New information on the Large-billed Reed Warbler *Acrocephalus orinus*, including its song and breeding habitat in north-eastern Afghanistan

R. J. TIMMINS, STEPHANE OSTROWSKI, NAQEEBULLAH MOSTAFAWI, HAFIZULLAH NOORI, ALI MADAD RAJABI, LARS SVENSSON, URBAN OLSSON and COLIN M. POOLE

We report in detail on the first well documented, probable breeding location of the Large-billed Reed Warbler *Acrocephalus orinus*, found in north-east Afghanistan, give a description of its song and summarise its identification criteria using new information from live birds. Fifteen birds were captured and measured in the presumed breeding season, and later their identity was confirmed using DNA markers. In one of the localities visited many birds were singing. We also describe the habitat and assess some conservation issues.

INTRODUCTION

This paper provides greater detail on the discovery of the Large-billed Reed Warbler *Acrocephalus orinus* in north-east Afghanistan during fieldwork in the summers of 2008 and 2009 (Timmins *et al.* 2009). Having been described in 1867 on the basis of a single specimen, with no further evidence of the species found in the following 130+ years, doubts about the validity of the Large-billed Reed Warbler were sometimes voiced, e.g. the species was omitted from the OBC checklist (Inskipp *et al.* 1996, Svensson *et al.* 2008, 2010). Two events effectively put an end to such resigned speculations.

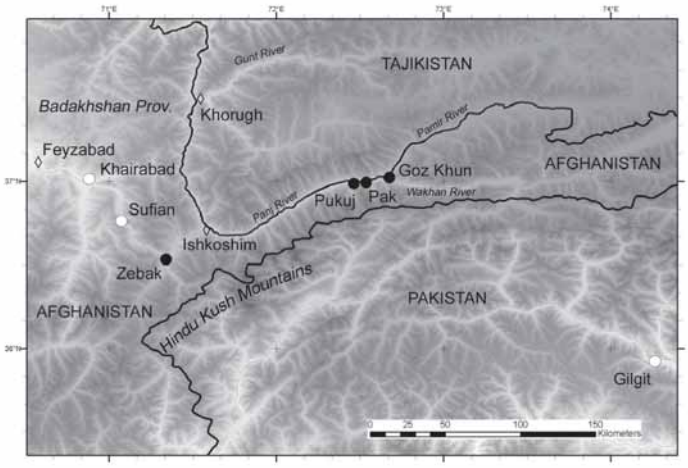
First, it was shown that the type specimen had a significantly different mitochondrial cytochrome b gene from all other known *Acrocephalus* species (Bensch & Pearson 2002), differing by some 7% from its nearest relative Blyth's Reed Warbler *A. dumetorum*. Then, remarkably, a live bird was caught in spring 2006 in a mist-net south-west of Bangkok in Thailand (Round *et al.* 2007). The following years saw the detection of more Large-billed Reed Warbler specimens in museums, catalogued invariably as Blyth's Reed Warbler (Table 1; Pearson *et al.* 2008, Svensson *et al.* 2008, 2010), and the capture of an additional individual in Thailand (Nimnuan & Round 2008). Debate over the species's seasonal movements, or lack thereof (Vaurie 1955, 1959, Bensch & Pearson 2002), became more robust with the inclusion of these additional records, especially the correlation of dates with geographic locality (Svensson *et al.* 2008) and the reinterpretation of wing morphology (Svensson *et al.* 2010).

In particular, four birds from north-east Afghanistan in July, which had been collected in 1937 by Walter N. Koelz, pointed to breeding in this area, and a fifth bird, a juvenile, collected in August in south-east Kazakhstan, suggested a perhaps rather extensive breeding range in Central Asia (Table 1). Adding to this, two historical specimens collected in Myanmar (Svensson *et al.* 2008) and the live birds captured in March from Thailand (Round *et al.* 2007, Nimnuan & Round 2008) appeared to affirm (western) South-East Asia as a potentially significant wintering area for the species (Svensson *et al.* 2008, 2010). There are also further unconfirmed but plausible records which have been described in some detail elsewhere (Round & Kennerley 2007, Svensson *et al.* 2010), although speculation of Large-billed Reed Warblers at Kanha Tiger Reserve in India (Raju *et al.* 2008) have now been refuted (Raju *et al.* 2009).

REDISCOVERY IN NORTH-EASTERN AFGHANISTAN IN 2008

While on 3 June carrying out a conservation assessment of the breeding bird communities of Wakhan District, Badakhshan Province, north-eastern Afghanistan, RJT observed singing *Acrocephalus* warblers (Fig. 1; note *Times atlas of the world* uses the name Vakhan, but it is otherwise almost universally spelt Wakhan). The birds were found in riparian bushlands around the confluence of the Wakhan and Pamir rivers, the two main rivers of the upper Wakhan that subsequently become the Panj river (otherwise known

Figure 1. Map showing localities in north-eastern Afghanistan where the Large-billed Reed Warbler *A. orinus* was found in 2008 and 2009 (black circles). The historical collection sites of Sufian and Khairabad, Afghanistan, and Gilgit, northern Pakistan, are also shown (white circles). Shading indicates elevation, with higher elevations being darker. International country boundaries are marked by broad black lines, while major rivers are indicated with narrower grey lines. The boundary between Afghanistan and Tajikistan in part follows the course of the Panj and Pamir rivers. Topographic source: USGS (2006), Shuttle Radar Topography Mission, 3 Arc Second, Filled Finished-A 2.0. scenes (12 scenes SRTM_f03_n035e071 to SRTM_f03_n037e074), Global Land Cover Facility, University of Maryland, College Park, Maryland, February 2000.



as the Amu Darya), near the village of Goz Khun (2,800 m asl; altitudes derived from GPSs with electronic barometers and rounded to the nearest 50 m). Recordings of the song of the first bird observed were made using a Sony Professional Walkman analogue recorder and a Sennheiser MKE 300 microphone. One of the more memorable initial impressions of the sighting was the bird's bill, which appeared especially long. Other observed features included a rather plain unmarked face except for a paler area from the lore to the eye, whitish crescents above and below the eye, a white throat, short primary projection and a largely pale lower mandible. These features suggested Blyth's Reed Warbler, a species unfamiliar to RJT. No more recordings of these birds were made during the 2008 survey.

The recordings consisted of approximately ten minutes of the at times intermittent, song of a single bird. These recordings were digitised using the computer program Audacity and saved as wav files. Four segments of the recordings were sent to LS and SO for analysis and use for playback respectively. Later the full recordings were sent to LS for more detailed analysis. The full recording has been archived at the Avian Vocalisations Center, Michigan State University, USA, and a part of the sequence can be found and downloaded at http://avocet.zoology.msu.edu/recordings/6322.

LS concluded that the song was not that of Blyth's, or any of the majority of other potential *Acrocephalus* spp. within range, thus leaving two main possibilities: either one of the little known western subspecies of Blunt-winged Warbler *A. concinens* or Large-billed Reed Warbler. Despite several differences (see below), the strong overall similarity of the song to that of Blyth's Reed Warbler suggested the likelihood of it being that of Large-billed Reed Warbler.

In conjunction with the newly discovered museum specimens from north-eastern Afghanistan, the field evidence from 2008 presented an overwhelming case for the need to determine precisely the identity of the birds in Wakhan.

THE 2009 SURVEY IN NORTH-EAST BADAKHSHAN

Owing to logistical and security constraints, it was only possible for an Afghan team to visit the province of Badakhshan in the breeding season of 2009. Thus prior to the survey three research assistants (AMR, HN and NM) of the Wildlife Conservation Society Afghanistan Program were trained by SO in mist-netting methods, bird measuring techniques and collection of tail-feather samples for genetic analysis. All three had, however, been closely involved with ornithological work in Wakhan and elsewhere in Afghanistan since summer 2006. Using a part of the 2008 recording, SO edited (Audacity 1.2.5) a two-minute segment for use in playback with a digital player (Phillips AZ1850).

AMR and HN arrived at Goz Khun, the site of the 2008 recording, on 1 June and chose an appropriate location for mist-netting the following day (details of net sites are given in Table 2). They used three 10 m long mist-nets along the edge of the riparian bushland and played the 2008 song recording for several hours each session. On several days they failed to capture any reed warblers, and they moved their net sites most days. On 6 June NM joined the team, but later the same day moved to a new area near the village of Pak (2,800 m asl), a site 10 km south-west of Goz Khun. On 7 June, AMR and HN continued with a single mist-net in the vicinity of Goz Khun, while simultaneously NM erected the other two mist-nets in the Pak area. AMR and HN continued mist-netting at Goz Khun until 8 June, with one last attempt on 25 June, but they failed to capture any birds in the later period.

