

Studies on the Rays and Skates Belonging to the
Family *RAJIDAE*, Found in Japan and Adjacent Regions

4. A Revision of Three Genera of Japanese Rajids,
with Descriptions of One New Genus and
Four New Species Mostly Occured
in Northern Japan^{*)}

By

Reizo ISHIYAMA

With 4 Plates and 7 Text-figures.

During the course of the present study, the writer has been able to examine a large number of specimens involving many interesting forms. These are represented by twentyfour species, which slightly exceed twice the hitherto known Japanese species. Of these, several one are recognized as new to science.

All the rajid-fishes of Japan and adjacent regions have hitherto been referred to a single genus *Raja*, whilst in the present study, the writer splited it into three genera, *Raja*, *Breviraja* and *Rhinoraja*, the last of which is proposed herein as new.

The present instalment deals with the revisional study of Japanese genra of rajids together with descriptions of a new genus and four new species principally found in northern Japan.

The classification of rajids have usually been done on the basis of the external characters. But, it appears that such taxonomic studies are not sufficient not only for the complete separation of the species but also for setting up the generic criterions.

Such being the case, the present study was made based mainly upon the characters such as the rostral cartilage, cranium, counts of both vertebrae and turns of intestinal valve, and egg-capsules, in addition to the external characters.

Although the characteristics of rostral cartilages in *Elasmobranchii* have been discussed in many works, the detailed analytical investiga-

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tions have not yet been taken into taxonomy so far as our knowledge on the rajids is concerned.

Quite recently, very interesting taxonomic studies of the Atlantic rajids has done by BIGELOW and SCHROEDER (1948, 1950) on the basis of the comparative studies of the rostral cartilage. In these works, they have referred six genera under the present Family. Of these, two genera, *Breviraja* and *Cruriraja*, were newly erected from the results of osteological observations that merely taken with the roentogen photographs but without giving any anatomical examinations of the rostral cartilages or the pelvic cartilage comparing with other known genera. The application of roentogenograms is often useful for the ichthyology or applied fishery biology without elaborations as already pointed out by Gosline (1948).

However, it appears that the method has some difficulties to clear out the osteological differences depicting the bony structure. As a matter of fact, the roentogen photographs in the present study showed the marked differences against the results of anatomical investigations, despite of these photographs appeared to have come out as sufficient as that of BIGELOW and SCHROEDER's ones (1948, Fig. 1). And, moreover, by the present technics of the photographs could not take even the presence of the rostral cartilage, especially when the species being the delicate cartilage covered by the tough skin (Fig. 1 A, A'—C, C').

Accordingly, it should be mentioned that the roentogenograms for the ichthyological studies are apt to give the cause of the erroneous conclusion, especially so when it was taken into the osteological examinations intended to set up the systematic basis. Wherefore, the present investigation of the rostral cartilages was taken place by the tedious anatomical method or histological study.

On the other hand, as for the vertebral counting, the application of roentogenograms was employed as a reliable method due to the heavy calcification segmenting obvious centrums, although they bear of much uncertainty for counting their posterior extremities owing to the incomplete segmentation. The writer, therefore, gave the vertebral count before the origin of 1st dorsal fin by roentogen photograph, but the rests were measured anatomically. Thus, the writer compared the counts of vertebrae split into three groups, the abdominal, precaudal and procaudal vertebrae, as explained later on.

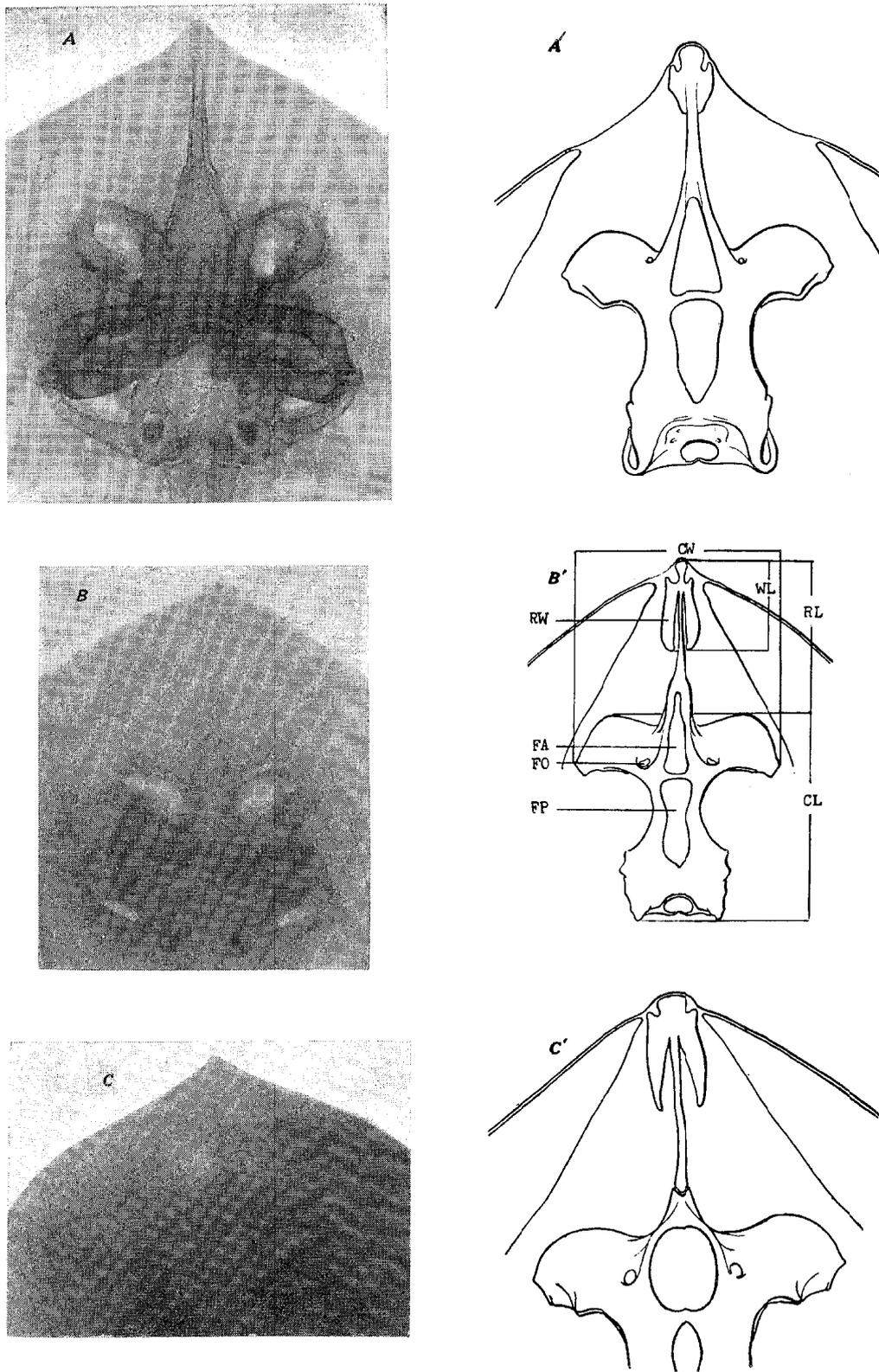


Fig. 1. Showing three types of rostral cartilage of Japanese rajids compared with their X-ray photographs (A-C) against anatomical views (A'-C'), and parts of cranium and rostral cartilage on which measurements were made (B'), see also explanation of p. 5. A, A', *Raja fusca*; B, B', *Breviraja tobitukai*; C, C', *Rhinoraja kujiensis*. All these photographs are not retouched, and unsatisfactory depicting the real structures of the cartilages, especially in C against C'. FA, anterior fontanelle; FO, foramen for superficial ophthalmic nerve; FP, posterior fontanelle; RW, rostral wing or appendix..

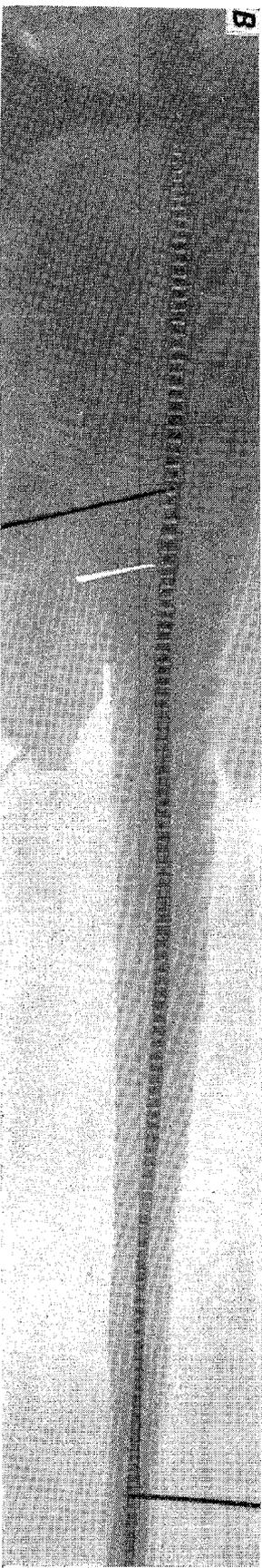
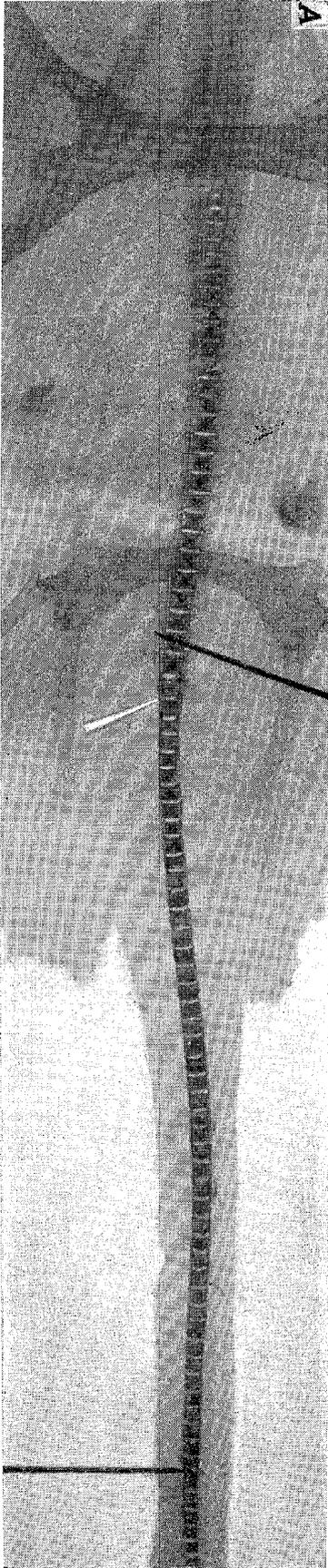


Fig. 2. X-ray photographs of the vertebrae in our rajids, showing two types in number and method of counting in the subdividing groups. A, *Raja henjoi*, B, *Brevivaja isatrachys*. Black pin-heads denote the anterior corner of cloaca and insertion of 1st dorsal fin respectively; white ones indicate the boundary between abdominal vertebrae and precandial ones.

