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A REVIEW OF THE CATFISH GENUS *PSEUDEXOSTOMA* (SILURIFORMES: SISORIDAE) WITH DESCRIPTION OF A NEW SPECIES FROM THE UPPER SALWEEN (NUJIANG) BASIN OF CHINA

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***ABSTRACT.* –** The species of *Pseudexostoma* are restricted to the upper Salween (Nujiang) and one upper branch of the Irrawaddy (Dayinjiang) rivers in China. It includes only two subspecies *P. yunnanensis yunnanensis* (Tchang) and *P. yunnanensis brachysoma* Chu. After comparing their morphology, it is discovered that they can be distinguished easily by the structure of lower lip, the shape of premaxillary tooth band, the number of branched pelvic fin rays and meristic and mensural characteristics. These two taxa are recognized as distinct species. A third species is known from Nujiang basin of China. The new species, *Pseudexostoma longipterus,* can be distinguished from *P. yunnanensis* by the following combination of characteristics: posterior margin of lower lip with three notches, depth of middle notch shallower than depth of lateral ones (vs. same depth); length of two smaller median lobes of lower lip longer than lateral lobes (vs. same length); pelvic fin i, 3–4 (vs. i, 5); base of adipose fin longer (37.8–45.1% SL vs. 28.8–39.8); caudal peduncle more slender (depth of caudal peduncle 4.6–6.1% SL and 19.6–30.8% in length of caudal peduncle vs. 6.4–8.3 and 32.6––42.7); premaxillary tooth band with16-18 tooth (vs. 18–22); premaxillary tooth band divided into two isolated patches (vs. patches partially connected). It differs from *P. brachysoma* in having longer pectoral, pelvic and caudal fins (pectoral fin 30.1-31.3% SL vs. 24.9–29.8, pelvic fin 23.1–24.3% SL vs. 16.1–22.9, caudal fin 18–19.6% SL vs. 13.6–17.9); bigger eyes and a wider interorbital width (eye diameter 8.2–10% HL vs. 5.8–7.8, interorbital width 25.5–30.8% HL vs. 19.7–24.7). The geographical and ecological isolation led to speciation in *Pseudexostoma.*

***KEY WORDS.* –** *Pseudexostoma*, new species, Irrawaddy River, Salween River, Sisoridae, China.

INTRODUCTION

The catfish genus *Pseudexostoma* is a member of the Family Sisoridae in the Order Siluriformes, and is only distributed in the upper Salween River (Nujiang) and one branch of Irrawaddy River (Dayinjiang) in China. Until now the genus was thought to include only two subspecies *P. yunnanensis yunnanensis* (Tchang) and *P. yunnanensis brachysoma* Chu (Chu, 1979).

Pseudexostoma yunnanensis was described as a species of *Glyptosternum* (Tchang, 1935) from an imprecise locality in Yunnan, China. Examination of nine paratypes of *Glyptosternum yunnanensis* preserved in the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZCAS) showed that this species was readily distinguished from other glyptosternoid fish in having shovel-shaped teeth on both premaxillary and mandibular tooth bands (vs. lacking shovel-shaped teeth or only on mandibular tooth band) (Chu, 1979). On this basis, Chu (1979) proposed that the species should be placed in a separate genus which he named *Pseudexostoma*. According to the collections of Kunming Institute of Zoology, Chinese Academy of Sciences (KIZ), *Pseudexostoma yunnanensis* (Tchang) was collected only from Guyong of Tengchong County, Yunnan, where is the upper of Dayinjiang drainage (a branch of Irrawaddy River). Therefore, Chu & Mo (1999) inferred that the type specimens of *G. yunnanensis* might have been collected from Dayinjiang of western Yunnan.

Eighteen specimens of glyptosternoid fish from a stream of Nujiang in Laowo of Yunlong County, Yunnan were recognized as a subspecies of *P. yunnanensis* and named *P. yunnanensis brachysoma* by Chu (1979). *Pseudexostoma yunnanensis brachysoma* was distinguished from *P. yunnanensis yunnanensis* by the following combination of characteristics: body depth 15.6–17.5% SL (vs. 9.8–14.9), interorbital width 27.8–32.3% HL (vs. 18.9–28.6), depth of

caudal peduncle 34.5–41.7% its length (vs. 28.6–35.7). The data in the works of "*The Fish of Yunnan, China*" and "*Fauna Sinica. Osteichthyes: Siluriformes*" were obtained from 18 types of *P. yunnanensis brachysoma* preserved in KIZ (Chu et al., 1990; Chu & Mo, 1999).

However, measurement characteristics used previously were no longer a good standard to distinguish the two subspecies as specimens of *Pseudexostoma* from different locations. The variation in range of measurement data in *P. yunnanensis yunnanensis* was wider than data recorded before, and overlaps the data in *P. yunnanensis brachysoma*. In addition, examination of specimens of *Pseudexostoma* collected from the Nujiang basin of China indicated that there was a great amount of morphometric variation and they could be divided into two groups according to some new selected meristic and mensural characteristics. So, a systematic review of this genus is necessary.

MATERIAL AND METHODS

Counts and measurements follow Chu (1979) and Ng & Rainboth (2001). Descriptions of the premaxillary tooth band and tooth shape follow Chu (1979) and He (1996). Observations and drawings of specimens are made using a binocular microscope (Motic D400) equipped with a drawing attachment.

All of the examined specimens are preserved in the Museum of Zoology, Southwest Forestry College (SWFC). In tables and text, the information on specimens is given as follows: total number of examined specimens (ex.), total length (TL), standard length (SL), range of specimens in millimeters, and collecting locality. Abbreviation HL (head length) is also used in the text.

