

A new species of *Phylloscopus* warbler from Sichuan Province, China

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A new species of leaf warbler (Sylviidae: *Phylloscopus*) is described from the mountain Emei Shan, Sichuan Province, China. Morphologically it is extremely similar to, yet significantly different from, the sympatric Blyth's Leaf Warbler *Phylloscopus reguloides* and White-tailed Leaf Warbler *Phylloscopus davisoni*. Songs and calls are both very different from *P. reguloides* and *P. davisoni*, and playback tests confirmed the specific status of the new species.

On 13 May 1987, a *Phylloscopus* warbler with unfamiliar song and call was observed by P.A. and U.O. near the Wannian temple on Emei Shan, Sichuan Province, China (29°31'N, 103°20'E) (Fig. 1). The call was heard many times and was tape-recorded by P.A., but the song activity was irregular and no tape recordings were obtained. Apart from the distinctive song and call, the bird appeared to be indistinguishable from Blyth's Leaf Warbler *Phylloscopus reguloides*, which was rather common in the area. Because of this, and because no further individuals with the same unknown song and call were heard on Emei Shan during the following week nor on visits in early to mid-May 1989 and late June 1990, we concluded that it was probably an aberrant *P. reguloides*. However, our interest in this bird was stirred when we learnt that A. Goodwin (*in litt.*) had heard birds with the same type of song in an area on Emei Shan which we had never visited. In late April 1992, we visited the area where Goodwin had heard the bird, and we found at least 20 singing males in a very limited area. It was confirmed that both song and call were very distinctive and different from the song and calls of *P. reguloides* as well as from the morphologically similar and sympatric White-tailed Leaf Warbler *Phylloscopus davisoni*. Slight, although significant, morphological differences between the unknown warbler and *P. reguloides* and *P. davisoni* were noted. Also, there was no response from the unidentified warbler to playback of song of *P. reguloides* and *P. davisoni* and *vice versa*. Three males were caught. They were examined, measured and photographed, and blood samples were taken. One of these birds was collected and preserved as a specimen. After examination by U.O. of all relevant types of *P. reguloides* and *P. davisoni* (cf. Appendix), the species which are morphologically most similar to the unidentified warbler, it was concluded that the latter belongs to an undescribed taxon. Its distinctness is further confirmed by its unique vocal repertoire. The mutual lack of response to playback of territorial song between the unnamed warbler and the sympatric *P. reguloides* and *P. davisoni* is a strong indication of reproductive isolation.

We propose the name

Phylloscopus emeiensis, sp. nov.

Emei Leaf Warbler

HOLOTYPE

Institute of Zoology, Academia Sinica, Beijing, China no. 60427, collected between Hongchun and Xianfeng temples on Emei Shan, Sichuan Province, China (29°31'N, 103°20'E), on 29 April 1992 at an altitude of c. 1400 m. Adult male, collected by Urban Olsson and Per Alström.

DIAGNOSIS

Very similar to *P. reguloides*, especially the subspecies *claudiae*. However, pattern of crown less distinct, with lateral crown-stripes dark greenish-grey instead of blackish posteriorly and median crown-stripe less pale and less contrasting at rear. Inner webs of outermost two pairs of rectrices show narrower whitish edges (≤ 0.5 mm on outermost and even narrower on penultimate), which are lacking or very indistinct at tip of outermost and completely or very nearly lacking on tip of penultimate. Also very similar to *P. davisoni*, but small amount of white on outermost two pairs of rectrices distinguishes from all subspecies except *P. d. ogilviegranti*. Differs from *P. d. ogilviegranti* by less distinct crown pattern (same difference as from *P. reguloides*, though slightly less clear because of on average paler lateral crown-stripes in *P. d. ogilviegranti* than in *P. reguloides*); less vivid green upperside; less yellow median crown-stripe, supercilium, throat, central belly and under tail-coverts, and usually also slightly narrower whitish margin to inner web of outermost rectrix.

DESCRIPTION OF HOLOTYPE

Lateral crown-stripes dark greyish-green anteriorly, gradually turning dark greenish-grey posteriorly, thus slightly darker posteriorly than anteriorly. Pale median crown-stripe



Plate 1. Emei Leaf Warbler *Phylloscopus emeiensis*, Emei Shan, Sichuan Province, China, 28 April 1992. Photograph by Urban Olsson.

very poorly defined anteriorly, at rear slightly but noticeably broader, paler and most distinct, slightly paler and more yellowish-tinged than mantle. Prominent pale yellowish-tinged supercilium from base of bill to beyond rear edge of ear-coverts, tapering in front of eye, not reaching nostril. Distinct dark grey-green eye-stripe from nostril to beyond

rear edge of ear-coverts. Rest of ear-coverts pale grey-green with indistinct pale yellowish mottling. Pale yellowish-tinged crescent below eye (broken eye-ring). Nape (including sides of neck) dull green.

Mantle, scapulars and back dull green, rump and upper tail-coverts marginally paler and more vivid green. Lesser coverts green, like rump, with marginally darker centres. Median coverts greenish-sepia, with pale greenish-yellowish, nearly 2-mm-wide tips to *c.* five feathers, forming rather distinct wing-bar. Greater coverts sepia on inner webs and greenish-sepia with narrow green edges on outer webs; distinct, *c.* 2.5-mm-wide, pale yellowish tips on numbers 1–6, indistinct pale tip to number 7 (numbered in ascending order), forming rather broad, distinct wing-bar. Alula sepia, largest feather with diffuse greenish-tinged outer edge, central feather with green outer web, indistinctly encircling tip of inner web; smallest feather with green outer web and tip to inner web. Carpal covert greenish-sepia with green outer edge and tip. Primary coverts sepia with narrow, diffuse green edges. Primaries sepia, P10 (numbered in descending order) with very narrow, indistinct paler outer edge, P9 with whitish outer web (narrow), P8-1 with narrow, distinct yellowish-green outer edges (to emarginations on the emarginated feathers). Secondaries sepia with diffuse yellowish-green



Figure 1. Map of China with Emei Shan, Sichuan Province, marked.



