

Synopsis of the Family Dasyatidae (Elasmobranchii, Rajiformes) from Korea

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Taxonomic revision of the family Dasyatidae was studied on the basis of the specimens collected from the Korean coasts from June 1994 to January 1996. The family Dasyatidae of Korea was classified into 6 species in genus *Dasyatis*, and the key to species was proposed with their synonyms and distributions. Three new records from Korea were described and figured in detail: *Dasyatis acutirostra* Nishida and Nakaya, *D. matsubarae* Miyosi and *D. sinensis* (Steindachner). Most species of the Korean stingrays are shared with those of China and Japan.

Key words : Rajiformes, Dasyatidae, *Dasyatis*

Introduction

The stingrays are a typical group widely distributed in various habitats as marine, brackish and freshwater in the world (Nelson, 1994). The genus *Dasyatis* widely distributed in the Korean coasts is one of the nine genera of the family Dasyatidae including about 70 species in the world (Nelson, 1994) and is characterized by the long and whip-like tail, poisonous spine (s) and ventral fold which terminates before the tip of tail (Compagno and Robert, 1984).

The family Dasyatidae from Korea was reported by Jordan and Metz (1913). Thereafter Mori and Uchida (1934), Mori (1952) and Chyung (1977) have reported 5 species belonging to 3 genera. Until now taxonomic study about family Dasyatidae from Korea has not been studied enough after Mori (1952).

In the course of the taxonomic study of the stingray from Korea, three species of genus *Dasyatis* were collected for the first time in the Korean coasts. This study aimed to redescribe the taxonomic characters of species of family Dasyatidae with their distribution in the Korean coasts.

Methods

Methods and terminology for counts and measurements followed those of Nishida and Nakaya (1988a) (Fig. 1). In this study, the disc width (DW) is employed for the standard measure of the body size. Collec-

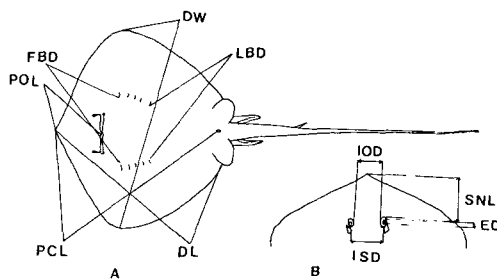


Fig. 1. Diagram showing the method of measurement of body part of genus *Dasyatis*.
A: ventral view, B: head part of dorsal view. DL: disc length, DW: disc width, ED: eye diameter, FBD: first branchial distance, IOD: interorbital distance, ISD: interspiracle distance, LBD: last branchial distance, PCL: precaudal length, POL: preoral distance, SNL: snout length.

tion sites and dates, and individual numbers of the examined specimens are written in description of each species. The examined specimens were deposited at Department of Biology, Kunsan National University (BKNU).

Systematic accounts

Genus *Dasyatis* Rafinesque, 1810

Dasyatis Rafinesque, 1810, Gratteri d'animale e piante Sicilia: 16 (type species, *Dasyatis ujo* Rafinesque); Mori and Uchida, 1934, J. Chosen Nat. Hist. Soc., 19: 12~33; Mori, 1952, Mem. Hyogo Univ. Agr., 1 (3), p. 36; Chyung, 1977, Iljisa, p. 95

Trygon Cuvier, 1817, Rehne Anim., 2: 136 (type species: *Raja pastinaca* Linnaeus).

1. *Dasyatis acutirostra* Nishida and Nakaya, 1988

(New Korean name: Ginko-gaori)(Fig. 2, A)

Dasyatis acutirostra Nishida et Nakaya, 1988a, Jap. J. Ichthyol., 35 (2), pp. 115~123. East China, Nagasaki, Kobe.

Materials: BKNU 2001, a specimen, male, 441.5 mm disc width (DW), Komso, Puan, Chollabuk-do, Nov. 25, 1994; BKNU 2002, (1), female, 457.0 mm DW, Mokpo, Chollanam-do, Dec. 3, 1994.

