

Three New Coelotes Spiders (Araneae: Amaurobiidae) from Taiwan

Xinping Wang^{1,*}, I-Min Tso² and Hai-Yin Wu³

¹Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, NY 10024, USA

(Accepted January 4, 2001)

Xinping Wang, I-Min Tso and Hai-Yin Wu (2001) Three new *Coelotes* spiders (Araneae: Amaurobiidae) from Taiwan. *Zoological Studies* 40(2): 127-133. Five species of the spider genus *Coelotes* were collected from pitfall traps in the Hui-Sun Experimental Forest Station in the central mountains of Taiwan. These include *Coelotes xinhuiensis* Chen, 1984, *Paracoelotes taiwanensis* Wang and Ono, 1998; and 3 new species: *Coelotes bifida* sp. n., *C. latus* sp. n., and *C. longus* sp. n. The new species are described and illustrated, and the spinneret morphology and natural history of the new species *C. bifida* and *C. latus* are reported. The current number of coelotine spider species in Taiwan is increased to 12. The species, *Wadotes primus* Fox, 1937, which was described from Hong Kong, is newly transferred to the genus *Coelotes* (new combination).

Key words: Coelotes bifida, Coelotes latus, Coelotes longus, Spinnerets, Hui-Sun Forest Area.

Coelotes spiders are widespread and specious in East Asia (Yaginuma 1986, Wang et al. 1990, Wang and Ono 1998), with currently more than 100 described species. Collections made in the past 3 decades (Lee 1964, Chu and Okuma 1970 1974 1975, Chen 1996) failed to discover any coelotine spiders from Taiwan. This situation was rectified when Wang and Ono (1998) reported 9 coelotine species of the genera Coelotes and Paracoelotes (8 of which were new) collected from an expedition conducted by the National Science Museum, Tokyo from 1989 to 1991. In that work, Wang and Ono (1998) also found that coelotine spiders were one of the most abundant components of Taiwanese ground spider fauna. Consequently, more new species should be expected if larger-scale collections using different techniques are conducted in mountainous areas. In a long-term ecological research project conducted at the Hui-Sun Experimental Forest Station, Nantou County, Taiwan, many pitfall traps were established in order to survey the population dynamics of insectivores. During the survey, a large number of spiders collected from these traps were forwarded to the authors. Since pitfall traps are rarely used in Tai-

wanese arachnofaunal surveys, many unrecorded species were found in these collections. Among the specimens obtained, coelotine spiders were quite abundant and were a major component of the spider fauna (IM Tso, unpubl. data). Of the 5 species of coelotine spiders found in these pitfall collections, two had been reported by Wang and Ono (1998): Coelotes xinhuiensis Chen, 1984 and Paracoelotes taiwanensis Wang and Ono, 1998, and 3 of them are shown to be new species: C. bifida sp. n., C. latus sp. n., and C. longus sp. n.

In addition to taxonomical information, in this paper we also report on coelotine spider spinneret morphology and natural history. The spinneret morphology of coelotine spiders, which has never been reported before, is explored using representatives of 2 new species *C. bifida* and *C. latus*. The results will help provide the ground plan for spinneret morphology of coelotine spiders. Besides spinneret morphology, any natural history information is lacking for the great majority of Taiwanese spiders. Generally, weavers such as coelotines seldom wander far from their web locations. However, during mating seasons, males will leave their web to ac-

²Department of Biology, Tunghai University, Taichung, Taiwan 407, R.O.C.

³Institute of Natural Resource Management, Tunghwa University, Hwalian, Taiwan 974, R.O.C.

^{*}To whom correspondence and reprint requests should be addressed. Current address: Department of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118, USA E-mail: xwang@CalAcademy.org

tively search for a mate, and females sometimes will also leave their web to search for oviposition sites (Draney 1997). Therefore, temporal abundance patterns of adults reflect the activity and periods of reproduction (Uetz and Unzicker 1976), thus can be used to imply the natural history of ground spiders. Therefore, we generated phenograms of both males and females by pooling adult specimens collected from all sites to serve as a basis for future ecological and behavioral studies.

