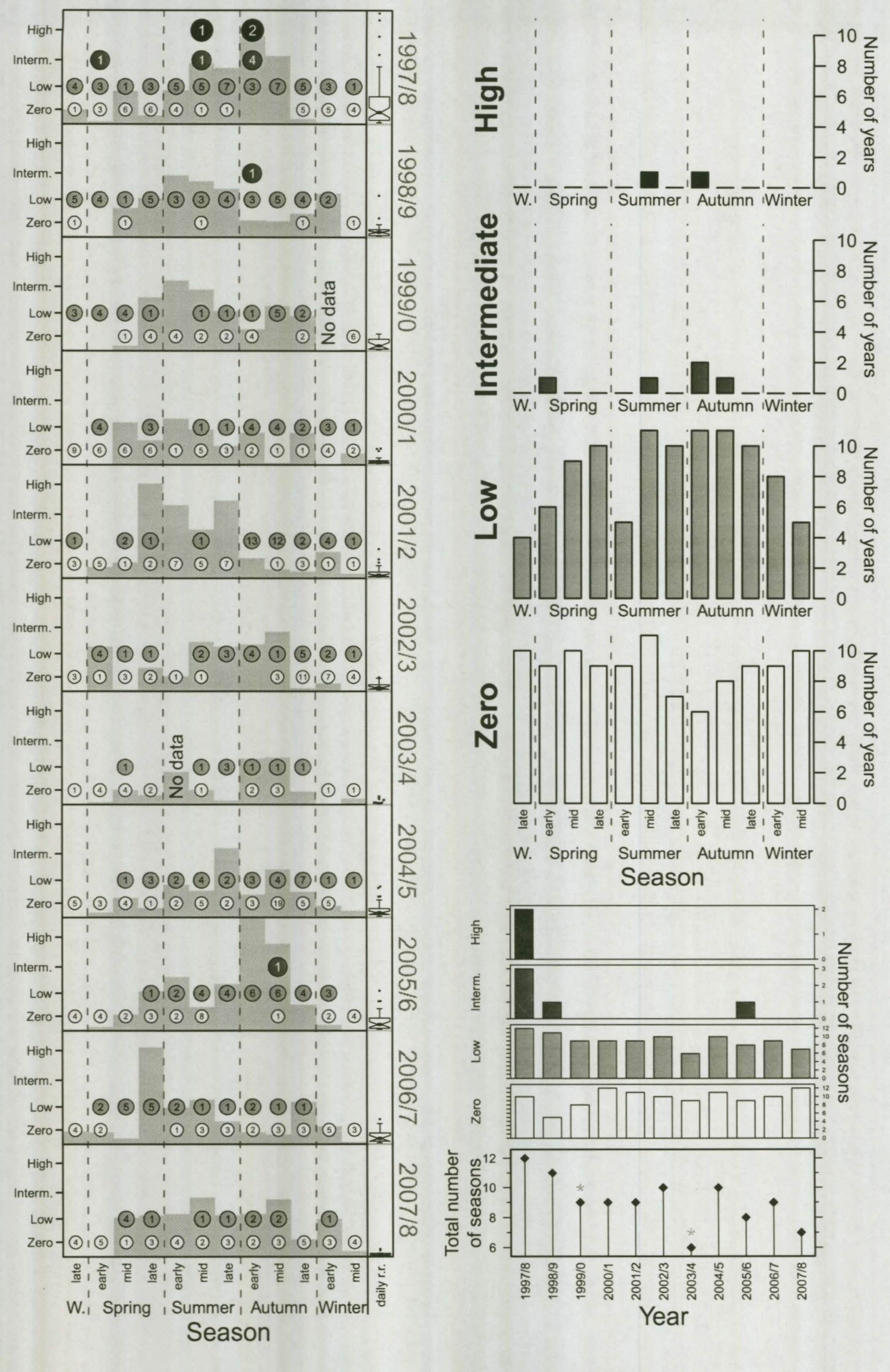
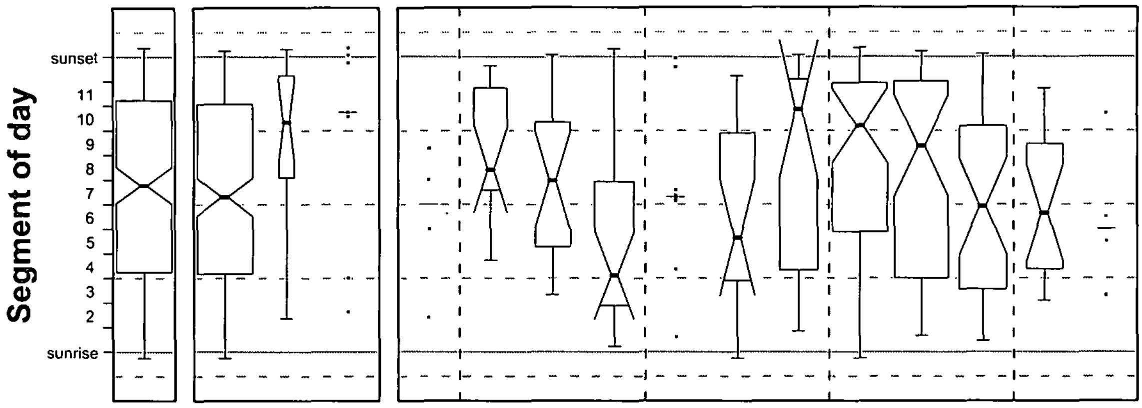
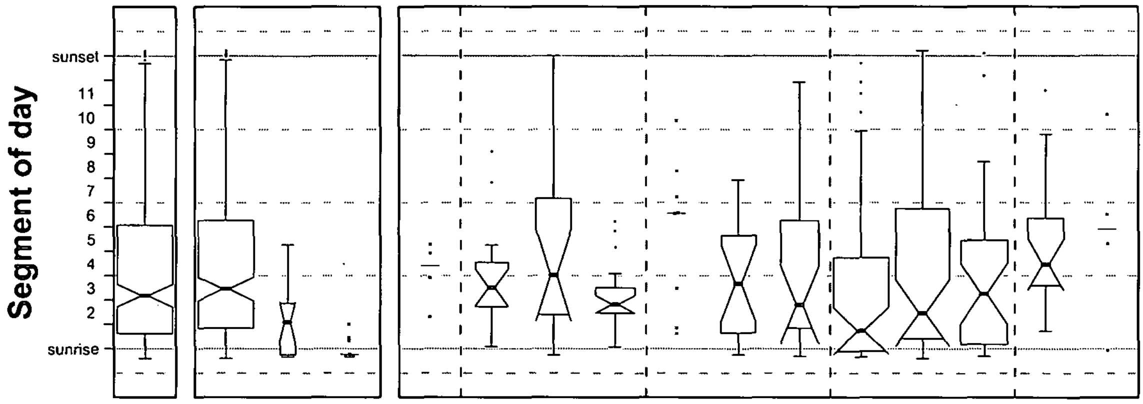


Figure 5.200: R685 Black-chested Prinia — birds heard only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.





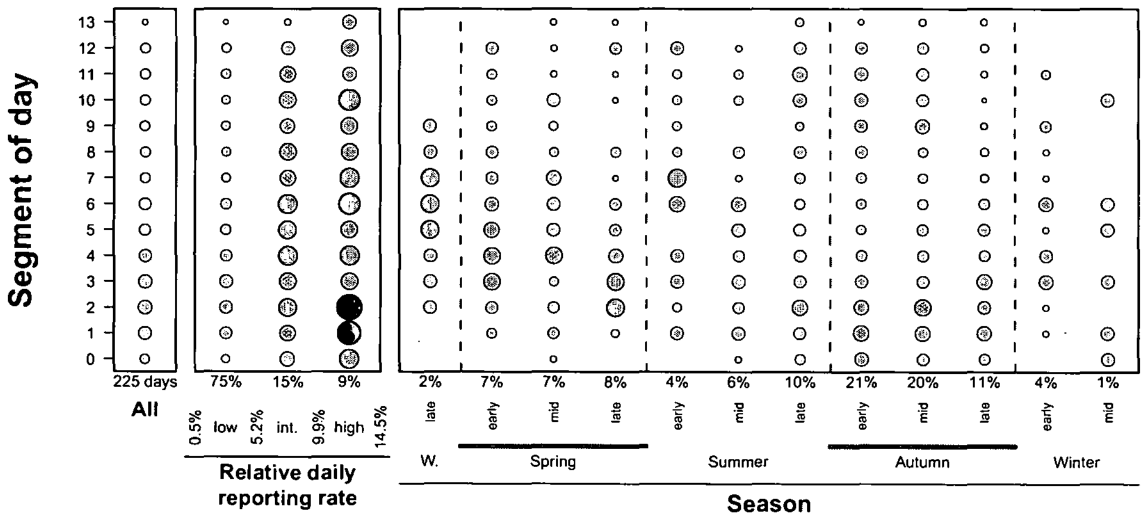
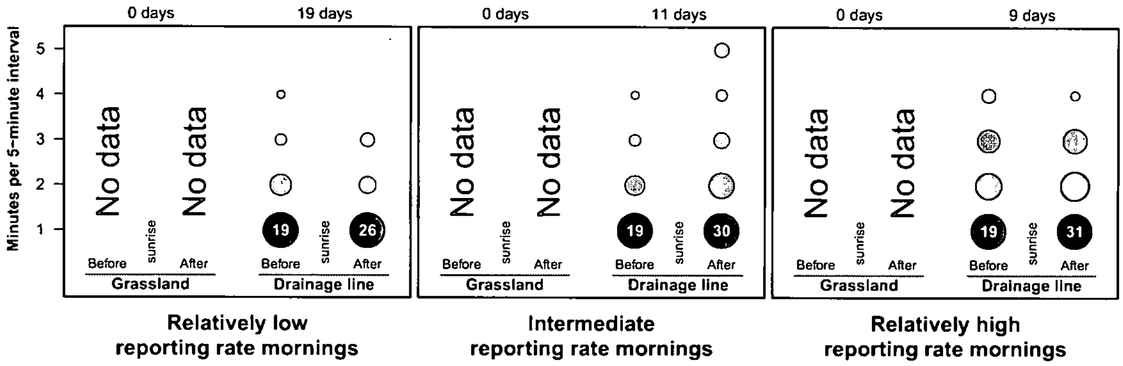
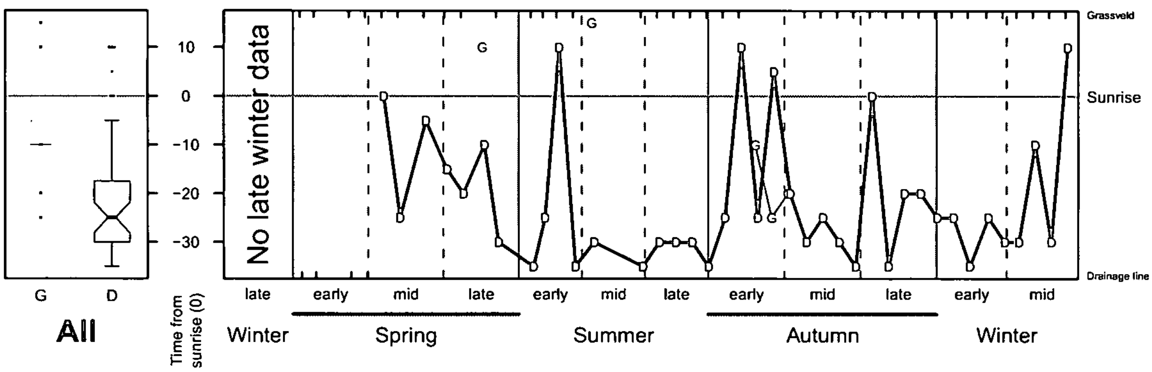


Figure 5.201: R685 Black-chested Prinia — birds heard only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

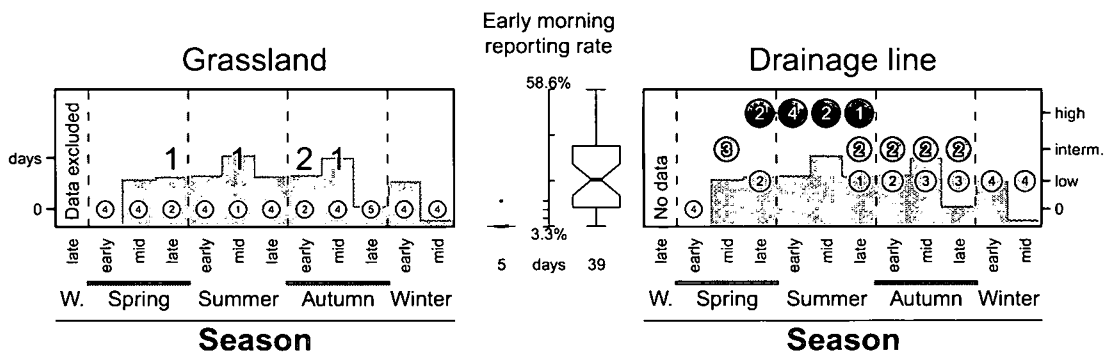


Figure 5.202: R685 Black-chested Prinia — birds heard only: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

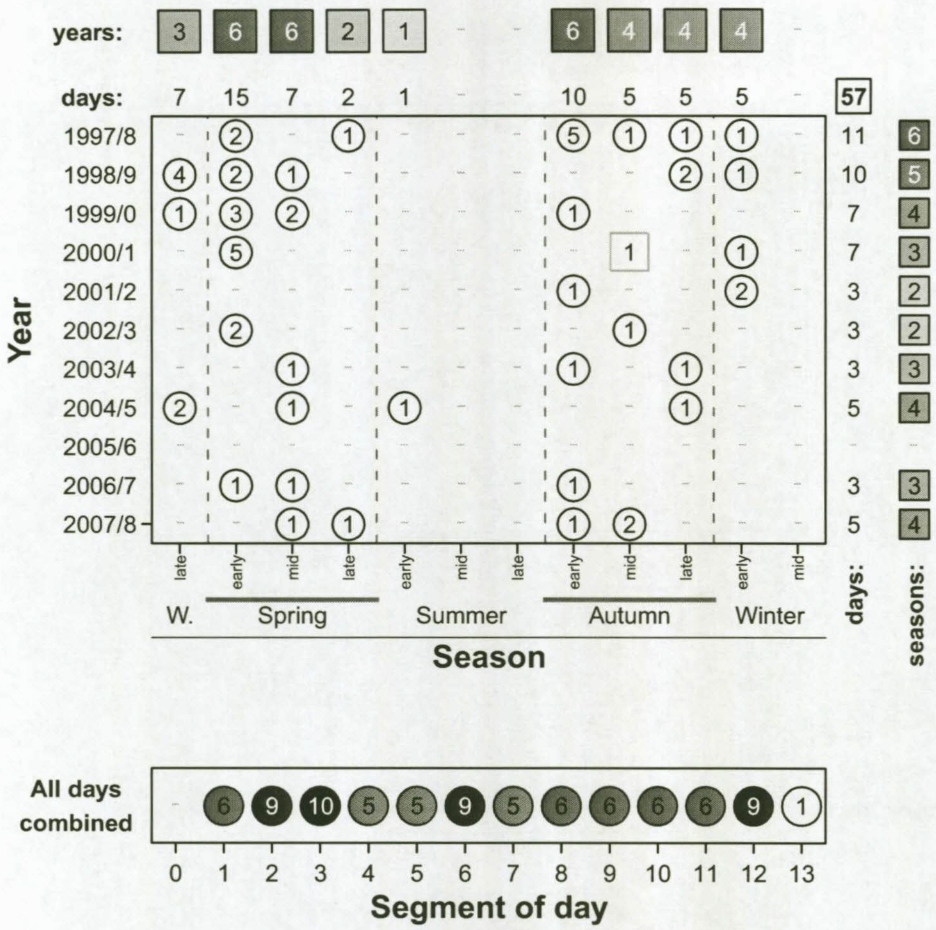


Figure 5.203: R685 Black-chested Prinia — birds seen: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R688 Rufous-eared Warbler .... *Malcorus pectoralis*

The Rufous-eared Warbler is endemic to southern Africa, occurring mainly in southern and central Namibia, southern Botswana and in South Africa as far east as the central Free State (Berruti 1997j). The study area is near the eastern limits of its range. It is associated with shrubby vegetation (Maclean 1985). Resident, but may move locally in response to rain (Berruti 1997j; Dean 2005v).

The birds at Glen

Recorded on nine days spread over three years: 1997/8, 2001/2 and 2004/5 (Fig. 5.204). Records are limited to the period from mid-spring to mid-autumn with records scattered throughout the day (Fig. 5.204).

Discussion

The Rufous-eared Warbler records at Glen presumably represent local nomadic movements.

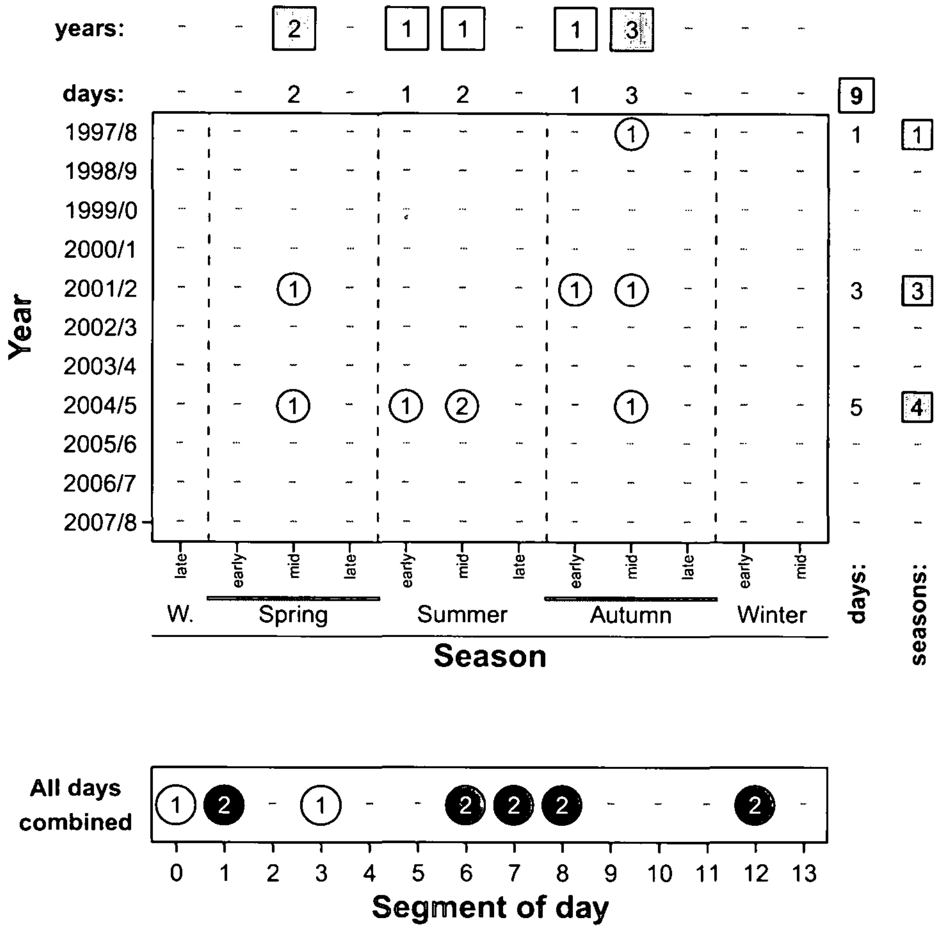


Figure 5.204: R688 Rufous-eared Warbler — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

5.10 Muscicapidae

Note: The Muscicapidae is continued from page 768.
See page 729 for an introduction to the family.

R689 Spotted Flycatcher . . . . *Muscicapa striata*

The Spotted Flycatcher breeds in the Palearctic with all races moving to sub-Saharan Africa where most birds spend the non-breeding season south of the equator (Cramp 1998). Found throughout southern Africa, but most common from Botswana eastward (Herremans 1997d; Parker 1999). Associated with habitats containing trees and open spaces where it can hawk insects (Herremans 1997d). The birds were recorded in SABAP1 Zone 7 from October to April [mid-spring to late autumn] (Herremans 1997d).

The birds at Glen

Seen and heard once in the drainage line in early summer 2007/8. Also recorded once during a transect in the drainage line, mid-autumn 2001/2.

R698 Fiscal Flycatcher .... *Sigelus silens*

The Fiscal Flycatcher is endemic to southern Africa with the bulk of its range in South Africa where it is widespread; absent only from the west (Johnson & Herremans 1997). It occupies a variety of habitats with suitable perches such as trees, and is often associated with *Acacia* spp. (Day 1975; Johnson 2005b; Maclean 1985; Martin *et al.* 1988; Winterbottom & Winterbottom 1984). Resident in parts of its range and a partial migrant elsewhere (Johnson 2005b; Johnson & Herremans 1997). It apparently disperses to habitats that are more open after breeding, *i.e.* during the cooler times of the year (Johnson & Herremans 1997).

The birds at Glen

The Fiscal Flycatcher inhabits the drainage line and visits the grassland — specifically the trampled area — occasionally. All records in the grassland refer to birds actually present in the grassland. Only vocal records are considered in the drainage line (Table 5.38). The analysis for the grassland is based on a year starting in late summer.

Table 5.38: R698 Fiscal Flycatcher: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	61	114 612	0.1	birds present	2.3	656	15	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	173	1 190	14.5	birds heard	83.7	43	36	5
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Birds in the grassland: Recorded on 13 days during five years with records limited to late autumn, late winter and early and mid-spring (Fig. 5.205). Recorded throughout the day but most frequently in the first part of the morning after sunrise and again around midday (Fig. 5.205).

Observations during early and mid-spring 2007 involved a male from the drainage line that regularly visited the trampled area to catch honeybees *Apis mellifera* on the ground. The bees were visiting *Albuca* spp. flowers.

Early morning occurrence of vocal activity in the drainage line during 2007/8: Noted in the drainage line only, being recorded during 83.7% of the mornings and during all seasons (Table 5.38; Fig. 5.206). The timing of the first activity of the morning was reasonably constant and mostly more than 20 minutes before sunrise (Fig. 5.206). Activity at higher intensities was slightly more frequent before sunrise (Fig. 5.206).

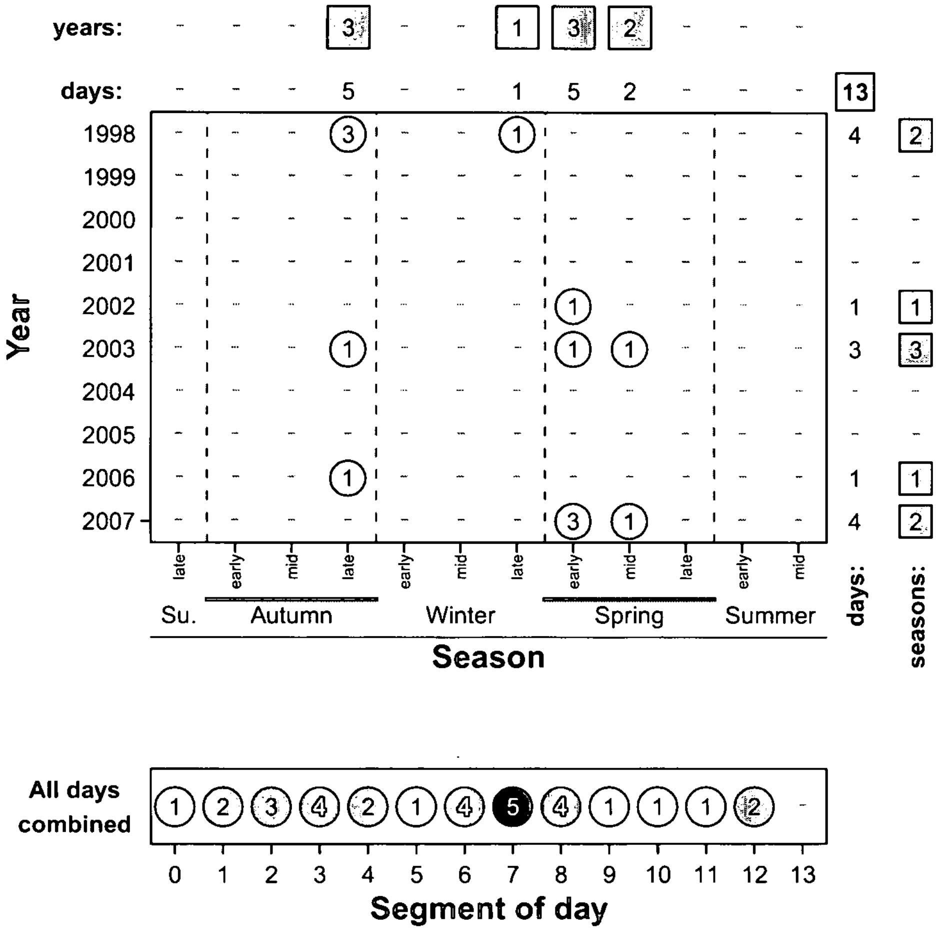


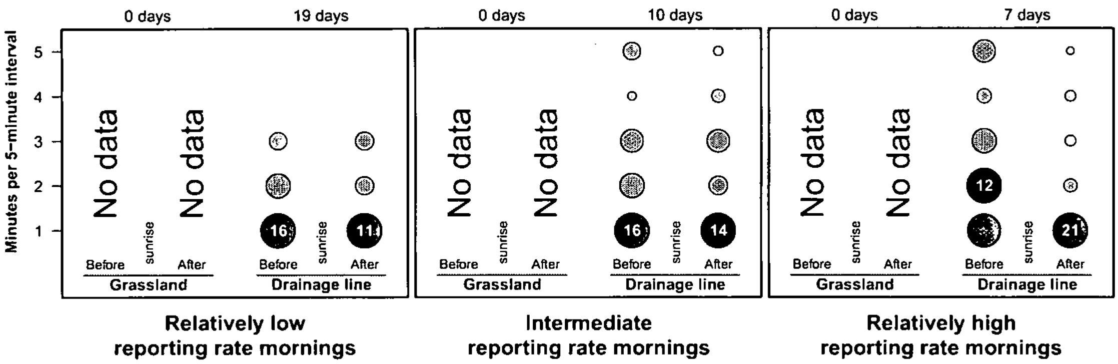
Figure 5.205: R698 Fiscal Flycatcher — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Discussion

The annual cycle of the Fiscal Flycatcher includes a well-defined breeding season centred on the period from October to December [late spring to mid-summer] (Johnson & Herremans 1997), followed by a complete post-breeding moult from January to April [late summer and autumn] (Johnson 2005b). The data collected in the drainage line at Glen during 2007/8 (Fig. 5.206) suggests that the birds are relatively active vocally during the breeding season and after moult, and least active before breeding. In the grassland (Fig. 5.205), the birds are present only after moult (late autumn) and again before breeding (late winter to mid-spring).

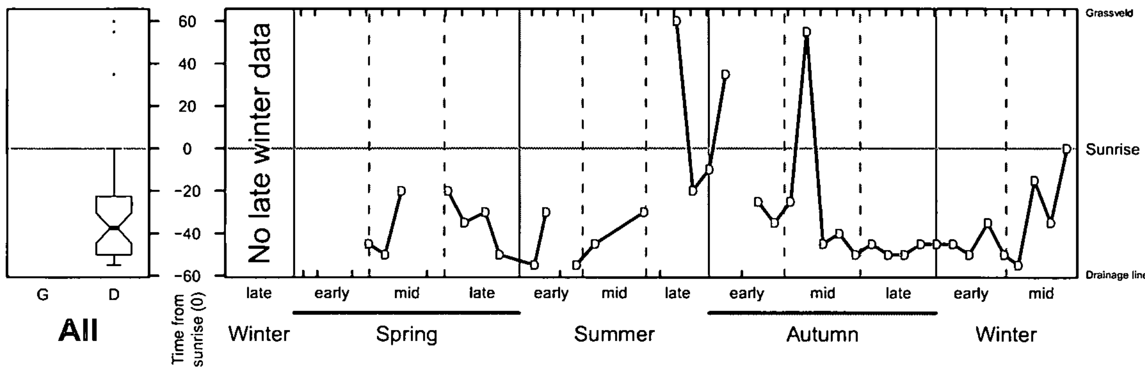
Commenting on Fiscal Flycatcher SABAP1 reporting rates, Johnson & Herremans (1997) attributed the "winter peak" to post-moult dispersal into more open habitats, and lower reporting rates during, and especially after, the breeding season to post-breeding moult when the birds apparently "keeps a lower profile." These explanations sound reasonable and may partially account for the seasonal presence of the birds in the grassland at Glen. It is further suggested that the bimodal character of the data (Fig. 5.205) may be related directly to food and indirectly to rainfall.

If it is assumed that their late autumn presence in the grassland coincides with the end of



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

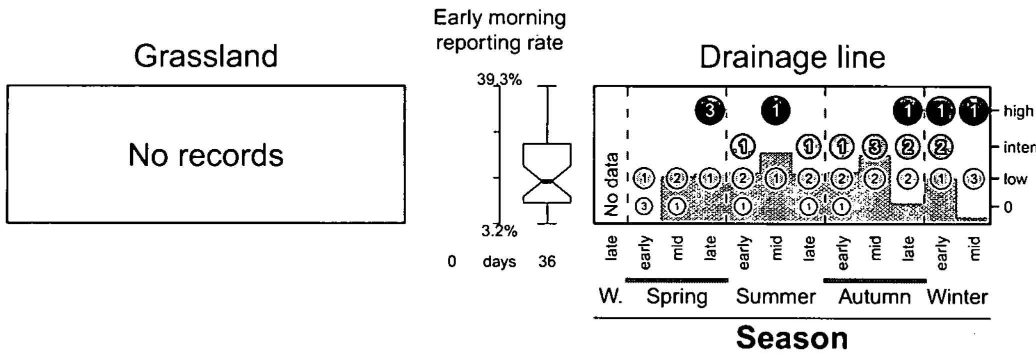


Figure 5.206: R698 Fiscal Flycatcher — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

moult, it may be that it represents birds looking for food to replenish their reserves after that energy demanding process. The occurrence of the birds during late autumn was also preceded by relatively good rains in mid-autumn during 1997/8, 2002/3 & 2005/6 (Fig. 2.16; Fig. 2.18; Fig. 5.205).

By contrast, the occurrence of the birds in the grassland before breeding (late winter to mid-spring) was always before the first significant rains of the year, except the single 2002 early spring record which occurred a day after 30 mm rain fell. This may imply that the birds in the grassland during that time of the year represent individuals that wander more widely in search for food, presumably because food have become scarce in their usual habitat. This is supported by the observation of the male that repeatedly ate honeybees during 2007/8, which may represent an unusual prey item for this species; neither Maclean (1993) nor Johnson (2005b) mention it in the diet of these birds.

5.11 Malaconotidae (Vangini): Batises, *etc.*

The Malaconotidae is a diverse group of birds placed in two subfamilies: Malaconotini (see page 882) and the Vangini, which include batises (Hockey *et al.* 2005). The 57 species in the subfamily Vangini occur in Africa, Madagascar and southern Asia, with 11 species found in southern Africa (Hockey *et al.* 2005). Three batis species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b) of which only the Pririt Batis R703 occurs in the central parts of the province.

R703 Pririt Batis . . . . *Batis pririt*

The Pririt Batis occurs from south-western Angola (Dean 2000) south through Namibia into South Africa where it is present as far east as the central Free State (Herremans 1997e). Also widespread in central and southern Botswana (Herremans 1997e). Occurs in a variety of woodland types including those along drainage lines (De Swardt 2000; Herremans 1997e; Maclean 1985). Resident, but during winter and drought may occasionally be found east of its breeding range (Herremans 1997e).

The birds at Glen

The Pririt Batis is confined to the drainage line, but is sometimes heard in the grassland too, probably from trees at the fringe of the drainage line.

Drainage line birds heard in the grassland: Recorded on eight days in five years from 1999/0 to 2004/5 with records restricted to late winter, early and late autumn (Fig. 5.207). Records were limited to the early morning after sunrise and mid-afternoon (Fig. 5.207).

Early morning occurrence of drainage line birds heard during 2007/8: Recorded during six mornings (14.0%) in the drainage line only (late spring and early and late summer).

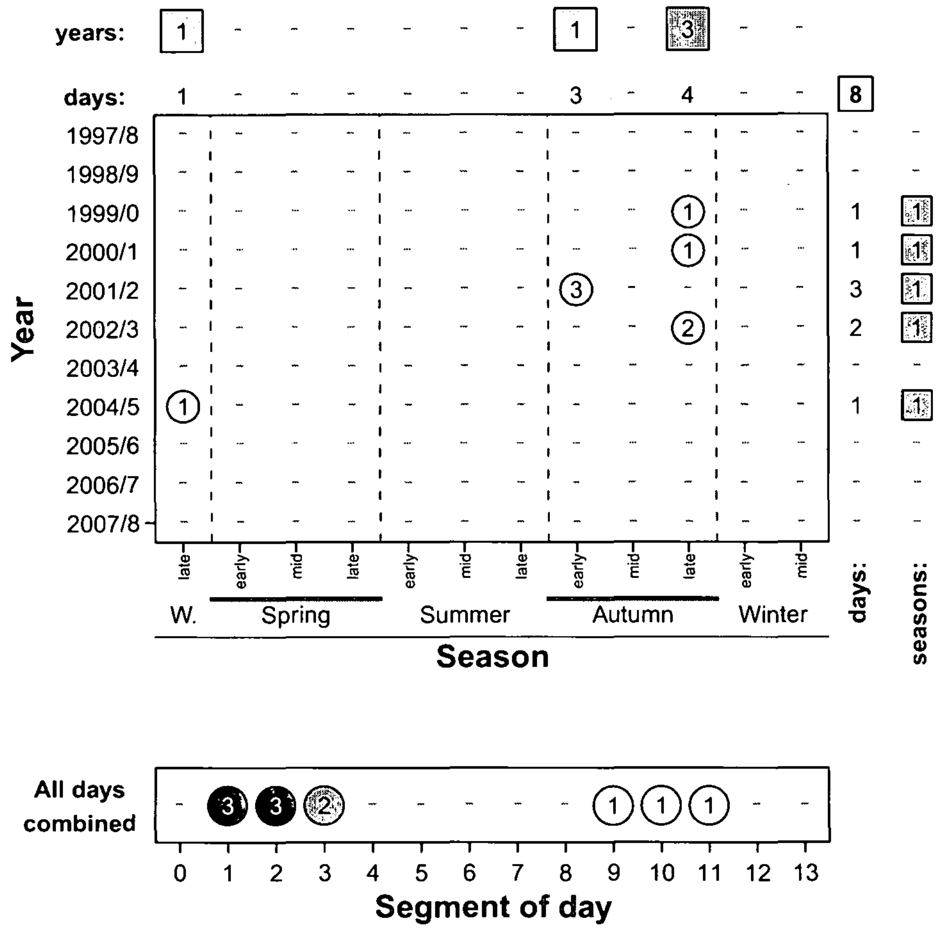


Figure 5.207: R703 Pririt Batis — birds heard only: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Note: The current classification of the Malaconotidae (Hockey *et al.* 2005) is different from that presented in Maclean (1985), whose order is followed here for practical reasons. Consequently, the family is continued on page 882.

5.12 Sylviidae

Note: The Sylviidae is continued from page 783.
See page 768 for an introduction to the family.

R706 Fairy Flycatcher . . . . *Stenostira scita*

The Fairy Flycatcher is endemic to southern Africa, with its distribution largely limited to South Africa where it is widespread (Johnson 1997). Due to its foraging and nesting requirements, it is always associated with shrubs and trees (Johnson 1997). While it is resident in certain areas, other areas such as the Free State experiences a winter influx from Lesotho (Benson 1982; Clancey 1980; Earlé & Grobler 1987; Johnson 1997; Van Niekerk 2004).

The birds at Glen

The Fairy Flycatcher was only found in the drainage line where recorded throughout the year except in early spring (Fig. 5.208). High reporting rate mornings were limited to late spring and early summer (Fig. 5.208). The occurrence of the first activity of the day was variable but frequently before sunrise (Fig. 5.208). Activity intensities were comparable between pre- and post-sunrise periods (Fig. 5.208).

Discussion

The Fairy Flycatcher appears to be resident at Glen (Fig. 5.208). In summer-rainfall areas breeding peak from October to November [mid-spring to early summer] (Tarboton 2001). Little is known about their moult. One of two birds examined in the southern parts of the Western Cape was just starting primary moult in late November/early December [early summer] (Du Plessis & Frauenknecht 2005). At Glen, a bird ringed in mid-summer had already started primary, tail and body moult and another ringed in late autumn already finished moulting. These few records suggest a complete post-breeding moult from about summer. Therefore, the early morning drainage line data shown in Figure 5.208 suggest that vocal behaviour is most prominent during the breeding season followed by a relatively silent period during moult, and subsequently higher levels of activity post-moult. The birds are silent before breeding commences. Breeding is possibly triggered by rain.

5.13 Motacillidae: Wagtails, Pipits, Longclaws

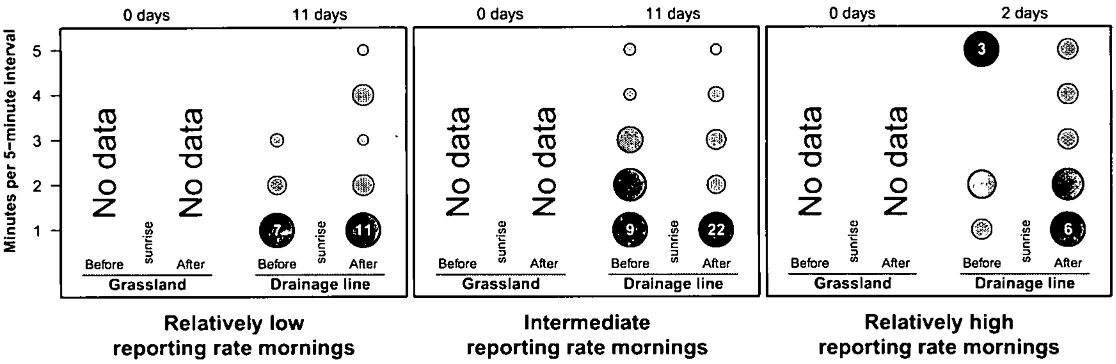
Wagtails, pipits and longclaws, of which there are 66 species, occur worldwide except in the polar regions, with 25 species occurring in southern Africa (Hockey *et al.* 2005). Approximately half of these species have been recorded in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b). The African Pied Wagtail *Motacilla aguimp* is the only one of the eight species occurring in the central parts of the Free State that was not recorded at Glen; its preferred habitat is large rivers that do not occur in the study area. The African Rock Pipit *Anthus crenatus* was recorded once at the mountain to the east of the study area and is not considered further here.

R713 Cape Wagtail .... *Motacilla capensis*

The Cape Wagtail is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa found virtually throughout South Africa, Lesotho and Swaziland, but it is more localised in Namibia, Botswana, Zimbabwe (Piper 1997) and southern Mozambique (Parker 1999). Typically associated with water (Piper 1997). Within southern Africa movements span the range form sedentary, to local and altitudinal movements, to partial migration (Earlé & Grobler 1987; Maclean 1985; Penry 1994; Piper 1997; Van Niekerk 2004).

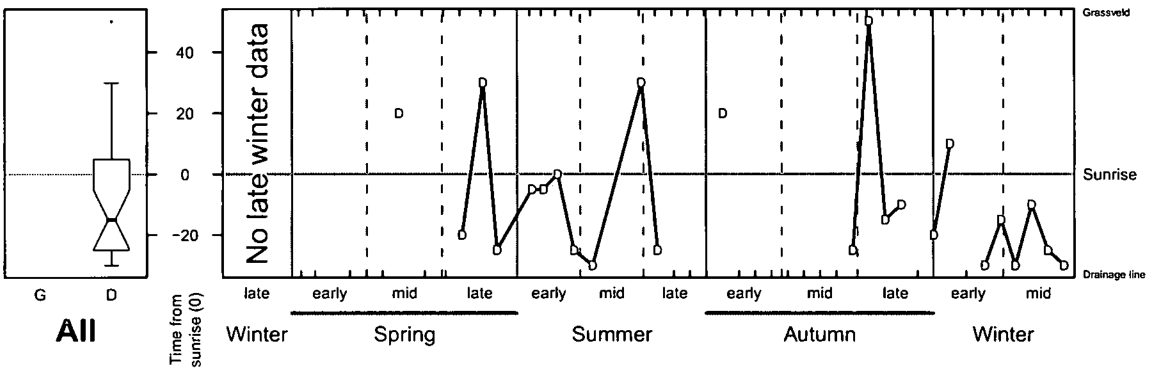
The birds at Glen

The Cape Wagtail was mainly associated with the farm dam in the drainage line (if it contained water), but was recorded in the grassland too, either when visiting the trampled area to feed



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

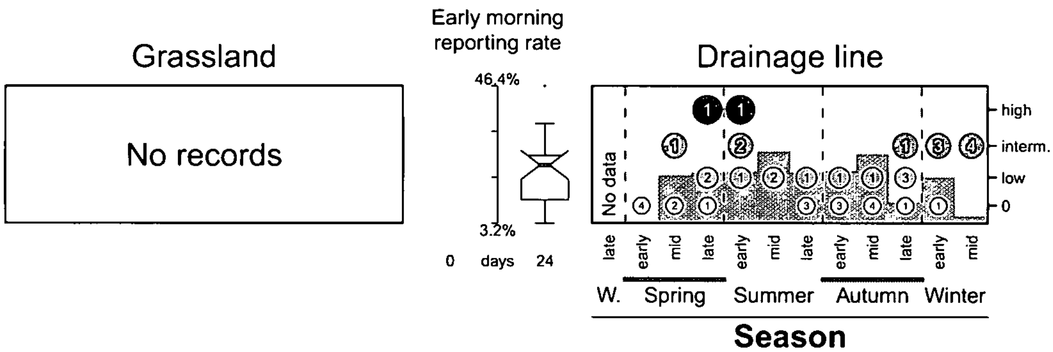


Figure 5.208: R706 Fairy Flycatcher — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

amongst cattle or as birds that flew overhead. They were always encountered as singles or in pairs. All records refer to birds that were heard (both seen and heard at times). The analysis of the grassland data is based on a year starting in late summer.

Birds in the grassland: Encountered on 7.6% of the days with an activity index of two (Table 5.39a). Found during all years during 1–4 seasons except in 2002 when recorded during seven (Fig. 5.209). Recorded during 4–5 years from mid-autumn to early winter and for 1–3 years in other seasons, except early summer when not recorded (Fig. 5.209). Heard throughout the day, but mostly in the earlier part of the morning (Fig. 5.209).

Table 5.39: R713 Cape Wagtail: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	116	114 612	0.1	birds heard	7.6	656	50	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	70	1 190	5.9	birds heard	32.6	43	14	5
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Early morning occurrence of birds during 2007/8. Only recorded in the drainage line where found on a third of the mornings (Table 5.39b & c), with activity virtually restricted to the period from late autumn to mid-winter (Fig. 5.210). The occurrence of the first activity of the day was variable, but it was often before sunrise (Fig. 5.210). Activity intensities tended to be higher after sunrise (Fig. 5.210).

Discussion

Breeding in the Cape Wagtail may occur throughout the year but mainly from August to December [spring to mid-summer] outside the Western Cape (Tarboton 2001). Adults undergo a complete post-breeding moult from about November to March or April [late spring, summer and autumn] (Piper 2005; further supported by limited data from the Free State, DJvN unpublished data). At Glen, therefore, the well-defined seasonal trend with a peak after the main rain period in both the grassland (Fig. 5.209) and the drainage line (Fig. 5.210) is suggestive of post-moult dispersal. However, it is noted that the occurrence of the birds at Glen was also influenced by the status of the farm dam in the drainage line, which most frequently retained water from the latter part of the main rain period until winter or spring. Furthermore, the occurrence of the birds in the grassland was positively influenced by the presence of cattle. These factors complicate the interpretation of the data.

The relatively frequent occurrence during 2002 (Fig. 5.209) are most probably related to the excellent rains of 2001/2 (Fig. 2.13; Fig. 2.16), which filled the farm dam.

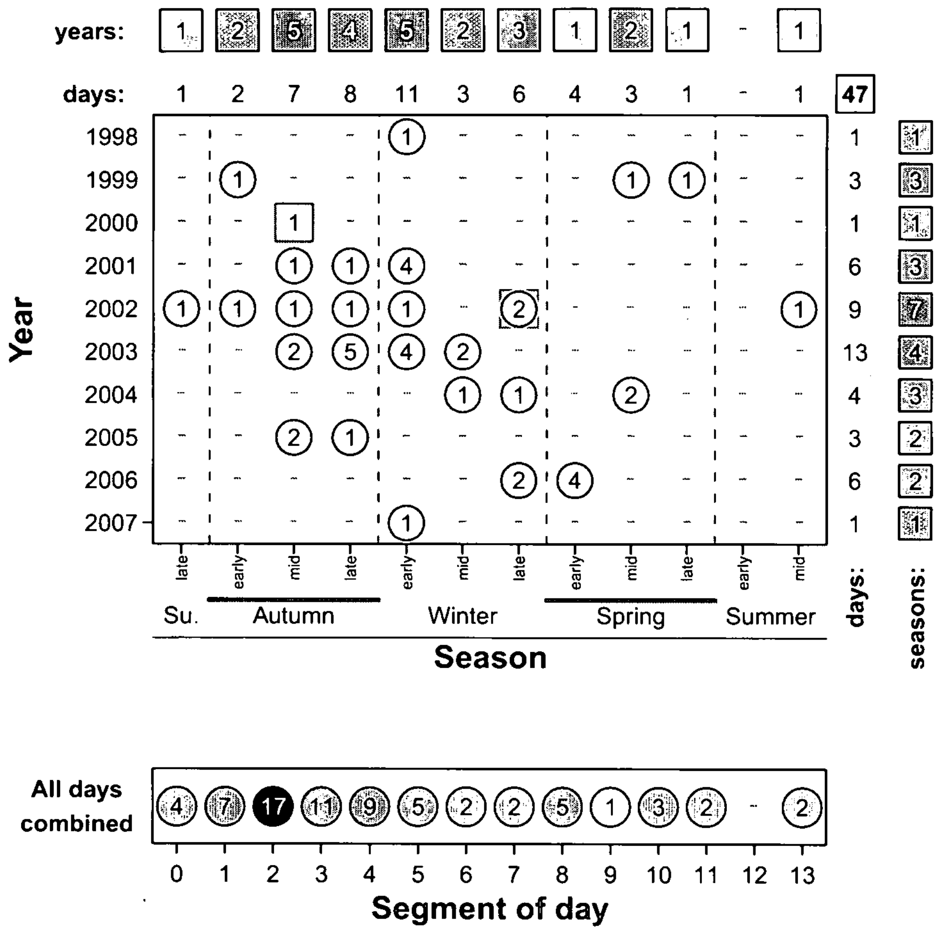


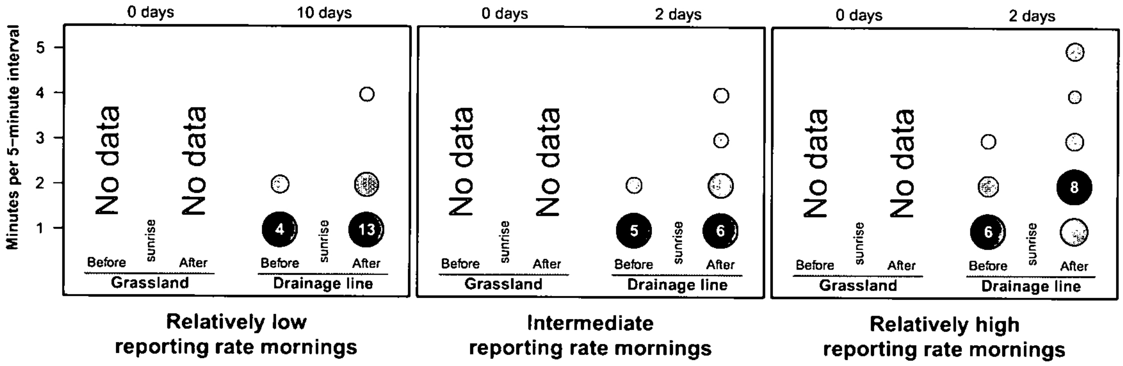
Figure 5.209: R713 Cape Wagtail — birds heard: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R716 African Pipit .... *Anthus cinnamomeus*

The African Pipit occurs from the south-western Arabian Peninsula southwards to southern Africa (Clancey 1990) where it is widespread, reaching its greatest abundance in South Africa (Clancey 1997b). It favours habitats with short grass or bare ground with limited tree cover (Clancey 1990). Both resident and migratory populations occur in southern Africa (Clancey 1997b).

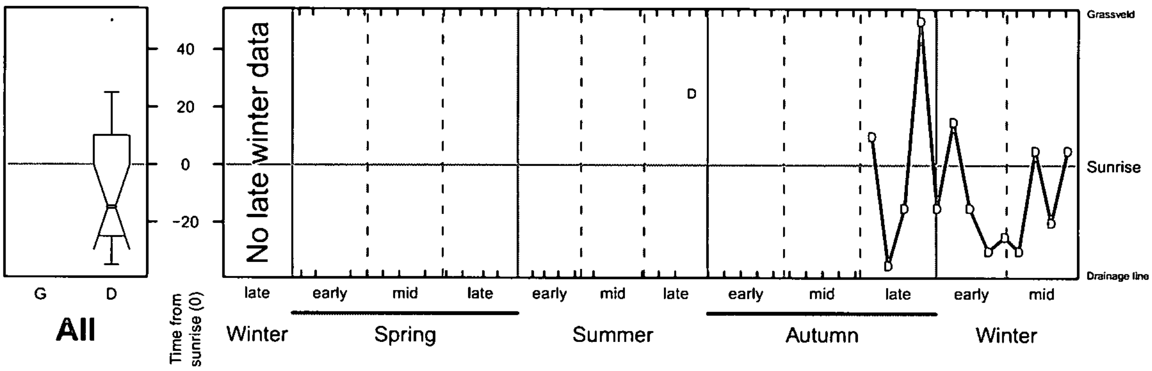
The birds at Glen

In the grassland, the African Pipit was mainly recorded in the trampled area, or else as birds in flight. They also occur at the farm dam in the drainage line were they utilise the open short grass areas. Data were collected separately for displays, other vocalisations and for birds seen only. Only data on displays are analysed in detail below, while the data on other vocalisations and birds seen only are combined to assess the overall presence of the African Pipit at Glen. Non-display vocalisations were often the result of birds being flushed and comprised the most frequently recorded activity (78.8% of five-minute checklists in the grassland), followed by displays (15.1%) and birds seen only (6.1%) (Table 5.40a). Displays were noted for each minute since 1998/9



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

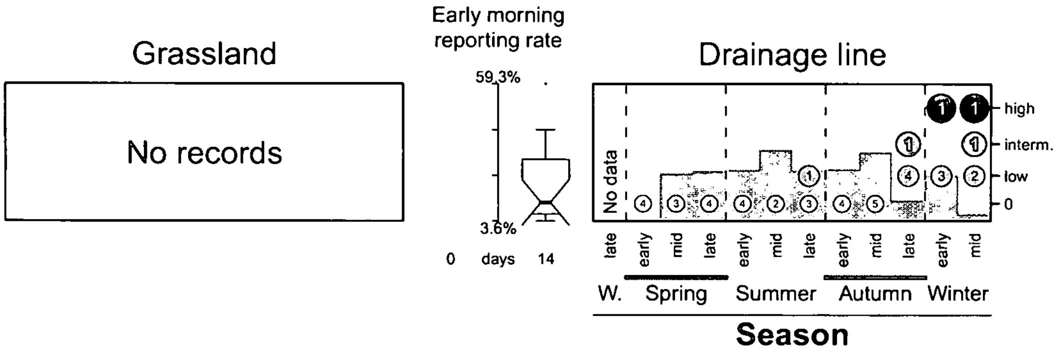


Figure 5.210: R713 Cape Wagtail — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

(Table 5.41). Figures start on page 841.

Table 5.40: R716 African Pipit: Numerical data summary of 5-minute checklists compiled in the study area at Glen. voc. = vocalisations.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.788	9 221	114 612	8.0	non-display voc.	90.5	656	594	16
0.151	1 763	114 612	1.5	displays	29.4	656	193	9
0.061	717	114 612	0.6	seen only	40.7	656	267	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
0.513	39	1 190	3.3	non-display voc.	46.5	43	20	2
0.487	37	1 190	3.1	displays	20.9	43	9	4
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.941	32	1 188	2.7	non-display voc.	51.2	43	22	1
0.059	2	1 188	0.2	seen only	4.7	43	2	1

Table 5.41: R716 African Pipit: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
displays	late winter 1998/9	1 309	480 100	0.3

Annual occurrence of displays in the grassland: Displays were recorded on 29.4% of the days with an activity index of nine (Table 5.40a). Activity was noted during six seasons in five years, but during as many as eight seasons in 1997/8 and 2002/3 and as few as four seasons in 2000/1 and 2006/7 (Fig. 5.211; Fig. 5.212). Daily reporting rates ranged from 0.5 to 56.8% with 92.2% of the bird-days attaining low reporting rates; the upper quartile of daily reporting rates were higher during 1997/8 than during other years (Fig. 5.211). That year together with 2005/6 were the only years with high reporting rate days (Fig. 5.211; Fig. 5.212). High activity intensities were more frequent during 1998/9 and 2003/4 than during other years (Fig. 5.211).

Seasonal occurrence of displays in the grassland: Activity occurred during all seasons except mid- and late winter, and was most frequent from mid-spring to late summer when it was recorded during 9–11 years compared to the 0–6 years of other seasons (Fig. 5.211; Fig. 5.212). The occurrence of days with zero records were least frequent during late spring and summer (Fig. 5.212), and the daily reporting rates during autumn and early winter were minimal (Fig. 5.211). High activity intensities were limited to summer when it occurred infrequently (Fig. 5.211).

Daily occurrence of displays in the grassland: Overall, activity occurred during a comparable frequency in segments between sunrise and sunset, and was relatively infrequent before sunrise and, especially, after sunset (Fig. 5.211). The pattern varied seasonally (Fig. 5.213). Only one bird-segment combination occurred during more than 5% bird-days, namely activity during S12 alone; this was particularly frequent in mid-spring (Fig. 5.214).

The overall timing of the first activity of the day was variable, but seasonally it tended to occur earlier during summer than during other seasons (Fig. 5.213). The timing of the last activity of the day was also variable and did not show a prominent seasonal pattern (Fig. 5.213).

The occurrence of high activity intensities was particularly frequent before sunrise (Fig. 5.211). Daily segment reporting rates ranged from 5.6 to 100% with 85.6% of the values relatively low (Fig. 5.211). The upper quartile of daily segment reporting rates were higher in the mornings than in the afternoon (Fig. 5.211).

Early morning occurrence of displays during 2007/8: Displays were heard in the drainage line only (Table 5.40b & c) where it was recorded from mid-spring to early autumn (Fig. 5.215).

All activities combined: The African Pipit was noted during all seasons in all years (Fig. 5.216).

Discussion

Breeding in the African Pipit occurs mainly from October to January [mid-spring to late summer] in the former Transvaal (Tarboton *et al.* 1987) and KwaZulu-Natal (Dean 1971). This period matches the frequent occurrence of display activity at Glen (Fig. 5.211).

In his review on moult data for the African Pipit, Voelker (2005a) found data for only seven South African birds. Data collected during the present study on 48 birds, mostly from Glen and from another farm approximately 60 km to the west, indicates that adults undergo a complete post-breeding moult from late summer to early winter. This appears to be similar to the situation in Zimbabwe (see Paterson 1959). Display activity became progressively less frequent during this period and was never recorded during mid- or late winter (Fig. 5.211). Displays resumed during spring, often with the first rain of the year or soon thereafter (Fig. 5.212).

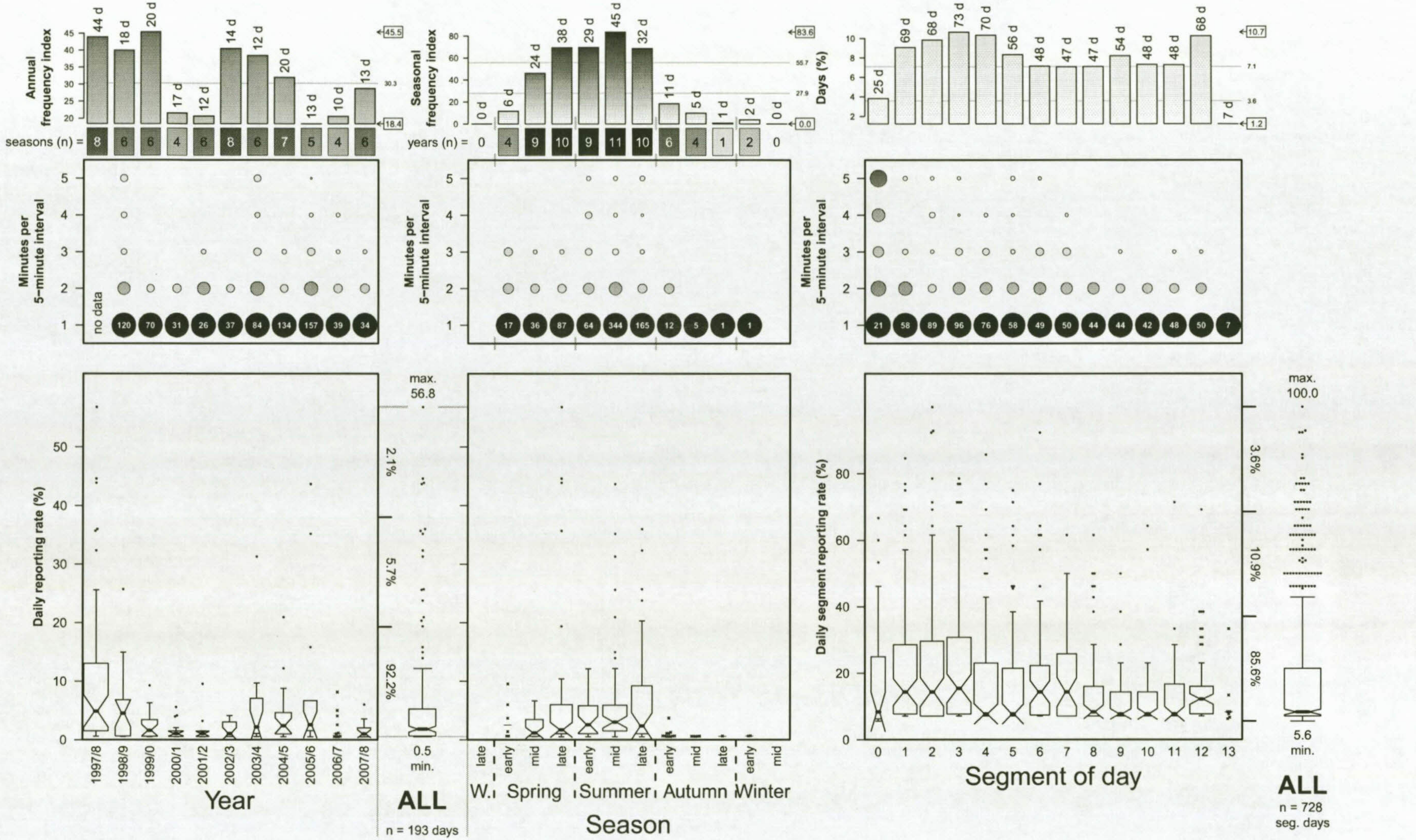


Figure 5.211: R716 African Pipit — displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

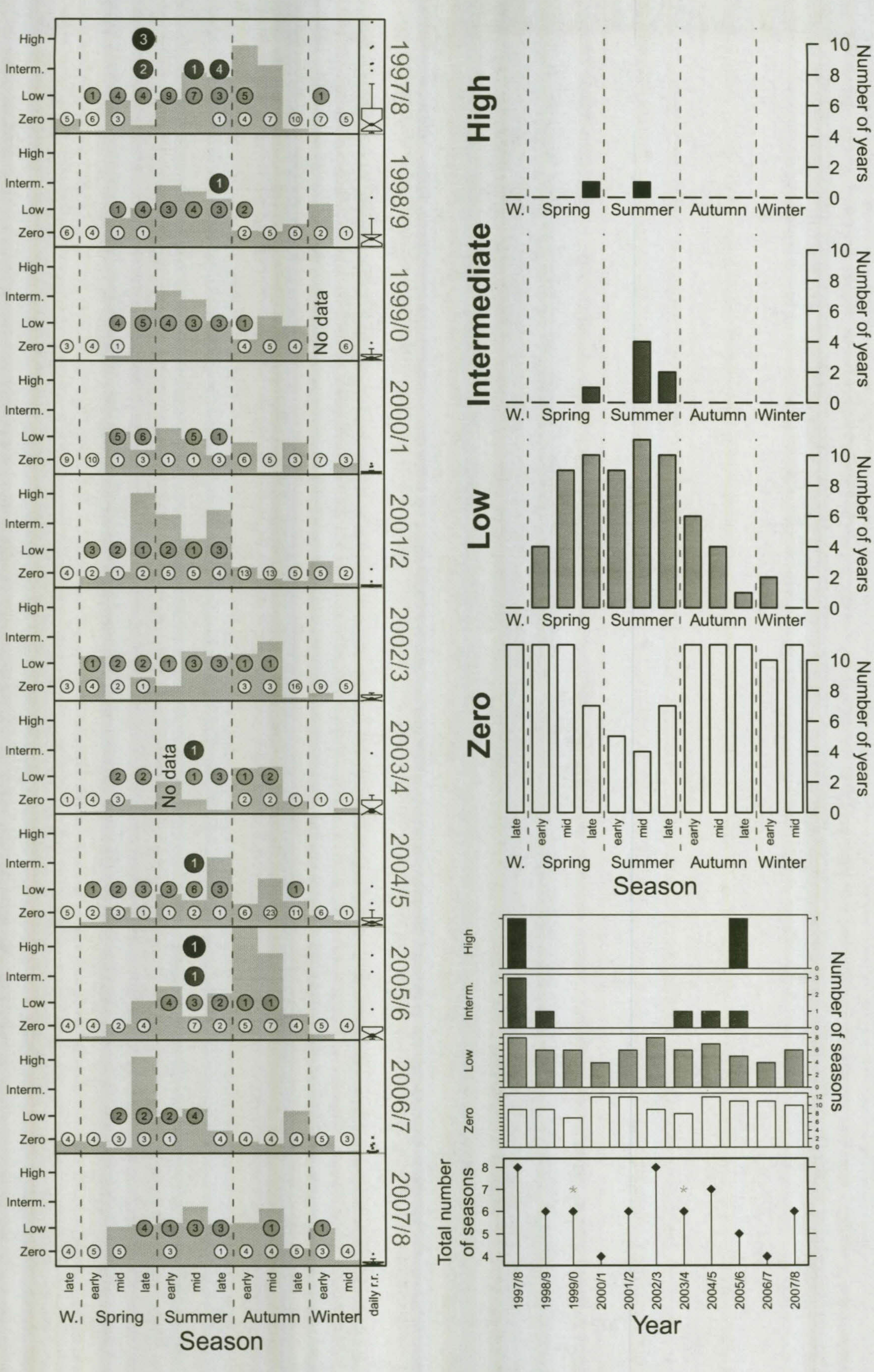


Figure 5.212: R716 African Pipit — displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

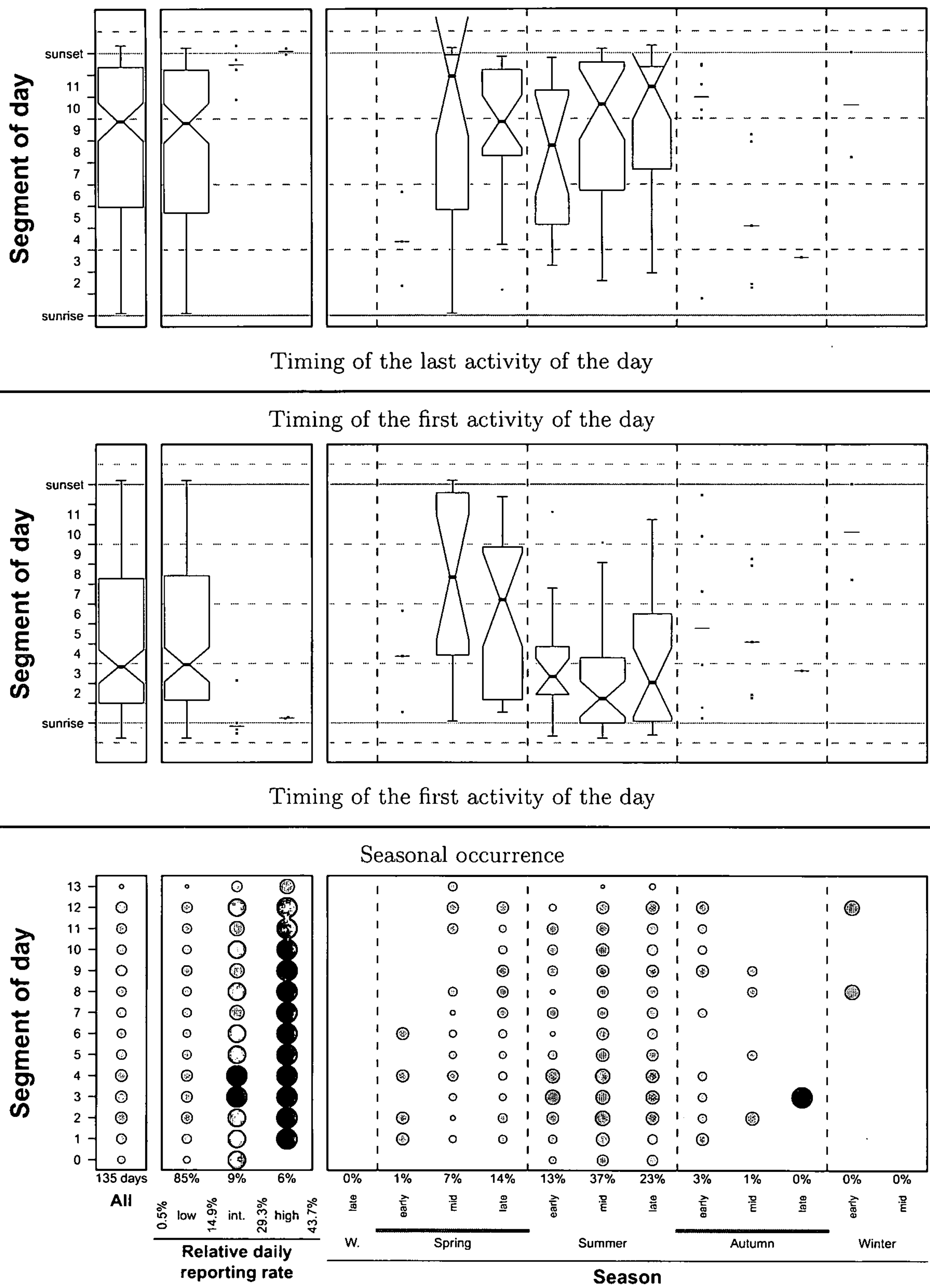


Figure 5.213: R716 African Pipit — displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

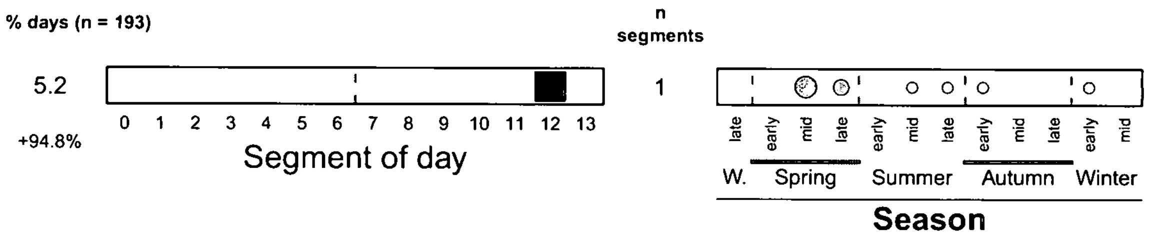


Figure 5.214: R716 African Pipit — displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

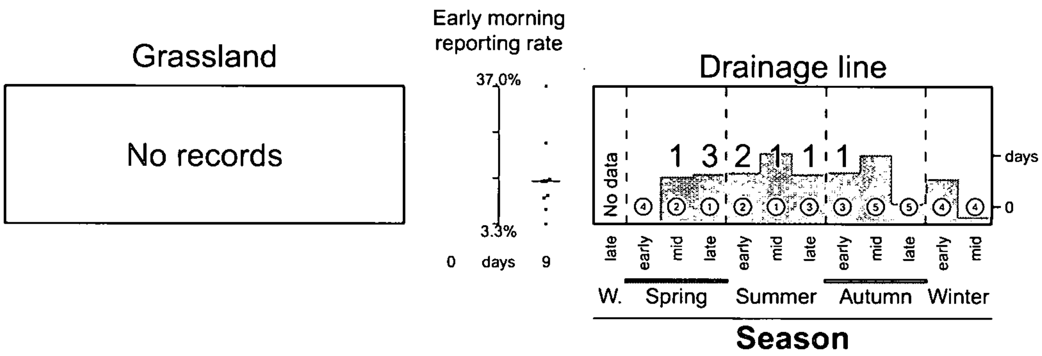


Figure 5.215: R716 African Pipit — displays: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. The seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates are illustrated. See page 136 for more information on this early morning figure.

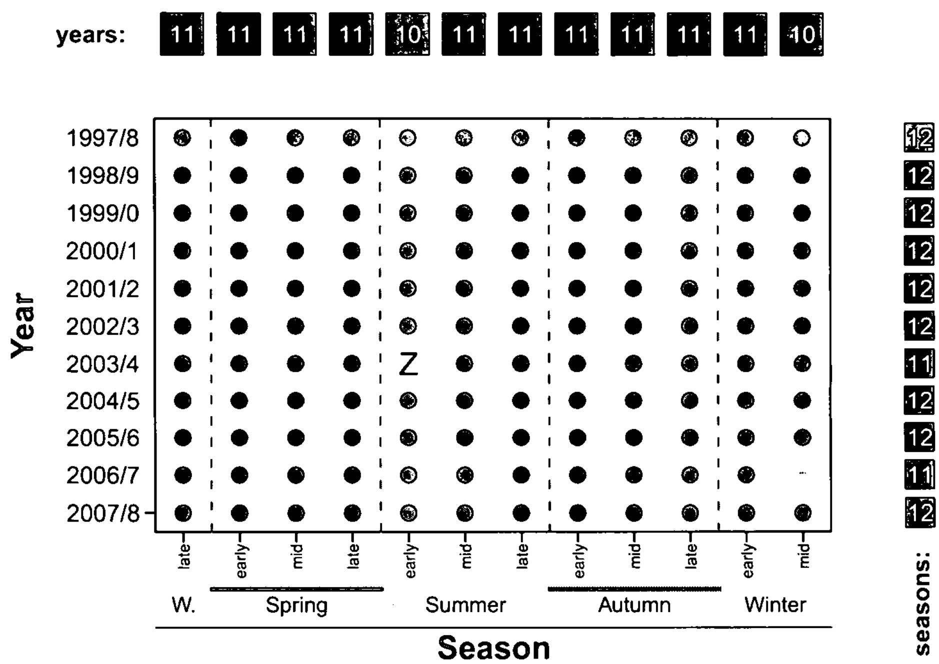


Figure 5.216: R716 African Pipit: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

R717 Long-billed Pipit .... *Anthus similis*

> **A note on identification problems:** It is difficult to identify the large pipits under field conditions and all species are frequently misidentified (Clancey & Herremans 1997; Peacock 2006). The Long-billed Pipit, Plain-backed Pipit R718 and Buffy Pipit R719 have been positively identified at Glen when circumstances allowed; however, positive identification was often not possible. As a result, it was decided to lump all the data, which is analysed under the heading **Large pipits at Glen** on page 846.

The Long-billed Pipit is found in Africa, the Arabian Peninsula, and from the Middle East east to India and Burma (Clancey 1990). In southern Africa, it is widespread in South Africa, Lesotho and Swaziland, and thinly distributed in the western parts of Namibia (Clancey 1997c). Note, however, that due to the aforementioned identification difficulties,

> "In the present [SABAP1] map, all putative Kalahari records have been deleted, and all records from the northern, broadleaved woodlands have been attributed to the Wood Pipit.... The remaining records fall within the known range of the Longbilled Pipit and overlap with its typical habitat of rocky slopes, but not all records could be confirmed." (Clancey 1997c).

The Long-billed Pipit inhabits sparsely vegetated rocky slopes with suitable perches, as well as well-grazed and burnt veld, and it is sedentary (Clancey 1990).

R718 Plain-backed Pipit .... *Anthus leucophrys*

See note on identification problems on page 845.

The Plain-backed Pipit is endemic to sub-Saharan Africa (Clancey 1990). In southern Africa it occurs in northern Namibia, northern and south-eastern Botswana and in the eastern half and southern parts of South Africa (Clancey & Herremans 1997). But note:

> "Scattered records from the Kalahari were deleted [from the SABAP1 data] as unsubstantiated and the distribution map illustrates primarily the known breeding ranges. Records beyond this range are likely ... but are in need of further confirmation, preferably on the basis of combined vocal and specimen evidence." (Clancey & Herremans 1997).

This, of course, is due to the identification problems highlighted on the current page. The Plain-backed Pipit is found in short grassland, especially where it was overgrazed or burnt, usually with termite mounds or rocks (Maclean 1985). Resident at some sites and migratory at others, but nothing is known about its status in the Free State (Clancey & Herremans 1997).

See note on identification problems on page 845.

The Buffy Pipit is endemic to sub-Saharan Africa (Pearson 1992a; see also Peacock 2006). Widespread in southern Africa where notably absent from the west (Clancey 1997d). Also absent from southern Mozambique (Parker 1999). Prefer bare ground and sparse grassland such as those caused by overgrazing, usually with low perches like termite mounds (Maclean 1985). The sub-species occurring in the Free State (*A. v. vaalensis* (*daviesi*)) is said to be sedentary (Clancey 1990), but post-breeding dispersal towards the east has been recorded (Clancey 1997d).

Large pipits at Glen

See note on identification problems on page 845.

The data-set consists mainly of vocal records; recorded exclusively from the grassland (Table 5.42a). Only displays are analysed in detail below with the rest of the data used to assess the overall occurrence of the birds at Glen. Data was collected separately for each minute since 2003/4 (Table 5.43). Figures start on page 848.

Table 5.42: R717/8/9 Large pipits: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.656	1 196	114 612	1.0	birds heard	51.4	656	337	4
0.344	626	114 612	0.5	all displays	23.2	656	152	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Table 5.43: R717/8/9 Large pipits: Numerical data summary of 1-minute checklists compiled in the study area at Glen.

Activity	Recorded since...	n	Total	%
all displays	late winter 2003/4	531	233 075	0.2

Annual occurrence of displays in the grassland: Displays were recorded on 23.2% of the days with an activity index of four (Table 5.42a). Activity was noted during 3–8 seasons each year, most frequently in 1997/8, 2002/3, 2004/5 and 2005/6, and least frequently in 1998/9, 2000/1, 2001/2 and 2003/4 (Fig. 5.217; Fig. 5.218). Activity intensities were comparable between the years for which it was measured (Fig. 5.217). Daily reporting rates ranged from 0.5 to 14.0% with 88.2% of the bird-days attaining low reporting rates; the median daily reporting rate of 2005/6 was slightly higher than that of other years (Fig. 5.217).

Seasonal occurrence of displays in the grassland: Activity was recorded during all seasons, except mid-winter, and was most frequent from late spring to mid-summer (Fig. 5.217; Fig. 5.218). The occurrence of days with zero records was least frequent during early and mid-summer (Fig. 5.218). Daily reporting rates were minimal during autumn and winter (Fig. 5.217). Activity intensities were comparable between the main bird-seasons (Fig. 5.217).

Daily occurrence of displays in the grassland: Overall, activity was most frequent in the early morning after sunrise with a secondary peak in the late afternoon before sunset (Fig. 5.217). This general pattern was similar for low and intermediate reporting rate days (Fig. 5.219) and for the main bird-seasons (Fig. 5.220). The three bird-segment combinations occurring during more than 5% bird-days were limited to combinations involving S1 and S2, collectively accounting for 20.4% of all bird-days and occurring mainly during spring and summer (Fig. 5.221).

The first activity of the day often occurred in the morning around sunrise on intermediate and high reporting rate days; there were no major differences between the respective seasons (Fig. 5.220). The timing of the last activity of the day was variable, both inter- and intra-seasonally (Fig. 5.220).

Activity intensities greater than one minute per five minute interval were largely limited to the early morning and late afternoon (Fig. 5.217; Fig. 5.219).

Overall, daily segment reporting rates ranged from 5.6 to 61.5% with 88.5% of the values relatively low (Fig. 5.211). The upper quartile of daily segment reporting rates were higher during S1 than during other segments (Fig. 5.217). A similar trend is seen for low and intermediate reporting rate days (Fig. 5.219).

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All activities combined: The birds were noted during all or most seasons each years, being relatively infrequent during 2003/4 and 2006/7 and during late summer and early autumn (Fig. 5.222).

Discussion

Displays show a remarkably well-defined seasonal pattern centred on the first part of the main rain period at Glen (Fig. 5.217). The abrupt end of the display period in late summer (Fig 5.217; Fig. 5.218) is likely influenced by a post-breeding moult. The Long-billed, Plain-backed as well as the Buffy Pipit all have a complete post-breeding moult (Voelker 2005b,c,d).

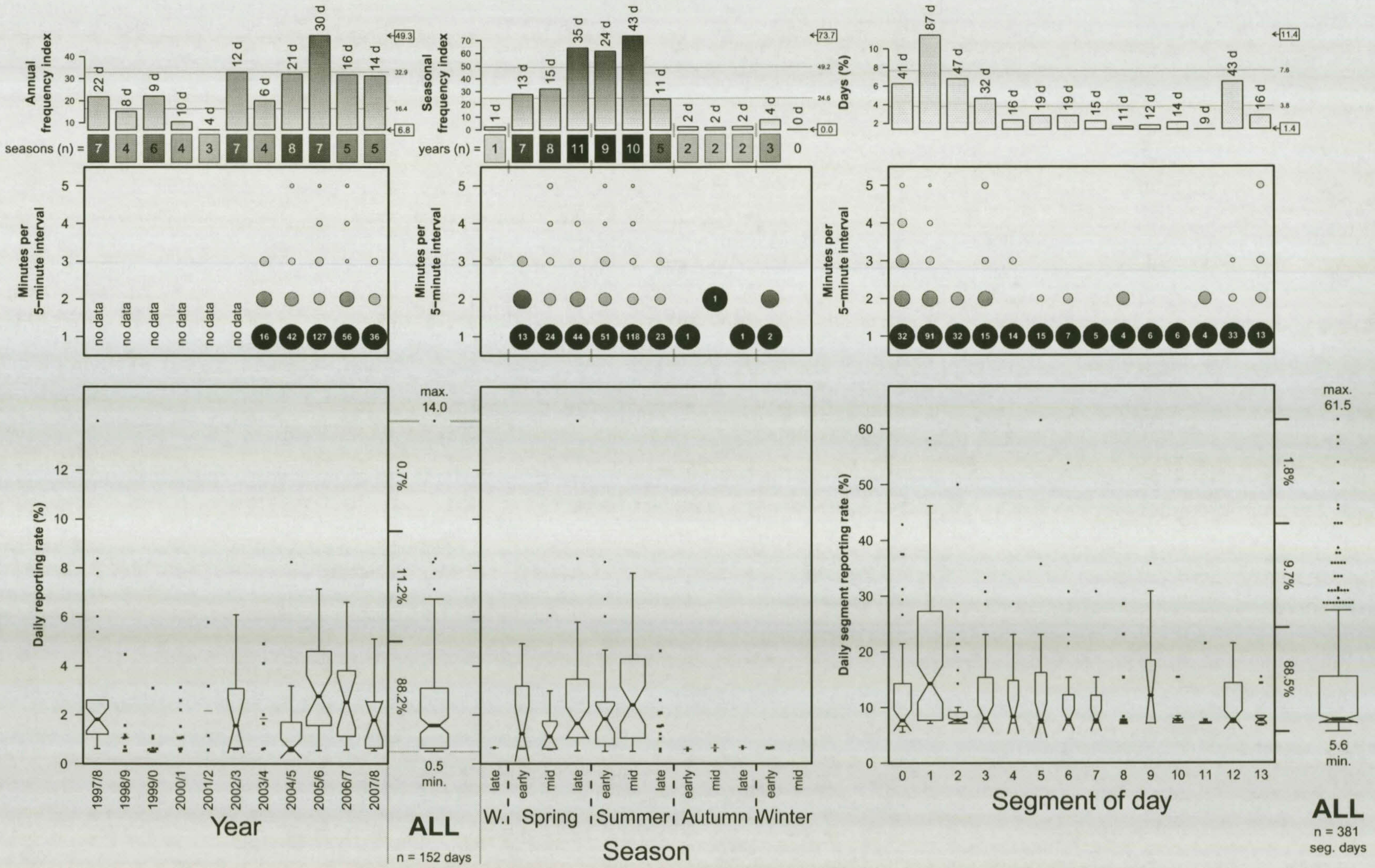

Figure 5.217: R717/8/9 Large pipits — all displays: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

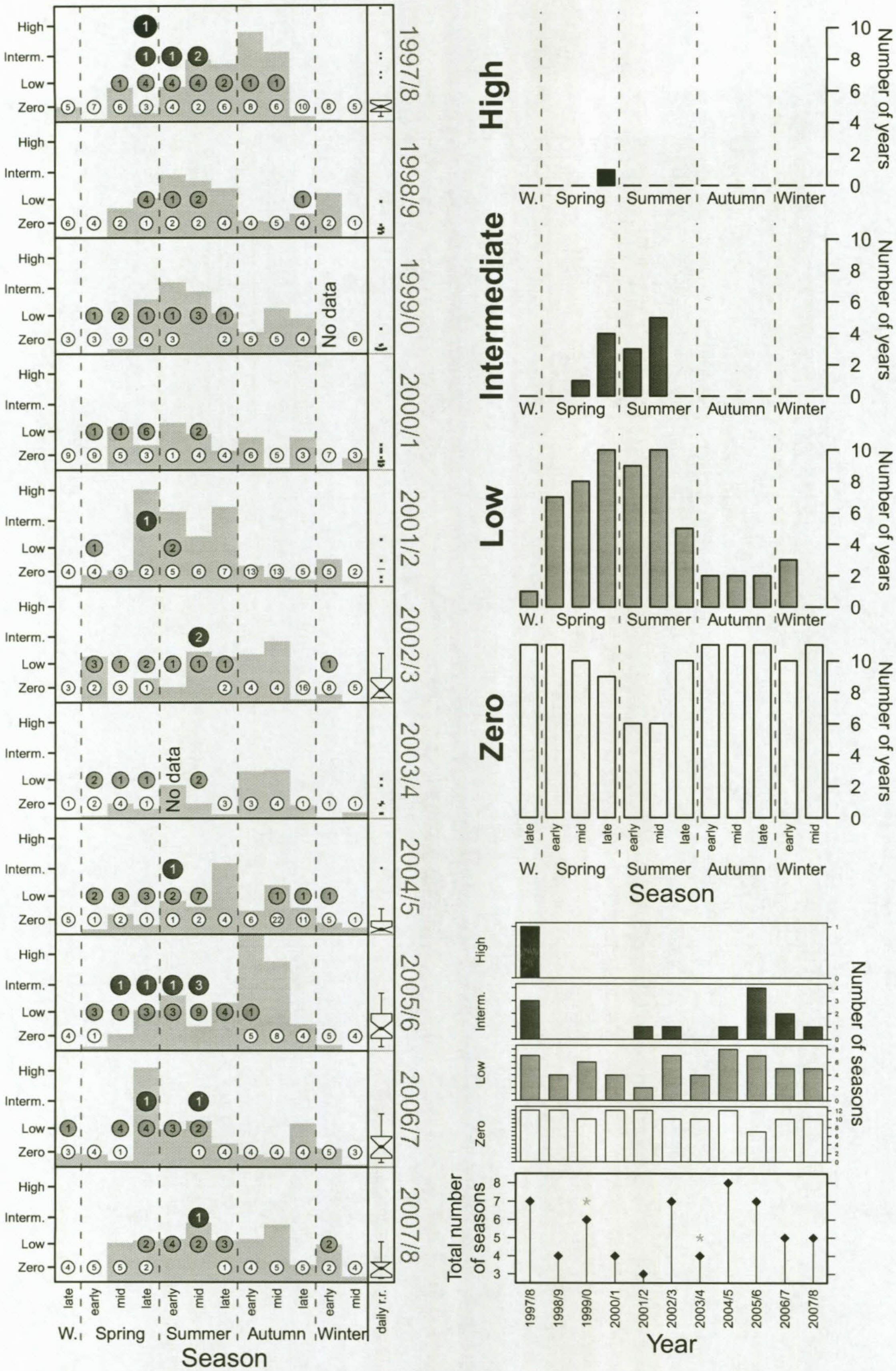

Figure 5.218: R717/8/9 Large pipits — all displays: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

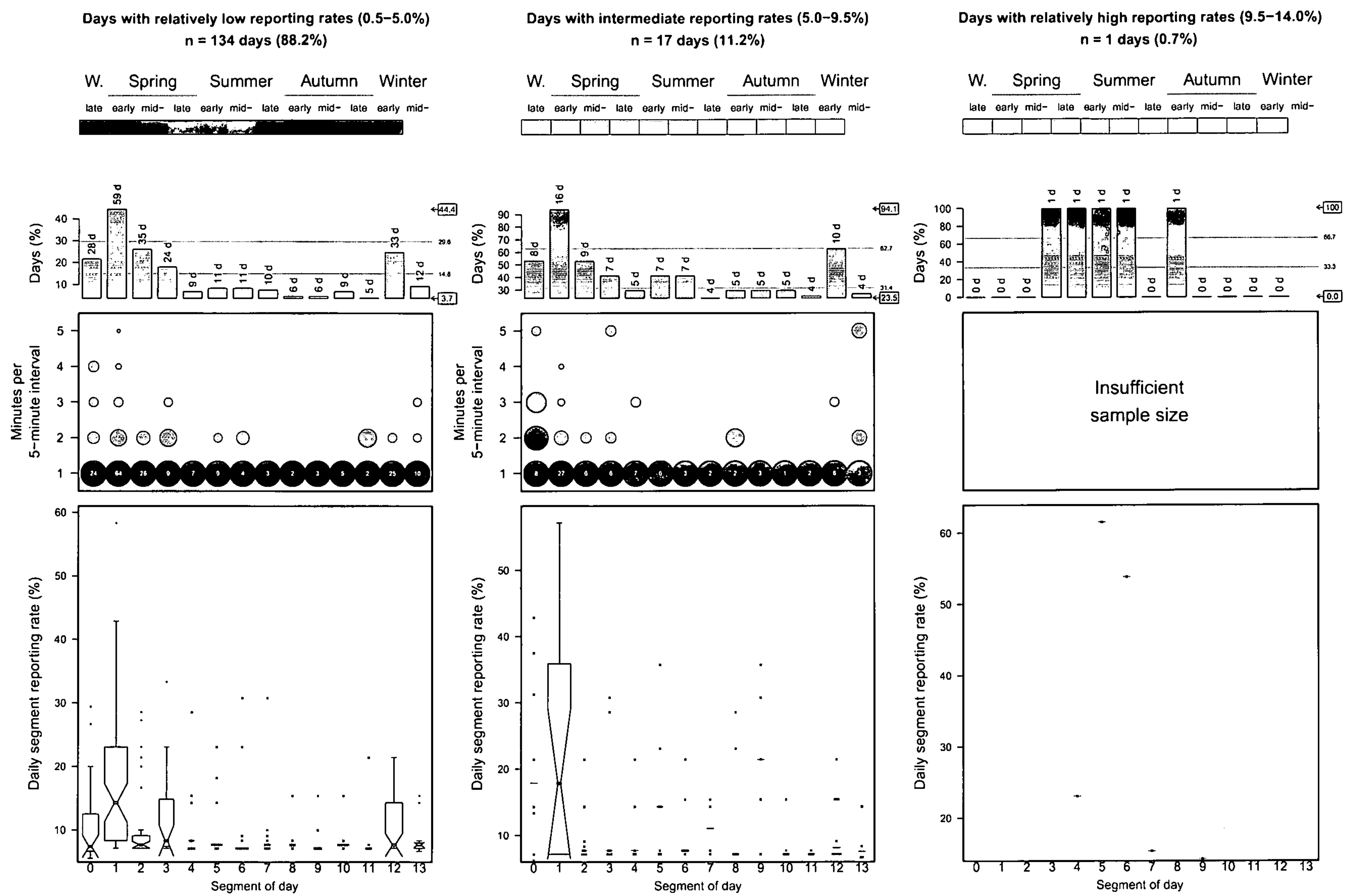

Figure 5.219: R717/8/9 Large pipits — all displays: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LJH figure.

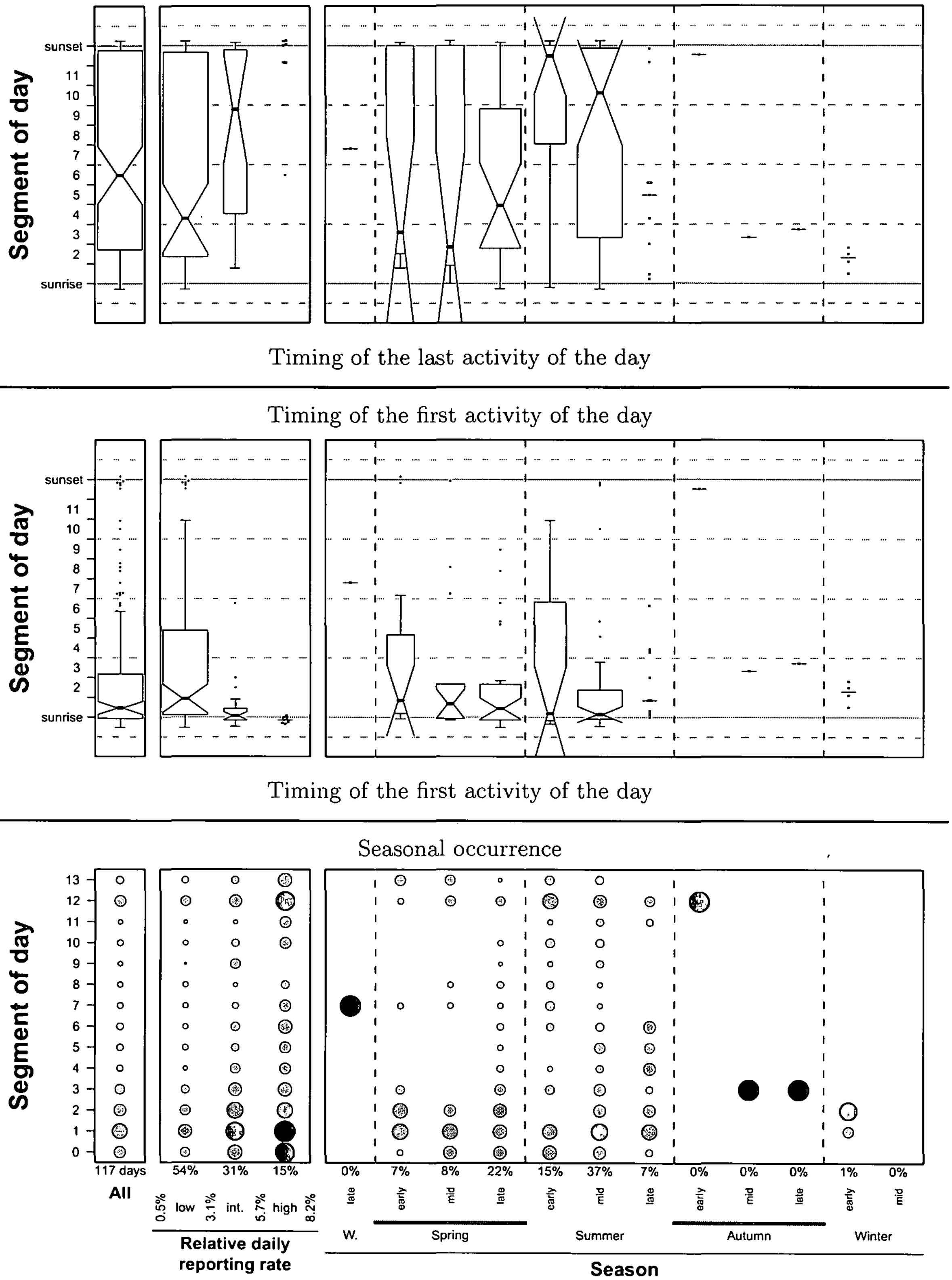

Figure 5.220: R717/8/9 Large pipits — all displays: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

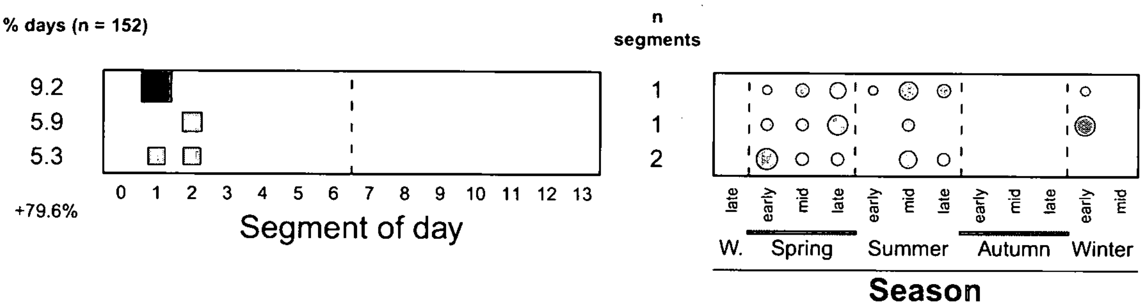

Figure 5.221: R717/8/9 Large pipits — all displays: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

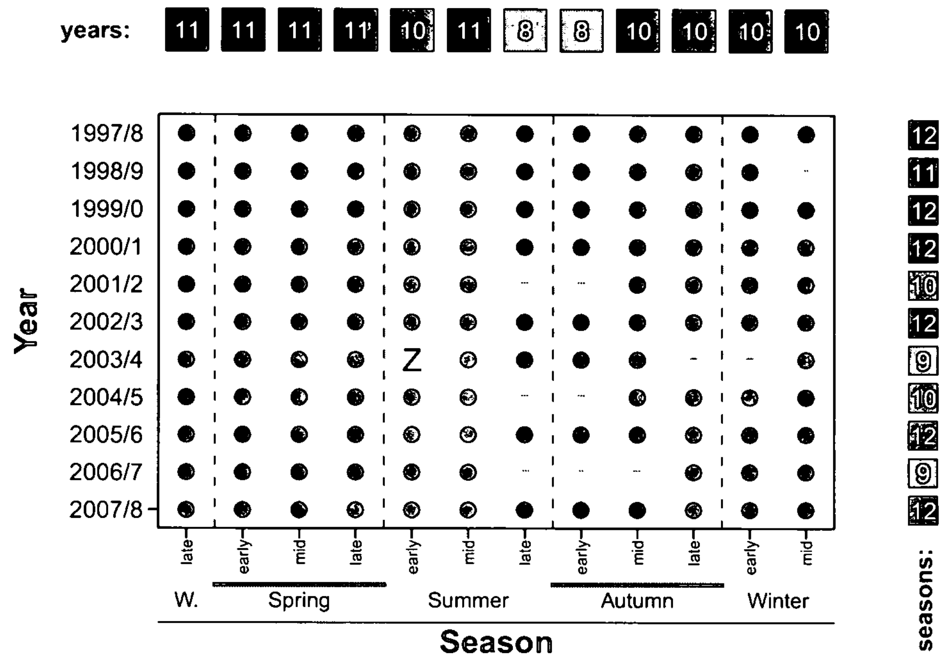

Figure 5.222: R717/8/9 Large pipits: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

R727 Cape Longclaw .... *Macronyx capensis*

The Cape Longclaw is endemic to southern Africa with its distribution restricted to the coastal areas in the south, the eastern half of South Africa from the Free State eastwards (including Lesotho and Swaziland) as well as extreme southern Mozambique, with an isolated population in the central plateau and eastern highlands of Zimbabwe too (Day 1997; Parker 1999). It prefers moist or other short dense grassland and is a resident species (Day 1997; Earlé & Grobler 1987).

The birds at Glen

There was at least one resident pair present in the grassland throughout the study. Distinction was made between the cat-like *meew* call (and associated calls) and the *tsweet* call since 1999/0.

In the analysis to follow, all calls in 1997/8 and 1998/9 are included under *meew* calls. It was also noted when birds were seen only, but this part of the data-set is not analysed in detail, but is used in the combined analysis of the data which assess the overall occurrence of the birds at Glen. A summery of the data is presented in Table 5.44. Figures start on page 856.

Table 5.44: R727 Cape Longclaw: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.819	4 329	114 612	3.8	*meew* calls	88.6	656	581	7
0.143	755	114 612	0.7	*tsweet* calls	22.9	656	150	5
0.038	203	114 612	0.2	seen only	14.6	656	96	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	2	1 190	0.2	*meew* calls	4.7	43	2	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.641	98	1 188	8.2	*meew* calls	76.7	43	33	3
0.346	53	1 188	4.5	*tsweet* calls	27.9	43	12	4
0.013	2	1 188	0.2	seen only	4.7	43	2	1

Annual occurrence of* meew *calls in the grassland: Recorded on 88.6% of the days with an activity index of seven (Table 5.44a). Activity occurred during almost all seasons of every year (Fig. 5.223; Fig. 5.224). Daily reporting rates ranged from 0.5 to 26.7% with 90.0% of the bird-days attaining low reporting rates (Fig. 5.223). Median daily reporting rates were similar for all years with a few high reporting rate days occurring during 2001/2 and 2005/6 only (Fig. 5.223; Fig. 5.224).

Seasonal occurrence of* meew *calls in the grassland: Recorded during all years in each season, except in early winter when recorded during nine years (Fig. 5.223; Fig. 5.224). The upper quartile range of daily reporting rates were higher from mid-autumn to late winter than during spring, summer and early autumn (Fig. 5.223), coinciding with the relatively frequent occurrence of intermediate reporting rate days during the former period (Fig. 5.224). The median daily reporting rate of early winter were higher than that of spring and summer (Fig. 5.223).

Daily occurrence of* meew *calls in the grassland: Overall, activity was most frequent during the early morning after sunrise with a secondary peak in occurrence in the late afternoon before sunset (Fig. 5.223). This general pattern was similar for low and intermediate reporting rate days (Fig. 5.225) and for most seasons (Fig. 5.226). No bird-segment combinations occurred during more than 5% bird-days.

The first activity of the day usually occurred during the early morning and was reasonably constant seasonally, but did tend to be earlier in mid-winter, particularly when compared to early summer (Fig. 5.226; Fig. 5.227). The dawn chorus sequence followed a similar trend

(Fig. 5.227). The timing of the last activity of the day was more variable, especially for low reporting rate days; on intermediate reporting rate days, it tended to end shortly before sunset (Fig. 5.226; Fig. 5.227).

Overall, daily segment reporting rates ranged from 5.3 to 100% with 95.0% of the values relatively low (Fig. 5.223). The median daily segment reporting rates of S1–S2 were relatively high and that of S0 relatively low (Fig. 5.223).

Early morning occurrence of *meew* ***calls during 2007/8:*** Heard during only two mornings (4.7%) in the drainage line compared to 33 mornings (76.7%) in the grassland (Table 5.44b & c).

Annual occurrence of *tsweet* ***calls in the grassland:*** Recorded on 22.9% of the days with an activity index of five (Table 5.44a). Heard during 4–6 seasons in five years and during 8–9 seasons in 2000/1, 2001/2, 2005/6 and 2006/7 (Fig. 5.228; Fig. 5.229). Daily reporting rates ranged from 0.5 to 16.9% with 86.7% of the bird-days attaining low reporting rates; Median daily reporting rates were particularly high in 2002/3 and 2007/8 (Fig. 5.228).

Seasonal occurrence of *tsweet* ***calls in the grassland:*** Recorded during all seasons, in 7–9 bird-years from mid- to late spring and from mid-summer to early autumn, and during 1–5 bird-years in other seasons (Fig. 5.228). The bimodal nature of the peaks is also seen in the daily reporting rates (Fig. 5.228; note upper quartile of late spring and late summer) and in the occurrence of low reporting rate days (Fig. 5.229). Zero record days were least frequent during mid-summer (Fig. 5.229).

Daily occurrence of *tsweet* ***calls in the grassland:*** Overall, activity was most frequent during the early morning around sunrise with a secondary peak in the late afternoon before sunset; Activity after sunset was exceptional (Fig. 5.228). This general pattern was most applicable for low reporting rate days, because for intermediate reporting rate days the peaks were less pronounced (Fig. 5.230). Most of the main bird-seasons showed peaks in the early morning and in the late afternoon (Fig. 5.231). Five bird-segment combinations involving S1–S2 and S12 occurred during more than 5% bird-days, collectively accounting for 40% of all bird-days (Fig. 5.232).

The first activity of the day usually occurred during the morning, earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.231). In spite of high variability the median values for the respective seasons were similar (Fig. 5.231). The timing of the last activity of the day was highly variable (Fig. 5.231).

Overall, daily segment reporting rates ranged from 5.6 to 78.6% with 90.2% of the values relatively low; Median daily segment reporting rates were similar for all segments (Fig. 5.228; Fig. 5.230).

Early morning occurrence of** tsweet **calls during 2007/8: In spite of activity being noted on 27.9% of the mornings in the grassland, it was not recorded in the drainage line (Table 5.44b & c).

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All activities combined: Except for early winter 2003/4, the Cape Longclaw was recorded during all seasons in all years (Fig. 5.233).

Discussion

According to Tarboton (2001), Cape Longclaws in the summer-rainfall areas lay eggs mainly from October to January [mid-spring to late summer]. Limited data suggest a complete post-breeding moult from about autumn. The only published data on the moult of the Cape Longclaw (see Chittenden 2005d) appears to be that of Liversidge (1968) who found one "bird in moult" during mid-May [early winter] in Port Elizabeth. Of three birds ringed in the Free State, no wing moult was noted in one ringed in late winter and another in late summer, but a bird ringed in mid-autumn was nearly halfway through its primary moult and otherwise in heavy body moult (DJvN unpublished data).

At Glen, the first occurrence of *tsweet* calls was closely associated with the first significant rains each year, except in 2000/1 when it was recorded in late winter before the rains started in mid-spring (and when activity was again recorded) and in 2003/4 when it occurred only in mid-summer (no data for early summer) after the first rains in mid-spring (Fig. 5.229). During the years prior to 2004/5 no *tsweet* calls occurred during early summer, causing a bimodal pattern in the data (Fig. 5.228; Fig. 5.229). It is not clear why this was not the case in the years since 2004/5. Overall, the data indicate that these calls are associated with the breeding season and that it subsides during moulting, becoming prominent again only during the next rain season.

On the other hand, *meew* calls, which occurred throughout the year, attained slightly higher daily reporting rates from mid-autumn to late winter (Fig. 5.223; Fig. 5.224). This probably overlaps with and/or follows on moult.

5.14 Laniidae: Typical Shrikes

Shrikes have a widespread distribution with the 31 species occurring in the Holarctic, Africa and from southern Asia to New Guinea; six species are found in southern Africa (Hockey *et al.* 2005). Four species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b), with all except the Magpie Shrike *Corvinella melanoleuca*, which does not normally occur in the central parts of the province, recorded at Glen.

R731 Lesser Grey Shrike .... *Lanius minor*

The Lesser Grey Shrike breeds in the Palearctic with virtually the entire population spending the non-breeding season in southern Africa (Dowsett 1971). In southern Africa it occurs mainly in Namibia, Botswana, Zimbabwe and South Africa where the Free State is at the southern

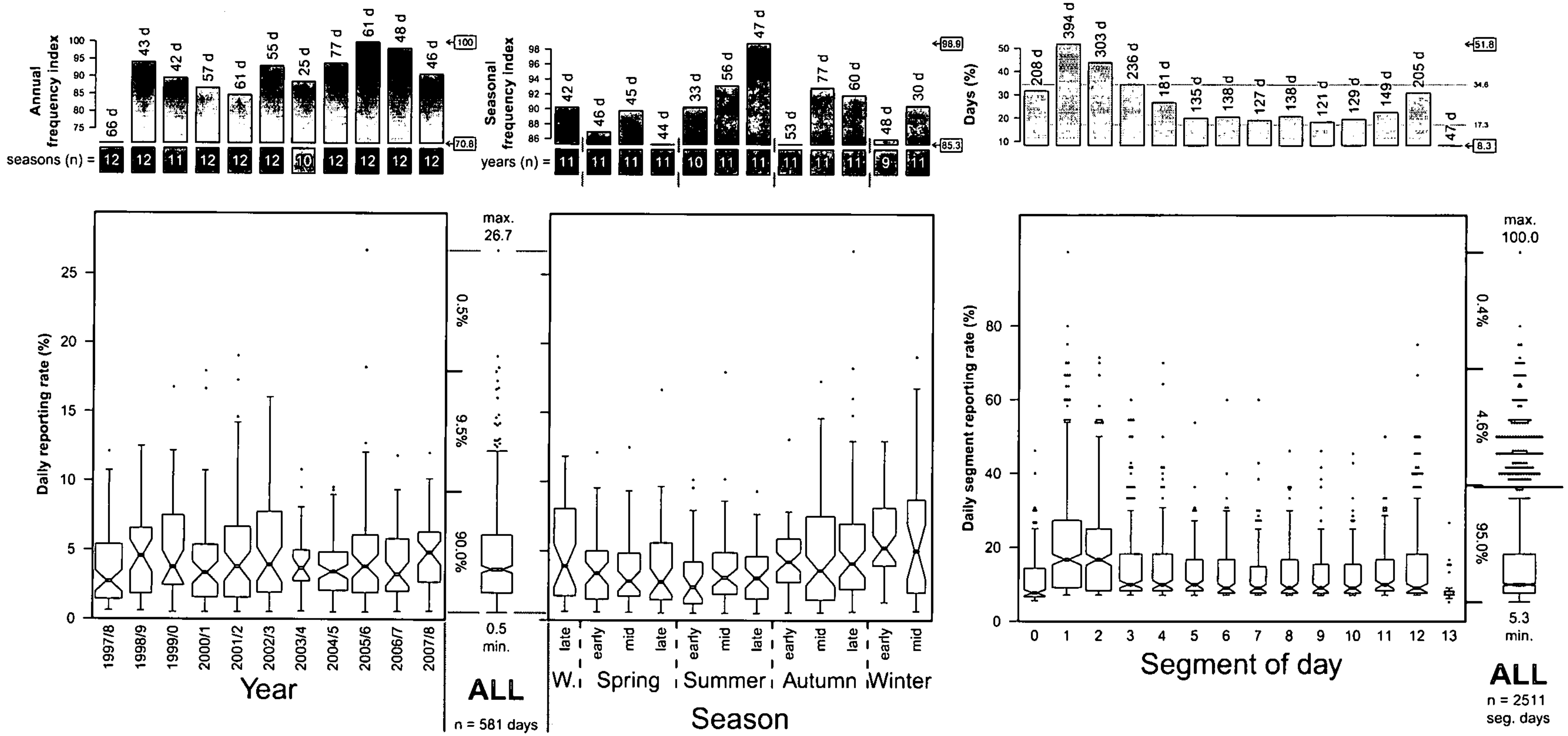


Figure 5.223: R727 Cape Longclaw — *meew* calls: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

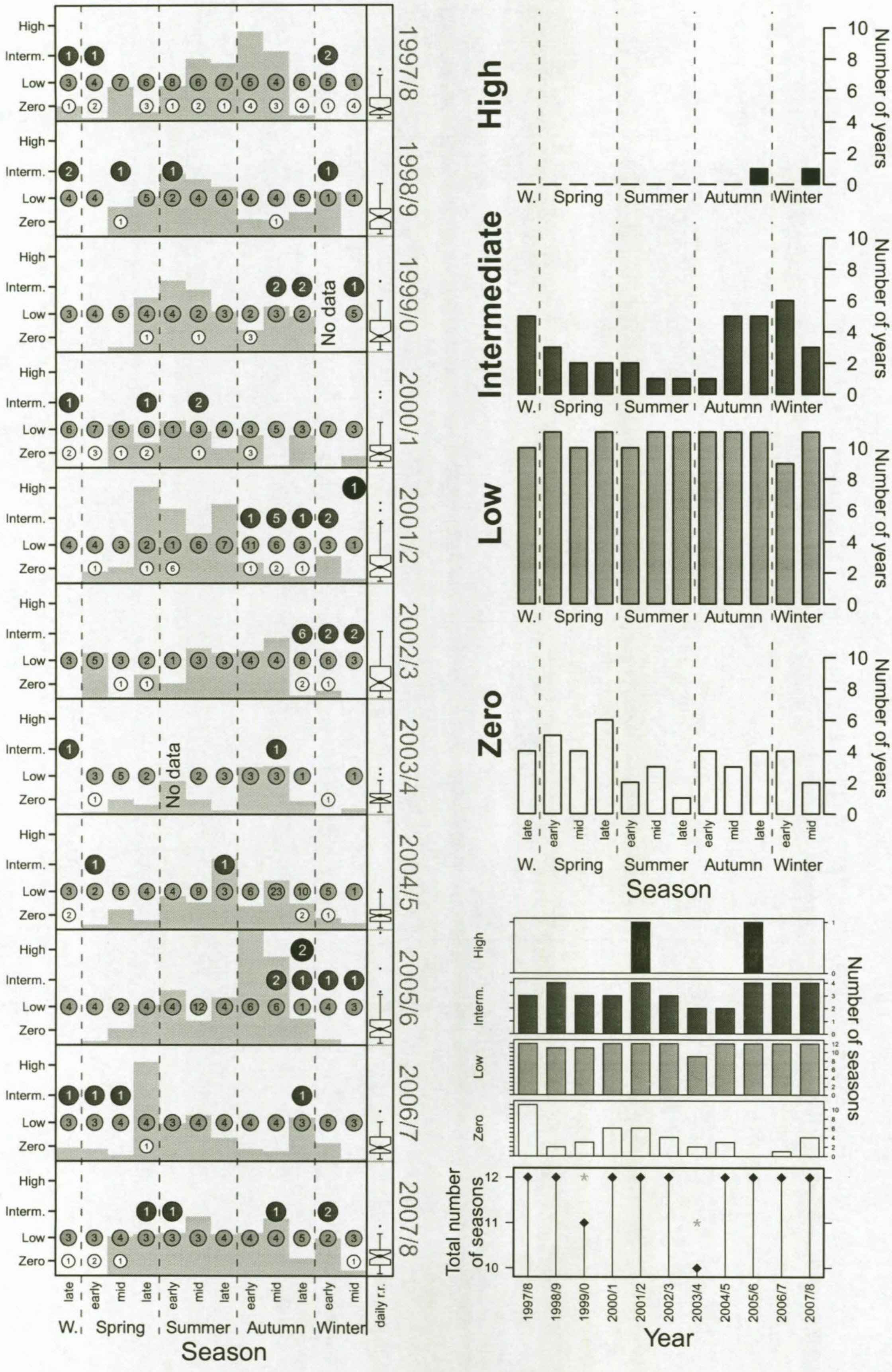


Figure 5.224: R727 Cape Longclaw — *meew* calls: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

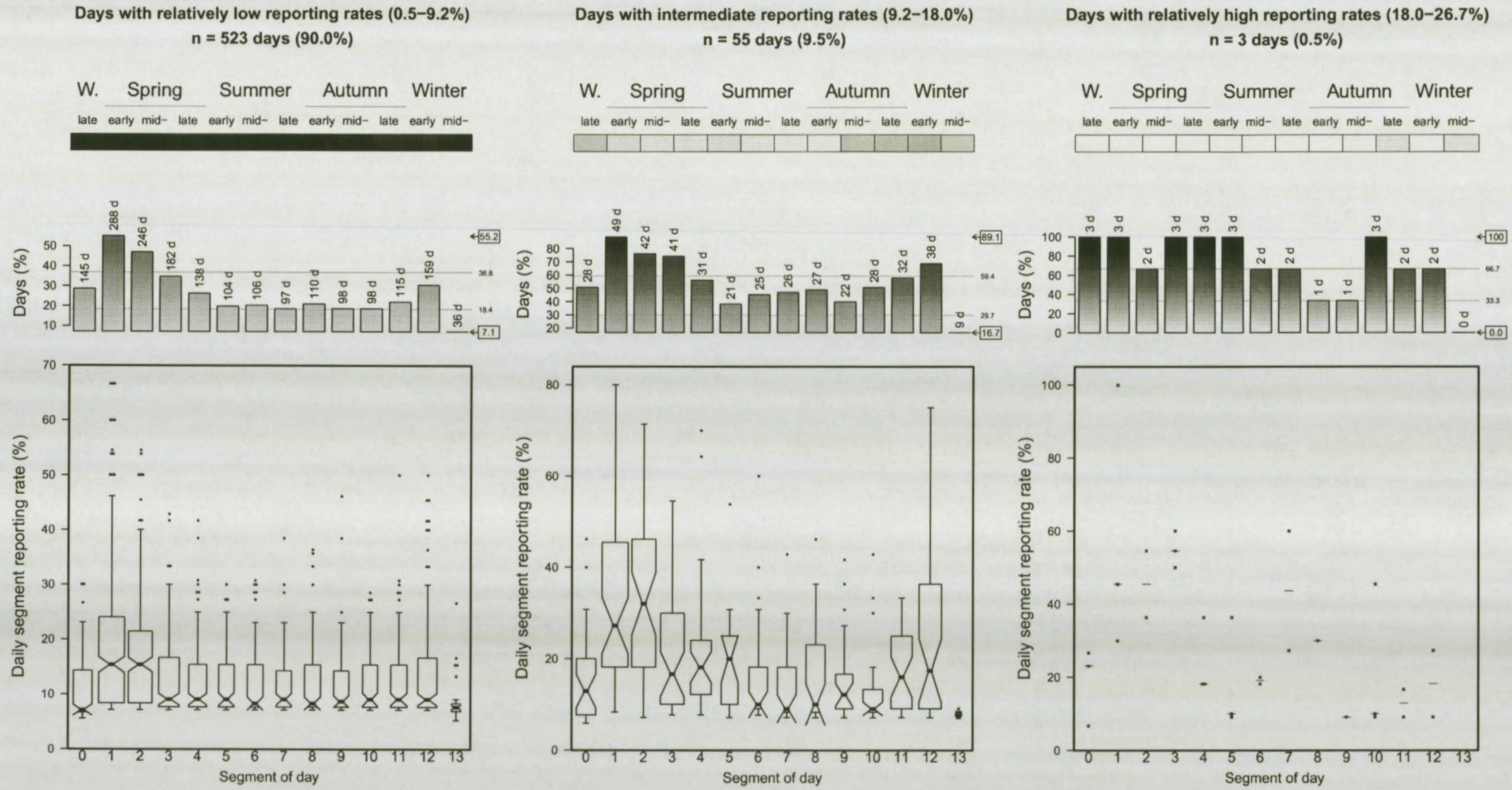


Figure 5.225: R727 Cape Longclaw — *meew* calls: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

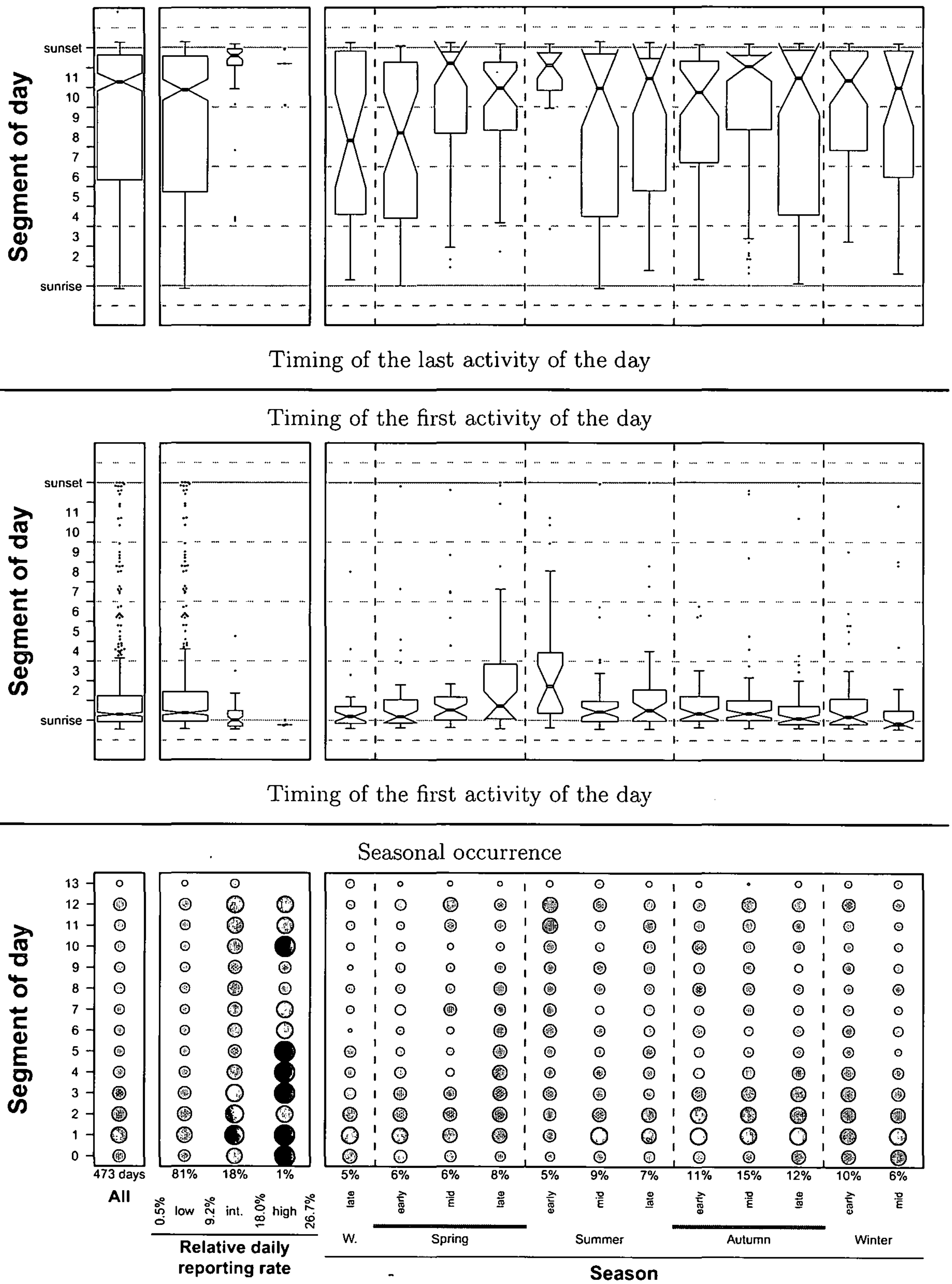
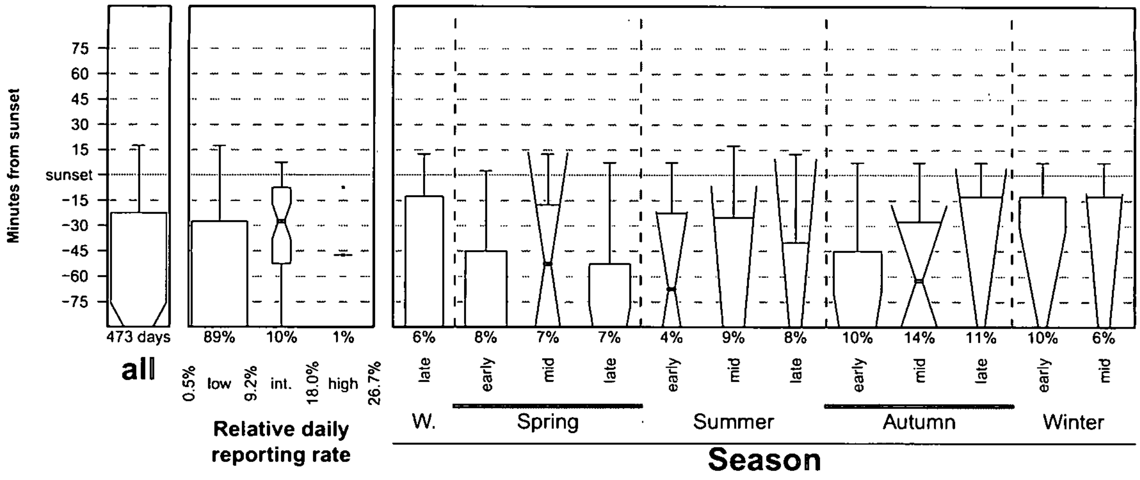
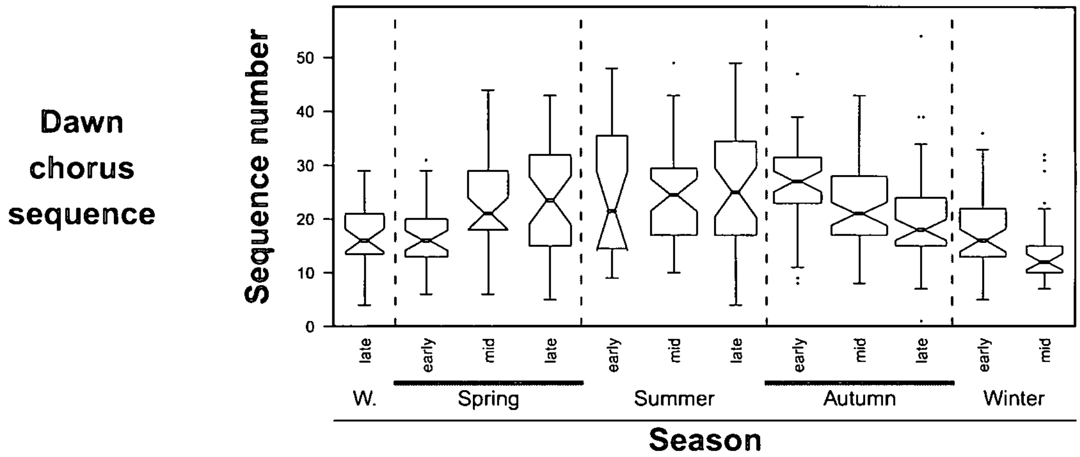


Figure 5.226: R727 Cape Longclaw — *meew* calls: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

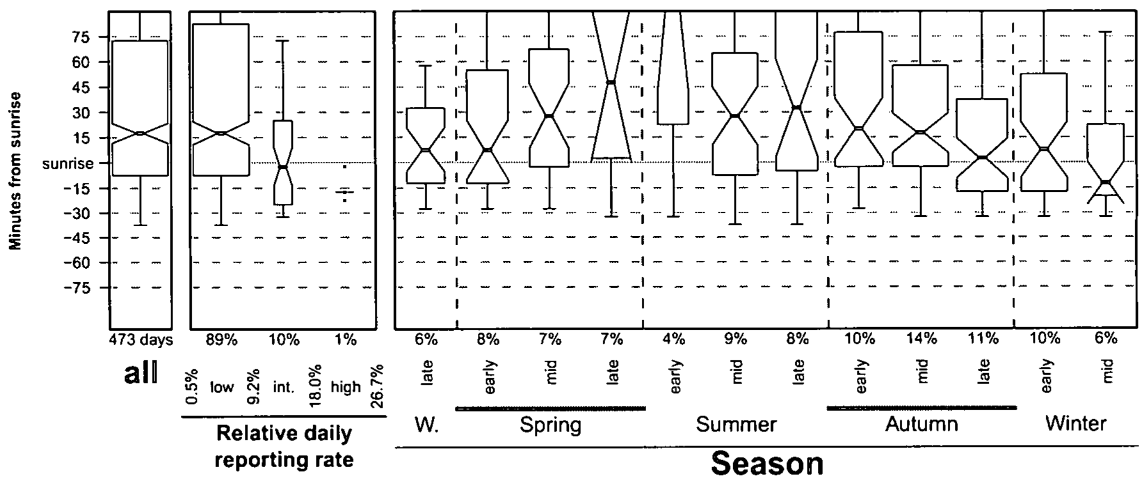


Figure 5.227: R727 Cape Longclaw — *meew* calls: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

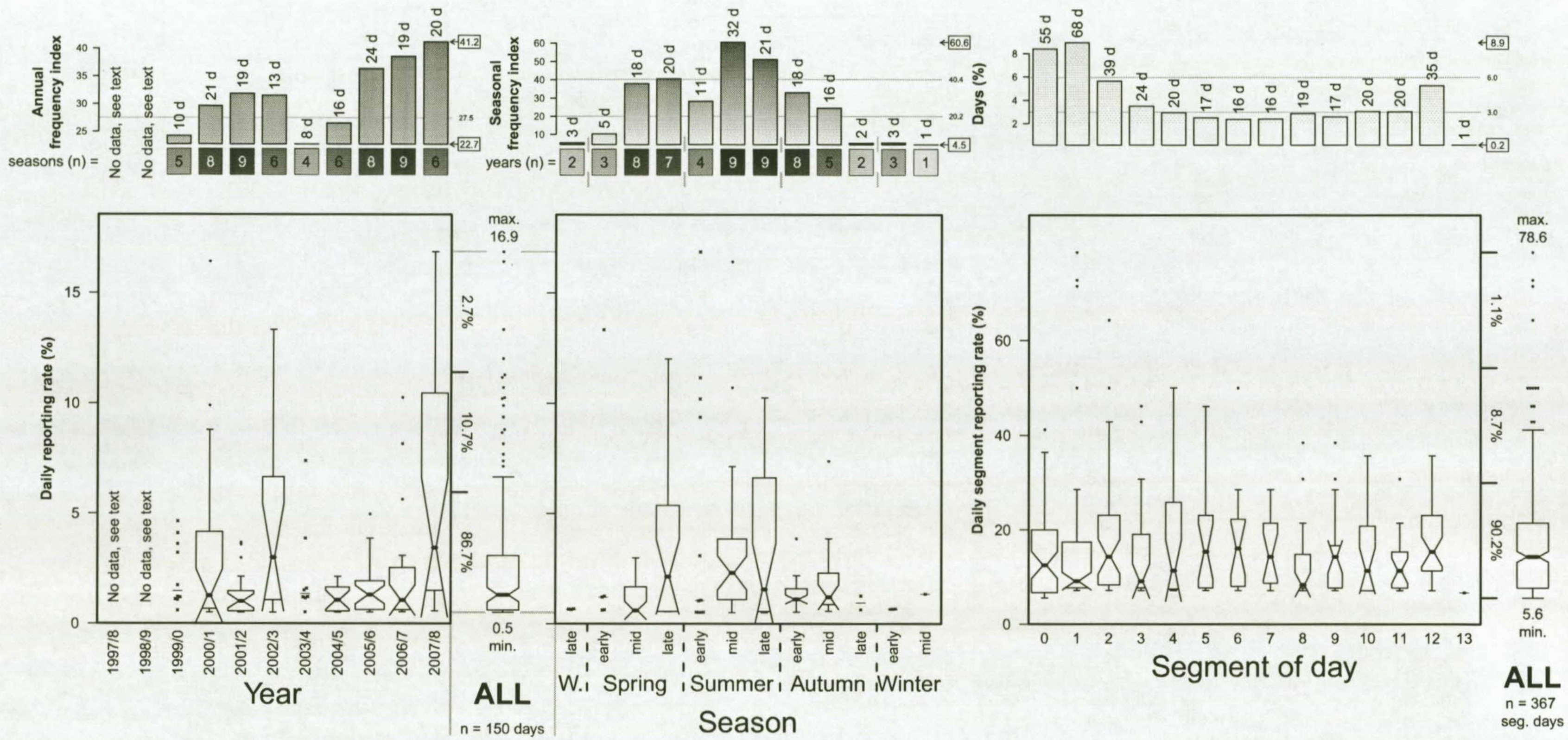


Figure 5.228: R727 Cape Longclaw — *tsweet* calls: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

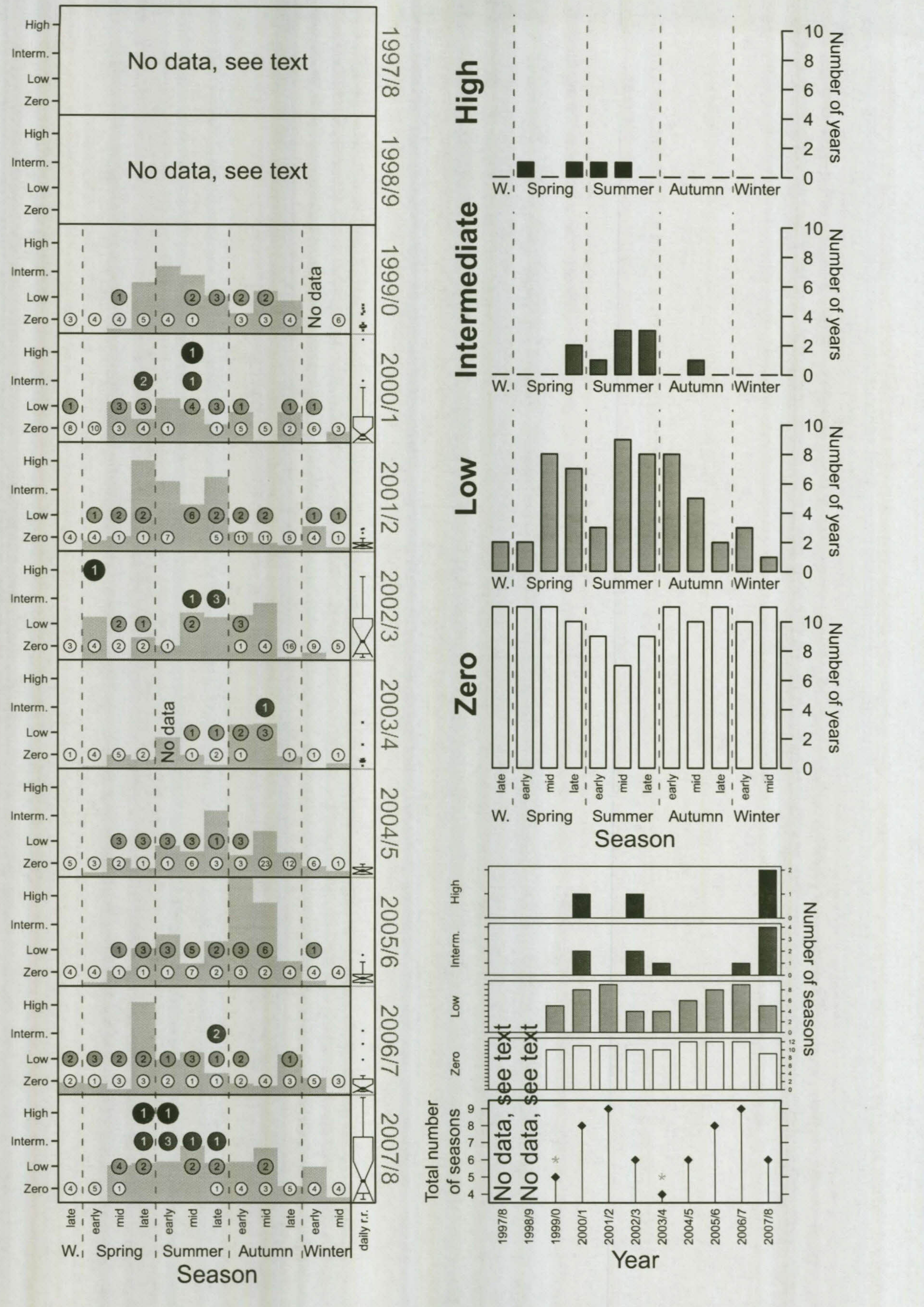


Figure 5.229: R727 Cape Longclaw — *tsweet* calls: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

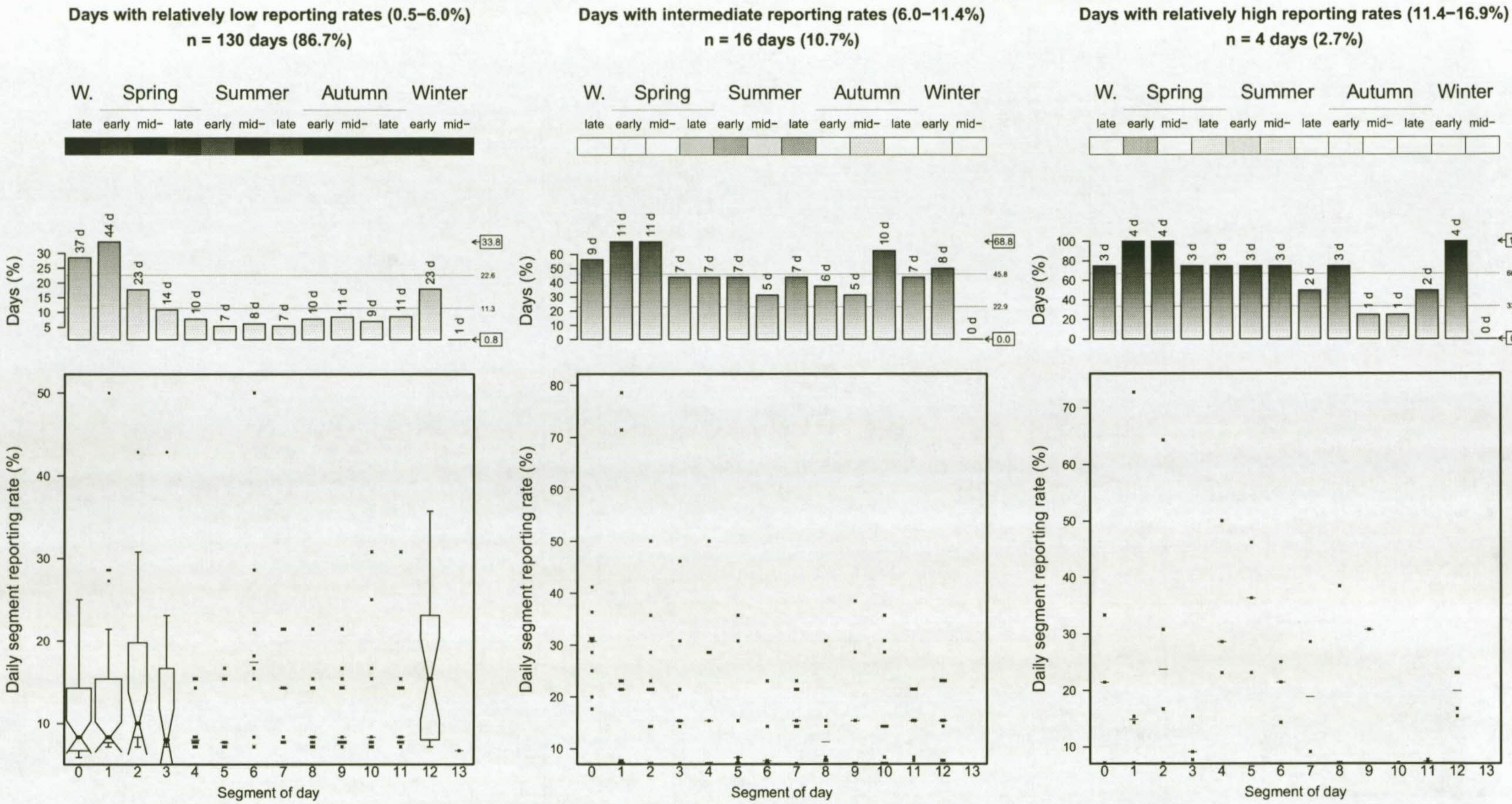


Figure 5.230: R727 Cape Longclaw — *tsweet* calls: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

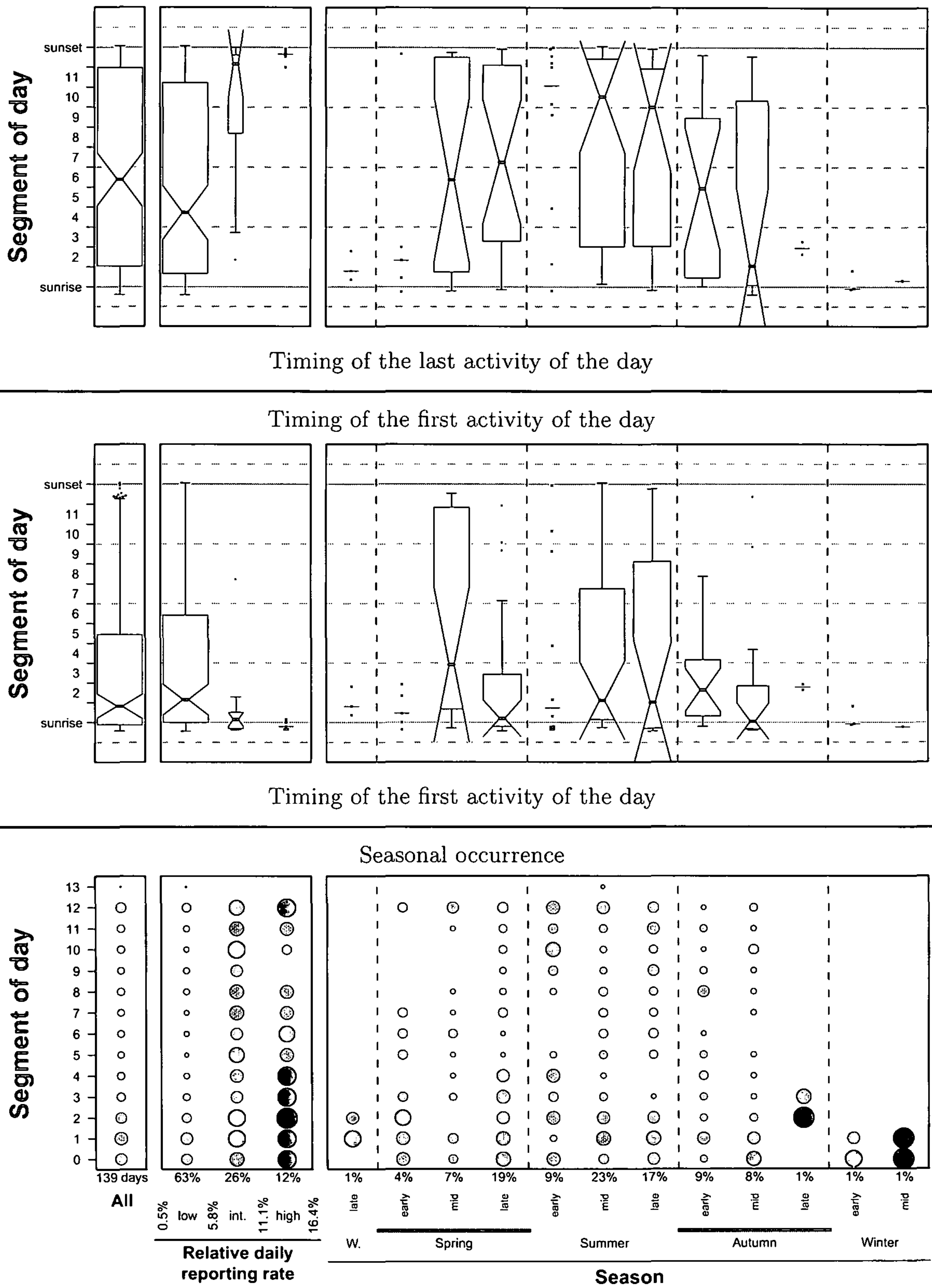


Figure 5.231: R727 Cape Longclaw — *tsweet* calls: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

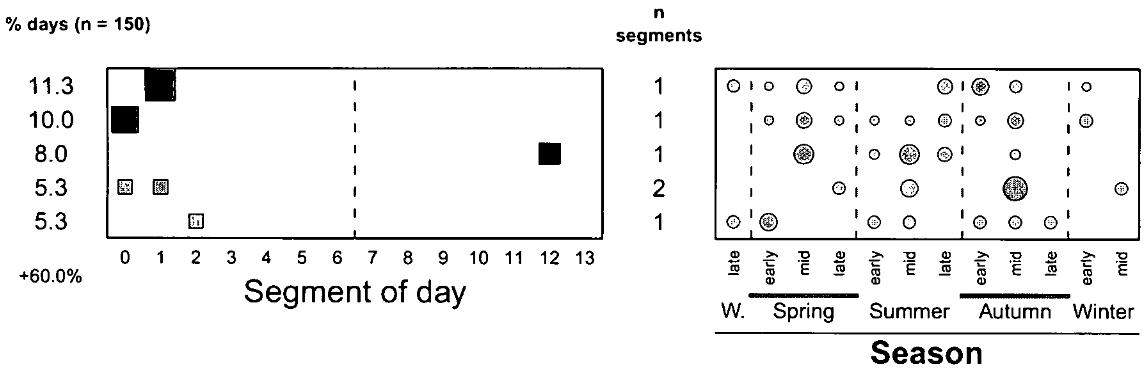


Figure 5.232: R727 Cape Longclaw — *tsweet* calls: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

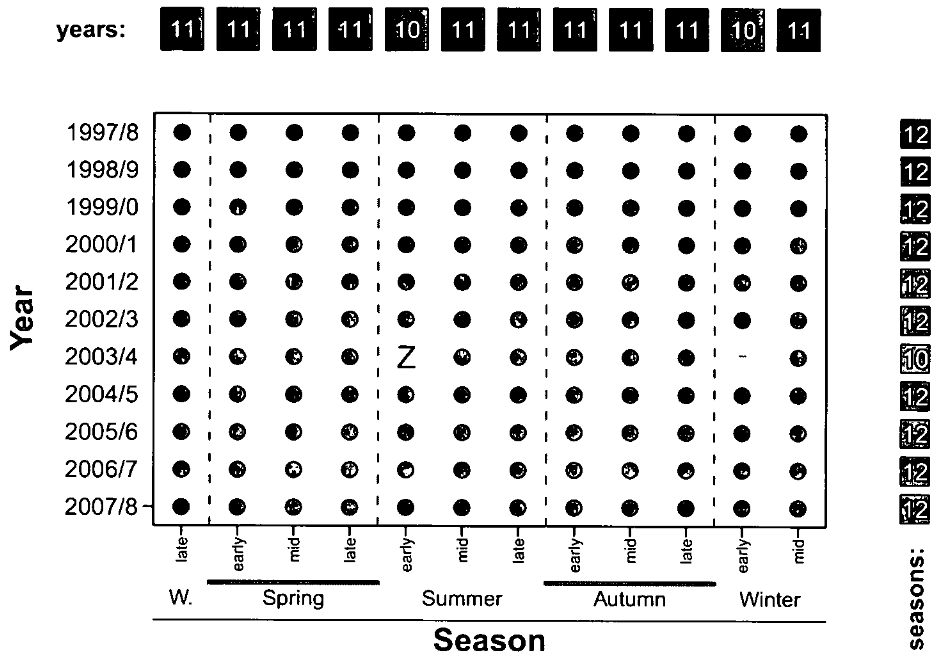


Figure 5.233: R727 Cape Longclaw: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

limit of its non-breeding distribution, except for a few scattered records further south (Herremans 1997f). It occurs in *Acacia* savanna and in open grassland (Maclean 1985). In SABAP1 Zone 7, they are present from the latter part of November to April [early summer to late autumn] (Herremans 1997f).