On 9 June NM moved to Pukuj (2,800 m asl), a village 6 km west of Pak, where on 10 June he erected mist-nets

Table 1. List of specimens of Large-billed Reed Warbler in museum collections, with dates, localities and mensural data.

Date	Locality	Museum and reg. no.	Collector	Age and sex	Primary projection	Wing	Tail	Bill (S)	Hind claw	Tarsus
13.11 1867	Sutlej Valley, Himachal Pradesh, N India	NHM 1886.7.8.1742	A. O. Hume	adult unk.	(12)	(61)	(56)	18.7	7.8	23.0
Oct. 1869	Mussorie, Uttar Pradesh, N India	NHM 1898.9.1.1233	W. E. Brooks	adult fem.	(9.5)	(59)	(53)	19.4	7.5	23.7
3.5 1879	Kyeikpadein, Lower Pegu, Burma	NHM 1882.1.20.933	E. W. Oates	adult fem.	11.5	61	52	19.2	7.3	23.7
25.8 1879	Gilgit, Hindu Kush, N Pakistan	NHM 1897.12.10.2457	J. Biddulph	juv. male	12.5	61	53	18.3	7.1	23.1
25.1 1880	Kyeikpadein, Lower Pegu, Burma	NHM 1882.1.20.932	E. W. Oates	adult male	11	60.5	50.5	18.0	7.7	23.0
18.8 1900	nr Zharkent, SE Kazakhstan	AMNH 594.681	N. Zarudny	juv. male	13	63	55	18.3	7.5	23.6
9.5 1933	Bhadwar, Kangra, Himachal Pradesh, N India	UMMZ 80.739	W. N. Koelz	adult male	13	64	57	18.2	7.8	23.2
19.5 1933	Baijnath, Kangra, Himachal Pradesh, N India	UMMZ 80.740	W. N. Koelz	adult male	12.5	61	55	18.1	7.1	22.5
16.7 1937	Khairabad, NE Afghanistan	AMNH 466.225	W. N. Koelz	adult male	12.5	60	51.5	19.0	7.1	23.3
18.7 1937	Sufiyan, [Wakhan], NE Afghanistan	AMNH 466.248	W. N. Koelz	adult male	12.5	63	55	18.2	7.3	23.7
21.7 1937	Zebak, [Wakhan], NE Afghanistan	AMNH 466.238	W. N. Koelz	adult male	13	64.5	55	18.3	7.3	23.5
22.7 1937	Zebak, [Wakhan], NE Afghanistan	AMNH 466.236	W. N. Koelz	adult male	12.5	65.5	56	19.2	7.3	23.8

NHM = Natural History Museum, Tring, UK. AMNH = American Museum of Natural History, New York, USA. UMMZ = University of Michigan Museum of Zoology, Ann Arbor, USA. Measurements in millimetres. Primary projection measured as distance between tip of outermost secondary to tip of wing when wing is folded. Bill (s) means length of bill to skull. Values within brackets are unreliable due to unfinished moult.

Table 2. Net sites where reed warblers were caught, their locations and times in use.

Net site number†	Location	Latitude and longitude* (decimal degrees)	Altitude (m)	Dates used	Number of nets
1	Goz Khun	37.02002°N 72.67698°E	2,800	3 June	3
2	Goz Khun	37.02105°N 72.67828°E	2,800	6 June	3
3	Goz Khun	37.01993°N 72.67857°E	2,800	7 June	1
4	Goz Khun	37.02279°N 72.67702°E	2,800	8 June	1
5	Pak	36.99378°N 72.53047°E	2,800	7 June	2
6	Pak	36.98970°N 72.54617°E	2,800	8 June	2
7	Pak	36.99002°N 72.54579°E	2,800	8 June	2
8	Pak	36.99282°N 72.53997°E	2,800	9 June	2
9	Pukuj	36.98641°N 72.46568°E	2,800	10 June	2
10	Zebak	36.53488°N 71.33936°E	2,600	14 June	2
11	Zebak	36.53113°N 71.34892°E	2,600	15 June	2
12	Zebak	36.53208°N 71.34270°E	2,600	16 June	2

† Some other net sites were used, but these caught no birds of interest, and are thus not included in the table.
* Datum used: WGS84

in similar riparian bushlands to the other sites. On 11 June NM moved again, to Zebak (2,600 m asl), one of the historical collection sites (Table 1; Svensson *et al.* 2008), a village area located outside the Wakhan valley between the towns of Ishkoshim and Boharak in the district of Zebak, where he stayed until 16 June.

Investigators removed the two outer rectrix feathers from each bird caught, except for one which escaped, measured them following the protocol laid out in Svensson (1992) and took photographs of most (but no standard photographic method was followed). All data and samples were forwarded on to LS and UO for further analysis. No further recordings of the song or calls were made in 2009.

The team captured 20 reed warblers for detailed assessment (Table 3), although feather samples from only 19 were taken, with an eventual total of 15 Large-billed Reed Warblers and two Blyth's Reed Warblers being determined on the basis of genetic analysis (see below). Photographs suggest that the bird that escaped before a sample could be taken for genetic analysis was most likely to have been a Large-billed Reed Warbler.

The novelty of the work for NM, HN and AMR had a number of repercussions on the data collected. Most importantly, their measurements (Table 3) must be treated as provisional as they clearly contain errors. Second, they unfortunately did not take photographs of all of the captured birds, including only 12 of the 15 confirmed Large-billed Reed Warblers (Table 3).

GENETIC ANALYSIS

DNA was extracted from the feather samples of all 19 reed warblers, plus two Cetti's Bush Warblers *Cettia cetti* caught during the same period and used as controls (Table 3). The protocol for extraction, amplification and sequencing of the cytochrome *b* gene followed standard procedures, as described in Olsson *et al.* (2005). These sequences, which will be deposited in GenBank, were compared to that obtained from the live bird caught in Thailand 2006 (Round *et al.* 2007) and to those from the museum specimens described by Svensson *et al.* (2008). Of the 19 reed warblers sampled, 15 could be conclusively identified as Large-billed Reed Warblers and another two as Blyth's Reed Warblers (Table 3).

Interestingly, data from the museum samples studied by Svensson *et al.* (2008) revealed that the haplotypes were divided into three surprisingly distinct, but seemingly not geographically structured, clusters (Fig. 2 in Svensson *et al.* 2008). Variation within a panmictic population would not normally show a pattern whereby the haplotypes are divided into such clear-cut groups. Indeed, the amount of divergence between these clusters was of a magnitude that would suggest that they came from different isolated subpopulations. We are not aware of any other case among Passeriformes in which the individual variation in a sympatric population exceeds 0.7% (uncorrected p) in the cytochrome *b* gene (UO unpublished data). Although divergence *per se* cannot be taken as a direct measure of taxonomic status, the amount of divergence present within *A. orinus* is at a level commonly found between different subspecies, and recently Bowie *et al.* (2009) proposed species status for a population diverging by 1.6% in the mitochondrial NADH dehydrogenase subunit 2.

In the case of *A. orinus,* divergence between the most different haplotypes in the new material presented here reaches 1.9% (uncorrected p). There is no geographical pattern evident in the distribution of the haplotypes, speaking against the existence of multiple populations evolving in isolation. Individuals representing more than one haplotype cluster (Fig. 2 in Svensson *et al.* 2008) were found in all localities, with the largest genetic variety found in Goz Khun (haplotypes present from all three of the main clusters). This patterning clearly demands further investigation.

DESCRIPTION AND IDENTIFICATION OF LARGE-BILLED REED WARBLERS

Species identification of birds captured in 2009 was based solely on the results of the genetic analysis, but with few exceptions the photographs (e.g. Plates 1–3; see also Plate

Table 3. Mensural and other data collected from the reed warblers caught in June 2009.