Description: In percentages to the disc width (Mean and standard deviation in parenthesis), disc length 104.0~107.2 (105.6 ± 1.62); head length 46.9~51.0 (49.0 ± 2.04); interspiracle width 14.6~14.7 (14.6 ± 0.02); preoral snout length 37.0~40.9 (38.9 ± 1.98); preorbital snout length 37.8~41.8 (39.8 ± 2.01); eye diameter 2.08~2.11 (2.1 ± 0.01); interorbital width 9.4~9.8 (9.6 ± 0.24); mouth width 8.0~8.4 (8.2 ± 0.23); prebranchial length 47.0~52.1 (49.1 ± 2.10); first branchial width 17.9~18.2 (18.1 ± 0.17); fifth branchial width 12.6~12.8 (12.7 ± 0.12); trunk length 89.9~91.9 (90.9 ± 0.99); caudal length 132.1~136.4 (134.2 ±

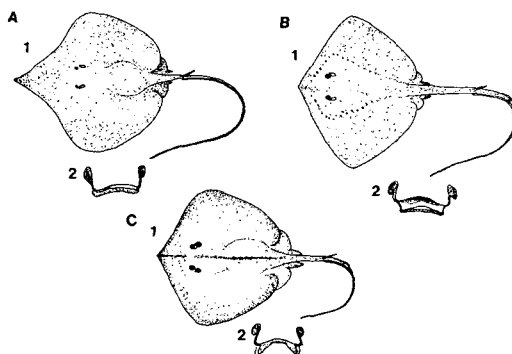


Fig. 2. A: *Dasyatis acutirostra*, 441.5 mm DW, BKNU 2001. B: *Dasyatis matsubarai*, 487.0 mm DW, BKNU 2005. C: *Dasyatis sinensis*, 402.0 mm DW, BKNU 2009. 1: dorsal view, 2: mouth part.

2.19); ventral fold 15.6~26.7 (21.1 ± 5.58).

Disc flat and acutely pointed anteriorly, rounded posteriorly. Disc width about equal to disc length. Snout much produced and pointed, 80.5~82.0 (81.3 ± 0.01) % in head length. Eye small; eye diameter 5.0~5.6 (5.3 ± 0.24) in preorbital snout length, 2.1~2.3 (2.2 ± 0.11) in interorbital width. Interspiracle width 34.8~38.8 (36.8 ± 1.34) in preorbital snout length, 28.5~31.2 (29.9 ± 0.18) in head length. Teeth pavement-like, arranged in quincunx, with a cusp on each tooth in adult male, and without cusp in female. Nasal curtain with a fringed, nearly straight posterior margin. Head length 46.9~51.0 (49.0 ± 0.21) % in dorsal disc width, 52.2~55.5 (53.9 ± 1.20) of trunk length. Dorsal surface and its midline of dorsal disc without tubercles or spine. Ventral surface of disc smooth. Tail long and whip-like, with a poison spine, and end of tail rough and asperites. A low and distinct ventral fold of tail begun from at just below spine base, fold length 11.4~20.2 (15.8 ± 4.11) in anterior-most point of cloaca to tail tip, but no dorsal fold. No dorsal and caudal fin. Clasper of adult male large and stout.

Color in formalin: Body color pale brown dorsally, whitish ventrally. No disc and ventral surface have bands.

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

Remarks: This species is similar to *Dasyatis zugei* in the disc shape and snout feature. Nishida and Nakaya (1988a) mentioned that several investigators have been confused the taxonomic position of *D. acutirostra* in relation to *D. zugei*. Practically, this confusion arised from misdescription by German (1913), Fowler (1941) and Tang (1962). However, *D. acutirostra* is clearly distinguishable from *D. zugei* by the following characters: eyeball diameter is 17.9~20.1 times in preorbital snout length (3.7~7.5 in *D. zugei*, after Nishida and Nakaya, 1988a); dorsal fold of tail is usually absent, or if present, it is a very inconspicuous keel (relatively distinct in *D. zugei*).

2. *Dasyatis kuhlii* (Müller et Henle, 1841)

(Korean name: Kongji-gaori)

Trygon kuhlii Müller et Henle, 1841, Syst. Besch. Plagiostomen, P. 164, pl. 50 (Vanocoro; New Guinia; India).

Dasyatis kuhlii Fang et Wang, 1932, Contr. Biol. Lab. Sci. China, Vol. 8, p. 270, fig. 24, (Chefo); Mori, 1952, Mem. Hyogo Univ. Agr., vol. 1 (3), p. 26; Chyung, 1977, Iljisa, pp. 96~97.

