

SYSTEMATIC REVISION OF CODLET (BREGMACEROTIDAE)
WITH DESIGNATIONS OF THE NEOTYPES FOR
BREGMACEROS PESCADORUS AND
BREGMACEROS LANCEOLATUS

SHIH-CHIEH SHEN and SY-WEN WANG

Department of Zoology, National Taiwan University,
Taipei, Taiwan 10764, Republic of China

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Shih-Chieh Shen and Sy-Wen Wang (1991) Systematic revision of codlet (Bregmacerotidae) with designations of the neotypes for *Bregmaceros pescadorus* and *Bregmaceros lanceolatus*. Bull. Inst. Zool., Academia Sinica 30(2): 63-71. This paper is a systematic revision of three codlet species: *Bregmaceros lanceolatus*, *Bregmaceros pescadorus* and *Bregmaceros maccllellandii* occurring around the coast of Taiwan. According to results from a continuous observation of a series of specimens, *B. lanceolatus* should evidently be separated from *B. maccllellandii* as a valid species. Unlike Belyanina (1974) who treated *B. lanceolatus* as a synonym of the latter. The previous record of *Bregmaceros arabicus* by Okamura from Taiwan is doubtful. Neotypes of *B. lanceolatus* and *B. pescadorus* have been redesignated since their holotypes were eventually lost.

Key words: Fish taxonomy, Bregmacerotidae, Taiwan.

The Bregmacerotidae created by Gill (1872) is a widely spread family of marine fishes occurring throughout the tropical and subtropical seas of the world (Nelson, 1984) including even the temperate region (Masuda *et al.*, 1984). They have been found from the sea's surface to the depth of approximately 4,000 M (D'Ancona and Cavinato, 1965). They also can migrate into the sulfurous anoxic zone (Wilson, 1972; Milliken and Houde, 1984). Only one genus, *Bregmaceros*, described early by Thompson (1840) was included in this family.

Because of great similarities in morphological features among the species of this family, a serious confusion in classification was expected from the historic revision of this family. D'Ancona

and Cavinato (1965) are the earliest scientists to describe the following 7 species, namely *B. arabicus*, *B. nectabanus*, *B. japonicus*, *B. maccllellandii*, *B. rarisquamosus*, *B. atlanticus* and *B. bathymaster*. Later in 1974, Belyanina described only 6 species. In recent years two new species, *B. cantori* and *B. neonectabanus* respectively described by Milliken and Houde (1984) and Masuda *et al.* (1986). If the two new species *B. pescadorus* and *B. lanceolatus* described by Shen (1960) are valid, the total number of *Bregmaceros* species in the world increased to at least 10 species. Unfortunately, because the holotypes of these two species were lost, the reexamination was made impossible. It was necessary to reestablish the type specimens (neotypes) and to make a revision

of the entire species of *Bregmacerotidae* in Taiwan.

After intensive collection in the past years, we found three species of *Bregmaceros* occurring on the western coast. They seem to have different vertical distributions ranging from the surface to a depth of 300 m; *Bregmaceros pescadorus* from the surface to a depth of 100 m; *Bregmaceros lanceolatus* from 50 to 200 m and *Bregmaceros macclellandii* occurring below a depth of 200 m.

MATERIALS AND METHODS

Specimens were collected at Tung-Kang and Ta-Hsi (Fig. 1), landed by trawlers operated from adjacent waters during October 1987 and June 1988 (Table 1). The method of meristic counting was modified from Shen (1960) and Masuda *et al.* (1986) (Fig. 2, Table 2). In some cases, radiographs were used as an aid for counting skeletal elements in the present study.

