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A PRELIMINARY SYSTEMATIC STUDY OF THE PHILIPPINE CHUB MACKERELS, FAMILY SCOMBRIDÆ GENERA PNEUMATOPHORUS AND RASTRELLIGER.

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ELEVEN TEXT FIGURES

INTRODUCTION

The chub mackerels constitute one of the important groups of fishes of the pelagic-neretic fisheries of the Philippines. They rank second to the anchovies with an annual average catch of about 4,500 tons (1949-1953) valued at no less than five million pesos¹ to the fishermen. Most of the catch is disposed off fresh or iced. The rest are smoked and split, salted and dried. Prior to World War II some experimental and semicommercial canning of the fish was undertaken by the government in Estancia, Iloilo Province. A small private canning plant in Catbalogan, Samar Province, has since 1949 been canning chub mackerel and other commercial species.

The genera *Pneumatophorus* and *Rastrelliger*, which comprise the stock of the commercial chub mackerel fishery in the Philippines, need systematic revision on a world-wide basis. Unfortunately, however, on account of inadequate library facilities and incomplete reference collection no attempt is made here to clarify some of the confused taxonomic relationship of the group. It is hoped, however, that the keys, diagnosis and comments presented in this paper will serve to identify the different species of chub mackerels entering the commercial fishery in Philippine waters. In order to avoid chaos and confusion on

¹ One peso is equivalent to \$0.50 U.S. currency.

the nomenclature of the Philippine chub mackerels, the names of the genera and species as used by Herre (1953) in his checklist have been retained for convenience and guidance purposes.

The present study was undertaken in May, 1949 and pursued at various intervals with other fishery research projects until December, 1952. The present paper is based mainly on materials collected personally by the writer, including those gathered by Messrs. Sixto V. Laron and Carlos Francisco of the same office. Part of the materials also used in this study was those collected by various fieldmen of the defunct Philippine Fishery Program of the United States Fish and Wildlife Service.²

The present paper deals with the description of two distinct species of *Rastrelliger* and two of *Pneumatophorus* with some notes on their juvenile forms.

Key to the genera of Philippine chub mackerel, family Scombridae.

1. Body elongated and fusiform, vomer and palatines toothed or showing indications of dental vestiges, gill rakers short and thorny, barely visible from gape of mouth, scales very small, lateral line scale, 153 to 189. *Pneumatophorus*.
2. Body deep and compressed, vomer and palatines toothless, gill rakers very long and numerous, visible from gape of the mouth like "feathers", interspinous bones of second dorsal and anal are flattened. Scales moderately small, lateral scales, 120 to 142 *Rastrelliger*.

Key to the Philippine species of Pneumatophorus Jordan and Gilbert.

1. Height 4.07 to 4.14 in body length; 4.56 to 4.82 in total length; lateral line scales about 155; body somewhat compressed. Anal spine very feeble and attached to fin. 1. *Pneumatophorus australasicus*.
2. Height 5.25 to 5.52 in body length; 5.94 to 6.40 in total length; lateral line scales about 180; body more or less rounded. Anal spine short but strong and free from fin. 2. *Pneumatophorus japonicus*.

PNEUMATOPHORUS (SCOMBER) AUSTRALASICUS (Cuvier and Valenciennes).

Text figs. 2-3.

Scomber australasicus CUVIER & VALENCIENNES, Hist. Nat. Poissons 8 (1851) 49.

Scomber australasicus GÜNTHER, Cat. Brit. Mus. 2 (1860) 359.

Scomber australasicus CUVIER & VALENCIENNES, The Fishes of the Indo-Australian Archipelago 9 (1951) 206, fig. 35.

Australian scomber; *Lumahang bato*; *sibobog*.

D¹ VIII-X (mostly X); D² 7-12 (mostly 12) + 5; A. 1, 9-12 (mostly 12) + 5; P. I, 18; V. 1, 5. L¹ line scales about

² A part of the Philippine Rehabilitation Program authorized by the Philippine Rehabilitation Act of 1946, title 50, App. U. S. Code, Sec. 1788.



4.9 in total

Philippine chub mackerels, the names used by Herre (1953) in his check-convenience and guidance purposes. Undertaken in May, 1949 and pursued under fishery research projects until the present paper is based mainly on material gathered by the writer, including those gathered by Dr. Carlos Francisco of the University of the Philippines. The materials also used in this study were collected by the fishermen of the defunct Philippine United States Fish and Wildlife

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chub mackerel, family Scombridae.

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 vomeronasal palatines toothless, gill rakers very long, extending from gape of the mouth like "feathers", dorsal and anal are flattened. Scales small, 120 to 142. *Rastrelliger*.

Pneumatophorus Jordan and Gilbert.

Length; 4.56 to 4.82 in total length; lateral line somewhat compressed. Anal spine very short. *1. Pneumatophorus australasicus*.

Length; 5.94 to 6.40 in total length; lateral line more or less rounded. Anal spine short. *2. Pneumatophorus japonicus*.

AUSTRALASICUS (Cuvier and Valenciennes)

R & VALENCIENNES, Hist. Nat. Poissons

HERRE, Cat. Brit. Mus. 2 (1860) 359.

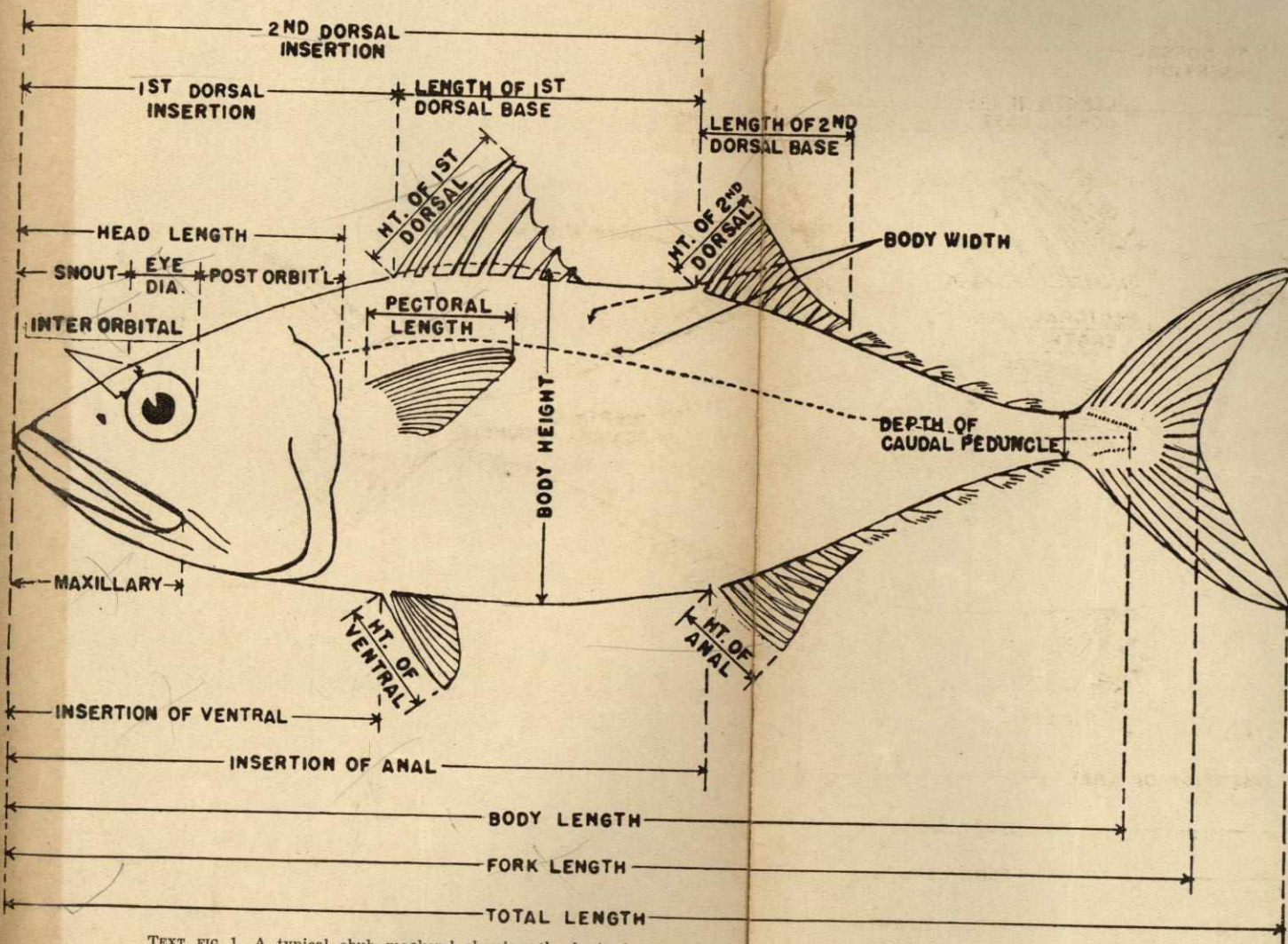
R & VALENCIENNES, The Fishes of the Philippines (1951) 206, fig. 35.

hang bato; sibobog.