Plate no.	Bird no. & measurer	Date	Time captured	Net site no.	Location	Wing	Tail	Tarsus	Wing-tip (wt)	p2 < wt	p1 > pc	Emargination of p5	Bill (S)	Bill W	Bill D	Hind claw
Large-billed Reed Warbler																
y	1: HN & AMR	03/06	07h30	1	Goz Khun	60.0	60.0	22.6	3, 4	5.4	3.5	Prom.	18.6	4.0	3.5	6.9
5	2: HN & AMR	03/06	07h30	1	Goz Khun	60.0	55.0	23.1	3, 4, 5	7.3	1.0	Prom.	17.1*	4.7	3.5	6.5
y	3: HN & AMR	03/06	08h00	1	Goz Khun	58.0	58.0	22.9	3, 4, 5	6.4	2.0	Prom.	15.7*	3.9	3.3	7.0
x	4: HN & AMR	03/06	09h30	1	Goz Khun	60.0	57.0	23.2	3, 4, 5	5.5	4.6	Unk.	16.2*	4.0	3.1	6.8
x	6: HN & AMR	06/06	11h00	2	Goz Khun	58.0	56.0	23.0	3, 4, 5?	5.7	4.6	Unk.	18.0	4.0	3.3	6.5
y	8: HN & AMR	08/06	06h00	4	Goz Khun	63.0	61.0	23.0	3, 4	6.0	4.6	Prom.	17*	4.1	3.0	5.5
x	5N: NM	07/06	06h35	5	Pak	63.0	59.0	22.3*	3, 4	7.4	1.8	Unk.	17.3	4.5	3.4	7.0
y	6N: NM	07/06	09h00	5	Pak	60.0	55.0	23.1	3, 4	5.9	2.0	Red?	18.2	4.2	3.1	6.9
y	7N: NM	08/06	10h00	6	Pak	60.0	64*	22.1*	3* [4>3>5]	5.1	1.0	Prom.	17.8	3.7	3.6	6.4*
2	8N: NM	08/06	15h35	7	Pak	59.0	66*	23.1	3, 4	6.3	2.3	Red?	15.4*	3.9	3.4	6.9
y	9N: NM	09/06	07h00	8	Pak	62.0	63.0	24.4	3, 4, 5	7.3	1.1	Red.	18.1	4.2	3.4	7.4
y	10N: NM	09/06	08h20	8	Pak	64.0	65*	22.3*	3, 4	7.2	2.0	Prom?	16.6*	4.0	3.5	6.3*
4	15N: NM	14/06	05h35	10	Zebak	61.0	63.0	22.4*	3, 4	9.3	1.0	Red.	18.4	3.1*	4.2	7.5
1	17N: NM	15/06	06h30	11	Zebak	61.0	69*	21.6*	3, 4 [4>3>5]	5.8	1.7	Prom.	18.4	3.4	3.4	6.5
3	19N: NM	16/06	04h54	12	Zebak	61.0	69*	23.1	3, 4	6.6	3.0	Red?	17.3	3.7	3.3	6.6
Blyth's Reed Warbler																
6	11N: NM	10/06	05h15	9	Pukuj	60.0	61*	21.0	3, 4	6.1	2.1	Prom.	15.6	3.5	3.6	5.0
7	13N: NM	10/06	07h30	9	Pukuj	61.0	58*	22.1	3, 4, 5	6.3	1.0	Prom.	14.4	4.0	3.4	5.4
reed warbler$																
y	7: HN & AMR	07/06	not recorded	3	Goz Khun	63.0	$	$	$	$	$	Prom.	$	$	$	$
Eurasian Reed Warbler†																
-	5: HN & AMR	06/06	10h30	2	Goz Khun	59.0	60.0	23.0	3, 4	5.9	4.6	-	17*	4.1	3.4	7.0
Clamorous Reed Warbler†																
-	18N: NM	16/06	04h54	12	Zebak	91.0	82.0	50.5	3, 4	6.0	1.0	-	25.0	5.0	5.4	10.4
Cetti's Bush Warbler†																
-	9: HN & AMR	08/06	13h30	4	Goz Khun	71.0	71.0	22.0	4, 5	14.0	13.0	-	12.0	3.0	4.0	5.0
-	12N: NM	10/06	05h15	9	Pukuj	68.0	73.0	22.1	3, 4	6.7	11.9	-	14.3	2.6	3.5	7.2

Column notes

Plate number: numbers refer to the plate on which photographs of the individual bird are reproduced; x = no photographs were taken of these birds; y = photographs taken, but not included here. Bird # 15N was also illustrated in Timmins *et al.* (2009; Plate 1), as was bird # 8 on Plate 5. The bird photographed in the net (Plate 2 in Timmins *et al.* 2009) was one of the four captured on 3 June.

Locations of net sites are given in Table 2.

Measurements are in mm. Measurement techniques followed Svensson (1992). Wing: wing length; tail: tail length; tarsus: tarsal length; wing-tip: primaries that make up the tip of the wing; p2<wt: length of primary 2 (p2) less than wing tip; p1>pc: length of primary 1 (p1) greater than primary coverts; bill (S): bill length to skull; bill W: bill width; bill D: bill depth; hind claw: length of hind claw.

Wing-tip: the photographs were not appropriate to assess this character independently, with the exception of two birds given in brackets. Emargination of p5: this was assessed from photographs taken, not at the time of capture. Prom. = prominent; Unk = unknown; Red. = reduced compared with p3 and p4.

Other notes

* Probably erroneous measurement. Measurements are given provisionally, as some (and possibly many) are certainly not accurate. NM, HN and AMR were novices at capturing and measuring birds, having had very little experience prior to the work in June 2009. An indication as to which of the measurements are most likely to be erroneous was made by LS, with the aid of the photographs of the captured birds; these are flagged with an asterisk (*). None of the measurements was used in the analysis of potential diagnostic differences described in the paper.

$ This bird escaped before further measurements or a sample were taken, but photographs suggest it was a Large-billed Reed Warbler.

† In addition to Large-billed and Blyth's Reed Warblers, two other *Acrocephalus* species (Eurasian Reed Warbler *A. scirpaceus* and Clamorous Reed Warbler *Acrocephalus stentoreus brunnescens*) were also captured, and these are included in the table along with two Cetti's Bush Warblers *Cettia cetti albiventris* as they were sequenced and used as controls within the genetic analyses.

5 in Timmins *et al.* 2009) and provisional measurement taken (Table 3) support these identifications. However, one individual, #15N, differed more substantially from the rest, primarily in bill coloration and plumage (Plate 4; see below), but an independent evaluation by the authors as to whether some error could have occurred between photograph labelling and sample labelling and or processing concluded that this was not reasonably possible. The provisional measurements of this bird (Table 3) are largely consistent with identification as a Large-billed Reed Warbler. Caution, as already mentioned, must be exercised in using the provisional mensural data, and bill measurements in particular appear to exhibit significant error. For example the bills of birds # 8N (Plate 2) and # 10N appear relatively long on the photographs, thus not matching their recorded short measurements (Table 3). The photographs do however suggest that several birds (see below) had bill lengths close to the known range of bill length in Blyth's Reed Warblers.

Description of the captured birds

Although notes on plumage were not taken during the 2009 field survey, the photographs taken of 12 of the Large-billed Reed Warblers allow a retrospective characterisation of the plumage. All 12 of the Large-billed Reed Warblers, the one bird that escaped and the two Blyth's Reed Warblers were clearly adults and not fledged juveniles from the then current season. In general, the plumage coloration of the Large-billed Reed Warblers seemed very similar to that of Blyth's Reed Warbler (compare Plates 1–5 with Plates 6–7), and especially in one bird (# 15N: Plate 4) even bore a close resemblance to the eastern subspecies of Eurasian Reed Warbler *A. scirpaceus fuscus*, both of which were present in the area together with the Large-billed Reed Warbler. The upperparts were dull rufous-brown, the underparts cream-white, with the sides of the breast, flanks, lower belly and vent tinged more saturated ochre or pink-buff. Only the throat and chin were a cleaner whitish, although at least some of the Large-billed Reed Warblers had a faint darker wash to the lower throat. Legs were rather nondescript pinkish-brown or grey-brown.

One feature which comes through on nearly all the photographs of the captured birds, but which is not quite so evident on museum specimens, is the long-looking tail especially compared with the short, relatively rounded wings (Plates 1–3). The appearance of a relatively short, rounded wing on the live birds in the photographs seems most likely attributable to the (on average shorter, compared with Blyth's) length of primaries 5–10 relative to the wing-tip (Table 3 in Svensson *et al.* 2010). The third primary (p3), however, appeared to be equal to p4, or not shorter than p5 (Table 3). This will be worth keeping in mind during future searches in museum collections for undetected Large-billed Reed Warbler specimens, as the relatively short wings and long tail might not always be eye-catching on a study specimen.