Materials: BKNU 2006-2007, (2), immatures, 181.0~223.0 mm DW, Haemang-dong, Kunsan, Korea, June 10, 1994.

Description: Disc moderately thick and diamond shape. Disc width fairly broader than disc length. Snout tip obtuse, anterior and posterior margin of disc slightly convex. Anterior angle of disc broader and posterior angle pointed. Snout angle about 120~140°. Preorbital snout length about 2 times of interorbital width. Eye and spiracle large. Floor of mouth with two papillae. Dorsal and ventral fold of tail present, dorsal fold very small but ventral fold large, with several black and white bands, begun at just below the spine of tail. Pelvic fin triangular and its outer corner much pointed. Length of tail 1.5~2.0 times of disc length.

Color in formalin: Dorsal surface of disc brown and ventral surface white, margin of ventral surface gray with brown. Whip-like tail dark brown without asperities. Sometimes bluish spots on dorsal disc present. Stripe of tail with black and white bands. Ventral tail fold dark.

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

Remarks: *D. kuhlii* is similar to *D. matsubarai* in morphological features as form of disc and color of disc surface, but *D. kuhlii* differ from *D. matsubarai* in having the scattered spots on the disc surface (linear spots directed anteriorly in *D. matsubarai*), cross banded tail (no band), dark band around both eyes (no dark bands), short and non-asperites tail.

3. *Dasyatis akajei* (Müller et Henle, 1841)

(Korean name: Norang-gaori)

Trygon akajei Müller et Henle, 1841, Syst. Besch. Plagiostomen, p. 165, pl. 54, Nagasaki.

Dasyatis akajei Jordan and Metz, 1913, Mem. Carn. Mus., 6 (1), p. 6, Fusan; Mori and Uchida, 1934, J. Chosen Nat. Hist. Soc., 19, p. 14; Mori, 1952, Mem. Hyogo Univ. Agr., 1 (3), p. 26; Chyung, 1977, Iljisa, p. 96.

Materials: BKNU 2008, (1), immature, 253.5 mm DW, Haemang-dong, Kunsan, June 10, 1994; BKNU 2010-2013, (4), mature, 489.0~865.8 mm DW, Haemang-dong, Kunsan, Nov. 28, 1995.

Description: Disc diamond and moderate thick. Disc width broader than disc length. Snout tip obtuse, with their angle about 120°, anterior and posterior margins of disc slightly convex. Preorbital snout length about 2 times of interorbital width, and a little longer than preoral snout length. Eyes moderately large; eyeball diameter 3.0~3.9 times in interorbital width, 6.0~9.3 in snout length. Head length and prebranchial length almost equal. Teeth pavement-like, with a cusp on each tooth. Floor of mouth with three stout papillae centrally. Dorsal and ventral fold of tail present, dorsal fold present far from the spine of tail, and vent-

ral fold begun at just below base of dorsal spine. Dorsal and ventral surface of disc naked and smooth. Clasper long and stout.

Color in formalin: Dorsal surface of disc red brownish with yellow, around eyes and spiracles yellow. Margin of dorsal surface yellowish with redish. Around margin of ventral surface yellow broader, and center of ventral surface pale or whitish. Surface of tail dark or blackish.

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

Remarks: *D. akajei* is widely distributed in around sea of Korea. Nakabo (1993) has mentioned that *D. akajei* is close similar to *D. laevigatus* in morphological features. But *D. akajei* well differed from *D. laevigatus* in having yellow band behind of spiracle (brown in *D. laevigatus*), ventral margin of disc yellow (dark), small tubercles on midline of disc surface (smooth) and more 85% of disc length to the disc width (below 85%).

4. *Dasyatis zugei* (Müller et Henle, 1841)

(Korean name: Chungdalnae-gaori)

Trygon zugei Möller et Henle, 1841, Syst. Besch. Plagiostomen, p. 165, pl. 53, Nakasaki, China, India.

Dasyatis zugei Jordan and Fowler, 1903, Proc. U. S. Natn. Mus., 26, 593~674; Mori, 1952, Mem. Hyogo Univ. Agr., 1 (3), p. 26; Chyung, 1977, Iljisa, p. 96, Chejudo.