Then, the most considerable differences in number of vertebrae of our rajids were noticed to exist in the precaudal series that may be used for the separation of this group above the rank of species, though the same trends was recognized as in the case of total number of vertebrae (Fig. 2).

It appears with some difficulties that we find the way to subdivide the caudal groups of vertebrae into two parts as mentioned above or will be given later on, but, with regard to the consideration in question, the present writer wishes to reserve for the future works*).

In short, the count of the precaudal vertebrae is fewer in *Raja* than in either *Breviraja* or *Rhinoraja*, being 36 to 37 instead of 63 to 89 in the latters.

Thus, the remarkable differences of the vertebral counts that are found to exist will enable us to separate the Japanese rajids into some phyletic groups, although the counts are not always useful for the separation of genera or species as given by some authors. But, it would be very worthy mentioning that these two groups of our skates or rays — the species belonging to genus *Raja* and those referred to two genera *Breviraja* and *Rhinoraja* — are so obviously set apart each other by the well defined rostral cartilages in addition to the remarkable difference in the vertebral counts.

The other important characters such as the anatomical characters of claspers and the arrangement of valves of conus arteriosus are supposed to be useful for the classification as well as for the phyletic significance.

Of this matter, however, is deferred in detail to the forthcoming issues.

The writer must express his cordial thanks to Dr. Kiyomatsu MATSUBARA, Professor of Kyoto University, who offered a kind guidance in many ways and placed his valuable specimens at the writers disposal. Also, the heartfelt thanks are extended to Mr. Ryozi ICHII, technical expert of Maizuru Municipal Hospital, by whom the many X-ray photographs for the present investigation were made; and other photographs were taken by Mr. Sueo HARADA, of our College. About the collection of materials especially in Hokkaido District, the author wishes to express his warmest thanks to Dr. Toraichiro KINOSHITA and the

* On the systematic relative length of the tail in relation to the number of vertebrae is deferred to another paper.

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Materials and method of study

The present study is made on 2 genera and 10 species which may constitute almost all the members of our northern forms characterized by having the soft snout, and they were chiefly obtained from the deep-seas. But, two of these in the genus *Breviraja* were collected from the middle part of Japan. The following table includes these fishes, showing the number of specimens and their localities, etc.

Table 1. Localities, number of specimens, and depth of collection (fathoms). A, *Breviraja tobitukai*; B, *B. isotruchys*; C, *B. aleutica*; D, *B. matsubarai*; E, *B. diplotaenia*; F, *B. abasiriensis*; G, *B. smirnovi*; H, *B. parmifera*; J, Japan Sea, K, *Rhinoraja kujiensis*; L, *R. longicauda*; O, Okhotsk Sea; P, Pacific; +, where the species nearly recognized; number of specimens for counting of vertebrae and intestinal valves were put in parenthesis.

Localities \ Species	A	B	C	D	E	F	G	H	K	L
Owase, Mie; P	6									
Maisaka, Shizuoka; //	2									
Chōsi, Chiba; //					2				2	9
Shiogama, Miyagi; //		+	2		8				13	10
Same, Aomori; //		3	+	2	+				10	4
Muroran, Hokkaido; //		3	4	+	9			1	+	+
Kushiro, // ; //		3	9	16	12				2	2
Abasiri, // ; O		+	+			9				
Monbetsu, // ; //		9	2			1	17			
Wakkanai, // ; //		+					2			
Funakawa, Akita ; J		10					1			
Sado, Niigata ; //							4			
Maizuru, Kyoto ; //		3					4			
Oki, Shimane ; //		3					1			
Number of specimens	8(5)	34(5)	17(5)	13(5)	31(5)	10(5)	29(5)	1(1)	27(5)	25(5)
Depth captured (ca. fathoms)	200~ 300	150~ 250	80~ 450	400~ 500	150~ 300	80~ 100	70~ 250	?	300~ 400	300~ 400

First, for the description of external characters of the new species I used holotype, and later, the individual variations in both numerical and proportionate characters of each species in accordance with growth or in two sexes were clarified by the paratypes, but with regard to the anatomical or histological investigations of the fish or the egg-capsules were operated on 1 or 5 specimens.

The method of measuring and terminology in the external were followed to CLARK (1926, p.6, Fig. 1) in so far as not otherwise mentioned later on.

The tail was distinguished into two parts, thus: the distance from the cloaca to the origin of 1st dorsal fin was termed precaudal, and the rest was referred to procaudal one. To indicate the degree of notch in the ventral fin, the distance from the tip of anterior lobe to incised corner between two lobes was measured and termed it as ventral incision. The length of clasper was measured from the tip and its point of emergence from the skin on the inner side as stated by STEVEN (1934 : p.887).

To indicate the characteristics of the cranium in each form satisfactory, the measurement and terminology of various parts of this organ were standardized as follows (Figs.1 B' ; 2) :

1. The length of the rostral cartilage measured the vertical line between from the anterior tip and the tangential line of nasal capsules in two sides (RL in Fig. 1 B).

2. The length of rostral wing measured from the tip of rostral cartilage to horizontal line passing through the posterior ends of the wings (WL in Fig. 1 B).

3. In length of cranium rostral cartilage is excluded (CL in Fig. 1 B).

4. The width of cranium is measured at the broadest portion (CW in Fig. 1 B).

The vertebrae are subdivided into three groups, thus: abdominal precaudal and procaudal respectively; the abdominal ones were regarded to the ordinary locus of vertebrae; the precaudal followed by the procaudal ones were divided from the latter at just under the origin of 1st dorsal fin (Fig. 2). Of these, however, in this work, for the convenience in the descriptions of vertebral counts, the first two regions in the vertebrae were taken into the systematic constants, but the rests were kept out side owing to their uncertainness for the counting. Those

concerning the egg-capsules were done as in the case previously given by the present author (1950).

Key to Japanese Genera: (Internal characters are italicized).

- A. Snout with hard axis in touch bearing clear rostral ridge, that scarcely be bent in its base. Tail always much shorter than length of disc. *Rostral cartilage very short, projecting from skull in a rod- or tape-like bar, inserted by rostral appendices or wings at the anterior extremity of the cartilage. Posterior ends of the wings free from the rostral axis on no occasion. Anterior tip of radial cartilages of pectoral fins falling far from outer edges of the wings in lateral sides of rostrum, leaving large semicartilaginous portion in front of the skull* (Fig. 1 A). *Precaudal vertebrae relatively few, about 36 to 57. Egg-capsule belongs to Kenojei- or Pulchra-type*..... *Raja* LINNAEUS
- AA. Snout very soft and flexible without rostral ridge. Tail usually longer than or nearly equal to length of disc with some exceptions. *Rostral cartilage very feeble, developing from skull in slender tape- or bar-like projection, inserted by rostral appendices or wings and in preceding one, but the posterior ends of the wings apparently free from the rostral axis, hanging more or less posteriorly. Anterior edges of radial cartilage of pectoral fins very close near the appendices* (Fig. 1 B', C'). *Number of precaudal vertebrae numerous, 63 to 89. Egg-capsule belongs to Isotrachys- or Parmifera-type.*
- B. *Rostral cartilage without segment* (Fig. 1 B'). Tail usually almost equal to or slightly longer or shorter than length of disc. Egg-capsule belongs to *Isotrachys- or Parmifera- type*..... *Breviraja* BIGELOW and SCHROEDER.
- BB. *Rostral cartilage with a segment* (Fig. 1 C'). Tail always longer than length of disc. Egg-capsule belongs to *Isotrachys* or allied one..... *Rhinoraja*, gen. nov. p.24.

Relationships: On the basis of the following two important characters, namely, a) feature of rostral cartilage, b) number of precaudal vertebrae in connection with the length of tail, the writer could attain to consider in Japanese rajids, it appears to be very reasonable to separate the evolutionary trend into two diversified series.

With regard to the rostral cartilages, the form referred to genus *Raja* may surely be interpreted to be more primitive than those of other two genera by having more fundamental feature, such as large rostral axis inserted by lower developed rostral wings which were supposed to be closely relating to those of the lower animals, Rhinobatidae (PARKER; 1879, GARMAN; 1913, WHITE; 1937, HOLMGREN; 1940, '41).

On the contrary, those of much reduced rostral cartilages and broadly developed rostral wings observed in other two genera are apparently

recognized as more advanced forms than those in genus *Raja*. Such phenomena of specialization and reduction found in the cartilages should have been offered to undergo the forward expansion of pectoral fins in the rostral region.

It should be noticed herewith that the highest specialization of the rostrum in our rajids is recognized in the genus *Rhinoraja*, which have a segment in the reduced rostral cartilage in addition to the large wings. Furthermore, it should be thought without any doubt that this type of rostrum must have diverged directly from that of the genus *Breviraja*.

On the other hand, for the reduction of vertebral counts in relation to the length of tail, the writer considers that the tail of the rajids must have been creating their evolutionary tendency to be to serve for the defensive or tactile organ being gradually undertaken its reduction in the tail which has regarded as the organ of movement, the original function in the elasmobranchs. The shorter length of tail with fewer number of vertebrae by which characterizing the tail in genus *Raja* is appeared to have resulted in the remarkable development of such organ, viz., the very sharp spines or the highly developed electric organ.

But, since other two genera being left the longer tail with larger number of vertebrae compared with those of former ones, their tails may be recognized that bearing more effective power for the movement of the body retaining more primitive state, though they also have poorly developing defensive organs in most cases.

Wherefore, we can see the reversed relationship between the specialization in the rostral cartilage and reduction of the tail within the groups of the fish diversing two representatives, *Raja*, and *Breviraja* and *Rhinoraja*.

The interspecific relationships in detail will be reported in other paper accompanying some other important characters supposed to be useful for the taxonomy and phylogeny of this group.

Breviraja BIGELOW and SCHROEDER, emend.

Breviraja BIGELOW and SCHROEDER, 1948, Jour. Mar. Reser. 7 (3) p. 558.

Type : *Breviraja colesi* BIGELOW and SCHROEDER, Atlantic.

External : Snout soft and flexible, forward extension of pectoral rays close nearly to the tip of snout on either sides; tail stout, rather

long, its dorsal border more or less roughened with spines or prickles; entire upper surface of disc or at least nuchal and orbital regions prickled.

Internal: — Rostral cartilage extends to tip of snout without any segments, its portion before the anterior fontanelle abruptly being reduced into a so weak or delicate bar that the X-ray can not sufficiently depict in the photographs (Fig. 1 A'—C'). Very thin translucent rostral appendices of the cartilage developed in preximal portion bearing three distinct small projections. Of these, the central one differs from others by having broad and flattened or domed apex instead of being pointed in other lateral ones. Shallowly or deeply notched between the former and the latter process. Posterior tips of the wings are free from the rostral bar, forming a pair of deep notches between the wings and rostral cartilage. Anterior tips of radial cartilags of pectoral fins usually close near the lateral edge of the wings, but the distance between them are found in considerable differences as specific ranks. Hence, the external feature in the preximal portions of the rostra are principally depend upon the degrees of development of the process and the relationships between the tips of pectoral radialias and the lateral wings.

Judging from the methods of examinations and the external features of the type described by the prior author, the rostral cartilage of the species which to be involved into the genus seem to me to be reaching the tip of snout with the cartilage as the case mentioned above.

