

Taxonomic Review of Flathead Fishes (Platycephalidae, Scorpaeniformes) from Korea

Chung-Lyul Lee and Dong-Soo Joo

Department of Biology, Kunsan National University, Kunsan 573-701, Korea

The taxonomic review of the family Platycephalidae from Korea was made based on the morphological characteristics of specimens collected in the Korean coasts from December 1987 to April 1998. The family Platycephalidae from Korea was classified into 10 species belonging to 7 genera : *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper*, *Suggrundus meerdervoorti*, *Inegocia japonica*, *I. guttata*, *Cociella crocodila*, *Ratabulus megacephalus*, *Platycephalus indicus* and *Platycephalus* sp. Of them, *Onigocia macrolepis* was recorded for the first time in Korea and *Platycephalus* sp. was demanded to recheck its taxonomic position comparing with other Asian specimens in future.

A new key to the genera and species of the family Platycephalidae from Korea was reported, with description of their morphological characteristics and distribution.

Introduction

The flathead fishes were chiefly distributed in Indo - Pacific, eastern Atlantic and eastern Mediterranean, and were consisted of 17 genera (Imamura, 1996) and 60 species (Nelson, 1994). They are usually sluggish bottom-dwellers, spending most of their time on sea-floor of shallow or moderately deep waters not far from the shore (Matsubara and Ochiai, 1953). They are plentiful in Korean waters, some of them are valuable and popular food fishes in the fish markets for the Koreans.

The first report of the Korean flatheads was made in 1913 by Jordan and Metz, who reported 2 species and 2 genera without any description for them : *Platycephalus indicus* and

Thysanophrys crocodilus (= *Cociella crocodila*). Mori (1952) and Chyung (1977) described that Platycephalidae from Korea was classified into 5 species belonging to 5 genera. Recently Jeon (1992) and Lee and Joo (1994, 1995) have added 3 species as new records of Korean flatheads : *Suggrundus meerdervoorti*, *Rogadius asper* and *Inegocia guttata*. But flathead fishes from Korea did not study hitherto enough to their taxonomic status.

The flathead fishes largely differed from other by having the following characters : head much depressed and armed with strong spines, projected lower jaw than upper one, body surface covered with ctenoid scales, two dorsal fins, and iris lappet.

The aim of this study is to review morpholog-

This study was supported by Basic Science Research Institute Program, Ministry of Education, 1997, Project No. BSRI-97-4428.

ical characters and their distribution of Korean flathead fishes, to add two species as a new record and *Platycephalus* sp. and to propose a new key of Platycephalidae from Korea. The examined specimens were collected in the coastal waters or fish - markets for small fishing boats of Korea from December 1987 to April 1998. And two species were used from National Fisheries Research Development Agency of Korea (NFRDA). The measurements and counts follow Hubbs and Lagler (1964). The counts of vertebrae and vertical fin rays were taken from skeletal specimens (Taylor, 1967) and radiograph. The collected sites and date, individual number and standard length of specimens were recorded at the examined materials of each species. The examined specimens were deposited at the Department of Biology, Kunsan National University (BKNU).

Family Platycephalidae

Genus *Rogadius* Jordan et Richardson

(Korean name : Banul - Yangtae - sok)

Rogadius Jordan et Richardson, 1908, 33 : 630 (Type specimen : *Platycephalus asper* Cuvier et Valenciennes).

Rogadius asper (Cuvier et Valenciennes, 1829)

(Korean name : Banul - Yangtae) (Fig. 1)

Platycephalus asper Cuvier et Valenciennes,

1829, p. 257, Japan (original description). *Rogadius asper* Jordan and Richardson, 1908, p. 63, fig. 1, Swatow, China (description); Lee and Joo, 1994, pp. 1 - 6, Pusan, Korea.

Materials examined : BKNU 903, 905 - 908, 911 - 912, 914 - 915 (9), 142.4 - 168.6 mm, standard length (SL), Nampo-dong, Chung-gu, Pusan, Feb. 3, 1993; BKNU 4167 - 4169 (3), 148.6 - 154.2 mm SL, Nampo-dong, Chung-gu, Pusan, Mar. 29, 1995.

Description : Dorsal fin rays (D) I - VIII - 11~12; anal fin rays (A) 11; pectoral fin rays (P₁) 20 - 23; ventral fin rays (P₂) I, 5; pored scales of lateral line (LLp) 52~55; gill rakers (GR) 1+6~7=7~8; diagonal scales (DS) 7~11; vertebrae (Vert) 27.

Ocular cirrus absent; iris lapped bilobed, but never cirrose. Anterior nostril with a dermal flap posteriorly. Preopercle armed with an antrose spine in lower face and 4 spines at angle, lowermost one usually rudimentary and uppermost one much longer than second one. Uppermost preopercular spine with a sharp accessory spine.

Color in 10% formalin : Head and body surface nearly yellow brownish, with 4 to 5 dark vertical bands or brownish, but belly pale. Caudal fin darkish, with 3 to 4 black bands.

Distribution : South Sea of Korea, Japan, China, Red Sea, Pakistan, Philippines and Australia.

Remarks : *Rogadius asper* was reported by Lee and Joo (1994), as a first record from Korea.

Genus *Onigocia* Jordan et Thompson, 1913

(Korean name : Binul - Yangtae - sok)

Onigocia Jordan et Thompson, 1913, p. 70 (original description, type specimen : *Platycephalus macrolepis* Bleeker).

Fig. 1. *Rogadius asper* (Cuvier and Valenciennes), 180.5 mm SL.

Fig. 2. *Onigocia spinosa* (Temminck and Schlegel), 109.2 mm SL

***Onigocia spinosa* (Temminck et Schlegel, 1842)**

(Korean name : Binul - yangtae) (Fig. 2)

Platycephalus spinosus Temminck et Schlegel, 1842, p. 40, pl. 16, figs. 1, 2, Nagasaki (original description).

Wakiyus spinosus Mori, 1952. p. 160.

Onigocia spinosa Matsubara and Ochiai, 1953. pp. 69~71 ; Chyung, 1977, p. 525, Korea ; Kim and Kang, 1993, p. 248, Korea.

Materials examined : NFRDA 1460 - 1~4 (4), 109.2~119.0 mm SL, Nampo-dong, Chung-gu, Pusan, Jun. 26, 1935.