Material: No specimen examined.

Distribution: South Sea of Korea, China and Japan.

Remarks: This species is close similar to *D. acutirostra* in exomorphological characters. Teng (1962) had ever misidentified *D. zugei* into *D. acutirostra* as well as German (1913) and Fowler (1941). Nishida and Nakaya (1988a) mentioned that the last syntype deposited in Museum für Naturkunde der Humboldt, Berlin, was lost. So Nishida and Nakaya (1988a) had assigned new lectotype and paralectotype of *Dasyatis zugei* from Japan.

5. *Dasyatis matsubarai* Miyosi, 1939

(New Korean name: Huk-gaori)(Fig. 2, B)

Dasyatis matsubarai Miyosi, 1939, Bull. Biogeo. Soc. Japan, 9 (5), pp. 91~97, Hyuga Nada, Japan; Nakabo, 1993, Tokai Univ. Press, p. 143~149.

Materials: BKNU 2003, 2004, (2), 360.0~371.0 mm DW, Komso, Puan, Chollabuk-do, July 9, 1994; BKNU 2005, (1), 487.0 mm DW, Mokpo, Chollanam-do, March 20, 1995; BKNU 2016~17, (2), 521.8~568.9 mm DW, Cheju-shi Tongmun Market, Cheju-do, January 25, 1996.

Description: In percentages to disc width, disc length 83.2~87.2 (85.1 ± 0.66); head length 29.2~30.3 (29.7 ± 0.46); interspiracle width 16.2~17.9 (17.3 ± 0.78); preoral snout length 18.2~18.8 (18.5 ± 0.25); preorbital snout length 19.8~20.1 (19.9 ± 0.12); eye diameter 3.7~4.7 (4.3 ± 0.41); interorbital width 10.4~12.0 (11.4 ± 0.68); mouth width 8.4~9.8 (9.3 ± 0.63); prebranchial length 29.6~32.2 (30.8 ± 1.07); first branchial width 21.3~23.5 (22.5 ± 0.89); fifth branchial width 15.0~15.6 (15.4 ± 0.26); caudal length 111.2~112.4 (111.8 ± 0.59); ventral fold length 28.9~31.7 (30.7 ± 1.31); dorsal fold length 6.3~7.8 (7.2 ± 0.68); trunk length 71.1~76.4 (74.6 ± 1.46).

Disc flat and somewhat point anteriorly. Dorsal surface smooth and naked, without any tubercles and spines, but with or without sharp processes along midline anterior to poisonous spine of tail. Body moderately thick. Disc width much longer than disc length (about 85.0 percent of disc width). Eye moderate. Snout obtuse, snout angles 146~148°. Dorsal disc diamond, front and hind margins more or less stright. Papillae of mouth base three. Form of teeth pavement-like rectangular. Tail with one (or two) spine (s) and asperites in end part of tail. Ventral fold of tail present and broader development, just below spine origin and dorsal fold present behind spine of tail, its size is small.

Color in formalin: Dorsal disc blue-black, with white linear spots directed anteriorly, having a sensory

pore in each spot. Ventral surface of disc white or pale but margin of ventral slightly darkish.

Distribution: South-western Sea of Korea and Japan.

Remarks: According to the description of Nishida and Nakaya (1988b), *Dasyatis matsubarai* is similar to *D. izuensis* in morphological features. But *D. matsubarai* differed from *D. izuensis* by having long snout length (14.1~18.7% to the disc width in *D. izuensis*), ventral fold dark (white), white spots on dorsal surface of disc (absent) and posterior part of tail rough (smooth). And *D. matsubarai* also resembles *D. kuhlii* in morphological characters but their different characters were described in remarks of *D. kuhlii*.

6. *Dasyatis sinensis* (Steindachner, 1982)

(New Korean name: Galsaek-gaori)(Fig. 2, C)

Trygon sinensis Steindachner, 1892, Anz. Akad. Wiss. Wien., 29, p. 133, Shanghai.

Dasyatis sinensis Chu, 1984, Fujian Sci. and Technol. Press, pp. 68~84, East Sea of China.

Material: BKNU 2009, (1), 402.0 mm DW, Komso, Puan, Chollabuk-do, August 20, 1995.

