

Changes in numbers and biometrics in relation to season in sedentary Yellow-vented Bulbul *Pycnonotus xanthopygos* at Eilat: a ringing study

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Abstract

The Yellow-vented Bulbul *Pycnonotus xanthopygos* is an abundant resident throughout Israel but no natural history and demographic studies on the species have been published to date. We analyzed the ringing data for eight years at the Bird Sanctuary of the International Birding and Research Centre in Eilat (IBRCE). We compared the changes in biometrics of the individuals that live in the desert region and their annual breeding cycle to that reported for other parts of Israel, as evidenced through the ringing data. During the 15 trapping seasons we caught a total of 1105 Yellow-vented Bulbuls. The largest numbers of Yellow-vented Bulbul ringed was in May in the spring and November in the autumn trapping period. Body mass and body condition index for adult birds were significantly lower in spring than in autumn. We suggest that the reduction in body mass is a result of the reproductive effort and is gradually improved through the summer and in autumn as a result of the lack of stress and abundance of fruits in the Bird Sanctuary. Conversely, juvenile body condition did not differ between seasons and is results of parental care during the spring and summer months and fruit abundance in the autumn. This study illustrates how ringing data from one location over many years can serve to understand the natural history and biological processes of sedentary species.

Key words: Yellow-vented Bulbul, *Pycnonotus xanthopygos*, biometrics, ringing data, Eilat.

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INTRODUCTION

The Yellow-vented Bulbul *Pycnonotus xanthopygos* is a monotypic species and is the most northern species of its genus (Paz 1987). The species distribution is limited to Turkey, Arabia, Syria, Lebanon, Jordan, Israel and Sinai (Shirihai 1996). In Israel, the species is an abundant resident throughout the country in natural areas and cultivated orchards, but denser populations are found in human habitations. The species was restricted to the Mediterranean coastline in the 19th century, but in the 1930s and 1940s expanded into all of the Mediterranean habitats, including Judea and Samaria. During the 1950s and 1960s, the species spread into the Negev and Judean desert regions of Israel following the establishment of agricultural settlements (Inbar 1976).

Although considered an abundant resident throughout the country with an estimated total population of a few hundred thousand pairs in the 1980s (Shirihai 1996), no natural history and demographic studies on the species have been published (Hasson 1978, Izhaki 1992, van Tets 2001, Tsahar et al. 2003). We analyzed the ringing data for eight years at the Bird Sanctuary of the International Birding and Research Centre in Eilat (IBRCE). We wished to compare changes in biometrics of the individuals that live in the desert region during their annual breeding cycle to that reported for other parts of Israel through ringing data.

STUDY AREA AND METHODS

Eilat is located at the southernmost tip of Israel and lies within the Saharo-Arabian desert, characterized by extreme temperatures and very low precipitation (avg. annual rainfall 17 mm). To help the Eurasian migratory bird populations that stage at Eilat in the spring (Safriel 1968), the IBRCE encourages eco-tourism to the region, educates laymen in conservation efforts, and undertook to reclaim the regional refuse dump in 1993. In the initial stages (1993-1996) the garbage was buried in large pits, covered with clean earth, and afforested with xeric plant species. This resulted in the Bird Sanctuary. Ringing in the region was conducted at

several locations but was moved to the Bird Sanctuary in spring 1996. Hence, we analyzed the ringing data for eight spring (February - June) and seven autumn (September - December) seasons in the years 1996 - 2003. A total of 1105 Yellow-vented Bulbul were ringed at the Bird Sanctuary (29°33.77N, 34°57.79E) and none have been recovered or controlled elsewhere. The data analyzed in this study were collected in the normal process of the work conducted at the IBRCE ringing station and no special efforts were made to trap the study species. Hence, the data are random and we consider it to be representative of the population in the Eilat region.

All birds trapped were ringed, sexed and aged, and biometric parameters were measured. We classified the Yellow-vented Bulbuls into two age and sex classes. Adults were sexed based on wing cord length: males have a wing cord > 99 mm, and females a wing cord < 97 mm (RY, unpublished Data). Individuals that had a wing cord between 97 - 99 mm, and juvenile birds, were not sexed. This is more conservative than the measurements presented by Snow and Perrins (1998), who give the male wing cord length as 96-103 mm and for females as 90-95 mm, but do not present sample sizes. The age of birds was determined based on plumage criteria (RY, unpublished data). Flattened maximum wing cord and tail length were measured to the nearest millimetre. Body mass was determined with a Pesola 100g (+ 0.1) spring balance. The relative body condition of the birds was compared using a body condition index: body mass divided by wing length (Gorney et al., 1999, Yosef et al. 2003).