Vertebrae about 100 to 130; spiral valves of intestine 5 to 13. Egg-capsule, *Isotrachys*- or *Parmifera*-type.

Key to the Japanese species of genus *Breviraja*: (Internal characters are italicized).

- A. Tail always shorter than half the total length of body; dorsal border of disc almost smooth with exceptions of sparsely prickled marginal portion, orbital rim and mid-belt of disc; nuchal and shoulder spines apparent; egg-capsule belongs *Parmifera*-type.
 - B. A row of 2-4 large nuchal spines isolated from those of caudal ones; tip of snout bluntly pointed; *rostral wing very small less than a fourth the length of rostral cartilage*.....*B. smirnovi* (SOLDATOV and PAVLENKO)
 - BB. Nuchal spines set in a single series run backward, joined to those of caudal series; distal end of snout roundly projected; *rostral wing rather long, about one-third times as long as rostral cartilage*.....*B. parmifera* (BEAN)
- AA. Tail commonly longer than half the length of total length of body; dorsal border of disc thickly armed with prickles or at least thorny in marginal portion, orbital

- rim and mid-belt of disc; egg-capsule, *Isotrachys*-type or its allied form.
- C. *Rostrla wing very long, hanging posteriorly, more than one-half times as long as rostral cartilage, disc shorter than tail.*
- D. Dorsal border of disc densely armed with prickles without any large spines; *precaudal vertebrae 63-66; intestinal valves 5-6*; body uniformly grey including both dorsal and under surfaces; smallest in this group, scarcely exceeds more than 500 mm in adult; inhabits deeps in the Pacific coast of middle of Honsyu (the main land)..... *B. tobitukai* (HIYAMA)
- DD. Dorsal surface of disc in adult largely smooth with exceptions of marginal region, orbital rim and mid-belt of disc covered with many prickles, but the entire surface is sparsely armed in young; nuchal spines 0-6 (mostly 3-6); shoulder unarmed with spine; *precaudal vertebrae 70-74; intestinal valves 11-12*; darkish purple in both surfaces; body large, extends more than 1000 mm in total length; inhabits very deeps, in the Pacific coast of northern Honsyu..... *B. matsubarai*, sp. nov., p.10.
- CC. *Rostral wings small, shorter than half the length of rostral cartilage; disc somewhat shorter or almost as long as tail.*
- E. Without large spine on shoulder, dorsal surface of disc almost smooth in adult, leaving prickles densely in marginal, orbital and mid-belt portion respectively, but in young thinly prickled on entire surface.
- F. Ventral fin deeply notched, the incision about 1.22-1.84 in snout; nuchal spines 0-3 (average, 0.35), caudal spines 18-28 (average, 22.25); ground color of dorsal surface uniformly faint rosy or dark chocolate, without any peculiar patterns; inhabits deeps in the Pacific coast of northern Honsyu *B. diplotaenia*, sp. nov., p. 15.
- FF. Ventral fin moderately notched; without nuchal spine; caudal spines sparsely set at places in a row, 0-15 (average, 8.2) in number; dorsal surface greyish brown, with irregular darker patterns; found in rather deeps of the Okhotsk Sea and the neighbouring waters *B. abasiriensis*, sp. nov., p.19.
- EE. Shoulder armed with 1-2 pairs of spines in most cases; disc uniformly prickled on dorsal surface even in adult.
- G. Nuchal spines 2-8 (3.62 in mean), isolated from those of caudal region; under surface of disc smooth and almost colorless; attains about 1000 mm in maximum; inhabits deep-seas, from middle of Honsyu to further north *B. isotrachys* (GÜNTHER)
- GG. Nuchal row of spines extend backward, joining with those of caudal region in most cases, the spines 34-40 in total; under surface covered with spinules or sometimes smooth; large black blotches present on under sides of disc and tail; body very large, attains about 1500 mm in total length; inhabits deeps from northern Honsyu to Alaska *B. aleutica* (GILBERT)

Breviraja matsubarai *) , sp. nov.

Pl. 1, Text-figs. 3-4

Holotype. — Ishiyama's Fish Coll. No. 16701 (1063mm, ♂, Pl. 1 A, Fig. 3 A), off Erimo Peninsula, Hokkaido, May 20, 1951.

Paratypes. — 17 specimens**) (176-1165mm, Pl. 1 B, C), off Kushiro to Same, May to June, 1951; deep-seas.

Description: Disc length 2.15, width 1.64 and tail 1.79 into total length. Head 2.01, snout 5.70, precaudal length 1.09 and distance between tip of upper jaw and cloaca 1.35 into disc length. Snout 2.83, length of 1st, 2nd dorsal and caudal fins, 3.84, 4.03 and 5.60 into head respectively. Interorbital space 2.03 and diameter of eye 3.22 into snout.

External:—Body with apparently deep-sea form amongst this group by having soft touch and spinations, and also in coloration. Disc broad, its width much longer than length of disc. Anterior oblique margin of disc undulated, the anterior one-third convex, but the posterior rest concave. Snout very short, thickened, bluntly pointed and with somewhat indefinite small notch on both sides. Interorbital space very broad and flat, 1.59 times the diameter of eye. Eye relatively small, a trifle less than oblique length of spiracle, which is broadly opened, directing latero-anteriorly. Tail very long and slender, rod-like in shape anteriorly, but little flattened posteriorly, the length 1.09, and precaudal 1.42 into disc width. Dorsals very large, terminated together, and scarcely succeeding each other, interspace between them 29.0 into snout. Caudal fin distinct, projecting posteriorly beyond the tip of caudal axis in small extent. Ventral fin moderately notched, reaching near the anterior one-fourth of tail. Clasper very large, bar-like, globular at the tip, extending posteriorly half the way between cloaca and posterior end of base of the 2nd dorsal fin. Dermal folds on sides of tail obviously developed, broadened posteriorly, arising at the short distance rearward from the posterior end of clasper (Fig. 3 A).

Internal:—Rostral cartilage very short more or less stout, forming

* The specific name is dedicated to Dr. K. MATSUBARA to whom the author is much indebted for many favours.

** Of these, one specimen was gathered by Dr. K. MATSUBARA at Akkesi market, Hokkaido, in 1938.

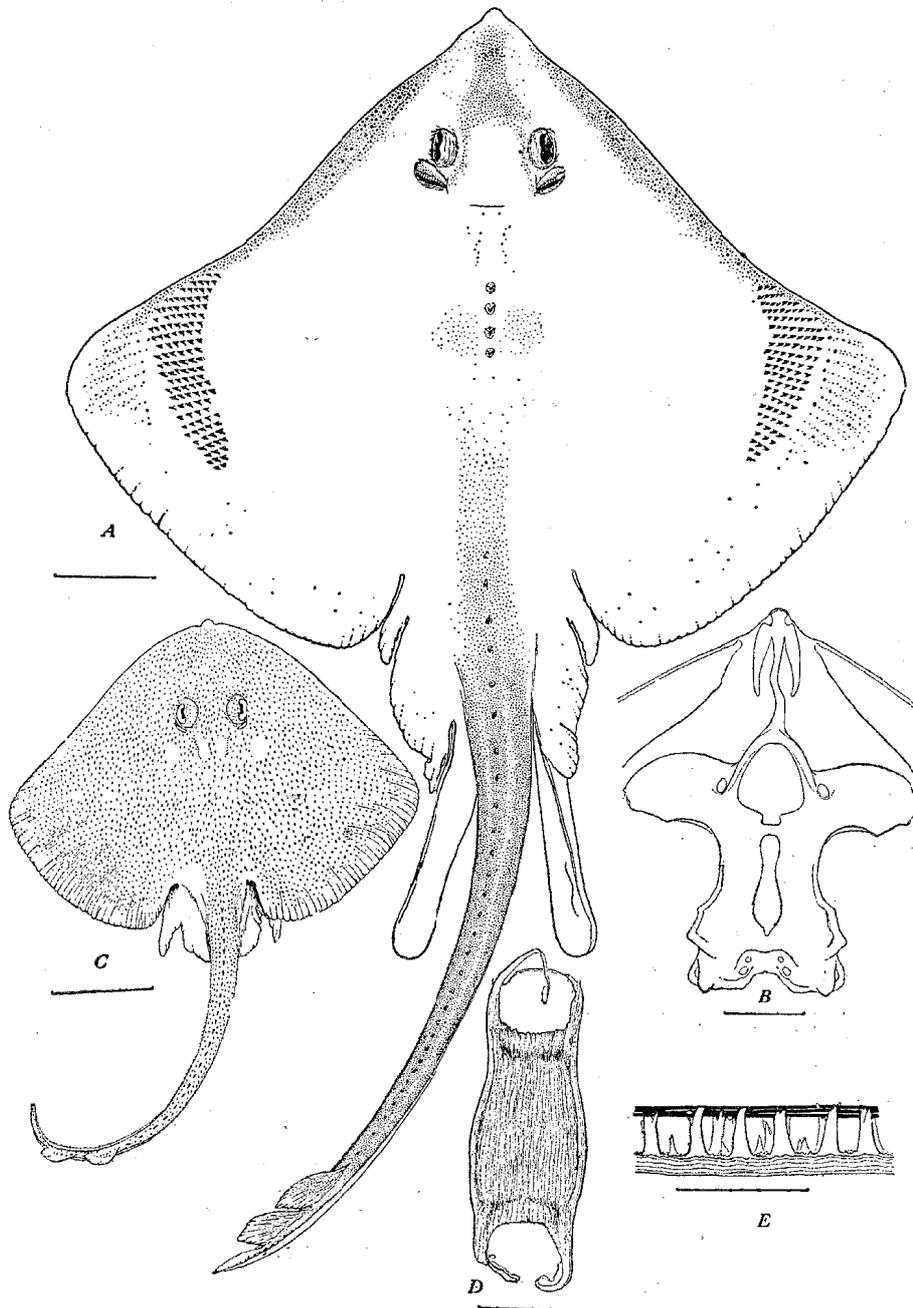


Fig. 3. *Breviraja matsubarai*, sp. nov. A, holotype; B, cranium and rostral cartilage; C, young female, total length 202mm; D, egg-capsule; E, semidiagrammatic illustration in the cross section of the capsule. A-D, dorsal views. These figures especially showing the difference in arrangements of the spines and prickles and also in the form of snout between A and C, and, large rostral wings in B, the arrangements of the spinules and fibroid hairs covered the surface of the capsule in E. Magnification of all the fig's are denoted by each scale graduating 1 cm, but 4 cm and 1mm scaled in A, E respectively.

tape-like bar; the wings very long and hanging posteriorly, its posterior tips extend beyond the half way to the origin of rostral axis. The maximum width of cranium much longer than that of the length inasmuch as the large nasal capsule being widely separated each other with straight line in their anterior margins. Anterior fontanelle very large, shaping just like the blade of spoon, and with small projection in posterior base. Posterior fontanelle elongated, narrowed anteriorly, and pointed rearward. Foramen for superficial ophthalmicus nerve large (Fig. 3 B).

Vertebral counts; 34 to 36+70 to 74.

Turns of intestinal valve; 11 to 12.