Key to Species of *Bregmacerotidae* in Taiwan

- 1a. Caudal fin forked2
- 1b. Caudal fin pointed; scales on lateral line 84-90; caudal vertebrae more than 44; dorsal rays 56-76; anal rays 62-69; abdominal chromatophores absent or present; or a black spot on caudal fin.
.....*Bregmaceros lanceolatus*

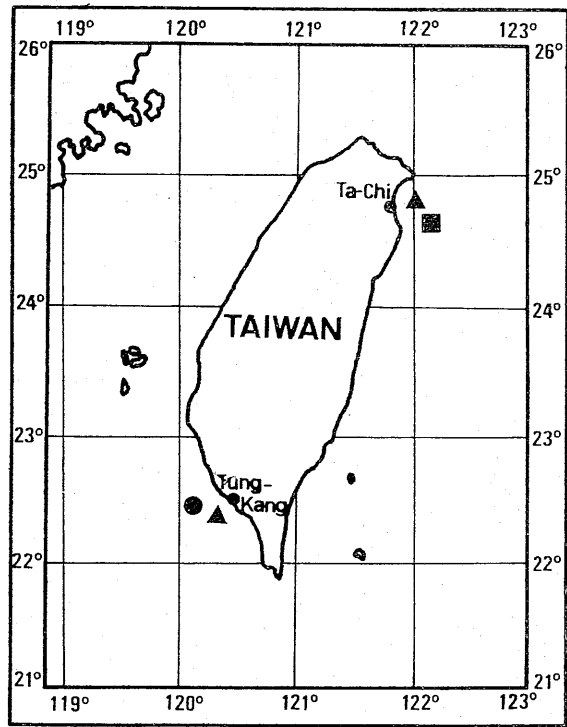


Fig. 1. Collecting locations of *B. lanceolatus* (▲), *B. pescadorus* (●), and *B. macclellandii* (■).

- 2a. Lateral line scales more than 80; caudal vertebrae 38-40; dorsal rays 48-64; anal rays 49-57; abdominal chromatophores absent; body color darker.....*Bregmaceros macclellandii*
- 2b. Lateral line scales less than 65; caudal vertebrae 41-43; dorsal rays 45-55; anal rays 45-51; chromatophores arranged in a regular order on the lateral sides; abdominal chromatophores present, maximum length 44 mm SL*Bregmaceros pescadorus*

Table 1
Collecting data of three Taiwanese *Bregmaceros* species

Date	Species	Location	No.
871017	<i>B. lanceolatus</i>	Tung-Kang	45
	<i>B. pescadorus</i>	Tung-Kang	18
880325	<i>B. lanceolatus</i>	Tung-Kang	24
880606	<i>B. lanceolatus</i>	Ta-Hsi	11
880615	<i>B. lanceolatus</i>	Ta-Hsi	21
	<i>B. macclellandii</i>	Ta-Hsi	12
880703	<i>B. lanceolatus</i>	Tung-Kang	44

