Species limits within *Rhopophilus pekinensis*

PAUL J. LEADER, GEOFF J. CAREY & PAUL I. HOLT

***Rhopophilus pekinensis* is a passerine endemic to north-east Asia occurring primarily in China; two or three subspecies are variously recognised. A review of museum material and fieldwork on the breeding grounds indicates that only two taxa (*R. p. pekinensis* and *R. p. albosuperciliaris*) are valid, and using criteria that grade morphological and vocal differences between allopatric taxa (Tobias *et al.* 2010), both achieve the threshold for species status. The English names Beijing Babbler and Tarim Babbler are proposed reflecting both the type location of each and the recently elucidated taxonomic affinities of *Rhopophilus*.**

INTRODUCTION

The White-browed Chinese Warbler *Rhopophilus pekinensis* is a passerine endemic to north-east Asia, occurring from north-west China to north-east China and North (and previously also South) Korea (Cheng 1987, Dickinson 2003, Duckworth & Moores 2008, Brazil 2009, Moores *et al*. 2009, BirdLife International 2013a). Whilst placed in the family Cisticolidae (Dickinson 2003), it was included in the Timaliidae, in a clade with *Sylvia* and *Paradoxornis*, by Alström *et al*. (2006), based on myoglobin and cytochrome *b* sequence data. In light of this, it was placed within the Timaliidae by Collar & Robson (2007) and Gill & Donsker (2012), using the English name Chinese Bush-dweller to reflect the fact that it was no longer considered a warbler. Subsequently Gelang *et al*. (2009) and Moyle *et al.* (2012) proposed treatment of the Sylviidae (which includes *Rhopophilus*) as a family rather than a subfamily within the Timaliidae.

Most authorities (Cheng 1987, Dickinson 2003, Zheng 2011, Gill & Donsker 2012) recognise three subspecies: *pekinensis* (eastern part of the range, type locality Beijing, China), *leptorhynchus* (central part of the range, type locality Gansu, China) and *albosuperciliaris* (western part of the range, type locality Xinjiang, China). The validity of *leptorhynchus* was questioned by Vaurie (1955), who suggested treatment as a synonym of *pekinensis*, and this is followed, albeit tentatively, by Collar & Robson (2007). Two further taxa, '*beicki*' (type locality north-west Nei Mongol, China) and '*major*' (type locality Qinghai, China) are not currently recognised and both have long been treated as synonyms of *albosuperciliaris* (Vaurie 1955, 1959).

In this paper the relationship between *pekinensis* and *albosuperciliaris* and the validity of *leptorhynchus* are reviewed based upon an examination of museum material and fieldwork conducted in China; the taxa '*beicki*' and '*major*' are also discussed.

METHODS

Museum specimens were examined at the Natural History Museum, Tring, UK (NHMUK) and the Museum für Naturkunde, Berlin, Germany (ZMB). The type specimens of *pekinensis*, *albosuperciliaris* (NHMUK), *leptorhynchus* and '*beicki*' (ZMB) were examined, as was material from the type locality of '*major*' (NHMUK). In total 55 specimens were examined comprising 29 *albosuperciliaris* (including one '*beicki*' and three '*major*'), 15 *pekinensis* and 11 *leptorhynchus*. The following biometrics were taken: wing (maximum chord), tail length (to base of tail measured under the undertail-coverts) and bill length (to skull); measurements taken accord with standard procedures (Redfern & Clark 2001). All measurements were taken by PJL. No plumage differences between males and females exist, but plumage differences attributable to age and especially feather wear were noted (juvenile birds were characterised by very fresh plumage and loose contour feathering).

During fieldwork on the breeding grounds, sound recordings were obtained from Beijing, Hebei, Qinghai and Xinjiang. Recordings were made using Telinga Pro 5 or Pro 7 parabolic microphones with either a Sound Devices 722 or an HHB Portadisc MDP 500, and a Sony PCM-M10 with a Sennheiser ME66. Spectrograms were produced and analysis of various parameters carried out using Raven Pro 1.4 (Cornell Laboratory of Ornithology 2003–11). Contrast was adjusted for each recording to ensure all elements (defined as any continuous line on a sonogram) were retained, while minimising reverberation. Measurements were made using a spectrogram window size of 512.

