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Seasonal biometric differences between sex and age groups of the Graceful Warbler *Prinia gracilis* at Eilat (Israel)

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Abstract. An abundant resident in Israel, the Graceful Warbler breeds in the northern and central parts of the country and has recently invaded desert areas following their human settlement. Possible seasonal changes in age and sex structure were investigated, as were differences in body measurements in individual sex and age classes as well as changes in the numbers of the Graceful Warbler population in Eilat. No difference was recorded between spring and autumn in the proportion of males to females, nor were significant differences found in the numbers of males and females ringed during the spring and autumn seasons. There was a significant difference in the proportion of juvenile to adult birds trapped in spring and in autumn. Moreover, males had longer wings than females in both seasons. There were no differences in body mass or body condition between sexes in the two seasons. Furthermore, adults had longer wings than first-year birds. Juveniles had longer wings in autumn than in spring, but no differences were recorded in the adults in this respect. In addition, juveniles were in better condition in spring than in autumn; however, there was no difference in body condition of the adults between seasons. The fact that a significant trend was found in the numbers of Graceful Warblers trapped in spring but no such trend in autumn, that a large proportion of recaptured birds were noted in both seasons, and that a high number of individual birds were caught repeatedly during the study period, suggests the existence of a stable or increasing breeding population in Eilat all the year round. In addition, the Bird Sanctuary is like an oasis in the desert environs of Eilat. Hence, the lack of differences among the years in the proportions of males and females between the seasons suggests that it is mainly breeding pairs that occupy the area.

Key words: Graceful Warbler, *Prinia gracilis*, Eilat, biometric

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INTRODUCTION

The breeding range of the Graceful Warbler is restricted to NE Africa, a part of the Middle East, and eastwards to northern India (Cramp 1998). The species is found in Mediterranean, dry subtropical, and tropical zones of the lower middle latitudes in the southeast part of the western Palearctic, and is said to avoid deserts (Snow & Perrins 1998). It is a polytypic species that is generally sedentary. In southern Turkey, some dispersal apparently occurs outside of the breeding season. However, there are very few records of sightings outside the species breeding range (Cramp 1998). In Israel, the Graceful Warbler is an abundant resident in most of the Negev and through central and northern parts on the country, and a common resident along the border with Jordan (Shirihai 1996).

The breeding season of the Graceful Warbler can be very long and lasts from late January to September (Shirihai 1996), but mostly begins in March and last fledging is observed in late July, rarely in August (Paz 1987, Cramp 1998). The Graceful Warbler is multi-brooded, mostly reared 2–4 broods but a female can lay up to 5 clutches (Paz 1987). The species is monogamous and territorial pair bond is maintained year round (Cramp 1998). In contrast, Shirihai (1996) states that the Graceful Warbler is territorial only during

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the breeding season after which they gather in groups. The contradictions between the information presented by Paz (1987), Shirihai (1996) and Cramp (1998) result in confusion and uncertainty about the ecology and the breeding biology of the species in Israel. This is further confounded by the fact that there are very few studies published on the species (e.g. Paz 1978, Yosef 1997).

None of the above mentioned authors have reported the breeding ecology of the Graceful Warbler from the Eilat region. Shirihai (1996) considered the species as only a sporadic breeder in the southern Arava region and the species is not included in the residence and breeding map.

The desert is a very abrasive habitat wherein the avian species are evolutionarily adapted to in all parameters of their life history. Hence, the penetration of a Tropical/Mediterranean Zone species into the desert should affect its life history patterns and survival. One of the most obvious, and most frequently measured parameter at any given ringing station, is body mass. The body mass of a bird is influenced by several different ecological parameters — reproductive stage, season of year, etc. Hence, we wished to identify the changes in biometrics of the Graceful Warbler through the year in the desert at Eilat, at the southernmost tip of Israel.

The aim of this study was to investigate the possible seasonal changes in age and sex structure, differences in body measurements in individual sex and age classes as well as changes in the numbers of the local Graceful Warbler population. We also show that it is possible to research sedentary populations of birds using the typical data collected at a generalist bird ringing station.