Pseudexostoma brachysoma Chu, 1979
(Figs. 1, 2A, 3A, 4)

Pseudexostoma yunnanensis brachysoma Chu, 1979: 78–79 (Laowo, Yunlong County); Chu, Mo & Kuang, 1990: 214–215, Fig. 215 (Laowo, Yunlong County); Chu & Mo, 1999: 179–180, Fig. 118 (Laowo, Yunlong County).

Material examined. **– Topotypes:** SWFC 9910007, 9910015, 2 ex., 85 mm TL, 72–75 mm SL, Laowo, Lushui County, Yunnan Province; SWFC 200103328-344, 200103352–367, 33 ex., 60–135 mm TL, 52–119 mm SL, Laowo, Lushui County, Yunnan Province. **Other materials:** SWFC 200102025–031, 200102041–045, 200102053–054, 200102056, 15 ex., 111-152 mm TL, 95–142 mm SL, Xiangda, Longling County, Yunnan Province; SWFC 9910074–080, 7 ex., 97–134 mm TL, 85–115 mm SL, Gudeng, Lushui County, Yunnan Province; SWFC 9910022–033, 9910035–38, 9910044–057, 30 ex., 61–153 mm TL, 52-135 mm SL, Muna, Fugong County, Yunnan Province; SWFC 200106001, 1 ex., 124 mm TL, 103 mm SL, Daxingdi, Lushui County, Yunnan Province; SWFC 200411001–002, 2 ex., Liuku, Lushui County, Yunnan Province.

Diagnosis. **–** *Pseudexostoma brachysoma* is distinguished from *P. yunnanensis* by the following combination of characteristics: posterior margin of lower lip with three notches, depth of middle notch shallower than lateral ones (vs. as the same depth), length of two smaller median lobes of lower lip longer than lateral lobes (Fig. 2A) (vs. as the same length, Fig. 2C); pelvic fin i, 3–4 (vs. i, 5); base of adipose fin longer (36.1–46.0% SL vs. 28.8–39.8); caudal peduncle more slender (depth of caudal peduncle 4.2–6.9% SL and 20–33.7% in length of caudal peduncle vs. 6.4–8.3 and 32.6–42.7); premaxillary tooth band with 16-18 teeth (vs. 18–22), premaxillary tooth band divided into two and isolated (Fig. 3A) (vs. connected partially, Fig. 3C). *Pseudexostoma brachysoma* differs from *P. longipterus* in having a shorter pectoral fin, pelvic fin and caudal fin (pectoral fin 24.9–29.8% SL vs. 30.1–31.3, pelvic fin 16.1–22.9% SL vs. 23.1–24.3, caudal fin 13.6–17.9% SL vs. 18–19.6), smaller eyes and a narrower interorbital width (eye diameter 5.8–7.8% HL vs. 8.2–10, interorbital width 19.7–24.7% HL vs. 25.5–30.8).

Description. **–** Morphometric data as in Table 1.

Body moderately compressed. Dorsal profile rising evenly and somewhat steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally to end of caudal peduncle. Head and abdominal region before origin of anal fin broad and flat. Body after adipose fin compressed gradually.

Head depressed and broad, triangular when viewed laterally and with rounded snout when viewed from above. Eye small and ovoid, subcutaneous and located at middle of dorsal surface of head. Mouth transverse and inferior, premaxillary and mandibular tooth bands exposed when mouth closed. Teeth embedded in skin, shovel-shaped, tips exposed and arranged in irregular rows. Premaxillary tooth band divided into two, with 16–18 teeth (Fig. 3A). Anterior nostril tubular, separated from posterior nostril by nasal barbel base. Gill opening narrow, extending from one-third of last ray of pectoral fin to the first ray. Dorsal surface smooth without tubercles. Barbels in four pairs. Maxillary barbel flattened, with surrounding flap of skin and rounded tip, extending beyond pectoral fin origin, but not reaching to gill opening and far from posttemporal. Nasal barbel with small flap of thin skin fringing posterior margin and not reaching anterior margin of orbital. Post labial groove connected. Lower lip broad with three notches along posterior margin, divided into two bigger lateral lobes and two smaller median lobes. Depth of middle notch shallower than depth of lateral side notches. Two smaller median lobes of lower lip longer than lateral lobes. Inner mandibular-barbel close to midline, extending to pectoral fin origin. Outer mandibular-barbel precedes lateral inner mandibular barbel, extending to pectoral fin origin (Fig. 2A).

Unbranched dorsal fin rays not ossified. Post-dorsal margin of dorsal fin concave slightly. Origin of dorsal fin located at point through anterior third of body. Adipose fin base not connected with caudal fin. Caudal fin emarginate, upper lobe smaller than lower lobe. Anal fin post-ventral margin emarginate. Distance of anal fin origin to caudal fin base shorter than to end of pelvic fin base. Origin of pelvic fin precedes vertical end of dorsal fin base. Pelvic fin margin

Table 1. Counts and proportional measurements of the genus *Pseudexostoma* (Italic and bold in the table show difference of data among species)

