

**Nine new records of boletes (Boletales, Hymenomycetes)
from Nam Nao and Phu Rua National Parks, Thailand**
เห็ดผึ้ง 9 ชนิดที่พบใหม่รายงานครั้งแรกในประเทศไทยจากอุทยานแห่งชาติน้ำหนาวและภูเรือ

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Abstract

Bolete fungi from Nam Nao and Phu Rua National Parks, Thailand were collected during the wet seasons of 2005 and 2006 in order to investigate their species diversity. There were fifty-two specimens, 40 from Nam Nao and 12 from Phu Rua, which were collected, photographed and examined morphologically at both macroscopic and microscopic levels. The collected specimens, belonged to nine genera as follows: *Boletellus*, *Boletus*, *Heimiella*, *Leccinum*, *Phylloporus*, *Pulveroboletus*, *Strobilomyces*, *Tylopilus* and *Xerocomus*. Nine species reported here are new records to Thailand. They are *Boletus laetissimus* Hongo, *Boletus obscureumbrinus* Hongo, *Boletus subvelutipes* Peck., *Heimiella japonica* Hongo, *Leccinum extremiorientale* (L. Vass) Sing., *Phylloporus* cf. *rhodoxanthus* (Schw.) Bres., *Strobilomyces confusus* Sing., *Tylopilus eximius* (Peck) Sing. and *Xerocomus subtomentosus* (L.:Fr.) Quél. *P.* cf. *rhodoxanthus* is the only species that needs more detailed study.

บทคัดย่อ

ทำการสำรวจและเก็บตัวอย่างเห็ดผึ้งจากป่าในเขตอุทยานแห่งชาติน้ำหนาวและอุทยานแห่งชาติภูเรือในระหว่างปี 2548-2549 เพื่อทราบจำนวนชนิดและความหลากหลายเชิงชนิด จากการศึกษาดังตัวอย่างเห็ดผึ้ง 52 ตัวอย่าง ซึ่งในจำนวนนี้ 40 ตัวอย่างได้มาจากน้ำหนาวและ 12 ตัวอย่างได้มาจากภูเรือ เมื่อทำการถ่ายภาพ ศึกษาลักษณะรูปร่างภายนอกและลักษณะใต้กล้องโดยละเอียดแล้วพบว่าเห็ดผึ้งเหล่านี้จัดอยู่ในสกุล *Boletellus*, *Boletus*, *Heimiella*, *Leccinum*, *Phylloporus*, *Pulveroboletus*, *Strobilomyces*, *Tylopilus* และ *Xerocomus* รายงานนี้เป็นการรายงานถึงชนิดของเห็ดผึ้ง 9 ชนิด เป็นครั้งแรกในประเทศไทย ชนิดที่พบเหล่านี้คือ *Boletus laetissimus* Hongo, *Boletus obscureumbrinus* Hongo, *Boletus subvelutipes* Peck., *Heimiella japonica* Hongo, *Leccinum extremiorientale* (L.Vass) Sing., *Phylloporus* cf. *rhodoxanthus* (Schw.) Bres., *Strobilomyces confusus* Sing., *Tylopilus eximius* (Peck) Sing. และ *Xerocomus subtomentosus* (L.:Fr.). Quél. เห็ดผึ้งชนิด *P.* cf. *rhodoxanthus* ยังต้องการการศึกษาในรายละเอียดเนื่องจากมีลักษณะที่ยังไม่สามารถชี้ชัดถึงชนิดที่ถูกต้องได้

Keywords: Boletes, new records, Thailand

คำสำคัญ: เห็ดผึ้ง บันทึกครั้งแรก ประเทศไทย

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Introduction

Boletes are mycorrhiza normally associated with trees. Their beautiful colors, distinctive features, and relative abundance make them one of the most popular groups collected. Boletes are a relatively safe group to collect for table and are immensely popular among mycophagists. The fruit body of the boletes is similar in appearance to the typical mushroom except that, in the boletes, tubes have replaced the gills, or lamellae, on the under surface of the pileus (Theirs, 1975). In Thailand, the diversity of bolete fungi has still never been well investigated due to lack of support and experienced experts. Very few reports of species of boletes in Thailand were found. Tongglam (1999) reported 31 species of boletes from Doi Sutep-Pui National Park in Chiang Mai province. Jones and Hyde (2004) wrote on some new species of fungus described from Thailand including 8 species of boletes. In total, there are 63 recorded species of boletes in Thailand. This study reported only new records to Thailand that were discovered in Nam Nao and Phu Rua National Parks.