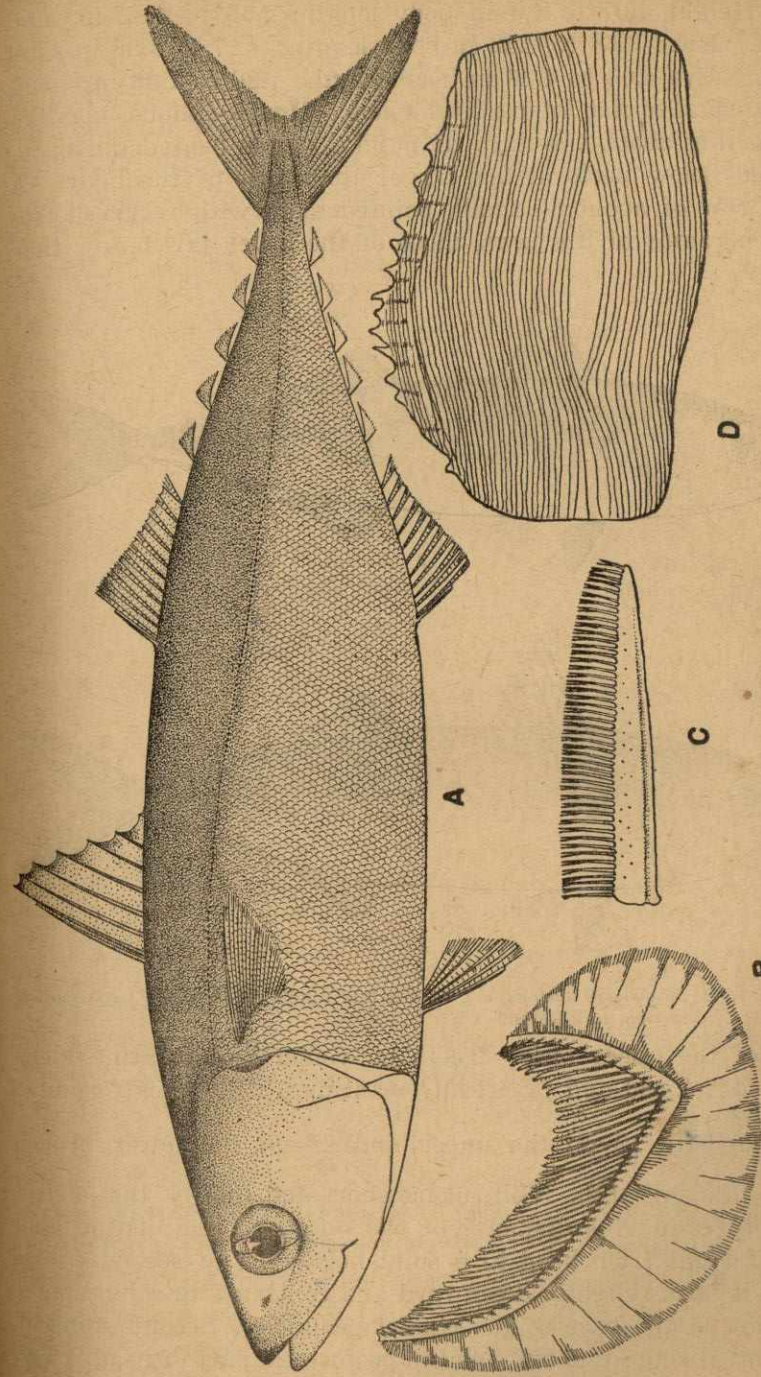
D^2 7-12 (mostly 12) + 5; A . 1, 18; V . 1, 5. L^1 line scales about

Rehabilitation Program authorized by the Department of the Interior, 1946, title 50, App. U. S. Code, Sec. 1782

PROPORTIONAL MEASUREMENT PROCEDURE

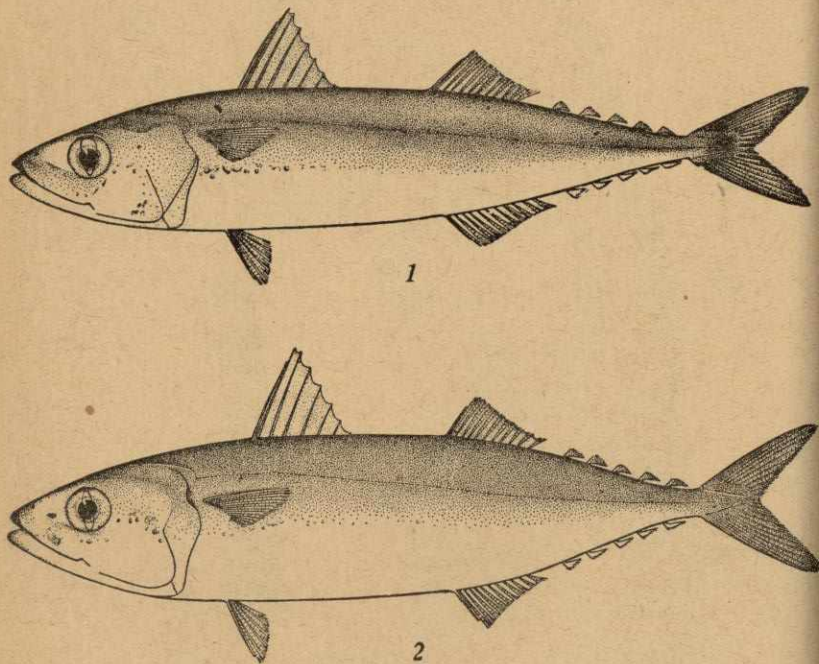


TEXT FIG 1. A typical chub mackerel showing the basis for proportional measurement procedure of the body; diagrammatic.



TEXT FIG. 2. The Australian chub mackerel, *Pseudomacropodus australasicus* (Cuv. & Val.).
 A, Adult, 190 mm fork length; B, first gill arch; C, longest gill raker;
 D, scale taken behind pectoral fin.

155. Height 4.07 to 4.4 in body length, 4.56 to 4.82 in total length. Head 3.68 to 3.82 in body length; 4.27 to 4.28 in total length. Eye 4.05 to 4.36 in head length; 1.20 to 1.36 in snout, almost equal to flat interorbital space. Mouth oblique, maxillary reaching about one-third of pupil. Scales behind gill opening and below pectoral fins larger than rest of the body. A single row of about 35 small, pointed teeth with recurved tips on each ramus of the jaws, those of the lower jaw larger than



TEXT FIG. 3. 1, Juvenile *P. australasicus*, 72 mm fork length; 2, juvenile *P. australasicus*, 158 mm fork length.

those of the upper ones. Teeth on vomer and palatines very poorly developed and practically wanting. Gill raker formula:

$\frac{12-15}{20.24}$ mostly 12 on the upper and 22 on the lower branch

of the first gill arch. Gill rakers short and thorny, the longest about three-fourths diameter of eye. Lateral line distinct and runs straight from head to a point below end of second dorsal where it bends slightly downward and continues in a horizontal direction to the base of the caudal peduncle. Second spine of first dorsal longest, about equal to postorbital part of head. The

last 9th or 10th spine minute, soft and almost vestigial, presumably disappearing in old age.³ Second dorsal fin falcate, the longest ray about as long as snout. Anal spine weak, flexible and attached to anal fin ray. Insertion of second dorsal almost above origin of anal. Pectoral pointed, equal to postorbital part of head. Dorsal and finlets, 5/5. Color of preserved specimens dark bluish above, silvery on sides and below. Anterior part of back with light bluish sinuous stripes. Margins of first dorsal, second dorsal, and caudal fins dusky. Anal, pectoral, and pelvic fins hyaline.

