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AND PREVIOUS "DANA"-EXPEDITIONS
UNDER THE LEADERSHIP OF THE LATE PROFESSOR JOHANNES SCHMIDT

DANA-REPORT No. 81

BRAMIDAE

26. MAJ 1972

BY

GILES W. MEAD
NATURAL HISTORY MUSEUM OF
LOS ANGELES COUNTY

Zoologiska Institutionen
UPSALA
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WITH 58 FIGURES IN THE TEXT AND 9 PLATES

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(continued on page 3 of cover)

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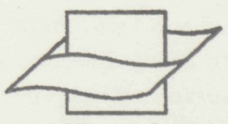
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CONTENTS

Page

Introduction 3

Acknowledgements 4

Bramidae 6

Key to genera 7

Eumegistus 8

E. brevorti (Poey, 1861) 9

E. illustris Jordan and Jordan, 1922 13

Taractes 16

T. rubescens (Jordan and Evermann, 1887) 16

T. asper Lowe, 1843 21

Brama 25

B. brama (Bonnaterre, 1788) 29

B. japonica Hilgendorf, 1878 49

B. dussumieri Cuvier, 1831 55

B. caribbea, new 63

B. orcini Cuvier, 1831 72

B. myersi, new 76

B. sp. 81

Taractichthys 83

T. longipinnis (Lowe, 1843) 85

T. steindachneri (Döderlein, 1883) 91

Pterycombus 93

P. brama Fries, 1837 93

P. petersii (Hilgendorf, 1878) 101

Pteraclis 104

P. carolinus Valenciennes, 1833 107

P. velifera (Pallas, 1769) 115

P. aesticola (Jordan and Snyder, 1901) 118

Summary 120

Literature cited 121

Appendices 134

INTRODUCTION

Some years ago, while disguised as a fishery biologist, I took a few small and lovely juvenile bramids from the stomach of a tuna. The identification of these being an amusing pastime and the group clearly needing review, I naively accepted an invitation from the late A. Vedel Tåning to report on the bramids in the Dana material. Circumstances soon thereafter made it impossible to discuss a modification of this commitment directly with Dr. Tåning or to consider its corollary, occasionally contemplated, of returning the collection, unworked, to Denmark. The revision that I had planned—the definition of genera and species and their evolution, the description of the larval and juvenile stages, and the geographical distribution of both young and adults—has not been possible. I attribute this only in part to the ineptness of the investigator, for the vagaries of collecting make meaningless any convincing statistical treatment of morphometry, and the allometry, most interesting in itself, compounds other difficulties of interspecific comparison. The adults of some species, and the young of others, remain unknown.

Thus this paper presents not a revision of the Bramidae but a collection of material assembled toward such a revision. It is replete with data and questions but somewhat wanting in answers and conclusions. I will be content if it is more of a blessing than a burden to the next reviser.

I have tried to define the bramid genera and species; to estimate their total, reproductive and bathymetric ranges; to identify and describe the larval and juvenile forms; and to comment on other aspects of their natural histories. I am nearly content with the generic taxonomy and with the conclusions drawn from a study of several of the species. Treatment of forms from relatively well-collected areas, such as the North Atlantic *Brama brama*, *Pteraclis carolinus* and *Pterycombus brama* is reasonably satisfactory. Such satisfaction grades rapidly into dissatisfaction as the study progresses from the well-collected area to the less-well, and from good material to bad. The known status of the Southern Hemisphere cold-temperate *Brama* and of Indo-Pacific *Pteraclis* is nearly as bad as it was when this study was begun. Similarly, allometric growth, both common and substantial among all bramids, could at times be described but, at others, not.

The massive bramid collection assembled by "Dana" is composed wholly of larval and juvenile specimens. They have been supplemented by adult material begged or borrowed from institutions throughout the world. But the young must be identified with the adult and the scarcity of half-grown individuals has been troublesome. These elusive juveniles are too small to be caught by line but too large to be taken commonly by net. But they are neither too large nor too small to be taken by tuna. I am indebted for the samples of these juveniles which I did examine to many throughout the world who study the food habits of such large predators. Unfortunately, proteolytic enzymes are not the biological fixatives of choice. All of my study material is listed in the appendix tables.

The permanent depository of most material other than that assembled by "Dana" is indicated throughout by museum or laboratory initials. Should doubt arise as to the meaning of these, most can be found in the introduction to Part Three, "Fishes of the Western North Atlantic" (Bigelow, ed., 1963: xvii-xviii). The following will not be found there: TABL (Tropical Atlantic Biological Laboratory, U.S. Bureau of Commercial Fisheries, Miami), HBL (Honolulu Biological Laboratory, U.S. Bureau of Commercial Fisheries), ISH (Institut für Seefischerei, Hamburg), and DM (Dominion Museum, Wellington).

Museum catalog numbers have, for the most part, been omitted and little of the material studied is so catalogued. Where two depositories are indicated for a single lot (e.g., HBL, USNM), the first is that from

which the material was received, the second that where it is currently housed. All lengths are standard lengths unless otherwise qualified. Standard counts and measurements were made according to standard methods (HUBB and LAGLER, 1941). The last ray in the vertical fins, which is usually divided to its base, was counted as one, and the anterior point for measurement of standard length was regularly taken on the snout at the anterior-most points of the premaxillae. This presents a somewhat anomalous situation in *Pteraclis*, the fan fishes. In some of these the forehead is terminal anteriorly, overhangs the opening of the mouth, and carries the origin of the huge dorsal fin. In these, the length of the base of this fin may exceed the "standard length" of the fish, but to assume an altered definition of "standard length" for this genus alone would destroy its use for certain other comparative purposes.

Field data are generally expressed in the units originally provided by the collector. All nets are to be considered open nets unless otherwise qualified. Depths in parentheses, e.g., 0–(180) m, indicate principal fishing depths, although specimens may have been taken between such depths and the surface while the net was being shot or hauled. All dates are twentieth century unless otherwise indicated (15/VII/65 vs. 15/VII/1865).

Other abbreviations: s.l. (standard length); t.l. (total length); f.l. (fork length); m.w. or m.w.o. (meters of wire out); w.a. (wire angle, or depth calculated by triangulation from wire out and wire angle); and TDR (time depth recorder, or depth determined by its use); D ("Dana" station number).

I have tried to trace the history of all scientific names or combinations through synonymy. Name combinations appear in chronological sequence. The first such usage is followed, again in chronological sequence, by successive ones and the content of each paper is noted. I have not seen all of the literature in which bramids are mentioned nor have I attempted to do so. Neither have I treated as separate synonyms various permutations of trivial names (e.g., *B. raii* vs. *raji*, *rajii*, etc.), obvious mistaken spellings (e.g., *Bramma*), or other nomenclatorial nonsense. I have tried to include reference to all major redescriptions, distributional records of importance in either the positive or negative sense, reference to vernaculars which have been useful in tracing species identities, life history notes, and at least an introduction to the literature in morphology, parasitology, etc. Although I know of over 200 papers that I have neither examined nor cited here, I am reasonably confident that few of significance have been overlooked.

ACKNOWLEDGEMENTS

This study has incorporated data and material from throughout the world, and I cannot adequately express my thanks to the scores of individuals who forwarded specimens—some collected fortuitously and some through planned effort. The names of these individuals are not to be catalogued here, but to each goes my most appreciative thanks. The primary basis for this account, the magnificent collections of the Carlsberg Foundation, were first offered to me by the late A. VEDEL TÅNING. His successor, E. BERTELSEN, has provided supplementary material, but of equal importance, both patience and encouragement. To him go my thanks for the continued opportunity to study this material, and to both him and the collections go my apologies for any injustice I may have done the latter through error or omission during the course of my analysis. Supplementary material, much of it critical to my attempts to relate young forms to the adult, were provided by the museums in Washington, London, Paris, Geneva, Stavanger, Bergen, Oslo, Copenhagen, Cape Town, Wellington, Tokyo, Los Angeles, Chicago, Stanford, Cambridge (U.S.), Philadelphia, and by the laboratories of the U.S. Bureau of Commercial Fisheries in La Jolla, Miami, Pascagoula, Seattle and Honolulu. To the curatorial and administrative staffs of all of these institutions go my sincere expressions of gratitude.

It is once again my pleasure to acknowledge with deep appreciation the continued interest and support of my fellow bramid enthusiast, TOKIHARU ABE of Tokyo. Many aspects of bramid taxonomy were studied jointly by us, and most of the known adult Pacific material at hand, much of it of sufficient rarity and importance to have warranted separate accounts by Dr. ABE, was generously forwarded to me for inclusion here.

I have similarly profited greatly through continued collaboration with RICHARD H. BACKUS and his associates in the Woods Hole Oceanographic Institution, an institution that has provided drafting and photographic assistance as well as the intellectual and, of inestimable importance, access to the oceans. Dr. B. ANDREU, fishery biologist of Vigo, introduced me to the Spanish fishery for *Brama brama* and directed me toward data from which at least a primordial account of the natural history of one bramid species could be developed.

Financial support for this study was derived in part from the Museum of Comparative Zoology, Harvard University, and in part through the generosity of the National Science Foundation through their grants no. G 15887 and GF 147—funds without which this review could not have been accomplished.

BRAMIDAE

As here understood, the family Bramidae, first recognized as such by Lowe (1838a, 1838b: 179; for the genera *Brama, Leirus,* and *Polymixia*) includes all or part of the species variously included within the following families or subfamilies: subfamily Pteraclinae of Swainson (1839: 178) or the families Pteraclididae Gill (1874) and Pteraclidae of subsequent authors; Bramaeformes or Bramini of Bleeker (1859: XXII); the Steinegeriidae of Jordan (1923); Pterycombidae of Shufeldt (1912); and Lepidotidae of de Buen (1958). Various genera have also been allied with unrelated families (*Amblytoxotes,* a synonym of *Brama,* in the Toxoteoidi by Bleeker, 1876; *Brama* with the chaetodonts by Cocco, 1884; etc.) but these arrangements will not be considered further. The species are here allocated among six genera: *Eumegistus, Taractes, Taractichthys, Brama, Pteraclis* and *Pterycombus*; and although subgeneric groupings within some are apparent, subgeneric names have been avoided.

The species of *Eumegistus,* the genus that appears to be the most primitive, may be bottom dwellers as adults, but the young are pelagic, as are those of all other bramids. The adults of all other species are high-seas fishes. Two species groups, *Brama orcini* and *B. caribbea* and the species of *Pterycombus,* are pseudopelagic, for they are found relatively close to land masses and have apparently differentiated accordingly. All others are oceanic, with distributions correlated with temperature and current structure. Most species are small and some are rare. Others are abundant and of considerable value. *Brama brama,* for example, is an abundant and valued part of the Spanish Atlantic fishery, and I believe that its congener will be of commercial significance in the northeastern and southeastern parts of the temperate Pacific and perhaps elsewhere. While several, such as *Taractichthys* and *Taractes rubescens,* were considered rarities when this study was begun, the intensive exploitation of the high seas by the tuna fishermen of the world has provided representatives of these large and succulent fishes in salable quantity, at least in Japan. However, the relative scarcity of the young of these compared either to other bramids or to scombroids suggests that the populations are not large. The juveniles of all species are an important part of the food taken by high-seas tunas and skipjack, the billfishes, and other oceanic predators.

Perusal of the plates at the end of this account will suggest that the bramid genera are distinctive one from another. They are, and most have been separated from the Bramidae proper, by one author or another, as independent families or subfamilies. The unity of the group remains uncertain. For example, a clear distinction can be made between the fanfishes, *Pteraclis* and *Pterycombus,* and the remaining bramids. They differ substantially in shape, fin form and extent, vertebral number, squamation and in a host of other characters. Yet *Pterycombus* shares with *Taractichthys* the flattened and enlarged thoracic ribs (Shufeldt, 1912, and original material), suggesting common ancestry. However, a conflicting conclusion, that the rib cages of the two genera are neither functionally nor structurally homologous, is emerging from work being done at Harvard University and soon to be reported by Thomas Brushart.

While generic diversity simplifies the definition of genera, it necessarily complicates that of the family, for there are virtually no characters of importance common to all genera. Even several features broadly typical of the acanthopterygians, such as a vertebral number approximating 24 and the ventral fin formed of a spine and five branched rays are modified, especially in the mesopelagic genera. But the general bramid appearance of these distinctive fishes, most of which are black, bluish-black, or silvery and ovate and compressed in form, can be confused with few other groups. All also have a single dorsal fin, the unbranched

anterior spines forming an integral part of the dorsal lobe when it is present; all, as juveniles, adults, or both, have scales which bear spines or keels on their surfaces; and all, as adults but not as young, have unarmed opercular and preopercular margins.

I will not consider here problems of origin and relationships of the family. Work is in progress. They are atypical percoids and only *Brama* has been used in past studies of relationship. They have frequently been aligned with *Coryphaena*, the carangoids, and especially *Mene* (Regan, 1909; Gregory, 1933) and with the stromateoids (Ueno, 1965, who based his conclusion on earlier work by Matsubara) and specifically with the Parastromatiidae (= Apolectidae) by Munro (1967: 219). Stromateoid affinities were suggested long ago but without supporting data (Lowe, 1842). The question remains open and might best be approached by an osteological study of *Eumegistus* rather than of *Brama*. Specimens for such a study are not yet extant. It is also possible that the enigmatic family Caristiidae (the mesopelagic genus *Caristius*) has been derived from a *Pteraclis*-like ancestor largely thorugh degenerative processes common among deep-water fishes. These nearly scaleless and poorly ossified fishes do have the fins and adjacent sheaths, and the general appearance of a fanfish. Haedrich (pers. comm.) has also noted that both *Brama* and *Caristius* have the *pons moultoni* in the inner ear, a feature also characteristic of other members of the group, including the stromateoids, with the "pattern ten" *ramus lateralis accessorius* system of Freihofer (1963).

The fossil record yields nothing of aid in determining the origin of the Bramidae. Two fossil forms have been described: *Protobrama avus* Smith Woodward, 1942; and *Tselfatia formosa* Arambourg, 1943, a species superficially resembling *Pterycombus* (see Patterson, 1964). C. Patterson (1967), however, has shown that neither is related to the Bramidae and the two are included in the suborder Tselfatioidei which he provisionally placed in the Osteoglossomorpha.

Key to Genera

The key which follows is based on adult material:

A Dorsal and anal fins high, scaleless, flexible, completely depressible and lying, when depressed, within a sheath formed by elongate scales which are inserted along the base of the fin.

B One of the anterior five dorsal and anal rays notably thicker than its neighbors; basal sheath of dorsal fin not preceded by scales which cross dorsal midline but continuing forward to scaleless area on snout.
Pteraclis Gronow, 1772; p. 104.

BB Anterior dorsal and anal rays of similar thickness, no one notably thicker than its neighbors; basal sheath of dorsal fin preceded by scales which cross the dorsal midline ..... *Pterycombus* Fries, 1837; p. 93.

AA Dorsal and anal fins of adults with scales, not wholly depressible but moderately stiff and erect and without a basal sheath of scales.

C Dorsal profile of head between eyes flat or slightly convex, not notably arched and rounded.
Taractes Lowe, 1843; p. 16.

CC Dorsal profile of head between eyes notably arched and rounded, the distance between orbit and nearest point on dorsal midline being more than half the diameter of the eye.

D Head strongly compressed with lower edges of mandibles wholly touching each other behind symphysis at ventral midline; scales on caudal peduncle forming a graded size series with those on bases of midcaudal rays.
Brama Bloch and Schneider, 1801, p. 25.

DD Head moderately compressed with lower edges of mandibles not wholly touching at ventral midline behind symphysis but with part of the isthmus visible between them; scales on caudal peduncle abruptly larger than those on base of caudal fin.

E Scaleless area present above and behind eye; pectoral fin ends over lobe of anal fin; insertion of ventral fin under posterior end of base of pectoral fin ..... *Eumegistus* Jordan and Jordan, 1922; p. 8.

EE No scaleless area over and behind eye; pectoral fin extends beyond lobe of anal fin; insertion of ventral fin under anterior end of base of pectoral fin ..... *Taractichthys* Mead and Maul, 1958; p. 83.

Eumegistus JORDAN and JORDAN, 1922.

Eumegistus JORDAN and JORDAN, 1922:36, pl. 2, fig. 1; type species, by monotypy, *Eumegistus illustris* JORDAN and JORDAN, 1922.

Generic Synonyms:

Pseudotaractes ABE, 1961:92–94 and 96, figs. 5 and 6; type species, by original designation, *Brama saussuri* LUNEL, 1865 = *Brama brevorti* POEY, 1861.

Characters:—Dorsal fin originating behind head, over base of pectoral fin, the adults with anterior dorsal and anal lobes. Most of elements in dorsal and anal fins branched and both fins moderately stiff,

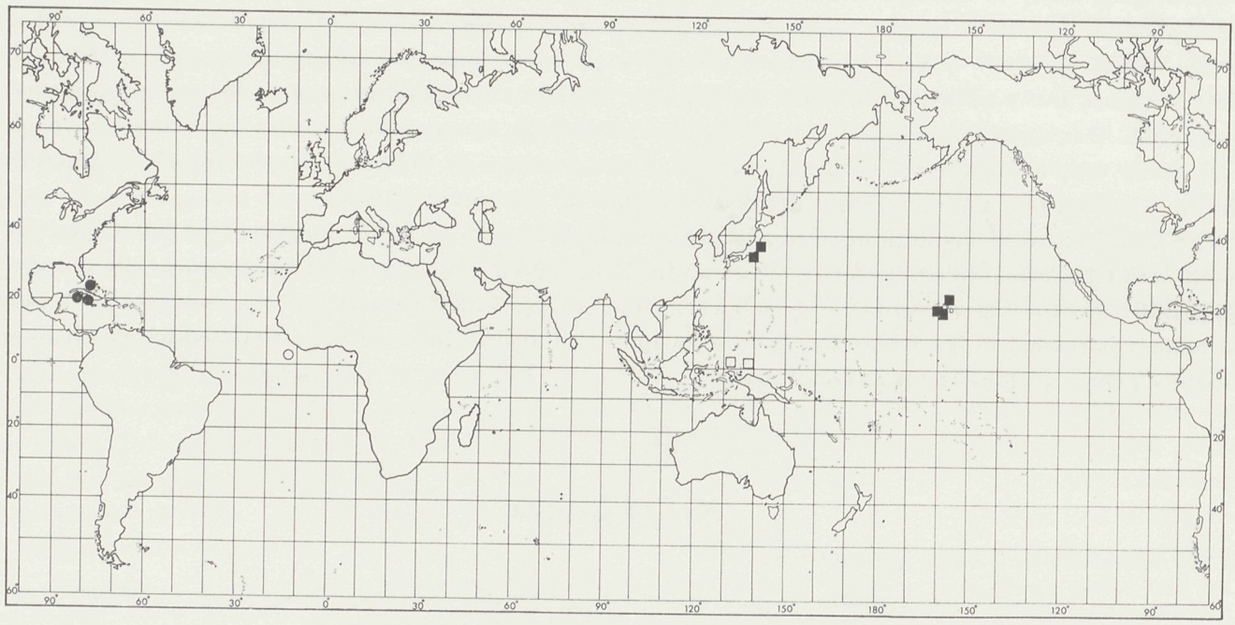


Fig. 1. Distribution of *Eumegistus illustris* and *E. brevorti*

E. illustris
□ shorter than 20 mm s.l.
■ longer than 20 mm s.l.

E. brevorti
○ shorter than 20 mm s.l.
● longer than 20 mm s.l.

erect and covered with scales and not depressible into a groove. No anterior dorsal or anal fin ray notably thicker than its neighbor. Ventral fin short and inserted under posterior half of base of pectoral. Pectoral fin terminating over anal lobe. Caudal fin stiff, its contour biconcave. No transverse precaudal grooves.

Dorsal profile of head strongly arched and rounded. Inner lower edges of mandibles behind symphysis of lower jaw fail to meet but are separated by a scale-bearing and pigmented part of the isthmus. Posterior nostril a slit. Thoracic ribs normal, their dorsal ends not expanded.

Spines on scales only of young. No modified or enlarged scales or spines on midlateral series of caudal peduncle. One or more scaleless areas above and behind eye. Lateral line persistent in adult, evenly arched, and not extending onto caudal fin. Scales on caudal peduncle abruptly larger than those on proximal part of caudal fin.

Range and Habitat:—The genus appears to be circumtropical but rare (Fig. 1). Hawaiian adults are caught on the bottom by hook and line (W. A. GOSLINE, pers. comm.) and none, to my knowledge, have been reported taken by the high-seas longline fishery. I suspect that in contrast to all other bramids the species of *Eumegistus* are benthic. It is of interest that none have been taken off the continental shelves but all, although there are few, from off large islands: Hawaii, Cuba and Japan.

Species:—Two here recognized, the Atlantic *E. brevorti* POEY and the Pacific form, *E. illustris* JORDAN and JORDAN.