Description: In percentages to the disc width, disc length 98.4%; head length 36.6; interspiracle width 17.4; spiracle diameter 7.2; preoral snout length 21.8; preorbital snout length 25.0; eye diameter 3.5; interorbital width 10.4; mouth width 10.5; prebranchial length 36.2; first interbranchial width 23.1; 5th interbranchial width 15.7; ventral fold length 44.8; dorsal fold length 14.8; trunk length 82.0.

Disc of body diamond. Disc moderately flat and thick, fairly pointed anteriorly and rounded posteriorly. Disc width and disc length almost equal. Length of preoral snout about two times of mouth width. Snout fairly prominence, and its angle about 100°. Preorbital snout length short, but longer than preoral length. Dorsal surface in center of shoulder and front of poison spine of tail with granular tubercle. Midline of snout with many sensory pores. Interorbital width to snout length about 41.6 percent. Clasper of matu-

red male large and stout. Teeth of upper and lower jaws with round form and with a cusp each. Posterior part of tail rough and asperities.

Color in formalin: Dorsal surface yellow-brown and ventral surface pale, without any spots.

Distribution: West-southern Sea of Korea and China.

Remarks: This species was similar to *D. akajei* in the exomorphological characters, but *D. sinensis* made with yellowish-brown in dorsal disc (red-brown with yellow in *D. akajei*); with snout angle about 100° (snout angle about 120°); with pale in ventral surface (yellow in margin of ventral disc); no spots behind eye and spiracle (yellow spots). Chu (1984) reported that *D. sinensis* was distributed in Yellow Sea.

Key to the species of genus *Dasyatis* of family Dasyatidae from Korea

- 1a. Snout angle fairly pointed, with below 100°, without papillae on floor of mouth. Hind margin of body disc almost round 2
- 1b. Snout angle moderate or obtuse, with more 100°, 2 or 3 papillae on floor of mouth, Form of disc almost diamond 3
- 2a. Dorsal and ventral folds present behind spine of tail *Dasyatis zugei*
- 2b. Only ventral fold present behind spine of tail *Dasyatis acutirostra*
- 3a. Length of tail moderate, with regular black band and smooth at the tip *Dasyatis kuhlii*
- 3b. Tail whip-like and very long with asperites, without any bands 4
- 4a. Ventral margin with yellow band *Dasyatis akajei*
- 4b. Ventral margin without yellow band 5
- 5a. Dorsal disc with white and small spots having a sensory pore each directed anteriorly. With ^-shaped sulcus between 5th branchial pore. Maxi-

- llary teeth rectangled, without a cusp
 *Dasyatis matsubarae*
- 5b. Dorsal disc without distinct white spots. Maxillary teeth rounded, with a cusp each one. Without ^-shaped sulcus between 5th branchial pore *Dasyatis sinensis*

Systematic discussions

Jordan and Metz (1913) and Mori and Uchida (1934) described three species as stingrays from Korea: *Urolophus fuscus*, *Dasyatis akajei* and *Pteroplatea japonica*. Thereafter Mori (1952) reported again that the family Dasyatidae from Korea was classified into five species belonging to three genera: *Urolophus fuscus*, *Dasyatis akajei*, *Dasyatis zugei*, *Dasyatis kuhlii*, *Pteroplatea japonica*. On the other hand, Chyung (1977) described *U. fuscus* and *P. japonica* into a junior synonym of *U. aurantiacus* and *Gymnura japonica*. According to the classification of Chu (1984), Masuda et al. (1988) and Nakabo (1993), *U. aurantiacus* belonged to family Dasyatidae heretofore was transferred into family Urolophidae, and *G. japonica*, into family Gymnuridae. I consider that above two species were transferred into families Urolophidae and Gymnuridae are very reasonable. Because the exomorphological features of *U. aurantiacus* and *G. japonica* have sharply different characters from those of family Dasyatidae.