Plate 2. Emei Leaf Warbler *Phylloscopus emeiensis*, holotype (right), with Blyth's Leaf Warbler *Phylloscopus reguloides claudiae*, Emei Shan, Sichuan Province, China, 29 April 1992. Note paler rear lateral crown-stripes and less distinct pale median crown-stripe in *P. emeiensis*. Photograph by Urban Olsson.

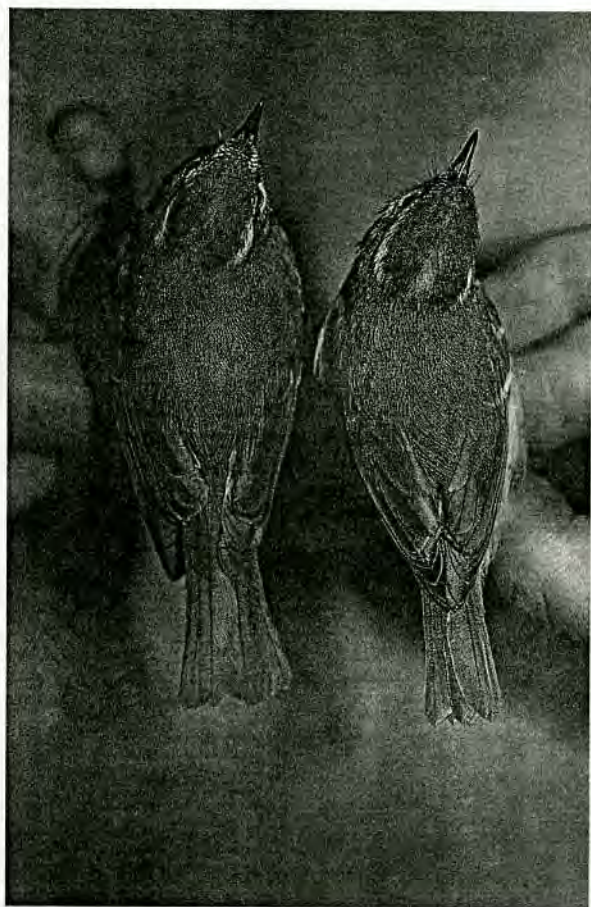


Plate 3. Emei Leaf Warbler *Phylloscopus emeiensis* (left) with White-tailed Leaf Warbler *Phylloscopus davisoni disturbans*, Emei Shan, Sichuan Province, China, 29 April 1992. Note less distinct pale median crown-stripe in *P. emeiensis*. Photograph by Urban Olsson.

outer edges. Tertiaries greenish-sepia with diffuse green outer edges. Inner webs of remiges with narrow greyish-white edges (to notches on notched feathers). Underwing-coverts pale yellow near edge of wing, whiter centrally. Central tail feathers greenish-sepia, paler green along edges, especially basally. Rest of tail feathers sepia on inner webs, more greenish-sepia on outer webs, outermost showing very narrow (<0.5 mm) whitish edge on inner web, very indistinctly paler on tip; penultimate showing even less distinct pale edge on inner web.

Underside whitish, indistinctly streaked with pale yellowish; flanks tinged with pale greyish-green; under tail-coverts pale yellow.

Upper mandible blackish, distinctly hooked at tip, lower mandible pale orange. Tarsus, toes and claws pinkish-grey, tarsus slightly paler than toes and claws, soles more yellowish. (Colour of bare parts noted while alive.)

Measurements (in millimetres, measured while alive): wing (maximum length; Svensson 1992) 58.5, tail 42.0, bill length

(to skull) 12.3, bill width (at distal edge of nostril) 2.9, tarsus 18.1, hind claw 4.8, longest rictal bristle 6.5/7.0.

Wing formula (primaries numbered in descending order, measured while bird was alive): wing point P7 = P6, P5 -1.0, P4 -4.0, P3 -6.5, P2 -8.0, P1 -9.0, P8 -2.0, P9 -11.0, P10 -31.0, P10 6 > primary coverts. Emarginations on outer webs of P8-P5, very faintly on P4. Notches on inner webs of P9-P5.

INDIVIDUAL VARIATION

Among the three males caught in late April 1992 and two males caught by P.A. in late May 1994, there is insignificant variation in plumage and bare parts and only slight variation in measurements and wing formula. Measurements and wing formula of four individuals are given below (cf. with type, above); wing maximum length (Svensson 1992), bill length to skull and bill width at distal edge of nostril.

Table 1. Wing-length (mm) of males of *Phylloscopus emeiensis* and all subspecies of *P. reguloides* and *P. davisoni*. Measurements by the authors from the Natural History Museum, Tring, U.K.; American Museum of Natural History, New York, U.S.A., and live birds. The sympatric *P. emeiensis*, *P. r. claudiae* and *P. d. disturbans* are shown in bold

	Range	Mean	s.d.	n
<i>P. emeiensis</i>	57.5–59.5	58.5	±0.7	5
<i>P. r. kashmiriensis</i>	58.0–60.0	59.2	±1.0	4
<i>P. r. reguloides</i>	58.0–64.5	60.5	±2.4	8
<i>P. r. assamensis</i>	54.0–63.0	58.5	±2.5	26
<i>P. r. claudiae</i>	58.5–65.5	62.8	±2.2	8
<i>P. r. fokiensis</i>	58.5–64.5	61.0	±1.5	14
<i>P. r. goodsoni</i> ¹	54.5–61.0	58.0	±3.3	3
<i>P. r. ticehursti</i>	57.5–61.5	60.2	±1.5	6
<i>P. d. davisoni</i>	51.0–57.0	54.5	±2.0	11
<i>P. d. disturbans</i>	55.5–58.0	56.2	±0.9	6
<i>P. d. ogilviegranti</i>	53.5–56.0	54.6	±1.1	5
<i>P. d. klossi</i>	51.0–57.5	54.6	±1.7	10

¹ Usually treated as a subspecies of *P. ricketti*, but cf. Alström *et al.* (1995).