Nam Nao and Phu Rua reserve areas represent two most beautiful National Parks which are located over the border between northeastern and northern Thailand. The areas are mountainous and their forests provide good shelter for varieties of organisms, including boletes. These parks, especially Nam Nao, are considered to be an Ecozone in which they are the meeting point among the southern end of mountains running from the southern part of China and the Himalayan high ground to meet with the most northerly part of the lowland from the Malaysian Peninsula. Normally, an ecozone is considered to be very rich in species diversity. In this case, species composition

should be similar to boletes that are found in southern China, northern Myanmar and the Himalayan areas and from the Malaysian Peninsula. The forests from Nam Nao and Phu Rua National Parks contain many different forest types, including dry dipterocarp, deciduous, evergreen, hill evergreen and pine forests. These forests create a cooler climate in the parks. The average daytime temperatures during summer are about 25 °C. The temperature during the cool season can be cold, with a frost in the morning and temperatures as low as 0 °C. Initially, very brief investigation on boletes species was done and there seemed to be more species to be discovered. This paper reports 9 more new records to the boletes species of Thailand.

Material and Methods

Specimens of fresh fruit bodies of boletes were photographed where found, collected and brought back to the laboratory for detailed investigation. In the laboratory suitable specimens were investigated macroscopically for size, shape, surface texture, colour of surface and context, colour change when bruised of pileus, stipe and pores. The reactions of various parts of the basidiocarp were determined by using chemical reagents such as 3% KOH, 14% NH_4OH and FeSO_4 . The microscopic characters of spores, basidium and cystidium were investigated and measured with the aid of compound microscopes. Most slide preparation was mounted with 10% glycerol and 3% KOH solution. In addition, Melzer's reagent was used to detect colour change, including amyloid and dextrinoid reactions. Microscopic measurement and photographs were taken at 1,000x magnification. Total details were then compared to various boletes identification keys (Scates, 2004;

Smith and Thiers, 1971; Thiers, 1975) and coloured illustration books (Besette et al., 1997; Courtecuisse and Duhem, 1995).

Results

Fifty-two boletes specimens, 40 from Nam Nao and 12 from Phu Rua National Parks were collected for identification of species. From these species recovered, there were nine new records to Thailand reported in this paper. Nine species were from Nam Nao and 2 species were found both from Nam Nao and Phu Rua National Parks. Taxonomic details of all new records are given below:

Taxonomic Details of New Records to Thailand

Boletus laetissimus Hongo. (Figure 1.1a, b)

Pileus 3.8–7.5 cm across, hemispherical to conical-convex when young, convex to broadly-convex with age; surface dry and glabrous, colour varies from orange to purplish rusty brown; context thick, deep yellow, turning slowly blue-green when cut or bruised. *Hymenophore* tubulose, nearly free from stipe. *Tubes* 0.3–0.5 cm deep, colour yellow orange, turning dark blue when cut; pores angular, colour yellow-orange to bright orange, turning immediately dark blue when bruised, finally black. *Stipe* 5–8.4 cm long, 1.5–2.3 cm broad, bulbous to cylindrical with age, colour orange becoming purple-red, surface covered with dark orange to red dots and fine fibrillose scales towards the apex; context solid, colour deep yellow, turning orange-red at apex when cut and dark blue at base. *Spore* 4–5.5 x 9.5–14 μm , smooth, fusiform.

Chemical reaction: pileus and stipe surface orange-red with KOH and NH_4OH ; pileus context orange-red with KOH, pale blue-green with NH_4OH ; stipe context yellow-orange with KOH, pale blue-green

or negative with NH_4OH ; pores surface orange-red with KOH, yellow-orange with NH_4OH .

Specimens examined: Nam Nao national Park (16 July, 2005) and Phu Rua National Park (4 June, 2006).

Boletus obscureumbrinus Hongo. (Figure 1.2a, b)

Pileus 1.8–7.5 cm across, subglobose to hemispherical when young, convex to broadly-convex with age; surface glabrous to finely velvety, dry, colour pale brown or yellow-brown, olive-brown to dark brown; context thick, pale yellow, some part turning slowly and weakly blue-green when cut. *Hymenophore* tubulose, adnated from stipe when young, becoming nearly adnexed with age. *Tubes* less than 0.1–0.6 cm deep, colour pale yellow, unchanging when cut; pores very small when young, becoming circular, colour orange-brown or yellow-brown, olive-brown to brownish, turning slowly blue-green when bruised. *Stipe* 2.5–8.3 cm long, 1.3–4.8 cm broad, bulbous, enlarging downward, colour pale yellow-brown to pale brown, surface smooth; context solid, colour and staining like context on pileus. *Spore* 4–5 x 8.5–13 μm , smooth, fusiform.