Description : D I - VIII~IX - 11~12 (rarely I - VIII - 11~12) ; A 12 ; P₁ 20~21 ; P₂ I, 5 ; LLp 35~42 ; DS 5 ; GR 1+3~5=4~6 ; Vert. 27.

Ocular cirri present and largely developed. Iris lappet developed, bilobed and finely cirrose. No pit behind eye. Anterior 10~16 pored lateral line scales quadrated and spined anteriorly. Interopercular flap absent. Perforating duct of scales robust, communicated with exterior through ends of 2 thick tubes.

Color in 10% formalin : Surface of body red - brownish, with 4 distinct dark brown bands vertically. All fins with brown spots except anal fin. Middle part of ventral blackish, and its margin yellowish. Caudal fin with about 4 vertical bands.

Distribution : South Sea of Korea, Japan, China and Taiwan.

Remarks : This species was used specimens collected at 1935, which were stored in National Fisheries Research Development Agency of

Korea. *Onigocia spinosa* was frequently appeared on the coastal area of Japan.

***Onigocia macrolepis* (Bleeker, 1854)**

(New Korean name : Kunbinul - Yangtae) (Fig. 3)

Platycephalus macrolepis Bleeker, 1854, p. 399 (Original description, type locality : Nagasaki).

Fig. 3. *Onigocia macrolepis* (Bleeker), 104.0 mm SL

Wakiyus spinosus Mori, 1952. p. 160.

Onigocia macrolepis Matsubara and Ochiai, 1953. pp. 71~72.

Materials examined : BKNU 4184~4186 (3), 78.6~104.0 mm SL, Nampo-dong, Chung-gu, Pusan, Feb. 12, 1996.

Description : D I - VII~VIII - 11~12 ; A 11~12 ; P₁ 21 ; LLp 39~40 ; GR 1+4~5=5~6 ; DS 4 ; Vert. 27.

Head and body depressed. Caudal peduncle slightly compressed. Eye large, but its diameter shorter than snout length. Side of head uicarinatus. Upper side of head armed with a number of largely strong and somewhat blunt spines. Sides of head with one row of saw-like carinatus. Lower jaw slightly protruded than upper one. Tip of ventral fin reaching below base of about second soft ray of dorsal fin. Interopercular flap absent. Pored scales of lateral line with 39 to 40, and anterior 3 to 4 scales in lateral line spined. Scales large and deciduous. Antorbital margin armed with 3 antorse strong spines. Iris lappet largely developed and bilobed with many cirri. Subor-

bital spinous ridge deeply incised below middle of eye.

Color in 10% formalin : Surface of body usually brown. Dorsal surface of body with about 4 to 5 indefinite and vertical dark brown bars. All fins with several dark crossing bands except anal fin. Ventral fin with numerous black spots. Posterior part of first dorsal fin membrane black.

Distribution : South Sea of Korea, Japan, China and Taiwan.

Rimarks : *O. macrolepis* is reported for the first time in Korea. This species was very similar to *O. spinosa* in their morphology. But *O. macrolepis* is well distinguished from *O. spinosa* in having 3 to 4 spinous scales in lateral line (10 to 16 in *O. spinosa*), 4 scales above

lateral line (3), 20 to 23 suborbital spines (25 to 31), deciduous scales of body surface (adhesive) and 2 antrorse spine at antorbital margin (3) (Table 1).

Genus *Ratabulus* Jordan and Hubbs

(Korean name : Bongori - Yangtae - sok)

Ratabulus Jordan and Hubbs, 1925, p. 286 (type by original description *Thysanophrys megacephalus* Tanaka).

***Ratabulus megacephalus* (Tanaka, 1917)**

Korean name : Bongori - Yangtae) (Fig. 4)

Thysanophrys megacephalus Tanaka, 1917, p. 9, Tokyo market (original description).

Ratabulus megacephalus Jordan and Hubbs,

Table 1. Comparison of meristic characters and their proportional measurement between *Onigocia macrolepis* and *O. spinosa*

Characters	Present study		Matsubara and Ochiai (1953)	
	<i>O. macrolepis</i>	<i>O. spinosa</i>	<i>O. macrolepis</i>	<i>O. spinosa</i>
Number of specimens	3	4	74	34
Dorsal spines	I - VII ~ VIII	I - VII ~ VIII	I - VII ~ VIII	I - VIII
Dorsal soft rays	11~12(11.67)	11~12(11.75) or I, 12	11~12(11.32)	11~12(11.94)
Anal fin rays	11~12(11.67)	12(12)	12(12)	12(12)
Pectoral fin rays	21(21)	20~21(20.75)	20~22(20.41)	20~22(21.07)
Pored scales in lateral line	39~40(39.33)	39~40(39.33)	35~42(37.50)	35~42(37.09)
Spinous scales in lateral line	3~4(3.33)	10~16(11.50)	2~4(3.00)	8~11(10.35)
Scales above lateral line	4	3	-	-
Number of suborbital spines	20~23(22)	25~31(27.00)	-	-
Preopercular spines	3	3	3	3
Gill raker	14 - 5 = 5 - 6	13 - 5 = 4 - 6	13 - 5 = 4 - 6(4.85)	13 - 5 = 4 - 6(5.02)
In % to the standard length				
Head length	2.72~ 2.85(2.77)	2.66~ 2.75(2.68)	2.76~ 3.10(2.91)	2.21~ 2.89(2.55)
Body depth	5.92~ 7.06(6.62)	4.95~ 5.33(5.09)	5.51~ 8.25(6.67)	5.18~ 7.70(6.24)
Caudal penuncle depth	17.75~19.80(18.46)	18.52~19.50(19.07)	15.80~21.60(17.60)	15.00~20.50(17.71)
In % to the head length				
Snout length	3.76~ 4.08(3.89)	3.58~ 3.71(3.65)	3.38~ 4.54(3.64)	3.00~ 4.50(3.77)
Eye diameter	3.81~ 4.20(4.02)	3.97~ 4.11(4.05)	3.47~ 4.63(3.85)	3.00~ 4.50(3.77)
Interorbital width	10.78~12.49(11.61)	12.91~14.44(13.67)	9.86~16.00(11.92)	11.26~18.50(13.92)

Genus *Suggrundus* Whitley

(Korean name : Kunnoon - Yangtae - sok)

Fig. 4. *Rotabulus megacephalus* (Tanaka), 180.7 mm SL.