Annual variations in local population size of the Yellow-vented Bulbul are presented as the number of trapped individuals in a given year; and as an index of a ringing point activity. We calculated the ringing point activity as the number of total birds of all species trapped (cf. Yosef & Tryjanowski 2002) in a given year, and consequently the year index is a percentage of the total number of Yellow-vented Bulbul trapped in relation to all individuals in the following years.

Data processing and analysis

In general, to describe the differences between the sex and age classes of Yellow-vented Bulbul, the whole data from the spring and autumn seasons were analysed. To avoid pseudoreplication only data from the first captures were used to calculate the biometric characteristics. However, data on wing cord length, tail length, body mass and body condition of birds were not available for all individuals, and resulted in large variations in sample sizes. Moreover, individuals not ascribed to one of the age or sex classes (in the case of adult birds) were excluded from the analyses. Also, only samples in the seasons where more than ten individuals were ringed were included in the analysis.

We analysed possible differences in body mass, and thereby body condition index, of the trapped birds between sexes in both trapping seasons. The analysis was limited to adult birds only. Hence, we compared only differences between juvenile and adult birds with all available measurements for both trapping seasons.

Analysis was conducted using the factorial ANOVA, the calculations were performed with the Visual General Linear Model (Zar 1999).

In addition, the changes of wing length, body mass, and condition index in relation to ringing date were analysed. The analysis was conducted for adult birds of both sexes and separately for juveniles.

The standardized trapping dates are presented in Julian dates. For each of the seasons the relative catching time of each bird was calculated as the residual from the seasonal median.

Standard statistical methods were used to describe and analyze the data (Sokal and Rohlf 1995). Bonferroni corrections were applied to adjust the P values for the increased probability of obtaining statistical significance from multiple testing. All statistical tests were two-tailed. Throughout the text, we use the abbreviation CL for 95% confidence limits.

RESULTS

Trapping success, sex-ratio and age-ratio

During the eight spring and seven autumn trapping seasons a total of 1105 Yellow-vented Bulbul (annual mean = 138.12, CL: 62.04 - 214.20, range: 21 - 262) were caught. Great variance in trapping success was found between years in spring and autumn (Figure 1a, b). Moreover, we found a significant positive trend in the total numbers of Yellow-vented Bulbul ringed over the study period ($r_s = 0.90$, $N = 8$, $P < 0.005$); this trend remained significant even as an index of ringing point activity ($r_s = 0.71$, $N = 8$, $P < 0.05$).

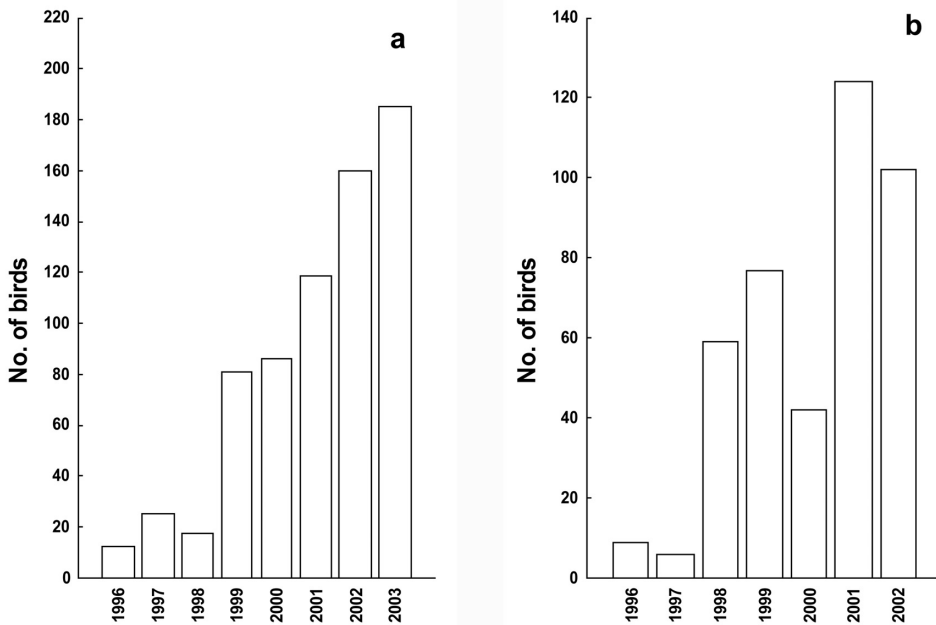
Of 1105 individuals, 197 (17.8%) were males and 393 (35.6%) females. The remaining 515 (46.6%) individuals were juveniles whose sex was undetermined. We found no difference in the proportion of ringed males and females between the spring and autumn seasons ($\chi^2 = 1.79$, $df = 1$, $P > 0.05$), in contrast to the great difference found in the number of males and females during the spring seasons ($\chi^2 = 23.66$, $df = 1$, $P < 0.0001$), wherein males comprised only 28.3 % of all the sexed birds. The sex ratio was female-biased also in autumn ($\chi^2 = 10.58$, $df = 1$, $P < 0.005$), but then males comprised 36.0% of the ringed population.