Members of family Dasyatidae are strikingly characterized in having greatly depressed disc, being united with pectorals to the flattened body, pelvics also flat and whip-like tail, with one or two poisonous spines and ventral fold (Fig. 3). On the other hand, Matsubara (1979) had divided family Dasyatidae into two subfamily, Dasyatinae and Gymnurinae, on the basis of the relationships of disc width and disc length. But at present it is not accepted as desirable criteria for subfamily divisions of family Dasyatidae (Chu, 1979; Cheng and Zheng, 1987; Nishida and Nakaya, 1988a, b; Nakabo, 1993; Nelson, 1994). Family Dasyatidae

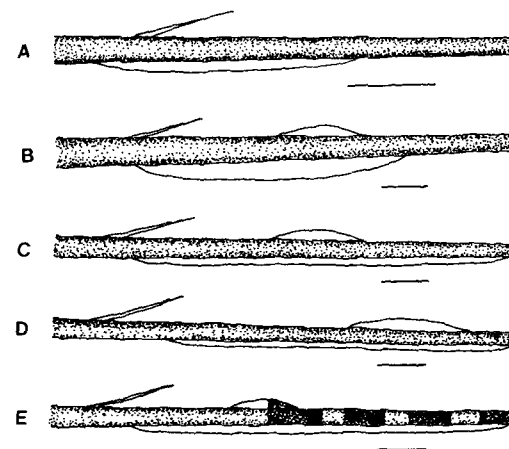


Fig. 3. Ventral and dorsal folds of genus *Dasyatis*.

A: *D. acutirostra*, 457.0 mm DW, BKNU 2002, B: *D. matsubarae*, 487.0 mm DW, BKNU 2005, C: *D. sinensis*, 402.0 mm DW, BKNU 2009, D: *D. akajei*, 489.0 mm DW, BKNU 2010, E: *D. kuhlii*, 228.5 mm DW, BKNU 2015.

Scale bars indicate 20 mm.

from Korea described by Mori (1952) and Matsubara (1979) formerly are divided into three families in the present day: Dasyatidae, Urolophidae and Gymnuridae. The most important taxonomic character of the family Urolophidae was well-developed caudal fin. And family Gymnuridae has a disc extremely broad. In the family Dasyatidae, the form of body was divided into diamond or round type. The species with diamond types were *D. sinensis*, *D. matsubarae*, *D. kuhlii* and *D. akajei*. They have snout angles more than 100°, and snout length shorter than those of round type (Table 1 and 2). The species with round type posteriorly were *D. acutirostra* and *D. zugei*. Their snout angles were made with less than 100° and long snout (Table 2). According to the description of Nishida and Nakaya (1988b), *D. matsubarae* is close similar to *D. izuensis* in their morphological features. But it was differed *D. matsubarae* from *D. izuensis* in the several morphological characters: ventral fold dark, white spots on dorsal surface of disc and rough in posterior part of tail. *D. zugei* is fairly similar to *D. acutirostra*

Table 1. Comparisons of average values of morphometric characters of genus *Dasyatis* from Korea

Characters	<i>D. acutirostra</i>	<i>D. kuhlii</i>	<i>D. akajei</i>	<i>D. matsubarai</i>	<i>D. sinensis</i>
In percentages to the DW ¹⁾					
Disc length	105.6	88.0	90.4	85.1	98.4
Head length	49.0	28.1	29.8	29.7	36.6
Interspiracle width	14.7	14.8	15.6	17.3	17.4
Preoral snout length	39.0	18.8	19.3	18.5	21.8
Preorbital snout length	40.0	19.2	20.0	19.9	25.0
Eye diameter	2.1	4.8	2.7	4.3	3.5
Interorbital width	9.6	8.9	12.6	11.4	10.4
Prebranchial length	49.1	30.7	31.2	30.8	36.2
First branchial width	18.1	18.2	20.2	22.5	23.1
5th branchial width	12.7	12.1	14.3	15.4	15.7
Ventral fold length	21.2	49.9	37.3	30.7	44.8
Trunk length	90.9	77.3	72.1	74.6	82.0
In percentages to the HL ²⁾					
Interspiracle width	29.2	52.6	50.6	58.3	47.5
Preoral length	80.0	66.9	63.6	62.3	59.6
Preorbital snout length	81.5	68.6	70.0	67.0	68.3
Eye diameter	4.2	17.1	10.1	14.4	9.5
Interorbital width	19.4	31.7	37.5	38.4	28.4
Mouth width	16.3	26.4	27.4	31.3	28.7

¹⁾: disc width, ²⁾: head length.

in their morphology, but *D. zugei* has a short and small dorsal fold behind spine of tail (Table 2)(Fig. 3). In the ventral fold of tail, *D. sinensis* and *D. akajei* were very long and narrow, and that of *D. matsubarai* was long and broad. That of *D. acutirostra* was short and narrow but *D. kuhlii* was crossed with black bands. Dorsal fold of *D. sinensis*, *D. akajei*, *D. matsubarai* and *D. kuhlii* have a short and narrow, but that of *D. acutirostra* absent (Fig. 3).