1925, p. 287, Kagoshima Bay (translation of Tanaka's original description of *Thysanophrys megacephalus* published in Japanese); Mori, 1952, p. 160; Chyung, 1977, p. 525, Korea.

Materials examined : NFRDA 1046 (1), 180.7 mm SL, Nampo-dong, Chung-gu, Pusan, May 15, 1937; BKNU 29~30 (2), 264.5~275.0 mm SL, Nampo-dong, Chung-gu, Pusan, April 13, 1998.

Description : D I - VIII - I - 11; A 12; P₁ 19~20; P₂ I, 5; GR 1+7=8; LLp 53~55; DS 14~16.

Eye very large, about 2.8 times of interorbital width. Iris lappet small, simple without cirrus. Interorbital region moderately concave, armed with a pair of posteriorly diverged longitudinal keels on each side of median line. A preocular spine in front of eye backward directed and stout. 3 preopercular spines, uppermost one much longer than others, lowermost one very small, immediately below middle one. Anterior 3 scales in lateral line with weak spinules. Perforating duct of scales slender, and their length with about three times of its width, communicated with exterior through end of it. Scales small and adhesive.

Color in 10 % formalin. : Body surface brown or grayish brown. Back and sides of body inclusive of head specked with darker spots and crossed with defined broad dark bars. Pectoral fin rays with dark spots and with several distinct cross bars. Caudal and pelvic fin pale, with dark spots.

Distribution : South Sea of Korea, Japan, China and Taiwan.

Suggrundus Whitley, 1930, p. 26 (type species : *Platycephalus rudis* Günther).

***Suggrundus meerdervoorti* (Bleeker, 1860)**
(Korean name : Kunnoon - Yangtae) (Fig. 5)

Fig. 5. *Suggrundus meerdervoorti* (Bleeker), 175.5 mm SL.

Platycephalus meerdervoorti Bleeker, 1860, p. 80, pl. 1, fig. 3, (original description; type locality : Nagasaki; Yedo).

Suggrundus meerdervoorti Whitley, 1930, p. 16; Joen, 1992, pp. 14~15; Kim and Kang, 1993, p. 249.

Materials examined : BKNU 898 (1), 187.6 mm SL, Nampo-dong, Chung-gu, Pusan, Feb. 3, 1993; BKNU 899 (1) 155.8 mm SL, Nampo-dong, Chung-gu, Pusan, Mar. 29, 1993; BKNU 900, 902 (2), 138.2~169.6 mm SL, Nampo-dong, Chung-gu, Pusan, May 1, 1993; BKNU 4156~4164 (9), 171.8~197.7 mm SL, Komso, Chinso-myon, Puan-gun, Chollabuk-do, Apr. 5, 1994; BKNU 4165~4166 (2), 165.6~175.5 mm SL, Nampo - dong, Chung - gu, Pusan, Mar. 29, 1995.

Description : D I - VIII - 11; A 11; P₁ 19~21; P₂ I, 5; LLp 52~55; GR 1+7~9; DS 10~13=8~10; Vert. 27.

Dorsal surface of head with spines and tubercles. Eye large, but its diameter shorter than snout length. Ocular cirrus absent. Suborbital ridge usually with four or more distinct spines.

Lappet of iris bilobed, without cirrose. Pored scales of lateral line nearly quadrate, anterior 7 to 12 scales in lateral line with spinule, the perforating duct robust, communicated with exterior through ends of two thick tubes. Interopercular flap absent.

Color in 10% formalin : Surface of body brown or dark grayish brown, but below pale. The membrane of first dorsal fin black and with numerous small black spots.

Distribution : South and West Sea of Korea, Japan, China and Taiwan.

Remarks : Matsubara and Ochiai (1953), Shao and Chen (1987) and Nakabo (1993) described that *S. meerdervoorti* from Japan and China had interopercular flaps, but specimens from Korea hitherto had not it. *S. meerdervoorti* was reported for the first time from Korea by Jeon (1992). Kim and Kang (1993) described that this species was collected in only Komso, Chinso-myon, Puan-gun, but it was confirmed that *S. meerdervoorti* was plentifully distributed in South Sea of Korea.

Genus *Cociella* Whitley, 1940

(Korean name : Kkaji - Yangtae - sok)

Cocius Jordan and Hubbs, 1925, p. 285 (original description, type species : *Platycephalus crocodilus* Tilesius).

Cociella Whitley, 1940, p. 243 (substitute for *Cocius* Jordan and Hubbs, 1925 preoccupied).

***Cociella crocodila* Tilesius, 1812**

(Korean name : Kkaji - Yangtae) (Fig. 6)

Platycephalus crocodilus Tilesius, 1812, pl. 59, fig. 2, Nagasaki (original description) ; Cuvier and Valenciennes, 1829, p. 188 ; Mori, 1952, p. 159.

Thysanophrys crocodilus Jordan and Metz, 1913, p. 54.

Cociella crocodila Matsubara and Ochiai, 1953, pp. 87~89 ; Chyung, 1977, p. 525, Korea ; Kim and Kang, 1993, pp. 246~247, Korea.

Materials examined : BKNU 4109 (1), 340.0 mm SL, Nagwol-myon, Yonggwang-gun, Chollanam-do, Jul. 31, 1994 ; BKNU 4110 (1), 295.0 mm SL, Wido-myon, Puan-gun, Chollabuk-do, Aug. 24, 1994 ; BKNU 4111 (1), 248.17 mm SL, Komso, Chinso-myon, Puan-gun, Chollabuk-do, Aug. 26, 1994 ; BKNU 4112~4114 (3), 275.0~294.0 mm SL, Kyokpo, Puan-gun, Chollabuk-do, Aug. 28, 1995 ; BKNU 4118 (1), 300.0 mm, Haemang-dong, Kunsan-shi, Chollabuk-do, Mar. 14, 1993 ; BKNU 4119 (1), 254.0 mm SL, Namsan-dong, Yosus-shi, Chollanam-do, Feb. 28, 1994 ; BKNU 4120~4125 (6), 226.8~249.7 mm SL, Pongsan-dong, Yosus-shi, Chollanam-do, Feb. 28, 1994 ; BKNU 4126~4136 (11), 228.4~418.0 mm SL, Nampo-dong, Chung-gu, Pusan, Apr. 10, 1994 ; BKNU 4137~4140 (4), 268.0~347.0 mm SL, Huksan-do, Shinan-gun, Chollanam-do, May 19, 1994 ; BKNU 4141~4145 (5), 253.1~297.0 mm SL, Sanso-dong, Mokpo-shi, Chollanam-do, May 18, 1994 ; BKNU 4146 (1), 274.0 mm SL, Komso, Chinso-myon, Puan-gun, Chollabuk-do, Aug. 26, 1994 ; BKNU 4147 (1), 365.0 mm SL, Anmado, Yonggwang-gun, Chollanam-do, Jul. 31, 1994 ; BKNU 4153 (1), 230.6 mm, Kyokpo, Pyonsan-myon, Puan-gun, Chollabuk-do, Aug. 28, 1995 ; BKNU 4154 (1), 100.0 mm, Haemang-dong, Kunsan-shi, Chollabuk-do, May 31, 1990 ; BKNU 4187~4189 (3), 297.0~316.0 mm SL, Tongmun market, Cheju-shi, Cheju-do,