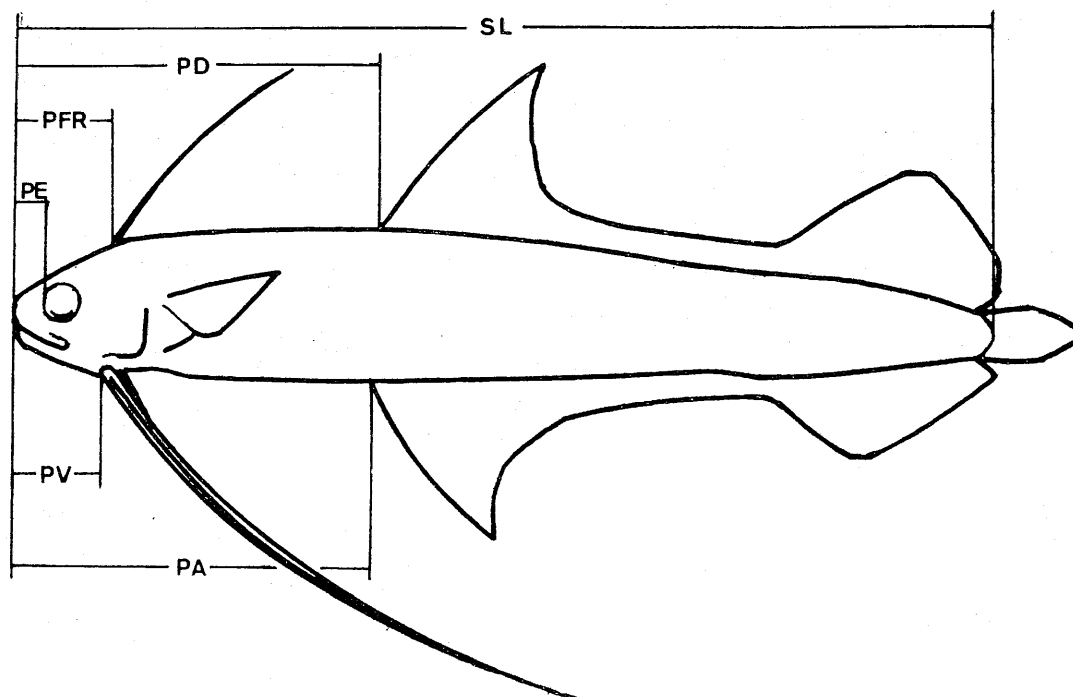

 Fig. 2. Morphometric measurements for *Bregmaceros*.

 Table 2
 Morphometric and meristic characteristics for three described
 species of *Bregmaceros* in Taiwan

	<i>B. lanceolatus</i>	<i>B. pescadorus</i>	<i>B. maclellandii</i>
SL	38.2-94.5	38.8-44	91-103.5
LS	84-88	82-85	58-65
L. tr.	14-15	14-15	14-15
Dorsal fin rays	I. 15-20-XVI-XXI-25-35	I. 14-16-XII-XIV-19-25	I. 15-20-XIV-XIX-19-25
Anal fin rays	20-21-XII-XV-30-33	14-15-IX-XII-22-24	20-22-IX-XI-20-24
Abdominal vertebrae	12-14	13	12-14
Caudal vertebrae	44-46	38-40	41-43
In SL%			
Head	14.2-14.8	15.5-17.2	15.0-16.0
Pre-1st-D-ray	7.4-12.3	8.7-10.1	9.1-10.4
Pre-dorsal	35.3-44.5	38.3-39.9	35.8-38.4
Pre-anal	31.7-44.5	36.2-38.2	34.9-37.3
Pre-ventral	7.4-9.3	8.7-10.9	6.7-8.2
Snout	6.8-9.3	7.0-11.1	8.1-9.1
Caudal fin	pointed	forked	emarginated

SYSTEMATIC ACCOUNTS
Bregmaceros lanceolatus Shen, 1960

(Figs. 3 and 4)

Bregmaceros lanceolatus Shen, 1960: 67.

Bregmaceros maclellandii (nec Thompson): Belya-
 nina, 1974: 96: 143.

Materials: Neotype—NTUM 07500 82
 mm SL, Tung-Kang, October 17, 1987, by
 trawlers.

Other materials: Type 1; Four specimens, including NTUM 07501 82 mm SL, NTUM 07502 94 mm SL, NTUM 07503 83 mm SL, NTUM 07504 92 mm SL collected in Tung-Kang on October 17, 1987 and July 6, 1988 by trawlers. Type 2: Three specimens, including NTUM 07505 47.6 mm SL, NTUM 07506 73.5 mm SL, NTUM 07507 69 mm SL collected in Tung-Kang on March 25, 1988 and July 3, 1988 by trawlers. Type 3: One specimen, NTUM 07508 73.5 mm SL collected in Tung-Kang on March 25, 1988, by trawlers.

Diagnosis: D.I. 15-20-XVI-XXI-25-35, A. 20-21-XII-XV-30-33; abdominal vertebrae 13 or 14, caudal vertebrae 44-46. Body proportion as percentage of standard length: base of first dorsal ray to snout tip 9.3 (7.4-10.9), origin of dorsal base to snout tip 36.4 (34.5-39.4), origin of anal base to snout tip 35.8 (31.7-44.6), origin of ventral base to snout tip 8.3 (7.4-9.3), snout length 8.1 (6.8-9.3).