Male, Emei Shan, 28 April 1992: Wing 59.5, tail 41.5, bill length 12.7, bill width 3.0, tarsus 18.1, hind claw 4.6, longest rectal bristle 7.0/7.5. Wing point P7 = P6, P5 ≤ 1.0, P4 – 3.5, P3 – 5.5, P2 – 7.5, P1 – 9.0, P8 ≤ 1.0, P9 – 9.0, P10 – 29.0, P10 9 > primary coverts. Primary projection beyond tertials 11.0. Emarginations on outer webs of P8–P5, very faintly on P4. Notches on inner webs of P9–P6, possibly also on P5.

Male, Emei Shan, 29 April 1992: Wing 58.5, tail 42.0, bill length 12.6, bill width 3.1, tarsus 18.2, hind claw 4.7. Wing point P7 = P6, P5 – ≤ 1.0, P4 – 3.0, P3 – 5.5, P8 – ≤ 1.0, P9 – 9.0, P10 – 29.0, P10 8 > primary coverts.

Male, Emei Shan, 27 May 1994: Wing 58.5, tail 44.0, bill length 12.9, bill width 3.0, tarsus 18.1, hind claw 4.3. Wing point P7, P6 – < 0.5, P5 – 1.5, P4 – 4.5, P3 – 7.5, P8 – < 0.5, P9 – 7.5, P10 8.5 > primary coverts. Emarginations on outer webs of P8–P5.

Male, Emei Shan, 30 May 1994: Wing 57.5, tail 43.0, bill length 12.5, bill width 2.9, tarsus 18.3, hind claw 4.5. Wing point P7, P6 – c. 0.5, P5 – c. 1, P4 – c. 3, P3 – c. 5.5, P8 – < 0.5, P9 – 8.0, P10 9 > primary coverts (primaries rather heavily worn). Emarginations on outer webs of P8–P4, rather distinct on P4.

MORPHOLOGICAL CHARACTERISTICS

Phylloscopus emeiensis is extremely similar to *P. reguloides*, especially the sympatric *P. r. claudiae*. Although the sample of *P. emeiensis* is very limited, *P. emeiensis* appears to be slightly smaller than all subspecies of *P. reguloides* except *P. r. assamensis* and possibly also *P. r. goodsoni* (usually treated

as a subspecies of *Phylloscopus ricketti*, but cf. Alström *et al.* [1995]); it is significantly smaller than *P. r. claudiae* (Table 1). The pattern of the crown is less distinct in *P. emeiensis* than in all subspecies of *P. reguloides*: the dark lateral crown-stripes are paler in *P. emeiensis* than in *P. reguloides*, especially at rear, where they are dark greenish-grey in *P. emeiensis* and blackish in *P. reguloides*, and the pale median crown-stripe is less pale at rear and consequently less distinct in *P. emeiensis* than in *P. reguloides*. Also, the dark eye-stripe is marginally paler on average in *P. emeiensis* than in *P. reguloides*, and the rest of the ear-coverts are marginally darker on average in *P. emeiensis* than in *P. reguloides*. The outermost tail feather shows a narrower, less clearcut and less distinct whitish edge to the inner web in *P. emeiensis* than in *P. reguloides* (≤ 0.5 mm in *P. emeiensis* [*n* = 5]; 0.5–1.5 mm, mean 0.98 mm, in *P. r. fokiensis* [*n* = 24], the subspecies of *P. reguloides* with the smallest amount of white; 0.5–2 mm, mean 1.0 mm, in *P. r. claudiae* [*n* = 13]). Also, the penultimate tail feather shows a narrower, less clearcut and less distinct whitish margin to the inner web in *P. emeiensis* than in *P. reguloides* (barely visible [*n* = 3] or < 0.5 mm [*n* = 2] in *P. emeiensis*; ≤ 0.5–1.0 mm, mean 0.60 mm, in *P. r. fokiensis* [*n* = 21], the subspecies of *P. reguloides* with the smallest amount of white; ≤ 0.5–1.0 mm, mean 0.75 mm, in *P. r. claudiae* [*n* = 6]). Moreover, unlike in all subspecies of *P. reguloides*, in *P. emeiensis* the whitish margin to the inner web of the outermost rectrix is lacking or very poorly defined at the tip, and the whitish margin to the inner web of the penultimate tail feather is lacking altogether or very nearly so at the tip (tail pattern shown in Fig. 2). The wing formula of *P. emeiensis* is very similar to some allopatric subspecies of *P. reguloides* (Table 2). However, the wing is slightly more rounded on average in *P. emeiensis* than in the sympatric *P. r. claudiae*, as P9 and P8 average shorter in the former than in the latter (Table 2). Also, two of the *P. emeiensis* examined in the hand showed a very faint emargination on P4, and one showed a rather distinct emargination of P4 (no emargination on P4 in one individual; not checked on one individual); *P. reguloides* usually does not show any emargination of P4, but rarely a very faint emargination is present in *P. r. assamensis*, *P. r. fokiensis* and *P. r. ticehursti*.

Phylloscopus emeiensis is also very similar to *P. davisoni*, especially the allopatric *P. d. ogilviegranti*. It appears to be slightly larger than *P. davisoni* (Table 1). The pattern of the crown is less distinct in *P. emeiensis* than in *P. davisoni* (though the difference is less clear than between *P. emeiensis* and *P. reguloides*). The dark lateral crown-stripes are slightly paler on average at rear in *P. emeiensis* than in *P. davisoni*. The pale median crown-stripe is less pale and consequently less distinct in *P. emeiensis* than in *P. davisoni* and less yellow than in all subspecies of *P. davisoni* (though only marginally less yellow than in *P. d. davisoni*). The supercilium and the underside (especially throat, central belly and under tail-coverts) are less yellow in *P. emeiensis* than in all subspecies of *P. davisoni* (difference least pronounced in comparison with *P. d. davisoni*). The mantle and scapulars are marginally less vivid green in *P. emeiensis* than in all subspecies of *P.*

davisoni (though difference from *P. d. davisoni* very slight). The pale bar on the median coverts is paler and more distinct on average in *P. emeiensis* than in *P. davisoni*. The most obvious difference between *P. emeiensis* and *P. davisoni* is the pattern of the outermost tail feather, as all subspecies of *P. davisoni* except *P. d. ogilviegranti* show considerably more white on the inner web (Fig. 2, *P. d. disturbans* illustrated; *P. d. klossi* shows similar pattern, while *P. d. davisoni* shows even more white). In *P. d. ogilviegranti* the pattern of the outermost tail feather is very similar to that of *P. emeiensis*, but the whitish border is slightly wider on average than in *P. emeiensis* (0.5–1.3 mm, mean 0.8 mm, $n = 6$), sometimes widening towards the tip (3.8 mm in one) and rarely showing very faint paler mottling on centre of inner web. On the penultimate tail feather, *P. emeiensis* shows a narrower whitish margin to the inner web than does *P. davisoni* (up to 1.5 mm but can be <0.5 mm in *P. d. disturbans* and *P. d. klossi*; usually considerably more in *P. d. davisoni*). The wing formula is not very different in *P. emeiensis* and *P. davisoni*,