Spination:—Body with almost smooth surface on dorsal border of disc, excepting marginal and mid-belt portions. Skin over eye naked. A narrow but denser band of prickles covering anterior margin of disc, being to disperse posteriorly into wide band of scarcely visible prickles. The mid-belt of prickles in dorsal border of disc is interrupted with two narrow smooth portions, the first one covering between from the posterior margin of interorbital space and the 1st nuchal spine, the second starting in the posterior end of the spine, and running to a short distance rearward. Four large nuchal spines broadly developed, but nothing on shoulder. Tail thickly prickled accompanying a row of 30 large spines, reducing gradually in size toward both extremities. The prickles in lower lateral side of tail denser and larger, forming a clear band anteriorly, jointed to the mid-belt of disc between the ventrals. Ventral fin almost smooth, possessing a few prickles on posterior lobes; two dorsals and caudal sparsely prickled. Alar spines apparently developed, set in 23 rows transversely, 7 spines in a row for the broadest row. Lower surface of disc and tail entirely smooth (Fig. 3 A).

Coloration:—In formalin the dorsal surface heavy darkish purple, darker along mid-belt from nuchal to tail, but somewhat paler in the inner margin of eye-ball and posterior margin of spiracle. Lower surface a trifle fainter than dorsal, especially the anterior part of head; jaws almost colorless, but lower jaw with a dark blotch. The margin of cloaca and the posterior part of anterior lobe of ventral colorless; extremity of clasper and membranous folds on sides of tail being paler (Pl. 1 A).

Supplementally notes with paratypes: Proportional length of disc

against large dimensional parts of the body, such as total length, disc width and head length being varied individually in some extents within both sexes, however, these characters show rather less variations than as in other species throughout the life of the fish. But, proportional lengths of caudal fin and diameter of eye showing considerable variations with growth of the fish as indicated in Fig. 4. Of these, the

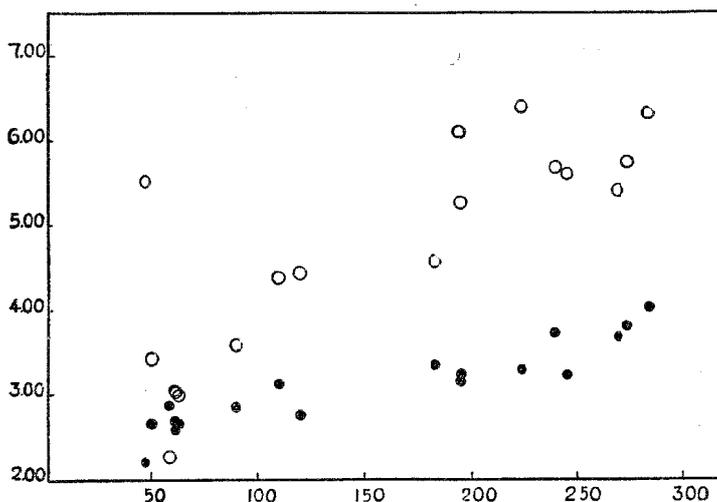


Fig. 4. Ratios of caudal-fin-length against head (o), and eye-diameter against snout (•) in relation to head as standard length in *Breviraja matsubarai*. Abcissa, head-length in mm; ordinate, ratios.

proportionate measurements of diameter of eye undergo remarkable change with the growth of the fish, *viz.*, interorbital space of adult about 1.0 to 1.5 times as long as the diameter of eye, but 0.7 to 0.8 times in very young stage. Similar phenomena in the proportional length of eye-diameter against snout, and that of caudal fin against head were noticed to exist.

A row of caudal spines apparently developing from the juvenile stage, ranging from 21 to 37, mostly 27 to 32 in number, and some individuals holding 1 spine between two dorsals. Furthermore, some specimens having the large spines, which never extend to the insertion of 1st dorsal being gently reduced in their size. In other one holding a row of the spines running continuously from the nuchal to caudal series, but mostly, 2-4 nuchal spines (range, 0-4) set in a row which isolated from the caudal series.

It is interesting to note the finding of many prickles on the dorsal surface in young stage, but they disappearing or the surface is almost

smooth in the adult as already mentioned in the holotype (*vide*, Fig. 3 A, C) and furthermore, such phenomenon of difference in the spination with growth of the fish is also notified to exist in the case of *B. diplotaenia*, which will be recorded later on.

Coloration in young stage somewhat differing from that of the adult by having heavy plum colour in dorsal surface and also marginal portion of under surface, and having the rest of colorless excepting the several faint blotches in the regions of nasal pores and gill slits (Pl. 1 C).

The proportional measurements of the bodily parts of the present species, which seem important to the clear identification from the related species are shown in Table 2.

Table 2. Proportional measurements in *Breviraja matsubarai* including both holotype and paratypes. Items in parenthesis for number of specimens.

Items	Holotype	Paratypes	
		Male (8)	Female (10)
In total length:			
Disc length	2.15	2.01—2.25	2.04—2.20
Disc width	1.64	1.53—1.82	1.54—1.77
Tail length	1.79	1.66—1.86	1.61—1.83
In disc length:			
Precaudal length	1.09	1.04—1.20	1.04—1.20
Mouth to cloaca	1.35	1.35—1.56	1.32—1.70
Head length	2.01	1.84—1.95	1.81—1.98
In head length:			
Snout length	2.83	2.26—2.60	2.08—2.55
1st dorsal length	3.84	4.22—5.00	3.88—4.70
2nd dorsal length	4.03	4.40—5.22	4.14—4.95
In snout length:			
Interorbital space	2.02	2.36—3.14	2.35—3.43

Egg-capsule moderate size, belonging *Isotrachys*-subtype. Namely, general feature of the own capsule just likes as that of *B. isotrachys* or the related species giving velvety texture with longer prickles on the entire surface (*cf.* ISHIYAMA, 1950, p. 32-33) but adhering the strong fibroid hair, by which the entire surface of the capsule is covered (Fig. 3 E). Length 105mm, width 55mm, anterior and posterior horns ca. 95, 60mm respectively.

It should be mentioned that, such peculiar surface of the capsule in this species as mentioned above must be the modification of *Isotrachys*-type, so as being adapted to the niche in the deep-sea. It is believed, therefore, that the egg-capsule with such features as is the case with this species is thought to be specialized than those having the prickled surface, such as *B. isotrachys* and *B. diplotaenia*, etc.

Habitat :—This species are captured by motor-trawlers or the log-lines in the deeps from off Hokkaido and northern Japan proper along the Pacific (see Table 1.), the depth of the capture is greater than those of any other species of our skates. It attains at maturity at a total length of about 1200 mm. The spawning presumably be taken place mainly from the winter to spring.

Remarks: This species somewhat resembles North American deep-sea skate, *Raja abyssicola* GILBERT and THOBURN, 1896, but differs apparently from this related species by having any long close-set slender bristle-like spines on upper and lower surfaces in no case, and moreover very shorter snout instead of being longer in the latter.

Our specimens thus far examined are closely related to *Raja trachura* GILBERT, a North Pacific deep-sea form, but may be sharply defined from the latter in having 1) longer disc (the length 1.15 times into disc width in the latter), 2) longer tail (tail is longer than disc by a length equal to snout length in the latter), and 3) entire dorsal surface is mostly smooth in adult instead of being prickly in the latter as compared with the description of the similar sized specimen.

Breviraja diplotaenia *) , sp. nov.

Pl. 2, Text-fig. 5

Raja diplotaenia ISHIYAMA, 1950, p. 30, fig. 1,2 (egg-capsule), Muroran.

Holotype.—No. 10886 (850mm, ♂, Pl. 2 A, Fig. 5 A), off Erimo Peninsula, Hokkaido, Oct. 18, 1948

Paratypes.—31 specimens **) (407-850 mm, Pl. 2), off Kushiro to Chōsi, Oct., 1948 and May to June, 1951; deep-seas.

Description: Disc length 2.03, width 1.46 and tail 1.80 into total length. Head 1.99, snout 4.19 and precaudal length 1.19 into disc length, which is 1.66 into disc width. Snout 2.10, length of 1st, 2nd and caudal fins 3.50, 3.62 and 5.25 into head respectively. Interorbital space 3.23, diameter of eye 2.85 into snout.

External:—Body very flat, generally thinner than in related forms. Disc very broad, much wider either than length of tail or than length

* From the Greek, *diplo*, double, and *taenia*, band or ribbon, ventral fin divide into double ribbons.

** Of these, 2 specimens were collected by Dr. K. MATSUBARA from the same regions.

of disc, 1.23 times as great as the former; anterior oblique margin of disc nearly straight, being slightly convex in the anterior lateral margins opposed orbits. Snout rather long, flat and acute, with somewhat obvious notches near the distal portion. Interorbital space flat, but slightly convex along the median line, broader than eye-diameter; spiracle large, almost as long as eye in diameter, directing forward and slightly outward. Tail slender rod-like in shape, precaudal 1.66 into disc width, and procaudal 1.73 into head. Two dorsals conspicuously large, terminated together, and similar in shape, but the 1st slightly larger than the 2nd in their oblique length; caudal fin small, being reduced into a low fold, projecting posteriorly beyond the terminal of the vertebral axis. Ventral fin peculiar, strongly notched, dividing two clear lobes, *) and the anterior lobe falciformed, directing backward and forward; length of ventral incision 1.35 into snout. Clasper large, shaping the rod-like, 2.40 and 2.70 times as long as the length of disc and tail respectively. Dermal folds along sides of the tail starting near the posterior one-third of the tail, becoming very broad posteriorly, the broadest part opposed the posterior end of base of the 2nd dorsal fin (Fig. 5 A).

Internal: - Rostral cartilage long, tapering in shape; the wing rather short and narrow, about one-third as long as the rostral cartilage. The nasal capsule very large, distending anteriorly. Anterior fontanelle very large, characteristic in form, being boat-shape with truncated base, but posterior one slender, the anterior half is constricted and the rear end is pointed. Foramen for superficial ophthalmicus nerve very large, and ovoid in general form (Fig. 5 B).

Vertebral counts, 33 to 35 + 70 to 73.

Turns of intestinal valve, 10 to 11.

Spination: - Body almost smooth in the main region of dorsal surface of disc, with exceptions of marginal regions and also mid-belt of disc being sparsely prickled from the anterior portion of eyes rearward to interorbital space, then running backward and connect with the band of denser prickles of tail. Skin over eye and ventral fins without prickles. Nuchal and scapular spines absent. Tail thorny with numerous prickles, forming clear characteristic thorny band together with that of the mid-belt of disc. A median row of 25 large spines with broad base running the median line of dorsal border of tail being originated at the

* This characteristic feature was taken into the specific name.