	P. brachysoma			*P. longipterus*			*P. yunnanensis*		
Locality	Fugong: Mula; Lushui: Gudeng, Laowo, Daxingdi, Liuku; Longling: Xiangda			Gongshan: Cikai			Tengchong: Guyong		
Number	90			12			18		
Dorsal fin rays	i, 5			i, 5			i, 5		
Pectoral fin rays	i, 16–18			i, 16–18			i, 16–18		
Pelvic fin rays	i, 3–4			i, 3–4			***i, 5***		
Anal fin rays	ii, 3–4			ii, 3–4			ii, 3–4		
Branched caudal rays	6+7			6+7			6+7		
in % standard length	**mean**	**range**	**S.D.**	**mean**	**range**	**S.D.**	**mean**	**range**	**S.D.**
Body depth	13.2	9.5–21.6	1.77	13	11.8–14.3	0.73	11.2	9.2–16.9	2.28
Predorsal length	34.2	28.8–39.8	1.97	34	32–36.1	1.46	31.7	27.6–35.7	1.92
Head length	25.3	20.8–29.8	1.95	24.8	22.9–27.1	1.44	22.8	20.8–25	1.34
Caudal peduncle length	20.1	15.6–24.6	1.67	20.8	18.9–24.1	1.51	20.1	16.6–21.5	1.25
Caudal peduncle depth	5.7	4.2–7.8	0.81	5.4	4.6–6.1	0.43	***7.2***	***6.4–8.3***	***0.53***
Length of dorsal base to adipose	12.4	8.5–17.7	1.71	11.3	9.8–13.6	1.32	12.3	9.5–14.5	1.24
Length of pre-adipose to snout	55.0	50.4–63.5	2.18	55	50.8–57.3	1.91	52.5	49.7–55.6	1.46
Length of dorsal fin base	10.6	8.6–13.6	1.13	9.8	7.6–11	0.92	10.4	8.7–12	1.12
Maximum head width	20.7	14.3–24.5	1.49	22.0	20.5–24.2	1.03	20.9	18.8–24.8	1.73
Dorsal fin length	17.7	11.5–20.4	1.31	19.1	16.7–20.3	1.03	17.6	15.8–19.8	1.09
Pectoral fin length	27.7	24.8–31.3	1.21	***30.5***	***30.1–31.3***	***0.35***	26.8	23.4–29.7	1.77
Pelvic fin length	22.1	16.1–25.6	1.84	***23.5***	***23.1–24.3***	***0.35***	21.2	19.6–22.8	1.15
Anal fin length	10.8	9.3–12.5	0.83	11.8	10.1–13.3	0.92	10.8	9.1–13.5	1.11
Length of anal fin base	5.1	3.0–7.1	0.94	4.5	3.6–5.1	0.51	4.1	2.8–5.6	0.77
Caudal fin length	16.1	13.6–19.3	1.14	***18.8***	***18–19.6***	***0.52***	16	13.9–17.8	1.18
Length of adipose fin base	40.3	27.9–46.0	2.48	41.2	37.8–45.1	2.21	***36.2***	***28.8–39.8***	***3.26***
in % head length									
Snout length	60.9	35.3–72.4	4.77	63.8	51.8–69.4	5.03	60.1	53.3–63.7	2.86
Eye diameter	7.6	5.8–10.0	1.00	***8.9***	***8.2–10***	***0.63***	7.4	6.1–7.9	0.45
Interorbital width	23.8	19.7–31.2	1.88	***27.8***	***25.5-–30.8***	***1.80***	22.7	20.4–24.6	1.19
in % P-V length									
Length of pectoral fin	114.2	90.7–137.1	10.71	121	111.1–131.6	6.42	109.7	85–121.1	9.75
in % V-A length									
Length of pelvic fin	57.3	45.5–73.3	5.68	60.6	55.1–66.5	3.02	56.4	47.2–69.6	6.75
in % length of caudal peduncle									
Depth of caudal peduncle	28.4	18.5–39.6	4.73	26.3	19.6–30.8	3.39	***35.8***	***32.6–42.7***	***3.02***
in % length of adipose fin base									
Length of anal fin base	12.7	7.1–18.2	2.50	11.1	8.7–12.9	1.37	11.4	7.3–17.4	2.82
in % dorsal fin base to origin of adipose fin									
length of adipose fin base	330.9	200.0–460.0	51.85	***370.4***	***291–437.2***	***53.3***	297.7	221.4–402.3	44.6

convex slightly, not extending to anus. Pectoral fin greatly enlarged and first unbranched ray not ossified. First unbranched ray of paired fins broadened with regular striae on ventral surface. Anus and urogenital openings located at end of pelvic fin and before origin of anal fin. Lateral line midlateral and complete.

***Coloration*. –** Grey black on dorsal surface without spots or patches. Grey yellow on ventral region. Caudal fin grey black with an irregular, small, yellow patch in the middle. Fins with grey yellow around distal edge.

***Distribution*. –** Only known from the middle and lower Nujiang basin (Fig. 4).

***Remarks.* –** "Laowo", the type locality of *Pseudexostoma yunnanensis brachysoma* Chu, belonged to Yunlong County of Dali Prefecture, Yunnan and now it belongs to Lushui County of Nujiang Prefecture, Yunnan. After comparing morphological characters, the results show that there are distinct differences between the topotypes of *P. yunnanensis brachysoma* Chu and specimens of *Pseudexostoma yunnanensis yunnanensis* (Tchang) in the structure of their lower lobe, shape of premaxillary tooth band, number of branched pelvic fin rays and meristic and mensural characteristics. So they should be given species status instead of subspecies status.

Pseudexostoma longipterus, new species

(Figs. 2B, 3B, 4, 5)

***Material examined.* –** Holotype: SWFC 200308022, 95.4 mm TL, 82.1 mm SL, Cikai (27°44.27'N 98°40.02"E), Gongshan County, Yunnan Province; W. Zhou, 12 Aug.2003.

