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一般論文

Addition of Kamchatka Leaf Warbler *Phylloscopus examinandus* and Sakhalin Leaf Warbler *P. borealoides* to Thailand's Avifauna

Philip D. Round*, Andrew J. Pierce, Takema SAITOH and Yoshimitsu SHIGETA

The non-breeding season distributions of some *Phylloscopus* warblers are poorly known due partly to the difficulties of field identification. We document the addition of Kamchatka Leaf Warbler *Phylloscopus examinandus* and Sakhalin Leaf Warbler *P. borealoides* to the avifauna of Thailand based on five individuals and 12 individuals respectively. All *P. examinandus* were caught and banded on spring (northwards) migration, while the *P. borealoides* sample included both autumn and spring birds. Their identity was established through assay of the cytochrome c oxidase subunit I (COI) gene (c. 700 bp) of the mitochondrial genome.

We present biometric data for these birds together with representative samples from the respective sibling species, Arctic Warbler *P. borealis* and Pale-legged Leaf Warbler *P. tenellipes*. We suggest that both *P. examinandus* and *P. borealoides* winter mainly or predominantly in the Sunda Subregion.

Key words: identification, migration, South-East Asia, taxonomy.

Introduction

The application of molecular methods combined with improved and more widespread recording of vocalizations, and increased sampling by ornithologists and bird banders across the breeding and wintering ranges of Asian birds, has greatly increased understanding of the taxonomy and distribution of sibling species among warbler genera. Among these, the large warbler genus *Phylloscopus*, with c. 60 species, is possibly the most taxing for identification.

We here document the addition of both Kamchatka Leaf Warbler *P. examinandus* and Sakhalin Leaf Warbler *P. borealoides* to the Thai avifauna, based on analysis of mitochondrial DNA recovered from tail feathers of birds trapped for banding and subsequently released.

The wide-ranging Arctic Warbler *P. borealis* was recently recognized as a complex of three species, including Japanese Leaf Warbler *P. xanthodryas* (breeding in Honshu to Kyushu), and Kamchatka Leaf Warbler *P. examinandus* which breeds in Kamchatka, Sakhalin and Hokkaido (Dickinson & Christidis 2014). Although *P. examinandus* was usually treated as an intergrade between *P. borealis* and *P. xanthodryas* (*e.g.,* Ticehurst 1938) it has since been shown to lie in a separate clade from the other two species in the complex, differing in morphology and song (Alström *et al*. 2011, Saitoh *et al*. 2006, 2008, 2010).

Arctic Warbler (*sens. lat.*) is a widespread and common passage migrant and winter visitor in

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Thailand, mainly in the south and southern central part of the country, south of roughly 15 degrees N latitude, occurring in both lowland terrestrial forests and mangroves (Lekagul & Round 1991). Nominate *P. b. borealis* was the only taxon listed for Thailand by Deignan (1963) while *P. xanthodryas* is so far known from a single individual caught and banded on northwards migration in SE Thailand (Round *et al*. 2015). A small number of exceptionally long-winged "Arctic Warblers", including some specimens, from southern Thailand and Malaysia thought likely to be *P. xanthodryas,* under which name *P. examinandus* was previously often subsumed (Medway & Wells 1976, Wells 2007) are perhaps also likely to have been *examinandus*, but we have not examined these and their identification remains tentative.

The Sakhalin Leaf Warbler *P. borealoides* was described as a distinct species by Portenko (1950) on the basis of its song, which is distinctively different from that of Pale-legged Leaf Warbler *P. tenellipes*. It breeds in southern Sakhalin, the Kuril Islands and Japan south to Shikoku (Dickinson & Christidis 2014) and shows different habitat preferences from Ussuri and North Chinese-breeding Pale-legged Leaf Warbler (Weprincew *et al*. 1989). Understanding of its distribution and movements has been confounded, however, owing its great morphological similarity to the latter species. The Pale-legged Leaf Warbler has long been recognized as a widespread and common visitor in forested areas, including mangroves, throughout most of Thailand, though is commonest in the eastern part of the country and scarcer in the peninsula (Deignan 1963, Lekagul & Round 1991).

Arguably, separating these two species pairs, *P. examinandus* from *P. borealis,* and *P. borealoides* from *P. tenellipes,* on morphology are among the most difficult identification challenges among Asian *Phylloscopus* species.

Methods

Biometrics and one or two tail feathers were collected from samples of Arctic Warblers and Pale-legged Leaf Warblers (*sens. lat*., both) banded mainly on passage at coastal localities in Thailand. Wing measurements were maximum chords and bill-length was measured to skull. All measurements were taken by either PDR or AJP.

