A Preliminary Study on Land Planarians of Taiwan

台灣陸生渦蟲初步研究

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Abstract

This paper provides an overview of the current status of land planarian taxonomy. Familial and subfamilial definitions of Bipaliidae, Rhynchodemidae (Rhynchodeminae and Microplaninae) and Geoplanidae (Geoplaninae, Caenoplaninae and Pelmatoplaninae) are detailed in Systematic Account on the various taxa. Previous taxonomical studies of Taiwan land planarians are discussed. Based on material collected by Lue in 1982-1985, Lee in 2002, and Wu, Tsai and Lin in 2002, this preliminary study identified a total of 18 species: one species of *Bipalium kewense* Moseley, 1878 and 13 species of *Diversibipalium* from the family Bipaliidae, one species from the family Rhynchodemidae; two species

from the subfamily Caenoplaninae, family Geoplanidae and one species of *Australopacifica* from the subfamily Caenoplaninae, family Geoplanidae. For each species, the material examined, description, distribution in Taiwan, remarks and specimen figures (if available) are provided in order to promote further studies on the Taiwanese land planarian fauna.

摘 要

本文備有現有陸生渦蟲分類大綱，並在系統分類(systematic account)部門詳述各科和亞科之定義。科及亞科擬命名如下：廣頭地渦蟲科(Bipaliidae)；雙眼地渦蟲科(Rhynchodemidae)含有雙眼地渦蟲亞科(Rhynchodeminae)和小雙眼地渦蟲亞科(Microplaninae)；多眼地渦蟲科(Geoplanidae)含有多眼地渦蟲亞科(Geoplaninae)、青色多眼地渦蟲亞科(Caenoplaninae)和狹蹠多眼地渦蟲亞科(Pelmatoplaninae)。本文也描述台灣陸生渦蟲研究歷史。根據呂(1982-1985)、李(2002)和吳、蔡、林(2002)採集材料，經鑑定共有18種：1種已確實定名爲*Bipalium kewense* Moseley，1878；其餘17種尚未確實定名—13種屬於廣頭地渦蟲科之*Diversibipalium*屬、1種(屬名未定)屬於雙眼地渦蟲科、2種(屬名未定)屬於青色多眼地渦蟲亞科和1種屬於青色多眼地渦蟲亞科的*Australopacifica*屬。爲促進將來台灣陸生渦蟲的研究，每一種紀錄備有檢驗材料、描述、在台灣的分布、觀察和照片(僅10種)。

Key words : taxonomy, Taiwan land planarians, Bipaliidae, Rhynchodemidae, Geoplanidae

關鍵詞：分類、台灣陸生渦蟲、廣頭地渦蟲科、雙眼地渦蟲科、多眼地渦蟲科

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Introduction

The present status of taxonomic studies of land planarians

Land planarians have been studied for the past 150 years or more. von Graff (1899) published the first Monograph for this group of animals. During 1912-1917 he also published a comprehensive review in the Bronn's Klassen und Ordnungen des Tier-Reichs. Next to these fundamental but classical studies, several European and American authors published their taxonomic studies while in Asia, Kaburaki (1920a, 1920b, 1922a, 1922b) was the first specialist in this research field (cf. Kawakatsu 1991; Kawakatsu and Lue 1984; Lue and Kawakatsu 1986; Kawakatsu *et al*. 2001).

The most important taxonomic characters for identification of land planarians reside in the

anatomy and histology of their copulatory apparatus. Although this identification method was established already in the late 19th Century, nevertheless, numerous land planarians were described as new species based on the external morphology of non-sexual specimens. In addition, these published records, notes, and information are scattered in various journals and magazines. All of these greatly complicate the construction of a modern classification of this group of animals.

Recent modern taxonomic review of land planarians were published by Ogren, Kawakatsu, Froehlich and Jones in their serial articles entitled the "Land Planarian Indices Series" (Ogren and Kawakatsu 1987, 1988, 1990, 1991; Ogren *et al*. 1992, 1997; Kawakatsu and Sasaki 2001; Kawakatsu *et al*. 2001, 2002, 2003) (see the last part of Literature Cited in the present publication). This series has been published annually since 1987, containing a complete list of published literature on land planarians.

Land planarians belong to the phylum Platyhelminthes, class "Turbellaria" (non homogenous group at present), order Seriata Bresslau 1933, suborder Tricladida Lang 1884, infraorder Terricola Hallez 1892. According to Ogren *et al*. (1997), the Terricola (land or terrestrial planarians) is now classified into 3 families and 5 subfamilies: Bipaliidae von Graff, 1896, Rhychodemidae von Graff, 1896 (with 2 subfamilies: Rhychodeminae Corrêa, 1947 and Microplaninae Pantin, 1953), and family Geoplanidae Stimpson, 1857 (with 3 subfamilies: Geoplaninae Stimpson, 1857; Caenoplaninae Ogren & Kawakatsu, 1991; Pelmatoplaninae Ogren & Kawakatsu, 1991). For the familial and subfamilial definitions, see Systematic Account. For the geographical distribution ranges, see Ogren *et al*. (1992: 99-103, pls. I-IV, and also Kawakatsu *et al*. 2001 in web articles).