In all 122 strophes were analysed, comprising 67 from nine *pekinensis* and 55 from eight *albosuperciliaris*. Analysis of parameters of each strophe was based on those proposed by Tobias *et al*. (2010), and comprised:

- start and finish times (from which duration was calculated);
- lowest and highest frequency (from which frequency range was calculated);
- peak frequency (the frequency at which peak power occurs);
- pace (calculated by dividing strophe length by number of elements).

For each individual, we calculated the mean of each parameter; we then used the mean and standard deviation of all individuals of each taxon to calculate Cohen's *d* values (see below). Due to their regular occurrence in flocks, the exact number of different individuals recorded was not always certain, although the figures provided are considered conservative estimates.

In order to review species limits between taxa we applied the quantitative scoring system proposed by Tobias *et al.* (2010) to assess the degree of phenotypic difference between allopatric taxa. These criteria were summarised by Collar (2011a, b) thus: an exceptional difference (a radically different colouration or pattern) scores 4; a major character (a pronounced and striking difference in the colour or pattern of a body part, or in measurement or vocalisation) 3; a medium character (clear difference reflected, e.g. by a distinct hue rather than a different colour) 2; and a minor character (a weak difference, e.g. a change in shade) 1. Tobias *et al.* (2010) set a threshold score of 7 to allow for species status; species status cannot be triggered by minor characters alone, and only three plumage characters, two vocal characters (one spectral and one temporal), two independent biometric characters and one behavioural or ecological character may be counted. Vocal and biometric characters were assessed for effect size using Cohen's *d* computed via the online calculator at http://www.uccs.edu/~faculty/lbecker/, where 0.2–2 is minor, 2–5 medium, 5–10 major and >10 exceptional.

RESULTS

Morphological differences between taxa

As noted elsewhere (Vaurie 1959, Collar & Robson 2007), there are pronounced plumage differences between *pekinensis* and *albosuperciliaris*. In general, *albosuperciliaris* is much paler and more uniform than *pekinensis*; the key differences between the two are detailed in Table 1 and illustrated in Plates 1–4. During fieldwork it became apparent that there is a highly distinct difference in iris colour, with *albosuperciliaris* having a dark brown iris and *pekinensis* a glaring pale yellow iris.

Table 1. Plumage and bare part differences between adult *Rhopophilus pekinensis pekinensis* and *R. p. albosuperciliaris*.

	pekinensis	***albosuperciliaris***
Head pattern	Blackish lores, pale grey supercilium, grey-buff ear-coverts, bold blackish submoustachial stripe.	Greyish lores, off-white to buff supercilium, buff ear-coverts, blackish submoustachial and mid-brown post-ocular stripe.
Upperparts	Crown and upperparts grey-brown with broad darker brown streaks, streaks longer and broader on mantle. Nape and crown flecked rufous.	Crown and upperparts sandy-grey with narrow mid-brown streaks, streaks slightly longer and bolder on mantle. Nape uniform sandy-grey.
Underparts	Chin, throat and belly white, sides of breast and flanks boldly streaked rufous, lower flanks and undertail-coverts rich buff and contrasting strongly with upperparts.	Chin, throat and belly white or off-white, sides of breast diffusely streaked apricot-buff, lower flanks and undertail-coverts pale buff.
Tail	Central rectrices pale brown, outer rectrices dark brownish-grey and with pale greyish tips.	Central rectrices sandy-grey, outer rectrices mid brownish-grey and with whitish tips.
Iris	Glaring pale yellow, clearly paler than pupil.	Very dark brown, similar in colour to pupil.

Plate 1. Adult male *R. p. pekinensis,* Shanxi, China, April 2012.

PAUL J. LEADER

Plate 2. Adult male *R. p. albosuperciliaris,* Xinjiang, China, June 2012.