Another feature which is difficult to examine in detail on specimens, but which can readily be studied on live and handled birds, is the face pattern. Both eye-lids were pale, the lower more white, the upper more buff-tinged and broader, but there was no impression of a full pale eye-ring. The supercilium was short and relatively indistinct on all birds, usually off-white to buffish-white, and blended in particular with the upper eye-lid, which was generally slightly darker. On some birds, at certain angles, the supercilium appeared faintly to extend beyond the eye (Plate 2 and 5; a subtlety brought about by a very slightly paler plumage tract on the crown-sides above the eye-crescents), while on others it appeared not to go beyond the upper eye-lid, and on one bird (# 15N: Plate 4) the supercilium was barely present even proximal to the eye. The loral tract was rather variable and somewhat indistinct, merging imperceptibly into the supercilium and darkest next to the eye, but never darker than other areas of the head or face, and thus generally not giving the impression of an eye-stripe. This face pattern is very similar to Blyth's and it is unlikely that useful differences between the two species will be found.

As explained above, we have treated the mensural data from the 15 birds trapped in 2009 (Table 3) with caution, and these measurements were not used in the analysis of morphometric differences between Blyth's and Large-billed Reed Warblers (see below). Nevertheless, it is evident both from the biometrics and from photographs taken (Plates 1–2 and 8) that most of the birds had a quite long and broad bill, although others appeared more like Blyth's Reed Warbler (Plates 3–5) and the shortest bill measurements (Table 3) overlapped substantially with those of Blyth's Reed Warbler (Svensson *et al.* 2010). But whether these short measurements were accurate requires confirmation. The same potential problems are present in the other biometrics obtained during the 2009 survey (Table 3). Of the 12 Large-billed Reed Warblers for which photographs were taken, the lower mandible was pinkish grading to a yellowish tip and cutting edge, lacking any prominent darker pigmentation patches (Plate 2), although at least three (# 2, # 15N and # 17N: Plates 5, 4 and 1 respectively) and possibly two to four more of the birds (# 8, # 6N, # 9N, # 19N: Plate 3) appeared to have a faint (or in one bird quite prominent) darker patch towards the tip or more medially on the ventral edge. The upper mandible coloration was relatively uniform dark brown, bar the paler cutting edge, in most, although one bird (# 19N: Plate 3) had what appeared to be a distinctly paler mid-section.

Identification summary

Svensson *et al.* (2010) should be consulted for a full account of biometrics and identification criteria. Here we will only give a summary of the most useful clues, based in part on the results from the 2009 survey. Clearly it is a priority in the future to obtain an extensive series of biometrics based on live birds (corroborated against DNA data) to determine fully the similarities and differences between the two species and thus provide reliable measurement-based methods for in-the-hand field identification of both Large-billed and Blyth's Reed Warblers.

Bill

As the name implies, Large-billed Reed Warbler has a long and rather broad bill. It is probably usually at least 18.0 mm to skull (Table 1), but slightly shorter bills might occur in large samples, perhaps down to 17.0 or at least 17.5 mm, as suggested by photographs (Plates 3–5) and the provisional measurements of some of the captured birds. Based on a large sample, Blyth's Reed Warbler has a maximum bill length of 18.0 mm (Svensson *et al.* 2010). When seen from above, the bill of Large-billed has often

rather straight, evenly tapering sides and a rather broad tip (Plate 8a), lacking the clearly concave sides and more pointed (or pinched in) tip of most Blyth's Reed Warblers (Plate 8c). But a few of both species are less typical as to this (e.g. Plate 8b of a Large-billed and 8d of a Blyth's). A further distinction between the two species at the population level appears to be that Large-billed Reed Warbler has on average a more evenly dark upper mandible, and a paler pinkish or yellowish lower mandible lacking (especially in the museum specimens) a prominent darkish tip or a darkish smudge just inside the tip. Almost all Blyth's observed by LS have had a slight darkish smudge on the lower mandible just inside the tip, although in a very small proportion either this can be so weakly marked as to be difficult to discern in certain lights or angles, or the whole bill is a little darker than average (melanin-rich birds, also with darker legs and even a little darker plumage overall). However, the two Blyth's captured in Wakhan either lacked such a bill pattern or fell into the latter group of barely discernible darker pigmentation (Plate 7), and thus had lower mandibles like those of the majority of Large-billed. The upper mandibles of these two birds were also very similar in uniformity to those of Large-billed. Therefore, great caution should be exercised, especially under field conditions, as there is clearly some overlap both as to shape and colour of the bill between the two species.

Claws

Large-billed has slightly longer and more pointed claws than Blyth's. The hind claw of Blyth's is usually both short and bluntly tipped, whereas in Large-billed it is more acutely pointed. Mean length of hindclaw is 7.3 mm in Large-billed and 6.1 mm in Blyth's (Svensson *et al.* 2010; Table 1). The middle claw is also about 1.0 mm longer in Large-billed than in Blyth's, being on average 6.3 mm and 5.3 mm respectively. The measurements (Table 3) and photographs taken in 2009 appear to support this prior assessment based on historical specimens.

Tarsus

Large-billed Reed Warbler has on average a somewhat longer tarsus than Blyth's, with mean values of 23.4 mm and 22.1 mm respectively, but there is considerable overlap due to individual variation (Svensson *et al.* 2010; Table 1). On museum specimens, the tarsus of Large-billed can look slightly darker grey than on the average Blyth's, but this possible difference should be better studied on live birds in the future. Unfortunately few of the photographs show the tarsus and legs clearly enough for comparison.

Tail

Large-billed Reed Warbler has a somewhat longer tail than Blyth's, especially noticeable when compared to wing length in the majority of live birds, and this is further enhanced by its on average somewhat blunter wing (Tables 2 and 3 in Svensson *et al.* 2010). In comparison Blyth's has a shorter appearing tail relative to its otherwise similar wings. We estimate that the majority of Large-billed Reed Warblers will prove to have a tail length between 51–63 mm, based both on museum specimens (Table 1) and the plausible measurements of live birds (Table 3, a few implausible extremes being discounted, especially when compared to photographs of the same individuals), whereas Blyth's Reed Warblers have tail lengths of 45–56 mm based on a sample of 185 skins (Svensson *et al.* 2010). This population-level difference, together with bill characteristics, should be a useful criterion in the field for provisional identification. As already discussed by Svensson *et al.* (2010) on the basis of museum specimens, the photographs suggest that there is no difference in absolute width or terminal shape of the rectrices between the two species, and that both species are rather variable in this respect.

Wing formula

In the museum specimens of Large-billed Reed Warbler it is common for the second outermost primary (p2) to fall in length between p6/7 or shorter (primaries numbered from outer inwards). Often the tip of p2 falls around p7 or 7/8, and sometimes equals p8. When between p6/7 in length, it is nearer p7 than p6. However, Round *et al.* (2007) reported that on the first Large-billed Reed Warbler captured in Thailand p2 fell between p8 and p9. In Blyth's Reed Warbler, p2 falls between p5/6, equal to p6, between p6/7 or, least often, equal to p7; only once has LS seen p2 fall between p7/8. It follows from these differences that Large-billed Reed Warbler has a slightly more blunt-tipped wing on average than Blyth's Reed Warbler, but there is significant overlap between the two (Table 3 in Svensson *et al.* 2010). Unfortunately this character was not assessed on the captured birds and neither can it be accurately determined from the photographs taken.

Based both on museum specimens and the captured birds Large-billed Reed Warbler has invariably an emargination on the outer web of p5, usually as prominent as that on p3–4 (Plate 9a), more uncommonly slightly less pronounced (as in 3–5 of the 12 captured and photographed birds: Table 3, Plate 9b,c). Blyth's Reed Warblers more commonly have reduced emargination of p5 compared with p3–4 (although the two birds from Pukuj were well emarginated: Plate 9d), especially in immature birds, and a few young Blyth's Reed Warblers lack any emargination of p5. It remains unclear whether a larger sample of immature Large-billed might also show a higher proportion of reduced emargination than adults.

Song

Based on the single available recording, the song of Large-billed Reed Warbler resembles most closely that of Blyth's Reed Warbler but differs in several details. There are few close resemblances to any other known *Acrocephalus* songs in LS's experience, except for short phrases and vaguely a slowed-down version of a Marsh Warbler *A. palustris* or Black-browed Reed Warbler *A. bistrigiceps* song. But anyone familiar with Blyth's Reed Warbler, Marsh Warbler, Eurasian Reed Warbler and Paddyfield Warbler *A. agricola* should find it fairly easy to recognise a Large-billed Reed Warbler from its song, being clearly different from these species, yet contextually similar enough to be recognisable as that of an *Acrocephalus*.