The birds at Glen

The Lesser Grey Shrike was seen (and sometimes heard also) in the grassland only, often in the trampled area and mostly single birds, rarely two. Recorded on a total of 21 days spread over seven years (Fig. 5.234). Usually recorded during only one season each year (either early or mid-summer), but during three seasons in 2000/1 (mid- and late summer and early autumn; Fig. 5.234). Seen during all segments of the day after sunrise (Fig. 5.234).

Discussion

In a study in the Kalahari basin, Botswana, Herremans (1997a) found that the Lesser Grey Shrike occupied habitats that were more open than that preferred by the Red-backed Shrike R733. A similar situation is evident at Glen where the former species were never recorded in the drainage line and the latter species never in the grassland.

On their non-breeding ground, the Lesser Grey Shrike undergoes a complete pre-breeding moult from the latter part of December until about the beginning of April [mid-summer to mid-autumn] (Dowsett 1971). It is possible, therefore, that in 2000/1 the birds (two of them at that time) were waiting for their moult to reach a stage appropriate for their northward journey.

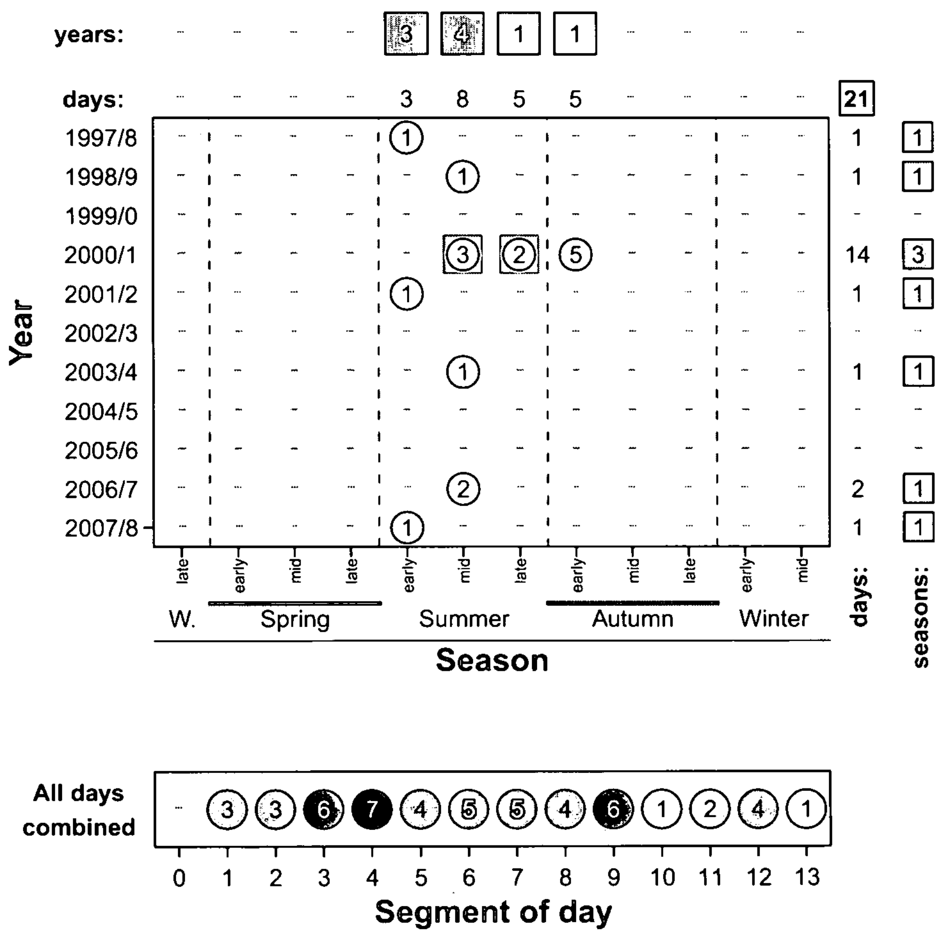


Figure 5.234: R731 Lesser Grey Shrike — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R732 Common Fiscal .... *Lanius collaris*

The Common Fiscal is endemic to sub-Saharan Africa (Maclean 1985). Widespread in southern Africa except in northern and north-eastern Namibia, Botswana, north-western Zimbabwe and southern Mozambique (Parker 1997a, 1999). Most abundant in South Africa (Parker 1997a). It is found in a wide variety of habitats, important factors being open areas with suitable perches and trees for nesting (Parker 1997a). It is generally considered to be resident (Maclean 1985; Parker 1997a).

Two readily distinguished subspecies occur in South Africa (Dean 2005l; Maclean 1985): *L. c. subcoronatus* has a white supercilium (eyebrow) and occur from the central Free State westwards to Namibia and northwards into Botswana while *L. c. collaris* has no white supercilium and occurs throughout much of South Africa, overlapping extensively with *L. c. subcoronatus* (Dean 2005l; Maclean & Maclean 1976; Toll 1979).

The birds at Glen

Both South African subspecies occur at Glen. In the analysis below, distinction was made between birds seen and birds heard, generally representing birds in the grassland and the drainage line respectively. Approximately 4% of the records that included birds both heard and seen were allotted to each category respectively. Figures start on page 870.

Annual occurrence of drainage line birds heard in the grassland: Activity was noted on 76.8% of the days with an activity index of six (Table 5.45a). Heard during all or nearly all seasons each year (Fig. 5.235; Fig. 5.236). Daily reporting rates ranged from 0.5 to 24.7% with 89.3% bird-days attaining low reporting rates; Median daily reporting rates showed limited inter-year variation (Fig. 5.235).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during nearly every season each year (Fig. 5.235). The data points to a bimodal seasonal pattern in occurrence with the two peaks centred on mid-spring and late autumn respectively. This pattern is seen in the seasonal frequency index (Fig. 5.235), the median daily reporting rates (Fig. 5.235), as well as the occurrence of high and especially intermediate reporting rate days (Fig. 5.236). Days with zero records were particularly frequent in late winter and least frequent in late autumn (Fig. 5.236).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity was most frequently recorded in the early morning with a slight increase in frequency towards the end of the day (Fig. 5.235). This general pattern is similar for low and intermediate reporting rate days (Fig. 5.237), and for all seasons (Fig. 5.238). Two bird-segment combinations occurred on more than 5% bird-days and involved single segments S1 and S2, which collectively accounted for 11.7% of all bird-days (Fig. 5.239).

The first activity of the day usually occurred during the early morning, often before sunrise on intermediate and high reporting rate days (Fig. 5.238; Fig. 5.240). There was also a clear seasonal pattern with the earliest times recorded during late autumn and latest times in early summer (Fig. 5.238; Fig. 5.240), the dawn chorus sequence showing a similar trend (Fig. 5.240).

The timing of the last activity of the day was variable for low reporting rate days, but largely limited to the late afternoon for intermediate and high reporting rate days (Fig. 5.238; Fig. 5.240). Although the values were somewhat variable, there was a seasonal pattern too, with activity tending to end later in the day from mid-summer to late autumn than during winter (Fig. 5.238; Fig. 5.240; Note medians).

Overall, daily segment reporting rates ranged from 5.0 to 81.8% with 91.1% of the values relatively low (Fig. 5.235). Daily segment reporting rates tended to be higher in the early morning than at other times (Fig. 5.237).

Early morning occurrence of drainage line birds heard during 2007/8: Activity was noted more frequently in the drainage line than in the grassland (Table 5.45b & c). In addition to a higher activity index (9 vs. 4; Table 5.45b & c), the early morning reporting rate was also higher in the drainage line than in the grassland (Fig. 5.241). The seasonal trend in both habitats suggests a bimodal pattern: In the drainage line there seems to be a break in occurrence during mid-summer when only low reporting rate mornings occurred, while no birds were recorded in the grassland during the same season (Fig. 5.241).

The first activity of the day often occurred slightly later in the grassland than in the drainage line (Fig. 5.241). In the drainage line, the timing was variable during summer, but more constant during spring, autumn and winter (no data for late winter) (Fig. 5.241). Activity intensity in the drainage line was similar before and after sunrise (Fig. 5.241).

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Annual occurrence of birds in the grassland: Activity was noted on 41.9% of the days with an activity index of four (Table 5.45a). Usually recorded during 9–11 seasons each year, but during only seven seasons in 1998/9 (Fig. 5.242; Fig. 5.243). Daily reporting rates ranged from 0.5 to 19.9% with 92.0% bird-days attaining low reporting rates (Fig. 5.242). Although the upper quartile of daily reporting rates were very high in 1998/9 and 2003/4 compared to those of other years, the differences in median values were less dramatic (Fig. 5.242).

Seasonal occurrence of birds in the grassland: Based on the number of bird-years and the seasonal frequency index there appear to be two main periods of occurrence: late winter to late spring and again mid-summer to early winter (Fig. 5.242). The median daily reporting rate of late winter was particularly high and the occurrence of high and intermediate reporting rates were centred on winter (Fig. 5.242; Fig. 5.243).

Daily occurrence of birds in the grassland: Overall, activity was similarly frequent during all segments between sunrise and sunset, and very infrequent before sunrise and after sunset (Fig. 5.242). This general pattern is most applicable to low reporting rate days, because on intermediate reporting rate days activity tended to follow a bimodal pattern with peaks in mid-morning and later in the afternoon (Fig.5.244). The pattern varied seasonally

(Fig. 5.245). Only one bird-segment combination involving S2 occurred during more than 5% bird-days (Fig. 5.246).

Table 5.45: R732 Common Fiscal: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists n	5-minute checklists Total	5-minute checklists %	Activity	Days %	Days Total	Days n	Activity index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.742	3 207	114 612	2.8	birds heard	76.8	656	504	6
0.258	1 116	114 612	1.0	birds seen	41.9	656	275	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	368	1 190	30.9	birds heard	97.7	43	42	9
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.963	104	1 188	8.8	birds heard	62.8	43	27	4
0.037	4	1 188	0.3	birds seen	9.3	43	4	1

The occurrence of both the first and the last activity of the day was variable (Fig. 5.245).

Overall, daily segment reporting rates ranged from 6.2 to 70.0% with 89.8% of the values relatively low (Fig. 5.242). Median daily reporting rates were similar for all segments (Fig. 5.244).

Discussion

Parker (1997a) suggested that the slight fluctuations in Fiscal Shrike SABAP1 reporting rates were "probably related to change in conspicuousness". Ironically, he noted two paragraphs earlier that the Fiscal Shrike is "highly conspicuous owing to its striking appearance, aggressive nature, use of exposed perches, and its attraction to roadsides." (Parker 1997a). He continued by saying that "It is therefore unlikely that it was overlooked anywhere where it occurs." It is suggested that the fluctuations in reporting rates indicate actual movements. There are several lines of evidence that point in this direction.

Movements have been inferred in the past from the presence of the white eyebrowed subspecies outside its normal distribution (Fraser & McMahon 1994; Maclean 1985). While Maclean (1985) suggested that this "may indicate some local movements", Dean (2005l) suggested that these movements imply possible nomadism. What is certain is that the birds are indeed capable of moving considerable distances.

Penry (1994) pointed out that the resident population in the south-east and south-west of Botswana is supplemented during "winter by birds moving in from the south", *i.e.* South Africa. Significantly, a closer look at the SABAP1 raw data reveals that the birds are more widespread in the adjacent North West Province from March to May [mid-autumn to early winter] (Fig. 5.247). This may represent birds from the Free State and elsewhere moving northwards. The only other South African province that shows a marked change in occurrence is the Northern Cape where the birds were recorded from a greater proportion of QDGS from March to August [mid-autumn to early spring] (Fig. 5.247). This may also involve birds from the Free State and elsewhere

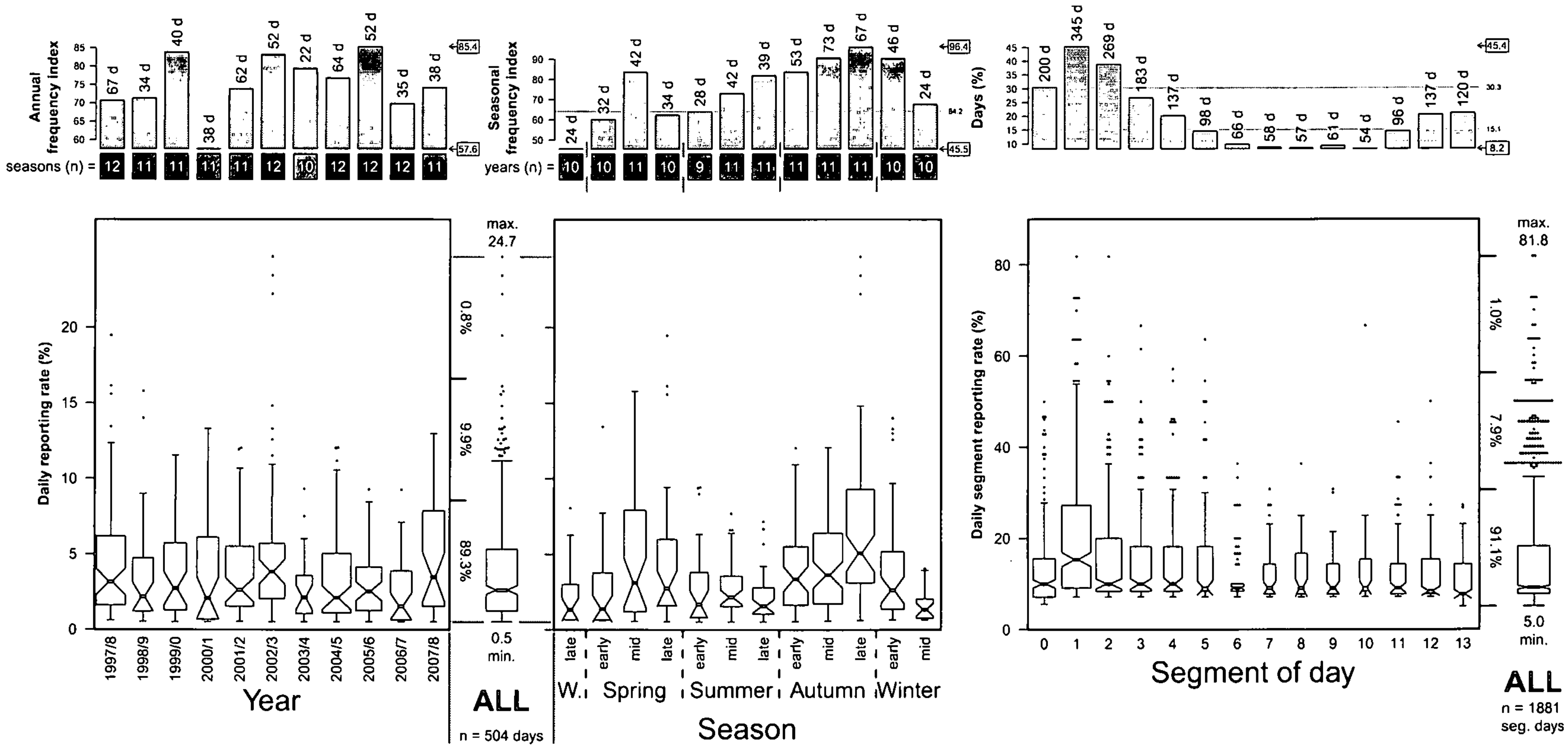


Figure 5.235: R732 Common Fiscal — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

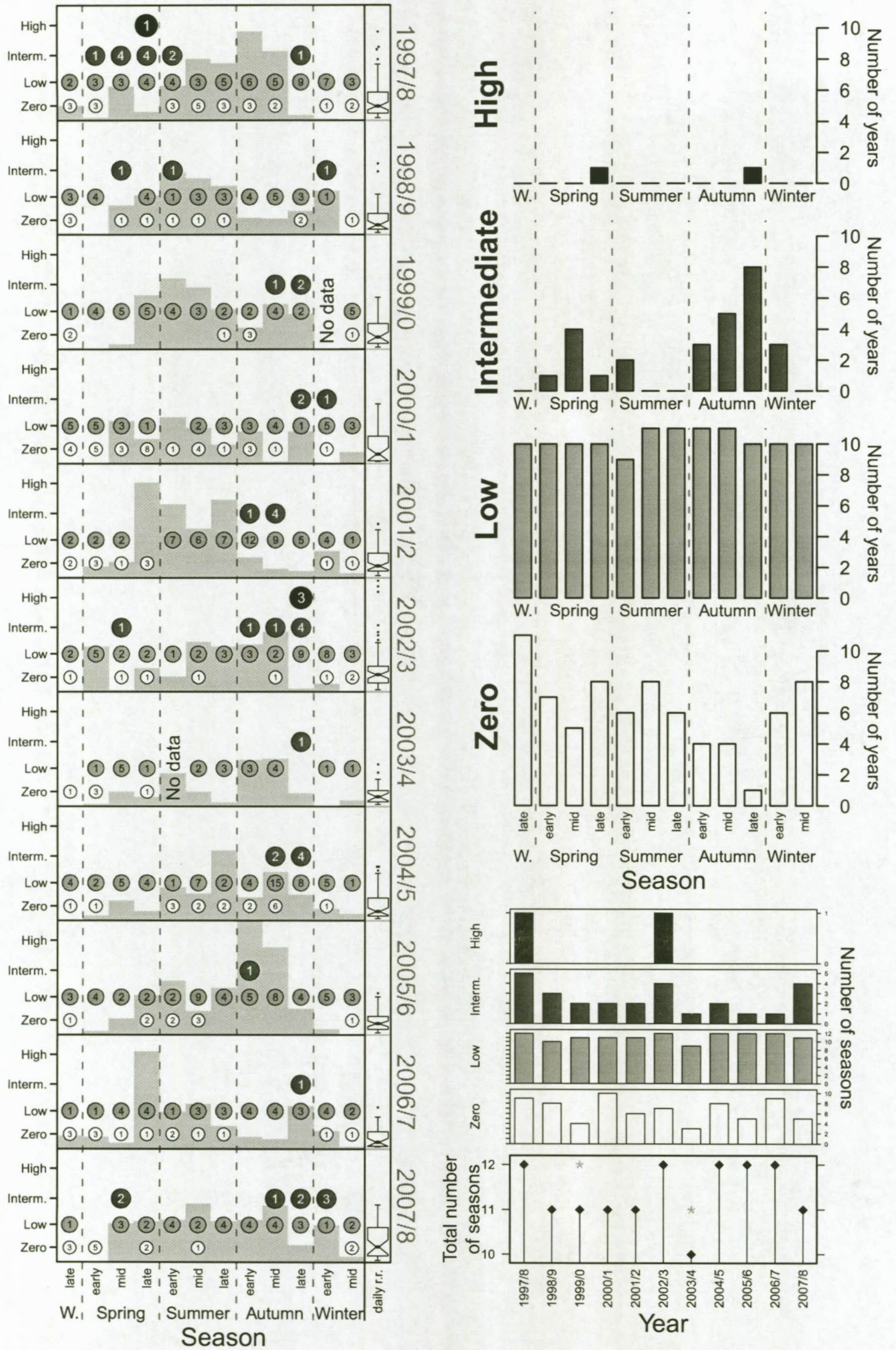


Figure 5.236: R732 Common Fiscal — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

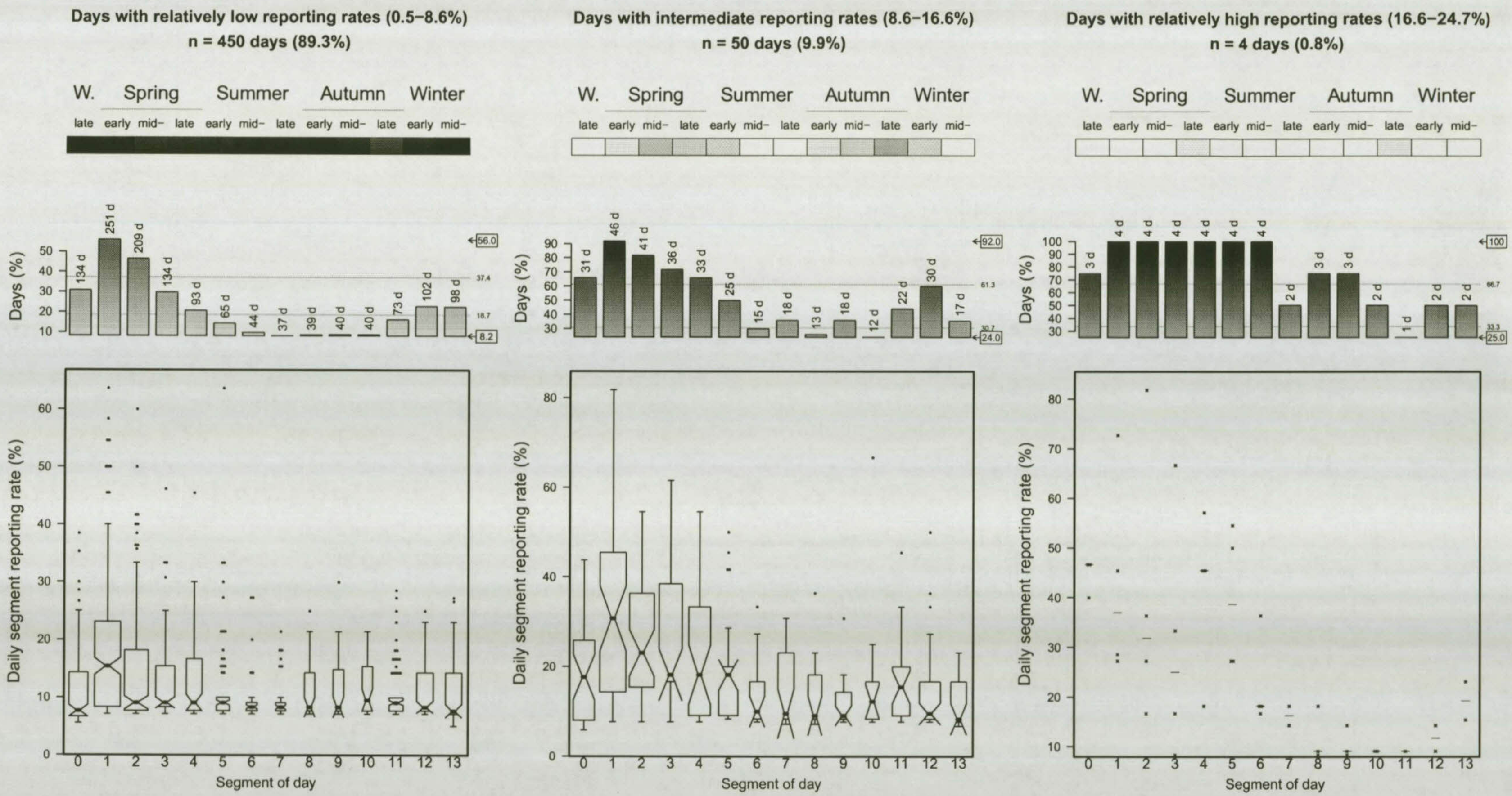


Figure 5.237: R732 Common Fiscal — birds heard: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

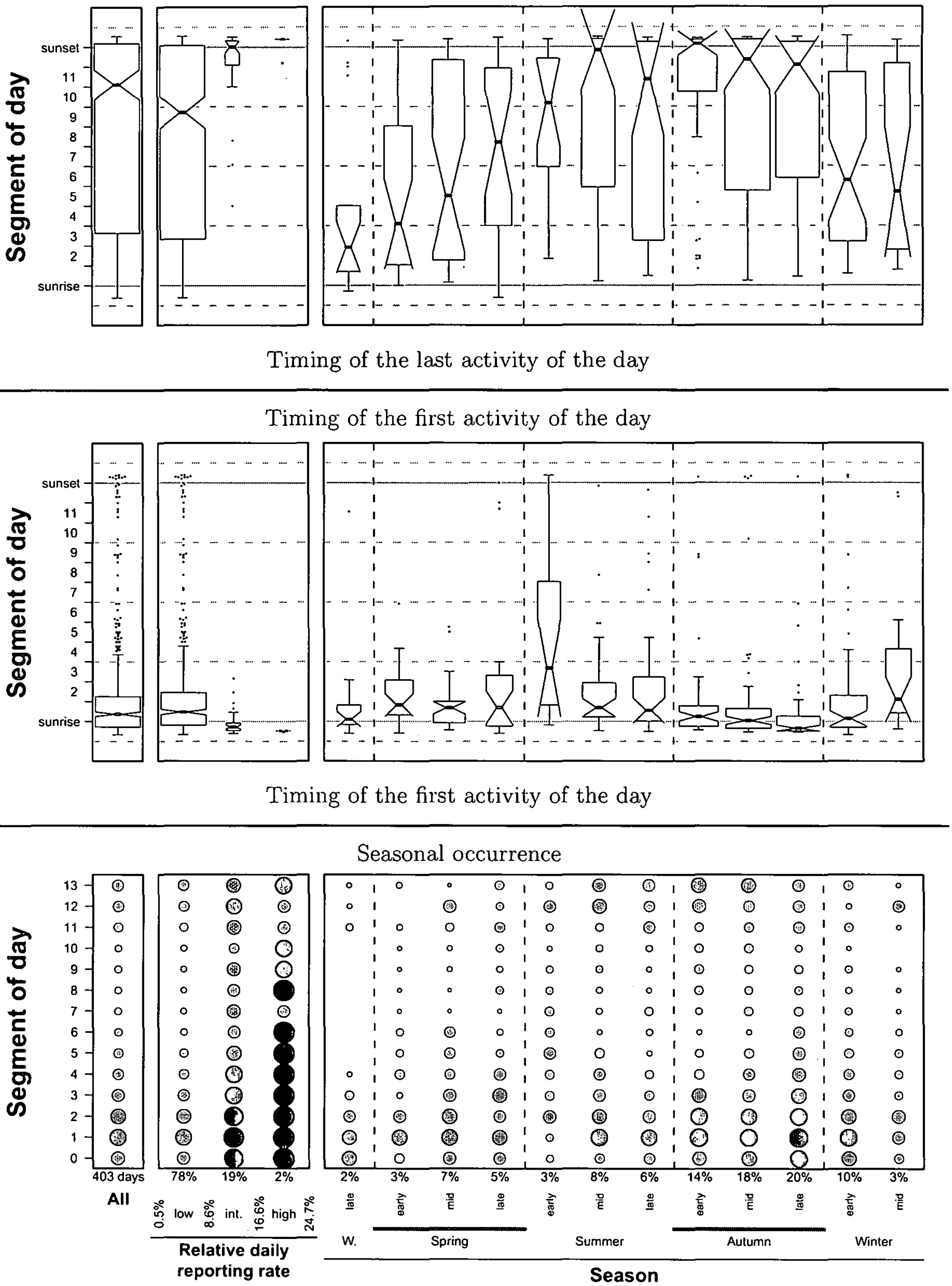


Figure 5.238: R732 Common Fiscal — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

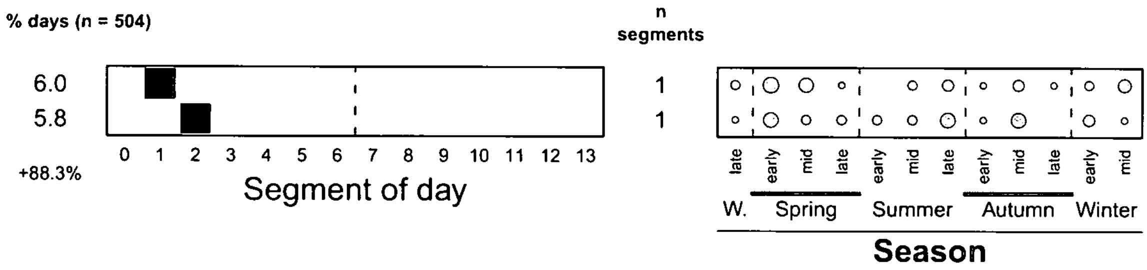


Figure 5.239: R732 Common Fiscal — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

moving into the area during this time of the year. SABAP1 data was not available for Lesotho, but surveys indicate a "winter" influx there too (Van Niekerk 2004). In addition, data collected on CAR[2] route #31 in the southern Free State since 1997/8 typically show higher reporting rates during late winter than during late summer (DJvN unpublished data). And finally, at Glen the median daily reporting rate of late winter was particularly high and the occurrence of high and intermediate reporting rates were centred on winter for instances where birds were seen in the grassland (Fig. 5.242; Fig. 5.243).

How is this presumed winter influx related to breeding and moult? Breeding occurs mainly from spring to mid-summer (Cooper 1971; Dean 1971; Tarboton *et al.* 1987). Limited data on moult suggests that South African birds undergo a complete post-breeding moult from about late summer to late autumn (Craig 1983a; DJvN unpublished data). Thus, it appears that the winter influx represents post-moult dispersal.

Regarding the well-defined bimodal seasonal pattern centred on spring and autumn of birds heard (Fig. 5.235; Fig. 5.236), it is noted that the respective peaks concur partially with breeding and (post-) moult.

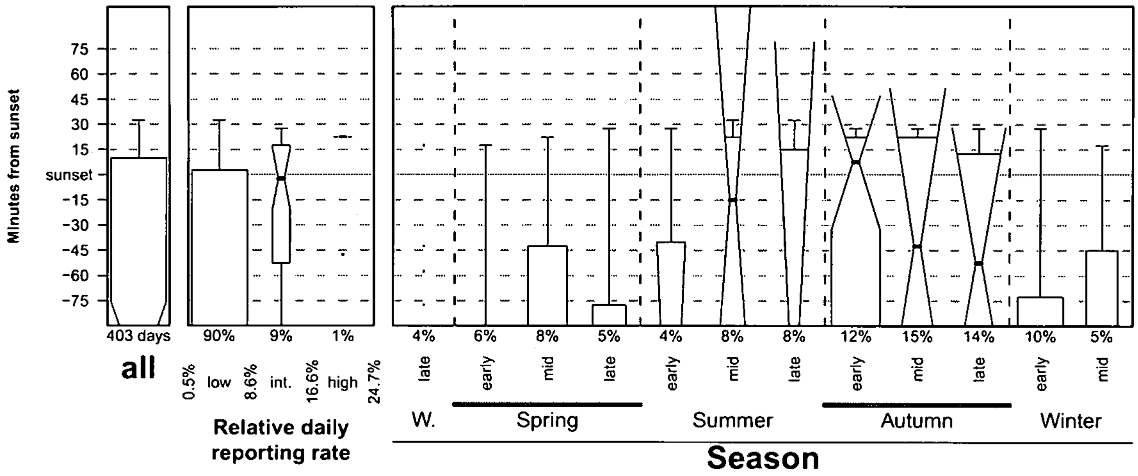
R733 Red-backed Shrike .... *Lanius collurio*

The Red-backed Shrike breeds in the Palearctic with the majority of the birds migrating to southern Africa for the non-breeding season (Cramp 1998). Widespread in southern Africa, but scarce in the western and southern parts of the region (Herremans 1997g). Primarily associated with the savanna biome (Bruderer & Bruderer 1993), but it also occurs in bushes in otherwise open grassland (Herremans 2005). Present in SABAP1 Zone 7 from the end of October to April [late spring to late autumn] (Herremans 1997g).

The birds at Glen

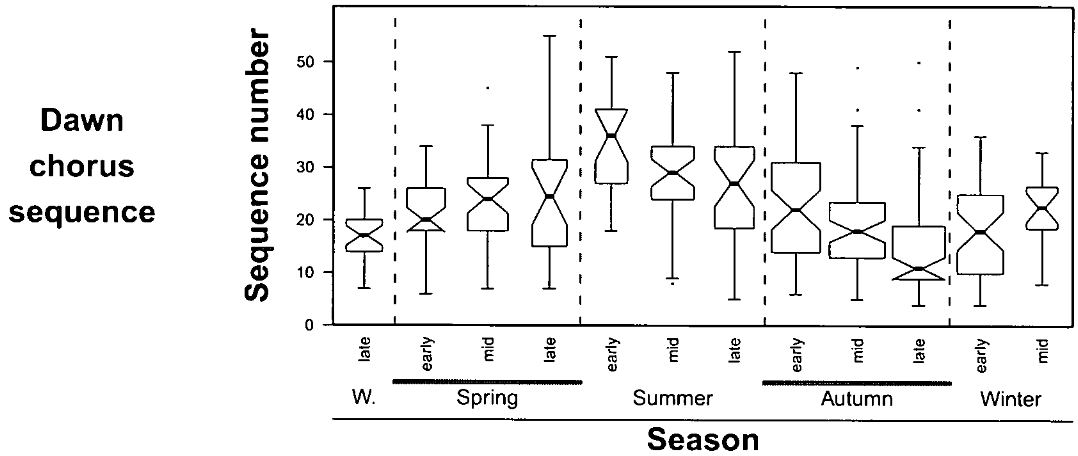
Recorded from the drainage line only. Encountered during summer and early and mid-autumn, with activity peaking in early autumn (Fig. 5.248).

[2]CAR: Coordinate Avifaunal Roadcount. See Young *et al.* (2003).



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

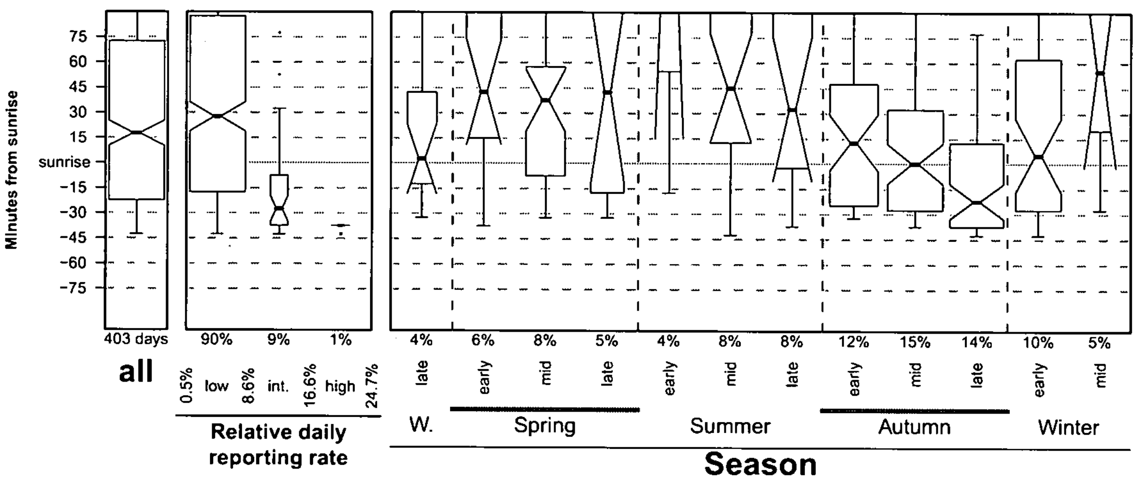


Figure 5.240: R732 Common Fiscal — birds heard: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

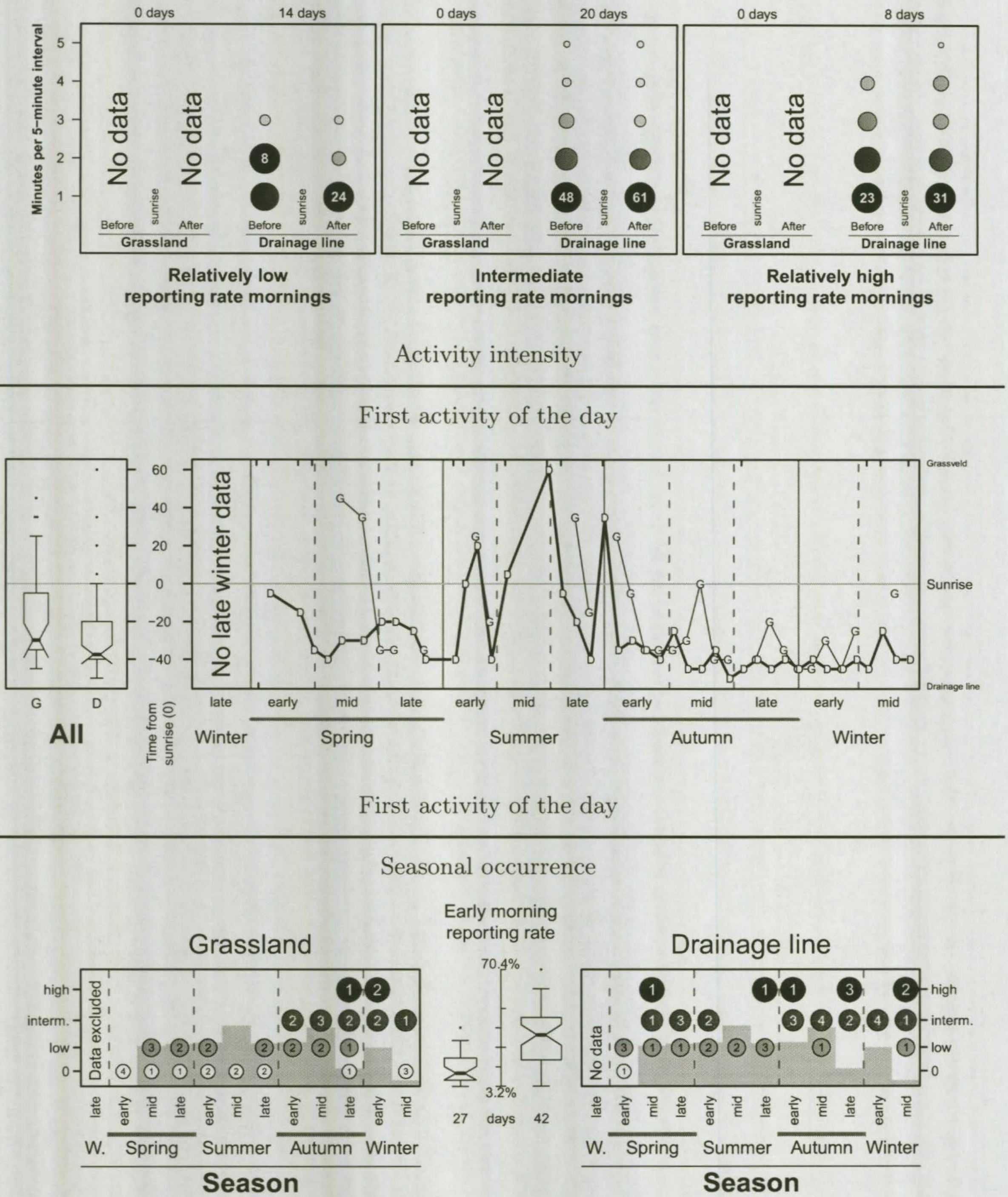


Figure 5.241: R732 Common Fiscal — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

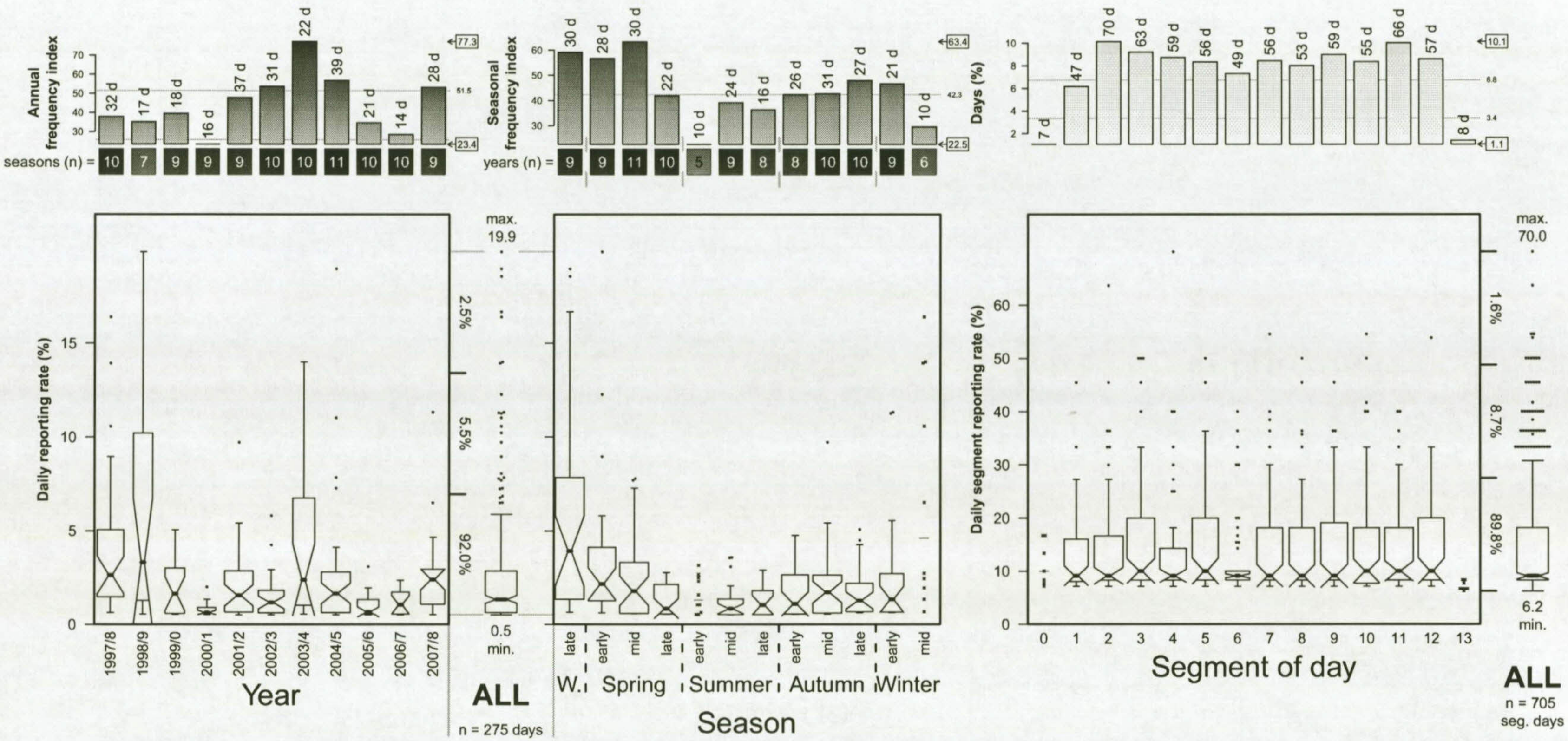


Figure 5.242: R732 Common Fiscal — birds seen: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Figure 5.243: R732 Common Fiscal — birds seen: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

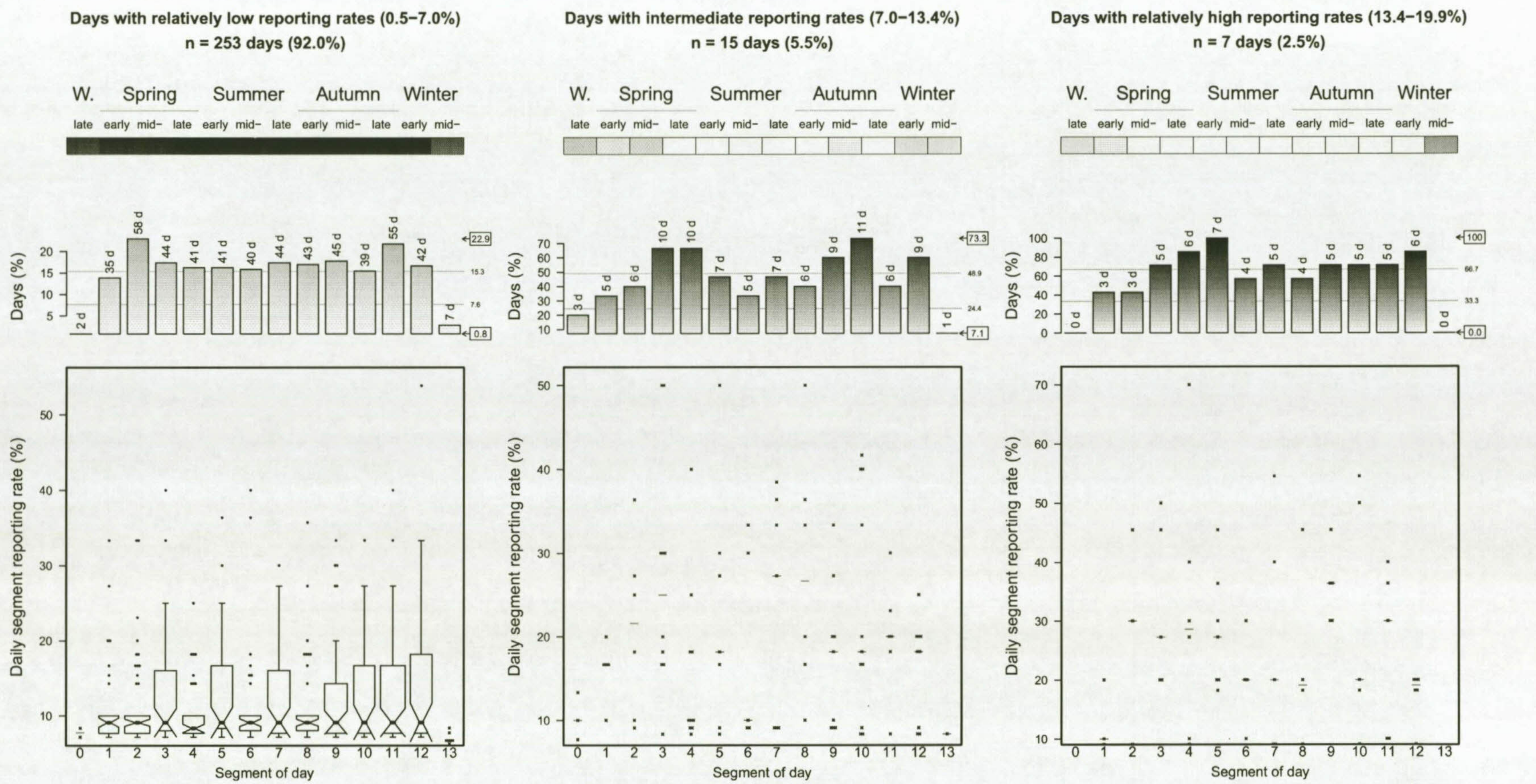


Figure 5.244: R732 Common Fiscal — birds seen: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

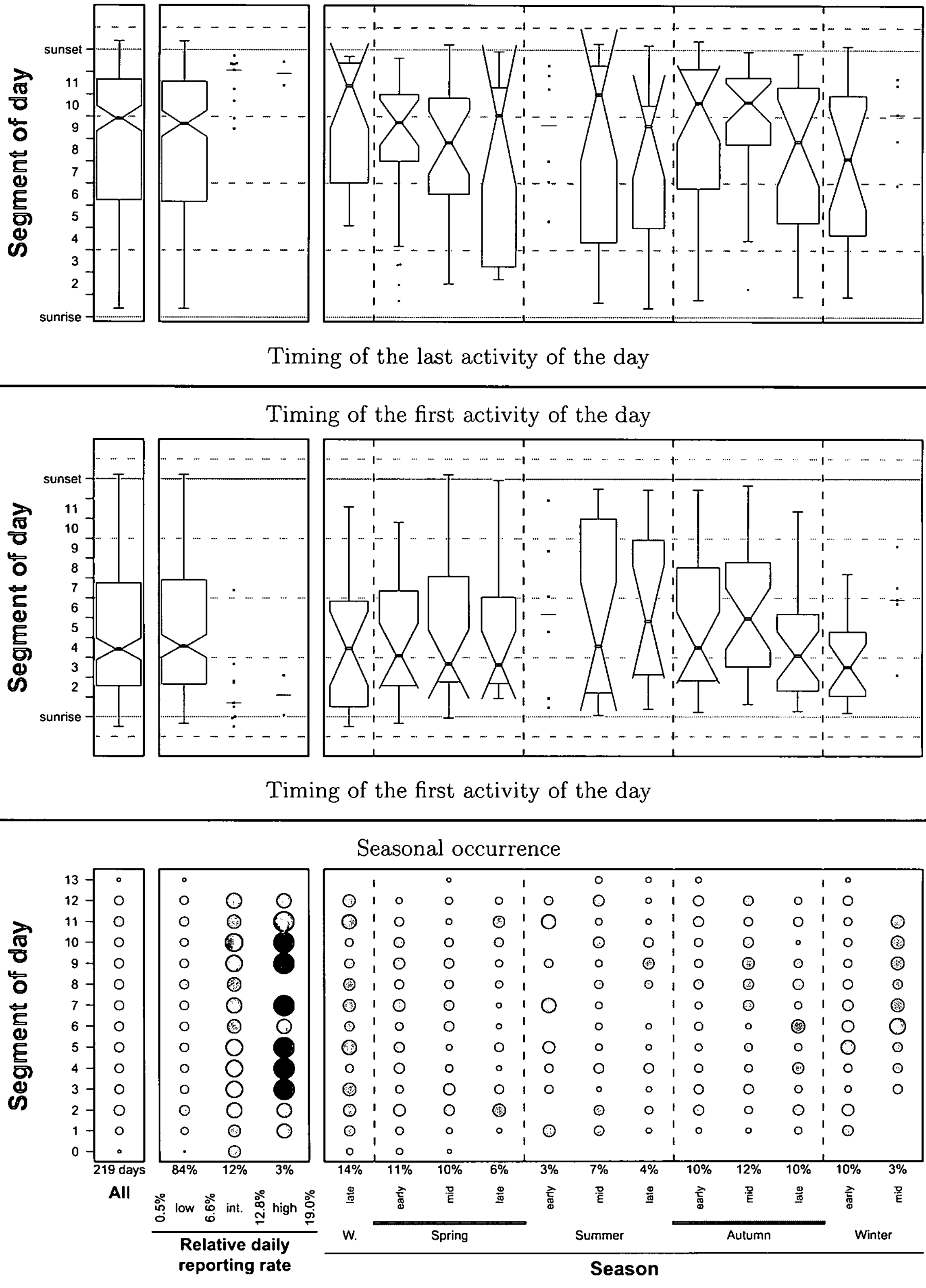


Figure 5.245: R732 Common Fiscal — birds seen: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

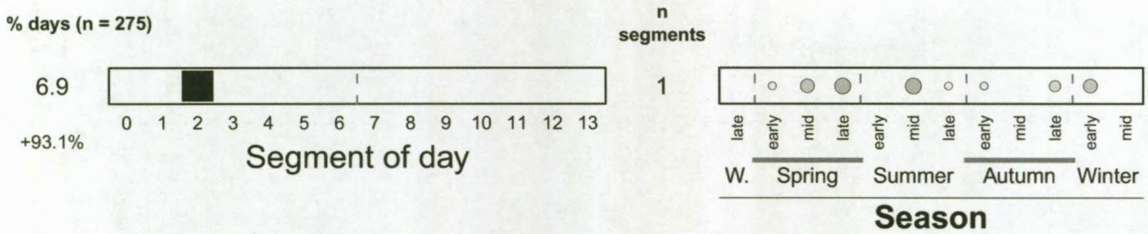


Figure 5.246: R732 Common Fiscal — birds seen: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

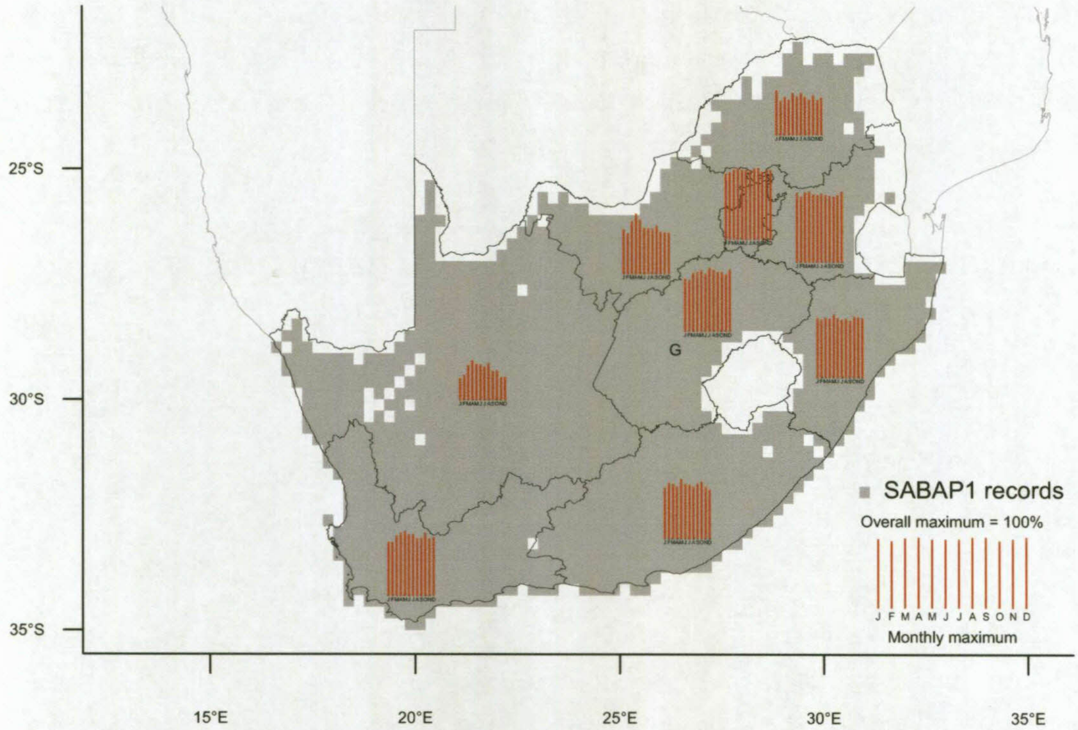


Figure 5.247: R732 Common Fiscal: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

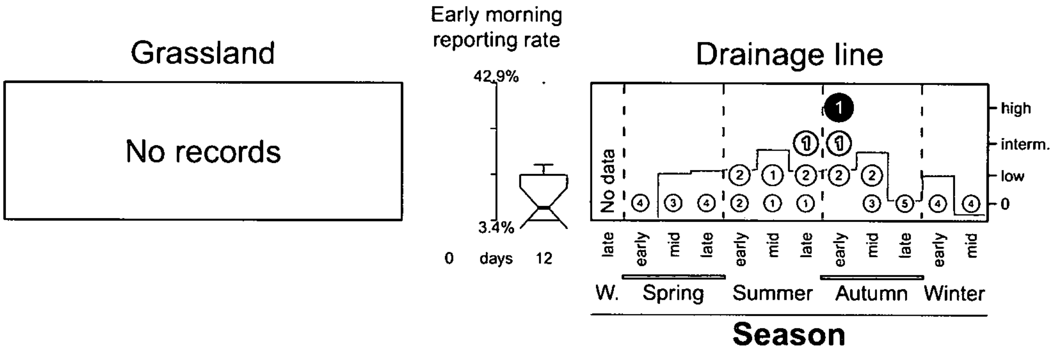


Figure 5.248: R733 Red-backed Shrike — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. The seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates are illustrated. See page 136 for more information on this early morning figure.

Discussion

In a study in the Kalahari basin, Botswana, Herremans (1997a) found that the Lesser Grey Shrike R731 occupied habitats that were more open than that preferred by the Red-backed Shrike. A similar situation is evident at Glen where the former species were never recorded in the drainage line and the latter species never in the grassland.

5.15 Malaconotidae (Malaconotini): Tchagras, Bush-Shrikes, *etc.*

Note: The Malaconotidae is continued from page 833.
See page 832 for an introduction to the family.

The 103 species in the subfamily Malaconotini is endemic to Africa, with 16 species occurring in southern Africa (Hockey *et al.* 2005). Seven species occur in the Free State of which only two are common in the central parts (Earlé & Grobler 1987; Harrison *et al.* 1997b). Both were recorded at Glen. A third species, the Crimson-breasted Shrike *Laniarius atrococcineus*, has been recorded at in the drainage line and at Glen village in the past (P. Goosen personal communication).

R743 Brown-crowned Tchagra .... *Tchagra australis*

The Brown-crowned Tchagra is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in the northern half of Namibia, Botswana, Zimbabwe, southern Mozambique (Parker 1999), Swaziland and South Africa where the central Free State is at the southern end of its distribution (Parker 1997b). It occurs in various types of woodland, including *Acacia* thickets, and it is resident (Maclean 1985).

The birds at Glen

The Brown-crowned Tchagra is resident in the drainage line and all records refer to birds calling from there. In the grassland, it was always the display flight call that was heard, but the observations in the drainage line include other vocalisations too. Figures start on page 885.

Annual occurrence of drainage line birds heard in the grassland: Recorded on 13.9% of the days with an activity index of two (Table 5.46a). Not recorded in 1998/9 and heard during 1–4 seasons in 2002/3–2004/5, 2006/7 and 2007/8, and during 6–8 seasons in other years (Fig. 5.249; Fig. 5.250). Daily reporting rates ranged from 0.5 to 7.5% with most days attaining reporting rates of less than 2%; Median daily reporting rates were similar for all seasons (Fig. 5.249).

Table 5.46: R743 Brown-crowned Tchagra: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	199	114 612	0.2	birds heard	13.9	656	91	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	40	1 190	3.4	birds heard	23.3	43	10	4
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 188	0.1	birds heard	2.3	43	1	1

Seasonal occurrence of drainage line birds heard in the grassland: Recorded primarily from mid-spring to late autumn, rarely in winter and not recorded in early spring (Fig. 5.249). Based on the number of bird-years as well as the seasonal frequency index, there are two peak periods of activity with the one centred on late spring and the other on mid-autumn (Fig. 5.249). Median daily reporting rates were similar for all seasons with most daily reporting rate less than 2% (Fig. 5.249).

Daily occurrence of drainage line birds heard in the grassland: Overall, most frequently recorded in the early morning after sunrise (Fig. 5.249). The main bird-seasons show a similar pattern (Fig. 5.251). The four bird-segment combinations occurring during more than five bird-days were limited to single segments S1–S3 and S11, collectively accounting for nearly half of all bird-days and occurring mainly in autumn (Fig. 5.252).

The first activity of the day usually occurred during the first half of the morning after sunrise, the pattern remaining reasonably constant throughout the year (Fig. 5.251). The timing of the last activity of the day was variable (Fig. 5.251).

Overall, daily segment reporting rates ranged from 6.2 to 53.8% with 95.3% of the values relatively low; Median daily reporting rates were similar for all segments of the day (Fig. 5.249).

Early morning occurrence of drainage line birds heard during 2007/8: Noted on 23.3% of the mornings in the drainage line in contrast to the 2.3% in the grassland (Table 5.46b & c). In addition to a higher activity index (4 vs. 1; Table 5.46b & c), the early morning reporting rates were also higher in the drainage line than in the grassland (Fig. 5.253). Whereas activity heard from the grassland was limited to late spring, it occurred during six seasons (including late spring) in the drainage line (Fig. 5.253).

Discussion

In South Africa, breeding in the Brown-crowned Tchagra peak from October to November [mid-spring to early summer] (Maclean 1993), followed by a complete post-breeding moult (Bowie 2005a). Therefore, the first peak in occurrence centred on late spring coincides with breeding, while the second mid-autumn centred peak appears to represent post-moult activity (*cf.* Fig. 5.249).

The Brown-crowned Tchagra's activity appears to be somewhat erratic with years with relatively frequent activity followed by years with infrequent or even no activity at all (Fig. 5.249). The effect of rainfall is unclear. Activity was most frequent in 2005/6 (Fig. 5.249) which was the year with highest rainfall, but the activity in that year started long before the main rains came in autumn (Fig. 5.250). In 2001/2, however, the start of activity coincided with the good rains of late spring (Fig. 5.250).

R746 Bokmakierie .... *Telophorus zeylonus*

From south-western Angola (Dean 2000) the distribution of the Bokmakierie extends southwards into western and southern Namibia, reaching its greatest abundance in South Africa where it is found throughout the country except in the north and far north-east (Parker 1997c). It also occurs in Lesotho and Swaziland with an isolated population in the Chimanimani mountains along the Zimbabwe/Mozambique border (Parker 1997c). Found in a variety of habitats, favouring open areas with scattered shrubs or trees (Maclean 1985; Oatley 2005a; Parker 1997c). Apart from altitudinal movements in Lesotho (Jacot-Guillarmod 1963) and adjacent KwaZulu-Natal (Johnson & Maclean 1994), the Bokmakierie is resident elsewhere (Parker 1997c).

The birds at Glen

The Bokmakierie had the third highest overall 5-minute reporting rate (36.6%; Table 5.47) of all species recorded in the grassland at Glen. The birds are largely confined to the drainage line and records in the grassland refer mostly to birds calling from there. According to Oatley (2005a) the vocalisations of a singing male are audible up to 2 km. They do enter the grassland from time to time and were recorded in the trampled area on rare occasions. In the analysis distinction was made between birds seen (and heard) in the grassland and birds heard in the drainage line (Table 5.47). Figures start on page 891.

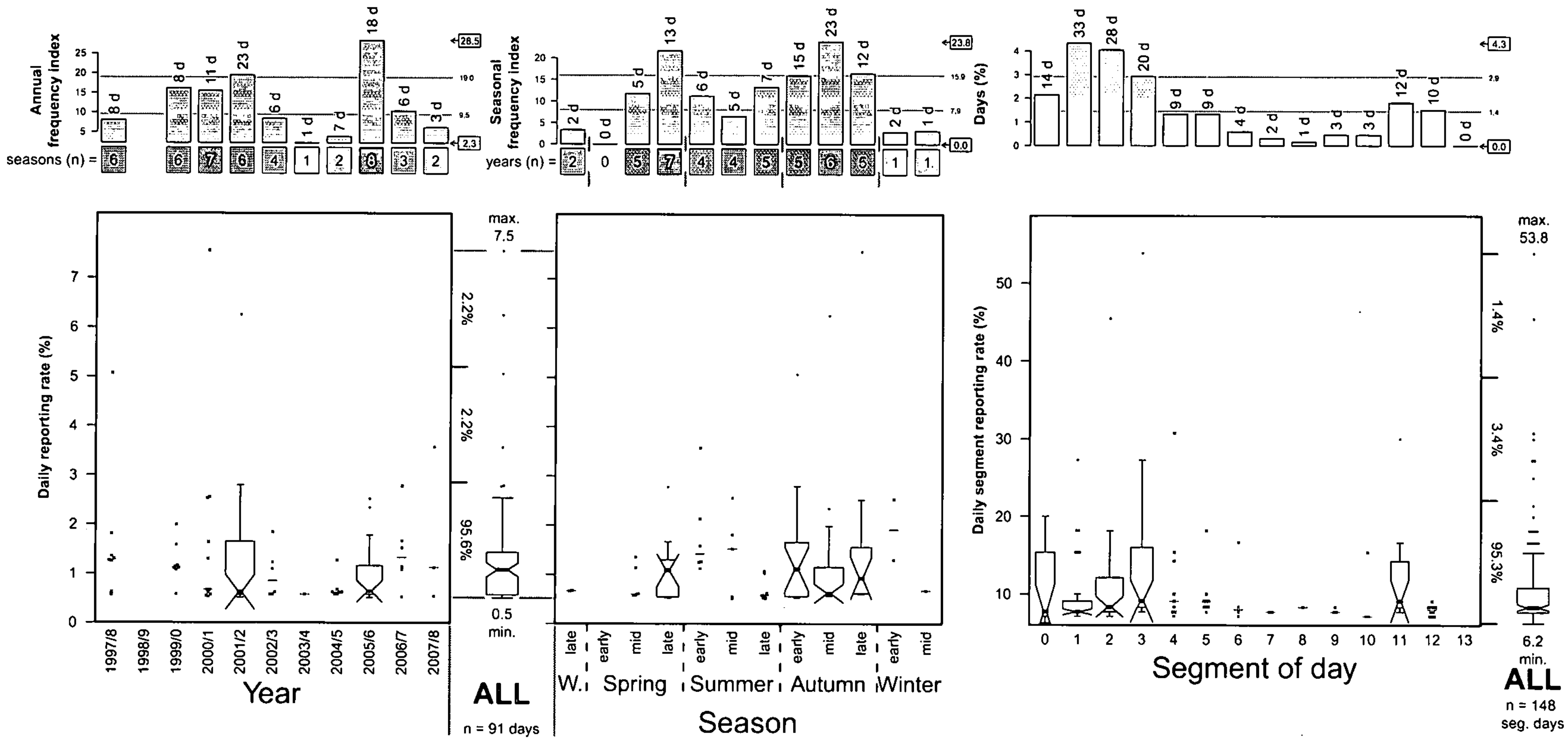


Figure 5.249: R743 Brown-crowned Tchagra — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

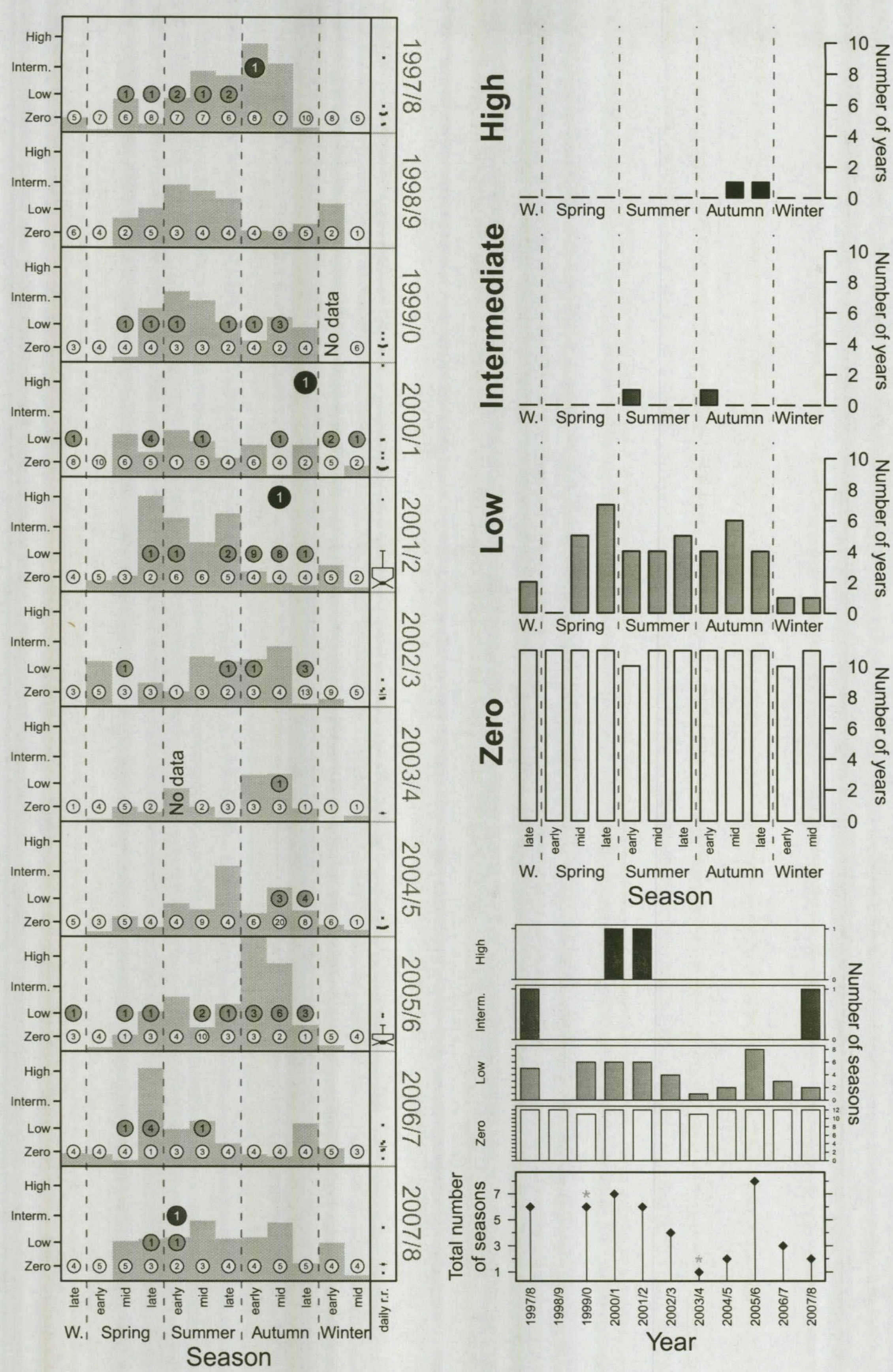


Figure 5.250: R743 Brown-crowned Tchagra — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

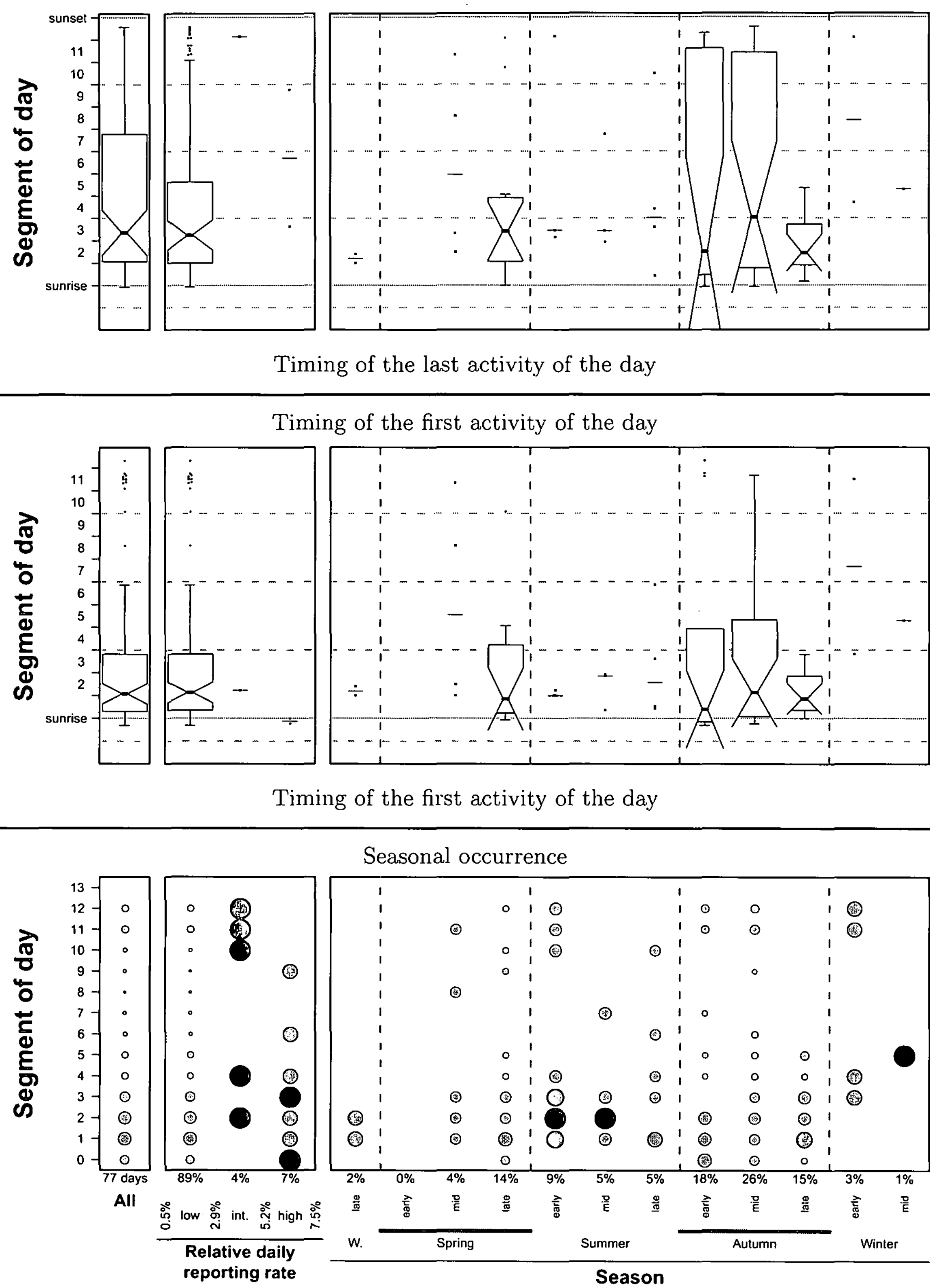


Figure 5.251: R743 Brown-crowned Tchagra — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

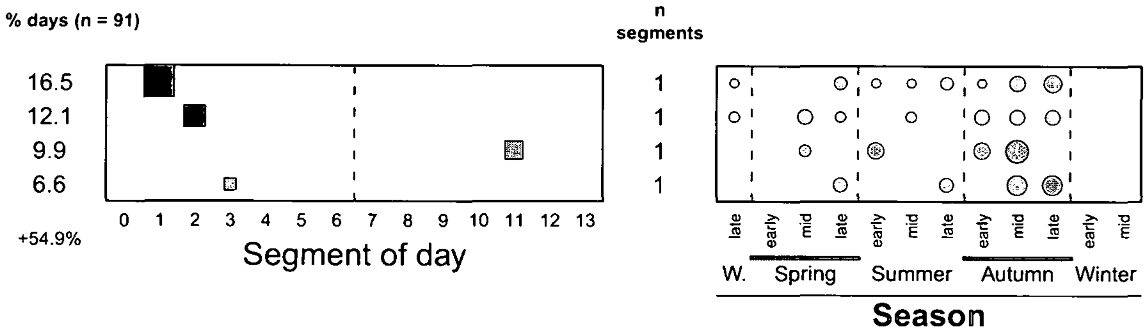


Figure 5.252: R743 Brown-crowned Tchagra — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

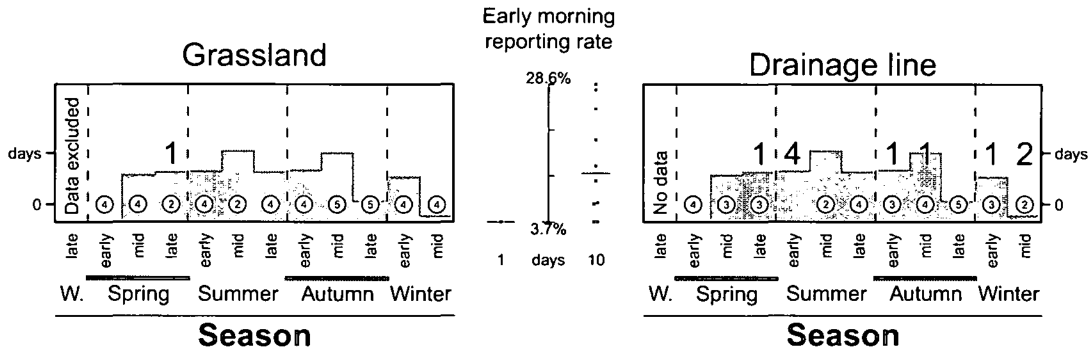


Figure 5.253: R743 Brown-crowned Tchagra — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. The seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates are illustrated. See page 136 for more information on this early morning figure.

Table 5.47: R746 Bokmakierie: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.999	41 937	114 612	36.6	birds heard	99.8	656	655	64
0.001	21	114 612	0.0	birds seen	3.0	656	20	1
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	646	1 190	54.3	birds heard	100.0	43	43	15
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	567	1 188	47.7	birds heard	97.7	43	42	14

Annual occurrence of drainage line birds heard in the grassland: With the exception of one day in mid-winter 1997/8, activity was noted on all the days with an activity index of 64 (Table 5.47a; Fig. 5.254). Daily reporting rates ranged from 0.6 to 81.8% with two thirds of the bird-days attaining intermediate or high reporting rates (Fig. 5.254). There was a more or less progressive increase in the incidence of high reporting rate days since the beginning of the study, coinciding with a progressive decrease in the incidence of low reporting rate days (Fig. 5.255). This coincided with median daily reporting rates that showed an increase from less than 30% in the beginning of the study to approximately 50% in the last few years (Fig. 5.254).

Seasonal occurrence of drainage line birds heard in the grassland: Recorded during all seasons each year (Fig. 5.254; Fig. 5.255). Median daily reporting rates also followed a clear seasonal pattern with a peak centred on autumn and lowest values during late winter, spring and early summer (Fig. 5.254). This pattern coincided with the frequent occurrence of high reporting rate days during autumn compared to the period from late winter to mid-summer when it was infrequent, with low reporting rate days following a complementary trend (Fig. 5.255).

Daily occurrence of drainage line birds heard in the grassland: Overall, activity was only marginally more frequent in the early morning and again in the late afternoon before sunrise, and least frequent after sunset (but still occurring on half the days!; Fig. 5.254). This general pattern was particularly prominent for low reporting rate days, but for intermediate and high reporting rate days activity was nearly equally frequent throughout the day, except after sunset when activity was still relatively less frequent (Fig. 5.256). Seasonally the pattern changed from autumn with its day-frequency pattern resembling that of intermediate and high reporting rate days, to late winter and early spring that most resembled the situation on low reporting rate days (Fig. 5.257). Two bird-segment combinations, involving all segments and S0–S12, occurred during more than 5% bird-days; these two combinations occurred most frequently during autumn and collectively they accounted for almost half of all bird-days (Fig. 5.258).

The first activity of the day usually occurred before sunrise, slightly earlier on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.257; Fig. 5.259). There is also a clear seasonal trend with activity often starting approximately 5–10 minutes earlier during late autumn than during spring and summer (Fig. 5.257; Fig. 5.259). The dawn chorus sequence followed a similar trend (Fig. 5.259).

The timing of the last activity of the day was also constant, typically occurring around sunset and slightly later on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.257; Fig. 5.259). Seasonally the timing was least variable during mid- and late autumn (Fig. 5.257; Fig. 5.259).

Overall, daily segment reporting rates ranged from 4.8 to 100% with more than half of the values intermediate or high (Fig. 5.254). Median daily segment reporting rates for low, intermediate and high reporting rate days were higher in the early morning after sunrise than later in the day, and particularly low before sunrise and after sunset (Fig. 5.256). Figure 5.260 illustrates the seasonal variation in daily segment reporting rates. Note in particular the correspondence between the patterns of autumn to mid-winter (Fig. 5.260) with those of high reporting rate days (Fig. 5.256) as well as those of spring and summer (Fig. 5.260) with those of low reporting rate days (Fig. 5.256).

Early morning occurrence of drainage line birds heard during 2007/8. The occurrence of activity was very similar in the drainage line and in the grassland (Table 5.47b & c; Fig. 5.261). The most notable difference involves the occurrence of high reporting rate mornings which were restricted to the period from mid-spring to early-autumn in the drainage line compared to the grassland where it occurred throughout the year (Fig. 5.261). Overall, the timing of the first activity of the day was more variable in the grassland than in the drainage line, but was nearly always recorded before sunrise in both habitats (Fig. 5.261). High activity intensities occurred more frequently after than before sunrise (Fig. 5.261).

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Birds seen in the grassland: Seen on 22 days spread over all years except 2004/5 (Fig. 5.262). These observations occurred during ten of the 12 seasons with no pertinent seasonal pattern (Fig. 5.262). Most frequently encountered in the early morning and in the late afternoon (Fig. 5.262).

Discussion

According to Oatley (2005a), egg-laying in the Bokmakierie mainly occurs from July to October [late winter and spring] followed by a complete post-breeding moult. At Glen, activity in the drainage line peaked from mid-spring to early summer and again from late summer to early autumn (Fig. 5.261). The former period was likely associated with breeding while the latter either coincides with or follows on moult. In the grassland the period with relatively low activity levels coincides with breeding and moulting, and the autumn centred peak represents post-moult activity (see Fig. 5.254; Fig. 5.255). It is possible that young birds practising their song contributed to peaks, but this needs verification.

The general increase in median daily reporting rates of the Bokmakierie over the years, particularly since the good rains of 2001/2 (Fig. 5.254), can possibly be related to bush encroachment — see the discussion of this topic on page 393. Apart from this indirect effect, it also appears that rainfall can have a more direct influence on activity. For example, the daily reporting rates during 2003/4 was generally lower than that attained during the previous year or in subsequent years (Fig. 5.254); 2003/4 was the driest year of the study (Fig. 2.13). This is in contrast to 2005/6, which was the wettest year of the study (Fig. 2.13) with half of the rain falling during early and mid-autumn (Fig. 2.18). It was the only instance where high reporting rate days continued into the next year, until late spring 2006/7 (Fig. 5.255).

5.16 Sturnidae: Starlings, Mynas, Oxpeckers

Of the 115 sturnids that occur in Eurasia, Africa, Madagascar and Australasia, 14 species is found in southern Africa (Hockey *et al.* 2005). Eight species occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b). Species not recorded in the study area include the Pale-winged Starling *Onychognathus nabouroup*, which is restricted to the southern parts of the

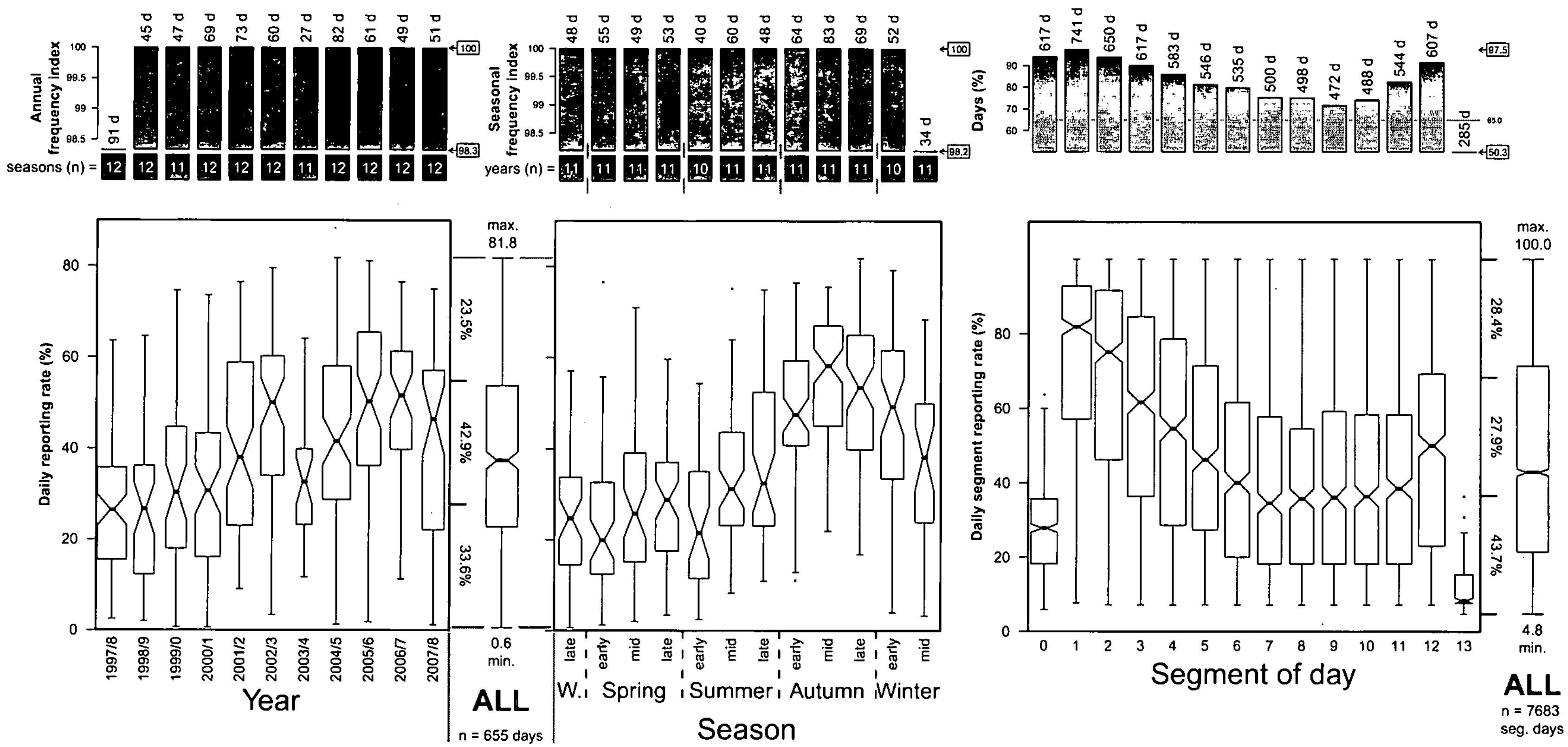


Figure 5.254: R746 Bokmakierie — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Figure 5.255: R746 Bokmakierie — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

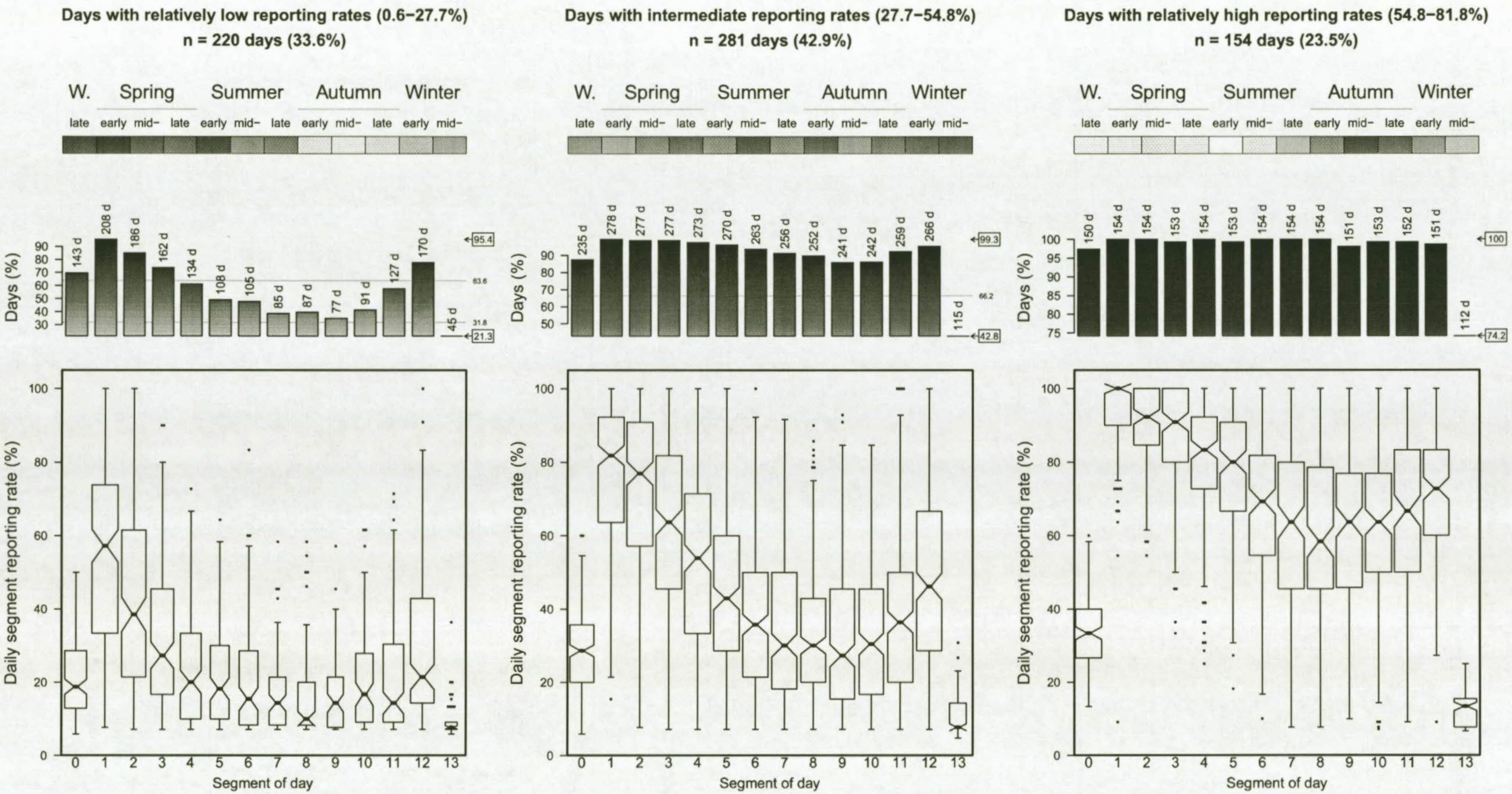


Figure 5.256: R746 Bokmakierie — birds heard: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

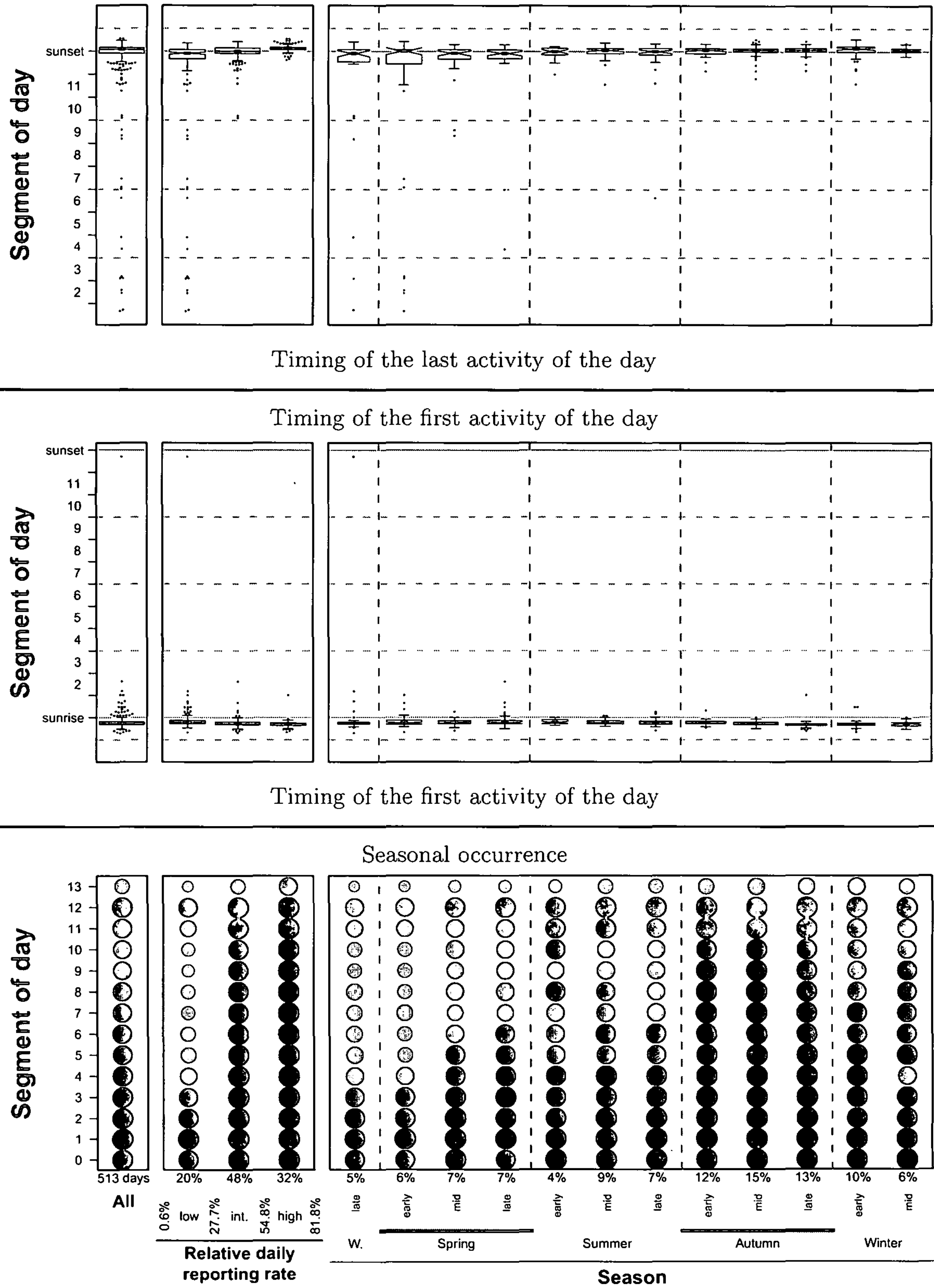


Figure 5.257: R746 Bokmakierie — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

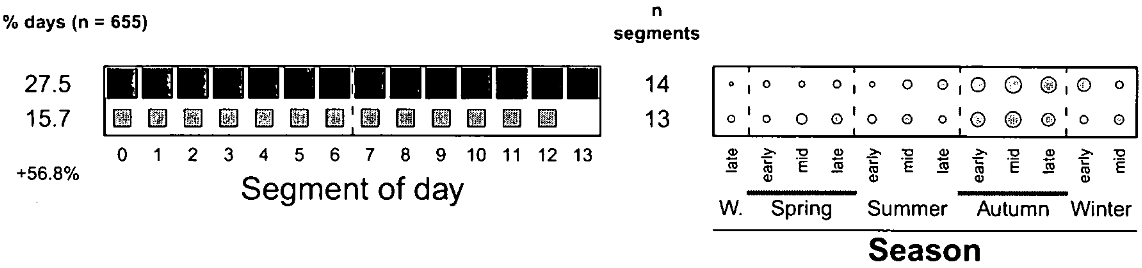


Figure 5.258: R746 Bokmakierie — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

province, the Violet-backed Starling *Cinnyricinclus leucogaster* occurring in the far eastern Free State, and the Common Starling *Sturnus vulgaris* and Common Myna *Acridotheres tristis*, both associated with human dwellings such as those found at Glen village.

Although seen after the study period under consideration here, it is noteworthy to mention that a single Red-billed Oxpecker *Buphagus erythrorhynchus* was recorded very close to the present study area in early autumn 2008/9.

R759 Pied Starling .... *Spreo bicolor*

The Pied Starling is endemic to South Africa, Lesotho and Swaziland (Craig 1997a). Widespread in South Africa, but absent from the east, north and arid north-west (Craig 1997a). It prefers karoo and grassland and is resident and mostly sedentary (Craig 1997a), but may occasionally occur in large nomadic flocks (Craig 2005c).

The birds at Glen

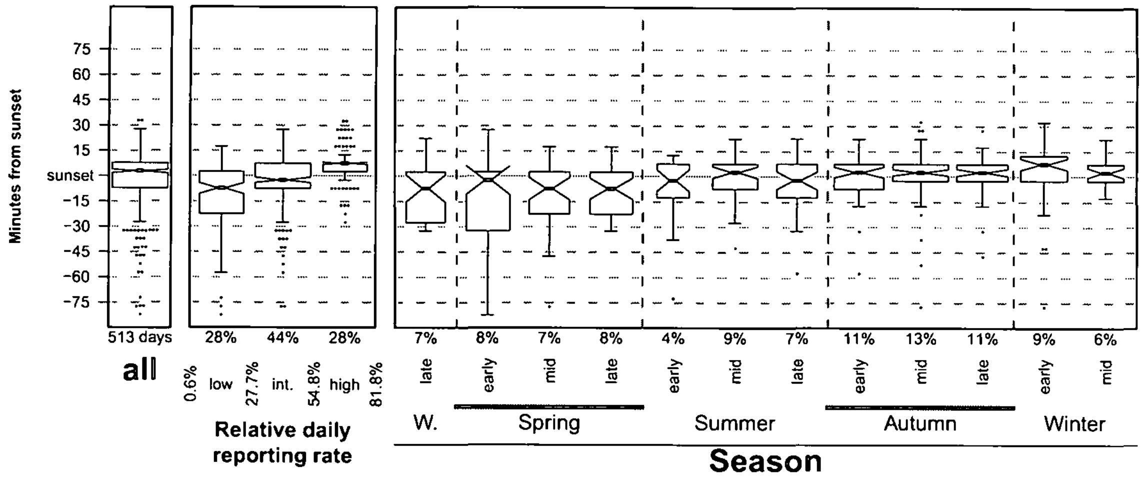
The Pied Starling is resident at Glen village. In the study area, mostly recorded as birds heard, with flocks of up to nine birds seen.

In the grassland, recorded on 25 days in eight years, mostly during 1–2 seasons per year, but during 5–6 seasons in 1997/8 and 2007/8 (Fig. 5.263, page 900). Noted during all seasons except late winter, with most seasons having records for 1–2 years, but recorded during four years in early winter (Fig. 5.263). Recorded in most segments between sunrise and sunset, most frequently in the early morning (Fig. 5.263).

During the early mornings of 2007/8, recorded during eight mornings in the drainage line (early summer, late autumn and early winter) compared to only two mornings in the grassland (mid-spring and early winter).

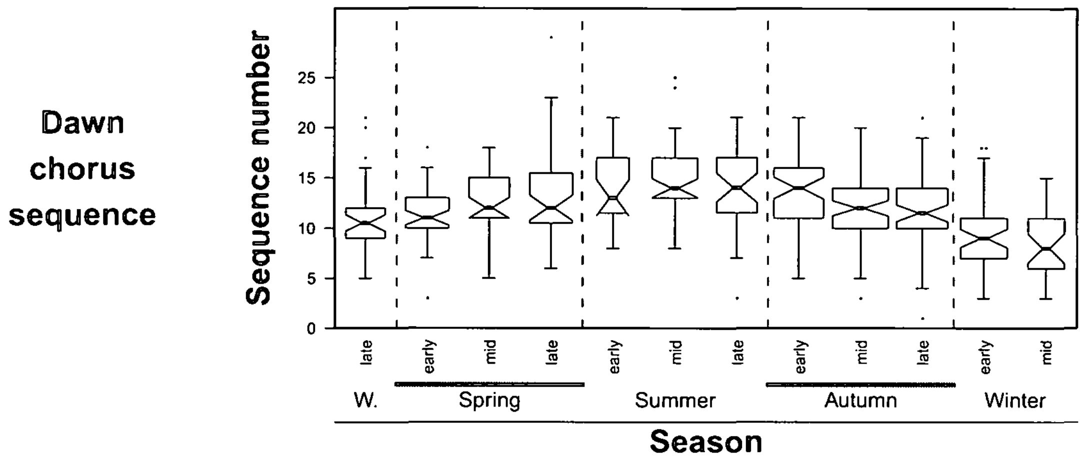
Discussion

The birds in the study area probably involved birds from Glen village on foraging excursions.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

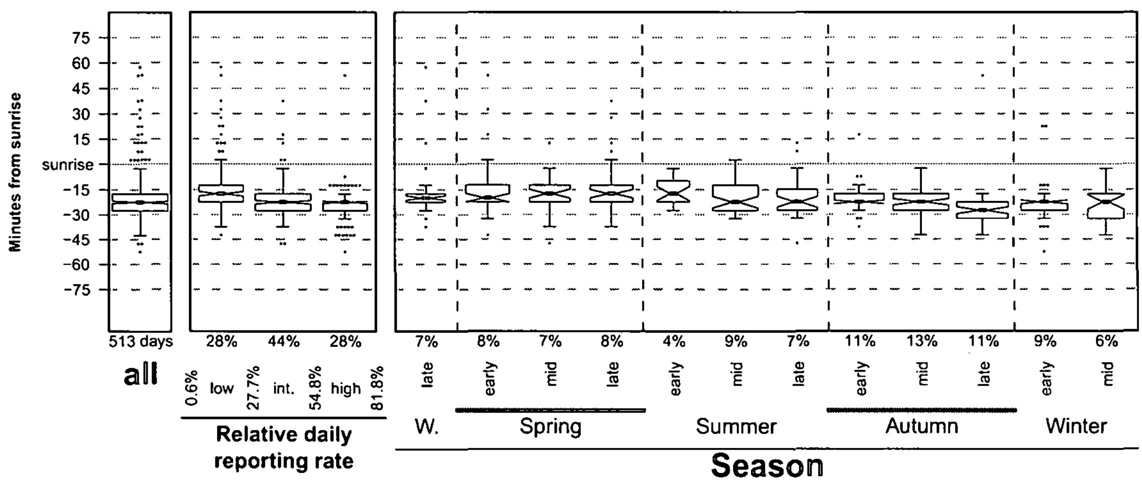


Figure 5.259: R746 Bokmakierie — birds heard: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

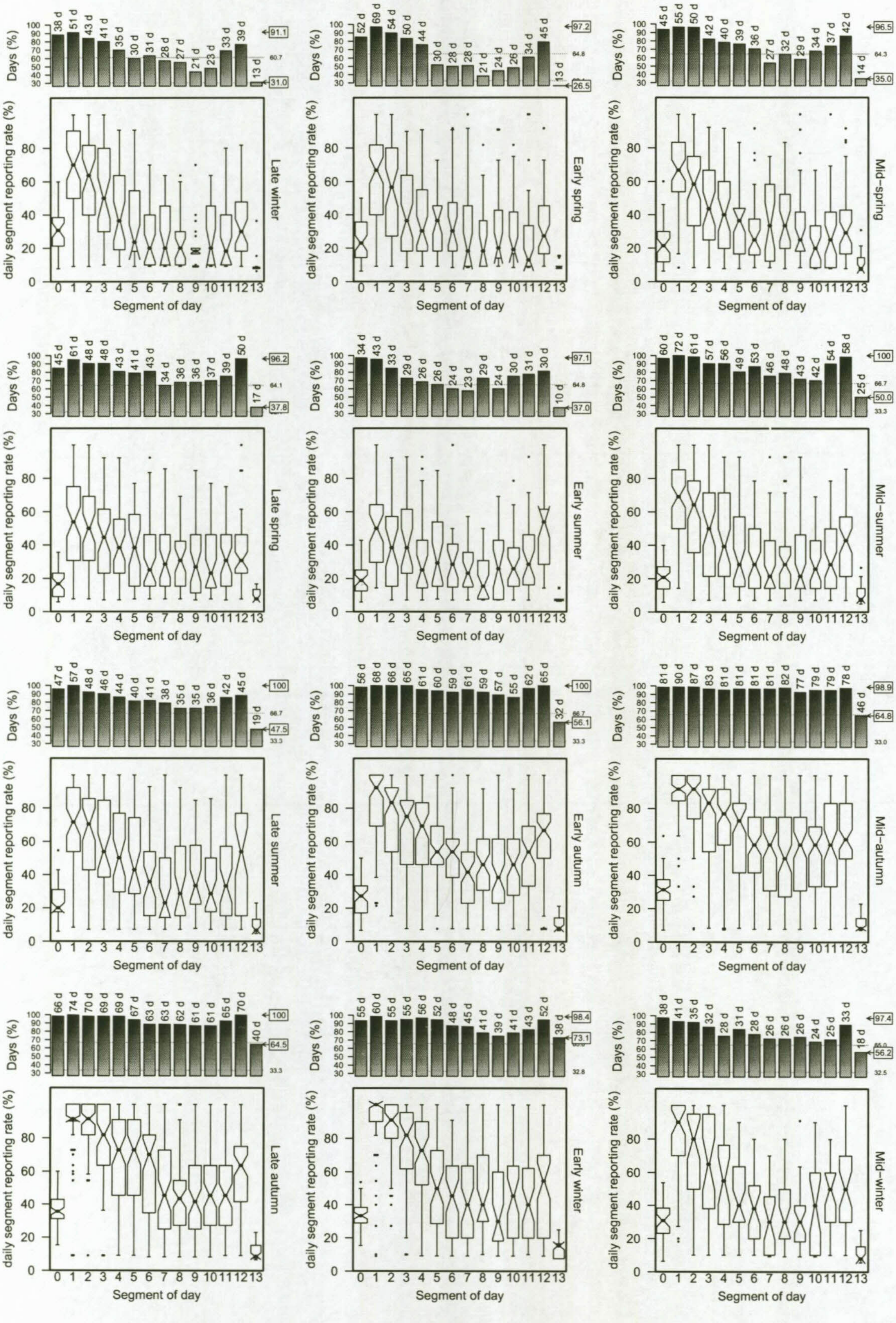


Figure 5.260: R746 Bokmakierie — birds heard: Seasonal fluctuations in daily occurrence in the grassland at Glen. See page 136 for more information on this seasonal detail figure.

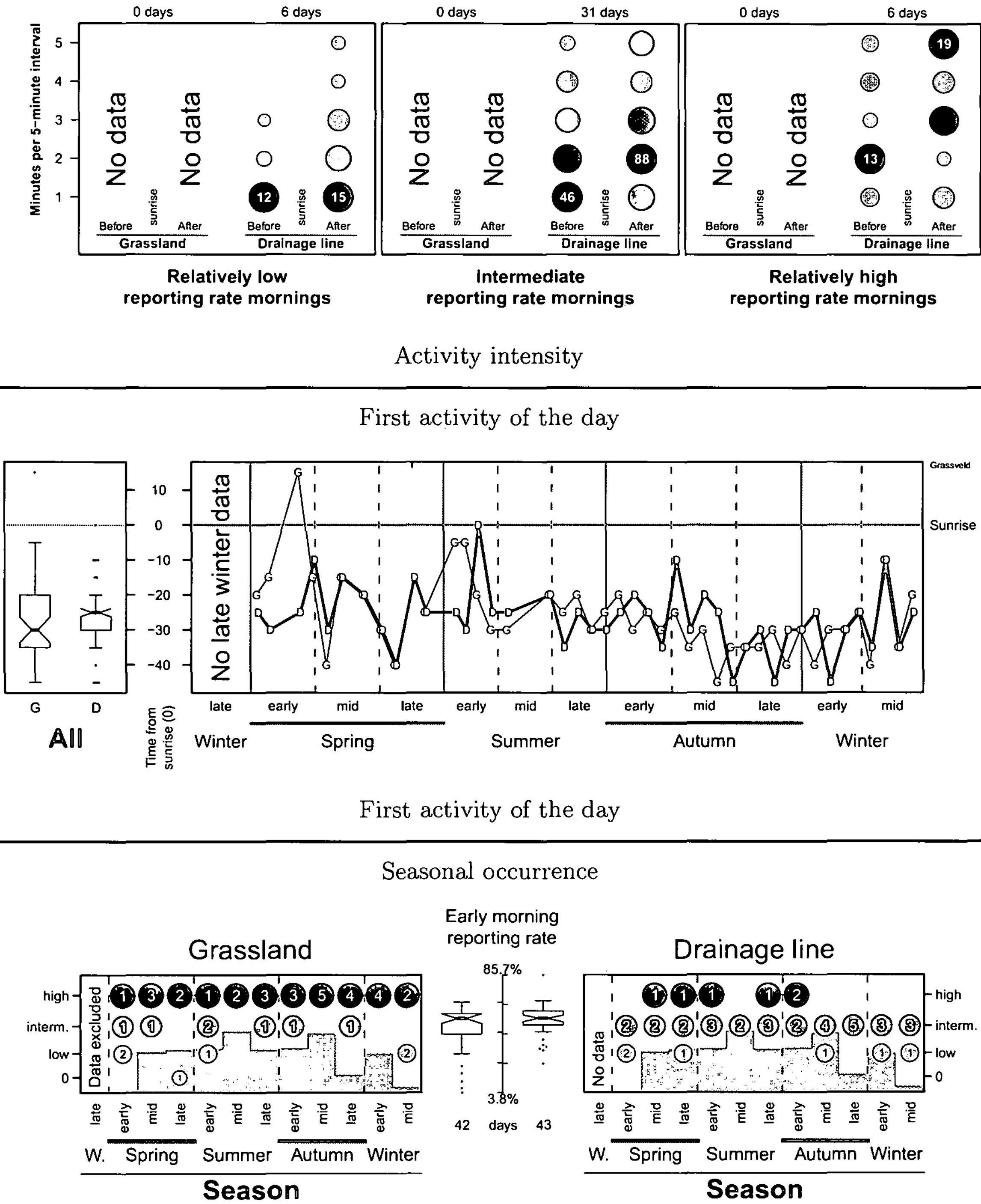


Figure 5.261: R746 Bokmakierie — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

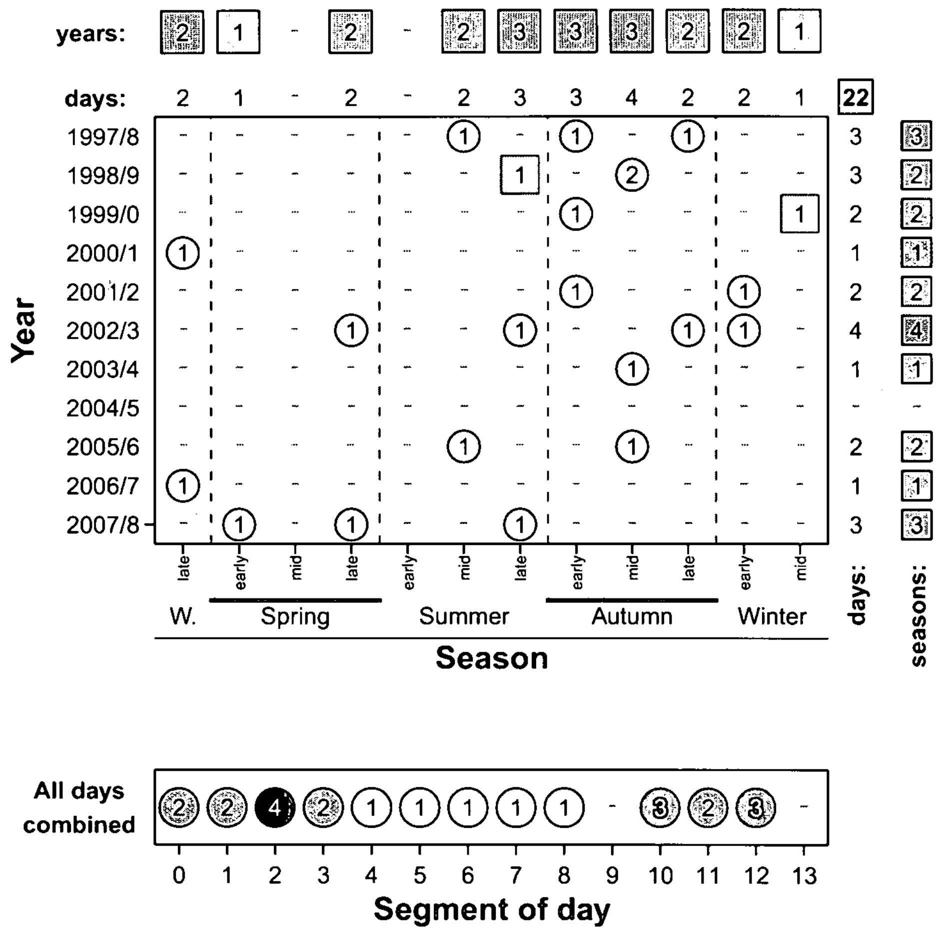


Figure 5.262: R746 Bokmakierie — birds seen: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R760 Wattled Starling .... *Creatophora cinerea*

The Wattled Starling occurs mainly in eastern and southern Africa, with winter records from the Arabian Peninsula, and vagrant records from western Africa, the Seychelles and Madagascar (Craig 2005d). Widespread in southern Africa with the western Free State being one of the regions in which it is most abundant; it is scarce in the eastern Free State (Craig 1992; Craig & Herremans 1997; Earlé & Grobler 1987). Nomadic, but more often recorded during the cooler times of the year in the Free State (Craig 1992; Earlé & Grobler 1987).

The birds at Glen

The Wattled Starling was closely associated with cattle. Recorded as flocks commuting to and from daily feeding grounds, which may include the study area if cattle were around. They also bred in the drainage line in early and mid-summer 2001/2, with at least 580 nests counted in 156 *Acacia karroo* trees. Figures start on page 902.

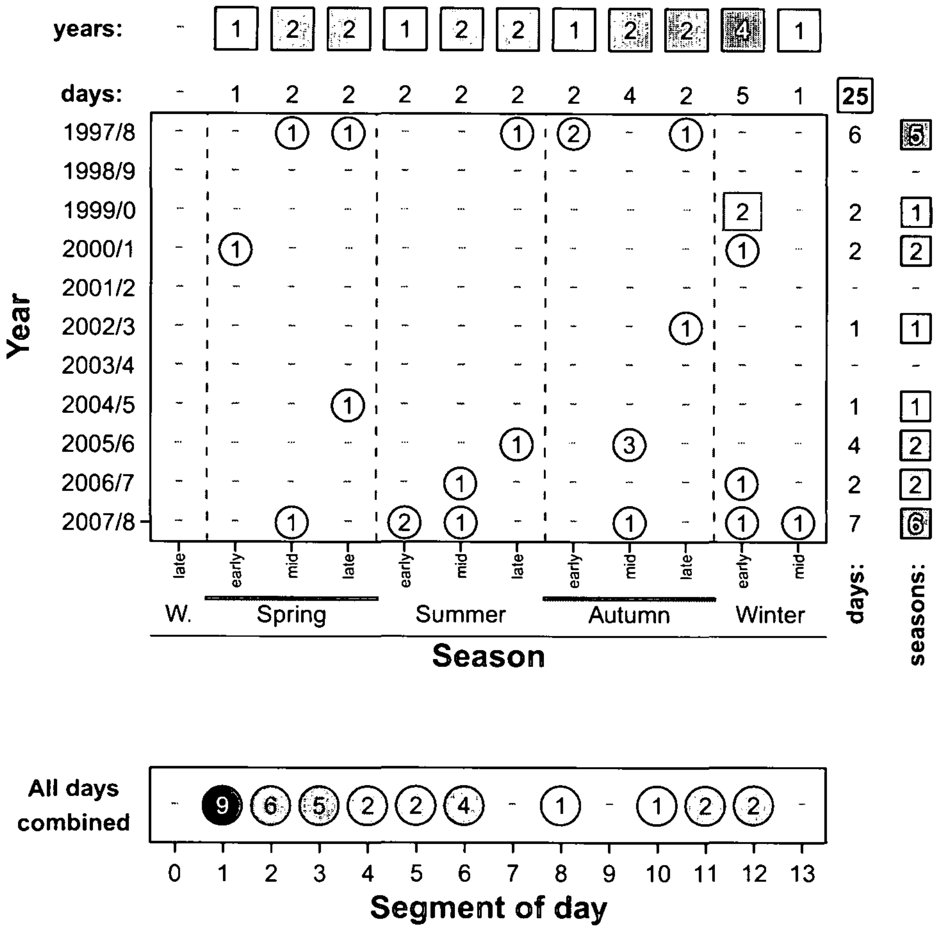


Figure 5.263: R759 Pied Starling — birds heard: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Annual occurrence of birds seen or heard in the grassland: Recorded on 32.0% of the days with an activity index of six (Table 5.48a). Usually recorded for 4–8 seasons each year, but during 10–11 seasons in 1997/8, 2000/1 and 2001/2 (Fig. 5.264; Fig. 5.265). Daily reporting rates ranged from 0.5 to 55.0% with 96.7% bird-days attaining low reporting rates (Fig. 5.264). Daily reporting rates were comparable between the years, however, intermediate and high reporting rate days were limited to 2001/2 when the birds bred in the drainage line (Fig. 5.264; Fig. 5.265).

Seasonal occurrence of birds seen or heard in the grassland: Recorded during 4–10 years each season, most frequently during late spring, late autumn and early winter, and least frequently during late summer and early autumn (Fig. 5.264). Median daily reporting rates were only marginally higher in certain seasons, and the upper daily reporting rate quartile of early summer was particularly high (Fig. 5.264). The occurrence of high and intermediate reporting rate days was limited to late spring, early and mid-summer 2001/2 when the birds bred in the drainage line (Fig. 5.264; Fig. 5.265).

Table 5.48: R760 Wattled Starling: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 170	114 612	1.0	birds present	32.0	656	210	6
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	82	1 190	6.9	birds present	55.8	43	24	3
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 188	0.4	birds present	9.3	43	4	1

Daily occurrence of birds seen or heard in the grassland: Overall, activity was most frequent in the early morning between sunrise and mid-morning as well as in the late afternoon before sunset (Fig. 5.264). This general pattern was the same for all seasons, except mid-summer when activity was most frequent in the late afternoon only (Fig. 5.266). Five bird-segment combinations involving single segments S1–S3 and S11–S12 occurred during more than 5% bird-days, and collectively they accounted for 42.9% of all bird-days (Fig. 5.267).

The first activity of the day mostly occurred in the earlier part of the morning after sunrise (Fig. 5.266). For most seasons the timing was also in the earlier part of the morning, the exceptions being mid-spring, mid-summer and mid-autumn when activity tended to start later in the day (Fig. 5.266). The timing of the last activity of the day was variable (Fig. 5.266).

Daily segment reporting rates ranged from 6.7 to 100% with 85.0% of the values relatively low; Median daily segment reporting rates were similar for all segments (Fig. 5.264).

Early morning occurrence of birds seen or heard during 2007/8: Activity was more frequent in the drainage line than in the grassland (Table 5.48b & c; Fig. 5.268). No activity occurred during summer in the drainage line, and in the grassland activity was restricted to late spring, late autumn and early winter (Fig. 5.268). The timing of the first activity of the day was variable, and typically recorded later in the grassland than in the drainage line (Fig. 5.268). Higher activity intensities were more frequent before sunrise (Fig. 5.268).