PAUL J. LEADER

Plate 3. Adult male *R. p. pekinensis,* Shanxi, China, April 2012.

PAUL J. LEADER

Plate 4. Adult male *R. p. albosuperciliaris,* Xinjiang, China, June 2012.

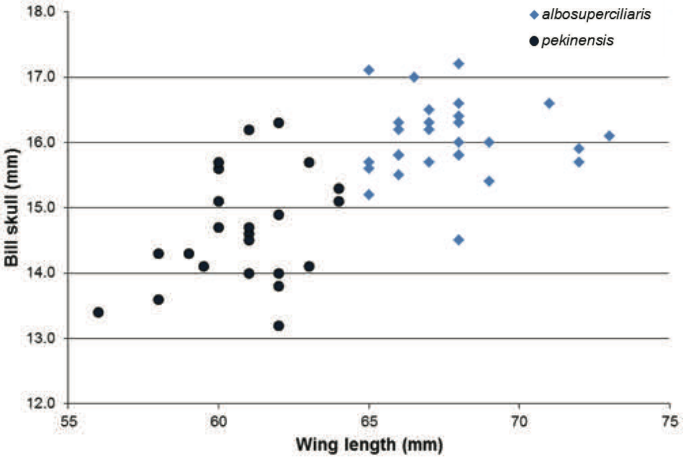
PAUL J. LEADER

Consistent structural differences also exist with *albosuperciliaris* being larger than *pekinensis* in terms of wing, tail and bill length (Table 2), such that when wing and bill lengths are plotted there is no overlap between the two (Figure 1).

Table 2. Average wing length, tail length and bill to skull (all measurements in mm) and standard deviation (SD) of *pekinensis* (*n* = 26) and *albosuperciliaris* (*n* = 29).

	pekinensis		*albosuperciliaris*	
	Mean	**SD**	**Mean**	**SD**
Wing	61.1	2.01	67.7	2.42
Tail	89.3	4.84	95.3	4.22
Bill (skull)	14.6	0.80	16.0	0.58

Figure 1. Bill to skull (mm) and wing length (mm) of *pekinensis* and *albosuperciliaris*.



The validity of *leptorhynchus* and comments on '*major*' and '*beicki*'

As noted above the treatment of *leptorhynchus* is inconsistent. Vaurie (1955) recognised *leptorhynchus* but noted that it was poorly differentiated from *pekinensis* and concluded that 'it is a matter of opinion whether or not it should be recognised in the nomenclature'. Specimens of *leptorhynchus* examined as part of this study were on average slightly smaller than *pekinensis* (0.8 mm shorter-winged, 0.9 mm shorter-tailed and 1.0 mm shorter-billed). There was, however, extensive overlap in biometrics (Figure 2). In addition there were no consistent plumage differences between the two, and plumage of the type specimen fell within the range of *pekinensis sensu stricto*. As such, we concur with Collar & Robson (2007) and consider *leptorhynchus* a synonym of *pekinensis*.

Vaurie (1955) concluded that '*major*' was comparable to *albosuperciliaris* and not larger and more densely streaked as noted by Meise (1937) and that birds from the type locality of '*major*' fell within the range of plumage variation and size of *albosuperciliaris* from Xinjiang. An examination of specimens from the Qaidam Basin, Qinghai (the type locality of '*major*'), and of birds in the field there provides nothing with which to contradict Vaurie's conclusion.

Meise (1937) described '*beicki*' from a single specimen collected in north-west Nei Mongol, China (note: Vaurie [1995] correctly mapped the type locality of '*beicki*', but incorrectly labelled the province as Ningxia), and considered it similar in colouration to '*major*' but smaller in size. Vaurie (1955) regarded any differences insufficient to establish the validity of '*beicki*' and questioned the wisdom of recognising it based on just a single specimen. Examination of the type specimen as part of this study established that in terms of plumage it falls within the range of variation of *albosuperciliaris*. Differences in biometrics are limited to wing length (62.0 mm), with values for tail (90.5 mm) and bill to skull (16.2 mm) falling within the range of *albosuperciliaris*. Examination of the type also suggested nothing unusual regarding the condition or preparation of the specimen which may have resulted in the smaller wing measurement and, whilst further material may prove otherwise, there appears no reason at this stage to recognise '*beicki*'.