DNA was extracted from tail feathers using DNeasy Blood & Tissue Kit (Qiagen, Hilden, Germany). We sequenced a partial region, the cytochrome c oxidase subunit I (COI) gene (c. 700 bp) of the mitochondrial genome, which is used as a standard DNA barcoding region for most animals (Hebert *et al*. 2003). The barcoding region was amplified using the following primers: L6697Bird (5'-TCAACYAACCACAAAGAYATCGGYAC-3') and H7390Thrush (5'-ACGTGGGARATRATTC-CAAATCCTG-3') following Saitoh *et al.* (2015). Neighbour-joining (NJ) trees with bootstrap values (1,000 replications) were constructed from the COI data using the Kimura 2-parameter model (K2P) model and Mega 5.2.2 (Tamura *et al*. 2011). A breeding season/location *P. borealis* VK57822 (Japan DNA Data Bank Accession no. LC087227) and a breeding season and location *P. examinandus* (specimen NSMT-A15083; DDBJ Accession no. AB843059) were used to provide sequences for comparison with Thai migrants of these two species, as was a *P. borealoides* specimen YIO-62722 (DDBJ Accession no.AB843689) and *a P.*

tenellipes specimen 1998-5165 (DDBJ LC087226; Appendix 1). A sequence from *P. xanthodryas* specimen YIO-64546 (DDBJ accession number AB843687) was used as an outgroup for both NJ trees (Figs. 2 and 3).

Results

Kamchatka Leaf Warbler *P. examinandus*

We were able to determine the DNA sequences of 23 "Arctic Warblers" sampled from 659 to 715 bp in the COI region (DDBJ accession Nos. LC087183, LC87186-88, LC87190-93, LC87195-87202, LC87209, LC87213-18; Appendix 1). Among these, five belonged in the *P. examinandus* clade, and 18 individuals belonged in the *P. borealis* clade (Fig. 2, Appendix 1). All but one of the sampled birds of both taxa, *P. examinandus* and *P. borealis*, were caught at locations that indicated they were almost certainly passage migrants: on northward (spring) migration 14 Apr. to 19 May, n = 13 both species combined; and southward (autumn) migration, 9 Sept. – 10 Oct., n = 9, *P. borealis* only). A presumed overwintering individual, another *P. borealis*, was sampled in lowland evergreen forest at Khao Soi Dao Wildlife Sanctuary, Chanthaburi Province, South-East Thailand, on 28 Dec. (Fig. 1, Appendix 1).

All five *P. examinandus* were caught at Laem Phak Bia, Phetchaburi Province, Central Thailand (Fig. 1), on northward migration: on 9 May 2010 (one); 14 May 2011 (one) and 19 May 2012 (three; Appendix 1).

The five *P. examinandus* were scarcely distinguishable in morphology from *P. borealis* (Table 1, Appendix 1), though tended to be slightly larger and longer-winged. One of these birds (band no.

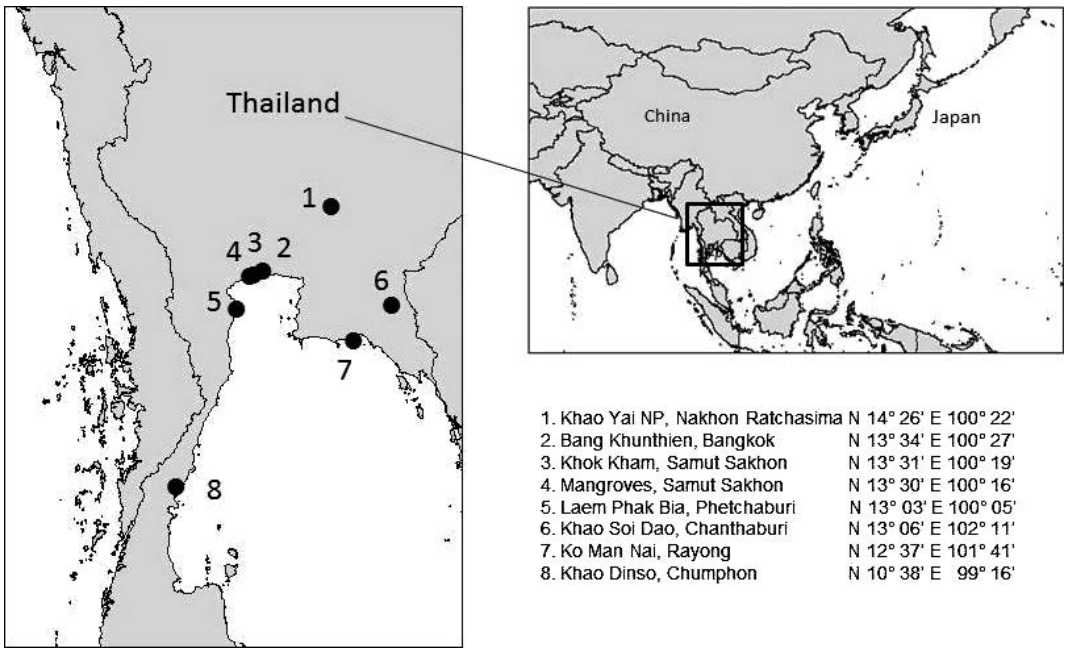

Fig. 1. Map of Thailand to show capture locations mentioned in the text.