MATERIALS AND METHODS

The Hui-Sun Experimental Forest Station (24°04'N; 121°01'E) situated in the central mountains of Taiwan (Nantou Co.), is a research and recreational facility operated by the Dept. of Forestry, Chung-Hsing Univ., Taiwan. The collecting site is located beside a stream (Kuandau Shi), and its vegetation structure is characterized by a mixture of patchy fir plantations (HWP) and secondary broadleaf woods (SBW). Ten pitfall stations were established in the collecting site (4 in HWP and 6 in SBW). Each station was composed of 3 pitfall traps (plastic cups of 9-cm diameter and 12.5-cm height with a cover made of cardboard) set 10 m apart. The collecting sites were sampled every 12 mo (each time for 6 d) for a year (Oct. 1997 to Oct. 1998, seven trips in total). The traps were set with 70% ethanol. While emptying the traps at the end of each sampling period, the contents were wrapped with cheesecloth and stored in a 70% ethanol solution. Sorting and preliminary identification were carried out in the Dept. of Biology, Tunghai Univ., Taiwan; morphological description and spinneret SEM were conducted in the Division of Invertebrate Zoology, American Museum of Natural History, USA.

Although coelotines have been regarded as agelenids (Peng and Yin 1998), the present paper follows the systematics in the world catalog (Platnick 1998).

All measurements are in millimeters. Leg measurements are shown as: total length (femur, patella + tibia, metatarsus, tarsus). Spinneret morphologies were observed using a scanning electron microscope (SEM). Fresh material, especially pitfall-trapped specimens, is good for SEM spinneret observation. Only fully extended spinnerets were selected as samples. Prior to SEM examination, all spinnerets were cleared and transferred to 90% (20 min), 95% (20 min), and finally 100% ethanol for at least 24 h. All spinnerets used in this study were air dried.

The voucher specimens used in this study are deposited at the Dept. of Biology, Tunghai Univ. (THU), Taiwan. The additional specimens examined are from the American Museum of Natural History, New York (AMNH) and the National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH). The abbreviations used in this paper are as follows: AME, anterior median eye; ALE, anterior lateral eye; PME, posterior median eye; PLE, posterior lateral eye; ALS, anterior lateral spinneret; PLS, posterior lateral spinneret; PMS, posterior median spinneret; MAP, major ampullate spigot; PI, piriform spigot; AC, aciniform spigot; CY, cylindrical spigot; mAP, minor ampullate spigot.

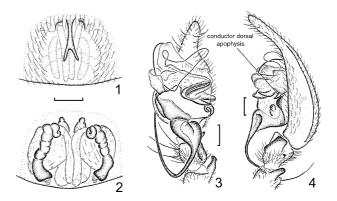
TAXONOMY

Coelotes bifida sp. n. (Figs. 1-10)

Types: ♀ holotype (THU-Ar-990017) with 1 ♂ paratype (THU-Ar-990020), Hui-Sun Experimental Forest Station, elev. 1680 m, Nantou Co., Taiwan, 31 Mar. 1998; Hai-Yin Wu.

Etymology: The specific name refers to the bifid shape of the female epigynal teeth.

Diagnosis: The female of this new species is similar to Coelotes primus (Fox, 1937) by the presence of bifid epigynal teeth, but can be distinguished by the relatively anteriorly situated copulatory openings; the moderately bifurcated epigynal teeth; the strongly developed copulatory ducts; the short, anteriorly situated spermathecal heads; and the longitudinally elongated, widely separated spermathecae (Figs. 1, 2). The male can be distinguished by the relatively broad, bifurcated, more-or-less spiral con-



Figs. 1-4. Coelotes bifida sp. n., 1) female epigynum, ventral view; 2) female epigynum, dorsal view; 3) male palp, ventral view; 4) male palp, retrolateral view. The scales are 0.2 mm in length.

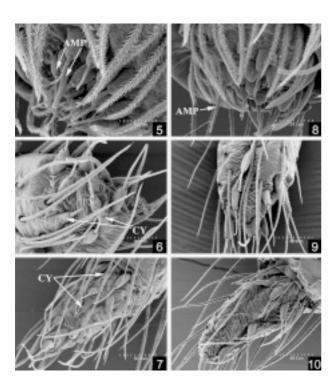
ductor, the well-developed conductor lamella, and the small conductor dorsal apophysis (Figs. 3, 4).