Chemical reaction: pileus and stipe surface orange-red with KOH and NH_4OH ; pileus and stipe context orange-red with KOH, negative with NH_4OH ; pores surface orange-red with KOH, orange with NH_4OH . **Specimens examined:** Nam Nao National Park (1 July and 1 September, 2006).

Boletus subvelutipes Peck. (Figure 1.3a, b)

Pileus 1.8–8.2 cm broad, hemispherical when young, becoming convex to broadly-convex with age; surface dry, glabrous or finely velvety, sometimes somewhat finely cracked with age, colour variable, yellow-brown, reddish-brown or reddish-

orange, quickly staining blue to blue-black when bruised; context bright yellow, immediately staining dark blue when cut or bruised. *Hymenophore* tubulose, nearly free to adnexed from stipe. *Tubes* 0.1–0.8 cm deep, colour yellow, turning dark blue when cut; pores round to subround, colour red or red-orange, orange to brownish orange, frequently yellow at the margin, quickly staining dark blue when bruised. *Stipe* 3.2–8.4 cm long, 1.2–3.5 cm broad, equal to nearly clavate, surface punctated with red dots or granules, not reticulate, variable in colour but typically yellow with red shades mixed in; base with stiff yellowish hairs on immature specimens becoming dark red with age; context solid, bright yellow, quickly staining blue to dark blue when cut or bruised, sometimes staining red at base. *Spore* 4–5.5 x 10–14.5 μm , smooth, fusiform to subventricose.

Chemical reaction: pileus surface mahogany-red with KOH and NH_4OH , olive with FeSO_4 ; pileus context orange-yellow to rusty orange with KOH and NH_4OH , pale orange-yellow with FeSO_4 ; stipe surface mahogany-red with KOH, orange-yellow with NH_4OH , olive with FeSO_4 ; stipe context yellow-orange with KOH, pale yellow or negative with NH_4OH , olive with FeSO_4 ; pores surface orange-red with KOH, pale yellow with NH_4OH , deep colour with FeSO_4 .

Specimens examined: Nam Nao National Park (31 July, 2005; 10 June and 1 September, 2006).

Heimiella japonica Hongo. (Figure 1.4a, b)

Pileus 2.3–15 cm broad, hemispherical to convex when young, becoming broadly-convex with age; surface glabrous, slightly viscid when moist, red or wine-red to peach-red; context light yellow, not staining when cut or bruised. *Hymenophore* tubulose, adnexed from stipe. *Tubes* less than

0.1–2 cm deep, colour light yellow; pores round to subround, colour light yellow to pale yellow, not staining. *Stipe* 6–11.6 cm long, 1–3 cm broad, slightly downward or nearly equal, typically narrowed abruptly at the base; surface covered with red reticulate, colour same as the pileus, yellow at the apex; context solid, light yellow, not staining. *Spore* 6–8 x 9–13 μm , ovoid to nearly ellipsoid, covered with reticulate-alveolate.

Chemical reaction: pileus surface pale yellow to orange-yellow with KOH and NH_4OH , pale colour with FeSO_4 ; pileus context orange-yellow with KOH, pale blue-green with NH_4OH , deep colour with FeSO_4 ; stipe surface pale yellow with KOH and NH_4OH , pale colour with FeSO_4 ; stipe context yellow-orange with KOH, pale blue-green or negative with NH_4OH , deep colour with FeSO_4 ; pores surface orange-red with KOH, negative with NH_4OH , deep colour with FeSO_4 .

Specimens examined: Nam Nao National Park (7 July and 17 September, 2005; 1 July and 1 September, 2006).

Leccinum extremorientale (L.Vass) Sing. (Figure 1.5a, b)

Pileus 8.7–14 cm, convex to broadly-convex; surface slightly viscid when wet, glabrous becoming deeply cracked which exposes pale flesh, finally entire cap surface forms a mosaic of deep cracks that, together with the large size; colour yellow brown to orange-yellow, darker with age; context cream-white to pale yellow, becoming pale pink, finally discolouring to grey when cut. *Hymenophore* tubulose, adnexed from stipe. *Tubes* 1.5–2.2 cm deep, colour pale yellow, not changing when cut; pores subround to angular, colour yellow to luteous yellow, staining red-brown when bruised. *Stipe* 12.2–16.5 cm long, 2.2–3.9 cm broad, nearly equal

to enlarging slightly downward; surface covered with fine orangeish brown scales or dots more distinctive toward the apex, colour yellow–brown, paler at apex; context solid, colour and staining like the context on pileus. *Spore* 3.5–4.5 x 11–14.5 μm , smooth, long and narrow, slightly sub-fusiform.