Key to Species

A Anal fin 22; pectoral fin 20; vertebrae 16 + 20 + 1 = 37 ..... *E. brevorti* POEY, 1861, p. 9 off Cuba.
AA Anal fin 24; pectoral fin 21–22; vertebrae 17 + 22 + 1 = 40 *E. illustris* JORDAN and JORDAN, 1922, p. 13, Pacific.

Eumegistus brevorti (POEY, 1861).

Figures 2 to 4.

Study Material:—The type of *E. saussuri* (LUNEL), here designated lectotype, 259 mm s.l., and a second 290 mm dried and mounted specimen taken with it, both from Cuba and now in the Natural History Museum in Geneva; eight larvae, 4.0 to 8.5 mm long and completely faded, from D-4001 IV, off West Africa (3°56′ N, 12°32.5′ W, 100 m.w.o.; 6 III 30; S 200); and a tracing of POEY's unpublished outline figure of the type of the Cuban *E. brevorti* (Fig. 3).

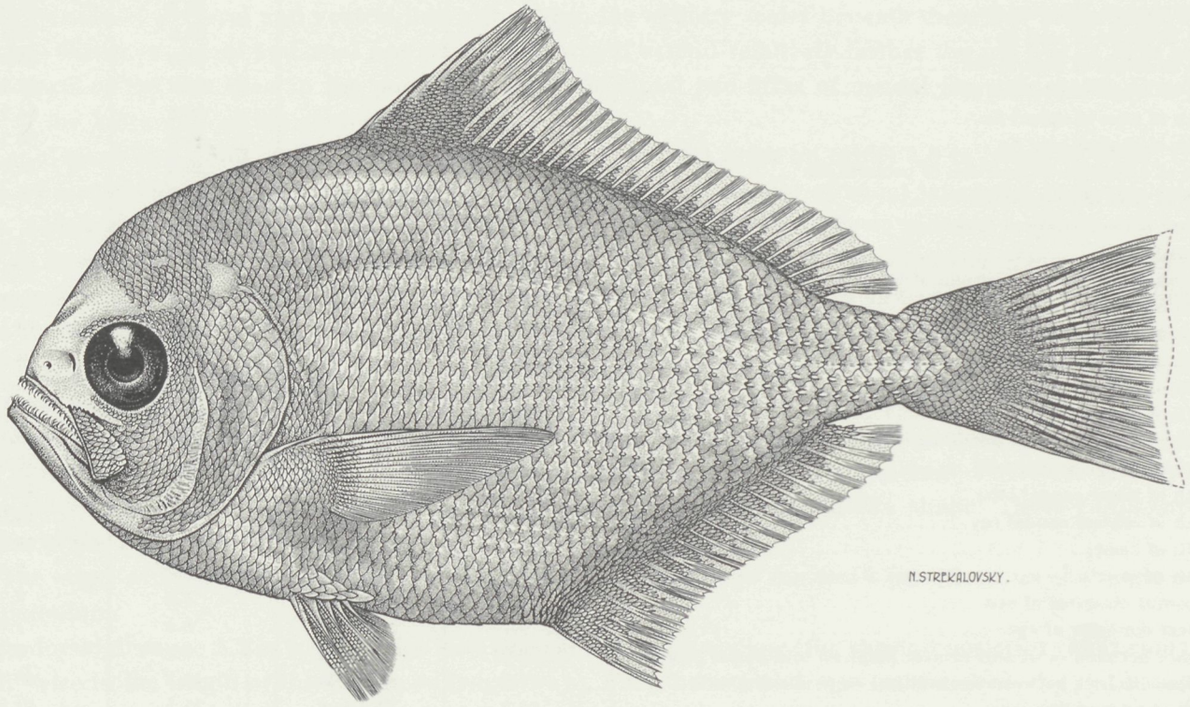


Fig. 2. Lectotype of *Eumegistus saussuri* (= *E. brevorti*), 259 mm s.l., from off Cuba. Drawn by N. STREKALOVSKY.

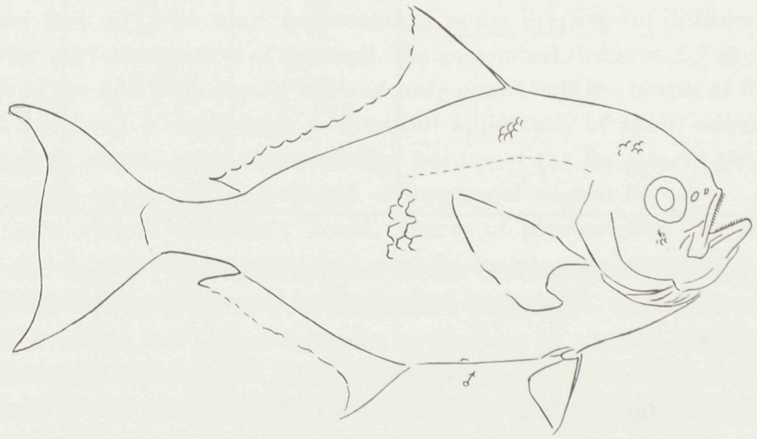


Fig. 3. Tracing of POEY's unpublished sketch of the type specimen of *Eumegistus brevorti* (POEY). Figure provided through the courtesy of Pedro Pablo Duarte-Bello of Havana.

Table 1. Counts, and proportional dimensions in per cent of standard length, of juvenile and adult *Eumegistus*. Head measurements of the type of *E. illustris* are in millimeters.

	E. brevorti. Type of *E. saurssuri*, Cuba	*E. illustris*, type, Hawaii	*E. illustris*, juvenile Japan	*E. illustris*, adult, Hawaii
Standard length (mm)	259.0	"about 2 ft."	121.0	470.0
Fork length (per cent)	119.0		130.0	110.4
Greatest depth of body	51.7		44.6	44.7
Least depth of caudal peduncle	9.6		9.2	7.4
Greatest width of body	13.7		15.3	17.0
Greatest width of head	15.8		16.2	17.0
Snout to origin of dorsal fin	44.1		38.4	39.5
Snout to origin of anal fin	61.8		56.6	57.2
Snout to origin of ventral fin	37.1		35.3	33.8
Snout to origin of pectoral fin	29.2		27.1	27.3
Length of base of dorsal fin	50.2		54.1	54.5
Length of base of anal fin	35.3		36.2	36.2
Origin of dorsal fin to insertion of pectoral fin	33.8		33.8	31.0
Width of base of pectoral fin	7.2		7.8	6.8
Distance between base of lowermost pectoral ray and insertion of ventral fin	9.6		8.8	8.2
Insertion of ventral fin to origin of anal fin	27.4		28.1	27.2
Length of pectoral fin	27.3		21.8	31.1
Length of ventral fin	13.7		15.7	13.4
Length of longest anal fin ray	13.1		13.2	14.9
Length of fifth-from-last anal ray	8.3		11.8	5.5
Length of longest dorsal fin ray	19.3		15.7	24.3
Length of fifth-from-last dorsal ray	9.4		12.7	6.2
Length of upper caudal lobe	24.1+		–	26.6
Length of lower caudal lobe	20.8+		–	26.6
Length of central caudal ray	19.3		30.2	14.5
Length of head	28.8	180.0 mm	27.0	26.6
Length of snout	7.6	52.5 mm	7.0	7.8
Horizontal diameter of eye	8.8	47.3 mm	7.8	6.7
Greatest diameter of eye	9.1	50.5 mm	8.4	7.5
Distance between orbit and nearest point on mid-dorsal profile	6.5	46.6 mm	6.4	6.4
Greatest distance between eye and free edge of subopercle	14.7	87.5 mm	15.3	13.4
Width of interorbital space	10.7	73.0 mm	11.5	12.6
Length of upper jaw	15.0	91.5 mm	16.2	13.4
Counts:				
Dorsal fin	33	33	34	35
Anal fin	22	24	24	24
Pectoral fin	20/20	21/22	21/22	22/21
Caudal fin	1-8-7-1	1-8-7-1	1-8-7-1	1-8-7-1
Gill rakers (first arch)	2+1+6	2+1+7	1+1+7	1+1+7
Branchiostegal rays	7	7	7	7
Vertebrae	16+20+1 = 37	–	17+22+1 = 40	–
Scales in horizontal series	ca. 50	–	ca. 48	50

Distinctive Characters:—The meristic values used above in the "Key to Species".

Description of Adult:—The description which follows is taken from the type of *E. saussuri* (Lunel). Counts, and proportional dimensions, in per cent of standard length, are provided in Table 1.

Body similar in shape to that of *B. brama*, its greatest depth, at origin of dorsal fin, 1.9 in s.l.; its greatest width, above base of pectoral fin, 3.8 in greatest depth. Head with scales except on snout, mandible, distal edges of preoperculum and gill flap and a few small areas above and behind eye. These small scaleless areas: (1) 5 mm long, placed 7 mm dorsoanterior to upper end of gill cleft; (2) anterior to (1) by 3 mm, its greatest

measure about 9 mm and separated from the orbit by about 10 rows of scales; (3 and 4) above eye, about at vertical of posterior margin of orbit, each of these about 2 mm long; (5) about 17 mm above a horizontal with eye and about 3 mm across. Scales on head without spines. Body, except for areas noted above, completely covered by scales. Those of the anterior half of the body are without spines; the posterior with spines; and those on the caudal peduncle largest. Spines on caudal peduncle and those on body immediately anterior to them antrorse. Of the series of scales on the mid-lateral line of the caudal peduncle, only the last bears a spine and this is small. Spines on the rows above and below this mid-lateral series much larger. About 50 scales in a horizontal series, counting from upper end of gill cleft to base of mid-caudal rays, the last clearly differentiated from the scales overlying the fin by its larger size and the presence of a small but clearly evident spine. About 28 rows of scales, counting upward and backward, from level of insertion of ventral fin to base of dorsal. Lateral line evident, extending from upper end of gill cleft to above a vertical with the 14th dorsal ray, its course slightly and evenly arched.

Bases only of pectoral and ventral fins with scales, the axillary scales beneath these fins prominent. Proximal two-thirds of dorsal and anal fins with scales which extend relatively farther toward tips of rays in anterior parts of the fins than in the posterior. About proximal two-fifths of caudal fin with scales, the distal ends of the lobes and of the central rays naked.

Snout short and blunt, its length (tip, at midpoint, to nearest point on orbit) 3.8 in length of head. Upper edges of nostrils above a horizontal with tip of snout, on line from tip of snout tangential to upper edge of orbit. Anterior nostril circular, the posterior a slit.

Eye irregular in outline, its horizontal diameter 3.4 in head, its greatest diameter the antero-dorsal to postero-ventral, 3.2 in length of head. Lower jaw terminal, its outer teeth not included within upper jaw when mouth is closed. Teeth of mandible and premaxillary similar in size and shape villiform, conical and recurved, and forming bands. No teeth on tongue or vomer. Palatine teeth similar to those in jaws, numerous, and forming bands which occupy the full extent of the exposed parts of the palatine bones.

Gill clefts long. Gill rakers developed on first arch only. Two rakers on epibranchial, the uppermost less than half the length of the second. One raker at angle of arch; six on ceratobranchial. There are a few rugose rudimentary rakers above and below those of the normal length and lath-like shape. These rudiments are similar to the rudiments on the successive arches.

Free edges of operculum and preopercular flaps smooth except for weak serrations on the angle of the preoperculum.

Predorsal distance 2.3 in s.l. Anterior lobe present but relatively low (the shortest posterior ray is contained about twice in the length of the fourth, or longest ray). First three dorsal rays unbranched, the rest branched. Length of base of dorsal fin 2 in s.l. Anal fin similar in shape, the fifth-from-last ray 1.3 in the third, or longest, ray. Base of anal fin 2.8 in s.l. Pectoral fin relatively short, its length 3.7 in s.l.; its rays, except for those which form the leading edge, branched. Axis of base of pectoral more nearly vertical than horizontal, forming an angle greater than 45° with main horizontal of body. Prepectoral distance 3.4 in s.l. Insertion of ventral fin under anterior part of insertion of pectoral, the preventral distance 2.7 in s.l. Ventral spine short, about a third the length of the first (outermost) ray and only about half the length of the axillary scale sheath. Length of ventral fin 2.1 in head. Caudal lobes broken but apparently of about equal length. Central caudal rays long, nearly as long as caudal lobes, the posterior border of the fin clearly biconcave. Anus located a third of the way from origin of anal fin to insertion of innermost ventral fin ray.

Color:—This specimen almost completely faded. Traces of pigmentation remain in eye, the proximal half of ventral fin, the distal parts of the dorsal and anal fin membranes posterior to the lobes of these fins, in the proximal two-thirds of these lobes, and in the central parts of the caudal fin. The outer border of the caudal fin is colorless.

Description of Young:—As the size range of available *E. brevorti* (4.0–8.5 mm) does not overlap that of *E. illustris* (9.0–14.0 mm) a direct comparison is impossible. Larger *E. brevorti* probably resemble closely those of *E. illustris* described and figured on p. 13. Description of those young is limited by the scarcity of the material to the following notes, the more diagnostic of which are given in expanded type:

Formula: D 33, A 22, P 20; these elements fully formed at 5.5 mm s.l. Origin of dorsal fin over posterior end of abdominal cavity when first formed (ca. 5.0 mm s.l.), moving forward to lie, at 8.5 mm, at a point behind a vertical from base of pectoral. Origin of anal fin in posterior half of body; the fin present from 5 mm onward. Insertion of pectoral fin nearly vertical, the fin growing rapidly and at 6 mm extending posteriorly beyond the end of the bases of the vertical fins. Insertion of ventral fin well in advance of that of pectoral fin at all sizes, the fin growing rapidly, reaching origin of anal fin at 5.8 mm and considerably beyond at greater lengths. Caudal fin rounded. Elevation of urostyle takes place at 5.0–6.0 mm s.l. No scales apparent in this series, i.e., in fish shorter than 8.5 mm. The cluster of upswept preopercular spines charac-

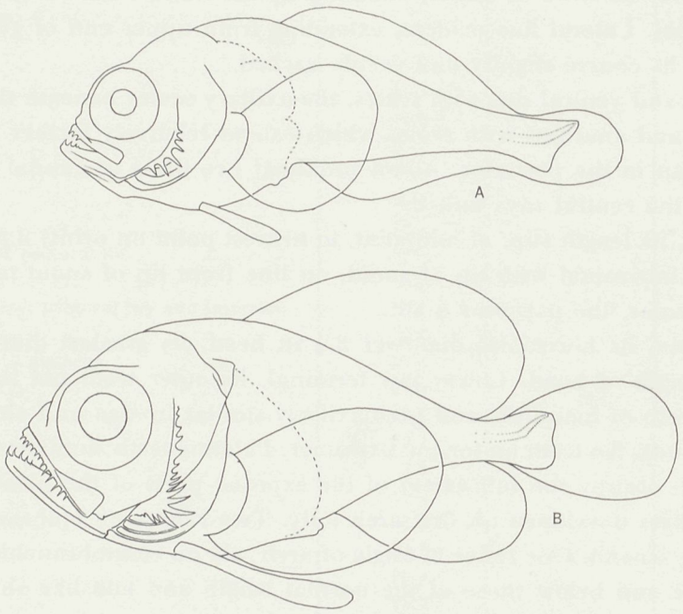


Fig. 4. Postlarval *Eumegistus brevorti* from D-4001 IV (3°56′ N, 12°32.5′ W, 6 III 30). (A) 6.1 mm s.l.; (B) 8.1 mm s.l. Drawn by N. Strekalovsky.

teristic of the genus is evident from about 6 mm s.l. Teeth present on posterior half of jaws by 5.5 mm s.l., as well as on the anterior. No enlarged anterior canines.

Size:—The species is known to attain a length of 290 mm, a size considerably shorter than that of its Pacific congener.

Range:—Known, as adults, only from the Havana fish market, and as larvae, only from waters off West Africa (see Study Material, above, and Fig. 1).

Synonyms and References.

Brama brevorti Poey, 1860 (1856–61):206, pl. 13, fig. 17 (orig. descr.; 410 mm spec. from off Cuba; fig. of outline of tail); Lunel, 1865:20 (orig. descr. repeated); Poey, 1868:358 (listed as rare; after Poey, 1860); Lütken, 1880:494 (mentioned, from Poey); Jordan and Evermann, 1896:959 (descr., from Poey, 1860); Bigelow and Schroeder, 1929:43 (notes from unpublished Poey sketch, which is reproduced here, that spec. has large scales, cf. *Brama*); Jordan, Evermann and Clark, 1930:265 (listed for Cuba).

Brama saussurii Lunel, 1865:21–28 (orig. descr. and fig., pl. 1, which is not wholly accurate; comp. with *B. brevorti*; type, in Geneva Mus., seen); Poey, 1868:358 (listed, after Lunel; not seen by Poey).

Taractes saussurii Jordan and Evermann, 1896:957 (descr., from Lunel, 1865, and Poey, 1868); Bigelow and Schroeder, 1929 (notes on identity); Jordan, Evermann and Clark, 1930:265 (listed from Havana, from Lunel, 1865); Duarte-Bello, 1959:79 (listed for Cuba).

Taractes (*Taractichthys*) *brevorti*, Mead and Maul, 1958:410 (in key as distinct from *T. saussuri*).

Taractes brevorti, Duarte-Bello, 1959:79 (listed for Cuba).

Eumegistus illustris JORDAN and JORDAN, 1922.

Plate 1; Figures 5 to 7.

Study Material:—The type: head, tail and fins of a specimen found in the Honolulu fish market and said to be "about two feet in length and weighing nearly nine pounds", CNHM 59325 (Fig. 5); a juvenile 121 mm s.l. taken in the fish trap at Manazuru, Sagami Bay, Japan, between December 1950 and April 1959 (presented to the MCZ by Dr. T. ABE (Fig. 6)); a badly-digested 63.5 mm fish (POFI 2687) from the

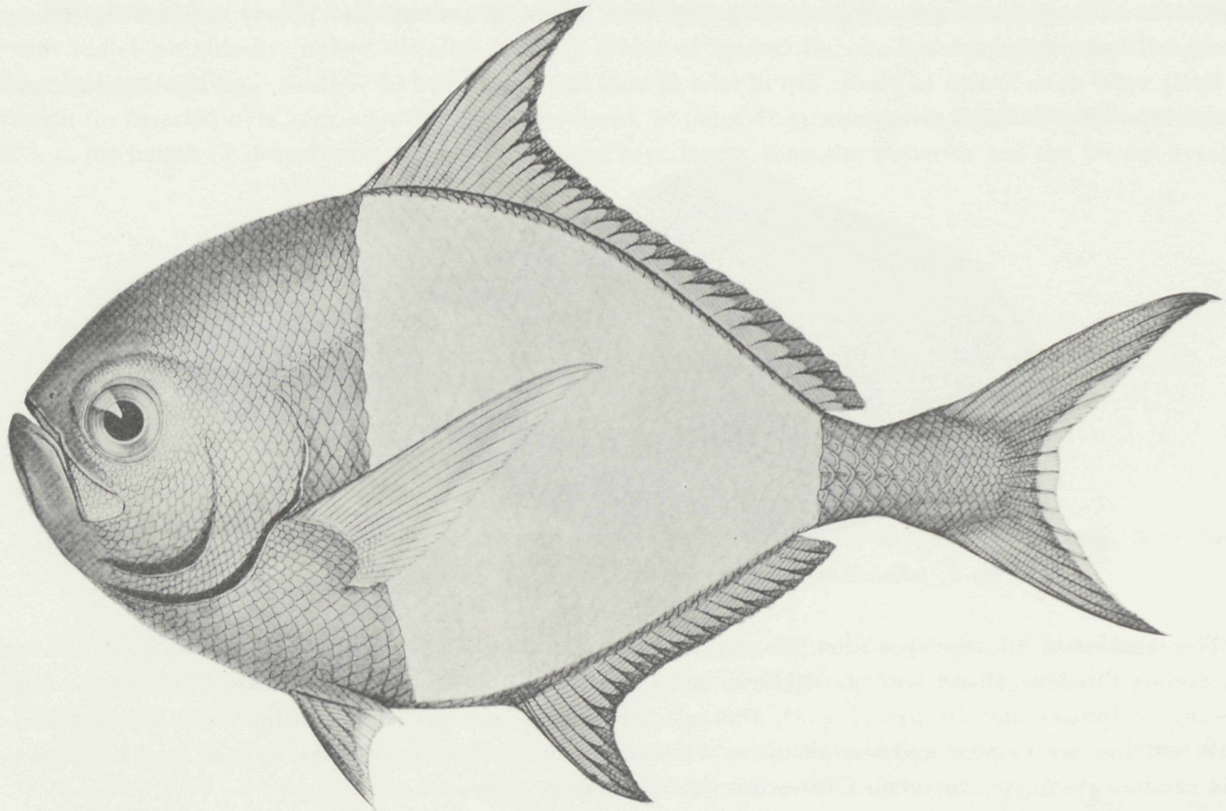


Fig. 5. Holotype of *Eumegistus illustris*, an adult "about two feet in length" from off Hawaii. Dark area represents that part of the specimen which was preserved. (From JORDAN and JORDAN, 1922.)

stomach of a tuna caught at an unknown Pacific Ocean locality; three early juveniles—9.0, 9.8, and 14.0 mm s.l. from D-3755 II (2°10′ N, 138°20′ E; 13 VII 29; 600 m.w.o.; S 200); and a fourth 9.6 mm s.l. from a nearby station (3746 II, 3°50′ N, 131°42′ E; 9 VII 29; 600 m.w.; S 200); and an adult, 470 mm s.l., caught by commercial fishermen near the bottom off the Hawaiian Islands (U. Hawaii coll.).