B. lanceolatus is conspicuously different from all other bregmacerotid species by its pointed caudal fin. This species is recorded only around the coastal waters of Taiwan, usually caught by trawlers at a depth of 50 m to 200 m. Body elongated, subcylindrical anteriorly, two-third's of the posterior laterally compressed, dorsal profile more convex than ventral. Eyes very large, bigger than snout. Mouth small, slightly oblique, maxilla extended to posterior border of the pupil. Head naked. Body scales small, cycloid and deciduous. Lateral side of body often host to parasitic copepod (Fig. 5).

Coloration of *B. lanceolatus* varied in different nontype materials. In neotype Type 1, belly yellow or pale on lateral side of abdomen, blackish throughout the lateral side of dorsal region, fins hyaline. In Type 2, belly yellow or pale throughout the entire body, with longitudinal series of chromatophores from dorsal to abdominal regions, all fins hyaline. Color

of Type 3 as Type 1, except for the minor difference in having a black spot on the caudal fin (Fig. 11).

***Bregmaceros pescadorus* Shen, 1960**

(Fig. 6 and 7)

Bregmaceros pescadorus Shen, 1960, 13: 67.

Bregmaceros arabicus Masuda *et al.*, 1984: 92.

Materials: Neotype—NTUM 07509 44 mm SL collected at Tung-Kang on October 17, 1987 by trawlers.

Other materials: Three specimens, including NTUM 07510 38.8 mm SL, NTUM 07511 39.9 mm SL, and NTUM 07512 39 mm SL collected at Tung-Kang on October 17, 1987 by trawlers.

Diagnosis: D.I. 14-16-XII-XIV-19-25, A. 14-15-IX-XII-22-24; abdominal vertebrae 13, caudal vertebrae 38-40. Body proportion as percentage of standard length: base of first dorsal ray to snout tip 9.8 (8.7-10.6), origin of dorsal base to snout tip 39.7 (38.3-39.9), origin of anal base to tip 37.3 (36.2-38.7), origin of ventral base to snout tip 8.5 (7.0-11.1). Body elongated, compressed or much compressed from the snout origin of the 2nd dorsal to the base of caudal. Mouth oblique, maxilla reaching the middle of pupil. Dorsal profile more convex than ventral. Scales thin, small, cycloid and deciduous. This species occurs only around coastal waters of Taiwan (Shen, 1960), usually caught by trawlers from the sea's surface to a depth of 100 m. This species differs from *B. arabicus* in having 45-51 anal rays instead of 50-63 in the latter. This species is also easily distinguished from *B. nectabanus* by having regular arranged dorsal chromatophores and prominent abdominal chromatophores (Table 3).

Body color yellowish or pale, with black dots arranged in a longitudinal series from the dorsal to the abdominal regions, fins hyaline.

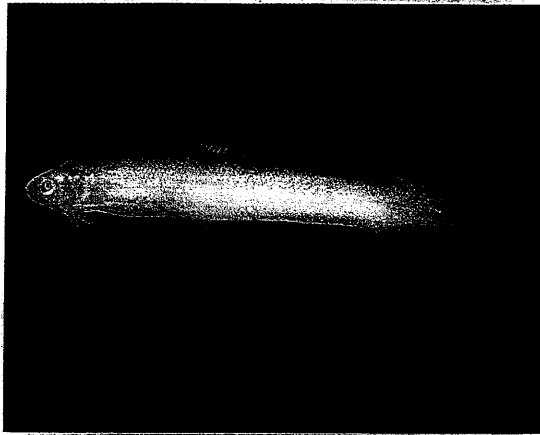


Fig. 3. *Bregmaceros lanceolatus*, Type 1, 82 mm SL.