In addition, we observed significant differences among years in the proportion of males to females in spring ($\chi^2 = 14.72$, $df = 7$, $P < 0.05$) and autumn seasons ($\chi^2 = 10.03$, $df = 4$, $P < 0.05$).

A significant difference in the proportion of juveniles trapped in the spring was found ($\chi^2 = 4.14$, $df = 1$, $P = 0.05$, Figure 2a). Juveniles comprised 44.3% of all the ringed birds. This difference was significant also during the autumn seasons ($\chi^2 = 55.26$, $df = 1$, $P < 0.0001$, Figure 2b) when juveniles comprised only 24.3% of all the ringed birds.

The differences in proportion of juveniles to adults among years of study for both trapping seasons were also significant (spring: $\chi^2 = 113.01$, $df = 7$, $P < 0.00001$; autumn: $\chi^2 = 47.13$, $df = 4$, $P < 0.0001$). The percent of juveniles ranged in individual spring seasons from 0% in 1996 to 71.9% in 2003, and in autumn seasons from 3.5% in 1998 to 54.8% in 2000.

Figure 1. The number of Yellow-vented Bulbul *Pycnonotus xanthopygos* ringed during the spring (a, N = 686, 1996 - 2003) and autumn (b, N = 419, 1996 - 2002) at Eilat, Israel.



Seasonal dynamics

The largest numbers of Yellow-vented Bulbul ringed were in May in the spring and November in the autumn trapping period (Figure 2).

We found no changes in the dates of ringing of male and female Yellow-vented Bulbul (spring: Mann-Whitney U-test, $U = 10663$, $P = 0.3159$; autumn: $U = 7169$, $P > 0.05$). Adult birds were ringed on average two weeks earlier than juveniles (adult: mean standardized date = -10.85 ; CL = -14.59 to -7.10 , $N = 359$; juvenile: mean = 3.45 , CL = $-0.74 - 7.64$, $N = 286$) in spring (Mann-Whitney U-test, $U = 36896.5$, $P < 0.0001$). No such difference was recorded in the autumn trapping season (Mann-Whitney U-test, $U = 13730$, $P > 0.05$).

Biometry and body condition index

We analysed biometry and body condition

for both sexes combined and separately for the spring and autumn seasons (Table 1, 2).

Differences in body mass and body condition index of adult birds in relation to sex and trapping season

We found a significant difference in body mass between the sexes (ANOVA $F_{1, 544} = 183.03$, $P < 0.0001$). Males were heavier than females in both seasons. Moreover, mean body mass was significantly greater in autumn than in the spring (ANOVA $F_{1, 544} = 10.22$, $P < 0.005$, Figure 3a). The interaction between sex and season was insignificant ($P > 0.05$).

We found a significant influence of sex on the body condition index (ANOVA $F_{1, 544} = 12.89$, $P < 0.0005$). In autumn both sexes were in better condition than in spring. Also mean body condition was greater in autumn than in spring (ANOVA $F_{1, 544} = 7.87$, $P <$

Figure 2. Phenology of Yellow-vented Bulbul (A; N = 1105); and the proportion of juveniles to adults ringed each month at Eilat, Israel (B). The hatched portion denotes juveniles and the white denotes adult birds. The sample size of the total number of ringed birds in each of the individual months are given above their respective bars.