Discussion

In summer rainfall areas, egg-laying in Wattled Starlings usually occurs from January to March, and opportunistic breeding at other times are exceptional (Craig 1996, 2005d). At Glen, 2001/2 was such an exceptional year, with breeding commencing after abundant rains during November [late spring] of that year. Breeding was very well synchronised with reporting rates jumping from 1.6% when no birds were recorded in the drainage line on 3 November 2001 to 55.0% on 9 November when nest building commenced. There was a similarly spectacular conclusion, with reporting rates decreasing from 48.8% on 12 December to 1.1% on 19 December when the colony was abandoned. The combined incubation and nestling/fledgling period amounts to

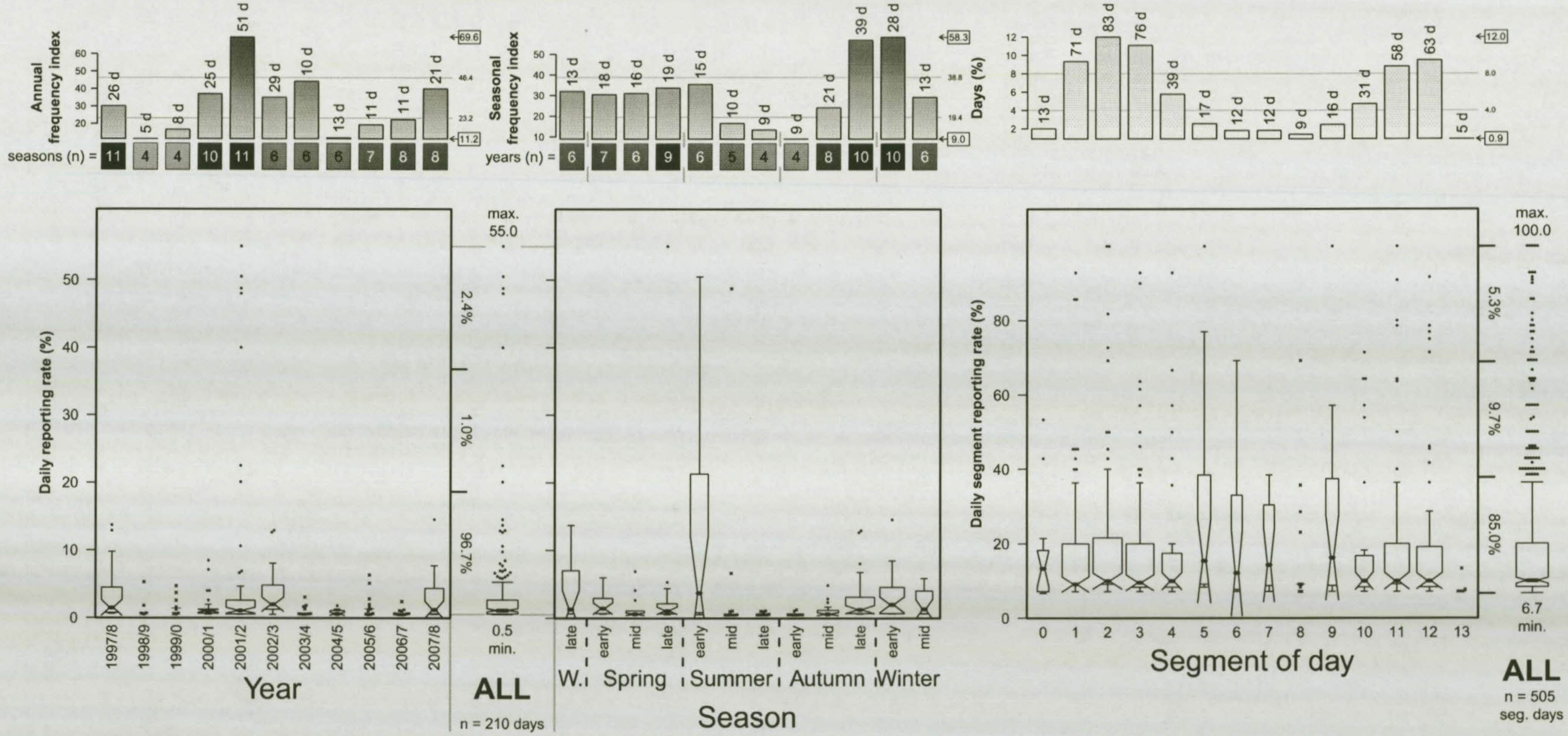


Figure 5.264: R760 Wattled Starling — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

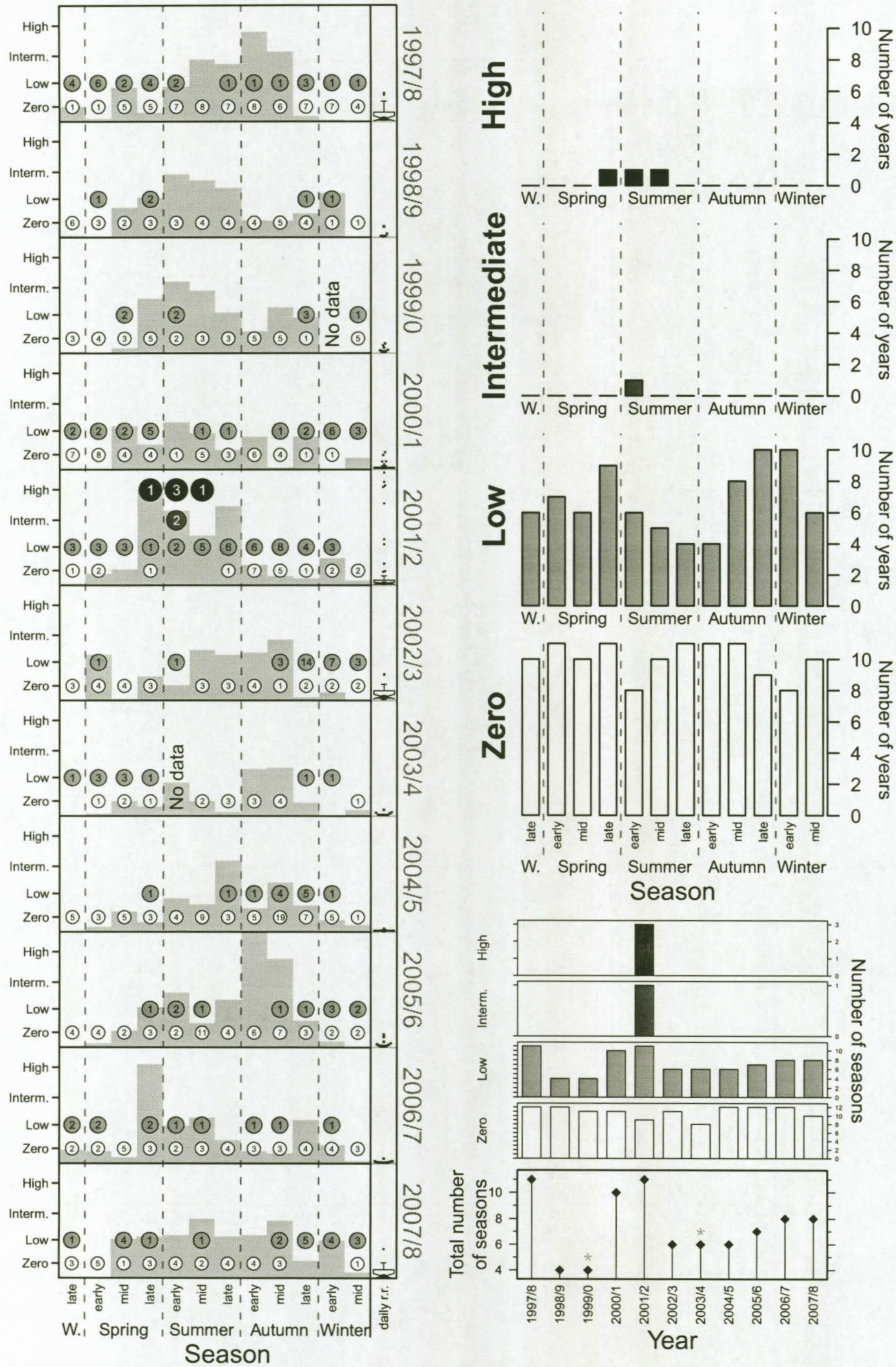


Figure 5.265: R760 Wattled Starling — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

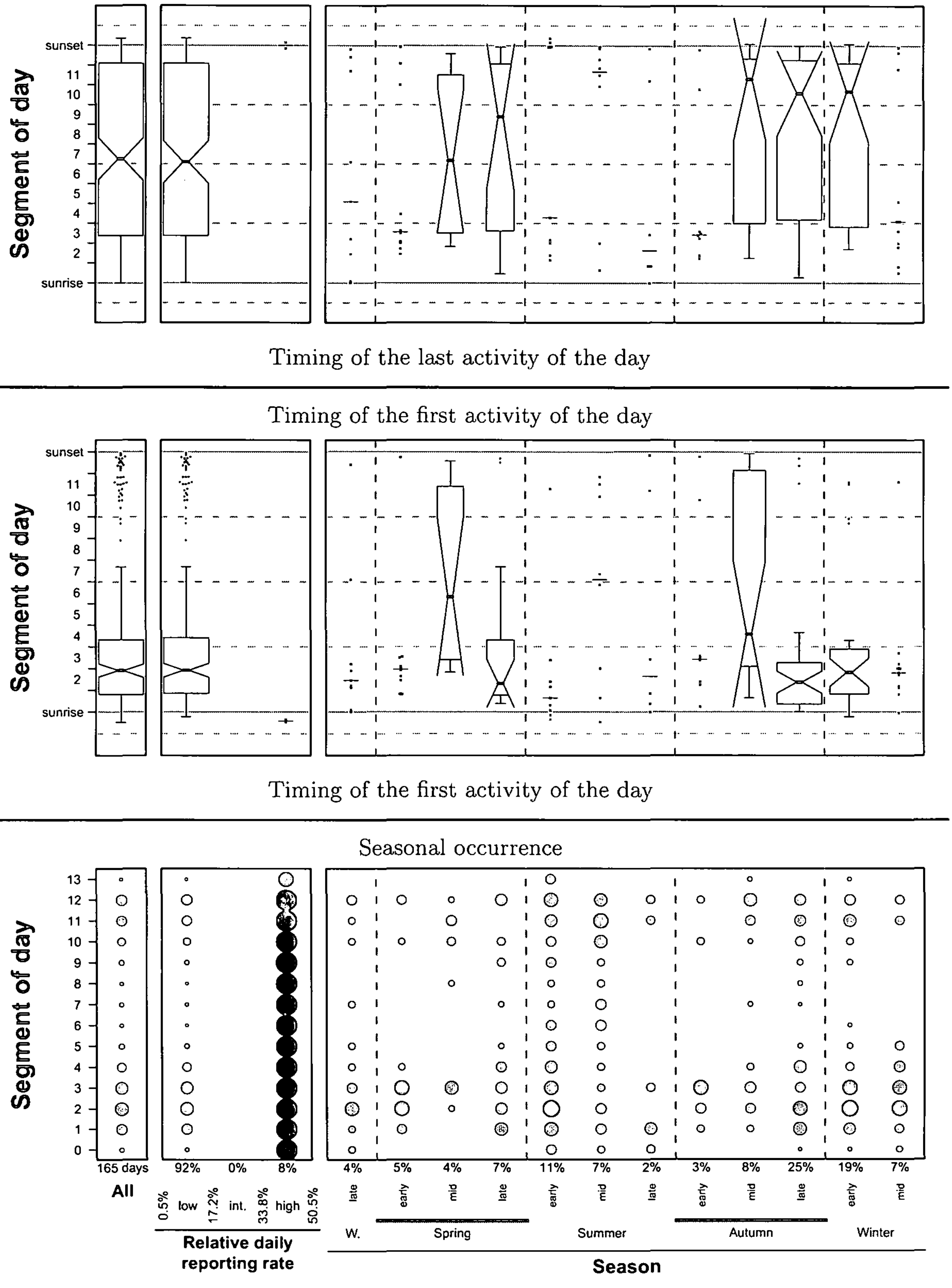


Figure 5.266: R760 Wattled Starling — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

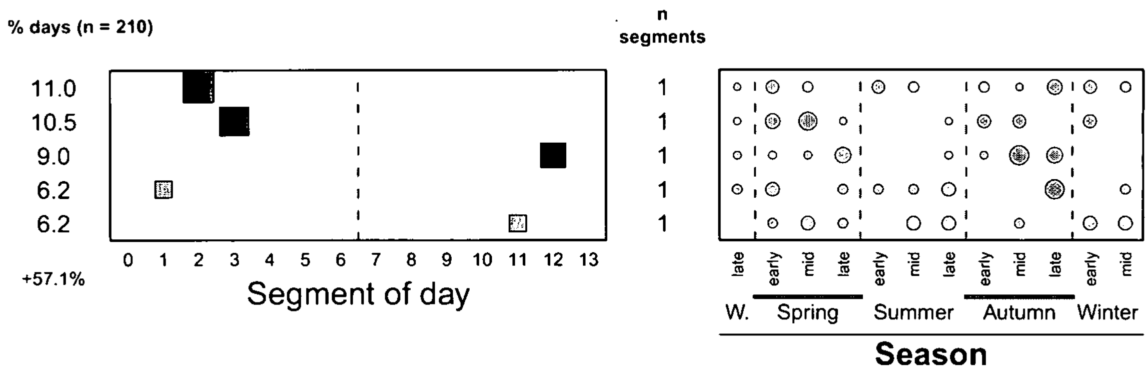


Figure 5.267: R760 Wattled Starling — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

approximately four weeks (Tarboton 2001), with the entire breeding event at Glen spanning five to six weeks.

Breeding is more seasonal than moult, and there is no evidence of overlap between these two activities which are probably regulated by a complex interaction between physiological mechanisms and environmental cues (Craig 1996).

R764 Cape Glossy Starling .... *Lamprotornis nitens*

The Cape Glossy Starling is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread except for much of the south-western and north-eastern parts of the region, and Lesotho (Craig 1997b). It is dependant on trees for nesting sites (Craig 1997b) and it is resident and sedentary (Craig 2005b).

The birds at Glen

The records include Cape Glossy Starlings that were seen and / or heard. In the grassland, recorded on 19 days spread over seven years, with most records during late autumn and winter (Fig. 5.269). Recorded during most segments between sunrise and sunset, most frequently during S12 (Fig. 5.269).

During the early mornings of 2007/8, recorded only in the drainage line on five mornings during early and mid-spring, late autumn and mid-winter.

Discussion

According to Craig (1997b, 2005b), the Cape Glossy Starling is resident and sedentary. The records at Glen, however, suggest that the birds may undergo local movements, which seem to follow on moult. According to Craig (1983b), breeding peaks during October and November [mid-spring to early summer] followed by a complete post-breeding moult from December to May [summer, autumn and early winter].

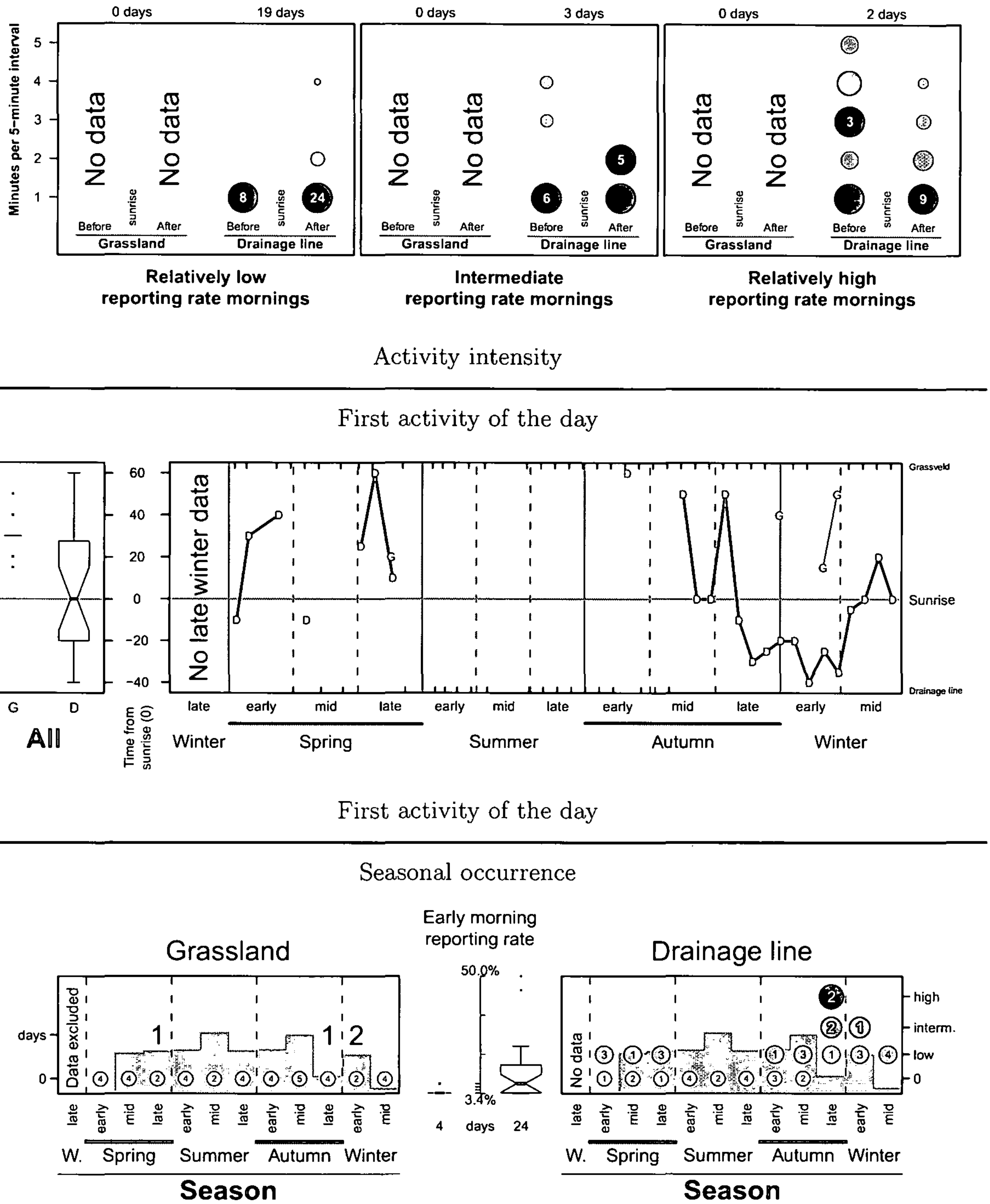


Figure 5.268: R760 Wattled Starling — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

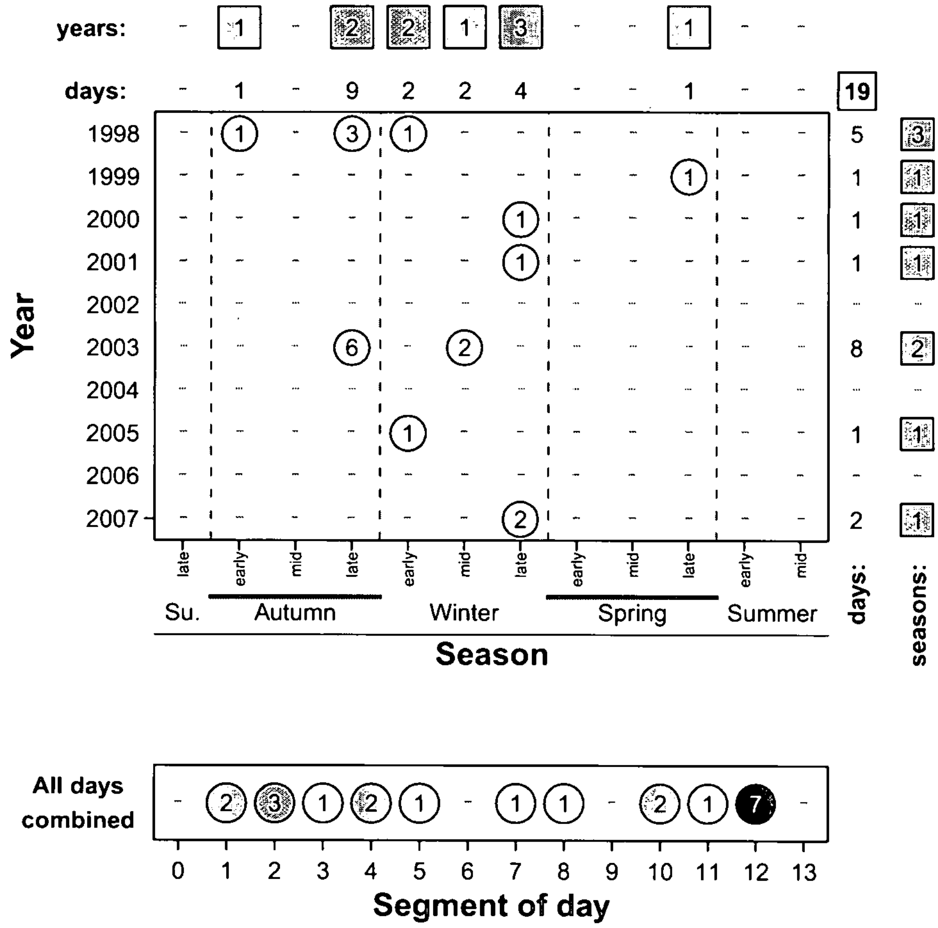


Figure 5.269: R764 Cape Glossy Starling — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R769 Red-winged Starling . . . . *Onychognathus morio*

The Red-winged Starling is endemic to sub-Saharan Africa (Craig 1997c). In southern Africa it occurs from the Cape eastwards through the southern and eastern Free State, Lesotho, Swaziland and Zimbabwe (Craig 1997c); it is scarce in southern Mozambique (Parker 1999). Associated with cliffs, rocky areas and buildings (Maclean 1985). It is a resident with local movements, particularly during winter (Craig 1997c, 2005a).

The birds at Glen

Not yet positively identified in the study area. A possible vocal record in early autumn 2005/6.

5.17 Nectariniidae: Sunbirds

Sunbirds, of which there are 168 species, occur in Africa, Asia and Australasia, with 21 occurring in southern Africa (Hockey *et al.* 2005). Six species occur in the Free State of which three are found in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). The study area is situated on the edge of the Malachite Sunbird's *Nectarinia famosa* and the Dusky Sunbird's *Cinnyris fuscus* distributions. Only the White-bellied Sunbird R787 was recorded at Glen.

R787 White-bellied Sunbird .... *Cinnyris talatala*

The White-bellied Sunbird is endemic to Africa south of the equator (Maclean 1985). In southern Africa it occurs in the north and north-eastern quarter of the region (Parker 1999; Tree 1997e), with the study area at the southern limit of their distribution in the Free State. It frequents a wide range of woodland habitats (Tree 1997e). The complex movements of this species are probably influenced by the previous season's rainfall with the population consisting of resident, nomadic and migratory elements (Tree 1997e, 2005b). Birds breeding in the western parts of its range apparently move into the more mesic areas in the east during "winter" (Tree 2005b). Recorded in Bloemfontein during the cooler seasons in some years (DJvN personal observation).

The birds at Glen

Seen in the hills at Glen and once heard in early autumn 2007/8 in the drainage line.

5.18 Zosteropidae: White-eyes

A total of 96 white-eye species occur in Africa, Asia, Australasia and Oceania with three found in southern Africa (Hockey *et al.* 2005). The two species occurring in the Free State (Bowie 2005b; Smith & Bowie 2005) were, until recently, regarded as one species (Maclean 1993; Nuttall 1997d), but according to Bowie (2005b) the Orange River White-eye *Z. pallidus* is genetically distinct from the Cape White-eye *Z. virens.* The distribution of the two species overlaps extensively, including the greater part of the Free State (Bowie 2005b; Smith & Bowie 2005). Both species were recorded at Glen.

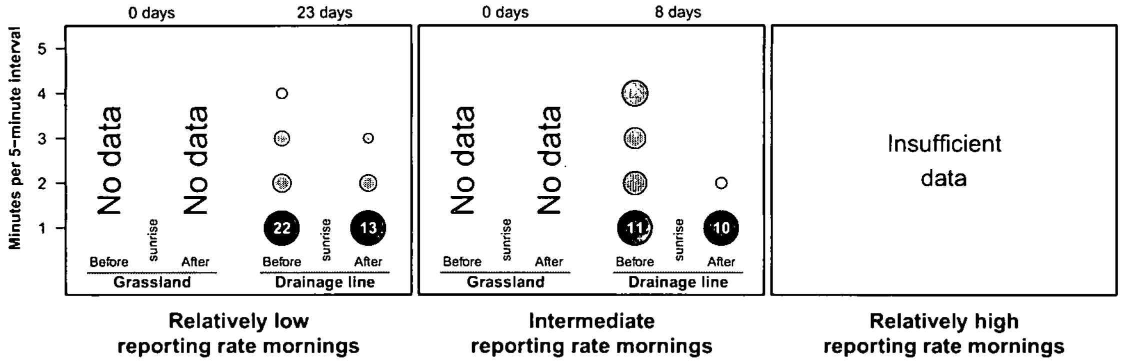
R796a Orange River White-eye .... *Zosterops pallidus*

The Orange River White-eye is endemic to southern Africa, occurring from Lesotho westwards and also recorded from scattered localities in Namibia (Bowie 2005b). They occur in a variety of habitats with a tree component (Bowie 2005b). Generally considered to be resident and sedentary (Bowie 2005b; Maclean 1985; Nuttall 1997d).

The birds at Glen

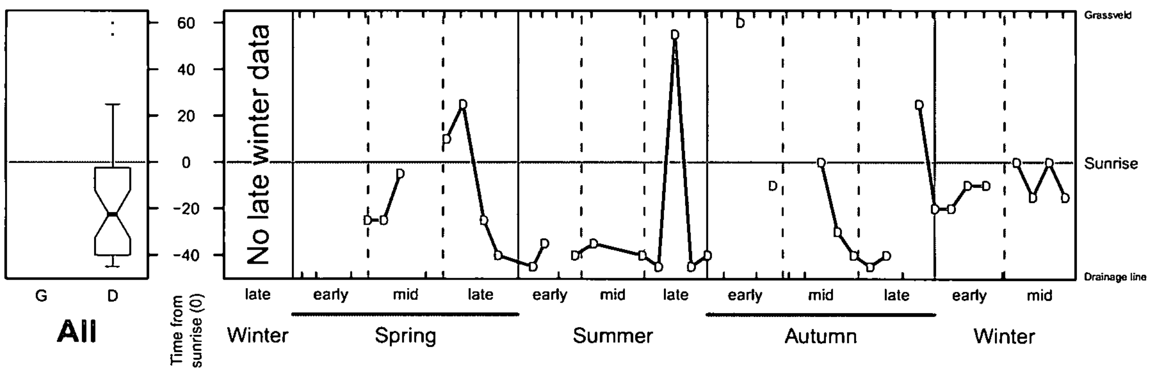
The Orange River White-eye is confined to the drainage line. Heard in the grassland only twice: early spring 1997/8 and late winter 2004/5.

Early morning occurrence of birds during 2007/8: Recorded throughout the year in the drainage line (Fig. 5.270□). Occurrence of the first activity of the day is variable, but usually before sunrise (Fig. 5.270□). Activity intensities higher than two minutes per five minute interval were mostly limited to the time before sunrise (Fig. 5.270□).



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

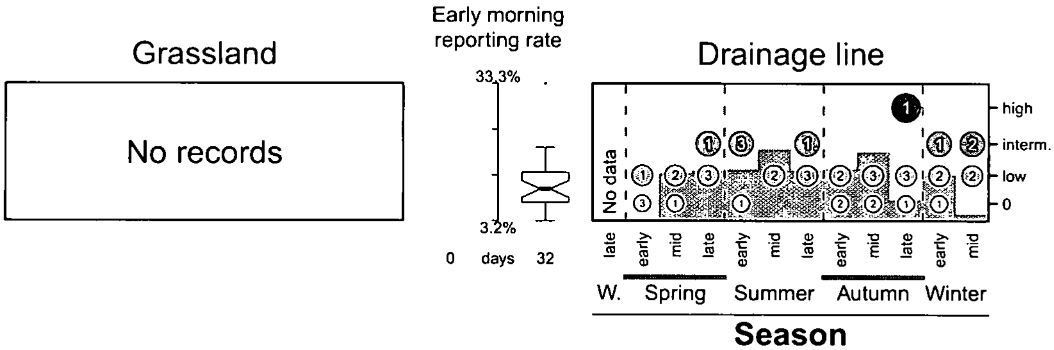


Figure 5.270: R796a Orange River White-eye — birds heard: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Discussion

Orange River White-eye breeding occurs from October to March [mid-spring to mid-autumn] (Bowie 2005b). There appears to be no published data on moult (Bowie 2005b). Limited data from birds ringed in the central Free State suggests that it starts in late summer (DJvN unpublished data), implying a post-breeding moult. The activity patterns in the drainage line at Glen shows no definite pattern (Fig. 5.270).

R796b Cape White-eye .... *Zosterops virens*

The Cape White-eye is endemic to southern Africa, occurring from the Cape eastwards and then northwards through the Free State, Lesotho, Swaziland to the north of South Africa; also in south-eastern Botswana (Smith & Bowie 2005). They occur in a variety of habitats with a tree component and are generally considered to be resident and sedentary (Smith & Bowie 2005).

The birds at Glen

Confined to the drainage line where recorded only once in mid-autumn 2007/8.

5.19 Ploceidae: Weavers, Queleas, Widowbirds

A total of 116 Ploceidae species occur in Africa, Madagascar and Asia, with 29 species occurring in southern Africa (Hockey *et al.* 2005). Approximately half of these species are found in the Free State of which eight occur in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). In this latter group, all except the Cape Weaver *Ploceus capensis* were recorded at Glen. In addition, the Sociable Weaver R800, a species normally occurring in the north-western Free State, was also recorded.

R799 White-browed Sparrow-Weaver .... *Plocepasser mahali*

The White-browed Sparrow-Weaver is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it occurs from the north, southwards to the Free State, with and isolated population in the Eastern Cape; absent from the eastern parts of southern Africa (Colahan 1997d). Nesting trees are usually at the ecotone between two habitats, the one with reduced ground cover for foraging and the other having good ground cover for providing nesting material (Vernon 1983). Nests are used for both breeding and roosting, having two entrances in the case of the latter (Vernon 1983). Resident (Colahan 1997d; Milstein 1975).

The birds at Glen

Nesting trees are situated approximately 1 km south, west and north of the study area and most, if not all, of the records probably involve these birds, which were always heard only. The analysis is based on a year starting in late summer. Figures start on page 913.

Annual occurrence of birds heard in the grassland: Activity was noted on 73.8% of the days, with an activity index of ten (Table 5.49a). There was a progressive increase in the number of bird-seasons per year (and the annual frequency index), starting with nine bird-seasons in 1998 and reaching a maximum of 12 bird-seasons in 2002 (Fig. 5.271; Fig. 5.272). This coincided with a general increase in median daily reporting rates (Fig. 5.271) concomitant with a decrease in the occurrence of zero record days and an increase in the incidence of intermediate reporting rate days (Fig. 5.272). Median daily reporting rates were highest in 2003, and together with 2005 were the only years with high reporting rate days (Fig. 5.271; Fig. 5.272). In spite of fluctuations in daily reporting rates (Fig. 5.271), the birds were recorded consistently during 11–12 seasons each year since 2001 (Fig. 5.271; Fig. 5.272).

Table 5.49: R799 White-browed Sparrow-Weaver: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	5 009	114 612	4.4	birds heard only	73.8	656	484	10
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 190	0.1	birds heard only	2.3	43	1	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	77	1 188	6.5	birds heard only	34.9	43	15	5

Seasonal occurrence of birds heard in the grassland: Recorded during all or most seasons each year, least frequently during late spring when recorded during seven years (Fig. 5.271). Median daily reporting rates peaked in late autumn and were lowest during spring and summer (Fig. 5.271), coinciding with the occurrence of high and intermediate reporting rate days centred on late autumn (Fig. 5.272). Zero record days were most frequent from late spring to mid-summer (Fig. 5.272).

Daily occurrence of birds heard in the grassland: Overall, activity was most frequently recorded in the early morning and in the late afternoon before sunset (Fig. 5.271). This general pattern is most applicable to low reporting rate days; for intermediate and high reporting rate days activity was very frequent throughout the day, except after sunset when it was relatively infrequent (Fig. 5.273). Seasonally, activity was most frequent in the early morning and in the late afternoon during most seasons, except from late spring to mid-summer when early morning activity was relatively infrequent (Fig. 5.274). No bird-segment combination occurred during more than 5% bird-days.

The first activity of the day typically occurred before sunrise on intermediate and high reporting rate days and often after sunrise on low reporting rate days (Fig. 5.274; 5.275). There is a well-defined seasonal pattern with activity starting earliest during late autumn and latest during early summer (Fig. 5.274; Fig. 5.275). The dawn chorus sequence follows a very similar pattern (Fig. 5.275).

The last activity of the day usually occurred around sunset on intermediate and high reporting rate days and earlier in the day on low reporting rate days (Fig. 5.274; Fig. 5.275). Seasonally it normally occurred around sunset in late autumn and earlier in other parts of the year, particularly during late winter, spring and summer (Fig. 5.274; Fig. 5.275).

Overall, daily segment reporting rates ranged from 5.6 to 100% with 86.3% of the values relatively low (Fig. 5.271). Except for the relatively low values of the segment after sunset, S13, median daily segment reporting rates varied little for other segments (Fig. 5.273).

Early morning occurrence of birds heard during 2007/8: In spite of activity occurring during 34.9% of the mornings in the grassland, birds were heard in the drainage line only once (Table 5.49b & c).

Discussion

In the Free State, breeding in the White-browed Sparrow-Weaver mainly occurs from September to February [spring, summer and early autumn] (Maclean 1985). Moult starts mainly from late November to early December and lasts approximately six months [summer, autumn and early winter] (Du Plessis 2005d). It appears, therefore, that the late autumn peak in activity recorded in the grassland at Glen (Fig. 5.271) may be associated with the end of moult.

R800 Sociable Weaver .... *Philetairus socius*

The Sociable Weaver is endemic to southern Africa, occurring in South Africa from the north-western Free State westwards and north into Namibia and south-western Botswana (Mendelsohn & Anderson 1997). It is dependant on open savanna grassland with large trees suitable for building their huge nests (Mendelsohn & Anderson 1997), and it is sedentary (Spottiswoode 2005b).

The birds at Glen

Recorded twice in the grassland. A group of six birds was seen on 22 January 2005 (late summer) and nearly eight months later, on 7 September 2005 (early spring), an unrecorded number of birds were seen again.

Discussion

The records at Glen are a few tens of kilometres south-east of the Sociable Weaver's known range.

Note: The current classification of the Ploceidae (Hockey *et al.* 2005) is different from that presented in Maclean (1985), whose order is followed here for practical reasons. Consequently, the family is continued on page 928.

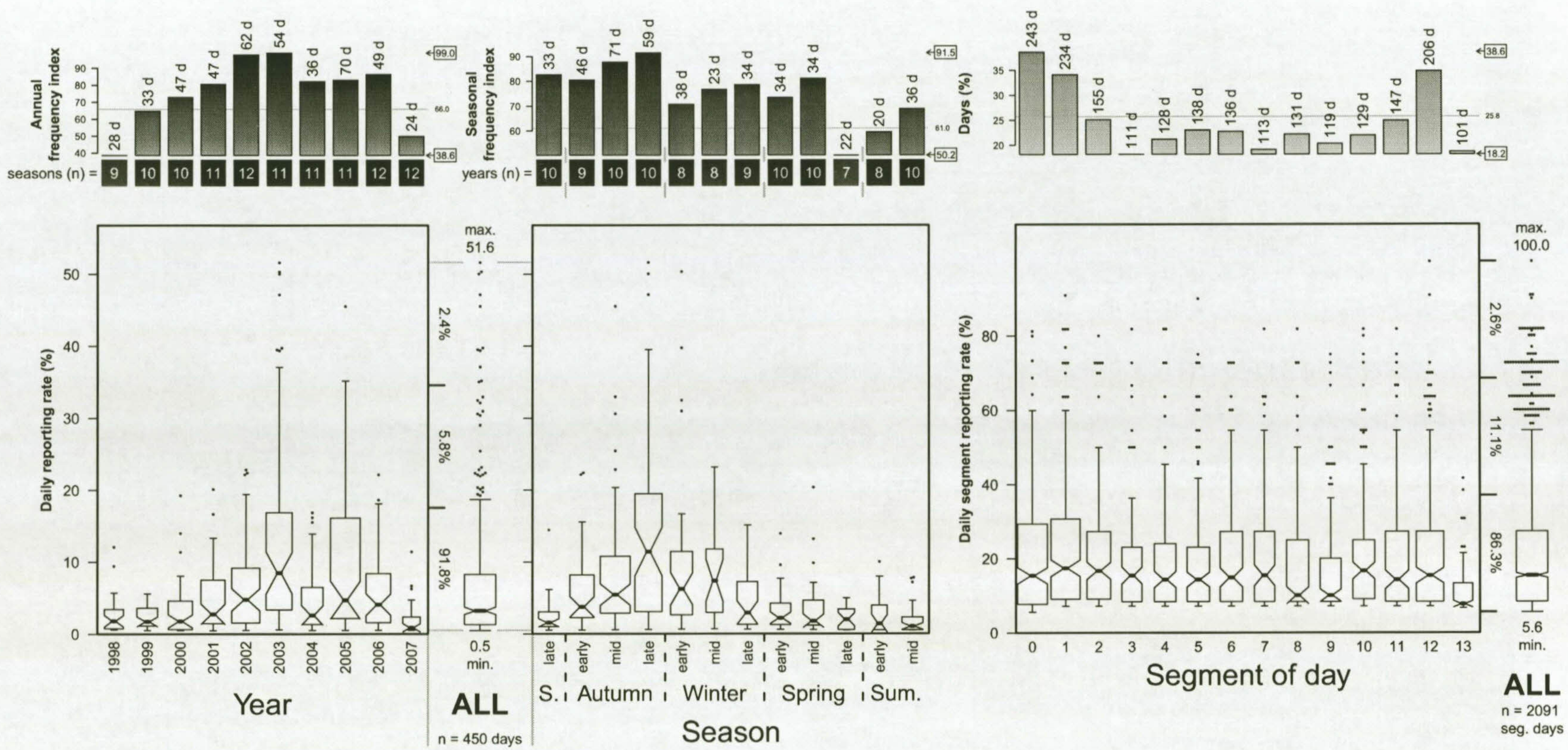


Figure 5.271: R799 White-browed Sparrow-Weaver — birds heard only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

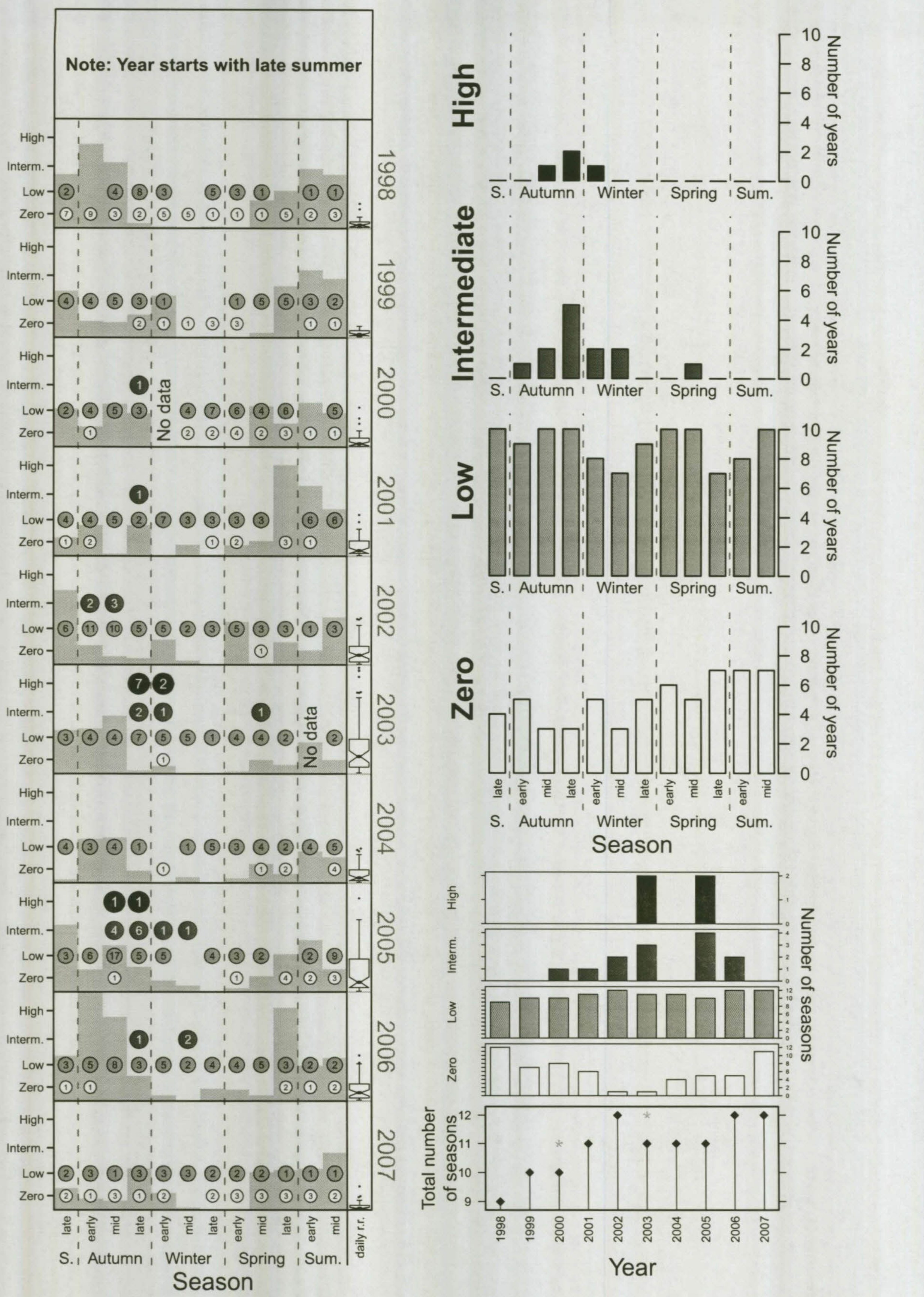


Figure 5.272: R799 White-browed Sparrow-Weaver — birds heard only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

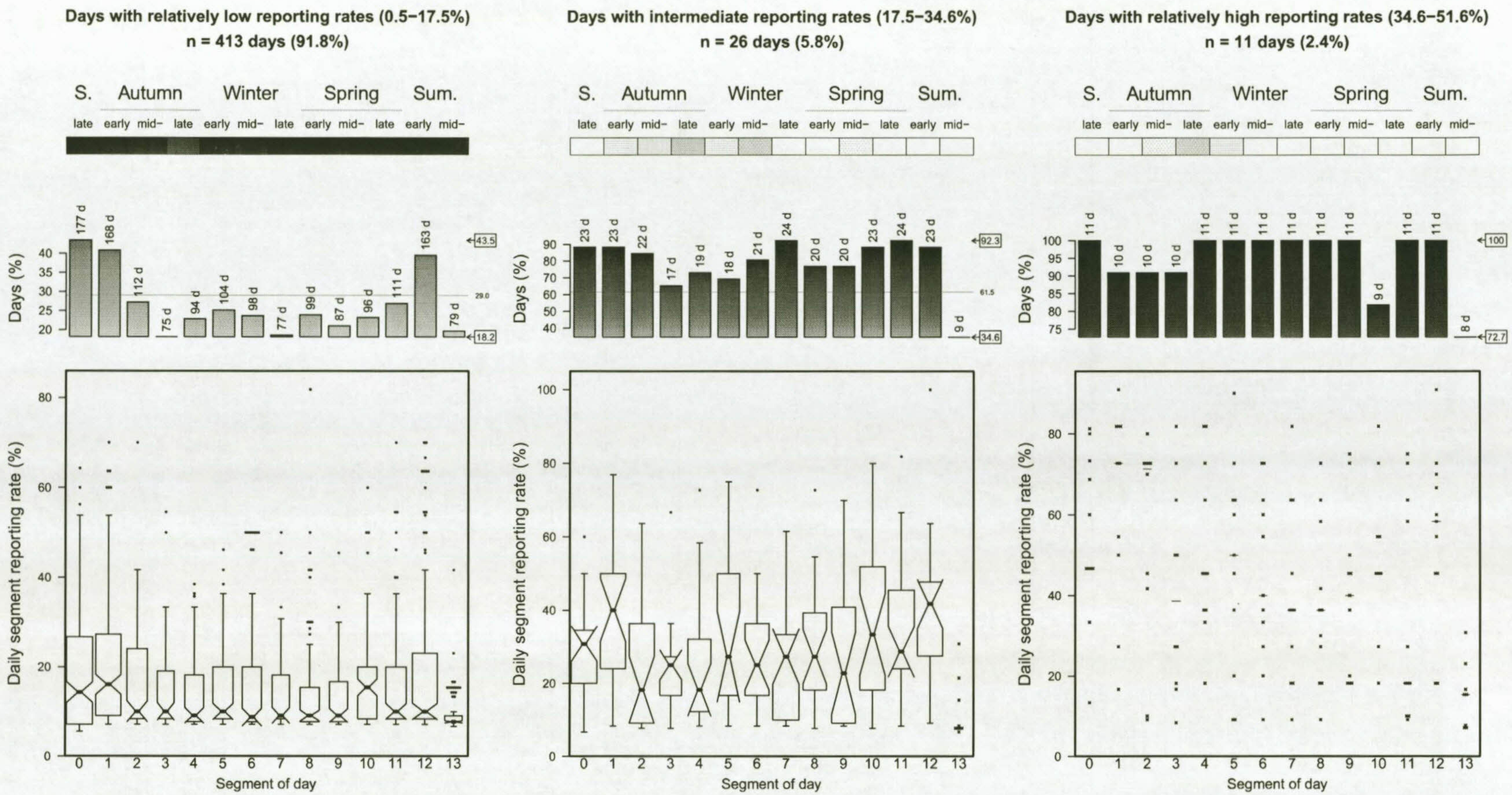
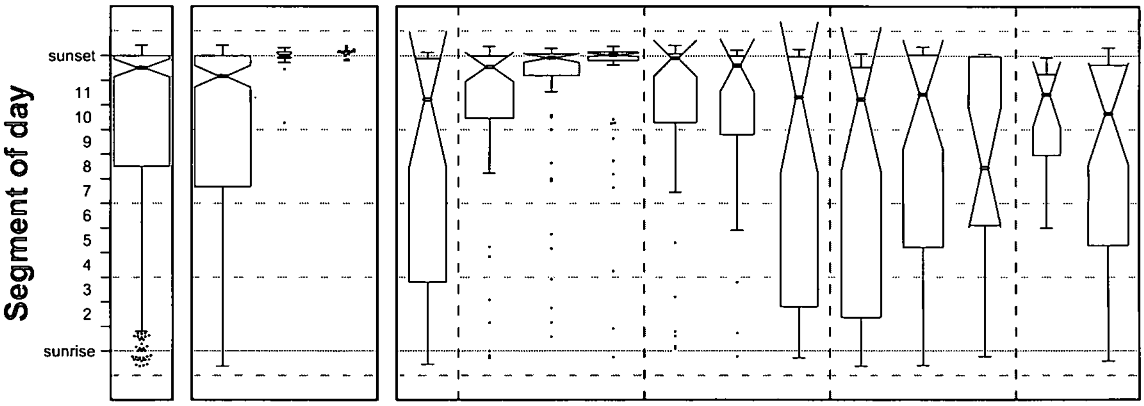
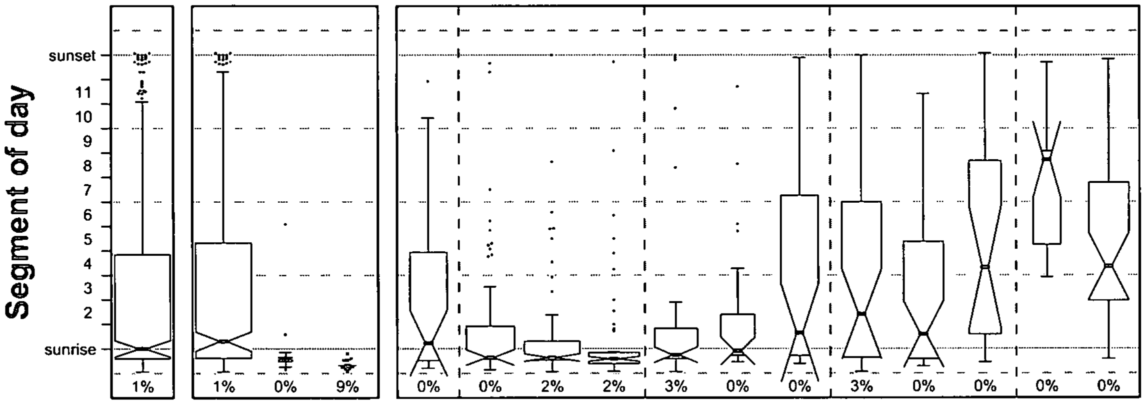


Figure 5.273: R799 White-browed Sparrow-Weaver — birds heard only: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.



Timing of the last activity of the day

Timing of the first activity of the day



Timing of the first activity of the day

Seasonal occurrence

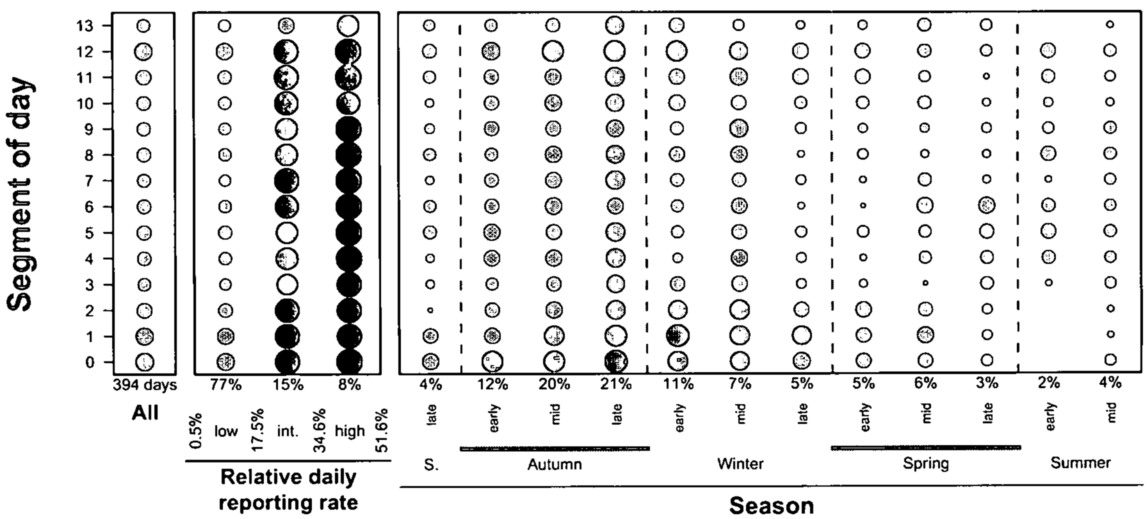
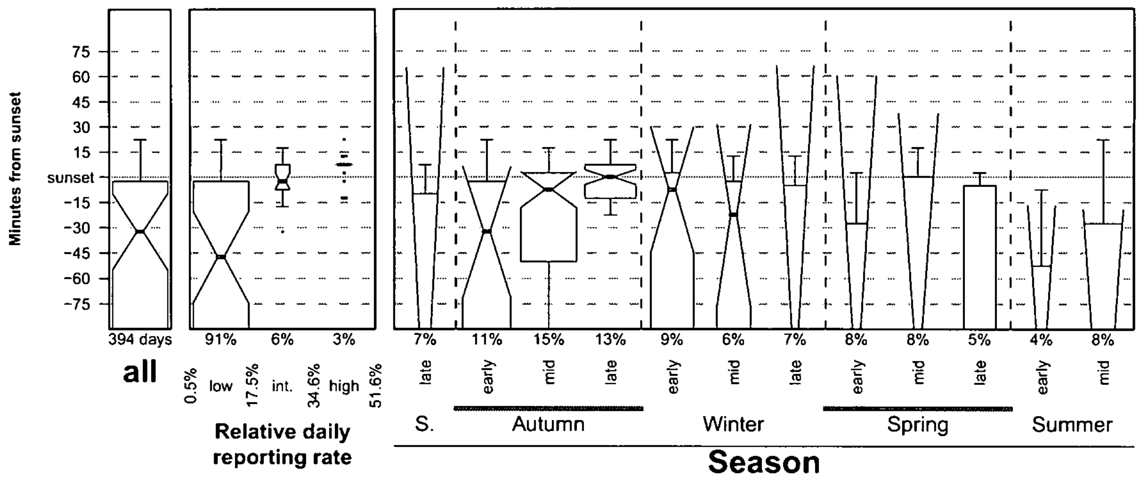
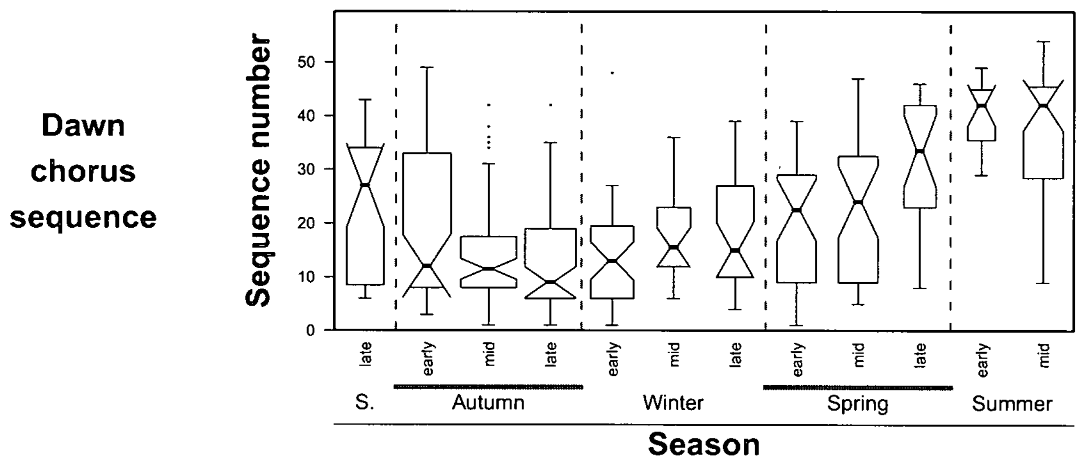


Figure 5.274: R799 White-browed Sparrow-Weaver — birds heard only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

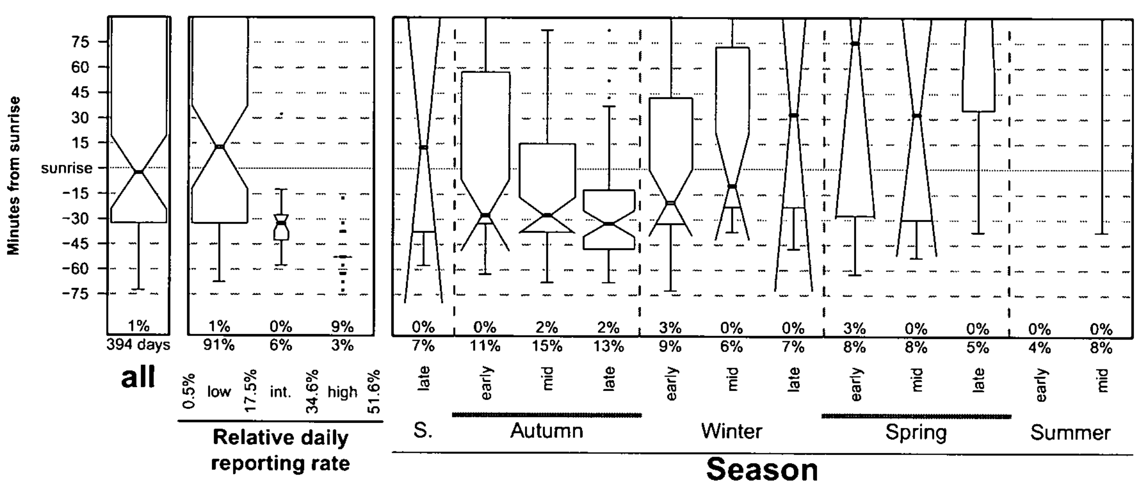


Figure 5.275: R799 White-browed Sparrow-Weaver — birds heard only: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

5.20 Passeridae: Sparrows, Petronias

Excluding introduced populations, 37 passerid species occur in Eurasia and Africa, with six species occurring in southern Africa (Hockey *et al.* 2005). Five occur in the Free State (Earlé & Grobler 1987; Harrison *et al.* 1997b), with all three commonly found in the central parts of the province recorded at Glen.

R801 House Sparrow .... *Passer domesticus*

The House Sparrow originally occurred in Europe and Asia, but has been introduced and has spread to many parts of the world, including sub-Saharan Africa (Cramp 1998). In southern Africa, it was introduced in the late 1800s and early 1900s (Maclean 1985). It presently occurs throughout South Africa, Lesotho, Swaziland and Zimbabwe, and is less common in Namibia, Botswana (Brooke 1997k) and southern Mozambique (Parker 1999). It is closely associated with human dwellings and constructions (Brooke 1997k; Maclean 1985). Generally considered to be resident and sedentary (Maclean 1985), but is also known or suspected to be dispersive (Brooke 1997k; Dean 2005aj), while seasonal altitudinal movements occur in Lesotho (Van Niekerk 2004).

The birds at Glen

The nearest resident birds are at Glen village. A bird was seen and heard in the grassland on 9 October 2003 (mid-spring). Another bird was seen on 24 April 2008 (late autumn) in the drainage line.

Discussion

The two records at Glen most probably represent dispersive movements.

R803 Cape Sparrow .... *Passer melanurus*

The Cape Sparrow occurs throughout South Africa — except the tropical lowlands in the north-east — Lesotho, the southern parts of Botswana and Namibia (Dean 1997n), extending into south-western Angola (Dean 2000). Found in a wide variety of habitats (Maclean 1985). Status varies from resident to nomadic (Dean 1997n, 2005ak; Maclean 1985).

The birds at Glen

A pair regularly visited the trampled area in the grassland, with fledglings at times. Nesting has been recorded in the small *Acacia* trees around the trampled area, but most of the time they roosted and bred outside the main study area, often at an unknown location in the west. Figures start on page 921.

Annual occurrence of birds in the grassland: The birds were present on 80.8% of the days with an activity index of ten (Table 5.50a). Recorded during 11–12 seasons each year (Fig. 5.276; Fig. 5.277). Daily reporting rates ranged from 0.5 to 35.2% with 84.9% bird-days attaining low reporting rates (Fig. 5.276). Median daily reporting rates decreased since the beginning of the study and were relatively low since 2004/5 (Fig. 5.276), coinciding with a decrease in the occurrence of high (none after 1999/0) and intermediate reporting rate days (none after 2003/4) and an increase in the incidence of days with zero records (Fig. 5.277).

Table 5.50: R803 Cape Sparrow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	5 305	114 612	4.6	birds present	80.8	656	530	10
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	4	1 190	0.3	birds present	9.3	43	4	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	13	1 188	1.1	birds present	18.6	43	8	2

Seasonal occurrence of birds in the grassland: Recorded during all or nearly all seasons each year (Fig. 5.276). Median daily reporting rates were only slightly higher during spring than during autumn (Fig. 5.276), with the occurrence of high and intermediate reporting rate days showing no seasonal trend (Fig. 5.277).

Daily occurrence of birds in the grassland: Overall, slightly more frequent during the early to mid-morning period and in the late afternoon before sunrise than during other parts of the day, and infrequent after sunset (Fig. 5.276). This pattern is most obvious for low reporting rate days; on intermediate and high reporting rate days activity was more evenly spread between sunrise and sunset and infrequent before sunrise and after sunset (Fig. 5.278). Seasonally the pattern tended to be more like that for low reporting rate days with activity most frequent during the early morning and late afternoon, except during late spring when activity was more evenly spread throughout the day (Fig. 5.279). No bird-segment combination occurred during more than 5% bird-days.

The timing of the first activity of the day was normally around sunrise on intermediate and high reporting rate days compared to low reporting rate days when it usually occurred during the first half of the morning after sunrise (Fig. 5.279; Fig. 5.280). Activity tended to start earlier during winter than during summer or autumn (Fig. 5.279; Fig. 5.280).

The last activity of the day was often noted later in the day (*i.e.* shortly before or just after sunset) on intermediate and high reporting rate days than on low reporting rate days (Fig. 5.279; Fig. 5.280). There was no definite seasonal trend (Fig. 5.279; Fig. 5.280).

Overall, daily segment reporting rates ranged from 5.3 to 100% with 91.7% of the values relatively low (Fig. 5.276). Median daily reporting rates tended to be slightly higher in the early mornings (Fig. 5.278).

Early morning occurrence of birds during 2007/8: Birds were noted during eight mornings in the grassland compared to four in the drainage line (Table 5.50; Fig. 5.281).

Discussion

In a study on the moult of the Cape Sparrow at Barberspan, Dean (1977) estimated that moulting in individuals could span a period of 90–225 days and found that it overlapped extensively with the protracted breeding season. This may explain why the birds did not show any clear seasonal trends in occurrence at Glen (see Fig. 5.276; Fig. 5.277).

The general decrease in daily reporting rates since the beginning of the study (Fig. 5.276) is at least in part the result of observer bias. During the initial years of the study more time was spend in the trampled area than in latter years, particularly since 2004/5 when very intensive observations were conducted on the Eastern Clapper Lark R495.

R804 Southern Grey-headed Sparrow .... *Passer diffusus*

The Southern Grey-headed Sparrow is endemic to the southern third of Africa (Urban 2004). In southern Africa it is absent mainly from the western parts of the region (Craig 1997h; Parker 1999). Found in various woodland types (Craig 1997h). Resident and sedentary, but may be locally nomadic in arid and semi-arid areas (Craig 1997h).

The birds at Glen

The Southern Grey-headed Sparrow is mainly a bird of the drainage line, but it was also heard (and seen) in the grassland. The grassland part of the analysis is based on a year starting in late summer.

Birds in the grassland: Found on nine days spread over four years, most frequently during 2001 when recorded during four seasons compared to other years when encountered during 1–2 seasons only (Fig. 5.282). Records were limited to six seasons during the period from early winter to mid-summer, and mostly recorded during the morning (Fig. 5.282).

Early morning occurrence of birds during 2007/8: Found in the drainage line on seven mornings (16.3%), but not recorded in the grassland (Table 5.51b & c). Six of the seven records in the drainage line were during spring (Fig. 5.283).

Discussion

There is some confusion in the literature regarding the moult of the Southern Grey-headed Sparrow. Craig (1983a) wrote: "All birds [presumably implying adults and juveniles] have a complete moult after breeding (Dean 1977)." Dean (1977), however, focused on the moult of the Cape Sparrow R803. The only reference he made to the Grey-headed Sparrow was the following:

> "*Post-juvenile moult*
> Juvenile Cape Sparrows replace all their feathers during the post-juvenile moult, unlike most other passerines [reference deleted] but also noted in the House Sparrow

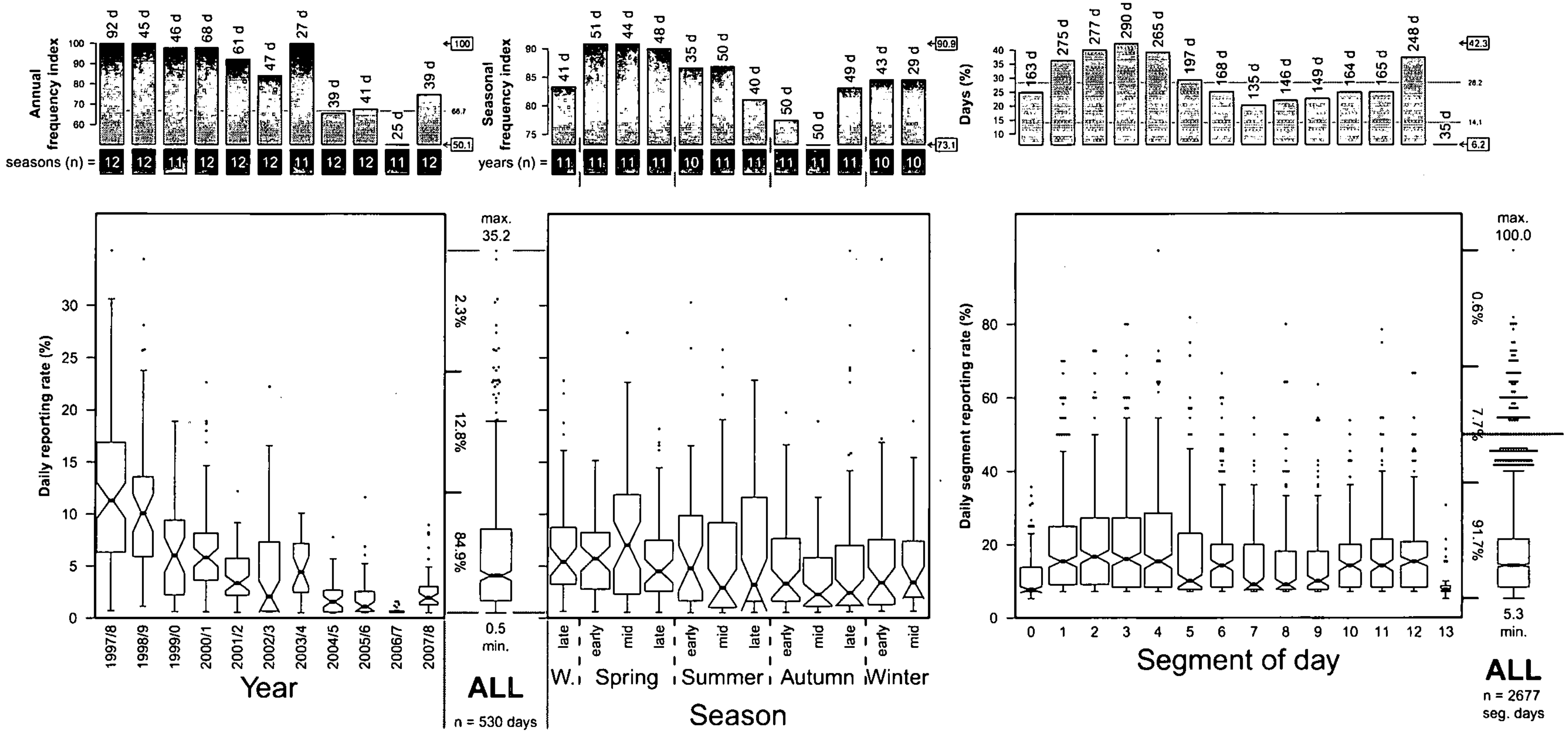


Figure 5.276: R803 Cape Sparrow — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

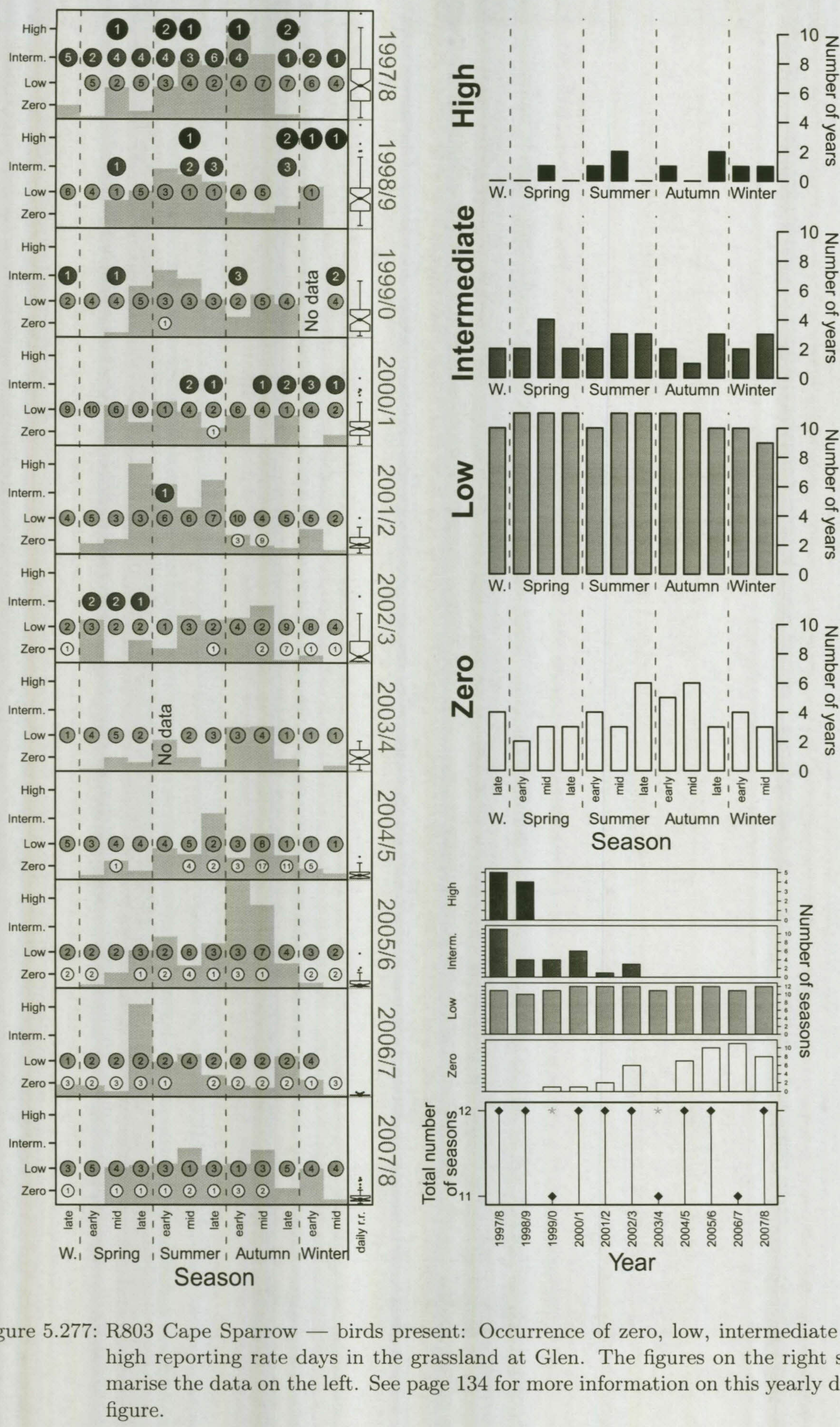


Figure 5.277: R803 Cape Sparrow — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

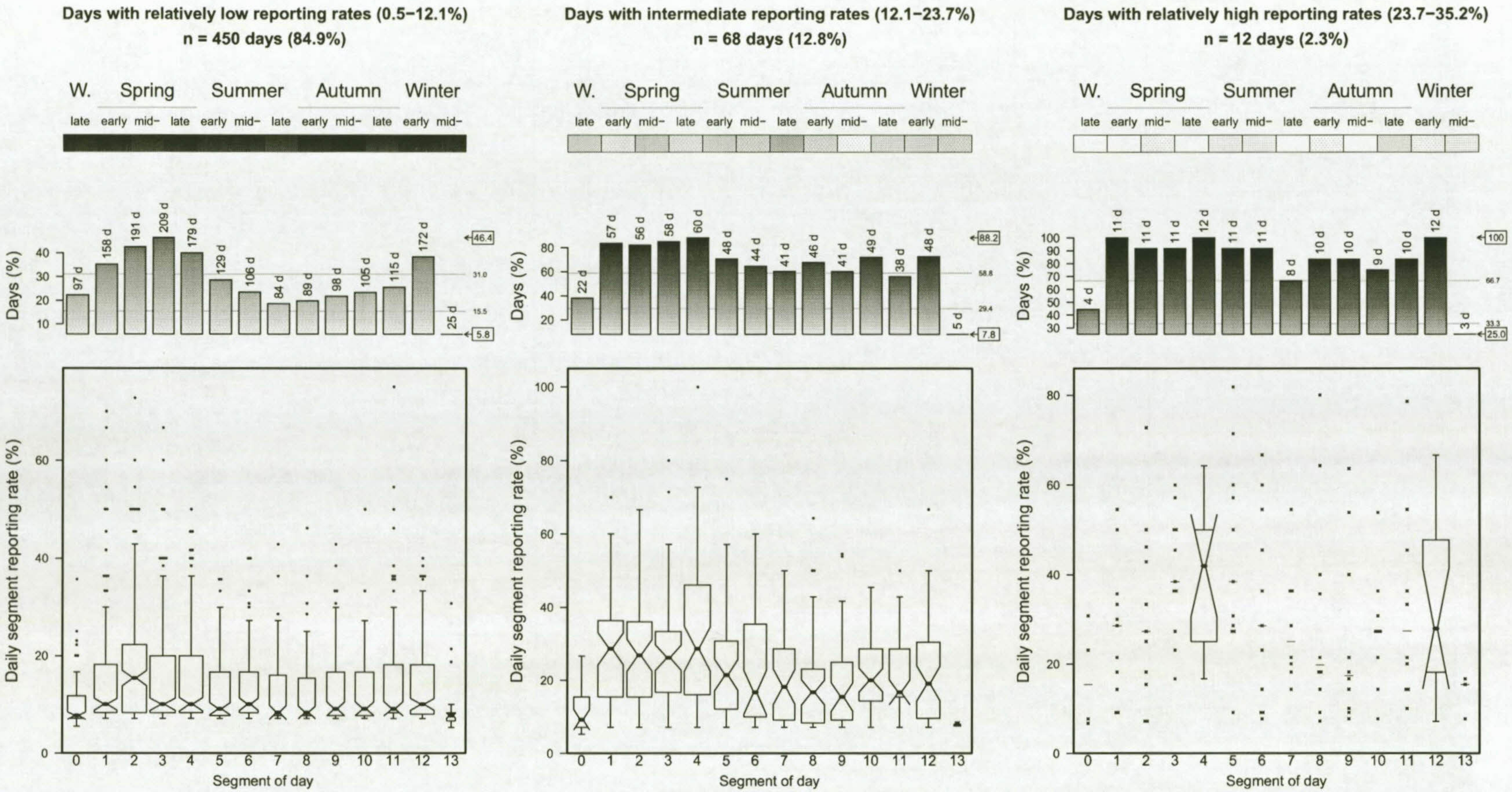


Figure 5.278: R803 Cape Sparrow — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

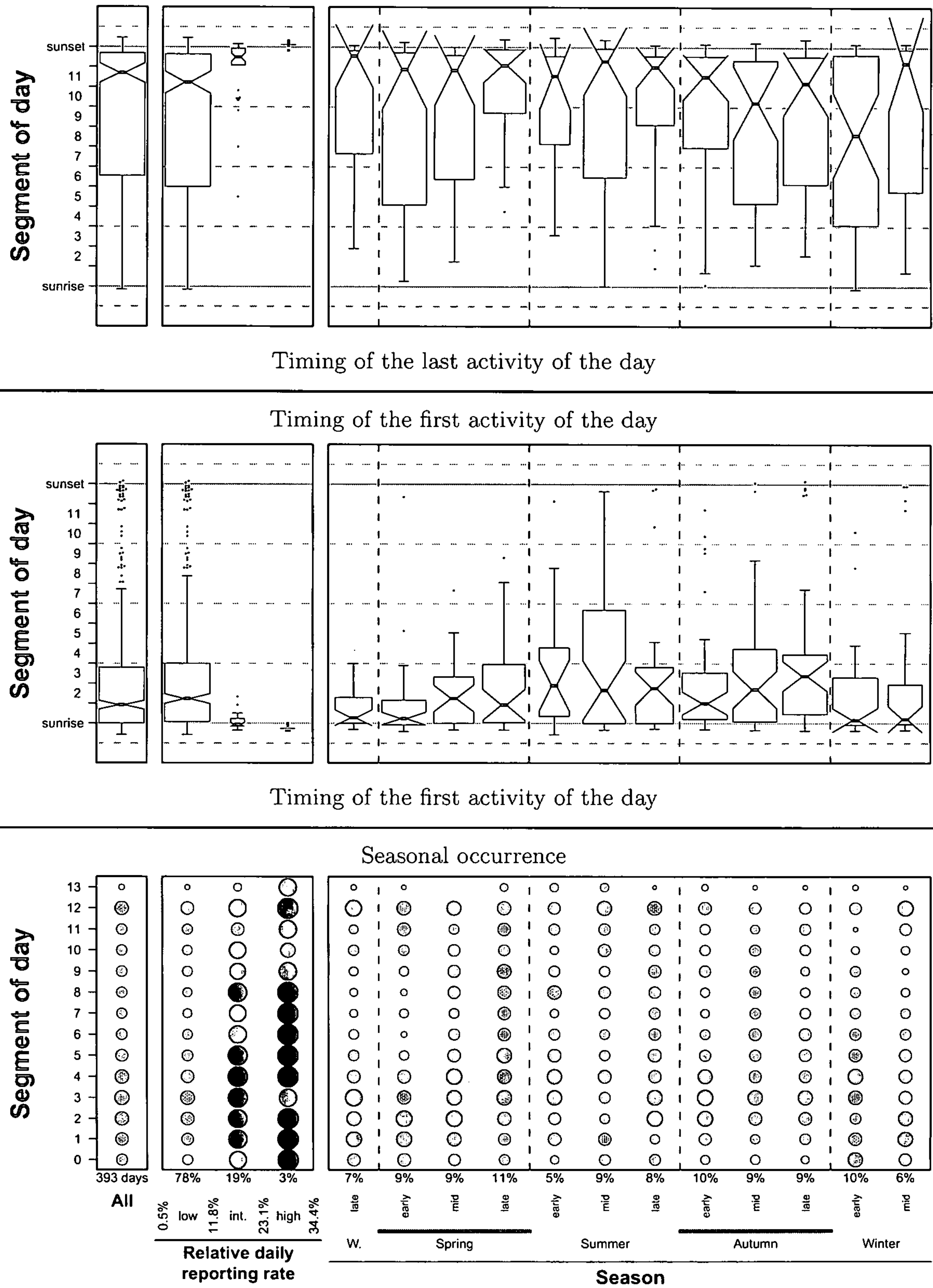


Figure 5.279: R803 Cape Sparrow — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

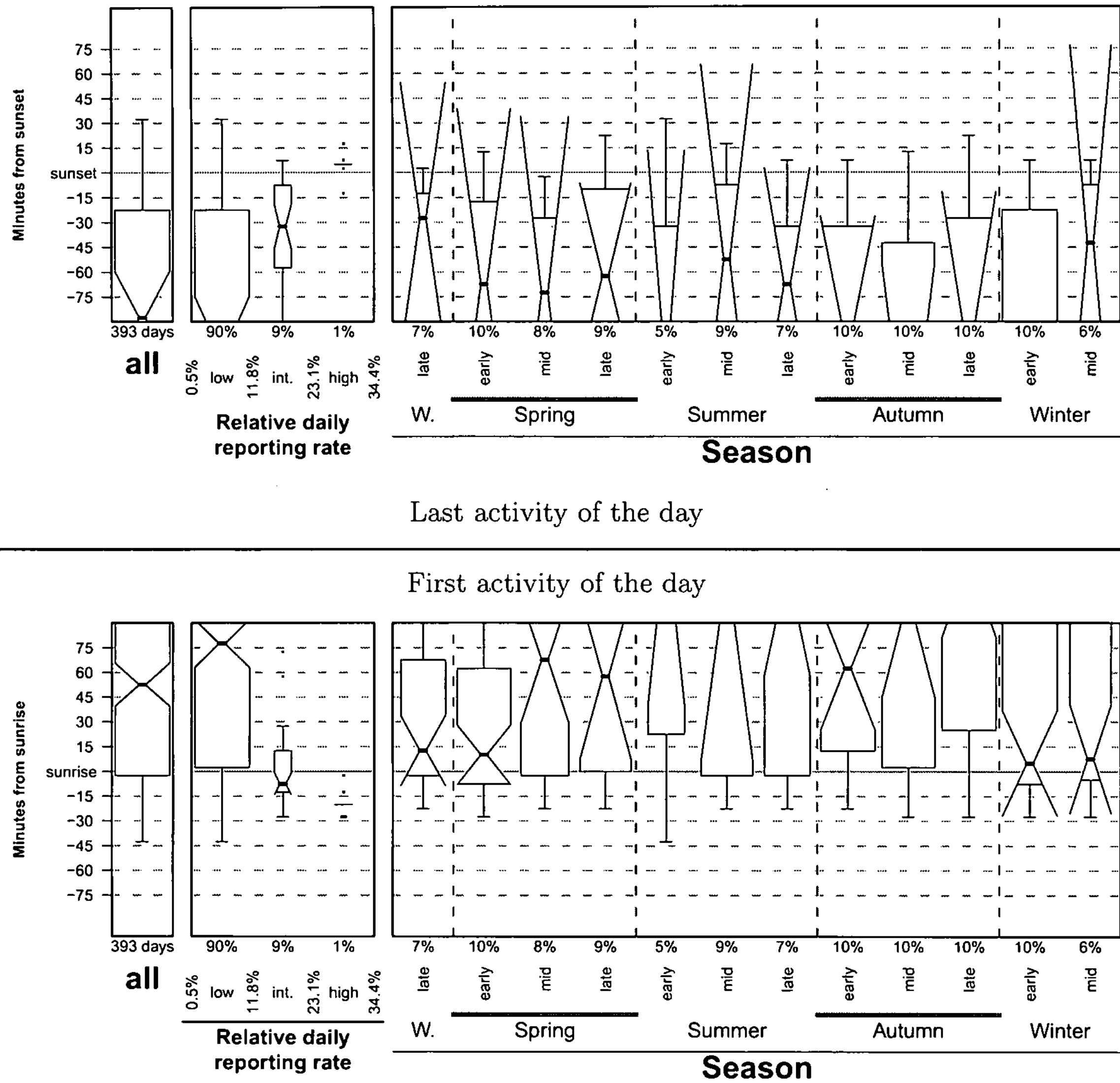


Figure 5.280: R803 Cape Sparrow — birds present: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

Table 5.51: R804 Southern Grey-headed Sparrow: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	8	114 612	0.0	birds present	1.2	656	8	1
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	15	1 190	1.3	birds present	16.3	43	7	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

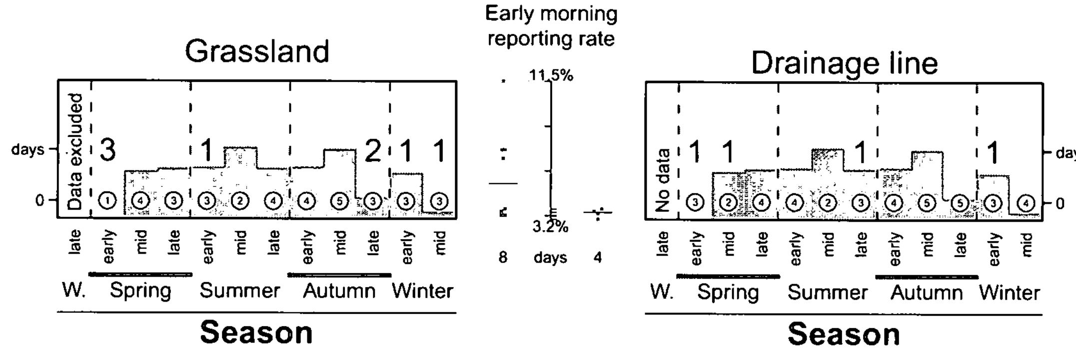


Figure 5.281: R803 Cape Sparrow — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. The seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates are illustrated. See page 136 for more information on this early morning figure.

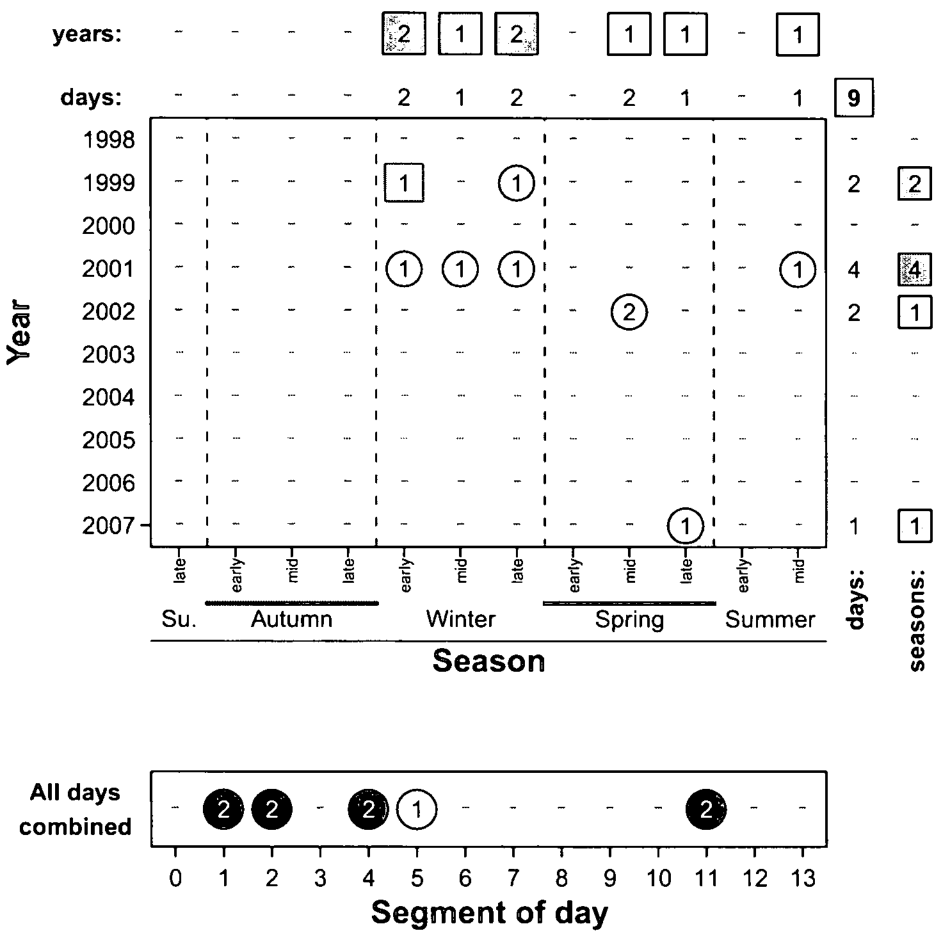


Figure 5.282: R804 Southern Grey-headed Sparrow — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

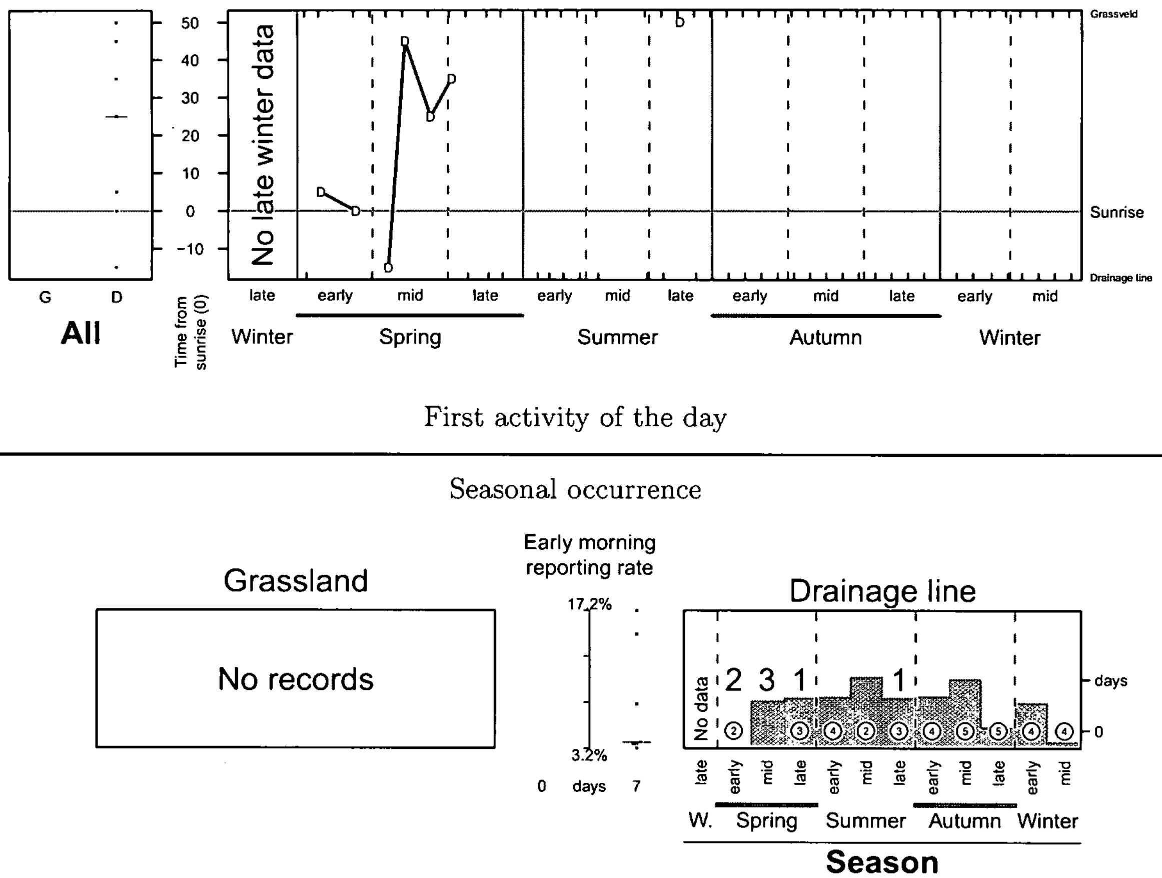


Figure 5.283: R804 Southern Grey-headed Sparrow — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Top: Occurrence of the first activity of the day. See page 136 for more information on this early morning figure.

Passer domesticus and Grey-headed Sparrow *Passer griseus* (pers. obs.).
The pattern of juvenile moult does not differ from the adult moult and the duration of moult appears to be similar in the adults." (Dean 1977) Emphasis in original.

In context, the last paragraph is clearly applicable to the Cape Sparrow only. Craig (1983a) was therefore mistaken when he concluded from Dean's (1977) work that adult Grey-headed Sparrows also have a complete moult after breeding. However, Craig (1983a) also cited De Bont (1970) who noted that both adult and juvenile Grey-headed Sparrows moult after breeding at a site in the Democratic Republic of Congo (Zaïre). Of two adult birds ringed in the Free State, one was moulting body but not flight feathers in late summer and the other started primary moult in early autumn (DJvN unpublished data). In southern Africa, breeding occurs mainly from November to March [summer to mid-autumn] (Maclean 1985). The seasonal occurrence of birds mainly during winter and spring at Glen (Fig. 5.282; Fig. 5.283) is therefore suggestive of post-moult dispersal.

5.21 Ploceidae: Weavers, Queleas, Widowbirds

Note: The Ploceidae is continued from page 912.
See page 910 for an introduction to the family.

R806 Scaly-feathered Finch .... *Sporopipes squamifrons*

The Scaly-feathered Finch occurs in southern and south-western Angola (Dean 2000), Namibia, Botswana, Zimbabwe and in South Africa from the central Free State northwards and westwards (Herremans 1997h). In addition, there are also two isolated populations in the interior of the Eastern Cape and Western Cape respectively (Herremans 1997h). The study area is situated on the south-eastern end of its distribution. It prefers low bushes, particularly *Acacia*, interspersed with grassy patches (Herremans 1997h), and it is a nomadic resident (Herremans 1997h; Maclean 1985).

The birds at Glen

Scaly-feathered Finches were recorded in the grassland on a total of five days in four years (twice in the trampled area), with records in mid-summer and mid- and late autumn (Fig. 5.284). Nearly all these records were in the morning (Fig. 5.284).

Also recorded once in the drainage line during a transect there in early winter 2000/1.

Discussion

Breeding in the Scaly-feathered Finch depends on rainfall and has been recorded during all months with a peak from January to June [late summer to mid-winter] in the former Transvaal (Tarboton *et al.* 1987). Moult recorded virtually throughout the year (Dean 2005ag). The records at Glen probably represent nomadic birds.

R814 Southern Masked-Weaver .... *Ploceus velatus*

The Southern Masked-Weaver is endemic to sub-Saharan Africa (Maclean 1985). It occurs throughout most of southern Africa where it is found in many types of habitats, including grassland (Craig 1997d; Maclean 1985; Parker 1999). The population consists of resident, sedentary as well as migratory elements (Craig 1997d; Oschadleus 2005), but it is apparently resident in the Free State (Earlé & Grobler 1987).

The birds at Glen

The Southern Masked-Weaver is mainly associated with the drainage line where they roost in flocks, with the early morning activity there primarily involving flocks flying from roosting sites in the west to feeding areas in the east. Also visits the grassland occasionally where it is mostly encountered in the trampled area where, on occasion, a bird was observed eating *Acacia karroo* seeds. All data (vocal and sight records) for the Southern Masked-Weaver are combined for analysis with the numerical data summary shown in Table 5.52.

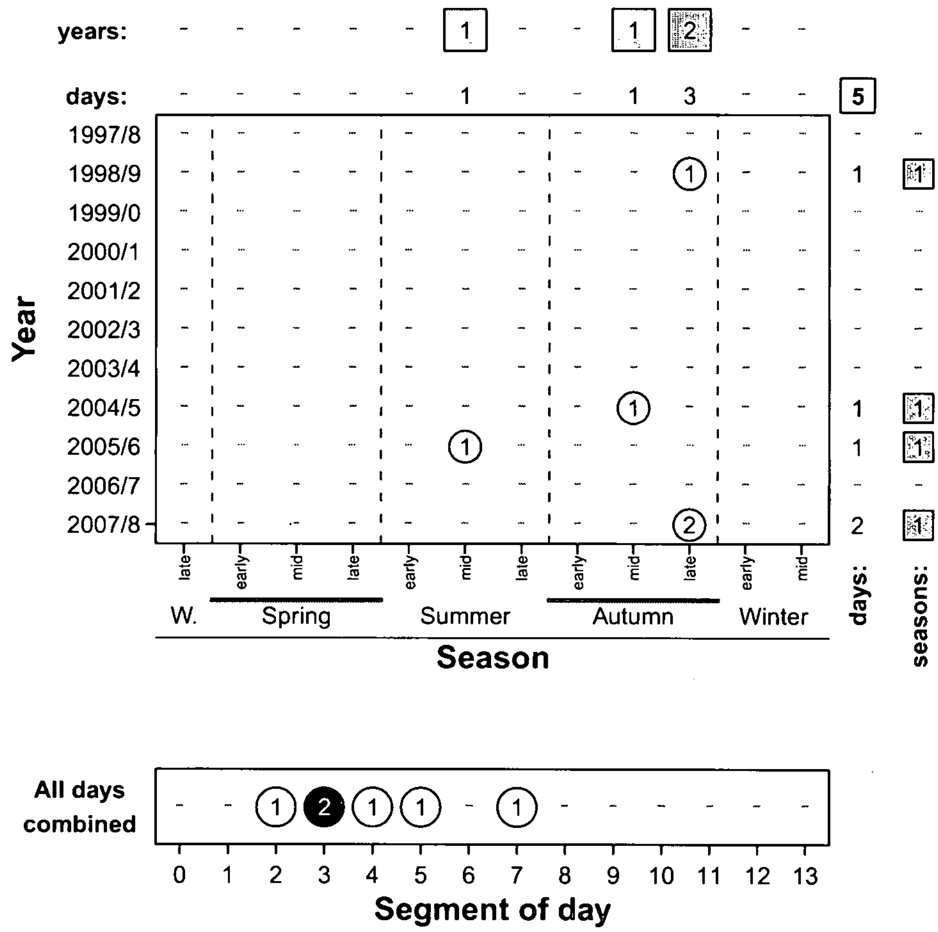


Figure 5.284: R806 Scaly-feathered Finch — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Table 5.52: R814 Southern Masked-Weaver: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	79	114 612	0.1	birds present	6.1	656	40	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	264	1 190	22.2	birds present	97.7	43	42	6
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Birds in the grassland: Recorded on 6.1% of the days with an activity index of two (Table 5.52a). Recorded during nine years (*i.e.* not in 2000/1 or 2001/2), most frequently during 1997/8, 2005/6 and 2007/8 when recorded during five or seven seasons compared to other years when recorded during 0–3 seasons (Fig. 5.285). Seasonally the records were largely limited to spring, summer and early autumn, with most of the records during the morning and midday (Fig. 5.285).

Early morning occurrence of activity during 2007/8: Activity was noted on all except one morning in the drainage line, compared to the grassland where no activity occurred (Table 5.52b & c). High reporting rate mornings occurred during most seasons, and days with low reporting rates did not occur in late autumn or early winter (Fig. 5.286). The timing of the first activity of the day was variable, particularly during autumn when it often occurred well after sunrise compared to other times when it occurred before or soon after sunrise (Fig. 5.286). Higher activity intensities were slightly more frequent after sunrise (Fig. 5.286).

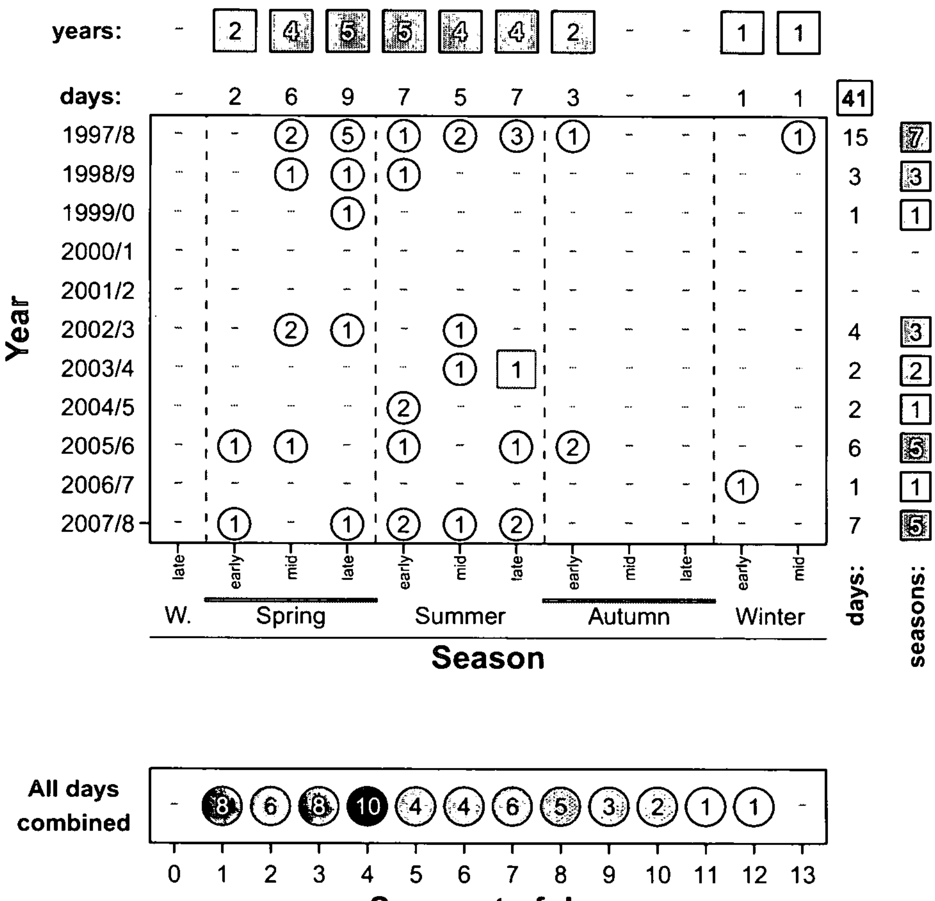


Figure 5.285: R814 Southern Masked-Weaver — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

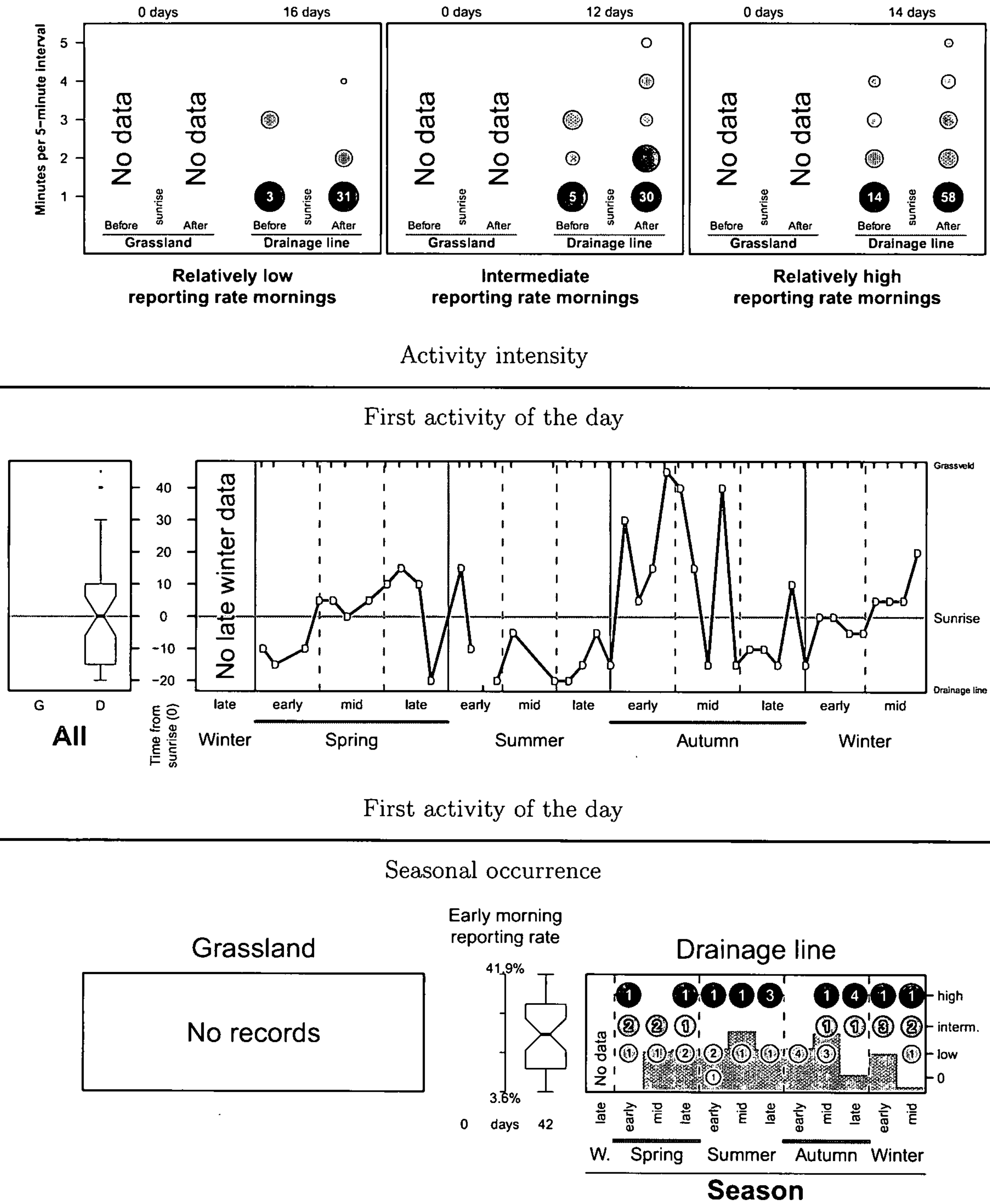


Figure 5.286: R814 Southern Masked-Weaver — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

Discussion

According to Oschadleus (2005), Southern Masked-Weavers leave their roost approximately 15 minutes before sunrise. The data from Glen, particularly Figure 5.286, shows that there is seasonal variability in the time that they fly to feeding areas, with the first activity of the day occurring particularly late during early and mid-autumn mornings. This appears to be related to moult.

Rainfall plays an important role in the timing of breeding in the Southern Masked-Weaver (Oschadleus *et al.* 2000). In the summer rainfall areas breeding occurs mainly from September to January [mid-spring to late summer] (Dean 1971; Tarboton 2001; Tarboton *et al.* 1987). This is followed by a complete post-breeding moult (mean starting date, mid-February [early autumn]) which lasts for approximately 11 weeks (Oschadleus *et al.* 2000) [*i.e.* approximately equivalent to autumn], and later a partial pre-breeding moult (Oschadleus 2005). Data for birds ringed at Glen confirms that the post-breeding moult is mainly during autumn (DJvN unpublished data).

It appears, therefore, that breeding coincides with the time of the year when activity levels in the drainage line are relatively high (Fig. 5.286), and when the birds are recorded most frequently in the grassland (Fig. 5.285). The sudden decrease in activity levels in the drainage line during early autumn (Fig. 5.286), accompanied by a relatively late start of activity (Fig. 5.286), probably signals the start of moult, while the lack of grassland records during much of autumn (Fig. 5.285) are probably moult related too. The ensuing activity peak from the latter part of autumn in the drainage line (Fig. 5.286) reflects the activity of flocks during the post-moult period.

R821 Red-billed Quelea .... *Quelea quelea*

The Red-billed Quelea is endemic to sub-Saharan Africa (Maclean 1985). Widespread in southern Africa but scarce or absent in the west and south, in southern Botswana and in Lesotho (Mundy & Herremans 1997). It prefers woodlands, grasslands and cultivated fields (Mundy & Herremans 1997). Highly mobile with many of the birds nomadic and others seasonal migrants in some areas (Craig 2005e; Maclean 1985; Mundy & Herremans 1997).

The birds at Glen

Recorded either as flocks visiting the grassland, as individuals amongst flocks of Southern Red Bishops R824 in the grassland (when probably often overlooked) or as birds that flew over the study area. Recorded in the drainage line too where it bred in 2001/2 (and more recently in 2008/9). Figures start on page 934.

Annual occurrence of birds in the grassland: Activity was noted on 36.9% of the days with an activity index of six (Table 5.53a). More frequent since 1999/0 when recorded for 7–11 seasons each year compared to 1997/8 and 1998/9 when recorded during 4–5 seasons (Fig. 5.287; Fig. 5.288). Daily reporting rates ranged from 0.5 to 49.4% with 94.2% bird-days attaining low reporting rates; Although the upper quartile for daily reporting rates were exceptionally high in 2001/2, median daily reporting rates were similar for all years (Fig. 5.287). The relatively high values in 2001/2 are due to the birds breeding in the drainage line then.

Table 5.53: R821 Red-billed Quelea: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 479	114 612	1.3	birds present	36.9	656	242	6
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	32	1 190	2.7	birds present	25.6	43	11	3
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	18	1 188	1.5	birds present	23.3	43	10	2

Seasonal occurrence of birds in the grassland: Recorded for 4–7 years from mid-winter to early summer and from 8 to 11 years from mid-summer to early winter (Fig. 5.287). The median daily reporting rates were highest for late autumn, but the upper quartile of early summer was exceptionally high (Fig. 5.287) due to the breeding colony in the drainage line in 2001/2. Zero record days were least frequent in early autumn (Fig. 5.288).

Daily occurrence of birds in the grassland: Overall, activity was most frequent in the early morning after sunrise and became progressively less frequent towards sunset (Fig. 5.287). The pattern varied seasonally with the activity peak that was in the early morning during summer shifting to mid-morning in mid- and late autumn (Fig. 5.289). Two bird-segment combinations, involving single segments S1 and S2 occurred during more than 5% bird-days and collectively accounted for 16.5% of all bird-days (Fig. 5.290).

The first activity of the day usually occurred during the morning, with limited seasonal variation (Fig. 5.289). The timing of the last activity of the day was variable (Fig. 5.289).

Daily segment reporting rates ranged from 5.9 to 92.9% with 87.6% of the values relatively low (Fig. 5.287). Median daily segment reporting rates were largely similar (Fig. 5.287).

Early morning occurrence of birds during 2007/8: Activity was approximately equally frequent in the grassland and the drainage line (Table 5.53b & c). The median morning reporting rates were also similar between the two habitats (Fig. 5.291). The first activity of the day was often noted around sunrise (Fig. 5.291).

Discussion

The Red-billed Quelea is known to breed erratically in response to rainfall (Tarboton 2001). The good rains which started early in the year (late spring) most certainly stimulated the Red-billed Quelea breeding event at Glen in 2001/2. More generally, breeding in South Africa mainly occurs from December to January [mid- to late summer] (Craig 2005e). Thus, the peak in occurrence at Glen from mid-summer to early winter (Fig. 5.287) probably represents post-breeding dispersal. It also overlaps with wing moult, which, in the Eastern Cape, is well synchronised

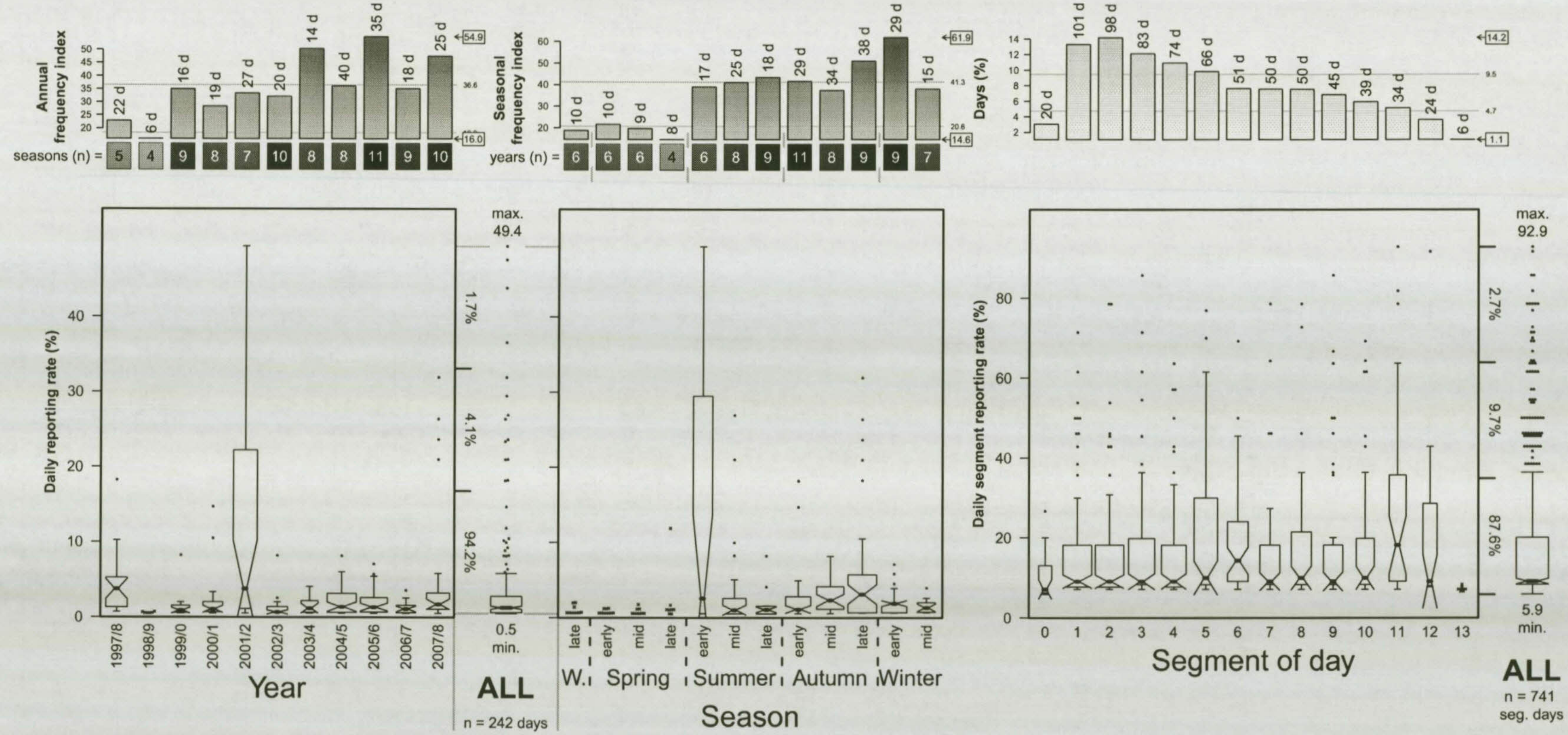


Figure 5.287: R821 Red-billed Quelea — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

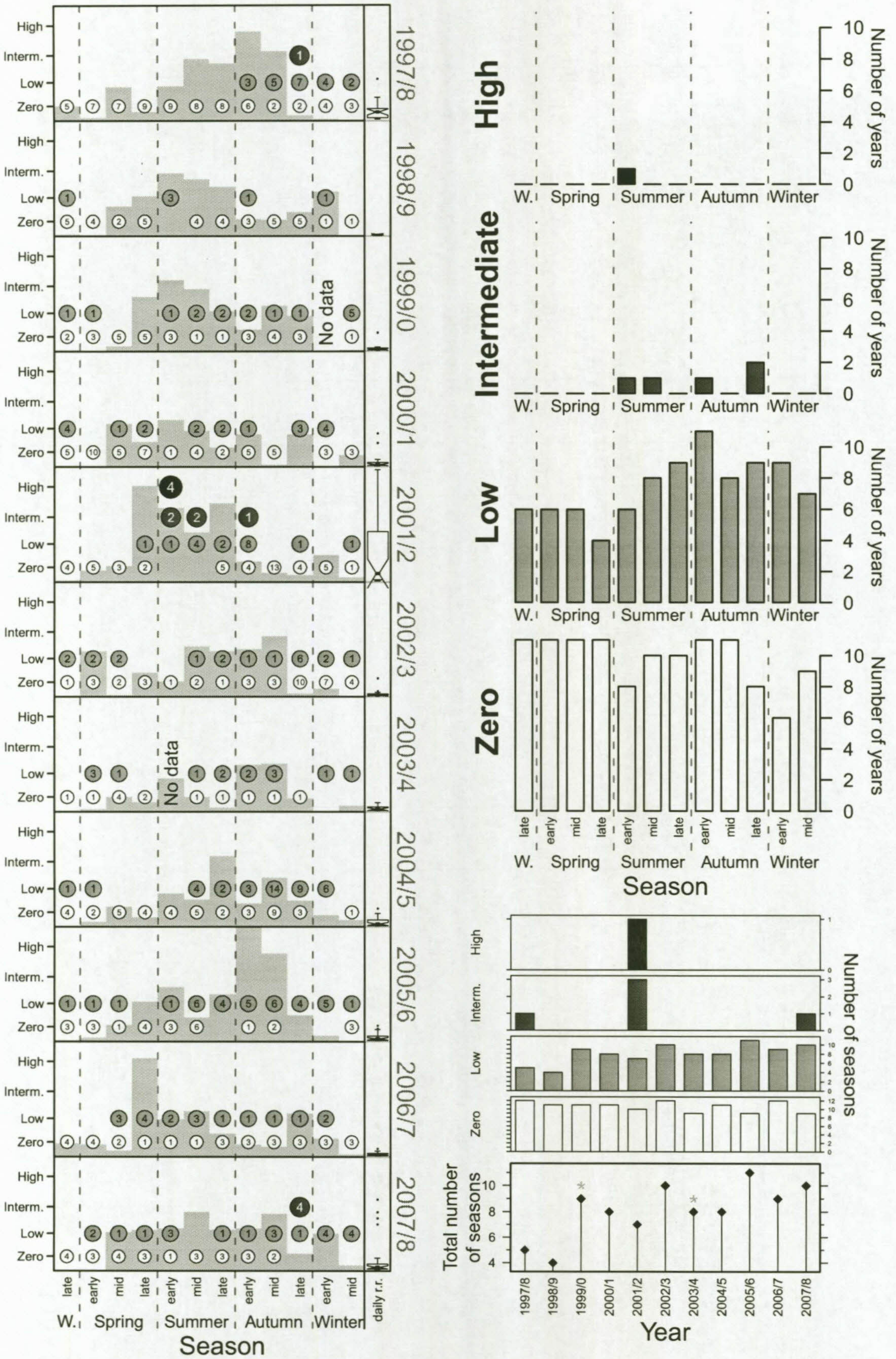


Figure 5.288: R821 Red-billed Quelea — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

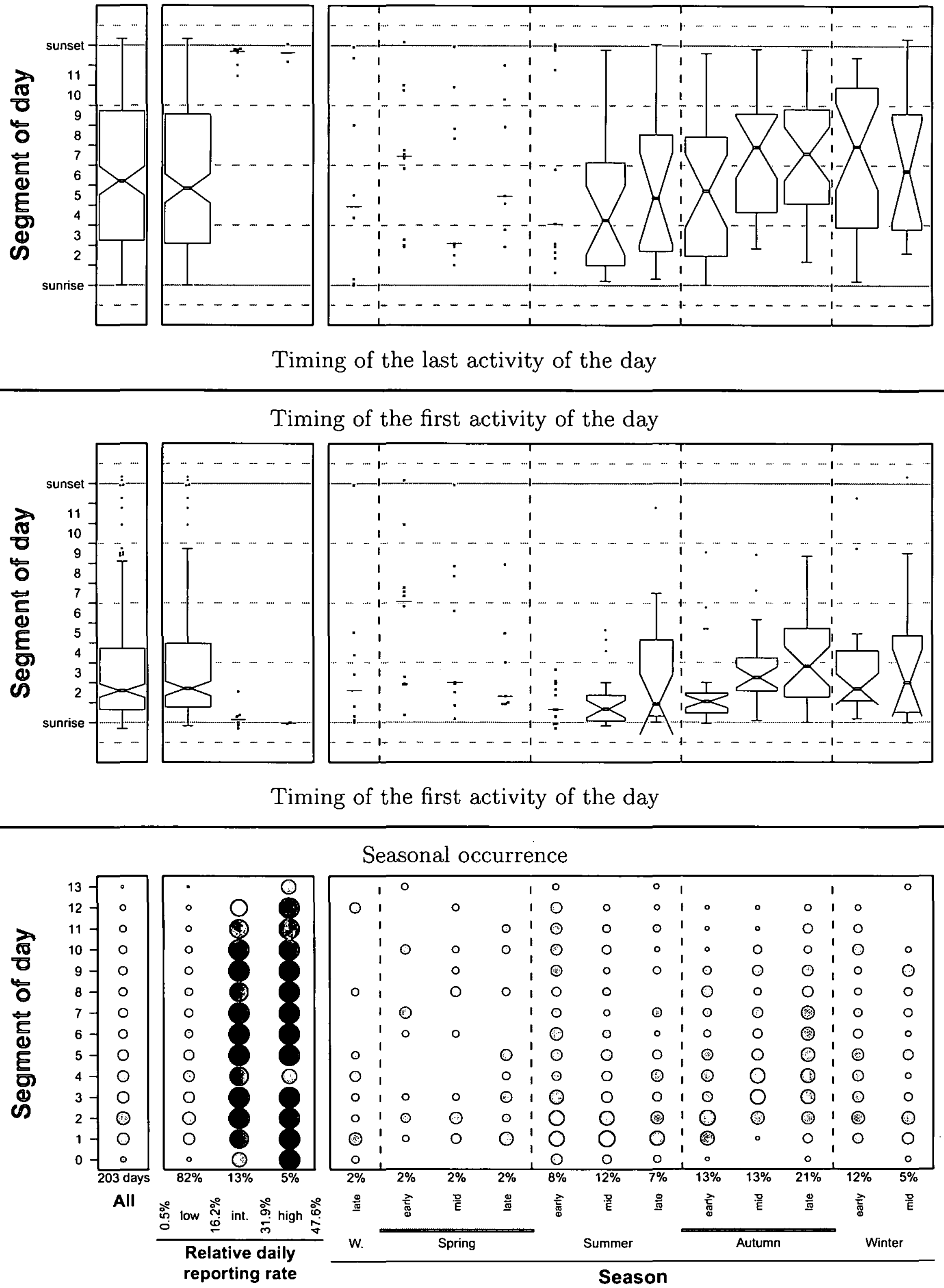


Figure 5.289: R821 Red-billed Quelea — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

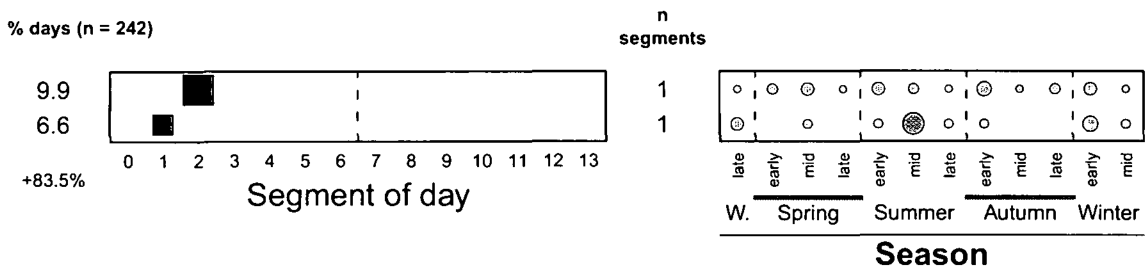
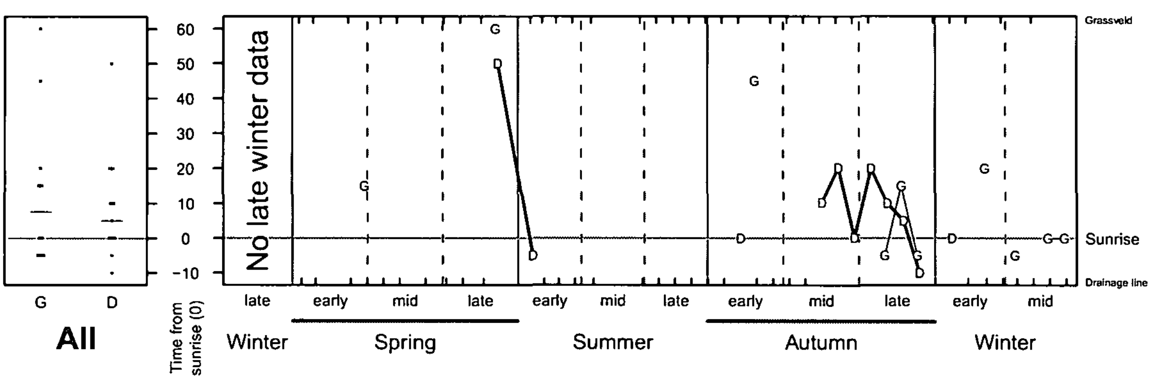


Figure 5.290: R821 Red-billed Quelea — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.



First activity of the day

Seasonal occurrence

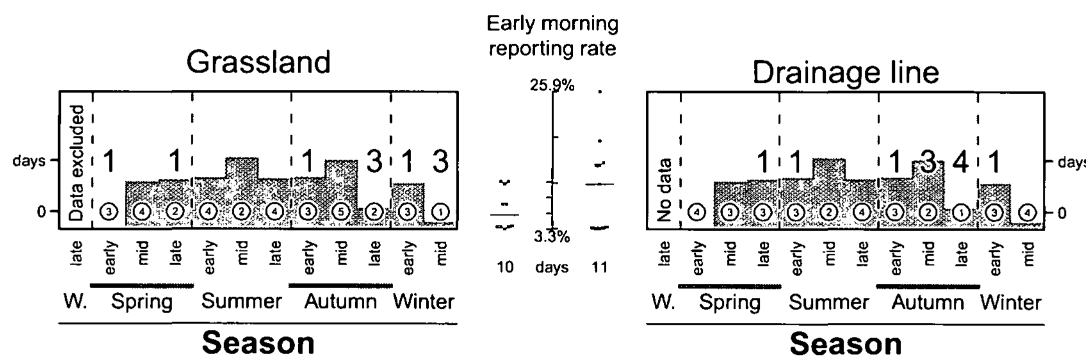


Figure 5.291: R821 Red-billed Quelea — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Top: Occurrence of the first activity of the day. See page 136 for more information on this early morning figure.

and concentrated in the period from April to September [mid-autumn to mid-spring] (Craig *et al.* 2001).

R824 Southern Red Bishop . . . . *Euplectes orix*

The Southern Red Bishop is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in South Africa, Lesotho, Swaziland and Zimbabwe, and is more localised in Namibia, Botswana (Craig 1997e) and southern Mozambique (Parker 1999). Associated with wetland habitats in grassland (Craig 1997e), typically roosting (and breeding) in reedbeds (Earlé & Grobler 1987). Resident in the Free State (Earlé & Grobler 1987).

The birds at Glen

Based on the direction from which the birds arrive in the morning and the direction in which they move in the late afternoon, the birds recorded in the study area most probably roost in the reedbeds at Glen village or along the Modder River. Recorded as foraging flocks numbering a few tens or hundreds, mainly in and around the trampled area in the grassland. These flocks often included Red-billed Queleas R821, which were always outnumbered by the bishops. The analysis is based on a year starting in late summer. Figures start on page 940.

Annual occurrence of birds in the grassland: Activity was noted on 76.2% of the days with an activity index of 12 (Table 5.54a). Recorded during 11–12 seasons each year, except 2003 when recorded during only nine seasons (Fig. 5.292; Fig. 5.293). Daily reporting rates ranged from 0.5 to 48.3% with 85.5% bird-days attaining low reporting rates (Fig. 5.292). Daily reporting rates were particularly high in 1998 and low in 2002, 2005 and 2006 (Fig. 5.292). Zero record days were particularly frequent during 2001, 2002, 2005, 2006 and 2007 (Fig. 5.293).

Table 5.54: R824 Southern Red Bishop: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	5 783	114 612	5.0	birds present	76.2	656	500	12
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	4	1 190	0.3	birds present	7.0	43	3	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	38	1 188	3.2	birds present	39.5	43	17	2

Seasonal occurrence of birds in the grassland: Recorded during 9–10 years each season (Fig. 5.292). Median daily reporting rates followed a clear seasonal trend with highest values from mid-winter to mid-spring and lowest values from mid-summer to mid-autumn

(Fig. 5.292). This coincides with the occurrence of high and intermediate reporting rate days, mainly during winter and early and mid-spring, and the occurrence of zero record days that was most frequent in early and mid-autumn (Fig. 5.293).

Daily occurrence of birds in the grassland: Overall, activity tended to be most frequent during the early morning after sunrise, becoming progressively less frequent towards sunset; not recorded after sunset (Fig. 5.292). This general pattern is most applicable to low reporting rate days, because on intermediate and high reporting rate days activity was almost equally frequent during all segments between sunrise and sunset (Fig. 5.294). Seasonally, activity was most frequent in the early morning during all seasons; during winter, spring and early summer it was frequent during other parts of the day too (Fig. 5.295).

The first activity of the day usually occurred soon after sunrise on intermediate and high reporting rate days, but usually not so early on low reporting rate days (Fig. 5.295; Fig. 5.296). There is also a well-defined seasonal pattern with activity noted earliest during winter (typically during S1) and latest in mid-autumn (around mid-morning) (Fig. 5.295; Fig. 5.296). No segment combinations occurred during more than 5% bird-days.

The last activity of the day was typically noted in the late afternoon before sunset on intermediate and high reporting rate days, but earlier in the day on low reporting rate days (Fig. 5.295). The seasonal pattern is also well-defined with activity ceasing later in the day during winter and especially spring than during early and mid-autumn (Fig. 5.295).

Overall, daily segment reporting rates ranged from 5.3 to 100% with 82.5% of the values relatively low (Fig. 5.292). Median daily segment reporting rates were always lower before sunrise than at other times (Fig. 5.294). For low reporting rate days, median daily segment reporting rates were similar for all segments between sunrise and sunset, but higher in the early morning after sunrise on intermediate and high reporting rate days (Fig. 5.294).

Early morning occurrence of birds during 2007/8: Activity was less frequent in the drainage line, occurring during only 7.0% of the mornings compared to the 39.5% of the grassland (Table 5.54b & c). Median early morning reporting rates were also higher in the grassland with activity peaking in early and mid-winter (Fig. 5.297).