Vocalisations

Both *pekinensis* and *albosuperciliaris* are garrulous and gregarious, and are most often found in small foraging flocks, the members of which frequently utter contact and other vocalisations. Both taxa have a wide repertoire of vocalisations, comprehensive comparative analysis of which would require a very large dataset of recordings.

Both taxa appear to have more than one territorial song, although we collected insufficient samples to clarify the situation. However, in the samples taken for this study, a single common vocalisation that appears to have the same territorial and/or advertising function was identified, and both taxa were seen perched prominently uttering it; based on this, we regard it as song. As a result, it has been possible to carry out the analysis described above. The relevant vocalisation is a short series of 2–5 very similar notes transcribed as *pyoo*, each descending in pitch; typical examples for each of the taxa are illustrated in Figures 3 and 4. The mean, standard deviation and Cohen's *d* values of the various

Figure 2. Tail length (mm) and wing length (mm) of *pekinensis* and *leptorhynchus*.

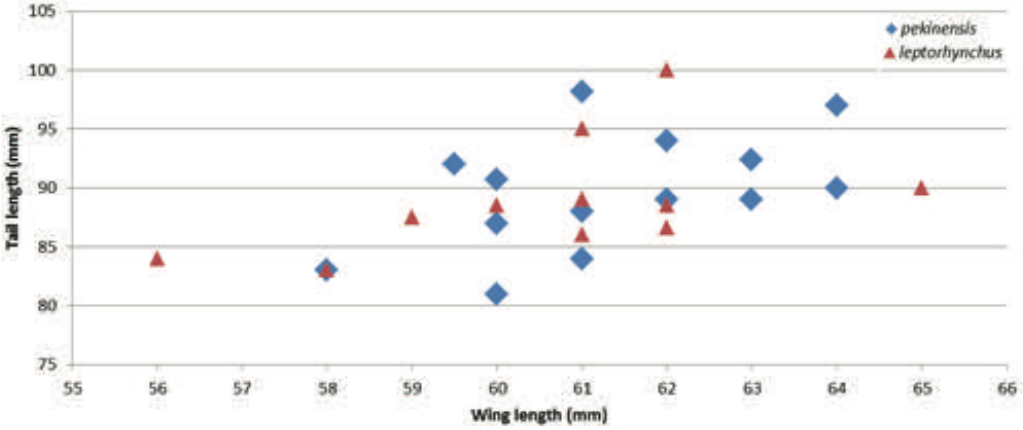


Figure 3. Typical *pyoo* vocalisation of *pekinensis*, Miyun Reservoir, Beijing, 4 November 2009. (Paul I. Holt)

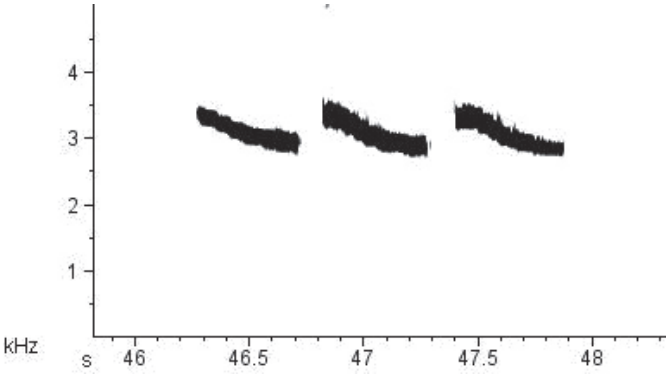
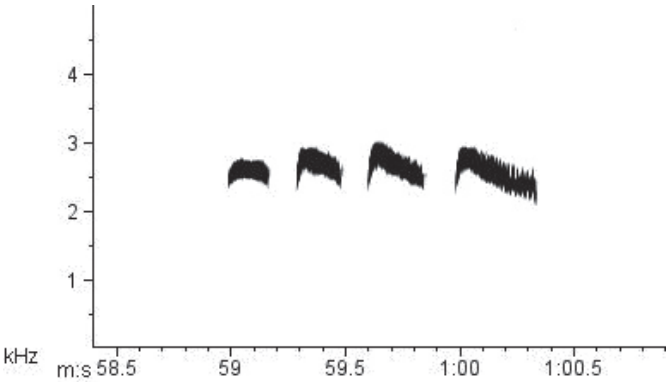