According to the genitalic structure, *Wadotes primus* Fox, 1937 from Hong Kong, which is similar to *C. bifida* sp. n., should be a species of the genus *Coelotes* (female holotype and 1 female paratype from Hong Kong, in AMNH and NMNH, examined by X Wang) (new combination).

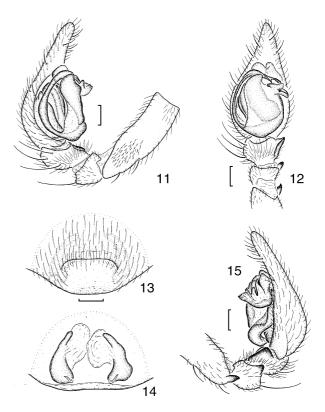
Female (holotype): Total length 4.30. Carapace 1.90 long, 1.25 wide. Cheliceral promargin with 3 teeth, retromargin with 2. Eye sizes and interdistances: AME 0.05, ALE 0.10, PME 0.10, PLE 0.10, AME-AME 0.05, AME-ALE 0.02, PME-PME 0.06, PME-PLE 0.07, ALE-PLE 0.05, AME-PME 0.08. Leg measurements: I: 5.35 (1.51, 1.80, 1.19, 0.85); II: 4.56 (1.32, 1.49, 1.03, 0.72); III: 4.29 (1.21, 1.37, 1.10, 0.61); IV: 6.08 (1.67, 1.95, 1.65, 0.81). Labium length slightly shorter than width (3.6/4.2). Epigynal teeth long, anteriorly situated, with bifurcated apex; atria small, anteriorly situated, close together; copulatory ducts strongly elongated, convoluted; spermathecal heads short, situated anterad spermathecae; spermathecae slender, longitudinally elongated, slightly convoluted, widely separated, with indistinct stalks and bases (Figs. 1, 2).

Male (paratype): Total length 5.00. Carapace 2.50 long, 2.50 wide. Cheliceral promargin with 3 teeth, retromargin with 2. Eye sizes and interdistances: AME 0.06, ALE 0.16, PME 0.13, PLE 0.14, AME-AME 0.05, AME-ALE 0.03, PME-PME 0.07, PME-PLE 0.08, ALE-PLE 0.04, AME-PME 0.10. Leg measurements: I: 8.32 (2.18, 2.72, 2.02, 1.40); II: 7.22 (2.00, 2.34, 1.70, 1.18); III: 6.04 (1.90, 2.04, 1.74, 0.96); IV: 9.30 (2.48, 2.98, 2.62, 1.22). Labium length slightly shorter than width (3.70/4.00). Palpal patellar apophysis present, distal end slightly curved; retrolateral tibial apophysis broad, distal end not stretched beyond tibia; lateral tibial apophysis small; lateral cymbial furrow strongly elongated, distal end extending beyond cymbium, dorsal edge strongly concave; conductor broad, slightly spiral, with bifid distal end; conductor lamella strongly developed; conductor dorsal apophysis small; median apophysis small, spoon-like, distal end not sharply pointed; embolus with posterior origin, extremely long and slender (Figs. 3, 4).

Spinnerets: ALS with 2 major ampullate spigots (MAP), 8-13 piriform spigots (PI), one MAP in male



Figs. 5-10. Coelotes bifida sp. n., spinnerets (female: THU-Ar-990027; male: THU-Ar-990026), ventral view, right side. 5) Female ALS; 6) female PMS; 7) female PLS; 8) male ALS; 9) male PMS; 10) male PLS.

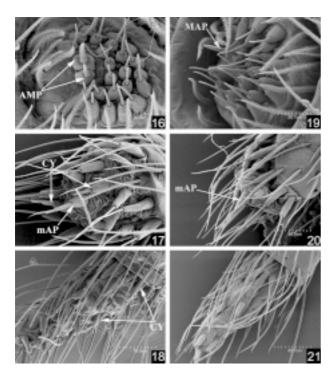


Figs. 11-15. Coelotes latus sp. n., 11) male palp, prolateral view; 12) male palp, ventral view; 13) female epigynum, ventral view; 14) female epigynum, dorsal view; 15) male palp, retrolateral view. The scales are 0.2 mm in length.