Described from 59 specimens, 120 to 205 mm. fork length, collected as follows: Nine from Manila Bay, Luzon, June 27, 1950; 50 from Coron Bay, northern Palawan, May 22, 1952.

NOTE: These specimens appear to conform with Dr. De Beaufort's recent description of the Indo-Australian species of *Scomber australasicus* in that the teeth on the palatines and vomer are almost wanting. Some roughness can be felt with a dissecting needle especially on the vomer. The feeble anal spine and the slightly compressed shape of the body make it very similar to *R. chrysozonus* (Rüppell). Moreover, the head and body proportions are quite characteristic of *R. chrysozonus*. But the moderately short gill rakers which are fairly visible when the mouth is opened, are characteristically scomberlike, and cannot possibly belong to *Rastrelliger*. The Philippine *Pneumatophorus* (*Scomber*) *australasicus* has a comparatively smaller number of gill rakers, being 12 to 15 on the upper and 20 to 24 on the lower branch of the first arch. As corroborated by Dr. De Beaufort, this species appears to be intermediate between *Rastrelliger* and *Pneumatophorus*. The Philippine species differs only in the fact that it has a proportionately shorter head and snout and smaller eyes compared with those of the specimens described by Dr. De Beaufort. These apparent regional differences in body proportions may possibly be raciation. It is possible that previous workers may have identified this species as *R. loo* or *R. micropelidotus*. The average size taken is about 180 mm. (120 gm.) and reaches a maximum of 200 mm. (150 gm.).

Frazer-Brunner (1950) in this review of the family Scombridae places *Scomber capensis australasicus* Cuvier and Valenciennes, a synonym of *Scomber japonicus* Houttuyn. In the Phil-

³ Noted also by Steindachner and Doderlein in *Scomber colias* from Japan as mentioned by de Beaufort.

TABLE 1.—The range for the species of *Pneumatophorus* and *Rastrelliger* in various body proportions. The minimum size of fish is shown in the first line and the maximum size in the second line of the table.

Body proportions	<i>Pneumatophorus australasicus</i>	<i>Pneumatophorus japonicus</i>	<i>Rastrelliger brachysoma</i>	<i>Rastrelliger chrysozonus</i>
Range in total length..... mm	173.50-205.00	160.00-190.00	174.00-222.00	216.00-303.00
Range in body length..... mm	149.00-183.00	138.00-190.00	150.00-183.00	202.00-255.00
Range in weight..... grams	45.50-75.00	38.00-63.80	71.00-121.80	153.00-330.00
Total length: body height.....	4.56-4.82	5.94-6.40	3.55-3.98	4.24-4.27
Total length: head length.....	4.27-4.28	3.81-3.92	3.89-4.08	3.79-3.96
Body length: body height.....	4.07-4.14	5.25-5.52	2.98-3.35	3.59-3.96
Body length: head length.....	3.68-3.82	3.82-3.47	3.24-3.45	3.34-3.56
Body length: insert first dorsal l.....	2.82-2.84	2.63-2.78	2.61-3.30	2.55-2.81
Body length: insert second dorsal.....	1.56-2.02	1.48-1.49	1.51-1.66	1.52-1.61
Body length: insert anal.....	1.57-2.02	1.45-1.45	1.50-1.58	1.50-1.55
Body length: insert ventral.....	3.24-3.39	2.85-2.98	2.66-3.20	2.81-2.97
Body length: first dorsal base.....	3.39-3.55	3.14-3.26	3.54-4.05	3.50-4.04
Body length: second dorsal base.....	5.63-5.90	7.26-7.82	5.72-6.70	6.37-6.61
Body length: pectoral.....	7.95-8.05	7.46-8.40	6.04-7.15	7.30-7.76
Body length: height first dorsal.....	6.55-8.27	6.72-6.90	5.02-6.04	6.07-6.62
Body length: height second dorsal.....	10.80-13.50	12.50-13.40	8.85-9.75	10.13-10.19
Body length: height anal.....	10.22-10.29	13.80-14.00	8.85-10.40	8.80-10.19
Body length: height ventral.....	8.76-9.15	8.62-10.40	7.70-8.10	8.88-9.40
Head length: body height.....	1.06-1.12	1.51-1.68	0.91-1.00	1.07-1.12
Head length: snout.....	3.20-3.37	2.89-2.94	3.22-3.67	2.94-3.17
Head length: maxillary.....	2.70-2.82	2.62-2.63	1.79-1.96	2.04-2.40
Head length: eye diameter.....	4.05-4.86	4.20-4.41	4.27-4.89	4.50-4.75
Head length: longest gill rakers.....	5.05-5.79	5.61-5.39	2.16-2.76	2.02-2.03
Head length: post orbital.....	2.08-2.09	2.10-2.94	1.83-2.12	1.96-2.06
Snout: eye.....	1.20-1.36	1.32-1.45	1.18-1.45	1.50-1.53
Snout: interorbital.....	1.26-1.36	1.81-1.82	1.15-1.37	1.37-1.53
Height: width of body.....	1.61-1.87	1.36-1.39	1.86-2.35	1.61-1.70

ippine material this does not appear to be so as will be noted in the following description.

The occurrence of this species is evidently the first record in the Philippines. It is occasionally taken with *Auxis* and *Decapterus* by fish corrals and purse seines. Some juvenile forms were recently collected in the haul of bag nets (*basnig*) in Manila Bay and approaches mixed with the young of *R. brachysoma*. In recent fishery survey, it appears that this species is being taken in fairly commercial quantities by fish corrals (*baklad*), bag nets and round haul seines (*sapiao*) from Tayabas Bay to the Southeast Coast of the Bicol Region and northern Palawan.

PNEUMATOPHORUS JAPONICUS Houttuyn. Text figs. 4-5.

Scomber japonicus HOUTTUYN, Verh. Holland, Maatsch, Wetenschapen HAARLEM 20 (1792) 331.

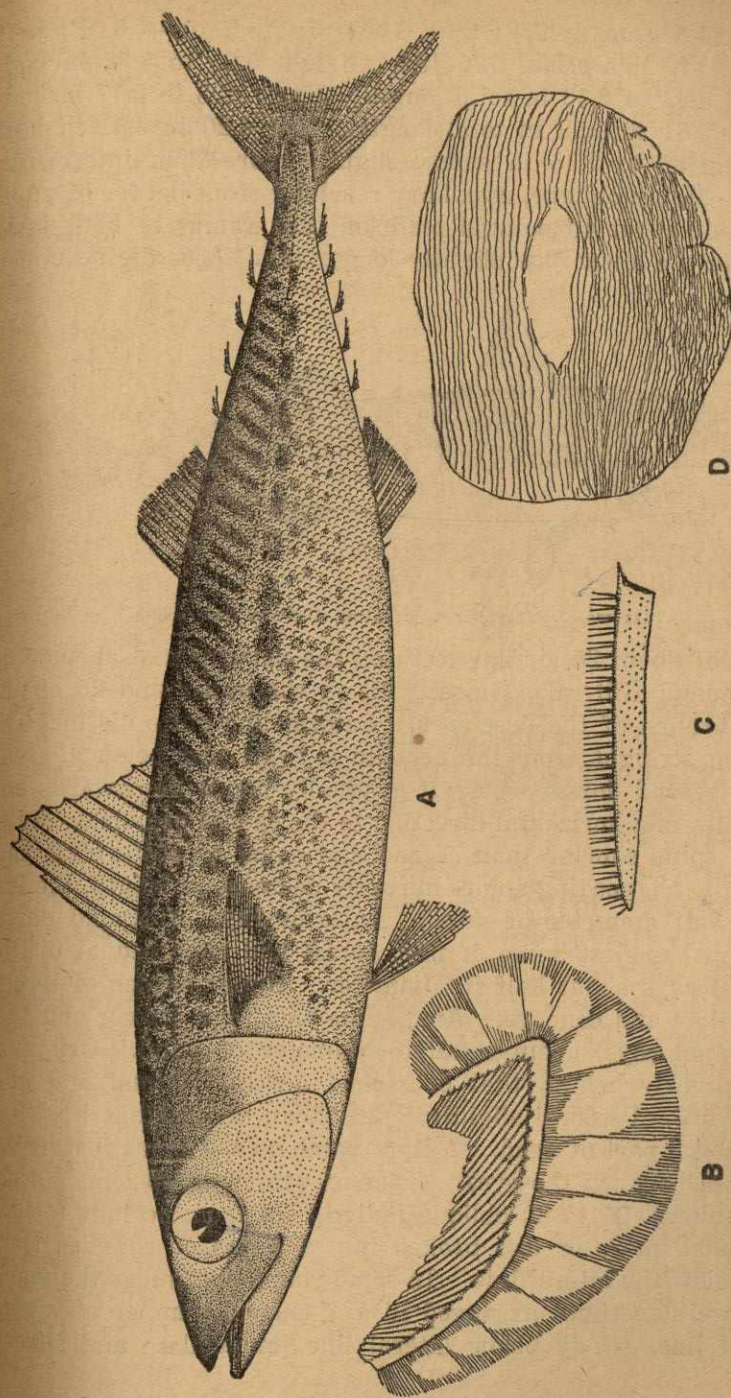
Scomber pneumatophorus japonicus, var. *minor* SCHLEGEL, Fauna Japonica, Pisces 1 (1842) 93.