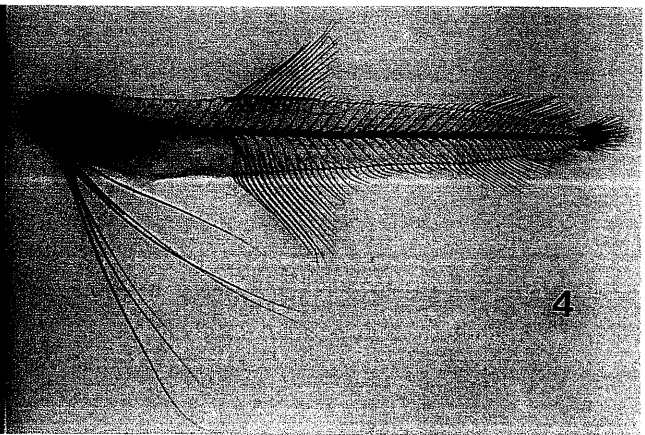


Fig. 4. Cleared specimen of *Bregmaceros lanceolatus*.



Fig. 5. *Bregmaceros lanceolatus* with parasite on the lateral side.

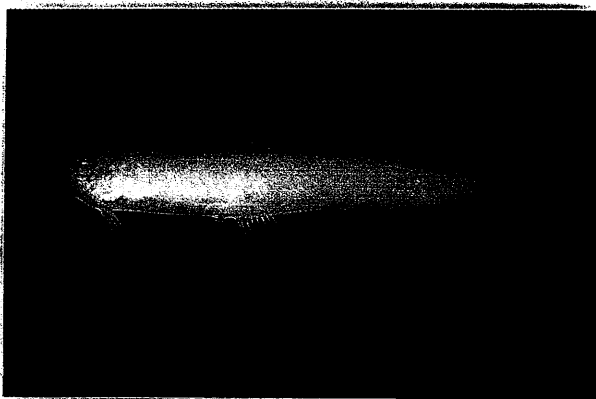


Fig. 6. *Bregmaceros pescadorus*, 40 mm SL.

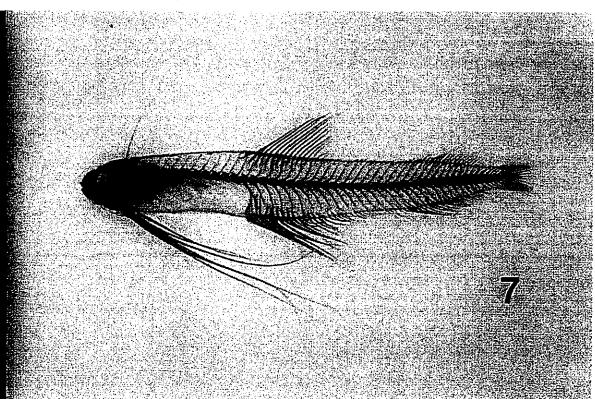
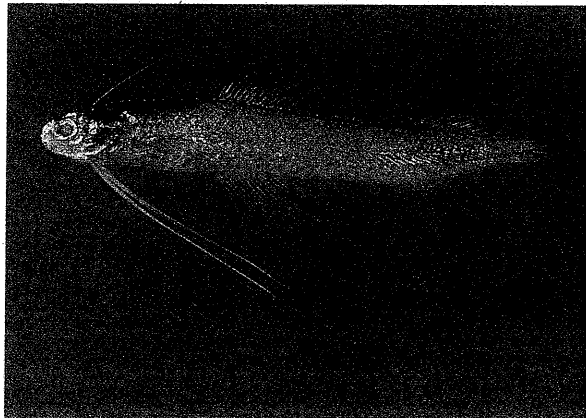
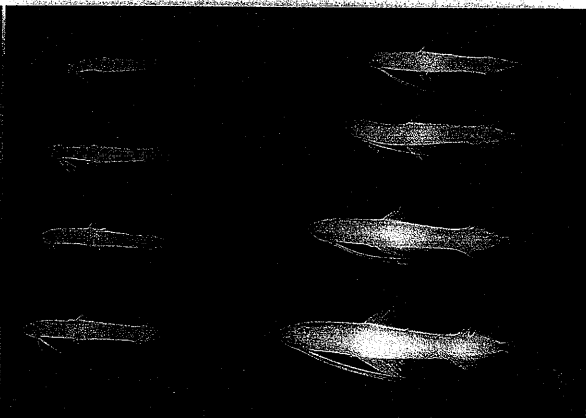