In common with the song of Blyth's Reed Warbler, that of Large-billed Reed Warbler is characterised by both the persistent repetition of short phrases or melodic figures several times and by the fairly slow general pace of the song (Figs. 2–5). Phrases are repeated either exactly or with only minor modifications. A phrase can be repeated 2–6 times, rarely more, but on average slightly fewer times than phrases repeated by Blyth's Reed Warbler (which

Plate 1. A Large-billed Reed Warbler showing a characteristic long bill, flattened head shape, relatively short, somewhat rounded wings enhancing the length of the long tail. Note also the short and subdued pale supercilium and pale lores, paler than in most Blyth's Reed Warblers, as well as a suggestion of a darker pigmentation patch on the lower mandible . Bird # 17N, 15 June 2009, near Zebak village.

Plate 2. A Large-billed Reed Warbler showing a long bill with a relatively uniform pale lower mandible. Note the very subtle continuation of the supercilium behind the eye. Bird # 8N, 8 June 2009, near Pak village.

Plate 3. Large-billed Reed Warbler showing in comparison to Plate 1 an apparently shorter tail and bill, but note the appearance of relatively short rounded wings which help enhance the apparent length of the tail. Note that the upper mandible on this bird appears to grade somewhat paler from the culmen. Bird # 19N, 16 June 2009, near Zebak village.

Plate 4. A Large-billed Reed Warbler showing several extreme characters including an extensively darker patch on the lower mandible, relatively dark lores and lack of a clear supercilium combined with strong contrast with the white throat, and also the appearance of a relatively short tail and bill. Birds such as this would be imposible to separate from Blyth's and even Eurasian Reed Warblers, without vocalisations, biometrics and/or genetic analysis. Bird # 15N, 14 June 2009, near Zebak village.

Plate 5. A Large-billed Reed Warbler showing a darker patch on the lower mandible and an apparently shorter bill than average. Such birds would be impossible to distinguish from Blyth's Reed Warblers. Note also the subtle continuation of the supercilium beyond the eye. Bird # 2, 3 June 2009, near Goz Khun village.

Plate 6. Blyth's Reed Warbler: note the short bill, but a tail that does not appear very short. Bird # 11N, 10 June 2009, near Pukuj village.

Plate 7. Blyth's Reed Warbler: note the short bill. However this bird appears to lack any dark pigmentation on the lower mandible. Bird # 13N, 10 June 2009, near Pukuj village.

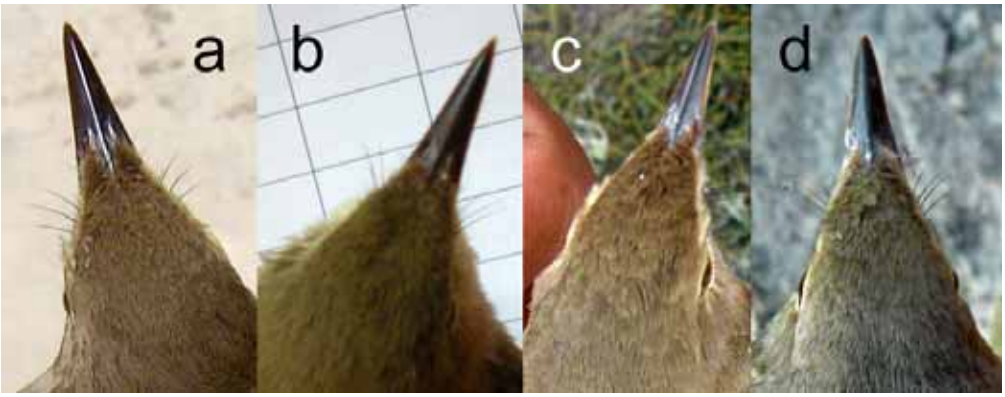


Plate 8. Bill shape, as viewed from above, in the Large-billed Reed Warbler. (a) bird # 2; (b) bird # 3; and Blyth's Reed Warbler: (c) bird # 11N; (d) bird # 13N.

Plate 9. Difference in emargination of the fifth primary in Large-billed Reed Warbler and Blyth's Reed Warbler. (a) Large-billed Reed Warbler showing clear emargination: bird # 17N; (b & c) Large-billed Reed Warbler showing reduced emargination: birds # 9N & 15N; (d) Blyth's Reed Warbler showing clear emargination: bird # 11N.

often repeats a phrase 10–15 times before switching to a new one) (Fig. 6). The pace of the full song is subtly faster than in Blyth's Reed Warbler, but clearly slower than that of a Marsh Warbler. A full song sequence of a Marsh Warbler will, without exception, include accelerations and very quick outbursts of notes, with rather few elaborate phrase repetitions included. In Large-billed Reed Warbler, the song appears to keep a steady and moderate pace.

The Large-billed Reed Warbler song recorded lacked the common insertion of 2–5 clicking call notes between phrases so characteristic of Blyth's Reed Warbler (Fig. 6), although a couple of the strophes have some clicking-like notes within them (Figs. 2, 3). This may well serve as the easiest way of identifying singing Large-billed Reed Warblers. Another difference may be the slightly feebler or more 'trembling' voice of the Large-billed Reed

Plate 10. Typical vegetation communities in Wakhan, 28 June 2008; note in particular small patches of 'short' riparian bushland along the river bank.

Plate 11. Riparian bushland in the Wakhan river valley, 28 June 2008. Goz Khun lies in the distance to the right, with the mountains of Tajikistan forming the background.

Plate 12. Relatively short, and fairly open, bushland along the Panj river in the Pak area, 31 May 2008.

compared with the clearer and perhaps louder voice of Blyth's Reed. This 'trembling' voice quality, meaning that notes are subdivided into briefer ones, at times creates a slight similarity with that of the Marsh Warbler. The Large-billed Reed Warbler also seems to include more variation and 'improvisations' than Blyth's Reed Warbler; the song of the latter can appear mechanical, following a rather 'rigid' melodic structure.

In summary, Large-billed and Blyth's Reed Warblers are extremely similar (cryptic species), being normally impossible to separate definitively in the field on structural differences alone, and with some difficult (perhaps impossible) to separate even in the hand. This is particularly important to remember in areas of potential sympatry (South and South-East Asia and at least south-western Central Asia), where for the time being song and/or genetic confirmation will be required for positive identification, except perhaps for extreme birds seen by persons highly familiar with both species. Extreme individuals of Large-billed would be those with a very long and broad bill, long claws, long tail and short wings.

Svensson *et al.* (2010) discussed reports on the internet regarding two putative field records of Large-billed Reed Warbler, in which birds reportedly had a habit of half-spreading (fanning) their tails and then slowly folding them again when moving around in the canopy. One of these records (Raju *et al.* 2008) has now, however, been relatively conclusively shown to refer to Blyth's Reed Warbler, based on the capture and measurement of three birds at Kanha Tiger Reserve in India (Raju *et al.* 2009). Furthermore there is a widely reported behaviour of Blyth's of frequently flicking, cocking and fanning (or flirting) the tail (Baker 1997, Grimmett *et al.* 1998, Rasmussen & Anderton 2005). Such behaviour requires re-evaluation in both species, although LS has not observed it in Blyth's Reed Warblers in northern Europe.

Despite the difficulty of field identification, it is imperative that reliable and widely accepted methods are established, not least because a reasonable global conservation assessment for the species depends on it (see later). We urge fieldworkers who believe they have

Figure 2. An approximately 11.5 second song sequence of the Large-billed Reed Warbler recorded in 2008. Note the rather varied nature of this sequence in comparison to the others (Figs. 3–5) and the addition of five 'clicking' notes after c. 4.5 seconds, which are somewhat reminiscent of the commonly inserted clicking notes of Blyth's (Fig. 6).

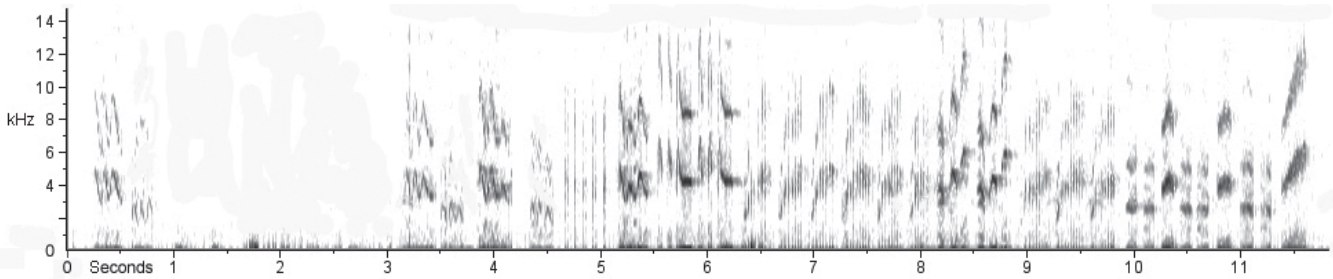


Figure 3. An approximately 9 second song sequence of the Large-billed Reed Warbler recorded in 2008. Note the repetition of phrases and also the addition of 'clicking-like' notes between phrases in the early part of the sequence, which are somewhat reminiscent of the commonly inserted clicking notes of Blyth's.