Pneumatophorus japonicus JORDAN and JORDAN. Mem. Carnegie Mus. 10 (1922) 31.

Scomber japonicus KISHINOUE. Jour. Coll. Agri., Univ. Tokyo 1 (1923) 403 (portion).

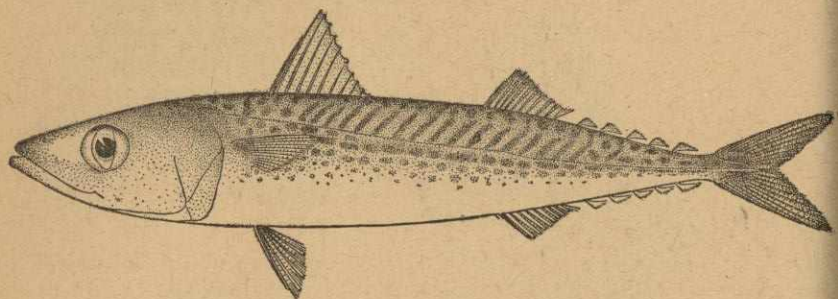
Pneumatophorus japonicus (Houttuyn).

Japanese mackerel; *alumahan*, *lumahan*.



TEXT FIG. 4. The Japanese chub mackerel *Pneumatophorus japonicus* (Houttuyn). A, Adult, 215 mm fork length; B, first gill arch; C, longest gill raker; D, scale taken behind pectoral fin.

D¹ IX-X (mostly X); D² I, 11 + 5; A. I, 10 + 5; P, I, 18 V. I, 5. L¹ line scales 170-189. Height 5.25 to 5.52 in body length; 5.94 to 6.40 in total length. Head 3.28 to 3.47 in body length; 3.81 to 3.92 in total length. Eye 4.20 to 4.41 in head length; 1.32 to 1.45 in snout, slightly more than interorbital space. Mouth oblique, maxillary reaching front border of pupil. A row of about 40 pointed teeth on each ramus of both jaws, those on the lower jaw slightly longer than those of the upper.



TEXT FIG. 5. Juvenile *P. japonicus*, 138 mm fork length.

A row of about 25 similar teeth on the palatine and about 5 on the vomer. Gill rakers mostly 12 on the upper and 25 on the lower branch of the first arch. Lateral line quite distinct and running straight from the head to a point just below the end of the second dorsal where it gradually bends downwards and continues in a horizontal direction to the caudal peduncle. First dorsal spine shorter than second and equal to postorbital part of head. Succeeding spines abruptly decrease in length, the last about half diameter of pupil. Anterior rays of second dorsal shorter than first spine of first dorsal and about equal to eye, the last rays about half its diameter. Upper border of second dorsal low and concave. Anal spine short but strong and free from anal rays, about equal to diameter of pupil. Origin of anal slightly behind that of second dorsal. Dorsal and anal finlets 5/5. Pectoral slightly longer than ventral but less than postorbital part of head. A light patch on the snout just before the area between the eyes. Color of preserved specimens light violet above, 25 to 30 oblique indigo bars from occiput to base of caudal, more or less broken into a series of rounded spots just below the lateral line. In some young specimens the markings are sometimes arranged in a V-shaped manner above the lateral line. Body below lateral line immaculate and silvery.

First and second dorsal fins with dark margins, caudal base with two yellowish-orange spots.

Described from 8 specimens ranging from 138 to 140 mm fish length, collected from Batangas Bay, Luzon, March 22, 1949.

NOTE: These specimens tally, in general basic characters, with the description of *S. janesaba* of the Indo-Australian Seas by de Beaufort. Thus the Philippine *Pneumatophorus japonicus* (Houttuyn) is placed in synonymy with *S. janesaba*. The only difference lies in the fact that the Philippine species has a proportionately longer maxillary, more teeth on each ramus of the lower jaw and palatines, being 40 and 25, respectively. Moreover, the head is relatively longer than high compared with the Indo-Australian specimens. The young specimens are evidently more rounded than the adults. This species is of minor economic importance in the Philippine mackerel fishery, being taken occasionally together with *Rastrelliger* and *Decapterus* in deep open bays. At times, however, according to commercial fishermen, this species is taken in fair quantities in Batangas and Tayabas Bays from January to March.

Key to the Philippine species of *Rastrelliger* Jordan and Starks.

1. Height⁴ 2.98 to 3.35 in body length, body deep and compressed. Gill formula: $\frac{16-24}{33-45}$ 1. *Rastrelliger brachysoma*.
2. Height 3.59 to 3.96 in body length, body fairly deep but less compressed. Gill formula: $\frac{19-23}{34-39}$ *Rastrelliger chrysozonus*.

RASTRELLIGER BRACHYSOMA (Bleeker). Text figs. 6-9.

Scomber brachysoma BLEEKER, Cat. Fishes British Mus. 2 (1860) 36.

Rastrelliger brachysoma HERRE, Field Mus. Nat. Hist. Zool. Ser. 30 (1936) 104 (Nec. Bleeker).

Rastrelliger neglectus (Van Kampen). The Fishes of the Indo-Australian Archipelago 9 (1952) 211.

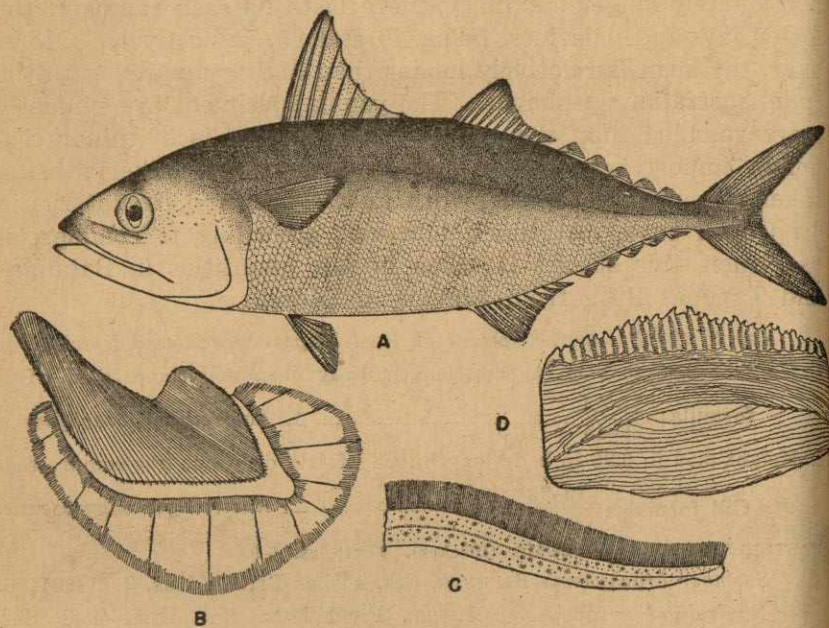
Rastrelliger brachysoma (Bleeker), Checklist of Philippine Fishes. Res. Rep. 20, U. S. Fish & Wildlife Service (1953) 243.