Figure 4. Typical *pyoo* vocalisation of *albosuperciliaris*, Aksu, Xinjiang, 10 August 2005. (Paul I. Holt)



measurements are presented in Table 3. Sample sizes of other vocalisations were insufficient to allow comparison in the absence of a thorough understanding of their function.

Table 3. Mean, standard deviation (SD) and Cohen's *d* values of parameters (see text) selected for analysis of *pekinensis* and *albosuperciliaris*.

	pekinensis		*albosuperciliaris*		Cohen's *d*
	Mean	**SD**	**Mean**	**SD**	
Low freq (Hz)	2093	145	2730	139	4.48
High freq (Hz)	2914	79	3630	202	4.67
Freq range (Hz)	821	108	900	172	0.55
Peak freq (Hz)	2670	108	3309	151	4.86
Duration (s)	1.34	0.17	1.32	0.32	0.08
No. of elements	3.51	0.83	2.96	0.52	0.79
Pace (elements/s)	0.39	0.06	0.44	0.05	0.91

From the summary statistics in Table 3, it can be seen that for low frequency, high frequency and peak frequency the mean values are higher in *albosuperciliaris* than *pekinensis*, with little overlap between the two taxa; these differences are clearly audible in recordings.

Habitat differences

A bird of dense secondary shrubland, *pekinensis* ranges from sea level (where generally rare) to at least 1,200 m and is found in degraded hill slopes, forest edge and forest clearings (Plate 5). Species regularly recorded in the same habitat include Vinous-throated Parrotbill *Paradoxornis webbianus*, Godlewski's Bunting *Emberiza godlewskii* and Meadow Bunting *E. cioides.* On the other hand, *albosuperciliaris* is a desert species occurring in areas of mature tamarisk and dense desert shrubland (Plate 6) particularly in areas where *Phragmites* are mixed with Chinese Date *Ziziphus jujuba* or 'Shazhao'—a central Asian xerophyte. It prefers low-lying, arid, sandy and often, but not always, well-drained areas and occurs from 780 to about 1,500 m in Xinjiang but up to 2,800 m in the Qaidam Basin, Qinghai. Lop Nur, Bayingol, is the lowest known site for this taxon but with the drying up of the lake and associated habitat changes there in recent years, it is quite possible that it is no longer present. It occurs alongside Eurasian Tree Sparrow *Passer montanus*, Saxaul Sparrow *P. ammodendri*, Desert Whitethroat *Sylvia minula,* with which it shares a very similar breeding distribution (Olsson *et al.* 2013), Isabelline Shrike *Lanius isabellinus* and even Biddulph's Ground Jay *Podoces biddulphi*.

PAUL J. LEADER

Plate 5. Typical habitat of *R. p. pekinensis,* Shanxi, China, April 2012.

PAUL J. LEADER

Plate 6. Typical habitat of *R. p. albosuperciliaris,* Xinjiang, China, June 2012.

DISCUSSION

Characters selected for comparison based on Tobias *et al.* (2010) were assessed (Table 4). Among biometric characters, only wing length was assessed because of the lack of clearly independent such characters (see Tobias *et al.* 2010). In terms of vocalisations, peak frequency and pace were selected; behavioural or ecological differences were represented by innate habitat. Geographical relationship (Tobias *et al.* 2010) is not applicable as the two taxa are allopatric, although Vaurie (1955) maps locations of both indicating that the two occur within approximately 300 km of each other. Overall, a score of 13 easily surpasses the threshold score of 7 for species status set by Tobias *et al.* (2010).