MATERIAL AND METHODS

Data were collected during 8 spring (February–June) and 7 autumn (September–December) seasons in the years 1996–2003 at the "Bird Sanctuary" of the International Birding and Research Centre in Eilat (29°33′N, 34°57′E). A total of 359 Graceful Warbler (annual: 19–62) have to date been ringed at Eilat and none recovered or controlled elsewhere.

Birds trapped were ringed, sexed, aged, and biometric parameters were measured. Ageing and sexing was based on a wide range of characteristics learned through years of field experience (R. Yosef, unpubl. data, K. Meyrom, A. Rochman, pers. comm.). We classified the birds in two age classes, adult or juvenile, based on eye colour (orange/yellow in adults, black in juveniles), plumage and gape; sex in adults was determined by a black gape vs. a mottled one in males, a pink upper mandible during the breeding season in females, and biometrics (wing chord length — male 44–46 mm vs female 40–41 mm; tail length male 51–68 mm, female 51–63 mm). Flattened maximum wing chord was measured to the nearest millimetre, and body mass was determined with a Pesola 10g spring balance to the nearest 0.1 g. The relative body condition of the birds was compared using a body condition index (body mass divided by wing length, Yosef et al. 2003).

DATA PROCESSING AND ANALYSIS

In order to receive an over view of the possible differences between the sex and age classes of the Graceful Warbler at Eilat we analysed all of the data from the spring and autumn seasons. To avoid pseudoreplication only data from the first captures were used to calculate the biometric characteristics. However, data on wing chord length, body mass and body condition were not evaluated for all individuals and has resulted in large variations in sample sizes. Moreover, individuals not ascribed to either one of the age or sex classes were excluded from the biometric analyses.

We analysed the simultaneous effect of sex and trapping season for adults, and the effect of age and season for all the ringed Graceful Warblers on wing length, body mass and body condition. The analysis was conducted using factorial ANOVA. The calculations were performed with the Visual General Linear Model (Zar 1999).

The trapping time was standardized and is presented in Julian dates. For each of the seasons the relative catching time for each of the birds was calculated as the residual from the seasonal median.

Standard statistical methods were used to describe and analyse the data (Sokal & Rohlf 1995). All statistical tests were two-tailed and we use the abbreviation CL for the 95% confidence limits.

RESULTS

Trapping success, sex-ratio and age-ratio

In the 15 trapping seasons during the eight years 1996–2003 of the study, we caught a total of

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359 individuals of Graceful Warbler (annual mean = 44.87, CL: 33.23–56.51, range: 19–62). We found a variance in trapping success between years in spring and autumn (Fig. 1a, b) but the mean number of birds caught in individual seasons was similar (Mann-Whitney U-test, U = 24.5, p = 0.69, spring: mean = 26.7, CL: 14.0–39.4, autumn: mean 20.7, CL: 11.8–29.6). Moreover, we found a significant trend in Graceful Warbler numbers in spring over the eight-year study period (Spearman correlation, r = 0.78, n = 8, p = 0.02) and the lack of such a trend in the autumn (r = -0.21, n = 7, p = 0.64).

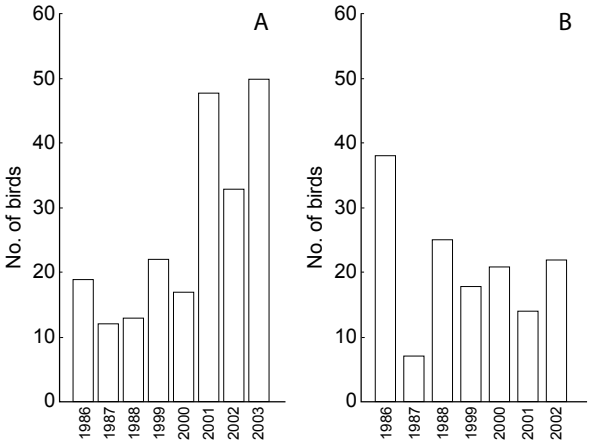

Fig. 1. The number of Graceful Warbler ringed during the spring (A, N = 214) and autumn (B, N = 145) trapping seasons at the IBRCE "Bird Sanctuary" in Eilat, Israel.

