Mycoscience (2012) 53:133–138
DOI 10.1007/s10267-011-0139-y

SHORT COMMUNICATION

Two new species of *Steccherinum* (Basidiomycota, Polyporales) from Taiwan

Hai-Sheng Yuan · Sheng-Hua Wu

Received: 1 March 2011 / Accepted: 27 June 2011 / Published online: 21 July 2011

Abstract *Steccherinum cremicolor* and *S. elongatum* are described and illustrated as new species from Taiwan. *Steccherinum cremicolor* is characterized by strictly resupinate basidiocarps, a fimbriate margin, short spines, generative hyphae dominating in the trama and subiculum, encrusted skeletocystidia, and ellipsoid basidiospores. *Steccherinum elongatum* has strictly resupinate and membranaceous basidiocarps, bearing fairly long spines, generative hyphae-dominated subiculum, elongated skeletocystidia, and ellipsoid to subglobose basidiospores.

Keywords China · Hydnaceous hymenium · Lignicolous fungi · Odontioid hymenium · Taxonomy

Introduction

Steccherinum Gray was established by S.F. Gray with *Hydnum ochraceum* Pers. as the type (Banker 1912). The genus is characterized by its effuse to effuse-reflexed basidiocarps with odontioid to hydnoid hymenial surfaces, a monomitic or dimitic hyphal system with cyanophilous skeletal hyphae, most species with clamped generative hyphae, encrusted or smooth skeletocystidia, and smooth, thin-walled, inamyloid, acyanophilous basidiospores (Maas Geesteranus 1974; Eriksson et al. 1984). *Steccherinum* relates to *Antrodiella* Ryvarden & I. Johans. and *Junghuhnia* Corda emend. Ryvarden in microscopic characters by sharing a similar hyphal structure, cyanophilous skeletal hyphae, and fairly small basidiospores (Dai and Niemelä 1997; Dai 2004). Molecular phylogenetic studies in some species in the three genera also support the viewpoint that they have a close relationship (Binder et al. 2005; Larsson 2007). Besides, three genera all cause white rot. However, *Steccherinum* differs from the other two genera by having odontioid to hydnoid hymenial surfaces. *Steccherinum* comprises about 50 species around the world [CBS database (http://www.cbs.knaw.nl/databases/)]. Thirteen species of *Steccherinum* have been recorded from East Asia (Hongo and Imazeki 1989; Dai 2011; Dai et al. 2004; Yuan and Dai 2005a, b), including three species recorded in Taiwan (Wang et al. 1999). Two new species of *Steccherinum* are illustrated, described and proposed as new to science in this paper based on the materials collected from Taiwan.

The studied specimens are deposited at the herbarium of the National Museum of Natural Science (TNM), Taichung, Taiwan. The microscopic procedure follows Dai (2010). The microscopic studies were made from thin sections of basidiocarp mounted in Cotton Blue (abbreviated as CB): 0.1 mg aniline blue dissolved in 60 g pure lactic acid; CB+ = cyanophily, CB− = acyanophily. Amyloid and dextrinoid reactions were tested in Melzer's reagent (IKI): 1.5 g KI (potassium iodide), 0.5 g I (crystalline iodine), 22 g chloral hydrate, aq. dest. 20 ml; IKI− = neither amyloid nor dextrinoid reaction. For observations and measurements of microscopic characters, 5% KOH was used as the standard mounting medium for

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all measurements. Sections were studied at magnifications up to ×1,000 using a ZEISS Axioskop microscope and phase contrast illumination. The apiculus was excluded in spore measurements. For presenting the spore size variation, 5% of the measurements out of each end of the range are given in parentheses. The following abbreviations are used: L = mean spore length (arithmetical average of all spores), W = mean spore width (arithmetical average of all spores), Q = extreme values of the length/width ratios among the studied specimens, and n = the number of spores measured from a given number of specimens. The color terms follow Anonymous (1969) and Petersen (1996).