Fig. 6. *Cociella crocodila* (Tilesius), 325.0 mm SL.

Jan. 12, 1995.

Description : D I - VII ~ VIII - 10~12 (rarely I - VIII - I - 11) ; A 11~12 ; P₁ 18~21 ; P₂ I , 5 ; GR 1~2+4~7=6~8 ; LLp 52~55 ; DS 12~19 ; Vert. 25~27.

Ocular cirrus absent. Iris lappet simple, neither bilobed nor cirrose. Interopercular flap absent. Anterior 3 or 4 scales in lateral line with spinules. Perforating duct of the scale slender, communicated with exterior through end of a single slender tube. No antrorse preopercular spine. Lowermost spine of preopercular rudimentary. The base of uppermost preopercular spine sharp with an accessory spine. Anterior nostril with a dermal flap posteriorly.

Color in 10% formalin : Back and side of body grayish brown or dark brown, with 4 to 5 cross dark bars broadly, which generally becoming fainter with growth of fish. In small specimens, back and side with numerous small roundish spots of dusky. Under side uniformly pale.

Distribution : West and South Sea of Korea, China, Japan, Taiwan, Philippines and India.

Genus *Inegocia* Jordan et Thompson, 1913

(Korean name : Jum - Yangtae - sok)

Inegocia Jordan et Thompson, 1913, p. 70 (type specimen : *Platycephalus japonicus* Tilesius).

***Inegocia japonica* (Tilesius, 1812)**

(Korean name : Jum - Yangtae) (Fig. 7)

Platycephalus japonicus Tilesius, 1812. p. 59,

pl. 59, fig. 1, (original description, type locality : Nagasaki).

Inegocia japonica Jordan and Thompson, 1914, p. 278, Misaki ; Mori and Uchida, 1934, p. 28, Pusan, Korea ; Chyung, 1977, p. 526.

Materials examined : no specimen.

Distribution : West and South Sea of Korea, China, Japan, Taiwan, Indonesia and Philippines.

***Inegocia guttata* (Cuvier et Valenciennes, 1829)**

(Korean name : Akoyangtae) (Fig. 8)

Fig. 8. *Inegocia guttata* (Cuvier and Valenciennes), 416.0 mm SL.

Platycephalus guttata Cuvier et Valenciennes, 1829, pp. 389~392 (original description, type locality : Japan).

Inegocia guttata Matsubara and Ochiai, 1953. p. 82 ; Lee and Joo, 1995, pp. 114~119.

Material examined : BKNU 4006 (1), 416.0 mm SL, Hallim-up, Pukcheju-gun, Cheju-do, Korea, July 6, 1994 ; BKNU 28 (1), 278.4 mm SL, Nampo-dong, Chung-gu, Pusan, March 3, 1998.

Description : D I - VIII - 11 ; A 11 ; P₁ 21 ; P₂ I , 5 ; GR 1+5 ; LLp 50~51 ; DS 14~15.

Distributions : South Sea and Cheju Island of Korea, Japan, China.

Remarks : *Inegocia guttata* was collected from Cheju Island, and was described for the first time by Lee and Joo (1995).

Genus *Platycephalus* Bloch, 1795

(Korean name : Yangtae - sok)

Platycephalus Bloch, 1795, p. 96 (type by

Fig. 7. *Inegocia japonica* (Tilesius), 225.0 mm SL (from Jordan and Richardson, 1908).

original designation *Platycephalus spathula* Bloch=*Callionymus indicus* Linnaeus, 1758).

***Platycephalus indicus* (Linnaeus, 1758)**

(Korean name : Yangtae) (Fig. 9)

Fig. 9. *Platycephalus indicus* (Linnaeus), 328.0 mm SL.

Callionymus indicus Linnaeus, 1758, p. 250, Asia (original description).

Platycephalus indicus Jordan and Metz, 1913, p. 54 ; Mori, 1952, p. 160 ; Chyung, 1977, pp. 524~525, Korea ; Kim and Kang, 1993, p. 246, Korea.

Materials examined : BKNU 4093~4096 (4), 300.0~350.0 mm SL, Wando-up, Wandogun, Chollanam-do, Jun. 2, 1995 ; BKNU 4097 (1), 365.0 mm SL, Hanlim-up, Pukcheju-gun, Cheju-do, Jul. 6, 1994 ; BKNU 4098~4101 (4), 220.5~333.0 mm SL, Chungang-dong, Tongyong-shi, Kyongsangnam-do, Jul. 16, 1995 ; BKNU 4102~4103 (2) 325.0~415.0 mm SL, Chungang-dong, Chungmu-shi, Kyongsangnam-do, Jul. 17, 1995 ; BKNU 4104~4105 (2), 314.0~336.0 mm SL, So-dong, Sachon-shi, Kyongsangnam-do, Jul. 17, 1995 ; BKNU 4106~4108 (3), 268.0~330.0 mm SL, Kyokpo, Pyonsan-myon, Puan-gun, Chollabuk-do, Oct. 27, 1995 ; BKNU 4117 (1), 328.0 mm SL, Kyokpo, Pyonsan-myon, Puan-gun, Chollabuk-do, Sep. 25, 1995 ; BKNU 4174 (1), 236.0 mm SL, Haemang-dong, Kunsan-shi, Chollabuk-do, Jun. 10, 1990.

Description : D I ~ II -VI ~ VII -I - 13~14 ; A. 13 ; P₁ 18~20 ; P₂ I , 5 ; LLp 70~80 ; GR 3~4+7~9=10~13 ; DS 13~19 ; Vert. 27.