Fig. 7. Cleared specimen of *Bregmaceros pescadorus*.

Fig. 8. *Bregmaceros maclellandii*, 102 mm SL.Fig. 9. *Bregmaceros lanceolatus*, Type 2, 57 mm SL.Fig. 10. *Bregmaceros lanceolatus*, Type 3, 74 mm SL.Fig. 11. Series of *Bregmaceros lanceolatus* from 30 mm to 50 mm SL.

***Bregmaceros maclellandii* Thompson, 1840**
(Fig. 8)

Bregmaceros maclellandii Thompson, 1840: 4: 184;
Günther, 1862: 386.

Calloptilum mirum Richardson, 1844: 94.

Materials: NTUM 07513 93.5 mm SL, NTUM 07514 101.5 mm SL, NTUM 07515 103.2 mm SL, NTUM 07516 103.5 mm 95.3 SL, NTUM 07517 93.5 mm SL, NTUM 07518 mm SL, NTUM 07519 99 mm SL, collected all from Ta-Hsi on June 15, 1988.

Diagnosis: D. I. 15-20--XIV-XIX-19-25, A. 20-22-IX-XI-20-24; abdominal vertebrae 13 (rarely 14), caudal vertebrae 41-43. Body proportion as percentage of stan-

dard length: base of first dorsal ray to snout tip 10.1 (9.1-10.4), origin of dorsal base to snout tip 37.1 (35.8-38.4), origin of anal base to snout tip 36.6 (34.9-37.4), origin of ventral base to snout tip 7.5 (6.7-8.2), snout length 8.7 (8.1-9.1). Maxilla extends to the posterior margin of the pupil. Ventral fins reach the insertion of the anal fin or slightly beyond it. Much like *B. japonicus*, but can be distinguished by opposite origins of dorsal fin and anal fin. The beginning of the dorsal fin in *B. maclellandii* is about in vertical line with that of the anal fin but not in *B. japonicus*.

Color blackish throughout the body,

which may be the result of its deeper habitat (below a depth of 200 m).

DISCUSSION

Among several characteristics used for identification of the bregmacerotid species, we found that comparing the number of caudal vertebrae is the easiest way to separate them. Because the number of caudal vertebrae has no correlation with body length, the number of caudal vertebrae is accepted as a stable diagnostic characteristics for species identification.

Resulting from our study, three morphological types of *B. lanceolatus* were recognized: Type 1 is the same as the one described by Shen (1960); Type 2 has a varied pattern on the lateral side of the body (Fig. 9); and Type 3 has a black spot on the caudal fin (Fig. 10). All three types share the common characteristic of a pointed caudal fin.

Belyanina (1974) treated *B. lanceolatus* as a synonym of *B. macclellandii*, yet they

can be separated by different caudal fin shapes. Furthermore, unlike *B. macclellandii*, judging from continuous observations of specimens at different growth stages (30 to 95 mm) (Fig. 11), *B. lanceolatus* shows a consistently pointed caudal fin shape. There is no indication of forked caudal fins at any growth stages of *B. lanceolatus*. Masuda *et al.* (1986) disagreed with putting *B. pescadorus* under *B. japonicus* by D'Ancona and Cavinato (1965) and *B. lanceolatus* as *B. macclellandii*. Nevertheless their treatment of *B. pescadorus* as a synonym of *B. nectabanus* is also considered inadequate, since the *B. pescadorus* has dorsal chromatophores arranged in a regular pattern and has well prominent abdominal chromatophores as listed by Masuda *et al.* (Table 3).