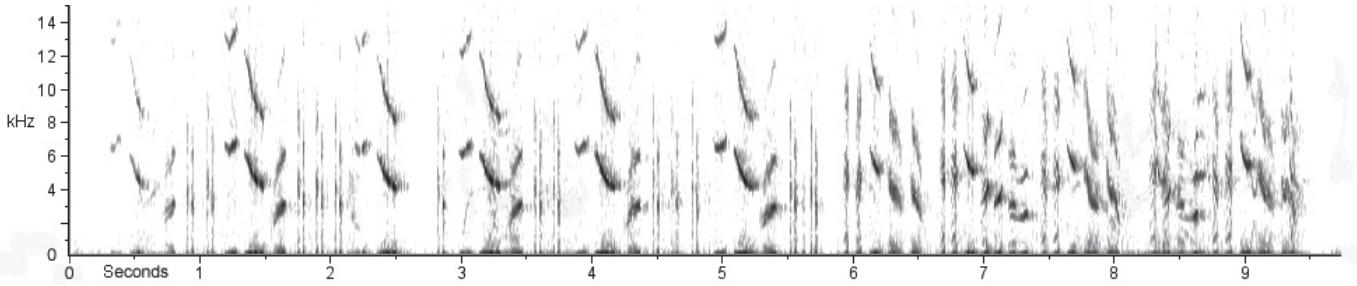


Figure 4. An approximately 14 second song sequence of the Large-billed Reed Warbler recorded in 2008. This sequence came c. 3.5 seconds after that in Fig. 3. Note the repetition of phrases, and the lack of clear clicking notes.

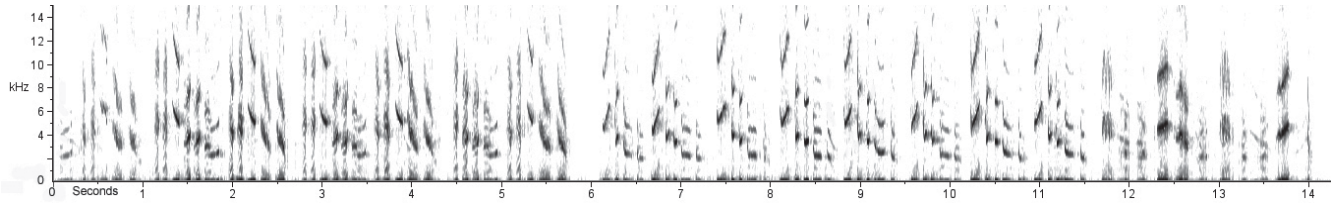


Figure 5. An approximately 9 second song sequence of the Large-billed Reed Warbler recorded in 2008. This sequence came c. 16.5 seconds after that in Fig. 4. Note the repetition of phrases and the lack of 'clicking notes'.

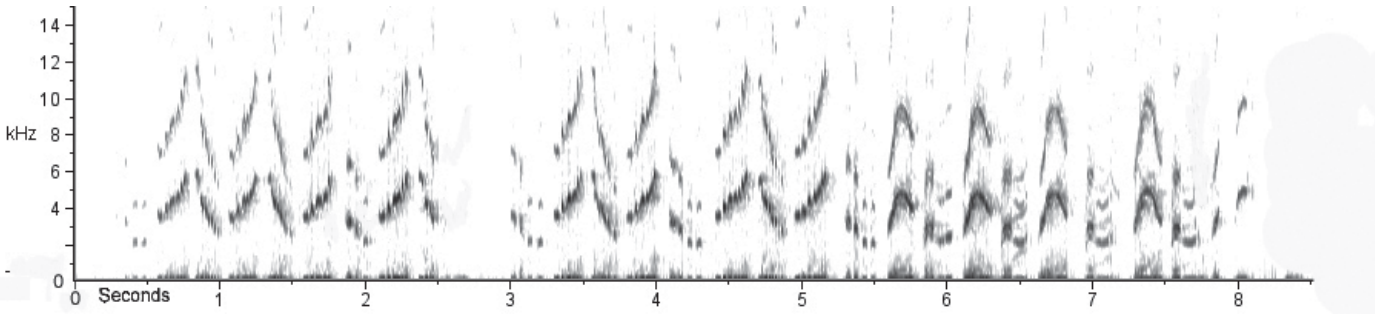
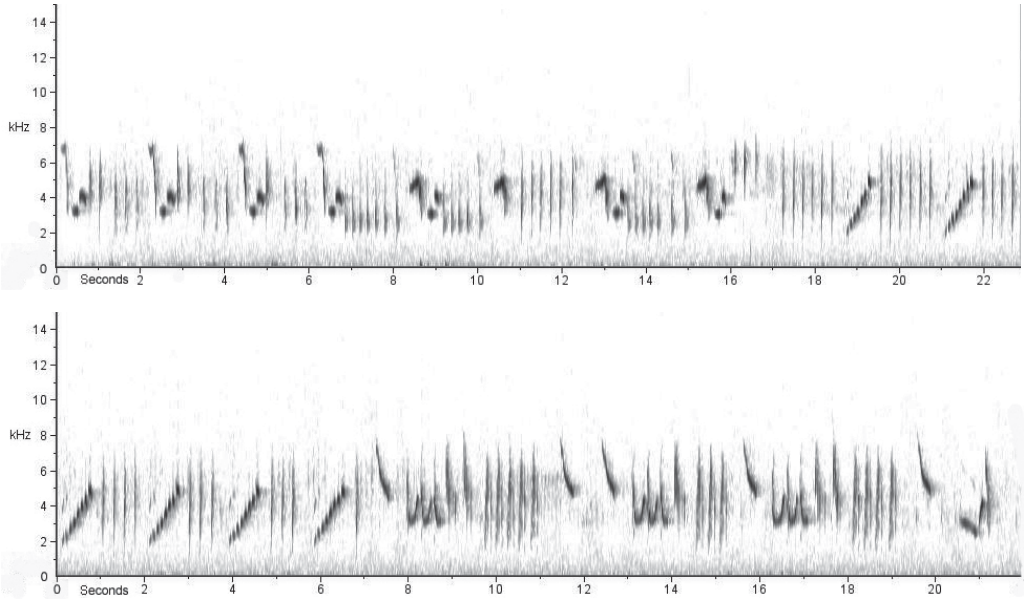


Figure 6. Partial song sequence of a Blyth's Reed Warbler. The two segments (a) and (b) are contiguous. The time scale (x axis) is more compressed than in Figs. 2–5. Note in particular the slightly slower pace of the song, most phrases lasting approximately a second, compared to approximately half a second in the Large-billed recording, and the insertion of clicking notes (vertical bars) between phrases. LS; Uppsala, Sweden, June 1984.



found *A. orinus* populations to make recordings of vocalisations and to take standardised measurements (Svensson 1992) and samples for genetic analysis from birds caught, whenever possible.

HABITAT AND ECOLOGY

That Large-billed Reed Warblers breed within the surveyed area is currently supposition, although the observation of many singing birds in 2008, and the dates over which Large-billed Reed Warblers were caught in 2009 strongly support this. Additionally AMR and HN observed a reed warbler with food items in the bill on 25 June at Goz Khun, which more than likely would have been a Large-billed Reed Warbler. The significance of the 2008 observations was not appreciated at the time, hence no additional effort was directed to confirmation of breeding, while in 2009 the emphasis was on capturing and thus confirming the identity of the birds, rather than confirmation of breeding which would have over-stretched the then current abilities of AMR, HN and NM.

Badakhshan, like most of northern Afghanistan, lies in the rainshadow of the Hindu Kush range, and Wakhan and Zebak are dominated by arid habitats at high altitude. Within both these areas, short stature, sparse, semi-desert plant communities predominate on both slopes and in valleys, while dense tall vegetation is rare within the landscape and typically associated with riparian areas and irrigated plantations (Plate 10). Additionally there are sporadic areas of arable, largely irrigated farmland and riparian grazing lands. Altitudes of the confirmed sites of Large-billed Reed Warbler range between approximately 2,600 m asl at Zebak and 2,800 m asl at the three sites (Goz Khun, Pak and Pukuj) in the Wakhan valley. The historical specimens from Sufian (Sufiyan) and Khairabad (Table 1, Fig. 1) were probably collected at lower altitudes still, as it appears that Koelz spent minimal time, a day or two at most, at these localities (see http://www.ummz.umich.edu/birds/collection/koelzafghanlocalities.pdf for details of his itinerary), thus suggesting that specimens were collected in the main valley, rather than from higher-altitude tributary valleys in the vicinity. The lowest altitudes possible at these two localities would be c.1,800 and 1,400 m asl respectively (elevations derived from global SRTM data; see Fig. 1).