Head very broad and extremely depressed,

with several minute spines. Ocular cirrus absent ; iris lappet simple, some bluntly pointed, neither bilobed nor cirrus. Interorbital width much broader, and longer than eye diameter. Interopercular flap present and V-shaped. Scales very small ; pored scales in lateral line 70 to 80 (mean 73.6). Scales in lateral line oval in shape. Anterior nostril has a flap posteriorly. Perforating duct of lateral line scales slender and communicated with exterior through end of a single tube. 2 spines of first dorsal fin minute, anteriormost one hardly visible with naked eye ; dorsal last spine also minute, free from preceding one. Teeth mostly villiform or granular, some of them enlarged. Teeth on upper jaw in broad band. Teeth on lower jaw in 2 or 3 series. Those of innermost series large and stout. Palatine teeth in 2 series. Discal tubercles on arch small, and set in 2 series. Preopercular spines 2, stout, subequal or lower one even longer than upper.

Color in 10% formalin : Dark brown or gray brown above and side of body, whitish below. Back and side of body specked with darker and crossed with several defined broad bars. Dorsal fins spotted, anal white, pectoral and ventral fin blotched. Caudal fin with 3 to 4 black bars.

Distribution : West, South and East sea of Korea, Japan, China, Taiwan, India, Srilangka, Indonesia, Maley, Thailand, Philippines, Australia, Pakistan, Gulf Bay, Red Sea, eastern Mediteranean.

Remarks : *Platycephalus indicus* was originally reported by Linnaeus(1758). But his description was not enough contents for identification between *P. indicus* and their allied species in *Platycephalus* except number of pectoral fin rays (Table 2). So we think, the classification of *P. indicus* complex based on description of Linnaeus (1758) was very difficult prob-

Table 2. Comparisons of taxonomic characters of the genus *Platycephalus* from Korea

Characters	<i>P. indicus</i>		<i>P. indicus</i>	
	<i>P. indicus</i>	Linnaeus(1758)	Knapp(1986)	
Dorsal fin rays	I~II - VII - I - 13~14	I - VII,13	I - VIII - I + 13	
Pectoral fin rays	18~20	20	18~20	
Anal fin rays	13	13	13	
Pored lateral line scales	70 - 80	-	68~82	
Gill rakers	3~4+7~9	-	2~3+5~7	

lem. Sakashita (1992) reported that distribution of *P. indicus* was from South Africa, Indian Ocean and Australia to Ryukyus. Also he mentioned that *P. indicus* identified by Linnaeus (1758) may be specimen from India. Imamura (1996) mentioned that the genus *Platycephalus* includes at least 15 species in world. But Korean flatheads had been identified as a single species, *P. indicus*, by many authors (Mori, 1952; Chyung, 1977; Kim and Kang, 1993; Kim and Kim, 1997). Knapp (1986), Sakashita (1992) and Imamura (1996) reported that *P. indicus* has two black bars in caudal fin, but Korean species has 3 to 4 black bars. Sakashita (1992) described that *P. indicus* was distributed in Indian Ocean, South Africa, India, Burma, Thailand, western Pacific Ocean, Australia, Philippines and Ryukyus, not costal region of Korea and Japan. Accordingly identification and distribution for *Platycephalus* from Korea were largely demanded to recheck in future.

***Platycephalus* sp.**

(New Korean name : Cham - Yangtae) (Fig. 10)

Materials examined : BKNU 4050 (1), 302.0 mm SL, Haemang-dong, Kunsan-shi, Chollabuk-do, Dec. 15, 1987; BKNU 4051~4052 (2), 235.0~247.0 mm, Haemang-dong, Kunsan-shi, Chollabuk-do, Sep. 10, 1988; BKNU 4053 (1), 238.6 mm SL, Namsan-dong, Yosu-shi, Chollanam-do, May 2, 1989; BKNU 4059 (1), 244.0 mm SL, Haemang-dong, Kun-

Fig. 10. *Platycephalus* sp., 292.0 mm SL.

san-shi, Chollabuk-do, Jun. 25, 1990; BKNU 4060 (1) 195.31 mm SL, Popsongpo, Yonggwang-gun, Chollabuk-do, May 11, 1993; BKNU 4062~4063 (2), 295.0~307.0 mm SL, Hang-dong, Chung-gu, Inchon-shi, Feb. 17, 1994; BKNU 4064~4065 (2), 274.0~282.0 mm SL, Yonggwang-up, Yonggwang-gun, Chollanam-do, Apr. 5, 1994; BKNU 4066~4067 (2), 358.0~423.0 mm SL, Kyokpo, Pyonsan-myon, Puan-gun, Chollabuk-do, Apr. 26, 1994; BKNU 4068 (1), 377.0 mm SL, Nampo-dong, Chung-gu, Pusan, May 16, 1994; BKNU 4069~4070 (2), 273.0~292.0 mm SL, Sanso-myon, Mokpo-shi, Chollanam-do, May 18, 1994; BKNU 4072~4073 (2), 215.7~218.2 mm SL, Chungang-dong, Tongyong-shi, Kyungsangnam-do, Jul. 16, 1994; BKNU 4075 (1), 476.0 mm SL, Kyokpo, Pyonsan-myon, Puan-gun, Chollabuk-do, Jul. 28, 1994; BKNU 4076~4077 (2), 325.0~336.0 mm SL, Namsan-dong, Yosu-shi, Chollanam-do, Jan. 8, 1995; BKNU 4078 (1), 272.0 mm SL, Wando-up, Wando-gun, Chollanam-do, Jun. 2, 1995; BKNU 4081~4082 (2), 321.0~350.0 mm SL, Kyokpo, Puan-gun, Chollabuk-do, Sep. 25, 1995; BKNU 4092 (1), 397.0 mm SL, Wando-up, Wando-gun, Chollanam-do, Dec. 13, 1995; BKNU 4177 (1), 216.0 mm SL, Kyehwado,

Puan-gun, Chollabuk-do, Aug. 25, 1990 ; BKNU 4178 (1), 200.0 mm SL, Tolsan-up, Yochon-gun, Chollanam-do, Apr. 23, 1994.

Description : D I ~ II - VI ~ VII - I - 12 ~ 14 ; A 12 ~ 14 ; P₁ 16 ~ 18 ; P₂ I , 5 ; LLp 83 ~ 100 ; GR 3 ~ 5 + 7 ~ 11 = 11 ~ 14 ; DS 16 - 20 ; Vert. 27.