ALS with shaft reduced; PMS with 7-10 aciniform spigots (AC), female PMS with 2 cylindrical spigots (CY), minor ampullate spigots (mAP) not apparent on either male or female PMS; PLS with 7-11 aciniform spigots in both male and female, two cylindrical spigots in female (Figs. 5-10).

Distribution: Taiwan (Nantou).

Natural History: Adult males of *C. bifida* were most abundant in Oct., and the number declined through the winter months. The number of females trapped was smaller than that of males, and they appeared at a latter time. This abundance pattern indicates that mating probably commences in fall and continues throughout the winter. Oviposition by females possibly begins in early winter and persists until spring. In addition, there seems to be a seasonal reproductive cycle in *C. bifida*, because, the number of adult males peaked again in the pitfall collection of Oct. 1998 (Fig. 24).



Figs. 16-21. Coelotes latus sp. n., spinnerets (male and female paratypes), ventral view, right side. 16) Female ALS; 17) female PMS; 18) female PLS; 19) male ALS; 20) male PMS; 21) male PLS.

(THU-Ar-99-0067~68), Apr. 1998; 23 & & , (THU-Ar-99-0069~91), Oct. 1997; 7 & & , (THU-Ar-99-0092~98), Dec. 1997; 1 & , (THU-Ar-99-0099), Feb. 1998; 14 & & , (THU-Ar-99-0100~0113), Oct. 1998.

Coelotes latus sp. n.

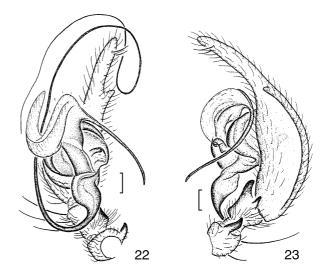
(Figs. 11-21)

Types: *{\it 3}* holotype (THU-Ar-990034) and 1 ${\it 3}$ paratype (THU-Ar-990033), Oct. 1997, Hai-Ying Wu; elev. 1500 m; 1 $\it 4$ paratype (THU-Ar-990025), Dec. 1997, Hai-Ying Wu, 1675 m, all from the Hui-Sun Experimental Forest Station, Nantou Co., Taiwan.

Etymology: The specific name refers to the broad copulatory ducts of the female.

Diagnosis: This new species is similar to *C. platnicki* Wang and Ono, 1998 by the presence of the male femoral apophysis and the absence of female epigynal teeth, but can be easily distinguished by the less-bifurcated femoral apophysis; the relatively broad patellar apophysis; the relatively short, less-modified conductor, the dorsally situated, relatively short conductor dorsal apophysis of the male (Figs. 11, 12, 15) and the relatively small copulatory ducts; and the less convoluted spermathecae of the female (Figs. 13-14).

Male (holotype): Total length 7.30. Carapace 3.50 long, 2.30 wide. Cheliceral promargin with 3 teeth, retromargin with 4. Eye sizes and interdistances: AME 0.10, ALE 0.18, PME 0.18, PLE 0.19, AME-AME 0.10, AME-ALE 0.04, PME-PME 0.10, PME-PLE 0.12, ALE-PLE 0.04, AME-PME 0.12. Leg measurements: I: 10.8 (2.92, 3.60, 2.72, 1.60); II: 9.74 (2.62, 3.16, 2.46, 1.50); III: 8.96 (2.48, 2.80,



Figs. 22-23. Coelotes longus sp. n., 22) male palp, ventral view; 23) male palp, retrolateral view. The scales are 0.2 mm in length.

2.48, 1.20); IV: 12.0 (3.24, 3.84, 3.50, 1.46). Labium length approximately same as width. Palpal femoral apophysis present, slightly bifurcated; femora with numerous short spines on prolateral surface; patellar apophysis present, short, relatively broad, not ventrally curved; retrolateral tibial apophysis as long as tibia, distal end not extending beyond tibia; lateral tibial apophysis not visible; lateral cymbial furrow short; conductor broad, modified; conductor lamella less developed; conductor dorsal apophysis present, situated relatively dorsad of conductor; median apophysis absent; embolus strong, moderately long, with basal origin, and bifurcated distal end (Figs. 11, 12, 15).