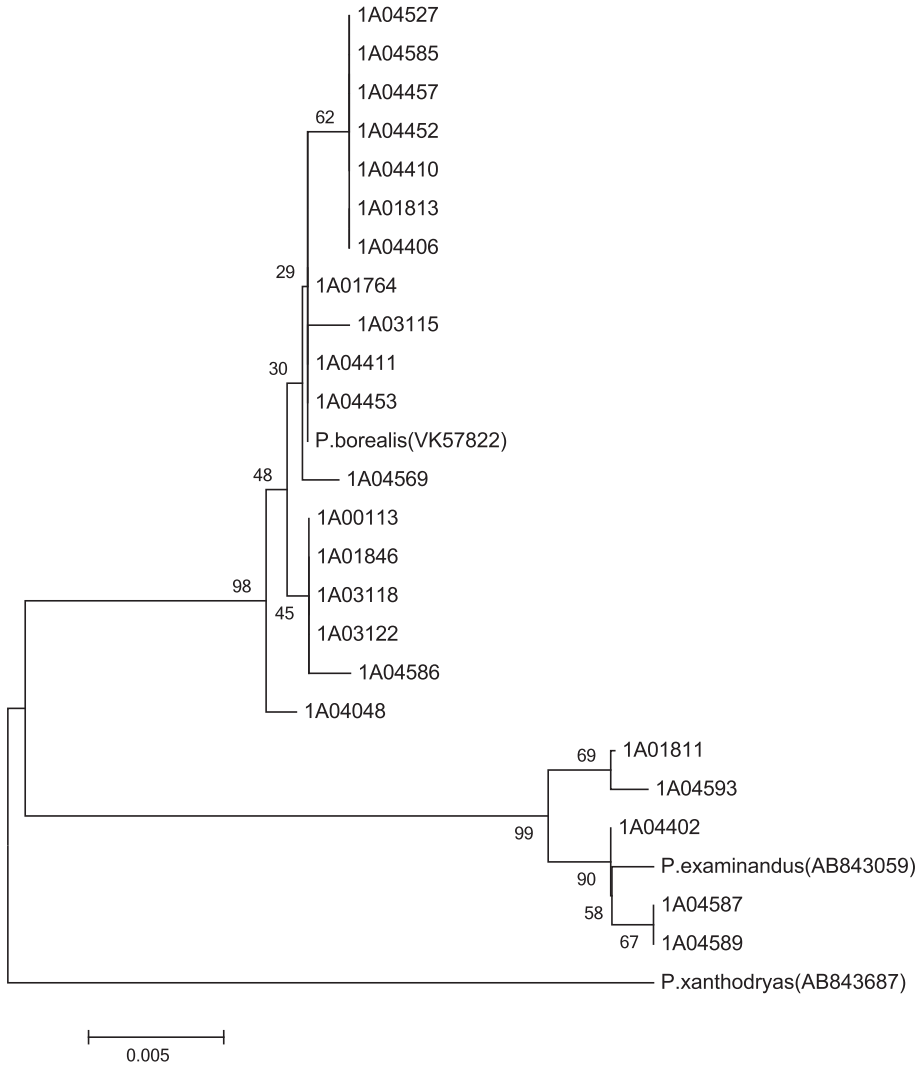

Fig. 2. Neighbour-joining trees of partial COI sequences from "Arctic Warblers". The tree was rooted using Japanese Leaf Warbler *P. xanthodryas* as outgroup (DNA accession number AB843687). Numbers at each node indicate bootstrap support (K2Pmodel, 1,000 replicates).

1A04402) was markedly yellower on the supercilium and throat than typical *borealis* and brighter green above (Figs. 4a, 4b, and 5), apparently agreeing with descriptions of *P. examinandus* in Ticehurst (1938) and Alstrom *et al.* (2011). However, another individual, 1A04411 with virtually identical colouration to 1A04402, and caught on the same day (Fig. 6) proved to be a *borealis* on DNA (Appendix 1), illustrating the extreme difficulty of reliably separating these two species on morphology.