Head very broad and much depressed, with smooth bony ridges. Two preopercular spines, upper a little shorter than lower. Body depressed anteriorly, tapering posteriorly, around caudal peduncle compressed. Head and body covered with ctenoid scales, small, but base of caudal fin with cycloid scales. Interorbital width broader than eye diameter or almost same. Eye small, iris lappet simple, without bilobed. No ocular cirrus. 83 - 100 (average 89.0) pored lateral line scales and oval and rectangular in their shapes. Teeth mostly villiform except for some canine-like on inside of upper jaw tip. All scales in lateral line without spines. Caudal fin truncate.

Color of body : Surface of body brownish or

greyish above, whitish below ; without dark bands crossing back, but numeral small dark spots on head and all over the back of body. Dorsal fin spotted and anal fin white. Ventral of body pale or bright brownish. Pectoral and pelvic fins with numerous brown blotches. Caudal fin with 2 or 3 horizontal black bars.

Distribution : West and South Sea of Korea, China and Japan.

Remarks : *Platycephalus* sp. is very similar to *P. indicus* from Korea in their exomorphology. However, *Platycephalus* sp. differs from *P. indicus* in having 2 pungent spines at the lower anterior margin of preorbital (3 blunt spines in *P. indicus*), pored scales in lateral line 83 to 100 (70 to 80), pectoral fin rays 16 to 18 (18 to 20), low caudal peduncle depth 25.7 to 32.5% to standard length (23.9 to 27.2), widest side lateral process of urohyal bone present (absent), small eye diameter 7.7 to head length (large 8.6) and no band or indistinct cross bands on the body (distinct). On the other hand, in the description

Table 3. Comparison of meristic and morphological characters between the *Platycephalus indicus* and *Platycephalus* sp.

Characters	<i>Platycephalus indicus</i>	<i>Platycephalus</i> sp.
Number of individuals	18	26
Standard length (mm)	220.5 - 365.0	195.0 - 423.0
Pored scales of lateral line	70 - 80	83 - 100
Gill rakers	3 - 4 + 7 - 9 = 10 - 13	3 - 5 + 7 - 11 = 11 - 14
Diagonal scales	13 - 19	16 - 20
Pectoral fin rays	18 - 20	16 - 18
% to standard length		
Head length	3.34(3.22 - 3.47)	3.42(3.22 - 3.68)
Body depth	9.01(6.74 - 10.63)	9.92(6.90 - 12.50)
Caudal peduncle depth	25.67(23.90 - 27.21)	29.52(25.66 - 32.46)
% to head length		
Snout length	4.38(4.15 - 4.59)	4.23(3.82 - 6.60)
Eye diameter	8.68(7.63 - 9.89)	7.65(6.47 - 9.20)
Interorbital width	6.25(5.54 - 6.92)	6.76(5.60 - 8.48)
Lower anterior margin of preorbital	3 blunt spines	2 pungent spines
Widest side lateral process of urohyal bone	absent	present
Subpelvic keel	pointed	blunt
Discal tubercles on the first gill arch	thick	sparse
Cross bands of body	present	absent or indistinct

of Linnaeus (1758), *P. indicus* was largely differed from *Platycephalus* sp. in having 20 pectoral fin rays (16 to 18 in *Platycephalus* sp.). The genus *Platycephalus* from Korea surely includes at least two species at present : *P. indicus* Linnaeus and *Platycephalus* sp., But *Platycephalus* from Korea had been hitherto identified as a single species (*P. indicus*) by many authors (Mori, 1952 ; Mori and Uchida, 1934 ; Chyung, 1977 ; Kim and Kang, 1993 ; Kim and Kim, 1997). Sakashita (1992) mentioned that *Platycephalus* sp. (= *Platycephalus* sp.2 in Sakashita, 1992) distributed only in southern waters of Korea and Japan and East and South China Sea. We think, *P. indicus* and *Platycephalus* sp. from Korea need to recheck their taxonomic position comparing with other Asian specimens.

Key to the genera and species

- 1a. Vomerine teeth in 2 parallel longitudinal bands. Head armed with strong spines or granules. Interorbital width narrow. Pored scales of lateral line fewer than 62 2
- 1b. Vomerine teeth in a crescentic band. Head nearly smooth. Interorbital width broad. The pored scales of lateral line more than 70. genus *Platycephalus* 9
- 2a. Side of head uncarinate, suborbital bone denticulated. 3
- 2b. Side of head bicarinate, process of suborbital bone very sharp. 5
- 3a. A stout anterose spine on lower face of preopercle. Pored scales of lateral line about 50. genus *Rogadius* *R. asper*
- 3b. No anterose spine on lower face of preopercle. Pored scales of lateral line about 40 to 50. genus *Onigocia* 4
- 4a. 3 scales above lateral line and anterior 10 – 16 pored lateral line scales armed with upstanding spines. *O. spinosa*
- 4b. 4 scales above lateral line and anterior 3 – 4 pored lateral line scales armed with upstanding spines. *O. macrolepis*
- 5a. Teeth highly specialized, some of teeth canine – like, last dorsal spine minute, free from the penultimate one, caudal truncated genus *Rotabulus*
. *R. megagephalus*
- 5b. Teeth either villiform or granular. Last dorsal spine connected with penultimate one by membrane. Caudal rounded. 6
- 6a. Upper side of head largely granulated. Preopercular spines 3, distinct and well developed. Iris lappet bilobed and not cirrose. genus *Suggrundus*
. *S. meedervoorti*
- 6b. Upper side of head not granulated. Preopercular spine 2 or 3 (if present, the one – third from upper, rudimentary). Iris lappet not bilobed. 7
- 7a. Interopercular flap absent. Iris lappet not cirrose. Perforating duct of lateral line scales communicated with exterior through end of a single slender tube.
. genus *Cociella* *C. crocodila*
- 7b. Interopercular flap present. Iris lappet cirrose. Perforating duct of lateral line scales communicated with exterior through ends of 2 tubes.
. genus *Inegocia* 8
- 8a. Dorsal and anal fin rays each 12, anterior 6 – 8 pored scales of lateral line. Body surface with 6 distinct dark bands. Dorsal surface of body without small dark spots. *I. japonica*
- 8b. Dorsal and anal fin ray each 11, anterior 2 pored scales of lateral line. Body surface with 7 distinct dark bands. Dorsal surface of body with small dark spots.