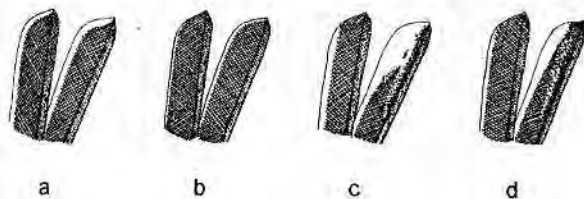


Figure 2. Outermost two tail feathers (left side of tail) of (a) *Phylloscopus reguloides claudiae*; (b) *Phylloscopus emeiensis*; (c) *Phylloscopus davisoni disturbans*; (d) *Phylloscopus davisoni disturbans* (variation). Drawing by Per Alström.

although P9 is on average slightly shorter in *P. emeiensis* than in *P. d. disturbans* (Table 2).

Phylloscopus emeiensis also resembles the allopatric Western Crowned Warbler *Phylloscopus occipitalis* (western Himalayas), Eastern Crowned Warbler *Phylloscopus coronatus* (southeast Russia, northeast China, Japan and Korea; pos-

Table 2. Wing formula of *Phylloscopus emeiensis* and all subspecies of *Phylloscopus reguloides* and *Phylloscopus davisoni*. Measurements by the authors from the Natural History Museum, Tring, U.K.; American Museum of Natural History, New York, U.S.A., and live birds. SS = secondaries. The sympatric *P. emeiensis*, *P. r. claudiae* and *P. d. disturbans* are shown in bold

	Primaries														1/SS	≤SS
	≈7	7/6	≈6	6/5	≈5	5/4	≈4	4/3	≈3	3/2	≈2	2/1	≈1			
P9																
<i>P. r. claudiae</i> (n = 22)								9	4	4	2	3				
<i>P. emeiensis</i> (n = 5)									1		1	1	1	1		
<i>P. d. disturbans</i> (n = 6)										3	1	1	1			
<i>P. r. kashmiriensis</i> (n = 6)									1	3	1			1		
<i>P. r. reguloides</i> (n = 15)								1		8		4	2			
<i>P. r. assamensis</i> (n = 54)								1	4	9	4	14	7	2		
<i>P. r. fokiensis</i> (n = 24)							1	7	5	5	1	5		13		
<i>P. r. goodsoni</i> ¹ (n = 3)								1				1				
<i>P. r. ticehursti</i> (n = 7)												2	1	1		
<i>P. d. davisoni</i> (n = 28)										2		5		3		
<i>P. d. ogilviegranti</i> (n = 8)												4	3	1		
<i>P. d. klossi</i> (n = 24)												5	1	1		
P8																
<i>P. r. claudiae</i> (n = 9)		1	2	6	2	2										
<i>P. emeiensis</i> (n = 5)			2		2	1										
<i>P. d. disturbans</i> (n = 5)				1	3	1										
<i>P. r. kashmiriensis</i> (n = 6)				5	1											
<i>P. r. reguloides</i> (n = 13)	1	1	1	5	2	3										
<i>P. r. assamensis</i> (n = 30)			1	9	5	15										
<i>P. r. fokiensis</i> (n = 20)				18	1	1										
<i>P. r. goodsoni</i> ¹ (n = 3)				2	1											
<i>P. r. ticehursti</i> (n = 6)						6										
<i>P. d. davisoni</i> (n = 14)				2	3	7		2								
<i>P. d. ogilviegranti</i> (n = 8)					2	6										
<i>P. d. klossi</i> (n = 21)					4	13	4									

¹ Usually treated as a subspecies of *P. ricketti*, but cf. Alström *et al.* (1995).

² According to our notes P8 is sometimes ≈P5 and rarely P5/P4.