Distinctive Characters:—*E. illustris* can be distinguished from its Atlantic counterpart, *E. brevorti* POEY, by the meristic features used above in the "Key to Species". The lack of specimens of comparable size and the fragmentary nature of the type preclude close direct comparison.

Description of Adult:—This description is based on a 470 mm s.l. adult caught off Hawaii. Counts and proportional dimensions are provided in Table 1.

General form of body, squamation, fins, etc. more closely resembling the species of *Taractichthys* than other bramids. Head 4.1 in s.l., the lower jaw terminal. Anterior nostril nearly circular, the posterior a large slit. Eye elliptical, the long axis nearly vertical. Broad bands of teeth on jaws and palatines; none on vomer. Greatest depth of body, at origin of dorsal fin, 2.2 in s.l. Caudal peduncle stout and without transverse dorsal or ventral grooves; its least depth 3.6 in length of head. Ventral profile flat between and anterior to ventral fins, becoming somewhat keeled between ventral and anal fins. Anus twice as far from base of ventral fin as from origin of anal fin.

Predorsal length 5.5 in s.l.; preanal 1.7; preventral 3.0; prepectoral 3.7 in s.l. Dorsal and anal fins with acute anterior lobes, these fins non-depressible and with the rays rigidly bound together. Pectoral fin 3.2 in s.l., its base more nearly horizontal than vertical. Length of ventral fin 2.0 in head, the fins lying in a horizontal plane when expanded. Caudal fin stiff and biconcave, the bases of all rays inflexibly fixed to one another by connective tissue and the overlying scales.

Snout, lower part of mandible, free edges of operculum and preoperculum, paired fins and distal parts of vertical fins without scales, the rest of the body and fins with spineless scales of various sizes and shapes. Prominent axillary scales present beneath paired fins. There is a small and poorly defined scaleless area above and behind the eye.

Body color dark brown to black. Tip of lobe of anal fin, distal third of ventrals, and tip of central part of caudal fin white. Pectoral dusky.

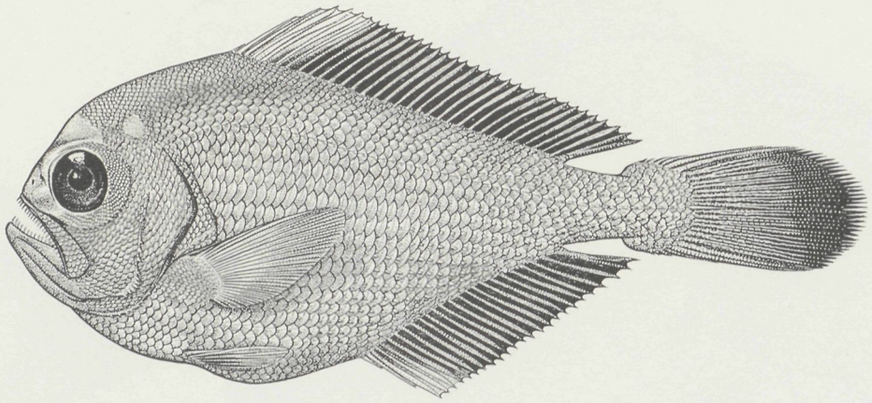


Fig. 6. Subadult of *Eumegistus illustris*, 121 mm s.l., from off Manazuru, Japan.

The remains of the type specimen, an adult, are now in the Chicago Natural History Museum. The parts constituting this type (head with paired fins, tail and vertical fins) is generally in accord with the original account by JORDAN and JORDAN (Fig. 5), although the lobes of the fins as shown there are too high and the small scaleless area above and behind the eye is not shown. Scale and vertebral counts, and body proportions cannot, of course, be verified from the type fragments at hand.

Description of Juveniles:—As only four small specimens have been identified with this species and these span a range of but 5 mm (9.0–14.0 mm, Fig. 7), no account of the development is offered. In addition to fin formula which can be determined by 9 mm, these young can be characterized as follows, the more diagnostic features appear in expanded type:

Origin of dorsal fin behind base of pectoral fin; high but without anterior lobe, and colorless. Anal fin similar to dorsal. Ventral fin inserted under the preoperculum at 9 mm s.l., shifting to beneath pectoral base at 14 mm, pigmented proximally and extending posteriorly to well beyond origin of anal fin. Caudal fin rounded and colorless. Largely naked below 10 mm (barring complete decalcification due to formalin). Preopercular spines: a unique group at angle arising from a plate and curved upward but lying in a single plane (cf. the short fringe-like series in *Taractichthys* and those of *Taractes* which include laterally directed spines). Gill membranes without pigment. Small sharp teeth in jaws, especially in the mandible; no enlarged and recurved anterior canines (i.e., no anterior tooth two or three times as long as its neighbor, cf. *Taractichthys*).

Counts and proportional dimensions of the single undigested larger juvenile, the 121 mm Japanese specimen, are included in Table 1. The head is relatively short, 3.7 in s.l. Eye nearly circular, not entering dorsal profile, about equal in diameter to length of snout. Interorbital relatively broad, 2.3 in h.l. Head fully covered by spinulose scales except for premaxillary and mandible, snout, forehead, and that part of circumorbital region adjacent to the posterior slit-shaped nostril and free edges of operculum and preoperculum. Snout and mandible covered by mucous pores. The preopercular spines forming the characteristic patch of juveniles

(concentric upswept spines lying in the single plane) becoming overgrown basally but still apparent. Free edge of suborbital with spines. Broad bands of conical teeth on jaws, the larger of which are depressible. A narrow band on each palatine, and two erect teeth on vomer. (The large adult type of this species has no vomerine teeth.) Typical lath-like gill rakers on first arch, the longest about two-thirds the length of the opposite gill filament, the rakers becoming progressively shorter above and below. Rakers reduced to spinulose plates on successive arches. Body posterior to head fully covered by spinulose scales, the spines becoming progressively larger and more antrorse posteriorly. Series of scales on mid-lateral line of caudal peduncle without spines except for the terminal scale of this series, the series anteriorly pierced by pores of the lateral line. Vertical fins with scales proximally, naked distally. Axillary scales of ventral fin much shorter relative to length of fin than in large adults.

Dorsal fin inserted over rear edge of base of pectoral, at point of greatest body depth. Predorsal distance 2.6 in s.l., the length of dorsal base 1.8 in s.l. Anterior rays longer than the posterior but the fin not notably

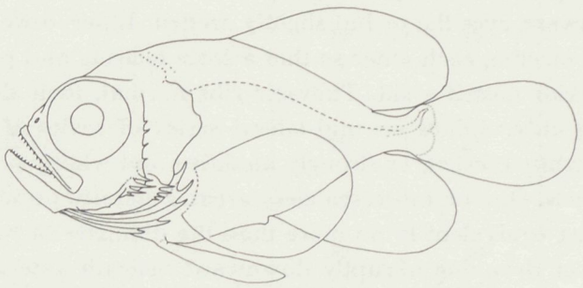


Fig. 7. Postlarval *Eumegistus illustris*, 9.8 mm s.l., from the western tropical Pacific at D-3755 II (2°10′ N, 138°20′ E, 13 VII 29). Drawn by N. Strekalovsky.

falcate. Anal fin similar in shape; preanal distance 1.8 in s.l.; length of anal base 2.8 in s.l. Caudal fin rounded. Pectoral fin short, its length 1.3 in h.l. Ventral fin relatively long, 1.7 in h.l. Anus in posterior fourth of distance between insertion of ventral fin and origin of anal fin.

In alcohol, the body and mouth are dark brown, the scaleless parts of the snout being darker than the head elsewhere. Caudal fin, dorsal and anal fins except for the white tips of the anterior rays, the proximal half of the central ventral rays, and the eye are black.

Size:—The largest known specimen is the original type which was said to be a little over 600 mm long.

Range and Habitat:—Known with certainty only from off Japan, Hawaii and, as early juveniles, northern New Guinea. The recently-captured Hawaiian adults were taken in a "particular place" off these islands in about 150 fathoms. The fishermen here believe it to be a bottom fish, in contrast to the wholly pelagic *Taractichthys* which is also known to them (W. A. Gosline, pers. comm., December 1963).

Common Names:—The Japanese vernacular "tchikame-etchiopia", meaning "shortsighted bramid" was coined by Abe (1961: 98).

Synonyms and References.

Eumegistus illustris Jordan and Jordan, 1922:36, pl. 10, fig. 1 (orig. descr.; Honolulu fish market; type now in CNHM, seen); Jordan, 1923:181 (generic type designation); Bigelow and Schroeder, 1929:42 (recognized without comment); Mead, 1957 (relationships cf. *Taractes* and *Taractichthys*); Mead and Maul, 1958:407 (from Jordan and Jordan, 1922); Gosline and Brock, 1960:181 (from orig. descr.).

Taractes steindachneri, Fowler, 1928:138, pl. 10, fig. B (608 mm spec. from Honolulu fish market now a cast in Bishop Mus.; photog.).

Brama raii, Fowler, 1928:137–138 (Hawaii, based on the type of *Eumegistus illustris* Jordan and Jordan).

Pseudotaractes saussuri, Abe, 1961 (in key to genera; type species; photog. and radiograph 120 mm spec. from Japan; vernaculars).

Genus **Taractes** Lowe, 1843.

Taractes Lowe, 1843:82–83; type species, by monotypy, *Taractes asper* Lowe, 1843:83.

Generic Synonyms:

Steinegeria Jordan and Evermann, 1887:467; type species, by monotypy, *Steinegeria rubescens* Jordan and Evermann, 1887.

Trachyberyx Roule, 1929:26; type species, by monotypy, *Trachyberyx barretoi* Roule, 1929:26 = *Taractes asper* Lowe, 1843.

Characters:—Dorsal fin originating behind head, over base of pectorals, the adults with an anterior dorsal lobe. Most elements in both dorsal and anal fins branched, these fins moderately stiff and erect in adults, covered by scales, and not depressible into a groove. No anterior dorsal or anal ray notably thicker than its neighbor. Ventral fin short and inserted under anterior half of base of pectoral. Pectoral fin terminating over anal lobe. Caudal fin moderately stiff, concave or somewhat biconcave in adults. Transverse precaudal grooves present but poorly developed.

Dorsal contour of head between eyes flat or but slightly arched. Inner, lower edges of mandibles posterior to symphysis of lower jaw not meeting each other so that a scale-bearing and pigmented patch of the isthmus is visible between them. Posterior nostril a slit. Thoracic ribs normal, their dorsal ends not expanded.

Spines on scales of young only. Spines on mid-lateral series of scales of caudal peduncle smooth and identical to their neighbors; slightly crested, or strongly modified and wholly or partially fused to form prominent and hard mid-lateral keels. One or more scaleless areas generally present above and behind eye; occasionally small and of an area equivalent to no more than the diameter of two or three scales. Lateral line of juveniles smoothly curved or dropping abruptly downward beneath anterior part of dorsal fin, obsolete in adults. Scales on caudal peduncle abruptly larger than those on proximal part of caudal fin.

Range:—All tropical and temperate seas; widespread but uncommon.

Species:—Two, here recognized, each cosmopolitan: *Taractes asper* Lowe, and *T. rubescens* (Jordan and Evermann).

Key to Species

A Caudal peduncle armed with a strong keel formed of enlarged and variously fused scales of variable number. Lateral line of adult obsolete, that of subadult forming a gentle curve between its origin near upper end of gill cleft and the mid-lateral straight and horizontal segment on the posterior part of the body.
Taractes rubescens (Jordan and Evermann 1887, p. 16).

AA Caudal peduncle without a keel, the scales of the mid-lateral series not notably different from those above and below. Lateral line generally present, the upper anterior segment dropping abruptly to the posterior at a point before the middle of the base of the dorsal fin. ..... *Taractes asper* Lowe, 1834, p. 21.

Taractes rubescens (Jordan and Evermann, 1887).

Plate 2a; Figures 8 to 10.

Study Material:—This account is based on two juveniles caught by "Dana" (Appendix Tables 3–4) and 16 juveniles and adults. Nine of the latter, a series ranging in length up to 690 mm, are in wretched condition because of commercial handling between capture by the Japanese longline fishery and the Tokyo Market, where they were secured by Dr. T. Abe. Only one bears locality data: 5°48′ N, 126°00′ W, 12 IV 61. The remaining material (Appendix Table 4) includes the type specimen.

Distinguishing Characters:—The heavy lateral keel on the caudal peduncle will distinguish *T. rubescens* from all other known bramids. In contrast to its congener, the lateral line, when present, curves gently downward from the upper end of gill cleft to the straight terminal segment. For morphometric and meristic differences, see Tables 2 and 3.

Description of Adult:—Body more nearly fusiform than that of most bramids, the greatest width 2.3 in greatest depth, the depth 2.5–2.6 in s.l., least depth of caudal peduncle 5.5–6.5 in greatest depth.

Table 2. Meristic Variation in *Taractes*.

Dorsal Fin	**30**	**31**	**32**	**33**	**34**	
T. asper		1	7	10	5	
T. rubescens	2	9	2			
Anal Fin	**21**	**22**	**23**	**24**	**25**	**26**
T. asper			3	5	8	4
T. rubescens	8	4	2			
Pectoral Fin	**18**	**19**	**20**	**21**	**22**	
T. asper	4	13	4			
T. rubescens		1	4	5	3	
Gill Rakers (total, excluding rudiments)	**8**	**9**	**10**	**11**	**12**	
T. asper	5	10	1			
T. rubescens		4	6	1	2	
Thoracic Vertebrae		**17**	**18**	**19**		
T. asper		2	6			
T. rubescens			6	2		
Abdominal Vertebrae (excluding urostyle)		**20**	**21**	**22**	**23**	
T. asper				4	4	
T. rubescens		2	3	3		
Total Vertebrae (including urostyle)		**39**	**40**	**41**	**42**	
T. asper				6	2	
T. rubescens		1	3	4		

Forehead slightly concave; nape sloping gently upward to origin of dorsal fin, which is at the deepest point of the body. Lower jaw terminal, meeting but not included within the upper with mouth closed. Anterior nostril circular, midway between snout and orbit; posterior nostril an oblique slit located midway between anterior nostril and orbit. Eye nearly round in a few specimens but more typically vertically elliptical. Edge of gill cover broad and smooth, terminating at or below a horizontal with top of orbit. Bands of small recurved, conical teeth on jaws; no enlarged canines. Symphyses of both jaws without teeth. Vomer naked; palatines bearing a short band of teeth which are smaller than those on the jaws. Gill rakers on first arch preceded above and below by rudimentary rakers. Rakers on successive arches represented by well-developed spinulose knobs. Gill filaments much longer than in more typical bramids, those on the first arch more than three times the length of the gill rakers opposite them.

Vertical fins falcate, the length of longest dorsal ray 1.2 in head. Predorsal length 2.4–2.6 in s.l., the length of the base 2.1 in s.l. These fins bear a dense covering of scales, each row inserted anteriorly on a fin ray and overlapping the next subsequent one posteriorly. Preanal length 1.6 in s.l., length of base 3.5–3.7 in s.l. Tips of posterior rays naked. Caudal fin, except for the distal parts of the central rays, with scales. Caudal lobes stout (as in scombrids, vs. *Brama*). Prepectoral length 2.9–3.2 in s.l., the fin extending nearly to middle of base of anal fin, 2.5–2.6 in s.l. Preventral length 2.6–2.8 in s.l., the fin truncate, its length 2.7 in length of head.

Snout, premaxillary, lower jaw, free edges of opercular and preopercular flaps, a small area or areas above and behind eye, and parts of caudal and paired fins naked; the body elsewhere covered by scales. Lateral line scales becoming indistinct with adult growth. Scales on spines present on young (see below), absent in adults. Axillary scales present and typical, those beneath ventral fin exceptionally long, frequently equal in length to the innermost ventral ray. Three to six scales on each side of caudal peduncle enlarged to form lateral keels. The form of these, through development, fusion, and perhaps wear, is quite variable.

Body and fins black except for the white crescentric area on the caudal fin, the caudal keels, the pectoral fin and, generally, the distal parts of the inner rays of the ventral fin. Mouth dusky but more nearly white than black.

Table 3. Proportional dimensions, in percent of standard length, and meristic data from selected adult and subadult specimens of *Taractes asper* and *T. rubescens*.

	T. rubescens			*T. asper*					
	Western Pacific (ABE 61-122; MCZ)	Gulf of Mexico (MCZ)	Gulf of Mexico (MCZ)	Western Pacific near Japan (3 specimens, MCZ)	Japan (ABE 60-1720; MCZ)	Eastern Atlantic, Spain to Norway (5 specimens)	Eastern Atlantic; type of *Trachyberyx barretoi* ROULE	Eastern Atlantic (MMF 3324)	Eastern Atlantic (BMNH 1953. 10.28.2)
Standard length (mm)	690.0	620.0	51.3	383–400	169.0	270–308	137.7	55.7	55.0
Fork length (percent)	109.5	110.0	131.5	112.5–114	120.0	112.6–115.9	–	136.0	132.0
Greatest depth of body	38.4	39.5	54.6	42.2– 45.5	46.6	38.7– 44.5	40.4	44.8	46.2
Least depth of caudal peduncle	7.0	6.1	8.0	7.1– 7.5	8.7	7.1– 8.2	9.1	10.6	9.6
Greatest width of body	16.7	16.9	24.4	–	15.3	12.4– 14.9	ca. 13.4	19.6	18.6
Greatest width of head	16.7	16.9	24.4	13.3– 15.3	16.6	14.9– 17.8	18.7	23.3	21.5
Snout to origin of dorsal fin	38.8	41.6	50.1	39.3– 40.2	38.1	38.2– 42.0	37.5	45.8	45.2
Snout to origin of anal fin	63.0	61.3	68.0	59.7– 62.2	63.0	57.6– 62.4	56.5	64.6	64.4
Snout to origin of ventral fin	39.1	35.2	43.3	35.4– 39.8	39.4	33.9– 37.0	36.8	35.9	35.4
Snout to origin of pectoral fin	34.1	31.4	40.6	31.0– 35.4	34.8	30.8– 33.0	33.8	36.6	38.2
Length of base of dorsal fin	47.8	47.3	44.6	50.1– 53.8	52.1	49.9– 52.2	49.9	47.6	46.4
Length of base of anal fin	28.3	26.8	27.7	35.7– 38.3	38.5	36.2– 38.5	39.5	34.7	36.4
Origin of dorsal fin to insertion of pectoral fin	28.0	29.0	39.0	28.7– 31.2	30.6	26.0– 30.1	32.3	32.5	33.6
Base of uppermost pectoral ray to that of lowermost	7.2	7.6	13.1	5.9– 6.4	8.3	6.6– 7.5	7.8	10.6	10.0
Base of lowermost pectoral ray to insertion of ventral fin	9.6	9.2	10.5	9.4– 10.0	10.3	7.3– 9.6	9.2	9.2	8.2
Insertion of ventral fin to origin of anal fin	29.7	30.6	32.7	26.1– 31.5	30.0	25.6– 31.1	28.6	33.8	36.0
Length of pectoral fin	39.7	38.2	40.0	31.3– 33.3	29.6	28.5– 32.9	–	35.0	33.8
Length of ventral fin	11.2	9.7	35.1	13.8– 17.7	24.3	14.5– 16.7	24.5	36.8	34.5
Length of 5th anal ray	–	–	28.9	28.3– 31.6	21.6	24.6– 30.4	24.0	31.0	–
Length of 5th-from-last anal ray	3.9	–	16.6	5.9– 7.6	13.7	10.4– 12.6	16.6	23.2	21.1
Length of 5th-from-last dorsal ray	4.5	3.2	25.3	ca. 7.0	13.9	10.9– 12.8	15.4	20.8	20.5
Length of upper caudal lobe	31.2		–	ca. 30.2	–	28.2– 32.6			
Length of lower caudal lobe	26.1	–	–	ca. 27.6	–	25.6– 28.9			
Length of central caudal ray	9.4	10.0	31.6	12.0– 12.6	21.6	13.6– 15.9		36.2	32.2
Length of head	30.8	30.2	42.9	30.7– 32.5	32.1	29.8– 32.8	34.5	39.5	40.4
Length of snout	9.3	9.7	10.7	8.2– 8.9	8.3	8.3– 9.6	9.1	9.2	10.0
Diameter of eye, horizontal	5.5	6.8	15.2	7.8– 8.3	8.9	7.2– 11.2	10.1	16.3	16.4
Diameter of eye, greatest	6.5	7.3	15.6	9.7– 10.7	9.6	9.3– 11.2	10.1	17.6	16.2

(To be continued.)