Of the features listed above, the differences in iris colour is considered major and therefore ranks highly. Iris colour varies with

Table 4. Characters selected for comparison of *pekinensis* and *albosuperciliaris* based on Tobias *et al.* (2010), with score (see text) in brackets.

	Character	Score
Plumage and bare parts		
Underparts	Medium	2
Upperparts	Medium	2
Iris colour	Major	3
Vocal		
Peak frequency (Cohen's *d*)	4.48	2
Pace (Cohen's *d*)	0.91	1
Biometric		
Wing length (Cohen's *d*)	3.0	2
Behavioural or ecological differences	Innate habitat	1
Total score		13

age in many passerine species, typically being duller in juveniles, so whilst it is possible that young *pekinensis* may show dull irides similar in colour to those of *albosuperciliaris*, the difference between *pekinensis* and *albosuperciliaris* appears to be consistent when breeding season adults are compared. The dark iris of *albosuperciliaris* was noted in the historical literature (Richmond 1896) but has been overlooked in recent times (Collar & Robson 2007).

A comparable situation in two taxa closely related to *Rhopophilus* exists in Vinous-throated Parrotbill and Ashy-throated Parrotbill *P. alphonsianus*, which have a dark brown and whitish iris respectively (Robson 2007). Whilst usually treated as separate species (Penhallurick & Robson 2009, Gill & Donsker 2012), recent genetic studies (e.g. Crottini *et al.* 2010) found these two taxa to be very closely related and suggested that *alphonsianus* may be a clinal morph of *P. webbianus*. In addition, in Silver-eared Mesia *Leiothrix argentauris,* the subspecies *laurinae* from Sumatra is unlike other subspecies in that it has pale irides, and the subspecies *orientalis* (from south Vietnam and east Cambodia) of Blue-winged Minla *Minla cyanouroptera* can also be distinguished from other subspecies by its pale irides. However, species limits within Silver-eared Mesia and the taxonomic status of *orientalis* require further evaluation (Collar & Robson 2007). Other examples in which iris colour varies between subspecies include Masked Booby *Sula dactylatra* (O'Brien & Davies 1990), whilst Kemp & Delport (2002) described a new subspecies of Red-billed Hornbill *Tockus erythrorhynchus* largely on the basis of iris colour and their proposal that the Red-billed Hornbill complex is better treated as five separate species (based on consistent differences in the colour of signal areas between geographically discrete populations) has been adopted elsewhere (Gill & Donsker 2012). In this study, it is noteworthy that even without the score for iris colour a score of 10 would still readily achieve the threshold for species status.

Based upon these results the following taxonomic treatment of two monotypic species is proposed:

Beijing Babbler *Rhopophilus pekinensis* (Swinhoe, 1868)

Tarim Babbler *Rhopophilus albosuperciliaris* (Hume, 1873)

The English names reflect the geographical origin of the type specimens and the use of 'Babbler' reflects recent taxonomic studies which place *Rhopophilus* within the Timaliidae. 'Bush-dweller' (Collar & Robson 2007) is not adopted as we feel that 'Babbler' is more accurate and that 'Bush-dweller' gives little or no insight into the taxonomic relationships of the two species. We acknowledge that some authorities treat the Sylviidae as a separate family rather

Figure 5. Map showing the approximate ranges of the two species *Rhopophilus albosuperciliaris* and *R. pekinensis* including the type localities.

than a subfamily within the Timaliidae (Gelang *et al*. 2009, Moyle *et al*. 2012), but refer to the use of the English name Sylviid Babblers for the Sylviidae (Gill & Donsker 2012) and note that the family includes a number of species which have 'Babbler' in their English name (e.g. African Hill Babbler *Pseudoalcippe abyssinica*).