-*I. guttata*
 9a. Pored scales of lateral line less than 80.
 Body surface dark brown or grayish, with-
 out dark spots, and with cross several
 dark bands. *P. indicus*
 9b. Pored scales of lateral line more than 80.
 Body surface bright brownish or grayish,
 with small dark spots, and without cross
 dark bands. *Platycephalus* sp.

Systematic discussion

Members of the flathead fishes are character-
 ized by largely compressed head, projected
 lower jaw than upper jaw, two dorsal fins and
 iris lappet. The family Platycephalidae was
 reported the earliest by Linnaeus (1758). After
 that, it has continually studied about the flat-
 head fishes by many workers (Cuvier and
 Valenciennes, 1829 ; Temmick and Schlegel,
 1842 ; Bleeker, 1854, 1877 ; Jordan and Sny-
 der, 1900 ; Jordan and Hubbs, 1925). Matsub-
 ara and Ochiai (1955) and Shao and Chen
 (1987) mentioned that *Suggrundus meerder-
 voorti* from Japan has a interopercular flap, but
 the Korean flatheads had not it. On the other
 hand, Imamura (1996) mentioned that charac-
 ter of interopercular flap is not homologous.

Matsubara and Ochiai (1955) described that
 the Rogadiinae (Jordan and Hubbs, 1925) and
 Cymbacephalinae (Fowler, 1938) were united
 under the Onigociinae (Jordan and Hubbs,
 1925), and the Thysanophrynae (Whitley, 1931)
 and Grammoplitinae (Fowler, 1938) were placed
 under the Inegociinae (Jordan and Hubbs,
 1925). Many authors have variously classified
 the platycephalids into subfamilies and genera.
 Jordan and Hubbs (1925) recognized 4 subfami-
 lies, Onigiciinae, Rogadiinae, Inegociinae and
 Platycephalinae. Keenan (1991) separated the
 Australian platycephalids into 5 subfamilies :

Cymbacephalinae, Onigociinae, Inegociinae,
 Elatinae and Platycephalinae. However, Ima-
 mura (1996) did not recognized Inegociinae,
 because it was paratypic comprising *Inegocia*,
Suggrundus, *Cociella* and *Ratabulus*. Recently,
 Imamura (1996) recognized two subfamilies :
 Onigociinae and Platycephalinae, based on apo-
 morphic characters in 32 transformations
 series for examined platycephalids. According to
 method of Imamura (1996), Platycephalidae
 from Korea was also composed of two subfami-
 lies : Onigociinae and Platycephalinae. The for-
 mer comprised six genera : *Onigocia*, *Rogadius*,
Suggrundus, *Inegocia*, *Cociella* and *Ratabulus*.
 the latter, one genus : *Platycephalus*. While
 presently *Platycephalus* distributed in the world
 is involving many problems in their taxonomic
 position. *Platycephalus* from Korea, Japan, Tai-
 wan and China reported only one species until
 now : *P. indicus*, which reported by Linnaeus
 (1758) for the first time. Because original
 description of *P. indicus* reported by Linnaeus
 (1758) was not given a full explanation, many
 ichthyologists are falling into difficult situation
 for classification of *P. indicus* and their allied
 species. And much more, type specimen of this
 species has not been found, also Linnaeus
 described about distribution (type locality) mere-
 ly "Asia". Sakashita (1992) and Imamura (1996)
 described that Japanese flatheads represent *P.*
indicus and other two undescribed species.
 Knapp (1984) and Sakashita (1992) mentioned
 that *P. indicus* was widely distributed from Red
 Sea and eastern Mediterranean, India, Indian
 Ocean and Western Central Pacific to Japan,
 Indonesia, Philippines and Australia. On the
 other hand, Sakashita (1992) described that *P.*
indicus reported by Linnaeus (1758) may indi-
 cate the *Platycephalus* fish caught from India.
 In this studies, 10 species and 7 genera of the
 family Platycephalidae from Korea including

Platycephalus sp. are rechecked. Here *O. macrolepis* is reported for the first time in Korea. Present *Platycephalus* species from Korea were showed two type specimens in their morphological features. *P. indicus* and *Platycephalus* sp. from Korea were largely differed from several morphometric and exomorphological characters (Table 1, 2). So we considered that *P. indicus* and *Platycephalus* sp. are another species.