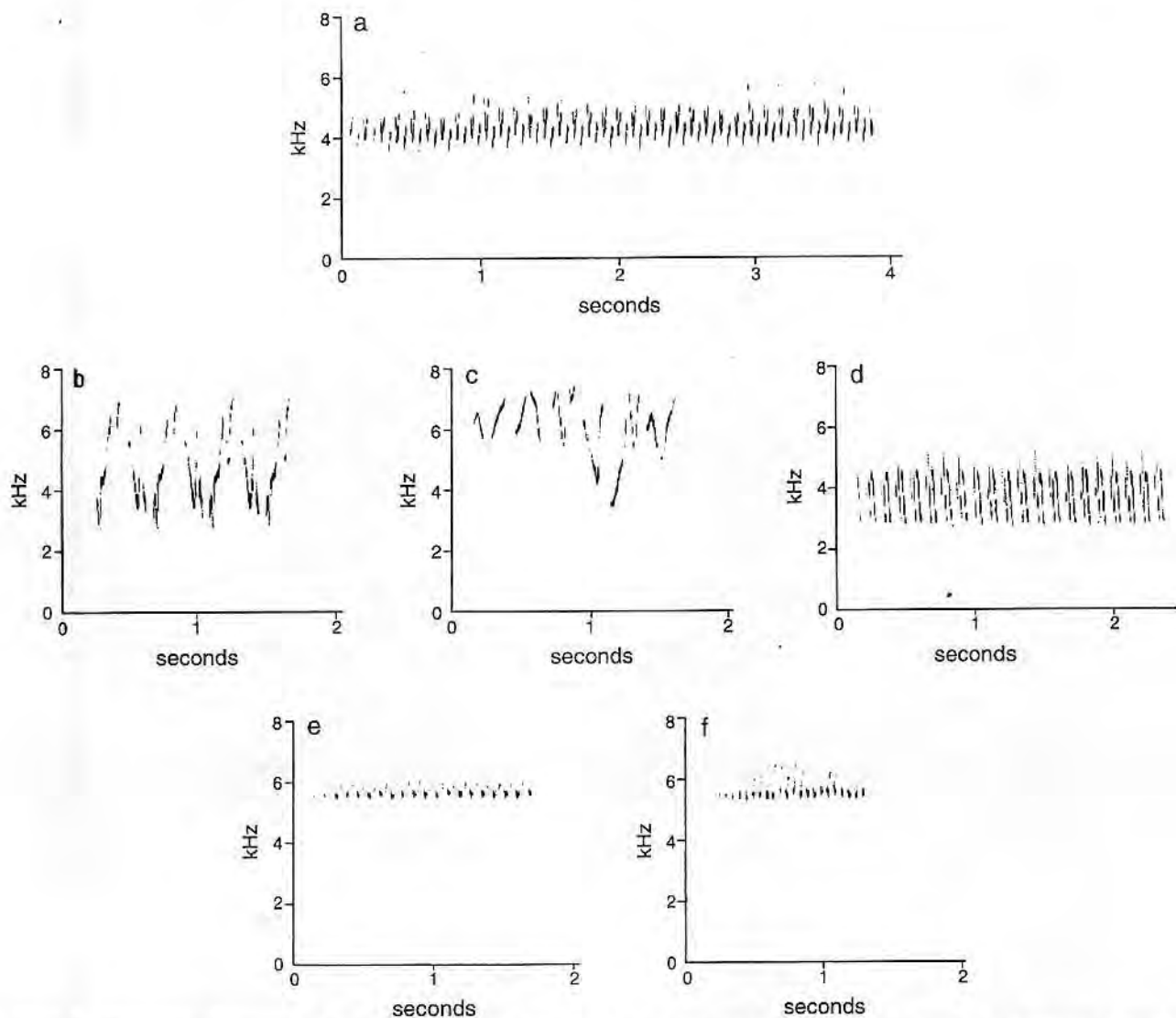


Figure 3. Sonograms of song of (a) *Phylloscopus emeiensis*, Emei Shan, Sichuan Province, China, late April 1992; (b) *Phylloscopus reguloides claudiae* (segment), Emei Shan, Sichuan Province, China, late April 1992; (c) *Phylloscopus davisoni disturbans* (segment), Emei Shan, Sichuan Province, China, late April 1992; (d) *Phylloscopus borealis borealis*, Huzong, Heilongjiang Province, China, late June 1988; (e, f) *Phylloscopus tenellipes* (*sensu* Martens 1988), Dailing, Heilongjiang Province, China, mid-June 1987. All tape-recorded by Per Alström. Sonograms produced by Paul Duck, National Sound Archive. Band width 300 Hz.

sibly breeds in Sichuan Province, China) and Ijima's Warbler *Phylloscopus ijimae* (Izu Islands, Japan). However, *P. emeiensis* is more different from these than from *P. reguloides*.

VOCALIZATIONS

The song of *P. emeiensis* is a clear, slightly quivering, straight trill between *c.* 4 and 6 kHz, usually lasting 3–4 seconds (Fig. 3). Of the Eurasian *Phylloscopus* warblers, it is most similar to, yet significantly different from, the song of the nominate subspecies of Arctic Warbler *Phylloscopus borealis*

(Fig. 3). It also recalls Bonelli's Warbler *Phylloscopus bonelli*, Pale-legged Leaf-warbler *Phylloscopus tenellipes* (*sensu* Martens 1988; Fig. 3) and Wood Warbler *Phylloscopus sibilatrix*. It is very different from the somewhat *Parus*-like songs of *P. reguloides* and *P. davisoni* (Fig. 3; cf. also Martens 1980; the songs are basically similar throughout each species' range, with only slight variation between the different subspecies of *P. reguloides* and slightly more pronounced variation in *P. davisoni*). Williamson (1967) erroneously described the song of *P. r. claudiae* as "a warbling trill reminiscent of Wood Warbler" without giving any reference (this it not mentioned in the description of *P. r. claudiae* by La Touche 1922); this