Chub mackerel; short-bodied mackerel; *hasa-hasa* (adult); *linachay* (young); *masangi*; *agumaa*; *kabalyas*.

D¹ VIII-X (mostly IX); D² 11-12 (mostly 11) + 4 to 6 (mostly 5); A. 9-12 (mostly 11) + 4-6 (mostly 5); P. I, 18; V. I, 5; L₁ scale 122-131.

⁴ Height of body equals the greatest perpendicular distance between the depressed first dorsal fin at a point above the 4th dorsal spine and the ventral pelvic region.

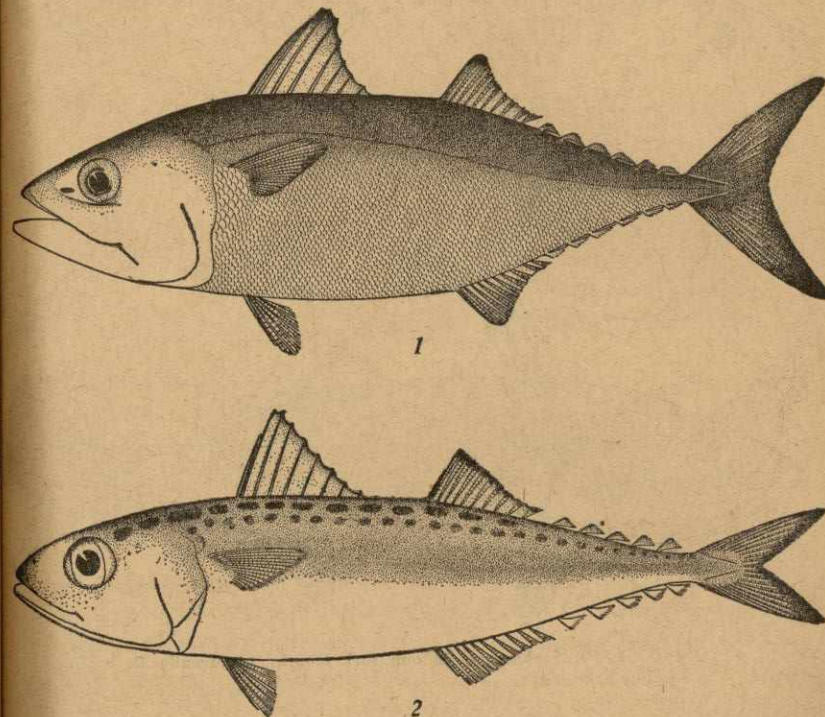
Height 2.98 to 3.35 in body length; 3.55 to 3.98 in total length. Head about as long as high, 3.24 to 3.45 in body length; 3.89 to 4.08 in total length. Eye 4.27 to 4.89 in head length 1.18 to 1.45 in snout and almost equal to interorbital space. Mouth oblique, maxillary 1.79 to 1.96 in head, reaching a little beyond hind border of eye. A single series of fine pointed teeth on both jaws. Palate and vomer edentulous. Gill rakers 16 to 24 (mostly 20) on upper branch and 33 to 45 (mostly 39) on the lower branch of the first gill arch, the longest ones about



TEXT FIG. 6. The deep-bodied chub mackerel, *Rastrelliger brachysoma* (Bleeker). A, Adult, 162 mm fork length; B, gill arch; C, longest gill raker; D, scale taken behind pectoral fin.

as long as or a little longer than distance between the tip of the snout and middle of eye. This gill raker simulates an inverted integral sign and is distinctly characterized with a bulbous terminal end. Gill raker pores very minute, of two rows, each row numbering from 180 to 200 pores. Height of 1st dorsal 5.02 to 6.04 in body length, less than length of fourth spine of first dorsal, last ray of second dorsal almost equal to diameter of pupil. Second dorsal fin concave. Insertion of anal fin similar to second dorsal. Pectoral triangular, longer than ventral or postorbital part of head. Scales distinctly ctenoid, those taken below the

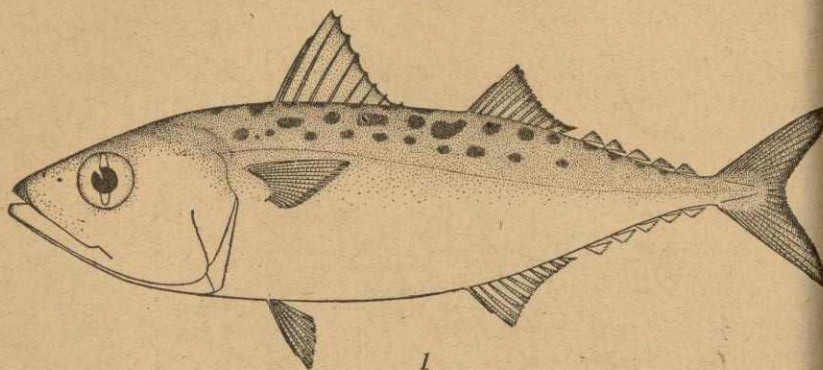
pectoral more or less rectangular in shape, ctenoid scale spines along the margins vary from 28 to 30. Lateral line scales range from 122 to 131 from behind opercle to base of caudal peduncle. Color in life bluish green above and immaculate, silvery below. Some specimens (or possibly a variety of the species) have one or two rows of dark rounded spots above the lateral line from below the first dorsal to the base of the caudal peduncle. Three to six dark spots along base of first dorsal seem to be retained



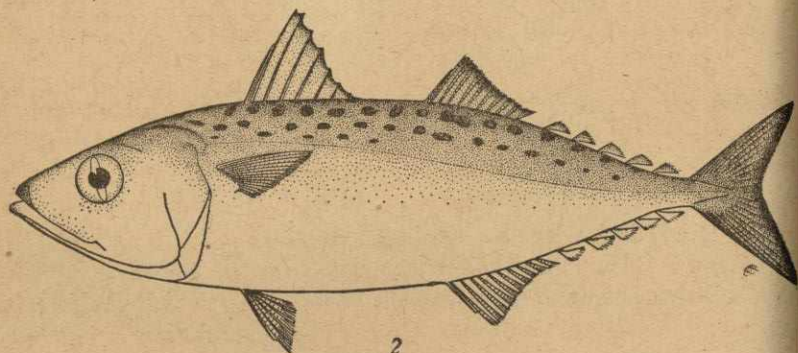
TEXT FIG. 7. 1, Adult *R. brachysoma*, with six dorsal and six anal finlets, caught by purse seine in Manila Bay, August 1950—175 mm fork length; 2, juvenile *R. brachysoma*, 54 mm fork length.

in older specimens. Dorsal fins dusky. Ventral, pectoral, and anal fins yellowish hyaline. First, second, and caudal with dusky margins. Caudal fin yellowish. Coloration gradually disappears after preservation in formalin or alcohol. The number of dorsal and anal finlets seems to be variable in the species. Examination of 831 species (young and adult). Table 2 shows that the number of dorsal and anal finlets ranges from 4/5 to 6/6 in alternate combination. However, the common ratio is 5/5 for dorsal and anal finlets.

Described from 68 specimens, 174 to 222 mm total length, collected as follows: 33 from Manila Bay, June and July, 1949; 5 from San Dionisio, Iloilo Province, July 30, 1949; from Malam-paya Sound, Palawan, May to June, 1949.