According to Ogren *et al*. (1997, 4 tables), a total of 44 genera and 808 species were reported in the above-mentioned 3 families and 5 subfamilies. Among these known species, nearly half of them (ca. 53.9% of the whole) were described adequately on the basis of sexually matured specimens with a reproductive apparatus, the rest of 46.1% was described insufficiently on the basis of non-sexual or immature specimens. Additionally, several new species and a few genera were reported after the year 1998.

It must be emphasized that numerous species of land planarians described cursorily in the past 230 years are actually poorly known. Their external features are incompletely known and internal, anatomical features are totally unknown. Because of this they cannot be accurately placed in one of the currently known genera.

Therefore, Kawakatsu and his coauthors proposed 5 collective groups for these poorly known species (genera without type species, ICZN, 3rd Ed., 1985, Art. 42c, i; ICZN, 4th Ed., 1999, Art. 42.3.1). They are as follows:

Diversibipalium Kawakatsu, Ogren, Froehlich & Sasaki, 2002, for *Bipalium* species inquirendae.

Anisorhynchodemus Kawakatsu, Froehlich, Jones, Ogren & Sasaki, 2003, for *Rhychodemus* species inquirendae.

Statomicroplana Kawakatsu, Froehlich, Jones, Ogren & Sasaki, 2003, for *Microplana* species inquirendae.

Pseudogeoplana Ogren & Kawakatsu, 1990, for *Geoplana* species inquirendae from North, Central and South America.

Australopacifica Ogren & Kawakatsu, 1991, for *Geoplana* species inquirendae from Australia and Pacific.

Many species for which only external features are known cannot be assigned to the appropriate genera, but they should be placed in one of these 5 collective groups until their anatomical features are described. Species incertae sedis and undescribed species should also be placed in one of these collective groups.

In the family Bipaliidae, 4 genera are currently known, including the collective group *Diversibipalium*. The other 3 genera are: *Bipalium* Stimpson, 1857, *Novibipalium* Kawakatsu, Ogren & Froehlich, 1998, and *Humbertium* Ogren & Sluys, 2001. Although the generic separation of the bipaliid species by their external appearance is impossible, the external morphology of each animal (i.e., shape of head, coloration, color patterns and longitudinal stripes on both dorsal and ventral sides of body) may have secondary taxonomic value. A tentative separation of the samples as different *Diversibipalium* species (spp.) sometimes is possible. The same may hold true in the families Rhynchodemidae and Geoplanidae. For this reason, a detailed description of external morphology of presently unidentified animals will contribute to the future progress in land planarian taxonomy.

For the correct identification of the material, several sets of serial sections of fully sexually mature specimens will be necessary. Usually, sagittal sections of the prepharyngeal, pharyngeal and copulatory apparatus pieces will be prepared for microscopic examination of histology and reconstruction of the anatomy of the copulatory apparatus. Additional transverse sections of a part of the preparyngeal region are also necessary for the examination of body muscle layers. Horizontal sections of the copulatory apparatus are also desirable for close examination of the genital anatomy.

Previous studies on Taiwan land planarians and the purposes of this preliminary study

Kaburaki (1922a) studied the taxonomy of planarians of Japan, reporting two bipaliid species from the vicinity of Taipei, Taiwan, of which one is a new species *Bipalium ruteofulvum* and the other is "*Placocephalus virgatus* (Stimpson)" (nec *Bipalium virgatum* Stimpson, 1857). Later, he also added another occurrence of "*P. virgatus*" from the vicinity of Taipei (Kaburaki 1922b). His identifications of *B. ruteofulvum* and "*P. virgatus*" were based merely on the external morphology of non-sexual immature specimens.

Kawakatsu *et al*. (1985, 1986) reported additional localities of Taiwan land planarians. Although he prepared serial histological sections of the additional specimens for later study, he had not been able to study these material prior to his retirement in 1999. These serial histological sections are now deposited at the Zoological

Museum, University of Amsterdam.

Winsor (1983) considered that "*Placocephalus virgatus*" (sensu Kaburaki 1922a, 1922b) is conspecific with the cosmopolitan species *Bipalium kewense* Moseley, 1878. This opinion is now accepted among turbellariologists (Ogren *et al*. 1997; Kawakatsu and Sasaki 2001; Kawakatsu *et al*. 2005).