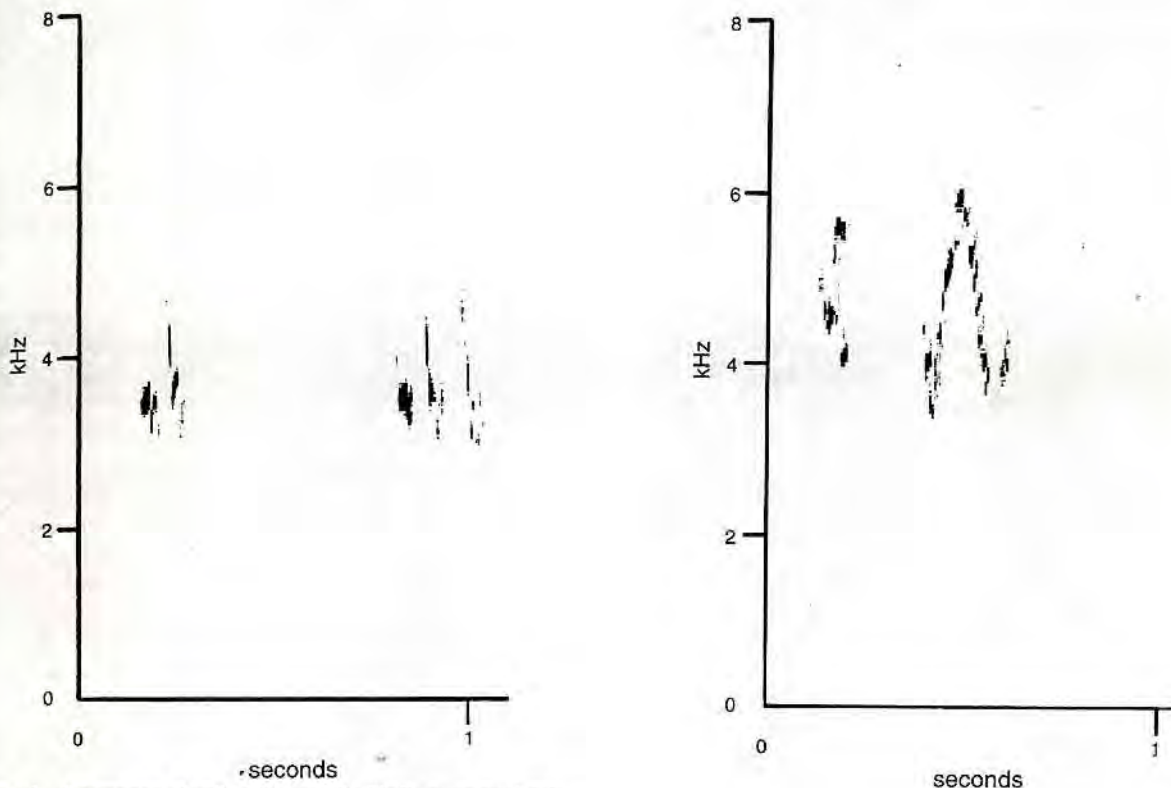


Figure 4. Sonograms of call of (above left) *Phylloscopus emeiensis*, Emei Shan, Sichuan Province, China, mid-May 1987; (above right) *Phylloscopus reguloides claudiae*, Emei Shan, Sichuan Province, China, late April 1992; (below right) *Phylloscopus davisoni disturbans*, Emei Shan, late April 1992. All tape-recorded by Per Alström. Sonograms produced by Paul Duck, National Sound Archive. Band width 300 Hz.

is obviously the song of *P. emeiensis*. The song of *P. emeiensis* is very different from the songs of *P. occipitalis*, *P. coronatus* and *P. ijimae* (see Martens 1980 for detailed descriptions and sonagrams of these).

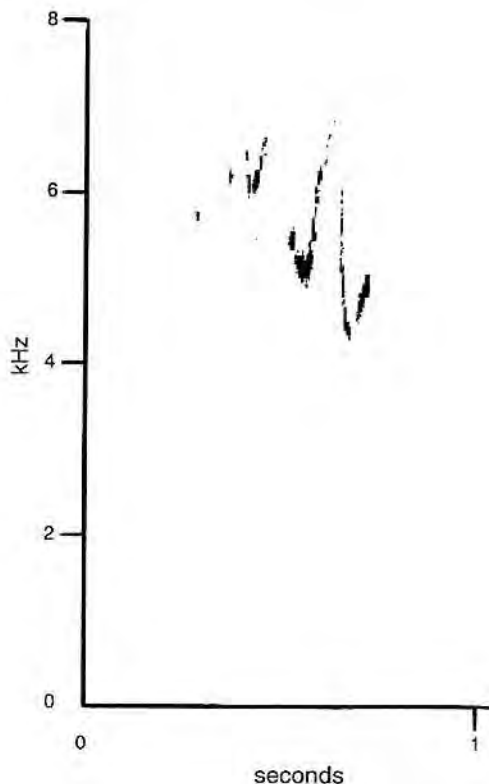
The call of *P. emeiensis* is a soft *tu-du-du; tu-du;* or *tu-du-du-du*, somewhat resembling one of the calls of Greenfinch *Carduelis chloris* (Fig. 4). It is clearly different from the calls of *P. reguloides* and *P. davisoni* (Fig. 4), as well as from other Eurasian *Phylloscopus* warblers.

Tape recordings of song and call have been deposited with the Wildlife Section at the National Sound Archive, London, and the Institute of Zoology, Academia Sinica, Beijing.

INTERSPECIFIC RELATIONS

We conducted a few playback tests at Emei Shan in 1992 and 1994.

(1) A territorial, singing male *P. emeiensis* was exposed to 2 min song of *P. emeiensis*, to which it immediately reacted with strong aggressive behaviour (vigorously searching for the source of the song, flitting its wings and singing). A



nearby singing male *P. r. claudiae* did not respond at all. Immediately after that, the same *P. emeiensis* was exposed to 2 min of playback of song of *P. r. claudiae*, to which there was no response whatsoever by the *P. emeiensis*, while the nearby male *P. reguloides* responded aggressively towards the recording. On one occasion, *P. emeiensis* and *P. reguloides* were singing in the same tree without taking any notice of each other; on another occasion, the two birds were less than 10 m apart without showing any aggression towards each other.

(2) A territorial, singing male *P. emeiensis* was exposed to song of *P. emeiensis* (2 min), *P. r. claudiae* (2 min), *P. emeiensis* (1 min), *P. d. disturbans* (2 min), *P. emeiensis* (2 min), *P. coronatus* (2 min) and *P. emeiensis* (1 min). There was no response at all to the songs of *P. reguloides*, *P. davisoni* or *P. coronatus* but an immediate, strong aggressive response towards the song of *P. emeiensis*. Later, a *P. reguloides* was attracted to the same spot when song of *P. reguloides* was played.

(3) A territorial, singing male *P. r. claudiae* was exposed to song of *P. r. claudiae* while a male *P. emeiensis* was singing nearby. The male *P. reguloides* responded aggressively towards the recording, but there was no response by the male *P. emeiensis*. After this, song of *P. emeiensis* was played. This time the male *P. reguloides* ignored the playback, whereas *P. emeiensis* responded with strong aggressive behaviour.

(4) A territorial, singing male *P. d. disturbans* was exposed to its own song while a territorial male *P. emeiensis* was singing nearby. The male *P. davisoni* responded vigorously towards the playback, but there was no response from the male *P. emeiensis*. When song of *P. emeiensis* was played shortly afterwards, there was no response by *P. davisoni* but a strong response by *P. emeiensis*.