Table 3 (continued).

	T. rubescens			*T. asper*					
	Western Pacific (ABE 61-122; MCZ)	Gulf of Mexico (MCZ)	Gulf of Mexico (MCZ)	Western Pacific near Japan (3 specimens, MCZ)	Japan (ABE 60-1720; MCZ)	Eastern Atlantic, Spain to Norway (5 specimens)	Eastern Atlantic; type of *Trachyberyx barretoi* ROULE	Eastern Atlantic (MMF 3324)	Eastern Atlantic (BMNH 1953. 10.28.2)
Least distance between orbit and dorsal midline	6.2	6.9	5.7	4.3– 5.4	4.7	4.2– 5.6	6.0	4.7	5.4
Greatest distance between orbit and free edge of subopercle	16.4	15.3	17.7	14.0– 15.1	17.8	11.5– 14.7	16.3	15.8	15.3
Width of Interorbital	10.1	10.5	12.9	8.0– 10.1	9.2	9.3– 10.5	10.7	11.1	10.9
Length of upper jaw	14.5	14.8	23.4	16.2– 17.1	17.5	15.8– 17.8	19.3	21.5	22.2
Counts:									
Dorsal fin	31 1/2	31 1/2	31 1/2	32 1/2–33 1/2	33 1/2	33 1/2–34 1/2	34 1/2	32 1/2	33 1/2
Anal fin	22 1/2	22 1/2	21 1/2	24 1/2–25 1/2	24 1/2	25 1/2–26 1/2	26 1/2	23 1/2	25 1/2
Pectoral fin	21	20	21	18–19	18/18	18–19	19	19/19	20
Gill rakers	1+1+7	3+1+6	2+1+7	1+1+6–7	1+1+7	1+1+6–7	2+1+6	2+1+6	1+1+6
Scales in horizontal series	41+5[1]	45+5[1]	–	45–46	43	43–45	–	42	44
Vertebrae	–			17–18+22–23+1 = 41	18+22+1 = 41	18+23+1 = 42	–	–	–

[1] Scale counts on this species are worthless, for the horizontal series includes posteriorly the enlarged keel scales, the number being variable and generally not determinable because of fusions.

Variation:—Pacific adults seem to have better developed caudal keels and somewhat more anterior insertions of the ventral fins than the adult Atlantic material. The Atlantic form has more and better developed rakers on the upper limb of the first arch.

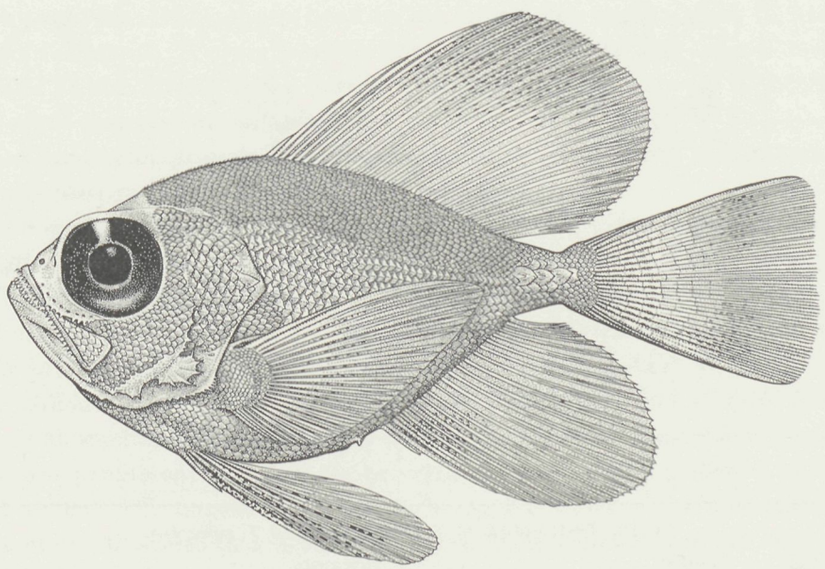


Fig. 8. *Taractes rubescens*, a juvenile 38.5 mm s.l., from the Pacific Ocean off Central America (D-3558 V, 0°18′ S, 99°07′ W). Drawn by N. STREKALOVSKY.

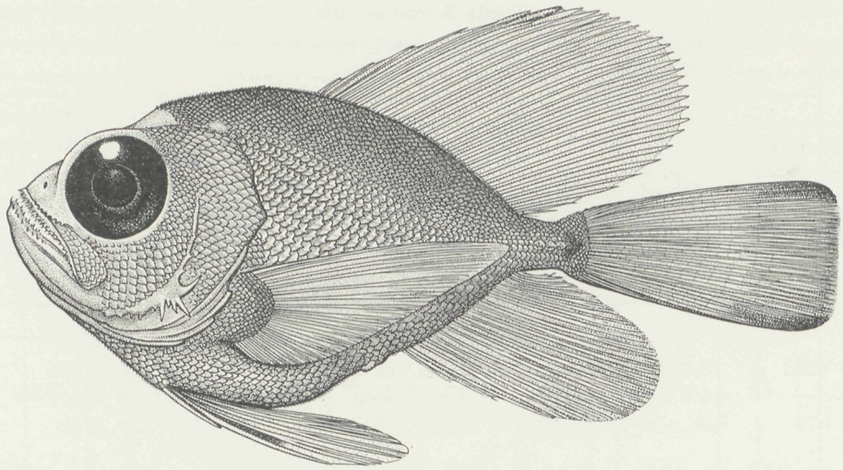


Fig. 9. *Taractes rubescens*, a juvenile 24.5 mm s.l., from the eastern Atlantic (D-4005 XI, 13°31′ N, 18°03′ W). Drawn by N. Strekalovsky.

Development:—The smallest specimen seen, 24.5 mm (Fig. 9), shows the smooth curve of the lateral line and the relatively large and crested scales of the caudal peduncle diagnostic of this species. Changes accompanying juvenile growth between this size and our largest juvenile (54.0 mm) parallel those reported for *T. asper*: shifts in relative positions of ventral and dorsal fins; decrease in relative lengths of head and eye; change from a rounded or truncate caudal fin to concave outline; and coloration. At 24.5 mm, fin coloration is restricted to a patch at the base of the ventral fin, a few melanophores at the tip of the anterior dorsal rays; and small pigmented areas at the tips of what are to become caudal lobes. At 38.5 mm, caudal and dorsal pigmentation has become more diffuse and similarly scattered melanophores have appeared in the anal fin (particularly its anterior part) while the ventral fin if viewed from above is uniformly dusky except for the tips but if seen from below shows two transverse bands of pigment: one near the base and another at about

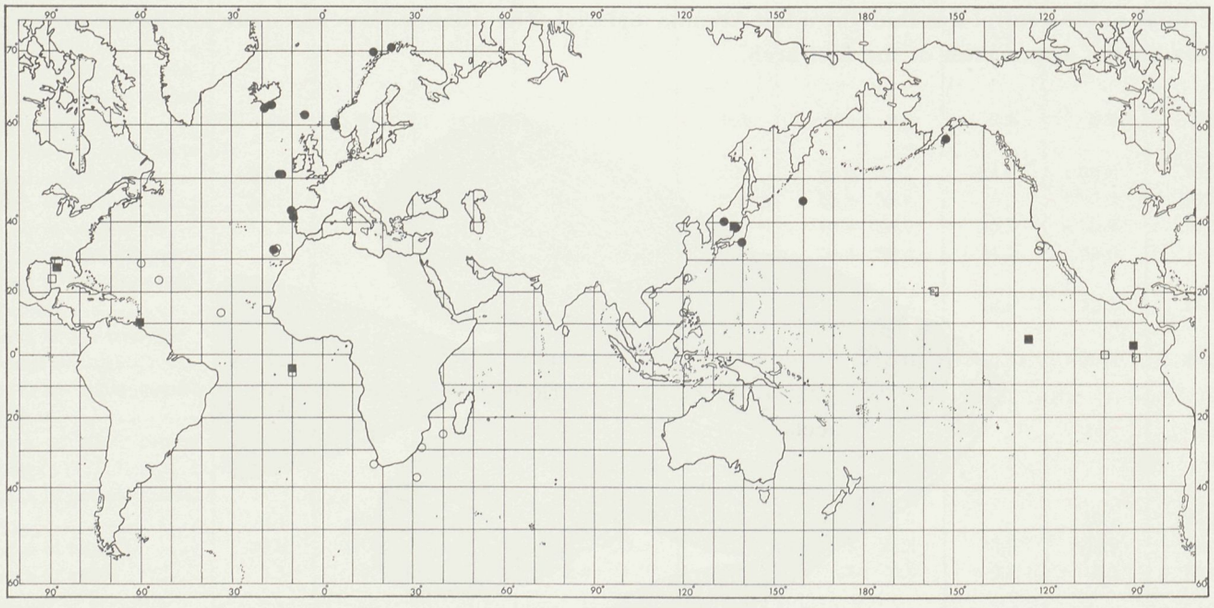


Fig. 10. Distribution of *Taractes asper* and *T. rubescens*.

T. asper
○ shorter than 100 mm s.l.
● longer than 100 mm s.l.

T. rubescens
□ shorter than 100 mm s.l.
■ longer than 100 mm s.l.

the third quarter of the length of the fin. At 54.0 mm pigmentation is more prominent and that of the dorsal and anal fins falls into transverse bands and two similar but vertical bands color the caudal fin.

Larvae and smaller juveniles are unknown. As diagnostic meristic, lateral line, or scale characters are probably apparent at 8 or 10 mm, it is doubtful that such young are present but overlooked or misidentified in the "Dana" or other material.

Range:—The adults are probably widespread in the tropical oceanic Pacific (T. ABE, personal communication based on his knowledge of the catches made by Japanese longliners) although known positions are few. Neither adults nor young are known from the Indian Ocean. The existence of this species in the eastern Atlantic is based on the single "Dana" juvenile caught off westernmost Africa and the larger juvenile taken by "Geronimo". The only records from elsewhere in the Atlantic are the three from the Gulf of Mexico and a large adult caught off Trinidad.

Remarks:—*T. rubescens* is landed as a commercial fish when caught incidental to the tuna fishery by the Japanese. They reach a length of over 700 mm and a weight in excess of 25 pounds. Elsewhere the species is a collectors' item and more specimens, especially larvae and adolescents, are urgently needed.

Vernacular Name:—The Japanese vernacular, "Tsurugi-etchiopia", was coined by T. ABE (1961: 99).

Synonyms and References.

Steinegeria rubescens JORDAN and EVERMANN, 1887:467–468 (orig. descr., no fig., from stom. "red grouper" caught in Gulf of Mexico off Pensacola, Florida; type, in USNM, seen); JORDAN and EVERMANN, 1896:960–962 (descr., from JORDAN and EVERMANN, 1887); BREDER, 1929:146 (listed, from orig. account; provided coined vernaculars: red pomfret, and deep-water pomfrets for the family); JORDAN, EVERMANN and CLARK, 1930:266 (listed for Gulf of Mexico); ABE, 1961 (figs., Japan; key to genera; considers *Steinegeria* generically distinct from *Taractes*); HONMA and MIZUSAWA, 1965:55 (rec. and fig. 266 mm spec. from Royotsu Bay, Sado I., Sea of Japan).

Taractes (*Taractes*) *rubescens*, MEAD and MAUL, 1958 (relationships, descr., figs. of Gulf of Mexico adult, type of *T. rubescens*, 54 mm juv. from Gulf of Mexico, and 27.5 mm spec. from Hawaii; synon.).

Taractes asper LOWE, 1843.

Plate 2b; Figures 11 to 13.

Study Material:—The "Dana" collections contained but four juveniles (Appendix Table 1). Additional specimens include adults from the northeastern Atlantic and off Japan and a series of juveniles (Appendix Table 2) variously taken in all three major oceans.

Distinctive Characters:—The sharp bend in the lateral line and the lack of heavy bony keel on the caudal peduncle will distinguish *T. asper* from its congener. There are also morphometric and meristic differences (Tables 2 and 3), the former being currently of limited value because of known differential growth and the scarcity of adult material of suitable size.

Description:—Counts and proportional dimensions taken from adult and subadult representatives of *Taractes asper* are provided in Tables 2 and 3.

Adults, 270 to 400 mm: Body fusiform and compressed, the greatest depth, at origin of dorsal fin 2.2–2.5 in standard length; the greatest width, above bases of pectoral fins, 3–4 in greatest depth of body. Snout, interorbital space, mandible and free angles of preoperculum and operculum naked. Usually present is a small scaleless area dorsal and anterior to the upper end of the gill cleft. This area may be absent or quite small, but is usually prominent. The remainder of head, body and vertical fins with scales. Scales on head heavily striated but without spines. Body scales, except for those below and anterior to the origin and dorsal fin and on the belly, with median horizontal ridges which, especially in smaller fish, are produced into spines. Anteriorly these are less prominent and retrorse or vertical; those on the posterior part of the body are antrorse and more prominent. The largest spines are those on the scales of the mid-lateral series of the caudal peduncle. There are about 43 scales in a horizontal series, from upper end of gill cleft to base of midcaudal ray, the last markedly larger than those overlying the caudal rays. In contrast to the juveniles, the lateral line of adults is indistinct or absent.

Scalation on dorsal and anal lobes nearly complete, the scales small, elongate and imbricate. The more posterior parts of these fins are covered by scales proximally but are naked distally, the scale-bearing areas decreasing posteriorly so that the last dorsal and anal rays are largely naked. Extreme bases of pectoral and ventral fins with scales, and prominent axillary scales are present beneath the bases of the fins. Caudal lobes with scales, but the crescentic lightly-pigmented area centered on the midcaudal rays is scaleless.

Snout short and blunt, its length 3.5–4.2 in length of head. Upper edges of nostrils on a horizontal with tip of snout, the anterior circular, the posterior a vertical slit. Eye obliquely elliptical, its greatest diameter about 3 in length of head. Interorbital space broad and nearly flat. Lower jaw massive and covered with minute pores; neither its free margin nor its outer teeth lying within the upper jaw when the mouth is closed. Free edges of preoperculum and operculum unevenly rounded and finely serrated but without spines.

Teeth in maxillary and premaxillary similar to one another in shape, being round in cross-section and recurved. Those in mandible larger than those in premaxillary and forming two rows, the outer composed of larger teeth than the inner. Premaxillary teeth within a single band but irregularly spaced within it. No teeth at symphysis of upper jaw or on tongue. Vomer generally toothless (a few small teeth present in some Japanese specimens). Palatine with or without teeth, these small and in a single series when present.

First gill arch usually with one raker above angle, one based in both the epibranchial and ceratobranchial, and six or seven on the ceratobranchial. There are spinulose rudiments above and below these on the first arch, and on the successive arches in lieu of rakers.

Predorsal distance 2.4–2.6 in standard length, the dorsal fin with a prominent anterior lobe. Fifth or sixth rays longest, the lobe changing markedly with growth from juvenile to adult. Four or five anterior dorsal rays unbranched. Anal fin similar in shape to dorsal, the preanal distance 1.6–1.8 in length. Base of pectoral fin set at an angle of about 45° with horizontal axis of the body. Upper three or four rays, and usually the lowermost one or two, simple; the rest branched. Length of pectoral .9–1.1 in length of head. Prepectoral distance 2.8–3.3 in standard length. Ventral fin inserted just anterior to a vertical from anteriormost point of pectoral insertion, the fin relatively long compared to those of most bramids but decreasing in relative size with growth of fish. Area between insertions of outer rays of the two ventral fins flat; this area, and the expanded fins, lying in a horizontal plane. Preventral distance 2.5–3.0 in length. Upper caudal lobe usually slightly longer than lower. In adults, the posterior profile of the caudal fin is usually evenly concave, although occasionally the central caudal rays form a nearly straight posterior outline.

Anus located about one-fourth of distance from origin of anal fin to insertion of inner rays of ventral fin.

Of the study specimens available only that caught off Vigo has retained pigmentation. The head and body of this specimen are a uniform dark brown. The dorsal, anal and caudal lobes are of similar tone. The pectoral fin is pigmented but pale, the pigment being most intense on the inner, dorsal part of the fin. Those areas of the low posterior parts of the dorsal and anal fins which bear scales are nearly as dark as the body; distal to this coloration is a pigment-free horizontal band which extends from about the mid-point of the fin just behind the anterior lobe to near the bases of the last dorsal and anal rays. These fins, distal to this light band, are dark. The ventral fins are dark, especially when viewed from above, the pigment being most intense in the membrane among the rays and at the tips of the fins. The tongue is dusky, but the other pharyngeal linings and the peritoneum are unpigmented.

Changes accompanying growth between 169 and 300 m s.l. include the transformation of a truncate caudal fin to a concave one, the formation of anterior lobes in the dorsal and anal fins, a relative shortening of the paired fins, the further displacement posteriorly of the ventral fins, the obliteration of juvenile fin pigmentation and preopercular spines and the further reduction of vertical spines and ridges on the body scales. Scales are restricted to the basal parts of caudal lobes and anterior vertical fins. In a 169 mm specimen the dorsal, anal and pectoral fins are uniformly dusky and the ventrals, except basally, are black. The lateral line, with its characteristic abrupt downward segment, is still clearly apparent.

Even greater changes occur between 19 and 169 mm. Changes in body form include a relative decrease in predorsal length and an increase in that of the body between verticals of origins of dorsal and anal fins; a shift posteriorly of the insertion of the ventral fin which at 19 mm is well before the pectoral base but beneath

the anterior edge of this base at 169 mm; a relative decrease in the width of body and head; a decrease in length of the head and most of its parts such as snout, eye, and upper jaw; a decrease in the width of the base of the pectoral fin; and a reduction of relative lengths or heights of all fins. The caudal, rounded at 19 mm, is truncate at 169 mm and concave thereafter. Scalation on vertical fins begins at some length greater than 60 mm, for below that length all fins are naked. Scale formation on head and body, however, is essentially complete at 20 mm although the vertical ridges or spines increase in relative size to about 30 mm s.l.

Typical juvenile coloration persists between 19 and 60 mm s.l. The head and body are dark brown or, in fresh specimens, nearly black. The more-or-less random pigmentation on the inner surfaces of the pectoral increase in intensity, as do the horizontal bands in the dorsal and anal fin. Each fin has two such bands.

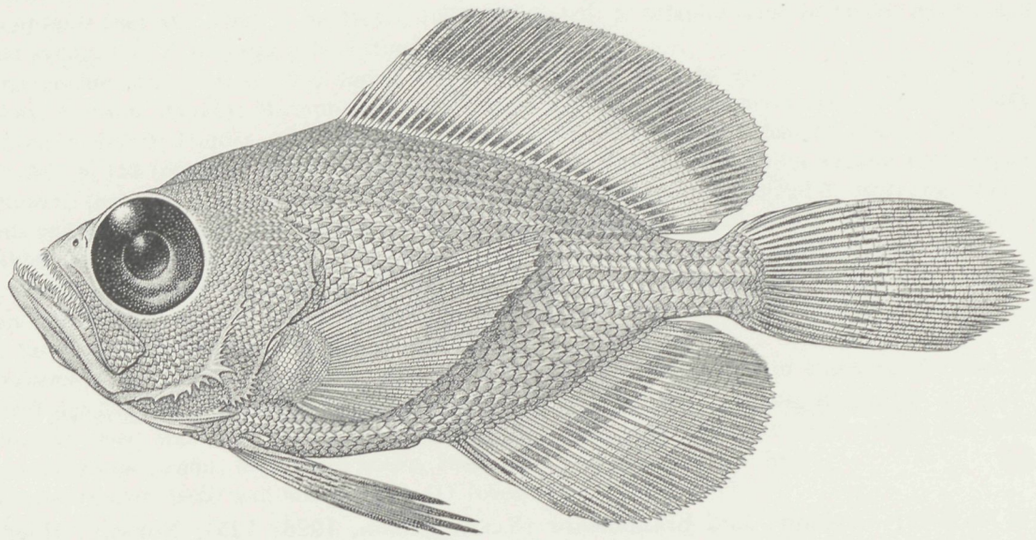


Fig. 11. *Taractes asper*, a juvenile 55.7 mm s.l. from Madeira (MMF 3324; MCZ). Drawn by N. Strekalovsky.