Kaburaki's (1922a) *Bipalium ruteofulvum* is now tentatively classified as *Diversibipalium ruteofulvum*, a species inquirenda (Kawakatsu *et al*. 1998; Kawakatsu and Sasaki 2001; Kawakatsu *et al*. 2005; Kawakatsu *et al*. 2005a). In addition, Stimpson's (1857) *B. virgatum*, a species inquirenda, was reported from the Ryûkyû Islands in the Southwest Islands of Japan (Ogren and Kawakatsu 1987; Kawakatsu and Sasaki 2001). *B. virgatum* is now classified as *D. virgatum* (Stimpson 1857).

For a more detailed taxonomic history of Taiwan land planarians, see a bibliographic web article by Kawakatsu *et al*. (2005).

The present report aims to present a general outline of the modern taxonomy of land planarians, together with the tentative taxonomic results for this animal group in Taiwan. Part of the detailed taxonomic study (Lue's 1985-1986 Collection) will be published in detail elsewhere.

This preliminary study on Taiwan land planarians is based on material collected by Lue in the 1980's, Lee in 2002, and Wu, Tsai and Lin in 2002 (Table 1). For each species, material examined, locality, brief diagnostic character, figures (Fig.1 except Lue's samples, i.e. *Diversibipalium* spp. 沴-洹 which were strongly contracted and partly broken in some cases), distribution and remarks are provided. The distribution map (Fig. 2) shows the known localities of land planarians in Taiwan. This report is also intended to promote further studies on the Taiwanese land planarian fauna.

Material and Methods

Lue's collection from the 1980's (eight unidentifiable bipaliids from 13 localities) was assigned with Kawakatsu's Specimen Lot Number (abbreviated as KSL) (Table 1). After photographing the animals, histological sections (7-8 micrometers, stained with Delafield's hematoxylin-eosin) were prepared for taxonomic study by Kawakatsu at the Fuji Women's College, Sapporo, Japan. Upon the retirement of Kawakatsu in March, 1999, the serial sections of about 800 glass slides and images, including sketch figures, monocolor films, etc. were transferred to Sluys' laboratory at the University of Amsterdam, The Netherlands.

The recent collections of preserved specimens and color transparencies made by Lee, Wu, Tsai and Lin in 2002 (Table 1) were also deposited at Sluys' laboratory.

Systematic Account

Order Seriata Bresslau, 1933
Suborder Tricladida Lang, l884
Infraorder Terricola Hallez, 1892

Family Bipaliidae von Graff, 1896

Land planarians having a broad, transverse, head plate, possessing numerous small eyes along the border and having the creeping sole begin at the base of the head piece. The

Table 1. Taiwan land planarians used for this preliminary study◎

Sta#	KSL#	GPS#	Spec#	Locality	Date collected	Tentative classification
59	1695	–	1*	Taipei City: Normal Taiwan Univ.	1982/07/09	*Diversibipalium* sp. 1
60	1753	–	1*	Taipei City: Normal Taiwan Univ.	1984/09/	*Diversibipalium* sp. 2
61	1694	–	1*	Taipei County: Shiting	1982/06/27	*Diversibipalium* sp. 1
62	1749	–	1+	Hualien County: Lienhua Pond	1983/06/25	*Diversibipalium* sp. 3
63	1750	–	1+	Hualien County: Chilai, Mt. Hohoan	1983/08/08	*Diversibipalium* sp. 4
64	1693	–	1+	Chiayi County: Mt. Ali	1982/06/21	*Diversibipalium* sp. 4
65	1751	–	1+	Chiayi County: Mt. Ali	1983/11/09	*Diversibipalium* sp. 5
66	1752A	–	1+	Pingtung County: Mt. Wutou	1983/01/24	*Diversibipalium* sp. 6
67	1752B	–	1+	Pingtung County: Mt. Wutou	1983/01/24	*Diversibipalium* sp. 7
79	1807-08	–	2+*	Taipei County: Harpen near Ulai	1985/07/30	*Diversibipalium* sp. 1
80	1809	–	1+	Nantou County: Tienchi, Nengkau	1985/07/26	*Diversibipalium* sp. 8
81	1810	–	1+	Nantou County: Tienchi, Nengkau	1985/07/26	*Diversibipalium* sp. 5
82	1811	–	2+*	Nantou County: Patongkoan	1985/07/04	*Diversibipalium* sp. 5
14	–	–	1+?	Chiayi County: Mt. Ali	2002/07/	*Bipalium kewense*
15	–	–	1+	Chiayi County: Mt. Ali	2002/07/	*Diversibipalium* sp. 9
16	–	–	1+?	Taichung City	2002/10/	*Diversibipalium* sp. 10
17	–	–	1*?	Taichung City	2002/10/	Rhynchodemidae sp. 1
18	–	–	1+?	Taichung City	2002/10/	*Australopacifica* sp. 1
19	–	232	2++?	Nantou County: South of Wushe	2002/10/17	*Diversibipalium* sp. 11
19	–	232	1+?	Nantou County: South of Wushe	2002/10/17	*Diversibipalium* sp. 12
19	–	232	1+	Nantou County: South of Wushe	2002/10/17	*Diversibipalium* sp. 13
19	–	232	1+?	Nantou County: South of Wushe	2002/10/17	?Caenoplaninae sp. 1
20	–	217	1*?	Nantou County: South of Wushe	2002/10/16	?Caenoplaninae sp. 2

◎Sexually matured (+), immature (*), questionable (?); Sta. Nos. 59-67, 79-82 were collected by Lue; Sta. Nos. 14-18 were collected by Lee; Sta. Nos. 19-20 were collected by Wu, Tsai & Lin.