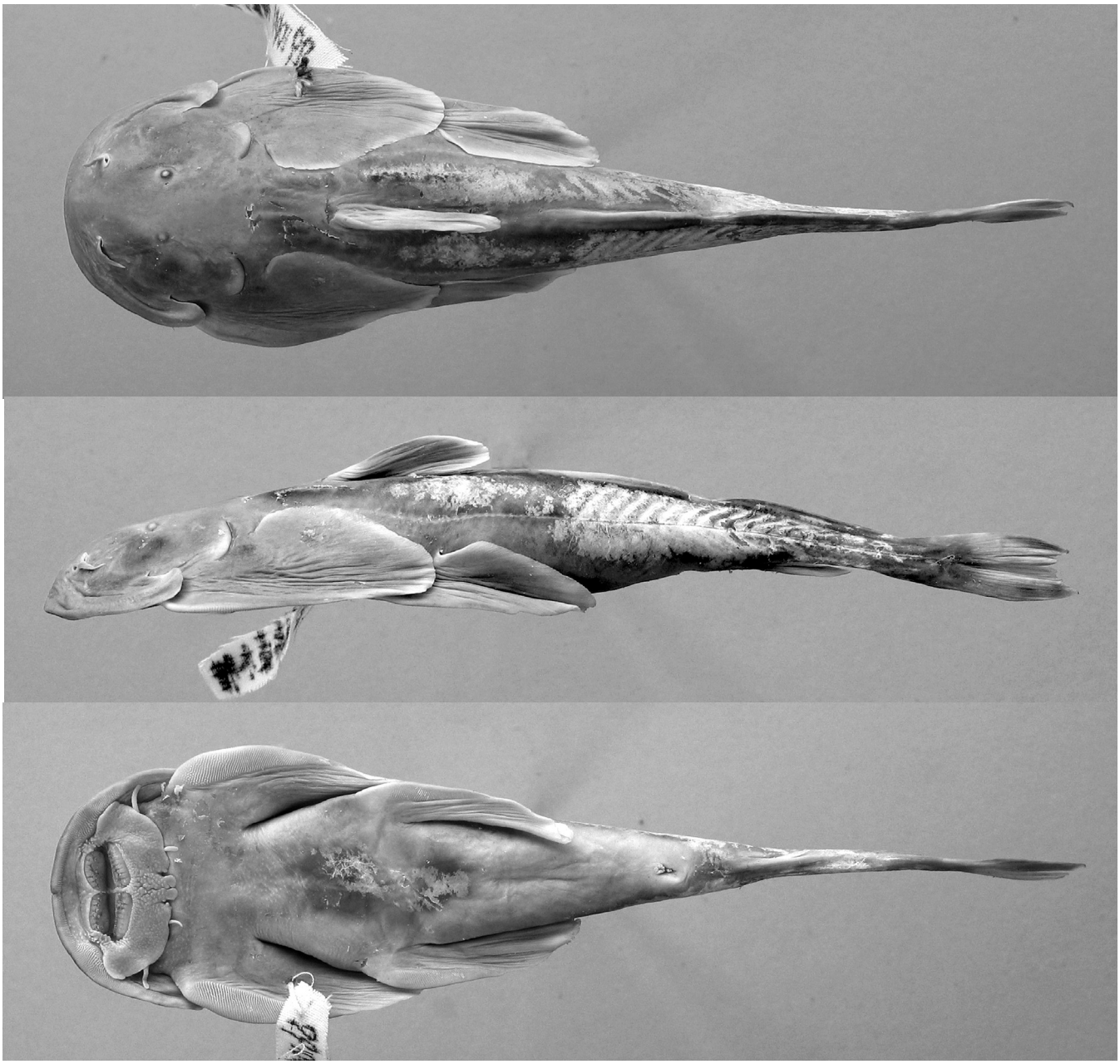

Fig. 1. *Pseudexostoma brachysoma*, SWFC 9910051, 118 mm SL; China: Nujiang (the upper Salween River) drainage. Dorsal, lateral and ventral views.

Paratypes: SWFC 200308020–021, 200308023–031, 11 ex., 68.2–113.8 mm TL, 59–99.2 mm SL, same data as holotype.

***Diagnosis*. –** *Pseudexostoma longipterus* is distinguished from *P. yunnanensis* by the following combination of characteristics: posterior margin of lower lip with three notches, depth of middle notch shallower than lateral ones (vs. as the same depth), length of two smaller median lobes of lower lip longer than lateral lobes (Fig. 2B) (vs. as the same length, Fig. 2C); pelvic fin i, 3–4 (vs. i, 5); base of adipose fin longer (37.8–45.1% SL vs. 28.8–39.8); caudal peduncle more slender (depth of caudal peduncle 4.6–6.1% SL and 19.6–30.8% in length of caudal peduncle vs. 6.4–8.3 and 32.6–42.7); premaxillary tooth band with 16-18 teeth (vs. 18–22), premaxillary tooth band divided into two and isolated (Fig. 3B) (vs. connected partially, Fig. 3C). *Pseudexostoma longipterus* differs from *P. brachysoma* in having a longer pectoral fin, pelvic fin and caudal fin (pectoral fin 30.1–31.3% SL vs. 24.9–29.8, pelvic fin 23.1–24.3% SL vs. 16.1–22.9, caudal fin 18–19.6% SL vs. 13.6–17.9), bigger eyes and wider interorbital width (eye diameter 8.2–10% HL vs. 5.8–7.8, interorbital width 25.5–30.8% HL vs. 19.7–24.7).