Development:—Only three specimens shorter than 19 mm (9.1, 10.0, and 14.9 mm) can be referred to *T. asper*, hence no substantial account of larval development is possible. The following remarks are submitted to provide data with which the accounts of other bramids can be compared, the more diagnostic characters appear in expanded type:

Fin formula: D 31–35, A 22–26, P 18–20; Vertebrae 17–18 + 22–23 = 41–42; all meristic elements present at 9.1 mm. Dorsal fin with origin at about middle of body at 9.1 mm, slightly more advanced at 14.9 mm; colorless. Anal fin colorless, its origin under about eighth dorsal ray. Pectoral fin relatively longer at 9.1 mm than at 14.9 mm, it base broad and low. Ventral fin inserted just anterior to pectoral base at 9.1 mm; moving anteriorly (and again posteriorly in late juveniles, see above); its tip extending well beyond origin of anal fin. Primordial scales on head and body at 9.1 mm. The diagnostic patch of preopercular spines (Fig. 11) which includes laterally directed as well as posteriorly directed spines incompletely developed at 14.9 mm. This patch formed by the rotation outward of the upper and lower spines of the 5 or 6 forming this cluster; at 10.0 mm s.l. and below, these spines do not differ appreciably from those of *Brama*. No enlarged anterior larval canines; teeth present in posterior half of premaxillary at 9.1 mm s.l.

Size and Abundance:—The largest specimen studied, 450 mm, is the Icelandic type, although larger individuals have been caught by the Japanese longline fishery. The species is nowhere abundant although it is not infrequently caught incidental to the fishery for *Brama* off northwestern Spain. Captures there are said to be more frequent during the winter than in summer, and the records are more numerous than those of the other bramid species similarly caught, *Pterycombus brama**.

* Information contributed by B. Andreu and his associates in the Instituto de Investigaciones Pesqueras, Vigo, Spain.

Distribution:—Larvae or juveniles shorter than 20 mm s.l. are now known from the Sargasso Sea north of the more eastern Antilles; waters off Formosa and the northern Philippines; and the subtropical southwestern Indian Ocean from off Southern Madagascar to a parallel somewhat south of the Cape. Juveniles 20-60 mm s.l. are known from these South African and Sargasso localities, and from Madeira and the coast of central California. Spawning in the subtropics is suggested, but numbers of captures are too few for further speculation.

Adolescents and adults are wide ranging, from waters off Japan and the Kuriles to off Kodiak Island, Alaska*; and in the eastern Atlantic from off North Africa to Iceland, the Faroes (Holgersen, 1961, a sight record) and northern Norway. The only Southern Hemisphere records are those of young juveniles caught off South Africa.



Fig. 12. *Taractes asper*, 14.9 mm s.l., from the western North Atlantic (D-947, 23°10′ N, 66°15′ W). Drawn by N. Strekalovsky.

Common Names:—Iceland: Litli bramafiskur (Saemundsson, 1926: 125); Norway: Høgfinnet havbrasme (Holgersen, 1961); Sweden: Rasch's havsbraxen (Anon., 1914: 23); Japan: Sagami-manzaiuo (Abe, 1962: 103).

Synonyms and References.

Taractes asper Lowe, 1843:82–83 (orig. descr., Madeira; no fig.; type lost); 1844:391 (redescr., from Lowe, 1843); Günther, 1860:410 (descr., from Lowe, 1843); Lunel, 1865:29 (descr. from Lowe); Bleeker, 1876:299 (diagnosis from Lowe; placed in subfamily Lepidontiformes of Fam. Chaetodontoidei); Bigelow and Schroeder, 1929:43 (notes on ident. Lowe spec.); Reintjes and King, 1953:98 (stom. cont. central Pacific yellowfin tuna); Abe, 1961 (in key to genera; Japan; correctly notes relationship of *T. platycephalus*, *T. asper* and *T. raschii*); Radovich, 1961:18, 36–37 (rec. juv. spewed up by albacore taken at 33°10′ N, 122°25′ W, July, 1959; UCLA coll.); Larkins, 1964 (rec. from gill net NE Pacific); Grindley and Penrith, 1965:284 (rec. juvs. from mid-water trawl off Natal coast S Africa); J. L. B. Smith, 1966:70–71 (rec. and descr. with fig. 51 mm spec. from docks at Cape Town, S Africa; comp. with *Trachyberyx barretoi*).

Brama raschii Esmark, 1862:238–247 (orig. descr. spec. from off N coast Norway; in Oslo Mus., seen); Lunel, 1865: 17–18 (descr. from Esmark); Esmark, 1868:521 cf. *T. longipinnis* Lowe); Van Beneden, 1871:44 (mentioned in connection with *B. brama*); Collin, 1874:418 (Scandinavian occur. incl. loc. Esmark's type spec.; rel. to *longipinnis*); Collett, 1875:46 (rec. from Varge-fjord in 1860; discuss *raschii* vs. *longipinnis* question); Saemundsson, 1903:20 (mention only of 1870 spec. from Vestmannaer Is.; first Icelandic rec., in Icelandic); Saemundsson, 1909:10 (Icelandic recs.); Anon., 1914:23 (part, range in NE Atlantic but considered synon. with *T. longipinnis*); Saemundsson, 1926:125–126 (fig. descr. in Icelandic); Lundbeck, 1933:9 (44 cm spec. from Iceland); Ehrenbaum, 1936:263 (notes 1870 Iceland and 1860 Finmark recs.); Saemundsson, 1949:18, 133, 135, 139 (occur. Iceland; refs.; rep. for Norway, Britain but not Faroes, E or W Greenland or N America and only S coast Iceland); Holgersen, 1959: 129–130 (resumé Norwegian recs.); Rasmussen and Dannevig, *in* Rollefsen, 1960, fig. 172 (excellent fig. on unnumbered p.); Mathiasson, 1962:18 (rec. adult trawled at 140 fms near Nordsjön, WSW of Utsira, Norway, 11 III 62).

* C. R. Hitz (pers. comm. and photograph, 18 IV 62).

Taractes raschii Lütken, 1880:494 (noted only); Saemundsson, 1903:46 (Iceland rec.); Saemundsson, 1927 b:13 (from Collin spec. from Iceland; rec. only); Barnard, 1927: 595–596 (relationships, recogn. of ident. species rep. by Smitt, 1893; comp. with *T. longipinnis*); Bigelow and Schroeder, 1929 (to synon. *T. princeps*, following Smitt et al., 1893); Mead, 1957 (relationships; fig. from Smitt et al.); Holgersen, 1961 (Vindafjord rec., distrib., taxonomy and rel. to *T. longipinnis*); Abe, 1962:104–105, figs. p. 113 (560 mm spec. from Tokyo mkt. descr. and fig.); Blacker, 1962:263 (rec. 2 spec. from the "Farm" area, 25 VIII 60: 51°36′ N, 14°04′ W; 250 fms; and 51°50′ N, 13°41′ W at 300 fms.; synopsis N Atlantic recs.).

Brama longipinnis (not of Lowe), Smitt, Fries, Ekström and Sundevall, 1893:80–82 (part, fig. from Esmark; descr. and synon., N Atlantic); Knipovich, 1926:88 (fig., *T. raschii* considered a synon.).

Trachyberyx barretoi Roule, 1929:26 (orig. descr.; type 153 mm from stomach *Aphanopus* caught off Madeira; comp. with the berycoids, with which it was said to be allied; fig. and descr.; type, in Monaco Mus., seen); Fowler, 1936 a: 1269 (as a berycid; descr. from Roule; terrible fig.).

Lepidotus longipinnis (not of Lowe), ? de Buen, 1935:102 (listed; S Atlantic coast of Spain; *raschii* and *longipinnis* considered synon. but *T. princeps* held distinct).

Taractes platycephalus Matsubara, 1936 (orig. descr., fig., Japan; key to species); Okada, 1938:172 (listed for Sagami Bay, Honshu, Japan); Matsubara, 1955:542 (in key, fig., in Japanese); Mead, 1957 (in key, considered distinct from *T. asper*); Honma, 1962:130 (rec. 280 mm spec. from Sea of Japan off Nigata Pref.; photog.); Abe, 1962:103, figs. p. 112 (noted as possibly synon. with *T. asper*; 212 mm spec. from Sagami Bay, Japan; descr.).

Taractes longipinnis (not of Lowe), Fowler, 1936:653–654 (part, descr. appears to be of *T. asper*; fig., said to be *Taractes longipinnis* and from Lowe, is of *T. raschii* and taken from Smitt et al., 1893, or from the Esmark original; localities include those for both *T. asper* and *T. longipinnis*, from lit.); Arté, 1952:100–101 (reps. 3 spec., 351–367 mm, taken in bramid fishery off Vigo, Spain); Andriashev, 1954:215 (descr. and fig. from Smitt et al., 1893; distrib. and synon. N Atlantic); Albuquerque, 1954–1956 (part, fig. of *T. raschii* from Smitt et al. and Esmark via Fowler, not from Lowe as stated; descr. and synon.; Portugal).

Taractes steindachneri (not of Döderlein), Parin, 1958:162–166 (fig. and descr., in Russian, of 42 cm spec. taken in salmon drift net 350 mi E of central Kurile I. chain at ca. 45° N, 160° E; synon. in error).

Taractes (*Taractes*) *asper*, Mead and Maul, 1958 (relationships and descr.; figs. 110, 56.5 and 30 mm spec.; synon.).

Taractes (*Taractes*) *platycephalus*, Mead and Maul, 1958:411 (considered valid in key).

Taractes (*Taractes*) *raschii*, Mead and Maul, 1958:411 (considered valid in key).

Genus **Brama** Bloch and Schneider, 1801.

Brama Bloch and Schneider, 1801:98; type species, subsequently designated by Bory de St. Vincent, 1823:260, *Sparus raii* Bloch, 1791; = *Sparus brama* Bonnaterre, 1788.

Generic Synonyms:

Lepidotus Asso y del Rio, 1801:38; type species, by monotypy, *Lepidotus catalonicus* Asso y del Rio, 1801; = *Sparus brama* Bonnaterre, 1788.

Lepodus Rafinesque-Schmaltz, 1810 a:53; type species, by monotypy, *Lepodus saragus* Rafinesque-Schmaltz, 1810:54; = *Sparus brama* Bonnaterre, 1788.

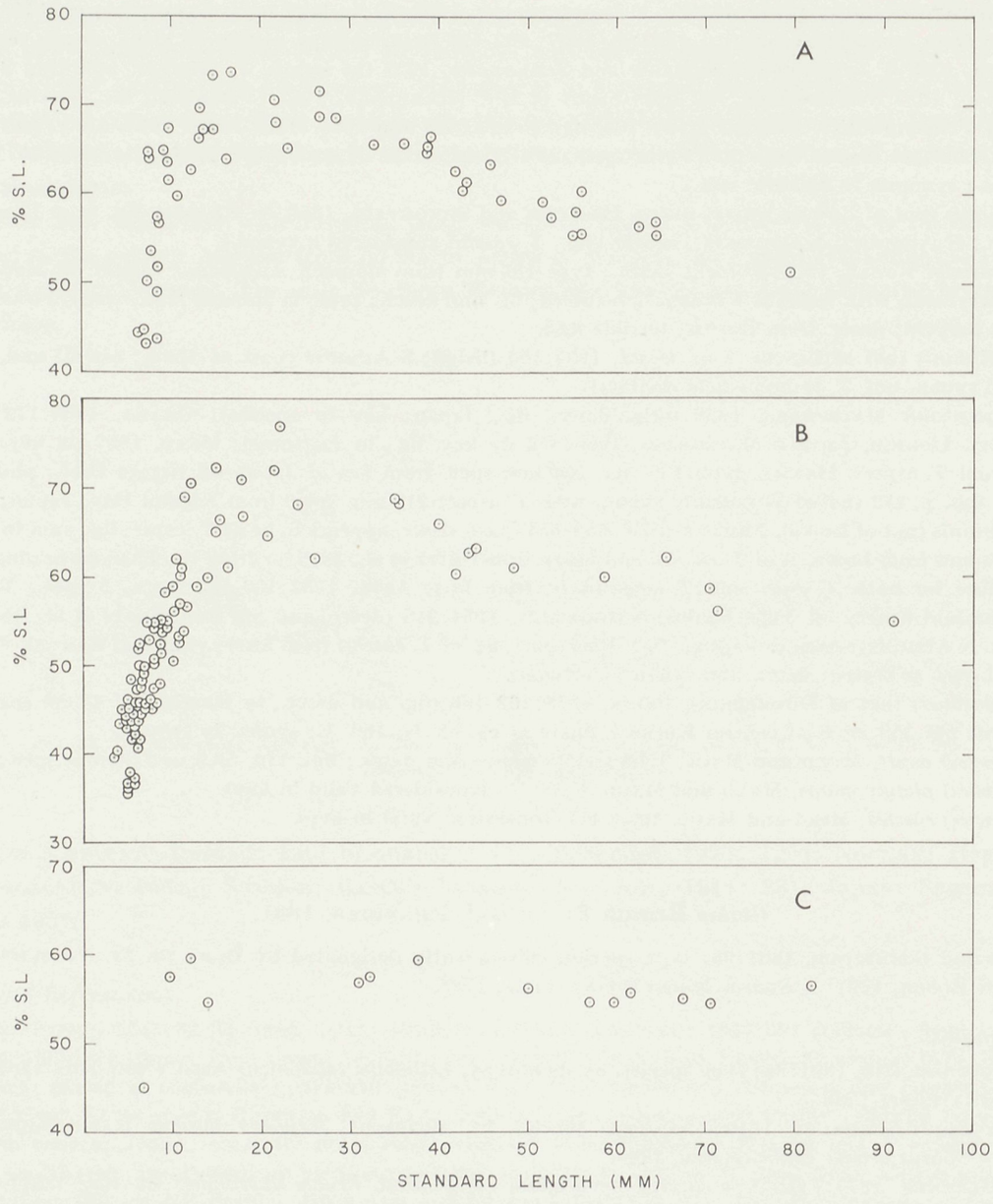
Tylometopon Bleeker, 1873:133; type species, by original designation, *Brama dussumieri* Cuvier, 1831; the generic name ex "Van Bemm." according to Bleeker, "Van Beneden" according to Jordan, 1919 (1917–1920):367.

Amblytoxotes Bleeker, 1876:311; type species, by monotypy, *Toxotes squamosus* Hutton, 1875:313, = *Sparus brama* Bonnaterre, 1788.

Collybus Snyder, 1904:525; type species, by original designation, *Collybus drachme* Snyder, 1904:525, = *Brama orcini* Cuvier, 1831.

Characters:—Dorsal fin originating behind head, over base of pectoral, the adults with an anterior dorsal lobe; most of the elements in dorsal and anal fin branched, and both fins moderately stiff, erect and covered with scales, and not depressible into a groove. No anterior dorsal or anal fin ray notably thicker than its neighbor. Ventral fins of adult short and inserted under posterior half of base of pectoral fin. Pectoral fin terminating over or just behind lobe of anal fin. Caudal fin moderately stiff, its contour rounded in young and deeply and evenly concave in adults. Transverse precaudal grooves present but poorly developed.

Dorsal profile of head strongly arched and rounded. Inner lower edges of mandible posterior to symphysis of lower jaw touching each other so that no part of the isthmus beneath is normally visible. Posterior nostril a slit. Thoracic ribs normal, their dorsal ends not expanded.



Spines on scales of young less prominent than in other genera and lost in most juveniles by a standard length of 80 mm. No enlarged spines or keels on caudal peduncle. No scaleless area above and behind eye. Lateral line evident only in juveniles. Mid-lateral scales of caudal peduncle unspecialized, these scales decreasing in size gradually to form a graded series with the smaller scales on the midcaudal rays.

Commercial Importance:—Those species that are both abundant and attain a large size are highly prized for food. While the only commercial fishery at the moment is that off the Atlantic coasts of Spain and Portugal (see p. 42 and Mead and Haedrich, 1965), I remain convinced that equivalent fisheries will be developed for *B. brama* in the southern hemisphere and *B. japonica* in the North Pacific when the migratory habits and water preferences of these populations are more fully understood. Its excellence as a food fish has long been known, as two representative statements will attest: Davies (1949: 32), writing of the South African population, notes that "Although very few *Brama raii* were included in samples from the trawlers, it is probably not as rare as it would seem, as there is always a rush made by the crew to get these fish from the last haul for 'frys'."; and McCoy (1887: 128–129), the notable Australian zoologist, reports that

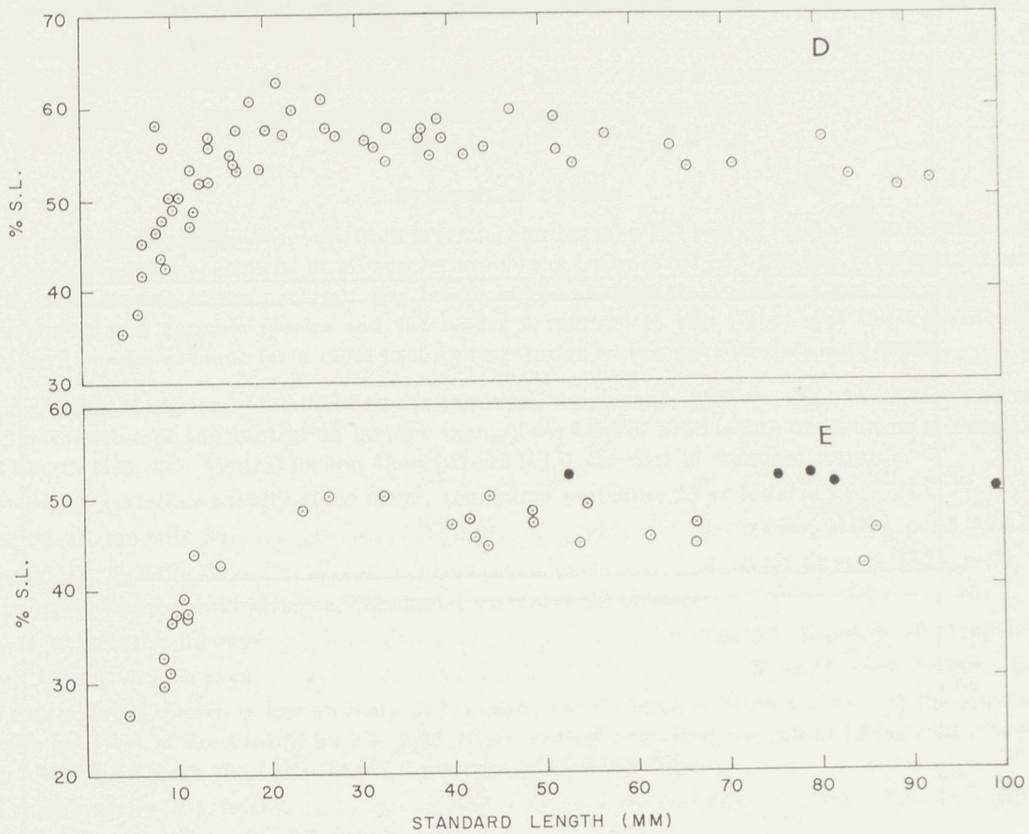


Fig. 13. (Opposite and above) Relative greatest depth of body in juvenile *Brama*: (A) *Brama caribbea*; (B) *B. orcini*; (C) *B. myersi*; (D) *B. dussumieri*; (E) *B. japonica* (open circles) and *B. brama* (solid circles).

"This is considered one of the most delicious fishes for the table of the Mediterranean, and the readiness with which the gourmets of Victoria recognize this quality in so unusual a visitor to our shores is rather amusing, most pressing letters requiring the name of this god-send arriving by every post for some time afterward."

The bramids are of considerable secondary importance as forage fishes. Clarke (1935) took a twelve-inch specimen of *B. brama* from the stomach of a North Atlantic cod and the species is doubtless preyed on occasionally by other ground fish; but the primary significance in this regard is with the oceanic predators such as the tunas and billfishes. Indeed much of the study material available for this report came from the stomachs of such fishes, and the contribution to the diet of these in the central Pacific has been reviewed in such papers as those of Reintjes and King (1953), Iversen (1962), and King and Iversen (1962). The more important species of *Brama* here are the tropical, the ranges of which more closely conform to those of the scombroids than do those of cold temperate *Brama brama* and *B. japonica*. Similarly, Manday (1964: 6) noted that about 37% of the diet of the Cuban broadbill swordfish (*Xiphias*) that he examined was composed of bramids (probably *B. dussumieri* and *B. caribbea* and not *B. raii* as reported).

Range:—The genus is worldwide save for the truly Arctic and Antarctic seas, but most species are tropical or subtropical. All species are pelagic and live, as adults, from the surface down to a depth below 400 meters. The young are found at lesser depths and spawning probably takes place near the surface, where the smallest larvae have been caught. Two, *Brama orcini* and *B. caribbea*, appear to be more closely bound to land masses than are their high-seas congeners.