Of 359 individuals 67 (18.7%) were classified as males and 47 (13.1%) females. The remaining were juveniles (n = 152, 42.3%) and birds whose sex or age were not determined (n = 93, 25.9%).

Ninety seven (27% of all ringed birds) Graceful Warbler were recaptured at least once during the eight-year study. The proportion of recaptured birds significantly differed between seasons (χ^2 = 8.20, df = 1, p = 0.004). In spring, 21.5% (n = 214) of the birds were recaptured and in autumn 35.2% (n = 145). The mean number of captures of the same individual was 3.98 (CL: 2.64–5.34) and varied from 1 to 44 times.

We recorded no difference between the spring and autumn seasons in the proportion of males to females (χ^2 = 2.6, df = 1, p = 0.11); nor did we find significant differences in the number of males and females ringed during the spring (χ^2 = 2.81, df = 1, p = 0.1), and autumn (χ^2 = 0.23, df = 1, p = 0.63) seasons. In addition, we did not note significant differences among years in the proportion of males and females in spring (χ^2 = 9.86, df = 7, p = 0.197) and in autumn seasons (χ^2 = 5.67, df = 6, p = 0.46).

There was a significant difference in the proportion of juvenile to adult birds trapped in spring (χ^2 = 11.90, df = 1, p < 0.001) where juveniles comprised 33% of all birds. Also in autumn the difference was significant (χ^2 = 7.34, df = 1, p = 0.007) and juveniles comprised 66.7% of all birds.

Seasonal changes in numbers

The largest numbers of Graceful Warbler were ringed in March, April and May in the spring and in September, October and November in the autumn (Fig. 2).

We found no changes in the dates of ringing of male and female Graceful Warbler in both trapping seasons (spring: Mann-Whitney U-test, U = 970.5, p = 0.48, autumn: U = 41.5, p = 0.84). However, we found differences in dates between juveniles and adults in the spring (U-test, U = 2857.0, p < 0.001). Adult birds were ringed on average 18 days earlier than juveniles (standardized time, adult: mean = -11.2, CL: -16.7– -5.6, n = 134, juvenile: mean = 7.2, CL: -0.7–15.1, n = 66). In contrast, in autumn there was no such difference (U-test, U = 1686.0, p = 0.42).

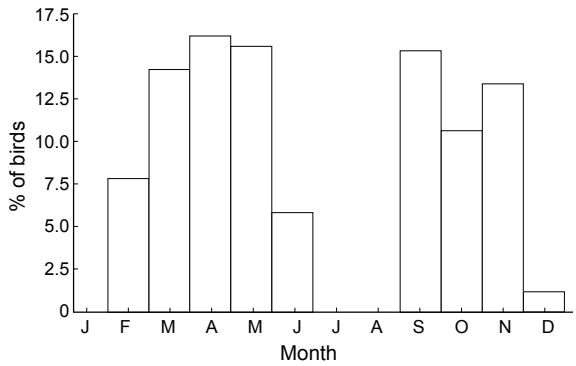

Fig. 2. Monthly changes in the numbers of Graceful Warbler ringed at Eilat, Israel (N = 359). Data for spring (February–June) and autumn (September–December) season.

Differences in biometric measurements in relation to sex, age and trapping season

In adult birds we found significant differences only in wing chord length and only between sexes (Factorial ANOVA, $F_{1, 10}$ = 13.55, p < 0.001). Males had longer wing than females in both seasons (Table 1). Moreover in adult birds we found no

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Table 1. Biometric measurements of males and females Graceful Warbler ringed in the spring and autumn in Eilat, Israel. All values presented as mean with 95% confidence of limits in parentheses.