At Goz Khun in June 2008 singing Large-billed Reed Warblers were common throughout the riparian bushlands. A minimum of 13 birds presumed to be the same species were seen and/or heard, but probably significantly more, during several hours of morning observation (c.05h00 to 08h00) along a route of just over 2 km, thus making it the second commonest species after 'Sind' Mountain Chiffchaff *Phylloscopus sindianus* recorded in this habitat. Reed warblers (based largely on singing densities) appeared scarce or absent in areas where thickets were smaller in size, shorter in stature and more open in their composition, perhaps not surprising given the preference of *Acrocephalus* for thick vegetation. The area in which the birds appeared commonest consisted of relatively tall (2+ m), thick riparian bushland, composed primarily of various shrubs, most notably sea buckthorn *Hippophae* (see Plates 3 and 4 in Timmins *et al.* 2009). At this site the shrubs form dense impenetrable thickets, often several tens of metres in width, both on older river terrace and newer sedimentary formations, and are interspersed with open grassy glades and stream channels (Plate 11).

The abundance of reed warblers in riparian bushlands at Goz Khun contrasted markedly with the results of the 2008 survey at other locations and in other well-vegetated habitats. In the Pak and Pukuj areas of riparian bushland, which are somewhat patchily distributed over the irrigated area of two outwash fans and the adjacent riparian terrace of the Panj river, six hours of observation on 31 May and 1 June yielded few records of reed warblers. This area was surveyed prior to the Goz Khun site (and somewhat later in the day), and reed warbler song heard in this area was retrospectively identified as such, because RJT was still familiarising himself with the common resident species. But this factor, although perhaps leading to some under-recording of reed warblers, surely does not fully account for the difference in abundance recorded between sites. The 2009 net sites lie roughly within the area surveyed in 2008, and confirm the presence of Large-billed Reed Warblers there; they also suggest, particularly in the Pak area, that Large-billed Reed Warblers were still numerous and widespread even if densities were significantly lower than at the Goz Khun site (assuming no reason for change in abundance between sites over the two years). The lower calling densities found in 2008 seem most likely attributable to differences in bushland characteristics when compared to Goz Khun. Thicket height in the 2008 surveyed area of Pak and Pukuj was rarely above 1.5 m, while thickets were generally smaller and less dense than at Goz Khun (Plate 12). The Zebak area was not surveyed on foot in 2008, so a direct comparison of habitats is not possible. But nets catching the species at this site in 2009 were set within mixed orchard plantations of apricot, black cherry, willow and white poplars, with the nets between the trees and unidentified thorn-bush hedges. It is however not known if birds were resident in such habitat, or attracted in from other vegetation types in the vicinity by song playback. However, based on notes taken by RJT while driving through the area in 2008 and by NM during the 2009 netting, and subsequently interpretation of remote imagery, habitats in this area were otherwise broadly similar to those in the Wakhan valley.

Higher up the Wakhan valley, where the valley was narrower and the valley terrain more rugged, reed warblers were not detected by RJT in sporadic riparian thickets along the Wakhan river. But these thickets were rarely dense, were generally richer in shrub species (juniper *Juniperus*, rose *Rosae* and tamarisk *Tamarix* were all more in evidence than at Goz Khun) and were invariably small (rarely more than 5 m wide). Probably even more notable was the lack of any records of reed warblers within birch-dominated (*Betula*) riparian thickets that occur in association with narrow, generally rugged, tributary valleys of the Wakhan river at still slightly higher elevations (c.3,400–3,600 m). Over 25 hours of observation during the course of seven days between 7 and 28 June 2008 was spent by RJT in four different birch-dominated tributary thickets.

It was thus perhaps not surprising that reed warblers were also not detected in the main Wakhan valley within small, but often quite dense, plantations of poplar *Populus* and willow *Salix*, along with other trees and shrubs. Several such plantations, often in close association with bushlands and or small scrubby thickets, were surveyed by RJT

between 31 May and 1 June in the Pak and Pukuj area, and later in the survey (29 June–1 July) over eight hours were spent in the Ishkoshim area where such vegetation was considerably more extensive.

Thus riparian bushland was the only habitat in which reed warblers were detected. Taken together with the relatively extensive survey effort in structurally similar complex areas of vegetation, this suggests that Large-billed Reed Warblers may well have a narrow breeding habitat niche. Also noteworthy is the apparent coincidence of the species's use of riparian bushlands with lower, broad, permanently human-inhabited valley areas. This is presumably because broad flat valley bottoms allow extensive riparian bushlands to form, and these same features are favoured by people for settlement and agriculture. In the Wakhan valley at least, riparian thickets in areas outside of major human use zones probably do not support large populations of Large-billed Reed Warblers.

It is also interesting to speculate on the capture of two Blyth's Reed Warblers at Pukuj, in an area of relatively mixed, low-stature open habitat, while none was captured at the four productive net sites at Goz Khun. This species has a wide geographical range, which now must be considered with some caution due to the potential past confusion between the two species (Svensson *et al.* 2010). North-eastern Afghanistan has previously been considered to lie within the south-easterly extent of the species's breeding range (Svensson *et al.* 2010), and the current results obviously support this. Although there is a possibility that these two birds were only late passage migrants, Svensson *et al.* (2010) were able to verify five specimens of Blyth's Reed Warblers collected historically in June–July from north-eastern Afghanistan, including the localities of Zebak and Khairabad, thus strongly suggesting that breeding takes place. The habitat in which the two birds were caught is typical of the relatively broad range of breeding habitats that the species occupies, which are generally drier (although usually in the vicinity of 'wet' areas) and dominated by woody species when compared to the norm for *Acrocephalus* breeding habitats (Baker 1997, Beaman & Madge 1998, Gavrilov & Gavrilov 2005, LS unpublished data).

The altitudinal range of Blyth's Reed Warbler within Central Asia has been reported as up to 1,000 m by Dement'ev *et al.* (1968), with breeding in the Tien Shan as high as 900–1,200 m (Kor'ev & Zarudny 1906 in Dement'ev *et al.* 1968) and up to 2,000 m (Gavrilov & Gavrilov 2005). However, considerable caution is needed in interpretation of these reports given the uncertainty of the geographical range of Large-billed Reed Warbler, especially as N. A. Zarudny collected a juvenile Large-billed Reed Warbler within the Tien Shan region (Table 1; Fig. 1 in Svensson *et al.* 2008). The altitude of Pukuj (and Zebak in the case of the historical specimens) is thus considerably higher than generally accepted for breeding Blyth's Reed Warblers. However, being at the southern extent of the species's potential breeding range, some increase in the upper altitude limit seems logical, and thus breeding within such habitat would not appear to be out of the question. If Wakhan and Zebak are typical of the breeding habitats of both species in southern Central Asia, then widespread sympatry (or at least close parapatry) between the two seems likely. This will obviously complicate any future endeavours to improve understanding of the breeding range of the Large-billed Reed Warbler, and potential breeding sites will need careful and systematic survey.

The reed warblers observed in the Goz Khun area in 2008, although skulking like other *Acrocephalus* species, were observed on a number of occasions singing from relatively high and exposed perches within the bushland. Such behaviour also appears to be characteristic of Blyth's (Beaman & Madge 1998, Baker 1997). Unfortunately the below-par health of RJT on 3 June, the effects of acclimatisation to altitude and the novelty of the fauna resulted in minimal notes being taken, especially on behaviour of the reed warblers.

CONSERVATION ISSUES

Passerine birds are not trapped or hunted by local people in Badakhshan, and the main threat to the Large-billed Reed Warbler appears to be habitat loss. Local people cut fuel-wood from the riparian bushlands and they are cleared to make way for arable and grazing lands. High livestock densities are also likely to exert their toll on the extent and composition of the riparian bushlands.