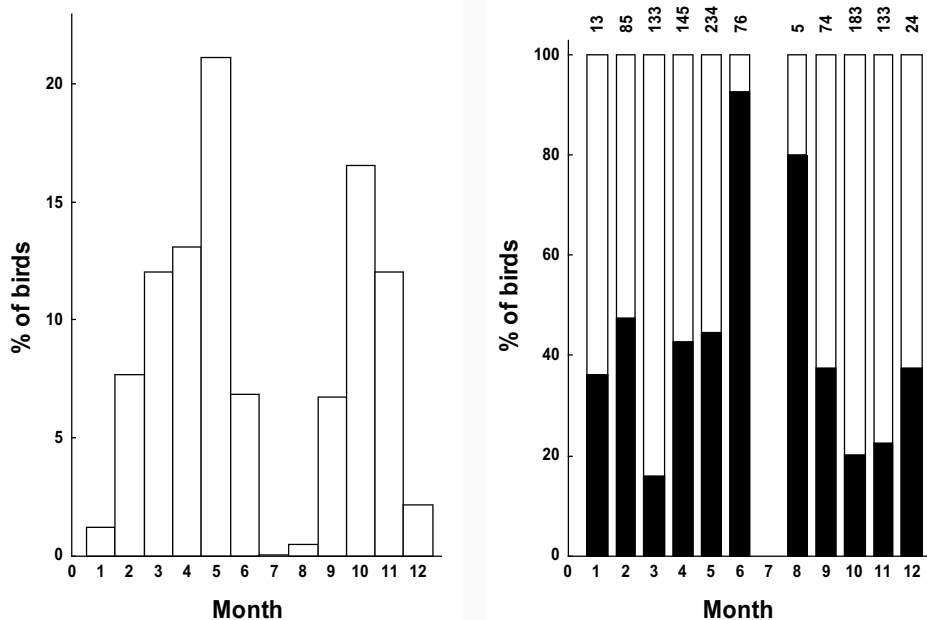


Table 1. The mean values, their 95% confidence limits, median values and range for wing cord length, tail length, body mass and body condition index of male and female Yellow-vented Bulbul *Pycnonotus xanthopygos* during spring (February to June) at Eilat, Israel.

Sex	Statistics	Wing [mm]	Tail [mm]	Body mass [g]	Condition
Male	N	102	85	90	90
	Mean	100.89	96.72	37.54	0.37
	Median	100.00	96.00	37.35	0.37
	95% CL	100.57 – 101.21	96.14 – 97.29	37.00 – 38.07	0.37 – 0.38
	Min - Max	99.00 – 108.00	91.00 – 103.00	30.90 – 45.50	0.31 – 0.45
Female	N	224	196	195	195
	Mean	94.01	92.32	34.00	0.36
	Median	94.00	92.00	33.80	0.36
	95% CL	93.74 – 94.28	91.85 – 92.78	33.60 – 34.39	0.36 – 0.37
	Min - Max	86.00 – 97.00	73.00 – 101.00	28.30 – 42.00	0.30 – 0.48

Table 2. The mean values, their 95% confidence limits, median values and range for wing cord length, tail length, body mass and body condition index of male and female Yellow-vented Bulbul *Pycnonotus xanthopygos* during the autumn at Eilat, Israel.

Sex	Statistics	Wing [mm]	Tail [mm]	Body mass [g]	Condition
Male	N	95	74	95	95
	Mean	101.44	97.59	38.35	0.38
	Median	101.00	98.00	38.00	0.38
	95% CL	100.91 - 101.96	96.78 - 98.40	37.74 - 38.96	0.37 - 0.38
	Min - Max	99.00 - 114.00	85.00-106.00	31.00 - 47.20	0.31 - 0.47
Female	N	169	138	167	167
	Mean	93.97	92.27	34.79	0.37
	Median	94.00	93.00	34.50	0.37
	95% CL	93.61 - 94.32	91.56 - 92.97	34.34 - 35.24	0.36 - 0.37
	Min - Max	80.00 - 97.00	63.00 - 100.00	28.70 - 45.70	0.30 - 0.48

0.05, Table 1, 2). There was no significant interaction between sex and season ($P > 0.05$).

Differences in wing cord length, body mass and body condition index in relation to age and trapping season

We found a significant difference in wing cord length between the age classes, adults having longer wings than juveniles (ANOVA $F_{1, 1015} = 62.17$, $P < 0.0001$). Moreover, mean wing length was greater in autumn than in spring (ANOVA $F_{1, 1015} = 27.02$, $P < 0.00001$). The interaction between age and season was also significant (ANOVA $F_{1, 1015} = 12.97$, $P < 0.0003$). This was due to fact that the mean wing length of first-year birds differed between seasons: in autumn juveniles had longer wings than in spring (Figure 3a). No such difference was found for the adults.