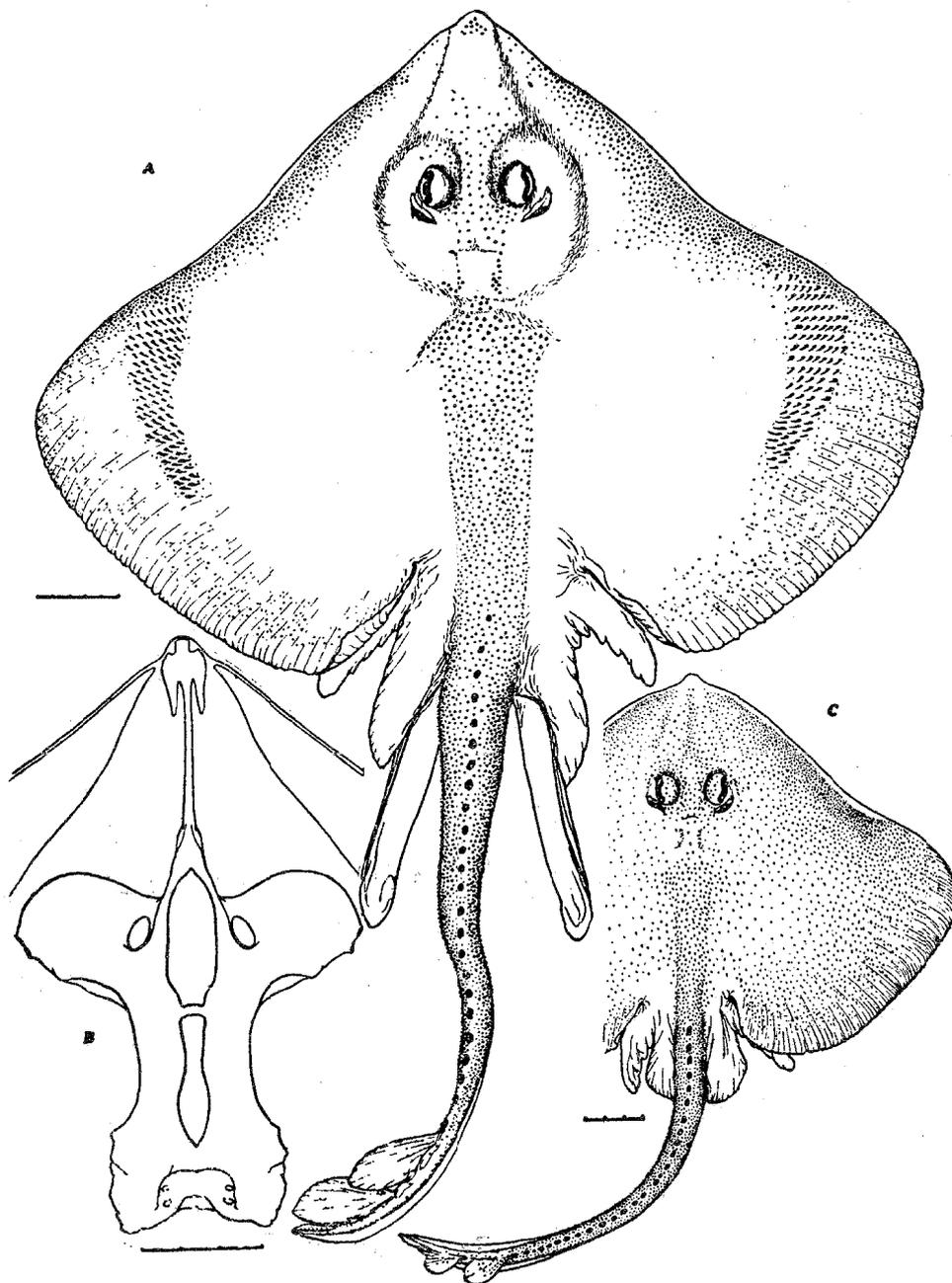


Fig. 5. *Breviraja diplotaenia*, sp. nov. A, holotype; B, cranium and rostral cartilage, and C, young male, total length 409 mm. Especially showing the deep notch of vential fin and the dermal fold along the side of tail in A and C, and the difference in spinations on dorsal surface in C against A. Magnifications are same as in Fig. 3.

opposite with the cloaca, but without spine between two, which are sparsely prickled together with caudal fin. Alar spines broadly developed in 22 (in left side), 23 (in right) rows, 8 spines in a row for the widest series. Under surface smooth with an exception of spination in the very small area at the tip of snout.

Coloration:—In life prior to preservation, uniformly faint rosy, but dark chocolate in formalin, on dorsal surface; inner margin of eye fainter; clasper and posterior lobe of ventral fin darker, but colorless in anterior lobe. Under surface colorless, excepting latero-posterior margin of disc and posterior lobe of ventral fin, which are faint purple; cloaca edged with a band of dark brown, and chocolate color the tail.

Supplementally notes with paratypes: Proportionate measurements of bodily parts notified by the following Table:

Table 3. Proportional measurements in *Breviraja diplotaenia* including both holotype and paratypes. Items in parenthesis for number of specimens.

Items	Holotype	Paratypes	
		Male (15)	Female (16)
In total length:			
Disc length	2.03	2.01—2.16	1.95—2.14
Disc width	1.46	1.41—1.66	1.42—1.55
Tail length	1.80	1.70—1.81	1.73—1.84
In disc length:			
Head length	1.99	1.85—1.98	1.86—1.98
Snout length	4.19	3.67—4.50	3.60—3.97
Precaudal length	1.19	1.10—1.22	1.07—1.26
In head length:			
1st dorsal length	3.50	3.52—4.00	3.65—4.33
2nd dorsal length	3.62	2.81—4.72	3.76—4.52
Caudal length	5.25	4.25—7.85	4.70—10.09
In snout length:			
Eye-diameter	3.85	3.04—3.91	3.18—4.24
Interorbital space	3.23	2.86—4.19	2.86—3.94
Length of ventral incision	1.35	1.22—1.55	1.36—1.84

As in the general cases within the rajids, proportional length of tail larger in young than in adults in some degree, and precaudal assigned more stable character in proportion than precaudal one. Distance between dorsals varying in great extent, but they usually closed together. Proportional length of snout varies in accordance with sex and age in some measure, *viz.*, larger in females than in males, and also larger in young than in adults. Interorbital space apparently larger than diameter of eye in adult, but larger the latter in young stage inverting the relations in their proportions when the fish being attained about 500 to

600 mm in total length.

The gradual disappearance in the spination with growth of the fish in dorsal surface was also notified in this species as aforerecorded in *B. matsubarai*, (Fig. 5 A, C).

Egg-capsule, *Isotrachys*-type (ISHIYAMA, 1950).

Habitat: - Deep-seas, from off Choshi to Kushiro (Table 1); attains at maturity at a total length of about 900 mm. The spawning may be last from the late of autumn to the winter.

Remarks: The present species resembles in general *Cruriraja poeyi* BIGELOW and SCHROEDER 1948, but make it separable at a glance from the latter by having deeply notched ventral fin, instead of complete separation of anterior lobe from the posterior one in the latter.

Further, the species is closely related to *B. abasiriensis*, which will be recorded in this paper as new to science, but it will be distinguished from the latter and the allied members included in the genus *Breviraja* by having much deeply notched ventral fin. And, it may be also notified that present species was captured in the northern Pacific of Honsyu; on the contrally, *B. abasiriensis* appears to be restricted to the Okhotsk Sea.

Of this species the present author merely given the characteristics of the egg-capsule provisionally under the name of *Raja diplotaenia* (1951: p. 30). It goes without saying that species should be included to genus *Breviraja* at least by having the diagnostic feature of the rostral cartilage of the genus.

Breviraja abasiriensis *) , sp. nov.

Pl. 3, Text-fig. 6

Holotype.—No. 16000 (715 mm, ♂; Pl. 3 A, Fig. 6 A), off Abasiri, Okhotsk Sea; June 5, 1951.

Paratypes.—9 specimens (622-714 mm, Pl. 3 B), offing from Abasiri to Monbetsu, Oct., 1948 and May to June, 1951; rather deep-seas.

Description: Disc very flat and much limp in fresh, the length 1.92, the width 1.43, tail 1.83 into total length. Head 1.85, snout 4.18, precaudal 1.16 and distance between tip of upper jaw and cloaca 1.55 into disc length. Snout 2.26, 1st, 2nd dorsal and caudal fins, 5.03, 5.15

* Abasiri, one of the city in northern Hokkaido that lies on the coast of the Okhotsk Sea, where the mostly specimens of this species were gathered.

and 10.05 into head respectively. Interorbital space 3.71 and eye-diameter 3.56 into snout.

External: — Body with broad disc and very soft snout; disc much broader than the long, the width 1.47 times as great as the latter. Anterior oblique margin of disc strongly undulated, convex in opposite margin of the eye, and deeply concave in posterior two-third portion. Snout acut, bluntly pointed with a pair indefinite small notchs near the tip. Interorbital space rather narrow, weakly concave, nearly as broad as the eye-diameter of that of spiracle. Tail rather long and flat dorso-ventrally in cross section, 1.23 times into disc width. Ventral fin moderate, obviously notched the anterior lobe broad. Two dorsals somewhat large, terminated together, 2nd dorsal a little smaller than the 1st, being inserted small interspace between them. Caudal fin rudimentally, overlapped by the lobe of 2nd dorsal, procaudal length 2.87 times into head. Clasper rather long and stiff in touch, extending half to tip of tail exclusive of caudal fin. Lateral fold of tail broader posteriorly, the origin opposite to tip of clasper.

Internal:—Rostral cartilage rather slender, but shorter than length of the cranium; the wing very short, measuring about one-third the length of the rostral cartilage. Nasal capsules slightly domed anteriorly on both sides; anterior fontanelle large, elongating into a spoon-like in shape and the posterior one-fourth is moderately constricted; posterior fontanelle rather broad, gradually becoming narrower toward the middle, and pointed at the rear end. Foramen for superficial ophthalmicus nerve very small, and roundish in shape.

Vertebral counts; 33 to 34 + 66 to 68.

Turns of intestinal valve; 8.

Spination: — Disc weak and sparsely prickled with the exception of marginal, mid-belt and orbital regions, where the disc rather strongly armed. Prickles in orbital region largest in those of the supraorbital rim. Marginal region of the disc armed densely with prickles, the armature beginning from opposite of eye and extends rearward to near the base of the ventral. Prickles in the mid-belt of disc extend rearward from the portion opposite to the anterior vertebral-plate and jointed posteriorly with caudal band of prickles. A patch of smooth area is found to exist before the beginning of the armature of mid-belt and immediately behind the spiracle. Posterior portion of disc margined with smooth space. Skin