Discussion

The breeding season of the Southern Red Bishop varies regionally, but in SABAP1 Zone 7 it peaked from November to February [late spring, summer and early autumn] (Craig 1997e). Breeding is followed by a complete moult (Craig & Manson 1979; Oschadleus & Underhill 2006). It appears that long day-length controls body but not wing moult (Craig 1985). The males acquire breeding plumage shortly before breeding in a partial moult involving body feathers only (Craig 2005f). Thus, the time of lowest activity at Glen from late spring to mid-autumn (Fig. 5.292) corresponds to breeding when the birds are presumably tied to nesting environs (see Rowan 1964). In KwaZulu-Natal Craig (1978) suggested that food shortage during "winter" might force birds to fly further than usual to forage. This may explain the relatively high activity from mid-winter to mid-spring at Glen (Fig. 5.292), which seems to follow on the complete

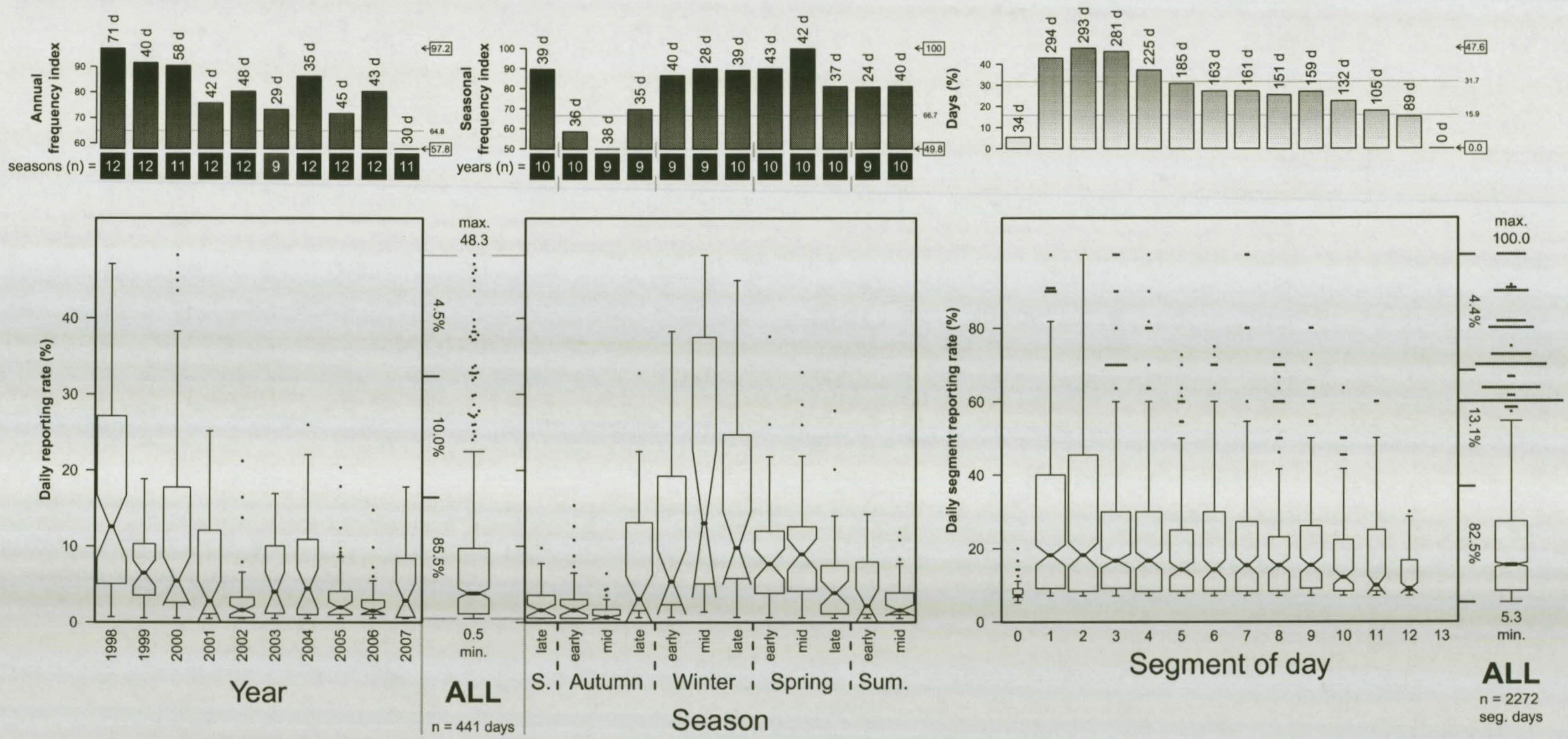


Figure 5.292: R824 Southern Red Bishop — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

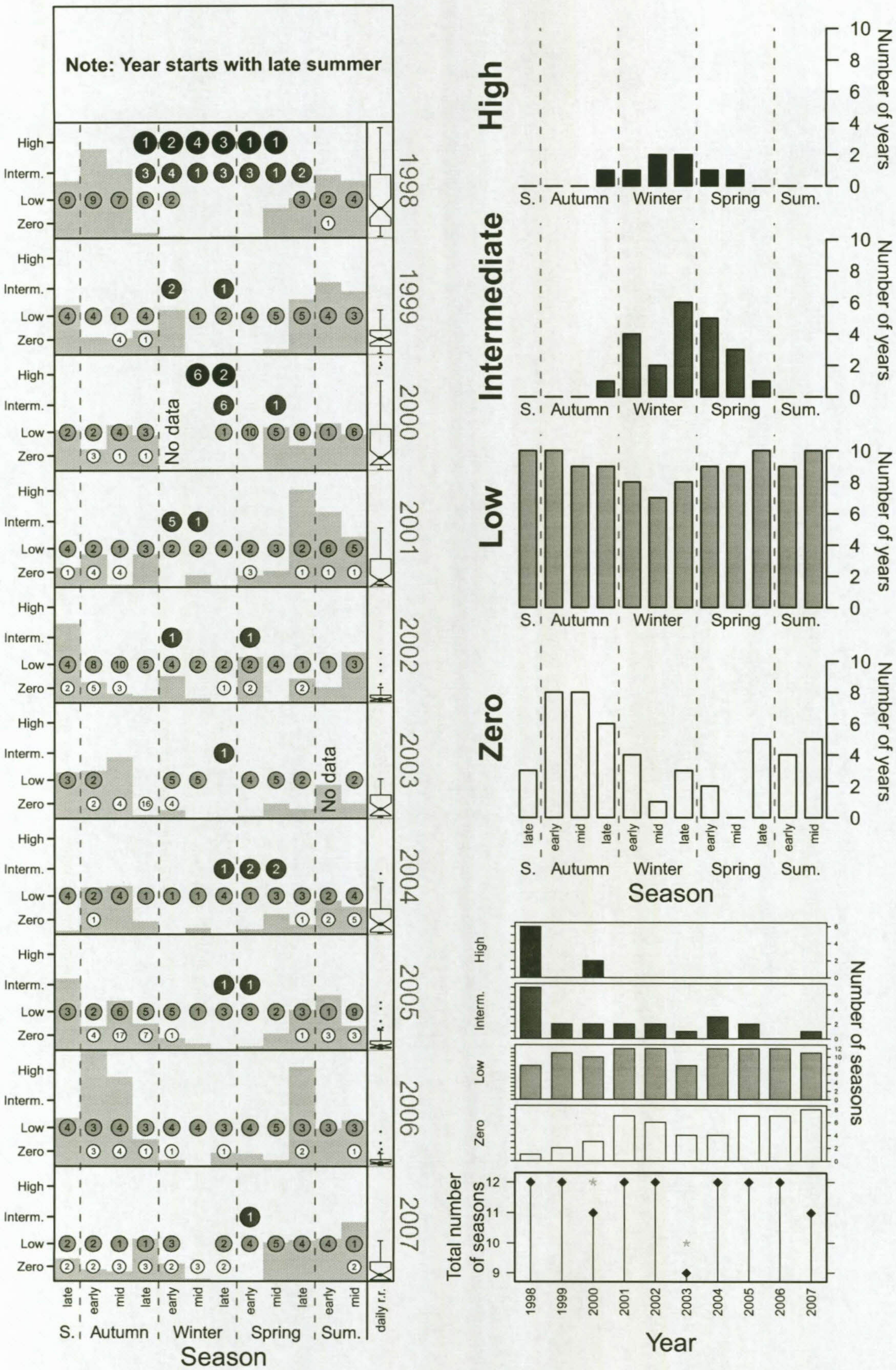


Figure 5.293: R824 Southern Red Bishop — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

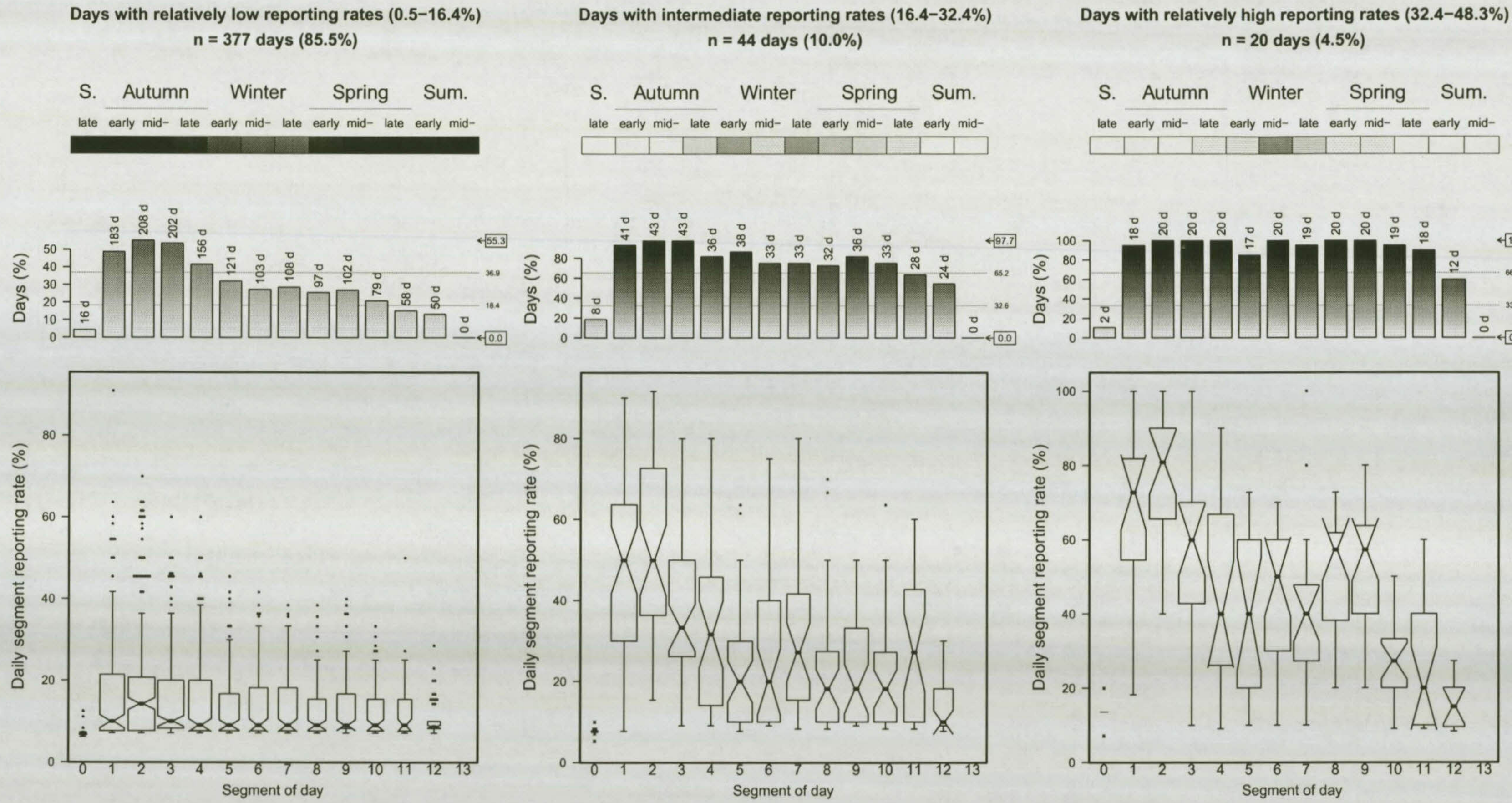


Figure 5.294: R824 Southern Red Bishop — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

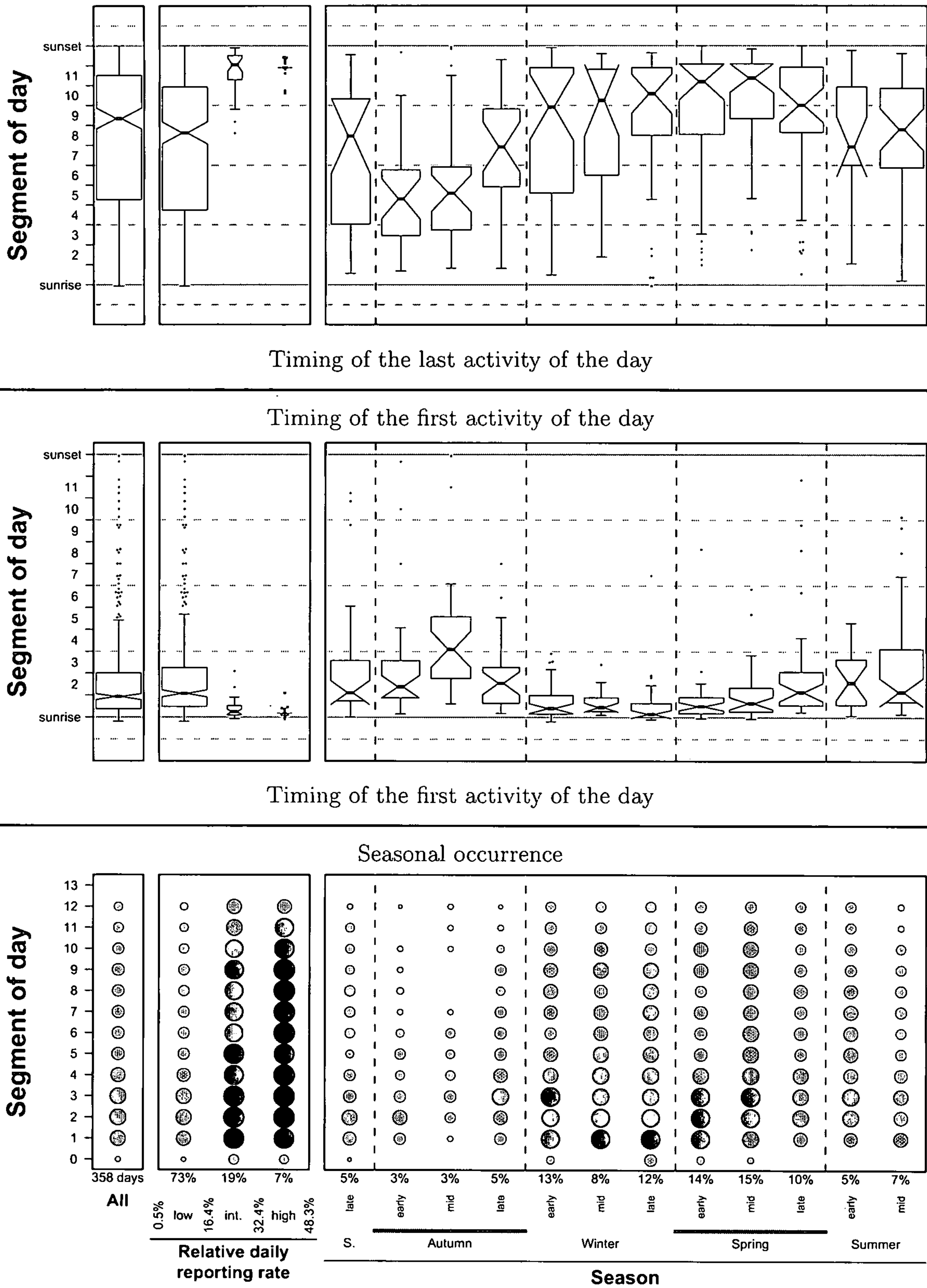


Figure 5.295: R824 Southern Red Bishop — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

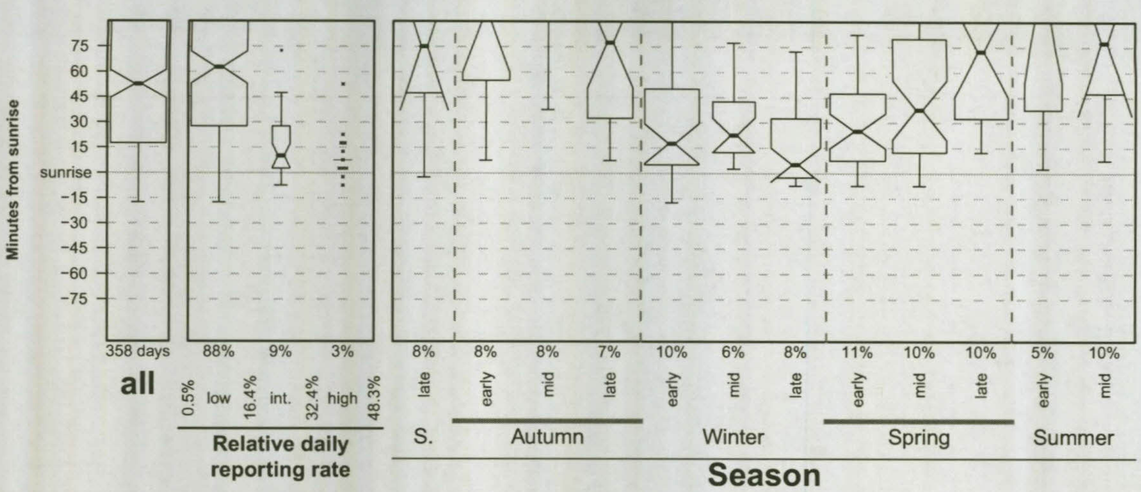


Figure 5.296: R824 Southern Red Bishop — birds present: Details on the daily occurrence of the first activity of the day in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

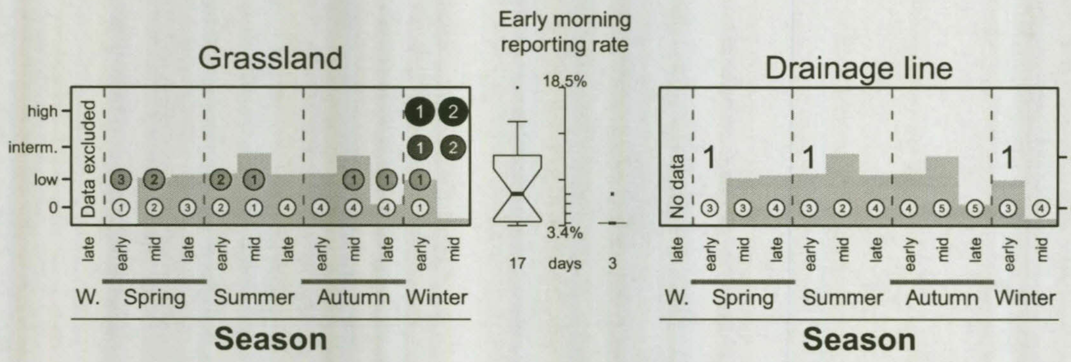


Figure 5.297: R824 Southern Red Bishop — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. The seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates are illustrated. See page 136 for more information on this early morning figure.

post-breeding moult.

R826 Yellow-crowned Bishop . . . . *Euplectes afer*

The Yellow-crowned Bishop is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, mostly encountered in the grasslands of the Free State and adjacent areas, occurring sparsely also in Namibia, Botswana, Zimbabwe (Craig 1997f) and southern Mozambique (Parker 1999). It is a grassland bird that usually nests in tall grass standing in water (Craig 1997f). Due to its specific breeding requirements, it is known to appear suddenly after rain in many areas (*e.g.* Brewster 1996; Skead 1956), suggesting nomadism (Craig 1997f).

The birds at Glen

The Yellow-crowned Bishop was mainly recorded as singles or a few birds in flight, with records restricted to the grassland. Activity was noted on 6.7% of the days with an activity index of three (Table 5.55a). Recorded during nine years, usually in 1–2 seasons per year but during 4–6 seasons in 2001/2, 2004/5 and 2005/6 (Fig. 5.298). The majority of records were during summer, early and mid-autumn (Fig. 5.298). Recorded during all segments of the day between sunrise and sunset with many of the records in the morning (Fig. 5.298).

Table 5.55: R826 Yellow-crowned Bishop: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	112	114 612	0.1	birds present	6.7	656	44	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–

Discussion

The seasonal occurrence of the Yellow-crowned Bishop at Glen (Fig. 5.298) coincides with the main rain period. Moreover, it's relative frequent occurrence during 2001/2, 2004/5 and 2005/6 is most probably related to the rainfall patterns in those years.

R832 Long-tailed Widowbird .... *Euplectes progne*

The Long-tailed Widowbird is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa mainly confined to Lesotho and South Africa, occurring from the Free State eastwards (Craig 1997g). Inhabits open grassland (Craig 1997g; Maclean 1985). Generally considered resident and sedentary with some local movements in the non-breeding season (Craig 1997g). In Lesotho, seasonal shifts occur in habitat utilisation and altitudinal distribution (Van Niekerk 2004).

The birds at Glen

Recorded in the grassland only, usually as single birds or flocks of up to ten, rarely 60, birds. The analyses distinguish between birds seen only and those heard (Table 5.56). Figures start on page 949.

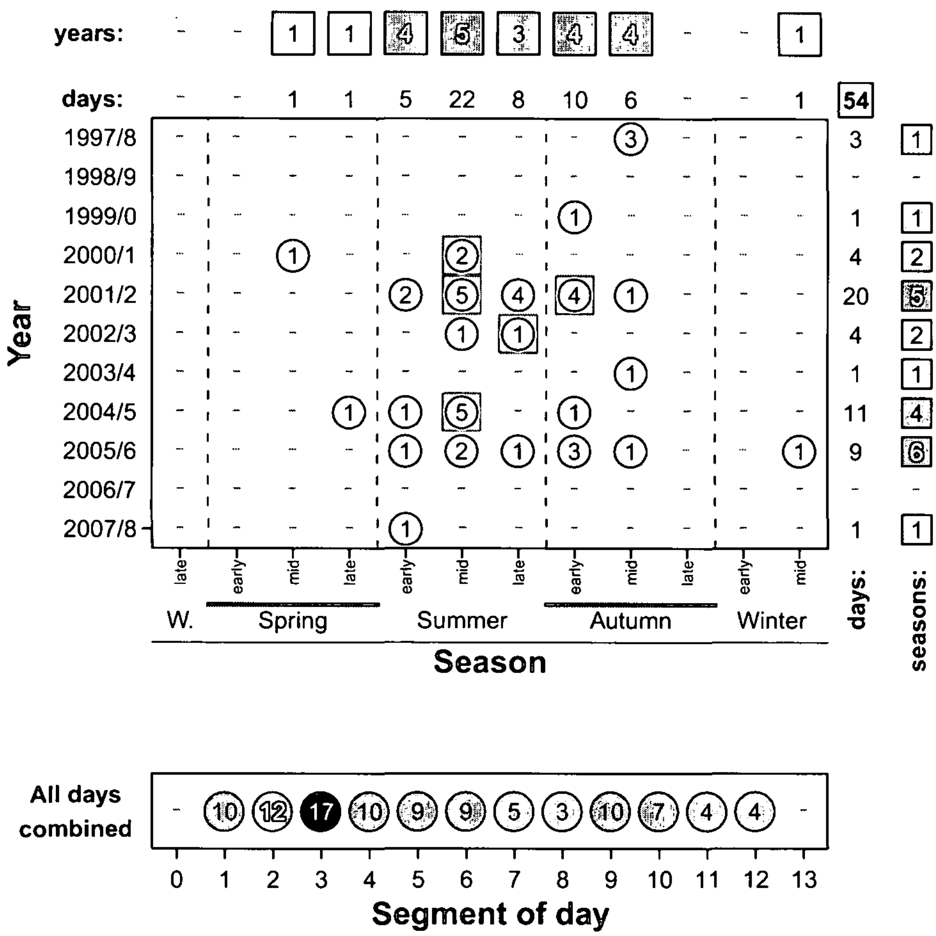


Figure 5.298: R826 Yellow-crowned Bishop — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Table 5.56: R832 Long-tailed Widowbird: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
0.859	1 359	114 612	1.2	birds heard	30.5	656	200	7
0.141	223	114 612	0.2	birds seen only	19.4	656	127	2
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
–	–	–	–	No Records	–	–	–	–
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
0.500	9	1 188	0.8	birds seen only	14.0	43	6	2
0.500	9	1 188	0.8	birds heard	9.3	43	4	2

Annual occurrence in the grassland of birds seen only: Activity was noted on 19.4% of the days with an activity index of two (Table 5.56a). Recorded during 2–4 seasons from 1997/8 to 2000/1 and during 5–9 seasons from 2001/2 to 2007/8 (Fig. 5.299; Fig. 5.300). Daily reporting rates ranged from 0.5 to 5.8% with 96.1% bird-days attaining low reporting rates (Fig. 5.299). Median daily reporting rates were largely similar with intermediate and high reporting rate days recorded during 1997/8 and 2003/4 only (Fig. 5.299; Fig. 5.300).

Seasonal occurrence in the grassland of birds seen only: Recorded during 7–9 years from mid-spring to mid-summer and during 1–6 years in other seasons (Fig. 5.299). Median daily reporting rates were similar for the respective seasons (Fig. 5.299).

Daily occurrence in the grassland of birds seen only: Overall, most frequently recorded in the early morning after sunrise with a secondary peak in occurrence shortly before sunset (Fig. 5.299). The pattern was more varied seasonally (Fig. 5.301). Four bird-segment combinations involving single segments S1, S2, S6 and S12 occurred during more than 5% bird-days, collectively accounting for 40.2% of all bird-days (Fig. 5.302).

The occurrence of the first activity of the day was variable (Fig. 5.301), as was the occurrence of the last activity of the day (Fig. 5.301).

Daily segment reporting rates ranged from 5.9 to 36.4% with 93.7% of the values relatively low; Median daily segment reporting rates were similar for all segments (Fig. 5.299).

Early morning occurrence in 2007/8 of birds seen only. Although noted in the grassland during the early mornings of 2007/8, no activity occurred in the drainage line (Table 5.56b & c).

Annual occurrence of birds heard in the grassland: Activity was noted on 30.5% of the days with an activity index of seven (Table 5.56a). Recorded during three seasons in 2000/1, 6–7 seasons from 1997/8 to 2001/2 and in 2007/8, and during 8–10 seasons from 2002/3 to 2006/7 (Fig. 5.303; Fig. 5.304). Daily reporting rates ranged from 0.5 to 37.2% with 90.0% bird-days attaining low reporting rates (Fig. 5.303). The upper quartile of daily reporting rates were particularly high in 1997/8 and also in 2003/4, and together with 2004/5 and 2005/6 represent the only years with intermediate reporting rate days (Fig. 5.303; Fig. 5.304).

Seasonal occurrence of birds heard in the grassland: The number of bird-years and the seasonal frequency index show a peak centred on late summer (Fig. 5.303). Median daily reporting rates were slightly higher during late autumn and in early winter than during some other seasons, with the occurrence of the few intermediate and high reporting rate days centred on autumn (Fig. 5.303; Fig. 5.304).

Daily occurrence of birds heard in the grassland: Overall, slightly more frequently recorded in the early morning after sunrise (Fig. 5.303). This general pattern is mainly a reflection of the situation on low reporting rate days, because on intermediate reporting rate days activity was more evenly spread throughout the day (Fig. 5.305). The pattern varied seasonally (Fig. 5.306). Three bird-segment combinations involving single segments S1, S2 and S12 occurred during more than 5% bird-days, collectively accounting for 20.5% of all bird-days (Fig. 5.307).

The occurrence of the first activity of the day was most variable during spring and occurred more constantly from late summer to mid-winter during the first half of the morning (Fig. 5.306). The timing of the last activity of the day was variable (Fig. 5.306).

Overall, daily segment reporting rates ranged from 5.6 to 90.9% with 85.7% of the values relatively low (Fig. 5.303). Median daily segment reporting rates were similar for all segments (Fig. 5.303; Fig. 5.305).

Early morning occurrence of birds heard during 2007/8. Although some activity occurred in the grassland during the early mornings of 2007/8, no activity was recorded in the drainage line (Table 5.56b & c).

Combined data: Recorded during five, seven or eight seasons from 1997/8 to 2001/2 and in 2007/8, and during 9–11 seasons from 2002/3 to 2006/7 (Fig. 5.308). Recorded during 6–11 years in all seasons except mid-winter when found during only four years (Fig. 5.308).

Discussion

Circumstantial evidence suggests that the vocal activity of Long-tailed Widowbirds at Glen were positively influenced by rainfall during some years, presumably via its effect on habitat. In the Free State breeding has been recorded from October to March [mid-spring to mid-autumn], followed by a complete moult (Craig 2005g; Oschadleus & Underhill 2006). The males are territorial and advertise their presence with calls from favourite perches (Craig 2005g). Nests are usually constructed in short (30–50 cm tall) dense grass, often over damp or wet ground where grass cover is thickest (Tarboton 2001). At Glen, vocal activity was most frequently recorded from mid-summer to early winter (Fig. 5.303; Fig. 5.304). This interval includes the latter part of the main rain period and seasons immediately following. It was often during this time of the year that the vegetation in the grassland is at its peak (due to rain), and presumably the time of year when suitable patches of breeding habitat for the Long-tailed Widowbird are most likely to occur.

5.22 Estrildidae: Waxbills, *Firefinches, Twinspots*

Estrildids occur in the Old World (142 species), with 27 species found in southern Africa (Hockey *et al.* 2005). Eleven species occur in the Free State of which eight in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). All except the Red-billed Firefinch *Lagonosticta senegala* was recorded at Glen.

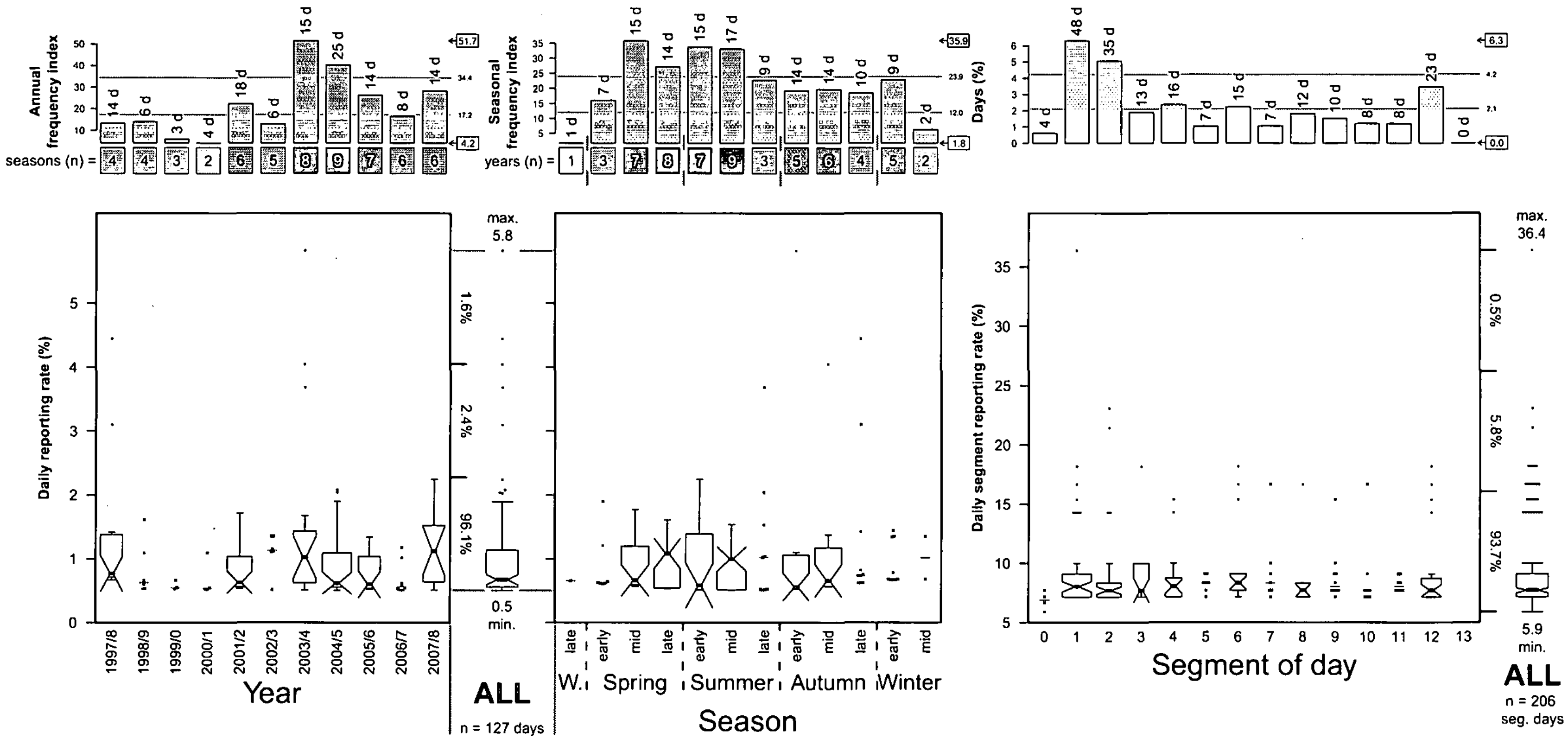


Figure 5.299: R832 Long-tailed Widowbird — birds seen only: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

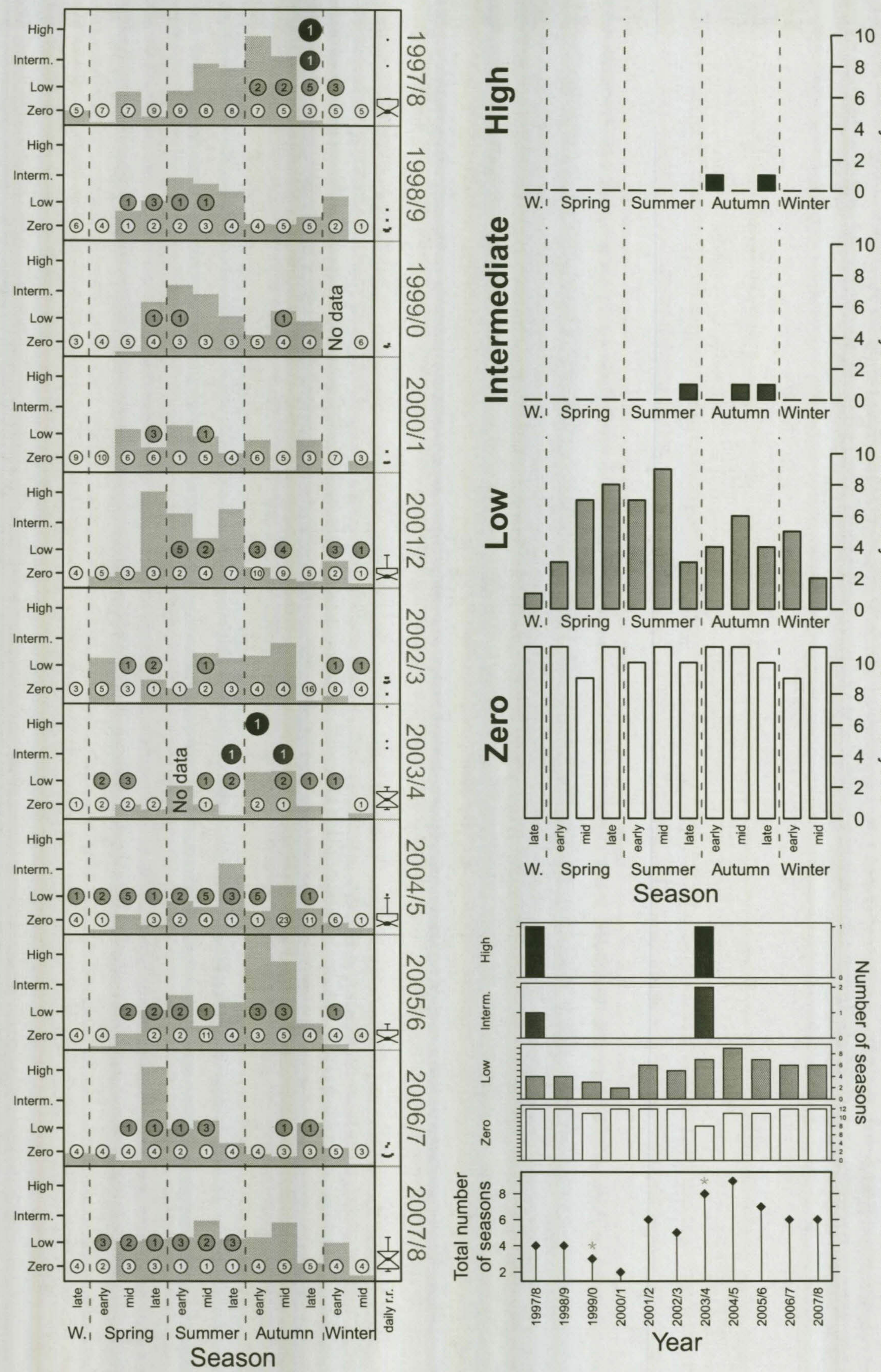


Figure 5.300: R832 Long-tailed Widowbird — birds seen only: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

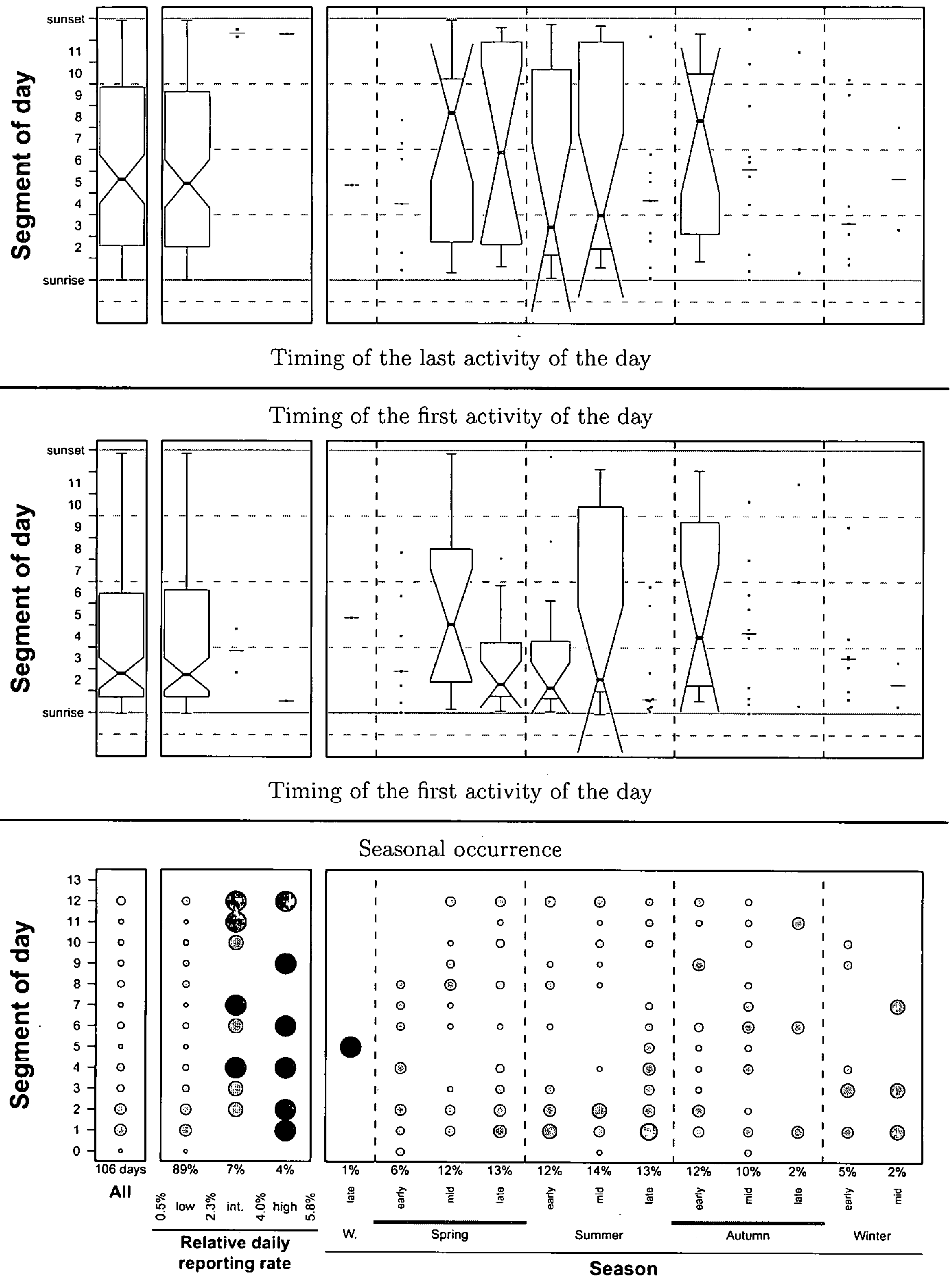


Figure 5.301: R832 Long-tailed Widowbird — birds seen only: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

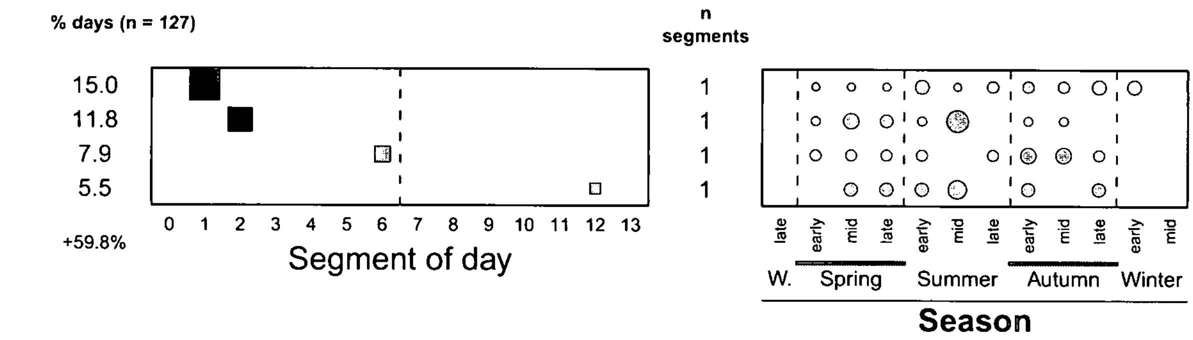


Figure 5.302: R832 Long-tailed Widowbird — birds seen only: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

R834 Green-winged Pytilia . . . . *Pytilia melba*

The Green-winged Pytilia is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa widespread in central and northern Namibia, northern and eastern Botswana, Zimbabwe, central, northern and north-eastern South Africa (Barnard & Herremans 1997a) and southern Mozambique (Parker 1999). The study area at Glen is near the southern limit of its range. It inhabits a range of habitats including *Acacia* savanna and open grassland near cover, and it is dependant on water (Barnard & Herremans 1997a; Maclean 1985). Resident and sedentary, with possible local nomadic movements in the non-breeding season (Dean 2005ai; Tyler 2001).

The birds at Glen

The Green-winged Pytilia was recorded during sporadic visits in the eastern part of the drainage line, but it was never recorded during transects or during the early morning observations of 2007/8.

R844 Blue Waxbill . . . . *Uraeginthus angolensis*

The Blue Waxbill is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, it occurs in the northern parts of Namibia, the northern and eastern parts of Botswana, and from Zimbabwe and Mozambique southwards (Barnard & Herremans 1997b; Parker 1999), with the study area at the southern limit of its Free State range. It occurs in a variety of woodland types, with the reliable availability of surface water being an important factor determining their distribution (Barnard & Herremans 1997b). Resident status influenced by low rainfall, which may lead to nomadism in the cooler times of the year (Barnard & Herremans 1997b).

The birds at Glen

Recorded once in mid-summer 2002/3 during a transect in the drainage line.

Discussion

The birds recorded at Glen probably represent nomads.

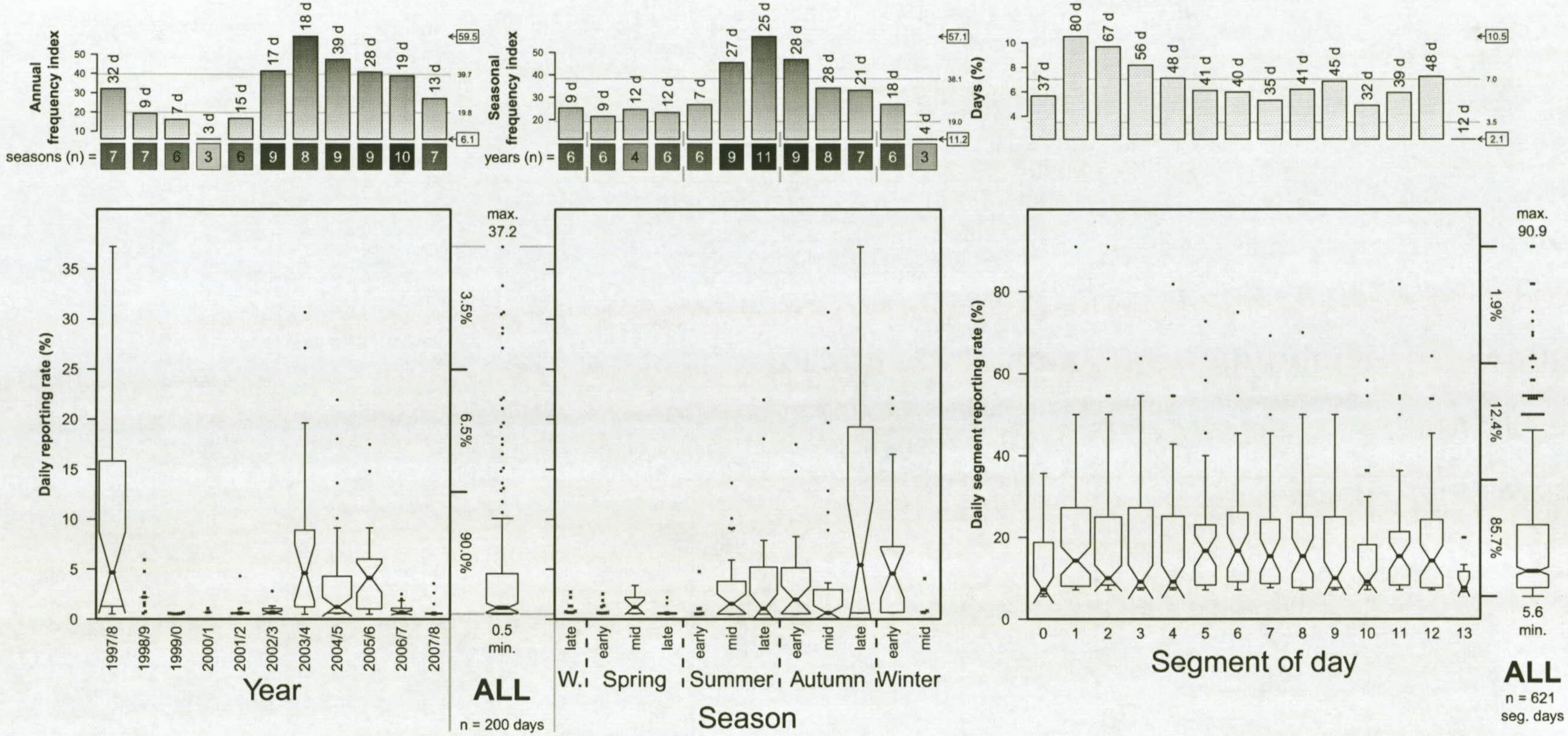


Figure 5.303: R832 Long-tailed Widowbird — birds heard: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

Figure 5.304: R832 Long-tailed Widowbird — birds heard: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

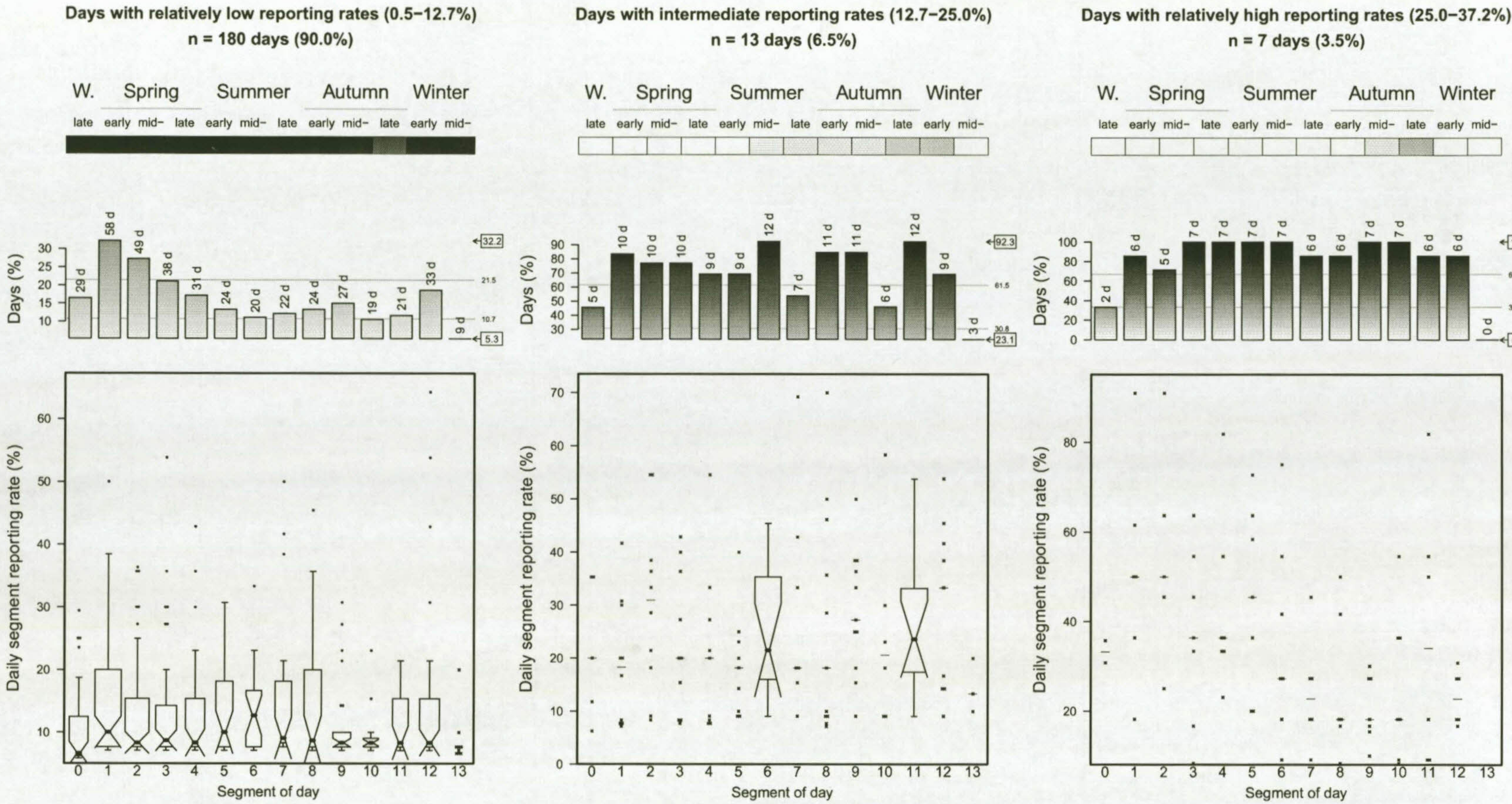


Figure 5.305: R832 Long-tailed Widowbird — birds heard: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

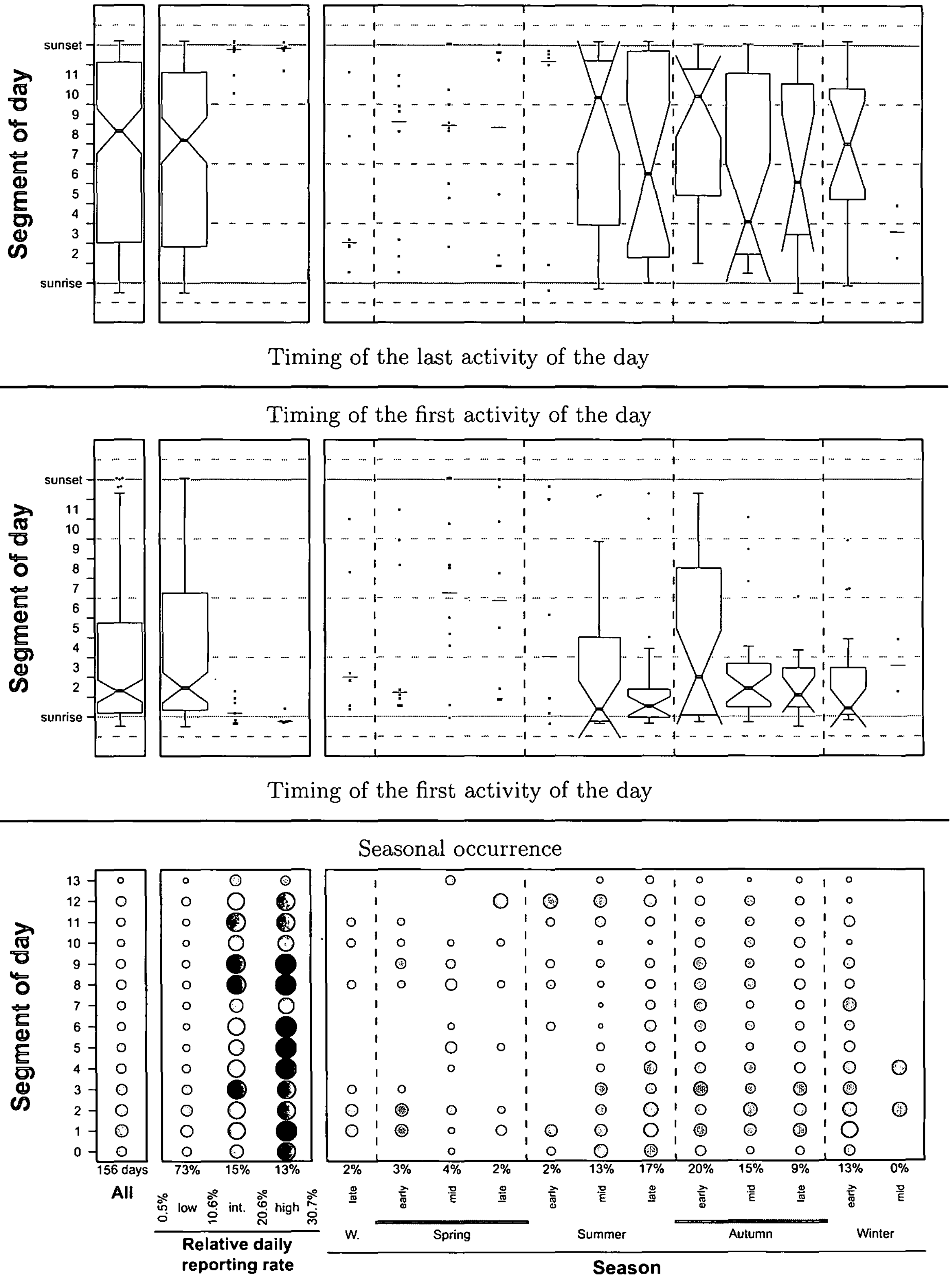


Figure 5.306: R832 Long-tailed Widowbird — birds heard: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

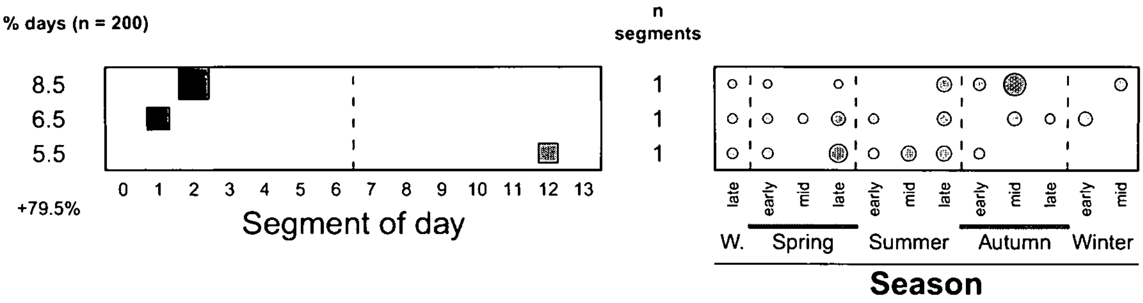


Figure 5.307: R832 Long-tailed Widowbird — birds heard: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

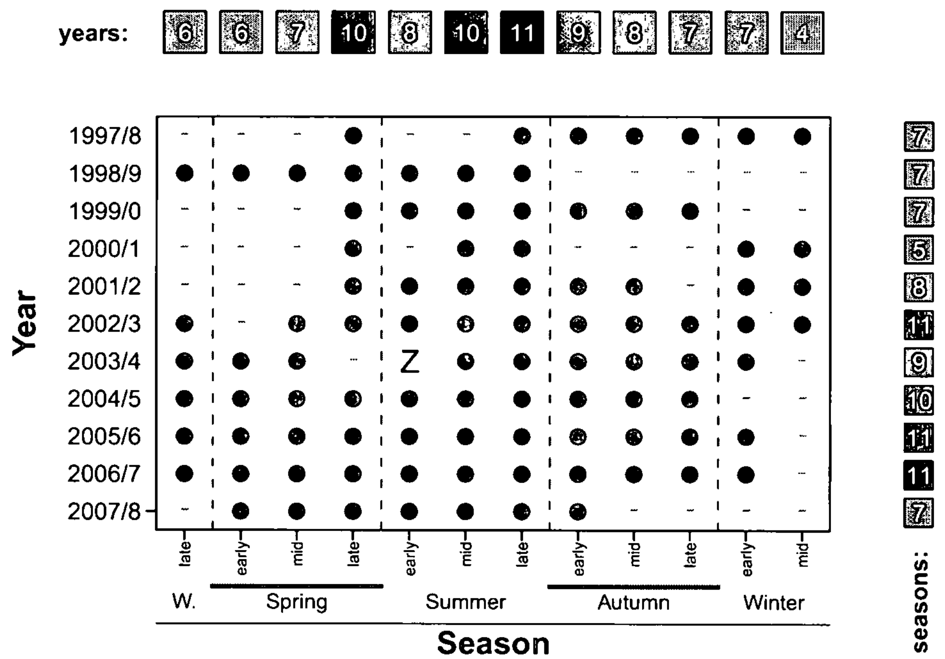


Figure 5.308: R832 Long-tailed Widowbird: Annual and seasonal occurrence at Glen when all data are combined. See page 137 for more information on this combined figure.

R845 Violet-eared Waxbill .... *Granatina granatina*

The Violet-eared Waxbill is endemic to the southern third of Africa (Maclean 1985). In southern Africa, it is widespread over much of Namibia, Botswana, Zimbabwe, northern and north-central South Africa (Barnard & Herremans 1997b) and southern Mozambique (Parker 1999). The study area at Glen is situated at the southern limit of its distribution. It prefers shrub thickets and appears to be independent of water (Barnard & Herremans 1997c). Sedentary, but subject to nomadic movements, especially in dry years (Nuttall 2005d).

The birds at Glen

Three birds were once seen in the grassland in mid-summer 1998/9. In the drainage line, recorded on three days in 2007/8: late autumn and mid-winter (n = 2 days). Also encountered during transects in the drainage line during late autumn and winter in 2000/1 and 2001/2 (n = 6 days).

R846 Common Waxbill .... *Estrilda astrild*

The Common Waxbill is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa, it is widespread in South Africa, Lesotho, Swaziland, Zimbabwe and southern Mozambique, and more localised in Botswana and Namibia (Barnard 1997a; Parker 1999). Associated with rank vegetation, usually near water (Maclean 1985). Resident (Maclean 1985), but may wander during drought years (Nuttall 2005c).

The birds at Glen

In the grassland, heard and/or seen on eight days spread over four years with all the records limited to the period from mid-summer to late autumn (Fig. 5.309). Most of the records involved birds encountered during the morning (Fig. 5.309).

Discussion

The birds recorded at Glen represent birds on the move.

R847 Black-faced Waxbill .... *Estrilda erythronotos*

The Black-faced Waxbill is endemic to sub-Saharan Africa (Maclean 1985). The subspecies occurring in southern Africa, *E. e. erythronotos* (including *E. e. soligena*), is isolated from the one occurring in east Africa, *E. e. delamerei* (Hall & Moreau 1970). *E. e. erythronotos* occurs from southern Angola (Dean 2000) and Zambia southwards into Namibia, Botswana, western Zimbabwe and northern and north-central South Africa (Barnard 1997b), the study area being at the south-eastern edge of its distribution. It is associated with dry *Acacia* thornveld with surface water, and is a resident and sedentary species subject to local movements (Barnard 1997b; Nuttall 2005b; Tarboton *et al.* 1987).

The birds at Glen

The only Black-faced Waxbill records were of birds seen and heard during transects in the drainage line during late autumn and mid-winter 2001/2.

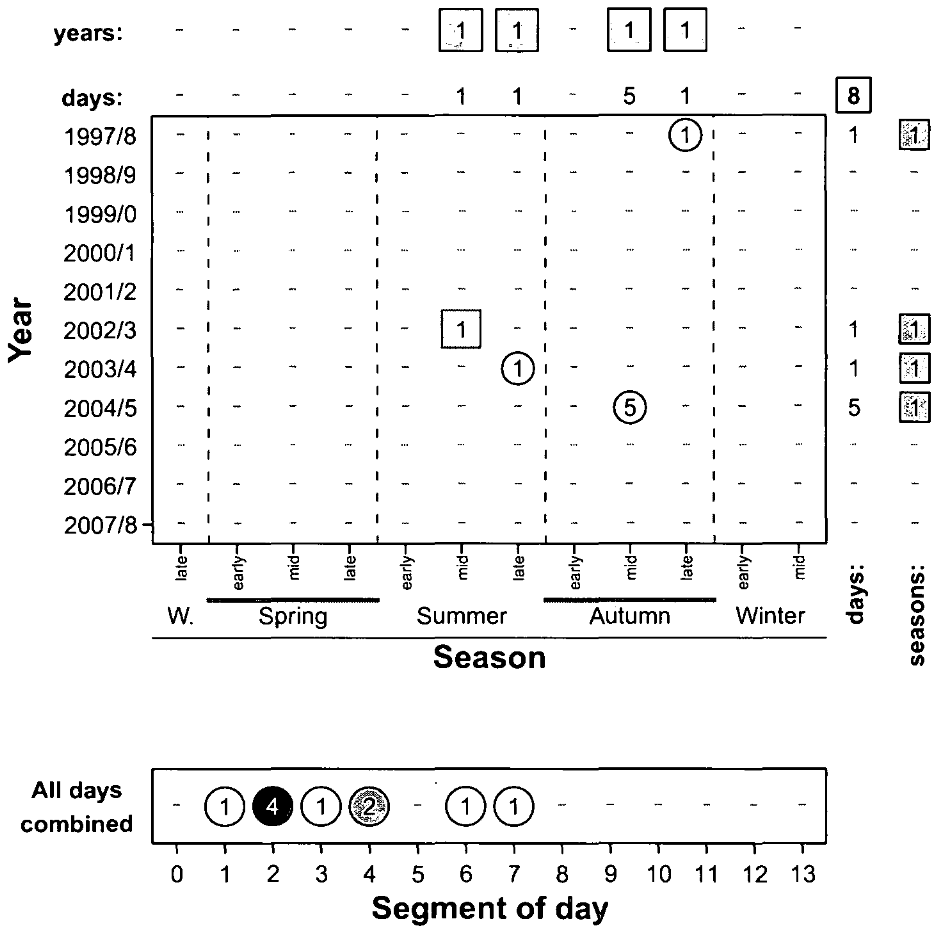


Figure 5.309: R846 Common Waxbill — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

R852 African Quailfinch .... *Ortygospiza atricollis*

The African Quailfinch is endemic to sub-Saharan Africa (Maclean 1985). Its southern African distribution is centred on South Africa from the Free State eastwards through Lesotho, Swaziland and southern Mozambique; also relatively frequent in Zimbabwe (Nuttall 1997e; Parker 1999). Associated with open areas with short grassland, often near water (Nuttall 1997e). Nomadic after breeding with irregular movements influenced by local rainfall and habitat conditions (Nuttall 1997e).

The birds at Glen

Virtually all records of the African Quailfinch involved birds heard and all the data is combined in the analysis below. It is primarily a grassland species that was also heard in the drainage line (Table 5.57), but then only as birds which flew over the area. Figures start on page 962.

Annual occurrence of birds in the grassland: Activity was noted on 97.4% of the days with an activity index of 36 (Table 5.57a). Recorded during all seasons each year (Fig. 5.310;

Table 5.57: R852 African Quailfinch: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	22 860	114 612	19.9	birds present	97.4	656	639	36
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	106	1 190	8.9	birds present	83.7	43	36	3
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	301	1 188	25.3	birds present	93.0	43	40	8

Fig. 5.311). Daily reporting rates ranged from 0.6 to 73.3% with more than a third of the bird-days attaining intermediate or high reporting rates (Fig. 5.310). Median daily reporting rates fluctuated greatly from year to year, with high reporting rate days occurring during nearly all years (Fig. 5.310; Fig. 5.311).

Seasonal occurrence of birds in the grassland: Heard in all seasons every year (Fig. 5.310). Median daily reporting rates follow a well-defined seasonal trend with a peak centred on late autumn (Fig. 5.310), concomitant with the occurrence of high and intermediate reporting rate days which shows a peak in occurrence centred on autumn (Fig. 5.311). Median daily reporting rates were lowest during late winter, spring and early summer (Fig. 5.310), coinciding with the only time of the year when zero record days occurred (Fig. 5.311).

Daily occurrence of birds in the grassland: Overall, activity was frequent during all segments of the day and only slightly more so during the first part of the morning (Fig. 5.310). This general pattern mostly reflects the situation on low reporting rate days, because on intermediate and high reporting rate days activity was almost equally frequent throughout the day (Fig. 5.312). Seasonally, activity was most frequent in the morning and again in the late afternoon/early evening during spring, with the pattern changing in subsequent seasons until activity is very frequent throughout the day during autumn (Fig. 5.313). Two bird-segment combinations occurred during more than 5% bird-days and involved all segments of the day and all segments except S13; collectively these combinations accounted for 21.9% bird-days and were most frequent during autumn (Fig. 5.314).

The first activity of the day normally occurred before sunrise, earlier during intermediate and high reporting rate days than on low reporting rate days (Fig. 5.313; Fig. 5.315). There is a well-defined seasonal pattern with activity starting earliest during autumn and latest during late spring (Fig. 5.313; Fig. 5.315). The dawn chorus sequence follows a similar pattern (Fig. 5.315).

Overall, the last activity of the day normally occurred 15 minutes either side of sunset (Fig. 5.313; Fig. 5.315). The median values of all seasons were just before or after sunset, but the timing was more variable in certain seasons than others (Fig. 5.313; Fig. 5.315).

Overall, daily segment reporting rates ranged from 4.8 to 100% with a two-thirds of the values relatively low (Fig. 5.310). On low reporting rate days, the median daily segment reporting rates were only slightly higher during the early morning than later in the day, in contrast to intermediate and high reporting rate days when it was much higher in the early morning than later in the day (Fig. 5.312).

Early morning occurrence of birds during 2007/8: Activity was slightly less frequent in the drainage line, occurring during 83.7% of the mornings with an activity index of three, compared to the grassland where it occurred during 93.0% of the mornings with an activity index of eight (Table 5.57b & c). The median early morning reporting rate was also higher in the grassland (Fig. 5.316). Furthermore, the seasonal occurrence of low, intermediate and particularly high reporting rate mornings was also different between the two habitats, with high reporting rate mornings being limited to early and mid-winter in the drainage line and to mid-summer and mid-autumn to early winter in the grassland (Fig. 5.316). Within the grassland the timing of the first activity of the day was remarkably constant seasonally, and often earlier than in the drainage line (Fig. 5.316). Activity intensities were comparable for the time before and after sunrise (Fig. 5.316)

Discussion

Egg-laying in the African Quailfinch is mainly from January to March [late summer to mid-autumn], and the combined incubation and nestling/fledgling period is approximately five weeks (Tarboton 2001). The young remain with the adults for some time after fledgling (Nuttall 2005a). Based on an extrapolation of data from birds near Pertrusburg in the central Free State, Nuttall (2005a) suggested that primary moult occurs over a 12-month period. However, data from birds ringed at Glen indicate a complete pre-breeding moult from spring (or perhaps earlier) to summer (DJvN unpublished data).

In terms of the activity patterns at Glen, the late autumn centred peak in activity concur with breeding and the quiescent period centred on spring with moult (see Fig. 5.310; Fig. 5.311; Fig. 5.313).

R856 Red-headed Finch .... *Amadina erythrocephala*

The Red-headed Finch occurs from southern and south-western Angola (Dean 2000) southwards through Namibia, Botswana, south-western Zimbabwe and South Africa where it is absent mainly from the east and the west (Herremans 1997i). Its habitat preferences include dry, open grassland with clumps of trees (Maclean 1985), with Herremans (1997i) suggesting a seasonal habitat shift from densely wooded thornbush in the breeding season to more open grasslands after the breeding season (Herremans 1997i). It is highly nomadic (Herremans 1997i).

The birds at Glen

The Red-headed Finch was usually recorded as birds visiting the trampled area. They breed in old Southern Masked Weaver R814 nests at the farm dam, and adults with recently fledged young

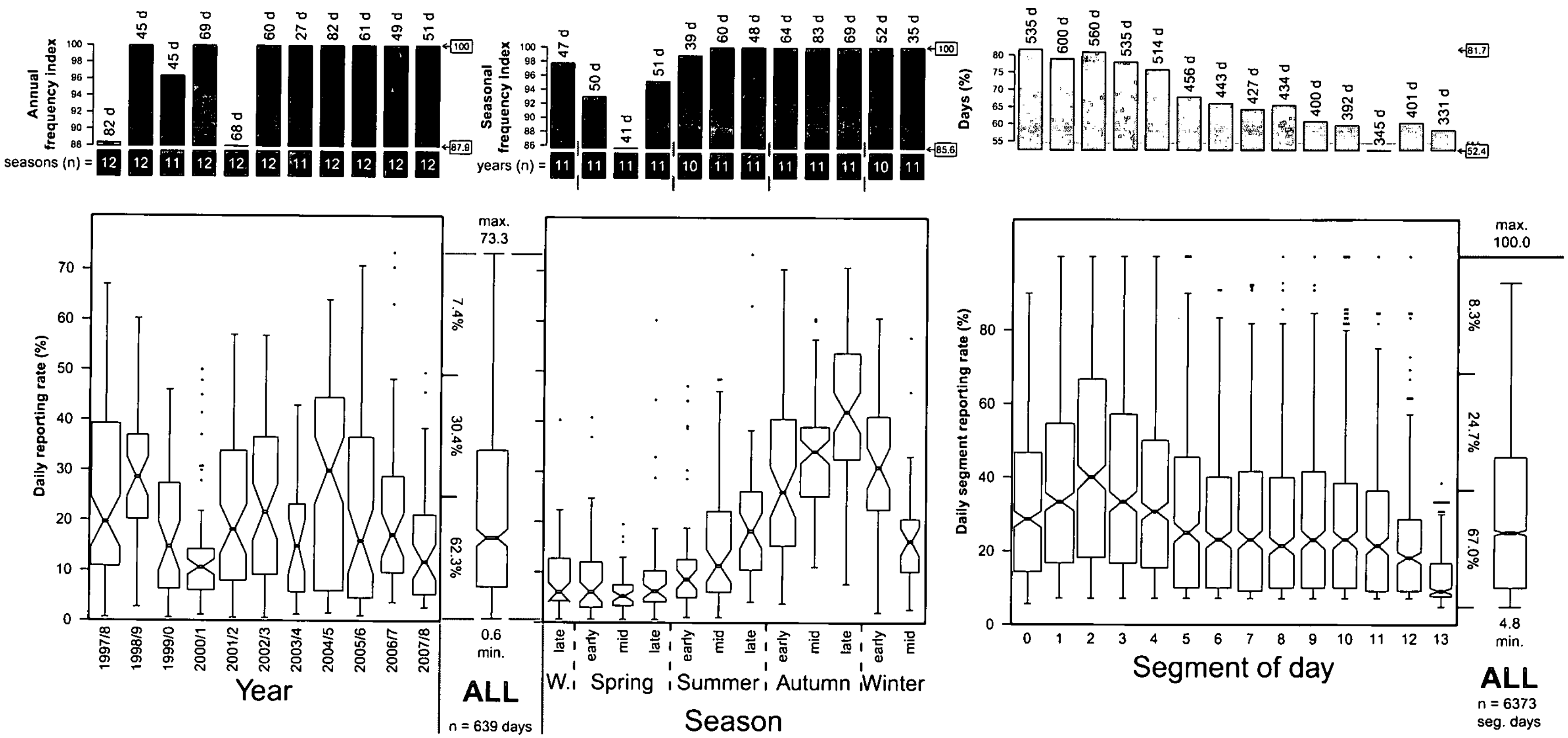


Figure 5.310: R852 African Quailfinch — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

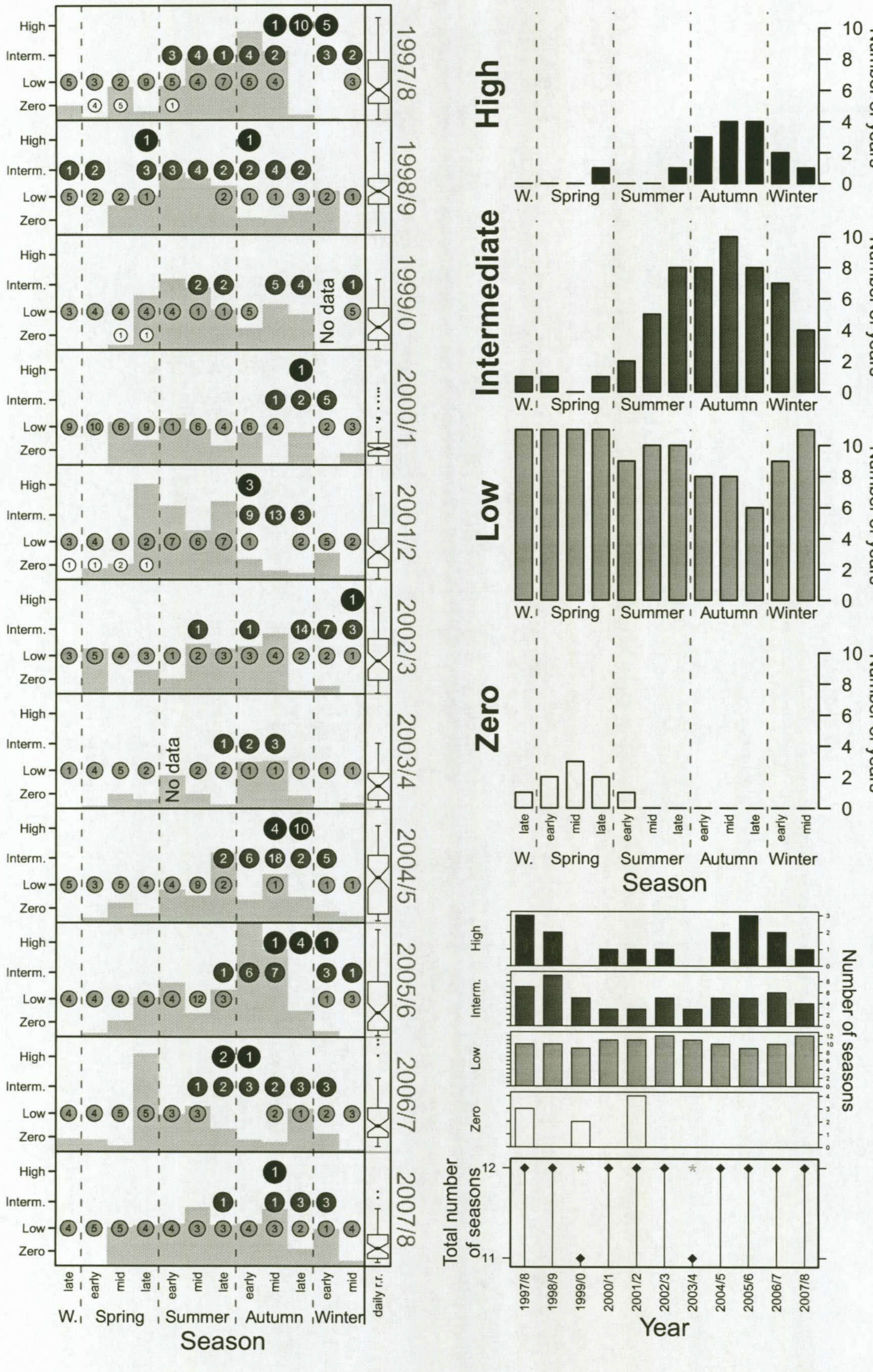


Figure 5.311: R852 African Quailfinch — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

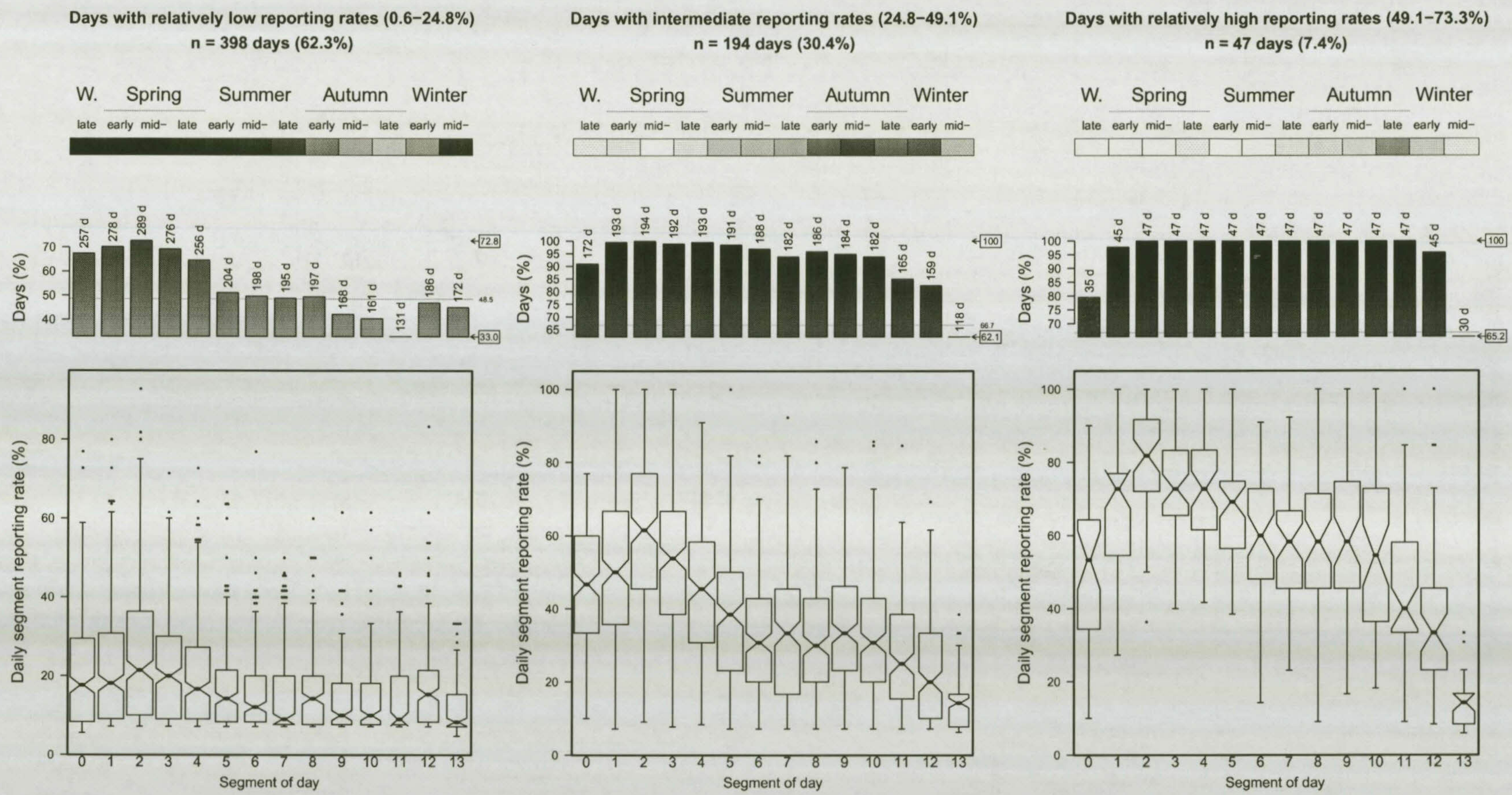


Figure 5.312: R852 African Quailfinch — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

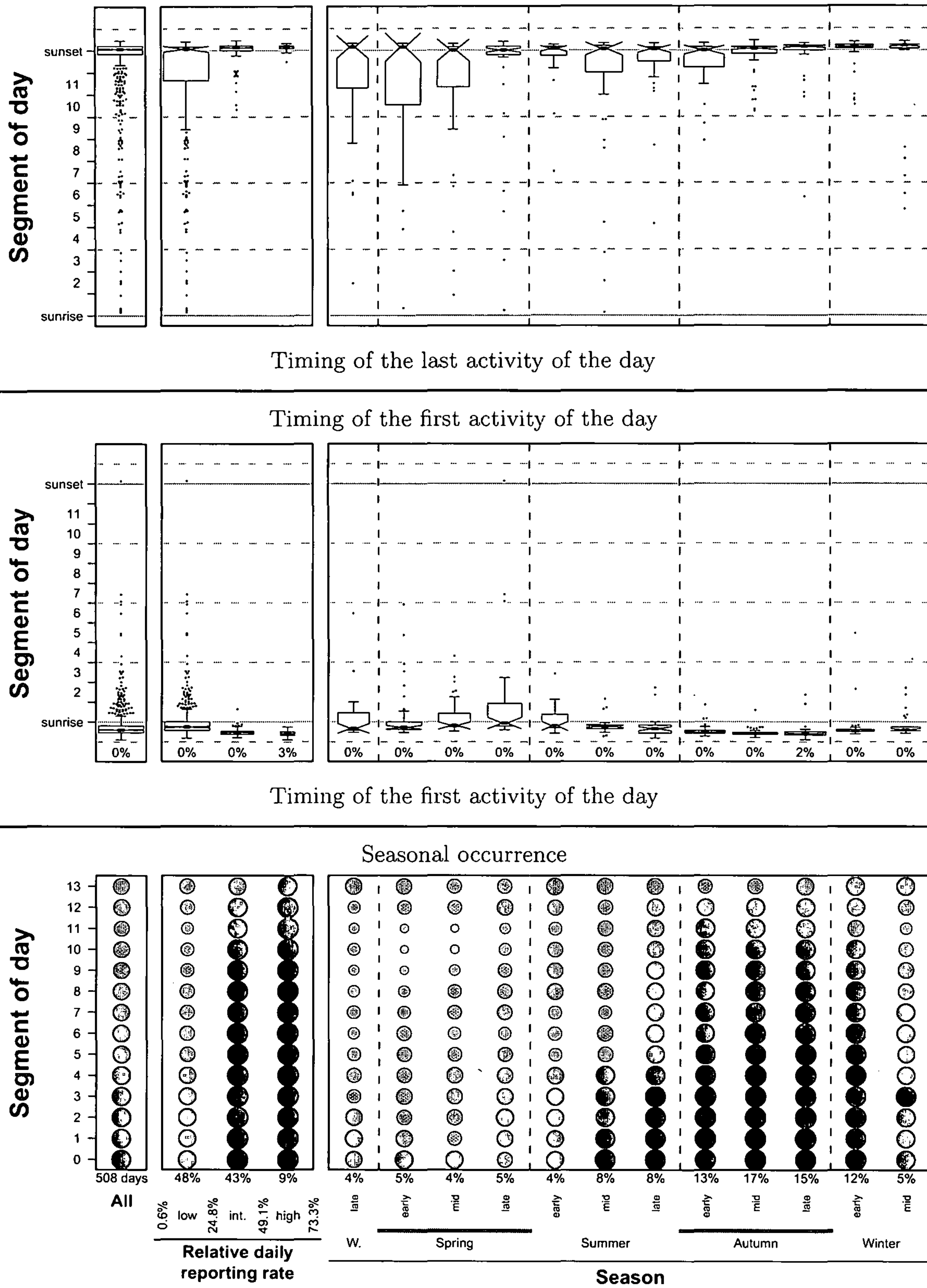


Figure 5.313: R852 African Quailfinch — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

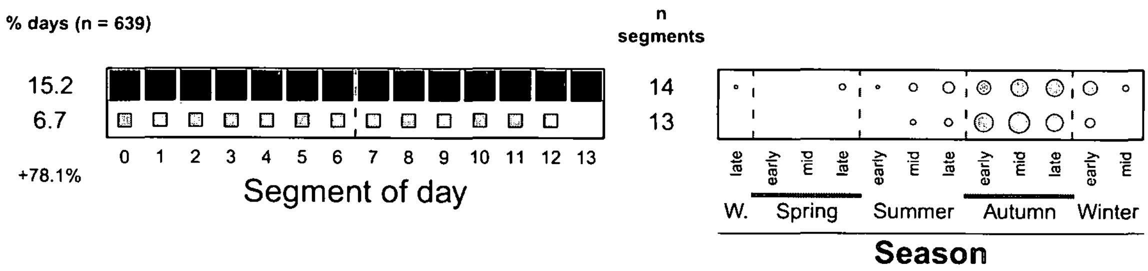


Figure 5.314: R852 African Quailfinch — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

occasionally occur in the grassland. The analysis is based on a year starting in late summer. Figure start on page 970.

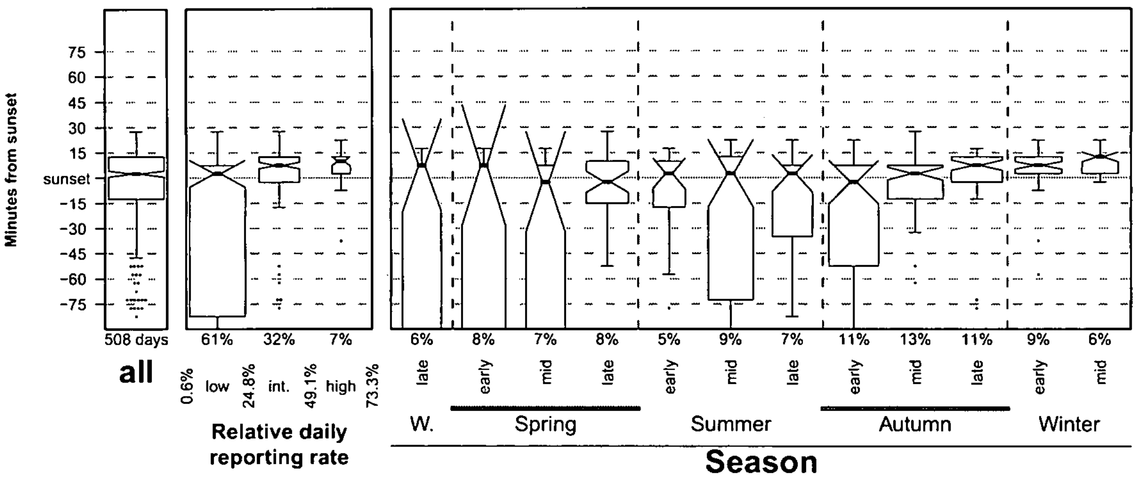
Annual occurrence of birds in the grassland: Activity was noted on 55.2% of the days with an activity index of seven (Table 5.58a). Recorded on 8–12 seasons each year, except 2007 when recorded during only five seasons (Fig. 5.317; Fig. 5.318). Daily reporting rates ranged from 0.5 to 44.2% with 92.9% of the bird-days attaining low reporting rates (Fig. 5.317). Compared to other years, the upper quartile of daily reporting rates were higher in 1998, 1999 and 2000, the only years with high reporting rate days (Fig. 5.317; Fig. 5.318).

Seasonal occurrence of birds in the grassland: Activity occurred in 8–10 years during autumn, winter and early and mid-spring, and during 6–7 years in late spring and summer, corresponding with fluctuations in the seasonal frequency index (Fig. 5.317). Median daily reporting rates were highest during winter (Fig. 5.317) with the occurrence of days with zero records least frequent in late autumn and winter (Fig. 5.318).

Table 5.58: R856 Red-headed Finch: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

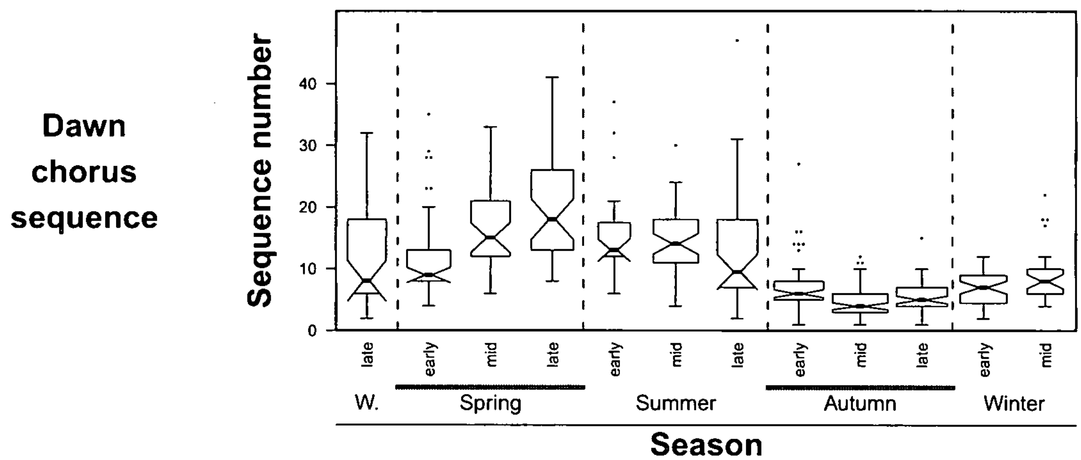
Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	2 570	114 612	2.2	birds present	55.2	656	362	7
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	2	1 190	0.2	birds present	4.7	43	2	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 188	0.4	birds present	11.6	43	5	1

Daily occurrence of birds in the grassland: Overall, activity was generally frequent throughout most of the day and least frequent after sunset (Fig. 5.317). This pattern is particularly evident



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

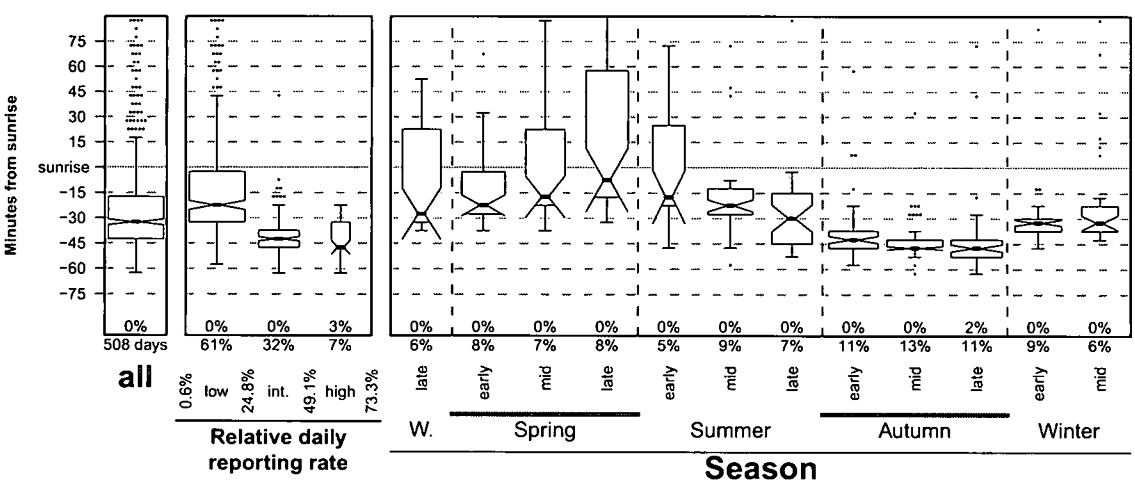


Figure 5.315: R852 African Quailfinch — birds present: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.

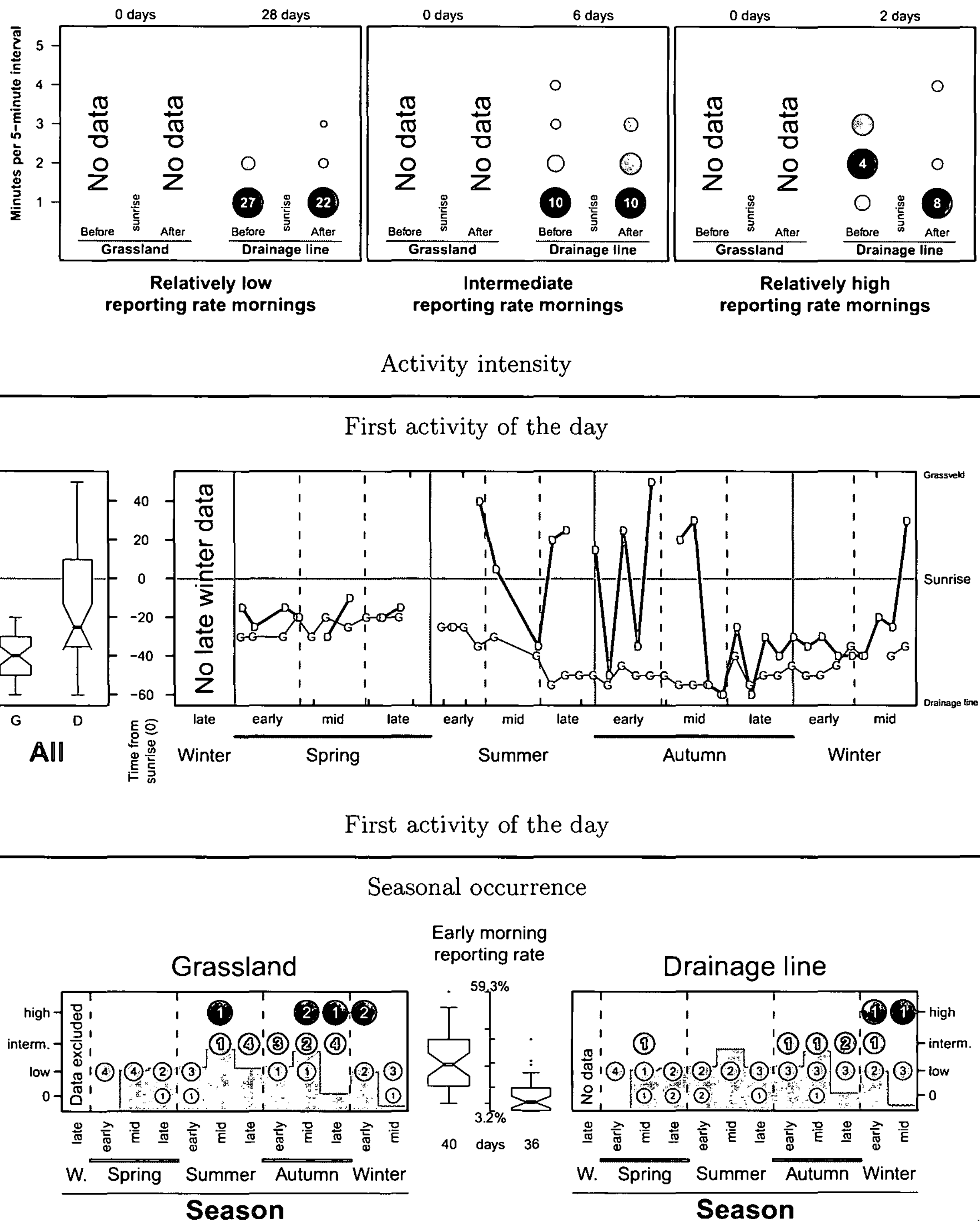


Figure 5.316: R852 African Quailfinch — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

for intermediate and high reporting rate days (Fig. 5.319), and most seasons show a similar pattern (Fig. 5.320). No bird-segment combinations occurred during more than 5% bird days.

The first activity of the day often occurred during the morning, usually around sunrise on intermediate and high reporting rate days (Fig. 5.320). Seasonally the timing was slightly earlier during winter than during other seasons (Fig. 5.320).

The occurrence of the last activity of the day was variable for low reporting rate days, but it typically occurred shortly before sunset for intermediate and high reporting rate days (Fig. 5.320). It also tended to occur later in the day during winter than during most other seasons (Fig. 5.320).

Overall, daily segment reporting rates ranged from 5.9 to 100% with 91.1% of the values relatively low (Fig. 5.317). Median daily segment reporting rates were similar for most segments of the day (Fig. 5.319).

Early morning occurrence of birds during 2007/8: Activity was slightly more frequent in the grassland than in the drainage line (5 vs. 2 bird mornings; Table 5.58b & c), with all of the grassland records during autumn and early and mid-winter, and the drainage line records in late autumn and mid-winter.

Discussion

The Red-headed Finch breeds mainly from February to May [autumn to early winter] (Tarboton 2001), with moult occurring mainly from August to February [spring, summer and early autumn] (Dean 2005ah; DJvN unpublished data). Therefore, peak occurrence at Glen during winter (Fig. 5.317) seems to represent post-breeding activity, which included flocks. The time of least activity (Fig. 5.317) coincided with moult.

5.23 Viduidae: Whydahs, Indigobirds, Cuckoo Finch

The family Viduidue with its 20 species is endemic to sub-Saharan Africa, with nine species occurring in southern Africa (Hockey *et al.* 2005). Three of the six species occurring in the Free State are found in the central part of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). Only the Pin-tailed Whydah R860 occurs in the study area, which is situated at the southern end of the distributions of the Shaft-tailed Whydah *Vidua regia* and the Village Indigobird *Vidua chalybeata*.

R860 Pin-tailed Whydah .... *Vidua macroura*

The Pin-tailed Whydah is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in South Africa (sparse or absent in the west), Lesotho, Swaziland, Zimbabwe and southern Mozambique, and localised in Botswana and Namibia (Barnard 1997c; Parker 1999). It occurs in a wide range of habitats, becoming more specifically associated with wetland habitats in arid areas (Barnard 1997c). Status varies form resident and sedentary to nomadic in the non-breeding season, the degree of nomadism probably correlated with aridity (Barnard 1997c).

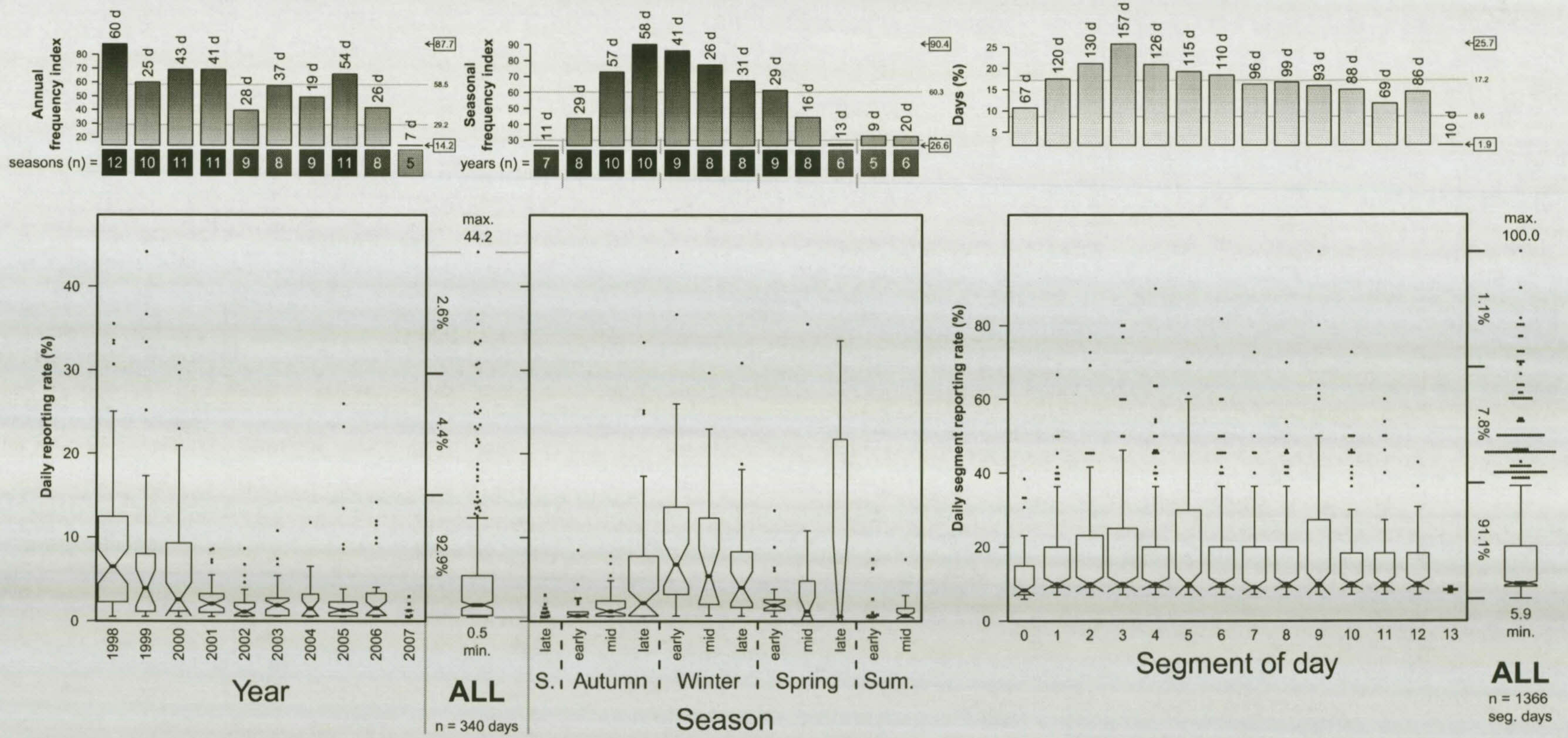


Figure 5.317: R856 Red-headed Finch — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

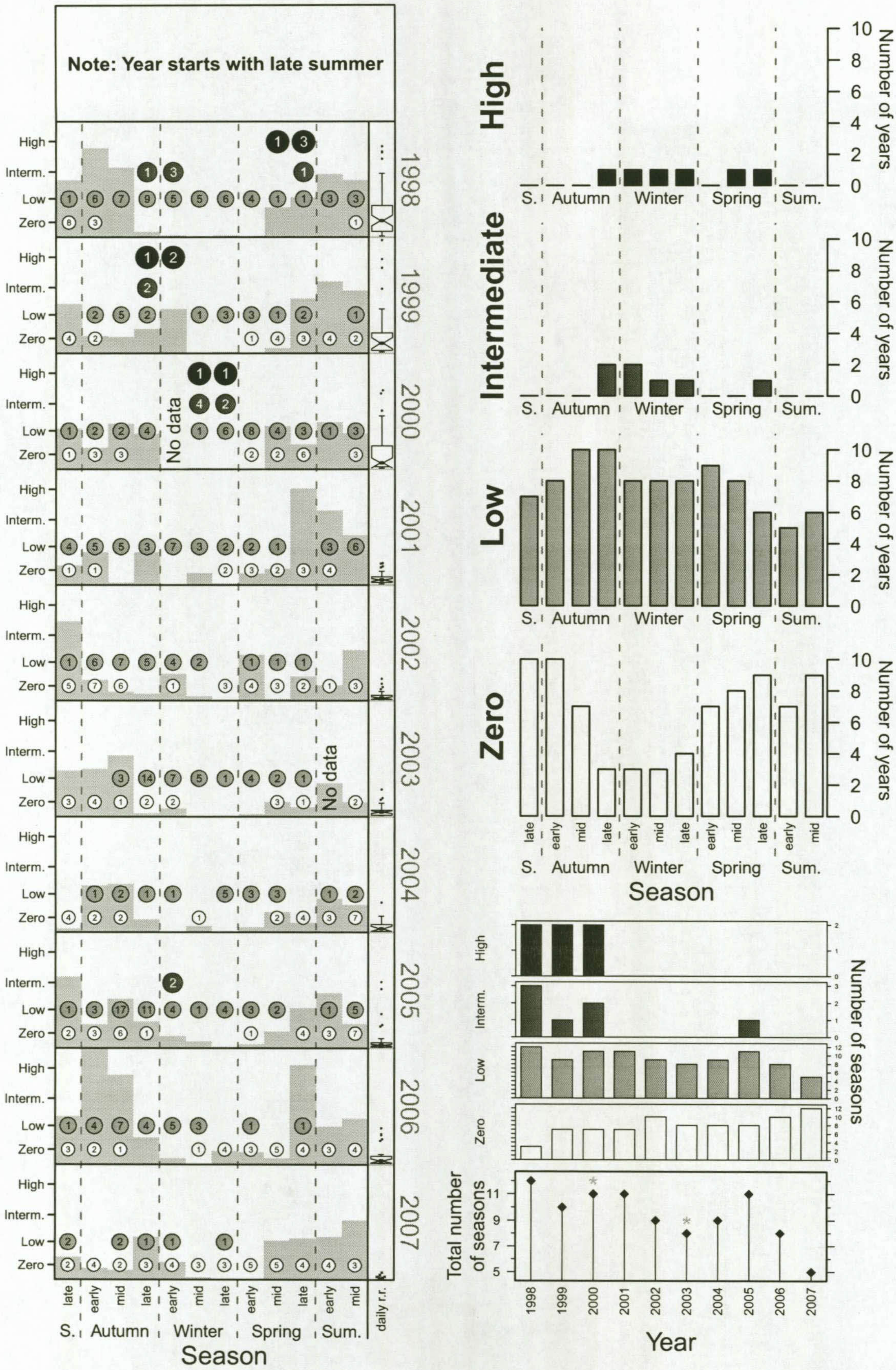


Figure 5.318: R856 Red-headed Finch — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

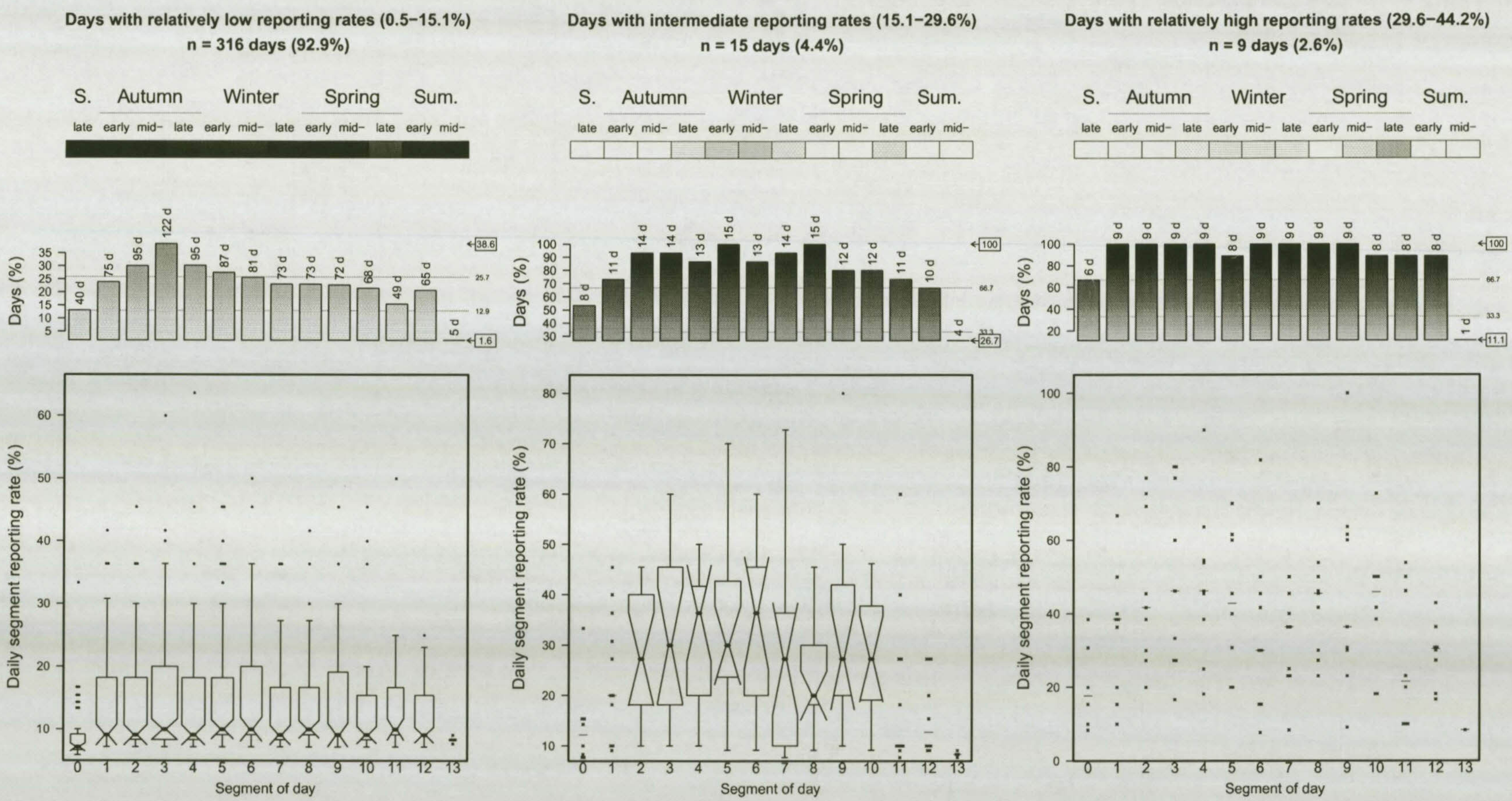


Figure 5.319: R856 Red-headed Finch — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

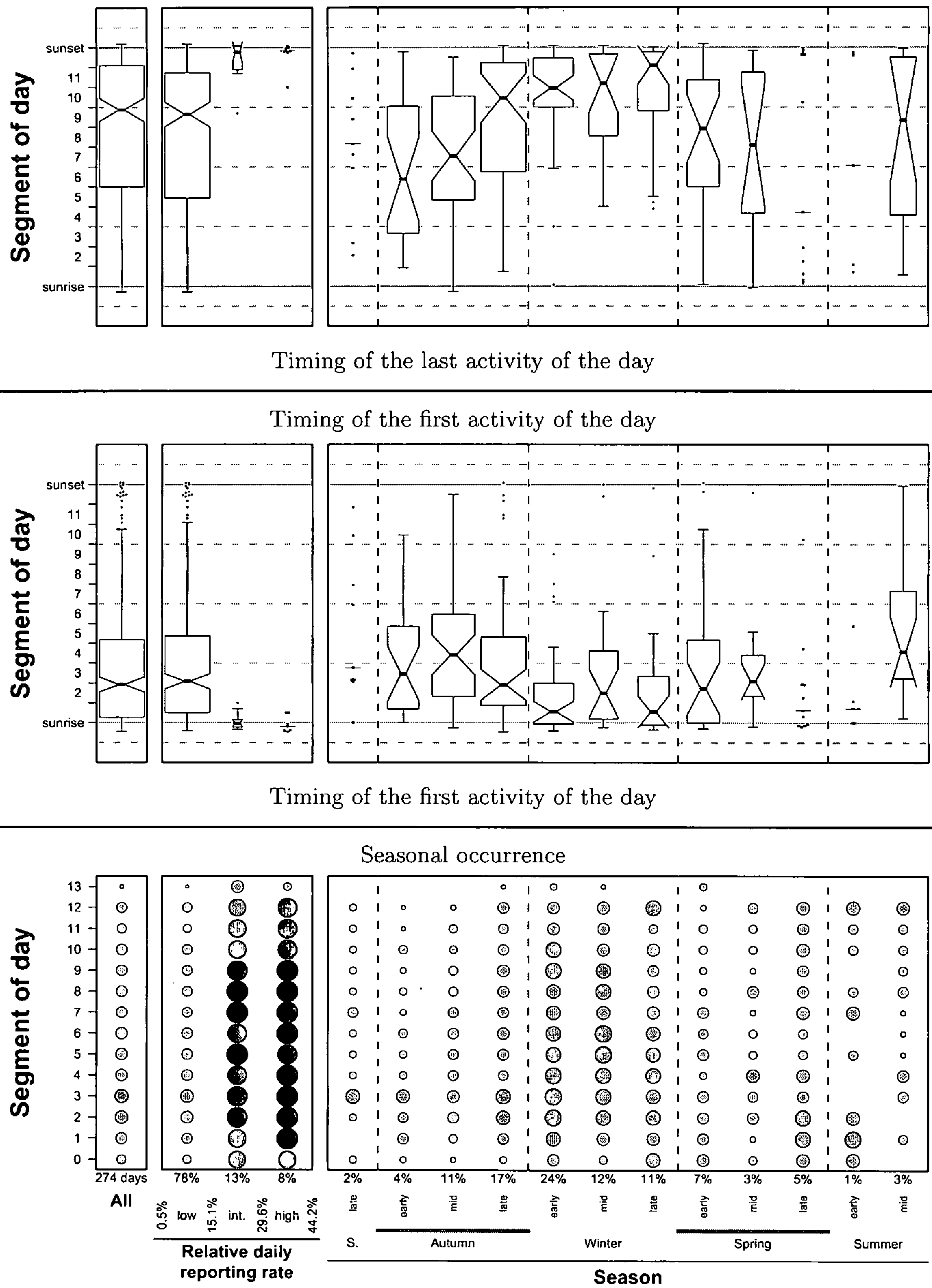


Figure 5.320: R856 Red-headed Finch — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

The birds at Glen

The Pin-tailed Whydah is a scarce visitor to the grassland and drainage line at Glen.

In the grassland recorded on 14 days spanning seven years, with records during 1–2 seasons per year (Fig. 5.321). Seasonally records were limited to the period from mid-spring to mid-autumn when recorded during 1–2 years in each season, except mid-summer when recorded during five years (Fig. 5.321). Most of the records involved birds seen in the morning (Fig. 5.321).

In the drainage line recorded on six mornings in 2007/8 (summer and mid-autumn).

Discussion

The occurrence of the birds at Glen coincides with the breeding season, which is mainly from December to February [mid-summer to early autumn] in eastern South Africa (Dean & Payne 2005b).

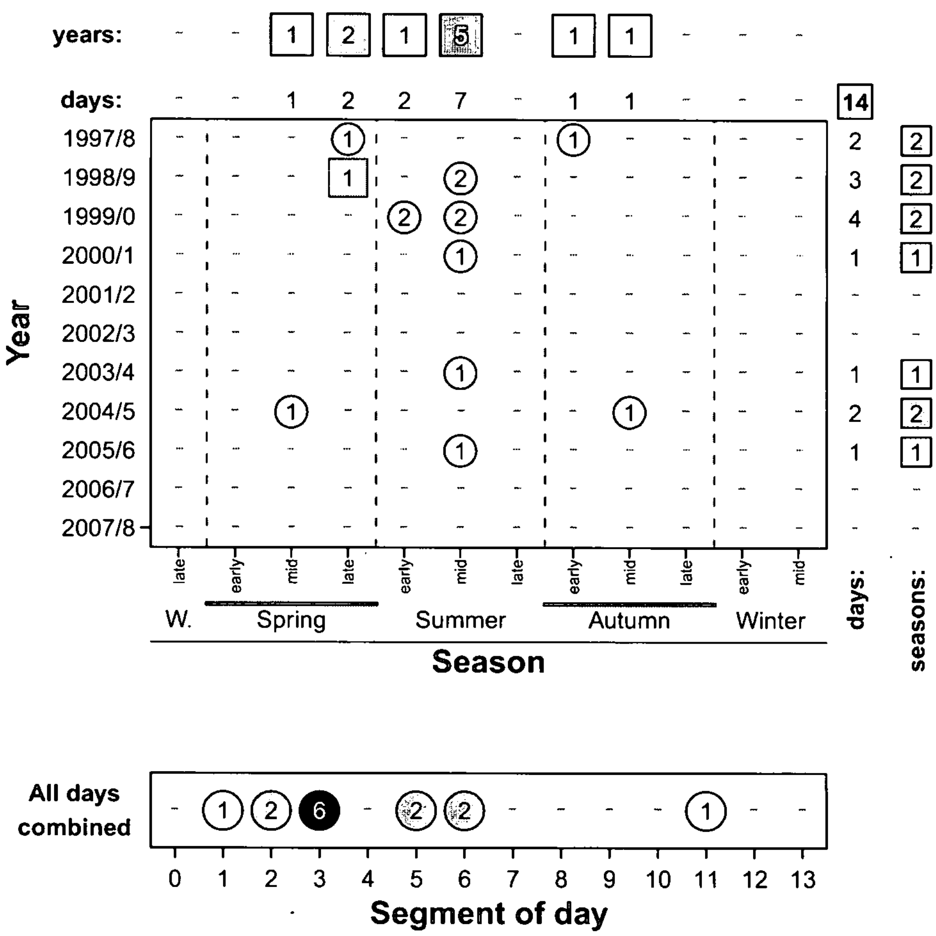


Figure 5.321: R860 Pin-tailed Whydah — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

5.24 Fringillidae: Chaffinches, Canaries, Buntings

Fringillidae is a large family with the 993 species occurring worldwide except in the polar regions, with 20 species occurring in southern Africa (Hockey *et al.* 2005). Seven of the 14 species found in the Free State also occur in the central parts of the province (Earlé & Grobler 1987; Harrison *et al.* 1997b). The White-throated Canary *Crithagra albogularis* was not recorded at Glen; it is relatively scarce in the central parts of the Free State.

R870 Black-throated Canary .... *Crithagra atrogularis*

The Black-throated Canary is endemic to sub-Saharan Africa (Fry 2004a). In southern Africa largely absent or scarce in the west, south and east of the region, as well as central and south-eastern Botswana with the Free State forming part of its core distribution in South Africa (Nuttall 1997f). It occurs in a variety of habitats, including grassland and lightly wooded areas (Nuttall 1997f). Considered to be resident, but some local seasonal movements do occur (Maclean 1985; Nuttall 1997f).

The birds at Glen

Recorded in the grassland either as birds in flight or as birds feeding, usually in the trampled area. Figures start on page 977.

Annual occurrence of birds in the grassland: Activity was noted on 45.9% of the days with an activity index of four (Table 5.59a). Recorded during 8–12 seasons each year (Fig. 5.322; Fig. 5.323). Daily reporting rates ranged from 0.5 to 33.8% with 98.0% of the bird-days attaining low reporting rates (Fig. 5.322). Median daily reporting rates were generally similar for all seasons, but 1999/0 was the only year with intermediate and high reporting rates (Fig. 5.322; Fig. 5.323).

Table 5.59: R870 Black-throated Canary: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	1 176	114 612	1.0	birds present	45.9	656	301	4
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	6	1 190	0.5	birds present	14.0	43	6	1
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	5	1 188	0.4	birds present	7.0	43	3	2

Seasonal occurrence of birds in the grassland: Mostly recorded during 10–11 years from mid-spring to late autumn and during only 5–7 years in mid- and late winter and early spring

(Fig. 5.322). The seasonal frequency index peaked in early summer (Fig. 5.322), coinciding with relatively few years with zero records then (Fig. 5.323). Median daily reporting rates were similar for all seasons (Fig. 5.322).

Daily occurrence of birds in the grassland: Overall, activity occurred almost equally frequent during most segments of the day, notable exceptions being before sunrise when activity was infrequent and after sunset when no activity was recorded (Fig. 5.322). There was no prominent seasonal trend (Fig. 5.324). Two bird-segment combinations occurred during more than 5% bird-days and involved single segments S3 and S5, collectively accounting for 12.6% of all bird-days (Fig. 5.325).

The first activity of the day frequently occurred during the morning with no seasonal trend in its timing (Fig. 5.324). The occurrence of the last activity of the day was variable (Fig. 5.324).

Daily segment reporting rates ranged from 5.6 to 76.9% with 96.0% of the values relatively low; Median daily segment reporting rates were similar for all segments of the day (Fig. 5.322).

Early morning occurrence of birds during 2007/8: Activity occurred on six mornings in the drainage line and on three mornings in the grassland (Table 5.59b & c). All the records were limited to the period from late summer to mid winter.

Discussion

In the Black-throated Canary breeding occurs from October to April [mid-spring to late autumn] in the Free State (Maclean 1985). Moult strategy unclear; primary moult recorded throughout the year (Dean 2005am). The largely aseasonal character of the data from Glen (Fig. 5.322; Fig. 5.323) may indicate that these birds, like the Cape Sparrow (see page 920), have a prolonged moulting stage that overlaps with its protracted breeding season.

R872 Cape Canary .... *Serinus canicollis*

The Cape Canary is endemic to southern Africa (Fry 2004b), occurring in the southern and eastern parts of South Africa (including Lesotho and Swaziland), with an isolated population in the eastern highlands of Zimbabwe (Fraser 1997). The study area is located on the edge of its distribution. It utilises a variety of vegetation types including grassland and woodland (Fraser 1997), and mobility spans the range from sedentary to altitudinal/seasonal migrations to nomadic (Fraser 1997; Maclean 1985). A winter influx occurs in the Free State (Dean 2005al).

The birds at Glen

In the grassland the Cape Canary was mainly found feeding in the trampled area. Recorded on 13 days spread over six years, during winter and spring with most of the records during the morning (Fig. 5.326).

Recorded in the drainage line on two occasions, once during a transect in late spring 2001/2, and once during early spring 2007/8.

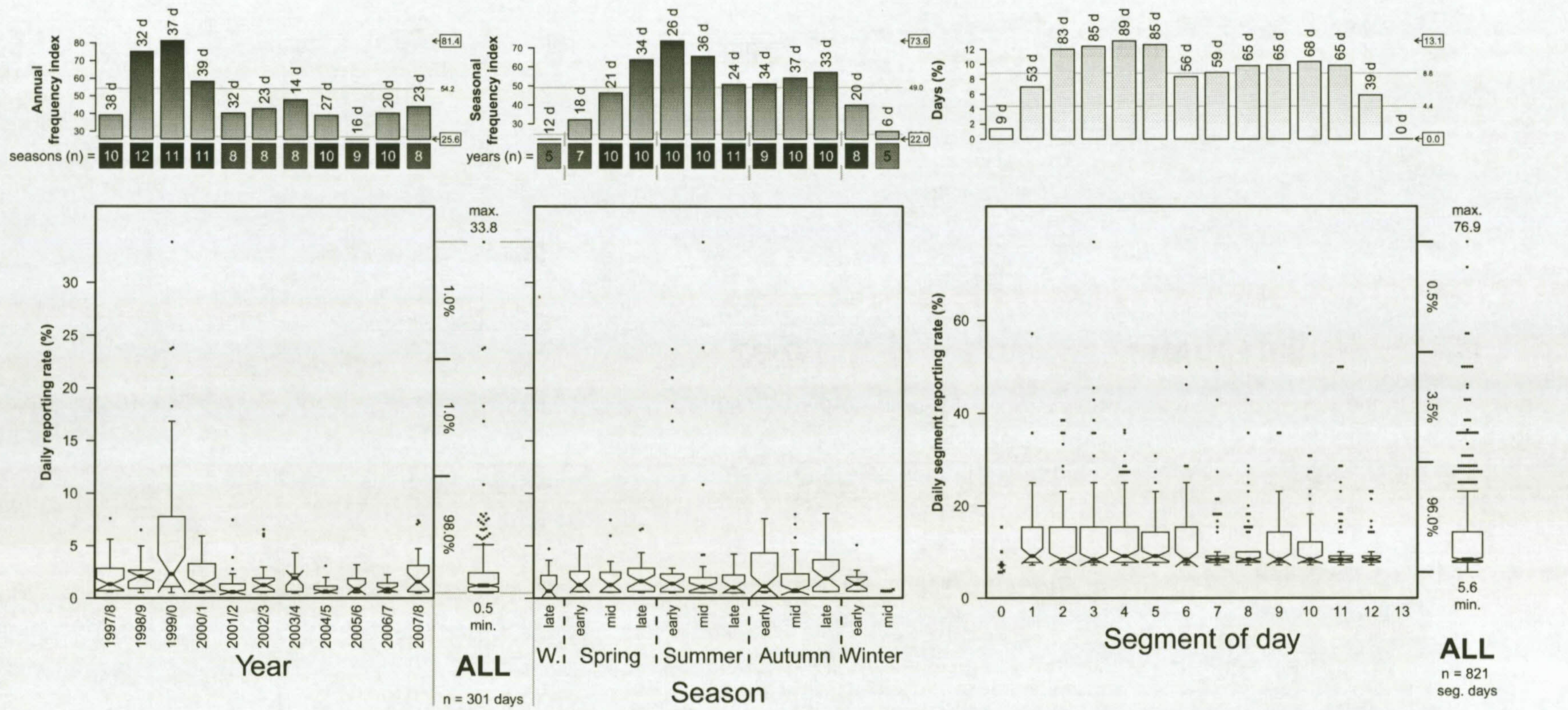


Figure 5.322: R870 Black-throated Canary — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

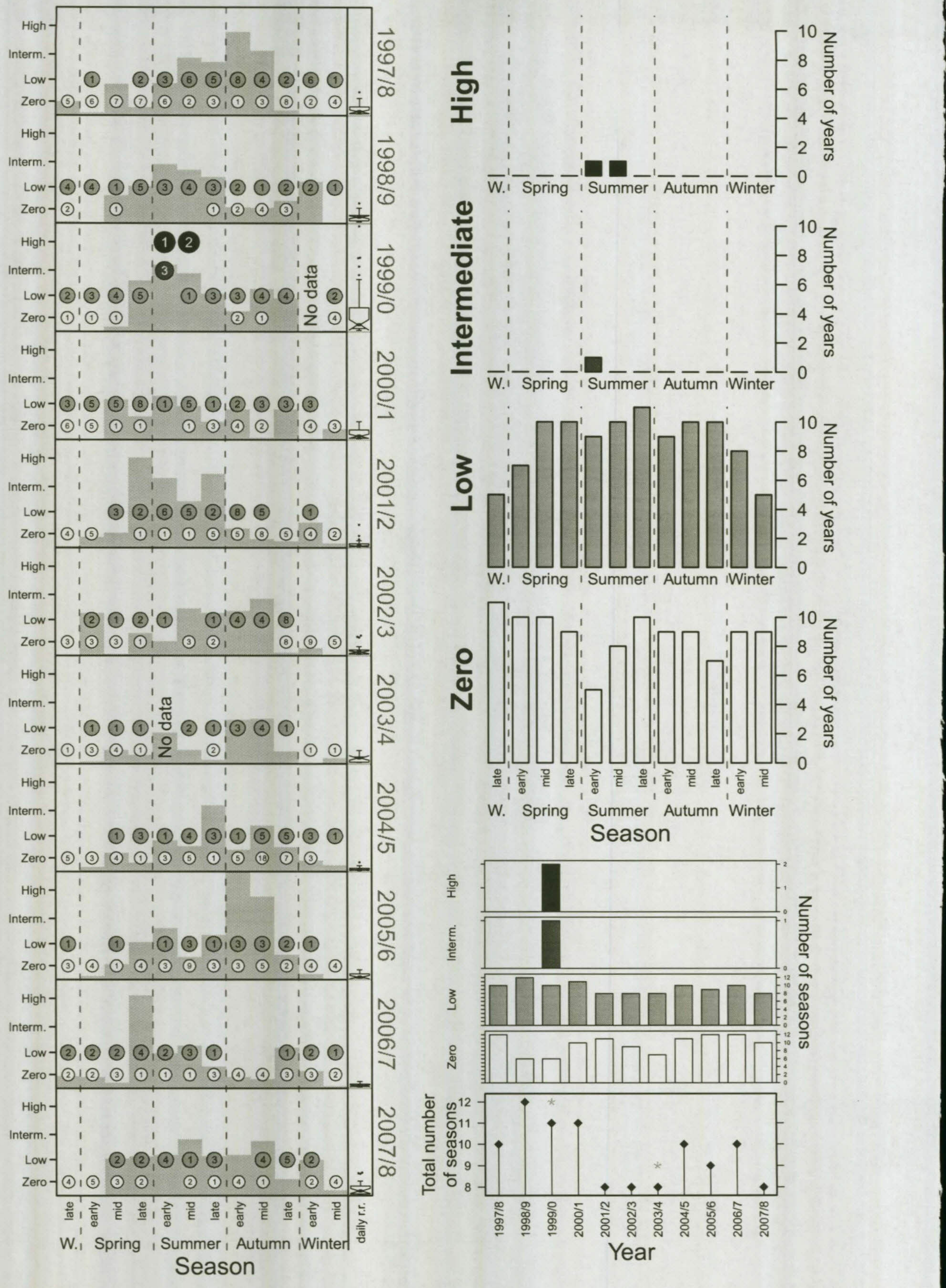


Figure 5.323: R870 Black-throated Canary — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

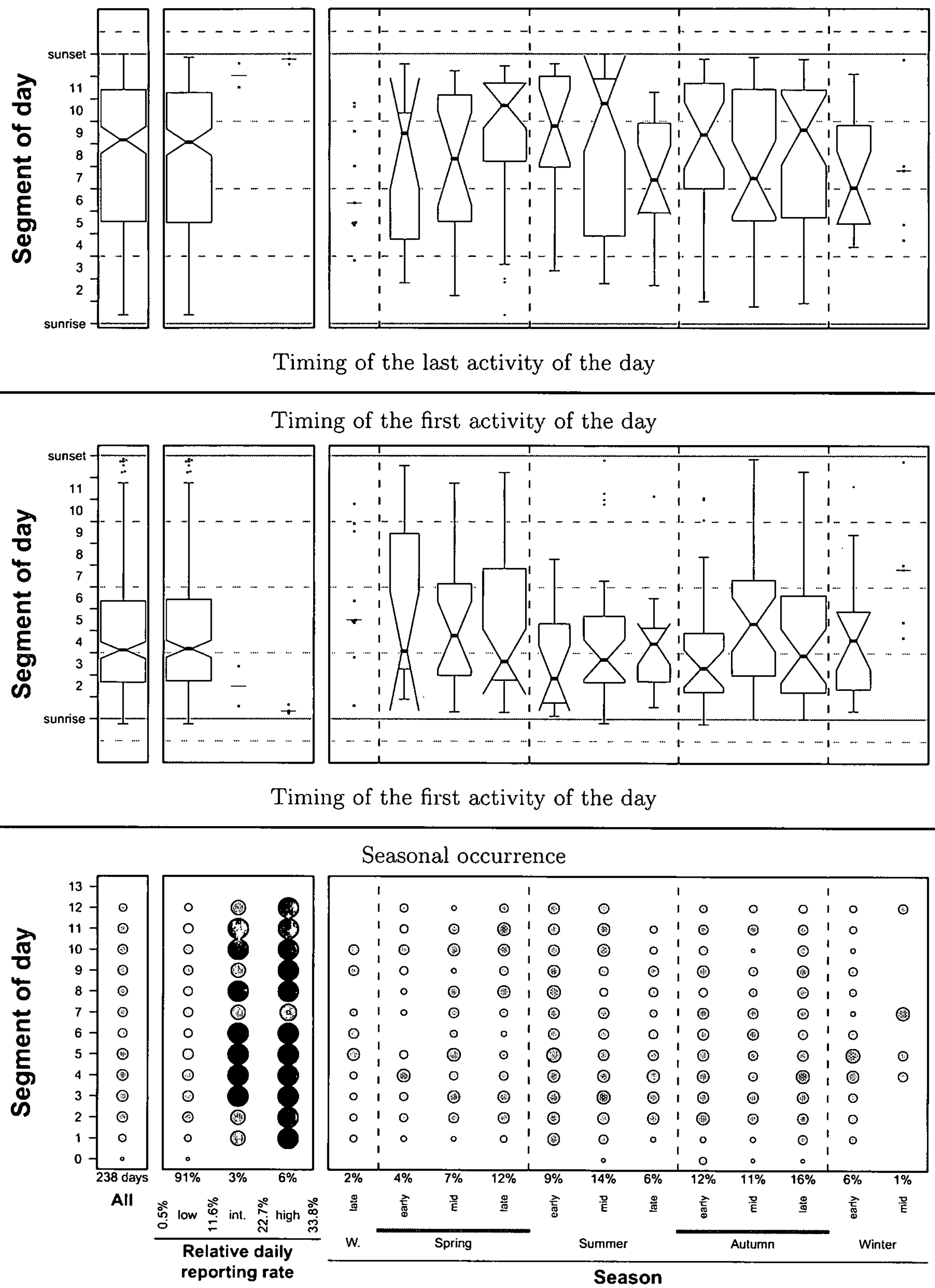


Figure 5.324: R870 Black-throated Canary — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

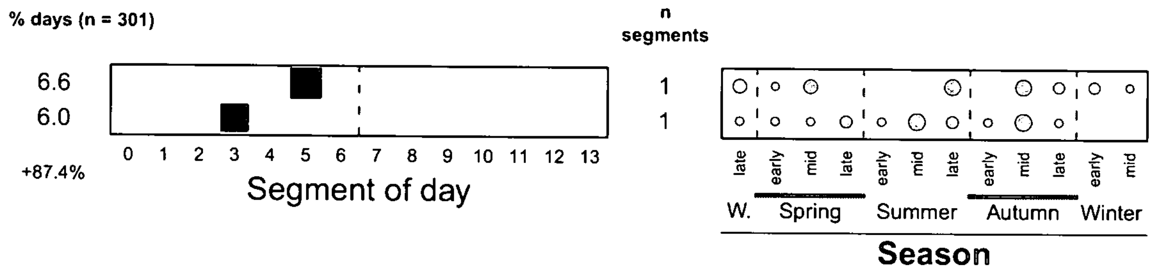


Figure 5.325: R870 Black-throated Canary — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

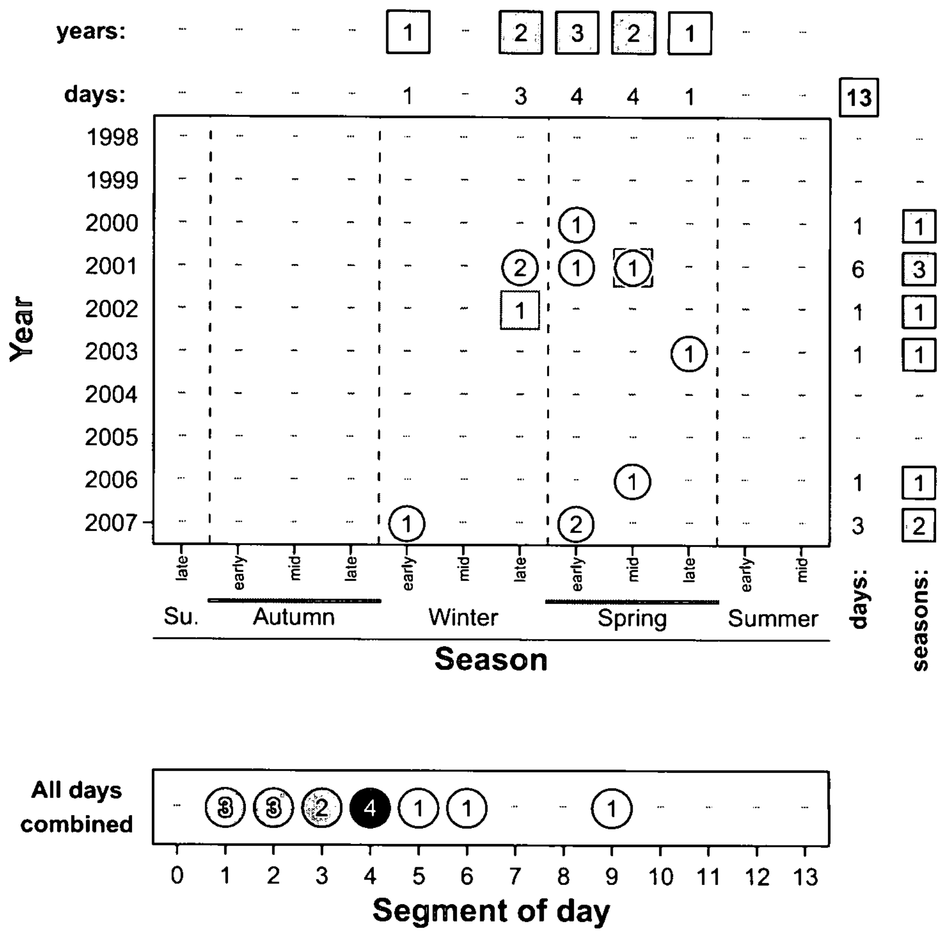


Figure 5.326: R872 Cape Canary — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

Discussion

Three sub-species of the Cape Canary are said to occur in southern Africa, the two occurring in South Africa, Lesotho and Swaziland having continuous ranges: *S. c. canicollis* "intergrades with *S. c. thompsonae* in east of range", *i.e.* around Lesotho (Dean 2005al). According to the map in Dean (2005al), the latter sub-species occurs only from Lesotho northwards through the eastern Free State and beyond (also in KwaZulu-Natal) and does not occur in the central and southern Free State. There appears to be no significant genetic differences between the two subspecies, *S. c. canicollis* and *S. c. thompsonae* (Ryan *et al.* 2004).