Taxonomy

Key to species of *Steccherinum* in East Asia:

1. Basidiome strictly resupinate 2
1. Basidiome effused, effused-reflexed to pileate . . 12
2. Margin of basidiome with strong radial rhizomorphs . . . . . .*S. fimbriatum* (Pers.) J. Erikss.
2. Margin of basidiome without rhizomorphs. 3
3. Basidiome reddish-orange 4
3. Basidiome with different color 5
4. Aculei 0.5–1.5 mm long, spores narrowly ellipsoid to subcylindrical, 4–6.5 × 2–3 μm . . . . . *S. laeticolor* (Berk. & M.A. Curtis) Banker
4. Aculei generally 3 mm long, spores ellipsoid, 3.8–4.2 × 2.7–3.0 μm . . . . . *S. robustius* (J. Erikss. & S. Lundell) J. Erikss.
5. Hyphal system monomitic or monomitic in context 6
5. Hyphal system dimitic in context and aculei trama. .7
6. Hyphal system monomitic in context, dimitic in trama, basidiospores broadly ellipsoid, 3.7–4.5 × 2.7–3.3 μm . . *S. aggregatum* Hjortstam & Spooner
6. Hyphal system monomitic in context and trama, basidiospores subglobose, 4–5 × 3.5–4 μm . . . . . *S. albofibrillosum* (Hjortstam & Ryvarden) Hallenb. & Hjortstam
7. Basidiome leathery 8
7. Basidiome membranaceous 9
8. Skeletal hyphae strictly parallel in trama, skeletocystidia clavate, basidiospores ellipsoid to subglobose, 2.6–3.1 × 1.9–2.2 μm. . . . . .*S. mukhinii* Kotir. & Y.C. Dai
8. Skeletal hyphae subparallel to interwoven in trama, skeletocystidia mostly subulate, basidiospores broadly ellipsoid, 3.8–5 × 2.3–3 μm. . . . . *S. subulatum* H.S. Yuan & Y.C. Dai
9. Basidiospores broadly ellipsoid to subglobose, 4.4–5.3 × 3.3–4.8 μm. . . . *S. elongatum* H.S. Yuan & Sheng H. Wu
9. Basidiospores ellipsoid to subcylindrical, width up to 2.6 μm 10
10. Basidiospores subcylindrical with parallel sides, 4.5–5.5 × 2–2.2 μm . . . . . *S. litschaueri* (Bourdot & Galzin) J. Erikss.
10. Basidiospores ellipsoid with convex side 11
11. Basidiospores shorter, 3–3.8 × 2–2.6 μm . . . . . *S. cremicolor* H.S. Yuan & Sheng H. Wu
11. Basidiospores longer, 4–4.5 × 2.25–2.5 μm . . . . . *S. ciliolatum* (Berk. & M.A. Curtis) Gilb. & Budington
12. Aculei up to 4–5 mm long, skeletocystidia mostly smooth . . . . . *S. murashkinskyi* (Burt) Maas Geest.
12. Aculei up to 2 mm long, skeletocystidia encrusted 13
13. Context corky, basidiospores thinner, 2.8–3.5 × 1.3–1.7 μm . . . . . *S. rawakense* (Pers.) Banker
13. Context leathery, basidiospores wider 14
14. Basidiospores subglobose, 3.9–4.7 × 3.3–4 μm . . . . . *S. subglobosum* H.S. Yuan & Y.C. Dai
14. Basidiospores ellipsoid, 3.0–3.6 × 1.9–2.6 μm . . . . . *S. ochraceum* (Pers.) Gray

Steccherinum cremicolor H.S. Yuan & Sheng H. Wu, sp. nov. Fig. 1

MycoBank no. MB 519892.

Carpophorum annuum, resupinatum, hydnaceum; dentes usque ad 0.5 mm longi, 7–8 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales contexti 2–3 μm diam. Skeletocystidia abundantia, clavata, incrustata. Sporae hyalinae, subglobosae, 3–3.6 × 2.1–2.5 μm.

Holotype **Taiwan**, Nantou: entrance of Shashilindao, 23.31N, 120.55E, alt. 1,300 m, on branch of *Cunninghamia lanceolata*, 7.XII.1994, *Wu 9412-3* (TNM F0002936).

Etymology From the Latin *cremicolor* = cream-colored, referring to the cream-colored hymenial surface.

Basidiome. Annual, resupinate, effuse, closely adnate, membranaceous when dry, up to 10 cm long and 1.5 cm wide. Hymenial surface odontioid, occasionally pilose due to projecting skeletocystidia, cream to pale buff; margin thinning out, white, fimbriate, indistinctly rhizomorphic. Aculei evenly distributed, cream to pale buff, subulate, up to 0.5 mm long, 7–8 per mm, separate or fused, more or less fimbriate due to projecting skeletocystidia. Subiculum very thin, ca. 50 μm, membranaceous when dry; tissues unchanged in KOH.