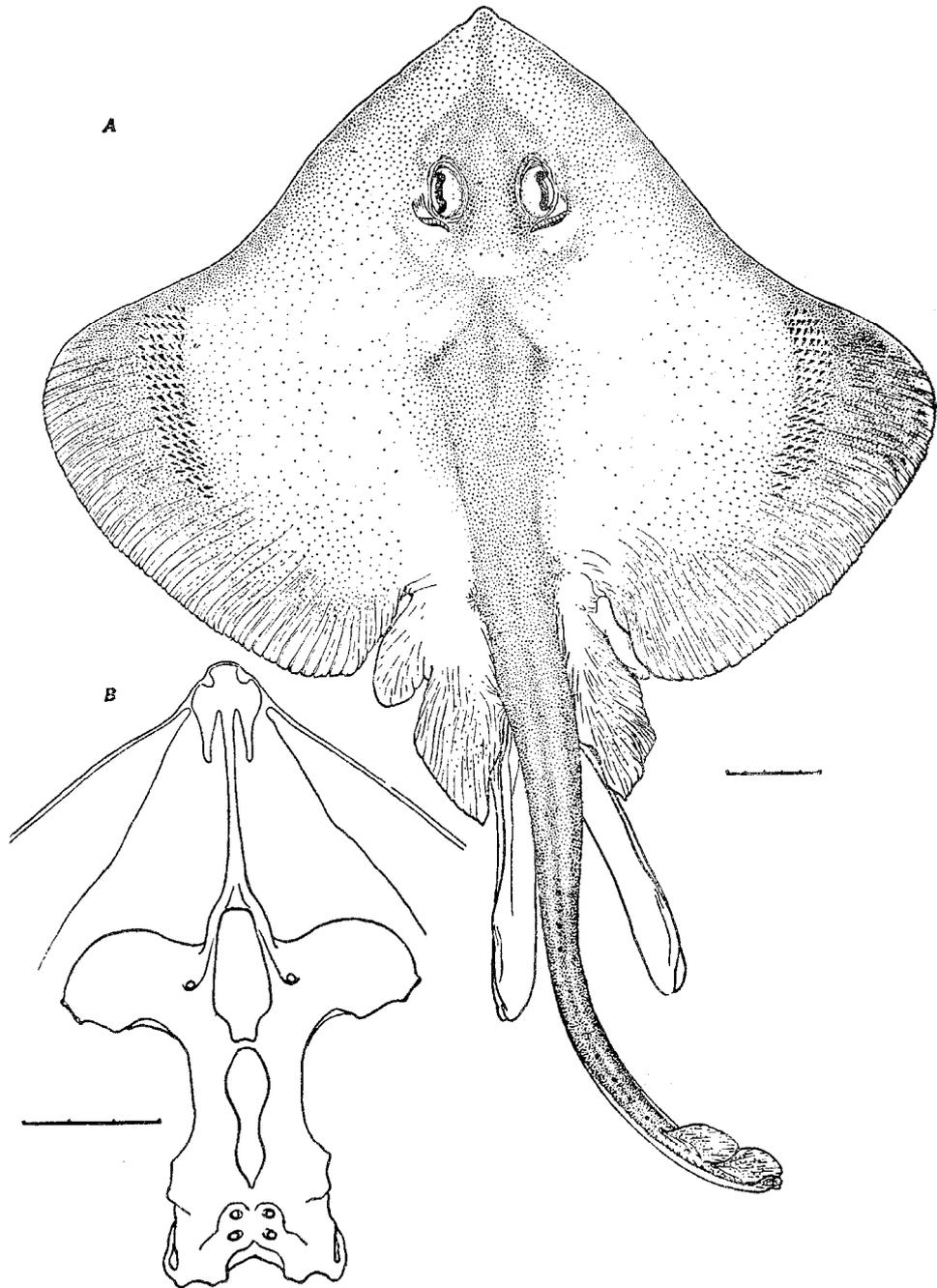


Fig. 6. *Breviraja abasiriensis*, sp. nov. A, holotype; B, cranium and rostral cartilage. Magnification are denoted by the same method as in Fig. 3.

covering eye poorly armed with very small prickles. Anterior lobe of ventral unarmed, but the central part of the lobe weakly prickled. Dorsal surface of tail entirely prickled, being slightly larger along lower lateral side. Without any large spines at nuchal or shoulder regions, but somewhat enlarged ones developed at places in a single series on tail, arising near the anterior one-third of the tail and ending near the insertion of the 1st dorsal. Under surface smooth, excepting the extremity of snout.

Coloration: - Color patterns on dorsal surface are characteristic, giving a clear diagnostic identification of the species (See Pl. 3), although usually more or less variable in their distribution. Greyish brown in base coloration bearing the many dark brown patterns with irregular shape on dorsal border of disc; the base color on mid-belt, posterior lobe of ventral, dorsal surface of clasper and tail are darker. Similar, but indefinite several dark bands crossing the dorsal surface of tail. Supra-orbital rim fainter, and anterior lobe of ventral markedly edged with white. Under surface colorless with the exceptions of dark greyish margin of cloaca, plumbeous posterior lobe of ventral, and the greyish brown tail.

Supplementary notes with paratypes: The proportionate lengths of tail and snout show the short differences by sexes. Namely, tail proportionally longer in male than in female, while the snout shorter in male than in female. Therefore, the ratios which introduced from these two parts against other dimensions of the bodily parts are caused to give rise more or less differences between two sexes. Accordingly, proportional measurements such as disc length and disc width against tail, snout against head, and interorbital space and diameter of eye against snout, all showed considerable sexual differences. The bodily parts other than mentioned above denoted rather proportionally stable between the sexes. 1st dorsal more or less larger than the 2nd, these are separating by a short space, but never jointed together with their bases, the space 24.3 to 93.0 times into head length; proportional length of caudal fin indicating rather stable values covering from 2.24 to 2.82 times into head length in adult specimens.

The modes of both arrangement and distribution of prickles on dorsal surface of the disc are similar as those of the holotype, although small individual variation being noticed to exist. Large spines developing along the median line of dorsal surface of tail, varying from 8 to

15 in number, being interrupted here and there, and reducing in size for either ends of the series.

Dimensions of the bodily parts which are thought to be useful for the identification of the species were tabulated as:

Table 4. Proportional measurements in *Breviraja abasiriensis* including both holotype and paratypes. Items in parenthesis for number of specimens.

Items	Holotype	Paratypes	
		Male (4)	Female (5)
In total length:			
Disc length	1.92	1.94—2.00	1.84—2.00
Disc width	1.43	1.41—1.57	1.46—1.56
Tail length	1.83	1.76—1.90	1.83—1.94
In disc length:			
Head length	1.85	1.79—1.90	1.91—1.97
Snout length	4.18	4.10—4.15	3.69—4.05
Procaudal length	1.16	1.12—1.20	1.14—1.36
In head length:			
1st dorsal length	5.03	4.25—4.83	4.70—5.60
2nd dorsal length	5.15	4.65—5.53	5.08—6.32
Precaudal length	2.87	2.24—2.78	2.30—2.80
Caudal length	10.05	8.58—13.30	7.48—9.00
In snout length:			
Interorbital space	3.71	3.36—3.50	3.68—4.23
Eye-diameter	3.56	3.40—3.62	3.72—3.88

Unfortunately, the young specimens and also egg-capsules of the present species were not available, but the speculation on the various characters of the species offers to remind us the egg-capsule should belong to *Isotrachys*-type.

Habitat: — This species may be northern form that being restricted to the Okhotsk Sea and the neighbourings^{*}), but very rare in the northern coast of Hokkaido.

Remarks: The present species resembles *Raja trachura* GILBERT, known from southern California, in general physiognomy, but it sharply differs from it in having 1) longer disc (1.22 to 1.40 in total length instead of being 1.50 in the latter), 2) weakly prickled disc instead of being sparsely and evenly covered with small, sharp prickles with stellate base in the latter, 3) prickled supraorbital rim (smooth, but a single small tubercular spine developing on nuchal and shoulder regions in the latter) and peculiar coloration, thus: upper surface of disc is

* Mr. T. DOMON, who had been passed as a fisherman in Sakkalin, said to the author as "this species is often trawled in the coast of Sakkalin, whereby it has been called as *Ijin kasube*", the foreign skate.

greyish brown furnished with many dark brown patterns with irregular shape (plum colour without any patterns in the latter); under surface colorless (brown in the latter).

Rhinoraja *), gen. nov.

External: — Body soft and flexible. Snout short and blunt. Tail very long and stout, longer than length of disc, bearing a row of large spines along the median line of the dorsal surface which armed with minute prickles. Nuchal, orbital and pectoral regions evenly prickled at least in the adult, but entire dorsal surface is thickly prickled in the young stage.

Internal: — Rostral cartilage with a segment, and other characters are essentially the same as in the genus *Breviraja* described in the foregoing chapter.

Vertebral counts; 30 to 37 + 74 to 82.

Turns of intestinal valve; 8 to 10.

Type species: *Raja kujiensis* TANAKA

In 1916 TANAKA erected a new species, *Raja kujiensis* (in Japanese), from Kuji, Ibaragi Prefecture. Besides this, in 1927 the same author erroneously described a new rajid, *Raja tobae*, that have been preoccupied by his another species from Toba, Mie Prefecture (1916) (in Japanese), and later, he gave a new name, *Raja karagea* for the species described in 1927.

Since my careful study on the figures and descriptions recorded by TANAKA in 1916 and 1927 mentioned above being compared to my specimens involving various size of the fish, I inclined to think that *R. kujiensis* and *R. karagea* are synonymous, in that case the former has priority cover *karagea*. To quate example, the spination on dorsal surface which scarcely serve for separating these two species of TANAKA should goes to sexual dimorphisms of the species as far as my investigation is concerned.

As already mentioned in the foregoing chapter, the genus *Breviraja* BIGELOW and SCHROEDER, which was emended by the author, is found quite identical with the type of the genus, which has a segment in the rostral cartilage, and it should be taken as a good generic character.

Hence, the creation of the new genus *Rhinoraja* is based on

* From the greek *rhino*, nose, *Rhinoraja*, *Raja* with peculiar projection in the rostrum.

Raja kujiensis of TANAKA 1916.

It may be thought that the new genus *Rhinoraja* very closely resembles *Breviraja*, besides, there is a monophyletic relationships through *Breviraja* to *Rhinoraja*.

Two species are referable to the new genus, of which one put as new to science as recorded later on.

In the landing by means of motor-trawlers, operating at the deeps along the Pacific coast off Chōsi to Kushiro, especially off Hachinohe and Muroran, these two species are rather common.

Rhinoraja longicauda, sp. nov.

Pl. 4, Text-fig. 7

Holotype.—No. 16737 (665 mm, ♂, Pl. 4, A, Fig. 7), offing from Hachinohe to Erimo Penninsula, May 23, 1951.

Paratypes.—25 specimens*) (305-688 mm, Pl. 4, B, C), offing from Chōsi to Kushiro, Oct., 1948 to June, 1951; deep-seas.

Description: Disc length 2.20, width 1.62 and tail 1.70 into total length. Head 1.97, snout 4.87, precaudal 0.93 into disc length, which is 1.27 into disc width. Snout 2.47, preoral length measured from upper margin of the teeth band in upper jaw to the tip of snout 2.38 and length of 1st and 2nd dorsal fins 3.64 and 3.82 into head respectively. Interorbital space 3.10 and diameter of eye 2.70 into snout.

External: — Body with robust appearance; disc broad, strongly undulated in the anterior oblique margins as in other species; the width almost equal to the length of tail, which is much longer than length of disc. Snout very short and rather pointed; interorbital space moderate in breadth and shallowly concave; eye large, the diameter contains 1.15 times in interorbital space; spiracle broadly opened, directing outward and foreward, the oblique length almost as great as the interorbital width. Tail very long, stout and somewhat flattened dorso-ventrally, the length 1.05 precaudal 1.27 into disc width respectively. Dorsals rather small, terminated in close together at the posterior portion of tail; interspace between them 51.0 into head; caudal fin very small, 4.76 times in snout. Clasper very slender, the length 2.90 times into tail; dermal fold along sides of tail very broad posteriorly, arising near the midway between base of clasper and end of the tail, the maximum

breadth almost equal to longitudinal diameter of the pupil, setting up in opposition between origin of both 1st and 2nd dorsal fins. Ventral fin moderately notched and the anterior lobe somewhat falciformed, ventral incision 3.73 times into head.