In the forms and arrangements of teeth, those of *D. matsubarai* and *D. acutirostra* were rectangular and pavement-like, but those of *D. akajei*, *D. kuhlii* and *D. sinensis* were round form, with a cusp on each tooth (Table 2)(Fig. 4). The claspers of *D. akajei*, *D. sinensis* and *D. matsubarai* were very strong and large in

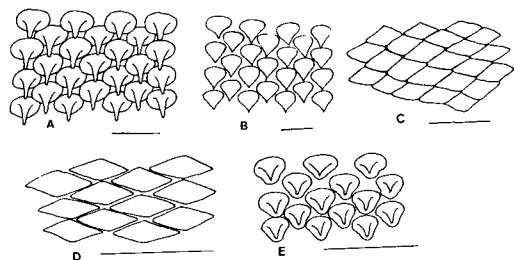


Fig. 4. The form and arrangement of teeth of genus *Dasyatis*. A: *D. sinensis*, B: *D. akajei*, C: *D. matsubarai*, D: *D. acutirostra*, E: *D. kuhlii*. Scale bars indicate 3 mm.

matured males, but those of *D. acutirostra* and *D. kuhlii* were weaker than those of the former (Fig. 5).

Table 2. Comparisons of morphological characters of the family Dasyatidae from Korea

Characters	<i>Dastatis sinensis</i>	<i>D. matsubarai</i>	<i>D. acutirostra</i>	<i>D. akajei</i>	<i>D. kuhlii</i>	<i>D. zuger</i> ³⁾
Body color	yellow-brown	blue-black	gray	red-brown with yellow	brown	red-brown, gray-brown
Snout angle	100°	146~148°	70°	120°	120~140°	60~80°
Papillae of mouth base	3	3	0	3	2	0
Snout length	short	short	long	short	short	long
Form of teeth	round with a cusp	rectangular, pavement-like	rectangular, pavement-like	round with a cusp	round with a cusp	—
Length of BW and BL ¹⁾	BW≅BL	BW>BL	BW≅BL	BW>BL	BW>BL	BW≅BL
Body form	diamond	diamond	anterior-pointed, posterior-round	diamond	diamond	anterior-pointed, posterior-round
Size of eye	small	moderate	small	small	moderate	small
Spots on body surface	without	white spots	without	yellow around eye & spiracle	crossed banded on tail	without
Fold of tail	dorsal, ventral	dorsal, ventral	ventral	dorsal, ventral	dorsal, ventral	dorsal, ventral
Posterior part of tail	rough	rough	rough	rough	smooth	smooth
HL and PBL ²⁾	HL≅PBL	HL≅PBL	HL≅PBL	HL<PBL	HL<PBL	—

HL¹⁾: body width and body length, ²⁾: prebranchial length, ³⁾: from Chu (1984).

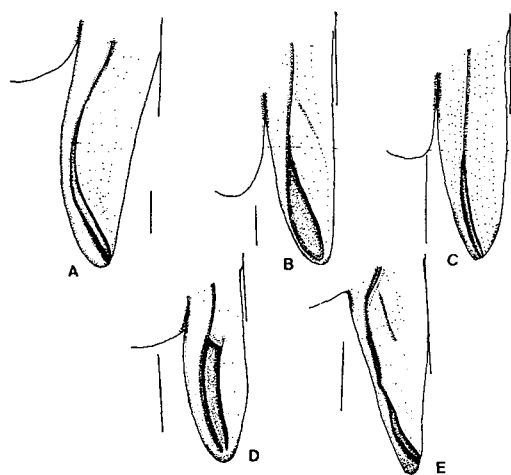


Fig. 5. Left claspers of genus *Dasyatis*. A: *D. akajei*, B: *D. matsubarai*, C: *D. acutirostra*, D: *D. kuhlii*, E: *D. sinensis*. Scale bars indicate 20 mm.

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