We found a significant influence of age on body mass (ANOVA $F_{1, 940} = 32.06$, $P < 0.0001$). Adults were heavier than juveniles in both seasons, and the mean body mass was greater in autumn than in spring (ANOVA $F_{1, 940} = 7.53$, $P < 0.05$, Figure 3b). There was no significant interaction between age and season ($P < 0.05$).

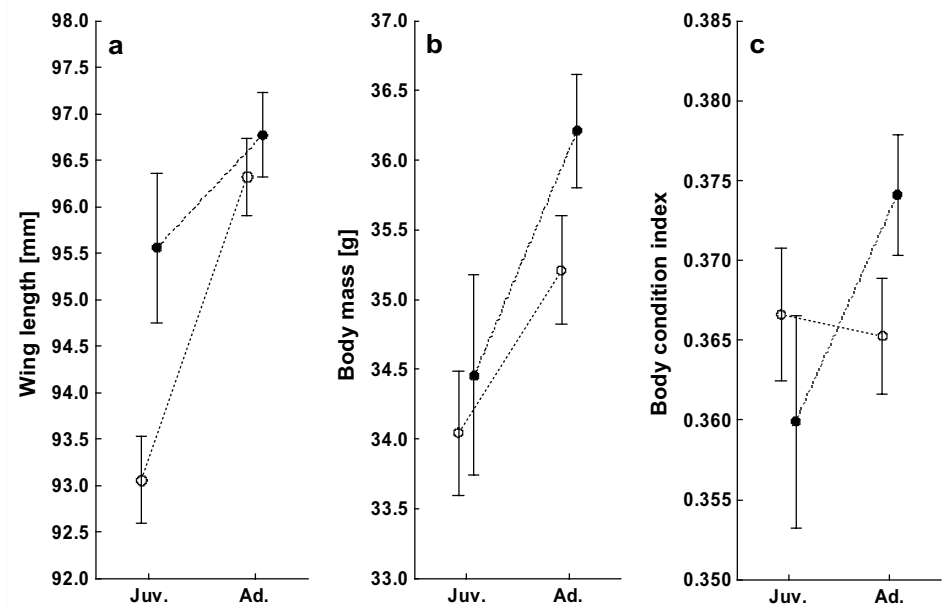
We found a significant difference in body

condition index between the age classes (ANOVA $F_{1, 927} = 7.13$, $P < 0.05$). Adults were in better body condition than juveniles. We did not record an influence of season on the condition of the birds from the two age classes ($P > 0.05$) but the interaction between age and season was significant (ANOVA $F_{1, 927} = 10.47$, $P < 0.005$). The adult birds were in better condition in autumn than in the spring (Figure 3c). Body condition of first-year birds did not differ between seasons.

Body measurements in relation to ringing date

In general, we found changes in biometrics with date of capture only in the spring. We recorded a decrease in wing cord length with the date of ringing for juveniles ($r_s = -0.37$, $N = 278$, $P < 0.001$); a negative correlation between time of ringing and body mass for males ($r_s = -0.41$, $N = 90$, $P < 0.001$) and for juveniles ($r_s = -0.28$, $N = 242$, $P < 0.001$); and a decrease in body condition during the trapping season for males ($r_s = -0.38$, $N = 90$, $P < 0.001$) and for first-year birds ($r_s = -0.17$, $N = 237$, $P < 0.05$). All relationships were significant also after sequential Bonferroni correction for multiple comparisons.

Figure 3. Mean values with 95% confidence limits of wing cord length (a), body mass (b), and body condition index (c) of Yellow-vented Bulbul *Pycnonotus xanthopygos* of the different age groups during spring (hollow circles) and autumn (full circles) at Eilat, Israel.



DISCUSSION

The lack of previous information for this common species makes comparisons difficult. Paz (1987) gave the wing cord length as 91 - 98 mm and body mass of 31 - 43 g, but does not present sample size or seasonal differences which in this study were found to be significantly different (Tables 1, 2). Similarly, Snow & Perrins (1998) do not present sample sizes or seasonal differences for the above-mentioned measurements. We consider our more conservative method of separating the sexes to have probably resulted in smaller sample sizes for each of the sexes, and a greater number with sex undetermined, but resulting in a more robust data analysis and the subsequent conclusions to be more representative of the population. However, one cannot ignore geographical and time differences in the studies presented and our location in Eilat. The data for the

above mentioned studies are from the 1960s and 1970s and relate to central and northern Israel. Yom-Tov (2001), basing his study on the measurements of tarsus length and body mass of five resident passerine species in Israel, including the Yellow-vented Bulbul, has shown that between the years 1950-1999 there was a significant decline in both. He attributed these declines to global warming and noted these time trends to be in accordance with Bergmann's rule (1847). Hence, one must treat our data as a geographically distinct study, in the midst of the desert, and the farthest south in Israel from the above data sets.