Female (paratype): Total length 8.40. Carapace 3.45 long, 2.18 wide. Cheliceral promargin with 3 teeth, retromargin with 4. Eye sizes and interdistances: AME 0.10, ALE 0.17, PME 0.16, PLE 0.17, AME-AME 0.08, AME-ALE 0.06, PME-PME 0.09, PME-PLE 0.15, ALE-PLE 0.06, AME-PME 0.15. Leg measurements: I: 8.86 (2.42, 3.06, 2.03, 1.35); II: 7.49 (1.92, 2.58, 1.82, 1.17); III: 6.89 (1.95, 2.18, 1.80, 0.96); IV: 9.95 (2.70, 3.29, 2.76, 1.20). Labium length approximately same as width. Epigynal teeth absent; atria small, shallow; copulatory ducts broad; spermathecal heads small, anteriorly situated; spermathecae slightly elongated, simple, with indistinct stalks and bases (Figs. 13-14).

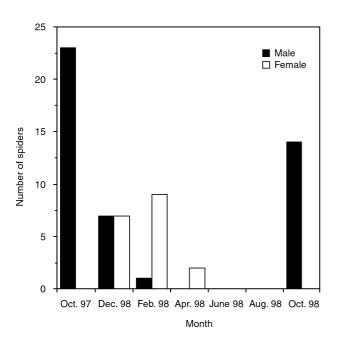


Fig. 24. Number of male and female *Coelotes bifida* collected bimonthly between October 1997 and October 1998 from 30 pit-fall traps established at the Hui-Sun Experimental Forest Station.

Spinnerets: ALS with 2 major ampullate spigots (MAP), 20-23 piriform spigots (PI), one MAP in male ALS with shaft reduced; PMS with 16-17 aciniform spigots (AC), female PMS with 2 cylindrical spigots (CY), both male and female PMS with 1-2 minor ampullate spigots (mAP); PLS with 15-19 aciniform spigots in both male and female, two cylindrical spigots in female (Figs. 16-21).

Distribution: Taiwan (Nantou).

Natural history: The temporal abundance pattern of *C. latus* is similar to that of *C. bifida*, but the sex ratio is more highly skewed. Mating of this species probably also begins in Oct., but seems to occur in fall only because no male specimens were found in the Dec. and Feb. collections. Similarly, oviposition of females probably is confined to Feb. only. An extremely high level of skewedness in the sex ratio indicates that females were normally not active on the ground, even during the mating seasons. Reproduction of *C. latus* seems to also exhibit a seasonal cycle, for the number of males in the Oct. 1998 collection peaked again (Fig. 25).

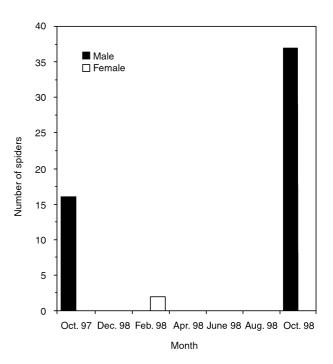


Fig. 25. Number of male and female *Coelotes latus* collected bimonthly between October 1997 and October 1998 from 30 pit-fall traps established at the Hui-Sun Experimental Forest Station.

1997; 16 & &, (THU-Ar-99-0116~0131), Oct. 1997; 37 & &, (THU-Ar-99-0132~0168), Oct. 1998.

Coelotes longus sp. n. (Figs. 22, 23)

Types: ♂ holotype (THU-Ar-990018) from Hui-Sun Experimental Forest Station, elev. 1500 m, Nantou Co., Taiwan, Oct. 1997, Hai-Ying Wu.

Etymology: The specific name refers to the long, slender conductor.

Diagnosis: The male of this new species is similar to that of *C. ensifer* Wang and Ono, 1998 by the absence of a male conductor dorsal apophysis, but can be distinguished by the relatively long patellar apophysis and the longer conductor (Figs. 22-23).