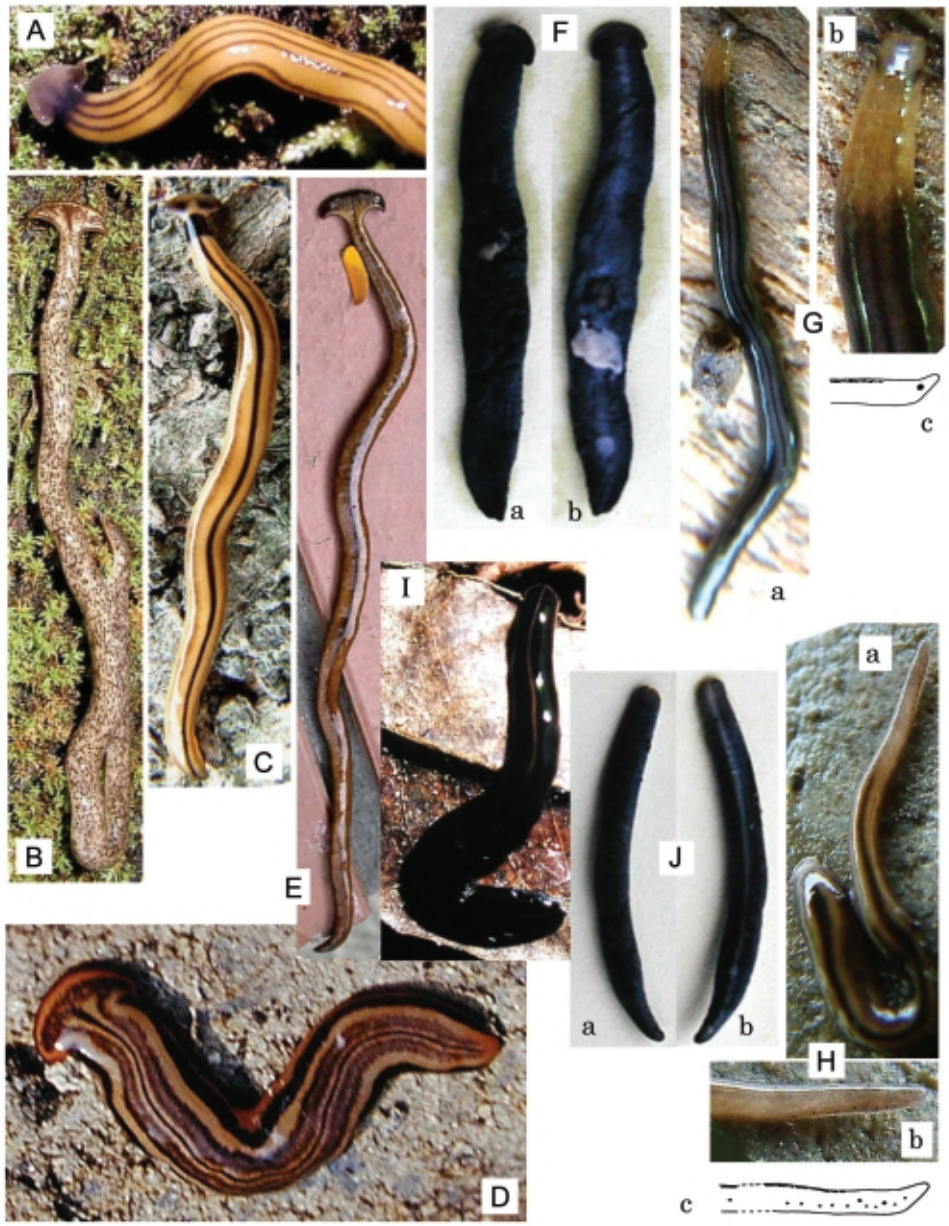

Fig. 1. External features of Taiwan's land planarians: A. *Bipalium kewense* Moseley, 1878; B. *Diversibipalium* sp. 9; C. *Diversibipalium* sp. 10; D. *Diversibipalium* sp. 11; E. *Diversibipalium* sp. 12; F. *Diversibipalium* sp. 13 (a, dorsal view; b, ventral view); G. Rhynchodemidae sp. 1 (a, dorsal view; b, dorsal view of the anterior part of the body; c, a sketch of the side view of the head; notice the large, right-side eye.); H. *Australopacifica* sp. 1 (a, dorsal view; b, side view of the anterior part of the body; c, a sketch of the side view of the head; notice many small eyes on the right side of the head); I. ?Caenoplaninae sp. 1; J. ?Caenoplaninae sp. 2 (a, dorsal view; b, ventral view).