Chemical reaction: pileus and stipe surface deep yellow to reddish–orange with KOH, orange–yellow with NH_4OH , pale colour or negative with FeSO_4 ; pileus context pale yellow or negative with KOH, pale yellow with NH_4OH , deep colour with FeSO_4 ; stipe context pale yellow with KOH, negative with NH_4OH and FeSO_4 ; pore surface reddish brown with KOH, deep colour with NH_4OH and FeSO_4 .

Specimens examined: Nam Nao National Park (23 July and 3 September, 2006).

Phylloporus cf. rhodoxanthus (Schw.) Bres. (Figure 1.6a ,b)

Pileus 2.3–5.4 cm across, convex becoming nearly flat, sometimes with a slightly depressed center; surface velvety, sometimes finely cracked with age, dry or slightly viscid when wet; colour dark red, dull red to reddish brown, or reddish yellow; context white to pale yellow, staining faintly blue or not when cut or bruised. *Gills* running down the stipe, decurrent, subdistant, often forked and with cross veins; colour golden yellow, staining greenish blue when bruised. *Stipe* 3.5–4.9 cm long, 0.4–0.7 cm broad, more or less equal, or tapering toward the base; surface pale yellow, with reddish tinge, or nearly smooth, basal mycelium yellow; context white to pale yellow, not staining. *Spore* 4–5 x 6–9 μm , smooth, ovoid to nearly ellipsoid.

Chemical reaction: pileus surface reddish orange with KOH, blue with NH_4OH ; pileus context pale orange with KOH, negative with NH_4OH ; stipe surface reddish orange with KOH, negative with

NH_4OH ; stipe context orange–red with KOH, negative with NH_4OH ; pores surface orange–yellow with KOH, pale blue with NH_4OH .

Specimens examined: Nam Nao National Park (1 July, 2006).

Remarks: This bolete specimen has macroscopic features closely related to *Phylloporus rhodoxanthus* but spores are ovoid to slightly ellipsoid.

Strobilomyces confusus Sing. (Figure 1.7a, b)

Pileus 3.1–11.5 cm across, hemispherical when young, convex becoming broadly convex with age; surface dry, sometimes slightly viscid when wet, with whitish to grayish ground colour, covered with acute, rigid, erect, often stiff and pointed scales, colour fuscous black to black; context white, quickly staining red, then brownish black when cut. *Hymenophore* tubulose, adnexed from stipe. *Tubes* 0.3–1.8 cm deep, white, staining coral to red when cut; pores large, angular, white, staining red, then black when bruised. *Stipe* 7.8–11.2 cm long, 1–1.5 cm broad, nearly equal to tapering downward; surface shaggy, fuscous black to grayish; context solid, colour and staining like the context on pileus. *Spore* 7–9 x 7.5–11 μm , subglobose, spiny to warty with very incomplete network connecting spines.

Chemical reaction: pileus and stipe context reddish brown with KOH, orange–yellow with NH_4OH ; pore surface rusty orange with KOH, pale yellow with NH_4OH .

Specimens examined: Nam Nao national Park (4 June, 2005) and Phu Rua National Park (18 June and 30 July, 2005).

Remarks: This species is similar from *Strobilomyces floccopus*, but the two species are distinguishable in the field. *S. floccopus* has scales or warts which feel softer and more woolly than *S. confusus*. Also, *S. floccopus* has short elliptic to globose spores, covered by a distinct reticulum.