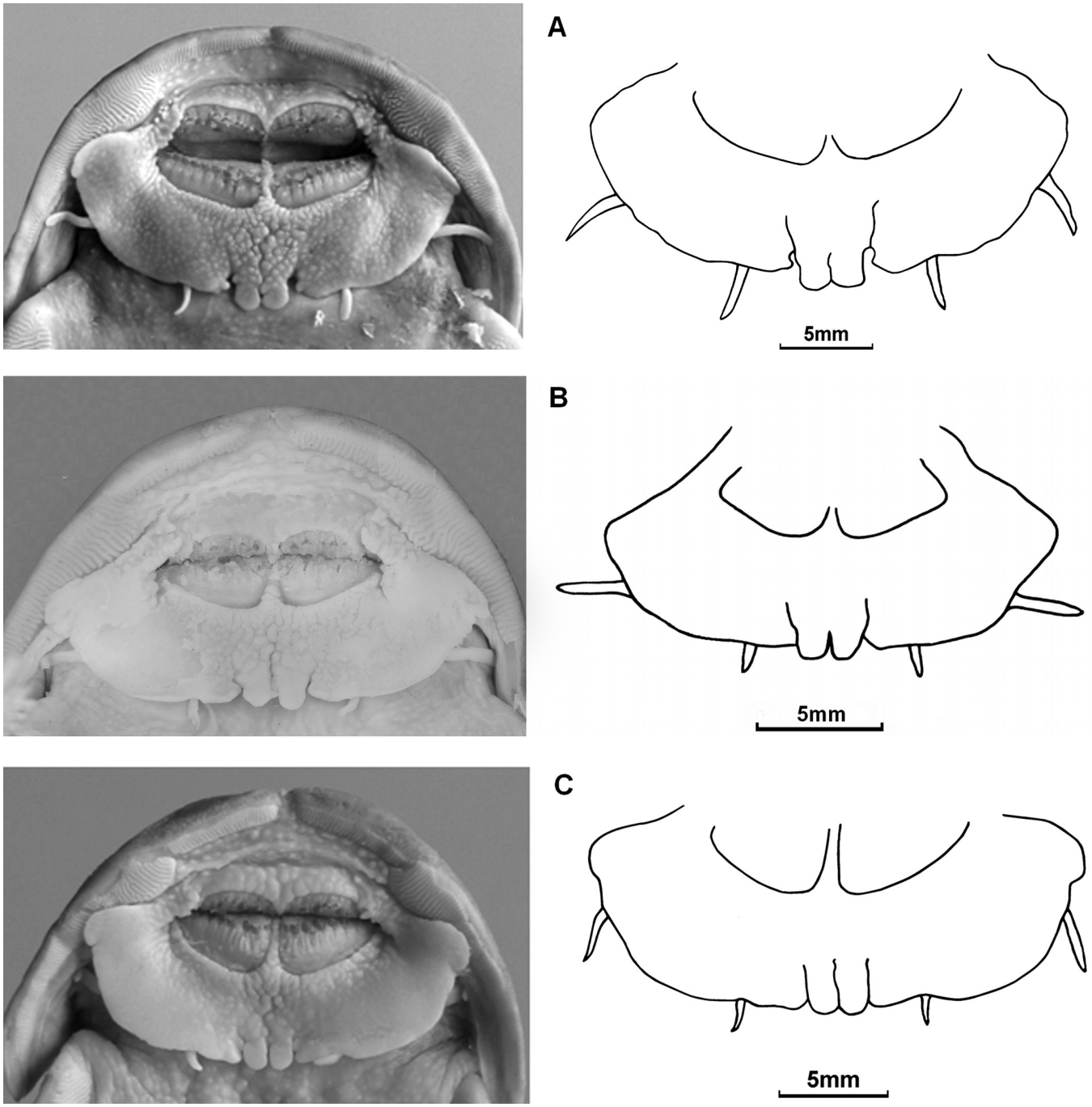

Fig. 2. Ventral view of lower lip. A–B, depth of middle notch shallower than depth of lateral ones, and length of two smaller median lobes of lower lip longer than lateral lobes (A , *P. brachysoma*, SWFC 9910051, 118 mm SL; B, *P. longipterus*, SWFC 200308022, holotype, 82.1 mm SL); C, Depth of middle notch the same as depth of lateral ones, and length of two smaller median lobes of lower lip the same as lateral lobes (*P. yunnanensis*, SWFC 200102201, 111 mm SL).

***Description*. –** Morphometric data as in Table 1.

Body moderately compressed. Dorsal profile rising evenly and somewhat steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally to end of caudal peduncle. Head and abdominal region before origin of anal fin broad and flat. Body after adipose fin compressed gradually.

Head depressed and broad, triangular when viewed laterally and with rounded snout when viewed from above. Eye small and ovoid, subcutaneous and located at middle of dorsal surface of head. Mouth transverse and inferior, premaxillary and mandibular tooth bands exposed when mouth closed. Teeth embedded in skin, shovel-shaped, tips exposed and arranged in irregular rows. Premaxillary tooth band divided into two, with 16–18 teeth (Fig. 3B). Anterior nostril tubular, separated from posterior nostril by nasal barbel base. Gill opening narrow, extending from one-third of last ray of pectoral fin to the first ray. Dorsal surface smooth without tubercles. Barbels in four pairs. Maxillary barbel flattened, with surrounding flap of skin and rounded tip, extending beyond pectoral fin origin, but not reaching to gill opening and far from post-temporal. Nasal barbel with small flap of thin skin fringing posterior margin and not reaching anterior margin of orbital. Post labial groove connected. Lower lip broad with three notches along posterior margin, divided into two bigger lateral lobes and two smaller median lobes. Depth of middle notch shallower than depth of lateral side notches. Two smaller median lobes of lower lip longer than lateral lobes. Inner mandibular-barbel close to midline, extending to pectoral fin origin. Outer mandibular-barbel precedes lateral inner mandibular barbel, extending to pectoral fin origin (Fig. 2B).