Species:—Nominal species are legion but few have been based on comparative distinctions of substance. Seven are recognized here. One of these, which I believe to be undescribed, is diagnosed but not named because there is no appropriate comparative material. *B. dussumieri* and the pseudopelagic *B. orcini* and *B.*

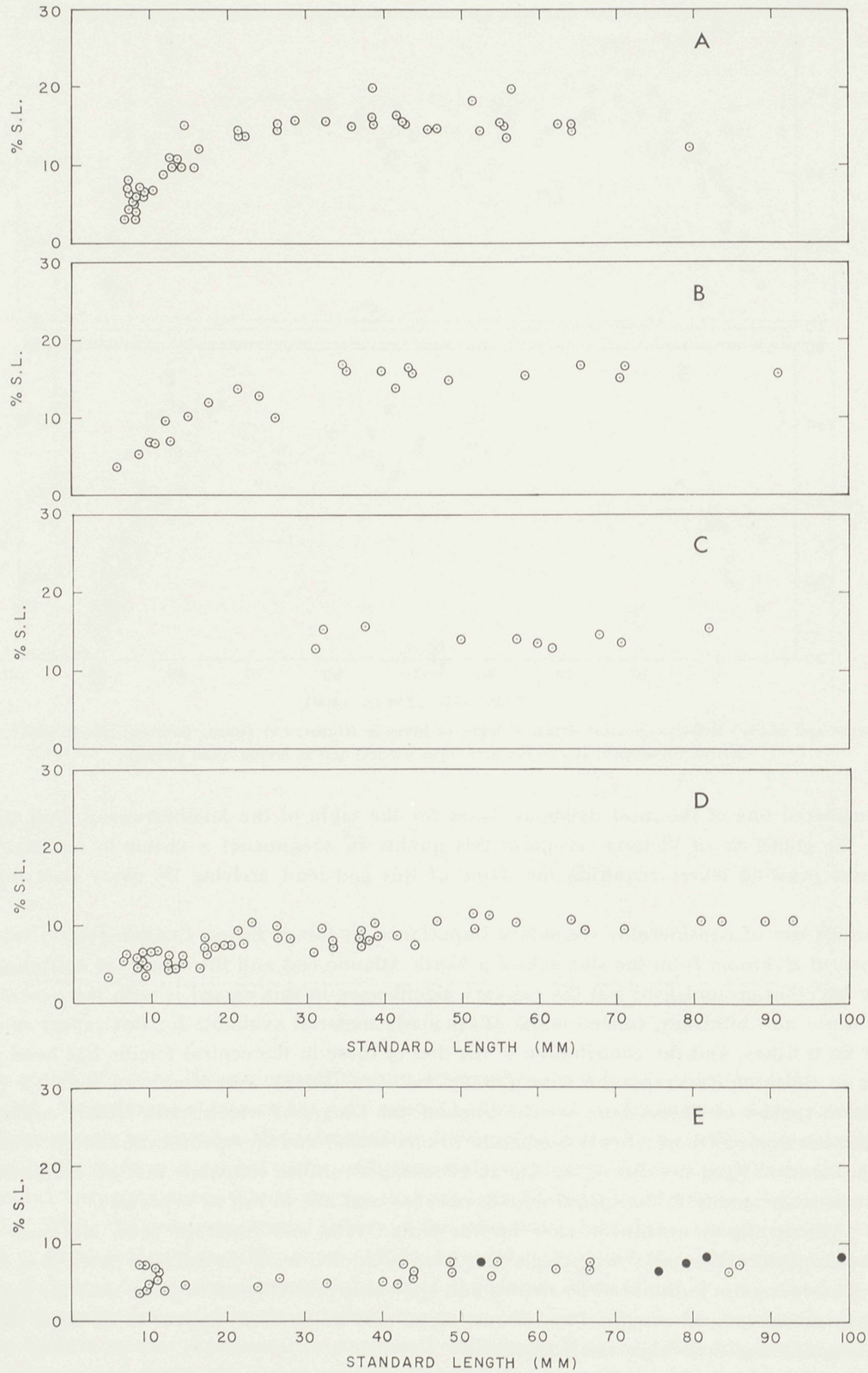


Fig. 14. Distance between base of lowermost pectoral fin ray and insertion of ventral fin in juvenile *Brama*: (A) *Brama caribbea*; (B) *B. orcini*; (C) *B. myersi*; (D) *B. dussumieri*; (E) *B. japonica* (open circles) and *B. brama* (solid circles).

caribbea are probably polytypic and may eventually be shown to include closely allopatric related species. Geographical variation, coupled with substantial allometry and a large range of sizes, make difficult the construction of a key to species such as that attempted below. Therefore the user is advised to refer to the diagnoses that precede each species description when identifying specimens.

Synopsis of Species

Two species here included are known only from juveniles shorter than 100 mm s.l., and a third only from adults longer than 400 mm. Most available specimens of all species are young between 20 and 120 mm. The natural division of the genus is based on placement of the pectorals and length of the ventrals in juveniles. Good key characters are scarce in these wide-ranging and variable species and the reader is referred to Figs. 14–15 and the frequency distributions accompanying each species account for a more useful presentation of the meristic data used below.

A Pectoral fins situated relatively high on body in juveniles, the distance between the base of the lowermost pectoral ray and the insertion of the ventral fin greater than 42 per cent of head length or about more than 12 per cent of standard length (Fig. 14). Ventral fin less than [25–.14 (s.l.)] per cent of standard length.

B Total number of vertebrae usually 40 or fewer, abodminal vertebrae 23 or fewer.

C Vertebrae 36–38, modally 36 ..... *B. caribbea*, Mead, p. 63, Western Atlantic

CC Vertebrae 38–40, modally 39..... *B. orcini* Cuvier, 1831, p. 72, Indo-Pacific

BB Total number of vertebrae 40 or more, adbominal vertebrae 23 or more.

D Fewer than 21 pectoral fin rays ..... *B. myersi**, Mead, p. 76, Tropical mid-Pacific

DD More than 21 pectoral fin rays..... *B.* sp.**, New Zealand, South Africa?

AA Pectoral fins situated relatively low on body in juveniles, the distance between the base of the lowermost pectoral ray and the insertion of the ventral fin less than 42 per cent of head length or about 12 per cent of standard length (Fig. 14). Ventral fin more than [25–.14 (s.l.)] per cent of standard length.

E Pectoral rays modally 20 (19–21) ..... *B. dussumieri* Cuvier, 1831, p. 55, Circumtropical

EE Pectoral rays modally 22 (21–23, infrequently 20).

F Adults (400–500 mm) greatly compressed, the greatest width of body more than 3.2 or 3.3 in distance between snout and insertion of ventral fin. Depth of body about 2 in s.l. Longest gill filament on first arch much longer than distance between anterior nostril and orbit, nearly as long as snout.. *B.* sp.**, New Zealand, South Africa?

FF Adults (400–500 mm) less compressed, the greatest width of body 2.9 or less in distance between snout and insertion of ventral fin. Depth of body about 2.2 in s.l. Longest gill filament in first gill arch short, about equal to distance between anterior nostril and anterior edge of orbit.

G Anal rays usually 28..... *B. japonica* Hilgendorf 1878, p. 49, North temperate Pacific

GG Anal rays usually 30 .... *B. brama* Bonnaterre 1788, p. 29, North temperate Atlantic, South temperate Pacific

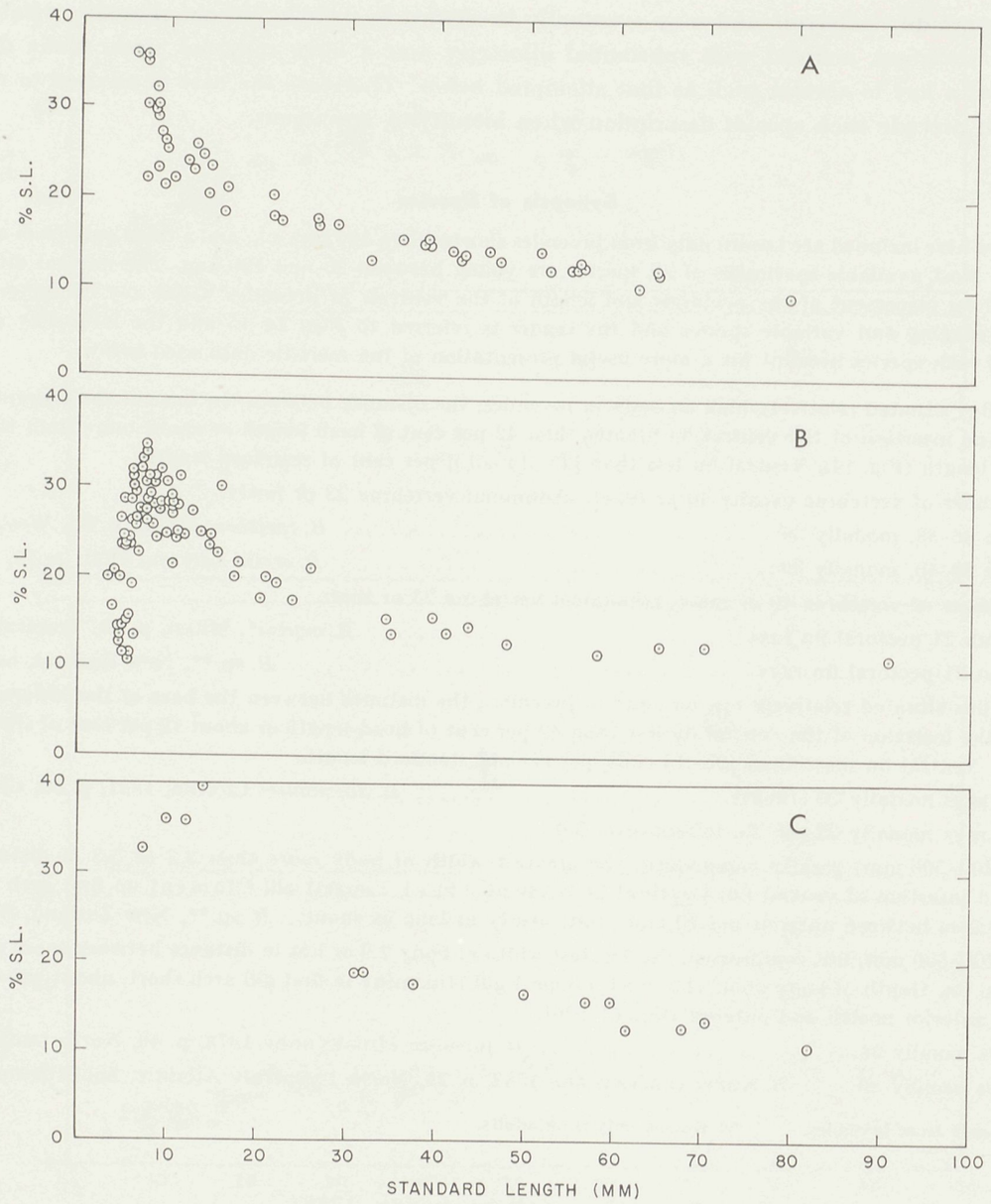
* Known only from juveniles. ** Known only from adults.

Brama brama (Bonnaterre, 1788).

Plate 3 a, Figures 16 to 20.

Study Material:—The larvae and juveniles examined are those caught by the "Dana", "Thor", "Pangan" and "Samui" (Carlsberg collections); the Norwegian "Michael Sars" (Bergen Museum), the U.S. Bureau of Commercial Fisheries vessel "Delaware" (various U.S. museums) and by William Beebe at Bermuda (Stanford University collection). These specimens are listed in Appendix Tables 5 and 6. In addition, I have examined about twenty adults from the commercial catch off Vigo, Spain, and Lisbon, Portugal; two Mediterranean specimens; about twenty from waters off or north of Great Britain and housed in various European museums; and the single western North Atlantic adult (USNM).

Tentatively referred to *Brama brama* is the Southern Hemisphere population, reported from off Valparaiso, Chile; New Zealand and Australia; and South Africa. Available for study are but two adult specimens, 303 mm and 478 mm in s.l., from New Zealand (Dominion Museum no. 1555 and 2233, respectively). An additional ten larvae and juveniles variously caught (Appendix Table 6) are also tentatively referred to Southern Hemisphere populations of *B. brama*.



Distinctive Characters:—*Brama brama* is most closely related to the North Pacific *Brama japonica*, from which it differs in its higher modal number of anal rays (31 cf. 28, the ranges broadly overlapping) and the greater number of gill rakers (16 or more, again with considerable overlap). Minor differences in number of scales may also be found when adequate numbers of counts can be compared. The early juveniles of these two species are markedly different in depth of body (less than half s.l. in *B. japonica*, vs. more than half in *B. brama*), a difference also reflected in the relatively greater distance between origin of the dorsal fin and the insertion of the uppermost pectoral ray. *B. brama* of this size also generally have higher vertical fins. Of the Atlantic species, *B. brama* is most closely allied to the Atlantic representatives of *B. dussumieri*, from which it differs in number of pectoral rays (modally 22, cf. 20 in *B. dussumieri*), and the lower set of the pectoral fin in the juveniles.

Description of Adult:—Counts and proportional dimensions are given in Tables 4 and 5. Head and body compressed but less so than in some congeners. Lower jaw usually but not invariably terminal. Dorsal profile of head and nape variable, the snout above the symphysis of the upper jaw sharply concave in some

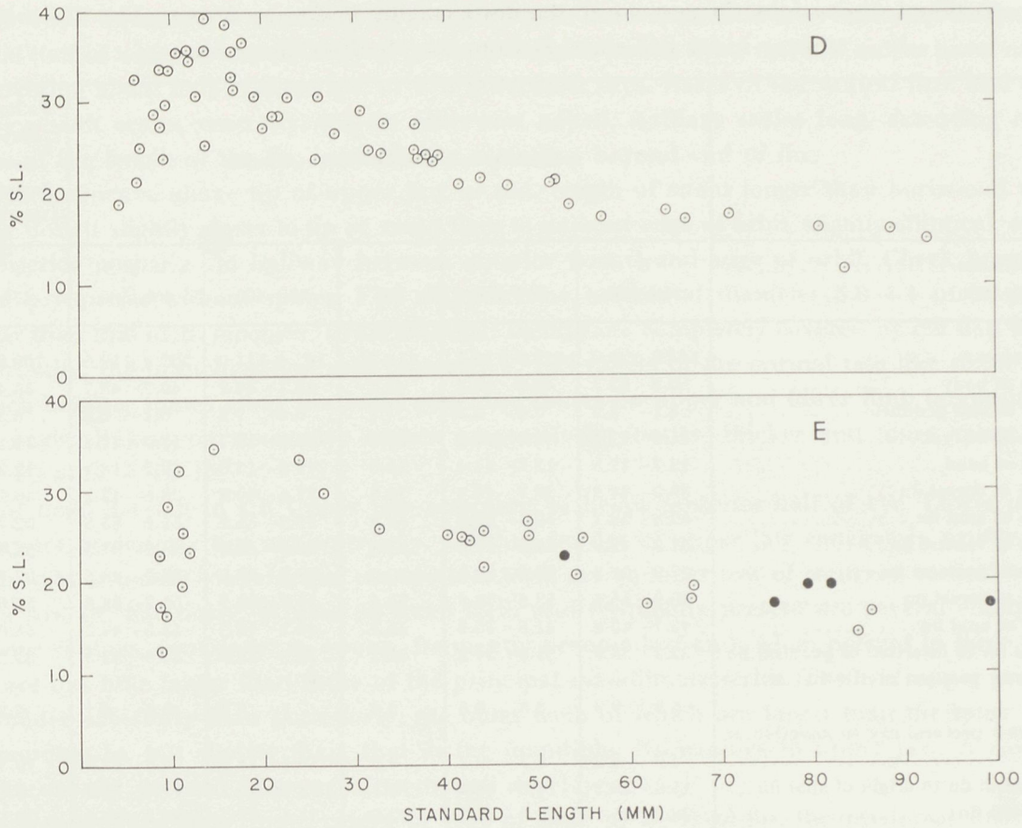


Fig. 15. (Opposite and above) Relative length of ventral fin in juvenile *Brama*: (A) *Brama caribbea*; (B) *B. orcini*; (C) *B. myersi*; (D) *B. dussumieri*; (E) *B. japonica* (open circles) and *B. brama* (solid circles).

while in others it forms a part of the gentle convex curve of the dorsal profile between tip of snout and origin of dorsal fin. The ventral profile is that of the lower edge of the mandible and subopercle to a point below the eye, at which point the isthmus emerges from between the gill covers and the ventral profile descends in

Table 4. Counts of fin rays and vertebrae, taken from adult and juvenile *Brama brama*.

Dorsal Fin	**35**	**36**	**37**	**38**
North Atlantic	10	16	12	2
New Zealand		1	1	
Anal Fin	**29**	**30**	**31**	**32**
North Atlantic	11	11	14	2
New Zealand		1	1	
Pectoral Fin	**20**	**21**	**22**	**23**
North Atlantic	1	8	24	3
New Zealand		1	1	
Thoracic Vertebrae		**16**	**17**	
North Atlantic		3	13	
New Zealand		2		
Abdominal Vertebrae (excluding urostyle)	**24**	**25**	**26**	
North Atlantic	13	3		
New Zealand			2	
Total Vertebrae (including urostyle)	**41**	**42**	**43**	
North Atlantic	2	14	2	
New Zealand			2	

Table 5. Proportional dimensions, in percent of standard length, of *Brama brama*. The 255 mm specimen, unique in its size class, is from the Mediterranean Sea.

	Eastern and Central North Atlantic					Palliger Bay, New Zealand (DM 2233)	Cook Strait, New Zealand (DM 1555)
Number of specimens	5	6	1	5	9	1	1
Standard length (mm)	50–100	100–150	255	300–400	400–500	478	303
Fork length (percent)	114.0–120.0	112.0–116.5	111.4	107.4–111.0	107.4–119.0	109.8	112.2
Greatest depth of body	50.4– 52.7	48.6– 52.4	45.3	45.4– 47.9	40.7– 48.7	46.4	46.2
Least depth of caudal peduncle	8.1– 8.5	7.0– 8.3	7.1	6.6– 7.3	6.1– 6.8	6.3	6.4
Greatest width of body	11.8– 13.9	11.8– 14.1	10.9	11.9– 12.7	13.0– 17.8	14.1	12.1
Greatest width of head	13.7– 17.3	13.5– 14.4	10.6	11.8– 13.0	12.2– 14.1	12.3	12.1
Snout to origin of dorsal fin	39.5– 44.8	36.7– 40.4	38.6	37.5– 40.8	38.6– 42.2	40.2	41.9
Snout to origin of anal fin	52.0– 58.3	52.4– 61.0	53.5	51.3– 55.2	51.1– 55.5	52.7	53.4
Snout to origin of ventral fin	37.6– 42.3	39.9– 47.5	37.6	36.5– 39.0	34.2– 37.3	35.8	38.3
Snout to origin of pectoral fin	27.9– 32.2	29.6– 34.0	30.0	28.2– 29.6	26.7– 28.5	27.7	28.9
Length of base of dorsal fin	50.9– 55.6	53.8– 58.8	55.1	55.7– 58.8	56.2– 58.8	57.5	55.0
Length of base of anal fin	43.7– 45.8	41.8– 45.4	45.3	44.1– 46.3	43.5– 46.2	48.0	44.0
Origin of dorsal fin to insertion of pectoral fin	32.2– 36.9	31.0– 34.2	31.2	29.8– 32.3	28.5– 32.5	32.2	31.3
Base of uppermost pectoral ray to that of lowermost	6.9– 9.9	8.8– 9.6	8.4	7.1– 8.2	6.6– 8.1	6.8	7.5
Base of lowermost pectoral ray to insertion of ventral fin	4.9– 8.2	8.3– 9.2	9.5	10.1– 11.2	9.8– 12.2	10.3	9.9
Insertion of ventral fin to origin of anal fin	15.6– 20.2	14.8– 18.8	19.1	16.0– 20.1	17.1– 19.5	19.6	17.1
Length of pectoral fin	28.5– 35.1	28.3– 33.3	32.0	34.4– 37.7	33.4– 38.8	35.1	37.3
Length of ventral fin	17.4– 22.6	14.6– 17.6	9.4	8.5– 9.6	7.8– 9.6	8.1	10.2
Length of 5th anal ray	18.8– 22.4	15.4– 21.4	15.5	10.4– 11.8	10.2– 12.9	9.2	11.5
Length of 5th-from-last anal ray	9.6– 11.8	8.1– 10.9	7.1	4.8– 7.3	4.2– 7.0	5.0	5.7
Length of 5th dorsal ray	25.3– 33.3	26.3– 32.3	19.1	16.5– 21.7	16.6– 20.0	14.6	20.3
Length of 5th-from-last dorsal ray	12.0– 13.8	10.4– 12.5	–	5.2– 7.2	5.2– 7.4	6.3	7.3
Length of upper caudal lobe	41.6– 47.4	37.6– 47.5	29.7	29.4– 36.6	27.4– 33.4	27.6	37.5
Length of lower caudal lobe	40.1– 41.0	35.7– 45.9	–	30.1– 36.0	27.2– 33.2	27.6	36.2
Length of central caudal ray	14.4– 19.8	12.0– 16.5	10.0	9.4– 11.0	7.8– 10.2	9.6	12.2
Length of head	27.6– 31.3	26.8– 28.7	24.7	26.1– 28.7	24.7– 27.8	25.9	26.9
Length of snout	6.8– 7.9	7.2– 8.1	6.9	6.1– 8.7	6.8– 9.9	8.1	7.8
Diameter of eye, horizontal	7.8– 11.2	6.0– 7.8	5.3	6.2– 6.7	5.6– 6.4	6.2	6.6
Diameter of eye, greatest	7.8– 11.2	6.9– 8.1	5.8	6.8– 7.5	5.9– 6.8	6.9	6.8
Greatest distance between orbit and free edge of subopercle	13.8– 15.4	14.5– 15.2	14.8	13.3– 14.5	12.7– 14.5	13.2	14.4
Width od interorbital space	8.5– 10.7	8.5– 10.1	7.7	8.0– 8.6	7.3– 9.2	9.0	8.5
Length of upper jaw	15.2– 16.2	14.1– 15.6	13.7	13.2– 14.3	12.4– 13.8	13.6	14.0

an uneven way to the insertion of the ventral fins. From insertion of ventral fin to origin of anal, the ventral profile is straight or nearly so. The greatest depth of the body is at the origin of the dorsal fin, this depth 2.0–2.5 in standard length. The bases of dorsal and anal fins converge posteriorly to the slender caudal peduncle, the least depth of which is 6.6–7.4 in greatest body depth. The vertical fins have pronounced anterior lobes, which are higher in adolescents (< 300 mm) than in the largest adults. The posterior margin of the caudal fin is roughly semicircular.