Hyphal structure. Hyphal system dimitic; generative hyphae with clamp connections; skeletal hyphae thick-walled to subsolid, IKI−, CB+.

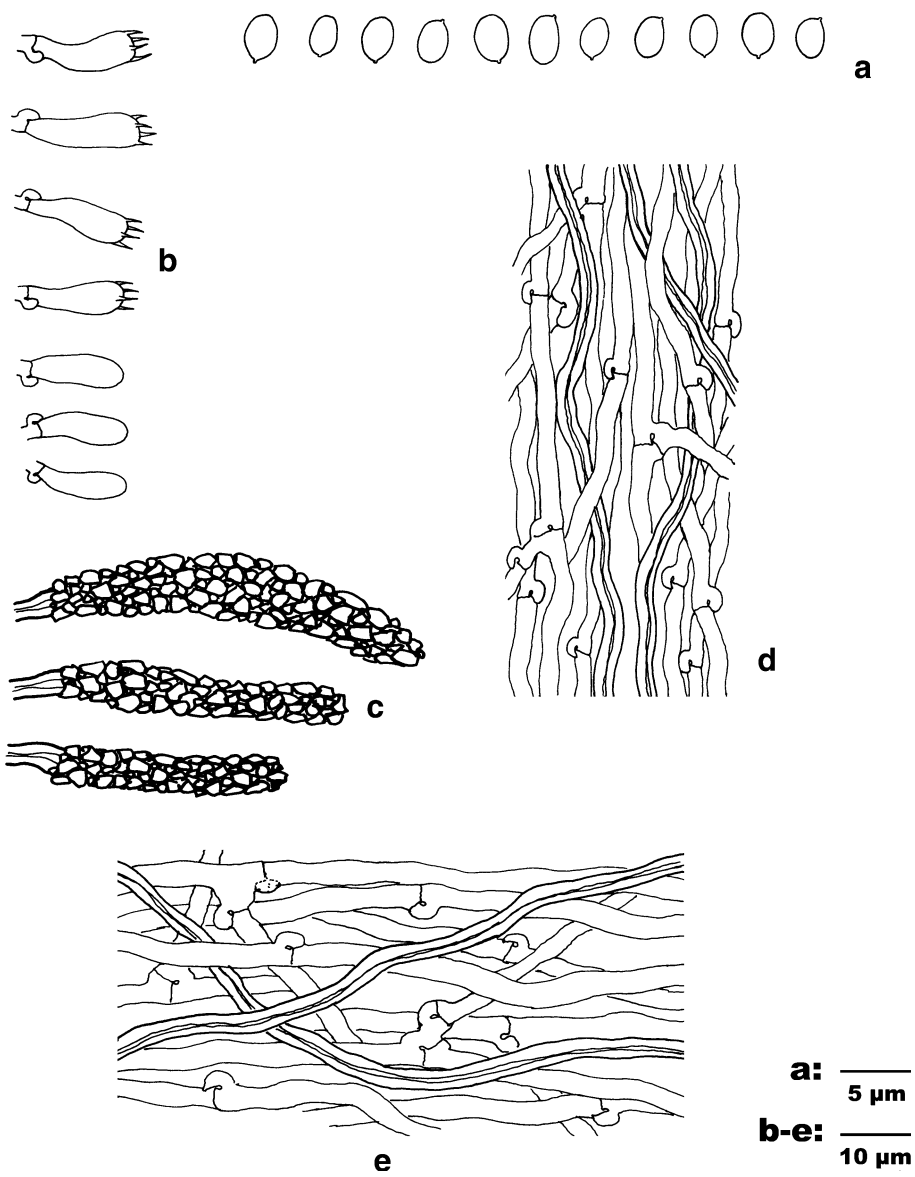

Fig. 1 Microscopic structures of *Steccherinum cremicolor* (holotype: TNM F0002936). **a** Basidiospores. **b** Basidia and basidioles. **c** Upper part of encrusted skeletocystidia. **d** Hyphae from aculei trama. **e** Hyphae from subiculum

Subiculum. Dominated by generative hyphae; generative hyphae hyaline, thin-walled, moderately branched, 2.5–4.5 µm diam; skeletal hyphae rare, loosely interwoven, colorless, thick-walled to subsolid, unbranched, 2–3 µm diam.