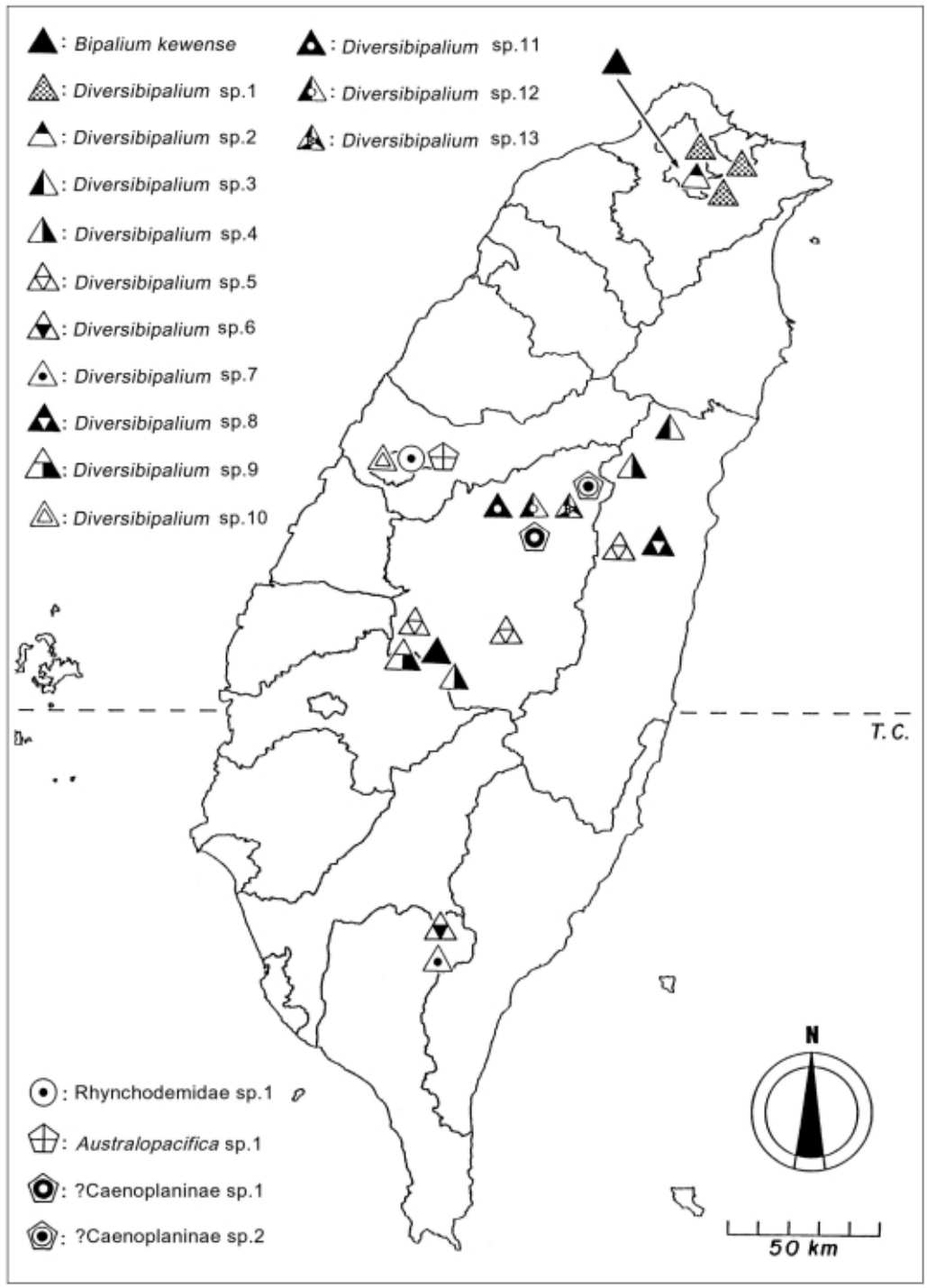

Fig. 2. The geographical distribution of Taiwan land planarians (from Kaburaki, 1922a and b; Kawakatsu *et al*. 1985; and the present study; the Taiwan map also showing county and city lines and adjacent islands).

copulatory organs are simple, without accessory ducts, or copulatory bursa, while the male and female exit ducts are separated by a fold of tissue before they enter the common genital antrum. (Ogren and Kawakatsu 1987: 79-80.)

Genus *Bipalium* Stimpson, 1857

Bipalium kewense Moseley, 1878

Fig. 1A

Material Examined:

Chiayi County: Mt. Ali at elevation 2,600 m: Station 14 (Lee collection).