Unbranched dorsal fin rays not ossified. Post-dorsal margin of dorsal fin concave slightly. Origin of dorsal fin located at point through anterior third of body. Adipose fin base not connected with caudal fin. Caudal fin emarginate, upper lobe smaller than lower lobe. Anal fin post-ventral margin emarginate. Distance of anal fin origin to caudal fin base shorter than to end of pelvic fin base. Origin of pelvic fin precedes vertical end of dorsal fin base. Pelvic fin margin convex slightly, not extending to anus. Pectoral fin greatly enlarged and first unbranched ray not ossified. First unbranched ray of paired fins broadened with regular striae on ventral surface. Anus and urogenital openings located at end of pelvic fin and before origin of anal fin. Lateral line midlateral and complete.

***Coloration*. –** Grey black on dorsal surface, no spots or patches. Grey yellow on ventral region. Caudal fin grey black with an irregularly, small, yellow patch in the middle. Fins with grey yellow around distal edge.

***Distribution*. –** Only known from the middle Nujiang basin (Fig. 4).

***Etymology*. –** From the Latin *longi-*, meaning longer, and the Latin *pterus*, meaning fin. In reference to the longer pectoral fin, pelvic fin and caudal fin, distinguished from *P. brachysoma* and *P. yunnanensis*. A noun in apposition.

Pseudexostoma yunnanensis (Tchang, 1935)

(Figs. 2C, 3C, 4, 6)

Glyptosternum yunnanensis Tchang, 1935: 174-175 (Yunnan).
Pseudexostoma yunnanensis yunnanensis - Chu, 1979: 78-79 (Guyong, Tengchong County); Chu, Mo & Kuang, 1990: 212-214, Fig. 213 (Guyong, Tengchong County); Chu & Mo, 1999: 178-179, Fig. 117 (Guyong, Tengchong County).

***Material examined.* –** SWFC 200102172–173, 200102175–186, 200102190, 200102197, 200102201–202, 18 ex., 81–125 mm TL, 72–111 mm SL, Guyong, Tengchong County, Yunnan Province.

***Diagnosis*. –** *Pseudexostoma yunnanensis* is distinguished from *P. brachysoma* and *P. longipterus* by the following combination of characteristics: posterior margin of lower lip with three notches, depth of middle notch the same depth as lateral ones (vs. shallower), length of two smaller median lobes of lower lip the same length as lateral lobes (Fig. 2C) (vs. longer, Fig. 2A–B); pelvic fin i, 5 (vs. i, 3–4); base of adipose fin shorter (28.8–39.8% SL vs. 36.1–46.0); caudal peduncle deeper (depth of caudal peduncle 6.4–8.3% SL and 32.6–42.7% in length of caudal peduncle vs. 4.2–6.9 and 20–33.7); premaxillary tooth band with 18–22 teeth (vs. 16–18), premaxillary tooth band divided into two and connected partially (Fig. 3C) (vs. isolated, Fig. 3A–B).

***Description*. –** Morphometric data as in Table 1.

Body moderately compressed. Dorsal profile rising evenly and somewhat steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally to end of caudal peduncle.

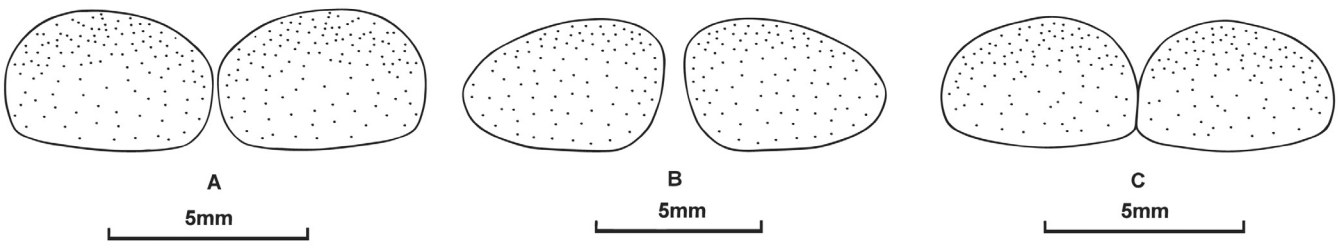

Fig. 3. Ventral view of premaxillary tooth band. A–B, Premaxillary tooth bands isolated (A, *P. brachysoma*, SWFC 200103329, 107 mm SL; B, *P. longipterus*, SWFC 200308022, holotype, 82.1 mm SL); C, Premaxillary tooth bands connected partially (*P. yunnanensis*, SWFC 200102178, 108 mm SL).

Head and abdominal region before origin of anal fin broad and flat. Body after adipose fin compressed gradually.