Aculei. Dominated by generative hyphae; generative hyphae hyaline, thin-walled, moderately branched, 2–4 µm diam; skeletal hyphae rare, loosely interwoven, colorless, thick-walled to subsolid, unbranched, 1.8–3 µm diam. Skeletocystidia abundant, clavate, thick-walled, originated from trama, (immersed) embedded or projecting, heavily encrusted, 21–55 × 5.5–9 µm (with encrustation). Basidia clavate, with a basal clamp connection and four sterigmata, 10–14 × 3.5–5 µm. Basidiospores ellipsoid, hyaline, thin-walled, smooth, IKI−, CB−, 3–3.6(–3.8) × (2–)2.1–2.5 (–2.6) µm, $L = 3.26$ µm, $W = 2.27$ µm, $Q = 1.43$–1.45 ($n = 60/2$).

Additional specimen (paratype) examined **Taiwan**, Nantou: Tungpu, entrance of Salishienshilindao, 23.32N, 120.55E, alt. 1,300 m, on branch of *Cunninghamia lanceolata*, 24.XII.1993, *Wu 9411-68* (TNM F0001498).

Specimens of some related species examined. *Steccherinum albofibrillosum*. **Colombia**, Cundinamarca, km 16 en la via Mosquera-La Mesa, 3.VI.1978 *Ryvarden 15435* (O). *S. ciliolatum*. **Thailand**, Cangwat Chiang Mai, Amphoe Mae Rim, Kong Hae, 15.II.1979 *Ryvarden 17520* (O); **Colombia**, Cundinamarca, km 16 en la via Mosquera-La Mesa, 3.VI.1978 *Ryvarden 15422* (O); **USA**, Tennessee, Great Smokey Mts. Nat. Park. Gatlinburg, Cherokee