	Wing length (mm)	Body mass (g)	Body condition index
Spring			
Males (N = 59)	43.9 (43.5–44.3)	6.6 (6.4–6.8)	0.151 (0.146–0.156)
Females (N = 36)	43.0 (42.6–43.5)	6.5 (6.3–6.8)	0.154 (0.147–0.160)
Autumn			
Males (N = 8)	44.5 (43.5–45.5)	6.8 (6.3–7.4)	0.155 (0.141–0.168)
Females (N = 11)	42.7 (41.9–43.6)	6.7 (6.2–7.2)	0.157 (0.146–0.169)

differences in body mass as well as body condition between sexes in both seasons ($p > 0.3$ in all cases).

We found significant differences in wing chord length between the age classes (Factorial ANOVA, $F_{1,318} = 14.21$, $p < 0.001$). Adults had longer wing than first-year birds. Moreover the interaction between sex and age of birds was significant. Juveniles had longer wings in autumn than in spring ($F_{1,318} = 5.85$, $p = 0.016$, Fig. 3a); there were no differences for adults.

We found a significant influence of age on body mass ($F_{1,314} = 11.09$, $p < 0.001$). Adults, in both seasons, were heavier than juveniles (Fig. 3b). Moreover, we found no difference in body mass between seasons ($p = 0.57$). There was significant interaction between age and season ($F_{1,314} = 4.04$, $p = 0.045$). In autumn adults were heavier than juveniles. No differences were recorded in spring.

We recorded significant differences in body condition index between the age classes ($F_{1,309} = 4.64$, $p = 0.03$). Adults were in better body condition than juveniles. However, we did not find any influence of season on the body condition of the birds from the two age classes ($p = 0.27$) but the interaction between age and season was significant ($F_{1,309} = 7.41$, $p = 0.007$). The juvenile birds were in better

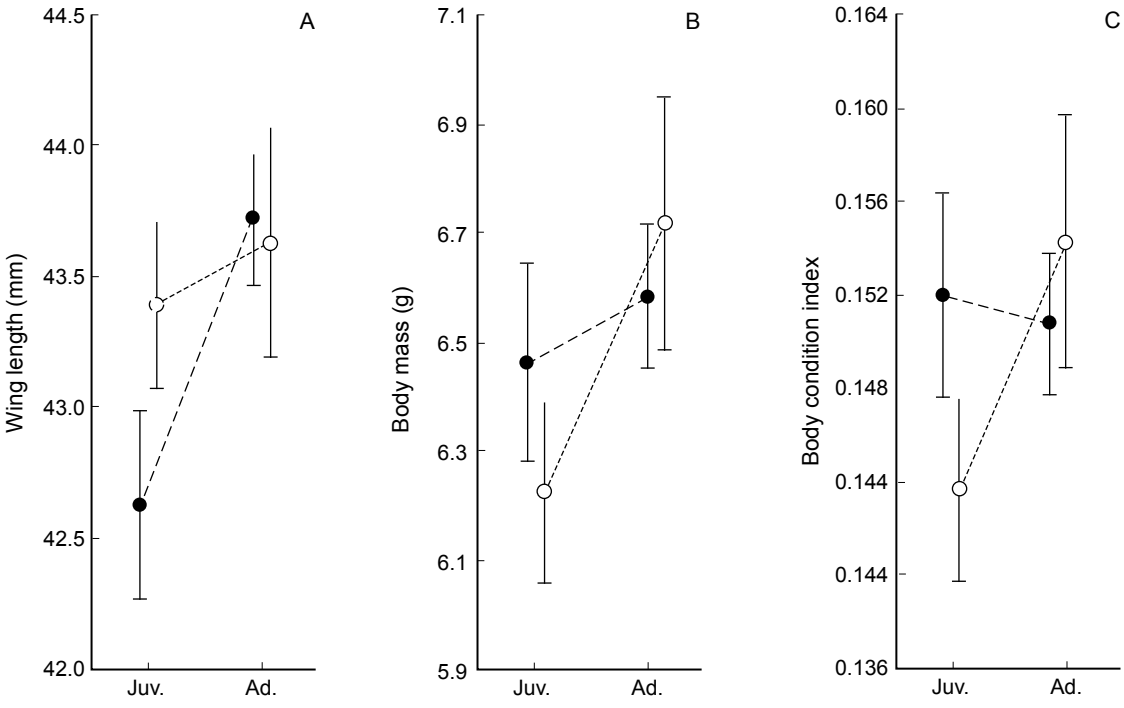

Fig. 3. Mean values with 95% confidence limits, of wing length (A) body mass (B) and body condition index (C) of Graceful Warbler from different age groups during spring (full points) and autumn trapping season (hollow points) at Eilat, Israel.