The increase in trapping success between years suggests an increasing population in the study area. However, there are several factors that could have contributed to the increase. In 2001 we changed trapping techniques and almost completely

stopped the use of mist-nets and built Helgoland/Rybachy type funnel traps. This has increased the trapping success for specific species (e.g., *Streptopelia* spp., unpubl. data) and this could also be the case for the Yellow-vented Bulbul. However, one must also take into account that a large portion of the afforested Bird Sanctuary matured during the same period and produced a large food supply that was utilized during most months of the year by the few sedentary species; this could have allowed their demographic increase, as is evident from the trapping success. The increased amount of food has probably allowed a greater number of Bulbuls to establish territories at the Bird Sanctuary and to breed.

Our study is based on the random trapping of the Yellow-vented Bulbul in the framework of a larger monitoring study and none of the individuals were marked specifically for a behavioral or reproduction study. This prevents us from individual documentation of territories. However, the trapping of young represents the fledging and dispersal of the young from the region. Also we have found nests in the Bird Sanctuary and the dates were documented. Based on this finding, the first clutch of the season is laid in February and the spring breeding season continues until late April. Young fledged during March and April, with the largest numbers caught and ringed in May. The last are probably foraging flocks of fledged individuals that form after they leave the natal territories and become independent (Shirihai 1996). A large proportion of young were also ringed in August, but the small sample size prevents further discussion. It appears that the Bulbuls in the Eilat Bird Sanctuary attempt 2-3 broods in the spring. This is very different from the breeding season for the species in central and northern Israel, where they are reported to breed from late March-late August (Inbar 1976, Paz 1987, Shirihai 1996, Snow & Perrins 1998). It appears that the warmer temperatures in the desert and abundance of food at the Bird Sanctuary allow the Bulbuls to breed much earlier in the year.

Our data suggest that even though a pair

may guard a territory more zealously during the breeding season than out of it (Shirihai 1996), there are always new, unringed individuals caught, suggesting that con-specific territorial defense may not be very rigorous. These appear to be part of a very large non-breeding, floater population. Breeding pairs are reported to defend territories with a radius of about 100 m (Snow & Perrins 1998). Similarly, the peak in November is probably the result of an influx of non-territorials trying to establish territories prior to the onset of the breeding season.

Body mass and body condition index for adult birds are significantly lower in spring than in autumn (Table 1, 2). Additionally, body mass and body condition of adult birds decreased only during the spring. Body mass loss during the breeding season is considered to be an adaptive adjustment of body reserves permitting a reduction in the power required for flight during the time when maximum food is to be gathered and nestlings to be fed (Freed 1981, Moreno 1989a). Moreno (1989b) suggested that mass loss during the breeding season could occur either by the incubating parent attaining the lowest mass when the chicks hatch, thus taking place mainly in species where only one parent incubates, or in parents who maintain or increase their body mass without reduction of attentiveness, an event which is known to occur mostly in small passerines. It is difficult in our study to suggest which of the two strategies the Yellow-vented Bulbul adapts because of the lack of specific data for each of the breeding individuals in the Bird Sanctuary. However, we suggest that the reduction in body mass is a result of the reproductive effort and stress (Nur 1984, Martin 1987, De Leat & Dhondt 1989) and is gradually reversed through the summer and in autumn as a result of the lack of stress and abundance of fruit in the Bird Sanctuary. Conversely, juvenile body condition did not differ between seasons and is a result of parental care during the spring and summer months and fruit abundance in the autumn. This study illustrates how ringing data from one location over many years can serve to improve understanding of the natural his-

tory and biological processes of sedentary species. The Yellow-vented Bulbul is an abundant but little-studied species in Israel, and future studies need to focus on their ecological requirements. This will help to avoid conflicts with human activities (e.g., agriculture; Shirihai 1996), help conservation efforts in case of unknown declines caused

by unknown reasons in common and abundant species that are taken for granted (eg., Barn Swallow, *Hirundo rustica*, Evans et al. 2003; House Sparrow, *Passer domesticus*, Hagemeyer & Blair 1997) and to contribute to furthering our understanding of yet another species in our environment.

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