Fraser (1997) acknowledges that altitudinal or coastward movement occur, but also lists "a decline in detectability", related to the end of breeding when the birds stop singing and concentrate in flocks, as a possible cause of lower reporting rates outside the breeding season, which is mainly from October to January [mid-spring to late summer]. Yet an analysis of SABAP1 raw data (see Fig. 5.327) indicate that the birds are more widespread during the breeding season as well as at other times of the year in the various regions. Peaks outside the breeding season is particularly clear in the central and western Free State from June to August [mid-winter to early spring]), in the southern Free State during April [late autumn] and in the Northern Cape in August [early spring]. It is suggested that these peaks during the cooler times of the year may be due to the movement of birds, possibly involving birds from Lesotho where they undergo altitudinal movements to escape the harsh weather during the cooler times of the year (Van Niekerk 2004). Given this theory, the bimodal peak in the southern Free State (Fig. 5.327) would be related to birds moving westwards into the Northern Cape during autumn and eastwards towards Lesotho during spring. The late winter and spring records at Glen (Fig. 5.326) could similarly involve birds moving towards the mountain kingdom.

R878 Yellow Canary .... *Crithagra flaviventris*

The Yellow Canary is found in southern Angola (Dean 2000), Namibia, Botswana, Lesotho and in South Africa as far east as the Free State (Dean 1997o). It is associated with a variety of habitats including grassland (Maclean 1985). Resident, nomadic and possibly a partial migrant too (Dean 1997o; Penry 1994).

The birds at Glen

The Yellow Canary roosts in the drainage line and visits the grassland often, particularly the trampled area. The analysis is based on a year starting in late summer. Figures start on page 984.

Annual occurrence of birds in the grassland: Activity was noted on 90.1% of the days with an activity index of 18 (Table 5.60a). Recorded during 11–12 seasons per year (Fig. 5.328; Fig. 5.329). Daily reporting rates ranged from 0.5 to 57.8% with 80.4% of the days attaining low reporting rates; Median daily reporting rates were particularly high in 1998, 1999 and 2000 (Fig. 5.328).

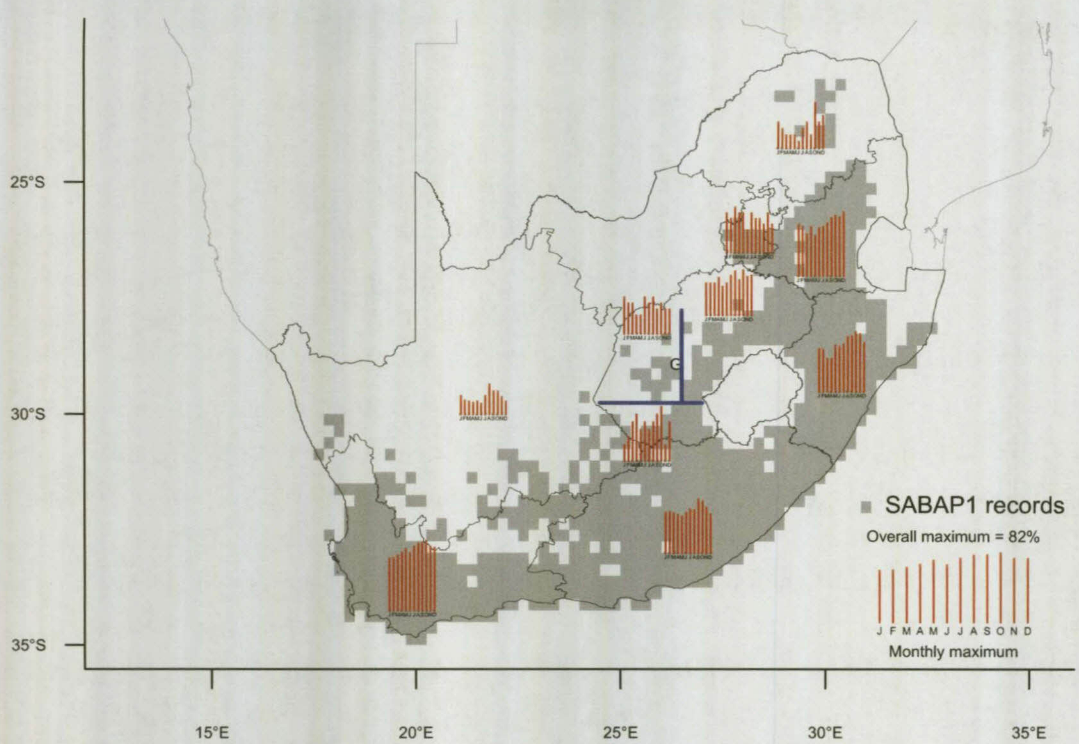


Figure 5.327: R872 Cape Canary: Seasonal changes in South African distribution based on an analysis of SABAP1 raw data. The lengths of the vertical red lines are proportional to the overall maximum percentage quarter degree grid-squares (QDGS) in which the birds were recorded (indicated bottom right), and is based on the total number of QDGS in which the species was recorded per region. The approximate location of the study site at Glen is indicated by a "G". See page 137 for more information on this SABAP1 figure.

Table 5.60: R878 Yellow Canary: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	10 870	114 612	9.5	birds present	90.1	656	591	18
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	344	1 190	28.9	birds present	97.7	43	42	8
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	179	1 188	15.1	birds present	81.4	43	35	5

Seasonal occurrence of birds in the grassland: Recorded during all years in most seasons (Fig. 5.328). The median daily reporting rate of mid-spring was particularly high (Fig. 5.328), with the data otherwise indicating a bimodal pattern, most clearly seen in the seasonal occurrence of intermediate reporting rate days which peaked from mid- to late autumn and again in mid-spring (Fig. 5.329).

Daily occurrence of birds in the grassland: Overall, activity was only slightly more frequent in the early morning after sunrise and in the late afternoon than during the middle of the day (Fig. 5.328). This pattern is most pronounced for low reporting rate days (Fig. 5.330). Seasonally, a bimodal pattern with activity frequent in the morning and in the afternoon was evident for most seasons (Fig. 5.331). Mid-spring is a notable exception when activity was very frequent during all segments between sunrise and sunset (Fig. 5.331). No segment combinations occurred during more than 5% bird-days.

The first activity of the day often occurred in the early morning after sunrise on low reporting rate days, but on intermediate and particularly high reporting rate days, it frequently occurred before sunrise (Fig. 5.331; Fig. 5.332). Although median values were generally similar for most seasons, the timing of the first activity of the day was notably less variable during certain seasons, especially mid-spring (Fig. 5.331; Fig. 5.332).

The last activity of the day often occurred during the latter half of the afternoon on low reporting rate days, but on intermediate and high reporting rate days it typically occurred shortly before sunset (Fig. 5.331; Fig. 5.332). Median values were largely similar for the respective seasons, however the seasons differed in terms of variability; least variable during mid-spring (Fig. 5.331; Fig. 5.332).

Overall, daily segment reporting rates ranged from 5.6 to 100% with 79.7% of the values relatively low (Fig. 5.328). The median daily segment reporting rates were higher in the morning and in the late afternoon than during the middle part of the day, and was lowest before sunrise and after sunset (Fig. 5.328). These differences are least obvious for low and most prominent for high reporting rate days (Fig. 5.330).

Early morning occurrence of birds during 2007/8: Activity was slightly more frequent in the drainage line, occurring during 97.7% of the mornings with an activity index of eight, compared to the grassland where it occurred during 81.4% of the mornings with an activity index of five (Table 5.60b & c). The median early morning reporting rate was also higher in the drainage line (Fig. 5.333). The occurrence of intermediate and, particularly, high reporting rate mornings were largely complimentary in the two habitats, with high reporting rate mornings limited to the period from mid-spring to mid-summer in the drainage line and no high reporting rate mornings from late spring to early autumn in the grassland (Fig. 5.333). The first activity of the day typically occurred later in the grassland than in the drainage line (Fig. 5.333). High activity intensities were most frequent before sunrise (Fig. 5.333).

Discussion

In the Free State, the Yellow Canary breeds mainly from November to February [late spring to early autumn] (Maclean 1985; Tarboton 2001). Adults undergo a complete post-breeding moult (Dean 2005an), which, at Glen, appears to occur mainly during autumn (DJvN unpublished data). Data from the Northern Cape (Liversidge 1968) indicates a similar timing for the birds there.

At Glen, the most prominent peak period in activity is during mid-spring (Fig. 5.328; Fig. 5.329; Fig. 5.331; Fig. 5.333). It is suggested that this relates to the beginning of the

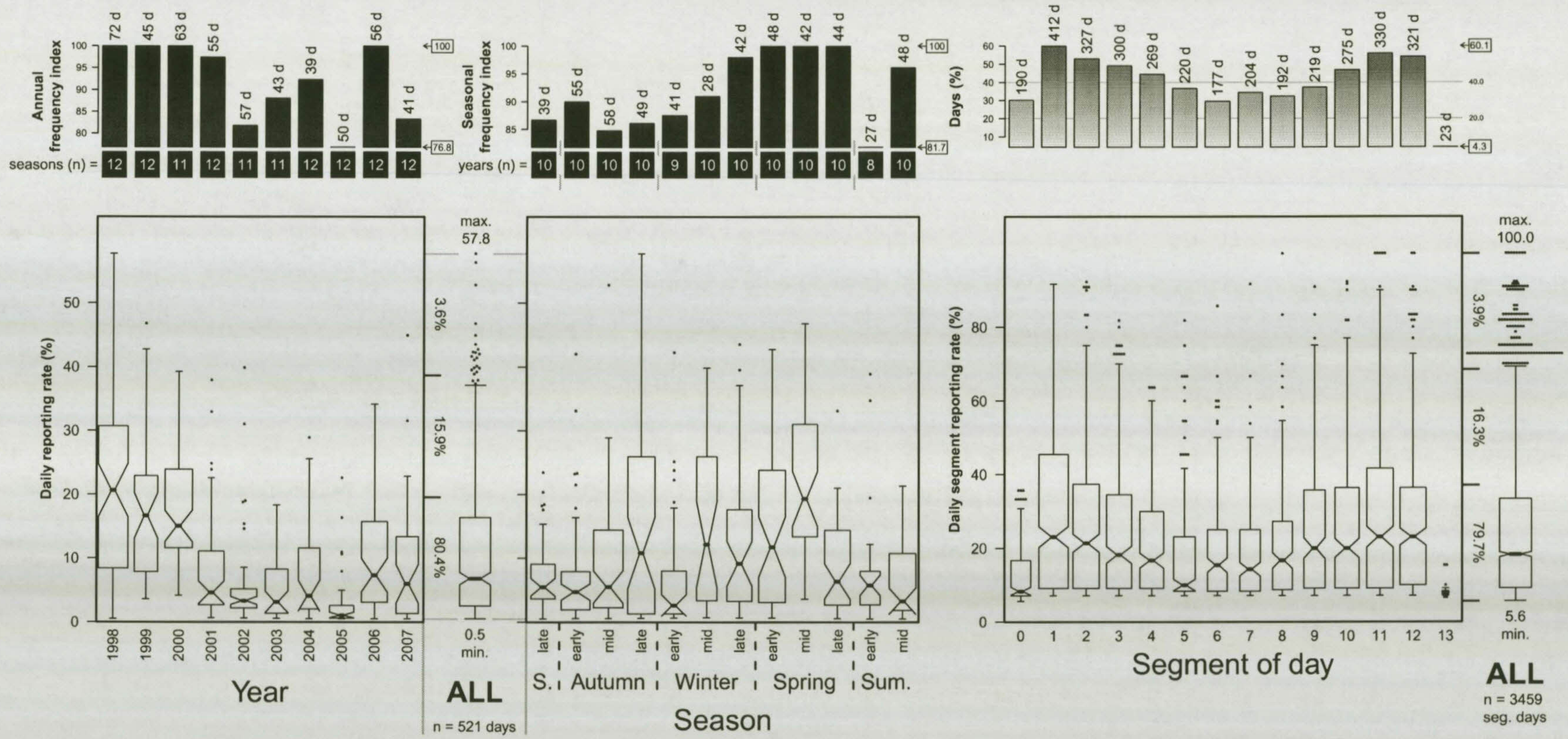


Figure 5.328: R878 Yellow Canary — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

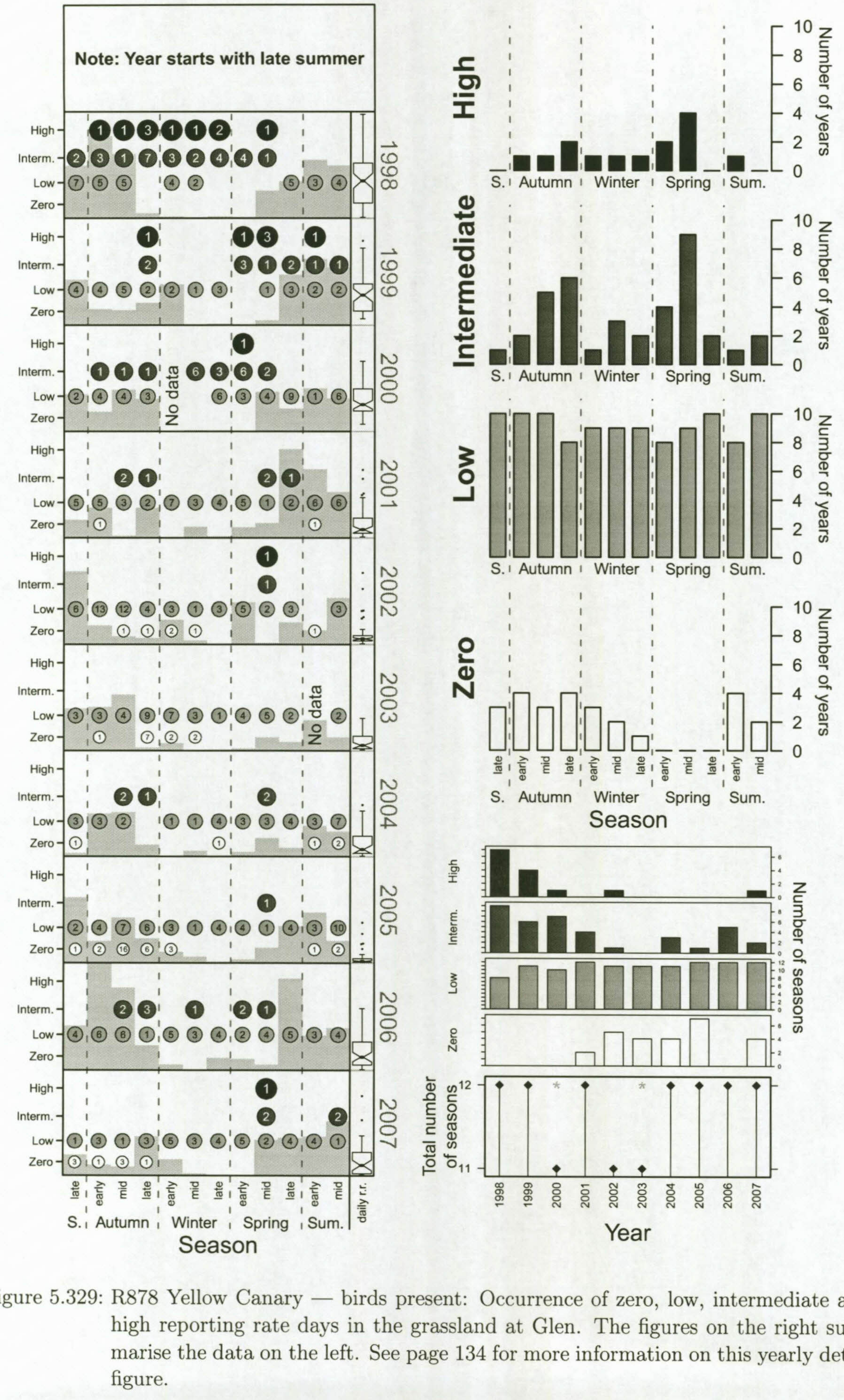


Figure 5.329: R878 Yellow Canary — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

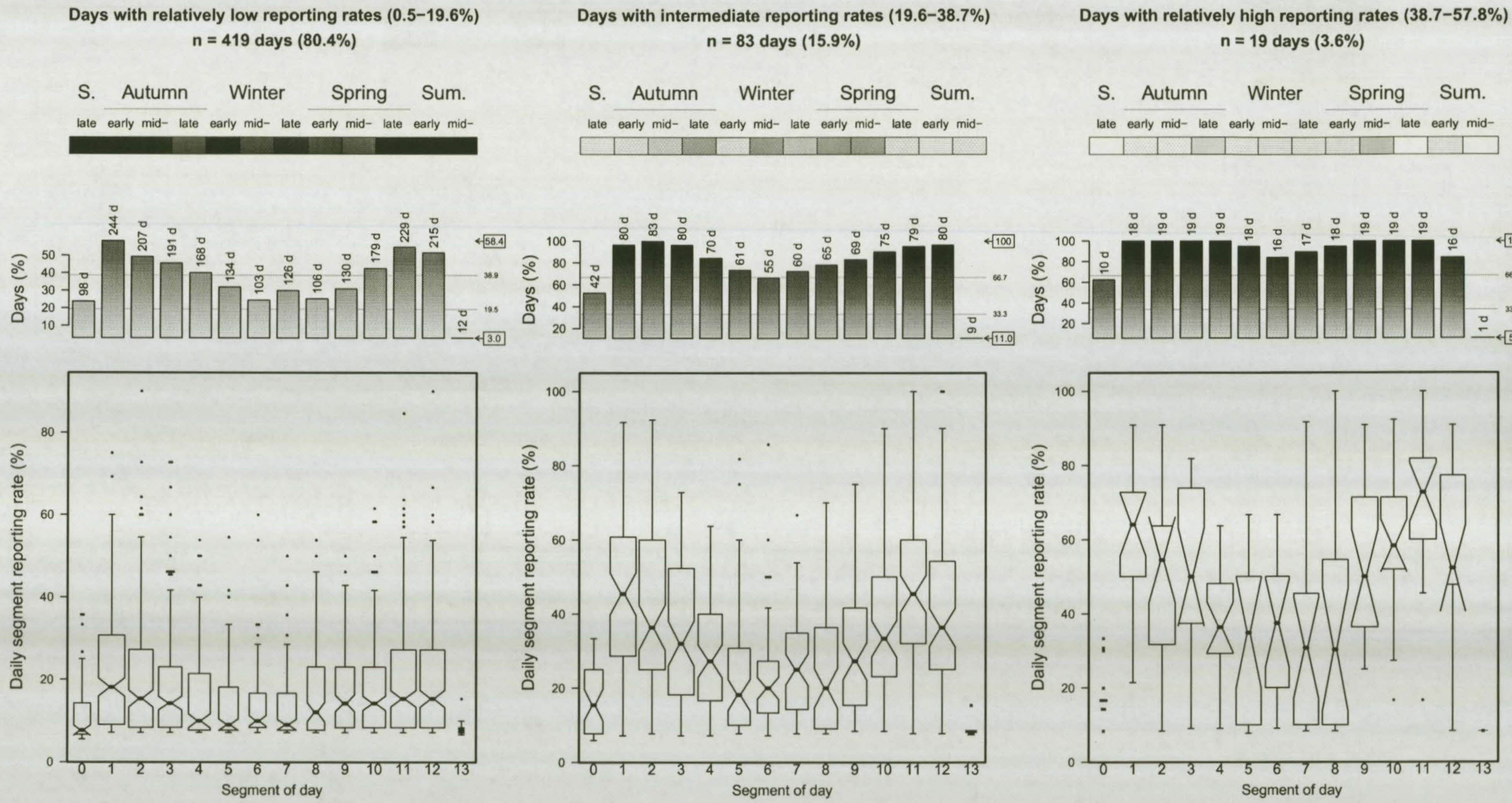


Figure 5.330: R878 Yellow Canary — birds present: Details on the daily occurrence during low (left), intermediate (middle) and high (right) reporting rate days in the grassland at Glen. See page 134 for more information on this LIH figure.

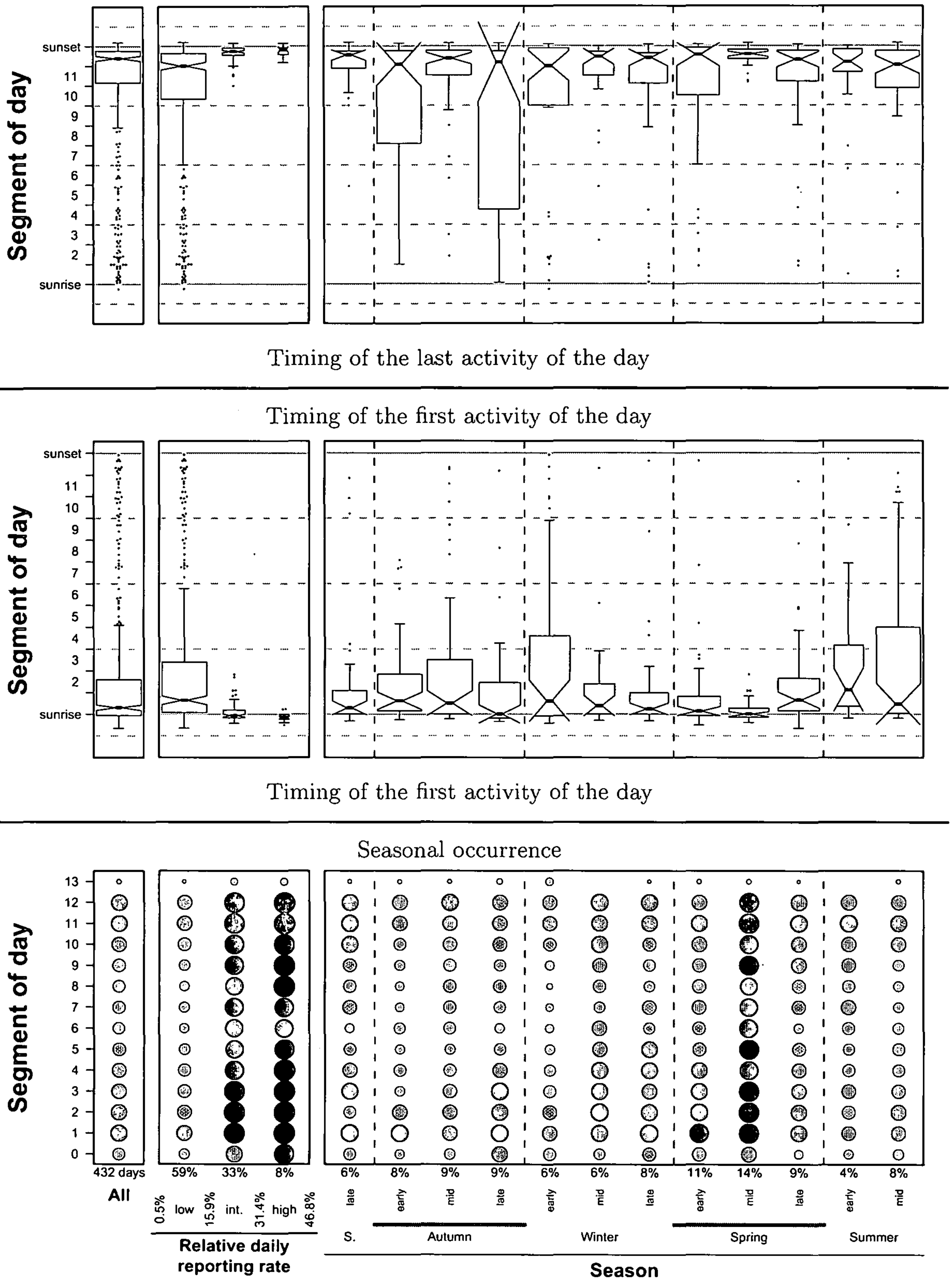
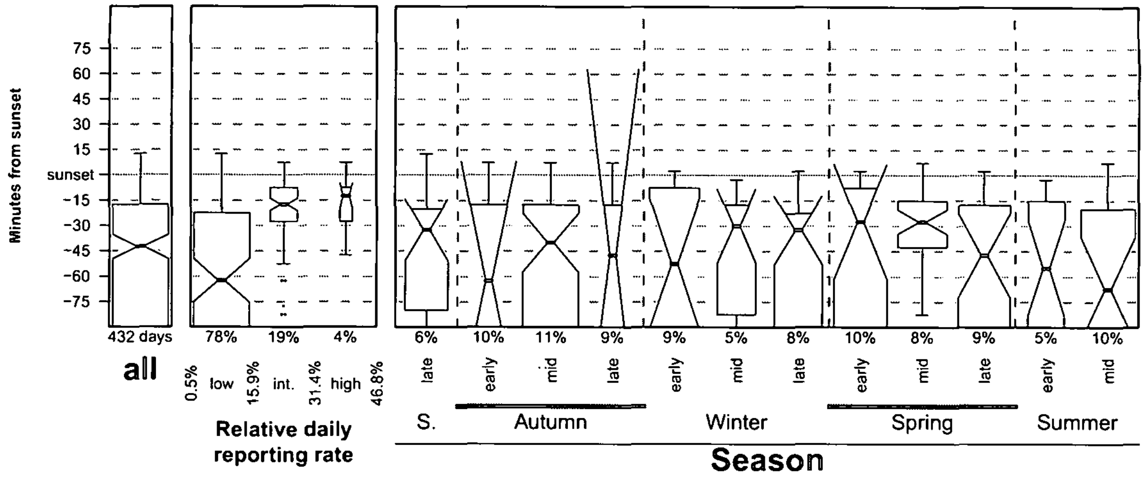
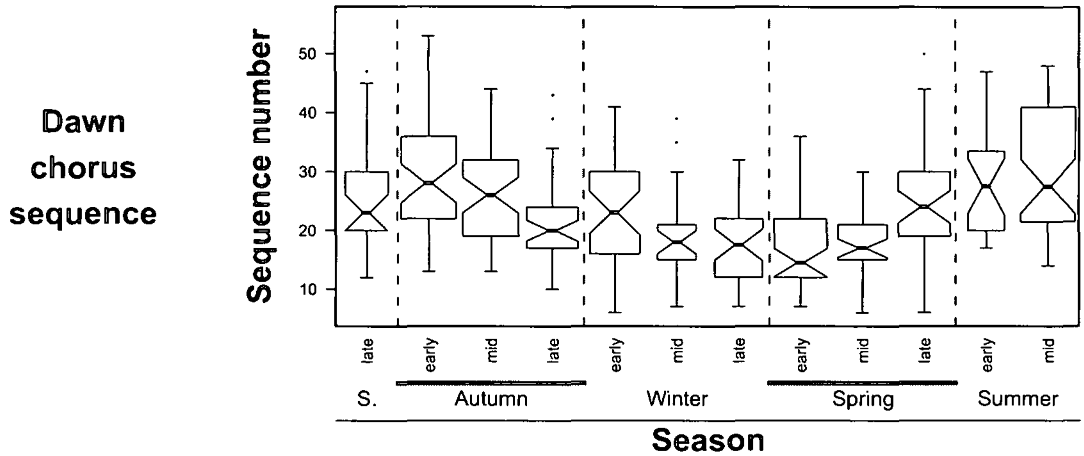


Figure 5.331: R878 Yellow Canary — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.



Last activity of the day

Dawn chorus sequence



Dawn chorus sequence

First activity of the day

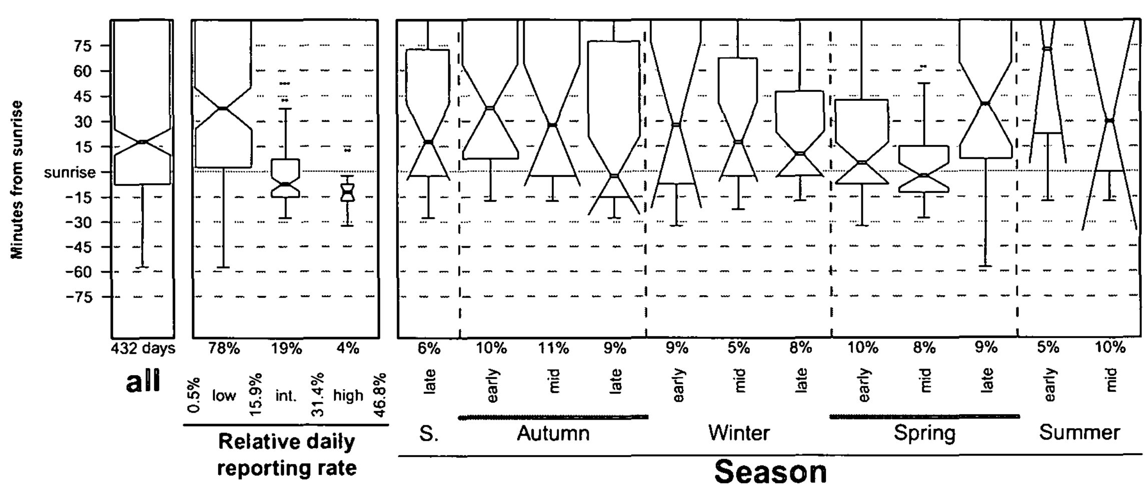
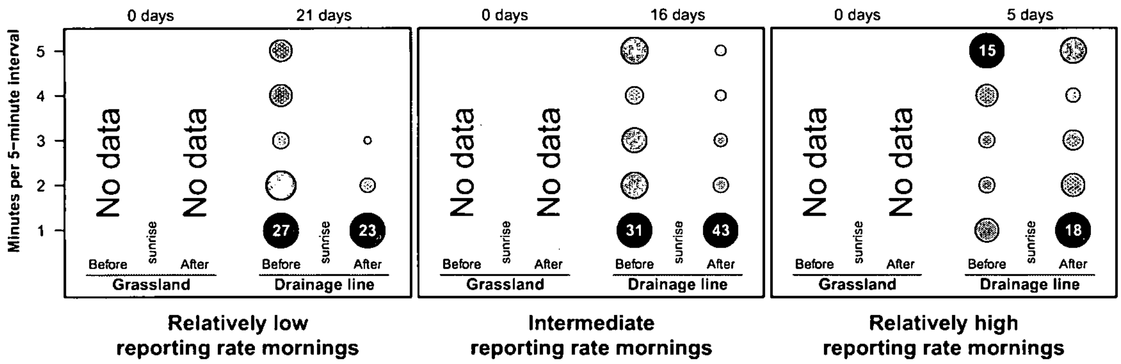
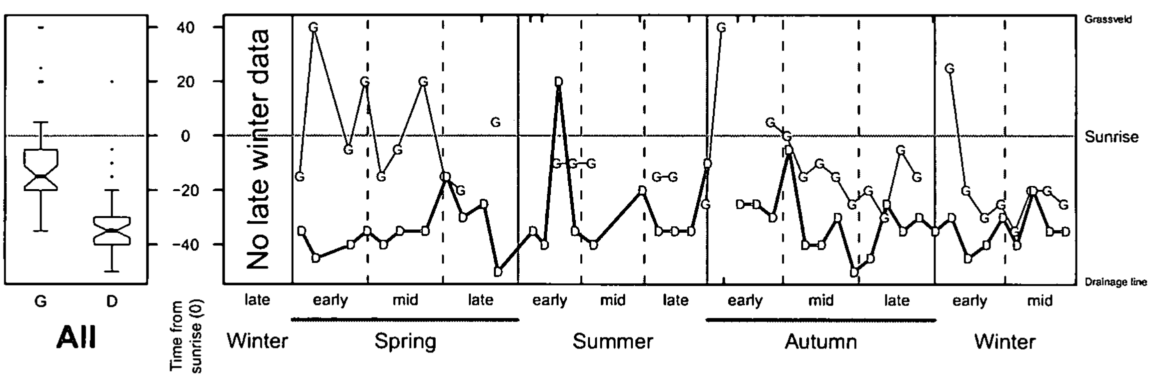


Figure 5.332: R878 Yellow Canary — birds present: Details on the daily occurrence of the first (bottom) and last (top) activity of the day in the grassland at Glen. The dawn chorus sequence is indicated in the centre. See page 136 for more information on this detailed first/last activity figure.



Activity intensity

First activity of the day



First activity of the day

Seasonal occurrence

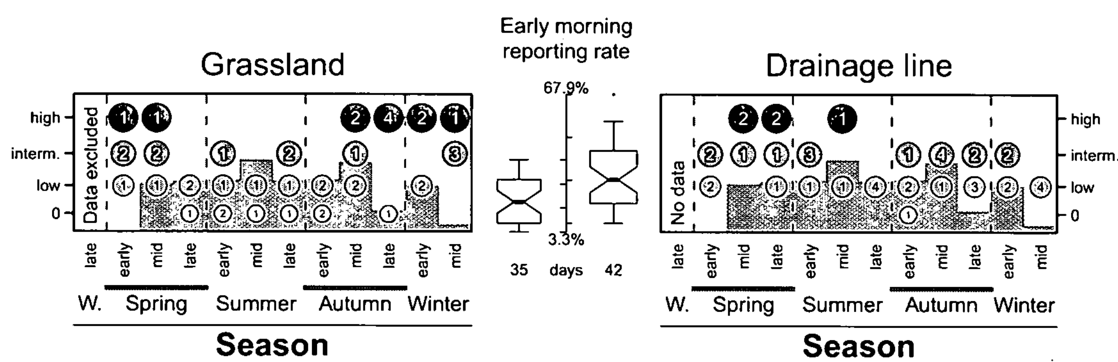


Figure 5.333: R878 Yellow Canary — birds present: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Middle: Occurrence of the first activity of the day; Top: Activity intensities before and after sunrise on low (left), intermediate (middle) and high (right) reporting rate mornings. See page 136 for more information on this early morning figure.

breeding season and an increase in day-length, which reach it peak during that season (Fig. 2.12). The relatively quiet period in the drainage line in late summer (Fig. 5.333□) is probably related to moult. The peak period during mid- and late autumn in the grassland (Fig. 5.328▣; Fig. 5.329) may overlap partially with, or follow on, moult.

R884 Golden-breasted Bunting .... *Emberiza flaviventris*

The Golden-breasted Bunting is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa it is widespread in the northern half of Namibia, Botswana, Zimbabwe, southern Mozambique, Swaziland, and the eastern half of South Africa; Recorded from only a limited number of localities in the Free State and adjacent areas, including Lesotho (Herremans & Tree 1997; Parker 1999; Van Niekerk 2004). It occurs in various types of woodland (Herremans & Tree 1997). Mainly a resident that may be locally nomadic in the dry season (Dean 2005ao).

The birds at Glen

The only records of the Golden-breasted Bunting were birds seen during transects in the drainage line on three days: late winter 2002/3 and early and mid-spring 2001/2.

R885 Cape Bunting .... *Emberiza capensis*

The Cape Bunting is endemic to the southern third of Africa (Maclean 1985). In southern Africa, it is widespread but sparse in Namibia and Zimbabwe, and more common in South Africa and Lesotho (Dean 1997p). Often associated with, but not necessarily limited to, rocky areas (Dean 1997p; Earlé & Grobler 1987; Maclean 1985). Apart from regular movements into the Western Cape, it is probably a resident elsewhere (Dean 1997p).

The birds at Glen

The Cape Bunting is largely confined to the mountains in the east. Seen in the grassland on six days in 1999, from mid-winter to early spring.

Discussion

The occurrence of the birds during 1999 at Glen probably represents an influx, possibly from Lesotho.

R886 Cinnamon-breasted Bunting .... *Emberiza tahapisi*

The Cinnamon-breasted Bunting occurs in sub-Saharan Africa, southern Arabia and on the island Socotra (Maclean 1985). In southern Africa it is widespread in the eastern half of the region (except southern Mozambique where it is scarce, Parker 1999) and in Namibia (Dean 1997q). It is normally associated with rocky areas (Earlé & Grobler 1987; Maclean 1985). The population consists of resident, breeding migrant and nomadic components (Dean 1997q).

The birds at Glen

The Cinnamon-breasted Bunting is mainly confined to the mountains in the east, but is also recorded in the grassland and in the drainage line (Table 5.61).

Table 5.61: R886 Cinnamon-breasted Bunting: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	213	114 612	0.2	birds present	12.7	656	83	3
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	3	1 190	0.3	birds present	4.7	43	2	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	1	1 188	0.1	birds present	2.3	43	1	1

Annual occurrence of birds in the grassland: Activity was noted on 12.7% of the days with an activity index of three (Table 5.61a). Recorded during 5 or 7 seasons in 1997/8–1999/0 and 2005/6 and during 1–3 seasons in other years (Fig. 5.334; Fig. 5.335). Daily reporting rates ranged from 0.5 to 11.3% with 91.6% of the days attaining low reporting rates; Median daily reporting rates were similar for the respective years (Fig. 5.334).

Seasonal occurrence of birds in the grassland: The data suggests a bimodal pattern with records during 4 or 6 years in summer and from mid-autumn to early winter, and during 0–2 years in other seasons (Fig. 5.334). Median daily reporting rates were similar for all bird-seasons (Fig. 5.334).

Daily occurrence of birds in the grassland: Overall, activity was recorded throughout the day (Fig. 5.334), but seasonally it was noted only during certain times of the day during the respective bird-seasons (Fig. 5.336). Three segments combinations involving single segments S1, S6 and S10 occurred during more than 5 bird-days, collectively accounting for 40.1% of all bird days (Fig. 5.337).

The occurrence of both the first and last activity of the day was variable (Fig. 5.336).

Overall, daily segment reporting rates ranged from 6.2 to 50.0% with 85.4% of the values relatively low (Fig. 5.334). Median daily segment reporting rates were similar for all segments (Fig. 5.334).

Early morning occurrence of birds during 2007/8: Rarely encountered (Table 5.61b & c).

Discussion

In the Free State, breeding occurs from December to April [summer & autumn] (Maclean 1985). This overlaps largely with the occurrence of the birds at Glen (Fig. 5.334).

R887 Lark-like Bunting .... *Emberiza impetuani*

The Lark-like Bunting is endemic to sub-Saharan Africa (Maclean 1985). In southern Africa its distribution is concentrated in north-western and southern Namibia and the western half of South Africa as far east as the western Free State (Dean 1997r). The study area at Glen is located just outside of its main range. Its habitat preferences include arid savanna and dry watercourses, and it is highly nomadic (Maclean 1985).

The birds at Glen

Only recorded from the grassland where found on a total of 18 days spread over four years up to 2002/3 only (Fig. 5.338). All the records were during summer and autumn and between sunrise and sunset (Fig. 5.338).

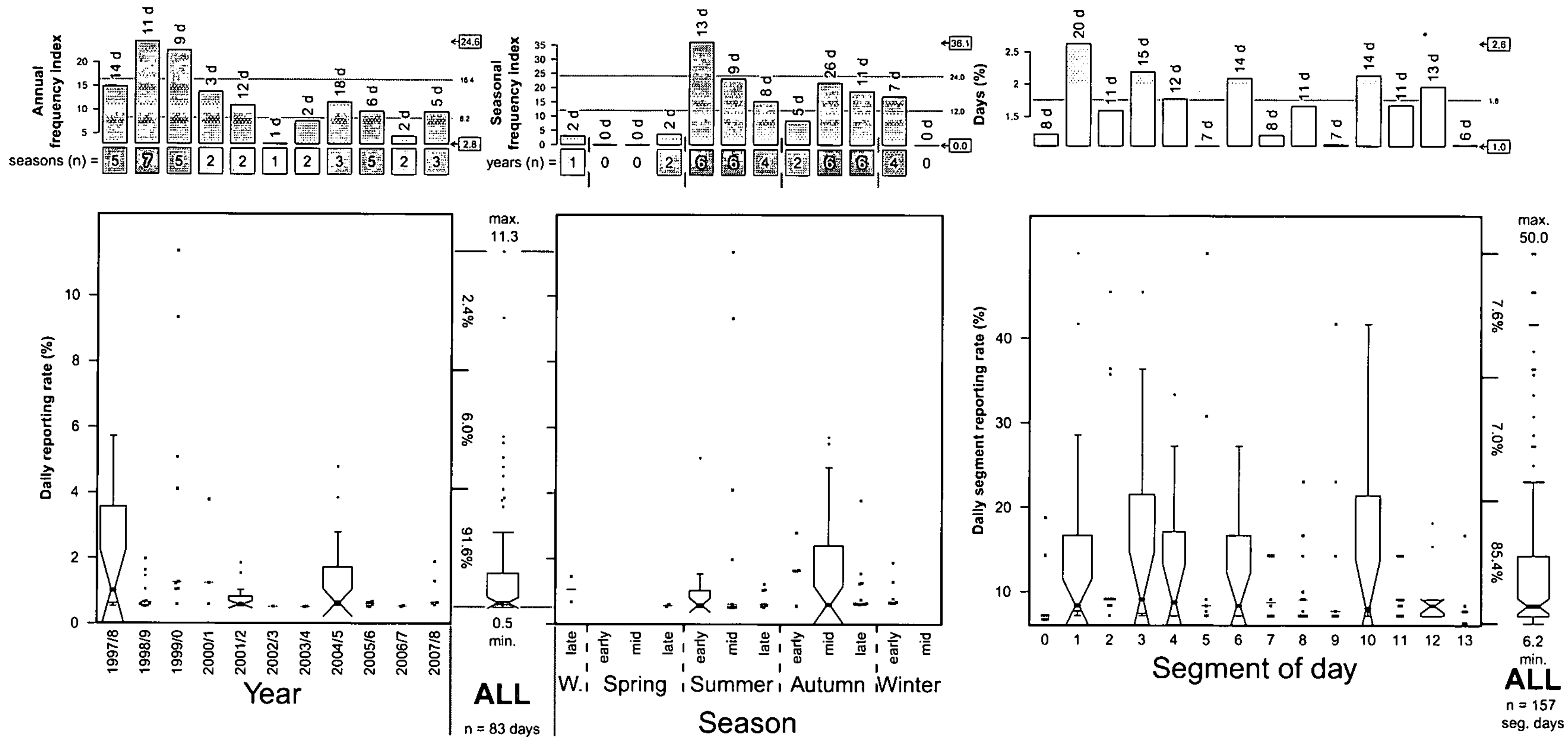


Figure 5.334: R886 Cinnamon-breasted Bunting — birds present: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

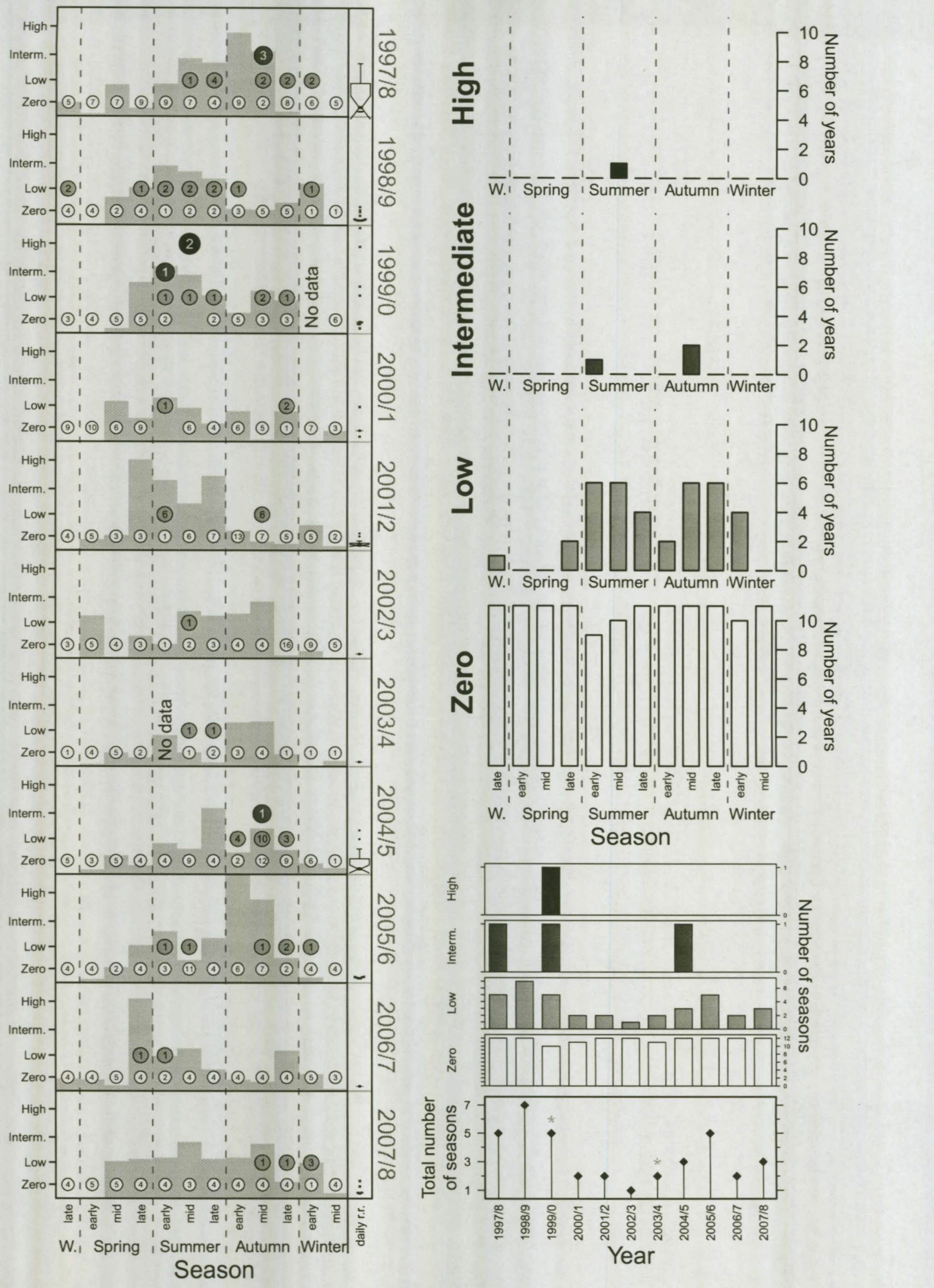
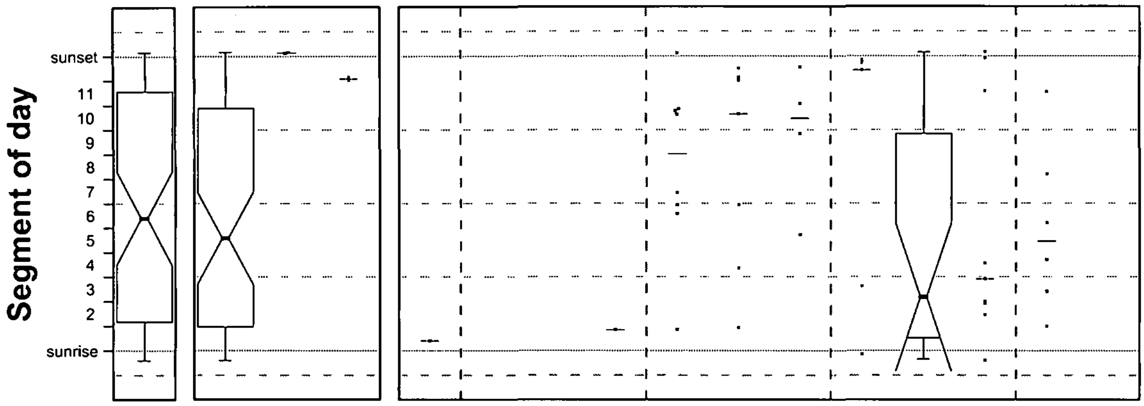
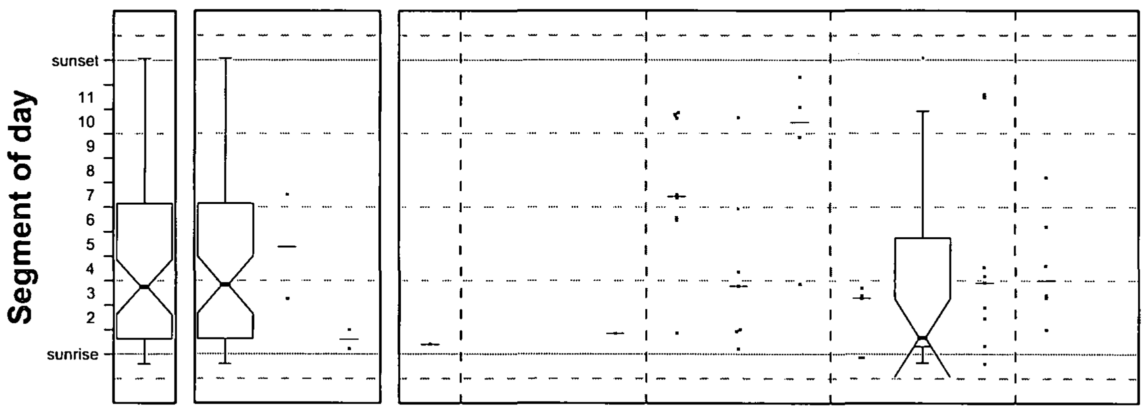


Figure 5.335: R886 Cinnamon-breasted Bunting — birds present: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

Timing of the last activity of the day



Timing of the first activity of the day



Timing of the first activity of the day

Seasonal occurrence

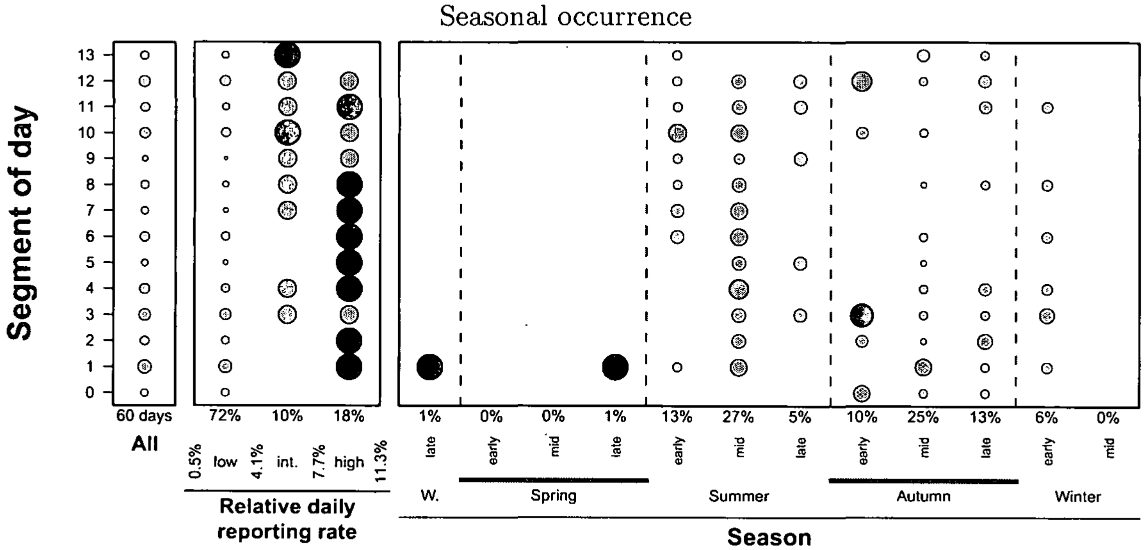


Figure 5.336: R886 Cinnamon-breasted Bunting — birds present: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

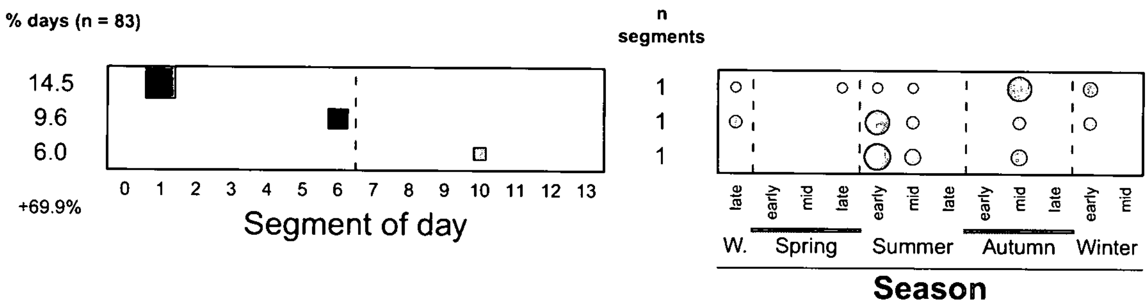


Figure 5.337: R886 Cinnamon-breasted Bunting — birds present: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

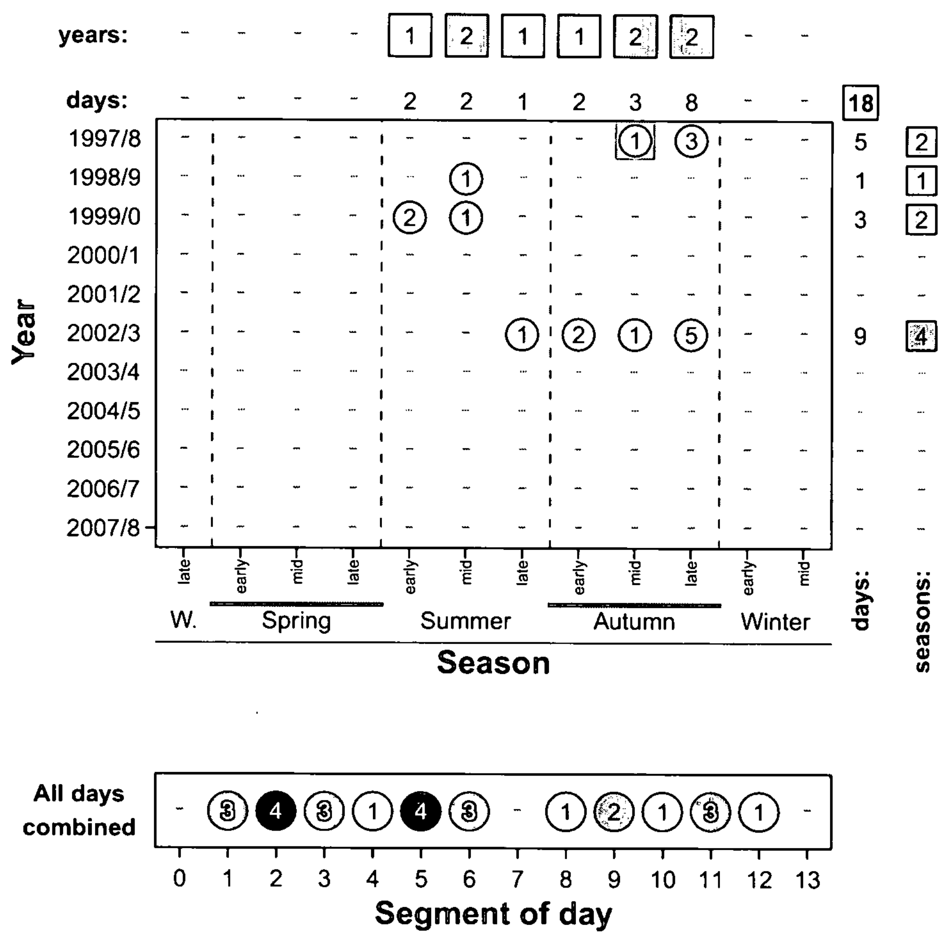


Figure 5.338: R887 Lark-like Bunting — birds present: Annual, seasonal (top) and daily (bottom) occurrence in the grassland at Glen. See page 138 for more information on this 'few records figure'.

6 The bird community at Glen

The amazing thing about nature's puzzles is that its pieces can be arranged in more than one way. Arrange them this way and you see X; arrange them that way and you see Y; arrange them in yet another way and you see Z. Even more amazing is the fact that the different arrangements often compliment each other. Put X and Y together, and you see a graph. Add Z and you have it in 3D. But it is not always *that* easy. To be sure, nature's puzzles and their pieces exist in three-dimensional space, but they themselves are multidimensional.

The species accounts in the previous two chapters detailed the activity patterns of the 203 bird species recorded at Glen[1] during the 11-year period from 1997/8 to 2007/8. Collectively they represent the bird community there — a multidimensional community, that is. In terms of time, the species span the range from those like the Bateleur R146 recorded only once to the ever-present Northern Black Korhaan R239 and Cape Turtle-Dove R354. In between these two extremes there are a number of other dimensions, including visitors from elsewhere in Africa and the Palearctic. In terms of space, there are those confined to the drainage line, to the grassland, or those that occur in both habitats, preferring one to the other. Some species merely visit during the day, while others find it suitable for roosting as well. Then there were those species that utilised neither of these habitats but merely flew overhead. All the species also have certain feeding preferences, be it in the air or trees, on the ground or in the water. Superimposed on all these dimensions are the species-specific annual, seasonal and daily activity patterns documented in the previous two chapters. When all these dimensions (and there are more) are stacked one upon another and one was to drill through each species, then it will be found that each is unique. It does not end there, however.

A species consists of unique individuals that often resist being placed into the neat boxes of generalisation. Yet such boxes are unavoidable if we want to grasp something multidimensional in character. In this chapter, the placement of a species into sets of boxes labelled status categories, habitat preferences, *etc.*, is subject to the following proviso: *Being in a box does not necessarily imply that it is confined to the box.* There are two meanings attached to this. Firstly, status categories, habitat preferences and feeding niches are generalisations of what is considered 'normal' in a species, and there are bound to be exceptions. Secondly, it is applicable to the annual, seasonal and daily patterns in an abstract kind of sense. The 'raw' activity patterns presented in Chapters 4 and 5 are unique for each species and any attempt to find general patterns using this data *as is* would be frustrated. This is why the data were converted to a relative scaling from zero to three as explained on page 138. The point is that two species showing the same annual/seasonal/daily pattern based on the zero to three scaling may in fact differ significantly as far as the details are concerned (*e.g.* the magnitude of the daily reporting

[1]The 203 species include the Red-winged Starling R769 of which the identity is uncertain and the Whiskered Tern R338 and White-winged Tern R339 which could not be positively identified.

rates). The grassland frequency classes explained in the next section partially compensate for this.

Although there are 203 species accounts, this chapter deals with only 196 species and focuses primarily on the grassland. The birds omitted include the Red-winged Starling R769 that needs confirmation and the Green-winged Pytilia R834 whose status is uncertain. In addition, the Whiskered Tern R338 and White-winged Tern R339 as well as the Long-billed Pipit R717, Plain-backed Pipit R718 and Buffy Pipit R719 are ignored because of identification problems.

The figures of this chapter start on page 1020.

6.1 Grassland frequency classes

In the grassland, approximately one fifth of the species were recorded during 1–2, 3–6 and 7–10 years respectively, with the remaining 40.1% recorded during all 11 years of the study (Fig. 6.1). Furthermore, an analysis of the median number of seasons that each species was recorded per year indicates that half of them occurred during 1–2, 38.5% during 3–11 and only 11.5% during all 12 seasons (Fig. 6.2). When these annual and seasonal groups are considered in a year versus season matrix, it results in $12 = 4 \times 3$ theoretical bird-groups. In reality, species fall into only seven of these groups, as shown in Figure 6.3. Each group is called a grassland frequency class (GFC) and is coded according to the system explained in Figure 6.3.

Species in GFC A3 were recorded during more than two thirds of all days and most A2 species less frequently, but nonetheless more than 5% of all days (Fig. 6.4; Fig. 6.5). The A2 exceptions include the Pink-billed Lark R508 and White-browed Sparrow-Weaver R799 that were recorded during approximately three quarters of the days (Fig. 6.4; Fig. 6.5). Almost all of the B2 birds were recorded during 5–17% of the days, and in all other GFCs most or all of the birds during less than 5% (Fig. 6.4; Fig. 6.5).

The Northern Black Korhaan R239 and Cape Turtle-Dove R354 attained the highest overall 5-minute reporting rates, 65.8% and 62.9% respectively, and the Bokmakierie R746 was third with 36.6% (Fig. 6.4; Fig. 6.5). Other A3 species that attained 5-minute reporting rates of more than 10% include the Cloud Cisticola R666 (25.9%), African Quailfinch R852 (19.9%), Eastern Clapper Lark R495 (18.8%), Laughing Dove R355 (14.2%) and the Ant-eating Chat R595 (14.2%); an additional seven species attained values greater than 5% (Fig. 6.4; Fig. 6.5). The only A2 birds that attained values greater than 5% were the Rufous-naped Lark R494 (18.7%) and the Desert Cisticola R665 (18.1%) (Fig. 6.4; Fig. 6.5). The 5-minute reporting rates of all species in the remaining GFCs were less than 1% (Fig. 6.4; Fig. 6.5).

6.2 The bird community at Glen

The bird community at Glen consists of permanent and temporary residents and regular, seasonal and aseasonal visitors. In addition, a number of species merely flew over the study area ('birds in transit') while others were recorded in the study area mainly, or only, as birds calling from outside the borders of the study area. Formal definitions for these categories appear in Appendix A. Appendix B contains a complete list of species recorded at Glen with their status and supplementary information, as explained in Appendix A. It includes the 187 species recorded while conducting observations in the grassland from 1997/8 to 2007/8, 109 species recorded during the early mornings of 2007/8 in the drainage line, plus 98 species recorded during transects in the drainage line during the middle part of the study (see Figure 3.7, page 128). The three data-sets have 76 species in common, with Table 6.1 also showing the number of unique species per data-set combination. Figure 6.6 lists the species in each Glen status category.

Table 6.1: Number of bird species unique to different combinations of data-sets collected from 1997/8 to 2007/8 at Glen.

	Grassland	**Drainage line early mornings**	**Drainage line transects**
Grassland	**76**		
Drainage line, early mornings 2007/8	24	**3**	
Drainage line transects	11	6	**5**
Common to all	76	76	76
Total (201)	187	109	98

Each Glen status category is considered separately below. After an introduction the annual, seasonal and daily occurrence patterns of each status category is considered, with the focus on the degree to which generalisations could be made. The section on annual occurrence usually includes a discussion on the influence of rainfall on activity patterns. It is assumed that the reader is familiar with the section, and in particular the figures, on rainfall in Chapter 2 (see pages 88 to 91). Further sections include a summary of annual cycles, and the birds in the grassland and drainage line.

A number of figures are used to summarise different aspects. This include figures showing, for each Glen status category, the change in the proportion of bird species during the course of the 11-year study period (Fig. 6.7), the number of species in the different Glen habitats and GFCs (Fig. 6.8), southern African status categories (Fig. 6.9), feeding niches (Fig. 6.10) and southern African habitat preference categories (Fig. 6.11, Fig. 6.12 and Fig. 6.13). Figure 6.14 shows the proportion passerine species relative to non-passerines for residents and visitors. Figures 6.15 to 6.31 summarise annual, seasonal and daily trends of individual species-activities as explained on page 138, with Figures 6.32 to 6.37 illustrating the total number of species-activities for each Glen status category and relative occurrence value (ROV) per year, season and segment. In addition, Figures 6.38 to 6.43 illustrate inter-annual, seasonal and segment comparisons, as explained on page 139. Reference to Figures 6.32 to 6.43 automatically implies reference to source Figures 6.15 to 6.31, as indicated in the captions of the former figures. In many of the abovementioned figures species are often represented by their Roberts' number plus a short five character 'name hint', *e.g.* "R552 AyTit" for the Ashy Tit and "R716 AfPpt" for the African Pipit.

Reference to a species often implies information available in the species accounts in Chapters 4 and 5.

6.2.1 RESIDENTS

Resident status implies that a species forages and sleeps in the grassland or drainage line for more than one season per year. After the first year of the study, permanent (28.1%) and temporary residents (21.9%) (Fig. 6.7) collectively constituted exactly half of all species. This proportion has decreased over the years (Fig. 6.7), reaching 39.1% after 11 years of the study. This decrease was largely due to an increase in aseasonal visitors and birds in transit (Fig. 6.7).

6.2.1.1 Permanent residents

All permanent residents at Glen, amounting to approximately a quarter of the species recorded (Fig. 6.7), are generally considered to be resident in southern Africa too, with some of the species also involved in local migratory and other movements (Fig. 6.9□). As a group, they have to face the full set of environmental circumstances of the area, including extremes in rainfall and temperatures (temperatures 5 cm above ground surface span a range of more than 60°C; Fig. 2.22, page 102). If a species is unable to survive a few, or perhaps only one very cold night, it is doomed as a permanent resident of the area.

Food availability is another limiting factor and resident birds have different survival strategies. For example, the Eastern Clapper Lark R495 manages to survive by switching to a diet of grass seeds when its favourite invertebrate prey becomes scarce, while the Spike-heeled Lark R506 is able to maintain its predominantly insectivorous diet throughout the year. Yet other species venture into atypical habitat in search for food, presumably because their usual haunts failed them. Examples include drainage line species such as the Ashy Tit R552, Chestnut-vented Tit-Babbler R621 and Fiscal Flycatcher R698 that frequent the trampled area during the cooler parts of the year. In terms of feeding niche, most permanent residents feed on the ground while the rest are arboreal (Fig. 6.10□).

The general habitat preferences of the birds are mainly woodland, grassland and scrub according to the hierarchical classification system of Harrison *et al.* (1994) (Fig. 6.11□). A number of species are indicators of these habitats (Fig. 6.12□). In addition, there are also habitat generalists and those that are associated with forest and montane habitats (Fig. 6.11□; Fig. 6.13□).

At Glen, two thirds of the permanent residents were primarily associated with the drainage line, another third with the grassland, and the Cape Bunting R885 and Cinnamon-breasted Bunting R886 with the hills in the east (Fig. 6.8■; Appendix B).

Annual occurrence: In some cases activity became less prominent during the course of the study (*e.g.* Ant-eating Chat R595), while in others activity increased over the years (*e.g.* Cape Turtle-Dove R354) (Fig. 6.15). Generally, however, the occurrence of annual peaks was variable (Fig. 6.15), but not completely random. Peaks in activity was most frequent during 2005/6, which year also had the lowest number of species-activities with low ROVs (Fig. 6.15■; Fig. 6.32□), coinciding with a high proportion of species-activities exhibiting an increase in ROVs (Fig. 6.38□). It is likely that the exceptional good rains of 2005/6, particularly during early and mid-autumn, contributed to these trends. In four of the eight species showing peaks during 2005/6, high levels of activity continued until mid-autumn (Rufous-naped Lark R494, Fig. 5.13; Cloud Cisticola R666, Fig. 5.187) or late autumn (Desert Cisticola R665, Fig. 5.179; Neddicky R681, Fig. 5.194), which is unusual for these species where high levels of activity normally ends by early autumn. The Eastern Clapper Lark R495 shows a similar pattern (Fig. 5.27), even though its overall activity did not peak during 2005/6 (Fig. 6.15■). In the Northern Black Korhaan R239 high reporting rate days are frequently recorded during early and mid-autumn (Fig. 4.138). However, in 2005/6 all days during these two seasons attained high reporting rates in contrast to most other years when intermediate and even low reporting rate days also occurred (Fig. 4.138). The activity of the Bokmakierie R746 shows a well-defined autumn centred seasonal peak (Fig. 5.254▣; Fig. 5.255). An outstanding feature of 2005/6 was that high reporting rate days was recorded from mid-summer 2005/6 until late spring 2006/7, in contrast to other years when it occurred between late-summer and mid-winter (Fig. 5.255). The occurrence of activity during autumn is not uncommon in the Kalahari Scrub-Robin R615 (Fig. 5.155) and the Chestnut-vented Tit-Babbler R621 (Fig. 5.160). In both species activity was recorded for six consecutive seasons in 2005/6, starting in mid- and late summer respectively (Fig. 5.155; Fig. 5.160).

Cluster analysis based on ROVs groups 1997/8, 1998/9 and 2005/6 separate from the other years (Fig. 6.38□). These represent years with relatively few species-activities with low ROVs (Fig. 6.32□) and a relatively large proportion of species-activities showing an increase in ROVs (Fig. 6.38□), characteristics which they share with 2002/3. It is suggested that annual and seasonal occurrence of rainfall is one of the most important factors that contributed to these patterns. It was already shown above that the relatively late rains in 2005/6 coincided with the extension of activity peaks in at least five species. In a similar way, it is possible that the good rains during the latter part of the main rain period in 1997/8 and 2002/3 (and 2005/6) contributed to higher, but not necessarily peak, levels in activity in a relatively large number of permanent resident species.

Although the seasonal rainfall patterns of the relatively dry years 2003/4 and 2004/5 were similar to that of the years mentioned above, precipitation was probably not enough to stimulate activity in most species. Collectively, these two years plus 2006/7 — another year with below average rainfall — had the smallest proportion of species-activities showing higher ROVs compared to other years (Fig. 6.38□). In addition, cluster analysis reveals that these three years had similar ROVs (Fig. 6.38□).

However, dry conditions do not automatically imply low activity levels (and *vice versa*; see below). For example, based on total annual rainfall, 2002/3 received 28 mm *less* rain than 2006/7. Yet ROVs were frequently higher during 2002/3 (Fig. 6.15■; Fig. 6.38□). This coincided with fundamentally different rainfall patterns, with approximately two-thirds of the rain in 2002/3 falling from mid-summer to mid-autumn compared to 2006/7 when nearly half of the rain fell earlier in the year, nearly a third in late spring.

Similarly, high annual rainfall does not guarantee relatively high activity levels in permanent residents. Once again it appears that the seasonal timing of rainfall is important. The highest annual rainfall during the study was recorded during 2005/6 (667 mm), with the corresponding values of the three remaining years with above average rainfall similar to one another (1997/8, 583 mm; 2001/2, 594 mm; 2007/8, 602 mm). As discussed in the forgoing paragraphs, it appears that good rains during the latter part of the main rain period could be important in stimulating activity in a number of permanent residents as was apparently the case during 1997/8 and

2005/6. One mechanism involves an extension of the occurrence of peak activity beyond its normal seasonal range, as illustrated above by species with a peak during 2005/6.

The seasonal rainfall pattern of 2001/2 was characterised by exceptional good rains during the first part of the main rain period with approximately 80% of annual rainfall occurring from late spring to late summer, followed by little rain during autumn; this was presumably not conducive for the extension of high levels of activity. Compared to 1997/8, it had only slightly less species-activities showing ROV increases, in contrast to 2005/6 which showed much more ROV increases (Fig. 6.38). Overall, 2001/2 had a relatively frequent occurrence of low (Fig. 6.32) or lower ROVs (Fig. 6.38).

The rainfall pattern of 2007/8 was distinct, with a reasonably constant amount (61–91 mm per season) falling throughout the main rain period, amounting to approximately three-quarters of the annual rainfall. Based on median values, the incidence of lower and higher ROVs was similar (Fig. 6.38), suggesting that the activity patterns of species was 'normal'. Compared to 1997/8 it had only slightly less species-activities showing ROV increases in contrast to 2005/6 which showed much more ROV increases (Fig. 6.38).

As already indicated above, cluster analysis grouped 1997/8 and 2005/6 together with 1998/9. In contrast to the late rains of the former two years, the rainfall of 1998/9 was more concentrated towards the middle of the main rain period. The rainfall pattern of 1999/0 showed a similar trend and both years had a similar amount of rainfall (516 and 514 mm respectively). In spite of these rainfall similarities, more species-activities attained higher ROVs in 1998/9 than in 1999/0 (Fig. 6.38). This could be related to the relatively high rainfall of the pre-1998/9 years (1997/8 marked the end of a three-year wet cycle), which had a positive influence on the birds in 1998/7, perhaps via improved habitat (*e.g.* grass cover). In this regard it is noted that 2002/3 also followed a good rainfall year (2001/2) and attained relatively high activity levels (Fig. 6.38). In this case the good rain during the latter part of the main rain period probably played an important role too. However, only a few species-activities attained higher ROVs during 2006/7 (Fig. 6.38), in spite of the good rains in 2005/6. Perhaps the unusual rainfall pattern of 2006/7 contributed to this.

The annual occurrence patterns of cool-season permanent residents were variable, but vocal activity in the Cape Turtle-Dove R354 and Laughing Dove R355 were most similar (Fig. 6.15).

Seasonal occurrence: The foregoing indicated that years where most rain occurred during the latter part of the main rain period, particularly early and mid-autumn, also had a relatively high proportion of permanent resident species-activities showing high, or at least higher, annual ROVs. This is compatible with the seasonal occurrence of many permanent resident bird species.

The seasonal occurrence of permanent residents shows that many species often had well-defined seasonal peak periods, most frequently involving the seasons from late spring to late autumn (Fig. 6.16; Fig. 6.34). The largest group permitting generalisation include those species-activities where peaks start in mid- or late spring and continue until mid-summer (Helmeted Guineafowl R203 'other vocalisations'), late summer (Northern Black Korhaan R239; Spotted Thick-knee R297 birds heard only; Cloud Cisticola R666; African Pipit R716) or early autumn (Rufous-naped Lark R494 perch song; Eastern Clapper Lark R495 displays; Desert Cisticola R665 displays; Neddicky R681) (Fig. 6.16A). In these species, relatively high rainfall during the latter part of the main rain period may lead to an extension of peak, or at least higher, activity levels.

The second most distinct group include cases where peak activity occurred during late spring (African Hoopoe R451 birds heard only) plus mid-spring (Helmeted Guineafowl R203 *buckwheat* calls; Ant-eating Chat R595) or early summer (Northern Black Korhaan R239 aerial vocalisations) (Fig. 6.16■B). These peaks in activity are associated with breeding.

In these two groups (Fig. 6.16■A & B) there are a number of cases where circumstantial evidence link the start of relatively high activity levels during mid-/late spring with change in day-length and/or the first significant rain of the year (see species accounts). Furthermore, the end of high, or relatively high, activity levels is linked to moult in most of these species.

The remaining species show a variety of seasonal occurrence patterns, frequently with higher ROVs during autumn than during other seasons (Fig. 6.16■). It is possible that rain late in the year could have a positive influence on the activity of these species.

Cluster analysis indicates two main season groups, the one consisting of the seasons from late spring to late summer (Fig. 6.40□). The second group is divided into two sub-groups, the first consisting of the three autumn seasons while the second include winter and early and mid-spring (Fig. 6.40□). Increases in ROVs were most evident from mid-spring to late autumn and infrequent during mid- and late winter (Fig. 6.40□). However, a few permanent resident species were more active during the cooler times of the year (Fig. 6.16□; Fig. 6.35□), coinciding with a frequent increase in ROVs during these times as compared to the warmer times of the year (Fig. 6.41□). In all three summer seasons low values dominated in this group (Fig. 6.16□; Fig. 6.41□).

Daily occurrence: There are a number of well-defined daily occurrence patterns ranging from species-activities that occurred frequently throughout the day to those that were infrequently recorded (Fig. 6.17). In between these two extremes are a number of species-activities that peaked during the early morning and/or late afternoon (Fig. 6.17).

Overall, activity peaks occurred most frequently in the early morning and in the late afternoon before sunset, with the occurrence of low (or lower) ROVs most prominent from late morning to mid-afternoon and the incidence of zero records particularly frequent after sunset (Fig. 6.17; Fig. 6.36□; Fig. 6.37□; Fig. 6.42□; Fig. 6.43□).

Annual cycles: Table 6.2 indicates the annual cycle in activity patterns of permanent residents of the grassland and the drainage line. There are generally four periods discernible: pre-breeding → breeding → moult → post-moult. Breeding is most often associated with high activity levels and is often flanked by a quieter pre-breeding and moult period. After moult, which often occurs during autumn, a number of species also show a period of activity higher than that during moult. This is probably related to a phenomenon known as 'autumnal sexuality', which is presumably caused by a regaining of photosensitivity during autumn, with day-lengths still long enough to lead to a transitory rise in gonadotrophin secretion (Ball & Ketterson 2008; Robinson & Follett 1982; Sharp 1996).

In most species breeding is centred on spring and/or summer. Exceptions include the Swainson's Spurfowl R199, Pink-billed Lark R508 and African Quailfinch R852 where it is centred on

Table 6.2: Annual cycle in activity patterns of permanent residents of the grassland (G) and drainage line (D) at Glen (See species accounts in Chapters 4 and 5). The following relative activity levels are indicated: ♩, none/low; ♪, moderate peak or intermediate; ♫, prominent peak; □, constant; ?, pattern obscure/unknown; -, no such period. These levels are associated with the indicated periods, but do not necessarily encompass the entire period. Asterisk (*) indicate post-moult activity associated with autumn (see text). The approximate centre of the breeding period is also indicated.

Habitat	Species	Period: Pre-br.	Breeding	Moult	Post-moult	Breeding: Spring	Summer	Autumn	Winter
G	R193 Orange River Francolin	□	□	□	□	?	?	?	?
D	R199 Swainson's Spurfowl	♪	♫	♩	♪			au	
D	R203 Helmeted Guineafowl	♩	♫	♩	♩	sp	su		
G	R239 Northern Black Korhaan	?	♫	?	?		su		
G	R255 Crowned Lapwing	♩	♪	♩	♪*	sp	su		
D	R297 Spotted Thick-knee	♩	♫	♩	♩	sp			
D	R354 Cape Turtle-Dove	-	♫	♩	-				wi
D	R355 Laughing Dove	-	♫	♩	-				wi
D	R425 White-backed Mousebird	♩	♩	♪	♪*	sp	su		
D	R426 Red-faced Mousebird	♪	♩	♩	♫*	sp	su		
D	R451 African Hoopoe	♪	♫	♩	♩	sp			
D	R454 Common Scimitarbill	♩	♫	♩	♫*	sp	su		
D	R465 Acacia Pied Barbet	♪	♫	♩	♫*	sp	su		
D	R473 Crested Barbet	♩	♫	♩	♫*	sp	su		
D	R486 Cardinal Woodpecker	⟶ Inconspicuous ⟵				sp			
G	R494 Rufous-naped Lark	♩	♫	♩	♩		su		
G	R495 Eastern Clapper Lark	♩	♫	♩	♪*		su		
D	R498 Sabota Lark	♩	♫	♩	♩	sp	su		
G	R506 Spike-heeled Lark	♫	♫	♩	♪*	sp			
G	R508 Pink-billed Lark	♪	♫	♩	♪			au	
D	R552 Ashy Tit	♩	♪	♩	♫*	sp	su		
D	R567 African Red-eyed Bulbul	□	□	□	□		su		
D	R577 Karoo Thrush	□	□	□	□	sp	su		
G	R595 Ant-eating Chat	♪	♫	♩	♩	sp			
D	R601 Cape Robin-Chat	♪	♪	♪	♫*	sp	su		
D	R615 Kalahari Scrub-Robin	♪	♫	♩	♫*	sp			
D	R621 Chestnut-vented Tit-Babbler	♩	♫	♩	♫*	sp			
D	R651 Long-billed Crombec	♩	♫	♩	♪*	sp	su		
G	R665 Desert Cisticola	♩	♫	♩	♩		su		
G	R666 Cloud Cisticola	♩	♫	♩	♩		su		
D	R681 Neddicky	♩	♫	♪	♩		su		
D	R685 Black-chested Prinia	♩	♫	♪	♩		su		
D	R698 Fiscal Flycatcher	♩	♫	♪	♫*	sp	su		
D	R706 Fairy Flycatcher	♩	♫	♩	♪*	sp	su		
G	R716 African Pipit	♩	♫	♩	♩	sp	su		
G	R727 Cape Longclaw	♩	♫	♩	♪*	sp	su		
D	R732 Common Fiscal	♩	♪	♩	♫*	sp	su		
D	R746 Bokmakierie	♪	♫	♪	♫*	sp			
D	R796a Orange River White-eye	□	□	□	□		su		
D	R814 Southern Masked-Weaver	♫	♪	♩	♫*	sp	su		
G	R852 African Quailfinch	♪	♫	♩	♩			au	
D	R878 Yellow Canary	♪	♫	♩?	♪?		su		

autumn. The two dove species were unusual as their annual cycles appear to consist only of breeding and moult. In addition, they were also the only species where breeding is centred on the cooler times of the year. The activity patterns of four species exhibited no clear seasonal trend.

In most of the permanent resident species the timing and sequence of the above mentioned events are probably controlled by day-length entrained circannual clocks to a greater or lesser extent. The build-up to activity peaks or the subsequent decline was sometimes abrupt. Examples include species where higher activity levels start during a narrow window, usually in mid-spring, but also in late spring (Rufous-naped Lark R494; Eastern Clapper Lark R495; Desert Cisticola R665; Cloud Cisticola R666; Neddicky R681; Yellow Canary R878). Similarly, there are a few species where moult seems to start abruptly during mid-autumn (Eastern Clapper Lark R495; Sabota Lark R498) or early winter (Swainson's Spurfowl R199). Significantly, mid-spring and mid-autumn are the two seasons during which changes in day-length are most marked (Fig. 2.12). In many other cases where the start or end of activity is less marked, the peaks were nonetheless associated with these two seasons.

Grassland species: All 13 grassland species feed on the ground (Fig. 6.10). The Northern Black Korhaan R239 is the largest and most conspicuous, and together with the Orange River Francolin R193 and Crowned Lapwing R255 the only non-passerines in this group (Fig. 6.6). Passerines include four larks, two cisticolas, plus four other species (Fig. 6.6). Thus, passerines outnumber non-passerines (Fig. 6.14).

The 13 grassland species are known to be associated with grassland in other parts of South Africa (Fig. 6.11). Some are also associated with scrub (Northern Black Korhaan R239, Eastern Clapper Lark R495, Spike-heeled Lark R506 and Ant-eating Chat R595) and woodland (Orange River Francolin R193 and Rufous-naped Lark R494) (Appendix B). The Crowned Lapwing R255, Pink-billed Lark R508, Desert Cisticola R665, African Pipit R716 and Cape Longclaw R727 have an obligate relationship with grassland according to Harrison *et al.* (1994) (Fig. 6.12; Appendix B).

The Swainson's Spurfowl R199 and Yellow Canary R878 are the only permanent residents of the drainage line that are also associated with grassland in South Africa according to Harrison *et al.* (1994). The former species was rarely encountered in the grassland, hence their classification as a drainage line bird here. The canary regularly visited the trampled area in the grassland (GFC A3; Fig. 6.3).

The Cape Bunting R885, here classified as a mountain species (Appendix B), is said to be associated with grassland in South Africa (Harrison *et al.* 1994), but at Glen the records in the grassland were attributed to an unusual influx during 1999; they were not otherwise recorded in the grassland (see page 990).

All grassland species fall into GFCs A3 and A2 (Fig. 6.6; Fig. 6.8). Annual changes in activity levels were variable and generally not distinctly different from those of drainage line species (Fig. 6.15). Seasonal patterns were often well-defined and ranged from peaks in mid- and late spring (*e.g.* Ant-eating Chat R595), summer (*e.g.* Cloud Cisticola R666) to autumn/early winter (*e.g.* African Quailfinch R852) (Fig. 6.16). There were no cool-season birds in the grassland (Fig. 6.16). Regarding daily activity patterns, grassland species are mainly concentrated in the group characterised by frequent to very frequent activity throughout or virtually throughout the day (Fig. 6.17■). This is in contrast to the drainage line species that are mostly concentrated in the branch of the dendrogram where activity was most frequent in the early morning and often also in the late afternoon, and activity infrequent during the middle part of the day (Fig. 6.17■). The only species-activities of grassland species in this latter group was that of the Crowned Lapwing R255, Orange River Francolin R193 and the *tsweet* calls of the Cape Longclaw R727; the *meew*-calls of the longclaw, however, also clustered in the first group (Fig. 6.17■).

Drainage line species: An almost equal proportion of arboreal and terrestrial feeders occurs in the drainage line (14 vs. 16; Fig. 6.10□). The Cape Turtle-Dove R354 is the most common species, or at least the most conspicuous, and the Helmeted Guineafowl R203 the largest. Together with the nocturnal Spotted Thick-knee R297, two mousebirds, two barbets, one woodpecker and four other species, they constitute the permanent non-passerine residents of the drainage line (Fig. 6.6). The Bokmakierie R746 is the most vociferous and one of the largest passerines of the drainage line; only the inconspicuous Karoo Thrush R577 is larger. Other passerines are smaller, the tiniest being the Fairy Flycatcher R706. Collectively the passerines outnumber the non-passerines, but not as much as in the grassland (Fig. 6.14).

Most drainage line species are either associated with or indicator species of woodland and scrub habitats in South Africa (Fig. 6.11□; Fig. 6.12□; Fig. 6.13□). In addition, the Karoo Thrush R577, Cape Robin-Chat R601 and Orange River White-eye R796a are also associated with forest habitats (Appendix B). Habitat generalists include the Helmeted Guineafowl R203, Spotted Thick-knee R297, Cape Turtle-Dove R354, Laughing Dove R355, Common Fiscal R732 and Southern Masked-Weaver R814 (Appendix B).

Most of the drainage line species belong to GFCs A3 and A2 (Fig. 6.8□). Although some of these species would visit the grassland at times, the grassland records refer mostly to birds calling in the drainage line. Species in classes B2, B1 and C1 (Fig. 6.8□) or those never recorded in the grassland (Fig. 6.6) include indicator species of woodland (White-backed Mousebird R425, Cardinal Woodpecker R486, Sabota Lark R498 and Fiscal Flycatcher R698), and scrub (Karoo Scrub-Robin R614), four species associated with woodland and/or scrub (Karoo Thrush R577, Long-billed Crombec R651, Fairy Flycatcher R706 and Orange River White-eye R796a) and one habitat generalist (Southern Masked-Weaver R814) (Appendix B). Their relative scarcity in the grassland therefore appears to be related to habitat preferences as well as their relative inconspicuous nature as compared to the A2 and A3 species.

As already indicated above, there were no major differences with regard to the annual occurrence of grassland versus drainage line species (see Figure 6.15). All the cool-season permanent residents are associated with the drainage line (Fig. 6.16□). Other drainage line species showed peaks in activity during spring (*e.g.* African Hoopoe R451), summer (*e.g.* Neddicky R681) and autumn (*e.g.* Chestnut-vented Tit-Babbler R621) (Fig. 6.16■). Activity peaks during the early morning (and late afternoon) occurred more often in drainage line than in grassland species (Fig. 6.17). It is noted that the activity of drainage line birds measured in the grassland does not always agree with that measured in the drainage line, suggesting that different types of activity are involved — see for example the Chestnut-vented Tit-Babbler R621 on page 769. This aspect needs further study.

Mountain species: The classification of the Cape Bunting R885 and Cinnamon-breasted Bunting R886 as mountain species is based on their presence in the hills to the east of the study area during sporadic visits there. Their classification here as permanent residents needs verification through more regular surveys in that habitat.

6.2.1.2 Temporary residents

Temporary residents differ from their permanent counterparts in that they are more mobile and may leave the area for some time. A combination of physiological and environmental factors stimulates these movements. For example, ducks inhabiting ephemeral wetlands may stay at a wetland for as long as there is sufficient water to sustain them, or they may move to larger bodies of water for their annual flightless moult, irrespective of the status of these wetlands. Migrants are another example of temporary residents.

Approximately one sixth of the species recorded at Glen are temporary residents (Fig. 6.7). They are represented by species from all southern African status categories including 11 residents, three local, five intra-African and two Palearctic migrants and 20 species exhibiting movements other than true migration (Fig. 6.9). In a southern African context, only part of the Capped Wheatear R587, African Stonechat R596 and Cape Wagtail R713 populations are local migrants. At Glen the stonechat is the only one of the trio whose occurrence was attributable exclusively to such birds.

In addition to species foraging on the ground and in water, some are also arboreal or aerial feeders (Fig. 6.10). In terms of general habitat preference, most species frequent aquatic, woodland or grassland habitats (Fig. 6.11). This includes a number of habitat indicator species (Fig. 6.12). Some species are also associated with forest and scrub habitats and the list is completed with three habitat generalists (Fig. 6.11).

Two thirds of all temporary residents at Glen were associated with the drainage line, and the remainder with grassland (Fig. 6.8). Whereas passerine species dominate in the grassland, non-passerines are more dominant in the drainage line (Fig. 6.14).

Annual occurrence: Activity peaks occurred most frequently during 2001/2 (Fig. 6.32) and involved eight species-activities from six species, all of which showing very similar overall annual occurrence patterns, including intermediate (or high) ROVs during 1997/8 (except Red-knobbed Coot R228) and 2005/6 (Fig. 6.18A). In South Africa all six species exhibit movements other than true migration (Fig. 6.18A). These movements are linked to the availability of suitable habitat (and food), which, in turn, relies on good rains such as occurred during 2001/2: the Little Grebe R008, Red-knobbed Coot R228 and Blacksmith Lapwing R258 are aquatic, and the Common Quail R200, Melodious Lark R492 and Zitting Cisticola R664 are dependant on tall grass. The activity of the Black-shouldered Kite R127 was also influenced by the rainfall in 1997/8 (and earlier), 2001/2 and 2005/6 (see page 221). The activity of two cool-season species, the Marsh Owl R395 and Cape Wagtail R713, peaked during 2002 (Fig. 6.18) and were probably related to the good rains of 2001/2 (see discussions in the relevant species accounts).

Although the occurrence of other waterbirds (White-faced Duck R099, Spur-winged Goose R116, Egyptian Goose R102, Red-billed Teal R108 and Yellow-billed Duck R104) are most certainly linked to rainfall events — particularly those that add water to the farm dam in the drainage line — the interpretation of their data is complicated by ecological and behavioural differences between them affecting their detectability and measurable activity patterns in the grassland.

Another well-defined group include three intra-African migrants (Jacobin Cuckoo R382; Diderick Cuckoo R386; Rufous-cheeked Nightjar R406) and one South African resident species (Black-throated Canary R870) (Fig. 6.18▮B). These four species showed the same general pattern with intermediate ROVs for all years (Fig. 6.18▮B). The annual occurrence patterns for the remainder of the temporary resident species were variable (Fig. 6.18).

Overall, the ROVs of most species-activities were lower during 1998/9, 1999/0 and 2000/1 than during other years, in contrast to 1997/8, 2001/2, 2004/5 and 2005/6 when it was higher (Fig. 6.38▯).

Seasonal occurrence: Absence of activity was often attributable to the physical absence of local, intra-African or Palearctic migrants, in contrast to species such as the Melodious Lark R492 where displays, and not necessarily presence, were restricted to a certain time of the year (Fig. 6.19). In a number of temporary residents activity was more or less centred on autumn, mostly involving species that showed movements other than true migration in South Africa (Fig. 6.19▮A). In another group, including three intra-African migrants and three with movements other than true migration in South Africa, activity was centred on summer (Fig. 6.19▮B). The seasonal occurrence of the remainder of species was more variable (Fig. 6.19▮).

Excluding cool-season birds, activity peaks were most frequent from late spring to mid-autumn (Fig. 6.19▮; Fig. 6.34▯□), *i.e.* the main rain period. Cluster analysis also groups these seasons together based on ROVs, the remaining seasons (late autumn to mid-spring) forming a separate group (Fig. 6.40▯). The seasons in the latter group (except late autumn) is characterised by the relatively frequent occurrence of zero records (Fig. 6.19▮; Fig. 6.34▯□) and a high proportion of species-activities with lower ROVs, in contrast to the main rain period during which ROVs was frequently higher (Fig. 6.40▯).

For cool-season species, peaks in activity occurred most frequently from late autumn to early spring (Fig. 6.19▯; Fig. 6.35▯□), with cluster analysis also grouping these seasons together (Fig. 6.41▯), coinciding with the frequent occurrence of higher ROVs (Fig. 6.41▯).

Daily occurrence: Groups of species-activities showed peaks in the early morning and/or late afternoon (Fig. 6.20). In a few instances, activity was also relatively frequent during other parts of the day (Fig. 6.20).

Overall, activity peaks most frequently occurred in the early morning, often inclusive of the time before sunrise, with a secondary peak in the late afternoon, frequently after sunset (Fig. 6.20; Fig. 6.36▯□; Fig. 6.37▯□). This is further emphasised by the frequent occurrence of higher ROVs at these times, in contrast the period from S5 to S10 during which ROVs was generally lower (Fig. 6.42▯). ROVs of S1 to S12 were frequently higher than during S0 and S13, with cluster analysis highlighting the uniqueness of the latter two segments by grouping them separately (Fig. 6.42▯). The rest of the segments are grouped into two distinct groups with S1–S4 and S12 in one group, reflecting the frequent occurrence of higher ROVs, particularly relative to S5–S11 in the other group (Fig. 6.42).

Annual cycles: Temporary residents where certain aspects of their activity patterns were narrowly restricted in time include migrants arriving in mid- (Rufous-cheeked Nightjar R406) or late spring (Diderick Cuckoo R386), or departing in mid-autumn (Rufous-cheeked Nightjar R406). The start of displays in the Zitting Cisticola R664 was restricted to late spring. In these cases it is highly likely that activity is tightly controlled by day-length entrained circannual clocks. By contrast, the occurrence of a number of other species was apparently more dependant on the availability of food and habitats. Examples include the Black-shouldered Kite R127 where the availability of rodent prey seems important, and the Common Quail R200 and Long-tailed Widowbird R832 where suitable habitat plays an important role. The occurrence of temporary resident waterbirds at Glen is to some extent linked to the status of the dam in the drainage line. However, a number of these species have an annual flightless moult that usually occur on a permanent water body. The species involved include the White-faced Duck R099, South African Shelduck R103, Yellow-billed Duck R104, Spur-winged Goose R116, and perhaps also the Little Grebe and Red-knobbed Coot R228.

Grassland species: All 11 grassland species forage on the ground (Fig. 6.10). The Black-shouldered Kite R127 and Marsh Owl R395 are raptors and together with the Common Quail R200 and Kurrichane Buttonquail R205 they constitute the non-passerines (Fig. 6.6). The Melodious Lark R492, the only alaudid, and the Long-tailed Widowbird R832 are the only grassland species that are generally considered to be resident in southern Africa. The rest of the species include one local migrant (African Stonechat R596) and birds that exhibit non-migratory movements (Appendix B).

Species classified as grassland birds at Glen include those considered to be indicators of grassland (Kurrichane Buttonquail R205, Melodious Lark R492 and Zitting Cisticola R664) or associated with grassland in South Africa (Common Quail R200, Marsh Owl R395, Capped Wheatear R587, African Stonechat R596, Long-tailed Widowbird R832 and Red-headed Finch R856), habitat generalists (Black-shouldered Kite R127) or associated with woodland and scrub (Lark-like Bunting R887) (Appendix B). In the case of the kite and the bunting, the data-set is biased towards the grassland and it is possible that these birds are, or were, more frequent in the drainage line than the current assessment seems to imply. Some of the grassland species are also associated with aquatic (Marsh Owl R395) or scrub habitats (Capped Wheatear R587, African Stonechat R596 and Red-headed Finch R856) (Appendix B).

Seven species fall into GFC A2, the Marsh Owl R395 in B2, Kurrichane Buttonquail R205 in C2 and Capped Wheatear R587 and Lark-like Bunting R887 in C1 (Fig. 6.6; Fig. 6.8). The activity of all grassland species peaked during 1–6 years, except for the Kurrichane Buttonquail R205, African Stonechat R596 and Lark-like Bunting R887 that showed no peaks (Fig. 6.18). This is in contrast to the drainage line birds, where a smaller proportion of species-activities showed peak years (Fig. 6.18). Seasonal patterns were similar in the two habitats with seasonal peaks often occurring during summer, autumn or winter (Fig. 6.19). Overall, the major themes in daily patterns were similar in both habitats (Fig. 6.19).

Drainage line species: Ten of the 22 temporary residents in the drainage line are associated with aquatic habitats and the same number with woodland habitats (Fig. 6.11▮□), including six indicator species in both cases (Fig. 6.12▮□). The Namaqua Dove R356 and Pearl-breasted Swallow R523 represent the two habitat generalists in Figure 6.11▮□. In addition to woodland, the Green Wood-Hoopoe R452 is also associated with forest and the Diderick Cuckoo R386 with grassland (Appendix B). These habitat preferences are partially reflected by feeding habits, which, in addition to waterbirds, include two aerial, four arboreal and six terrestrial species (Fig. 6.10▮□).

In terms of grassland frequency classes, eight species are in A2 and five in B2 (Fig. 6.8⬒). In most cases the reason for their frequent 'occurrence' in the grassland was due to the vocalisation of birds in the drainage line heard in the grassland. Notable exceptions include ducks and geese that were often seen commuting between the farm dam in the drainage line and, presumably, foraging areas elsewhere. There are an additional six species in classes B1–D1 (Fig. 6.8⬒), their relatively infrequent occurrence in the grassland reflecting their habitat preference to a large degree, with vocal behaviour being a contributory factor.

Twelve of the temporary residents in the drainage line are neither resident nor migratory in southern Africa, with the rest including seven residents, five intra-African, two Palearctic and one local migrant (Fig. 6.9▮□). Activity levels were similar for all years in the Jacobin Cuckoo R382, Diderick Cuckoo R386 and Rufous-cheeked Nightjar R406 — all three intra-African migrants — as well as the Black-throated Canary R870 (Fig. 6.18■B). In many other cases activity peaked during certain years, most frequently during 2001/2 and 2002 (Fig. 6.18). Seasonal peaks often occurred during summer or autumn, less frequently during the cooler times of the year (Fig. 6.19). Daily patterns often involved peaks in activity during both the early morning and late afternoon, with some species-activities also frequent to very frequent at other times of the day (Fig. 6.20).

6.2.2 VISITORS

Visitors represent species that do not regularly stay in the study area overnight, at least not for more than a few weeks at the most. In many cases the most obvious reason relates to the lack of suitable roosting sites within the study area. Some examples include the Lesser Kestrel R183 that typically roosts in urban areas, swifts that roost in their nests or on the wing and the Barn Swallow R518 that roosts in reed-beds. In other cases the birds may utilise the area only as a stopover, for example the Sickle-winged Chat R591 and the Lesser Grey Shrike R731.

Over the years, the proportion of seasonal visitors has remained fairly constant at approximately one fifth of all species (Fig. 6.7). This is in contrast to the increasing proportion of aseasonal visitors, which presently amounts to 7.6% of all species (Fig. 6.7). The proportion of regular visitors shows a slowly decreasing trend (Fig. 6.7).

6.2.2.1 Regular visitors

All five the species in this category were regularly recorded in the grassland (GFCs A3 or A2; Fig. 6.8⬒). Whereas the Cattle Egret R071, Wattled Starling R760, Red-billed Quelea R821 and Southern Red Bishop R824 were regularly recorded in mono-specific flocks, the Cape Sparrow R803 was recorded only as a family group — male and female, plus youngsters at times. When the bishop and queleas occurred in mixed flocks, the former always outnumbered the latter. The roosting sites of these species are not precisely known. Possible locations include the reed-beds and the many large trees around Glen village. A Cape Sparrow R803 pair was suspected to roost somewhere west of the study area.

All five species are associated with the grassland at Glen (Fig. 6.8■), but note that two species (the Wattled Starling R760 and Red-billed Quelea R821) bred in the drainage line in 2001/2. Whereas the bishop is associated with aquatic habitats, the other four are habitat generalists (Appendix B; Fig. 6.13□□). The sparrows and the bishops probably represent local resident birds in contrast to the other three species that are known to undertake non-migratory movements in southern Africa (Appendix B). All five species forage on the ground (Fig. 6.10□□).

Activity of the bishop, sparrow and the egret has generally decreased since the beginning of the study (Fig. 6.21). In the former two species, this is at least in part due to observer bias. The presence of cattle affected the occurrence of the egrets. The peaks in activity during 2001/2 in both the queleas and starlings (Fig. 6.21) were due to breeding activity in the drainage line in that year, which was probably stimulated by the exceptional good rains during late spring. Seasonal patterns included peaks in spring, autumn and winter in the various species (Fig. 6.22). All five species were most frequently recorded in the morning, but also in the late afternoon in the case of the egret, starling and sparrow (Fig. 6.23).

Circumstantial evidence suggests that the arrival as well as the start of the breeding season in the Cattle Egret R071 may be tightly tied to increased day-length (mid-spring). By contrast, it seems likely that a complex interaction between physiological mechanisms and environmental cues are involved in the regulation of breeding and moult in the Wattled Starling R760 (Craig 1996). Peak occurrence at Glen of the Red-billed Quelea R821 is linked to post-breeding dispersal, and that of the Southern Red Bishop R824 to post-moult dispersal. Moult in the Cape Sparrow R803 overlaps extensively with its protracted breeding season and consequently their occurrence at Glen shows a poorly defined seasonal pattern.

6.2.2.2 Seasonal visitors

The 43 seasonal visitors at Glen include birds from all southern African status categories, including 19 residents, 12 intra-African, nine Palearctic and nine local migrants, and eight species involved in non-migratory movements (Fig. 6.9□□). Many of the species are in GFCs A2 (n = 9 species), B1 (13) or C1 (10), with the rest of the species in classes B2 (1), C2 (2) or D1 (4) (Fig. 6.8□).

Annual occurrence: Annual occurrence patterns were variable, but peaks in activity were relatively frequent in 2001/2 (Fig. 6.32□□) and involved six species-activities of five species, all being either intra-African (Red-breasted Swallow R524; South African Cliff-Swallow R528) or Palearctic migrants (Lesser Kestrel R183; European Bee-eater R438; Barn Swallow R518) (Fig. 6.24■). The swallows and the bee-eater are specialised aerial insectivores and the peak in their activity was presumably caused by the good early rains of 2001/2.

Cluster analysis also indicates that the occurrence of activity during 2001/2 in general was very different from that of other years, coinciding with the very frequent occurrence of higher

ROVs (Fig. 6.38). It is likely that the early onset of good rain in late spring contributed to this. This is supported by the arrival and/or peak activity of birds during or soon after the main rains of that year (Hamerkop R081, Fig. 4.20; Lesser Kestrel R183, Fig. 4.85; Red-chested Cuckoo R377, Fig. 4.222; European Bee-eater R438, Fig. 4.281; Barn Swallow R518, Figs. 5.74 & 5.80; Red-breasted Swallow R524, Fig. 5.92; South African Cliff-Swallow R528, Fig. 5.101).

Seasonal occurrence: Activity patterns are generally strongly seasonal (Fig. 6.25). For warm-season birds, the most prominent patterns occurred during the warmer times of the year and involved intra-African and Palearctic migrants (plus the Little Swift R417 which is possibly a resident species), most of which belong to GFC A2 in contrast to almost all other seasonal visitors that fall into lower classes (Fig. 6.25; Fig. 6.34). Cluster analysis reveals two well-defined season groups with the main rain period characterised by the frequent occurrence of higher ROVs, particularly in relation to the second group of seasons, late autumn to mid-spring (Fig. 6.40).

Approximately a third of the seasonal visitors occurred during the cooler seasons (Fig. 6.25). This group of birds consists of southern African residents and local migrants in equal proportions, in addition to the Burchell's Courser R299 that exhibits nomadic movements (Fig. 6.25). The occurrence of zero activity was most frequent during summer in this group (Fig. 6.25; Fig. 6.35). Cluster analysis shows the same grouping of seasons than that revealed for warm-season birds (*cf.* Fig. 6.40), with the incidence of increases in activity levels being particularly frequent from late autumn to mid-spring (Fig. 6.41).

Daily occurrence: Seasonal visitors show two major daily patterns, the one characterised by relatively frequent activity in the morning *after* sunrise and the other group where activity was always infrequent, including most of the cool-season species (Fig. 6.26; Fig. 6.36). The former group consists exclusively of grassland species of which all are in GFC A2, except the Common Swift R411 (B2) and Sickle-winged Chat R591 (B1) (Fig. 6.26). The rest of the species include both grassland and drainage line birds, all falling into GFCs B1–D1 (Fig. 6.26).

On a finer scale, cluster analysis reveals that the occurrence of activity from S2 to S5 was very different from that of other segments, coinciding with the relatively frequent occurrence of higher ROVs, mainly in relation to other segments (Fig. 6.42). These other segments may be further divided into two groups with S0 and S13 forming a group of their own, coinciding with the relatively frequent occurrence of lower activity levels compared to other segments (Fig. 6.42). Cool-season species showed a similar pattern (Fig. 6.43).

Grassland species: The majority of species belong to GFCs A2 (n = 9 species) and B1 (11), with 1–4 species in classes B2, C2, C1 and D1 (Fig. 6.8). The seasonal visitors associated with grassland at Glen include species from all southern African status categories, in all cases with more species in the grassland than in the drainage line (Fig. 6.9).

In terms of feeding niche, 17 grassland species — including swifts, swallows, bee-eaters and a pratincole — are specialised aerial insectivores; 12 feed on the ground and one is arboreal (Fig. 6.6; Fig. 6.10). Seasonal visitors constitute the bulk of all aerial foraging species recorded at Glen (Fig. 6.10).

Nearly three quarters of all seasonal visitors are associated with the grassland at Glen (Fig. 6.8■). In a South African context, most of them are associated with grassland (n = 13 species) or are habitat generalists (10) (Fig. 6.11□□). The Lesser Kestrel R183, Black-winged Pratincole R305 and Wing-snapping Cisticola R667 represent the three grassland indicator species in Figure 6.12□□. A number of species associated with grassland are also associated with scrub (Black Harrier R168, Burchell's Courser R299, Double-banded Courser R301, Greater Striped Swallow R526, Sickle-winged Chat R591 and Rufous-eared Warbler R688), woodland (Red-breasted Swallow R524) and with scrub, montane and rocky areas (Sentinel Rock-Thrush R582) (Appendix B).

Seven species that were associated with grassland at Glen normally occur in other habitats. The White-fronted Bee-eater R443 and Lesser Grey Shrike R731 are both indicator species of woodland (Appendix B). The former species visits the study area at Glen during the non-breeding season and the latter is a Palearctic migrant during the warmer time of the year (Fig. 6.25). The Fork-tailed Drongo R541, a cool-season visitor at Glen (Fig. 6.25□), is associated with woodland and forest habitats (Appendix B). The White-throated Swallow R520 and Brown-throated Martin R533 are indicators of aquatic habitats (Appendix B). While the swallow, an intra-African migrant, was often associated with the zinc dam during the warmer seasons, the martin is a cool-season visitor (Fig. 6.25). The Rock Martin R529, another cool-season visitor (Fig. 6.25□), is associated with montane and rocky areas. The seventh species is the Rufous-eared Warbler R688, an indicator species of scrub habitats that was infrequently recorded during the warmer seasons (Fig. 6.25■).

Since grassland species predominate the seasonal visitors, the annual, seasonal and daily patterns for them are similar to that already discussed above.

Drainage line species: Approximately a quarter of the seasonal visitors are associated with the drainage line at Glen (Fig. 6.8■). Six are arboreal, three forage on the ground, the Swallow-tailed Bee-eater R445 in the air and the Hamerkop R081 is aquatic (Fig. 6.10□□; Appendix B). Except for the Hamerkop R081 (aquatic) and the Spotted Eagle-Owl R401 (habitat generalist), the remaining species are all associated with woodland and the Red-chested Cuckoo R377 with forest habitats (Fig. 6.11; Appendix B).

Four species were never detected in the grassland (Klaas's Cuckoo R385, Swallow-tailed Bee-eater R445, Icterine Warbler R625 and Spotted Flycatcher R689), five are in GFC C1 (Red-chested Cuckoo R377, Spotted Eagle-Owl R401, Lesser Honeyguide R476, Pririt Batis R703 and Southern Grey-headed Sparrow R804) and two in B1 (Hamerkop R081 and Cape Glossy Starling R764) (Fig. 6.6; Fig. 6.8□).

Mountain species: Layard's Tit-Babbler R622 is an indicator species of scrub and is presumably a cool-season visitor to the hills at Glen (see discussion on page 773).

6.2.2.3 Aseasonal visitors

The aseasonal visitors include 15 bird species considered resident in southern Africa (Fig. 6.9□□). The Greater Honeyguide R474, White-bellied Sunbird R787, Blue Waxbill R844 and Golden-breasted Bunting R884 also have populations that undergo local migratory or non-migratory movements (Appendix B). A 16^{th} species, the African Spoonbill R095, is nomadic. GFCs range from A2 (Yellow-bellied Eremomela R653) to D1 (n = 5 species), plus five species that were never recorded in the grassland (Fig. 6.6).

Most of the aseasonal visitors are associated with woodland habitats (Fig. 6.11), including the Cape Penduline-Tit R557, Yellow-bellied Eremomela R653 and Cape White-eye R796b that are also associated with scrub, and, in the case of the white-eye, forest (Appendix B). The list also includes two habitat generalists (Secretarybird R118 and Barn Owl R392) and an aquatic species (African Spoonbill R095) (Fig. 6.11; Appendix B). In addition to the latter aquatic species, nine forage on the ground and six are arboreal (Fig. 6.10).

Only three aseasonal species (Fig. 6.8), namely Secretarybird R118, Cape Penduline-Tit R557 and Yellow-bellied Eremomela R653, were associated with the grassland at Glen. In addition to woodland, the penduline-tit and eremomela are also associated with scrub in South Africa, and the Secretarybird R118 is considered a habitat generalist (Appendix B).

Most of the species associated with the drainage line at Glen are generally associated elsewhere with woodland, including seven indicator species of that habitat (Brown-hooded Kingfisher R435, Greater Honeyguide R474, Red-throated Wryneck R489, White-bellied Sunbird R787, Violet-eared Waxbill R845, Black-faced Waxbill R847 and Golden-breasted Bunting R884) (Fig. 6.12). The only two species not associated with woodland are the African Spoonbill R095 (aquatic) and the Barn Owl R392 (a habitat generalist).

Annual occurrence: Peaks in occurrence were limited to the three grassland species and the Barn Owl R392 (Fig. 6.27). The former three species showed peaks in occurrence during 2004/5 and 2005/6 and two of the species also during 2007/8 (Fig. 6.27). Cluster analysis indicates that the occurrence patterns in 2004/5, 2005/6 and 2007/8 was different form that of other years, coinciding with the relatively frequent occurrence of higher ROVs during those three years (Fig. 6.38).

Seasonal occurrence: There were no strong seasonal patterns (Fig. 6.27; Fig. 6.34; Fig. 6.40).

Daily occurrence: The daily patterns of the Cape Penduline-Tit R557 and Yellow-bellied Eremomela R653 both peaked during the early morning and that of the Barn Owl R392 after sunset (Fig. 6.27). In general, ROVs tended to be slightly higher in the early morning after sunrise (Fig. 6.27; Fig. 6.42).

6.2.3 BIRDS IN TRANSIT

Whereas the groups discussed so far utilised the study area to some extent, birds in transit represent species that merely flew over without utilising the area for foraging, *etc.* In some cases (especially raptors and swifts) it was difficult to determine whether the birds were actually feeding or at least looking for food or not. In other cases the birds were usually not utilising the area, but sometimes they did use the study area for feeding (Red-capped Lark R507) and even breeding (Chestnut-backed Sparrowlark R515 and Grey-backed Sparrowlark R516). Most birds in transit find their food on the ground (n = 29 species) or in water (19), while an additional four species are aerial feeders (Fig. 6.10), including two raptors (Peregrine Falcon R171 and Lanner Falcon R172) and two swifts (Alpine Swift R418 and African Palm-Swift R421) (Appendix B).

The proportion of birds in transit has increased over the years and they currently constitute more than a quarter of all the species recorded at Glen (Fig. 6.7). Most of these birds were generally scarce, with many attaining GFCs C1 or D1 (Fig. 6.8). The most frequently recorded species were the Hadeda Ibis R094 (A3) and the Steppe Buzzard R149, Lanner Falcon R172, Speckled Pigeon R349 and Red-capped Lark R507 (A2), with an additional ten species in GFCs B2 or B1 (Fig. 6.6; Fig. 6.8).

Birds in transit mostly involve southern African resident species (n=26) and species subject to non-migratory movements (24) (Fig. 6.9). Migrants include nine from the Palearctic, five local migrants and one intra-African species; a number of these probably represent birds on passage.

Twenty species are habitat generalists and 19 are associated with aquatic habitats (Fig. 6.11), ten of which are indicator species (Fig. 6.12). In addition to marine habitats in some, the latter group also include the Yellow-crowned Bishop R826 associated with grassland (Appendix B), a habitat with which nine species are linked (Fig. 6.11). Only the Blue Crane R208 is an indicator species of this latter habitat (Appendix B). Other grassland species are also associated with scrub (Greater Kestrel R182, Red-capped Lark R507 and Grey-backed Sparrowlark R516) and woodland (Montagu's Harrier R166, Pallid Harrier R167 and Chestnut-backed Sparrowlark R515) (Appendix B). The Bateleur R146 is the only indicator species of woodland; the remaining two woodland species are the Sociable Weaver R800 and Scaly-feathered Finch R806 (Appendix B). Scrub habitats also have only one indicator species (Ludwig's Bustard R232), with the only species of this habitat that has not been mentioned yet being the Namaqua Sandgrouse R344. The Peregrine Falcon R171 is the only species associated with mountainous terrain (Fig. 6.11; Appendix B).

Annual occurrence: Annually, the activity of a limited number of birds in transit showed peaks during 1–4 years, all of them belonging to GFCs A3, A2, B2 or B1 whereas the remaining species were mostly in lower classes C1 and D1 (Fig. 6.28). Cluster analysis showed various groupings of years, but each year appears to be reasonably unique (Fig. 6.38; Fig. 6.39).

Seasonal occurrence: Many of the birds in transit species were recorded during certain times of the year only, with a few of the more common ones showing well-defined seasonal peak periods (Fig. 6.29). Cluster analysis shows two relatively ill-defined groups of seasons, the one from late spring to mid-autumn (*i.e.* the main rain period) and the other from late autumn to mid-spring (Fig. 6.40). The ROVs of a relatively large proportion of species-activities increased during mid-spring and from mid-summer to mid-autumn (Fig. 6.40). A more distinct grouping of seasons is shown by cool-season species with the three summer seasons forming a group of their own, coinciding with the relatively frequent occurrence of lower levels of activity then (Fig. 6.41). Autumn and early winter also cluster together, often showing relatively higher levels of activity (Fig. 6.41).

Daily occurrence: The daily timing of activity clustered into a limited number of groups with activity recorded during one or a few segments in a number of species, while others showed activity throughout much of the day (Fig. 6.30). Cluster analysis indicates two poorly defined groups, S4 to S11 versus the rest of the segments (Fig. 6.42□).

6.2.4 BIRD HEARD OUTSIDE THE STUDY AREA

Four species were recorded only, or mainly, as birds heard outside the study area. All four species are considered to be resident in southern Africa with the Southern Pale Chanting Goshawk R162 also having non-migratory movements (Fig. 6.9□; Appendix B). The Common Ostrich R001 was recorded infrequently (C1) and the rest of the species more frequently (A2) (Fig. 6.6; Appendix B).

The Blue Korhaan R234 is an indicator species of grassland and the White-browed Sparrow-Weaver R799 of woodland (Appendix B). The Common Ostrich R001 is a habitat generalist and the Southern Pale Chanting Goshawk R162 is associated with forest, woodland and scrub (Appendix B).

Annual and seasonal patterns were variable, but the daily pattern in occurrence of the Southern Pale Chanting Goshawk R162, Blue Korhaan R234 and White-browed Sparrow-Weaver R799 was very similar, showing a peak in the early morning with a secondary increase in activity in the late afternoon before sunset (Fig. 6.31).

6.3 Migrants

Migrants constitute an important part of the temporary resident and seasonal visitor community components at Glen (Fig. 6.9□□□). In terms of number of species, intra-African migrants are the most numerous group with 17, followed by Palearctic and local migrants with 11 and 12 species respectively (Fig. 6.9□□□). In addition, the Alpine Swift R418 is the only intra-African migrant that is often recorded as birds in transit, compared to the five local and nine Palearctic migrants (Fig. 6.9□). In many cases these birds in transit probably represent birds on passage. All intra-African migrants are breeding in southern Africa in contrast to the non-breeding Palearctic migrants.

The time of arrival and departure of migrants at Glen is summarised in Figure 6.44. One of the most striking differences between local migrants and those from further afield involves the presence of the former species during the cooler time of the year (mainly during late autumn, winter and early spring) in contrast to the rest of the migrants that are present during the warmer seasons only (Fig. 6.44). In the grassland, the African Stonechat R596* was the most frequently recorded local migrant (GFC A2), followed by the Namaqua Sandgrouse R344 (B2), Black Harrier R168, Brown-throated Martin R533 and Sickle-winged Chat R591* (B1), Three-banded Plover R249 and Cape Canary R872* (C1), and the Sentinel Rock-Thrush R582* and Layard's Tit-Babbler R622* (D1); the Swallow-tailed Bee-eater R445 is the only local migrant of the drainage line (Fig. 6.44). Circumstantial evidence suggests that the five species indicated by asterisks above visits Glen as altitudinal migrants from Lesotho.

In general, there is no clear difference between intra-African and Palearctic migrants with regards to their seasonal occurrence. The more common species, particularly those in GFC A2, exhibit a number of general patterns (Fig. 6.44). In some cases the timing of arrival was always or mostly during a very specific time of the year (*e.g.* Lesser Kestrel R183 and Rufous-cheeked Nightjar R406), while in others the time of arrival was more variable (*e.g.* White-rumped Swift R415 and Barn Swallow R518) (Fig. 6.44). A similar trend is seen in departure dates that ranged from species where it was variable (*e.g.* Steppe Buzzard R149 and European Bee-eater R438) to species where it usually occurred during a specific time of the year (*e.g.* Rufous-cheeked Nightjar R406 and Barn Swallow R518) (Fig. 6.44).

It is likely that day-length entrained circannual rhythms play an important role in the timing of migration in most or all of the migrants occurring at Glen. In a number of cases it appears that the timing of arrival and departure are particularly tightly controlled by day-length. The species involved include the following (see Fig. 6.44): *Arrival:* early spring (White-throated Swallow R520; South African Cliff-Swallow R528); mid-spring (Rufous-cheeked Nightjar R406; Alpine Swift R418; European Bee-eater R438; Greater Striped Swallow R526); late spring (Lesser Kestrel R183; Diderick Cuckoo R386); *Departure:* mid-/late autumn (Rufous-cheeked Nightjar R406; Barn Swallow R518; White-throated Swallow R520; South African Cliff-Swallow R528).

6.4 Discussion

The information presented in this chapter highlights the heterogeneous nature of activity patterns. In general, high ROVs were least common for annual and most for daily data. Consider, for example, the warm-season permanent residents where a maximum of only ten species-activities attained high ROVs annually (Fig. 6.32□) compared to 16 seasonally (Fig. 6.34□) and 30 daily (Fig. 6.36□). This points to an imbalance, resulting from the uniqueness of each species when annual, seasonal and daily data are combined. Compare, for example, the Jacobin Cuckoo R382, Diderick Cuckoo R386, Rufous-cheeked Nightjar R406 and Black-throated Canary R870 — their annual patterns are exactly the same (Fig. 6.18■B), but their seasonal (Fig. 6.19■) and daily patterns (Fig. 6.20■) are different.

When annual, seasonal and daily data are considered separately, a number of trends emerge. Overall, the most general trend involved the relatively frequent occurrence of high activity levels during the earlier part of the day and, to a lesser extent, again in the late afternoon before sunset; high activity levels was least frequent in the early afternoon (Fig. 6.36; Fig. 6.37; Fig. 6.42; Fig. 6.43). In general terms, this pattern correlates with the daily variation in temperature which is lowest in the early morning and late afternoon and at its highest in the early afternoon (Fig. 2.26; Fig. 2.27; Fig. 2.28). However, it is likely that the bimodal daily activity patterns is controlled largely by endogenous rhythms (Aschoff 1966), although environmental cues may modify parts of the pattern (Cuthill & MacDonald 1990; Kacelnik & Krebs 1982; Slagsvold 1996). At Glen, seasonal changes in the daily pattern varied from subtle (*e.g.* Orange River Francolin R193, Fig. 4.93❑) to pronounced (*e.g.* Rufous-naped Lark R494 perch song, Fig. 5.15❑), with activity typically extended to later in the morning and even into the afternoon during peak seasons. These activity extensions are probably significantly influenced by endogenous circannual rhythms, which could be fine-tuned by environmental factors including the availability of food resources.

In seasonal visitors, peak activity most frequently occurred around mid-morning in contrast to residents where it occurred earlier (Fig. 6.36; Fig. 6.37; Fig. 6.42; Fig. 6.43). Two factors probably contributed to this effect. Whereas resident species could, theoretically, be recorded from dawn because they sleep in the study area, seasonal visitors sleep outside the study area and consequently they are detected only later when they move from their roosting sites. Furthermore, a large proportion of seasonal visitors are aerial insectivores (Fig. 6.10□□) such as swallows. These birds are known to feed later in the morning, presumably because there are fewer flying insects active earlier in the day (Pomeroy 1992).

In the case of birds in transit (*e.g.* Hadeda Ibis R094) and birds in other status categories (*e.g.* Black-shouldered Kite R127), activity in the early morning and late afternoon probably represent movements between roosting and foraging areas.

In another group of birds activity was mostly noted during the late morning and/or early afternoon. The presence of thermals during that part of the day probably explains this phenomenon in many cases, particularly in raptors (Secretarybird R118; Cape Vulture R122; African Fish-Eagle R148; Steppe Buzzard R149; Jackal Buzzard R152; Rufous-chested Sparrowhawk R155) and other large birds (White Stork R083; Yellow-billed Stork R090; Blue Crane R208).

A few of the permanent residents were very active throughout the day (*e.g.* Cape Turtle-Dove R354 and Northern Black Korhaan R239).

Except for some species where activity appear to be largely an aseasonal phenomenon (*e.g.* Orange River Francolin R193), seasonal patterns were sufficiently distinct to differentiate between warm- and cool-season species in most cases (see page 87). For both groups, cluster analyses based on ROVs of the various status categories tended to group most or all of the main rain period seasons (*i.e.* late spring to mid-autumn) separate from the rest (Fig. 6.40; Fig. 6.41). This coincided with the relatively frequent occurrence of higher activity levels during the main rain period for warm-season species (Fig. 6.40), and during seasons outside that period for cool-season species (Fig. 6.41). Endogenous circannual rhythms probably underlie these patterns in many cases, with the timing of breeding presumably reflecting a temporal window during which food for the young and adults are most likely to be sufficiently available (Dawson & Sharp 2007; Sharp 1996). This would explain why so many of the species breed during the warmer times of the year (see Table 6.2), corresponding with the main rain period. In addition, most of the migrant species, both breeding and non-breeding, also visit during that time (Fig. 6.44).

There are exceptions. Local migrants visiting the study do so only during the cooler times of the year (Fig. 6.44). In some of these cases there are circumstantial evidence indicating the involvement of altitudinal migrants from Lesotho (*e.g.* African Stonechat R596). Doves and pigeons (Columbidae) are another exception as breeding often occurs during the cooler times of the year. The fact that they feed their young on crop milk may make it easier for them to do so (Dawson 2008; Hahn *et al.* 2009; Rowan 1983). The influence of photoperiod in southern African species is obscure.

Whereas daily and seasonal trends in activity patterns can be generalised across status categories, particularly for residents and seasonal visitors, annual occurrence patterns are distinct for each status category (Fig. 6.32; Fig. 6.33; Fig. 6.38; Fig. 6.39) and was partially influenced by rainfall. In years when good rains occurred during the latter part of the main rain period, particularly early and mid-autumn, activity levels of a number of permanent residents were higher. This is in contrast to temporary residents and especially seasonal visitors where higher activity levels were most prevalent during 2001/2 when good rains occurred during the first part of the main rain period (late spring to late summer). Conversely, ROVs of a number of permanent resident species-activities were relatively low during 2001/2 (Fig. 6.38□) with seasonal visitors showing a similar trend for years with good rains late in the year (2002/3 and 2005/6; Fig. 6.38⊟), except 1997/8 which was the end of a three year wet period. This suggests that the timing of rainfall influence the activity patterns of many permanent residents and seasonal visitors differently. A possible mechanism involve the permanent residents that can take advantage of rains late in the year by simply extending their normal activity period, an option that is not available for the other two more mobile groups as the late rains is towards the end of their stay when they are preparing to head northwards. However, it is not yet clear why permanent residents in general do not show peaks during years when good rains occur early. This aspect warrants further investigation.

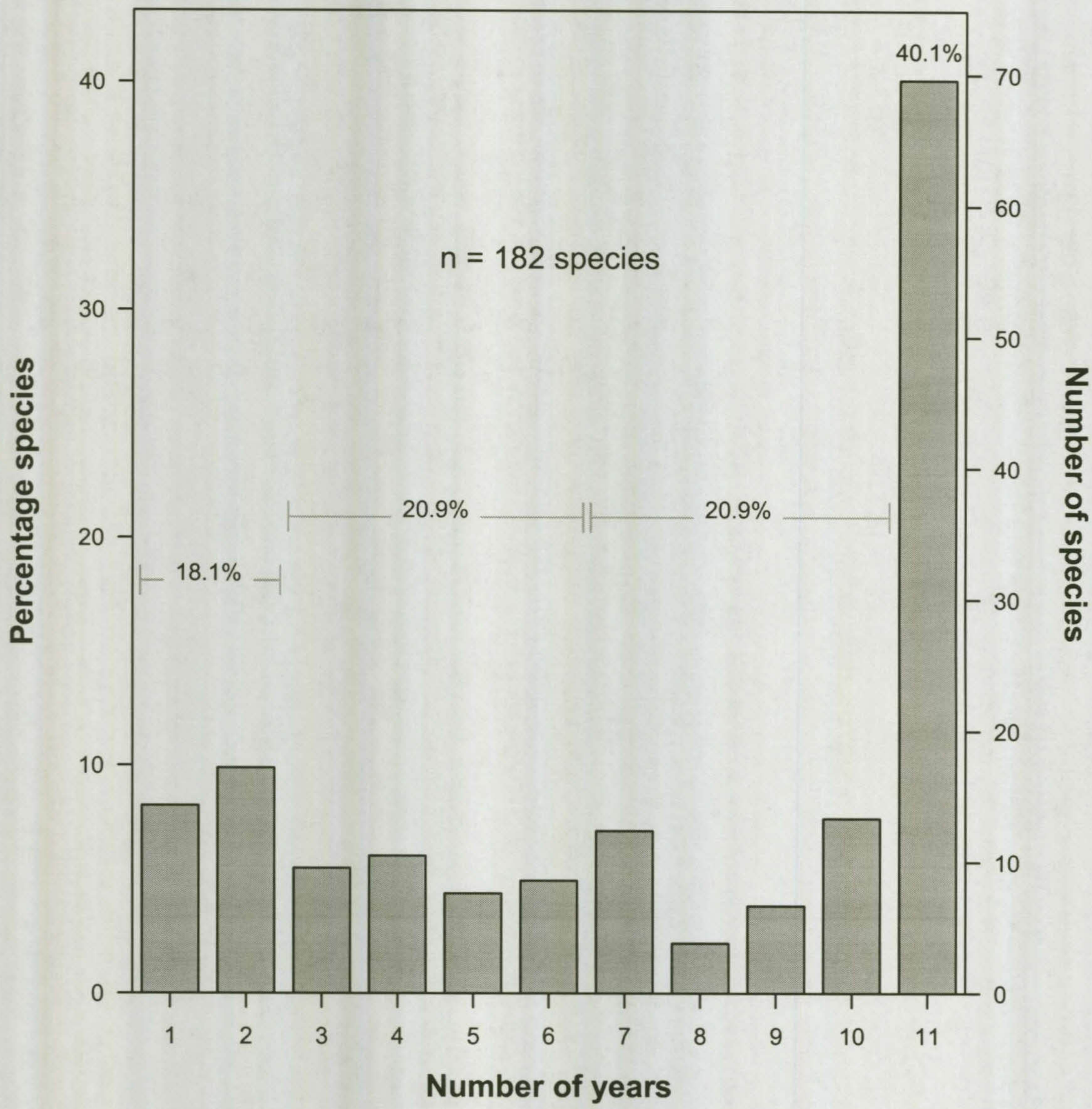


Figure 6.1: Total number of bird species recorded in the grassland at Glen during 1–11 years over the period from 1997/8 to 2007/8.

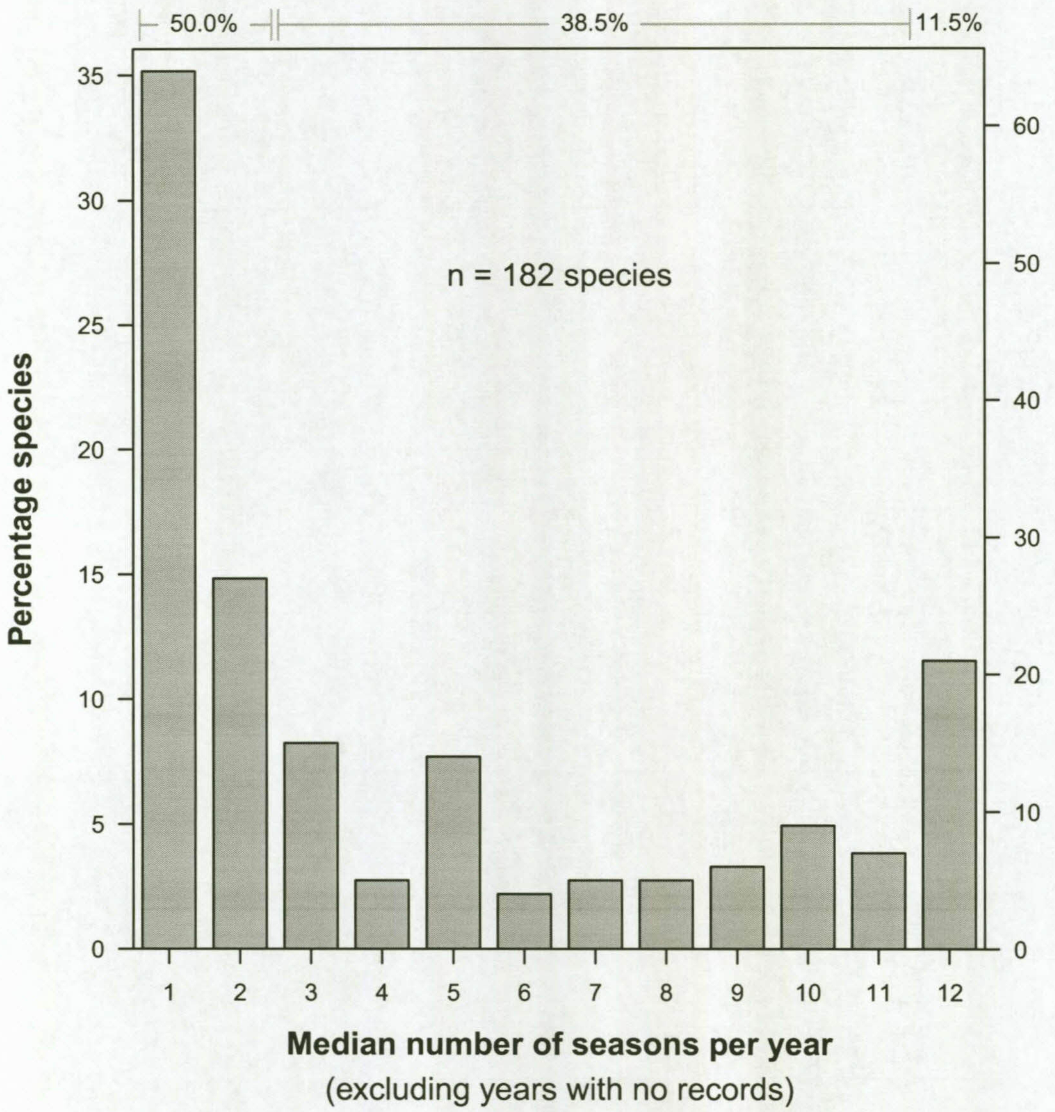


Figure 6.2: Total number of bird species recorded during a median of 1–12 seasons per year in the grassland at Glen during the period 1997/8 to 2007/8.