Tylopilus eximius (Peck) Sing. (Figure 1.8a, b)

Pileus 2.2–7.5 cm wide, hemispherical when young, convex for a long time before expanding; surface velvety, often slightly pitted, dry, sometimes slightly viscid when wet; colour purplish brown to reddish brown, then chocolate brown, often with a fine whitish bloom when young; context white to pale purplish brown, not staining when cut. *Hymenophore* tubulose, adnexed from stipe. *Tubes* 0.2–1 cm deep, light brown or brownish purple, becoming dark brown to purplish brown, unchanging when cut; pores are nearly circular, purplish brown, then dark pinkish brown, staining brown when bruised. *Stipe* 3.6–8.2 cm long, 1.3–2.4 cm broad, equal to subequal, clavate or tapered at either end; surface on upper half covered with pale purplish, finely scabrous when young, then subpruinose to scabrous with age; lower half covered with pale purplish, finely scabrous when young, then scabrous to subscabrous ridged, pale purplish brown to brown; base white; context solid, not staining when cut, pale purplish brown to pale lilac brown at the apex; context at base colour like at the apex, sometimes cream or yellowish. *Spore* 4–5 x 10–14 μm , smooth, ellipsoid to subfusoid.

Chemical reaction: pileus and stipe surface pale colour with KOH and NH_4OH ; pileus and stipe context pale greenish yellow with KOH, negative with NH_4OH ; pores surface orange–yellow with KOH, negative with NH_4OH .

Specimens examined: Nam Nao National Park (1 July and 3 September, 2006).

Xerocomus subtomentosus (L.:Fr.) Quél. (Figure 1.9a, b)

Pileus 4.5–5.2 cm broad, convex, becoming broadly–convex or almost applanate; surface dry, subtomentose to velvety, often becoming cracked in

age, with yellowish showing in the cracks; colour dull olivaceous to olive–brown, or yellowish brown; context thick, whitish, becoming slowly pale yellow, staining faintly blue or not when cut or bruised. *Hymenophore* tubulose, depressed or decurrent from stipe. *Tubes* 0.2–0.9 cm deep, yellowish, staining slowly greenish blue when cut; pore 0.1–0.3 cm broad at maturity, somewhat angular or more rarely sublamellate near stipe, yellowish, staining greenish blue when bruised, finally brownish. *Stipe* 3.5–6.1 cm long, 1.2–1.8 cm broad, equal downward to a narrowed base; surface with dark brick–coloured ridge approaching an obscure reticulum, sometimes pruinose to scabrous, basal mycelium sulphur–yellow to pallid; context solid, yellowish, with reddish brown stains, not staining when cut. *Spore* 4–5 x 9.5–13 μm , smooth surface, ellipsoid to subfusiform.

Chemical reaction: pileus surface mahogany–red with KOH and NH_4OH ; pileus context pale orange–yellow with KOH, negative with NH_4OH ; pores surface orange–red with KOH and NH_4OH .

Specimens examined: Nam Nao National Park (23 July and 13 August, 2005).

Discussion

In this investigation, All specimens belonged to 9 genera and 13 species as follows: *Boletellus emodensis*, *Boletus laetissimus*, *B. obscureumbrinus*, *B. subvelutipes*, *Heimiella japonica*, *Leccinum extremiorientale*, *Phylloporus* cf. *rhodoxanthus*, *Pulveroboletus ravenelii*, *Strobilomyces confusus*, *S. floccopus*, *Tylopilus ballouii*, *T. eximius* and *Xerocomus subtomentosus*. We have described 9 species of newly recorded boletes of Thailand. Up to present, this study brings the number of boletes recorded in Thailand to a total of 72 species. *B. laetissimus* and *S. confusus* were found in both

Nam Nao and Phu Rua National Parks, but *B. obscureumbrinus*, *B. subvelutipes*, *H. japonica*, *L. extremiorientale*, *P. cf. rhodoxanthus*, *T. eximius* and *X. subtomentosus* have been found in only Nam Nao National Park.

A *Heimiella* which commonly occurs in Thailand is *H. retispora* (Pat. and Baker) Boedijn. *H. japonica* has similar spore shape but is slightly longer in length compared to *H. retispora*. Obviously, the colour of *H. japonica* is bright red, turning waxy and viscid when wet with bright yellow hymenophore where the *H. retispora* is dull red with light yellow hymenophore. Their stipes are also different and they can be differentiated by the reticulate pattern in *H. japonica* and smooth pattern in *H. retispora*. During the survey, 2005–2006, we often found only *H. japonica* in Nam Nao National Park, where the *H. retispora* specimens were found in Phu Phan National Park, Sakon Nakhon and Phu Taka in Khon Kaen.

Phylloporus that was found at Nam Nao National Park was very similar to *P. rhodoxanthus* in terms of macroscopic character, oxidation when bruised and reaction to chemicals. Only the spore shape is different from *P. rhodoxanthus*.