The international border between Afghanistan and Tajikistan within the Wakhan valley follows the Panj river. This geopolitical boundary has resulted in very interesting land use differences between the two countries, which shed considerable light onto potential future scenarios for the conservation needs of the riparian bushlands and the Large-billed Reed Warbler. Both RJT (in 2008) and SO (in September 2009, while on the Tajik side of the valley) independently noted that riparian bushlands were largely non-existent or very impoverished on the Tajik side of the river. It was also noteworthy that infrastructure on the Tajik side of the border was significantly more advanced, with an all-season surfaced road, many bridges and electric supply-lines along most of the valley, whereas there was only an unsurfaced track, few bridges and no electricity network on the Afghan side. The irrigation system was also more developed and engineered on the Tajik side of the valley. Clearly agricultural conversion and livestock grazing have significantly reduced the riparian bushlands in Tajikistan in contrast to those on the Afghan side of the river.

However, almost certainly riparian bushlands would have once been more extensive on the Afghan side than they currently are, if it were not for heavy grazing and, probably to a lesser extent, use of riparian areas for arable land. Even in Afghanistan, much of the agriculture is irrigated and often on high terraces, outwash fans or low gradient valley sides, and thus not directly on former areas of riparian bushland (although some certainly is). But livestock densities are certainly significantly higher than natural ungulate densities would have been and, given the aridity of the landscape, livestock are largely concentrated in the close vicinity of the Panj river or its tributary streams, being commonly seen out on islands in braided river sections. As a consequence, extensive areas of riverbank and terrace support closely cropped grazing meadows.

Currently in Wakhan it seems that riparian bushlands are used by local communities primarily for fuel-wood and fodder and, to a lesser extent, for construction timbers. As such, the presence of the bushlands is vital for the supply of these materials, and thus there appears to exist

a delicate balance in favour of maintaining some extent of bushlands, as alternative sources for fuel, fodder and construction timber supplies are otherwise limited. Although no socio-economic surveys have been undertaken to determine the extent of management, its social context and the ultimate uses of bushland, it is clear that some form of community management is taking place at least locally in some areas. In support of this, a significant proportion of the riparian bushlands in the Pak and Pukuj areas (spread out over glacial outwash fans) were certainly being deliberately fostered by local communities through a simply engineered system of irrigation.

In the Goz Khun area, the bushlands are largely natural in occurrence and occupy a broad braided stream plain at the confluence of the Wakhan and Pamir rivers. It was here, on both sides of the international border, that riparian bushlands were best developed and most extensive in the region surveyed, with an extent covering tens of hectares. But they are seemingly used in the same manner as other bushland areas by local communities and even here it was observed, on the basis of remnant stumps, that one fairly large area of several hectares had been cleared at some point in the past.

A further consideration in the balance of land use and resultant vegetation types is the extent to which human management favours the persistence of riparian bushland over 'climax' riparian woodlands and forest. There are currently none of the latter in Wakhan, with the possible exception of birch thickets outside of permanently inhabited areas, and any tree growth appears to be highly controlled by human intervention. However, in the absence of people it would be easy to envisage many riparian areas of bushland developing a woodland or forest character, other than those regularly scoured by floodwaters.

Despite the current ongoing conflict within Afghanistan, the local economy appears to be increasing, probably driven predominantly by external aid largely in the form of infrastructural development. These factors, together with an almost certainly increasing human population, seem very likely to increase pressure on bushlands as livestock herds increase in size and arable agricultural intensity increases to support a growing population and economy with easier access to distant markets. At the same time, alternative sources of construction materials, fodder and, particularly, fuel (energy) will likely become available, thus decreasing the reliance of local communities on the bushlands, which might then be vulnerable to clearance.

Although some bushland is always likely to survive in inaccessible areas, such as river islands, establishing long-term protection for significant tracts of riparian bushland in this part of Afghanistan is a matter of urgency. Conservation measures will have to consider the complex balance between different land uses and investigate in more detail than our discussion above how likely future development scenarios for the area will change these. It will be particularly important to consider how riparian bushlands can best be conserved in the face of agricultural and livestock intensification and changes in fuel-wood use. Conservation measures will probably have to include some proactive set-aside of areas of bushland protected from agricultural conversion, excessive grazing and wood removal, and perhaps also development of alternative fuel supplies. Agricultural intensification, which could theoretically help take pressure off bushlands, will probably occur without conservation intervention, but 'best-practice' and recognition of the significance of bushlands is unlikely to be fostered without concerted efforts. The Agha Khan Foundation for instance has apparently been successfully fostering the development of plantations within Wakhan, a policy that seems more likely than not to help maintain bushland area.

Any current conservation *in situ* initiatives in Afghanistan are doubly difficult due both to remoteness of sites and security issues. To reach Wakhan requires many days travel by car from Kabul, while part of the route between Feyzabad (itself a full day's drive from Wakhan), the provincial capital of Badakhshan, and Ishkoshim, the town at the head of the Wakhan valley, has often been deemed unsecure owing to tribal rivalries.

In order to understand more precisely the possible significance and conservation priority of riparian bushland habitat in north-eastern Afghanistan, a visual search of remote imagery covering north-eastern Afghanistan, eastern Tajikistan, northern Pakistan and adjacent areas of China, available on Google Earth, was undertaken by RJT in March 2010. Many of the images were dated 2005 or later and almost all were detailed enough to be reasonably certain of distinction of bushlands from farmland, grasslands and, in many cases, even plantations. This analysis suggested that large patches of riparian bushland as found around Goz Khun (Plate 11) are very rare within the landscape, with few if any other river valleys in the area searched appearing to have bushland as extensive as in the Wakhan valley. However, smaller patches within heterogeneous mosaics, usually dominated by agricultural land (as at Pak and Pukuj), are relatively frequent within broad mid-altitude valleys of at least the three western nations, although such valleys themselves are a relatively rare landscape feature.

Despite the general impoverishment of riparian bushlands along the Tajik bank of the Panj river, SO (September 2009) was able to determine, in addition to small patches, generally on islands, within the Wakhan valley, that patches of bushland also still occur further downstream on islands within wider stretches of this river, such as north of the city of Khorugh, and along the course of the Gunt river (a tributary of the Panj) between 2,600 and 3,300 m of altitude. This pattern was also apparent on the images reviewed on Google Earth.

The conservation outlook for the species will depend importantly on the broadness or otherwise of its altitudinal and habitat distribution across its potential Western Himalayan breeding range. It is thus a priority to determine not only its geographical breeding range, but also its ecological tolerances, in order to understand more fully the species's global conservation needs. Such work should be particularly focused in countries where land-use patterns are significantly different from Afghanistan, notably where economic development is more advanced, as evidence presented here suggests that conservation status may prove to be inversely related to economic development. The ongoing conflict within Afghanistan may at least in the short term allow somewhat easier proactive protection of bushlands because of subdued economic development, but there is a great need to try to locate breeding populations in nations with greater stability, where conservation interventions may stand a better chance of long-term success.

Currently the Large-billed Reed Warbler is listed as Data Deficient (DD) on the IUCN 2010.1 Red List.

Given all the uncertainties, including the possibility it has a relatively large global breeding range, we suggest that the species should remain listed as DD until more research has been conducted. However, based on the evidence presented in this paper, it seems reasonably probable, if the speculated habitat association is correct, that the species's 'area of occupancy' if taken to only include its total breeding habitat (arguably 'the smallest area essential at any stage to the survival of existing populations of' the species: IUCN 2001) might well be smaller than 2,000 km², even with a breeding range covering most of the western Himalayas. The species may thus potentially qualify for IUCN status Vulnerable, on the basis of criterion B2 (IUCN 2001). But at present there is no evidence to suggest severe fragmentation or fluctuation in its population, nor a very restricted breeding distribution, evidence of which would also be required for a 'VU B2' listing.

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Robert Timmins, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA; present address: 2313 Willard Avenue, Madison, WI 53704, USA. Email: rjtimmins@gmail.com
Stephane Ostrowski, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA.
Sayeed Naqeebullah Mostafawi, WCS Afghanistan Program, c/o 2300 Southern Boulevard, Bronx, NY 10460, USA
Ali Madad Rajabi, WCS Afghanistan Program, c/o 2300 Southern Boulevard, Bronx, NY 10460, USA
Hafizullah Noori, WCS Afghanistan Program, c/o 2300 Southern Boulevard, Bronx, NY 10460, USA
Lars Svensson, S:ta Toras väg 28, SE-260 93 Torekov, Sweden. Email: lars@lullula.se
Urban Olsson, Systematics and Biodiversity, Göteborg University, Dept. of Zoology, Box 463, SE-405 30 Göteborg, Sweden. Email: urban.olsson@zool.gu.se
Colin M. Poole, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA.