

Plumage and wing biometrics of the juvenile Cyprus Warbler *Sylvia melanothorax* in its Cypriot breeding grounds

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An account of the juvenile plumage of Cyprus Warbler is presented with biometrics of wing and tail feathers, including from a DNA-tested individual. Wing morphology data from juveniles are compared to those previously published for fully grown birds with adult-type feathers. Relatively short primary flight feathers were found in the juveniles. Tonal variation of the upperparts of juvenile plumage is reported and it is suggested that it may be linked to sexual dimorphism or natural variation.

INTRODUCTION

The true juvenile plumages of some *Sylvia* species are remarkably similar (Shirihai *et al* 2001). Consequently, it is not always obvious to which species individual juveniles should be assigned, in the field or in the hand, before post-juvenile (late first calendar year/first winter) plumage shows adult-type, sexually dimorphic feathers. This is compounded when morphologies and biometrics of congeners overlap. No photographs or illustrations of Cyprus Warbler *Sylvia melanothorax* in juvenile plumage are presented in Shirihai *et al*'s (2001) seminal monograph on the genus. In some sources, illustrations of Cyprus Warbler in juvenile plumage appear to include some post-juvenile plumage characteristics (*eg* Cramp 1992). Such references that are available do not appear to account for the apparent tonal variation in plumage of the individual juvenile Cyprus Warblers observed in the current study.

In many regions of Cyprus, Cyprus Warbler and Sardinian Warbler *S. melanocephala* are sympatric as a result of a recent rapid range expansion of the latter species (Flint & McArthur 2014). Breeding Spectacled Warblers *S. conspicillata* are also present, though are patchily distributed (*pers obs*). The increased sympatry of Cyprus and Sardinian Warblers appears to have important implications for the conservation status of Cyprus Warblers and for conservation management plans for associated habitats (Flint & McArthur 2014). These issues highlight the desirability of increased awareness of juvenile plumage of the Cyprus Warbler.

For the purposes of the present study the term juvenile plumage is confined to its strictest sense *ie* Euring/BTO age code 3J and moult code J, abbreviated here to 3JJ. Ornithologists sometimes use the term 'juvenile' more loosely, as a convenient shorthand for passerines which are either sub-adult with sub-adult plumage or which have evidence of retained juvenile plumage irrespective of calendar age before full adult plumage is attained. However, the use of the term when unqualified can be misleading as 'juvenile' conflates separate developmental moult stages, namely 3JJ (true juvenile), 3JP (started post-juvenile body moult), 3P (advanced post-juvenile body moult) or 3O (completed post-juvenile moult). The true juvenile plumage in passerines constitutes the initial, short-lived, plumage stage the feather groups of which are grown while in the nest and which are at least partially replaced soon after fledging, hence post-juvenile moult (Svensson 1992, Jenni & Winkler 1994). It is the short-lived nature of this true juvenile plumage which results in it being relatively rarely encountered by observers.

METHODS

Sylvia warblers in their first calendar year were trapped using mist nets at a site in the west of Girne/Kyrenia District, North Cyprus, in July 2009 and July–early August 2010 under the

Kuşkor (www.kuskor.org) ringing scheme. Before release, each was marked using A-size leg rings with unique alphanumeric identifiers. The trapping area was within sparsely-wooded open scrub amounting to a patchwork of low to high limestone-based *garrigue* vegetation. Adult Cyprus Warblers on territories were readily observed throughout the breeding season without the presence of other *Sylvia* Warblers. At these times Sardinian Warbler had yet to be recorded within several kilometres of the site though may well have been close by. Allowing for the possibility of either Sardinian or Spectacled Warbler post-fledging dispersal from adjacent regions, specific attribution was derived on the basis of feather structure, moult condition, plumage colour, bare parts and biometrical criteria following Svensson (1992) and Shirihai *et al* (2001) and, for one individual, DNA analysis (see below).

Trapped fully grown birds which were not adult were inspected for the presence of juvenile-type feathers, feather tracts and/or growth patterns and the presence or extent of post-juvenile moult. Juvenile plumage of *Sylvia* warblers appears similar to 1st winter plumages in the field but is distinctive on close inspection of the feathers and skin surface in the hand. Uniquely, juvenile body feathers emerge from a few well-defined tracts separated by wide gaps of featherless skin. Individual juvenile feathers have weak shafts and light vane structure as a consequence of loosely connected barbules. These give juvenile body plumage a characteristic matt, ragged texture. First winter or adult-type body feathers emerge later as a result of post-juvenile moult which is readily identified by feather pins appearing on the bare skin between the juvenile tracts and from which emerge new firm-textured feathers of contrasting tone and colour. The previously bare skin is eventually covered with these feathers. Concurrently, the juvenile feathers of the original tracts are themselves replaced. For the purpose of the study, individuals with post-juvenile feathers showing were discounted and aged as 1st winter.

Biometrics of various wing morphology features were recorded: wing length (maximum length, Svensson 1992) using a zero-stopped rule; the distance between the tip of the outer vestigial primary feather and the tip of the adjacent primary feather (P10 and P9 numbered descendantly, or P9>P10); tail length from the base of the feathers to the tip of the longest tail feathers; the distance between the tip of the longest primary covert and the tip of primary 10 (P10>PC); the distance from the tip of the longest tertial feather to the wing point (WP>tertials). These observations were compared with data from live birds presented in Shirihai *et al* (2001: p507).

A sample was taken from a dropped tail feather of one putative juvenile Cyprus Warbler (A000974) for the purposes of DNA analysis in order to confirm the species. The mitochondrial DNA of this sample was analysed by Elizabeth Heap of the University of Edinburgh who matched it against DNA sequences for *Sylvia* species.

RESULTS AND DISCUSSION

All of the study juveniles trapped (n=14) were attributed to *S. melanothorax* on the basis of plumage, wing formula and biometrics, though some of the biometrical values overlapped with the other *Sylvia* warblers found in Cyprus. The overall structure and bare parts as well as alarm and contact calls were observed to match *S. melanothorax*. Three individuals had commenced post-juvenile moult of either flight feathers, or had progressed body moult. Since the study was primarily concerned with the biometrics of true juvenile feathers only, these individuals were excluded from the data set.

Wing and tail measurements are described in Table 1. Shirihai *et al* (2001) gave age-related data for wing and tail of migrating or wintering birds trapped in Israel post-breeding for both adults and 'juveniles' but they were presumably able to ascertain the sex of the latter only on the basis of post-juvenile sexually dimorphic plumage characteristics.

Table 1. Biometrics of true juveniles (present study) and fully grown (fg) immatures (Shirihai *et al* 2001) of Cyprus Warbler *Sylvia melanothorax*.

	n	Range	Mean	SE	SD
Wing unsexed true juveniles, Cyprus	11	56–60	58	0.43	1.44
Wing fg immature males, Israel	16		60.1		1.22
Wing fg immature females, Israel	15		58.5		0.73
Tail unsexed true juveniles, Cyprus	11	53–58	55.6	0.49	1.62
Tail fg immature males, Israel	16		56.3		1.67
Tail fg immature females, Israel	16		54.9		2.49

Table 2. Biometrics of true juvenile Cyprus Warbler *Sylvia melanothorax* in Cyprus (present study) and fully grown (immature and adult) birds from Shirihai *et al* (2001).

	n	Range	Mean	SE	SD
P9>P10 unsexed juveniles, Cyprus	11	23.2–28.8	26.8	0.59	1.97
P9>P10 all fg, Israel	31	27.5–32.7	30.6		1.23
Tail/Wing ratio unsexed juveniles, Cyprus	11	0.898–1.01	0.956	0.008	0.028
Tail/Wing ratio all fg, Israel	53	0.893–1.00	0.942		0.026
P10>PCs unsexed juveniles, Cyprus	11	0.6–4.5	2.3	0.4	1.36
P10>PCs all fg, Israel	37	0.5–4.5	2.5		1.04
WP>tertials unsexed juveniles, Cyprus	6	6.8–8.3	7.5	0.23	0.58
WP>tertials all fg, Israel	14	8.0–11.2	9.3		0.88

Strictly, these ‘juveniles’ would be described as 1st winter or fully grown immature since they no longer had full juvenile plumage. Since, ordinarily, post-juvenile moult in Cyprus Warbler may include some of the flight feathers as well as body feathers; it is assumed that Shirihai *et al*'s (2001) 1st winter/immature birds might have had some adult-type flight feathers. In the present study true juveniles appear to be shorter-winged than Shirihai *et al*'s (2001) 1st winter birds and the presence of post-juvenile wing moult accounts for this. It is common in passerines for juvenile flight feathers to be shorter than adult-type equivalents (Svensson 1992).

Further biometrics are reported in Table 2. These are linked to length of primary flight feathers. With the notable exception of tail/wing ratio, which is a relative measure, the means suggest dimensions of the present study's juveniles were smaller than those sampled from older birds trapped in Israel. This was also found when comparing the present study juveniles with the fully grown Cyprus Warblers trapped in Cyprus during the study. The mean juveniles' wing lengths compared to the mean of fully grown Cyprus Warblers (post-juvenile and adult) differ significantly in a two-tailed test: 58 mm (SD1.4) compared to 59 mm (SD1.5), $t_{11,16} = 2.074$, $p = 0.05$. This could be further clarified by larger sample sizes.

Real differences in wing size between true juveniles and post-juvenile/adult birds might also account for the differences between Shirihai *et al*'s (2001) groupings of data points on his chart, which plots tail/wing ratio against the distance between p10 and p9 (Shirihai *et al* 2001: p509 figure 10), compared to the findings of the current study. In Shirihai *et al*'s (2001) chart Cyprus Warbler biometrics are neatly grouped such that they are distinct from Sardinian Warblers of both the nominate and the Levantine

Table 3. Mitochondrial DNA match report for the juvenile Cyprus Warbler *Sylvia melanothorax* sample A000974, Cyprus, trapped 30 July 2009, analysed by Elizabeth Heap.

Sylvia melanothorax mitochondrial cytb gene for cytochrome b

Length=1143

Score = 658 bits (356), Expect = 0.0

Identities = 356/356 (100%), Gaps = 0/356 (0%)

Sylvia cantillans albistriata haplotype a5 cytochrome b (cytb) gene,

partial cds; mitochondrial

Length=1090

Score = 558 bits (302), Expect = 6e-156

Identities = 338/356 (94%), Gaps = 0/356 (0%)

Sylvia rueppelli mitochondrial cytb gene for cytochrome b
Length=1143

Score = 492 bits (266), Expect = 2e-143

Identities = 326/356 (91%), Gaps = 0/356 (0%)

Sylvia melanocephala voucher IPMB 6937 cytochrome b (cytb) gene,

partial cds; mitochondrial

Length=917

Score = 488 bits (264), Expect = 3e-142

Identities = 325/355 (91%), Gaps = 2/355 (0%)

the prospect of this bird being the product of mixed parentage is presumed remote. Cyprus Warbler is otherwise not known to hybridise with congeners including Sardinian Warbler (Shirihai *et al* 2001), which is not its closest *Sylvia* relative (Table 3).

Plate 1 shows photographs of A000974, confirmed by DNA analysis as Cyprus Warbler. It shows a typical bill shape and colour, eye and head shape of Cyprus Warbler. Also

momus subspecies. However the equivalent criteria from the current study plotted on the same chart would classify only four of the study individuals as Cyprus Warblers, the remaining seven falling within *S. melanocephala momus*, including individual A000974: the Cyprus Warbler whose specific identity was confirmed by DNA analysis. There was no evidence to suggest these birds were *S. m. momus* and the coincidence can be accounted for by the subspecies' size proximity to Cyprus Warbler, which is in contrast to the larger nominate *S. m. melanocephala*. The breeding Sardinian Warbler of Cyprus is the nominate subspecies, based on the biometrics derived from routine ringing and previous studies (pers obs, Flint & McArthur 2014).

Table 3 gives the results of the DNA analysis from the single juvenile, A000974. The DNA sample gave a 100% match, confirming the original attribution to Cyprus Warbler. Since mitochondrial DNA analysis tests maternity only, the mother of this individual was a Cyprus Warbler. In the absence of either direct or circumstantial evidence for hybrid breeding in the area,



Plate 1. DNA tested true (3JJ) juvenile Cyprus Warbler *Sylvia melanothorax*, A000974, in complete juvenile plumage, Girne/Kyrenia District, Cyprus, 24 July 2009. Changes in colour temperature and ambient colour environment between the two images accounts for the browner appearance of the image on the right. © C Walton



Plate 2. Unsexed true (3JJ) juvenile Cyprus Warbler *Sylvia melanothorax* (right) and a true (3JJ) juvenile, presumed female, Sardinian Warbler *Sylvia melanocephala* (left), Kalkanlı/Kapouti, Cyprus, 22 July 2011. Juvenile Cyprus Warbler plumage is less contrasting and more concolourous than that of the juvenile Sardinian Warbler, which show mixes of brown and grey and greater contrasts across feather groups. The underparts of Cyprus Warblers are invariably lighter in tone than their upperparts and brown hues to head and body are less vivid than those of Sardinian Warbler. © C Walton

Plate 3. One of the true (3JJ) juvenile Cyprus Warblers *Sylvia melanothorax* from the present study showing dark tones to upperparts, Girne/Kyrenia District, Cyprus, 22 July 2009. Sexually dimorphic juvenile plumage is not yet proven in Cyprus Warbler (see text). © C Walton



the rather monotone and concolourous grey-brown plumage is characteristic of juveniles. Sardinian Warbler has a sexually dimorphic juvenile plumage so males may be separable from females when comparison together in the field is possible, even before the onset of post-juvenile moult (Peter Flint pers comm). Plate 2 compares a juvenile Cyprus Warbler and a juvenile Sardinian Warbler, presumed female, trapped outside the main study area. No unequivocally juvenile (3JJ) male Sardinian Warbler was trapped or observed.

Juvenile Cyprus Warbler is currently not known to be sexually dimorphic (Shirihai *et al* 2001). However, juveniles appear to have more than a single morph, with some individuals appearing grey-brown with dark brown flight feathers: these would be putatively female due to their proximity to post-juvenile female characteristics. Others appear to be greyer, with darker grey-

brown upperparts and dark grey-brown tail feathers (Plate 3). This possibility requires further investigation.

CONCLUSIONS

There are small differences between juvenile and adult wing morphology in Cyprus Warblers. Juvenile primary flight feathers appear shorter than the adult-type. Juvenile Cyprus Warblers are separable from juvenile Sardinian Warblers on plumage and structural criteria. Whether observed tonal differences in the plumage of juvenile Cyprus Warblers is due to normal variation or is sexually-determined dimorphism requires further investigation. Further details on the sexually-dimorphic juvenile plumage of Sardinian Warbler are also required.

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