Description:

The living sexual matured (?) specimen with a typical appearance of *Bipalium kewense*: a semicircular head, pale brownish purple in color with a pair of moderately developed auricles and a pair of dark, narrow transverse patches at the "neck", 5 longitudinal stripes on dorsal side (1 mid-dorsal, 2 laterals and 2 marginals abbreviated as 1 md + 2 la + 2 mg) (Fig. 1A), 2 longitudinal lateral stripes (abbreviated as 2 vla) on ventral side.

Distribution in Taiwan:

Taipei City and its vicinity (Kaburaki, 1922a, b); Mt. Ali.

Remarks:

This cosmopolitan bipaliid species has been considered as one of the old exotic animals in Taiwan. However, judging from Kaburaki's (1922a, 1922b) *Bipalium reteofulvum* (=*B. kewense*) and Lue's samples from Taipei City and its vicinity, this species might be a natural habitant of Taiwan. In recent years *B. kewense* may have expanded its range by asexual reproduction and through the commercial distribution of potted garden plants (Kawakatsu *et al*. 2001).

Genus *Diversibipalium* Kawakatsu, Ogren, Froehlich & Sasaki, 2002

In this section, descriptions of *Diversibipalium* spp. 涉-洹 are based upon the data presented in two previous papers (Kawakatsu *et al*. 1985: 120-122, fig. 8 and 1986: 70-71, fig. 6).

Diversibipalium sp. 1

Material Examined:

Taipei City: Campus of Taiwan Normal University (KSL No. 1965).

Taipei County: Shiting (KSL No. 1694); Harpen near Ulai (KSL Nos. 1807 and sexual specimen 1808).

Description:

Body 32-150 mm long and 2-4 mm wide; pale yellowish brown (fixed in Bouin's fluid); three or 5 longitudinal stripes (1 md + 2 la + 2 mg) on dorsal side and 2 longitudinal stripes (2 vla) on ventral side.

Distribution in Taiwan:

Taipei City.

Taipei County: Shiting, Harpen near Ulai.

Remarks:

It is highly probable that *Diversibipalium* sp. 1 is conspecific with *Bipalium kewense* (see "Remarks" on *B. kewense* above).

Diversibipalium sp. 2

Material Examined:

Taipei City: Campus of College of Science, Taiwan Normal University (KSL No. 1753).

Description:

The single sexual immature specimen measured 62 mm long and 2.5 mm wide. Live specimen pale yellowish brown above, with a single mid-dorsal longitudinal stripe (1 md), no stripes on ventral side, lateral margins of body slightly serrulate.

Distribution in Taiwan:

Taipei City.

Remarks:

5S rRNA has been sequenced by Dr. H. Hori of Nagoya University, Nagoya, Japan (Kawakatsu personal communication).

Diversibipalium sp. 3

Material Examined:

Hualien County: The vicinity of Lienhua Pond along the East-West Cross Mountain Highway at elevation 1,100m (KSL No. 1749).

Description:

The single sexual specimen (fixed in Bouin's fluid) measured 52 mm long and 2.5 mm wide. Body pale-yellowish brown with 5 longitudinal stripes (1 md + 2 la + 2 mg) on dorsal side and 2 longitudinal stripes (2 vla) on ventral side.

Distribution in Taiwan:

The Central Mountain Range: Lienhua Pond, Hualien County.

Diversibipalium sp. 4

Material Examined:

Hualien County: Mt. Hohoan at the vicinity of Chilai Cottage, elevation 3,200m (KSL No. 1750).

Chiayi County: Mt. Ali at elevation 2,100m (KSL No. 1693).

Description:

The sexual specimens (fixed in Bouin's fluid) measured 25-29 mm long and 3.5-4 mm wide. Body pale yellowish brown with 2 thin mid-dorsal and 2 wide lateral longitudinal stripes (2 md + 2 la) on dorsal side, no ventral stripe, lateral margin slightly serrulate.

Distribution in Taiwan:

The Central Mountain Range: Mt. Hohoan and Mt. Ali.

Diversibipalium sp. 5

Material Examined:

Chiayi County: Mt. Ali at elevation 2,100m (KSL No. 1751).

Nantou County: The vicinity of Nengkau Tienchi at elevation 2,900m (KSL No. 1810); Patongkuan at elevation 2,800m (KSL No. 1811a , b).

Description:

The sexual specimens measured 45-92 mm long and 6-9 mm wide and asexual specimens (fixed in Bouin's fluid) measured 43 mm long and 3 mm wide. Body blackish grayish on both

dorsal and ventral sides.

Distribution in Taiwan:

The Central Mountain Range: Nengkau Trail in Chiayi and Nantou Counties.

Diversibipalium sp. 6

Material Examined:

Pingtung County: The vicinity of Lake Takuei, Mt. Wutou at elevation 2,280m (KSL No. 1752 A).

Description:

The single sexual specimen (fixed in Bouin's fluid) measured 31 mm long and 4 mm wide. Body yellowish orange brown with a pair of brown deltoid marks on head plate and 2 longitudinal blackish brown marginal stripes (2 mg) on dorsal side and no stripe on ventral side.