(5) A territorial, singing male *P. emeiensis* was exposed to 2-min sequences of song of, in order, *P. r. assamensis* (tape recorded by P.A. at Tomi, southeast Tibet, April 1987), *P. r. assamensis* (tape-recorded by P.A. at Kunming, Yunnan Province, China, May 1990), *P. d. davisoni* (tape-recorded by P.A. on Doi Suthep-Pui, northwest Thailand, March 1992), *P. d. klossi* (tape-recorded by P.A. at Lang Bian, Dalat, Vietnam February 1992) and *P. emeiensis* (the same individual). There was no response whatsoever towards the songs of *P. reguloides* of *P. davisoni* but an immediate, strong, aggressive response towards its own song. This sequence was repeated twice with the same results.

These playback tests show that *P. emeiensis* and *P. r. claudiae* and *P. emeiensis* and *P. d. disturbans*, respectively, do not consider each other as competitors and that *P. emeiensis* and *P. r. claudiae* and *P. emeiensis* and *P. d. disturbans*, respectively, may even have overlapping territories.

BEHAVIOUR

When agitated by playback of its own species' song inside its territory, *P. emeiensis* very quickly flicks both its wings, similar to *P. davisoni* (and several other *Phylloscopus* species)

but unlike *P. reguloides*, which relatively slowly flicks one wing at a time in a manner somewhat reminiscent of male Pied Flycatcher *Ficedula hypoleuca* (this has been observed by us in *P. r. assamensis*, *P. r. claudiae*, *P. r. fokienensis* and *P. r. ticehursti*, but not in *P. r. reguloides*; the subspecies *P. r. kashmiriensis* and *P. r. goodsoni* have not been studied by us in the breeding season; cf. Alström & Olsson 1993).

Phylloscopus emeiensis was never observed feeding in the typical *P. reguloides* manner (the latter often looks on the undersides of branches, frequently hanging almost vertically head-down).

DISTRIBUTION AND STATUS

Phylloscopus emeiensis has been found only on Emei Shan, Sichuan Province, China (Fig. 1). Even on Emei Shan it appeared to be restricted to a relatively small area: we have recorded it twice near the Wannian temple at an altitude of c. 1000 m (one singing on 13 May 1987 and one singing on 1 June 1994). Between the Hongchun and Xianfeng temples, at an altitude of c. 1200–1700 m, at least 20 singing males were noted by us in late April 1992 and at least 12 in late May 1994. In the same area, L. Imby and S. Karlsson (pers. comm.) heard five singing males on 4 May 1993 and E. Hansson, A. Magnusson and P. Eriksson (pers. comm.) noted four singing males on 6 June 1993. In late May 1994, P.A. also heard four singing males between the Xianfeng and Huayan temples (the latter at c. 1900 m).

Habitat similar to that on Emei Shan exists in the southern part of Sichuan Province and adjacent Yunnan Province, and it is possible that *P. emeiensis* occurs there.

It is not known where *P. emeiensis* winters. The rounded wing suggests that it is only a short distance migrant, and it may even winter at low altitude on Emei Shan.

HABITAT

Phylloscopus emeiensis has been found only in subtropical deciduous broad-leaved forest with dense undergrowth. Two individuals were also observed in places where there was also some spruce *Picea/Abies*.

BREEDING

The breeding season presumably begins in mid- to late April, as males were singing very actively in late April. In late May, song activity was low, and two of the singing males exposed to playback of *P. emeiensis* responded only slightly towards the playback, indicating that breeding was well under way. However, we have no direct evidence of breeding.

DISCUSSION

Phylloscopus emeiensis is morphologically most similar to *P. reguloides* and *P. davisoni*. Although in size and wing formula it is similar to some allopatric subspecies of *P. reguloides*, it

still differs significantly from these in some other respects. The tail pattern of *P. emeiensis* is most similar to that of the allopatric *P. d. ogilviegranti* and the crown pattern also is rather similar in these two taxa. However, they differ in several other respects. Vocally, *P. emeiensis* is profoundly different from all subspecies of *P. reguloides* and *P. davisoni*; its song and call are unique among Eurasian *Phylloscopus* warblers, although most similar to *P. borealis*. In *Phylloscopus* species, the songs are very important prezygotic reproductive isolating mechanisms, and each species has its own diagnostic song. In some sympatric sibling species, e.g. Large-billed Leaf Warbler *Phylloscopus magnirostris* and Greenish Warbler *Phylloscopus trochiloides*, there are very pronounced differences in song (Martens 1980), while in others, e.g. *P. reguloides* and *P. davisoni*, there are only slight but still significant differences (Lekagul *et al.* 1991, Alström & Olsson 1993). As a rule, differences in song between different subspecies are slight in *Phylloscopus* warblers, and forms which differ much in song are generally better treated as separate species (cf. Martens 1980, 1988, Alström & Olsson 1990, Alström *et al.* 1992, Svensson 1992). Accordingly, the very distinctive song of *P. emeiensis* is in itself strong evidence that it should be considered a distinct species. However, in a few *Phylloscopus* species, e.g. Lemon-rumped Warbler *Phylloscopus chloronotus* (*sensu* Alström & Olsson 1990), each male's repertoire includes two completely different types of song, which are alternated between; in *P. chloronotus* each male most of the time sings only one type of song (Alström & Olsson 1990). Since *P. emeiensis* does not respond to playback of *P. reguloides* and *P. davisoni* and *vice versa*, and is morphologically and behaviourally distinct from the sympatric *P. reguloides* and *P. davisoni*, *P. emeiensis* is certainly not just a *P. reguloides* or *P. davisoni* which sings with a previously unknown song type nearly all the time. The lack of response to playback of the song of *P. reguloides* and *P. davisoni* and the sympatry with these species confirm that *P. emeiensis* is indeed a distinct species.

Phylloscopus emeiensis is intermediate in size between *P. reguloides* and *P. davisoni* (Table 1) and differs slightly in wing formula (Table 2). This suggests that prey size choice and foraging methods of the three species differ slightly (cf. Norberg 1990, Price 1991) and, consequently, that they occupy different niches. We have not been able to find any well-defined differences in habitat preference between *P. emeiensis* and *P. reguloides* and *P. emeiensis* and *P. davisoni*, respectively, on Emei Shan, although *P. reguloides* also occurs higher than *P. emeiensis* (up to at least 2800 m), and *P. davisoni* appears to be most numerous where spruce is relatively plentiful (*P. davisoni* has been recorded by us on Emei Shan between c. 1300 and 2100 m, and most commonly around 1700 m).