Furthermore, the *B. arabicus* noted by Okamura (Masuda *et al.*, 1984) could be *B. pescadorus* since D'Ancona and Cavinato (1965) inappropriately put *B. pescadorus* under the name of *B. arabicus*. This was wrong for the following reasons: 1. the distributional range of *B. arabicus* indi-

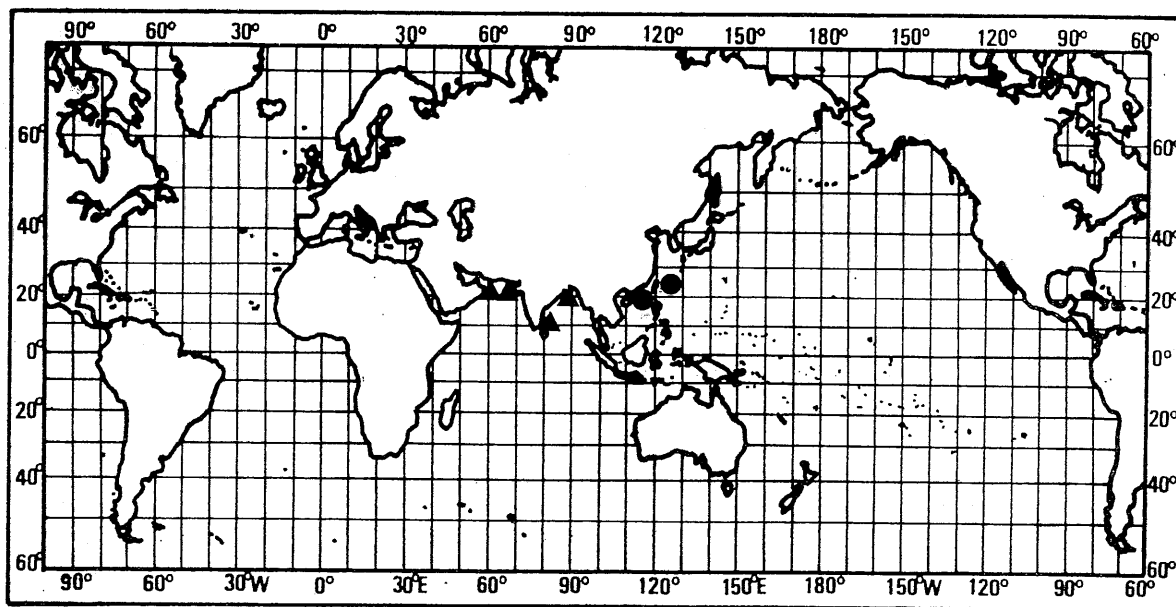


Fig. 12. Collecting locations for *B. arabicus* (▲) and *B. pescadorus* (●) based on D'Ancona and Cavinato (1965).

Table 3
Comparisons of meristic counts and body chromatophores of *B. nectabanus*
listed by Masuda *et al.* (1986) with *B. arabicus* and *B. pescadorus*

	<i>B. nectabanus</i>	<i>B. arabicus</i>	<i>B. pescadorus</i>
SL (mm)	30.4-65.5	Max. 43	38.8-44
Total vertebrae	49-53	52-54	51-53
D	46-55	50-60	45-55
A	47-57	50-63	45-51
PC	13	?	13-14
LS	71-80	78-89	82-85
TS	15-17	14-16	14-15
Dorsal chromatophores	Irregular	Regular	Regular
Abdominal chromatophores	Absent	Present	Present

cated that it was widely separated from that of *B. pescadorus* (Fig. 12); 2. the number of dorsal fin rays and anal fin rays is quite different between the two species (Table 3).