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condition in spring than in autumn (Fig. 3c). There was no difference in body condition of the adults between seasons.

DISCUSSION

Our study illustrates how analyses of ringing data can shed light on some of the life-history parameters of the target sedentary species. The data show differences between males and females and adults and juveniles in an annual cycle that has not been reported to date.

We found a significant increase in the numbers of Graceful Warbler trapped randomly in spring but not in autumn; however, the mean number of trapped birds did not differ between seasons throughout the study period. Additionally, we noted the great proportion of recaptured birds in both seasons and the high number of repeatedly caught individuals which indicates a stable, or perhaps increasing, breeding population at the Bird Sanctuary in Eilat. This conclusion is further corroborated by the fact that we did not observe any significant differences in the numbers of birds ringed in months when the ringing point activity was high. Further, the fact that we did not find any differences in trapping dates between the sexes in both trapping seasons suggests a sedentary population. Hence, we can assume that the Graceful Warbler in the Eilat region could conform to the information that pairs hold territory year round (Cramp 1998).

It is of interest that we found differences in the proportion of juvenile to adult birds between the spring and autumn seasons. In spring adults predominated which is probably connected with a low survival of juveniles. Paz (1978) found that nestling survival was low for Graceful Warblers, and that only 26.7% of nestlings survived a month or more. It is possible that adults defending territories during the breeding season force their fledglings from the earlier broods to abandon the breeding area.

In autumn, in contrast to the spring, the age ratio was juvenile-skewed. This, we suspect is the effect of the overall reproductive output of the local, sedentary population that has fledged between three to five times their numbers resulting in higher number of juveniles in the study area in the autumn. Moreover, the differences between the seasons could be a result of the Graceful Warbler breeding to the end of August or later as reported by Paz (1978). It is also possible that the hot summers in the desert force the species to split their breeding season with a break during the hottest months of July and August, however this needs to be substantiated by field studies. This could also explain why adults are trapped on average 17 days earlier in the spring than the fledglings, but no difference is apparent in the autumn. Also, the juvenile to adult ratio is lower in late-spring as compared to autumn, which represents the collective breeding success of the Graceful Warbler population in the Bird Sanctuary in Eilat. It is also possible that that the marked increase in juveniles in autumn is the result of dispersal of all the Graceful Warblers of the southern Arava region that are searching for appropriate areas to set up their own territories. We found no differences the proportion of ringed males to females in the spring and autumn seasons and can be interpreted as evidence for the stability in the local breeding population, the loyalty between mates, year-round territorial fidelity and a monogamous mating system.

In addition, the Bird Sanctuary is like an oasis in the desert environs of Eilat. It is heavily vegetated, fresh water easily accessible in the form of a fresh water lake or through the drip system used for irrigation, and there are always some plant species that either fruit or flower during any given month of the year. Hence, the lack of differences among years in the proportion of males and females between the seasons suggests that mainly breeding pairs occupy the area (see Fuisz & Yosef 2001).

The biometrics of the Graceful Warbler is also of interest. We suspect that the differences in wing length between seasons in juveniles are connected with post-juvenile moult. Also, the better body condition of the juveniles in the spring is probably connected to the accessibility of appropriate food resources in the Bird Sanctuary.