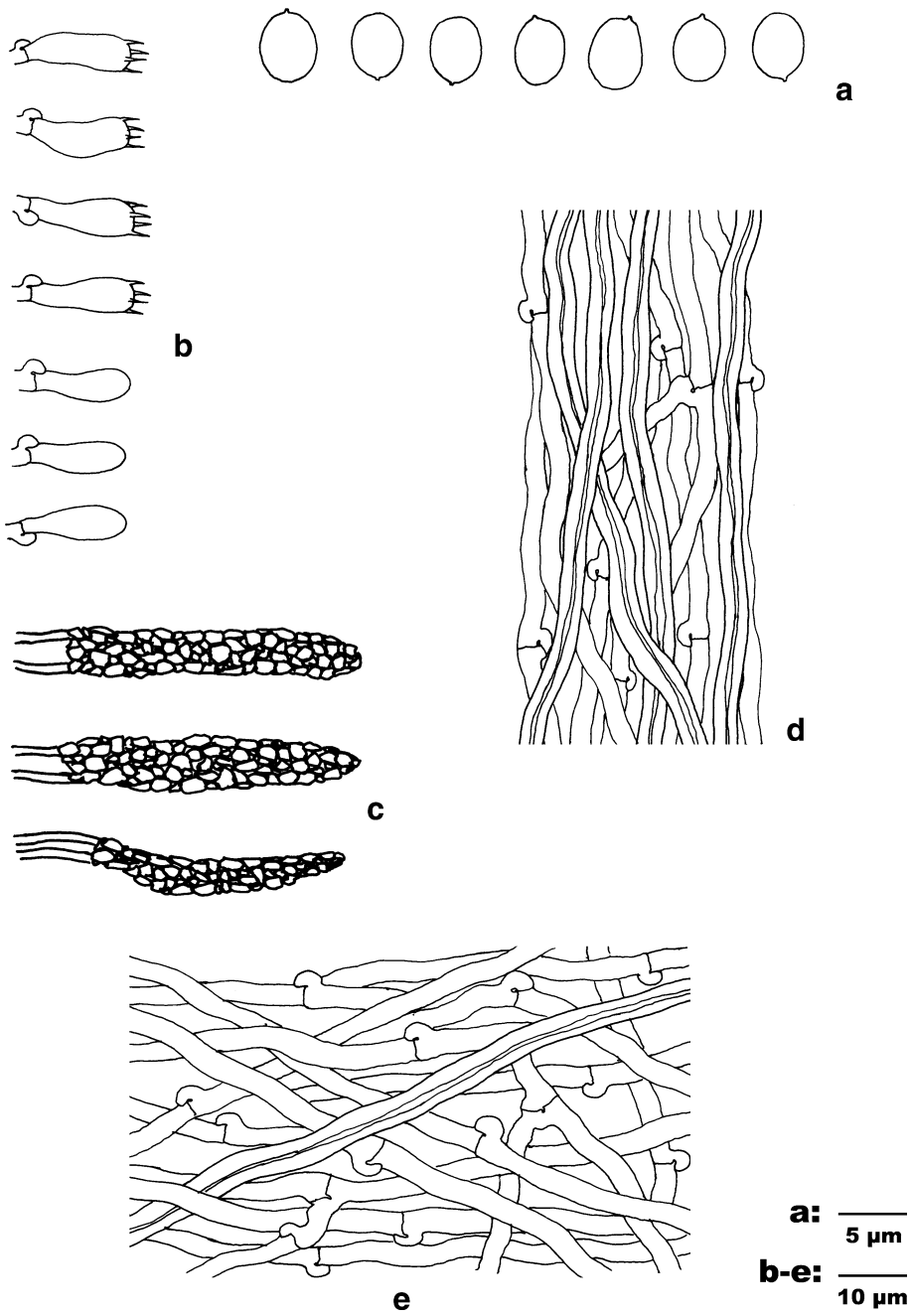

Fig. 2 Microscopic structures of *Steccherinum elongatum* (holotype: TNM F0001612). **a** Basidiospores. **b** Basidia and basidioles. **c** Upper part of encrusted skeletocystidia. **d** Hyphae from aculei trama. **e** Hyphae from subiculum

Orchard, 8.IX.1977 *Ryvarden 14225* (O). *S. litschaueri*. **Finland**, Hollola, Kalliola, Meruenkorpi puronvarsilehto, kuorellinen lahorunko maassa, on *Salix caprea*, 1.IX.1991 *Haikonen 13411* (H). *S. ochraceum*. **China**, Heilongjiang Prov., Great Xinggan Mts., Huzhong Nature Reserve, on fallen trunk of *Larix*, 16.XIII.2003. *Dai 4645* (IFP); Hulin, Qihulin Forest farm, on dead tree of *Alnus*, 11.IX.2004. *Yuan 416* (IFP); Liaoning Prov., Tieling, Xifeng County, Binglashan Forest Park, on dead tree of angiosperm, 30.IX.2003. *Dai 5192* (IFP).

Remarks. *Steccherinum cremicolor* resembles *S. albofibrillosum*, *S. ciliolatum*, *S. cremeoalbum* Hjortstam, *S. litschaueri*, and *S. straminellum* (Bres.) Melo by sharing resupinate, pale-colored basidiocarps, odontioid hymenial surface and very thin subiculum.

Steccherinum albofibrillosum differs from *S. cremicolor* in having a monomitic hyphal system, slightly thick-walled hyphae, and subglobose basidiospores (4–4.5 × 3.5–4 µm, Hallenberg and Hjortstam 1988). *S. ciliolatum* has longer basidiospores (4.5–5.4 × 1.8–2.7 µm, Maas Geesteranus

1974) than *S. cremicolor*. *S. cremeoalbum* differs from *S. cremicolor* in having simple-septate genrerative hyphae. *S. litschaueri* is distinct from *S. cremicolor* by having longer spines and longer basidiospores (4.5–5.5 × 2–2.2 μm, Eriksson et al. 1984). *S. straminellum* has a pale ochraceous hymenial surface, ellipsoid to subcylindrical basidiospores (3.5–4.5 × 2–2.2 μm), and a wider skeletocystidia (7–15 μm, Melo 1995), which can distinguish it from *S. cremicolor*.

Macroscopically, the resupinate part of the cosmopolitan species, *S. ochraceum*, is similar to *S. cremicolor*, but the former is delimited from the latter already in the field by its effused-reflexed to pileate basidiomes and tough leathery consistency (Maas Geesteranus 1971).