Distribution in Taiwan:

The Central Mountain Range: Mt. Wutou, Pingtung County.

Diversibipalium sp. 7

Material Examined:

Pingtung County: The vicinity of Lake Takuei, Mt. Wutou at elevation 2,280m (KSL No. 1752 B).

Description:

The single sexual specimen (fixed in Bouin's fluid) measured 23 mm long and 3 mm wide. Body pale gray on both dorsal and ventral sides, lateral margin serrulate.

Distribution in Taiwan:

The Central Mountain Range: Mt. Wutou, Pingtung County.

Diversibipalium sp. 8

Material Examined:

Nantou County: The vicinity of Nengkau Trail, Tienchi at elevation 2,900m (KSL No. 1809).

Description:

The single sexual specimen (fixed in Bouin's fluid) measured 35 mm long and 3.5 mm wide. Body nearly black on dorsal side and dark brown with a pair of wide reddish-brown longitudinal band (2 vla) on ventral side.

Distribution in Taiwan:

The Central Mountain Range: Nengkau Trail.

Diversibipalium sp. 9

Fig. 1B

Material Examined:

Chiayi County: Mt. Ali at elevation 2,600m: Station 15 (Lee collection).

Description:

The living sexual specimen measured 200 mm long and 8 mm wide, with a conspicuous, crescent-shaped head and well-developed and pointed auricles. Body pale brown with numerous small dark brown spots on dorsal side.

Distribution in Taiwan:

The Central Mountain Range: Mt. Ali.

Diversibipalium sp. 10

Fig. 1C

Material Examined:

Taichung City: Station 16 (Lee Collection).

Description:

The living sexual (?) specimen measured 20-30 mm long and 2 mm wide, with a crescent-shaped head, moderately developed, non-recurved auricles, and a pair of indistinct, blackish spots on head plate. Body is pale yellowish brown with 3 longitudinal stripes (1 md + 2 la) on dorsal side, "neck" with a wide black band.

Distribution in Taiwan:

West side of the Central Taiwan.

Diversibipalium sp. 11

Fig. 1D

Material Examined:

Nantou County: Roadside on Hwy 83 at 16 km sign (Wu *et al*. Collection: GPS No. 232).

Description:

Two living sexual (?) specimens measured about 18 mm long and 3 mm wide, with a large, lunate head and well-developed and recurved auricles. Brownish body rather stocky with bluntly pointed posterior end, a blackish, mid-dorsal longitudinal stripe with an oblanceolate anterior end at the head plate, a dark, broad, bipaliid-shaped pattern around the mid-dorsal stripe, a pair of blackish lateral stripes, the margin of the head and auricles surrounded by an inner, crescent-shaped, orange brown band and outer, thin, semicircular edge, two conspicuous rather broad and blackish marginal stripes. Color pattern: 1 md + 2 la + 2 mg.

Distribution in Taiwan:

The Central Mountain Range: Wushe area.

Diversibipalium sp. 12

Fig. 1E

Material Examined:

Nantou County: Roadside on Hwy 83 at 16 km sign, south of Wushe (Wu *et al*. Collection: GPS No. 232).

Description:

The living sexual (?) specimen measured 100 mm and 5 mm wide, with a very large, lunate head and a pair of well-developed and recurved auricles. The entire head plate is dark brown. The brownish gray body with a thin, blackish mid-dorsal stripe reaching the anterior end of the head, and a pair of thin, blackish marginal stripes (1 md + 2 mg).

Distribution in Taiwan:

The Central Mountain Range near the Wushe area.

Remarks:

The coloration of head plate is frequently different from that of dorsal side of the body. The differing color patterns between head plate and body have a great value in the land planarian taxonomy.

Diversibipalium sp. 13

Figs. 1F (a, b)

Material Examined:

Nantou County: Roadside on Hwy 83 at 16 km sign, south of Wushe (Wu *et al*. Collection: GPS No. 232).

Description:

The fixed sexual specimen measured 25 mm long and 3.5 mm wide, with a rotundate head and a pair of rather short rounded auricle. Dark blue body (both dorsal and ventral sides) rather stocky and without stripes.

Distribution in Taiwan:

The Central Mountain Range near the Wushe area.

Family Rhynchodemidae von Graff, 1896

Land planarians of elongate cylindroid form with two eyes near the simple, tapered anterior end; no tentacles or head plate; with well-defined creeping sole occupying part of the ventral surface. Anterior end may have a sucker organ on ventral surface (*Cotyloplana*). (Ogren and Kawakatsu 1988: 44.)

Subfamily Rhynchodeminae Corrêa, 1947

Rhynchodemidae with strong cortical musculature in which the subepithelial longitudinal muscle fibers are grouped into large, definite bundles; penis papilla absent or greatly reduced (*Platydemus* in part). (Ogren and Kawakatsu 1988: 44.)