Further, we found significant differences only in the wing chord length between the sexes, which are a common phenomenon in passerines (e.g. Svensson 1992). The lack of a difference in body mass, and thereby body condition, between sexes indicates that owing to the fact that the Graceful Warbler is a monogamous species wherein both parents participate in all parental duties, the result is an equal expenditure of energy connected with parental care (Moreno 1989). Moreno (1989) suggested the incubatory mass constancy models to understand body mass regulation in the parents during the breeding season wherein mass constancy occurs when parents maintain or increase their body mass without reducing their level of attentiveness. This strategy occurs in species wherein both the male and the female share in the parental responsibilities, as in most of the small passerines.

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Based on our data, it appears that the Graceful Warbler in Eilat conforms to the incubatory mass constancy model with body mass loss occurring only after the young hatch and the parents are stressed to find food for their progeny.

The importance of this study is in our attempt to use an existing data set of a ringing station to interpret the annual life cycle of a sedentary species. This is especially of interest because the Graceful Warbler is a very recent intruder into the desert areas of the southern Arava region.

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STRESZCZENIE

[Sezonowe różnice biometryczne między płciowymi i wiekowymi grupami prinii w Eilat, Izrael]

Badania populacji prinii prowadzono z wykorzystaniem danych z punktu obrączkowania ptaków leżącym w Izraelu, nad Morzem Czerwonym. Teren badań to duża oaza oferująca ptakom doskonale warunki do całorocznego bytowania w krajobrazie o charakterze pustynnym. Zebrane dane pochodzą z 8 wiosennych (luty–czerwiec) i 7 jesiennych (wrzesień–grudzień) sezonów z lat 1996–2003. Schwytane ptaki obrączkowano, mierzono i ważono. Do głównej analizy włączono tylko informacje z pierwszych złowień. Ogółem zaobrączkowano 359 ptaki, z czego 18.7% to samce a 13.1% samice. Pozostałe 42.3% to osobniki młode oraz ptaki, których płeć bądź wiek nie został oznaczony (25.9%).

Rocznie odławiano od 19 do 62 osobników. Liczba złapanych ptaków w poszczególnych sezonach różniła się między latami badań (Fig. 1). W sezonie wiosennym najwięcej ptaków odławiano w marcu, kwietniu i maju. W sezonie wiosennym był to wrzesień, październik i listopad (Fig. 2).

Stwierdzono wzrostowy trend liczebności prinii w trakcie okresu badań w sezonie wiosennym i brak takiego trendu w sezonie jesiennym. Jednocześnie nie odnotowano różnic w średniej liczbie złapanych ptaków między sezonami badań. Dodatkowo, w obydwu sezonach, aż 27% osobników odłowiono ponownie, z czego średnia liczba ponownych złowień wynosiła 3.98 i wahała się od 1 do 44, co wskazuje na istnienie stabilnej lub zwiększającej liczebność populacji lęgowej na badanym terenie. To stwierdzenie potwierdza brak różnic w dacie złowień między płciami w obydwu sezonach.

Dodatkowo nie odnotowano różnic w proporcji płci w obydwu sezonach, jak i brak różnic w proporcji płci pomiędzy sezonami. Ponadto nie wykryto różnic w proporcji płci między latami w poszczególnych sezonach, co pozwala na stwierdzenie, że pary ptaków występujące na badanym terenie są terytorialne przez cały rok (Cramp 1998). Brak różnic w proporcji płci wskazuje również na monogamiczny system kojarzenia się w badanej populacji.

Stwierdzono istotne różnice w proporcji ptaków z poszczególnych grup wiekowych między sezonami. Wiosną dominowały ptaki dorosłe (67.0% wszystkich odłowionych ptaków), co prawdopodobnie wynika niskiej przeżywalności młodych osobników. Paz (1978) w swoich badaniach wykazał, że jedynie 26.7% młodych przeżywa miesiąc bądź więcej po opuszczeniu gniazda. Jest również możliwe, że ptaki dorosłe zmuszają młode z wczesnych lęgów do opuszczania terenów lęgowych.