Internal: - Rostral cartilage very feebly elongated, and having a segment at the posterior one-third of the cartilage; rostral appendix wide but short, hanging posteriorly, scarcely in contact with anterior extremity of pectoral radialis in two sides. Olfactory capsules expanding bilaterally with horizontal anterior margins. Anterior fontanelle large, rectangular in shape, becoming narrower anteriorly, but posterior one very long and narrowed in two portions, and the posterior end pointed. Foramen for superficial ophthalmicus nerve large and ovoid in general appearance.

Vertebral counts; 30 to 33 + 74 to 81.

Turns of intestinal valve; 8 to 9.

Coloration: - In fresh prior to preservation, purplish grey in base color with indefinite darkish brown patterns or spots on dorsal surface, but these markings disappear soon after the fish is put in formalin solution or as time goes on after landing, and base color change into greyish brown or purplish brown. A distinct triangular white crest as large as spiracle occurring in front margin of the eye-ball, directing forward. Under surface white, excepting posterior oblique margin of disc and ventral fin and tail, all of which are faint purplish brown; a narrow band of dusky color edged cloaca.

Spination: - Entire surface armed with rather large but spiny prickles setting on the stellate base, they are numerous along anterior margin of disc and interorbital region in connection with the mid-belt of spination, but somewhat sparsely in the main portion of pectoral, behind of spiracle and over gill chamber; skin covering eye and two dorsals prickled, but very fewer or none on posterior lobe of ventral, and nothing on anterior one as well as on the ventral surface of disc. A very large spines setting as nuchal one, and the same of 22 in a row running along the median line of the tail arising at the opposite portion of cloaca; none of shoulder spine. Interspace between dorsals naked; 18 rows of the backler spines, 7 spines in broadest row, on pectorals. Tail densely prickled above and sides, the prickles becoming smaller and denser toward lower lateral portion.

Supplementary notes with paratypes: Dimensional characters of the bodily parts described with holotype are essentially the same as those in the paratypes, although the variations in some extent are noticed to exist in accordance within either ages or sexes of the fish. Proportional lengths of caudal fin and interspace between dorsals show so large variations that these characters could not be taken as the specific constants. Further, the dimensional relationships between eye-diameter and snout length in the youngs, denoting more or less smaller than in the adults, especially these phenomenon notified in the female. Degree of undulation in anterior oblique margin of disc scarcely be seen or merely rounded anteriorly in both female and young. Variation in number of nuchal spine is large, covering 1 to 4, but 3 in most cases. Caudal spines running in a series, numbering 18 to 28, but 21 to 23 in most cases. These large spines apparently being developed still in young stage, wherefore the character may serve for the identification from other related species.

Coloration on dorsal border of the disc is fundamentally the same as in the holotype, but the patterns indistinct in young. The white crest in front of eye having neither in female nor in the young.

Proportional measurements of bodily parts which enable us to identify the present species from other related ones are shown in Table 5.

Table 5. Proportional measurements in *Rhinoraja longicauda* including both holotype and paratypes. Items in parenthesis for number of specimens.

Items	Holotype	Paratypes	
		Male (10)	Female (15)
In total length:			
Disc length	2.20	2.18—2.30	2.23—2.32
Disc width	1.62	1.62—1.77	1.73—1.89
Tail length	1.70	1.66—1.76	1.61—1.77
In disc width:			
Precaudal length	0.96	0.90—0.97	0.88—0.95
In disc length:			
Head length	1.97	1.89—1.98	1.89—2.01
Mouth to cloaca	1.44	1.33—1.59	1.35—1.53
In head length:			
Snout length	2.47	2.33—2.56	2.21—2.52
Preoral length	2.33	2.10—2.44	1.95—2.33
1st dorsal length	3.64	3.53—4.60	2.02—4.96
2nd dorsal length	3.82	3.83—4.79	3.88—5.95
Caudal fin length	11.75	7.25—10.63	5.80—11.70
In snout length:			
Diameter of eye	2.70	2.18—2.90	1.93—2.90
Interorbital space	3.10	2.90—3.62	2.94—3.56
In eye-diameter: Spiracle	1.10	1.69—1.33	1.17—1.60

Egg-capsule rather small, possessing intermediate feature between

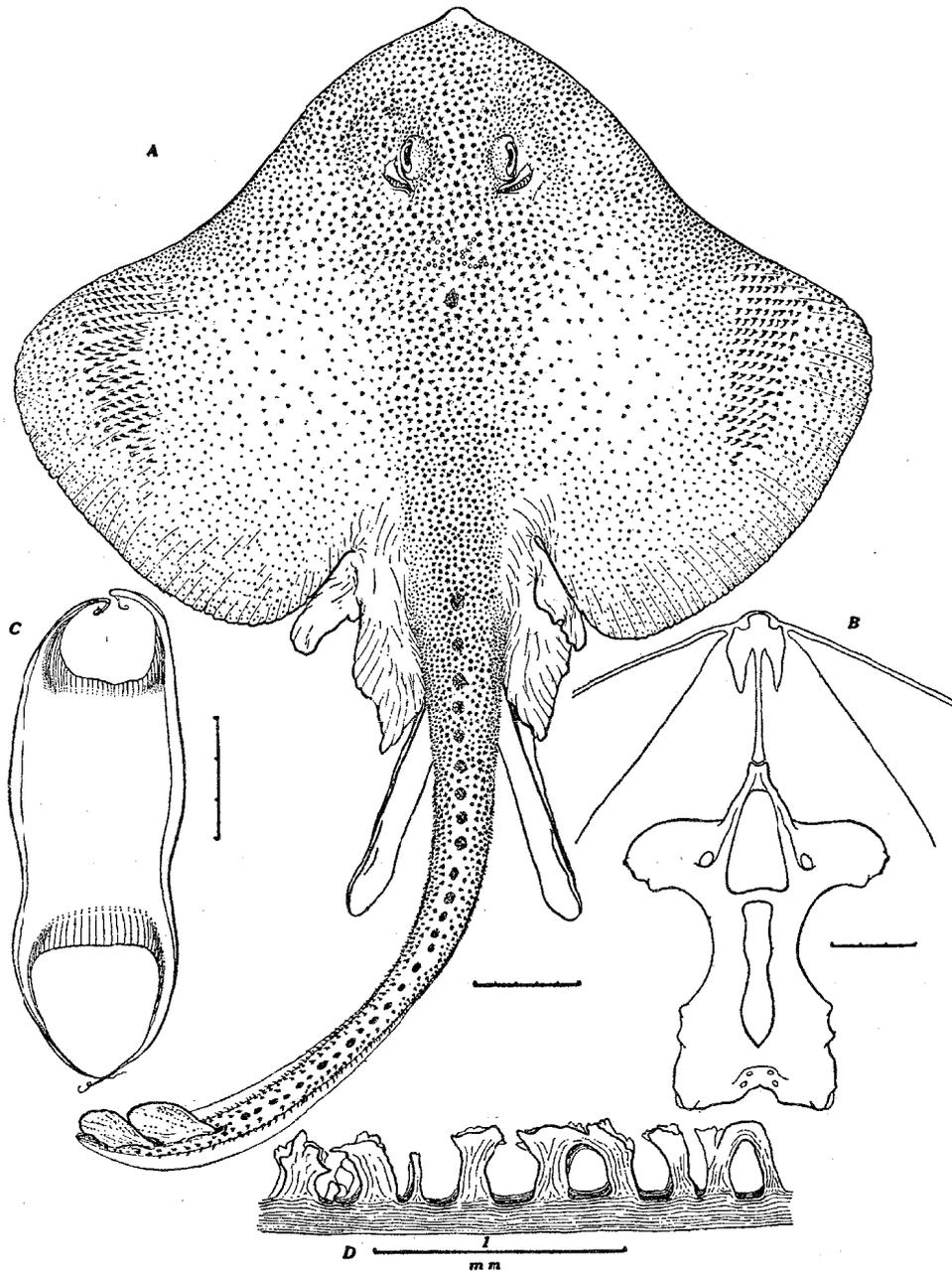


Fig. 7. *Rhinoraja longicauda*, sp. nov. A, holotype; B, cranium and rostral cartilage; C, egg-capsule; D, cross section of the capsule. Especially showing the distribution of both spines and prickles, and broad dermal folds along sides of tail in A, and also a segment of rostral cartilage in B. Magnificatons in all these fig's other than D are indicated by each scale as the same in Fig. 3.

Isotrachys and *Parmifera*-types, and therefore called herein *Isotrachys*-subtype for it, since the minute velvety prickles are seen between any stalked ridges which running lengthwise series, and the capsule bearing the long filamentous horn in each corner (Fig. 7 C, D). 3 pairs of the capsule were taken out from the females, measuring 587 to 620 mm in total length, which were captured from 350 to 450 fathoms deep. Measurement of the capsule are as follows; length 68 mm; width 46 mm; length of anterior and posterior horns, 43 and 32 mm respectively.

Habitat: - This species is probably distributed from Kusiro to Chōsi, (*Vide*, Table 1), where the fish were observed as rather common fish in the landings, especially being abundant at Hachinohe market in the spring, captured from 300 to 450 fath's deep. The fish may attain at maturity at a total length of 700 mm, and spawning may be taken place in the spring, inasmuch as the capsules were very often taken out from the females in this season.

Remarks: In general physiognomy the present species resembles *Rhinoraja kujiensis*, especially in the young stage, but distinguishable from it in following points: 1) nuchal spines are much fewer, numbering 1 to 4, mostly 3, and they are not continuous posteriorly with those of caudal ones (the spines are larger in number and continuous with those of the caudal ones in the latter), 2) shoulder spines are entirely absent (a pair of shoulder spines are always present in the latter), 3) eye and spiracle in adult are smaller, and 4) precaudal longer than disc length (almost equal in the latter).

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PLATE I

PLATE 1

Breviraja matsubarae ISEIYAMA, sp. nov.

Fig. A. Ventral view of holotype.

// B. Adult female, measuring 1105 mm.

// C. Young male, measuring 259 mm.