Steccherinum elongatum H.S. Yuan & Sheng H. Wu, sp. nov. Fig. 2

MycoBank no. MB 519893.

Carpophorum annuum, resupinatum, hydnaceum; dentes usque ad 1.5 mm longi, 3–4 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales contexti 3–5.5 μm diam. Skeletocystidia abundantia, clavata, incrustata. Sporae hyalinae, late ellipsoideae vel subglobosae, 4.5–5.1 × 3.4–4.3 μm.

Holotype **Taiwan**, Pingtung: Kenting National Park, Nanjenshan, alt. 150 m, on angiosperm branch, 19.II.1992, *Wu 9202-3* (TNM F0001612).

Etymology From the Latin *elongatum* = elongate, referring to the very long skeletocystidia.

Basidiome. Annual, resupinate, effuse, closely adnate, membranaceous when dry, up to 15 cm long and 5 cm wide. Hymenial surface odontioid, white, cream to pale buff; margin thinning out, white, fimbriate. Aculei unevenly distributed, up to 1.5 mm long, 3–4 per mm, cream to buff, subulate, mostly separated, rarely fused, apex more or less fimbriate. Subiculum very thin, ca. 80 μm, cream, membranaceous when dry; tissues unchanged in KOH.

Hyphal structure. Hyphal system dimitic; generative hyphae with clamp connections; skeletal hyphae colorless, thick-walled to subsolid, IKI−, CB+.

Subiculum. Dominated by generative hyphae; generative hyphae hyaline, thin-walled, moderately branched, 3–4.5 μm diam; skeletal hyphae rare, loosely interwoven, colorless, thick-walled to subsolid, unbranched, 3–5.5 μm diam.

Aculei. Dominated by generative hyphae when young, with more skeletals when old; generative hyphae hyaline, thin-walled, occasionally branched, 2.5–4 μm diam; skeletal hyphae loosely interwoven, colorless, thick-walled to subsolid, unbranched, 3–4.5 μm diam. Skeletocystidia abundant, clavate to cylindric, thick-walled, originated from tramal skeletal hyphae, embedded or projecting, heavily encrusted, normally 25–80 × 5–10 μm (with encrustion), occasionally up to 130 μm long. Basidia clavate, with a basal clamp connection and four sterigmata, 12–15 × 4.5–6 μm. Basidiospores broadly ellipsoid to subglobose, hyaline, thin-walled, smooth, IKI−, CB−, (4.4–)4.5–5.1(–5.3) × (3.3–)3.4–4.3(–4.8) μm, $L = 4.79$ μm, $W = 3.89$ μm, $Q = 1.19$–1.23 ($n = 60/2$).

Additional specimen (paratype) examined **Taiwan**, Kaohsiung: Liukuei, Shanping, 22.58 N, 120.41E, alt. 750 m, on angiosperm branch, 22.XII.1993, *Wu 9312-44* (TNM F0001553).

Specimen of a related species examined. *S. bourdotii*. **Finland**, U. Helsinki, Wiik, Säynäslahti, puhdistamo Rantalehdosta eristetty ojitettu soppi lehto, on fallen branch of *Alnus glutinosa*, 8.IX.1990 *Saarenoksa 31090* (H).

Remarks. *Steccherinum elongatum* resembles *S. albofibrillosum* by having white to buff-colored basidiocarps and similar-sized subglobose basidiospores. However, the latter species differs from *S. elongatum* by having shorter spines, a monomitic hyphal system and smaller basidiospores.

Steccherinum bourdotii Saliba & A. David and *S. subglobosum* resemble *S. elongatum* in sharing features of fairly long spines and similar basidiospores. However, the leathery consistency of the former two species can separate *S. elongatum*, which is membranaceous. Moreover, the former two are temperate species, while specimens of *S. elongatum* were collected from tropical lowland southern Taiwan.

Acknowledgments We express our gratitude to Dr. Yoshitaka Ono and two anonymous reviewers to improve the manuscript. The senior author is grateful to the colleagues of the National Museum of Natural Science of ROC for offering help during his visit there. This project was supported by a Postdoctoral Fellowship Grant (no. NSC98-2811-B-178-003) from the National Science Council of ROC and National Nature Science Foundation of China (nos. 31070023 and 30700004).

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