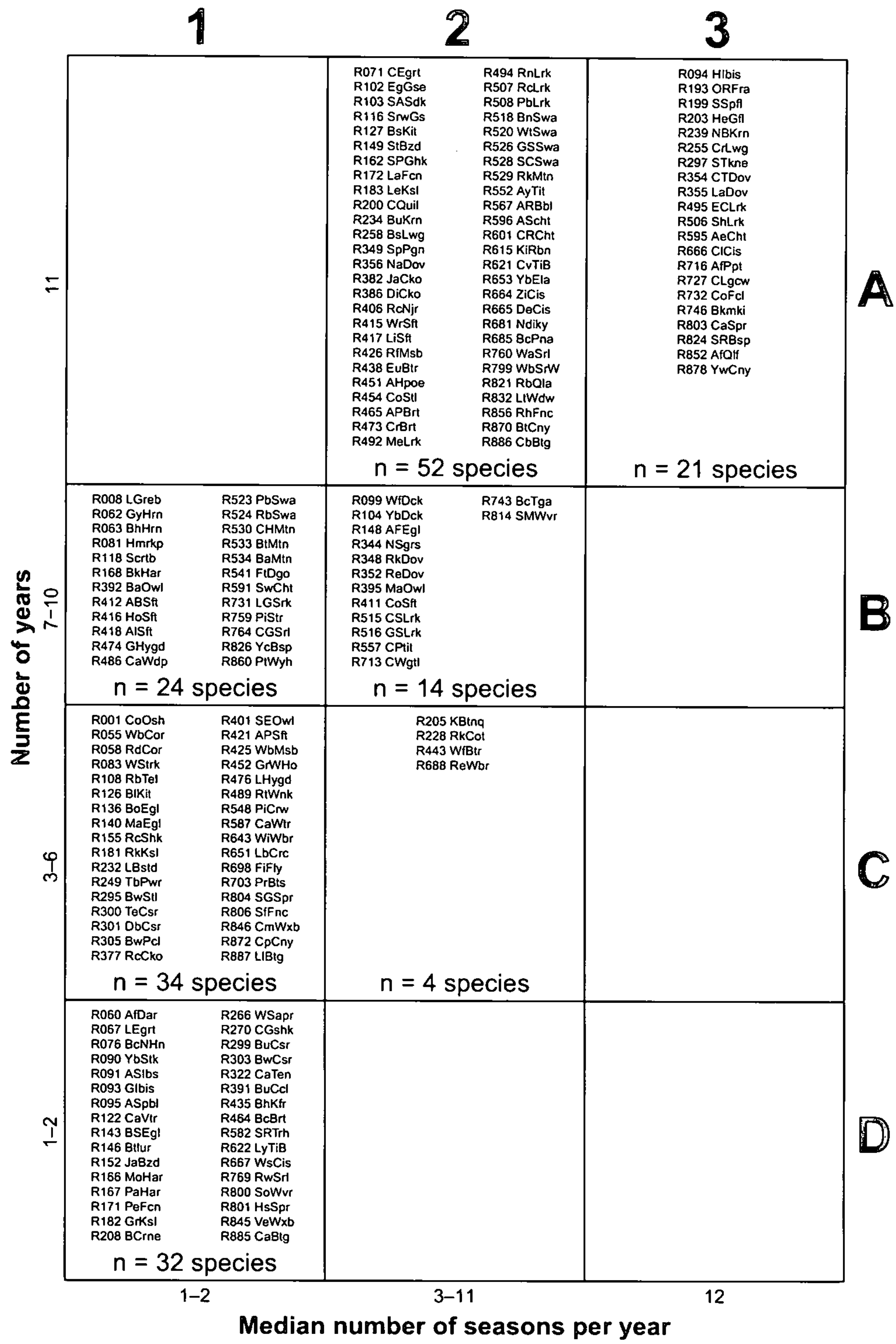


Figure 6.3: A classification of bird species based on the number of years and the median number of seasons per year that each were recorded in the grassland at Glen from 1997/8 to 2007/8 (see also Figures 6.1 & 6.2). Each block in the diagram represents a grassland frequency class (GFC) that is coded according to the letters A, B, C and D (right) and numbers 1, 2 and 3 (top). For example, species in the block top right have the code A3. Within each block, species are arranged by Roberts' number. The Helmeted Guineafowl R203, Rufous-cheeked Nightjar R406 and Spike-heeled Lark R506 were 'promoted' from the "7–10" year category to the "11" year category because they were recorded during all the years for which data were considered (see pages 289, 458 and 620).

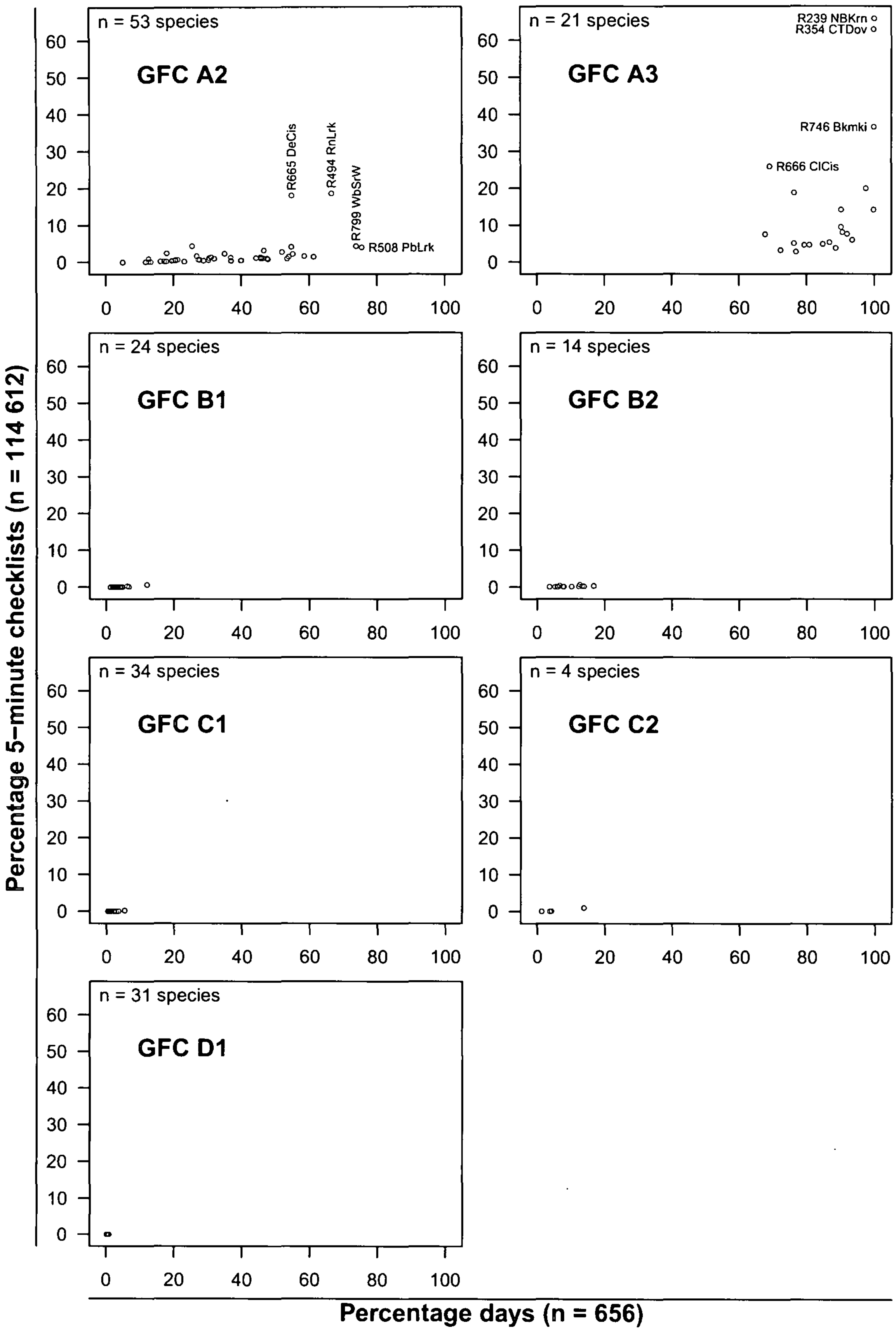


Figure 6.4: Overall 5-minute checklist reporting rate versus day reporting rate for bird species in each grassland frequency class (GFC) at Glen (see Figure 6.3) plotted on the same scale (*cf.* Fig. 6.5). Only the activity with the highest 5-minute checklist reporting rate is used for species where more than one activity were assessed.

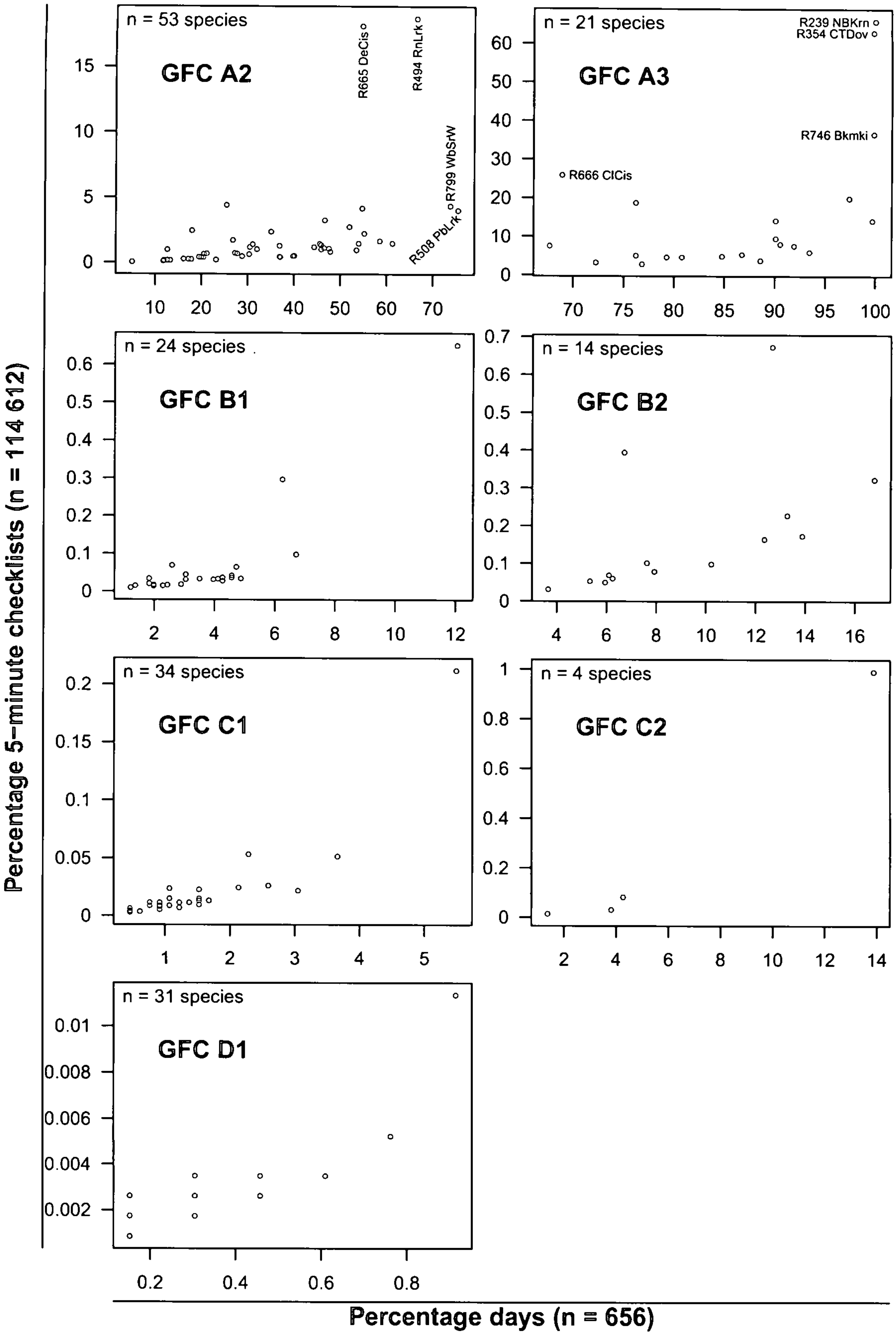


Figure 6.5: Overall 5-minute checklist reporting rate versus day reporting rate for birds in each grassland frequency class (GFC) at Glen (see Figure 6.3) plotted according to its own scale (*cf.* Fig. 6.4). Only the activity with the highest 5-minute checklist reporting rate is used for species where more than one activity were assessed.

The birds at Glen

Residents

Permanent
n = 45 spp.

- **A3 R193 ORFra**
- A3 R199 SSpfl*
- A3 R203 HeGfl*
- **A3 R239 NBKrn**
- **A3 R255 CrLwg**
- A3 R297 STkne*
- A3 R354 CTDov*
- A3 R355 LaDov*
- C1 R425 WbMsb*
- A2 R426 RfMsb*
- A2 R451 AHpoe*
- A2 R454 CoStl*
- A2 R465 APBrt*
- A2 R473 CrBrt*
- B1 R486 CaWdp*
- **A2 R494 RnLrk**
- **A3 R495 ECLrk**
- Z0 R498 SaLrk*
- **A3 R506 ShLrk**
- **A2 R508 PbLrk**
- A2 R552 AyTit*
- A2 R567 ARBbl*
- Z0 R577 KrTrh*
- **A3 R595 AeCht**
- A2 R601 CRCht*
- Z0 R614 KoRbn*
- A2 R615 KiRbn*
- A2 R621 CvTiB*
- C1 R651 LbCrc*
- **A2 R665 DeCis**
- **A3 R666 ClCis**
- A2 R681 Ndiky*
- A2 R685 BcPna*
- C1 R698 FiFly*
- Z0 R706 FyFly*
- **A3 R716 AfPpt**
- **A3 R727 CLgcw**
- A3 R732 CoFcl*
- A3 R746 Bkmki*
- Z0 R796a ORWye*
- B2 R814 SMWvr*
- **A3 R852 AfQlf**
- A3 R878 YwCny*
- D1 R885 CaBtg
- A2 R886 CbBtg

Temporary
n = 33 spp.

- B1 R008 LGreb*
- B2 R099 WfDck*
- A2 R102 EgGse*
- A2 R103 SASdk*
- B2 R104 YbDck*
- C1 R108 RbTel*
- A2 R116 SrwGs*
- **A2 R127 BsKit**
- **A2 R200 CQuil**
- **C2 R205 KBtnq**
- C2 R228 RkCot*
- A2 R258 BsLwg*
- D1 R303 BwCsr*
- B2 R352 ReDov*
- A2 R356 NaDov*
- A2 R382 JaCko*
- A2 R386 DiCko*
- **B2 R395 MaOwl**
- A2 R406 RcNjr*
- C1 R452 GrWHo*
- **A2 R492 MeLrk**
- B1 R523 PbSwa*
- **C1 R587 CaWtr**
- **A2 R596 AScht**
- C1 R643 WiWbr*
- **A2 R664 ZiCis**
- B2 R713 CWgtl*
- Z0 R733 RbSrk*
- B2 R743 BcTga*
- **A2 R832 LtWdw**
- **A2 R856 RhFnc**
- A2 R870 BtCny*
- **C1 R887 LlBtg**

Visitors

Regular
n = 5 spp.

- **A2 R071 CEgrt**
- **A2 R760 WaSrl**
- **A3 R803 CaSpr**
- **A2 R821 RbQla**
- **A3 R824 SRBsp**

Seasonal
n = 43 spp.

- B1 R081 Hmrkp*
- C1 R126 BlKit
- **B1 R168 BkHar**
- **A2 R183 LeKsl**
- **D1 R299 BuCsr**
- **C1 R300 TeCsr**
- **C1 R301 DbCsr**
- **C1 R305 BwPcl**
- C1 R377 RcCko*
- Z0 R385 KlCko*
- C1 R401 SEOwl*
- **B2 R411 CoSft**
- **B1 R412 ABSft**
- **A2 R415 WrSft**
- **B1 R416 HoSft**
- **A2 R417 LiSft**
- **A2 R438 EuBtr**
- **C2 R443 WfBtr**
- Z0 R445 StBtr*
- C1 R476 LHygd*
- **A2 R518 BnSwa**
- **A2 R520 WtSwa**
- **B1 R524 RbSwa**
- **A2 R526 GSSwa**
- **A2 R528 SCSwa**
- **A2 R529 RkMtn**
- **B1 R530 CHMtn**
- **B1 R533 BtMtn**
- **B1 R534 BaMtn**
- **B1 R541 FtDgo**
- **D1 R582 SRTrh**
- **B1 R591 SwCht**
- D1 R622 LyTiB
- Z0 R625 IcWbr*
- **D1 R667 WsCis**
- **C2 R688 ReWbr**
- Z0 R689 SpFer*
- C1 R703 PrBts*
- **B1 R731 LGSrk**
- B1 R764 CGSrl*
- C1 R804 SGSpr*
- **B1 R860 PtWyh**
- **C1 R872 CpCny**

Aseasonal
n = 16 spp.

- D1 R095 ASpbl*
- **B1 R118 Scrtb**
- D1 R391 BuCcl*
- B1 R392 BaOwl*
- D1 R435 BhKfr*
- D1 R464 BcBrt*
- B1 R474 GHygd*
- C1 R489 RtWnk*
- **B2 R557 CPtit**
- **A2 R653 YbEla**
- Z0 R787 WbSnb*
- Z0 R796b CaWye*
- Z0 R844 BuWxb*
- D1 R845 VeWxb*
- Z0 R847 BfWxb*
- Z0 R884 GbBtg*

Birds in transit
n = 52 spp.

- C1 R055 WbCor
- C1 R058 RdCor
- D1 R060 AfDar
- B1 R062 GyHrn
- B1 R063 BhHrn
- Z0 R066 GEgrt
- D1 R067 LEgrt
- D1 R076 BcNHn
- C1 R083 WStrk
- D1 R090 YbStk
- D1 R091 ASlbs
- D1 R093 Glbis
- A3 R094 Hlbis
- D1 R122 CaVtr
- C1 R136 BoEgl
- C1 R140 MaEgl
- D1 R143 BSEgl
- D1 R146 Btlur
- B2 R148 AFEgl
- A2 R149 StBzd
- D1 R152 JaBzd
- C1 R155 RcShk
- D1 R166 MoHar
- D1 R167 PaHar
- D1 R171 PeFcn
- A2 R172 LaFcn
- C1 R181 RkKsl
- D1 R182 GrKsl
- D1 R208 BCrne
- C1 R232 LBstd
- C1 R249 TbPwr
- D1 R266 WSapr
- D1 R270 CGshk
- C1 R295 BwStl
- D1 R322 CaTen
- Z0 R338 WsTen
- Z0 R339 WwTen
- B2 R344 NSgrs
- B2 R348 RkDov
- A2 R349 SpPgn
- B1 R418 AlSft
- C1 R421 APSft
- A2 R507 RcLrk
- B2 R515 CSLrk
- B2 R516 GSLrk
- C1 R548 PiCrw
- B1 R759 PiStr
- D1 R800 SoWvr
- D1 R801 HsSpr
- C1 R806 SfFnc
- B1 R826 YcBsp
- C1 R846 CmWxb

Birds heard outside
n = 4 spp.

- C1 R001 CoOsh
- A2 R162 SPGhk
- A2 R234 BuKrn
- A2 R799 WbSrW

Figure 6.6: Classification of birds based on their temporal occurrence at Glen. The code prefix (A3, B1, *etc.*) to the Roberts' number and 'name hints' refers to the specific grassland frequency class (GFC) as per Figure 6.3; the code "Z0" refers to species that were never recorded in the grassland. Species in **bold** are primarily associated with the grassland and species with asterisk (*) with the drainage line. Passerine species include all those with Roberts' numbers greater than 489. Based on Appendix B. See also Figure 6.8.

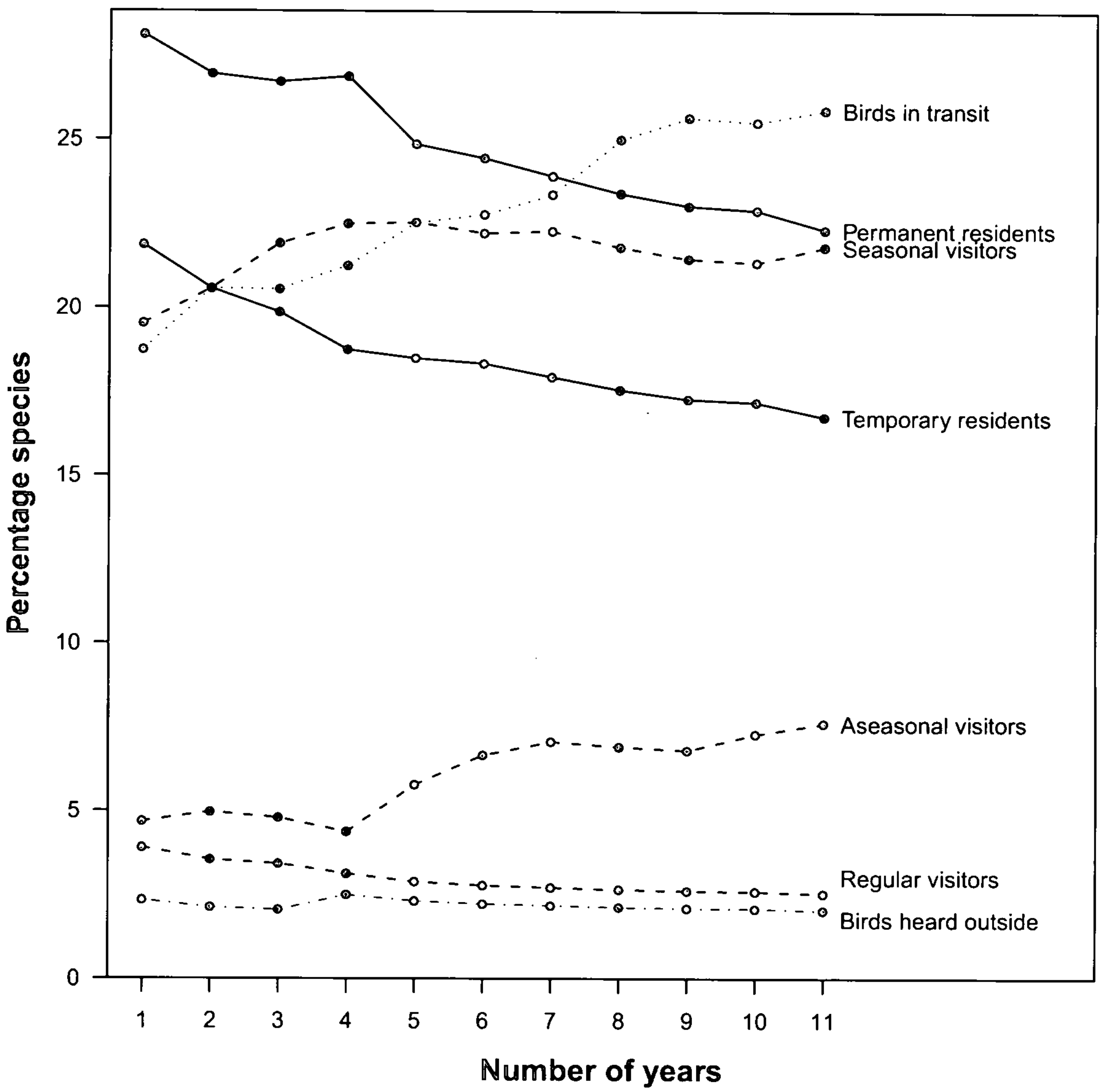


Figure 6.7: Change in the proportion of bird species in each Glen status category during the course of the 11-year study period (1997/8 to 2007/8).

Grassland frequency class	Glen status: Resident – Permanent G	Resident – Permanent D	Resident – Permanent O	Resident – Temporary G	Resident – Temporary D	Visitor – Regular G	Visitor – Seasonal G	Visitor – Seasonal D	Visitor – Seasonal O	Visitor – Aseasonal G	Visitor – Aseasonal D	Birds in transit O	Birds heard outside O
A3	10	5	3	–	–	2	–	–	–	–	–	1	–
A2	3	12	1	7	8	3	9	–	–	1	–	4	3
B2	–	1	–	1	5	–	1	–	–	1	–	5	–
B1	–	1	–	–	1	–	11	2	–	1	2	5	–
C2	–	–	–	1	1	–	2	–	–	–	–	–	–
C1	–	3	–	2	3	–	4	5	1	–	1	14	1
D1	–	–	1	–	1	–	3	–	1	–	5	20	–

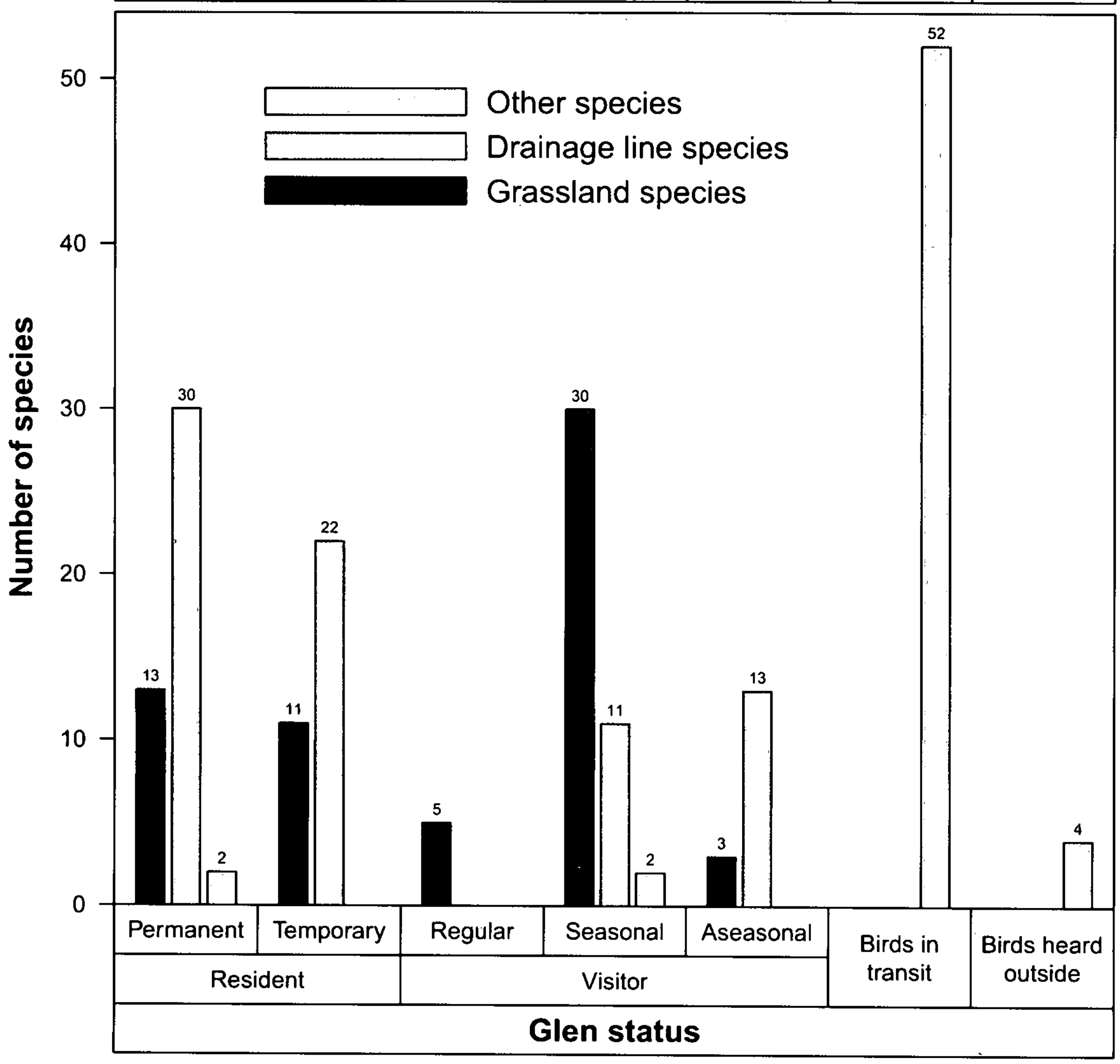


Figure 6.8: Number of bird species recorded within each Glen status category from 1997/8 to 2007/8. The data is shown separately for species associated with the grassland (G), the drainage line (D) and other habitats (O), the latter including mainly birds that flew over the study area, but also two mountain species as well as birds heard outside the study area. Totals for grassland frequency classes are given at the top. Based on Figure 6.6.

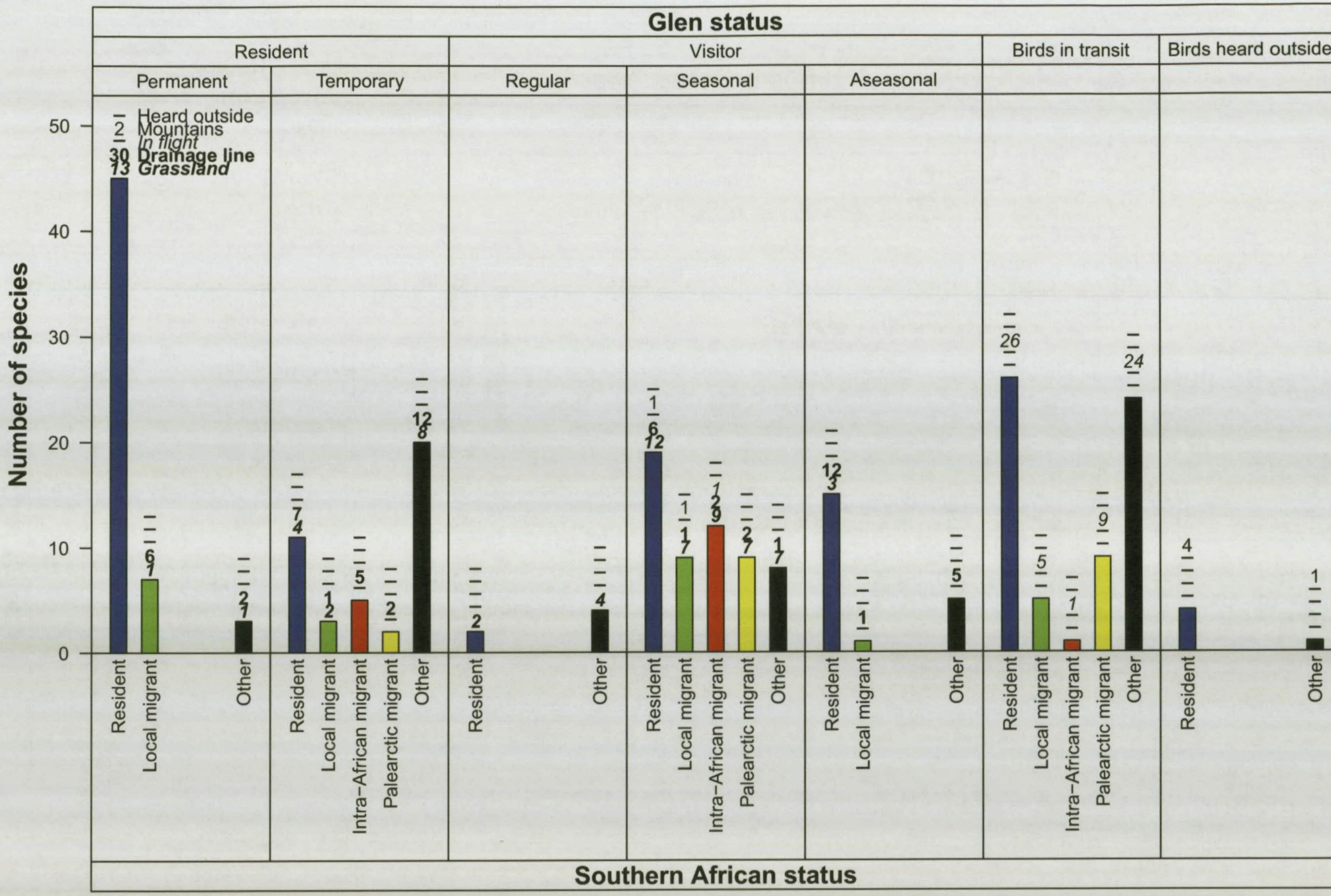


Figure 6.9: Number of bird species in the various Glen and southern African status categories (see Appendix A for definitions). The number of species in each Glen habitat category is indicated above each bar in the order shown top left; a dash represents zero. Note that some of the species fall into more than one southern African status category — see Appendix B for details.

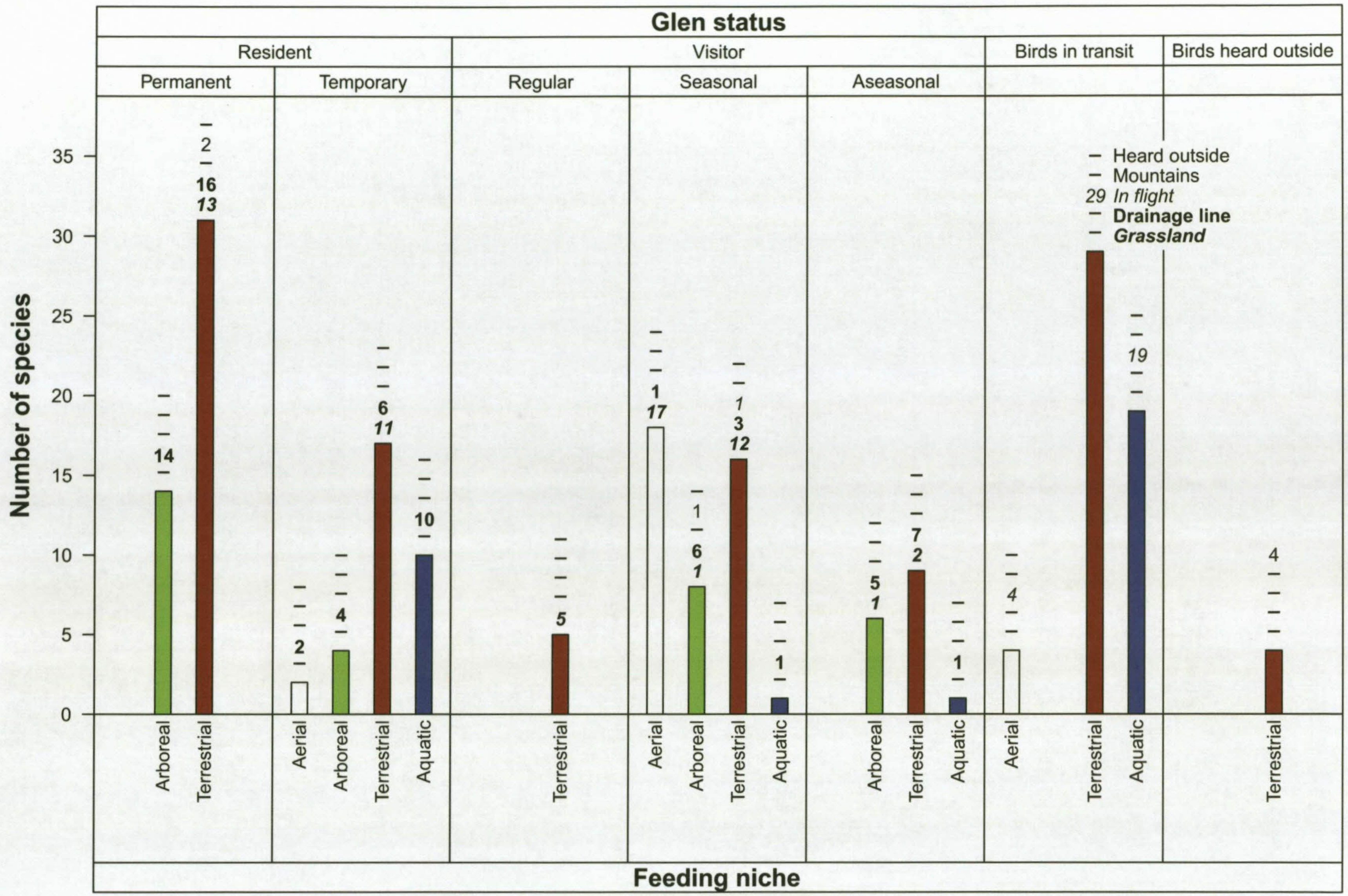


Figure 6.10: Feeding niche distribution of birds recorded at Glen from 1997/8 to 2007/8. The number of species in each Glen habitat category is indicated above each bar in the order shown for birds in transit and the terrestrial feeding niche; a dash represents zero. See Appendix B for the species involved.

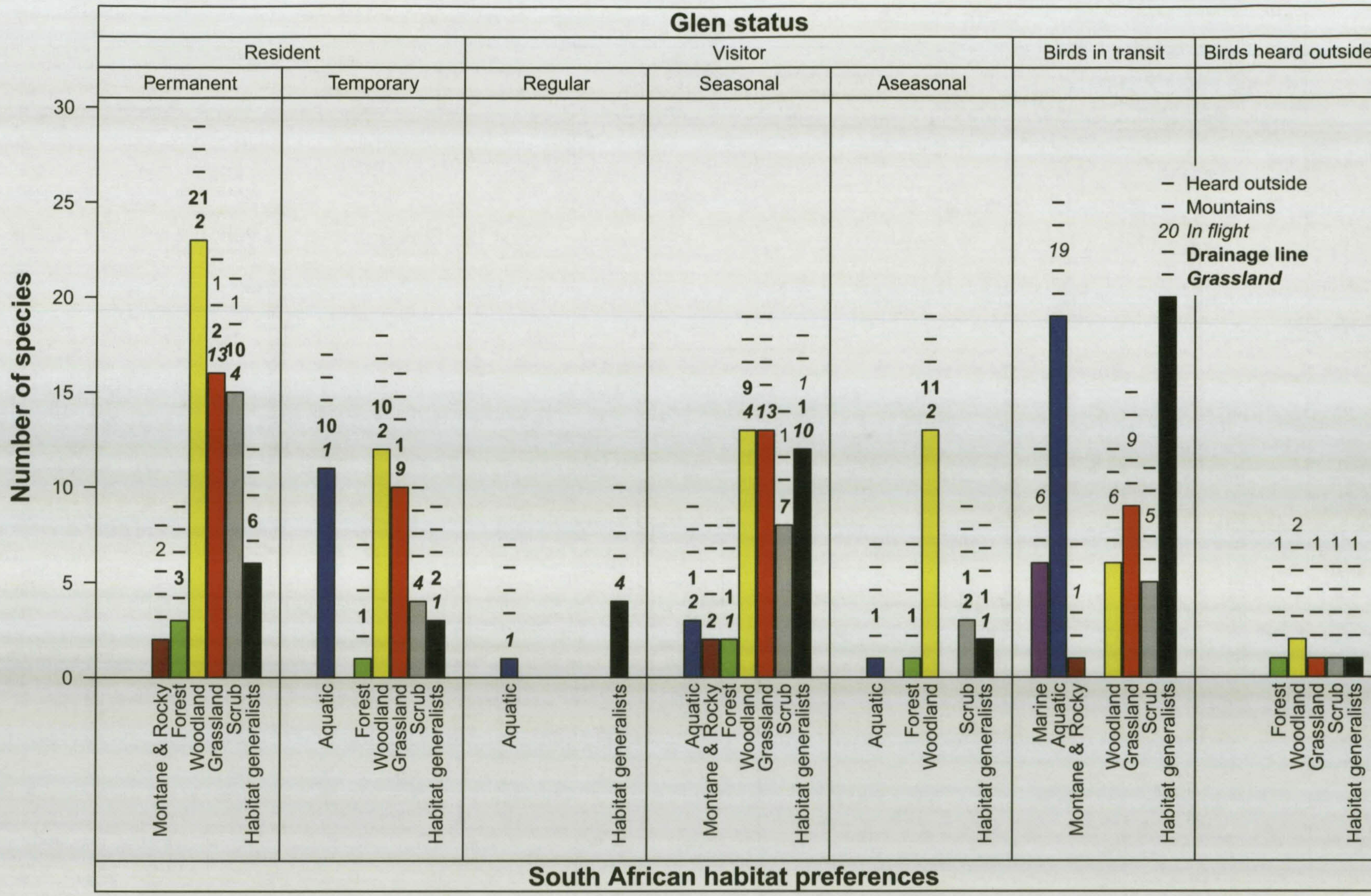


Figure 6.11: South African habitat preferences of the birds recorded at Glen according to the hierarchical system of Harrison *et al.* (1994) (see Appendix A), grouped by Glen status category (see Appendix B for the species involved). The number of species in each Glen habitat category is indicated above each bar in the order shown under birds in transit; a dash represents zero. Figures 6.12 and 6.13 show the data separately for indicator and associated species respectively.

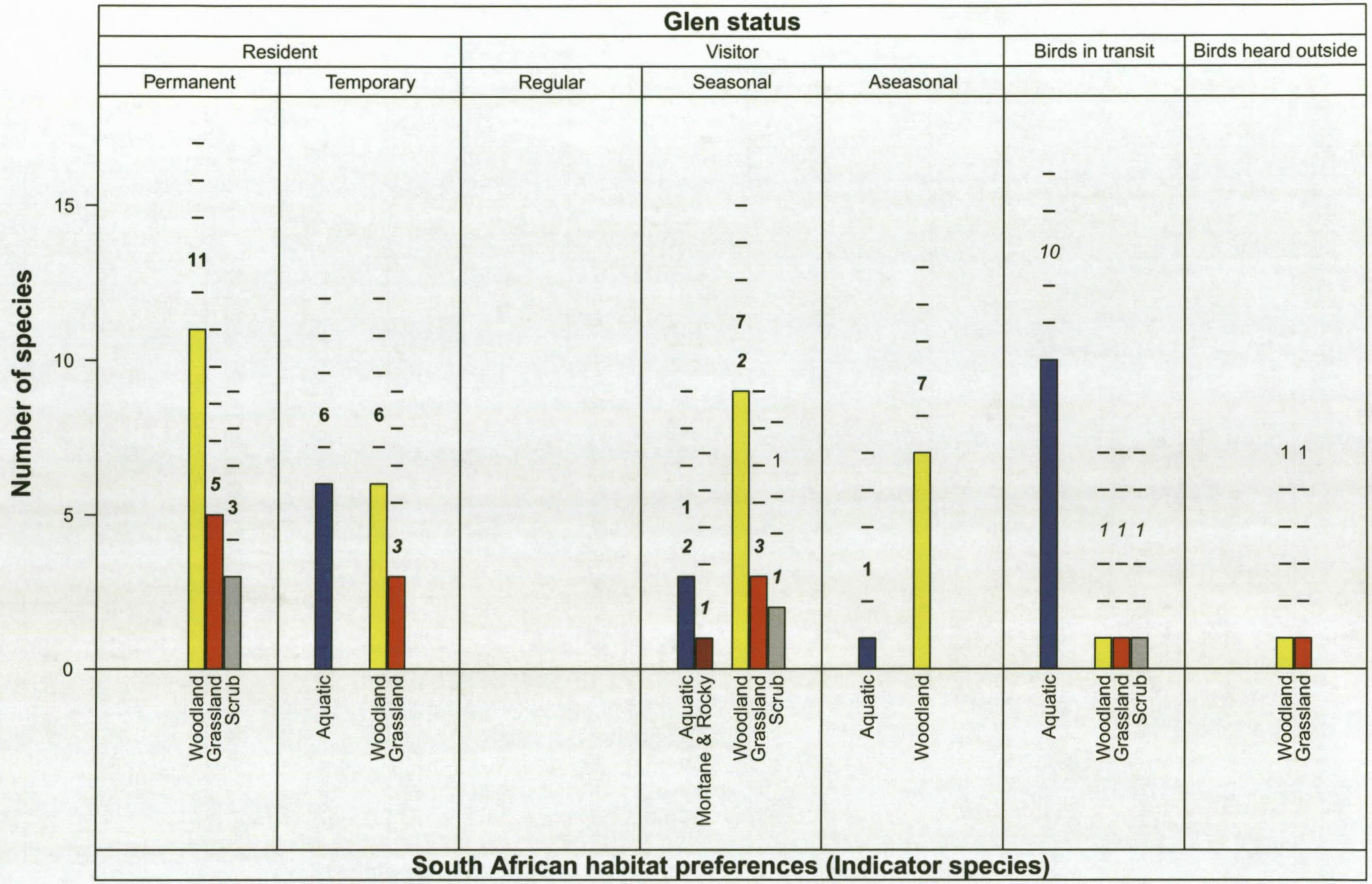


Figure 6.12: Number of *indicator* bird species of specific South African habitats according to the hierarchical system of Harrison *et al.* (1994) (see Appendix A), grouped by Glen status category (see Appendix B for the species involved). The number of species in each Glen habitat category is indicated above each bar in the order shown under birds in transit in Figure 6.11; a dash represents zero.

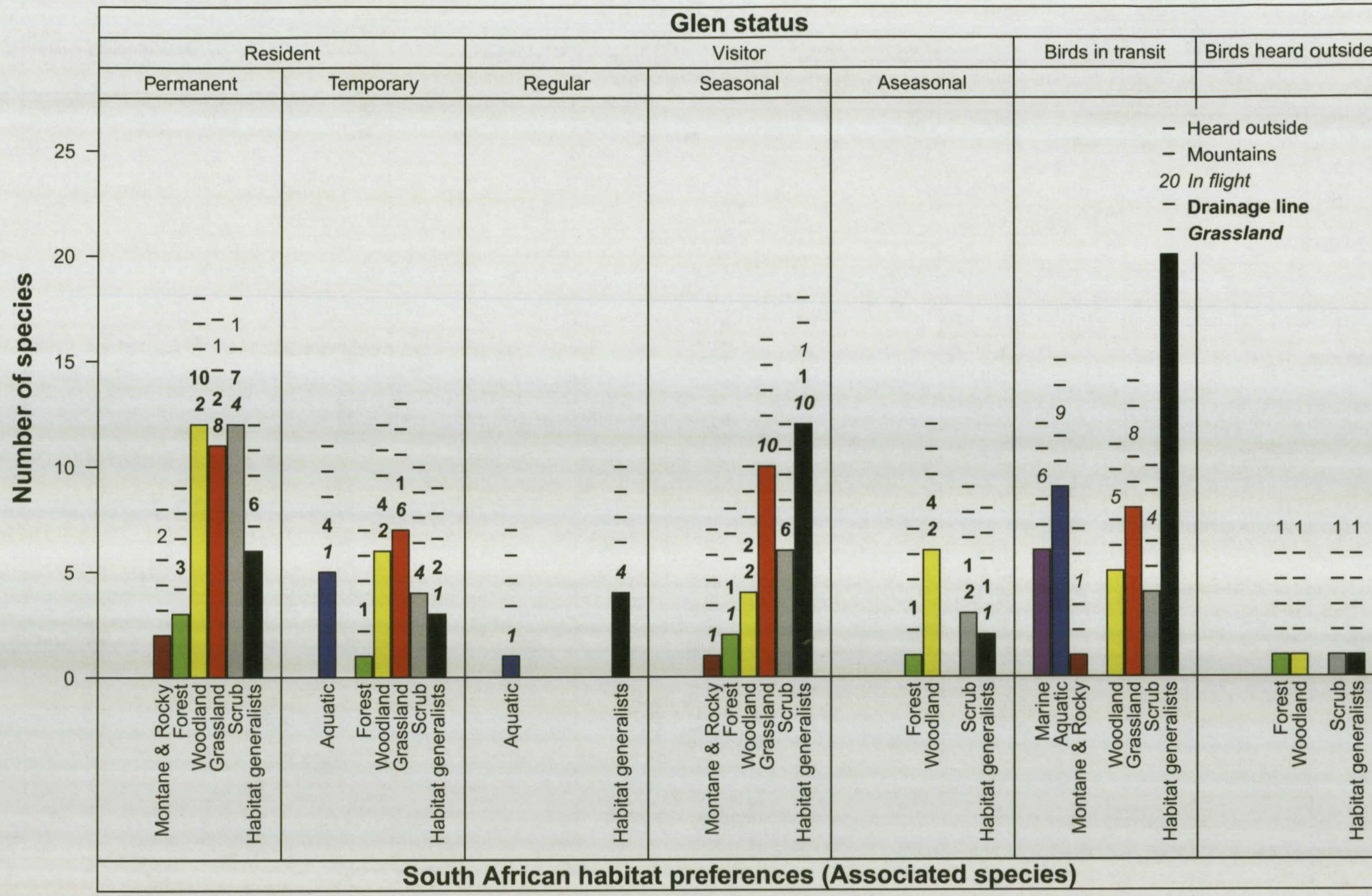


Figure 6.13: Number of bird species *associated* with specific South African habitats according to the hierarchical system of Harrison *et al.* (1994) (see Appendix A), grouped by Glen status category (see Appendix B for the species involved). The number of species in each Glen habitat category is indicated above each bar in the order shown under birds in transit; a dash represents zero.

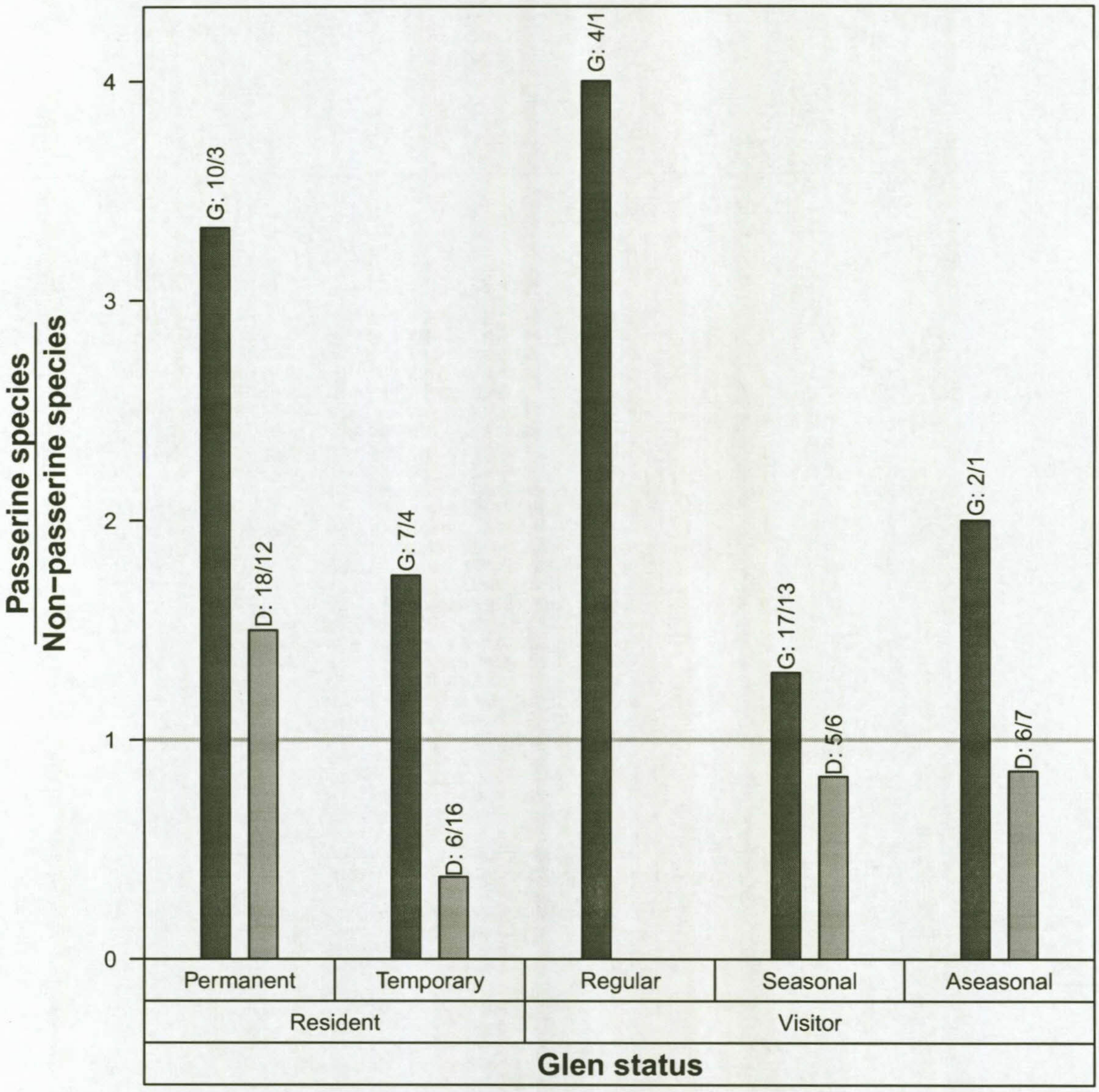
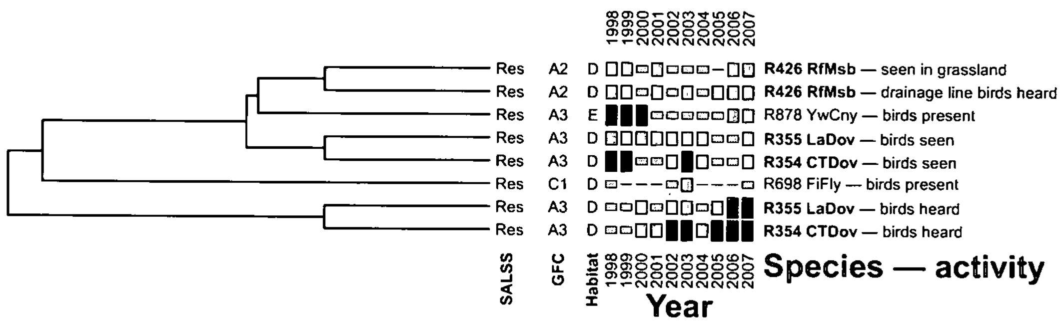


Figure 6.14: Proportion passerine species relative to non-passerine species in the grassland (G) and the drainage line (D). The actual numbers are indicated above each bar. Values greater than 1 indicate that there are more passerine than non-passerine species. Data from Figure 6.6.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

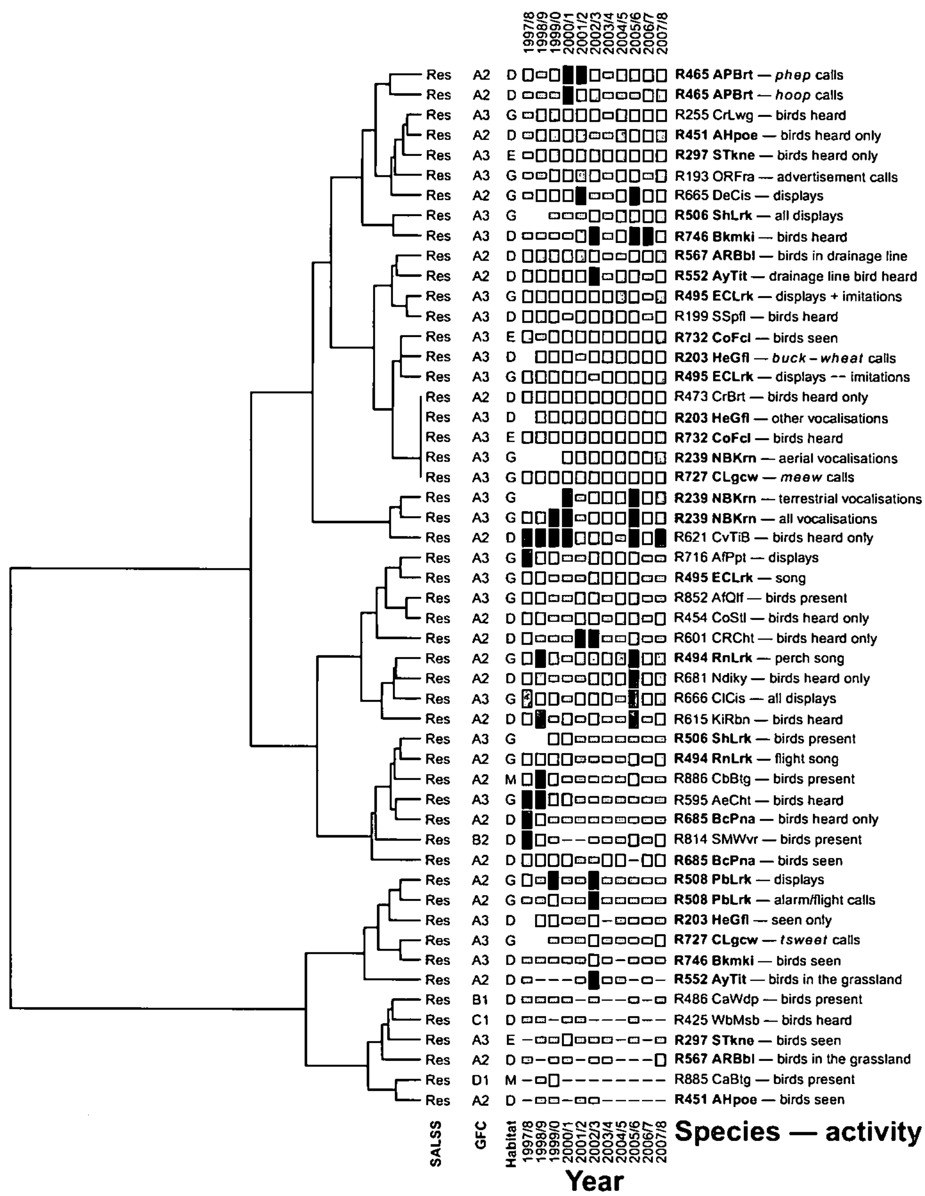


Figure 6.15: Annual occurrence of permanent resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.

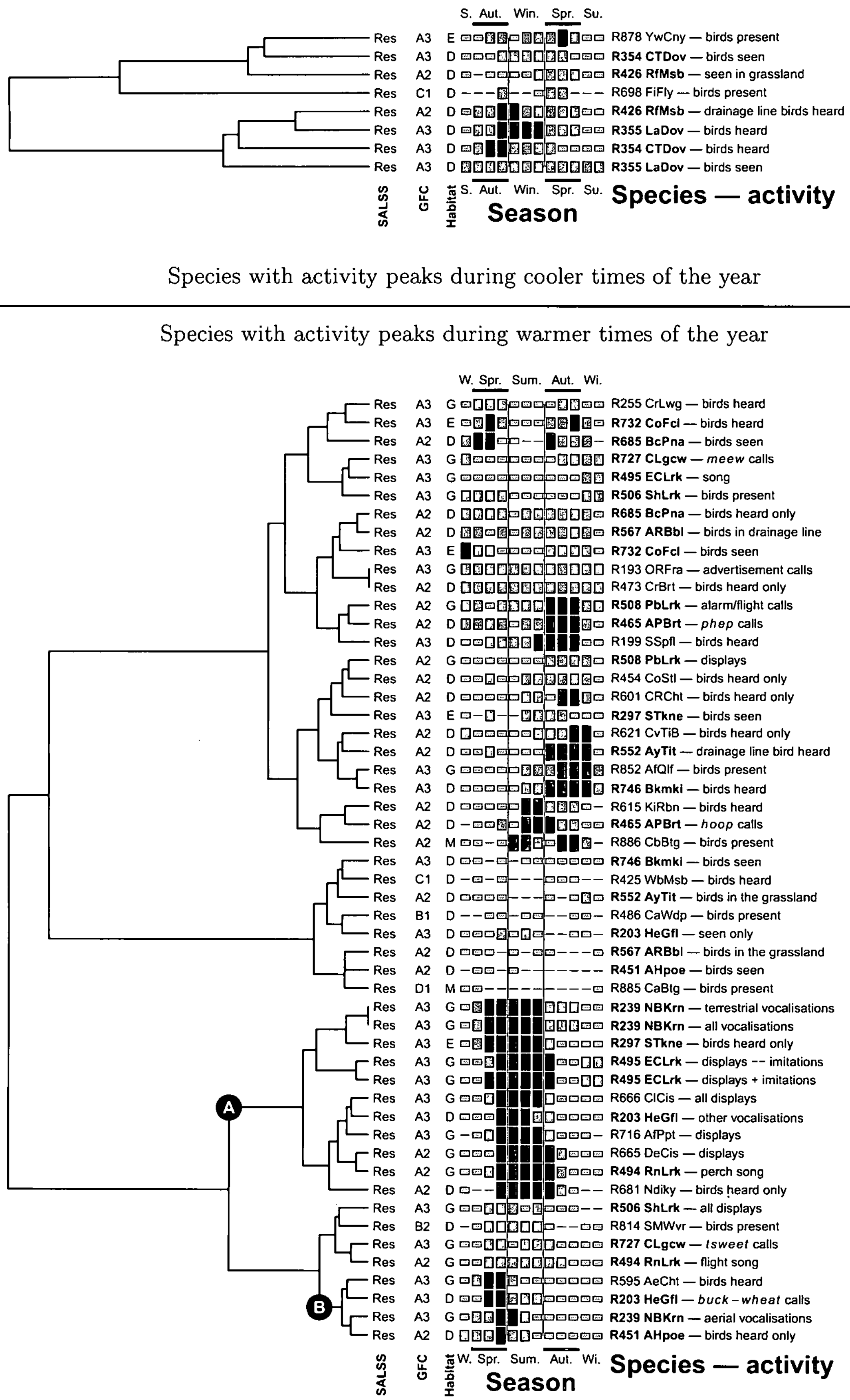
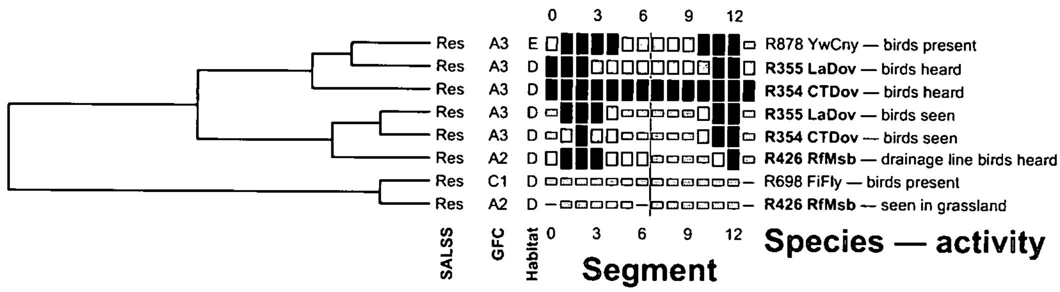


Figure 6.16: Seasonal occurrence of permanent resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

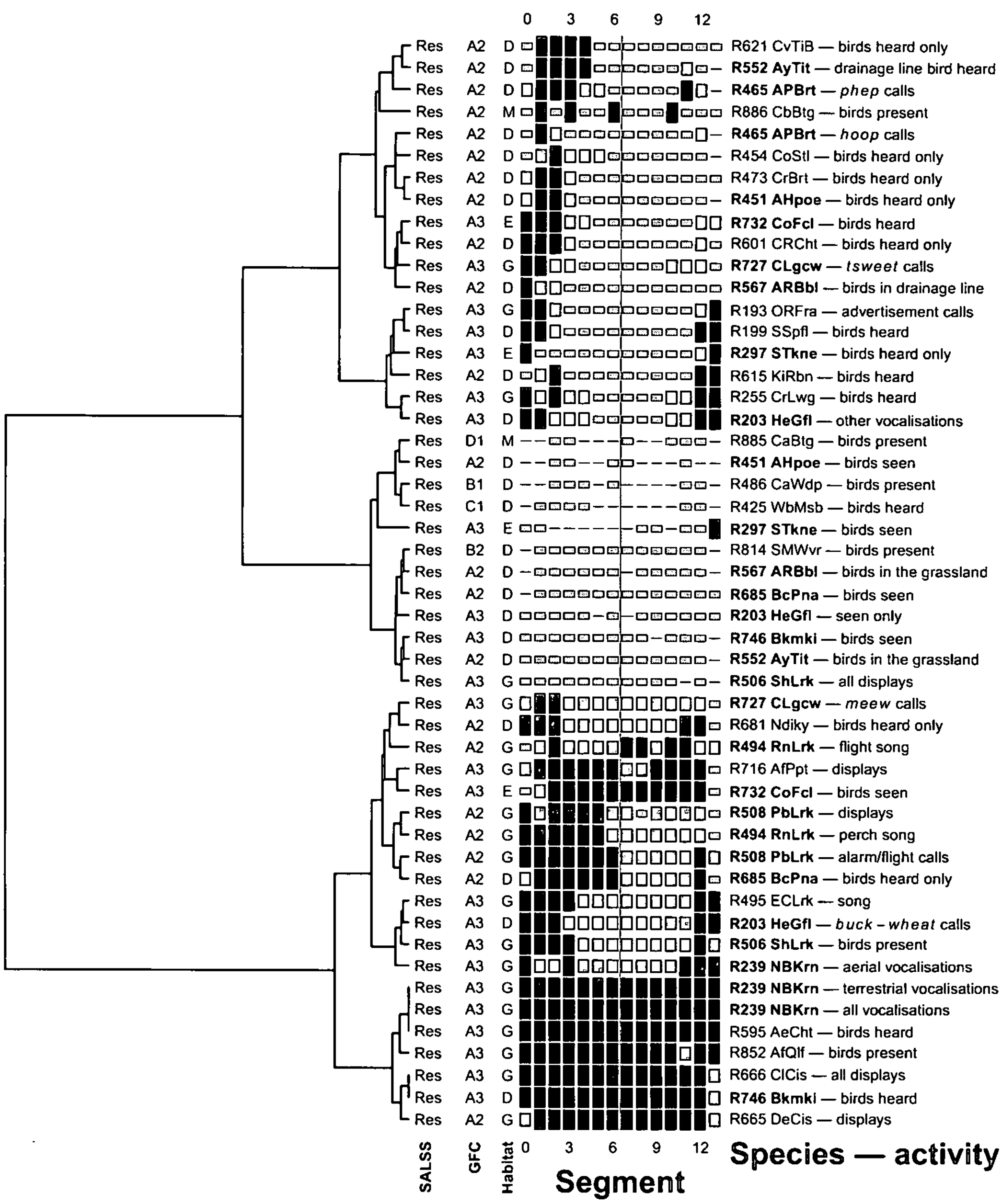
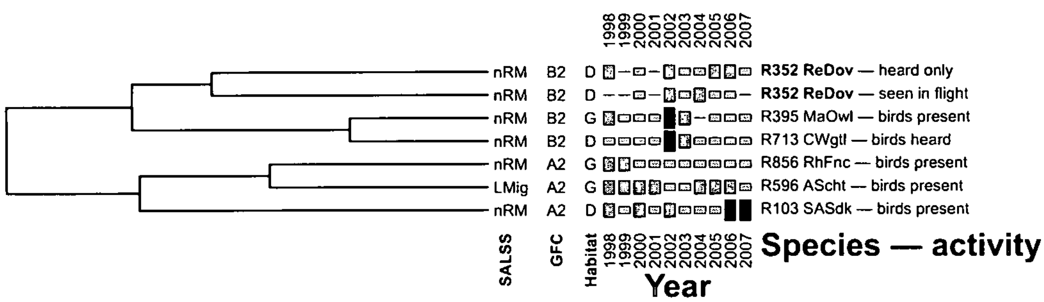


Figure 6.17: Daily occurrence of permanent resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

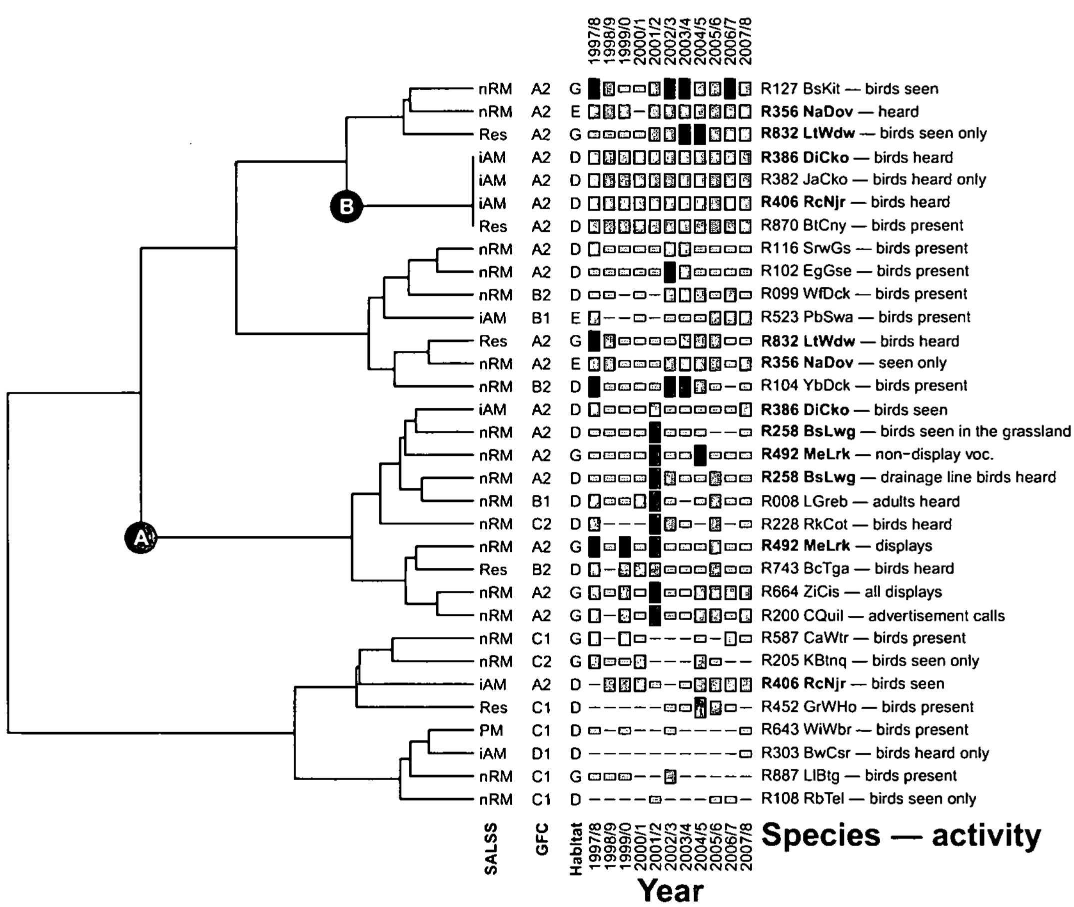
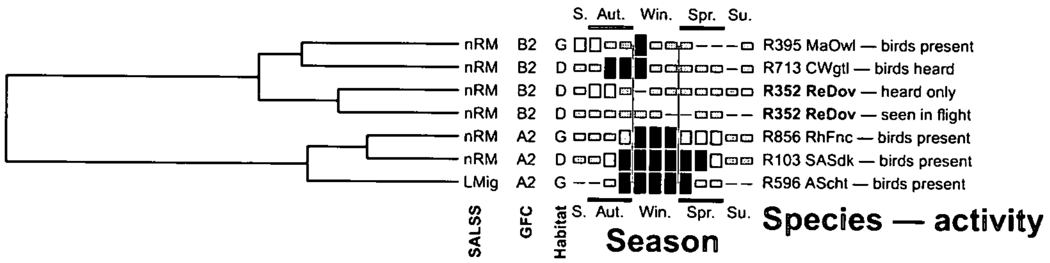


Figure 6.18: Annual occurrence of temporary resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

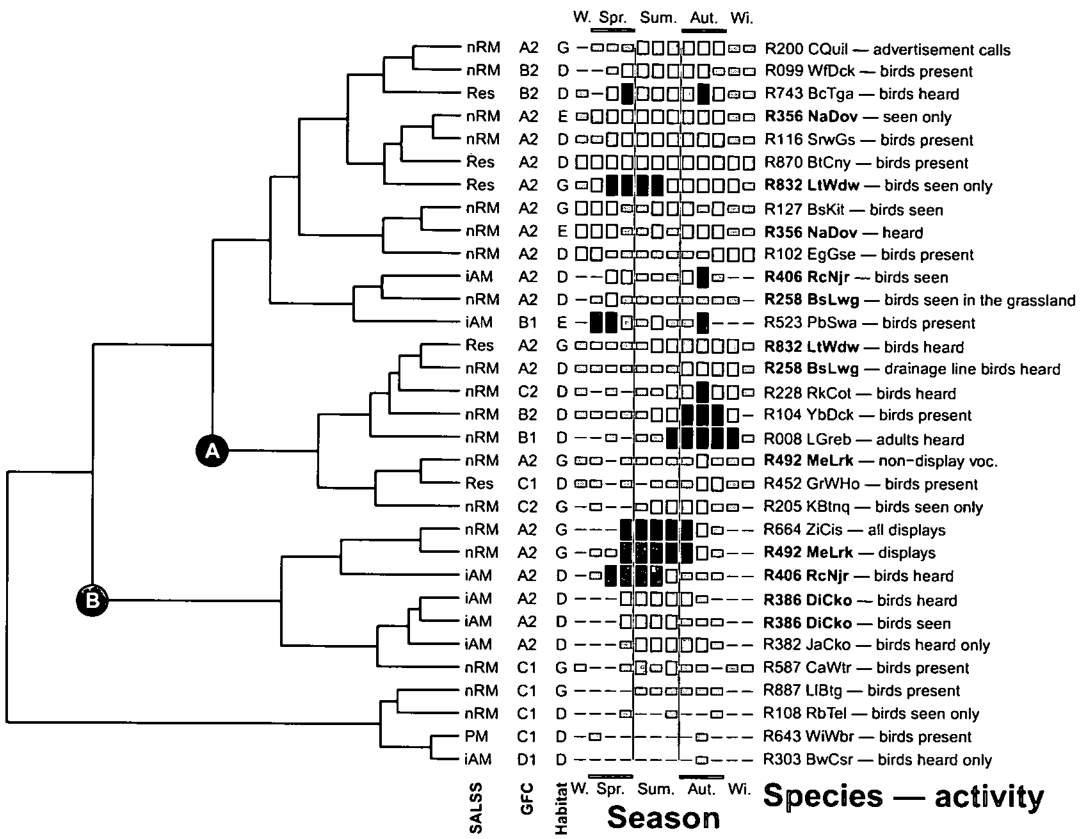
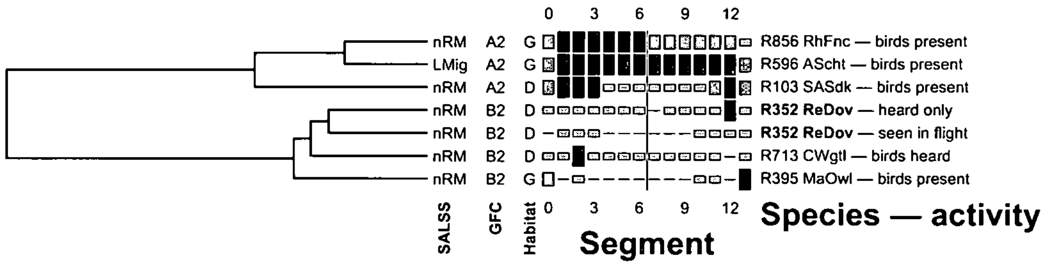


Figure 6.19: Seasonal occurrence of temporary resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

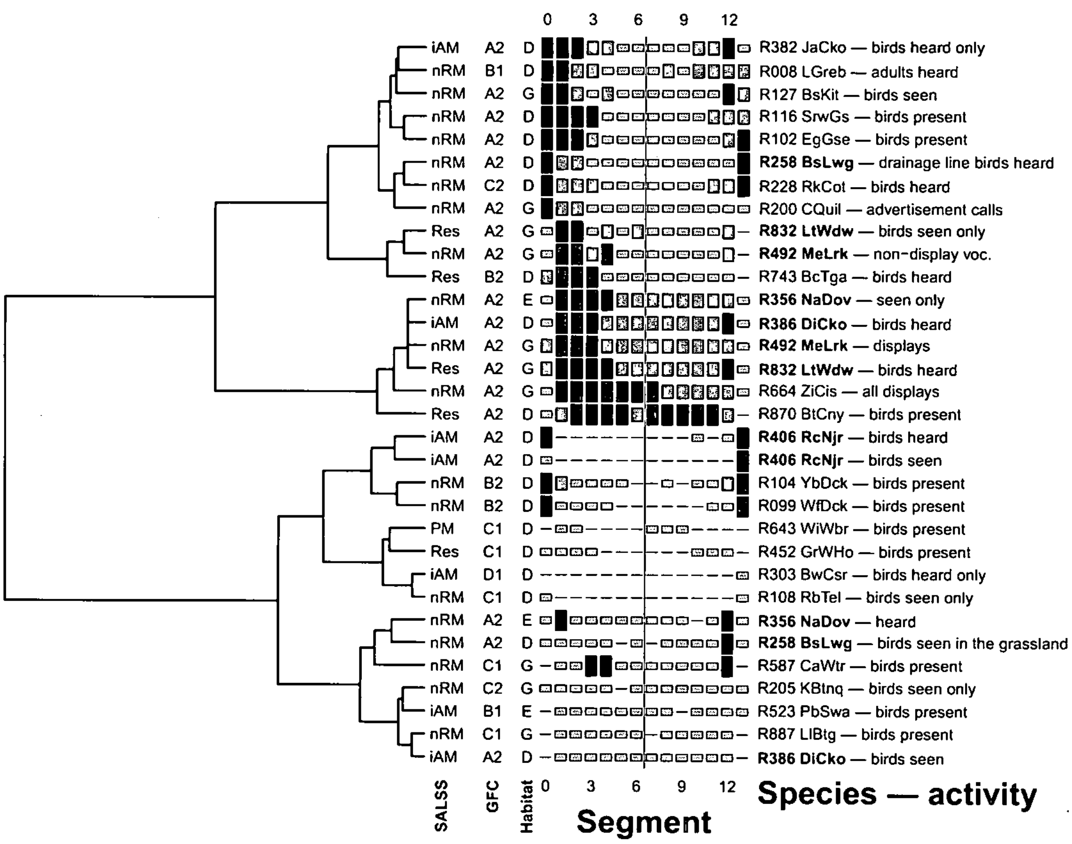


Figure 6.20: Daily occurrence of temporary resident bird species at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.

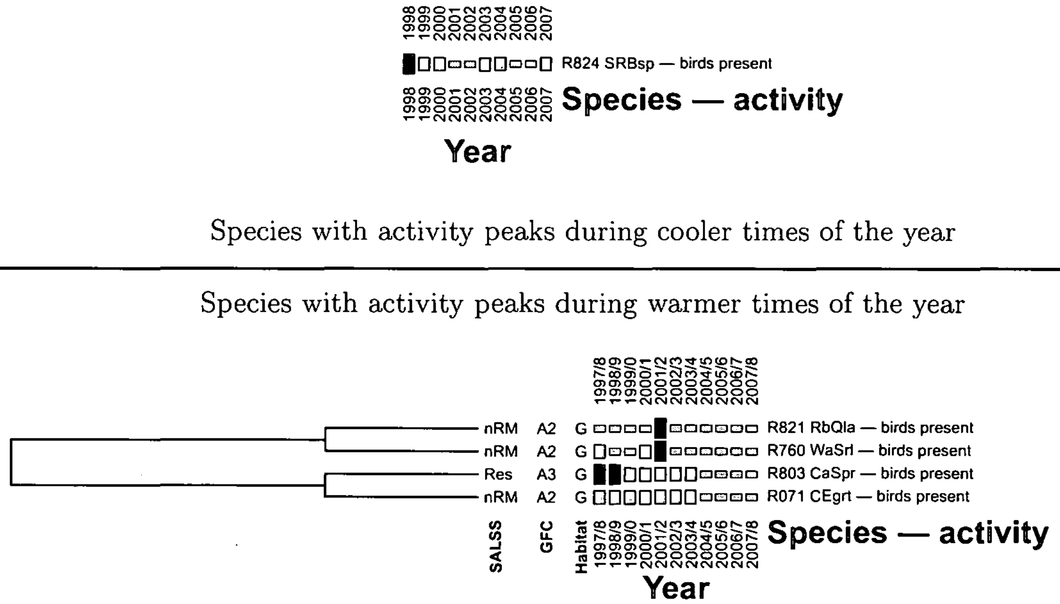


Figure 6.21: Annual occurrence of regular visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.

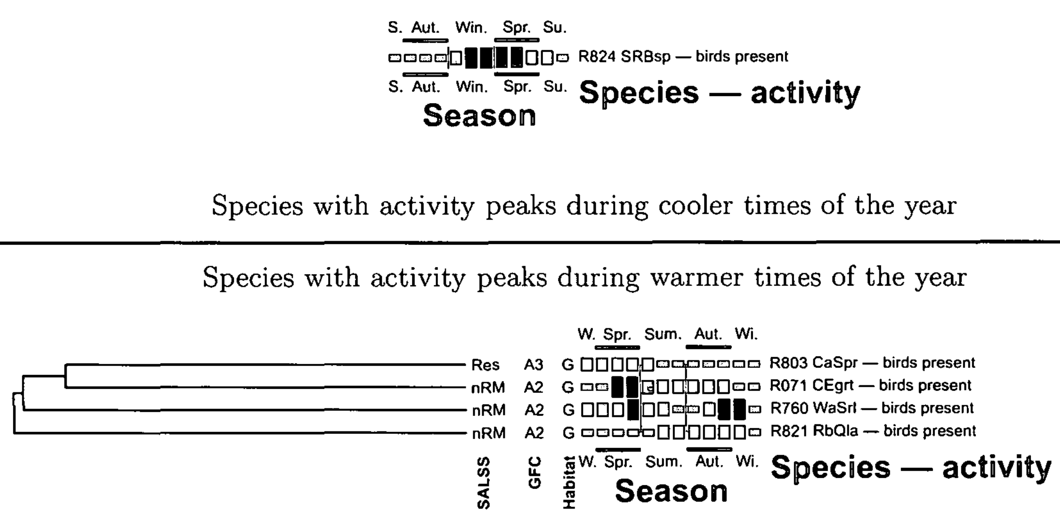
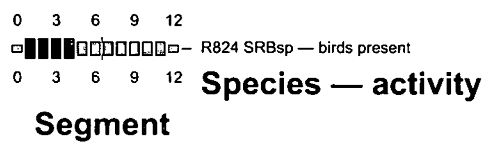


Figure 6.22: Seasonal occurrence of regular visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

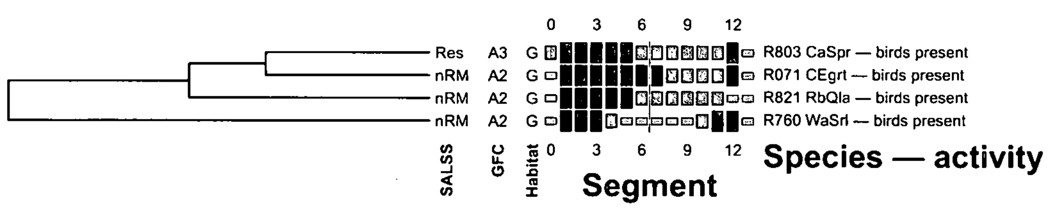
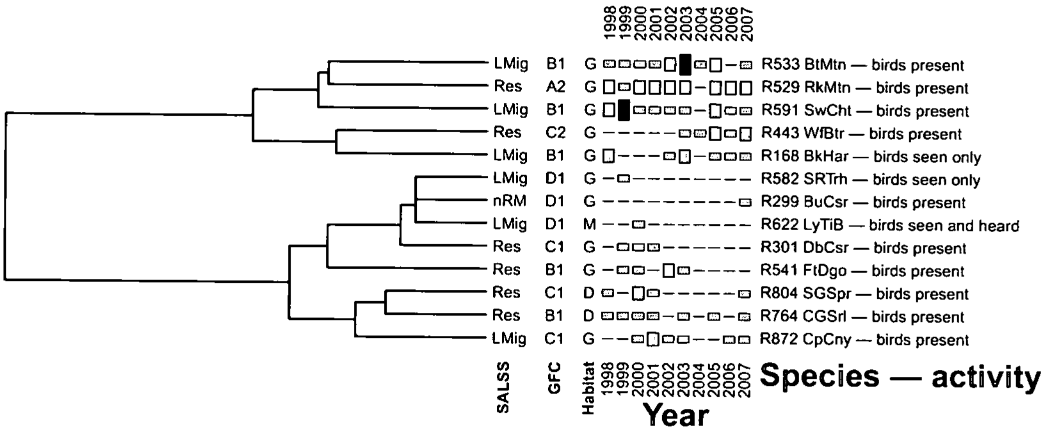


Figure 6.23: Daily occurrence of regular visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

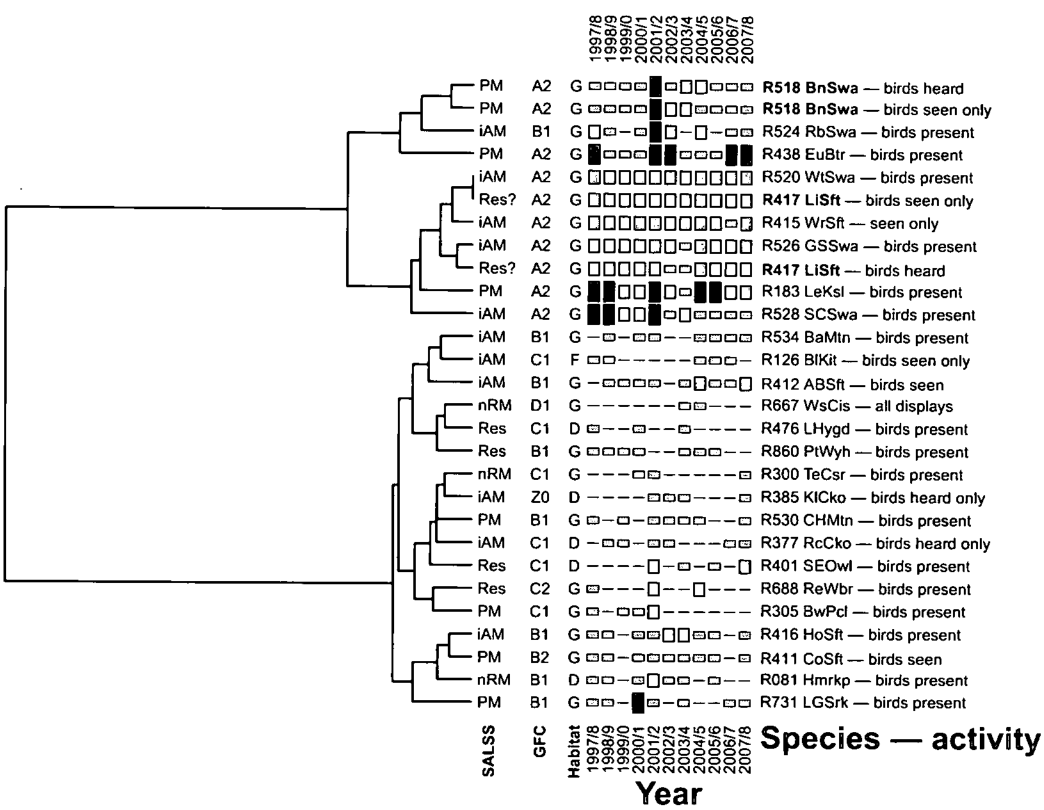
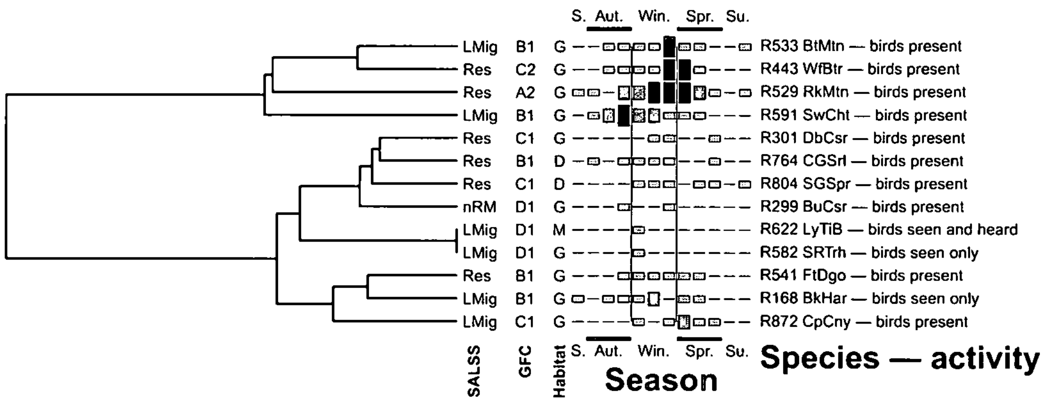


Figure 6.24: Annual occurrence of seasonal visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

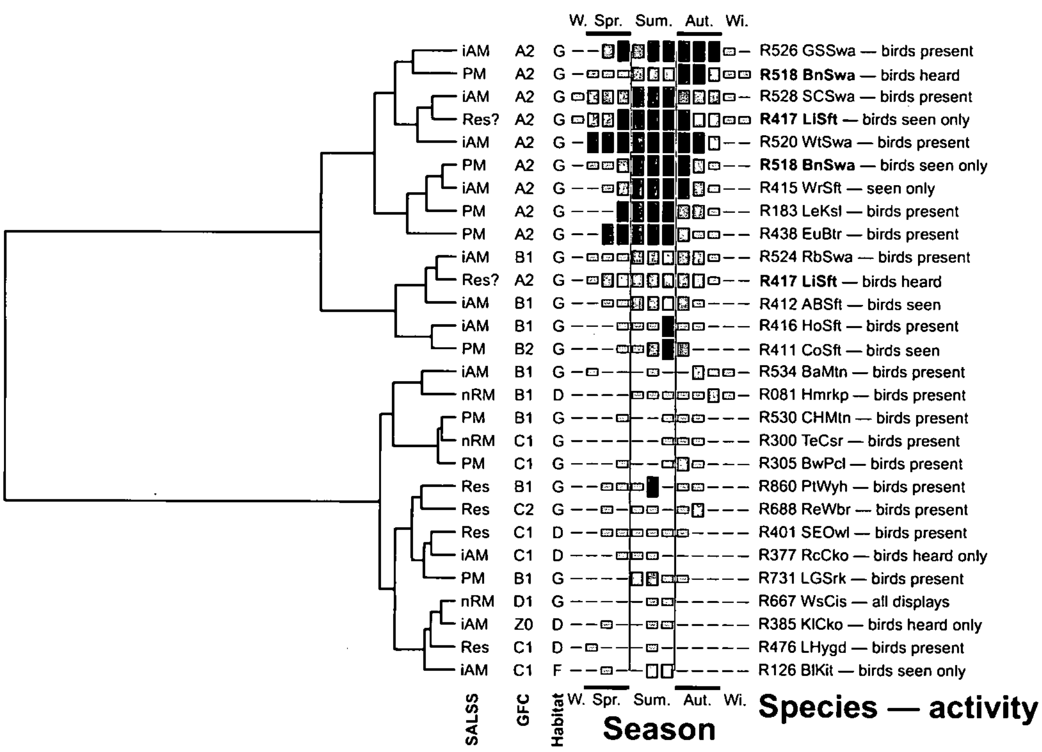
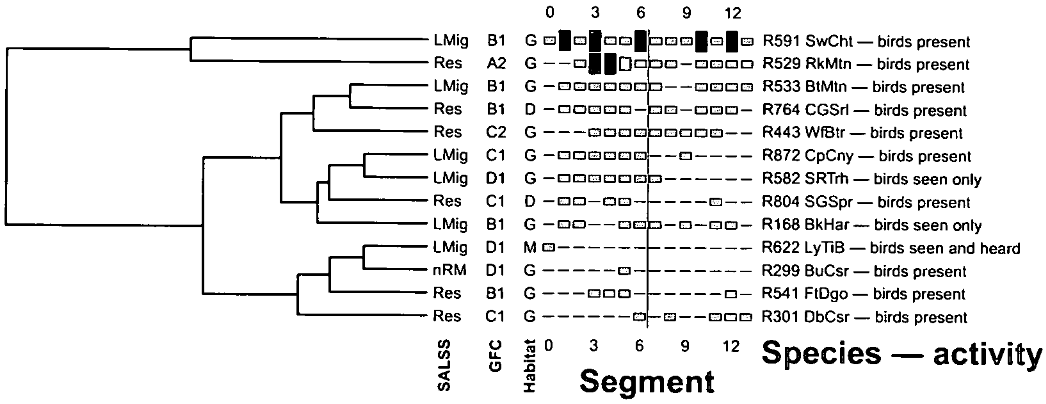


Figure 6.25: Seasonal occurrence of seasonal visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

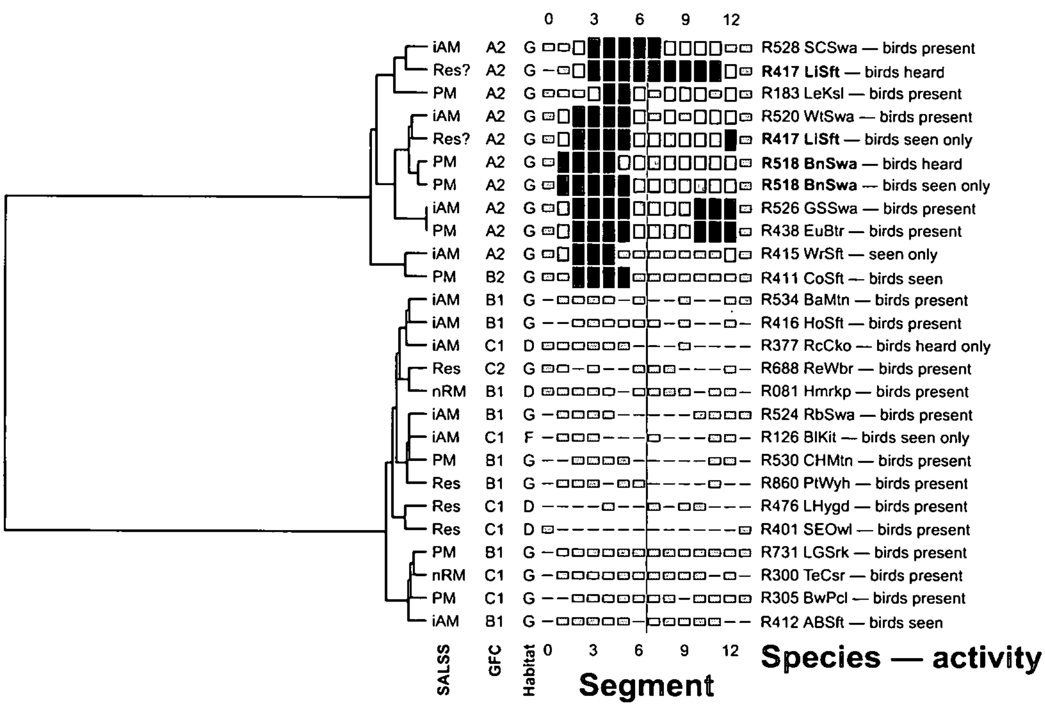
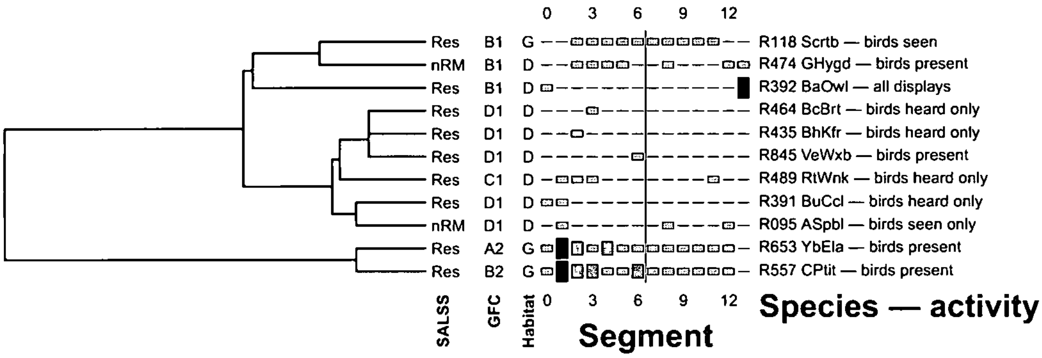
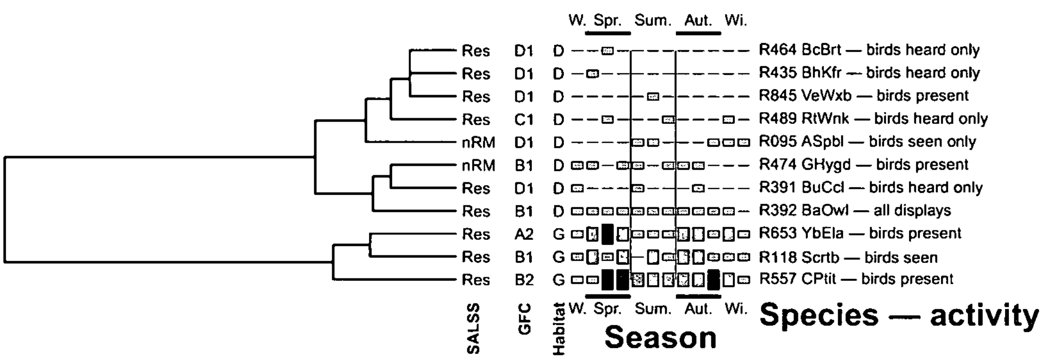


Figure 6.26: Daily occurrence of seasonal visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Daily occurrence

Seasonal occurrence



Seasonal occurrence

Annual occurrence

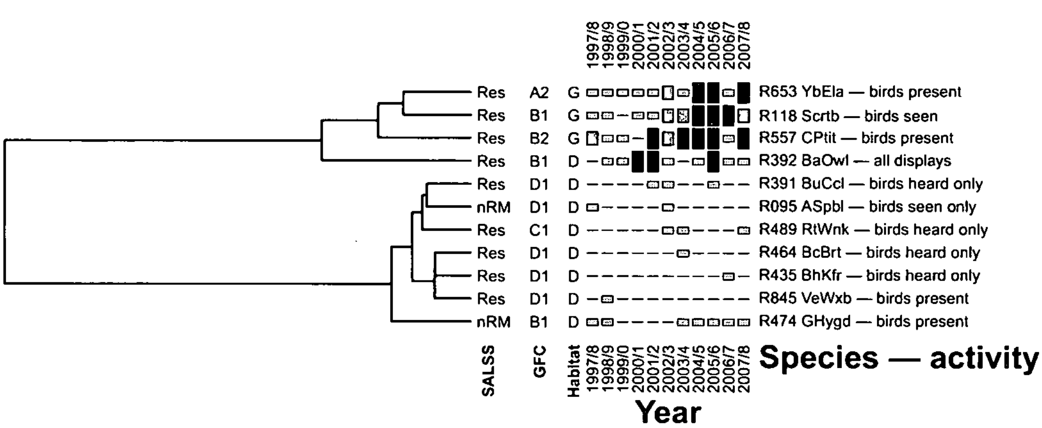
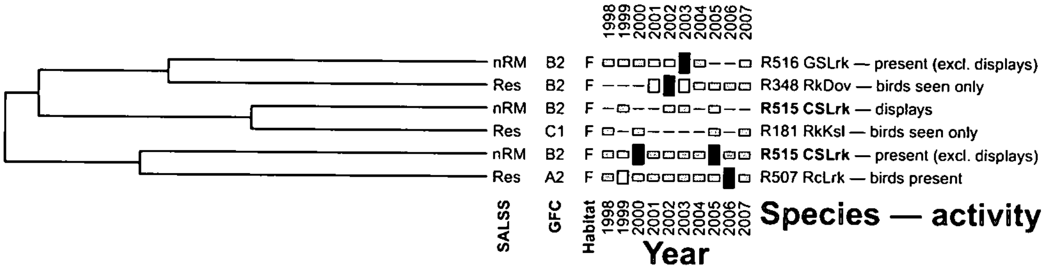


Figure 6.27: Annual, seasonal and daily occurrence of aseasonal visitors at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

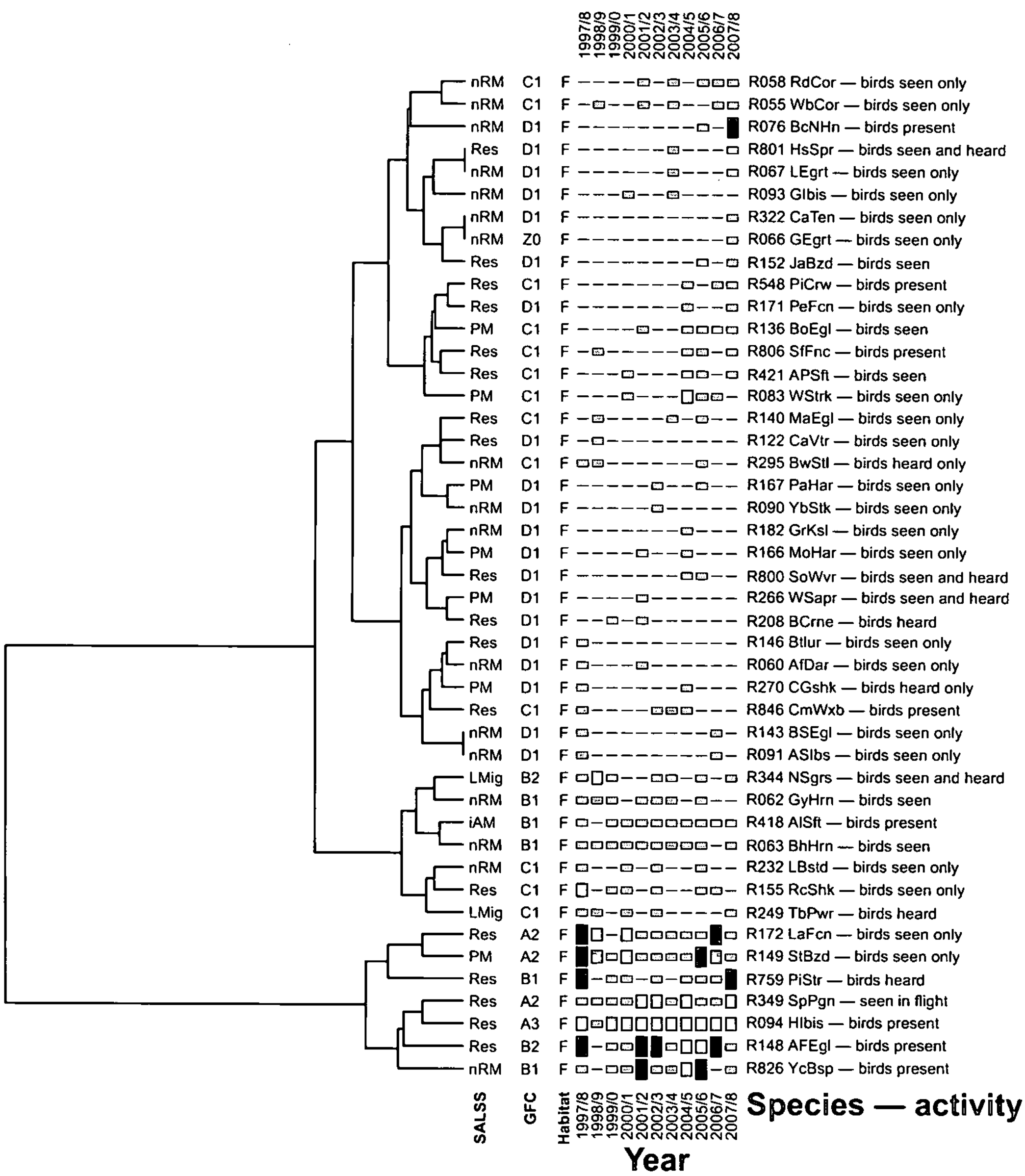
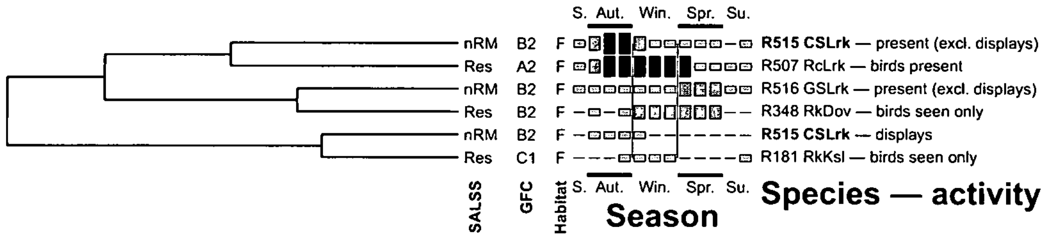


Figure 6.28: Annual occurrence of birds in transit at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

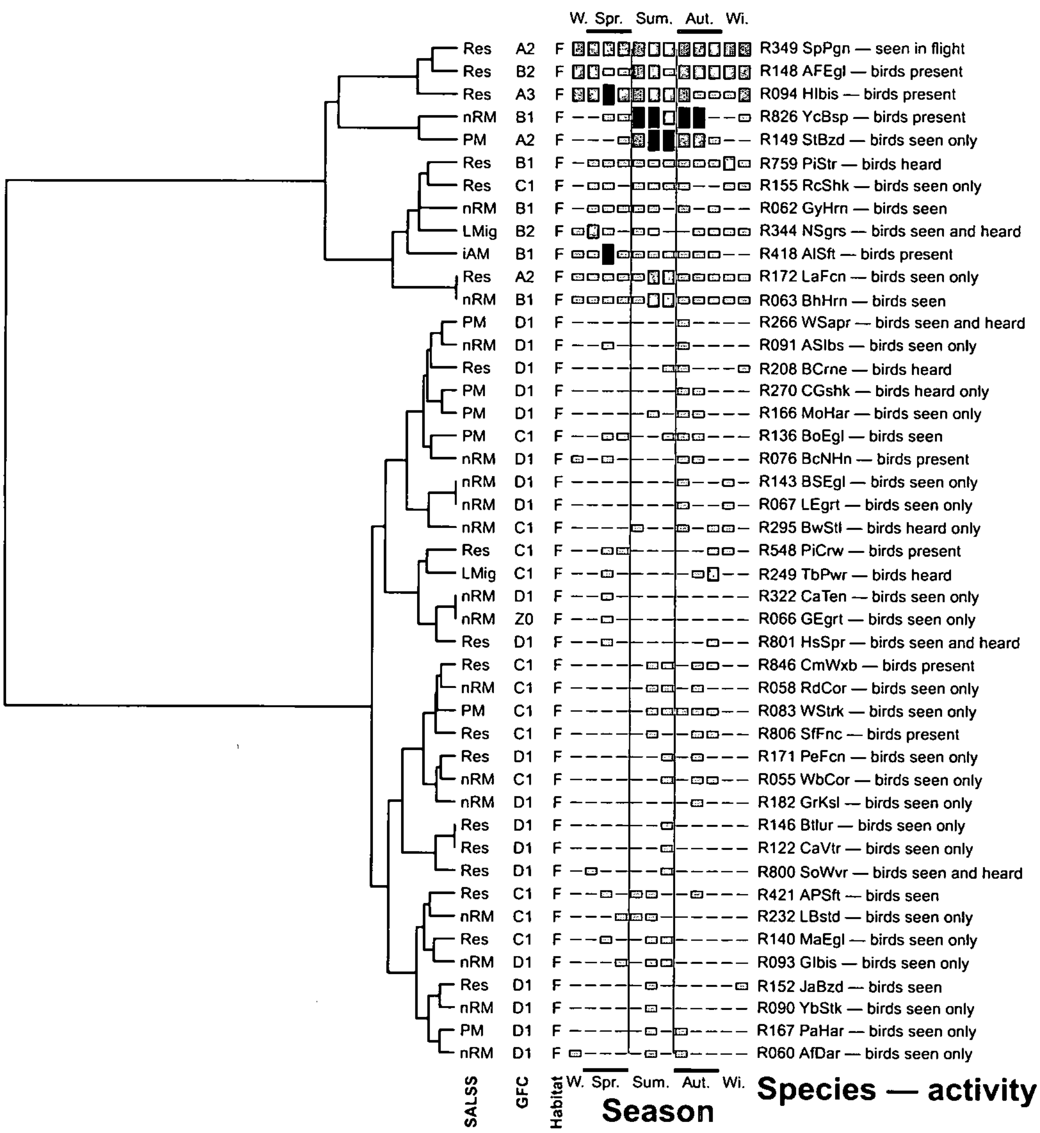
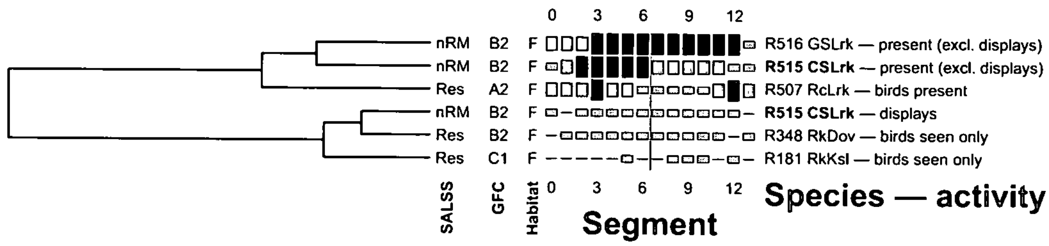


Figure 6.29: Seasonal occurrence of birds in transit at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Species with activity peaks during cooler times of the year

Species with activity peaks during warmer times of the year

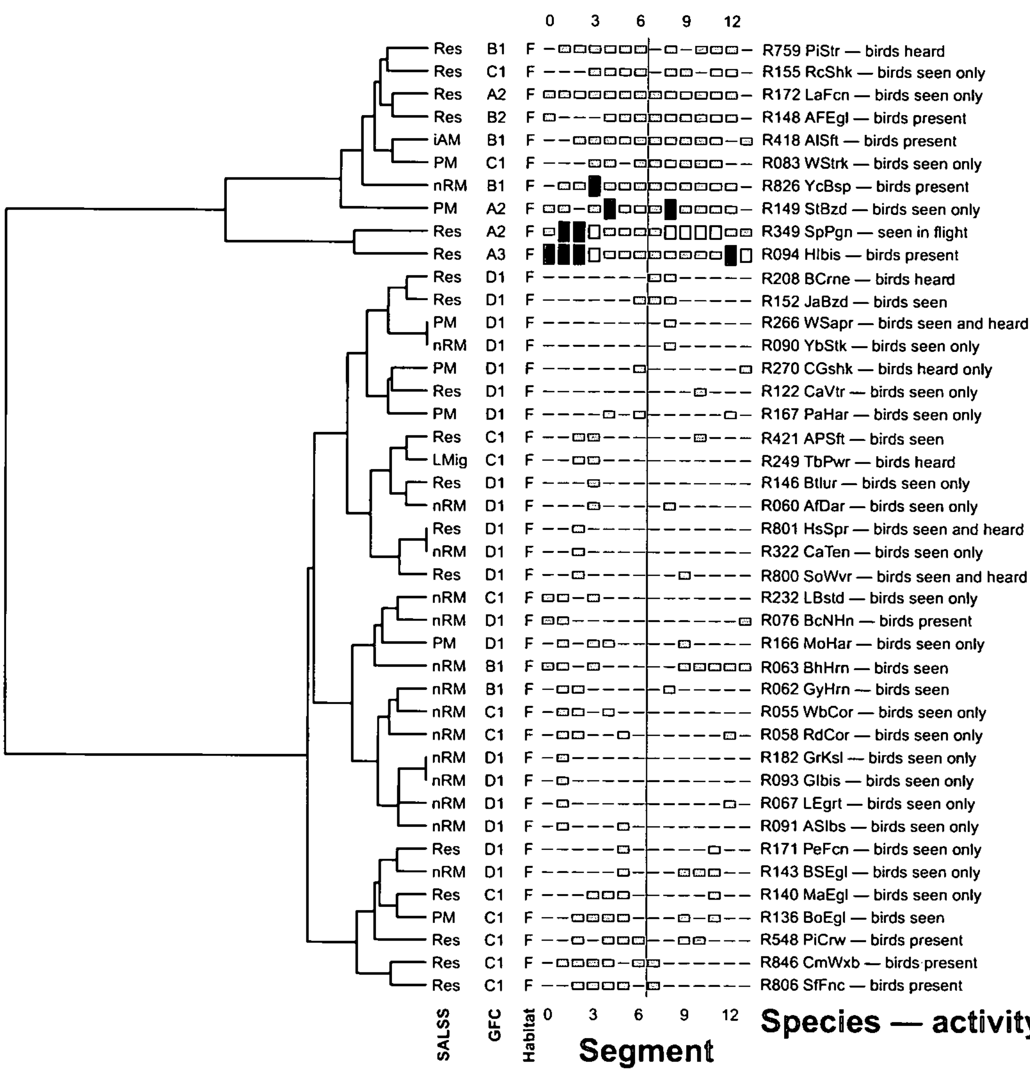
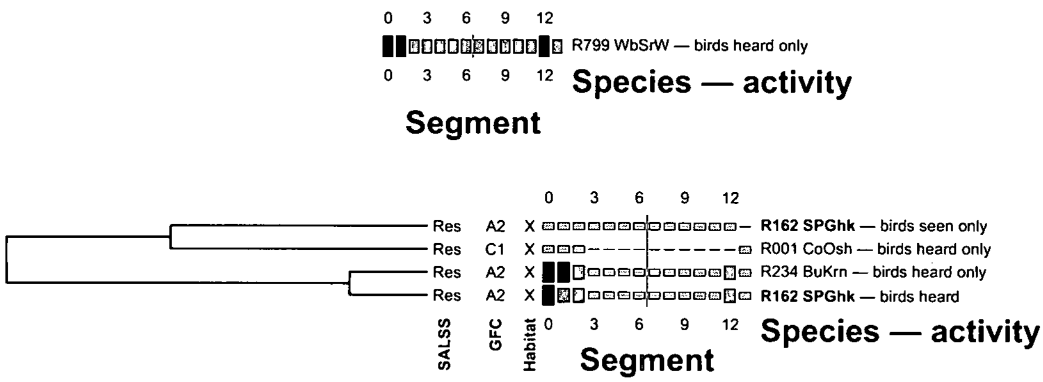
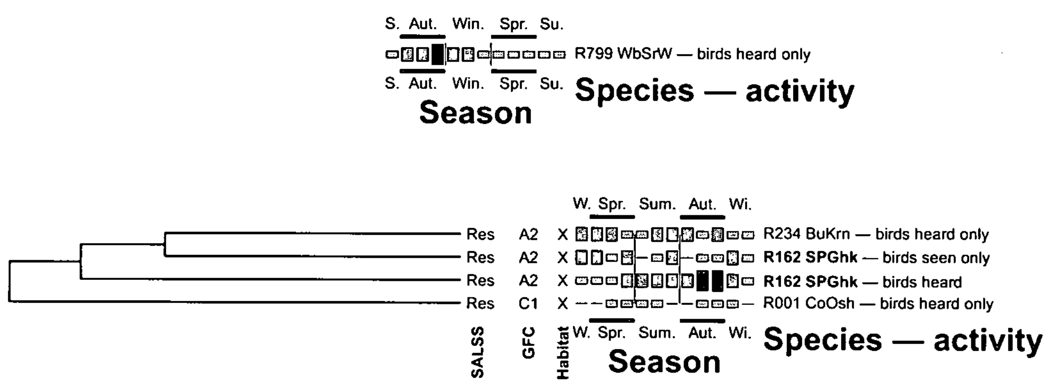


Figure 6.30: Daily occurrence of birds in transit at Glen based on data collected in the grassland from 1997/8 to 2007/8. See page 138 for explanation of diagram.



Daily occurrence

Seasonal occurrence



Seasonal occurrence

Annual occurrence

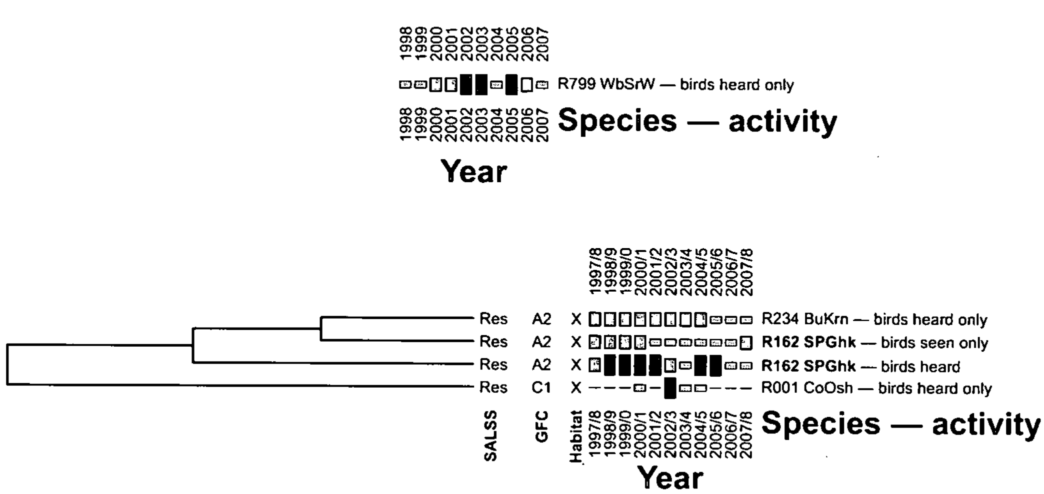


Figure 6.31: Annual, seasonal and daily occurrence of birds heard outside the study area at Glen based on data collected in the grassland from 1997/8 to 2007/8. Species with peaks in activity during the cooler times of the year are illustrated at the top in each case. See page 138 for explanation of diagram.

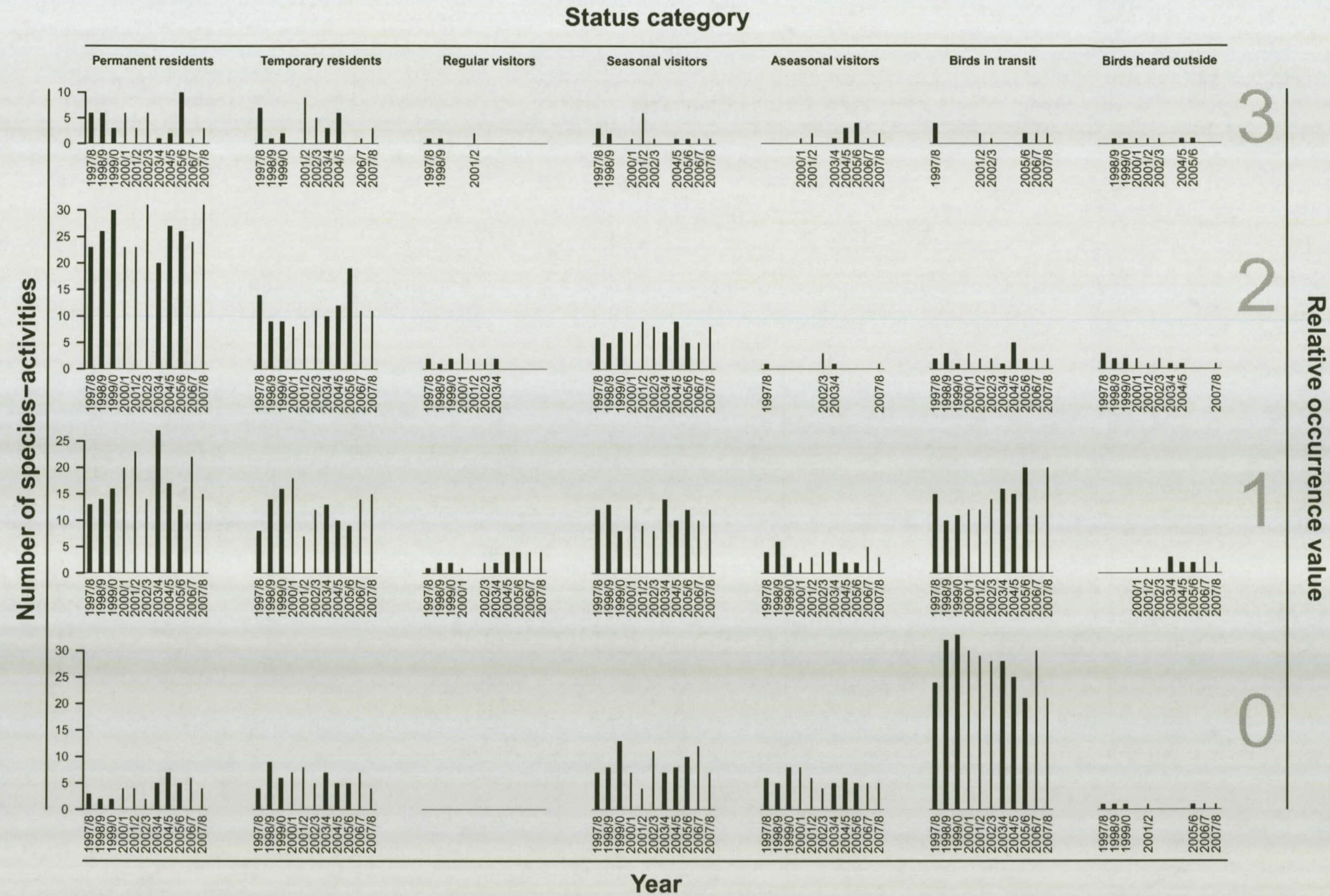


Figure 6.32: Annual variation in the total number of species-activities of bird species (excluding cool-season birds) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for each three years for identification purposes only. The vertical scale is the same for all groups. Based on Figures 6.15, 6.18, 6.21, 6.24, 6.27, 6.28 and 6.31.

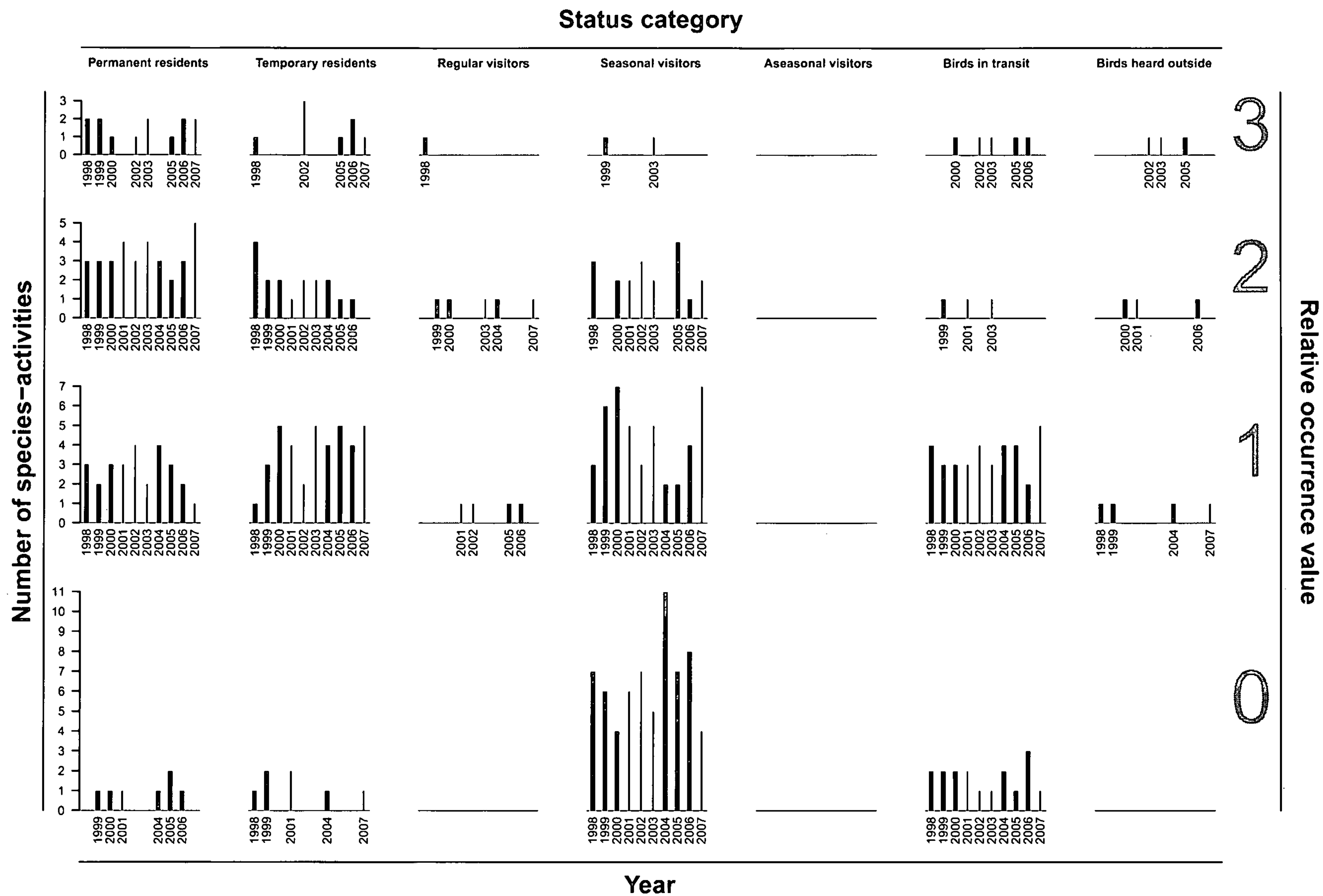


Figure 6.33: Annual variation in the total number of species-activities of bird species (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for each three years for identification purposes only. The vertical scale is the same for all groups. Based on Figures 6.15, 6.18, 6.21, 6.24, 6.28 and 6.31.

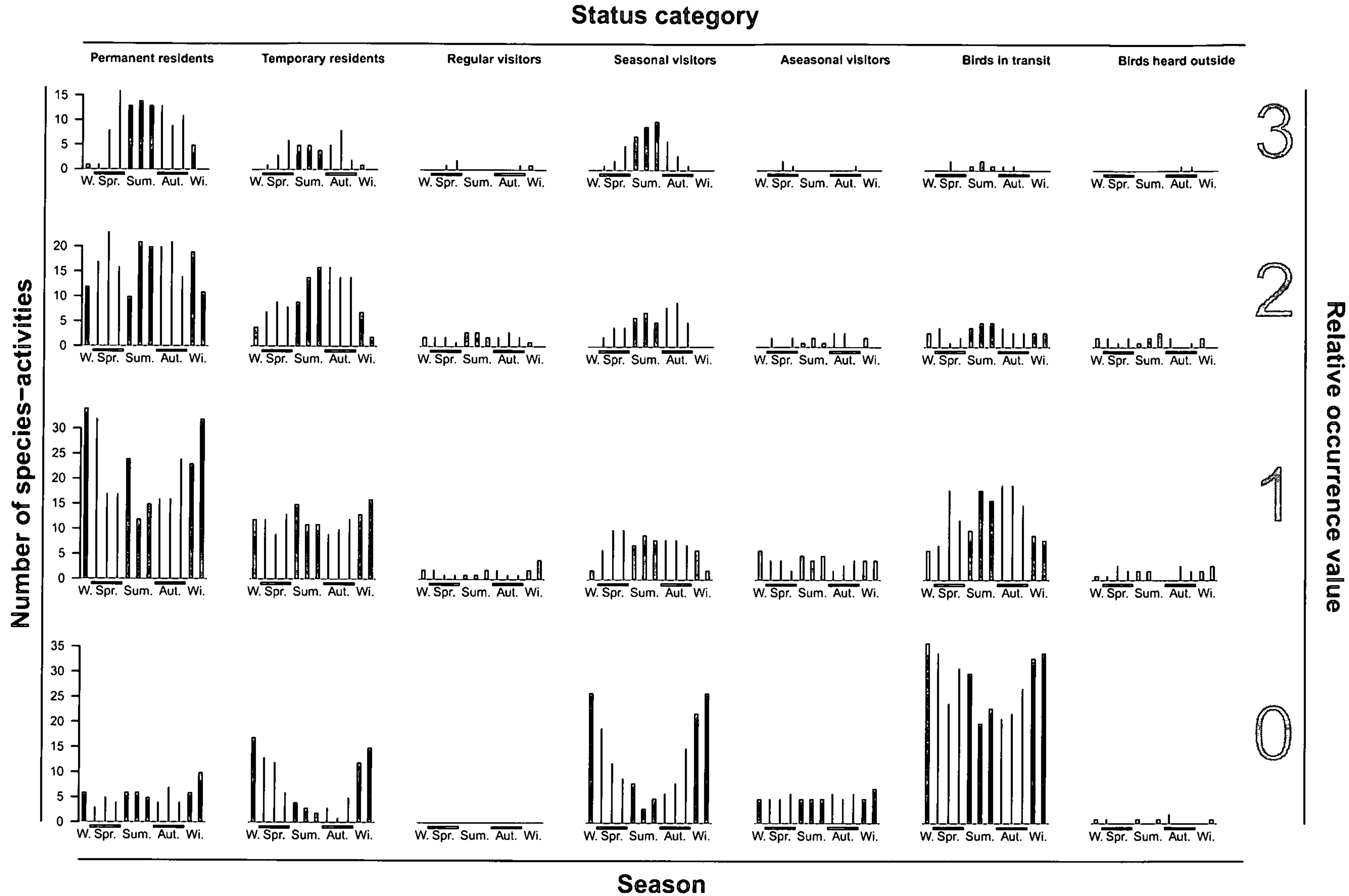


Figure 6.34: Seasonal variation in the total number of species-activities of bird species (excluding cool-season birds) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for winter, spring, summer and autumn for identification purposes only. The vertical scale is the same for all groups. Based on Figures 6.16, 6.19, 6.22, 6.25, 6.27, 6.29 and 6.31.