Sakhalin Leaf Warbler *P. borealoides*

A total of 24 "Pale-legged Leaf Warblers" were sampled of which we were able to determine the

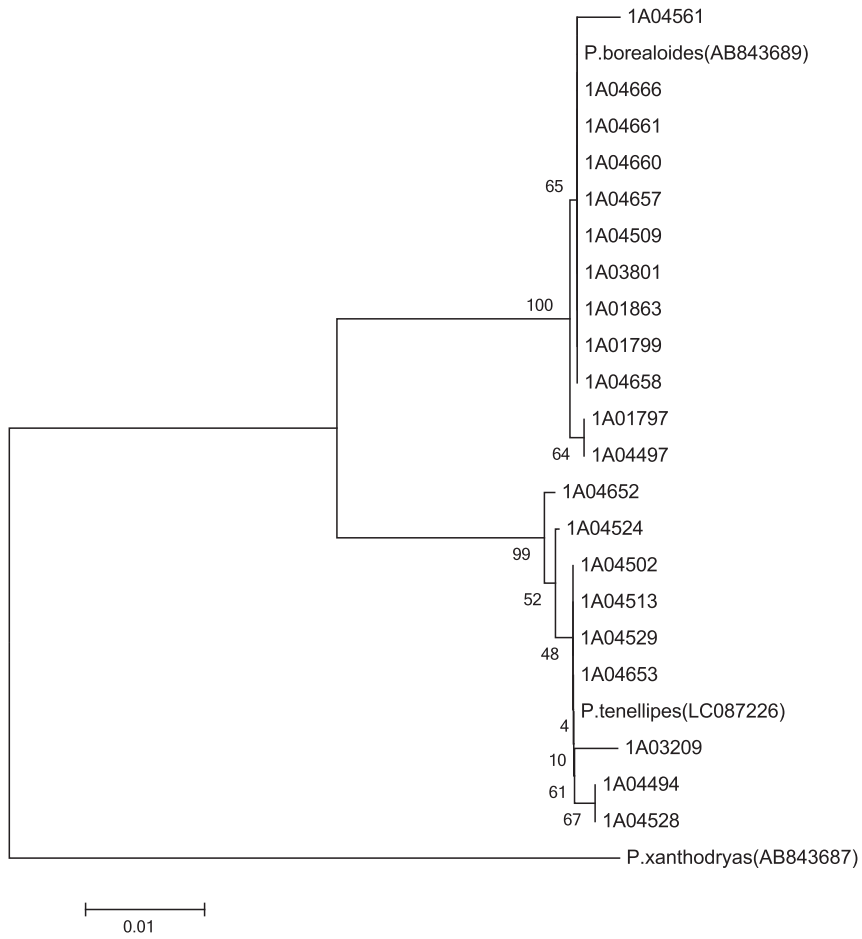

Fig. 3. Neighbour-joining trees of partial COI sequences from "Pale-legged Leaf Warblers". The tree was rooted using Japanese Leaf Warbler *P. xanthodryas* as outgroup (DNA accession number AB843687). Numbers at each node indicate bootstrap support (K2Pmodel, 1000 replicates).

Table 1. Summary of biometrics (mm) of trapped Phylloscopus sampled for DNA.

	Wing	Tail	Bill length	Bill width	Bill depth	p1
P. examinandus	67.80 ± 2.17 (66–71, n = 5)	47.40 ± 1.95 (45–50, n = 5)	15.22 ± 0.66 (14.5–16.0, n = 5)	3.90 ± 0.16 (3.7–4.0, n = 5)	2.78 ± 0.10 (2.7–2.9, n = 4)	0.52 ± 1.72 (−2.20 – +2.00, n = 5)
P. borealis	64.58 ± 2.72 (61–70, n = 18)	45.56 ± 2.25 (42–50, n = 16)	14.62 ± 0.54 (13.7–15.4, n = 13)	3.90 ± 0.28 (3.5–4.3, n = 7)	2.76 ± 0.15 (2.6–3.0, n = 7)	−0.13 ± 0.74 (−1.3 – +1.3, n = 8)
P. borealoides	63.71 ± 1.51 (61–66, n = 12)	47.50 ± 1.31 (46–50, n = 12)	14.43 ± 0.42 (13.6–15.0, n = 12)	3.79 ± 0.22 (3.4–4.1, n = 10)	2.79 ± 0.11 (2.7–3.0, n = 9)	4.16 ± 0.93 (2.9–5.9, n = 12)
P. tenellipes	62.06 ± 1.93 (59–65, n = 9)	46.44 ± 1.33 (45–49, n = 9)	14.04 ± 0.79 (13.4–15.0, n = 8)	3.61 ± 0.21 (3.4–3.9, n = 7)	2.66 ± 0.15 (2.5–2.9, n = 7)	4.91 ± 0.63 (3.7–5.5, n = 7)

Bill width measured proximally (base of the nares) and bill depth distally (distal edge of the nares). P1 (Outermost primary) was measured as projection beyond the longest primary covert.