Analiza biometryczna wykazała różnice w długości skrzydła między płciami, co jest pospolitym zjawiskiem u ptaków wróblowych (e.g. Svensson

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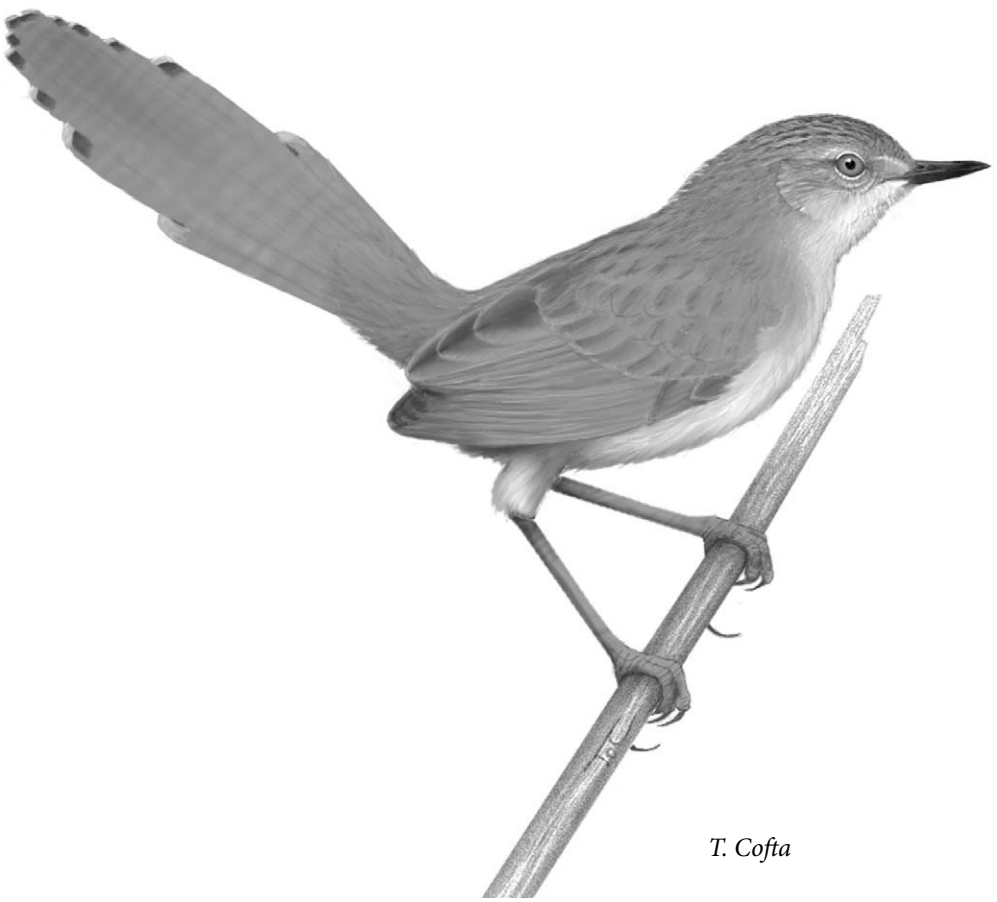
1992) (Tab. 1). Dodatkowo ptaki młode miały dłuższe skrzydło na jesieni niż na wiosnę, co łączy się z postjuvenilnym pierzeniem się (Fig. 3 a). Również różnice w kondycji między sezonami wykazano jedynie wśród młodych osobników (Fig. 3 c), co najprawdopodobniej warunkowane jest większą dostępnością pokarmu wiosną na badanym terenie w tym okresie. Dodatkowo nie znaleziono różnic w masie ciała i kondycji między płciami (Tab. 1), co wynika prawdopodobnie z monogamicznego systemu kojarzenia się i tym samym równomiernym podziałem obowiązków rodzicielskich, czyli wydatkowaniem energii (Moreno 1989).

Prezentowane badania pokazują możliwość wykorzystania danych z punktu obrączkowania ptaków do interpretacji rocznych cykli życiowych osiadłych populacji. Jest to szczególnie przydatne w przypadku takich gatunków jak prinia, która stosunkowo niedawno zasiedliła obszary pustynne najdalej wysuniętej na południe części Izraela.



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