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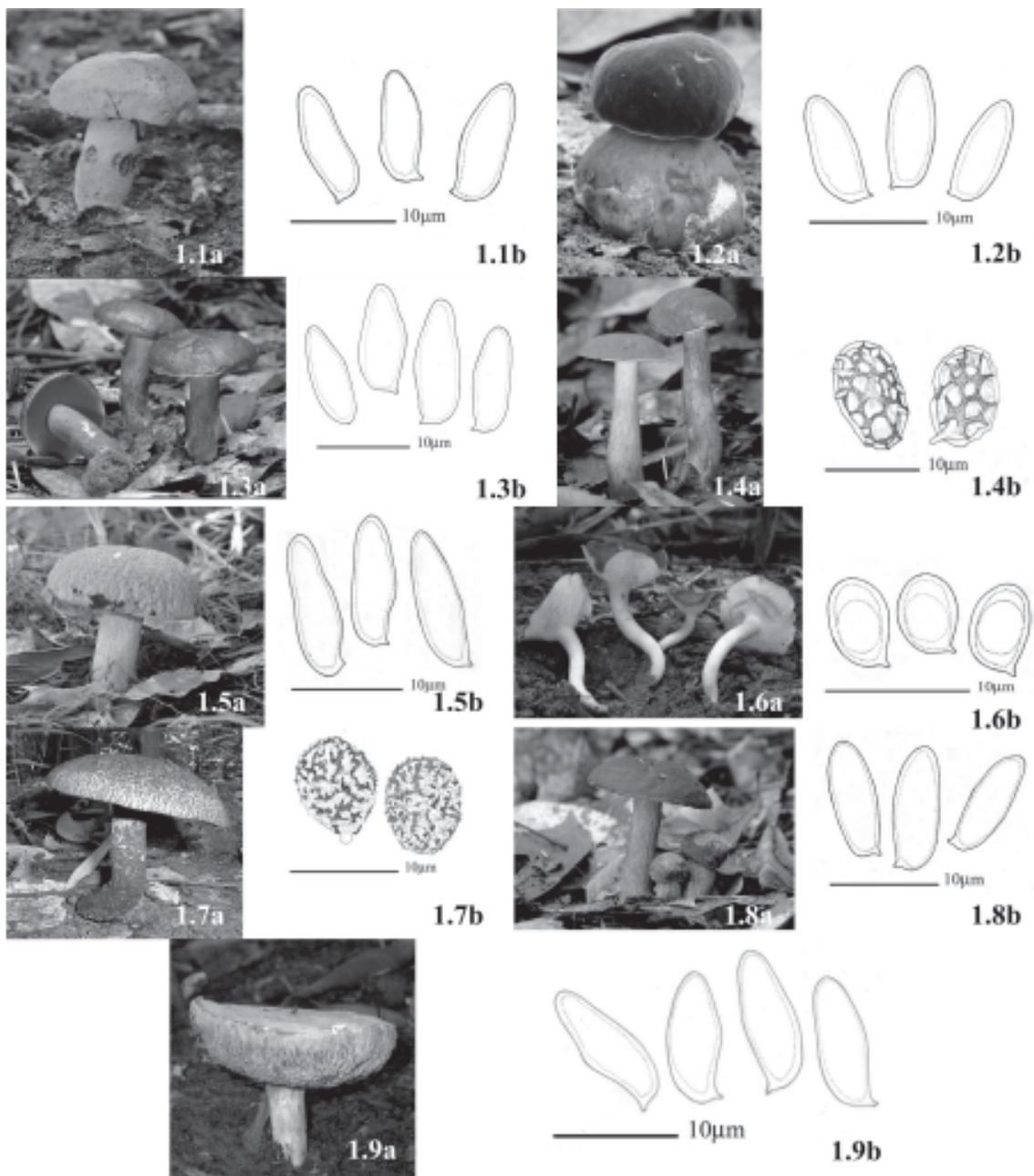


Figure 1. Fruiting bodies (a) and basidiospores (b) of the 9 new records of boletes to Thailand 1.1 *Boletus laetissimus* Hongo, 1.2 *Boletus obscureumbrinus* Hongo, 1.3. *Boletus subvelutipes* Peck., 1.4 *Heimiella japonica* Hongo, 1.5 *Leccinum extremiorientale* (L.Vass) Sing., 1.6. *Phylloporus* cf. *rhodoxanthus* (Schw.) Bres., 1.7. *Strobilomyces confusus* Sing., 1.8. *Tylopilus eximius* (Peck) Sing. and 1.9 *Xerocomus subtomentosus* (L.:Fr.) Quél.