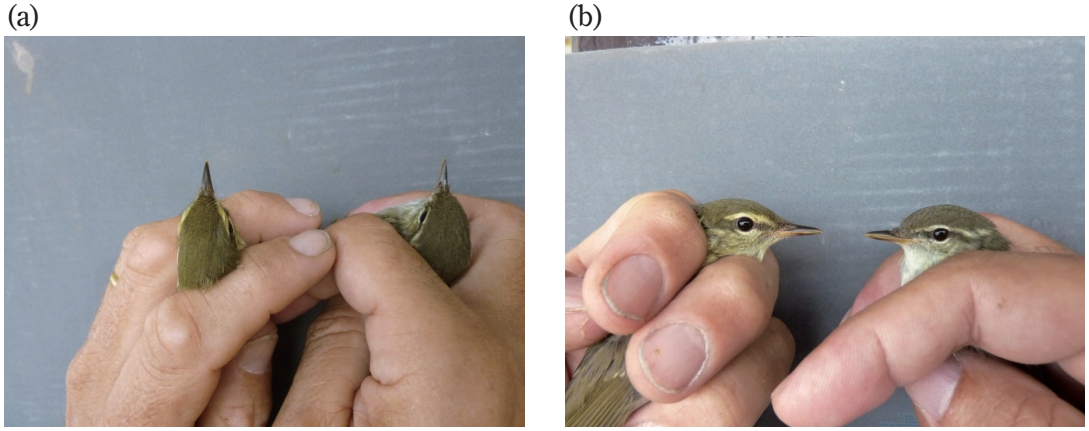

Fig. 4. A Kamchatka Leaf Warbler *Phylloscopus examinandus* (band no. 1A04402) alongside an Arctic Leaf Warbler *P. borealis* (1A04401) showing the brighter green upperparts and more strongly yellow-tinged supercilium and underparts of the left individual.
(a) Dorsal view; (b) lateral view.

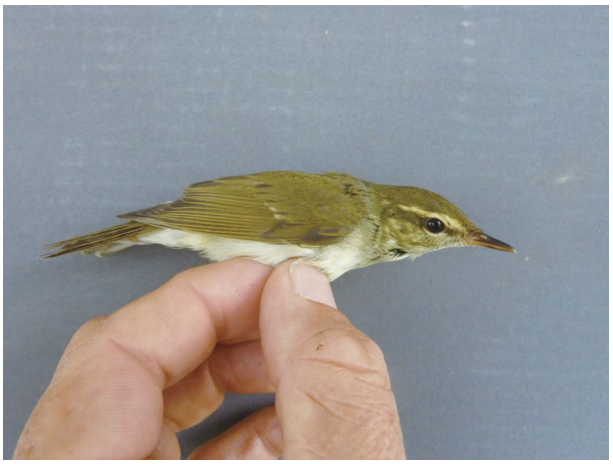

Fig. 5. Kamchatka Leaf Warbler *Phylloscopus examinandus* (band no. 1A04402) lateral view.

DNA sequences of 21 individuals, sampling 602 to 691 bp in the COI region (Japan DNA Data Bank accession Nos. LC087184–85; LC087189, LC87194, LC87203–08; LC87210–12; LC87219–25; Appendix 1, Fig. 3). Nine belonged in the *P. tenellipes* clade, and 12 in the *P. borealoides* clade (Fig. 3). No result could be obtained for three other birds for which no usable DNA was extracted.

The *P. borealoides* were caught as presumed passage migrants, all but two during presumed southward passage, 2 Oct. to 2 Nov., from four localities. Three of the localities (Khok Kham, Samut Sakhon Mangrove Research Station and Laem Phak Bia, all on the shores of the Gulf of Thailand), were mangrove-dominated and the fourth, Khao Dinso, Chumphon Province, Peninsular Thailand was scrub and secondary forest on a 300 m elevation mountain, 1.5 km from the coast (Fig. 1). One of the two spring

Fig. 6. Unusually bright Arctic Leaf Warbler *P. borealis*, band no, 1A04410, apparently identical in colouration to previous (*P. examinandus*) individual.

birds was caught in mangroves at Laem Phak Bia (on 19 Mar.) and the other on a forested island, Ko Man Nai, on 13 Apr. (Fig. 1, Appendix 1).

The nine undoubted *P. tenellipes* included five birds that were presumed southwards passage migrants caught during 5–20 October from two of the same localities reported for *P. borealoides*: Khao Dinso (four) and from mangroves at Khok Kham (one). Four further *P. tenellipes* were caught from inland forest sites in eastern Thailand: three midwinter birds from Khao Soi Dao Wildlife Sanctuary and one bird in mid-April at Khao Yai National Park. It was unfortunate that this latter bird (band no. 1A03209; Appendix 1) was the only one of four putative *P. tenellipes* caught at Khao Yai (where the species has long been considered to be a common winter visitor; Lekagul & Round 1991) to give an adequate DNA signature. Even so, while the result was sufficient to identify it unequivocally as a *P. tenellipes,* the full sequence was not registered with DDBJ as many unreadable sections were interspersed within.