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REFERENCES

- Baird, R.C., D.F. Wilson and D.M. Milliken (1973) Observation on *Bregmaceros nectabanus* Whitley in the anoxic sulfurous water of the Cariaco Trench. *Deep-Sea Res.* **20**: 503-504.
- Belyanina, T.N. (1974) Development, taxonomy and distribution of fishes of the family Bregmacerotidae. *Trudy Inst. Okeanol.*, **96**: 143-188.
- D'Ancona, U. and G. Cavinato (1965) The fishes of the family Bregmacerotidae. *Dana Rep.* **64**: 1-92.
- Dawson, C.E. (1966) Observations on the Anacanthine Fish *Bregmaceros atlanticus* in the North Central Gulf of Mexico. *Copeia* 1966 (3): 604-605.
- Day, F. (1869) Day on Indian Fishes. *Proc. Zool. Soc. Lond.* 1869 (Nov.): 522.
- Markle, D.F. (1982) Identification of larval and juvenile Canadian Atlantic gadoids with comments on the systematics of gadid subfamilies. *Can. J. Zool.* **60**(12): 3420-3438.
- Masuda, H., K. Amaoka, C. Araga, T. Uyeno and T. Yoshino (1984) *The Fishes of the Japanese Archipelago*. Tokai Univ. Press, Tokyo. 437 pp.
- Masuda, S. and T. Ozawa (1979) Reexamination of the Holotypes of *Bregmaceros japonicus* Tanaka and *B. nectabanus* Whitley. *Jap. J. Ichthyol.* **25**(4): 266-268.
- Masuda, S., T. Ozawa and O. Tabeta (1986) *Bregmaceros neonectabanus*, a new species of the Family Bregmacerotidae, Gadiformes. *Jap. J. Ichthyol.* **32**(4): 392-399.
- Milliken, D.M. and E.D. Houde (1984) A new species of Bregmacerotidae (Pisces), *Bregmaceros cantoni*, from the Western Atlantic Ocean. *Bull. Mar. Sci.* **35**(1): 11-19.
- Regan C.T. (1903) On the systematic position and classification of the Gadoid or Anacanthine fishes. *Ann. Mag. Nat. Hist. Ser.* **7**(11): 459-466.
- Shen, S.C. (1960) *Bregmaceros lanceolatus* and *Bregmaceros pescadorus* two new species of dwarf fishes from Southern Taiwan and Pescadore Islands. *Quart. J. Taiwan Mus.* **13**: 67-74.
- Smith, M.M. and P.C. Heemstra (1986) *Smiths' Sea Fishes*. Macmillan South Africa (Publishers) Ltd.
- Tanaka, S. (1908) Descriptions of eight new species of fishes from Japan. *Annot. Zool. Jap.* **7**(1): 27-47.
- Webber, M. and L.F. de Beaufort 1929) *The Fishes of the Indo-Australian Archipelago*. Vol. 5. E.J. Brill, Leiden. 458 pp.
- Wilson, D.F. (1972) Diel migration of sound scatterers into, and out of, the Cariaco Trench anoxic water. *J. Mar. Res.* **30**: 168-176.

臺灣產海魴鰵科魚類之研究與新模式標本之建立

沈世傑 王司文

本報告旨在對臺灣附近海域所產之海魴鰵科魚類重新進行分類研究，研究期間共採得三種海魴鰵科魚類，分別為：尖尾海魴鰵 (*Bregmaceros lanceolatus*)，澎湖海魴鰵 (*B. pescadorus*) 和斑點海魴鰵 (*B. maclellandii*)。由連續標本觀察結果顯示尖尾海魴鰵是一個獨立種，Belyanina 氏在 1974 年稱尖尾海魴鰵為斑點海魴鰵的同種異名的正確性堪虞。Masuda 等人 1984 年所謂的阿拉伯海魴鰵亦甚值得懷疑。在本研究中並已建立尖尾海魴鰵與澎湖海魴鰵的新模式標本。