Head depressed and broad, triangular when viewed laterally and with rounded snout when viewed from above. Eye small and ovoid, subcutaneous and located at middle of dorsal surface of head. Mouth transverse and inferior, premaxillary and mandibular tooth bands exposed when mouth closed. Teeth embedded in skin, shovel-shaped, tips exposed and arranged in irregular rows. Premaxillary tooth band divided into two, with 18–22 teeth, and connected partially (Fig. 3C). Anterior nostril tubular, separated from posterior nostril by nasal barbel base. Gill opening narrow, extending from one-third of last ray of pectoral fin to the first ray. Dorsal surface smooth without tubercles. Barbels in four pairs. Maxillary barbel flattened, with surrounding flap of skin and rounded tip, extending beyond pectoral fin origin, but not reaching to gill opening and far from posttemporal. Nasal barbel with small flap of thin skin fringing posterior margin and not reaching anterior margin of orbital. Post labial groove connected. Lower lip broad with three notches along posterior margin, divided into two bigger lateral lobes and two smaller median lobes. Depth of middle notch as the same depth as lateral ones, length of two smaller median lobes of lower lip as the same length as lateral lobes. Inner mandibular-barbel close to midline, extending to pectoral fin origin. Outer mandibular-barbel precedes lateral inner mandibular barbel, extending to pectoral fin origin (Fig. 2C).

Unbranched dorsal fin ray not ossified. Post-dorsal margin of dorsal fin concave slightly. Origin of dorsal fin located at point through anterior third of body. Adipose fin base not connected with caudal fin. Caudal fin emarginate, upper lobe smaller than lower lobe. Anal fin post-ventral margin emarginate. Distance of anal fin origin to caudal fin base shorter than to end of pelvic fin base. Origin of pelvic fin precedes vertical end of dorsal fin base. Pelvic fin margin convex slightly, not extending to anus. Pectoral fin greatly enlarged and first unbranched ray not ossified. First unbranched ray of paired fins broadened with regular striae on ventral surface. Anus and urogenital openings located at end of pelvic fin and before origin of anal fin. Lateral line midlateral and complete.

Coloration. **–** Grey black on dorsal surface, no spots or patches. Grey yellow on ventral region. Caudal fin grey black with an irregularly, small, yellow patch in the middle. Fins with grey yellow around distal edge.

Distribution. **–** Only known from the upper Dayinjiang (an upper branch of the Irrawaddy River) (Fig. 4).

Remarks. **–** The specimens of *Pseudexostoma yunnanensis* deposited in the museum of Kunming Institute of Zoology (KIZ), the Chinese Academy of Sciences were collected from Guyong of Tengchong County, Yunnan (Chu, 1979; Chu et al., 1990; Chu & Mo, 1999). However, the specimens of *Pseudexostoma yunnanensis* were only collected from the same locality while Southwest Forestry College respectively investigated the Dayinjiang and collected fish specimens in 1999, 2001 and 2004.

Key to species of the genus *Pseudexostoma*

1. Posterior margin of lower lip with three notches, depth of middle notch shallower than depth of lateral ones, length of two smaller median lobes of lower lip longer than lateral lobes; pelvic fin i, 3-4; base of adipose fin 36.1–46.0% SL; depth of caudal peduncle 4.2–6.9% SL and 20–33.7% in length of caudal peduncle; premaxillary tooth band with 16–18 teeth (vs. 18–22), divided into two isolated patches 2
– Posterior margin of lower lip with three notches, depth of middle notch the same depth as lateral ones, length of two smaller median lobes of lower lip the same as lateral lobes; pelvic fin i, 5; base of adipose fin 28.8–39.8% SL; depth of caudal peduncle

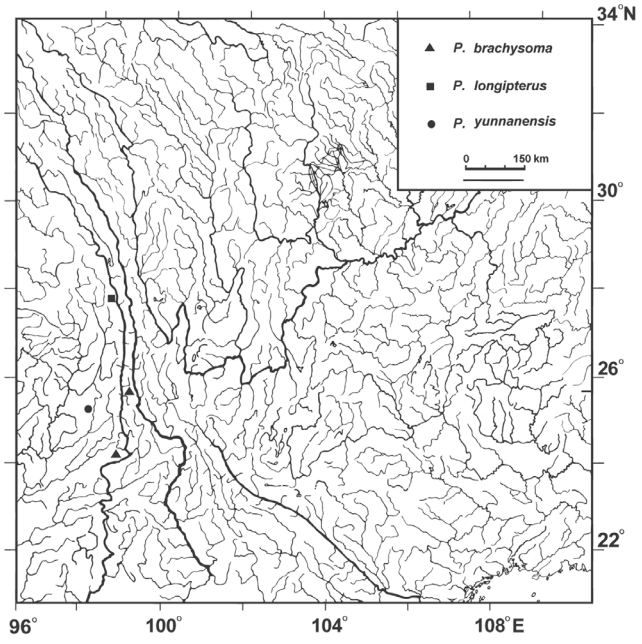

Fig. 4. Map showing distribution of *P. brachysoma*, *P. longipterus* and *P. yunnanensis*.

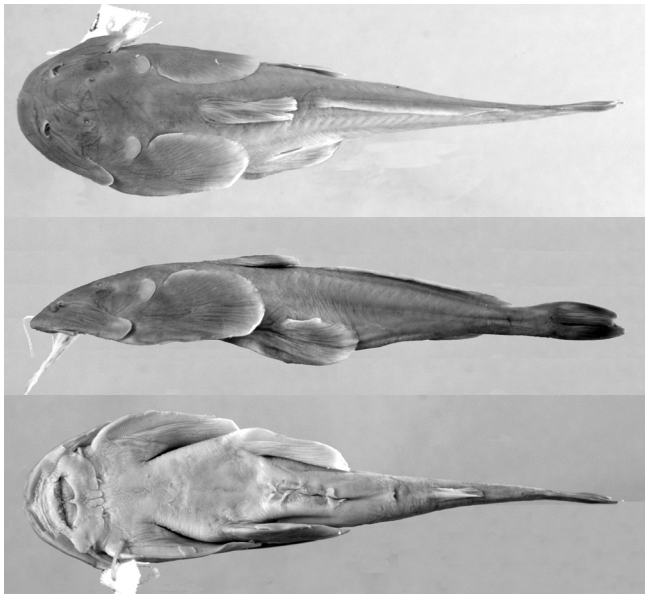

Fig. 5. *Pseudexostoma longipterus*, SWFC 200308022, holotype, 82.1 mm SL; China: Nujiang (the upper Salween River) drainage. Dorsal, lateral and ventral views.