The two species are very hard to distinguish, with similar plumage, and a large overlap in wing measurements and wing formulae (Table 1). While *P. borealoides* is longer-winged than *P. tenellipes*, most birds caught lay in an overlap zone which presumably encompasses longer-winged (male) *P. tenellipes* and shorter-winged (female) *borealoides*. The longest-winged *P. tenellipes* caught in the present sample had a wing-length of 65 mm (Table 1, Appendix 1).

Discussion

We have provided details for five records of Kamchatka Leaf Warblers *P. examinandus* and twelve records of Sakhalin Leaf Warblers *P. borealoides* in Thailand established through assay of the cytochrome c oxidase subunit I (COI) gene (c. 700 bp) of the mitochondrial genome. We present supporting biomet-

ric data for our small samples of both the former species compared with Arctic Warblers *P. borealis* and Pale-legged Leaf Warblers *P. tenellipes* (Table 1, Appendix 1).

Distinguishing morphologically between *P. examinandus* and *P. borealis*, and *P. borealoides* and *P. tenellipes* are among the most difficult tasks facing the bird bander in the field. Where canonical discriminant analysis has been used successfully, for example to distinguish between *borealis* and *examinandus* (Saitoh *et al.* 2008, Saitoh *et al.* 2014), it is best applied to sexed specimens. When larger, longer-winged males and smaller, shorter-winged females are combined in an unsexed sample, as with live-trapped birds, this technique may be less reliable in separating between all the members of either species pair. Our results concerning the separation of *P. tenellipes* from *P. borealoides* would suggest that any individuals with wing lengths longer than 65 mm might reasonably be identifiable as *P. borealoides*. However Bozó & Heim (2015) apparently recorded *P. tenellipes* with a wing length up to 67.5 mm from a sample of 79 individuals trapped and ringed during autumn passage in the Amur region.

Our birds were mostly caught as passage migrants at coastal sites. It is important to resolve the wintering ranges of the taxa through increased mist-netting and sampling during the midwinter period at a wide range of inland forest locations in Thailand and elsewhere in SE Asia. We consider, based on the location and late timing of the spring passage captures of *P. examinandus,* that its wintering range most likely lies in peninsular Thailand or further south within in the Sunda subregion (perhaps Malaysia or Sumatra). Supporting evidence for a Sundaic wintering area in *P. examinandus* comes from long winged "Arctic Warblers" (wings $>$ 71–73 mm), both specimens and banded birds, captured at localities further south in peninsular Thailand and Malaysia on likely spring (21 Apr. – 30 May) and autumn (24 Sept.) passage dates (Medway & Wells 1976, Wells 2007).

Dates of all *P. borealoides* so far identified in Thailand are likewise concordant with migration to a wintering area south of the capture localities, in the Sunda subregion. Additionally, an over-wintering *P. borealoides* was documented in Singapore (Yap *et al.* 2014). The midwinter capture dates of three *P. tenellipes* in Eastern Thailand, on the other hand, together with three further relatively short-winged (59–63 mm) individuals from which DNA could not be obtained (Appendix 1), but which were likewise almost certainly *P. tenellipes* rather than *P. borealoides*, suggests that the former species may winter predominantly in that region (where *borealoides* has not yet been recorded). Since *P. tenellipes* were also captured on migration alongside *P. borealoides* in peninsular Thailand, this indicates that its full wintering range certainly extends to the peninsula or elsewhere in the Sunda subregion. Similarly, given our limited sampling, the possibility that some *P. borealoides* may also winter as yet undetected alongside *P. tenellipes* in eastern or central Thailand cannot yet be ruled out.

Increased sampling of migrants may also resolve the differences in timing of passage between P. *examinandus* and *P. borealis* on the one hand, and *P. borealoides* and *P. tenellipes* on the other. Larger samples of the latter species-pair, particularly if both wing-formula and vocalizations are recorded, may yield more reliable methods of distinguishing them since the call of *P. tenellipes* is markedly higher in frequency than that of *P. borealoides* (Weprincew *et al.* 1989, Yap *et al.* 2014). *P. examinandus* is also distinguishable on call from *P. borealis* (Alström *et al.* 2011).

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要　約

タイの鳥類相へ新たに追加されたオオムシクイ *Phylloscopus examinandus* とエゾムシクイ *P. borealoides* の標識記録

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いくつかのムシクイ属 *Phylloscopus* の種の非繁殖期の分布域があまり分かっていないのは，野外における種同定が難しいことがその一因である．私達は，オオムシクイ *Phylloscopus examinandus* 5個体とエゾムシクイ *P. borealoides* 12個体に基づく新たな記録を確認し，タイの鳥類相に加えることができた．すべてのオオムシクイの個体は，北方への春の渡り時期において捕獲・標識され，エゾムシクイの記録は，秋と春の両方の渡り時期であった．それらの種の同定は，ミトコンドリア DNA 内のチトクローム c オキシダーゼサブユニット I（COI）遺伝子（約700塩基対）を用いて，確立された分析方法によって行われた．

さらに，これらの種の計測データと共に，両種の姉妹種である，コムシクイ *P. borealis* とアムールムシクイ *P. tenellipes* の計測値についても示した．

このことから，オオムシクイとエゾムシクイの両種が主に，スンダ亜区で越冬していることが明らかとなった．

キーワード：種同定，東南アジア，分類学，渡り．

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Appendix 1. Detailed biometrics and wing formula of all Phylloscopus sampled for DNA.