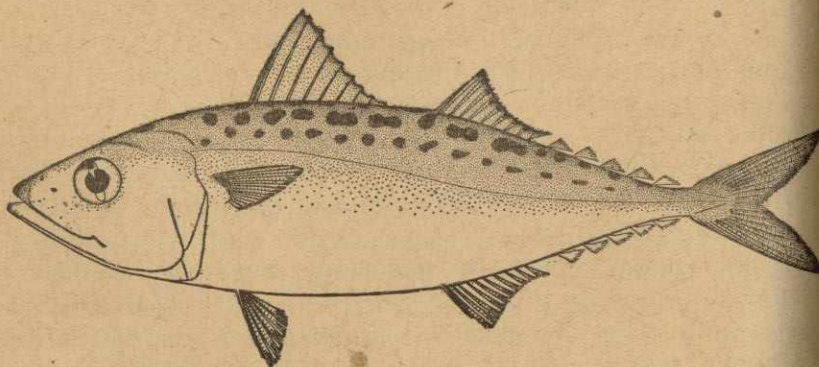


1



2

TEXT FIG. 8. 1, Juvenile *R. brachysoma*, 72 mm fork length; 2, juvenile *R. brachysoma*, 98 mm fork length.



TEXT FIG. 9. Juvenile *R. brachysoma*, 110 mm fork length.

Recorded from Manila Bay, Lingayen Gulf, Luzon; Catbalogan, Tarangnan, and Zumarraga, Samar; Malampaya Sound, Palawan; San Miguel Bay, Luzon; Ragay Gulf; Zamboanga City and Margosatubig, Zamboanga; Bauang, La Union; Calapan, Mindoro; Capiz, Capiz; Estancia, Iloilo.

TABLE 2.—Number of dorsal and anal finlets by species of Philippine chub mackerels, all localities combined (1949-54)

Number of finlets	<i>Pneumatophorus australasicus</i>		<i>Pneumatophorus japonicus</i>		<i>Rastrelliger brachysoma</i>		<i>Rastrelliger chrysozonus</i>	
	Number of specimen	Per cent	Number of specimen	Per cent	Number of specimen	Per cent	Number of specimen	Per cent
5/5	59	100.00	8	100.00	839	92.40	72	93.50
5/6					50	5.60	3	3.90
6/5					6	0.67		
6/6					2	0.23	2	2.60
5/4					1	0.11		
4/5					9	0.99		
Total	59	100.00	8	100.00	907	100.00	77	100.00

* The numerator represents the number of dorsal finlets and the denominator the number of anal finlets.

NOTE: These specimens agree in many specific characters with *R. neglectus* of Van Kampen but the body is not so high as the type specimen of *Scomber brachysoma* of Bleeker as cited by de Beaufort. This difference in body height appears to be a variation in the species as this character may be effected by the physiological conditions of the fish. In the commercial hauls of *R. brachysoma* in Manila Bay, mackerel fishermen can apparently recognize, by means of body height and coloration, three possible varieties, namely, (1) a white variety, "puti"; (2) a spotted variety, "talingan"; and (3) a deep-bodied variety, "punggol". The "puti" and "punggol" varieties come close to the type description of *R. brachysoma* of Bleeker in body height, although the former have proportionally smaller eyes. This variation in body height has also been noted from specimens collected from different fishing areas. As to whether this regional difference is significant enough for the establishment of distinct races remains to be determined. This study is still in progress.

R. brachysoma is the most important commercial species entering the Philippine chub mackerel fishery. It is evidently a coastal or inshore form subsisting principally on microplankton. The adults are caught the year round by native purse seine

(talakop) and fish corral (baklad) in Manila Bay, but the larger annual "runs" usually occur from April to August in Malampaya Sound and vicinity, Palawan. This commercial chub mackerel reaches a maximum length of 220 mm. and a weight of about 200 grams. The average size taken is about 180 cm. and the average weight 100 grams. The juvenile stages are caught both in Malampaya Sound and in Manila Bay almost throughout the year. In Manila Bay, however, the commercial "runs" of the young occur from July to October and are taken by fish corrals and bag nets. They are commonly used as bait in still handline fishing for yellowfin tuna (*Neothunus macropterus* and Spanish mackerel, *Scomberomorus commersonii*) off the approaches of Manila Bay.

RASTRELLIGER CHRYSOZONUS (Ruppell). Text figs. 10-11.

Scomber chrysozonus RUPPELL, Neue Wisbelt, Fische Rothen Meeres, (1835) p. 10, pl. 11, fig. 1, Massua.

Scomber microlepidotus GUNTHER, Cat. Fishes Brit. Mus. 2 (1860) 361.

Scomber kanagurta JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1902) 336.

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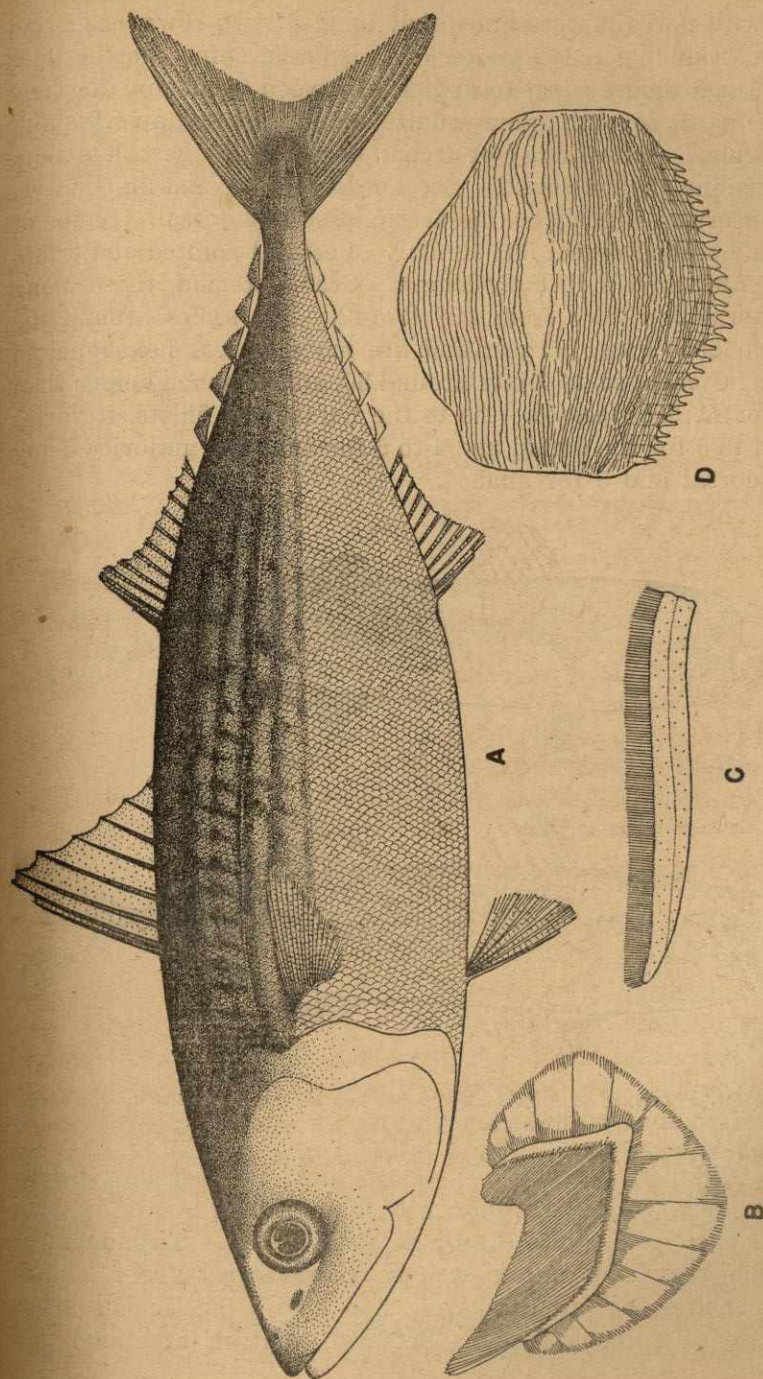
Rastrelliger kanagurta (C). The Fishes of the Indo-Australian Archipelago 2 (1952) 212, fig. 36.

Rastrelliger chrysozoma HERRE, 1940-41 Exped. Manila Bay, Luzon. *R. chrysozoma* HERRE, Checklist of Philippine Fishes (1953) 243.

Striped chub mackerel, *agumaa*, *alumahan*, *lumahan*, *burao*.