The Beijing Babbler occurs from North Korea, north to southern Jilin and then west across north China to Gansu and eastern Qinghai. According to BirdLife International (2013a), the range continues south through northern Sichuan, western Henan and north-eastern Hubei as far as south-western Anhui; however, we are unaware of any records from Sichuan, Hubei or Anhui and these provinces are omitted by Zheng (2011), although it has been recorded from Henan since the 1930s (Fu 1937). The Tarim Babbler occurs in southern Xinjiang from the western part of the Tarim Basin (restricted to the rivers and oases around the margins of the Tarim Basin and avoiding the Taklamakan Desert proper) east to the Qaidam Basin, Qinghai. The ranges of the two species are shown in Figure 5.

Beijing Babbler is a fairly common and widespread species found in shrubland and although its range has contracted and it is no longer recorded in South Korea (Moores *et al*. 2009) and has declined in North Korea (Duckworth 2006), it is probably not globally threatened. Tarim Babbler, whilst sometimes locally common, is probably facing similar threats to Biddulph's Ground Jay and may be declining due to fragmentation and degradation of desert habitats caused by intensive grazing of livestock, extraction of fuelwood and conversion of suitable habitat to irrigated land (BirdLife International 2013b) and may qualify as Near Threatened.

ACKNOWLEDGEMENTS

We thank Lei Wei Dong, Gou Jun, Ma Ming and David Stanton for their help in the field in Xinjiang and Wang Qingyu for her help in Xinjiang and Beijing. Kadoorie Farm and Botanic Garden kindly funded the visit by PJL to the ZMB. Richard Lewthwaite assisted with distributional information and both Michael Leven and Per Alström provided useful comment on the English names of the two species. Hincent Ng prepared Figure 5 and Urban Olsson assisted with references. Mark Adams (NHMUK) and Sylke Frahnert (ZMB) kindly permitted access to specimens in their collections. Will Duckworth and Nial Moores commented on the status of *pekinensis* in Korea. Finally, Michael Leven and Nigel Collar provided very helpful comments on a draft of this paper.

REFERENCES

Alström, P., Ericson, P. G. P., Olsson, U. & Sundberg, P. (2006) Phylogeny and classification of the avian superfamily Sylvioidea. *Mol. Phylogenet. Evol*. 38: 381–397.

BirdLife International (2013a) Species factsheet: *Rhopophilus pekinensis*. Downloaded from http://www.birdlife.org on 22/01/2013.

BirdLife International (2013b) Species factsheet: *Podoces biddulphi*. Downloaded from http://www.birdlife.org on 22/01/2013.

Brazil, M. A. (2009) *Birds of East Asia*. London: Christopher Helm.

Cheng, T.-H. (1987) *A synopsis of the avifauna of China*. Beijing: Science Press.

Collar, N. J. (2011a) Species limits in some Philippine birds including the Greater Flameback *Chrysocolaptes lucidus*. *Forktail* 27: 29–38.

Collar, N. J. (2011b) Taxonomic notes on some Asian babblers (Timaliidae). *Forktail* 27: 100–102.

Collar, N. J. & Robson, C. (2007) Family Timaliidae (babblers). Pp.70–291 in J. del Hoyo, A. Elliott & D. A. Christie, eds. *Handbook of the birds of the world*, 12. Barcelona: Lynx Edicions.

Crottini, A., Galimberti, A., Boto, A., Serra, L., Liu, Y., Yeung, C., Yang, X. J., Barbuto, M. & Casiraghi, M. (2010) Towards a resolution of a taxonomic enigma: first genetic analyses of *Paradoxornis webbianus* and *Paradoxornis alphonsianus* (Aves: Paradoxornithidae) from China and Italy. *Mol. Phylogenet. Evol*. 57: 1312–1318.

Dickinson, E. C. ed. (2003) *The Howard and Moore complete checklist of the birds of the world* (third edition). London: Christopher Helm.

Duckworth, J. W. (2006) Records of some bird species hitherto rarely found in DPR Korea. *Bull. Brit. Orn. Club* 126: 252–290.

Duckworth, J. W. & Moores, N. (2008). A re-evaluation of the pre-1948 Korean breeding avifauna: correcting a 'founder-effect' in perceptions. *Forktail* 24: 25–47

Fu, T.-S. (1937) *L'étude des oiseaux du Ho-Nan* [*Birds of Henan*]. Langres: Imprimerie Moderne.