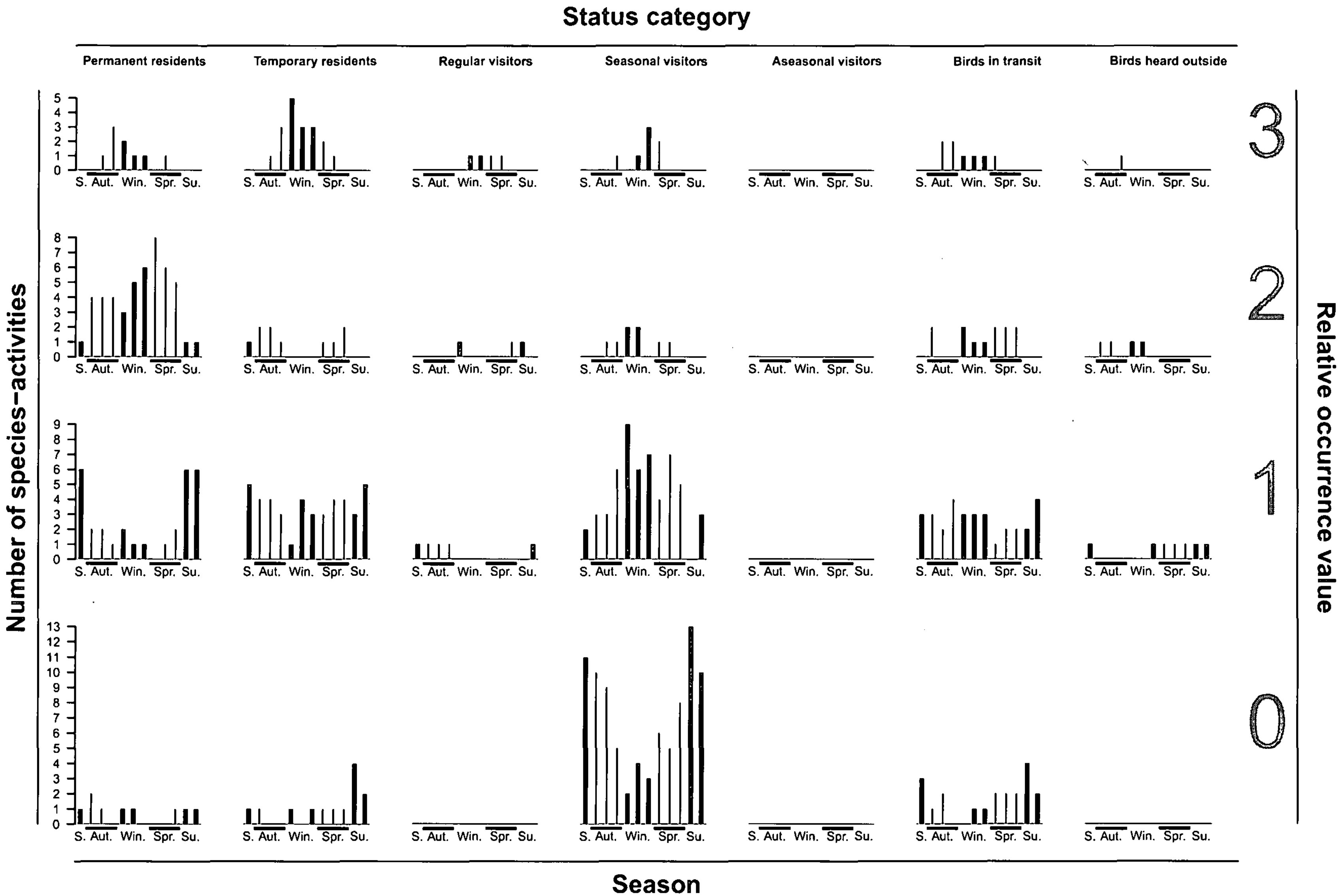


Figure 6.35: Seasonal variation in the total number of species-activities of bird species (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for winter, spring, summer and autumn for identification purposes only. The vertical scale is the same for all groups. Based on Figures 6.16, 6.19, 6.22, 6.25, 6.29 and 6.31.

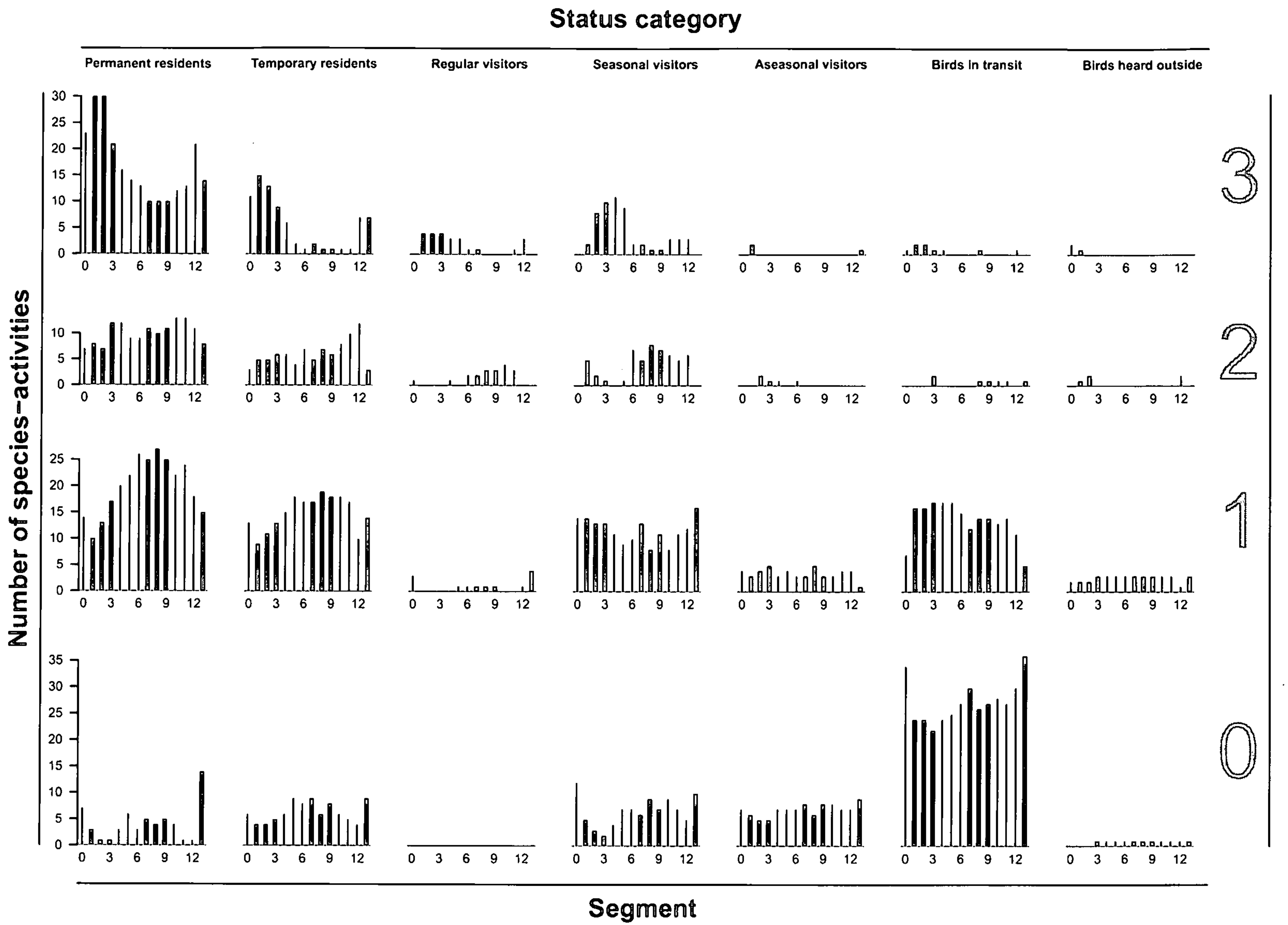


Figure 6.36: Daily variation in the total number of species-activities of bird species (excluding cool-season birds) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for different parts of the day for identification purposes only. Vertical scale is equal for all groups. Based on Figures 6.17, 6.20, 6.23, 6.26, 6.27, 6.30 and 6.31.

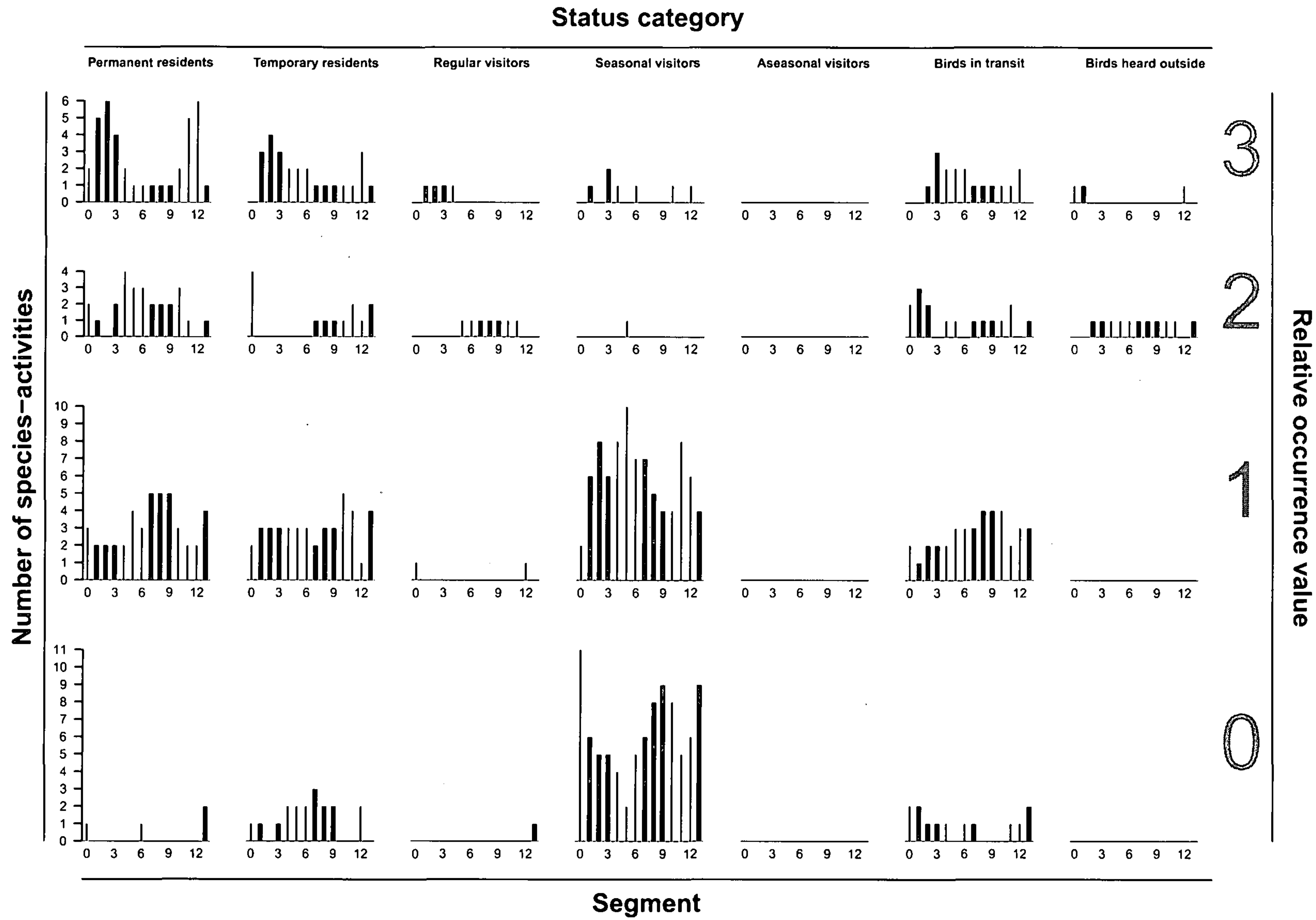


Figure 6.37: Daily variation in the total number of species-activities of bird species (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 grouped by Glen status category and relative occurrence value (0 = zero records; 3 = peaks in activity). The widths of vertical bars are varied for different parts of the day for identification purposes only. Vertical scale is equal for all groups. Based on Figures 6.17, 6.20, 6.23, 6.26, 6.30 and 6.31.

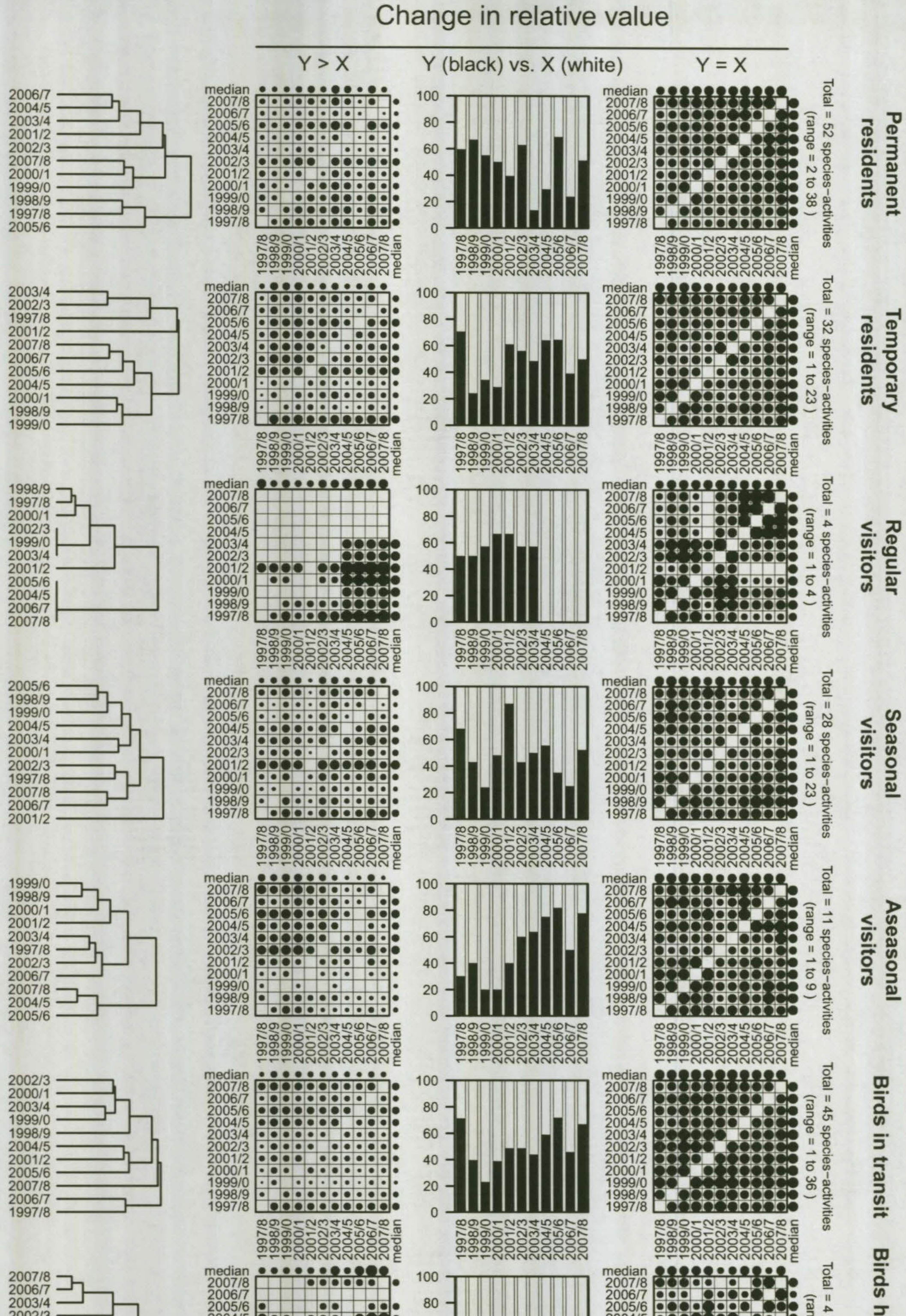


Figure 6.38: Inter-annual comparison based on the 0–3 scaled values of species-activities (excluding cool-season birds), recorded in the grassland at Glen from 1997/8 to 2007/8, and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.15, 6.18, 6.21, 6.24, 6.27, 6.28 and 6.31. See page 139 for more information on this figure.

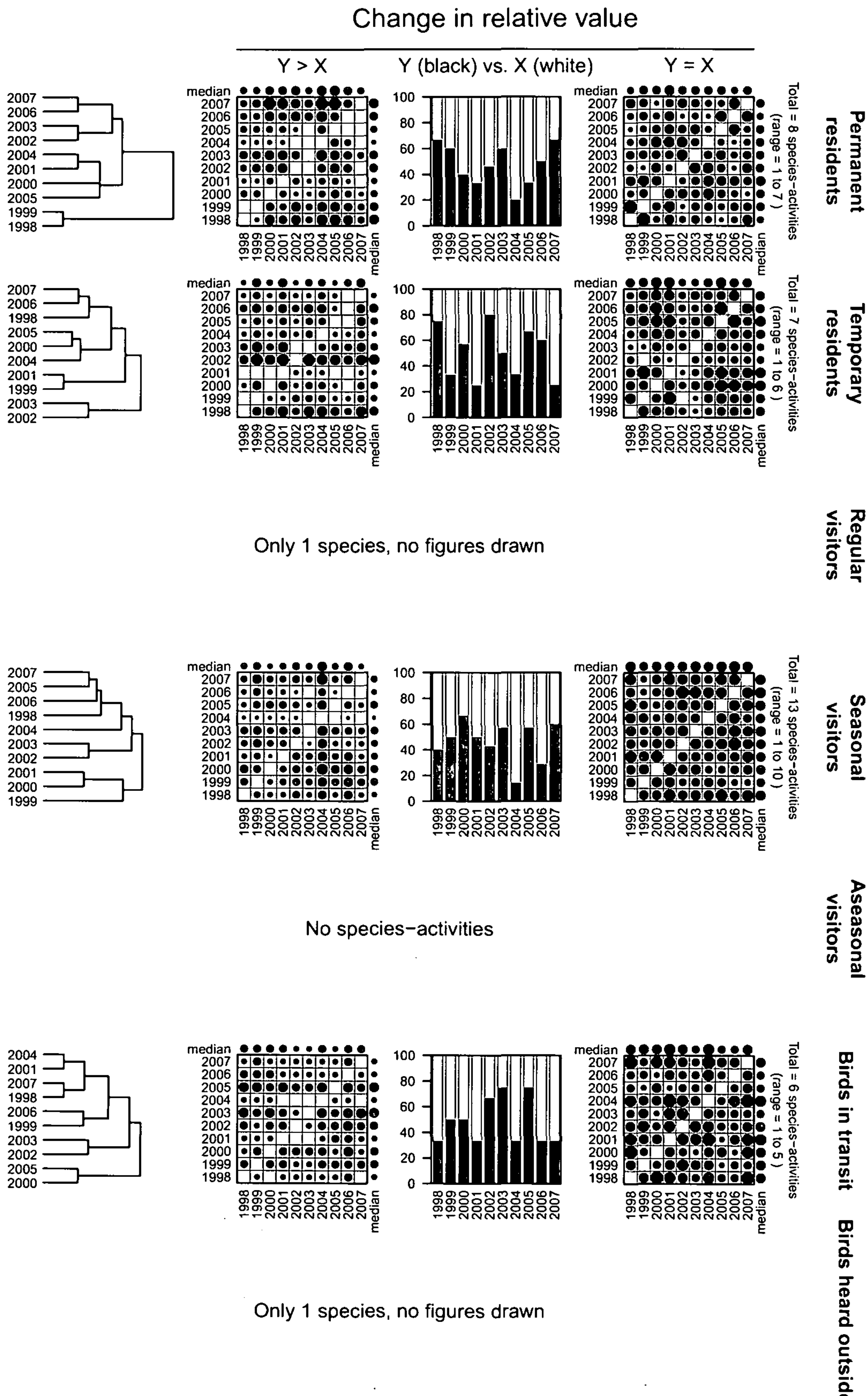


Figure 6.39: Inter-annual comparison based on species-activities (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.15, 6.18, 6.21, 6.24, 6.28 and 6.31. See page 139 for more information on this figure.

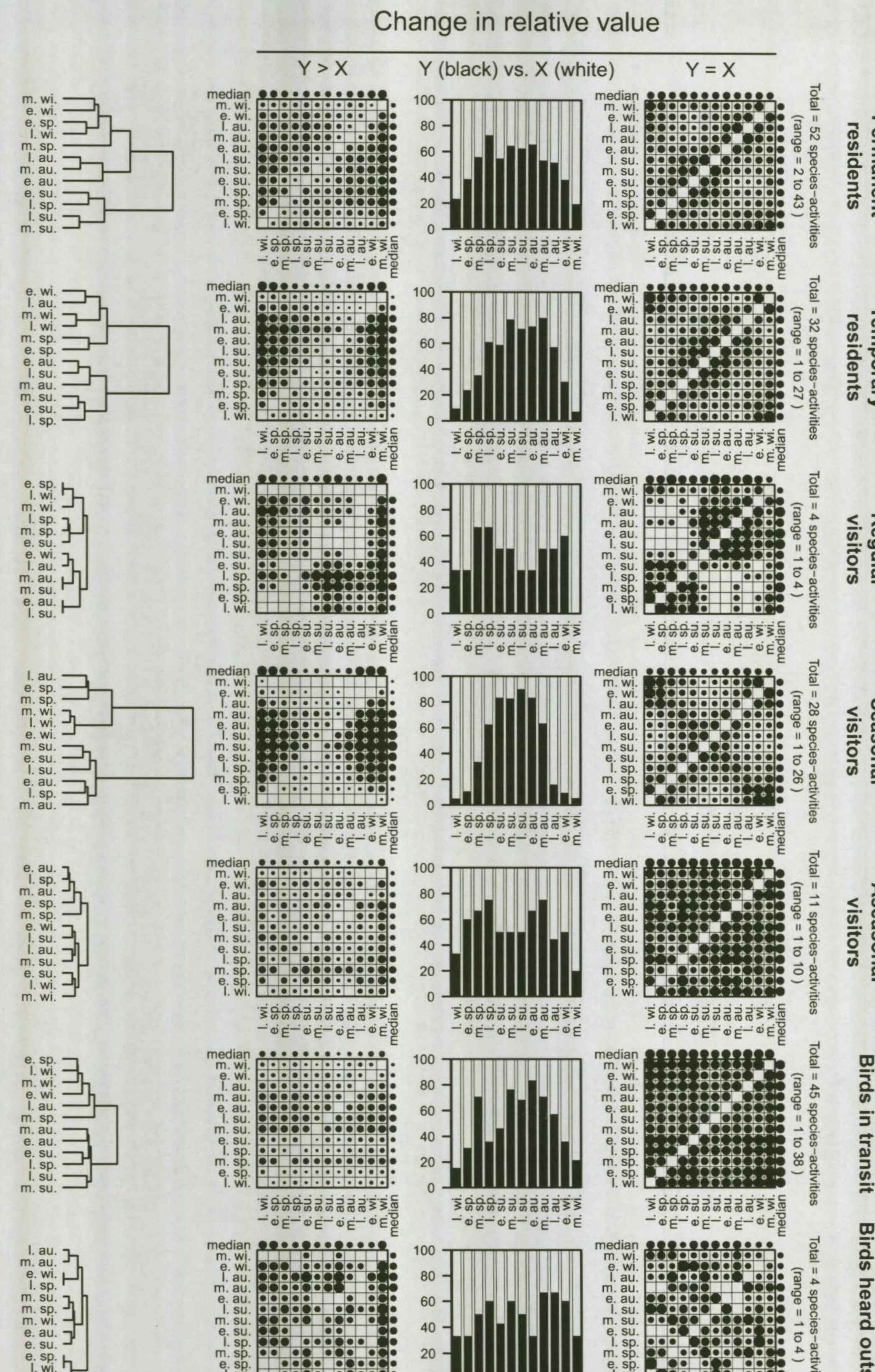


Figure 6.40: Inter-seasonal comparison based on species-activities (excluding cool-season birds) recorded in the grassland at Glen from 1997/8 to 2007/8 and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.16, 6.19, 6.22, 6.25, 6.27, 6.29 and 6.31. See page 139 for more information on this figure.

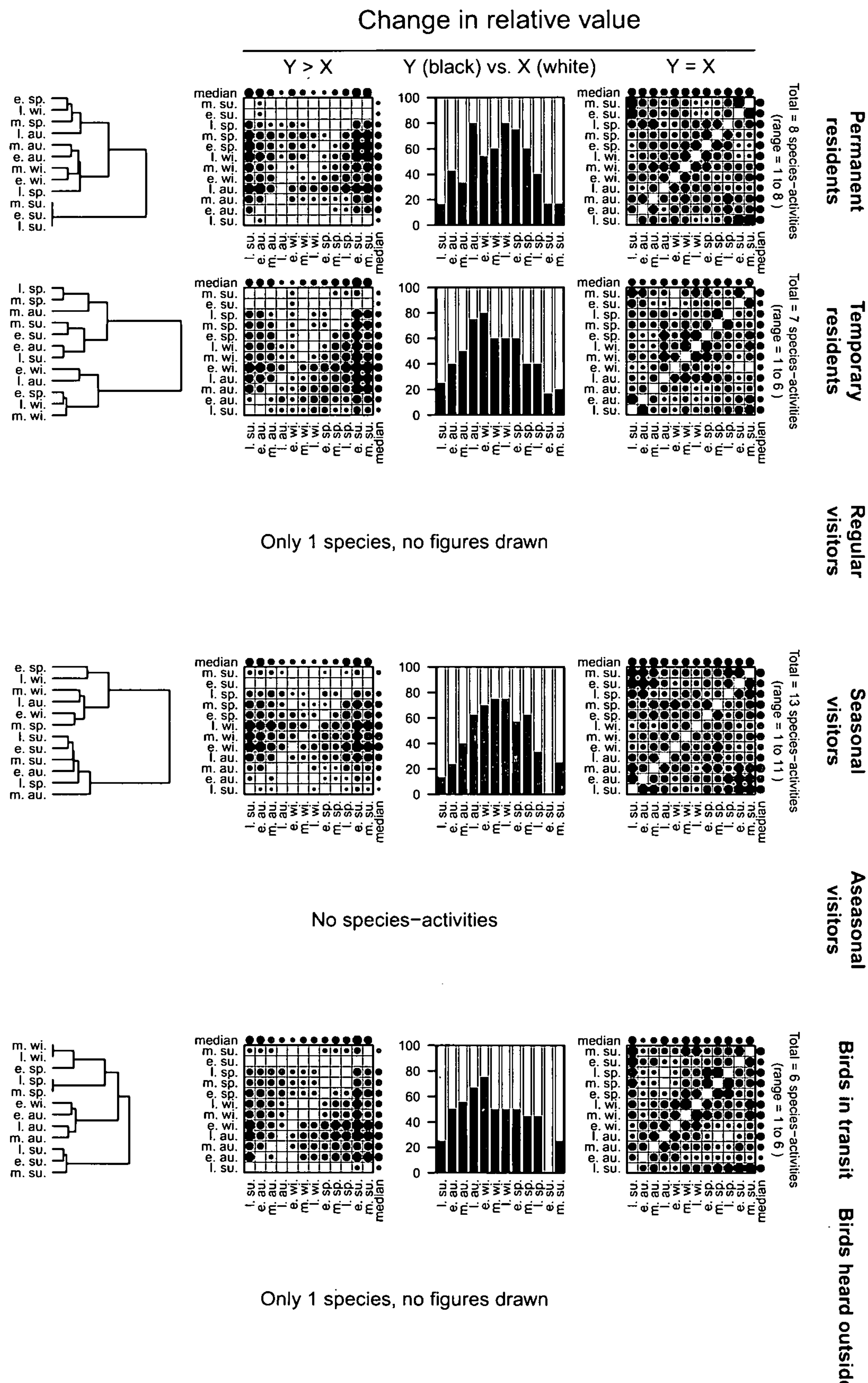


Figure 6.41: Inter-seasonal comparison based on species-activities (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.16, 6.19, 6.22, 6.25, 6.29 and 6.31. See page 139 for more information on this figure.

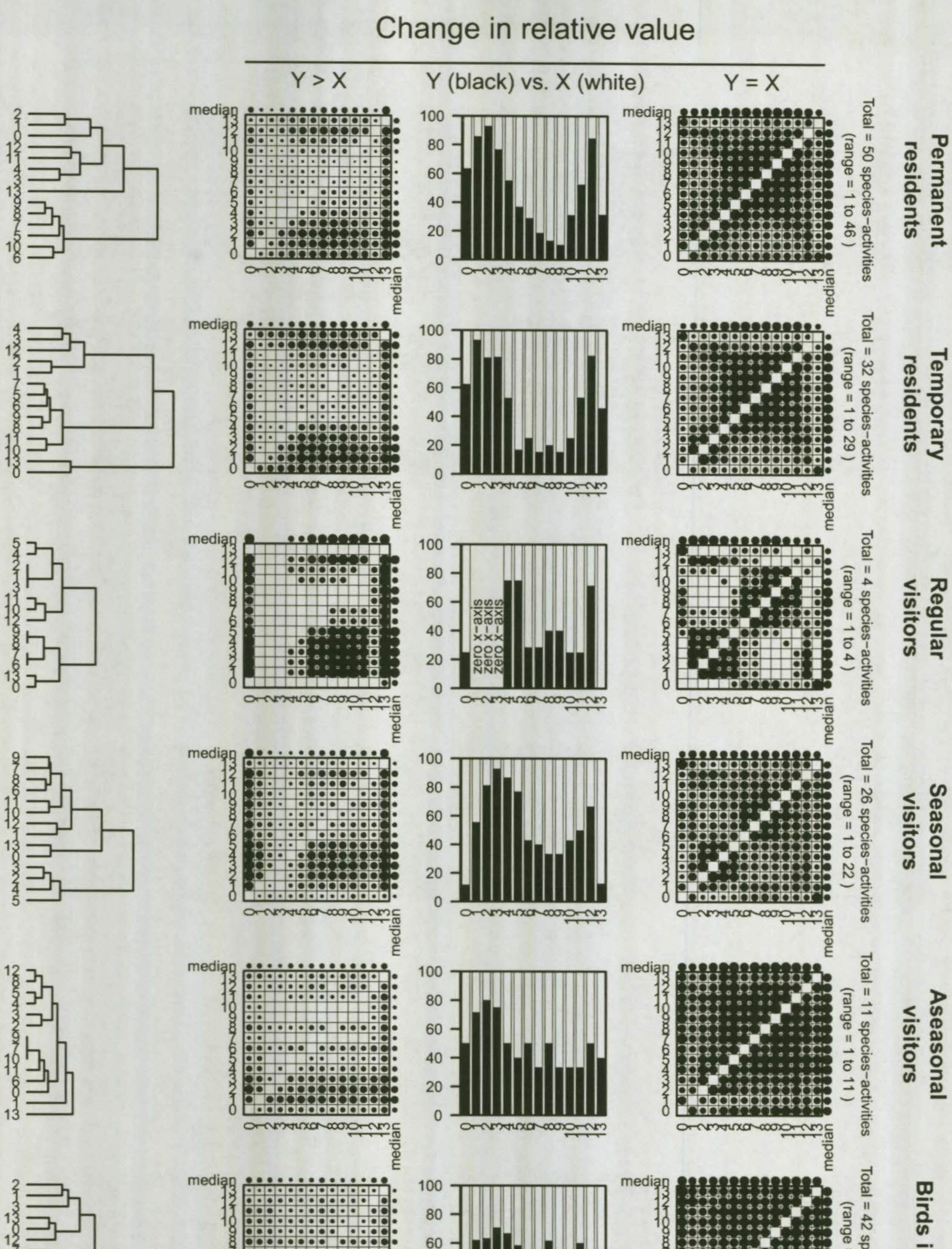


Figure 6.42: Inter-segment comparison based on species-activities (excluding cool-season birds) recorded in the grassland at Glen from 1997/8 to 2007/8 and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.17, 6.20, 6.23, 6.26, 6.27, 6.30 and 6.31. See page 139 for more information on this figure.

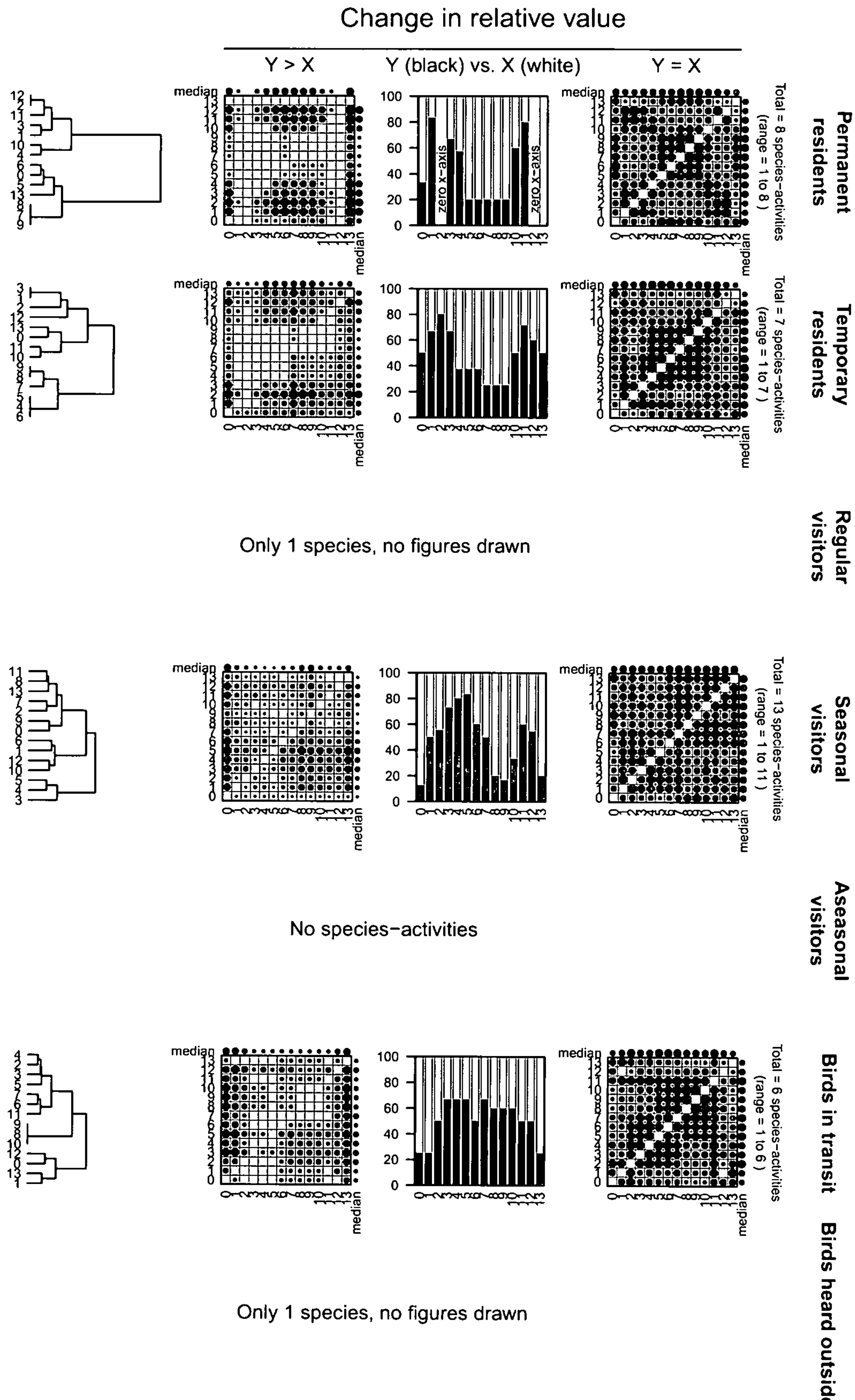


Figure 6.43: Inter-segment comparison based on species-activities (cool-season birds only) recorded in the grassland at Glen from 1997/8 to 2007/8 and grouped according to Glen status categories (Permanent residents, Temporary residents, *etc.*). Based on Figures 6.17, 6.20, 6.23, 6.26 and 6.30. See page 139 for more information on this figure.

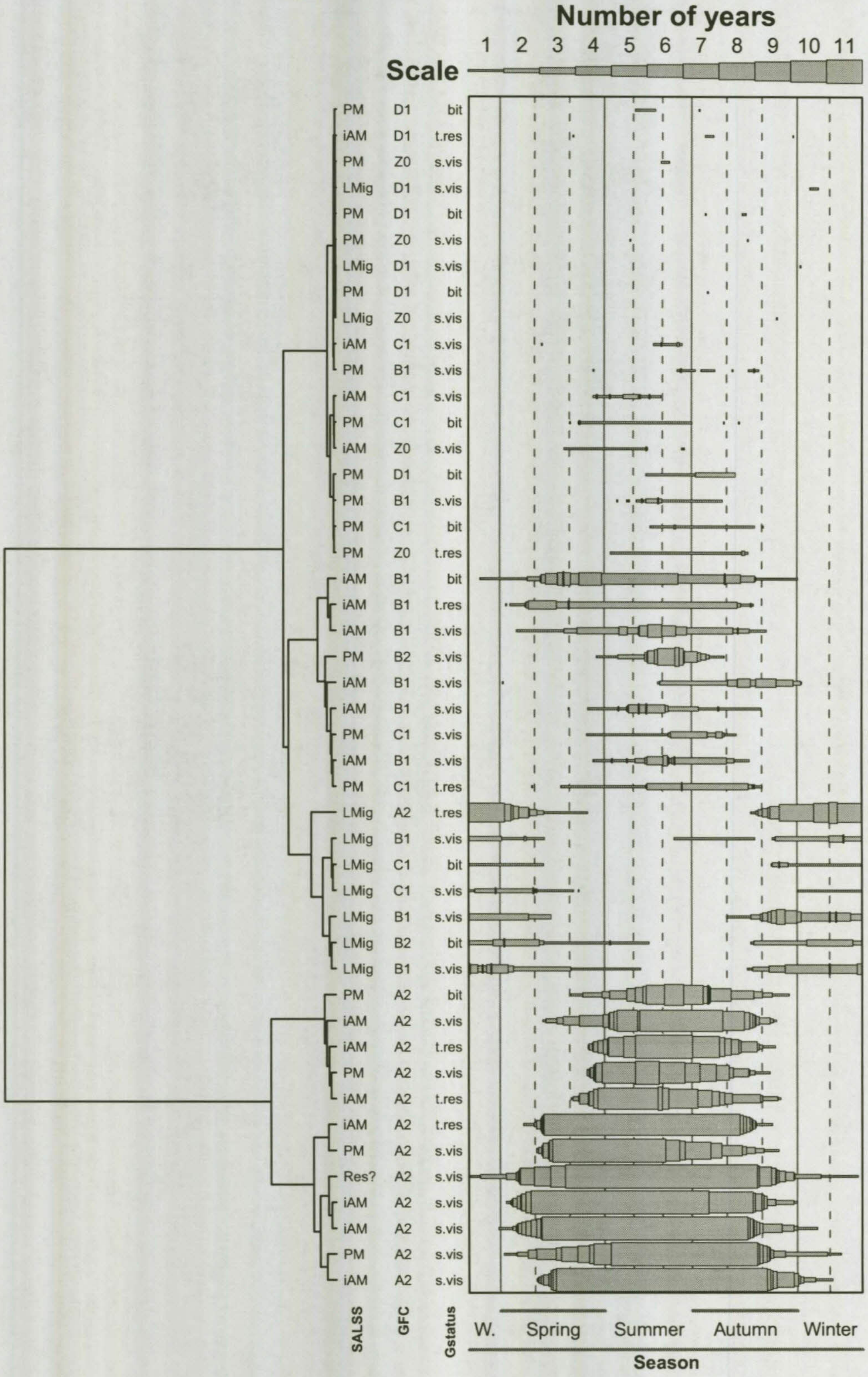


Figure 6.44: The timing of arrival and departure of local (LMig), intra-African (iAM) and Palearctic migrants (PM) at the Glen study area from 1997/8 to 2007/8. Illustrated from left to right: dendrogram, type of migrant (SALSS), grassland frequency class (GFC; A2, *etc.* Fig 6.3), Glen status (s.vis, *etc.*) (See page 1175), a summary of occurrence with height relative to the number of years recorded (see scale at the top) and vertical black lines indicating the arrival and departure dates of the respective years (see also the migration figure section on page 134) and species name.

7 Contributions to SABAP2 and beyond

> "Often numbers can be collected, but they may not represent data because they have little meaning and cannot be interpreted without making critical, but very unrealistic, assumptions. Such numbers are not trustworthy and cannot lead to valid inferences about the population of interest." (Anderson 2001)

The first Southern African Bird Atlas Project (SABAP1) ran from 1987 to 1991, culminating in a two-volume publication in 1997 (Harrison *et al.* 1997a,b). In July 2007 the second Southern African Bird Atlas Project (SABAP2) commenced as a follow-up to SABAP1. It introduced a number of methodological refinements, including the reduction of the geographical sampling unit from the quarter-degree grid cells (QDGCs) used in SABAP1 to pentad grid cells (pentads)[1] in SABAP2 (Harebottle *et al.* 2008). According to Harebottle *et al.* (2008), this finer scale would result in "more detailed information on the occurrence of species and will give us a clearer and better understanding of bird distributions. The quarter degree grid gave us an excellent broad brush picture of bird distributions, but has been demonstrated to be too course for the kind of fine-scale planning decisions which are needed for the conservation of biodiversity. Because there are nine pentads in a QDGC, the data for pentads can also be combined into QDGC format, which can then be compared with SABAP1 data to detect any large-scale changes in bird distribution."

A second refinement involves observer effort. During SABAP1, the only limit was that a checklist should not exceed one calendar month. This resulted in lists compiled over periods ranging from a few minutes to 31 days, causing problems in the interpretation of the data. SABAP2 addresses this issue by "standardizing observer effort as much as possible so that the data can be used in a more comparable way, thus strengthening the quality of the data collected" (Harebottle *et al.* 2008). This involves setting the minimum observation time to two hours, "motivated by the concept that two hours in a pentad with uniform habitat in low-diversity areas is probably enough to locate most species. For pentads with more varied habitats and in high-diversity areas the minimum time could take as long as 10 hours to locate all possible species in a complex grid cell" (Harebottle *et al.* 2008).

Harebottle *et al.* (2008) continues by emphasising that "**The minimum time period is known as the period of initial intensive survey**." The SABAP2 Instruction Manual (Harebottle *et al.* 2008) gives more specific instructions on how to carry out a survey once the initial planning (pentad selection, *etc.*) is in place. Two main aspects covered include the way to approach the initial intensive survey in each pentad, and secondly the way in which species should be recorded. For each pentad, observers are instructed to try to visit as many different habitats

[1]A QDGC covers 15 minutes of latitude by 15 minutes of longitude (15' x 15'); a pentad covers 5 minutes of latitude by 5 minutes of longitude (5' x 5')

and to record as many different species as possible within the minimum time period. Species are to be recorded in the order in which they were encountered (seen and/or heard) and assigned a sequence number. In addition, the number of new species observed after each hour of the initial intensive survey should be recorded. Once the observer is satisfied that all habitats in the pentad are covered, *i.e.* that the initial intensive survey is completed, additional species can be added to the overall list for up to five days. For example, if the initial intense survey started on Monday morning at 8h00 and lasted until 12h00 (*i.e.* the initial intensive survey was 4 hours), additional species can be added to the overall list until 8h00 on Saturday morning, after which a new data sheet and initial intensive survey can follow. Observers are instructed to record the total number of hours "ACTUALLY" spent observing during the five days. Assume that after the initial intensive survey of 4 hours on Monday morning another 3 hours was spent in total observing until Saturday morning at 8h00, then the total number of hours spent observing, *i.e.* 7=4 + 3, should be recorded, even though the data sheet covers a 120-hour period (5 days x 24 hours).

There are limits to what a project like SABAP2 can achieve. As an atlas project, it is an excellent way of mapping the distribution of birds as SABAP1 has shown. The reduction in spatial scale from QDGCs to pentads is certainly an improvement, and combined with the standardised observer effort it would enable a more detailed analysis than was possible with the SABAP1 data-set. However, the usefulness of the sequence in which birds are recorded is questioned. In addition to exploring the concept of species sequences, this chapter also investigates other aspects relevant to SABAP2 and other surveys.

7.1 Species sequences

Harebottle *et al.* (2008), henceforth referred to as the "SABAP2 Instruction Manual", state the three primary objectives of SABAP2 as follow:

- "To measure the impact of environmental change on southern African birds through a scientifically rigorous and repeatable platform which uses standardised data collection on bird distribution and abundance;
- To provide a basis for increasing public participation in biodiversity data collection, and public awareness of birds, through large-scale mobilization of citizen scientists; and
- To provide information that can be used to determine changes in the distribution and abundance of birds since SABAP1."

Species sequences are irrelevant to all three objectives. Firstly, it has no equivalent in the SABAP1 data-set and is therefore of no comparative use. It is further the author's contention that species sequences as currently employed are counter productive in terms of the second objective — would not more people participate in SABAP2 if they can just keep a simple checklist without having to worry about the sequence in which they saw the birds? Admittedly, this is the least serious concern.

The most serious concern is the irrelevance of species sequences to the first objective. It is important to note that "standardised data collection" does not necessarily entail "a scientifically rigorous and repeatable platform", for if the "standardised data collection" method is flawed, so too will be anything based thereon. In the case of SABAP2 (and SABAP1), the methods used to determine *distributions* are scientifically rigorous and repeatable enough to enable realistic and meaningful conclusions to be drawn from the data. But note that distribution per se is determined by the mere presence or absence of a species on checklists, without any reference to its sequence number on these lists.

Furthermore, SABAP1 measured abundance in addition to distribution. Harrison & Underhill (1997) explain: "Reporting rates are a way of extracting quantitative information from presence/absence data; observers did not count birds, they recorded the presence of identified species on checklists. The reporting rate is the proportion of checklists on which a species is recorded; a species which was recorded on 10% of checklists is said to have reporting rate equal to 10%. Subject to the caveats listed below, differences in reporting rate between different geographical areas and different times of the year may be interpreted as pointing to changes in abundance (or density). However, reporting rates are not proportional to density (birds per hectare), but provide an index which fluctuates with changes in density."

In this regard, the standardisation of the observer effort in SABAP2 is a significant step forward and is likely to result in more 'accurate' reporting rates. But note once again that reporting rates are calculated from presence/absence data without recourse to the sequence in which species were recorded on checklists.

7.1.1 ARE SPECIES SEQUENCES A SUITABLE SURROGATE FOR ABUNDANCE?

It is impractical for projects such as SABAP2 to measure abundance or density (*e.g.* birds per hectare) directly. As already discussed in the Introduction to this thesis, all counting methods, even the more sophisticated varieties, have their strengths and weaknesses. There is no perfect method (Bibby *et al.* 2000). In addition, it is highly unlikely that these methods would appeal to most (any?) "citizen scientists". Accordingly, the SABAP2 Instruction Manual states: "***Record species only once*** (*i.e.* presence/absence). ***Do NOT count individuals*** ..." (Emphasis in the original). Reporting rates calculated from such presence/absence data could be a useful index of relative abundance **only if sources of bias are taken into account**. For example, according to Harrison & Underhill (1997) reporting rates measure conspicuousness, which they crudely define as the likelihood that the average observer, with an average amount of search effort, records a species. Thus, given the same density, a relatively conspicuous species would be recorded more frequently than a relatively inconspicuous one. It is for this reason that Harrison & Underhill (1997) suggest that reporting rates should generally be used only for intra-specific comparisons. There are a host of other biases, which Harrison & Underhill (1997) categorised under species, geographic, observer and arithmetic effects.

Species sequences are subject to the same set of biases as reporting rates. For it to be useful as an index of abundance it must be assumed, in addition, that there is some intrinsic regularity in the order in which species are recorded — presumably, this regularity entails that the most abundant species will be recorded sooner than the scarcer ones, for how else could a species *ranking* abundance analyses work? However, this is an unrealistic assumption. Consider this:

The SABAP2 Instruction Manual specifically states that observers should "try to visit as many different habitats to record as many different species as possible within the minimum time period". A species sequence resulting from such a strategy would reflect the order in which habitats were visited more than anything else would. For example, a data sheet on which the first birds include mainly waterbirds, followed by species mainly associated with woodland and finally birds more usually associated with grassland obviously indicates that the atlaser first visited a wetland of some kind, then woodland and finally grassland. To complicate matters even further, on the "How do I participate in SABAP2?" page on their website (`http://sabap2.adu.org.za/participate.php`) under the heading "Conducting a field survey (*i.e.* atlas protocols)", they state: "Try, where possible, to start your surveys for the same pentad at different points and try and use different routes. This contributes to the species ranking abundance analyses we will do at the end of the project." Presumably the intent is to get a random sample for statistical purposes. However, this is the crux of the problem: the species sequences resulting from such a protocol will be a random mess consisting of a set of *random* species sequences with no biological relevance.

No ties are allowed in the sequence. When faced with a large group of species simultaneously, the SABAP2 Instruction Manual suggests that the atlaser "try and record the most abundant species first". But which species are most abundant? Consider this example: "Greater Flamingo #1, Red-knobed Coot #2, Egyptian Goose #3, ... Southern Red Bishop #11, ...". Obviously this observer started the pentad at a wetland of some kind, but which of the species are most abundant, the 17 flamingos seen when the atlaser first arrived at the wetland or the 2 573 Red-Bishops which were there all the while but were listed only once the larger, more conspicuous species were ticked off. And what if the atlaser arrived at the wetland mid-way through the pentad; consider: Eastern Clapper Lark #1, Crowned Lapwing #2, Ant-eating Chat #3, ..., Greater Flamingo #32, Red-knobed Coot #33, Egyptian Goose #34, ..., Red-bishop #42, ...". Which of these birds are most abundant: the pair of lapwings or the 17 flamingos? There is a fundamental principle involved here: Recording species in order of abundance is of potential value **ONLY** if it involves a specific locality at a specific point in time. It is of no value if this 'abundance listing' is preceded by other species. Again, atlasers are instructed:

> "***Do NOT count individuals*** of each species you record (unless this is part of Additional Information you are collecting, see "additional information" on p. 12)." (Harebottle *et al.* 2008, p. 16; Emphasis as in the original).

Page 12 declares,

> "It should be emphasized that the **collection of additional information will be entirely optional** and observers should not, in any way, feel obligated to collect additional information for SABAP2. However, we encourage SABAP2 observers to learn the system, and to add value to their observations by recording the additional information they observe while they are doing fieldwork for the project." (Harebottle *et al.* 2008; Bold in the original).

One can imagine our hypothetical observer writing, "Saw 17 Greater Flamingos at Bishop's Glen," without ever mentioning the *common* bishops.

In the first SABAP2 web-based newsletter (dated 21 February 2008 and available form their website, `http://sabap2.adu.org.za`) it is noted that the data from "the standard protocol, which includes (in one way or another) a two-hour-plus period of intensive fieldwork", will be subjected to "the sophisticated analyses done by macro-ecologists and biogeographers". Presumably, this "sophisticated analyses" will, amongst other things, utilise the species sequences in one way or another. At this point, further analysis of the birds at Glen is instructive.

7.1.2 SPECIES SEQUENCES OF THE BIRDS AT GLEN

The foregoing section suggested that the SABAP2 species sequences is a flawed concept. That assertion is further explored in this section. The SABAP2 Instruction Manual suggests that observations start "about an hour after sunrise". The dawn chorus sequence may therefore appear to be irrelevant to the SABAP2 species sequences. It nonetheless serves as a useful introduction to the topic.

7.1.2.1 Dawn chorus sequences at Glen

The overall sequence[2] in which birds become active in the grassland during the morning is summarised in Figure 7.1. Most species show great variability in the sequence in which they were recorded; exceptions include the Northern Black Korhaan R239, Cape Turtle-Dove R354, Spotted Thick-knee R297, Eastern Clapper Lark R495, Rufous-naped Lark R494 and the Bokmakierie R746 (Fig. 7.1).

Seasonal variation in the grassland dawn chorus sequence is illustrated for the individual species in Chapters 4 and 5. In most cases, seasonal fluctuations in dawn chorus sequence reflected changes in the timing of the first activity of the day, suggesting that the sequence in these species are in part the result of changes in behaviour, *i.e.* the birds becoming active earlier or later in the morning. Other species moving up or down in the sequence would also influence the position of a particular species. The data is rearranged by season in Figures 7.2 and 7.3, which illustrate only species attaining a maximum median dawn chorus sequence value of 20. Late spring and summer are the time of the year when the sequence of species was generally most stable, in contrast to other seasons, particularly late autumn and winter when sequences were highly variable in a number of species (Fig. 7.2; Fig. 7.3). Birds with relatively stable positions are generally those with the lowest median, mostly values of less than ten (Fig. 7.2; Fig. 7.3).

Figures 7.4 and 7.5 depict inter-specific seasonal changes in median dawn chorus positions. The Northern Black Korhaan R239 and Cape Turtle-Dove R354 showed the lowest median position overall (position #2), closely followed by the Spotted Thick-knee R297 and Rufous-cheeked Nightjar R406 (#3) (Fig. 7.1). These four, together with the Common Ostrich R001, were the only species that showed a median position of #1 during at least one season (Fig. 7.4). The Crowned Lapwing R255 was at position #4 and the Eastern Clapper Lark R495 at #5 (Fig. 7.1). Seasonal fluctuations in the median position are apparent for all of these (and other) species, with the position of the Northern Black Korhaan most stable, being in position #1 or #2 for all seasons except early winter when it was #4 (Fig. 7.2; Fig. 7.3).

[2]See "Detailed first/last activity figure" on page 136 for how this was determined.

Overall, downward shifts in the dawn chorus sequence were most frequent between early and mid-spring and between early and mid-summer, with more than half of the shared species between these seasons moving down in the sequence (Fig. 7.6). In many cases, behavioural changes caused the birds to become active later in the day, leading to positional changes (see for example Figure 4.205, page 415). The Yellow Canary R878 is a notable exception as it moved down in the sequence during mid-spring in spite of becoming active earlier in the day (Fig. 5.332, page 988). This is probably because it was already low down in the sequence during early spring (#14) and other species including the Helmeted Guineafowl R203, Egyptian Goose R102 and Cloud Cisticola R666 moved up into higher positions in mid-spring (Fig. 7.5). Another factor to take into consideration involves the five new species that moved into the sequence during mid-spring (*e.g.* Rufous-cheeked Nightjar R406), contributing to the downward movement in other species (Fig. 7.6).

Upward movements in the sequence were particularly frequent between late autumn and early winter when only a few species remained at the same position (Fig. 7.6). In this case, the correlation between upward movement in the sequence and timing of first activity of the day was less clear, presumably because a fair proportion of other species moved down in the sequence as well (Fig. 7.6).

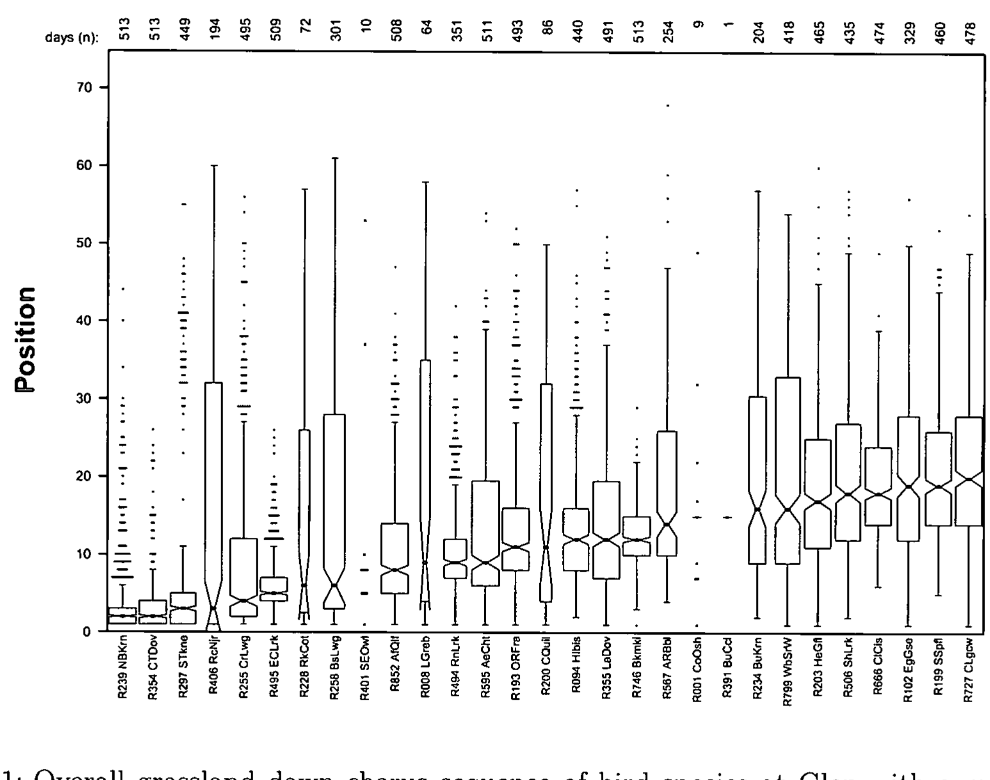


Figure 7.1: Overall grassland dawn chorus sequence of bird species at Glen with a median sequence value of 20 or less. The calculation of positions is explained on page 136. Species arranged by median values.

7.1.2.2 Field tests

For the SABAP2 species sequences to be of use, be it for an index of abundance or whatever, it must be assumed that the sequence in which birds is recorded is *repeatable*: A list compiled now

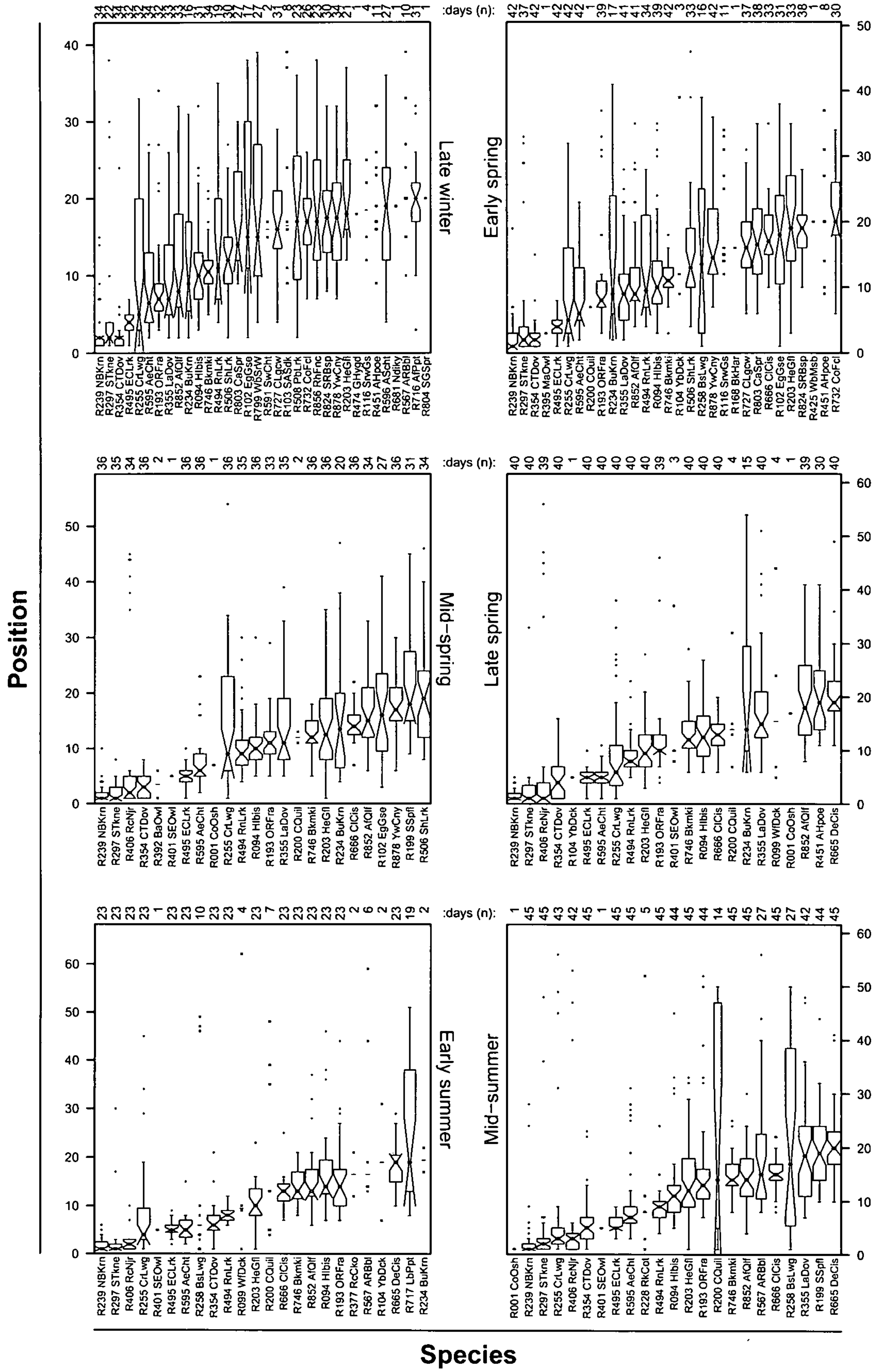


Figure 7.2: Seasonal variation (late winter to mid-summer) in grassland dawn chorus sequence for bird species at Glen with a median sequence value of 20 or less. The calculation of positions is explained on page 136. Species arranged by medians.

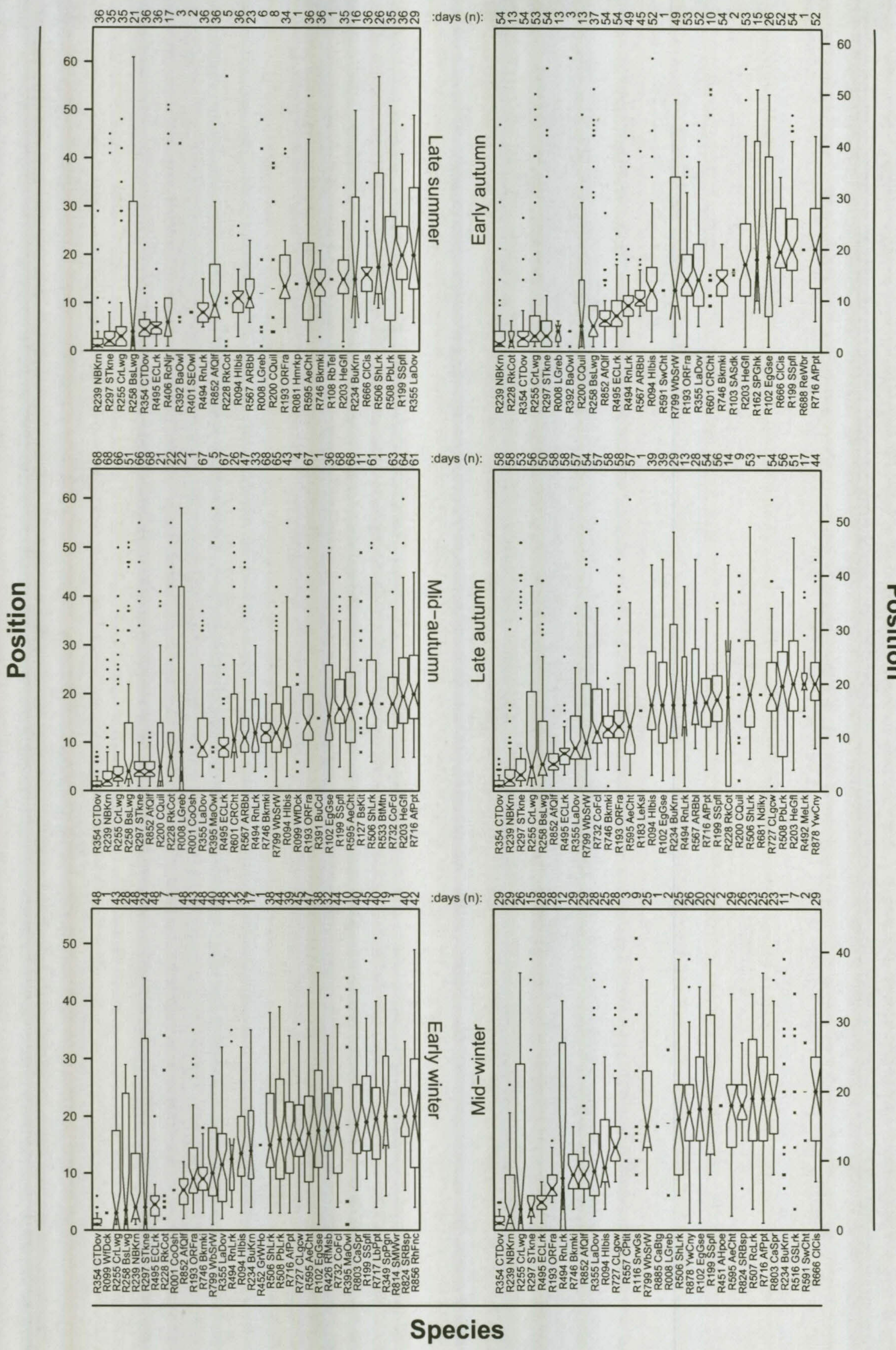


Figure 7.3: Seasonal variation (late summer to mid-winter) in grassland dawn chorus sequence for bird species at Glen with a median sequence value of 20 or less. Species arranged by medians.

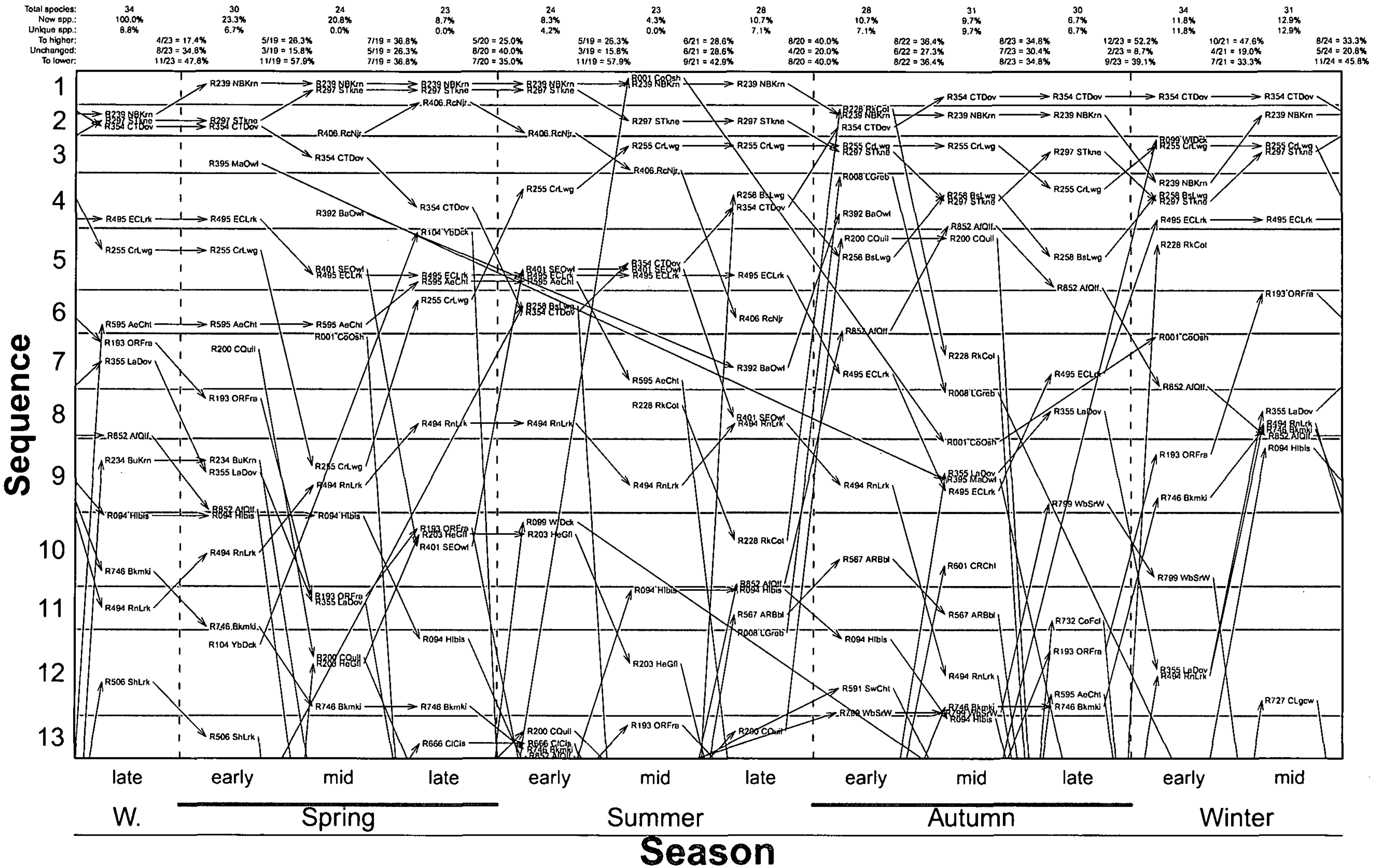


Figure 7.4: Seasonal changes in grassland dawn chorus sequence of bird species at Glen based on the median value of each season (see Figures 7.2 and 7.3). The diagram is continued in Figure 7.5 (positions 14–20). Arrows link the same species. Horizontal arrows indicate no change in position and diagonal ones upward or downward movements. The diagram is circular in the sense that lines on the right edge continue on the left. The summary statistics printed at the top are illustrated graphically in Figure 7.6.

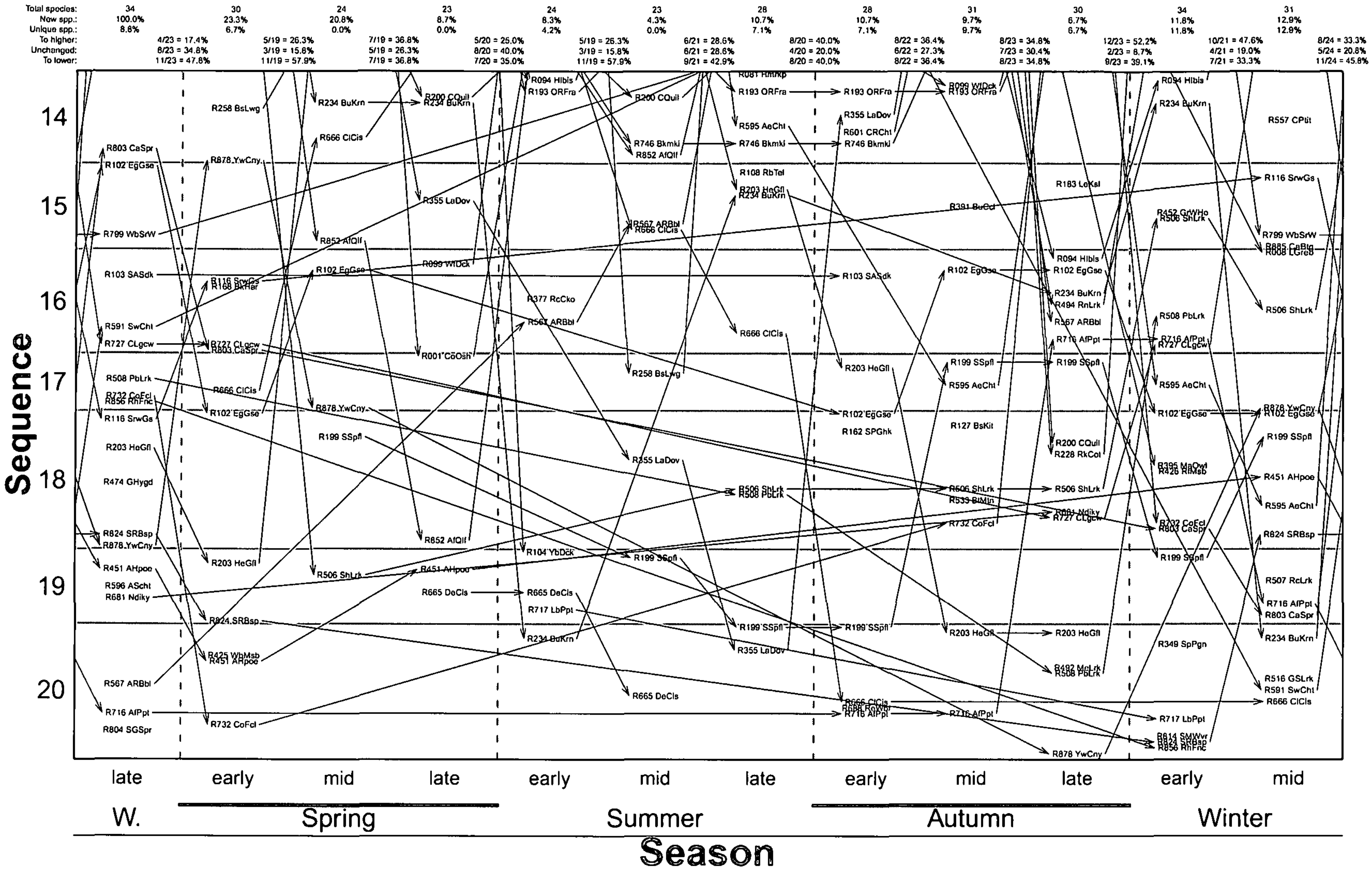


Figure 7.5: Seasonal changes in grassland dawn chorus sequence of bird species at Glen based on the median value of each season (see Figures 7.2 and 7.3). The diagram continuous from Figure 7.4 (positions 1–13). Arrows link the same species. Horizontal arrows indicate no change in position and diagonal ones upward or downward movements. The diagram is circular in the sense that lines on the right edge continue on the left. The summary statistics printed at the top are illustrated graphically in Figure 7.6.

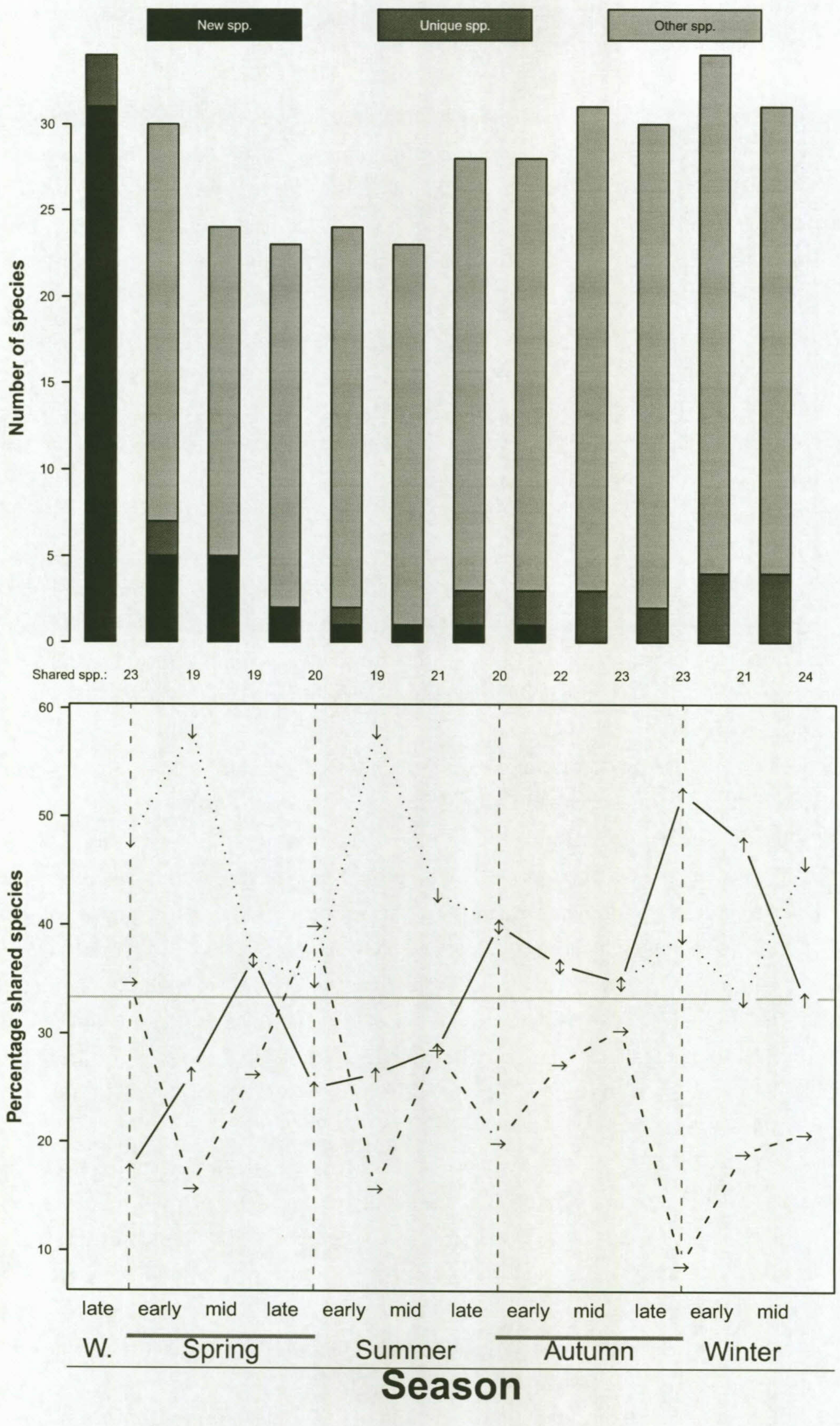


Figure 7.6: Summary statistics of seasonal changes in the grassland dawn chorus sequence of birds at Glen based on Figures 7.4 and 7.5. Arrows in the bottom figure identify lines for upward, downward or no movement in the sequence.

must have a similar sequence to one compiled a short while later. The Glen data-set offers an opportunity to test the validity of this assumption.

Test 1: The aim of this test is to investigate the degree to which species sequences are static. Days were randomly selected from those with a minimum of 10 5-minute checklists for each segment of the day (n=513 days). For each day, the following analysis was conducted. The species sequence was determined for a 60 minute period. Since the data were entered into the database in 5-minute units and not strictly in the sequence in which it was recorded for each unit in the field, the sequences are based on the specific 5-minute checklist on which a species was recorded (see page 136). This would favour the analysis towards the SABAP2 sequences because it reduces variation in the data. Note that the sequence number does not necessarily imply the number of 5-minute periods that transpired since the start of the experiment, because there could have been 5-minute periods during which no new birds were added to the list. In other words, the sequence number will always be equal to or smaller than the actual number of 5-minute periods assessed.

Twelve 60-minute periods were assessed for each day, with each period starting 5 minutes after the previous one. The SABAP2 protocol recommends that observation start about an hour after sunrise. Consequently, the first 60 minutes were started 30 minutes after sunrise, the second 35 minutes after sunrise, the third after 40 minutes, until the last 60-minute period was started 85 minutes after sunrise. Thus, the trials involve part of S1, S2 and part of S3. Table 7.1 illustrates the experimental design.

Examination of the results from a number of days shows convincingly that species sequences are dynamic. Due to space limitations, only one example is treated in full here, but the pattern for the many other days examined was similar. Figure 7.7 illustrates the results for 14 January 2004 (Figures for test 1 start on page 1077). A typical trend in all the days examined is the progressive move of species to higher positions in the sequence with every new trial; this is the result of 'new' species entering at the bottom and working their way up in the sequence (Fig. 7.7). For example, the Namaqua Dove R356 started at position #9 and an hour later it was at position #1 (Fig. 7.7). There is also a constant movement of species in and out of the top position (Fig. 7.7). The practical implication of this is that the sequence resulting from a survey that started at time x would differ significantly from a similar survey done less than an hour later *at the same place.*

On closer examination, Figure 7.7 also indicates that a few species at the top of the sequence remained there (see also Fig. 7.8). Figure 7.9 shows clearly that the position of the Northern Black Korhaan R239, Cape Turtle-Dove R354, Eastern Clapper Lark R495, Cloud Cisticola R666 and Bokmakierie R746 all stayed consistently at position #1 and the data for species with higher median values tend to be more variable.

In order to assess the consistency of this, a random sample of 100 days was subjected to the same analysis as above. All species attaining a median position of #1 during at least one of the 100 days were selected and the median values for all 100 days summarised with box-and-whisker plots in Figure 7.10. Six species attained an overall median value of one with the Orange River Francolin R193 and Rufous-naped Lark R494 recorded on little more than half the days, compared to the Northern Black Korhaan R239, Cape Turtle-Dove R354, Eastern Clapper Lark

Table 7.1: Experimental design of a test investigating the nature of species sequences. See 'Test 1' on page 1074 for details.

Minutes	Trial number											
after sunrise	1	2	3	4	5	6	7	8	9	10	11	12
30	1											
35	2	1										
40	3	2	1									
45	4	3	2	1								
50	5	4	3	2	1							
55	6	5	4	3	2	1						
60	7	6	5	4	3	2	1					
65	8	7	6	5	4	3	2	1				
70	9	8	7	6	5	4	3	2	1			
75	10	9	8	7	6	5	4	3	2	1		
80	11	10	9	8	7	6	5	4	3	2	1	
85	12	11	10	9	8	7	6	5	4	3	2	1
90		12	11	10	9	8	7	6	5	4	3	2
95			12	11	10	9	8	7	6	5	4	3
100				12	11	10	9	8	7	6	5	4
105					12	11	10	9	8	7	6	5
110						12	11	10	9	8	7	6
115							12	11	10	9	8	7
120								12	11	10	9	8
125									12	11	10	9
130										12	11	10
135											12	11
140												12

R495 and Bokmakierie R746 that were recorded on more than 95% of the trials (Fig. 7.10).

The Rufous-naped Lark is an example where sequence can lead to a useful result. This lark was recorded during 58% of the trials and showed a median position of #1 (Fig. 7.10). The correct interpretation of this is that the birds were active mainly during certain times of the year (hence the 58% reporting rate), but when active they were recorded more or less continuously (hence position #1). This conclusion stems from Figures 5.12, 5.15 and 5.18 on pages 580, 583 and 586 respectively. Note that the sequence only indicates the *continuous* nature of the behaviour and that reporting rates based on presence/absence data show the seasonal pattern (Fig. 7.11).

The interpretation of the reporting rate/sequence combination is species specific. The Orange River Francolin shows similar statistics to that of the lark with a reporting rate of 55% versus 58%, and a median position of #1 in both cases (Fig. 7.10). However, in the case of the francolin the explanation involves diurnal variation in activity and not seasonality of occurrence. Note in Figure 4.92 on page 268 how the francolin's activity becomes more frequent during S2 on intermediate reporting rate days as compared to low reporting rate days. As indicated at the top of that figure, there is no strong seasonality. The data from the 100 days likewise show an aseasonal pattern (Fig. 7.12). Thus, the lower reporting rate in the trial (Fig. 7.10) is probably the result of the observations starting too late, *i.e.* after activity ceased, on a number of days.

In the case of the lark, activity is still relatively frequent during S2, even on low reporting rate days (see Figure 5.14, page 582).

The first position represents birds recorded during the first five minutes of each trial. Further analysis of the 100 randomly selected days mentioned above shows that this was the only position where some species stayed for more than five trials (Fig. 7.13). More specifically, during nearly all of the 100 days the position of at least one species was consistently at #1 during all 12 trials (Fig. 7.13). In *all* other positions species stayed in the same position for a maximum of only five consecutive repetitions with median values of one or two (Fig. 7.13). This is an exceedingly important discovery. It means that species sequences are stable for certain species recorded during the first five minutes of a survey only. The order in which species are recorded after the first five minutes of a survey is ever-changing with species either moving up or down in the sequence. This is readily explained in terms of the differential detectability of the various species. The reason why some species are consistently recorded in the top position is that they remain conspicuous for an extended period of time, mainly by virtue of their vocal behaviour, for example the Northern Black Korhaan. In other words, these species will be recorded whenever an observation is started and they consequently end up at the top of most lists. On the other hand, the less conspicuous species are only recorded when they happen to vocalise, are flushed, fly overhead, *etc.*, hence the high turn-over in position after the first five minutes of a survey.

Test 2: From the first test if follows that species sequences are very dynamic, except for a few of the more conspicuous species that are consistently recorded at position #1. A prediction that follows from this is that surveys conducted on different days (or at different times of the day) would show a chaotic change in sequence from one day to the next, except for those few species that remain conspicuous for an extended period of time each day which will end up at the top of the list.

Although the median interval between observations at Glen was six days, there were times when observations were conducted at shorter intervals (see Figure 3.3, page 124). As shown in Figure 3.6 (page 127), there were a few periods when observations were conducted on consecutive or nearly consecutive days. A period with 12 such days (7–19 March 2005; mid-autumn) was selected, conforming to the same number of repetitions as in the first test. Observations were conducted on all of these days except the 13^{th}; observations were made during all 14 segments of the remaining 12 days except the last day which was interrupted by rain in the late afternoon. The temperature profiles for the days from 7 to 13 March were similar and suggestive of clear skies with T5cm temperatures of approximately 20°C at the beginning of segment two. From 14 to 19 March there were more cloud cover and the temperatures were somewhat lower at around 15°C. Overall, the weather of these days would have passed for SABAP2's "favourable weather conditions." One 60-minute period was assessed for each day starting an hour after sunrise as per SABAP2 recommendation. Thus, the only variable that really changed is the day.

Except for the Northern Black Korhaan R239, Cape Turtle-Dove R354 and Bokmakierie R746 at the top position, the sequence of the remaining species show a chaotic change from one day to the next, as predicted (Fig. 7.14). In addition, a number of species were recorded on certain days only (note the numerous lines crossing the figure), including the Orange River Francolin R193,

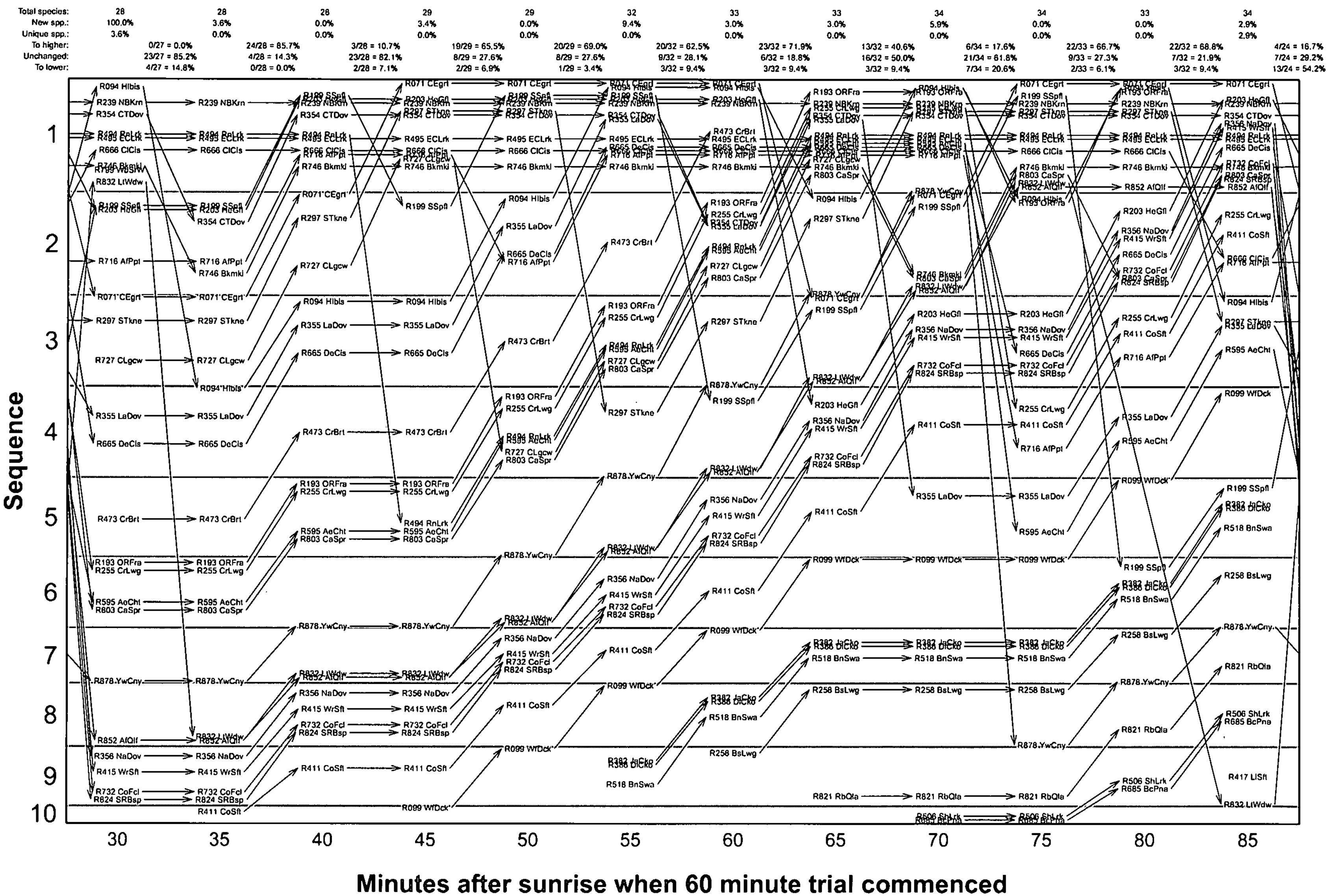


Figure 7.7: Test 1: Changes in species sequence in the grassland on 14 January 2004 [late summer] at Glen based on 12 consecutive 60-minute trials spaced five minutes apart with the first trial starting 30 minutes after sunrise. Arrows link the same species. Horizontal arrows indicate no change in position and diagonal ones upward or downward movements. The diagram is circular in the sense that lines on the right edge continue on the left. The summary statistics printed at the top is illustrated graphically in Figure 7.8. See discussion on page 1074.

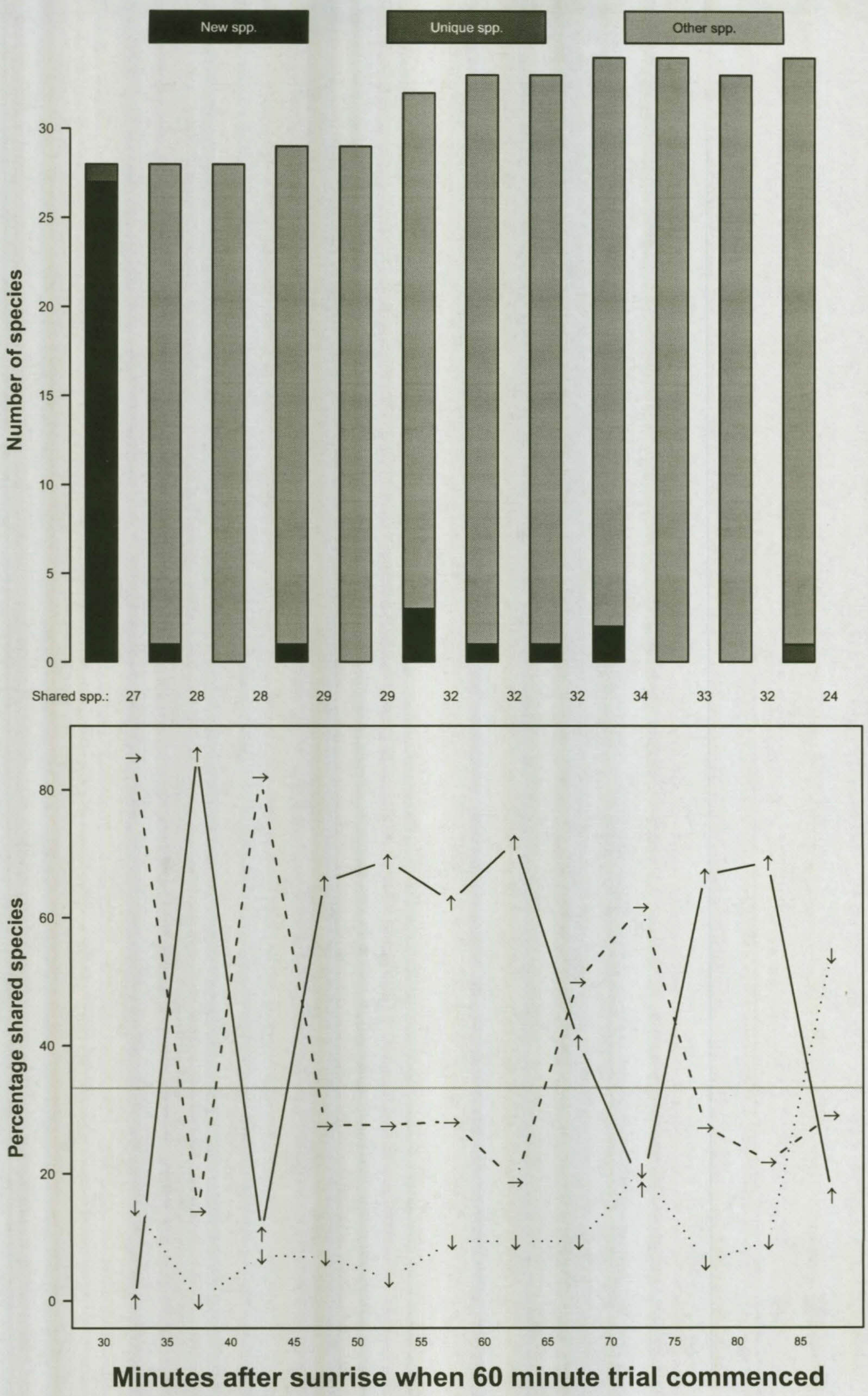


Figure 7.8: Test 1: Summary statistics of changes in species sequence in the grassland on 14 January 2004 [late summer] at Glen based on consecutive 60-minute trials spaced five minutes apart with the first trial starting 30 minutes after sunrise. Based on Figure 7.7. Arrows in the bottom figure identify lines for upward, downward and no movements in the sequence. See discussion on page 1074.

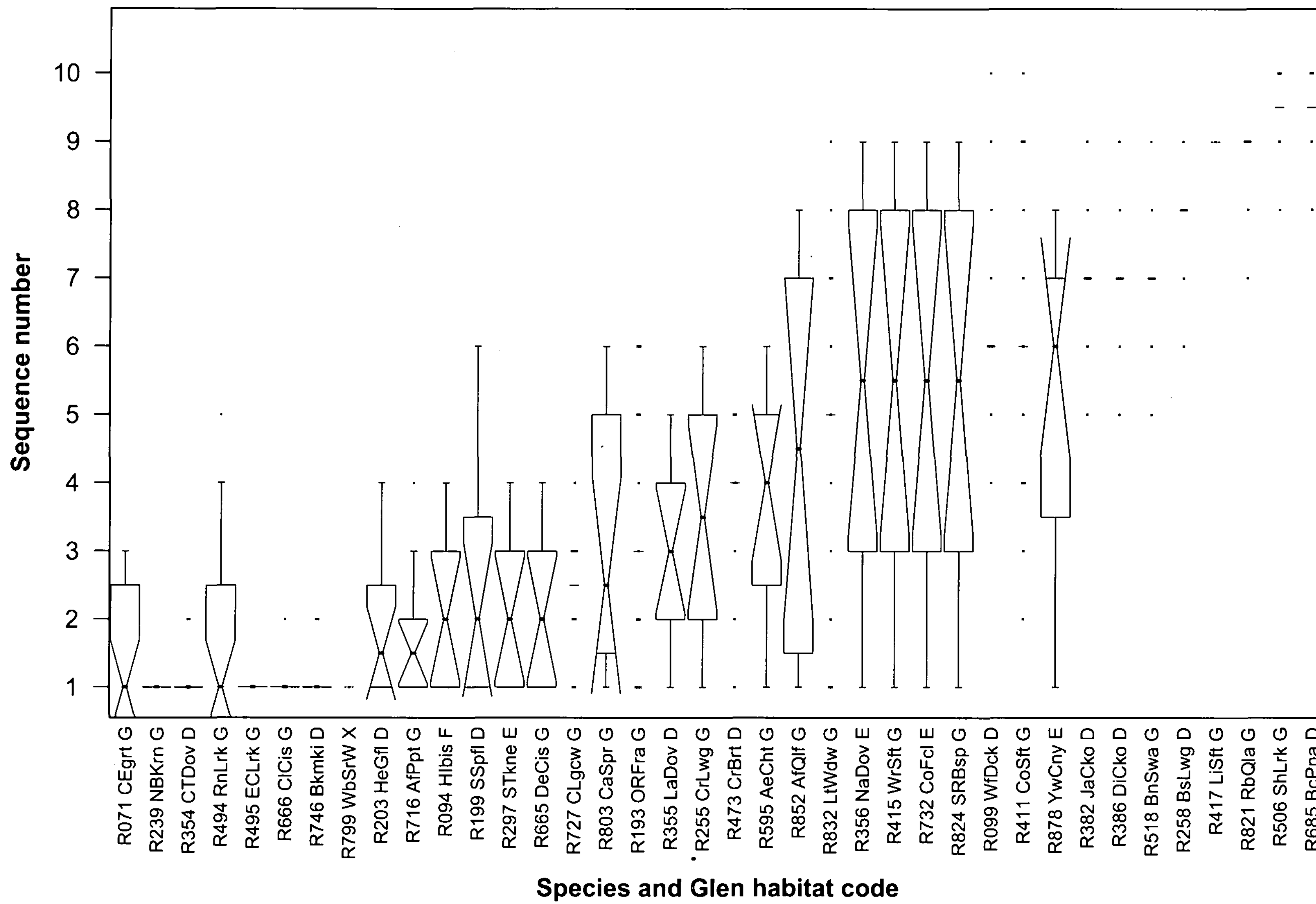


Figure 7.9: Test 1: Summary of positions attained in the grassland on 14 January 2004 [late summer] at Glen based on 12 consecutive 60-minute trials spaced five minutes apart with the first trial starting 30 minutes after sunrise. Based on Figure 7.7. See discussion on page 1074.

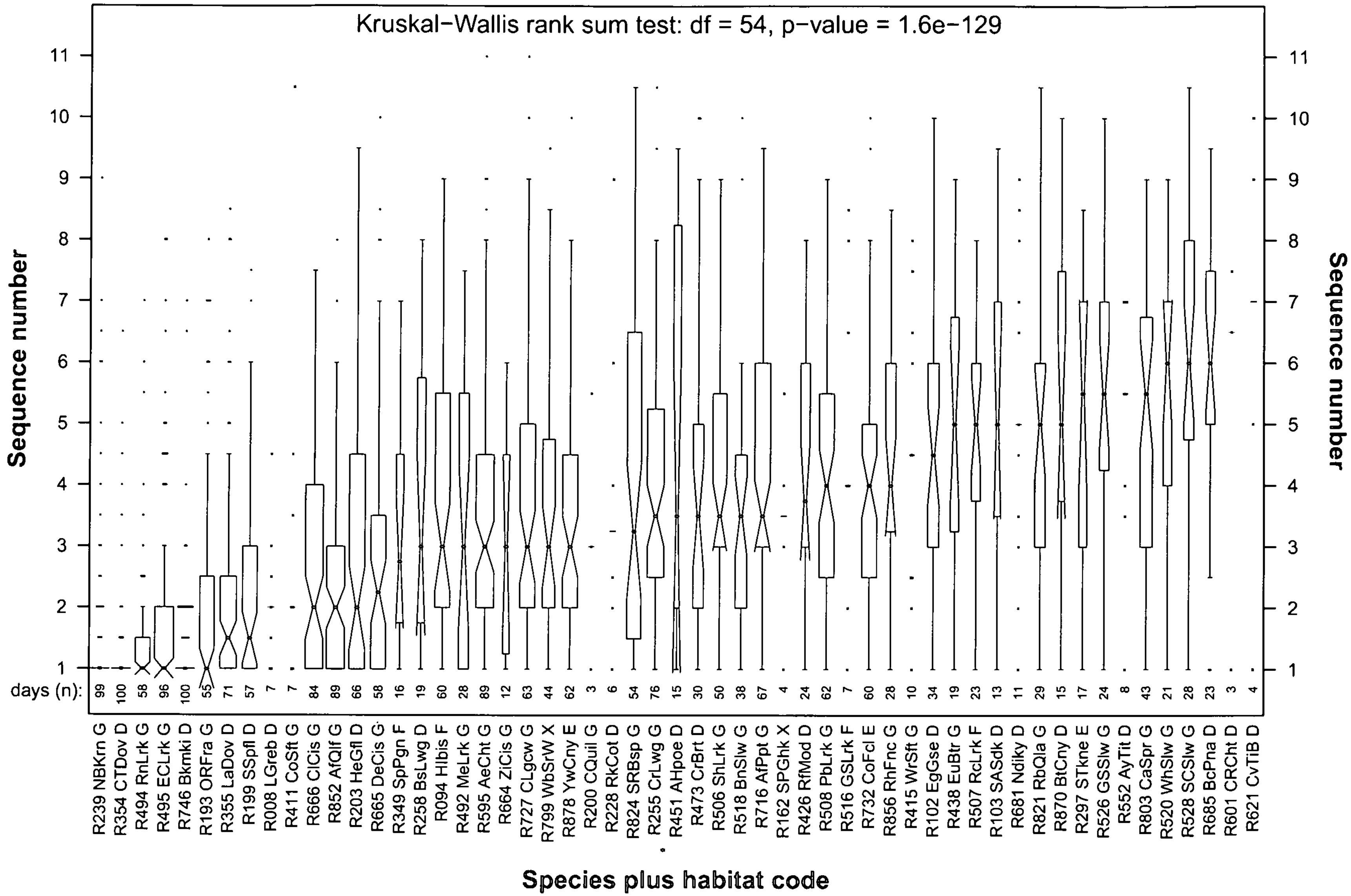


Figure 7.10: Test 1: Variation in position of all species attaining a median sequence of #1 at least once in a random sample of 100 grassland days subjected to the experimental design illustrated in Table 7.1. See page 1074.

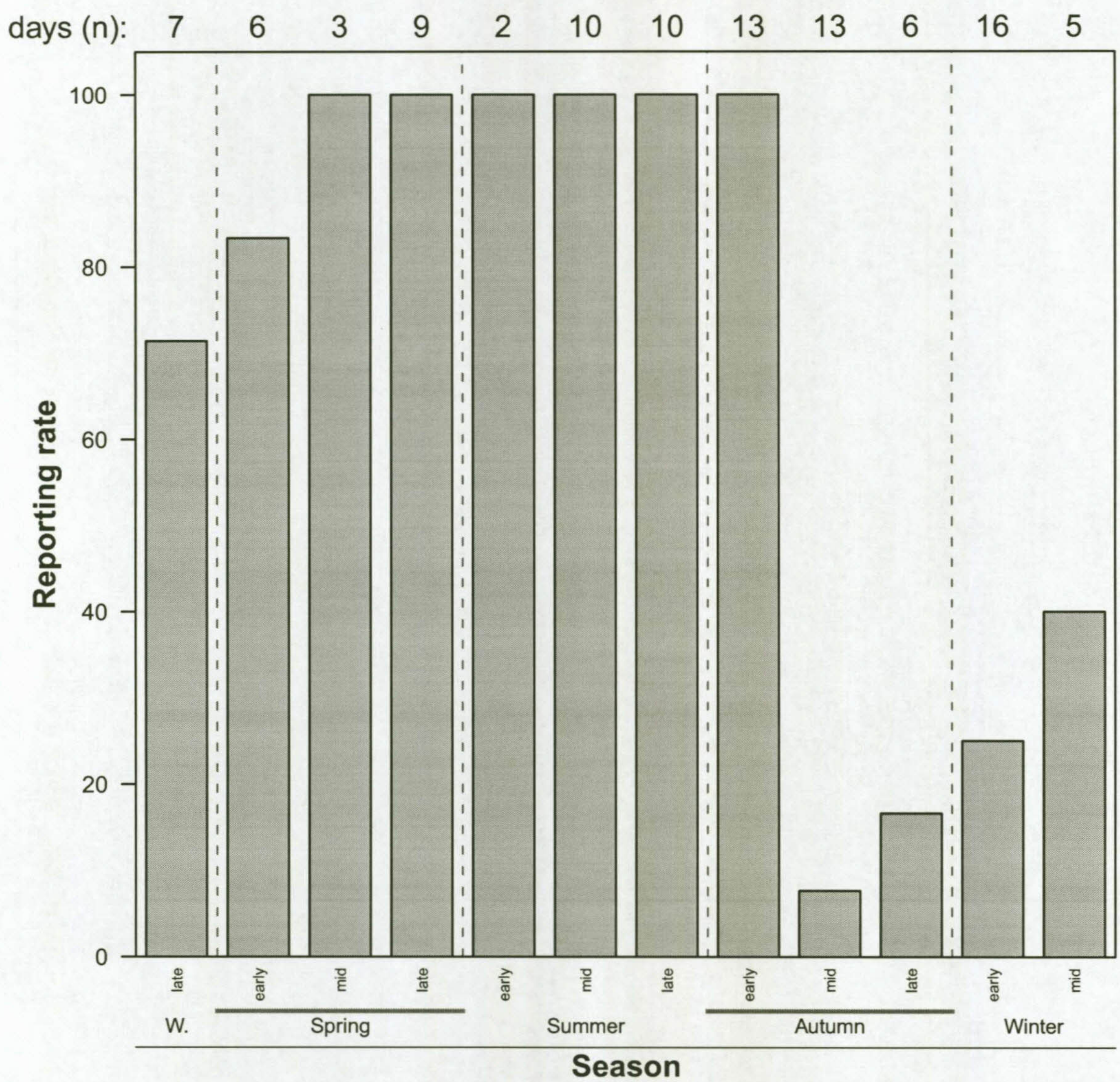


Figure 7.11: Test 1: Seasonal occurrence of the Rufous-naped Lark R494 at Glen based on reporting rates calculated from a random sample of 100 days. See page 1075.

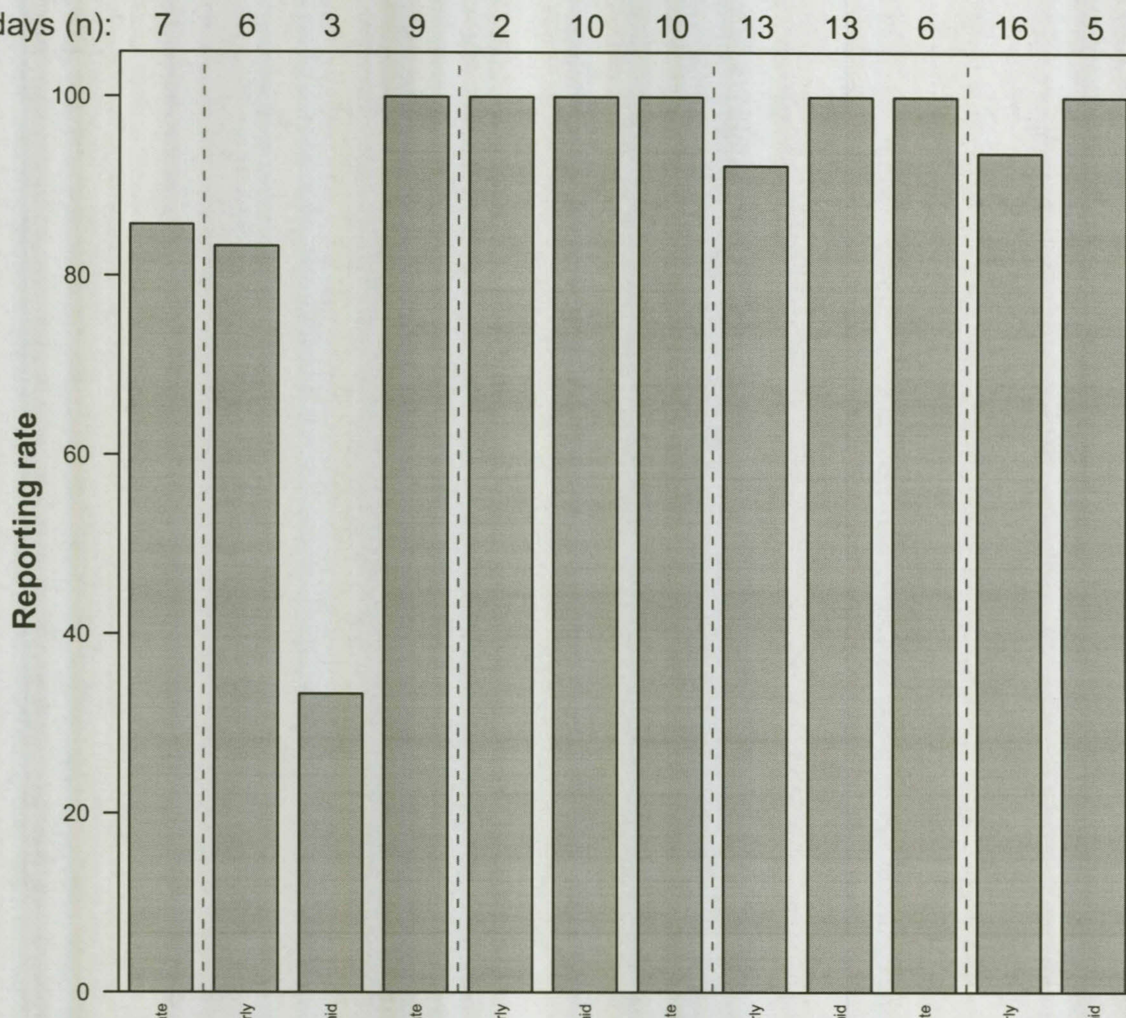


Figure 7.12: Test 1: Seasonal occurrence of the Orange River Francolin R193 at Glen based on reporting rates calculated from a random sample of 100 days. See page 1075.

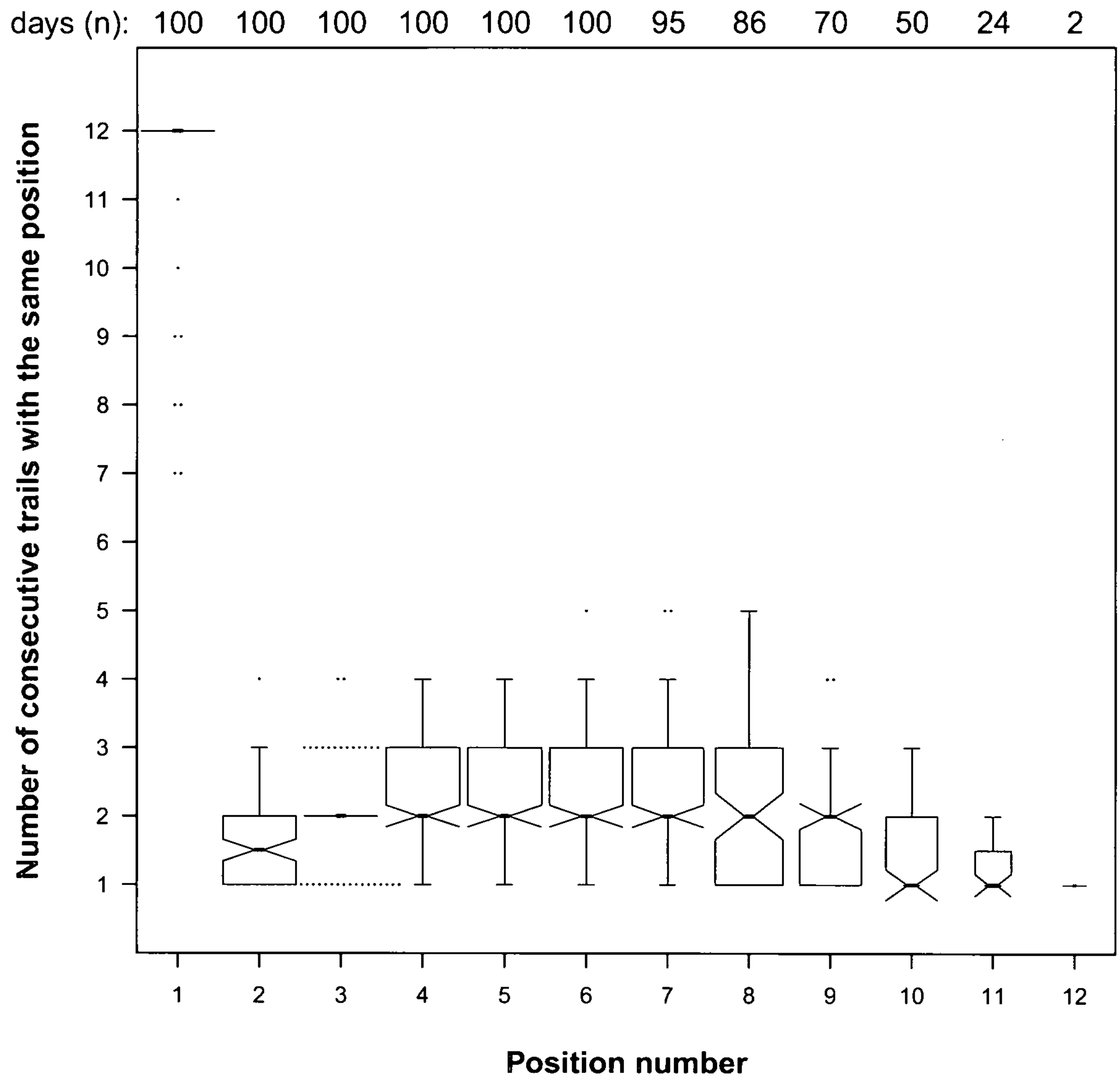


Figure 7.13: Test 1: The 5-minute position of bird species was determined for each of 12 consecutive 60-minute trials spaced five minutes apart with the first trial starting 30 minutes after sunrise. This procedure was repeated for a random sample of 100 days from the Glen database. For each day, the maximum number of consecutive trails that a species remained at a specific position was determined. This figure summarise the data by showing the number of consecutive trails with the same position versus position number. See page 1076.

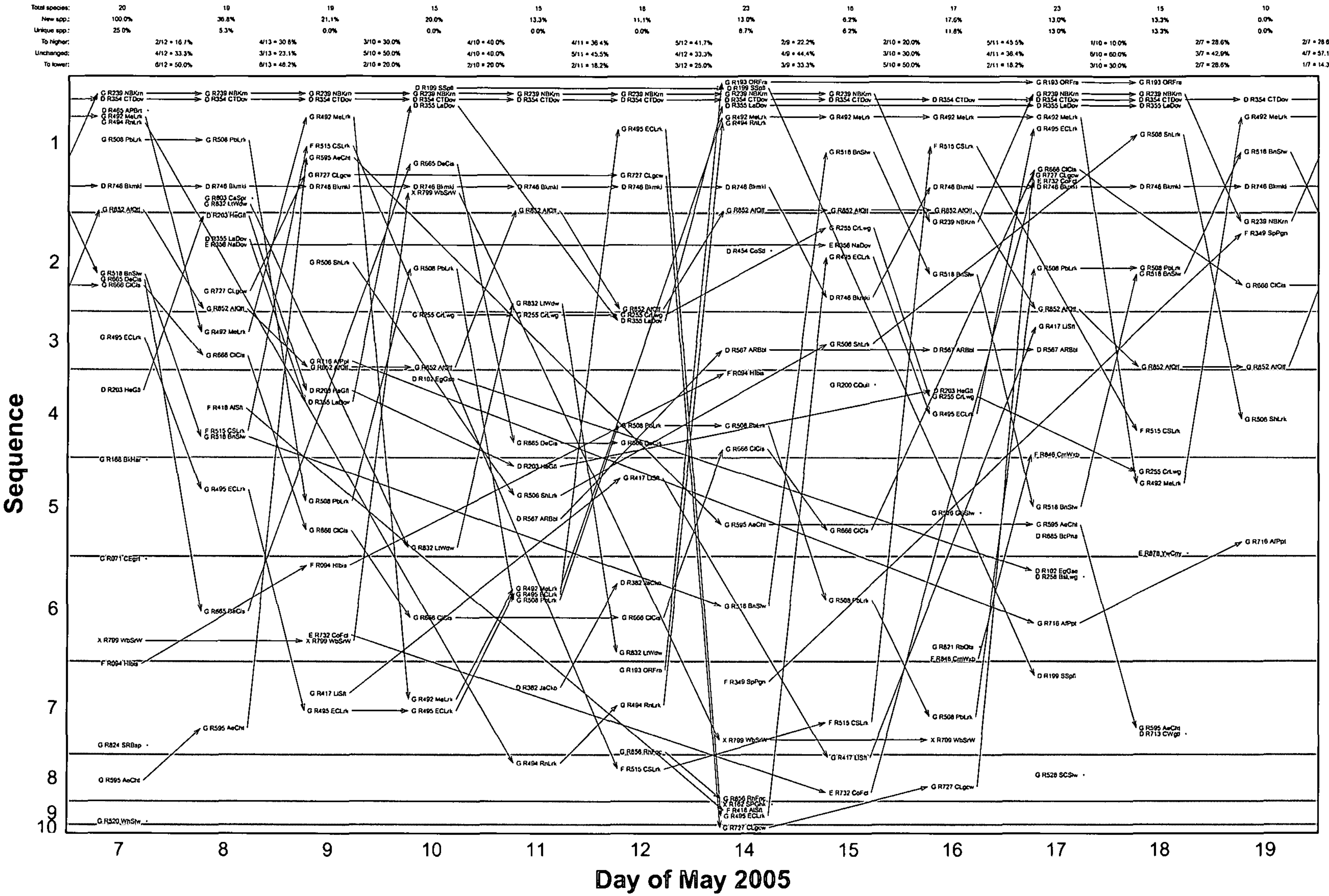


Figure 7.14: Test 2: Changes in bird species sequence between consecutive days in May 2005 at Glen with observations starting 60 minutes after sunrise on each day. Arrows link the same species. Horizontal arrows indicate no change in position and diagonal ones upward or downward movements. The diagram is circular in the sense that lines on the right edge continue on the left. The summary statistics printed at the top is illustrated graphically in Figure 7.15.

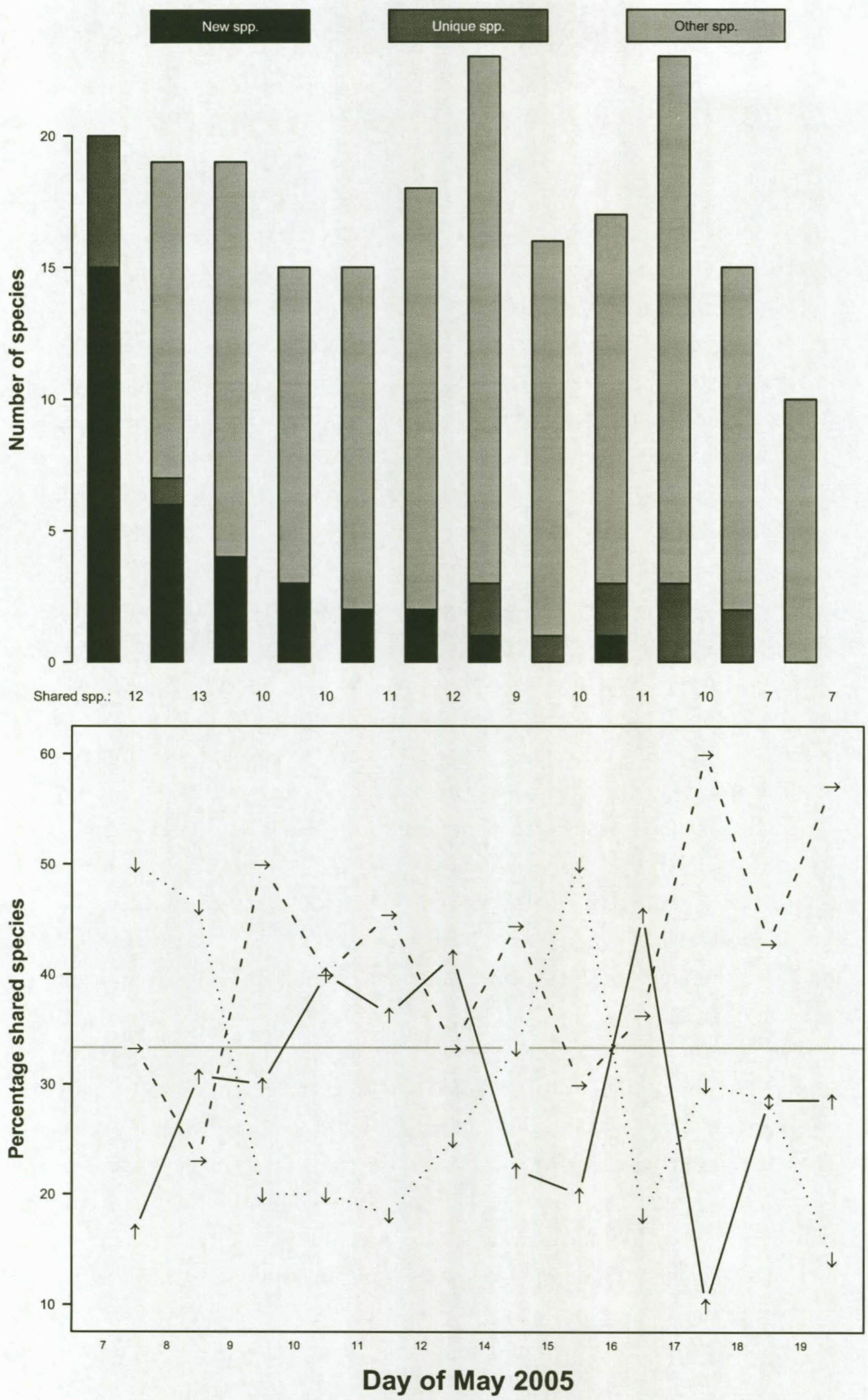


Figure 7.15: Test 2: Summary of changes in bird species sequence between consecutive days in May 2005 at Glen with observations starting 60 minutes after sunrise on each day. Based on Figure 7.14.

Swainson's Spurfowl R199, Laughing Dove R355 and Cape Longclaw R727 that were recorded in the #1 position on some days but not at all during two subsequent trials (Fig. 7.14). The total number of species ranged from ten to 23 with new species entering the sequence on all except the last day (Fig. 7.15).

Test 3: One possible criticism of Tests 1 and 2 is that they represent relative and not absolute sequences and that this would somehow invalidate the results. Test 3 uses absolute sequences as per SABAP2 protocol. A discussion on absolute sequences is appropriate at this point.

It can be surprisingly difficult to establish the actual sequence in which birds are heard or seen. To be sure, it is *easy* to list a bunch of species on paper, record their names on a voice recorder, or on whatever recording medium one prefers. The important question, however, is to what extent such lists reflect reality. It often happens that more than one species are noticed at a specific time. The sequence in which they are recorded by an observer depends on various factors. For example, suppose that two species call on an observer's attention simultaneously. The species being first recorded may be the rarer one of the two, the one that the observer likes the most, the one whose name is first remembered or found on the checklist, *etc.* In the end, one species would be #1 and the other #2 on the list. In purely mathematical terms, the difference between these two positions is $1 = 2 - 1$. Consider next a situation where you, the observer, are faced with ten species simultaneously. Your list will consist of ten species numbered sequentially from one to ten. The mathematical difference between the first and the last species on the list is $9 = 10 - 1$. The only criterion for being listed was that a species must be present. Therefore, since all ten our hypothetical species qualified equally, they each deserve the same position on the list, at least on a list that is to be used in a scientific endeavour of some kind, such as SABAP1 that use presence/absence data. In the case of SABAP2, no ties are allowed in the sequence; if it does occur it "will be flagged during the data capturing or submission process" (Harebottle *et al.* 2008). The point is that numbered species lists of the kind required by SABAP2 contain an unknown but probably significant amount of arbitrary information that is of little use, scientifically speaking.

Ordered lists, with or without numbering, do have a *practical* application. For example, when compiling a checklist in the field by writing down the species as they are encountered, it is convenient to do so in a sequential manner. This was the protocol at Glen too. Without going into the details, for each 5-minute checklist collected in the grassland, the data was often entered into the database in a different sequence than it was recorded in the field. In contrast, the drainage line data were recorded in such a way that it was always entered into the database in the same sequence as in the field. The drainage line data in the database is thus compatible with the SABAP2 protocol as far as species sequences are concerned.

The drainage line data-set is mainly limited to S0 and S1 and this places certain restrictions on the analysis. The design of Test 3 is similar to that of Test 1 except that each repetition is for 30 minutes only (instead of 60) and the end of the last trial is at the last observation conducted, approximately 70 minutes after sunrise. The data for all 43 mornings are used.

Based on absolute sequences, the number of consecutive trials in which at least one species attained the same position was virtually always one or two (Fig. 7.16). This means that the absolute position is highly dynamic for ALL species. By contrast, when the same data is analysed

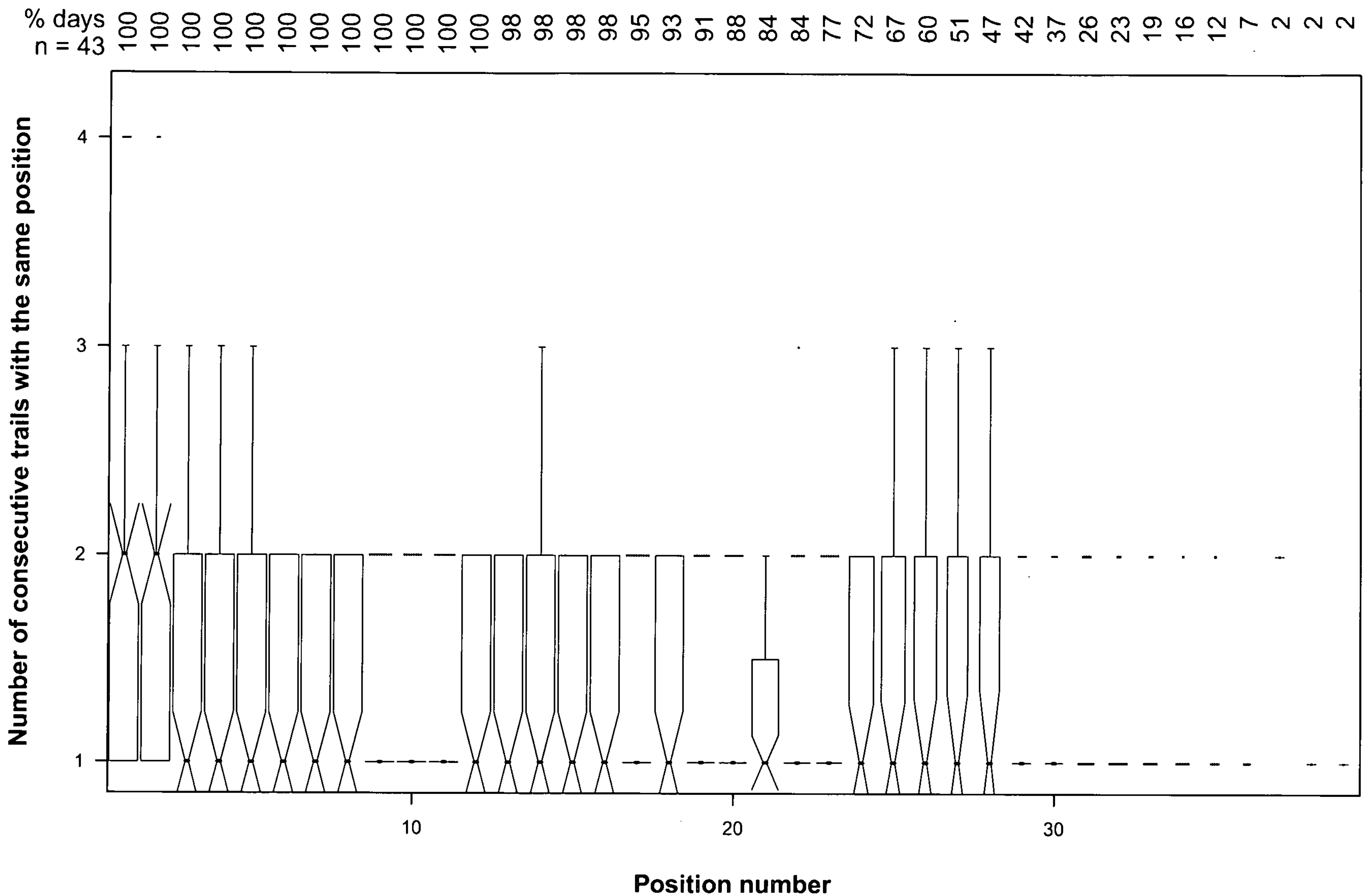


Figure 7.16: Test 3: The absolute sequence of bird species was determined for a 30-minute period on 43 mornings during 2007/8 in the drainage line at Glen. For each morning the maximum number of consecutive trails that a species remained at the same position was determined for each position. This figure summarises the data by showing the number of consecutive trails with the same position versus position number. See page 1086.

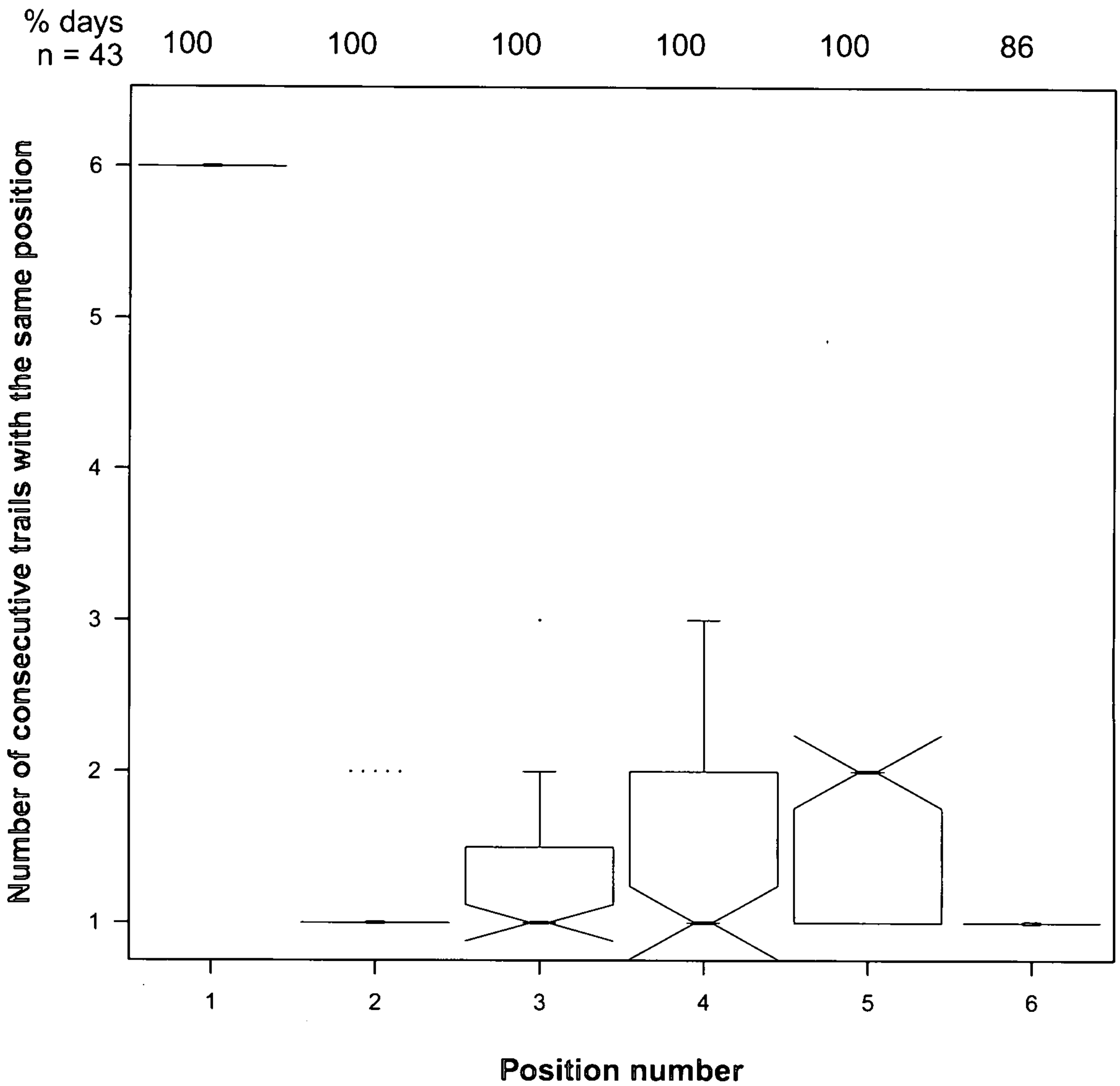


Figure 7.17: Test 3: The 5-minute sequence of bird species was determined for six consecutive 30-minute periods spaced 5 minutes apart using the data collected during 2007/8 in the drainage line at Glen. For each morning (n=43) the maximum number of consecutive trails where a species remained at a specific position was determined. This figure summarises the data by showing the maximum number of consecutive trails per day with the same position versus position number. See page 1086.

using relative sequences (birds recorded per 5-minute period), then all the days showed at least one species in position #1 during all six trials, compared to other positions where species usually remained at a particular position in the sequence for only one or two consecutive trials (Fig. 7.17).