References

- Bleeker, P. 1854. Fauna ichthyologicae Japonicae species novae. Nat. Tijdschr. Neder. Indië6, pp. 395~426.
- Bleeker, P. 1860. Zesde bijdrage tot de kennis der vischfauna van Japan. Act. Soc. Sci. Indo-Neerl. 8, pp. 1~104.
- Bleeker, P. 1877. Atlas ichthyologique des Indes orientales. Neerlandaises 9, 80 pp.
- Bloch, M. E. 1795. Naturgeschichte der ausländischen Fische. J. Morino, Berlin, 9 : 1~192.
- Chyung, M. K. 1977. The Fishes of Korea. Iilji - sa, Seoul, Korea, pp. 523~527. (In Korean)
- Cuvier, C. and A. Valenciennes. 1829. Histire naturelle des poissons. F. G. Levrault, Paris, 4 : VII + pp. 167~176, 188.
- Fowler, H. W. 1938. Description of new fishes obtained b the United States Bureau of Fisheries steamer "Albatross", chiefly in Philippine seas and adjacent waters. Proceedings of the United States National Museum 85 : 31~135.
- Hubbs, C. L. and K. F. Leger. 1964. Fishes of the Great Lakes Region. University of Michigan Press, Michigan, pp. 19~24.
- Imamura, H. 1996. Phylogeny of the family Platycephalidae and related taxa (Pisces : Scorpaeniformes). Japanese Society of Systematic Zoology, 1(2) : 123~233.
- Jeon, B. D. 1992. A study on fishes along the coast of Chollabuk - do, Korea. Dissertation, Chonbuk National University, pp. 14~15. (In Korean)
- Jordan, D. S. and C. L. Hubbs. 1925. Record of fishes obtained by David Starr Jordan in Japan, 1922. Mem. Car. Mus., 10 (2) : 93~346, fig. 1, pls. 5~12.
- Jordan, D. S. and C. W. Metz. 1913. A catalog of the fishes known from the waters of Korea. Mem. Car. Mus., vol., VI (1) : 54.
- Jordan, D. S. and R. E. Richardson. 1908. A review of the flat - heads, gurnards, and other mailcheeked fishes of the waters of Japan. Proc. U. S. Nat. Mus., 33 (1581) : 629~670.
- Jordan, D. S. and J. O. Snyder. 1900. A list of fishes collected in Japan by Keinosuke Otaki, and by the United Stated steamer Albatross, with descriptions of fourteens new species. Proc. U. S. Nat. Mus. 23 : 335~385.
- Jordan, D. S. and W. F. Thompson. 1913. Notes on a collection of fishes from the Island of Shikoku in Japan, with a description of a new species *Gnathypops iyonis*. Proc. U. S. Nat., 46 : 65~72.
- Jordan, D. S. and W. F. Thompson. 1914. Record of the fishes obtained in Japan in 1911. Mem. Car., Mus., 6 (4) : 205~313, figs. 1~37, pls. 24~42.
- Keenan, C. P. 1991. Phylogeny of Australian species of flatheads (Teleostei, Platycephalidae) as determined by allozyme electrophoresis. J. of Fish Biology 39 : 237~249.
- Kim, I. S. and U. J. Kang. 1993. Coloured fishes of Korea, Academy Pub. Co. Seoul, Korea, pp. 246~249. (In Korean)
- Kim, Y. U. and I. S. Kim. 1997. Subphylum Vertebrata : Pisces. pages 243~281. In Kim, H. S. ed. List of Animals in Korea (excluding insects). The Korean Society of Systematic Zool., Seoul, Korea.
- Knapp, L. W. 1984. Platycephalidae. Pages 1~22. In : W. Fisher and G. Bianchi (eds). FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area 51), Vol. 3. FAO, Rome.
- Knapp, L. W. 1986. Family No. 155 : Platycephalidae. Pages 482~486. In M. M. Smith and P. C. Heemstra, eds. Smiths' Sea Fishes. Springer - Verlag, Berlin.
- Lee, C. L. and D. S. Joo. 1994. A new record of the

- thorny flathead fish, *Rogadius asper* (Platycephalidae) from Korea. Korean J. Ichthyol. 6(1) : 1~6.
- Lee, C. L. and D. S. Joo. 1995. A new record of the flathead fish, *Inegocia guttata* (Platycephalidae) from Korea. Korean J. Ichthyol., 7(2) : 114~119.
- Linnaeus, C. 1758. Systema naturae sive regna tria naturae, systematice proposita per classes, ordines, genera et species, cum characteribus, differentiis, synonymis, locis, etc., 10th ed. pp. 249~250.
- Matsubara, K. and A. Ochiai. 1953. A revision of the Japanese fishes of the family Platycephalidae (the flatheads). Mem. Coll. Agr. Kyoto Univ., No. 68 : 1~102.
- Mori, T. 1952. Check list of the fishes of Korea. Mem. Hyogo Univ. Agr., 1(3) : 159~160.
- Mori, T. and K. Uchida. 1934. A revised catalogue of the fishes of Korea. Jour. Chosen Nat. Hist. Soc., 19 : 28.
- Nakabo, T. 1993. Fishes of Japan with Pictorial Keys to the Species. Tokai Univ. Press, Tokyo, pp. 535~539. (In Japanese)
- Sakashita, M. 1992. Taxonomic study of *Platycephalus indicus* - complex found in the western Pacific Ocean and the eastern Indian Ocean (Pisces : Platycephalidae). Dissertation, University of the Ryukyus. Japan, 38 pp. figs. 6, pls. 4.
- Shao, K. T. and J. P. Chen. 1987. Fishes of the family Platycephalidae (Teleostei : Platycephaloidei) of Taiwan with descriptions of two new species. Bull. Inst. Zool., Academia Sinica., 26 (1) : 77~94.
- Tanaka, S. 1917. Eleven new species of Japanese fishes. Zool. Mag., 27 (339) : 11.
- Taylor, W. R. 1967. An enzyme method of clearing and staining small vertebrates, Pro. of U.S. Nat. Mus., 122 (3596) : 1~17.
- Temminck, C. J. and H. Schlegel. 1842. Siebold's Fauna Japonica, 2. Pisces. Leden, 323 pp.
- Tilesius, T. 1812. Abbildungen und Beschreibungen einiger Fische aus Japan und einiger Mollusken aus Brasilien, welche bei Gelegenheit der ersten russischen kaiserlichen Erdumseglung keubendig beobachtet wurden. Denkschr. Bayer. Akad. Wiss. pp. 71~88, 2 pls.
- Whitley, G. P. 1930. Ichthyological miscellanea. Mem. Queensland Mus., 10 (1) : 8~31, fig. 1, pl. 1.
- Whitley, G. P. 1931. Studies in ichthyology, No. 5. Rec. Aust. Mus. 18 (4) : 131~160.
- Whitley, G. P. 1940. The nomenclator zoologicus and some new fish names. Aust. Nationalist, pp. 241~243.

한국산 양태과 어류(농어목)의 분류학적 재검토

이 충렬·주 동수

군산대학교 자연과학대학 생물학과

1987년 12월부터 1998년 4월까지 우리나라 연안에 서식하고 있는 양태과 어류에 대한 분류학적 위치를 재검토한 결과 모두 7속 10종 즉 큰비늘양태 *Onigocia macrolepis*, 비늘양태 *O. spinosa*, 바늘양태 *Rogadius asper*, 큰눈양태 *Suggrundus meerdervoorti*, 점양태 *Inegocia japonica*, 악어양태 *I. guttata*, 까지양태 *Cociella crocodila*, 봉오리양태 *Ratabulus megacephalus*, 양태 *Platycephalus indicus* 및 참양태 *Platycephalus* sp. 등이었다. 이들 어류 중에서 *Onigocia macrolepis*는 아직까지 우리나라의 미기록종이고, *Platycephalus* sp.는 외부형태적 특징 및 주요 계수계측에서 *P. indicus*와는 다르게 나타나는 미확인종으로써 추후 면밀한 검토가 요구된다.

아울러 이들 종들의 각종 분류학적 주요 형태 형질을 중심으로 한국산 양태과 어류의 속, 종 검색표를 작성하였고, 각종들의 형태적 특징 및 계수 계측 형질들을 기재하면서 한국산 양태과 어류의 지리적 분포에 대하여 보고하였다.