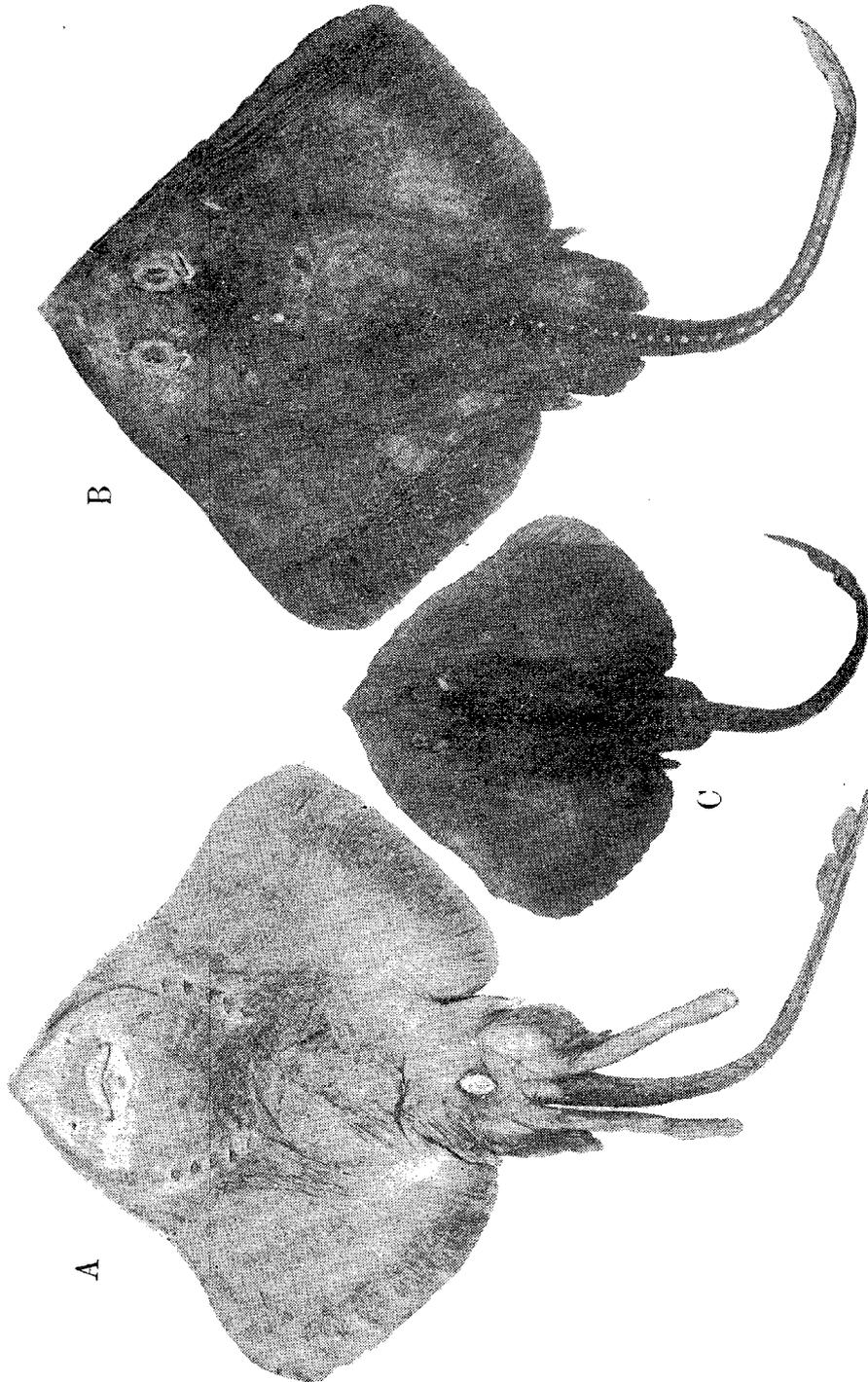


PLATE II

PLATE 2

Breviraja diplotaenia ISEIYAMA, sp. nov.

Fig. A. Ventral view of holotype.

// B. Adult female measuring 797 mm.

// C. Young male measuring 452 mm.

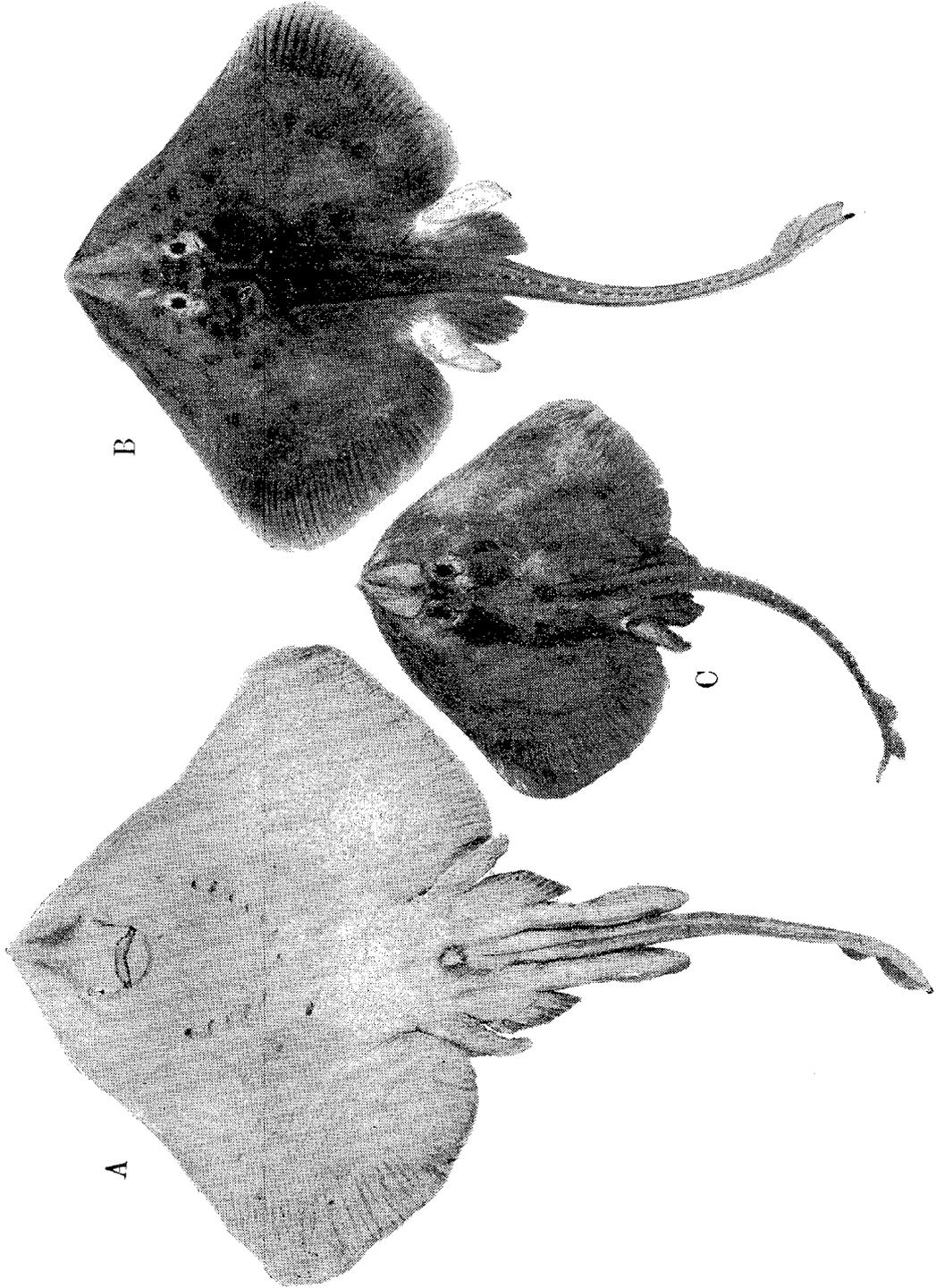


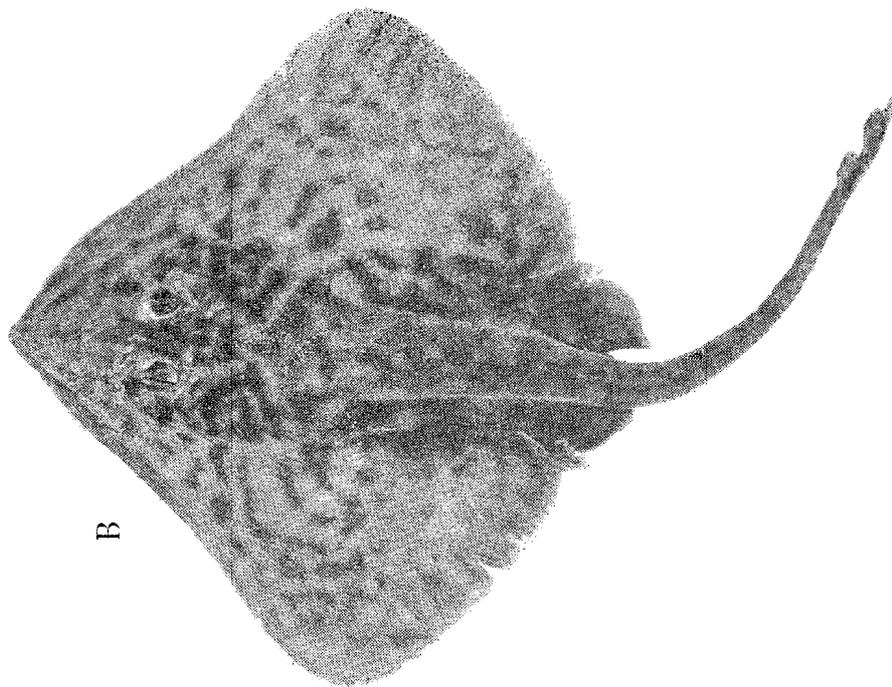
PLATE III

PLATE 3

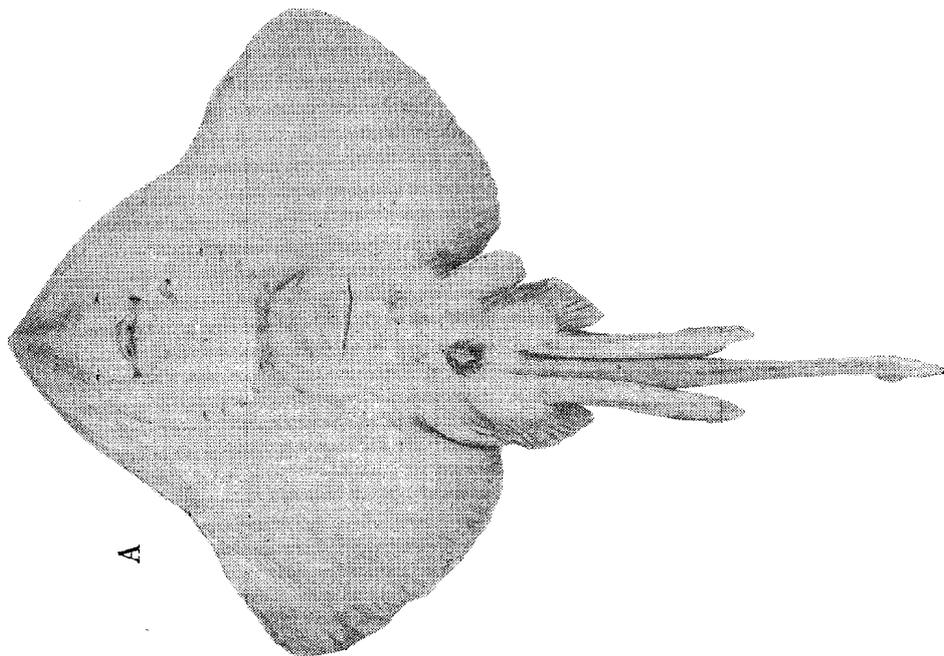
Breviraja abasiriensis ISHIYAMA, sp. nov.

Fig. A. Ventral view of holotype.

// B. Adult female measuring 712 mm.



B



A

PLATE III

PLATE 4

Rhinoraja longicauda ISHIYAMA, sp. nov.

Fig. A. Ventral view of holotype

// B. Adult female measuring 602 mm.

// C. Young male measuring 490 mm.