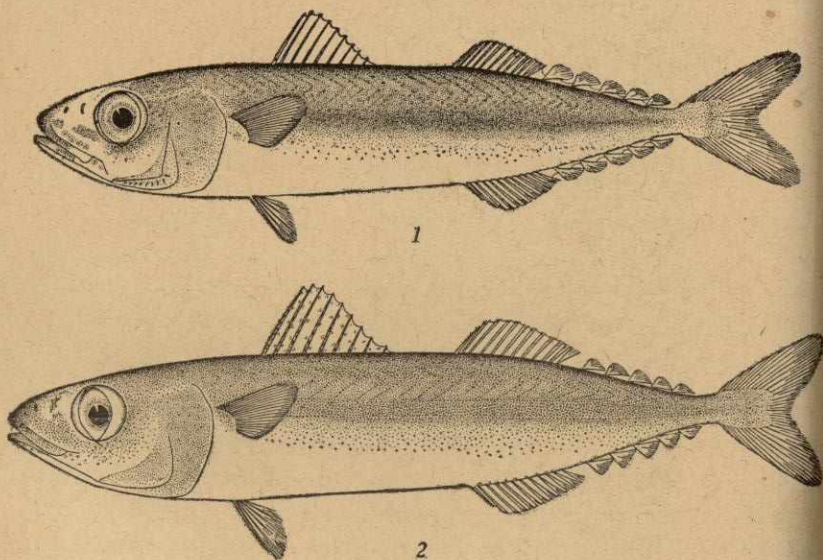
D¹ VIII-IX (mostly IX) D² 11-12 (mostly 12) + 5-6 (mostly 5); A. 11-12 (mostly 12) + 5-6 (mostly 5); P. I. 20-21 (mostly 20); V. I. 5; L₁ scale 128-142.

Height 3.59 to 3.96 in body length; 4.24 to 4.27 in total length. Head longer than high, 3.34 to 3.56 in body length; 3.79 to 3.96 in total length. Eye 4.50 to 4.75 in head length; 1.53 in snout. Snout slightly less than flat interorbital space. Mouth oblique, maxillary not reaching to a point below hind border of eye or not so far in the young. A single series of fine pointed teeth in both jaws. No teeth on palate and vomer. Gill raker formula: $\frac{19 \text{ to } 23}{34 \text{ to } 39}$ mostly 23 on upper and 37 on lower branch of first gill arch, the longest equal to distance from snout to middle of pupil. Gill rakers moderately long, straight and with pointed



TEXT FIG. 10. The striped chub mackerel, *Rastrelliger chrysozonus* (Ruppell). A, Adult, 218 mm fork length; B, first gill arch; C, longest gill raker of B; D, scale taken behind pectoral fin.

tips. Gill pores minute and fairly long, of two rows, each row having from 130 to 152 pores. First dorsal spine shorter than second and almost equal to distance between snout and forward rim of pupil; seventh spine equal to pupil, last spine very small and feeble. Anterior ray of second dorsal fin longest, less than fourth spine of first dorsal. Second dorsal and anal fin concave. Anal insertion slightly behind origin of second dorsal. Shape of anal and second dorsal fins similar. Pectoral pointed and triangular, 7.30 to 7.76 in body length. Scales ctenoid, those along the lateral line vary from 128 to 142. The scales around the pectoral base being largest and are more or less hexagonal in shape. Ctenoid scale spines around 30, appear much longer than those of *R. brachysoma*. As to the number of finlets, it varies from 4 to 5 for the dorsal and 4 to 6 for anal, the majority being 5 for dorsal and 5 for anal.



TEXT FIG. 11. 1, Juvenile *R. chrysozonus*, 26 mm fork length; 2 juvenile *R. chrysozonus*, 48 mm fork length.

Color in life, bluish green above and silvery-yellow below. Vortex dark, with two prominently oblong, metallic shining spots behind each eye which disappear after death. Two or three greenish gray longitudinal stripes above lateral line. A dark blotch behind each pectoral base, and 2 to 3 black spots along the base of spinous dorsal. Pectoral, ventral, and anal fine

hyaline. First, second, and caudal fins dusky along their margins.

Described from 25 specimens, 216 to 303 mm. total length, collected in northern Palawan, May to June, 1949.

Local habitat: Busuanga, Coron Island, Palawan; Catbalogan, Samar; Zamboanga City, Zamboanga; Manila Bay, Luzon; San Miguel Bay, Luzon; Ragay Gulf, Luzon.

NOTE: These specimens agree in general characters with *R. kanagurta* (Cuvier) of the Indo-Australian Seas. In de Beaufort's synopsis of the genus *Rastrelliger*, the Philippine *R. chrysozonus* is placed in synonymy with *R. kanagurta*. The only differences occur in the relatively shorter head and smaller eye of the Philippine species. Thus the Philippine *R. chrysozonus* appears to be a variant of *R. kanagurta*.

R. chrysozonus ranks second in commercial importance among the species of chub mackerel entering the mackerel fishery. It is apparently an open sea form and feeds mostly on macroplankton such as larval shrimps and fishes, as evidenced from examination of stomach contents. This species is usually caught by fish corrals and explosives along the coasts close to submerged shoals and reefs. The average size of the commercial catch is about 250 cm. (230 gm.) with a maximum of about 300 cm. (380 gm.). The juvenile stages are infrequently taken with those of *R. brachysoma* inside sounds and bays. Racial and biological studies of the species are in progress.

JUVENILE STAGES OF THE GENERA PNEUMATOPHORUS AND RASTRELLIGER.

Juvenile stages of *Pneumatophorus* have been recorded in many parts of the world, but as far as it could be ascertained from locally available literature little is known about them in the tropical West Pacific. On the West Coast of California of the United States, Fry (1949) has made an extensive study of the embryological, larval, and juvenile stages of a related species, *Pneumatophorus diego*. On the Atlantic Coast, Sette (1932-33) made studies on the fluctuation of the year classes of the juvenile stages as it affects the changing abundance of the Atlantic mackerel, *Pneumatophorus grex*. Notation of the occurrence of the juvenile stages of *Rastrelliger* mixed with jacks, anchovy, and saury has been recorded in Southern Japan (Kishinouye, 1933). Wade (1949) made mention of some distinguishing characteristics of *Rastrelliger* and *Pneumatophorus* compared with those of *Auxis*.

During the course of the field collections conducted by the biological staff of the Philippine Fishery Rehabilitation Program and the Philippine Bureau of Fisheries (1947-1950) 53 specimens of juvenile *Pneumatophorus* and 395 specimens of *Rastrelliger* were collected in Philippine waters.

Of the genus *Pneumatophorus* 45 specimens were collected and identified in the following localities: 30 specimens, 18 to 25 mm fork length, Limbones Cove, Manila Bay Approaches, Luzon, taken by night light collection by M/V Theodore N. Gill, 27 October 1947-49; 9 specimens, 120 to 140 mm fork length, Manila, by basnig operated with the aid of electric or petrol light, 27 June, 1949; 6 specimens, 57 to 81 mm fork length, Manila Bay, also by basnig, 22 Nov., 1949. Those taken by commercial basnig fishermen were found usually mixed with the juvenile forms of *R. brachysoma* in Manila Bay.

Of the genus *Rastrelliger*, 395 specimens were collected and identified from the following localities: 200 specimens, 45 to 110 mm fork length, Manila Bay, taken by basnig, May to December, 1949; 6 specimens, 90 to 109 mm fork length, Nasugbu, Batangas, collected at Nasugbu market, Batangas, 3 May, 1950; 85 specimens, 80 to 110 mm fork length, Malampaya Sound, taken by baklad, 7 July 1949.

The collection of juvenile chub mackerels on board the M/V Theodore N. Gill⁵ was made with the use of a 500-watt electric bulb hung over the stern a few feet above the water. A reflector hood was set over the bulb to focus the light on the water surface. Fine-meshed scoop and dip nets were used in collecting the specimens. All fish larvae and juvenile were preserved in five per cent formalin. Those juvenile chub mackerels taken by basnig and baklad were collected as they were landed on board the fishing vessel or right at the fish landings.