The results of this test show that absolute sequences *destroy* the pattern revealed by relative sequences. The reason for this is that absolute sequences as employed in SABAP2 are arbitrary. At Glen, and in particular in the drainage line, there was often a number of species active at a time. The order in which they were recorded in the field-book reflects nothing more than the sequence that the observer managed to record them as quickly as possible.

7.1.2.3 Discussion

This section set out to test a key (unstated) assumption of the SABAP2 species sequences, namely that there is an inherent sequence in which species are recorded. The tests show that the species sequence remains stable for certain species *only* during the first five minutes of a survey. Sequences determined after the first five minutes are ever-changing and thus of no use. Unfortunately, the SABAP2 protocol requires that a time marker be noted on the list for each hour only. There is, therefore, no way to determine which birds were recorded during the first five minutes. However, even if such a marker separated the species, it would still not help the SABAP2 data analyst because there are other fundamental flaws in the protocol too.

The SABAP2 protocol completely ignores the influence of habitat on species sequences. It must be remembered that each of the tests above were based on data from one specific location and habitat only, and that time was the only variable that changed. It shows convincingly that species sequences are in a constant state of flux beyond the first five minutes of a survey and that numerous species move in and out of this first 5-minute period. This proves to be the case in both the grassland and the drainage line.

Species consistently recorded during the first 5 minutes are those that are conspicuous (vocal) for an extended period of time. It is conceivable that each habitat will have its own set of these species. For example, considering only species with a median position of #1, four of the six species (66.7%) recorded in the grassland (based on a sample of 100 days) were associated with that habitat (Fig. 7.10). By contrast, in the drainage line there were 12 species of which eight (66.7%) were associated with the drainage line (Fig. 7.18). This is submitted as further proof that the order in which habitats are visited does influence species sequences. It also shows that a list compiled in one habitat may be 'contaminated' by species from another. In addition, there are a host of other species that also featured in the number one position at one time or another (Fig. 7.10; Fig. 7.18).

As a generalisation, it may be said that at each location there are two types of sequences in which species will be recorded at any given time. The first is a *predictable sequence* involving species that are conspicuous for extended periods, and as a result they are amongst the first to be recorded during that interval. There are many other species that call on the observer's attention at these times too, but they do so in a more or less random manner. Collectively, they constitute an *unpredictable sequence.* These birds may appear at the top of the list in a haphazard way, creating analytical 'noise'. The unpredictable sequence is ever-changing and thus of no biological

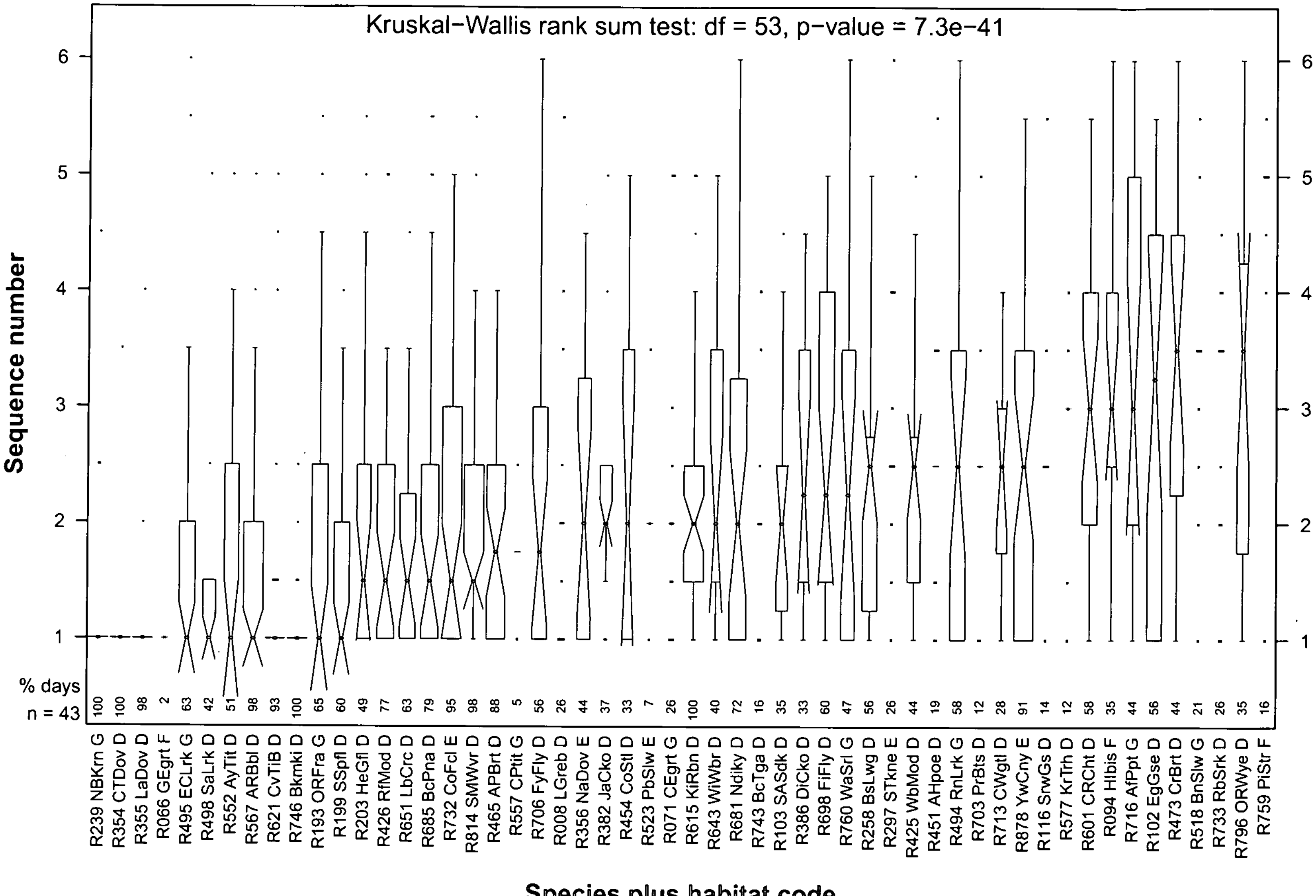


Figure 7.18: Variation in position in the drainage line of all bird species attaining a median sequence value of one at least once in 43 mornings subjected to an analysis similar to that used in the SABAP2 species sequence test #1.

relevance, in contrast to the predictable sequence which could potentially be of use.

The implication of the above is that a SABAP2 observer roaming about in a pentad from one habitat to the next will be moving from one set of sequences into the next. In other words, his or her list would end up being a *mixture* of a number of predictable and unpredictable sequences, amounting to a biologically meaningless sequence of species. In addition, Ricklefs (1981) made the important point that "factors influencing detectability appear to be so numerous and complexly interrelated that it is not yet possible to judge the detectability of *particular species* under *particular conditions* simply by generalizing past experience. Therefore, the error inherent in the census techniques employed in a particular study can be estimated accurately only by direct validation." (Emphasis added). If this is true for a "particular species", then it is inconceivable how *any* SABAP2 analysis, no matter how "sophisticated", could ever model the detectability of numerous species simultaneously *and* after the fact. SABAP2 should take note of the "caveats" highlighted by Harrison & Underhill (1997) and Underhill *et al.* (1992) for the interpretation of the atlas data, because it militates against the use of the SABAP2 species sequences.

The tests presented above exposed the nature of species sequences and call into question not only the SABAP2 protocol (species sequences in particular), but all current methods that rely on such sequences. For convenience, these methods are henceforth term species sequence methods. The idea behind species sequence methods is that the "commoner species are likely to be recorded, on average, before rarer ones", as Freeman *et al.* (2003) expresses it. It is consequently assumed that the weights assigned to species based on *when* they were seen/heard have some biological relevance. However, whereas the experiments above indicate that only two weight levels may be appropriate (*i.e.* species recorded during the first 5 minutes of a survey versus the rest), species sequence methods rely on *multiple* weights without there being any good theoretical basis for it (see also Bibby *et al.* 2000, pp. 121-122).

Being well aware of this deficiency of species sequence methods, Freeman *et al.* (2003) attempted to "establish a theoretical background to the analysis of both TSC [Timed Species Count; a species sequence method; see Pomeroy & Dranzoa 1997; Pomeroy 1992; Trager & Mistry 2003] and frequency-type data ... In order to model this situation, we make an additional assumption that birds of a particular species are encountered at random at a constant rate." But how can it be random *and* at a constant rate? The data from Glen indicates that there are a few species that are encountered at a constant rate but not randomly, *i.e.* more or less continuously due to their conspicuous nature, at least during certain times of the year. The rest of the species are encountered at random, but certainly not at a "constant rate". Therefore, it appears that the "additional assumption" of Freeman *et al.* (2003) is invalid, and since their model is based thereon, it is probably flawed too.

It is not presently known to what extent the findings at Glen could be generalised. It does seem to make logically sense. Researchers, particularly those planning to use a species sequence method, are encouraged to replicate Tests 1, 2 and 3, or similar tests, elsewhere.

7.2 When is the best time to do atlasing?

From a SABAP2 point of view, the best time to do atlasing would be that time of the day when the most species could be recorded. The Instruction Manual states:

> "This initial intensive survey should be approached along the lines of a Birding Big Day (BBD) exercise, *i.e.* try to visit as many different habitats to record as many different species as possible within the minimum time period." (Harebottle *et al.* 2008)

The focus of the study at Glen was different, namely to monitor the activity patterns of birds at a specific location. As such, it offers an opportunity to explore the question of this section in more detail.

Overall, the number of species recorded per day follow a clear seasonal trend, with more species recorded during summer (*ca.* 50 species per day) than during winter (*ca.* 35 species per day) (Figure 7.19). From an atlasing perspective, this is perhaps not so important because observers are encouraged to do surveys throughout the year. The daily occurrence pattern is more important in this respect.

Based on median values, the highest number of species was recorded in the early morning (*ca.* 20 species per segment per day) with a secondary peak in the late afternoon before sunset (Fig. 7.20). The lowest number of species was recorded in the early afternoon (Fig. 7.20). Apart from changes in the absolute number of species, the overall pattern was similar for all 12 seasons (Fig. 7.21).

7.2.1 ZERO RECORD DAYS

Although it may seem counter-intuitive at first, the occurrence of 5-minute checklists with no records may provide some useful insights too. The following paragraphs detail the occurrence of such checklists. Figures start on page 1097).

Annual occurrence of zero records in the grassland: Noted on three quarters of the days with an activity index of seven (Table 7.2a). Recorded during all or nearly all seasons each year (Fig. 7.22). Daily reporting rates ranged from 0.5-39.1% with 96.8% bird-days attaining low values; median daily reporting rates showed limited annual variation (Fig. 7.22).

Seasonal occurrence of zero records in the grassland: Recorded during 10-11 years in all seasons, except in early summer when recorded during only eight years (Fig. 7.22). The seasonal frequency index was also slightly lower from mid-spring to early summer (Fig. 7.22), corresponding to a relatively high occurrence of days during which there were no 5-minute checklists with zero records (Fig. 7.23). Median daily reporting rates were slightly higher in late winter (Fig. 7.22).

Daily occurrence of zero records in the grassland: Overall, most frequently recorded during the early morning before sunrise and again after sunset (Fig. 7.22). Considering only the period between sunrise and sunset, it was relatively frequent in the mid-afternoon (Fig. 7.22).

Table 7.2: No birds recorded: Numerical data summary of 5-minute checklists compiled in the study area at Glen.

Proportion	5-minute checklists			Activity	Days			Activity
	n	Total	%		%	Total	n	index
a) Grassland data-set for all 11 years (excl. days with <10 obs. segs.)								
1.000	3 253	114 612	2.8	nul	75.9	656	498	7
b) Drainage line data-set for 2007/8 – segments 0 and 1 only:								
1.000	69	1 190	5.8	nul	69.8	43	30	2
c) Grassland data-set for 2007/8 – segments 0 and 1 only:								
1.000	96	1 188	8.1	nul	69.8	43	30	3

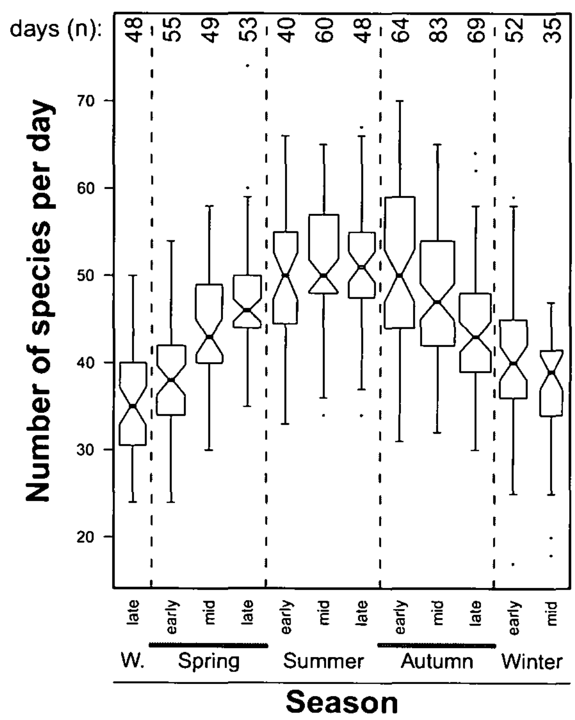


Figure 7.19: Seasonal variation in the number of bird species recorded per day in the grassland at Glen. Based on 513 days during which observations were conducted during all 14 segments.

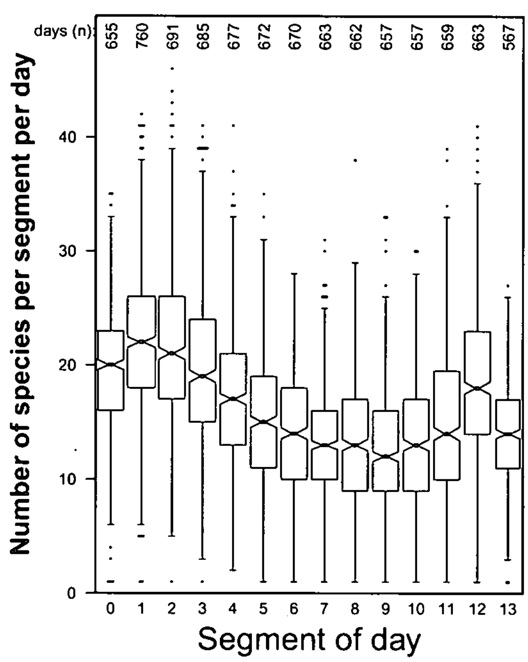


Figure 7.20: Daily variation in the number of bird species recorded per segment per day in the grassland at Glen. Based on 513 days during which observations were conducted during all 14 segments.

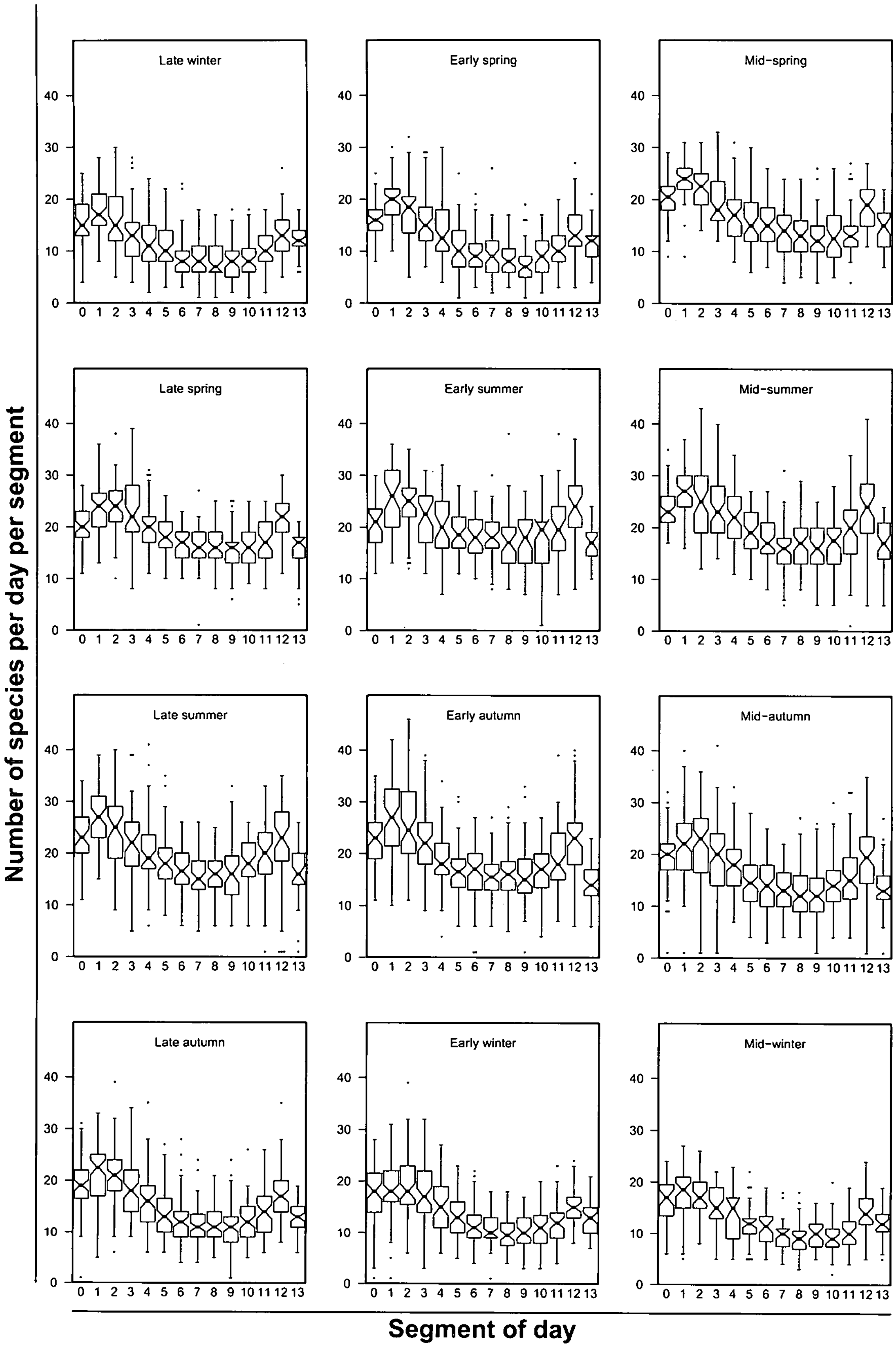


Figure 7.21: Daily variation in the number of bird species recorded per segment per day per season in the grassland at Glen. Based on 513 days during which observations were conducted during all 14 segments. The scale is the same for all seasons.

A similar pattern is noticeable for all seasons (Fig. 7.24). All three segment combinations that occurred during more than 5% of the days involved S0 and S13; collectively these combinations accounted for nearly half of all zero-days and were particularly frequent during autumn (Fig. 7.25).

The first zero record of the day occurred during the first 5-minute interval of the day on less than half of all zero-days (Fig. 7.24; Fig. 7.26). Seasonally, median values were at or close to the first 5-minute interval of the day from late summer to late winter (Fig. 7.24; Fig. 7.26).

The last zero record for the day was at the last 5-minute interval of the day on only half of all zero-days (Fig. 7.24; Fig. 7.26). The median values of all seasons were at or close to the last 5-minute interval of the day (Fig. 7.24; Fig. 7.26).

Early morning occurrence of checklists with zero records during 2007/8: The incidence of days with zero records was similar between the grassland and the drainage line (Table 7.2b & c). However, the early morning reporting rate was slightly higher in the grassland than in the drainage line (Fig. 7.27). Nevertheless, in both habitats no mornings with zero records occurred during mid-summer and high reporting rate mornings occurred during mid-winter only (Fig. 7.27). The first occurrence of the day was similar too, with a median of 80 minutes before sunrise (Fig. 7.27).

Discussion

Most of the birds in the study area at Glen are generally assumed to be diurnal. The activity of most of these species usually starts some time before sunrise. Because the study was focused on the activity patterns of these species, it was aimed to commence observations before their activity started and to continue until activity ceased (see Figure 3.4, page 125). Hence the peaks in occurrence of checklists with zero records before sunrise and after sunset (Fig. 7.22). During these peak periods zero records occurred during only about half of the days (Fig. 7.22). This is partially explained by the activity of nocturnal species at these times, particularly the Rufous-cheeked Nightjar R406 (Fig 4.243, page 465) and the Spotted Thick-knee R297 (Fig 4.169, page 368). In addition, certain 'diurnal' species are frequently active at these times too, including the Northern Black Korhaan R239 (Fig. 4.142, page 331) and Cape Turtle-Dove R354 (Fig. 4.192, page 399). In fact, the latter two species were frequently the first ones recorded in the morning (Fig. 7.1), even when the activities of the nocturnal species were at its peak (Fig. 7.4).

At other times of the day, zero records were most frequent in the early afternoon (Fig. 7.22; Fig. 7.24). This conforms to the trend seen in permanent and temporary residents where low levels of activity most frequently occurred at these times (Fig. 6.36).

7.2.2 WHAT IS THE BEST TIME TO OF THE DAY TO DO ATLASING?

The following analyses are based on the 513 days with at least ten 5-minute checklists per segment (S0–S13). For each day the number of species recorded per 15-minute window was determined, starting with the first observation of the day at dawn (see Figure 3.4, page 125). After determining the number of species, the 15-minute window was advanced forward five minutes and the process repeated until the end of the observation at dusk (Fig. 3.4). The

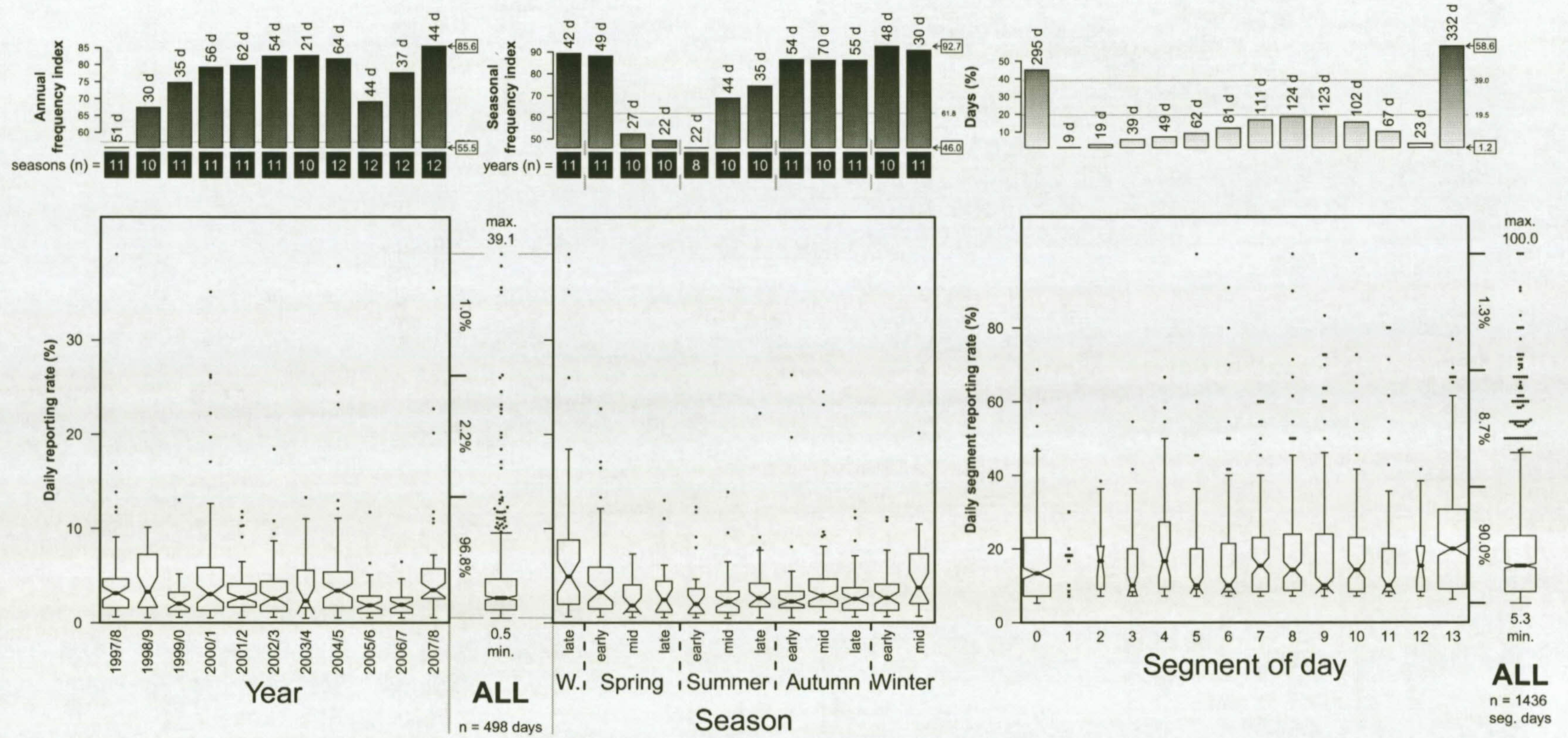


Figure 7.22: No birds recorded: Annual (left), seasonal (middle) and daily (right) occurrence in the grassland at Glen. See page 132 for more information on this general summary figure.

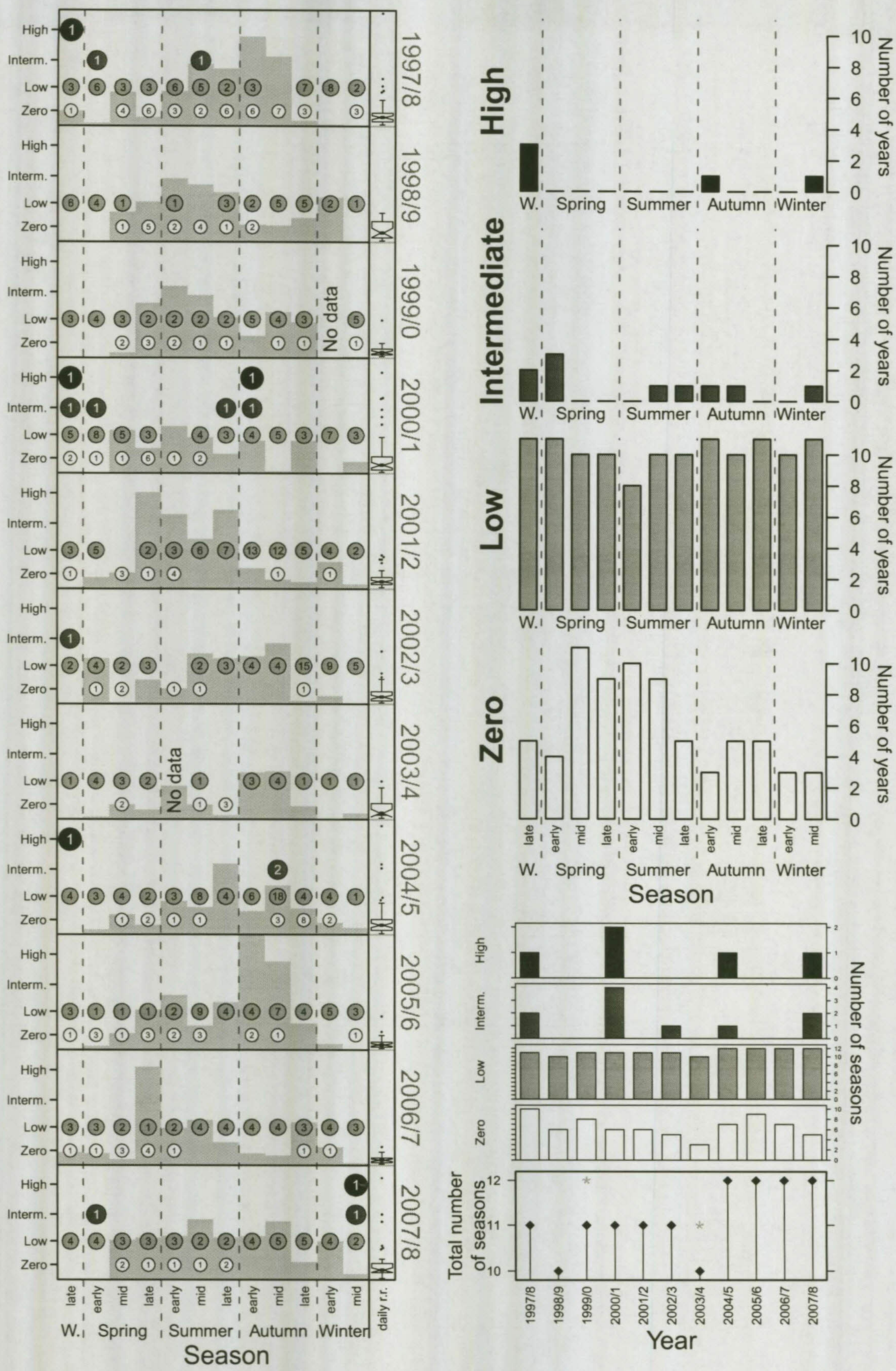


Figure 7.23: No birds recorded: Occurrence of zero, low, intermediate and high reporting rate days in the grassland at Glen. The figures on the right summarise the data on the left. See page 134 for more information on this yearly detail figure.

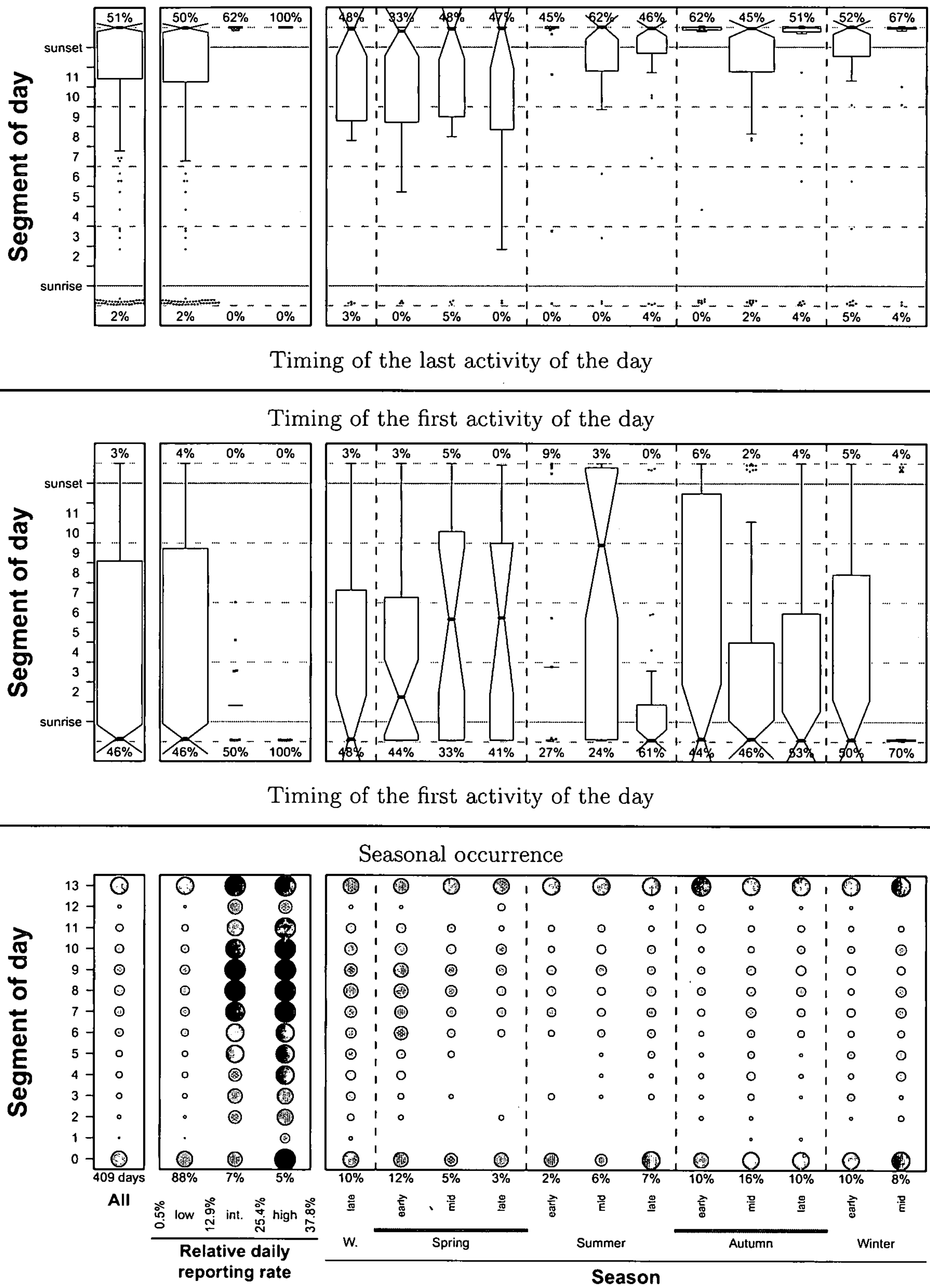


Figure 7.24: No birds recorded: Details on daily occurrence in the grassland at Glen. See page 135 for more information on this daily activity figure.

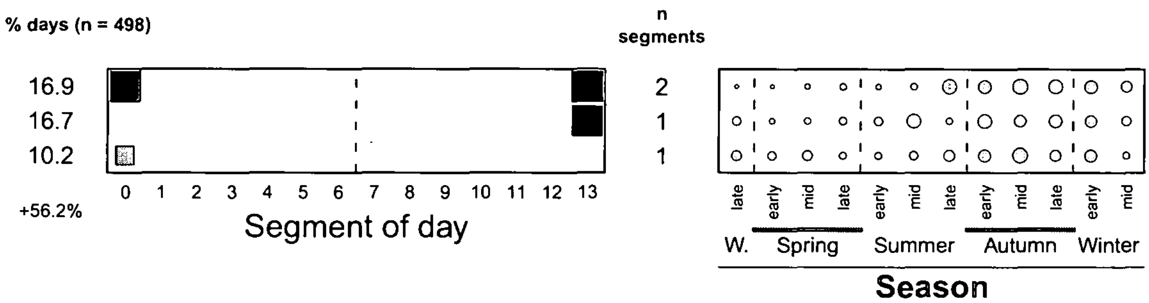


Figure 7.25: No birds recorded: Daily occurrence of activity during segment combinations in the grassland at Glen. See page 135 for more information on this bird-segment combination figure.

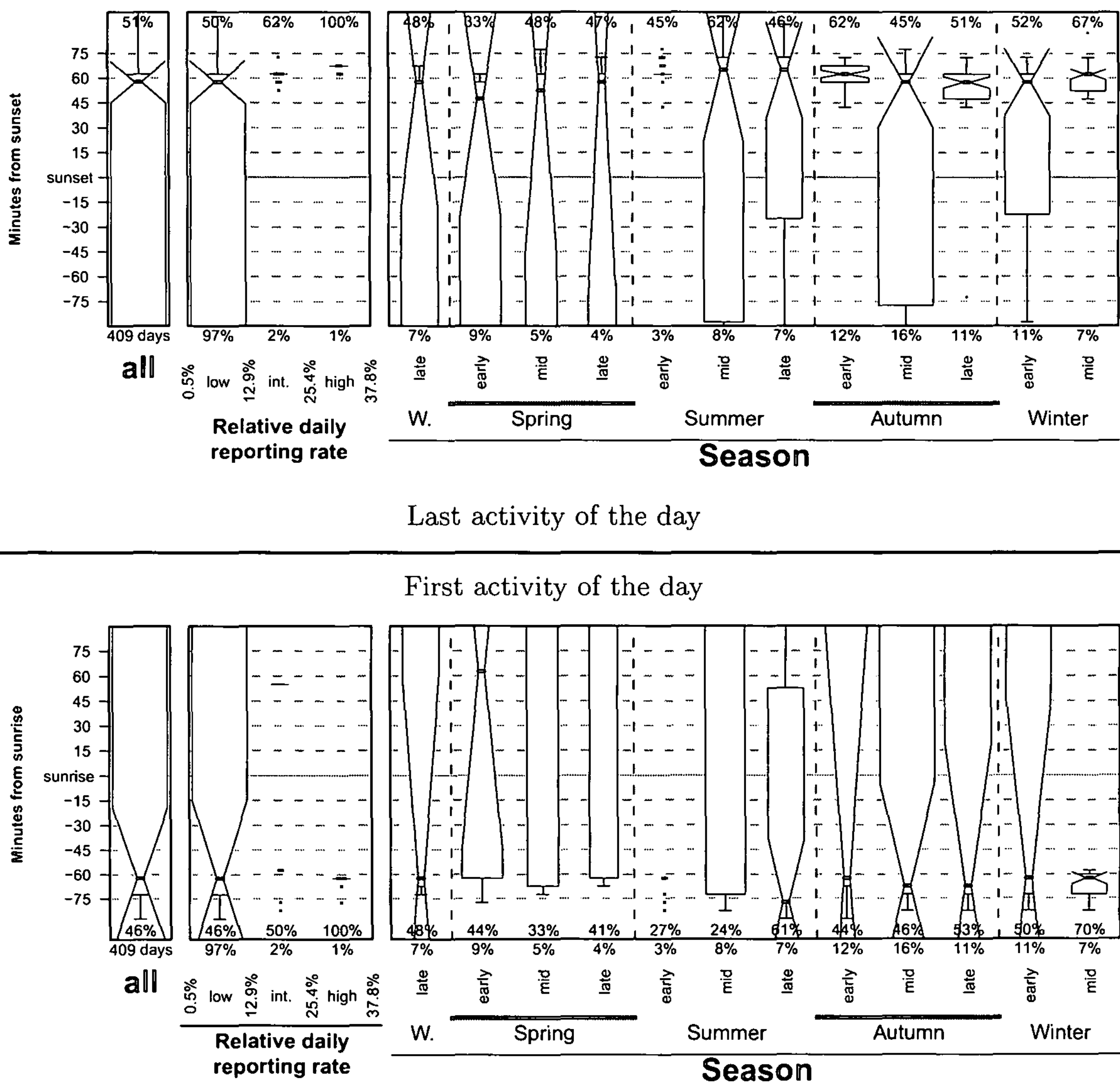


Figure 7.26: No birds recorded: Details of the first (bottom) and last (top) occurrence of the day in the grassland at Glen. See page 136 for more information on this detailed first/last activity figure.

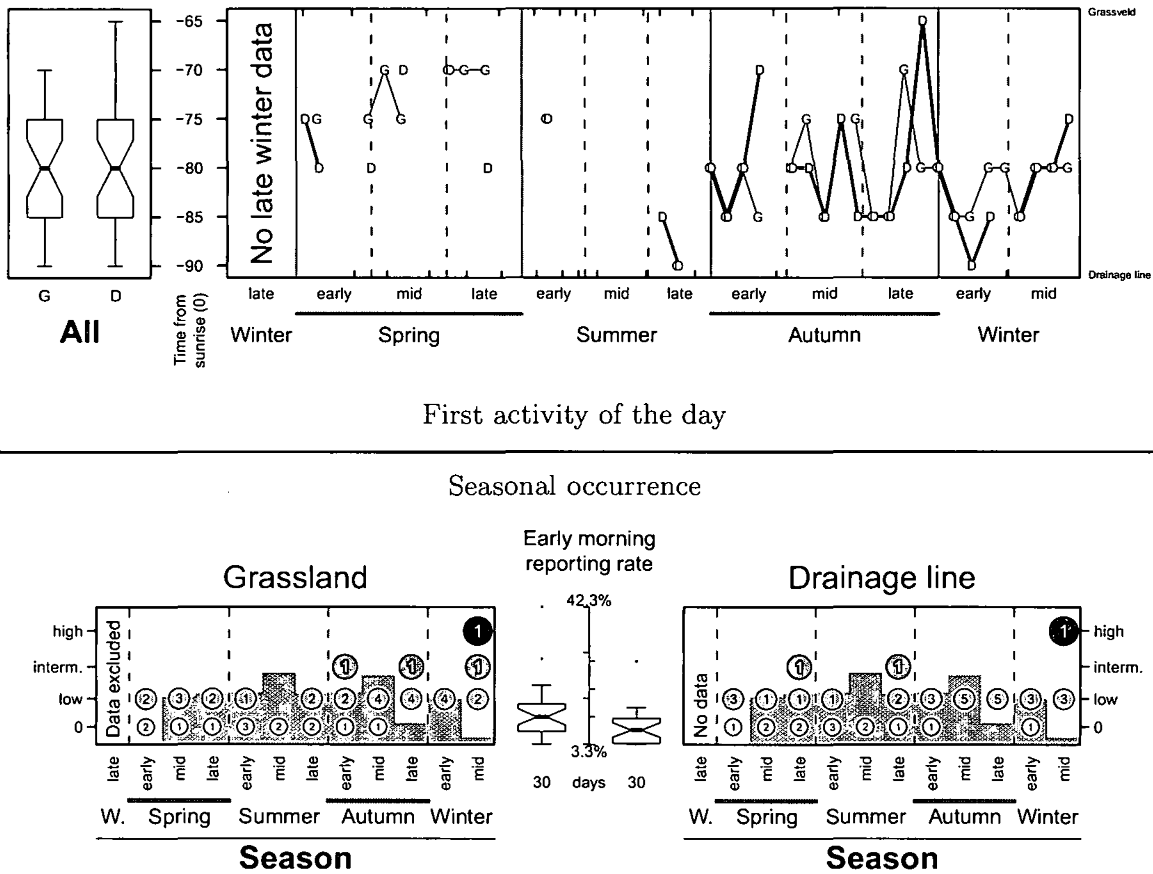


Figure 7.27: No birds recorded: Summary of data collected during 2007/8 in S0 – S1 at Glen, first in the grassland and the following morning in the drainage line. Bottom: Seasonal occurrence of days with zero, low, intermediate and high early morning reporting rates; Top: Occurrence of the first activity of the day. See page 136 for more information on this early morning figure.

date and fraction of the segment were recorded with each count. The analysis below is based on the 15-minute windows with the maximum count each day.

The maximum number of species recorded during a 15-minute window per day (Fig. 7.28) followed a seasonal pattern comparable to that for the total number of species recorded per day (Fig. 7.20). Proportionally, there is limited seasonal variation with the species on the 15-minute checklists comprising approximately 35–45% of daily totals in most cases (Fig. 7.29). Approximately a quarter to a third of the species is recorded before the peak 15-minutes, except during early summer when this proportion was close to half of all species (Fig. 7.29). This is in contrast to the proportion of species recorded after the peak 15-minutes, which usually involve about half of the species, except during early summer when this proportion was lower (Fig. 7.29).

Regarding the timing of these 15-minute windows, from autumn to mid-spring (except early winter) it mostly occurred from shortly after sunrise to the end of S2, *i.e.* approximately two hours after sunrise (Fig. 7.28). From late spring to late summer and in early winter the median timing was still before the end of S2, but a fair proportion of the windows occurred later in the day too; the median timing occurred exceptionally late, around mid-morning, during early summer (Fig. 7.28).

It appears, therefore, that the best time of the day to do atlasing would be within the first two hours after sunrise, except during the warmer seasons when this could be a bit later.

7.3 To count or not to count

It seems that the accuracy of most methods employed to count birds — be it to obtain relative or absolute values — are compromised in some way or another by detectability issues (in addition to this chapter, see also the Introduction, starting from page 63). There are various reasons for this, but one of the most fundamental ones involves the heterogeneous nature of the counted subjects, including the variability of their activity patterns. Given this heterogeneous setting in which most counts are conducted, one may rightfully ask if it is useful to count at all (although the focus of this section is on the counting of bird communities, the same principles may also apply to less ambitious projects). Before commencing with a 'counting' project, careful consideration should be given to this question. The following points are particularly important.

Firstly, would the numbers collected represent reality? For example, do 10 pairs per hectare, say, mean that there are really 10 pairs per hectare? If the answer is no, then the next question is: What is the direction of the error, *i.e.* did the count under or over estimated the real number of pairs? Whether the answer is that it is assumed that the number 'is more or less correct', or 'is probably an under (or over) estimate the true number', the crucial point to note is that we rarely know what the 'true number' is. Using count data as a 'relative abundance' index does not solve the problem either. If anything, it makes it worse. As (Bibby *et al.* 2000) succinctly put it: "relative abundance is a concept that greatly confuses real abundance and detectability."

Secondly, will repeated 'counts' be conducted to check the consistency of the data. If not, then the usefulness of the data will be further compromised, because there will be no way of knowing to what extent the single count was 'normal' or 'abnormal'. Agreed, there are various reasons

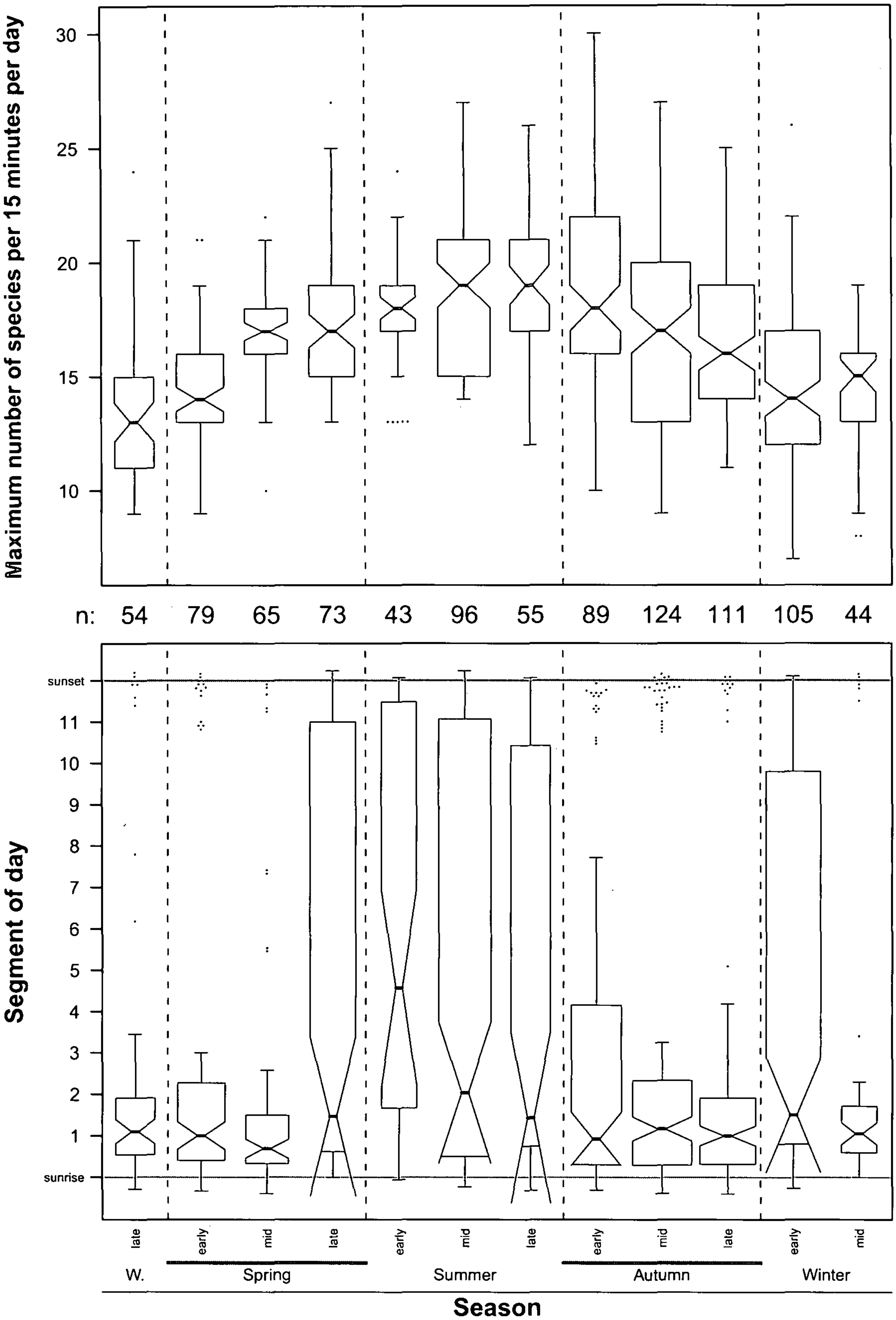


Figure 7.28: Seasonal variation in the time of day (bottom) and maximum number of species recorded (top) during a 15-minute window per day. Based on 513 days with observations during all 14 segments.

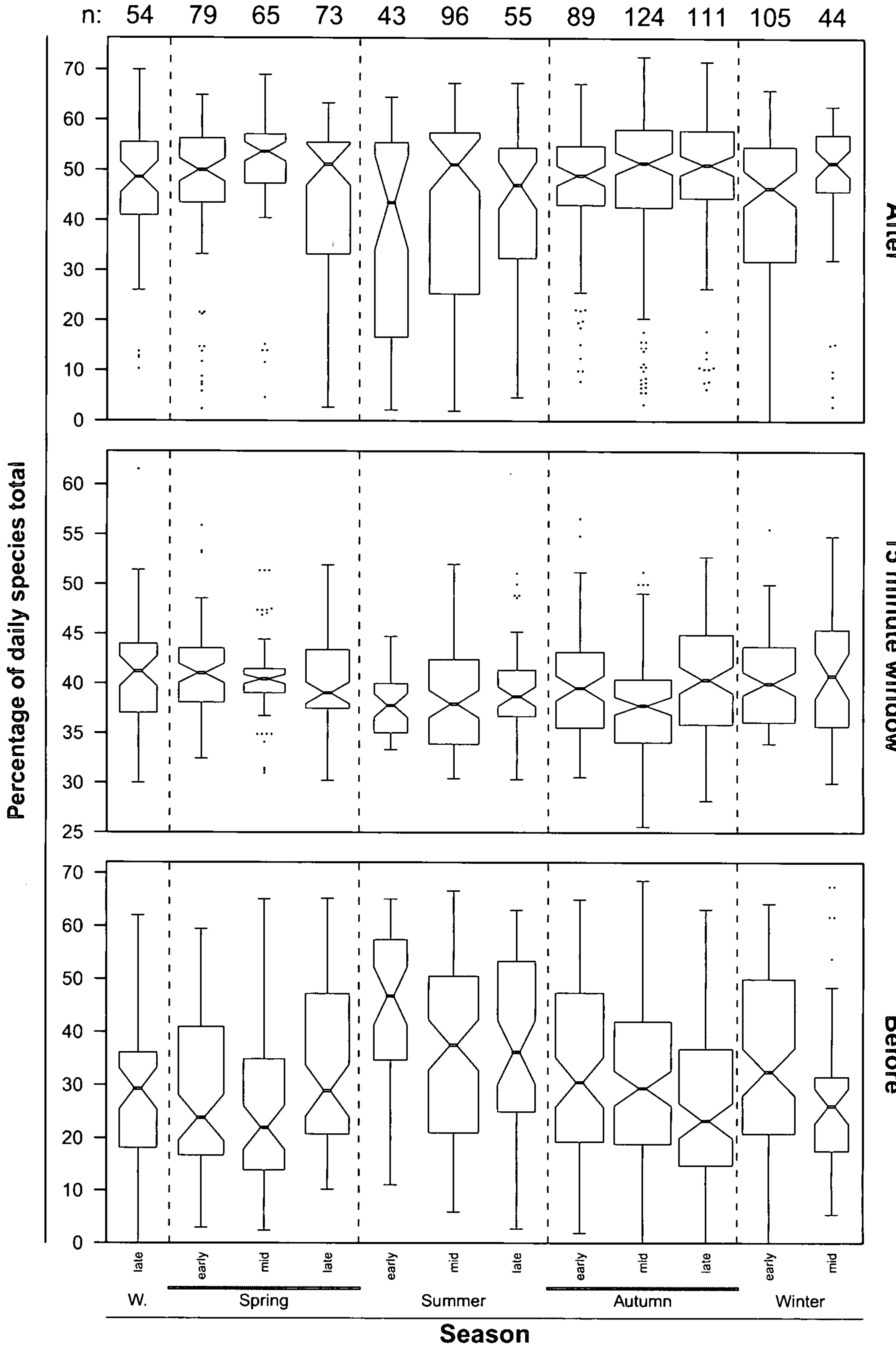


Figure 7.29: Seasonal variation in the proportion of species, relative to daily totals, recorded during a 15-minute window per day (centre) (see Figure 7.28). The proportion of unique species relative to those recorded in the 15-minute window is also illustrated.

why it may not be feasible to do repeated counts (*e.g.* time constraints and limited funding). However, these type of circumstances cannot be used as an alibi for amassing inaccurate data.

As important as the counting of birds (and other biota) may be, we must face the reality that it is, at best, a difficult enterprise — at worst it can amount to a feckless number generating exercise (*cf.* Anderson 2003). It is proposed that the study of activity patterns would make for a more profitable line of inquiry in many instances. The forgoing chapters demonstrated how a relatively simple method could be used to help unravel the annual cycle of birds. In addition, it indicated that environmental factors such as rainfall (timing and amount) could influence activity. In this regard it is noted that two of the consequences of global climate change include rapid shifts in distributional ranges and changes in the timing of annual events such as breeding and migration (see Helm 2009 and references therein). In principle, the SABAP1 and SABAP2 data-sets could be used to assess changes in the distribution and timing of migration (*e.g.* De Villiers 2009). However, the methods of these two studies were slightly different and this should be taken into account when interpreting the data. Furthermore, the two atlases represent only two points in time with a gap of 15 years in between. Given that the seasonal occurrence of rainfall changes from year to year (*e.g.* Fig. 2.16) and that this can influence the occurrence of certain species (*e.g.* Barn Swallow R518, page 667), it would be prudent to approach the SABAP data with caution. More detailed site/species specific studies such as the one at Glen would be required to detect changes in annual life-cycle events. The present analysis of the Glen data-set did not specifically addressed climate change, but it would be possible, in principle, to use it for that purpose.

7.4 Pointers to future research

In spite of the criticisms expounded above with regards to the SABAP2 species sequences, the author fully supports the project in other respects (as he did SABAP1), and will make the applicable data from Glen (and elsewhere) available to SABAP2 in due course.

Hopefully the study at Glen will act as a catalyst for further research. The focus of the remainder of this section is on highlighting one particular line of inquiry, namely the circadian and circannual rhythms of southern African bird species, which represent an open research field.

One of the most topical issues today is climate change. In order to assess the influence of climate change on birds there is a need for long-term data on the phenology of activities during their annual cycle (see Visser & Both 2005). One of the ways to investigate the mechanisms causing changes in the timing of these activities is to focus on intra-specific variation in response to climate change, *i.e.* studies should be replicated across parts of a species range, because the effects of climate change may differ on a small geographical scale (Visser *et al.* 2003). Such studies may reveal the ecological circumstances under which populations are most vulnerable to the effects of climate change (Both *et al.* 2004). For example, based on data from 25, 10+ year studies in Europe, Both *et al.* (2004) concluded that climate change causally affects breeding date advancement in *Ficedula* flycatchers. It is unlikely that this type of analysis would be possible in Africa, where one would be fortunate to find more than a handful of detailed studies on any particular species. Most such studies would probably have been conducted over a relatively short period and at different times and locations. The fact that there are relatively few ornithologists working on the continent compared to the situation in Europe (see Underhill in Anonymous 2002) further aggravates the situation. Nonetheless, it is proposed that monitoring of activity patterns could be a cost and time effective way of assessing changes in life-cycle stages on a large scale. While it may not be as detailed as studies elsewhere (*e.g.* where the timing of egg-laying is directly assessed), it is sure to fill a significant knowledge gap.

A good starting point is to know what the activity patterns of the birds are like. As already indicated in the Introduction, there is a major knowledge gap with regards to the activity patterns of southern African bird species, particularly at the community level. Although the study at Glen addresses this to a certain extent, studies conducted elsewhere along similar lines could help to further establish the generality of the findings, and expand the type of habitats and species covered. The method is both simple (checklists for each 5-minute interval) and cost effective. The most basic needs include an enthusiastic observer and time. Information may be collected on various scales ranging from those encompassing all species and the whole day from dawn to dusk, to those that focus on a particular species at a particular time of the day, *e.g.* to determine the timing of the first activity of the day. If such observations could be made at regular intervals (at least once a week) and sustained for years, it would reveal the extent to which activities are a seasonal phenomenon, in addition to indicating daily patterns. It is important that repeated observations of such studies be conducted at the same spot and at the same relative time of the day in order to minimise the variables that could influence the results. Such a project could be taken one step further by collecting data in two or more habitats simultaneously (multiple observers), or on consecutive days (single observer). This would make for an even more comprehensive study.

In order to interpret activity patterns correctly, it is very useful to have accurate, recent and detailed data on the timing of breeding, moulting and migration. Statements on the breeding seasons of southern African birds are all too often based on small or unknown sample sizes, and from one or a few areas where studies were conducted decades ago. There is a need for a fresh update based on recent fieldwork, in the Free State in particular, but also further afield. The same counts for moult.

In a number of species moulting was invoked as the cause of a silent period in the annual cycle at Glen. The most convincing case is that of the Eastern Clapper Lark R495 which was (and still is) also the subject of an intensive behavioural study at Glen. In many other instances the inference rested largely, or exclusively, on the observed activity patterns, either because moult data were not available, or available but limited in extent and/or regional coverage. Even for common birds such as the Hadeda Ibis R094 there is nothing known about moult. Moult studies in various regions would greatly enhance our understanding of the behaviour of birds in that it would indicate the extent to which moult is seasonal, thereby confirming or disproving the explanations advanced in this thesis or other subsequent studies. A closer look at roadkills could also fill important gaps in our knowledge (*e.g.* owls).

In addition to distribution, the SABAP1 data was a particularly useful source of information on the timing of migration. However, the analysis presented in Harrison *et al.* (1997a,b) is insensitive to certain movement patterns occurring within southern Africa. One of the best examples of this involves Lesotho, which falls in SABAP1 Zone 7 together with Swaziland, KwaZulu-Natal, the Free State and the southern parts of the former Transvaal. By considering these areas as one unit, it rendered the analysis completely insensitive to altitudinal migration, and in so doing helped to perpetuate the tradition of treating the Mountain Kingdom as an isolated unit in as far as the Free State and areas beyond are concerned. The fact is that the same data, analysed in a different way, complimented by the data from Glen and elsewhere, paints a different picture, suggesting that altitudinal migrants from Lesotho move into the Free State and beyond during the cooler times of the year more often than the current literature would suggest. It is acknowledged that this theory is at this stage largely based on circumstantial evidence. The ultimate way to test it would be through intensive colour ringing projects. The species involved include the Sentinel Rock-Thrush R582, Sickle-winged Chat R591, African Stonechat R596, Layard's Tit-Babbler R622, Cape Canary R872 and others. A complimentary or alternative way may be through intensive field observations in and around Lesotho and further afield. A more detailed analysis of the two SABAP data-sets could also be considered. However, the coverage of Lesotho (and other areas) during both atlas projects was poor. Nonetheless, it is recommended that, in general, the SABAP2 analysis should be based on smaller geographic units, and that these should be species specific.

The patterns observed in free-living birds may not reveal possible cryptic flexibility in their circadian/circannual systems (MacDougall-Shackleton *et al.* 2009). Experimental investigations into the circadian/circannual rhythms of southern African bird species are rare (*e.g.* Craig 1985) and represent an open research niche. Such studies could build on work done elsewhere on widespread species (*e.g.* African Stonechat *Saxicola torquatus* Gwinner & Dittami 1990; Gwinner & Scheuerlein 1998, 1999; Helm 2009; Scheuerlein & Gwinner 2002), introduced species (*e.g.* Common Starling *Sturnus vulgaris*; Dawson 1987, 1991, 2005; Dawson *et al.* 1985; Schwab & Rutledge 1979), or start afresh on another species.

Because the complex biological clock of birds is intimately connected to the complexity of bird functioning, it is appropriate to conclude with a reference to broader background assumptions. Ultimately, the unravelling of biological clocks will require the integration of abiotic, behavioural, physiological, biochemical and genetic aspects. Besides learning more about birds as such, it may lead to better insights of clockworks in humans, thereby enabling us "to trick mother nature", to borrow a phrase from Revell & Eastman (2005). It is also the author's opinion that an appreciation of the complexities involved and the implications they entail would further enhance the motivation for clock studies.

There is generally very little known about circadian/circannual mechanisms in birds (Ball & Ketterson 2008; Cassone *et al.* 2008; Dawson 2008; Wikelski *et al.* 2008) and other biota (Hastings & Follett 2001; Helfrich-Förster 2009; Lakin-Thomas 2000, 2006; McClung 2006; McWatters *et al.* 2001; Tauber & Kyriacou 2008; Vitalini *et al.* 2006). This is due to the diversity and complex nature of biological clocks in general, and in birds in particular (Brandstätter 2003). In an article entitled: "Circadian systems: different levels of complexity" — which formed part of an international conference entitled "Complex clocks" (Kippert & Rosato 2001) — Roenneberg & Merrow (2001) wrote: "After approximately 50 years of circadian research, especially in selected circadian model systems (*Drosophila*, *Neurospora*, *Gonyaulax* and, more recently, cyanobacteria and mammals), we appreciate the **enormous complexity** of the circadian programme in organisms and cells, as well as in physiological and molecular circuits." (Bold added). In order to grasp a little of this "enormous complexity", consider their description of the mammalian system: "Thus, the SCN [suprachiasmatic nuclei] is entrained to exogenous *zeitgeber* (*e.g.* light) and produces (directly or indirectly) endogenous *zeitgebers* to entrain the peripheral target clocks. Endogenous *zeitgeber* time can either be transmitted via neuronal pathways [reference deleted] or via factors, such as glucocorticoids, circulating in the bloodstream [reference deleted]. As such, clocks within animals constitute a clearly structured hierarchy similar to those in ecosystems." (Roenneberg & Merrow 2001). Birds are even more complex: "Compared with mammals, birds are equipped with a rather complex and diverse circadian pacemaking system. It varies greatly among species and it appears to be flexible within a species and even within an individual bird." (Gwinner & Brandstätter 2001). In a similar vein, consider these quotes: Circadian clocks are "an inherently complex, networked system. ... It appears that even a relatively simple organism, such as *Neurospora*, shows evidence of this kind of complexity. ... The *Neurospora* circadian system is probably more complex than it needs to be, ... [but] it is certainly not as complex as the circadian system of a vertebrate, in which there may be multiple pacemakers in the brain, eye and pineal, interacting with each other and driving slave oscillators in peripheral tissues." (Bell-Pedersen *et al.* 2001; see also Vitalini *et al.* 2006); "The molecular bases of circadian clocks are complex and cannot be sufficiently explained by the relatively simple feedback loops, based on transcription and translation, of current models" (Kippert 2001; see also Iwasaki & Kondo 2004); "Furthermore, the experimental data forces us to face the conclusion that the circadian system comprises a population of oscillatory systems." (Morgan *et al.* 2001). "Plants epitomize complex clocks. Clock research in plants seems to be poised between the knowledge of a variety of genes with circadian or photoperiodic effects and a model of their interactions to form the clock itself. Many pieces of the puzzle are already on the table ... but they have not yet been fitted together to provide a complete picture of the clock." (McWatters *et al.* 2001).

Historical narratives proceed from the presupposition that naturalistic mechanisms must explain the origin of *everything*. This is incorrect because it certainly does not explain books and computer programmes, for example. There is no way that circadian/circannual clocks could have arisen naturalistically. Like numerous other biological systems, which are likewise complex (see Kippert & Rosato 2001), the basic problem is that these clocks and their "molecular gears", as Froy *et al.* (2003) describe it, are genetically programmed, and natural processes are not up to the task — just as a computer program requires a programmer, so too does biological programs written on DNA; Circadian rhythms are endogenous biological programs (Mori & Johnson 2001), hence articles with titles such as "Circadian and circannual programmes in avian migration" (Gwinner 1996b; see also Duffield *et al.* 2002; Johnson & Golden 1999; Mori & Johnson 2001; Roenneberg & Mittag 1996). Naturalistic mechanisms such as natural *selection*, multiple lateral transfers, and gene duplications and *losses* — which are Dvornyk *et al.*'s (2003) "speculations" (see Sharma 2003) as to the major factors shaping the evolution of prokaryotic circadian clocks — all involve the selection, shuffling, and/or loss of *already existing* genetic information, *i.e.* these type of mechanisms cannot explain the origin of clocks or their genetic blueprints; at best they can only fine-tune already existing, functional clocks. It should come as no surprise, therefore, that Enright (1970) found that "no adequate solutions have yet been proposed for this puzzle", referring specifically to the naturalistic origins of "rhythmic timing processes which are self-sustained oscillations, ... ". Sharma (2003) concurs: "it is not clear how and why clocks with an approximately 24h period evolved in a cyclic environment of an exactly 24h period, ...". After considering the fact that "it provides optimal stability to its expression under natural LD [light:dark] cycles", he concluded that this "non-24h nature of circadian clocks may be a well-planned strategy of natural selection rather than an error." (Sharma 2003). He is probably correct that it is a "well-planned strategy", but he is mistaken to attribute such powers to natural selection which cannot plan ahead — natural selection can only *select* from already existing genetic variation within a population at *a particular point in time*. It is illogical to invoke, or even "speculate" about, natural selection as an explanation for something that does not already exist.

By considering the option that circadian clocks are a "well-planned strategy", Sharma (2003) inadvertently conceded that they exhibit signs of intentional design. It is indeed appropriate to refer to the circadian "clock's overall design", as did Wager-Smith & Kay (2000), for the same reasons that it would be to refer with such terms to the watch on one's arm, for example. Several other lines of evidence further bolster the inference that biological (and man-made) clocks require a designer. The purpose of the elaborate clock systems in biota is to ensure that various aspects of behaviour, physiology and metabolism occur at appropriate times by anticipating periodic biotic and abiotic events (Emerson *et al.* 2008; Sharp 1996; Tauber & Kyriacou 2008; Vitaterna *et al.* 2001), thereby contributing significantly to the well-being of the organism (Vitaterna *et al.* 2001). As Tauber & Kyriacou (2008) put it: "circadian regulation percolates through to every aspect of biological function." Naturalistic explanations for the appearance of circadian clocks on earth are, therefore, nonsensical. For example, according to one of these hypotheses, "circadian rhythms evolved to protect organisms from deleterious photo-oxidative effects of the environment by helping them reschedule light-sensitive reactions during the night" (Paranjpe & Sharma 2005). But what would have prevented those supposed ancestral organisms *without circadian rhythms* to go extinct before they could "evolve" such elaborate protective mechanisms? And for how many millions of years would they need to endure these "deleterious" conditions without being 'deleted' themselves?

The fact is that the adaptability potential of an organism is genetically constrained and, as pointed out above, natural selection cannot select something that does not exist. This principle, here called the *selection principle*, holds for all genetically determined traits. It implies that there is potential for adaptation only if there is adequate genetic variation in a trait; in the absence of such variation no adaptation can occur regardless the selection pressure (see also Newton 2008). A logical consequence of this principle is that if an organism MUST have a certain trait in order to survive, then it DOES NOT follow that it will get it — if it does not have it, it perishes. As logical as this may seem, it is often ignored in the "historical narratives" — as Mayr (2004) refers to it — of evolutionary biologists. The selection principle is also illustrated in cases such as migratory birds. Crossbreeding experiments between birds of different populations indicate that the timing and duration of migratory restlessness (or *Zugunruhe*) as well as directional preferences are under genetic control (Newton 2008). These studies indicated that the existence of complete migratory or complete resident behaviour stems from a range of genotypes from migratory to resident in the same population (Newton 2008). This innate flexibility contradicts the historical narratives of evolutionary biologists according to whom migration "might have evolved independently several times in birds by convergent evolution" (Newton 2008). Either way, both *inherent* flexibility and convergence point to design (see below). The selection principle also comes into play in cases where a comparatively inflexible photoperiodically (and hence genetically) controlled physiological window for breeding/migration may limit the flexibility, and hence capability, to respond to selection pressure in the face of natural/anthropogenic environmental change, which may increase the vulnerability of a species (Dawson 2008; Helm 2009; MacDougall-Shackleton *et al.* 2009; Visser & Both 2005; Visser *et al.* 1998).

Contrary to the historical narratives of evolutionary biologists, the scientific evidence clearly points to *designed* circadian clocks. The "most primitive organisms" already possessed "complex networks of metabolism" (Roenneberg & Merrow 2002), and circadian clocks and the complex mechanisms it entail is found in them, indicating that these clocks "appeared on earth *along* with primitive life forms" (Paranjpe & Sharma 2005; emphasis added). Furthermore, clock genes are not conserved between higher biotic taxa, yet central clock mechanisms are, and, "paradoxically, clock components that are conserved between species can be used in diverse ways." (Harmer *et al.* 2001; see also Hastings & Follett 2001; Kippert 2001; Roenneberg & Merrow 2002; Sharma 2003). By claiming that these and other aspects are due to "convergence rather than common descent", and by predicting that further research in circadian rhythms would reveal "many further spectacular examples of clock proteins with converging and diverging functions", Harmer *et al.* (2001) unwittingly (?) acknowledged that the "clock machinery [was] *designed* to measure daily time" (emphasis added). Indeed, convergence is an integral part of the biotic message, because it sends both its unifying (*i.e.* life was designed to look like the product of a single designer) and non-naturalistic message (*i.e.* life was designed to resist the historical narratives of evolutionary biologists[3]; see ReMine 1993 for more information on the biotic message). Back to circadian clocks, Roenneberg & Merrow (2002) note that one of the most conspicuous qualities of circadian systems, namely self-sustained oscillation in constant conditions, "is a consequence of how the system is built to function optimally under entrained conditions rather than being the object of the evolutionary process."

The bottom line is that living organisms are information driven systems designed to survive (see Sarfati 2008, 2010). As such they are able to adapt, within limits, to an ever-changing world through natural selection operating on the available genetic variation. As indicated above, there is abundant scientific evidence for this. By contrast, the evidence goes against the historical narratives of evolutionary biologists, because the increase in genetic information content required to change microbes into microbiologists is not observed. Again, processes such as natural selection involve the sorting and/or loss of information. And as for mutations, the vast majority that make a difference remove information, since breaking something is much easier and more probable than making it (see Sarfati 2010). Most genetic variation available for selection is the result, not of mutations, but of recombination of already existing genetic information (Mayr 2002).

[3]According to Mayr (2004, page 25), evolutionary biology employs historical narratives when "experiments are inappropriate."

Unfortunately, science is burdened with a term that has come to imply both of these fundamentally different processes. That term, of course, is 'evolution.' The following two quotes from Kruuk (2004) illustrate this point:

1. "Evolutionary biology aims to explain diversity."
2. "... a trait must be heritable in order to evolve. ... The genetic basis of phenotypic traits is central to the study of evolution and biological diversity."

The first instance implies that evolution is about explaining biological diversity; how microbes 'evolved' into mousebirds; how "evolutionary novelties" 'evolved'; how *novel* genetic information diversity arose. Yet in the second instance we are told, in effect, that evolution is about the sorting and sifting of *already existing* genetic diversity. Projecting these two disparate processes back in time, the first would lead to less and less genetic diversity until a certain point in the past, 'in the beginning', when there was nothing. This is the "General Theory of Evolution", which Kerkut (1960) defined as "the theory that all the living forms in the world have arisen from a single source which itself come from an inorganic form." It is this type of 'evolution' that is controversial, precisely because it is contradicted by the scientific evidence. To be sure, the historical narratives of evolutionary biologists frequently invoke the General Theory of Evolution. The following example is taken from Homberger & De Silva (2000): "A selective regime favoring a streamlining of body contours and surfaces is proposed as having been instrumental in driving the morphological and functional transformations of an unfeathered reptilian integument into a feather-bearing avian one." But this would probably require a significant amount of novel genetic programs for the following: "a complex, integrated organ system that includes an intricate, hydraulic skeleto-muscular apparatus of the feathers, a dermo-subcutaneous muscle system of the integument, and a subcutaneous hydraulic skeletal system formed by fat bodies. ... the highly intricate feather-bearing integument represents a machinery to move feathers or to stabilize them against external forces; ... the aerodynamic role of feathers as pressure and turbulence sensors and as controllable temporary turbulators;" And to crown it all, "These transformations are likely to have occurred more than once." (Homberger & de Silva 2000). Yet this kind of story runs counter to the selection principle explained earlier. The code-word for such situations is "evolutionary novelties." As Prum & Brush (2002) explain: "Many features of feathers and feather development ... qualify as evolutionary novelties. The follicle, the differentiated sheath and feather germ, differentiated barb ridges, barb rami, barbules, differentiated pennulae of the proximal and distal barbules, and the rachis are all evolutionary novelties, as are the derived mechanisms by which these novel structures develop. At a molecular level, the derived 10 kilodalton ϕ-keratins of feathers are also novel."

The second process, involving the sorting and sifting of *already existing* genetic diversity, implies that there was great genetic diversity 'in the beginning' which became *less* diverse with time; this type of change is not controversial, because it is what science clearly shows. A self proclaimed "Darwinian clock-watcher" penned what must surely qualify as one of the most apt analogies to describe the situation:

> "A whimsical analogy I enjoy and find useful sees the living world as a vast literature comprising millions of volumes, many still available but even more out of print. All

are vignettes written in the universal language of nucleotide sequences. All have the same happy ending (reproduction) which, when reached, assures the volume stays in print." (Pittendrigh 1993)

The big question, of course, is the identity of the author of all these volumes. Like Sharma (2003) and others (see above), the Darwinian clock-watcher errs in awarding the title to the "historical process of natural selection [who] has written under several pen-names," such as "The Blind Watchmaker" and "Darwin's Demon" (Pittendrigh 1993). As shown above, he is clearly mistaken. At their best, 'Darwin's Demon' and his accomplice, mutation, cannot create anything novel, and at worst they are apt to corrupt and destroy. And as for the 'Blind Watchmaker', he was surely not responsible for "the exquisite precision of the molecular events at the heart of the clockwork" (quote from Hastings *et al.* 2007).

What science in general and biology in particular need is a new way of thinking. At present, these fields of human endeavour are permeated by the idea that demons and blind watchmakers — to continue Pittendrigh's (1993) whimsical analogy — write books and computer programs. The old avian brain nomenclature illustrates how that kind of thinking had led to error in the past. Based on the *erroneous* idea that evolution was progressive and unilinear — "from fish, to amphibians, to reptiles, to birds and mammals, to primates and, finally, to humans" — it was assumed that intelligence followed in a chronological series from 'lower' to 'higher' (Jarvis *et al.* 2005). This led to "inaccurate evolution-based terminology" for the brain of vertebrates that severely impeded the communication of scientific discoveries and the generation of new insights for decades (Jarvis *et al.* 2005). Fortunately, an international Avian Brain Nomenclature Consortium of specialists in avian, mammalian, reptilian and fish neurobiology rectified the problem recently by renaming the various subdivisions in the avian brain with terms that allow reference to named regions in mammals, and that "eliminated all phylogeny-based prefixes (palaeo-, archi- and neo-) that erroneously implied the relative age of each subdivision." (Jarvis *et al.* 2005; see also Reiner 2005; Reiner *et al.* 2004). Alas, they still cling tenaciously to the idea that bony fish 'evolved' into birds (see Jarvis *et al.* 2005).

Science, however, has not always been so confused. More than three centuries ago, for example, John Ray (1627–1705) laid the foundation of modern ornithology (Birkhead 2008; Haffer 2007; Sibley & Ahlquist 1972). His contribution was twofold (see Haffer 2007). Amongst other works, his treatise, with Francis Willughby (1635–1672), on *Ornithologiae Libri Tres* in 1676 (Latin edition, English edition in 1678) focused on the 'arrangement' of birds — "how they fitted together in God's scheme" (Birkhead 2008) — and initiated the study of bird taxonomy. A few decades later, Ray's scheme inspired Carl Linnaeus (1707–1778), whose classification works *Systema Naturae* (1735) and *Species Plantarum* (1753) were "profoundly influential" (Futuyma 1986). Like Ray before him, Linnaeus undertook it "for the greater glory of God" (Futuyma 1986).

Ray's second contribution to modern ornithology came with his famous book entitled *The Wisdom of God Manifested in the Works of the Creation* (1691). This book ran into 13 editions and was translated into German and French. It was widely used by naturalists in the 18th century and formed the intellectual foundation for the field study of birds. The key to his success was that his "God was responsible for the natural world in all its beauty and in particular the wonderful fit between an animal and its environment" (Birkhead 2008). As Birkhead (2008) explains, "Ray's

Wisdom transformed the way people viewed the natural world. It was a revelation: for the first time there was a scheme that unified natural history and accounted for the way the world was."

To summarise, the two books of John Ray launched the study of bird taxonomy and the field study of birds, respectively. "Either one", remarks Birkhead (2008), "would have been enough to ensure his enduring reputation. To have done both was extraordinary." It was in *Wisdom* that Ray wrote: "If all the men of the world cannot make such a thing as a pile of grass or ear of corn, who can, or did make it but God? To tell them, that it made itself, or sprung up by chance, would be ridiculous." (As quoted in Haffer 2007). It is suggested that we return to our roots.

Given the intricate and highly complex character of this mother of all puzzles we call nature, one cannot help but marvel at the ingenuity of the Designer of it all. What a great privilege (and challenge!) it is to study the works of a Genius. Moreover, unlike historical narratives, "the word of the LORD is right; and all his works are done in truth." (Psalm 33:4). Indeed.

> "And God said, Let there be lights in the firmament of the heaven to divide the day from the night; *and let them be for signs, and for seasons, and for days, and years*: And let them be for lights in the firmament of the heaven to give light upon the earth: and it was so. And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: he made the stars also. And God set them in the firmament of the heaven to give light upon the earth, And to rule over the day and over the night, and to divide the light from the darkness: and God saw that it was good. And the evening and the morning were the fourth day." (Genesis 1:14-19; Emphasis added)

Summary

Activity patterns of bird species were studied at Glen Agricultural College within the grassland area of the central Free State, South Africa, during a period of 11 years (July 1997 – July 2008). The study focused on a specific grassland locality where 5-minute checklists were compiled continuously from dawn to dusk at least once a week for a total of 656 days. Data were also collected each minute for selected species. Additional observations in an adjacent tree and shrub dominated drainage line included 1-minute checklists compiled during transects over a two-year period (late autumn 2000/1 to mid-autumn 2002/3) as well as surveys from a fixed position from dawn to approximately 70 minutes after sunrise during 2007/8. The central aim of the study was to quantify and explain annual, seasonal and daily activity patterns of all bird species recorded in the study area. This data is summarised in separate species accounts where aspects of the annual cycle, particularly breeding and moulting, were also considered. In addition, the potential influence of rainfall was investigated.

The bird community at Glen consists of 197 species for which the status could be determined. This number excludes six species where identification problems were experienced. Permanent residents constitute nearly a quarter of the species (n = 45) and include the Northern Black Korhaan *Afrotis afraoides* and Cape Turtle-Dove *Streptopelia capicola*, the two most frequently recorded bird species. The 33 temporary residents include five intra-African, three local and two Palearctic migrants. Five species visited the study area regularly. Seasonal visitors (n = 43 species) constitute more than one fifth of all the birds recorded at Glen and include 12 intra-African, nine Palearctic and nine local migrants. Aseasonal visitors consist of 16 species that are mostly resident in southern Africa. The Hadeda Ibis *Bostrychia hagedash* is the most common of the 52 species that normally flew over the study area without utilising it in some way or another. Four species were recorded only, or mainly, as birds heard outside the study area.

The occurrence of species experiencing annual peaks in activity was particularly frequent during years with relatively high rainfall. Permanent residents in particular showed high levels of activity during 2005/6, while temporary residents and seasonal visitors occurred more often during 1997/8 and 2001/2 compared to other years. Seasonal timing of rainfall contributed to these results as much of the rain in 2005/6 occurred during autumn, presumably too late for migrants, temporary residents and seasonal visitors to respond. The few cases where regular and aseasonal visitors, birds in transit and birds heard outside the study area showed high levels of activity were likewise associated with years of high rainfall.

Seasonally, high levels of activity occurred during the period from late spring to late autumn in most species, while others showed peaks during the cooler times of the year. In permanent residents these peaks were the result of annual fluctuation in activity levels while for most temporary residents and seasonal visitors this was the only time of the year that the birds were present in the study area. Only a few species in the remaining groups experienced seasonal peaks

from mid-spring to late autumn.

Based on the time of day when activity was most frequently recorded, the daily occurrence of birds in the study area could be classified into four categories. Activity in several bird species frequently occurred throughout the day and included birds in all status categories except aseasonal visitors and birds heard outside the study area. In a number of permanent and temporary residents (*e.g.* Orange River Francolin *Scleroptila levaillantoides*), as well as one of the regular visitors (Wattled Starling *Creatophora cinerea*) and a bird in transit (Hadeda Ibis), activity was most frequently recorded during the early morning as well as the late afternoon. Activity mainly limited to the early morning occurred in a few species only (*e.g.* African Red-eyed Bulbul *Pycnonotus nigricans*). The activity of the remaining species was either infrequent whenever it occurred or, in a few cases, frequent during other parts of the day.

The Glen database clearly demonstrates that the species sequence concept currently employed in the second Southern African Bird Atlas Project (SABAP2) is flawed and inadequate. In general, two types of sequences in which bird species will be recorded at any given time and location could be demonstrated. The first is a *predictable sequence* involving species that are conspicuous for extended periods and thus likely to be recorded first during a field survey. Secondly, birds that are detectable only for a short period, *e.g.* when flushed for instance, collectively constitute an *unpredictable sequence* which is ever-changing and thus of little or no biological relevance. The standardised field procedure of SABAP2 therefore results in the compilation of bird lists with predictable and unpredictable bird sequences amounting to meaningless data that is of little or no scientific value.

Keywords: activity pattern; annual cycle; birds; circadian rhythm; circannual rhythm; drainage line; grassland; rainfall

Opsomming

Aktiwiteitspatrone van voëlsoorte in die grasveld van die sentrale Vrystaat is oor 'n tydperk van 11 jaar (Julie 1997 – Julie 2008) te Glen Landbou-Kollege, Suid-Afrika, nagevors. Die ondersoek is op 'n spesifieke grasveldgebied toegespits, waar deurlopende 5-minuut spesielyste vanaf dagbreek tot aandskemering minstens eenmaal per week vir 'n totaal van 656 dae saamgestel kon word. Data is ook elke minuut vir geselekteerde spesies versamel. Bykomende opnames in 'n aangrensende boom- en struikoorheersde dreineringslyn het die samestelling van 1-minuut spesielyste tydens transekte oor 'n tydperk van twee jaar (laatherfs 2000/1 tot middel herfs 2002/3) ingesluit, asook opnames vanaf 'n vaste punt vanaf dagbreek tot nagenoeg 70 minute na sonop gedurende 2007/8. Die hoofdoel van die studie was om die jaarlikse, seisoenale en daaglikse aktiwiteitspatrone van alle voëlsoorte in die studiegebied te kwantifiseer en te verklaar. Hierdie data is in afsonderlike spesiebeskrywings opgesom waar aspekte van die jaarsiklus, veral broeiaktiwiteite en ververing, ook in ag geneem is. Die moontlike invloed van reënval is ook ondersoek.

Die voëlgemeenskap te Glen bestaan uit 197 spesies waarvan die status bepaal kon word. Dié getal sluit ses spesies waarmee probleme met identifikasie ondervind was, uit. Permanente standvoëls beslaan amper 'n kwart van die spesies (n = 45) en sluit die Witvlerkkorhaan *Afrotis afraoides* en Gewone Tortelduif *Streptopelia capicola*, twee van die mees genoteerde voëlsoorte, in. Tydelike standvoëls (n = 33 spesies) behels vyf intra-Afrika, drie plaaslike en twee Palearktiese trekvoëls. Vyf spesies het die studiegebied op 'n gereelde basis besoek. Seisoenale besoekers (n = 43 spesies) vorm meer as 'n vyfde van al die voëls wat by Glen opgeteken is en sluit 12 intra-Afrika, nege Palearktiese en nege plaaslike trekvoëls in. Nie-seisoenale besoekers bestaan uit 16 spesies wat meestal standvoëls in suidelike Afrika verteenwoordig. Die Hadeda *Bostrychia hagedash* is die mees algemene van die 52 spesies wat normaalweg oor die studiegebied gevlieg het sonder om dit op een of ander wyse te benut. Vier spesies was slegs, of meestal, genoteer as voëls wat buite die studiegebied gehoor is.

Die voorkoms van spesies wat jaarlikse aktiwiteitspieke toon, was dikwels met jare van relatief hoë reenval geassosieer. Hoë vlakke van aktiwiteit gedurende 2005/6 het veral onder permanente standvoëls voorgekom, terwyl dié van tydelike standvoëls en seisoenale besoekers meer dikwels gedurende 1997/8 en 2001/2 as in ander jare voorgekom het. Die tydstip van seisoenale reënval dra waarskynlik tot hierdie resultate by, want gedurende 2005/6 het volop reën slegs tydens die herfs voorgekom, vermoedelik te laat vir trekvoëls, tydelike standvoëls en seisoenale besoekers om daarop te reageer. Die enkele gevalle waar gereelde en nie-seisoenale besoekers, voëls in deurtog en voëls wat buite die studiegebied gehoor is hoë vlakke van aktiwiteit getoon het, was eweneens met jare van relatief hoë reënval geassosieer.

Op 'n seisoensbasis het hoë vlakke van aktiwiteit by die meeste voëlsoorte gedurende die laat lente tot laat herfs voorgekom, terwyl ander piekperiodes tydens die koeler tye van die jaar getoon het. Onder permanente standvoëls was hierdie pieke die resultaat van jaarlikse siklusse in aktiwiteitspatrone, terwyl die meeste tydelike standvoëls en seisoenale besoekers slegs gedurende sekere tye van die jaar in die studiegebied teenwoordig was. Slegs enkele spesies in die oorblywende groepe het seisoenale aktiwiteitspieke vanaf middel lente tot laat herfs ondervind.

Gebaseer op die tydstip van die dag wanneer die meeste aktiwiteite plaasgevind het, kan die daaglikse voorkoms van voëls in die studiegebied in vier kategorieë geklassifiseer word. Aktiwiteit in verskeie voëlsoorte het dikwels dwarsdeur die dag voorgekom en sluit alle statusgroepe, behalwe nie-seisoenale besoekers en voëls wat buite die studiegebied gehoor is, in. By 'n aantal permanente en tydelike standvoëls (bv. die Kalaharipatrys *Scleroptila levaillantoides*), asook een van die gereelde besoekers (Lelspreeu *Creatophora cinerea*) en 'n voël in deurtog (Hadeda), het die grootste aktiwiteit gedurende die vroegoggend en laat middag plaasgevind. Aktiwiteite wat hoofsaaklik tot die vroeë oggend beperk was, het slegs by enkele voëlsoorte voorgekom (bv. Rooioogtiptol *Pycnonotus nigricans*). Die aktiwiteite van die oorblywende spesies was uiters seldsaam indien dit plaasgevind het, óf, in enkele gevalle, meestal gedurende ander tye van die dag.

Die Glen-databasis toon duidelik aan dat die rangordekonsep van voëlsoorte wat tans deur die tweede Voëlatlasprojek (SABAP2) gebruik word gebrekkig en onvoldoende is. Oor die algemeen kon twee tipes rangordes waarin voëlsoorte op 'n gegewe tydstip en plek genoteer word, onderskei word. Die eerste is 'n *voorspelbare volgorde* waarby spesies ingeluit is wat vir 'n uitgebreide tydperk prominent vertoon en waarskynlik dus eerste tydens veldopnames opgemerk sal word. Tweedens, voëls wat slegs vir 'n kort periode opgespoor kan word, wanneer opgejaag byvoorbeeld, vorm gesamentlik 'n wisselende *onvoorspelbare volgorde* van min of geen biologiese betekenis. Die gestandaardiseerde veldprosedure van SABAP2 lei dus tot die samestelling van voëllyste bestaande uit 'n mengsel van voorspelbare en onvoorspelbare rangordes van voëlsoorte van min of geen wetenskaplike waarde.

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Regardless of your opinion of my thesis, one thing we all can agree on is that it was not simply the result of random change processes between paper and ink. The probability of that happening is so small that we can confidently state that it is impossible. Living organisms, including the birds studied for this thesis, are information driven systems with their libraries worth of information stored on the most compact information storage system in the Universe, DNA. If we had to wait for random change processes to generate these libraries, there would have been no puzzles to solve, and nobody to write about it — ever. I thank the Creator for opening my eyes to these truths and for enabling me to investigate His puzzles — and to write about it. Along the way He also employed a number of people and institutions. I personally wish to express my sincere appreciation to the following for their contributions:

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APPENDIX A: Status determination of individual bird species at Glen

Status in South Africa, Lesotho and Swaziland

The status of bird species in South Africa, Lesotho and Swaziland, (SALSS) is based on the assessment of the individual species disccussed in Chapters 4 and 5. The following categories were used:

1. **Resident — Res**: Species, or populations of a species, that stays in the same area throughout the year.

2. **Migrant**: Migration is generally defined as "movements of bird populations occurring at predictable times of each year, between breeding and one or more non-breeding areas, and therefore involving flights in predictable directions" (Evans 1985). Distinction is made between three migrant groups:

   a) **Local migrant — LMig**: Migrants whose breeding and non-breeding areas fall mainly within the borders of southern Africa, for example altitudinal migrants. All species assigned to this category have populations that exhibit other movement strategies too, including residents.

   b) **Intra-African migrant — iAM**: Species migrating between southern African countries and other parts of the continent.

   c) **Palearctic migrant — PM**: Species migrating between southern African countries and the Palearctic region.

3. **Other — nRM**: Species or a population that is neither resident nor migratory. It includes, amongst others, birds dependant on ephemeral habitats (*e.g.* waterbirds) and otherwise nomadic species.

A number of species fall into more than one of the aforementioned categories. In such cases the category listed first in Appendix B is generally considered to be the most likely status of the birds mostly involved at Glen. For example, both resident and local migratory populations of the African Stonechat R596 occur in southern Africa, but the local migratory population is listed first in Appendix B because the available evidence implicates that segment of the population occurring at Glen.

Glen status categories

The assessment of the Glen status for each species is based on the analysis presented in Chapters 4 and 5. Four main categories are distinguished, namely resident (with two sub-categories), visitor (with three sub-categories), birds in transit and birds heard outside the study area. The definitions are as follow:

1. **Resident**: Species which forage and sleep in the grassland or the drainage line for more than one season per year. The title is applicable to the species level and does not necessarily imply that *individuals* stay in the same area for an extended period of time. Thus, there may be seasonal or annual fluctuations in densities, a factor that is ignored in this appendix. Distinction is made between permanent and temporary residence:

   a) **Permanent Resident — p.Res**: Resident species that occurs or are suspected to occur throughout the year. Allowance is made for exceptional circumstances that could cause a species to vacate the area temporarily.

   b) **Temporary Resident — t.Res**: Resident species that occurs or are suspected to occur during less than 12 seasons per year.

2. **Visitor**: A species that uses the study area mainly for foraging, sleeping elsewhere. It also includes species that use the area in a transient manner, for example passage migrants that usually do not stay in the area for longer than a few weeks at most. Three groups are distinguished as follows:

   a) **Regular Visitor — r.Vis**: A visitor encountered too regularly to qualify as a seasonal visitor.

   b) **Seasonal Visitor — s.Vis**: A visitor that occurs or are suspected to occur during a certain time of the year only.

   c) **Aseasonal Visitor — a.Vis**: A visitor whose occurrence is unpredictable seasonally.

3. **Bird in transit — Bit**: Species that flew over the study area without utilising it for foraging.

4. **Bird heard outside the study area — Out**: Species recorded in the study area only (or mostly) as birds calling outside the study area.

In single cases, signified by "id" in Appendix B, identification problems complicated the assessment of status — consult the relevant species accounts. Assignment to a specific category is applicable to a specific habitat at Glen (see below). An in-depth analysis of each status category is presented in Chapter 6 from page 998.

Grassland frequency classes — GFC's

A two-character code (*e.g.* A2) is used to symbolise the number of years and seasons during which the species were recorded in the grassland at Glen. The symbols used for the grassland frequency classes are: A = 11 years; B = 7–10 years; C = 3–6 years; D = 1–2 years; 1 = 1–2 seasons; 2 = 3–11 seasons; 3 = 12 seasons. The code "Z0" indicates species not recorded in the grassland. In single cases, signified by "id" in Appendix B, identification problems complicated the assessment of status — consult the relevant species accounts. A detailed analysis of GFC's is presented in Chapter 6 from page 998.

Breeding status

The breeding status was assessed for all species, both in southern African and at Glen, with the same set of codes used in both areas as follows:

1. **Breeding confirmed — Br**: Nest building, nests, eggs, chicks or fledgelings recorded at least once in the study area. When breeding was confirmed less than 2 km from the study area it is indicated in brackets (Br).
2. **Breeding suspected — br**: No evidence of nesting found yet, but circumstantial evidence, *e.g.* resident status or occurrence of juveniles suggest that the species probably breed in the study area. When breeding is suspected to occur less than 2 km from the study area it is indicated in brackets (br).
3. **Breeding status not determined — ?**: The available information is inadequate to determine breeding status one way or the other.
4. **Breeding not suspected — n-br**: No breeding is suspected given the general scarcity of the birds, but they may possibly breed on rare occasions.
5. **Breeding improbable — N-br**: The species is not known to breed in the Free State; OR if it breeds in the province there is no suitable nesting place for it in the study area; OR the species is recorded as birds in transit only; OR there is no evidence otherwise to suggest that breeding is likely to occur.

Feeding niche

The feeding niche refers to the medium in/on which a species obtains most or all of its food. Four categories are considered:

1. **Aerial**: In addition to specialised aerial insectivores including bee-eaters, nightjars, pratincoles, swallows and swifts, this category also includes two specialised aerial avivores, the Lanner Falcon R172 and Peregrine Falcon R171. Species such as the Spotted Flycatcher R689 and Fork-tailed Drongo R541 which habitually hawks insects in flight are excluded.
2. **Arboreal**: By definition this term refers to species living in trees. Included in this group are species such as the Spotted Flycatcher R689 and Fork-tailed Drongo R541 which habitually hawk insects in flight from a perch, often trees.
3. **Terrestrial**: Species that obtain most of their food on the ground.
4. **Aquatic**: Species feeding in or on water.

South African habitat preference

The hierarchical habitat classification system of Harrison *et. al.* (1994) was adopted for the South African habitat preferences of the birds occurring at Glen. This is how they described their hierarchy:

> "Broadly defined, general habitat types were put at the first level of the hierarchy and progressively more specific, narrowly defined habitat types at the second and third levels of the hierarchy." (Harrison *et. al.* 1994)

Thus, there are primary, secondary and tertiary habitat levels (see Table 1 in Harrison *et. al.* 1994). Only primary habitat levels are indicated using the codes assigned by Harrison *et. al.* (1994), namely: MR1 (Marine); AQ1 (Aquatic); RC1 (Montane & rocky); FR1 (Forest); WO1 (Woodland); GR1 (Grassland) and SC1 (Scrub). In addition, "habitat-unspecific" species, or habitat generalists, were placed in an "unclassified" category (Harrison *et. al.* 1994). This category was not assigned a specific code by Harrison *et. al.* (1994), but for the purpose of this study it is assigned the code "HG1".

An extension of the habitat hierarchy is the additional categorisation of each species as an "indicator" or "associate" of each habitat category to which it was allocated (Harrison *et. al.* 1994). "Indicator status", writes Harrison *et. al.* (1994), "implies that a species has an obligate relationship to its habitat with the corollary that it will not be found under any other main (primary level) habitat category, although it may occur in more than one secondary category of a given primary category. Associate status implies that the species is highly likely to utilise and thus be associated with a given habitat, if that habitat type is available, but that its relationship to the habitat type is facultative rather than obligate." They noted further that "A corollary of associate status is that a species may be listed as an associate under more than one primary habitat category." (Harrison *et. al.* 1994) The habitat code of indicator species appears in **bold** in Appendix B.

Glen habitat preference

All bird species observed at Glen were assigned one of the following habitat preference codes:

1. **D**: Species primarily associated with the drainage line
2. **E**: Species roost/breed in drainage line and visits the grassland often.
3. **F**: Species recorded as birds flying over the study area without utilising it for feeding.
4. **G**: Species primarily associated with the grassland
5. **M**: Species primarily associated with the mountains/hills east of the study area
6. **X**: Birds confined or largely confined to habitats outside the study area

Appendix B: Summary of the status of 197 bird species recorded at Glen from 1997/8 to 2007/8. An additional six species where identification problems were experienced are also included.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R001 Common Ostrich (*Struthio camelus*)	Res	Out	C1	N-br	Br	Ground	HG1	X
R008 Little Grebe (*Tachybaptus ruficollis*)	nRM	t.Res	B1	Br	Br	Aquatic	**AQ1**	D
R055 White-breasted Cormorant (*Phalacrocorax lucidus*)	nRM	Bit	C1	N-br	Br	Aquatic	AQ1,MR1	F
R058 Reed Cormorant (*Phalacrocorax africanus*)	nRM	Bit	C1	N-br	Br	Aquatic	**AQ1**	F
R060 African Darter (*Anhinga rufa*)	nRM	Bit	D1	N-br	Br	Aquatic	**AQ1**	F
R062 Grey Heron (*Ardea cinerea*)	nRM	Bit	B1	N-br	Br	Aquatic	AQ1,MR1	F
R063 Black-headed Heron (*Ardea melanocephala*)	nRM	Bit	B1	N-br	Br	Ground	HG1	F
R066 Great Egret (*Egretta alba*)	nRM	Bit	Z0	N-br	Br	Aquatic	**AQ1**	F
R067 Little Egret (*Egretta garzetta*)	nRM	Bit	D1	N-br	Br	Aquatic	AQ1,MR1	F
R071 Cattle Egret (*Bubulcus ibis*)	nRM	r.Vis	A2	N-br	Br	Ground	HG1	G
R076 Black-crowned Night-Heron (*Nycticorax nycticorax*)	nRM	Bit	D1	N-br	Br	Aquatic	AQ1,MR1	F
R081 Hamerkop (*Scopus umbretta*)	nRM	s.Vis	B1	N-br	Br	Aquatic	**AQ1**	D
R083 White Stork (*Ciconia ciconia*)	PM	Bit	C1	N-br	N-br	Ground	HG1	F
R090 Yellow-billed Stork (*Mycteria ibis*)	nRM	Bit	D1	N-br	Br	Aquatic	**AQ1**	F
R091 African Sacred Ibis (*Threskiornis aethiopicus*)	nRM	Bit	D1	N-br	Br	Aquatic	HG1	F
R093 Glossy Ibis (*Plegadis falcinellus*)	nRM	Bit	D1	N-br	Br	Aquatic	**AQ1**	F
R094 Hadeda Ibis (*Bostrychia hagedash*)	Res	Bit	A3	(Br)	Br	Ground	HG1	F
R095 African Spoonbill (*Platalea alba*)	nRM	a.Vis	D1	N-br	Br	Aquatic	**AQ1**	D
R099 White-faced Duck (*Dendrocygna viduata*)	nRM	t.Res	B2	N-br	Br	Aquatic	**AQ1**	D
R102 Egyptian Goose (*Alopochen aegyptiaca*)	nRM	t.Res	A2	Br	Br	Aquatic	AQ1	D
R103 South African Shelduck (*Tadorna cana*)	nRM	t.Res(C)	A2	Br	Br	Aquatic	**AQ1**	D

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...The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R104 Yellow-billed Duck (*Anas undulata*)	nRM	t.Res	B2	Br	Br	Aquatic	**AQ1**	D
R108 Red-billed Teal (*Anas erythrorhyncha*)	nRM	t.Res	C1	N-br	Br	Aquatic	**AQ1**	D
R116 Spur-winged Goose (*Plectropterus gambensis*)	nRM	t.Res	A2	N-br	Br	Aquatic	AQ1	D
R118 Secretarybird (*Sagittarius serpentarius*)	Res	a.Vis	B1	(Br)	Br	Ground	HG1	G
R122 Cape Vulture (*Gyps coprotheres*)	Res	Bit	D1	N-br	Br	Ground	HG1	F
R126 Black Kite (*Milvus migrans*)	iAM	s.Vis	C1	N-br	Br	Ground	HG1,HG1	F
R127 Black-shouldered Kite (*Elanus caeruleus*)	nRM	t.Res	A2	N-br	Br	Ground	HG1	G
R136 Booted Eagle (*Aquila pennatus*)	PM	Bit	C1	N-br	N-br	Ground	HG1	F
R140 Martial Eagle (*Polemaetus bellicosus*)	Res	Bit	C1	N-br	Br	Ground	HG1	F
R143 Black-chested Snake-Eagle (*Circaetus pectoralis*)	nRM,LMig,Res	Bit	D1	N-br	Br	Ground	HG1	F
R146 Bateleur (*Terathopius ecaudatus*)	Res	Bit	D1	N-br	Br	Ground	**WO1**	F
R148 African Fish-Eagle (*Haliaeetus vocifer*)	Res	Bit	B2	N-br	Br	Aquatic	**AQ1**	F
R149 Steppe Buzzard (*Buteo vulpinus*)	PM	Bit	A2	N-br	N-br	Ground	HG1	F
R152 Jackal Buzzard (*Buteo rufofuscus*)	Res,nRM	Bit	D1	N-br	Br	Ground	HG1	F
R155 Rufous-chested Sparrowhawk (*Accipiter rufiventris*)	Res	Bit	C1	N-br	Br	Ground	HG1	F
R162 Southern Pale Chanting Goshawk (*Melierax canorus*)	Res,nRM	Out	A2	(br)	Br	Ground	FR1,SC1,WO1	X
R166 Montagu's Harrier (*Circus pygargus*)	PM	Bit	D1	N-br	N-br	Ground	GR1,WO1	F
R167 Pallid Harrier (*Circus macrourus*)	PM	Bit	D1	N-br	N-br	Ground	GR1,WO1	F
R168 Black Harrier (*Circus maurus*)	LMig,Res,nRM	s.Vis(C)	B1	N-br	Br	Ground	GR1,SC1	G
R171 Peregrine Falcon (*Falco peregrinus*)	Res,PM	Bit	D1	N-br	Br	Aerial	RC1	F
R172 Lanner Falcon (*Falco biarmicus*)	Res,LMig,nRM	Bit	A2	N-br	Br	Aerial	HG1	F
R181 Rock Kestrel (*Falco rupicolus*)	Res	Bit(C)	C1	N-br	Br	Ground	HG1	F

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... The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R182 Greater Kestrel (*Falco rupicoloides*)	nRM,Res	Bit	D1	N-br	Br	Ground	GR1,SC1	F
R183 Lesser Kestrel (*Falco naumanni*)	PM	s.Vis	A2	N-br	N-br	Ground	**GR1**	G
R193 Orange River Francolin (*Scleroptila levaillantoides*)	Res	p.Res	A3	Br	Br	Ground	GR1,WO1	G
R199 Swainson's Spurfowl (*Pternistis swainsonii*)	Res	p.Res	A3	Br	Br	Ground	GR1,WO1	D
R200 Common Quail (*Coturnix coturnix*)	nRM	t.Res	A2	?	Br	Ground	GR1	G
R203 Helmeted Guineafowl (*Numida meleagris*)	Res	p.Res	A3	Br	Br	Ground	HG1	D
R205 Kurrichane Buttonquail (*Turnix sylvaticus*)	nRM	t.Res	C2	?	Br	Ground	**GR1**	G
R208 Blue Crane (*Anthropoides paradiseus*)	Res	Bit	D1	N-br	Br	Ground	**GR1**	F
R228 Red-knobbed Coot (*Fulica cristata*)	nRM	t.Res	C2	Br	Br	Aquatic	**AQ1**	D
R232 Ludwig's Bustard (*Neotis ludwigii*)	nRM	Bit	C1	N-br	Br	Ground	**SC1**	F
R234 Blue Korhaan (*Eupodotis caerulescens*)	Res	Out	A2	N-br	Br	Ground	**GR1**	X
R239 Northern Black Korhaan (*Afrotis afraoides*)	Res	p.Res	A3	Br	Br	Ground	GR1,SC1	G
R249 Three-banded Plover (*Charadrius tricollaris*)	LMig,Res,nRM	Bit	C1	N-br	Br	Aquatic	**AQ1**	F
R255 Crowned Lapwing (*Vanellus coronatus*)	Res	p.Res	A3	Br	Br	Ground	**GR1**	G
R258 Blacksmith Lapwing (*Vanellus armatus*)	nRM	t.Res	A2	Br	Br	Aquatic	AQ1	D
R266 Wood Sandpiper (*Tringa glareola*)	PM	Bit	D1	N-br	N-br	Aquatic	**AQ1**	F
R270 Common Greenshank (*Tringa nebularia*)	PM	Bit	D1	N-br	N-br	Aquatic	AQ1,MR1	F
R295 Black-winged Stilt (*Himantopus himantopus*)	nRM	Bit	C1	N-br	Br	Aquatic	**AQ1**	F
R297 Spotted Thick-knee (*Burhinus capensis*)	Res	p.Res	A3	Br	Br	Ground	HG1	E
R299 Burchell's Courser (*Cursorius rufus*)	nRM	s.Vis(C)	D1	N-br	Br	Ground	GR1,SC1	G
R300 Temminck's Courser (*Cursorius temminckii*)	nRM	s.Vis	C1	N-br	Br	Ground	GR1	G
R301 Double-banded Courser (*Rhinoptilus africanus*)	Res	s.Vis(C)	C1	(Br)	Br	Ground	GR1,SC1	G

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...The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R303 Bronze-winged Courser (*Rhinoptilus chalcopterus*)	iAM,Res	t.Res	D1	?	Br	Ground	**WO1**	D
R305 Black-winged Pratincole (*Glareola nordmanni*)	PM	s.Vis	C1	N-br	N-br	Aerial	**GR1**	G
R322 Caspian Tern (*Sterna caspia*)	nRM	Bit	D1	N-br	Br	Aquatic	AQ1,MR1	F
R338 Whiskered Tern (*Chlidonias hybrida*)	nRM	id	id	N-br	Br	Aquatic	**AQ1**	F
R339 White-winged Tern (*Chlidonias leucopterus*)	PM	id	id	N-br	N-br	Aquatic	AQ1,GR1	F
R344 Namaqua Sandgrouse (*Pterocles namaqua*)	LMig,nRM	Bit	B2	N-br	Br	Ground	SC1	F
R348 Rock Dove (*Columba livia*)	Res	Bit(C)	B2	N-br	Br	Ground	HG1	F
R349 Speckled Pigeon (*Columba guinea*)	Res	Bit	A2	(br)	Br	Ground	HG1	F
R352 Red-eyed Dove (*Streptopelia semitorquata*)	nRM,Res	t.Res(C)	B2	?	Br	Ground	WO1	D
R354 Cape Turtle-Dove (*Streptopelia capicola*)	Res	p.Res(C)	A3	Br	Br	Ground	HG1	D
R355 Laughing Dove (*Streptopelia senegalensis*)	Res	p.Res(C)	A3	Br	Br	Ground	HG1	D
R356 Namaqua Dove (*Oena capensis*)	nRM,Res	t.Res	A2	Br	Br	Ground	HG1	E
R377 Red-chested Cuckoo (*Cuculus solitarius*)	iAM	s.Vis	C1	?	Br	Arboreal	FR1,WO1	D
R382 Jacobin Cuckoo (*Clamator jacobinus*)	iAM	t.Res	A2	br	Br	Arboreal	**WO1**	D
R385 Klaas's Cuckoo (*Chrysococcyx klaas*)	iAM,Res	s.Vis	Z0	?	Br	Arboreal	**WO1**	D
R386 Diderick Cuckoo (*Chrysococcyx caprius*)	iAM	t.Res	A2	Br	Br	Arboreal	GR1,WO1	D
R391 Burchell's Coucal (*Centropus burchellii*)	Res	a.Vis	D1	N-br	Br	Arboreal	WO1	D
R392 Barn Owl (*Tyto alba*)	Res	a.Vis	B1	N-br	Br	Ground	HG1	D
R395 Marsh Owl (*Asio capensis*)	nRM, Res	t.Res(C)	B2	N-br	Br	Ground	AQ1,GR1	G
R401 Spotted Eagle-Owl (*Bubo africanus*)	Res	s.Vis	C1	N-br	Br	Ground	HG1	D
R406 Rufous-cheeked Nightjar (*Caprimulgus rufigena*)	iAM	t.Res	A2	Br	Br	Aerial	**WO1**	D
R411 Common Swift (*Apus apus*)	PM	s.Vis	B2	N-br	N-br	Aerial	HG1	G

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...The status of the birds at Glen, continued.

Name[1]	**Status**			**Breeding**		**Habitat**		
	SALS[2]	**Glen**[3]	**GFC**[4]	**Glen**[5]	**SALS**[6]	**Feeding**[7]	**SALS**[8]	**Glen**[9]
R412 African Black Swift (*Apus barbatus*)	iAM	s.Vis	B1	N-br	Br	Aerial	HG1	G
R415 White-rumped Swift (*Apus caffer*)	iAM	s.Vis	A2	N-br	Br	Aerial	HG1	G
R416 Horus Swift (*Apus horus*)	iAM	s.Vis	B1	N-br	Br	Aerial	HG1	G
R417 Little Swift (*Apus affinis*)	Res?	s.Vis	A2	N-br	Br	Aerial	HG1	G
R418 Alpine Swift (*Tachymarptis melba*)	iAM,Res	Bit	B1	N-br	Br	Aerial	HG1	F
R421 African Palm-Swift (*Cypsiurus parvus*)	Res	Bit	C1	N-br	Br	Aerial	HG1	F
R425 White-backed Mousebird (*Colius colius*)	Res	p.Res	C1	Br	Br	Arboreal	**WO1**	D
R426 Red-faced Mousebird (*Urocolius indicus*)	Res	p.Res(C)	A2	Br	Br	Arboreal	**WO1**	D
R435 Brown-hooded Kingfisher (*Halcyon albiventris*)	Res	a.Vis	D1	N-br	Br	Ground	**WO1**	D
R438 European Bee-eater (*Merops apiaster*)	PM,iAM	s.Vis	A2	N-br	Br	Aerial	HG1	G
R443 White-fronted Bee-eater (*Merops bullockoides*)	Res	s.Vis(C)	C2	N-br	Br	Aerial	**WO1**	G
R445 Swallow-tailed Bee-eater (*Merops hirundineus*)	LMig	s.Vis	Z0	N-br	Br	Aerial	**WO1**	D
R451 African Hoopoe (*Upupa africana*)	Res,LMig,nRM	p.Res	A2	br	Br	Ground	WO1	D
R452 Green Wood-Hoopoe (*Phoeniculus purpureus*)	Res	t.Res	C1	?	Br	Arboreal	FR1,WO1	D
R454 Common Scimitarbill (*Rhinopomastus cyanomelas*)	Res	p.Res	A2	br	Br	Arboreal	**WO1**	D
R464 Black-collared Barbet (*Lybius torquatus*)	Res	a.Vis	D1	N-br	Br	Arboreal	WO1	D
R465 Acacia Pied Barbet (*Tricholaema leucomelas*)	Res	p.Res	A2	br	Br	Arboreal	**WO1**	D
R473 Crested Barbet (*Trachyphonus vaillantii*)	Res	p.Res	A2	br	Br	Arboreal	**WO1**	D
R474 Greater Honeyguide (*Indicator indicator*)	nRM,Res	a.Vis	B1	?	Br	Arboreal	**WO1**	D
R476 Lesser Honeyguide (*Indicator minor*)	Res	s.Vis	C1	?	Br	Arboreal	**WO1**	D
R486 Cardinal Woodpecker (*Dendropicos fuscescens*)	Res	p.Res	B1	br	Br	Arboreal	**WO1**	D
R489 Red-throated Wryneck (*Jynx ruficollis*)	Res	a.Vis	C1	?	Br	Ground	**WO1**	D

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... The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R492 Melodious Lark (*Mirafra cheniana*)	nRM,Res	t.Res	A2	Br	Br	Ground	**GR1**	G
R494 Rufous-naped Lark (*Mirafra africana*)	Res	p.Res	A2	Br	Br	Ground	GR1,WO1	G
R495 Eastern Clapper Lark (*Mirafra fasciolata*)	Res	p.Res	A3	Br	Br	Ground	GR1,SC1	G
R498 Sabota Lark (*Calendulauda sabota*)	Res	p.Res	Z0	Br	Br	Ground	**WO1**	D
R506 Spike-heeled Lark (*Chersomanes albofasciata*)	Res	p.Res	A3	Br	Br	Ground	GR1,SC1	G
R507 Red-capped Lark (*Calandrella cinerea*)	Res	Bit(C)	A2	N-br	Br	Ground	GR1,SC1	F
R508 Pink-billed Lark (*Spizocorys conirostris*)	Res	p.Res	A2	Br	Br	Ground	**GR1**	G
R515 Chestnut-backed Sparrowlark (*Eremopterix leucotis*)	nRM,LMig,Res	Bit(C)	B2	?	Br	Ground	GR1,WO1	F
R516 Grey-backed Sparrowlark (*Eremopterix verticalis*)	nRM	Bit(C)	B2	Br	Br	Ground	GR1,SC1	F
R518 Barn Swallow (*Hirundo rustica*)	PM	s.Vis	A2	N-br	N-br	Aerial	HG1	G
R520 White-throated Swallow (*Hirundo albigularis*)	iAM	s.Vis	A2	(Br)	Br	Aerial	**AQ1**	G
R523 Pearl-breasted Swallow (*Hirundo dimidiata*)	iAM	t.Res	B1	Br	Br	Aerial	HG1	E
R524 Red-breasted Swallow (*Hirundo semirufa*)	iAM	s.Vis	B1	N-br	Br	Aerial	GR1,WO1	G
R526 Greater Striped Swallow (*Hirundo cucullata*)	iAM	s.Vis	A2	(Br)	Br	Aerial	GR1,SC1	G
R528 South African Cliff-Swallow (*Hirundo spilodera*)	iAM	s.Vis	A2	N-br	Br	Aerial	GR1	G
R529 Rock Martin (*Hirundo fuligula*)	Res,LMig	s.Vis(C)	A2	N-br	Br	Aerial	RC1	G
R530 Common House-Martin (*Delichon urbicum*)	PM	s.Vis	B1	N-br	N-br	Aerial	HG1	G
R533 Brown-throated Martin (*Riparia paludicola*)	LMig,Res,nRM	s.Vis(C)	B1	N-br	Br	Aerial	**AQ1**	G
R534 Banded Martin (*Riparia cincta*)	iAM	s.Vis	B1	N-br	Br	Aerial	GR1	G
R541 Fork-tailed Drongo (*Dicrurus adsimilis*)	Res	s.Vis(C)	B1	N-br	Br	Arboreal	FR1,WO1	G
R548 Pied Crow (*Corvus albus*)	Res	Bit	C1	N-br	Br	Ground	HG1	F
R552 Ashy Tit (*Parus cinerascens*)	Res	p.Res	A2	br	Br	Arboreal	**WO1**	D

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...The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R557 Cape Penduline-Tit (*Anthoscopus minutus*)	Res	a.Vis	B2	br	Br	Ground	SC1,WO1	G
R567 African Red-eyed Bulbul (*Pycnonotus nigricans*)	Res	p.Res	A2	br	Br	Arboreal	**WO1**	D
R577 Karoo Thrush (*Turdus smithi*)	Res	p.Res	Z0	br	Br	Ground	FR1,WO1	D
R582 Sentinel Rock-Thrush (*Monticola explorator*)	LMig	s.Vis(C)	D1	N-br	Br	Ground	GR1,RC1,SC1	G
R587 Capped Wheatear (*Oenanthe pileata*)	nRM,LMig	t.Res	C1	N-br	Br	Ground	GR1,SC1	G
R591 Sickle-winged Chat (*Cercomela sinuata*)	LMig,Res	s.Vis(C)	B1	N-br	Br	Ground	GR1,SC1	G
R595 Ant-eating Chat (*Myrmecocichla formicivora*)	Res	p.Res	A3	Br	Br	Ground	GR1,SC1	G
R596 African Stonechat (*Saxicola torquatus*)	LMig,Res	t.Res(C)	A2	N-br	Br	Ground	GR1,SC1	G
R601 Cape Robin-Chat (*Cossypha caffra*)	Res,LMig	p.Res	A2	br	Br	Ground	FR1,SC1,WO1	D
R614 Karoo Scrub-Robin (*Cercotrichas coryphoeus*)	Res	p.Res	Z0	br	Br	Ground	**SC1**	D
R615 Kalahari Scrub-Robin (*Cercotrichas paena*)	Res	p.Res	A2	Br	Br	Ground	**WO1**	D
R621 Chestnut-vented Tit-Babbler (*Parisoma subcaeruleum*)	Res	p.Res	A2	Br	Br	Arboreal	SC1,WO1	D
R622 Layard's Tit-Babbler (*Parisoma layardi*)	LMig,Res	s.Vis(C)	D1	?	Br	Arboreal	**SC1**	M
R625 Icterine Warbler (*Hippolais icterina*)	PM	s.Vis	Z0	N-br	N-br	Arboreal	**WO1**	D
R643 Willow Warbler (*Phylloscopus trochilus*)	PM	t.Res	C1	N-br	N-br	Arboreal	**WO1**	D
R651 Long-billed Crombec (*Sylvietta rufescens*)	Res	p.Res	C1	br	Br	Arboreal	SC1,WO1	D
R653 Yellow-bellied Eremomela (*Eremomela icteropygialis*)	Res	a.Vis	A2	?	Br	Arboreal	SC1,WO1	G
R664 Zitting Cisticola (*Cisticola juncidis*)	nRM,Res	t.Res	A2	Br	Br	Ground	**GR1**	G
R665 Desert Cisticola (*Cisticola aridulus*)	Res	p.Res	A2	Br	Br	Ground	**GR1**	G
R666 Cloud Cisticola (*Cisticola textrix*)	Res	p.Res	A3	Br	Br	Ground	GR1	G
R667 Wing-snapping Cisticola (*Cisticola ayresii*)	nRM,LMig,Res	s.Vis	D1	N-br	Br	Ground	**GR1**	G
R681 Neddicky (*Cisticola fulvicapilla*)	Res	p.Res	A2	br	Br	Arboreal	SC1,WO1	D

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... The status of the birds at Glen, continued.

Name[1]	**Status**			**Breeding**		**Habitat**		
	SALS[2]	**Glen**[3]	**GFC**[4]	**Glen**[5]	**SALS**[6]	**Feeding**[7]	**SALS**[8]	**Glen**[9]
R685 Black-chested Prinia (*Prinia flavicans*)	Res	p.Res	A2	Br	Br	Arboreal	SC1,WO1	D
R688 Rufous-eared Warbler (*Malcorus pectoralis*)	Res	s.Vis	C2	N-br	Br	Ground	**SC1**	G
R689 Spotted Flycatcher (*Muscicapa striata*)	PM	s.Vis	Z0	N-br	N-br	Arboreal	**WO1**	D
R698 Fiscal Flycatcher (*Sigelus silens*)	Res,LMig	p.Res(C)	C1	br	Br	Ground	**WO1**	D
R703 Pririt Batis (*Batis pririt*)	Res	s.Vis	C1	?	Br	Arboreal	**WO1**	D
R706 Fairy Flycatcher (*Stenostira scita*)	Res,LMig	p.Res	Z0	?	Br	Arboreal	SC1,WO1	D
R713 Cape Wagtail (*Motacilla capensis*)	nRM,Res,LMig	t.Res(C)	B2	?	Br	Aquatic	AQ1	D
R716 African Pipit (*Anthus cinnamomeus*)	Res,LMig	p.Res	A3	br	Br	Ground	**GR1**	G
R717 Long-billed Pipit (*Anthus similis*)	Res	id	id	?	Br	Ground	RC1	G
R718 Plain-backed Pipit (*Anthus leucophrys*)	Res,LMig	id	id	?	Br	Ground	**GR1**	G
R719 Buffy Pipit (*Anthus vaalensis*)	Res	id	id	?	Br	Ground	GR1	G
R727 Cape Longclaw (*Macronyx capensis*)	Res	p.Res	A3	Br	Br	Ground	**GR1**	G
R731 Lesser Grey Shrike (*Lanius minor*)	PM	s.Vis	B1	N-br	N-br	Ground	**WO1**	G
R732 Common Fiscal (*Lanius collaris*)	Res,LMig	p.Res	A3	Br	Br	Ground	HG1	E
R733 Red-backed Shrike (*Lanius collurio*)	PM	t.Res	Z0	N-br	N-br	Ground	**WO1**	D
R743 Brown-crowned Tchagra (*Tchagra australis*)	Res	t.Res	B2	br	Br	Ground	**WO1**	D
R746 Bokmakierie (*Telophorus zeylonus*)	Res	p.Res	A3	br	Br	Ground	**SC1**	D
R759 Pied Starling (*Spreo bicolor*)	Res	Bit	B1	N-br	Br	Ground	HG1	F
R760 Wattled Starling (*Creatophora cinerea*)	nRM	r.Vis	A2	Br	Br	Ground	HG1	G
R764 Cape Glossy Starling (*Lamprotornis nitens*)	Res	s.Vis(C)	B1	?	Br	Ground	WO1	D
R769 Red-winged Starling (*Onychognathus morio*)	Res	?	D1	N-br	Br	Ground	RC1	F
R787 White-bellied Sunbird (*Cinnyris talatala*)	nRM,LMig,Res	a.Vis	Z0	N-br	Br	Arboreal	**WO1**	D

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... The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R796a Orange River White-eye (*Zosterops pallidus*)	Res	p.Res	Z0	br	Br	Arboreal	FR1,SC1,WO1	D
R796b Cape White-eye (*Zosterops virens*)	Res	a.Vis	Z0	br	Br	Arboreal	FR1,SC1,WO1	D
R799 White-browed Sparrow-Weaver (*Plocepasser mahali*)	Res	Out(C)	A2	(Br)	Br	Ground	**WO1**	X
R800 Sociable Weaver (*Philetairus socius*)	Res	Bit	D1	N-br	Br	Ground	WO1	F
R801 House Sparrow (*Passer domesticus*)	Res	Bit	D1	N-br	Br	Ground	HG1	F
R803 Cape Sparrow (*Passer melanurus*)	Res,nRM	r.Vis	A3	Br	Br	Ground	HG1	G
R804 Southern Grey-headed Sparrow (*Passer diffusus*)	Res	s.Vis(C)	C1	?	Br	Ground	**WO1**	D
R806 Scaly-feathered Finch (*Sporopipes squamifrons*)	Res	Bit	C1	N-br	Br	Ground	WO1	F
R814 Southern Masked-Weaver (*Ploceus velatus*)	Res	p.Res	B2	Br	Br	Ground	HG1	D
R821 Red-billed Quelea (*Quelea quelea*)	nRM	r.Vis	A2	Br	Br	Ground	HG1	G
R824 Southern Red Bishop (*Euplectes orix*)	Res	r.Vis(C)	A3	N-br	Br	Ground	AQ1	G
R826 Yellow-crowned Bishop (*Euplectes afer*)	nRM	Bit	B1	N-br	Br	Ground	AQ1,GR1	F
R832 Long-tailed Widowbird (*Euplectes progne*)	Res	t.Res	A2	?	Br	Ground	GR1	G
R834 Green-winged Pytilia (*Pytilia melba*)	Res	?	Z0	?	Br	Ground	WO1	D
R844 Blue Waxbill (*Uraeginthus angolensis*)	nRM,Res	a.Vis	Z0	n-br	Br	Ground	WO1	D
R845 Violet-eared Waxbill (*Granatina granatina*)	Res	a.Vis	D1	n-br	Br	Ground	**WO1**	D
R846 Common Waxbill (*Estrilda astrild*)	Res	Bit	C1	N-br	Br	Aquatic	AQ1	F
R847 Black-faced Waxbill (*Estrilda erythronotos*)	Res	a.Vis	Z0	?	Br	Ground	**WO1**	D
R852 African Quailfinch (*Ortygospiza atricollis*)	Res,nRM	p.Res	A3	Br	Br	Ground	GR1	G
R856 Red-headed Finch (*Amadina erythrocephala*)	nRM	t.Res(C)	A2	Br	Br	Ground	GR1,SC1,WO1	G
R860 Pin-tailed Whydah (*Vidua macroura*)	Res,nRM	s.Vis	B1	?	Br	Ground	HG1	G
R870 Black-throated Canary (*Crithagra atrogularis*)	Res	t.Res	A2	?	Br	Ground	WO1	D

continued on next page ...

...The status of the birds at Glen, continued.

Name[1]	Status			Breeding		Habitat		
	SALS[2]	Glen[3]	GFC[4]	Glen[5]	SALS[6]	Feeding[7]	SALS[8]	Glen[9]
R872 Cape Canary (*Serinus canicollis*)	LMig,Res,nRM	s.Vis(C)	C1	N-br	Br	Ground	HG1	G
R878 Yellow Canary (*Crithagra flaviventris*)	Res,LMig,nRM	p.Res(C)	A3	Br	Br	Ground	GR1,SC1	E
R884 Golden-breasted Bunting (*Emberiza flaviventris*)	nRM,Res	a.Vis	Z0	?	Br	Ground	**WO1**	D
R885 Cape Bunting (*Emberiza capensis*)	Res	p.Res	D1	?	Br	Ground	GR1,RC1,SC1	M
R886 Cinnamon-breasted Bunting (*Emberiza tahapisi*)	Res	p.Res	A2	(Br)	Br	Ground	RC1	M
R887 Lark-like Bunting (*Emberiza impetuani*)	nRM	t.Res	C1	N-br	Br	Ground	SC1,WO1	G

LEGEND (see Appendix A from a more detailed discussion):

[1] *Name — The sequence and number (e.g. R354 ...) follows Maclean (1985) and the taxonomy otherwise follows Hockey* et al. *(2005).*

[2] *Status, SALS — General status in South Africa, Lesotho and Swaziland:* **Res** = Resident; **LMig** = Migratory within southern Africa;

iAM = intra-African migrant (all breeding in southern Africa); **PM** = Palearctic migrant (none breed in southern Africa); **nRM** = Not resident or migratory.

[3] *Status, Glen:* **p.Res** = Permanent resident; **t.Res** = Temporary resident; **r.Vis** = Regular visitor; **s.Vis** = Regular visitor; **a.Vis** = Aseasonal visitor;

Bit = Birds in transit; **Out** = Birds heard outside the study area; ? = Status uncertain, see species account; **(C)** = activity peaks during cooler seasons; **id** = consult species account.

[4] *Status,* GFC: Classification based on the number of years and seasons recorded in the grassland, called the Grassland Frequency Class (GFC) (see Table 6.3 on page 1022):

A = 11 years; **B** = 7–10 years; **C** = 3–6 years; **D** = 1–2 years; **1** = 1–2 seasons; **2** = 3–11 seasons; **3** = 12 seasons; **Z0** = Not recorded in grassland; **id** = consult species account.

[5,6] *Breeding — In study area, or when in (brackets) close to study area:* **Br** = Breeding confirmed; **br** = Breeding suspected; ? = Breeding status undetermined;

n-br = Breeding not suspected; **N-br** = Breeding improbable.

[7] *Habitat, Feeding:* Feeding niche. One of aerial, arboreal, ground or water.

[8] *Habitat, SALS — Hierarchical habitat classification of birds in South Africa, Lesotho and Swaziland according to Harrison* et al. *(1994), showing only the primary level as follows:*

MR1 = Marine; **AQ1** = Aquatic; **RC1** = Montane & rocky; **FR1** = Forest; **WO1** = Woodland; **GR1** = Grassland; **SC1** = Scrub; **HG1** = Habitat generalists.

***Bold** signifies indicator species as opposed to associated species. See page 1178.*

[9] *Habitat, Glen — Habitat with which mostly associate at Glen:* **D** = Drainage line; **E** = Drainage line, but visits grassland often; **F** = Overflying; **G** = Grassland.

APPENDIX C: Glossary

Activity: Context specific type of data, *e.g.* birds present, birds seen only, birds heard, displays or song.

Activity intensity: The number of minutes per 5-minute interval during which *activity* was recorded.

Bird-days: All days during which *activity* was noted for the particular species.

Bird-mornings: All mornings during which *activity* was noted for the particular species, referring to the early morning data (S0 and S1) of 2007/8.

Bird-seasons: All seasons during which *activity* was noted for the particular species.

Bird-segments: All segments during which *activity* was noted for the particular species.

Bird-years: All years during which *activity* was noted for the particular species.

CAR: Coordinate Avifaunal Roadcount. See Young *et. al.* (2003).

Cool-season species/bird: A species that tends to be more active during the cooler times of the year. See page 87.

Glen: The study area including the grassland and drainage line (see Chapter 2). Distinct from *Glen village.*

Glen village: The area around and including the village at Glen Agricultural College.

High reporting rate day: A *bird-day* with its reporting rate within the upper third of the total daily reporting rate range for the species and *activity* under consideration.

Intermediate reporting rate day: A *bird-day* with its reporting rate within the middle third of the total daily reporting rate range for the species and *activity* under consideration.

LIH-days: *Low*, *Intermediate* and *High reporting rate days.*

LIH-mornings: *Low, Intermediate and High reporting rate* mornings, referring to the early morning data (S0 and S1) of 2007/8.

Low reporting rate day: A *bird-day* with its reporting rate within the lower third of the total daily reporting rate range for the species and *activity* under consideration.

Main bird-seasons: The seasons during which the *activity* under consideration was most prominent/frequent.

Main rain period: Late spring to mid-autumn. See page 88.

Observation day: A day with 10–14 *observation segments.*

Observation segment: A segment with at least ten 5-minute checklists.

Pentad: A pentad covers 5 minutes of latitude by 5 minutes of longitude (5' x 5').

QDGS: Quarter degree grid-square. A QDGC covers 15 minutes of latitude by 15 minutes of longitude (15' x 15').

Reporting rate: Percentage 5-minute checklists per day (for annual and seasonal analyses) or segment (for segmental analyses) on which a particular *activity* of a species occurred.

SABAP1: First Southern African Atlas Project, 1987–1991 (Harrison et al. 1997a,b).

SABAP2: Second Southern African Atlas Project, 2007–present (`http://sabap2.adu.org.za`).

Segment: A day is divided into 14 segments: S0 (before sunrise), S1–S12 (equal length segments between sunrise and sunset) and S13 (after sunset). See Figure 3.1, page 121.

Warm-season species/bird: A species that tends to be more active during the warmer times of the year. See page 87.