Male (holotype): Total length 5.02. Carapace 2.52 long, 1.84 wide. Cheliceral promargin with 5 teeth, retromargin with 4. Eye sizes and interdistances: AME 0.08, ALE 0.16, PME 0.12, PLE 0.13, AME-AME 0.05, AME-ALE 0.02, PME-PME 0.06, PME-PLE 0.06, ALE-PLE 0.03, AME-PME 0.09. Leg measurements: I: 9.24 (2.52, 3.18, 2.16, 1.38); II: 8.02 (2.28, 2.60, 1.94, 1.20); III: 7.36 (2.04, 2.24, 1.98, 1.10); IV: 10.2 (2.74, 3.22, 3.00, 1.28). Labium length slightly shorter than width (4.8/5.5). Palpal patellar apophysis present, relatively long; distal end of retrolateral tibial apophysis strongly extending beyond tibia; lateral tibial apophysis large, long; lateral cymbial furrow strongly elongated, distal edge extending beyond cymbium, dorsal edge strongly concave; conductor extremely long, slender; conductor lamella strongly developed; conductor dorsal apophysis absent; median apophysis spoonlike, distal end slightly pointed; embolus posterior origin, extremely long, slender (Figs. 22-23).

Distribution: Taiwan (Nantou).

Natural history: No information is available due to the scarcity of the specimens collected. Other specimens examined: none.

ACCOUNTS ON COELOTINE SPINNERET MORPHOLOGY

Coelotines have 3 pairs of spinnerets, and the anterior median spinnerets are represented by only a cluster of hairs. The anterior lateral spinnerets (ALS) and the posterior lateral spinnerets (PLS) are 2-segmented; the posterior median spinnerets (PMS) are unisegmented. The distal segment of ALS is very short; the distal segment of PLS is almost as long as the 1st segment. Five types of spigots are found in adult female coelotines. The ALS has 2

types of spigots: two major ampullate spigots (MAP) at the mesal margins and a group of piriform spigots (PI) distributed across the distal face; the number of piriform spigots may vary among species or individuals. The PMS has 3 types of spigots: two to 4 cylindrical spigots (CY) across the distal face (most coelotine species have only 2 cylindrical spigots), one to 2 minor ampullate spigots (mAP) on the distal face (maybe not always so distinct from aciniform spigots), and a group of aciniform spigots (AC) across the distal face; the number of aciniform spigots may vary among species or individuals. The PLS has 2 types of spigots: two cylindrical spigots near the base of the 2nd segment and a group of aciniform spigots along the inner face of the 2nd segment; the number of aciniform spigots may vary among species or individuals. A comparative study of spinnerets of coelotines, other amaurobiids, and related agelenid fauna may be critical in phylogenetic analysis of their relationships.

Acknowledgments: We are indebted to I-Chia Chou and Chung-Li Huang of the Dept. of Biology, Tunghai Univ. for their unfailing assistance in sorting the specimens. Special thanks are given to San-Li Wang and Jin-Nan Hwang for their dedicated assistance at an early stage of the taxonomic study. K.M. Catley of State Univ. of New Jersey at Rutgers, NJ, USA read a draft of the manuscript. This study is supported by a National Science Council grant (NSC-87-2621-B-001-002-A07) to HY Wu.

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臺灣產隙蜘屬(蜘蛛目:崖地蜘蛛科)三新種之描述

王新平¹ 卓逸民² 吳海音³

於 1997-1998 年間在臺灣中部山區惠蓀實驗林場以掉落式陷阱所進行為期一年之採集,共獲得五種隙蛛,分別為已發表之隙蛛屬的新會隙蛛(Coelotes xinhuiensis Chen, 1984),擬隙蛛屬的臺灣擬隙蛛(Paracoelotes taiwanensis Wang and Ono, 1998);以及隙蛛屬的叉齒隙蛛(C. bifida sp. n.),寬囊隙蛛(C. latus sp. n.)和長導隙蛛(C. longus sp. n.)等三新種。本文描述此三新種隙蜘之外部形態,並對標本數量較多之 C. bifida sp. n.及 C. latus sp. n.進行紡絲器形態及季節性數量變化之描述。這三個新種之發現使臺灣隙蜘屬之種數增加為十二。

關鍵詞: 叉齒隙蛛,寬囊隙蛛,長導隙蛛,紡絲器,惠蓀林場。

¹Division of Invertebrate Zoology, American Museum of Natural History, USA

² 私立東海大學生物學系

³國立東華大學自然資源管理研究所