					Bill								
Band no. / specimen no.	DDBJ Accession no.	Species	wing	tail	length	width distal	width (prox.)	depth	p1	p2 shortfall	wing-point	date	location
1 A01811	LC087186	*P. examinandus*	71	50	15.7	2.5	3.7	2.7	−2.2	−4.4 (p5/p6)	p4	9 May 2010	Laem Phak Bia
1 A04402	LC087196	*P. examinandus*	66	46	14.5	3.0	3.8		2.0	−4.7 (p5/p6)	p4	14 May 2011	Laem Phak Bia
1 A04587	LC087216	*P. examinandus*	69	48	16.0	3.1	4.0	2.9	0.6	−4.2 (p5/p6)	p4	19 May 2012	Laem Phak Bia
1 A04589	LC087217	*P. examinandus*	66	48	15.3	3.1	3.9	2.8	2.0	−5.0 (p5/p6)	p4	19 May 2012	Laem Phak Bia
1 A04593	LC087218	*P. examinandus*	67	45	14.6	3.0	4.1	2.7	0.2	−4.1 (p5/p6)	p3	19 May 2012	Laem Phak Bia
NSMT-A15083	AB843059	*P. examinandus*	62.8	47.4	14.2	3.0	3.6	2.8	1.7	(=p5/p6)	P3	16 July 2004	Japan: Mt. Rausu, Hokkaido
1 A01764	LC087183	*P.borealis*	63	46	14.6		3.5	2.6				26 Apr. 2009	Laem Phak Bia
1 A01813	LC087187	*P.borealis*	65	47	14.2		4.0	2.7	0	−5.2 (=p6)	p4	8 May 2010	Laem Phak Bia
1 A01846	LC087188	*P. borealis*	64	44	15.2					−5.8 (=p6)	p4	10 Oct. 2010	Laem Phak Bia
1 A04406	LC087197	*P.borealis*	63	45	13.9				−1.3	−4.9 (=p6)	p3	14 May 2011	Laem Phak Bia
1 A04410	LC087198	*P.borealis*	62	44	14.5				−0.3	−4.5 (=p6/p7)	p4	14 May 2011	Laem Phak Bia
1 A04411	LC087199	*P.borealis*	63	44	14.5				0			15 May 2011	Laem Phak Bia
1 A03113	LC087190	*P. borealis*	64	45								30 Sept. 2007	Khao Yai
1 A03115	LC087191	*P. borealis*	62	44								30 Sept. 2007	Khao Yai
1 A03118	LC087193	*P. borealis*	68	49								30 Sept. 2007	Khao Yai
1 A03122	LC087192	*P. borealis*	64	43								4 Oct. 2007	Khao Yai
1 A04048	LC087195	*P. borealis*	61									10 Nov. 2008	Bang Khunthien
1 A04452	LC087200	*P. borealis*	66	46	14.1	3.2	4.1	2.9				9 Sept. 2011	Laem Phak Bia
1 A04453	LC087201	*P. borealis*	62	42	14.7							9 Sept. 2011	Laem Phak Bia
1 A04457	LC087202	*P. borealis*	69		13.7							10 Sept. 2011	Laem Phak Bia
1 A04527	LC087209	*P.borealis*	64.5	45	15.3	3.0	4.0	2.7	−0.7	−4.7 (=p5/p6)	p4	28 Dec. 2011	Khao Soi Dao
1 A04569	LC087213	*P.borealis*	70	49	15.4	3.3	4.3	3.0	0	−4.0 (=p4/p5)	p4	13 Apr. 2012	Ko Man Nai
1 A04586	LC087215	*P.borealis*	63	46	15.0	2.7	3.7	2.8	1.3	−4.7 (=p5/p6)	p3	19 May 2012	Laem Phak Bia
1 A04585	LC087214	*P.borealis*	69	50	15.0	2.7	3.7	2.6	0.0	−5.2 (=p5/p6)	p3	19 May 2012	Laem Phak Bia
VK57822	LC087227	*P. borealis*	64.2	45.3	14.7	2.95	3.59	2.98	0	(=p5/p6)	p3	7 July 2007	Russia: Magadan, Khasyn river middle part
1 A01797	LC087184	*P. borealoides*	61	46	13.7	2.9	3.7	2.7	nm	−7.2 (=p7)	p4	2 Oct. 2009	Mangrove Research Station
1 A01799	LC087185	*P. borealoides*	63	48	14.4	2.8	3.6	2.8	3.3	−7.6 (p7/p8)	p4	2 Oct. 2009	Mangrove Research Station
1 A03801	LC087194	*P. borealoides*	64	48	14.3	2.9	3.8	2.7	4.1	−7.6 (p6/p7)	p4	3 Oct. 2009	Mangrove Research Station
1 A01863	LC087189	*P. borealoides*	64	46	14.6	2.8	3.8	2.9	5.2	−5.6 (p6/p7)	p4	19 Mar. 2011	Laem Phak Bia
1 A04497	LC087204	*P. borealoides*	65	50	13.6				4.2	−7.2 (p6/p7)	p4	5 Oct. 2011	Khao Dinso
1 A04509	LC087206	*P. borealoides*	64	48	14.5	3.1	4.1	2.7	4.6	−7.2 (p6/p7)	p4	8 Oct. 2011	Khok Kham
1 A04561	LC087212	*P. borealoides*	65	47	15.0	3.2	4.0	2.8	4.8	−7.0 (p6/p7)	p4	13 Apr. 2012	Man Nai Island