6.4–8.3% SL and 32.6–42.7% in length of caudal peduncle; premaxillary tooth band with18–22 teeth, divided into two partially connected patches (Irrawaddy River) .... *P. yunnanensis*

2 Pectoral fin, pelvic fin and caudal fin longer, pectoral fin 30.1–31.3% SL, pelvic fin 23.1–24.3% SL, caudal fin 18–19.6% SL; eye diameter 8.2–10% HL, interorbital width 25.5–30.8% HL (Salween River) ..... *P. longipterus*

– Pectoral fin, pelvic fin and caudal fin shorter, pectoral fin 24.9–29.8% SL, pelvic fin 16.1–22.9% SL, caudal fin 13.6–17.9% SL; eye diameter 5.8–7.8% HL, interorbital width 19.7–24.7% HL (Salween River) ..... *P. brachysoma*

DISCUSSION

The shape of the lower lip is considered to be a chief characteristic in identifying genera of glyptosternoid catfishes (Hora & Silas, 1951; Chu, 1979). In this review the shape of lower lip is used as a new taxonomic characteristic to distinguish species in *Pseudexostoma*. Three species are recognized in a restricted area. Glyptosternoid catfish are not good at swimming over long distances and bottom-living (Hora & Silas, 1952). This suggests that populations in different rivers or in different sections of the same river could easily form variable populations with different body types.

The earliest known fossil record of the Sisoridae is *Bagarius bagarius* found in Sumatra and India of the Pliocene (Hora, 1939). Therefore, the origin of glyptosternoid fishes could be in the later Pliocene (Chu, 1979). Qinghai/Tibet Plateau rose so rapidly from the late Pliocene to the early Pleistocene that the pattern of river systems of the Pliocene Level was destroyed (Li & Pan, 2002). The results of a biogeographic study indicated that Qinghai/Tibet Plateau had been greatly uplifted three times (Cao et al., 1981). The ancestor of *Euchiloglanis* originated from the allied of *Glyptosternum* in the second uplift and *Pareuchiloglanis*, *Pseudexostoma*, *Oreoglanis*, *Exostoma* and *Glaridoglanis* originated with the third uplift of the Qinghai/Tibet Plateau (He, 1995; He et al., 2001). The *Exostoma* group (including *Pseudexostoma*, *Oreoglanis* and *Exostoma*) originated after the outline of Qinghai/Tibet Plateau was formed. The speciation of the *Exostoma* group was not so strong and their distribution was limited. There was no their track in the north slope of the Himalayas and Jinshajiang drainage (Chu, 1979). It was inferred that the *Exostoma* group was originated after Jinshajiang drainage was isolated.

Fig. 6. *Pseudexostoma yunnanensis*, SWFC 200102201, 111 mm SL; China: Irrawaddy River drainage. Dorsal, lateral and ventral views.

Due to the late Himalayan Orogenic Movement in the early Pleistocene, plateaus were lifted and rose higher. Discrepancies in elevation were strengthened. In the northwest of Yunnan received extrusions from the Indian Plate. This area was gradually uplifted and the folds and ruptures formed (Wang, 2001: 3). The northwestern part of Yunnan was seen as an axis at that time; the entire western part of Yunnan rotated to the southwest and spread out like a broom under pressure with the northwestern part being pushed and the southern part becoming convoluted. The crust of earth shortened about 200 km along the Nujiang breaking in the length 400 km from Duochong to Lushui (Wang, 2001: 13).

According to study results of genus *Pseudecheneis* (Sisoridae), the last isolated rivers were the upper Salween River (Nujiang) and the upper Irrawaddy River in the eastern river systems of Qinghai/Tibet Plateau (Zhou & Zhou, 2005). The Gaoligong Mountain rapidly rose during the middle Pleistocene, which was the directly reason caused the upper Salween River (Nujiang) and the upper Irrawaddy River to be isolated (Wang et al., 2001: 119). *Pseudexostoma* is restricted to the Nujiang basin and the upper Dayinjiang (an upper branch of the Irrawaddy River) and unrecorded in other river systems (Chu, 1979). The Biluo Snow Mountain (Nu Mountain System) also rapidly rose in belt lift form and separated rivers of the Nujiang and the Lancangjiang (the upper of Mekong River) (Wang et al., 2001: 119). According to the case stated above, the isolation of Lancangjiang might be slight early.

There is an obvious geographic barrier between the species of *Pseudexostoma* distributed in the Nujiang and the Dayinjiang. The facts indicate that the Nujiang and the Dayinjiang (perhaps including other upper branches of Irrawaddy River) were connected before the Burma-Malaya Geoblock moved northward. On the one hand, the rising of Gaoligong Mountain caused the differentiation of *Pseudexostoma* in the Nujiang and Dayinjiang. The species in Irrawaddy River is limited to the Dayinjiang and did not differentiate. On the other hand, the rising and continuous displacement northward of Gaoligong Mountain along with the movement of the plate resulted in the isolation of the two rivers, and their geographical latitude changed. The water environment and temperature of the Nujiang became greatly different between south and north areas, leading to speciation in cold water at the upper Nujiang, and in warm water in the middle and lower Nujiang.

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