Gelang, M., Cibois, A., Pasquet, E., Olsson, U., Alström P. & Ericson, P. G. P. (2009) Phylogeny of babblers (Aves, Passeriformes): major lineages, family limits and classification. *Zool. Scr.* 35: 225–236.

Gill, F. & Donsker, D., eds. (2012) IOC World Bird Names (v 3.1). Available at http://www.worldbirdnames.org [Accessed on 29/01/2013].

Kemp, A. C. & Delport, W. (2002) Comments on the status of subspecies in the red-billed hornbill (*Tockus erythrorhynchus*) complex (Aves: Bucerotidae), with the description of a new taxon endemic to Tanzania. *Ann. Transvaal Museum* 39: 2–8.

Meise, W. (1937) in Stresemann, E., Meise, W. & Schönwetter, M. (1937) Aves Beickianae. *J. Ornithol.* 85: 375–576.

Moores, N., Park, J.-G. & Kim, A. (2009) *The Birds Korea checklist: 2009*. Available at http://www.birdskorea.org/Birds/Checklist/BK-CL-Checklist-Aug-2009.shtml [Accessed 28/04/2013].

Moyle, R. G., Andersen, M. J., Oliveros, C. H., Steinheimer, F. D. & Reddy, S. (2012) Phylogeny and biogeography of the core babblers (Aves: Timaliidae). *Syst. Biol.* 61: 631–651.

O'Brien, R. M. & Davies, J. (1990) A new subspecies of Masked Booby *Sula dactylatra* from Lord Howe, Norfolk and Kermadec Islands. *Mar. Ornithol.* 18: 2–7.

Olsson, U., Leader, P., Carey, G., Khan, A., Svensson, L. & Alström, P. (2013) New insights into the intricate taxonomy and phylogeny of the *Sylvia curruca* complex. *Mol. Phylogenet. Evol.* 67: 72–85.

Penhallurick, J. & Robson, C. (2009) The generic taxonomy of parrotbills (Aves, Timaliidae). *Forktail* 25: 137–141.

Redfern, C. P. F. & Clark, J. A. (2001) *Ringer's manual*. Thetford: British Trust for Ornithology.

Richmond, C. W. (1896) Catalogue of a collection of birds made by Doctor W. L. Abbott in eastern Turkestan, the Thian-Shan Mountains, and Tagdumbash Pamir, central Asia, with notes on some of the species. *Proc. U.S. Natn. Museum* 18: 569–591.

Robson, C. (2007) Family Paradoxornithidae (parrotbills). Pp.292–320 in J. del Hoyo, A. Elliott & D. A. Christie, eds. (2007) *Handbook of the birds of the world*, 12. Barcelona: Lynx Edicions.

Tobias, J. A., Seddon, N., Spottiswoode, C. N., Pilgrim, J. D., Fishpool, L. D. C. & Collar, N. J. (2010) Criteria for species delimitation based on phenotype. *Ibis* 152: 724–746.

Vaurie, C. (1955) Systematic notes on Palearctic birds, No. 18. Supplementary notes on Corvidae, Timaliinae, Alaudidae, Sylviinae, Hirundinidae and Turdinae. *Amer. Museum Novit.* 1753.

Vaurie, C. (1959) *The birds of the Palearctic fauna. Passeriformes.* London: H. F. & G. Witherby.

Zheng, G., ed. (2011) *A checklist on the classification and distribution of the birds of China*. Beijing: Science Press. (In Chinese.)

***Paul J. LEADER**, AEC Ltd., 127 Commercial Centre, Palm Springs, New Territories, Hong Kong. Email: pjl@aechk.hk*

***Geoff J. CAREY**, AEC Ltd., 127 Commercial Centre, Palm Springs, New Territories, Hong Kong. Email: gjc@aechk.hk*

***Paul I. HOLT**, Bracken Dean, Pendleton, Clitheroe, Lancashire, UK. Email: piholt@hotmail.com*