The species determination of the juveniles was made primarily on the basis of gill raker and gill raker pore counts, especially for those stages below 50 mm fork length. All gill raker and gill pore counts were made under 45 to 60 diameter magnification with a wide field binocular microscope. Every nodule indicating the development of a gill raker has been counted (Table 3). Stages longer than 50 mm could be easily distinguished

⁵ M/V Theodore N. Gill was one of the three experimental fishing vessels used by the U. S. Fish and Wildlife Service Rehabilitation Program in the Philippines (1947-50).

TABLE 3.—*Fin ray, gill raker and lateral line scale counts by species (based on adult and juvenile specimens)*

	<i>Pneumatophorus australasicus</i>	<i>Pneumatophorus japonicus</i>	<i>Rastrelliger brachysoma</i>	<i>Rastrelliger chrysozonus</i>
First dorsal fin	VIII-X (mostly X)	IX-X (mostly X)	VIII-X (mostly X)	VIII-IX (mostly IX)
Second dorsal fins	I, 6-I, 11 (mostly 12)	I-II	I, 10-I, 12 (mostly 12)	I, 10-I, 11 (mostly 12)
Anal in	I, 8-I, 11 (mostly 12)	I, 10	I, 8-I, 12 (mostly 11)	I, 10-I, 11 (mostly 12)
Dorsal finlets	5	5	4-6 (mostly 5/5)	5-6 (mostly 5/5)
Anal finlets	5	5	4-6	5-6
Pectoral fin	I, 18	I, 18	I-18	I, 20-21 (mostly I, 20)
Ventral fin	I, 5	I, 5	I, 5	I, 5
Lateral line scales	153-159 (mostly 12)	170-189 (mostly 12)	122-131 (mostly 20)	128-142 (mostly 23)
Upper gill raker	12-15 (mostly 12)	12-15 (mostly 12)	16-24 (mostly 20)	19-23 (mostly 23)
Lower gill raker	20-24 (mostly 22)	23-25 (mostly 25)	33-45 (mostly 39)	34-39 (mostly 37)
Number of gill raker pores	39-46	30-36	180-200	130-152
Combined counts	32-39 (mostly 34)	35-40 (mostly 37)	49-69 (mostly 59)	53-62 (mostly 60)
Vertebrae	14-17	13-18	13-17	12-18

from the general conformation of the body and the body markings.

Juvenile of Pneumatophorus australasicus Cuvier and Valenciennes.—Body fusiform but slightly narrower and slightly thicker than those of the *R. brachysoma* and *R. chrysozonus*. Back bluish green and body silvery towards the ventral sides. There are no apparent markings on the body of the juvenile stages between 72 and 158 mm long. The gill raker count is characteristic of the species with 12 to 15 (mostly 12) on the upper and 20 to 24 (mostly 22) on the lower gill raker arch. This count overlaps with that of *P. japonicus* but the number of gill pores ranges from 39-46 in number and higher than that of *P. japonicus*.

In life, between 72 and 158 mm long, two series of roundish spots are seen along the base of the first and second dorsal. Base of the dorsal fins grayish dark which disappears after death. Dark spot behind the pectoral. Irridescent blue above and immaculate cream below. Fin hyaline with dark margins. Stages below 72 mm long were not collected.

Juveniles of Pneumatophorus japonicus (Houttuyn).—Body elongate and spindle shape. Snout much more pointed than *P. australasicus*. In life, back bluish green above becoming lighter posteriorly. Belly silvery white with irridescent light, about 30 dark branching zigzag bands line the dorso-ventral side from behind opercle to base of caudal peduncle; below this is a series of 20 to 23 dark blotches; toward the belly is another series

of 3 to 4 rounded dots from base of pectoral to that of caudal. According to Kishinouye zigzag bands apparently correspond to the number of vertebra and coincide with the center lines between the myotomes. Dorsal fins, dorsal finlets, pectoral and caudal grayish. Ventral and anal finlets colorless. Gill raker counts, overlaps with those of *P. australasicus*, being 12 to 15 (mostly 12) on the upper and 23 to 25 (mostly 25) on the lower gill raker arch. However, the number of gill pores ranges, is much less than former, from 30 to 36 on the longest gill raker and 39 to 46 in the latter. Juvenile stages between 18 and 57 mm long were collected and identified in Manila Bay and approaches, but were lost during the transfer of the offices and laboratory of the Bureau of Fisheries, hence illustrations could not be made.

Juveniles of Rastrelliger brachysoma (Bleeker) text fig. 6.—Among the juvenile stages of the Scombroid fishes, *R. brachysoma* is the most commonly encountered in Manila Bay, Malampaya Sound, and the Visayan Sea. A series of the size group of the species has been collected, but unfortunately no stage smaller than 54 mm was found from the catch of commercial basnig fishermen. In life it is fusiform, flattened, blue-green above and silvery white below. In specimens between 20 and 22 mm long, two series of dark, rounded spots along the back sides from occiput to the caudal peduncle, those spots on the upper being more enlarged than the lower sides. All fins are hyaline, those of the first, second, and caudal with dark margins.

In specimens between 98 and 110 mm long the series of the dorsal spots appear to coalesce and become less pronounced toward the caudal peduncle in the latter juvenile stages. Those on the head apparently have disappeared. At maturity and possibly in old age, these dorsal markings seem to disappear. The scales become discernible at 60 cm fork length. Gill raker counts 16 to 24 (mostly 20) on the upper and 33 to 45 (mostly 29) on the lower gill raker arch.

The number of gill rakers apparently overlaps with that of *R. chrysozonus* but the number of gill pores in the longest gill raker of the lower gill arch is decidedly more, being between 180 to 200 in the former and 130 to 152 in the latter.

Juvenile of Rastrelliger chrysozonus (Rüppell) text fig. 10.—The juvenile forms of this species are usually caught mixed with those of *R. brachysoma*, *Auxis* spp. and *Decapterus* spp. A series have been collected by the technical men of the oceanographic

vessel M/S Spencer F. Baird.⁶ The larger juvenile forms were collected by the writer on board commercial basnig vessels in Manila Bay and in Malampaya Sound.

General conformation fusiform but apparently slender than the juvenile of *R. brachysoma*. Back bluish with greenish lustre on the anterior part. A row of grayish dots on each side of the base of the dorsal. The two greenish longitudinal bands above the lateral line and two golden longitudinal bands from the pectoral base are characteristic of the maturing forms. The longitudinal dark bands above lateral line became more apparent upon attainment of sexual maturity which have disappeared in preserved specimen. The grayish dots on the back also disappeared in old age. Gill raker counts 19 to 23 on the upper and 24 to 39 on the lower gill raker arch.

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ILLUSTRATIONS

TEXT FIGURES

- FIG. 1. A typical chub mackerel showing the basis for proportional measurement procedure of the body; diagrammatic.
2. The Australian chub mackerel, *Pneumatophorus australasicus* (Cuv. & Val.). A, Adult, 190 mm fork length; B, first gill arch; C, longest gill raker; D, scale taken behind pectoral fin.
 3. 1, Juvenile *P. australasicus*, 72 mm fork length; 2, juvenile *P. australasicus*, 158 mm fork length.
 4. The Japanese chub mackerel, *Pneumatophorus japonicus* (Houttuyn). A, Adult, 215 mm fork length; B, first gill arch; C, longest gill raker; D, scale taken behind pectoral fin.
 5. Juvenile *P. japonicus*, 138 mm fork length.
 6. The deep bodied chub mackerel, *Rastrelliger brachysoma* (Bleeker). A, Adult, 162 mm fork length; B, gill arch; C, longest gill raker; D, scale taken behind pectoral fin.
 7. 1, Adult *R. brachysoma*, with six dorsal and six anal finlets, caught by purse seine in Manila Bay, August 1950—175 mm fork length; 2, juvenile *R. brachysoma*, 54 mm fork length.
 8. 1, Juvenile *R. brachysoma*, 72 mm fork length; 2, juvenile *R. brachysoma*, 98, mm fork length.
 9. Juvenile *R. brachysoma*, 110 mm fork length.
 10. The striped chub mackerel, *Rastrelliger chrysozonus* (Ruppel). A, Adult, 218 mm fork length; B, first gill arch; C, longest gill raker of B; D, scale taken behind pectoral fin.
 11. 1, Juvenile *R. chrysozonus*, 26 mm fork length; 2, juvenile *R. chrysozonus*, 48 mm fork length.