Snout, lower jaw, premaxillary (but not maxillary), angle of preoperculum and free edge of operculum, extreme tips of dorsal and anal rays, and part of the caudal fin and paired fins naked, the rest of head and body covered by scales which, in the adult, are spineless, with smooth but uneven free edges. Lateral line evident or not, complete or incomplete. Scales in a horizontal series 70–80, counting from the uppermost point of the gill opening to the base of the midcaudal ray. Scales on dorsal and anal rays covering all but

the tips of the rays. Squamation of caudal fin complete save for a crescentic area centering on the midcaudal ray, the distal half of which is naked. Base of pectoral fin with scales, those inserted on the bases of the lowermost rays covering about half of these one or two lowermost rays. Bases of the ventral fins, and most of the innermost ray, with scales ventrally, the fin otherwise naked. Axillary scales long, extending along about three-fourths of the length of the fin, occasionally extending beyond end of fin.

Snout blunt, concave above tip of upper jaw or not, length of snout longer than horizontal diameter of eye. Anterior nostril slightly closer to tip of snout than to anterior edge of orbit, slightly elliptical, and directed forward. Posterior nostril a slit halfway between anterior nostril and edge of orbit. Cheek broad; edges of gill flap and preopercle without spines. Eye elliptical, the horizontal diameter 3.9–4.4 in length of head, slightly larger than that of *B. japonica*. Branchiostegal membrane completely covered by gill flap when mouth is closed normally, the branchiostegal rays regularly 7. Gill rakers of the normal lath-like shape on the first gill arch, each bearing spines along the inner edge, the rakers on upper and lower limb increasing in length toward the angle. Rakers on successive arches progressively shorter, thicker and more spiny. Rakers on first arch 4–7 + 8–12 = 15–18.

Length of head 3.4–4.0 in s.l. Upper jaw extending to below posterior-half of eye. Lower jaw included within the upper posteriorly but not anteriorly. Toothed border of upper jaw concave in profile, that of the lower jaw straight or nearly so. Principal mandibular teeth are an inner row of recurved conical teeth. Lateral to these is a row or, anteriorly, a band of small teeth and frequently present are several enlarged anterior canines. These canines, prominent in young, frequently become lost and, when present in large individuals, these teeth are but little larger than those of the principal mandibular series. Teeth in upper jaw in a band which is broader anteriorly than posteriorly, the outer teeth of which are larger than the inner and form a row corresponding to, but shorter than, that in the mandible. No canines in upper jaw. A row of minute palatine teeth usually present. Pharyngeal teeth well developed.

Dorsal fin originating over front, center or rear of base of pectoral fin, the predorsal distance 2.3–2.8 in s.l. About six simple anterior rays (the first frequently buried in flesh or scales), the length of the fin base 1.6–1.8 in s.l. Anal fin similar, with 3 or 4 simple anterior rays, the lobe less high than that of the dorsal. Preanal length 1.8–2.0 in s.l., length of base of anal fin 2.1–2.3 in s.l. Pectoral fin of adult situated high on body (cf. juvenile), the base forming an angle of about 45° with axis of body (cf. *B. caribbea* and *myersi*, in which the angle between horizontal body axis and pectoral base is less than 45°, i.e., the fin is more horizontally placed). Prepectoral length 3.2–3.7 in s.l.; length of fin, which becomes slightly longer with adult growth, 2.1–2.9 in s.l. Ventral fin inserted under posterior half of base of pectoral fin or occasionally slightly behind, the preventral distance 2.4–2.7 in s.l., the length of fin about 2.7–3.2 in length of head.

Body black in preservative, but the paired fins, and in most individuals, an area in the distal half of the central caudal rays, more lightly pigmented.

In fresh specimens, the body and head are a mottled metallic silvery-black, with dark countershading along the dorsal edge of the body. The scaleless tip of the snout is black. Those portions of the vertical fins which are covered by scales are of the same color as the body, but the protruding tips of the rays are black. The first two elements of the ventral fin are pigmented, the rest clear. The black pigmentation of the pectoral fin decreases posteriorly, from a nearly black leading edge to the colorless shorter rays below. The lobes of the caudal fin are black except where covered by the silvery scales. The central caudal rays are dark proximally but lighter distally, the light area being variable in size, distinctness, and intensity of pigmentation. The lining of the mouth is black.

Diagnostic Characters of Juveniles:—The characters in expanded type are those most helpful for the separation of young *B. brama* from other Atlantic bramids.

Formula: D 35–38; A 29–32; P 22 (20–23); vertebrae: 16–17 + 24–25 = 41–43; BR 7. Origin of dorsal fin behind vertical from pectoral fin, relatively constant; predorsal scales numerous. Three or four graduated rays in dorsal, those following these are the longest in the fins but do not form a lobe in individuals shorter than about 35 mm s.l. Pigmentation beginning at about 10 mm, forming two dark bands in the fin with growth. Origin of anal fin behind vertical from origin of dorsal fin and relatively constant. Anal with little

pigment. Anal lobe beginning to form at about 30 mm. Pectoral fin set low, as in *B. caribbea* and *B. dussumieri* below 15 mm s.l., but pectoral remains in this low position, separated from the ventral fin by a distance less than the width of the pectoral base, to the relatively large size of 130 mm. Ventral fin inserted under or slightly in advance of pectoral; failing to reach origin of anal fin in smallest larvae and in adults, but ventral extending to or beyond anal origin to over 55 mm s.l. Tips of caudal rays pigmented below 10 mm s.l., the colored area expanding with growth. Flexure of urostyle occurs at 5.0–6.5 mm s.l. No scales at lengths less than 12 mm s.l. Spines on mid-lateral scales of caudal peduncle similar in size to those adjacent. Four or more preopercular spines depending on size, that at angle

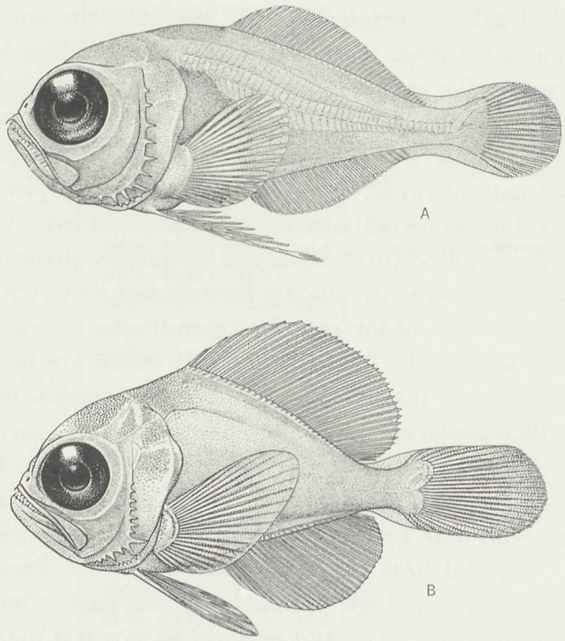


Fig. 16. Young *Brama brama*. (A) 7.5 mm s.l. (D-1124, 37°15′ N, 2°55′ E); (B) 9.5 mm s.l. (D-1366 VII, 32°30′ N, 40°04′ W). Drawn by N. Strekalovsky.

longest, those adjacent graduated in length, all lying in a single plane. These are overgrown at about 50 mm s.l. Gill membranes nearly colorless. Teeth present in all sizes.

Development:—The description of the developmental stages which follows is based on net-caught "Dana" specimens from the Mediterranean Sea and eastern north-temperate Atlantic.

5–15 mm:—The youngest (although not the smallest) specimen in this study material is a 6.0 mm Mediterranean fish. This individual corresponds in degree of development to the larva artifically reared by Sanzo (1928, pl. 1, figs. 7–9), a fish seven days beyond hatching and 4.36 mm in length. This suggests that our smallest specimen was about ten days old when caught. The body is quite slender; its depth being but 1.7 mm, or 28 per cent of standard length. The eye is black, and pigmentation is prominent over the brain and on the nape, cheeks, isthmus and branchiostegal membrane and on the peritoneum, especially that lining the dorsal and posterior parts of the abdominal cavity. There are two or three minute melanophores in the caudal fin near the tip of the urostyle (which is still quite straight) and a few others more diffuse and not easily seen, can be found on the pectoral fin.

In pigmentation, this specimen is intermediate between Sanzo's seven-day larva and the 5.2 mm stage illustrated by Schmidt (1918) and reproduced by Sanzo (1928, fig. 11). The principal difference is the less diffuse appearance of the pigmentation in the dorsal and pectoral fins, but this may have been caused by differences in original fixation or subsequent preservation and is not considered significant.

A second specimen of about equal length was cleared and stained and shows that even at this small size some teeth and paired fins are ossified, with development of ossified gill rakers and rays in the vertical fins also begun.

Elevation of the urostyle occurs at lengths between 6.5 and 7.0 mm, and this flexure, a deepening and compression of the body, and an apparent depression of the head in relation to the horizontal axis of the body,

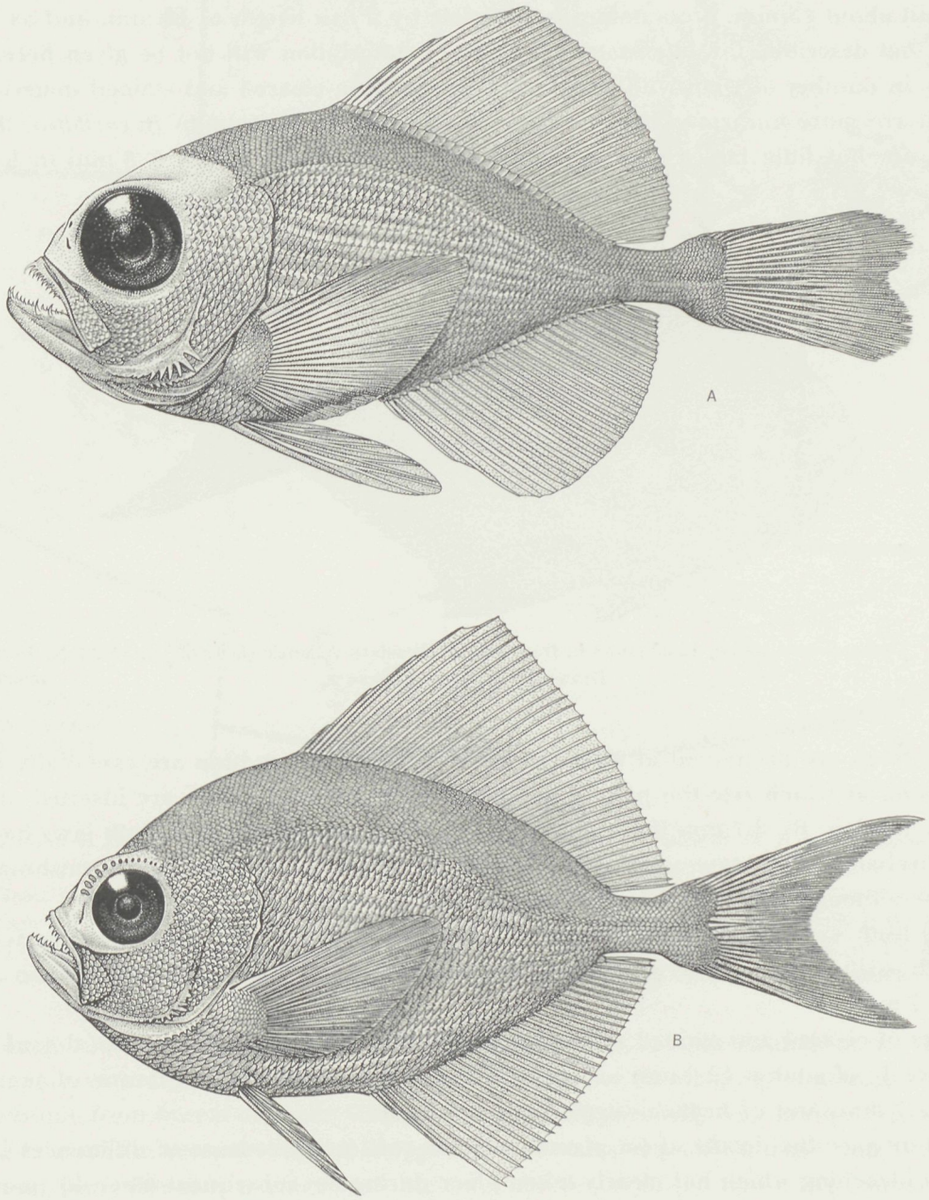


Fig. 17. Young *Brama brama*. (A) 19.7 mm s.l. (D-829, 25°07′ N, 19°20′ W); (B) 42.7 mm s.l. ("Thor" Sta. 10, 33°55′ N, 43°40′ W; the specimen completely faded). Drawn by N. Strekalovsky.

causes a decrease in the total length to about 5.1 mm, the stage represented by the larvae described by Schmidt (1918). At 5.1 mm the flexure of the urostyle is about half complete, the body is robust compared with younger specimens (the body depth is about 40 per cent of standard length compared to about 28 per cent in the younger but longer specimens). The head, except for the snout and jaws, is pigmented, as are the isthmus and branchiostegal membrane. The body itself is becoming dark anteriorly, and the abdominal peritoneum is dark. The melanophores of the caudal and pectoral fins could not be found.

Changes between 6 and 10 mm are largely those of form and pigmentation. The head and body anterior to the dorsal fin above and the anus below darken, a darkening which includes subdermal coloring in the vicinity of the anterior neural arches. One or several isolated melanophores are almost always present at the bases of several principal caudal rays, but the posterior part of the body, and the other vertical fins as well as the paired fins are colorless. At 10 mm pigmentation can again be found in the pectoral fin, and at 12 mm the first indications of scale pockets can be found. Stained scales do not appear, however, in alizarine preparations until about 13 mm. Squamation is complete by a fish length of 15 mm, and as its development is so similar to that described for *B. dussumieri* (p. 56), a description will not be given here.

The increase in number of teeth with growth is best traced in cleared and stained material. Teeth at any given fish length are more numerous than in *B. dussumieri* but, in contrast to *B. caribbea*, the anterior premaxillary fangs are but little larger than adjacent teeth in young specimens 6–8 mm in length. The anterior mandibular fangs are prominent at all sizes. The teeth in the mandible are essentially uniserial in fish smaller than 7 mm, at which size the pair of outwardly-directed teeth which are inserted on the outer side of the mandible develop. By 8.7 mm the orderly uniserial tooth arrangement in both jaws has been replaced by a non-uniform band, with some anterior teeth recurved and sloping obliquely forward and outward, and with an irregular although uniserial arrangement posteriorly.

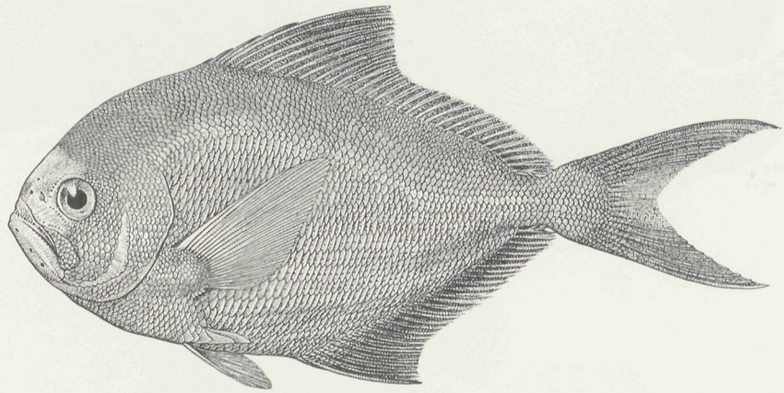


Fig. 18. Young *Brama brama*, 128.8 mm s.l., from the northeastern Atlantic (D-1372 VI, 37°23′ N, 26°02′ W). Drawn by N. Strekalovsky.

No vomerine teeth were found in any of the stained specimens (all of which were shorter than 15 mm), but a single tooth ossifies on the anterior end of the palatine bone at 7 mm; there are two in an 8.7 mm fish, and three at 11.7 mm.

A small series of cleared and stained specimens shows that the full complement of dorsal fin rays ossifies at about 6.7 mm s.l., of anal at 12.0 mm, of pectoral at 6.7 mm, of ventral at 6.0 mm, of caudal at 13.0 mm, of vertebrae at 8.7 mm, and of branchiostegal rays at 6.0 mm.

It is difficult to trace the details of fin pigmentation in this series because of differences in original preservation and the bleaching which has clearly taken place during the subsequent 30 or 40 years. In life, fishes between 10 and 15 mm probably show the pigmentation seen in the "14.32 mm" juvenile illustrated by Sanzo (1928, fig. 10), which was caught swimming at the surface in the Strait of Messina. In this fish the outer edges of both caudal and dorsal fins are pigmented, along with the entire pectoral fin, and the melanophores at the base of the caudal are most clearly defined. The pigmentation in all of the "Dana" material is far less conspicuous, especially in that preserved in formalin. Although minute and indistinct melanophores can be found in the vertical fins of nearly all specimens, they are not distinct. Pigmentation alone is thus an untrustworthy character for the separation of these young from their relatives.

Size:—The largest known North Atlantic specimen, 66 cm in total length, is one cast ashore dead in Iceland in 1922 (Saemundsson, 1927: 162). The normal adult population fished off Vigo is composed of

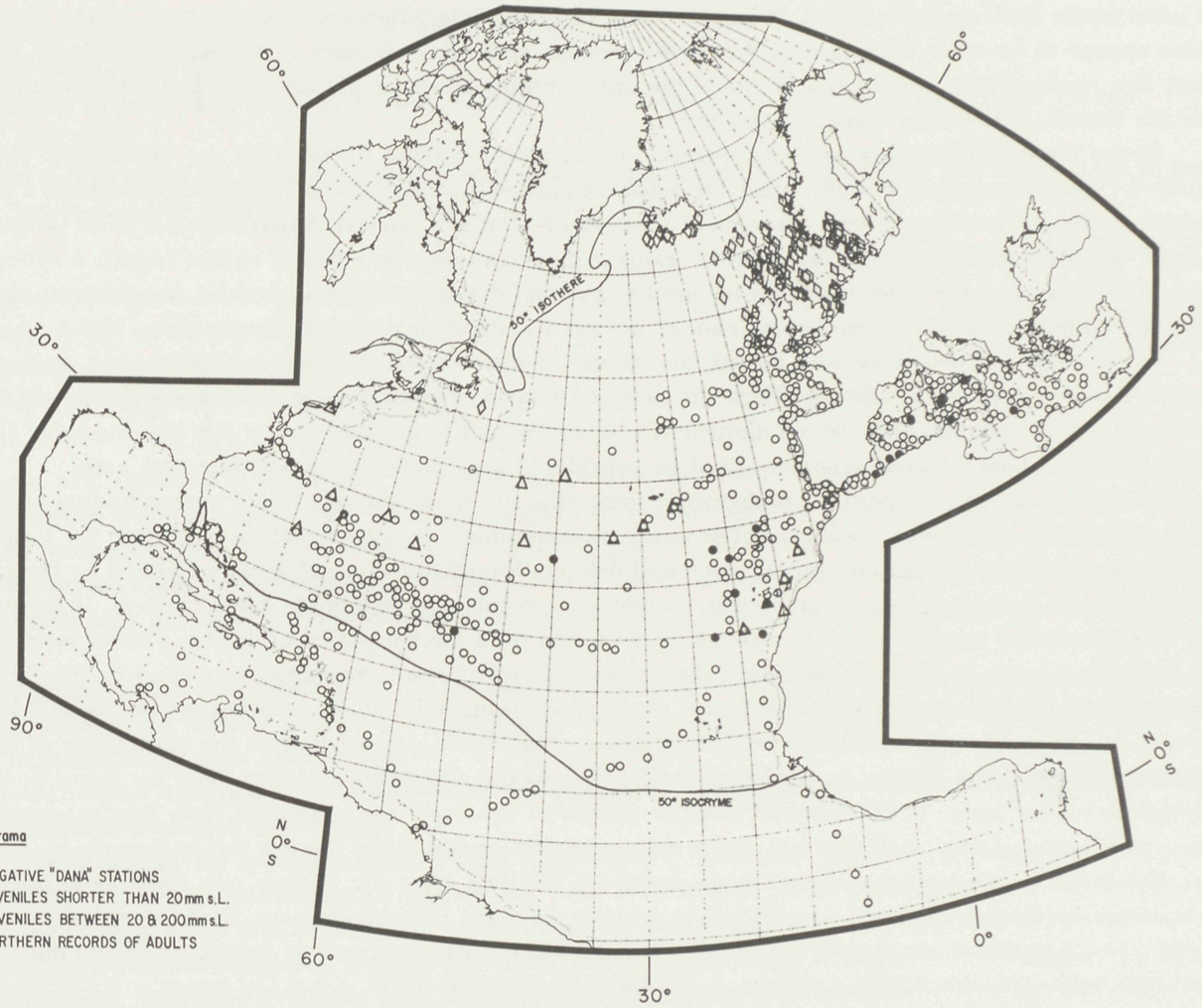


Fig. 19. The distribution of *Brama brama* in the North Atlantic. Adult distribution south of 45° N is not shown, for it is apparently continuous in the eastern Atlantic and adjacent waters south of the Bay of Biscay and the southern limit of the adults is not known. One point may indicate more than one specimen. All locality data are from Appendix Tables 5 and 6. The 67.5° F (20° C) isothere was compiled directly from the 1944 "World Atlas of Sea Surface Temperatures (Scripps Inst. Oceanogr., 1948) in the method of HUTCHINS and SCHARFF (1947) and this line probably defines the northernmost possible reproductive limit of the species. The 50° F (10° C) isothere, from HUTCHINS and SCHARFF (1947), is probably the northernmost limit of adult distribution.

fish 40–55 cm long, a range overlapped at both extremes by the catches further north. The ranges support the observations of many who have compared adult samples of many species from the tropics with a corresponding sample from boreal or arctic waters: that within a primarily tropical species, specimens caught in high latitudes beyond the normal range of the species tend to be larger than those caught in lower latitudes within the normal species range.