RELATIONSHIPS

Phylloscopus occipitalis, *P. reguloides*, *P. davisoni* and *P. hainanus* form a morphologically and vocally rather homogeneous

species group (hereafter referred to as the *P. reguloides* group), and, although this has not yet been tested, it seems likely that they form a monophyletic group. The members of this group share a basically similar morphology: (1) not small size (distinctly larger than the Pallas's Warbler *Phylloscopus proregulus* group); (2) relatively large bill with all pale lower mandible (very faint dark smudge near tip in some *P. d. disturbans* and *P. d. ogilviegranti*); (3) distinctly patterned crown, with darker lateral crown-stripes which are darker posteriorly than anteriorly (least pronounced in *P. hainanus*) and a well-marked pale median crown-stripe, which in all except *P. hainanus* is more distinct posteriorly than anteriorly; (4) rather uniformly green wing with distinct, usually double, pale wing-bars and (5) whitish edges of variable prominence to inner webs of outer tail feathers (most pronounced in *P. hainanus*). They also have basically similar vocalizations: the songs are somewhat *Parus*-like, built up of short, high-pitched, well-separated notes delivered rather quickly in short strophes, and the calls are usually bi- or trisyllabic and have a structure similar to song notes. Based on morphological characters, *P. coronatus* appears to belong to this group, but its song is strikingly different from the others' and it does not appear to have any distinct call note. Ijima's Leaf-warbler *P. ijimae*, Lemon-throated Leaf-warbler *Phylloscopus cebuensis* and Philippine Leaf-warbler *Phylloscopus olivaceus* are morphologically similar to the *P. reguloides* group but lack crown-stripes, and the latter two species show very faint wing-bars. The song of *P. ijimae* is rather similar to that of the *P. reguloides* group, but the songs of *P. cebuensis* and *P. olivaceus* are very different. Richman and Price (1992), based on studies of mitochondrial DNA sequences, have shown that *P. coronatus*, *P. ijimae* and *P. cebuensis* form a monophyletic group separate from *P. occipitalis* (they did not test any other members of the *P. reguloides* group).

The position of *P. emeiensis* is more difficult to ascertain. On morphological characters it appears to belong to the *P. reguloides* group. However, the pronounced vocal differences between *P. emeiensis* and all the members of this group seem to contradict this, while the similarity of the song of *P. emeiensis* to the songs of *P. tenellipes* (*sensu* Martens 1988) and *P. borealis* seems to suggest a closer relationship to one of these. Hence, either the morphological or the vocal characteristics are due to convergence. It seems likely to be the latter since in other monophyletic species groups of *Phylloscopus* warblers, e.g. the *P. collybita*-*P. trochilus* group (cf. Richman & Price 1992), there are pronounced interspecific differences in song. Accordingly, differences in song in sibling *Phylloscopus* species do not necessarily deny close relationship but instead reflect the importance of the song as a reproductive isolating mechanism.

ETYMOLOGY

The name *emeiensis* refers to Emei Shan, where the species was found. By emphasizing the name of this locality, we hope to focus attention on this unique, very vulnerable and

not yet protected site. Two other rare, very localized and highly threatened taxa, *Liocichla Emei Shan Liocichla omeiensis* and Silver Pheasant *Lophura nycthemera omeiensis*, have also been named after Emei Shan, as has Striped-throated Yuhina *Yuhina gularis omeiensis*.

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APPENDIX

Other taxa studied. Number of individuals/specimens of *Phylloscopus* warblers examined in the field and in museum collections of relevant taxa. 100+ means between 100 and several hundred. Specimens examined in Natural History Museum, Tring, U.K.; American Museum of Natural History, New York, U.S.A.; Museum of Comparative Zoology, Harvard University, U.S.A.; National Museum of Natural History, Washington, D.C., U.S.A., and Institute of Zoology, Academia Sinica, Beijing, China. + indicates songs and calls heard by us in the field

	Field	Museum	Song	Call
<i>P. reguloides kashmiriensis</i>	—	12 ¹	—	—
<i>P. reguloides reguloides</i>	100+	50+ ¹	+	+
<i>P. reguloides assamensis</i>	100+	60+ ¹	+	+
<i>P. reguloides claudiae</i>	100+	20 ¹	+	+
<i>P. reguloides fokienensis</i>	70+	40 ¹	+	+
<i>P. reguloides ticehursti</i>	20+	8 ¹	+	+
<i>P. reguloides goodsoni</i> ²	—	3 ¹	—	—
<i>P. davisoni davisoni</i>	100+	70+ ¹	+	+
<i>P. davisoni disturbans</i>	50+	9 ¹	+	+
<i>P. davisoni pseudus</i> ³	—	3 ⁴	—	—
<i>P. davisoni ogilviegranti</i>	30+	6 ¹	+	+
<i>P. davisoni klossi</i>	50+	14 ¹	+	+
<i>P. davisoni intensor</i> ⁵	—	1 ¹	—	—
<i>P. occipitalis</i>	100+	50+	+	+
<i>P. coronatus</i>	100+	50+	+	— ⁶
<i>P. ijimae</i>	50+	10+	+	+

¹ Including type.

² Usually treated as a subspecies of *P. ricketti*, but cf. Alström *et al.* (1995).

³ Usually treated as a synonym of *P. davisoni disturbans* (e.g. Ticehurst 1938, Cheng 1987).

⁴ Type of *P. davisoni pseudus* probably no longer exists, but specimens on which most probably Ticehurst has written on labels "matches type of *pseudus*" have been examined in Natural History Museum, Tring, U.K. Original description of *pseudus* (Stresemann 1923) disagrees with *P. emeiensis*.

⁵ Treated as a synonym of *P. davisoni klossi* by Williamson (1967) based on study of H.G. Deignan; this is our opinion, too.

⁶ This species does not appear to have any distinct call.