Subfamily Microplaninae Pantin, 1953

Rhychodemidae of generally short, plump, cylindroid form, anterior end often blunt; eyes often small or may be retrogressed; body wall with weak subpithelial musculature consisting of thin outer circular layer and single layer of longitudinal fibers inconspicuously developed and not aggregated into large bundles; male copulatory organ often complicated with well-developed penis papilla; female copulatory organ simple or complex, may have genito-intestinal connection, with or without seminal bursa with one or more exits. (Ogren and Kawakatsu 1988: 46.)

Rhynchodemidae sp. 1

Figs. 1G (a, b, c)

Material Examined:

Taichung City: Station 17 (Lee Collection).

Description:

The living immature (?) specimen measured 20 mm long and 2 mm wide in a tube-like shape. The bluntly pointed head is yellowish-orange in color with a pair of eyes near the anterior end; the rest of the body bluish in color with a conspicuous blackish mid-dorsal longitudinal stripe (1 md).

Distribution in Taiwan:

West-Central Taiwan.

Remarks:

The two-eyed animal is undoubtedly a member of the family Rhynchodemidae. The subfamily and genus are not known until microscopic examination of subepidermal muscle layers and genital morphology is studied.

Family Geoplanidae Stimpson, 1857

Land planarians having numerous small eyes concentrated around the anterior, and along the sides, sometimes located dorsally, or without eyes; without auricular or tentacular organs, or semilunar headplate. (Ogren and Kawakatsu 1990: 83.)

Subfamily Geoplaninae Stimpson, 1857

Geoplaninae with broad ciliated creeping sole covering most of ventral surface (or sparse body cilia as in the *Geobia*); mouth just behind midbody (since in *Polycladus* mouth is in posterior fourth); dorsal testes; subepithelial or cutaneous longitudinal musculature, well developed, arranged in bundles; longitudinal parenchymal muscle absent, or not well developed, nor forming a ring zone. (Ogren and Kawakatsu 1990: 83.)

Subfamily Caenoplaninae Ogren & Kawakatsu, 1991

Geoplanidae of testes ventrally situated; subepithelial longitudinal musculature in large bundles; mouth in third quarter; eyes often in single row around anterior, continuing posteriorly ; but not usually extending dorsally. (Ogren and Kawakatsu 1991: 28).

?Caenoplaninae sp. 1
Fig. 1I

Material Examined:

Nantou County: Roadside on Hwy 83 at 16 km sign, south of Wushe (Wu *et al*. Collection: GPS No. 232).

Description:

The living sexual (?) specimen measured 50 mm long and 5 mm wide, with a small, rotundate head without conspicuous auricles. Body is dark brown to blackish, rather stocky with bluntly pointed posterior end. Anterior edge of head and margin of body with a thin dark-orange line. Except for the regions of pharynx and copulatory apparatus, this species has a rather wide, dark orange mid-dorsal longitudinal stripe. Color pattern: 1 md + 2 mg.

Distribution in Taiwan:

The Central Mountain Range near the Wushe area.

Remarks:

Examination of the preserved specimens is necessary for identification of this sample.

?Caenoplaninae sp. 2
Figs. 1J (a, b)

Material Examined:

Nantou County: Roadside on Highway 85 (=Hocho Agriculture Route) at 1.2 km place, north of Wushe (Wu *et al*. Collection: GPS No. 217).

Description:

The living asexual (?) specimen measured 40 mm long and 4 mm wide, with a rotundate head without auricles (slightly damaged). Dark blue body is slender with pointed end.

Distribution in Taiwan:

The Central Mountain Range near the Wushe area.

Remarks:

Examination of the preserved specimen is necessary for identification of this sample.

Genus *Australopacifica* Ogren & Kawakatsu, 1991

Australopacifica sp. 1
Figs. 1H (a, b, c)

Material Examined:

Taichung City: Station 18 (Lee Collection).

Description:

The living sexual (?) specimen measured 43 mm long and 2 mm wide, with a rather pointed head of pale-grayish brown in color and several small eye spots at both sides of the head; the rest of body had grayish brown coloration with a rather wide, blackish mid-dorsal stripe (except for head) and a pair of thin, blackish lateral stripes (1 md + 2 la).

Distribution in Taiwan:

West-Central Taiwan.

Remarks:

Examination of the preserved specimen is necessary for identification.

Subfamily Pelmatoplaninae Ogren & Kawakatsu, 1991

Geoplanidae of elongated narrow body with tapered anterior; numerous eyes clustered along sides of anterior, but usually not extending behind the mouth; cylindrical pharynx; creeping sole narrow, about 25% of ventral area; testes ventral; tegmentary subepithelial longitudinal muscle weak not in bundles; parenchymal longitudinal musculature very strong and forming annular ring zone; male copulatory organ with a well-developed penis papilla. (Ogren and Kawakatsu 1991: 33.)

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