1 A04657	LC087221	*P. borealoides*	64	48	14.9	2.8	3.4	2.8	5.9	−6.7 (p6/p7)	p4	22 Oct. 2012	Khao Dinso
1 A04658	LC087222	*P. borealoides*	66	49	14.3	2.6	3.9	3.0	3.2	−8.6(p6/p7)	p4	23 Oct. 2012	Khao Dinso
1 A04660	LC087223	*P. borealoides*	64.5	48	14.8	3.0	3.6	2.7	4.3	−8.5 (p7/p8)	p4	24 Oct. 2012	Khao Dinso
1 A04661	LC087224	*P. borealoides*	63	46	14.5				2.9	−7.9 (p7/p8)	p4	1 Nov. 2012	Laem Phak Bia
1 A04666	LC087225	*P. borealoides*	61	46	14.5	2.9	4.0	2.9	3.3	−7.4 (p6/p7)	p4	2 Nov. 2012	Laem Phak Bia
YIO-62722	AB843689	*P. borealoides*										12 May 1996	Japan: Hokkaido, Yagishiri Is,
1 A03209	-	*P. tenellipes*	63	46								14 Apr. 2008	Khao Yai NP
1 A04513	LC087207	*P. tenellipes*	60	46	13.9	2.8	3.4	2.5	5.4	−7.9 (=p8)	p4	8 Oct. 2011	Khok Kham
1 A04524	LC087208	*P. tenellipes*	59.5	45	13.5	3.1	3.9	2.9	5.0	−8.4 (p7/p8)	p4	28 Dec. 2011	Khao Soi Dao WS
1 A04528	LC087210	*P. tenellipes*	63	45	15.3	2.8	3.8	2.7	5.5	−6.6 (=p7)	p4	28 Dec. 2011	Khao Soi Dao WS
1 A04529	LC087211	*P. tenellipes*	59.5	46	13.4					−7.3 (p7/p8)	p4	30 Dec. 2011	Khao Soi Dao WS
1 A04494	LC087203	*P. tenellipes*	62.5	46	14.2	2.8	3.8	2.6	3.7	−8.5 (p7/p8)	p4	5 Oct. 2011	Khao Dinso
1 A04502	LC087205	*P. tenellipes*	63	47	14.0	2.8	3.4	2.6	4.7	−7.9 (=p7)	p4	5 Oct. 2011	Khao Dinso
1 A04652	LC087219	*P. tenellipes*	63	48	13.0	2.5	3.5	2.8	4.7	−9.8 (p7/p8)	p4	12 Oct. 2012	Khao Dinso
1 A04653	LC087220	*P. tenellipes*	65	49	15.0	2.5	3.5	2.5	5.4	−7.0 (=p7)	p4	20 Oct. 2012	Khao Dinso
1 A03117		[*P. tenellipes**]	59	45						(=p7)	p4	30 Sept. 2007	Khao Yai
1 A03175		[*P. tenellipes**]	63	46								19 Jan. 2008	Khao Yai
1 A03235		[*P. tenellipes**]	60.5	48	12.5							21 Jan. 20 09	Khao Yai
1998–5165	LC087226	*P. tenellipes*										1 Aug. 1998	China: Heilongjiang, Harbin

Wing lengths are maximum chord and bills measured to the skull. Bill-widths were measured at the distal edge of the nares (distal) and the proximal edge of the nares (proximal). Depth measured at distal edge of nares. Tarsus was measured following the minimum method outlined by Svensson (1992). The highlighted rows indicate the outgroups. Individuals from known breeding localities were used to provide comparative sequences. [*] identification as *P. tenellipes* tentative in three individuals from Khao Yai from ewhich no usable was DNA obtained.