Distribution of young:—While the known range of the species encompasses most of the North Atlantic (see Fig. 19) juveniles smaller than about 25 mm have been found in a much more restricted area. These young are broadly distributed across the temperate Atlantic, from Florida to the Mediterranean. The distribution of these is shown by solid circles, in Fig. 19. Also drawn on this map are the 75° F (23.9° C) isocryme, which excludes to the south waters always warmer than that temperature, and the 70° F (21.1° C) isothere, which excludes more northern waters which are always colder at their surface than 70° F. If sea surface temperature limits the distribution of the hatchlings, the area between these two curves is that within which larvae and early juveniles should be expected. (These curves were taken from HUTCHINS and SCHARFF, 1947: 264–268, pls. 1 and 2, and were compiled by these authors from the World Atlas of Sea Surface Temperatures,

United States Hydrographic Office, Pub. 225, 1944, and later data published by FUGLISTER, 1954). The young also appear to be more abundant in the Mediterranean and adjacent parts of the Atlantic than in the central and more western areas, and certainly the area circumscribed by the isotheres and isocrymes is larger in the eastern than in the western Atlantic.

In the absence of closing net data, precise statements of vertical distribution are impossible. However BRUUN (1943) has suggested a procedure for depth estimation from the "Dana" open-net collections, a method satisfactorily followed by several subsequent students of "Dana" material. Since a modification of this technique was used to estimate the bathymetric ranges of several species included in this report, a synopsis of the method is provided here. It should be emphasized that depth estimates so derived from data such as the bramid collections are quite imprecise and do not even pretend to statistical significance.

Various types of nets were used during the "Dana" cruises, these being strung in series on a single towing wire. Those of concern in this report are silk nets of 100 and 150 cm diameter (designated P100 and P150), stramin nets of 100, 150 and 200 cm diameter (S100, S150 and S200 nets), and a 300 cm ring trawl (E300). Slight modifications of these types need not be considered separately from these standard nets.

BRUUN takes as the uppermost bathymetric limit of a species simply the depth corresponding to the uppermost capture. The lower limit cannot so easily be determined, for nets which fished below the lower limit of the species were lowered and raised, open and fishing, through the layer of water inhabited by the species. Thus animals living in upper layers will be caught by nets intended to sample deeper waters. If the number of individuals of a species caught in a standard net fished for a known period of time in a water layer known to be normal to the species can be found, the number of individuals to be expected per hour's fishing in this layer can be determined. We expect a deeper net to catch animals inhabiting shallow waters while it is being raised and lowered, and the number of individuals so caught will depend first on the abundance of animals (determined from the catches in shallower nets) and next the amount of time the deep net fishes in the appropriate higher layer. If the number actually caught in the deep net is smaller than that expected from the catch-per-hour of a shallower net, these were probably caught while the net was in transit.

Before such computations can be made, however, the data from the various nets must be corrected for variations in fishing efficiency. Justifications for the standard corrections have been provided by BRUUN (1943). As a standard net, BRUUN chose the S200, and as the standard unit of fishing, the S200-hour. Other nets are related to the S200 as follows: 1 S200-hour = 4 P100-hours = 2 S150 hours = 0.5 E300-hours. All fishing effort is thus first converted to S200-hour equivalents. For each locality at which the species was caught, the fishing effort at each depth, expressed in S200 units, is tabulated. The probable depth range of the species can be estimated roughly by inspection of the catch vs. depth data, and the catch-per-S200-hour within this range computed.

Next the number of hauls below this depth, each adjusted for net efficiency, is multiplied by two (for each deep net makes two tours through the upper layers), and by the time spent during the raising and lowering, for which BRUUN suggests 20 minutes per thousand meters of wire. This will provide the total number of S200-hours during which the deep nets fished in the shallower layer, and the actual number of specimens caught by these nets divided by this S200-hour figure will give the catch-per-S200 hour of raising and lowering time.

In the computation of the vertical distribution of *B. brama* I have modified BRUUN's method slightly by the deletion of all E300 nets. As this net was fished far below the depths of the juveniles and according to BRUUN (1943: 14) "is not fit for catching the sizes smaller than about 15 mm", the inclusion of E300 data would contribute nothing except an excess of ineffectual fishing effort. (This net did, in fact, take but a single specimen of this species, a 131.2 mm individual from a haul fished with 1000 meters of wire out.) I have also divided the catch into two size categories, those smaller and those larger than 12 mm, for although the total catch was too small to permit a depths vs. length correlation, it would be unreasonable to assume that the vertical distribution of the hatchlings will correspond to that of larger juveniles.

A depth corresponding to 400 meters of wire was chosen as the most probable lower limit, and the catches of deeper nets evaluated as follows:

S 200-hours of fishing effort above 399 m.w.: 178.5

S 200-hauls below 399 m.w.: 34

Duration of each deep haul while in transit through the upper 399 m.w. layer (399/1000×1/3×2): .267 hours

Total fishing effort (in S 200 equivalents) during the raising and lowering of deep nets through the upper 399 m.w. layer (.267×34): 9.07 hours

	< 12 mm	> 12 mm
Catch, 0–399 m.w.	32	11
Catch, 0–399 m.w., per S 200-hour	.179	.062
Catch by deep (399 m.w.) nets	1	2
Catch by deep (399 m.w.) nets per S 200-hour of transit time above 399 m.w.	.110	.221

Those nets intended to fish below a depth corresponding to 399 m.w. would thus be expected to catch .179 small fish per S 200-hour while being raised and lowered through the upper 399 m.w. layer. The actual catch by these deep nets (.110 per S 200-hour) was lower. (This was not true when 299 rather than 399 m.w.o. was taken as the lower bathymetric limit.) Thus the lower limit of distribution of *B. brama* smaller than 12 mm can provisionally be set at a depth corresponding to about 400 m.w.—a vertical depth of perhaps 150–200 meters.

The lower limit of fish longer than 12 mm however, cannot be set at 399 m.w., for the number expected, 0.62, is considerably smaller than two, the number actually caught. It is thus likely that these larger juveniles swim in water below their smaller fellows.

Distribution of adults:—The known records of *B. brama* from southern oceans are too few to provide meaningful distributional conclusions.

In New Zealand, the species is known from relatively few specimens variously taken on the east coast south to New Brighton (Christchurch) and on the west, to Hokitika. South African catches, which are not infrequent, appear to be limited to waters off the Cape. In Australia, the species has been reported from off the coast of New South Wales and Victoria (Portland) and off the east and west coasts of Tasmania, Fortescue Bay to Temma. The only available data on the distribution along the west coast of South America is the known occurrence from near Valparaiso and Mann's comment (1954: 233) that this fish is "rare along northern and central coasts of Chile".

The species is well known in the North Atlantic and an account of seasonal distribution there, together with a tabulation of northern records and seasonal abundance has been provided by Mead and Haedrich (1965). A hydrographic explanation for the apparent winter abundance of *B. brama* off northwestern Spain and of the northward extent of the summer-fall migration in terms of limiting isotherms (10° to 12.5°C) is discussed there in detail. While that analysis may be valid for the segment of the population found north of Portugal, it is clearly incomplete. The species is obviously abundant elsewhere (for example, the Bay of Cadiz supports a commercial fishery, see Ashton 1965) and must occur in some abundance on the high seas. The adults probably occur from the surface to about 400 meters.

Reproduction:—Little is known of the sexual cycle of the adults. Sex ratio in samples from off northern Europe is 1:1 (Rae and Wilson, 1954, and Krefft, 1962), noting that when two specimens are taken by trawl they are likely to be a male and a female, suggested pair formation—which would be unusual among oviparous oceanic fishes. These reports, and that of Rae and Wilson (1956a), note that the gonads of a fish caught in the far north during late summer and fall are not in spawning condition, and Legendre (1924) notes that specimens taken at Concarneau were spawned out in September. These northern observations thus suggest more southern spawning during the early months of the year. Navarete (1900) also suggests a spring spawning season in the western Mediterranean, but Risso (1826) indicates summer spawning as does Gourret (cited by Legendre, 1924); while Lo Bianco (1909) reports young in the Gulf of Naples between October and December.

Spawning season can be estimated from the dates of capture of smaller juveniles. From such "Dana" material, August and September would appear to be the months of most active spawning in the Mediterranean and this is in accord with the remarks of SCHMIDT (1918) and SANZO (1928). The smallest fish taken in the adjacent eastern Atlantic were caught during October, March and April while the single postlarva from the western Atlantic (D-1345 V, off Norfolk, Virginia) was caught in May. Differences such as these suggest either long and random spawning or several spawning populations, but questions such as these cannot be answered until spawning adults can be found and studied.

As noted in the account of larval development above, *B. brama* is thought to hatch at a length of about 4 mm. These smallest fish are virtually absent in the "Dana" collections, undoubtedly due in part to the loss of these slender larvae through the net but more importantly to the lack of fishing effort in waters corresponding to wire lengths of less than 50 meters.

I think that the eggs and earliest larvae are at or near the sea surface, a conclusion consistent with the "Dana" collection data and supported by observations of sea surface temperatures at localities at which young "Dana" specimens were taken.

Surface temperatures at these stations were between 19.5 and 23.8°C., with most catches beneath surface waters of 21–23.8°C. If juveniles which were caught between 50 and 400 m.w. in a rather broad range of temperatures are correlated in their geographical distribution with the more narrow sea surface temperature limits above them, it is reasonable to believe that they, as larvae, lived at or near the surface and were limited then in distribution by surface temperatures, and that they descended as early juveniles to water somewhat deeper. Since the spawning season, in one area or another, extends through much of the year, the definition of possible spawning range in terms of temperature—specific areas is impossible, and as yet collections of eggs and early larvae are too few to permit the direct definition of such areas. Certain areas, the sea surface temperatures of which are always outside of the temperature range suggested above, can be excluded by the application of the isotheres and isocrymes shown in Fig. 19. Within these two curves is the area which, at one time of the year or another, is of suitable spawning temperature.

Coincident with the apparent temperature limit at 23.8°C is a biological factor which may effect the distribution of young or adult *B. brama*. This is its replacement in waters warmer than 23.8°C by the very similar *B. dussumieri*. The spawning season of *B. dussumieri* is similar to that of *B. brama*, the young live in comparable depths, and this species too is oceanic.

Data demonstrating this species replacement with temperature is apparent in a segment of the "Dana" 1921–1922 cruise: the western part (Sta. 1344 to 1352) of the Norfolk-to-Bermuda section. This section traverses the Gulf Stream on a line about ESE from the entrance to Chesapeake Bay. Two small specimens of *B. dussumieri* were caught at a station in the Stream (D-1352), while not far east of this station but east

Table 6. Temperature data associated with the capture of young *Brama brama* and *B. dussumieri* in a section ESE of Norfolk, Virginia. Stations are arranged in order of distance from shore, St. 1349 being the westernmost here considered. The cross under station number 1345 denotes the probable depth of capture of *B. brama* (taken as one half of length of wire), those at St. 1352 the probable depth of *B. dussumieri*.

Depth (m)	Station							
	1349	1350	1351	1347	1352	1346	1345	1344
0	18.17	10.3	26.33	25.75	25.60	23.04	21.40	21.71
25	19.09		.02	.75		.02		19.93
50	.34		.06	.59		20.97		.27
75	.57		24.93	24.50		.68	+	18.94
100	.42		23.55	23.96	+	.30		.83
125	–		22.70	.30		19.28		.76
150	19.57		20.85	22.65	+	.15		.72
200	.54		19.44	20.39		18.90		.57

B. dussumieri — *B. brama*

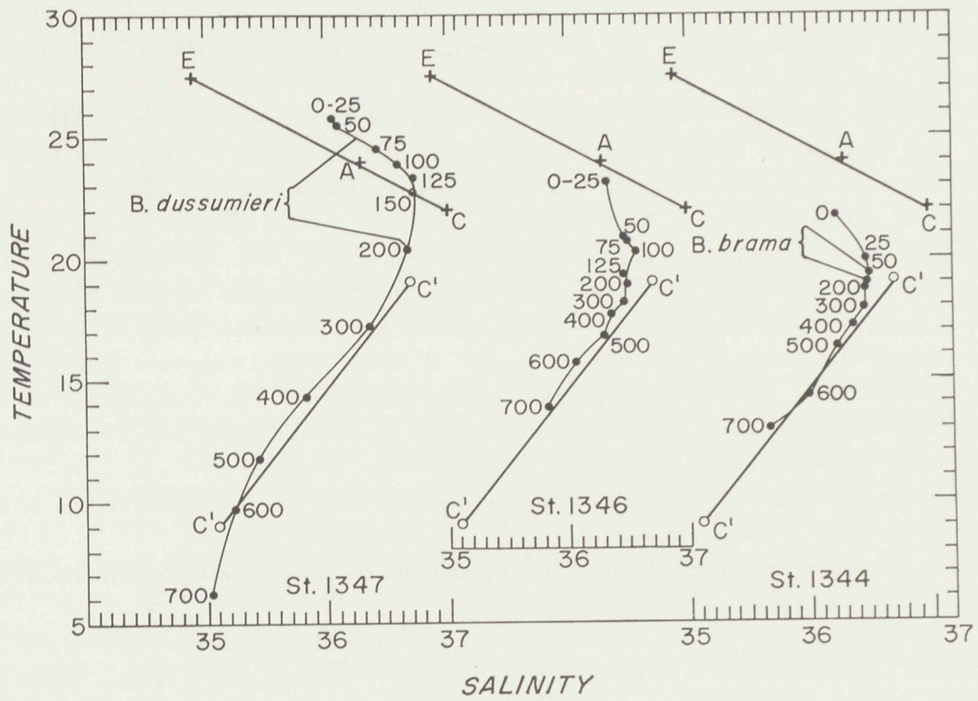


Fig. 20. Three temperature-salinity diagrams, 0 to 700 m, to illustrate differences in water type associated with juvenile *Brama dussumieri* and *Brama brama*. These stations lie on a line ESE of Norfolk, Virginia. Two small *Brama dussumieri* were caught at Sta. 1352, a plankton station immediately adjacent to hydrographic station 1347, both of which lie in the Gulf Stream. Depths within which these fish were probably caught were taken as those corresponding to one-third to two-thirds of wire length. Hydrographic stations 1346 and 1347 lie further east. About midway between these, at Sta. 1345, a small juvenile *Brama brama* was collected in a net fished with 150 m.w. The depth of capture is indicated on the t-s diagram for Sta. 1344. The points E, A, and C are those used by JACOBSEN (1929:28–32) to characterize surface waters near the equator (E), from the Antilles and Florida current down to 100 meters depth (A), and the warm salt water found at 100 m depth in a belt between the Canary Islands and Puerto Rico (C). The line C'–C' is that used by SVERDRUP, JOHNSON and FLEMING (1946:668) to define North Atlantic Central Water. These curves indicate that the Gulf Stream surface waters from which *Brama dussumieri* were taken are replaced to the east by Central surface water and its characteristic species, *Brama brama*.

of the Stream (D-1345) a small *B. brama* was collected. The temperatures at these, and adjacent hydrographic stations (Table 6) indicate clearly that *B. dussumieri* inhabits the warm waters of the Gulf Stream while *B. brama* seems to be restricted to colder areas. Similar although less spectacular transitions from *B. brama* to *B. dussumieri* associated with an increase in surface temperature can be seen in a segment of an eastern Atlantic cruise: the collections of *B. brama* at stations 1141 to 1148 (21.4°–22.1°C) soon followed by those of *B. dussumieri* at stations 1157 to 1171 (24.0°–27.7°C).

The surface-water characteristics essential for the presence of larval *B. brama* (and thus of spawning area) cf. *B. dussumieri* are also shown by a comparison of the temperature-salinity characteristics at the points of capture. Those for the stations ESE of Norfolk, Virginia (Fig. 20), suggest the reliance of *B. dussumieri* on surface water with "Antillean" or "Equatorial" characteristics. *B. brama* seems to be excluded from such areas. Temperature-salinity diagrams representative of *dussumieri* and *brama*-localities in the eastern Atlantic can be found in JACOBSEN (1929), who divided the eastern Atlantic into sub-areas characterized by t-s diagrams. His area XXIII (1929, Fig. 63), a *Brama*-area, has only Central water near the surface, as shown by his t-s figure 51 (p. 86). In the more southern areas, e.g., areas XI, XII and XIII with corresponding t-s curves (Fig. 63, and 38–40), surface waters are considerably different, for their surface characteristics, though variable, are similar to the types which JACOBSEN called the "A" (Antilles Current) and "E" (Equatorial Surface) types rather than to "C" or Central.

B. brama thus appears to spawn in waters warmer than 19.5°C but is limited toward the tropics by a temperature of 23.8°C and possibly by the appearance there of *B. dussumieri*; the eggs and newly-hatched

larvae, largely unknown, are probably in surface waters, the juveniles descending with growth; and the adults and sub-adults ranging widely throughout the North Atlantic but returning southward, at various times of the year in different areas, to spawn.

Food:—Unfortunately nothing has been reported on the food habits of *B. brama* in areas such as the waters off Spain and Portugal in which the species is sufficiently abundant to support a fishery. Further north, specimens which were caught off Concarneau incidental to the tuna fishery there were examined by LEGENDRE (1924) and, not astonishingly, their stomachs contained species common to the stomachs of the tunas with which they swam: the amphipod *Euthemisto bispinosa* BOECK; *Meganyctiphanes norvegica* (SARS), and fish remains, one of which was a myctophid. One of the many specimens reported from off Penzance, England, contained a cephalopod (CORNISH, 1875), but most of the individuals taken off Great Britain and Scandinavia and examined by various writers were empty. STEPHEN (1928) suggested that the species does not feed while in the North Sea. However, more recent writers have reported the remains of various species: sand eels, the otolith of flatfish, whiting, various gadoid fishes (e.g., *Gadus esmarki* and *Urophysis blennoides*), cephalopods, *Argentina sphyraena*, and others (e.g., GIBSON, 1962; RAE and WILSON, 1954, 1956). *Brama* in these waters probably eat whatever they can catch, and there is even one published record of a specimen caught on a hook baited with a sea anemone.

Off South Africa, *B. brama* is known to feed on *Myctophum humboldti*, megalops crab larvae, *Loligo reynaudi* and possibly *Paralepis* (DAVIES, 1949: 32).

Parasitism:—*B. brama* is well known to the parasitologist as host to numerous forms, and many ichthyologists have noted various degrees of infestation (CUVIER, 1817; HARRIS, 1851; JUNEL, 1865; LEGENDRE, 1924; NORONHA and SARMENTO, 1948; RAE and WILSON, 1953, 1954 and 1956; and many others). Among the most offensive parasites, at least aesthetically, is the intra-muscular cestode *Gymnorhynchus reptans* (RUDOLPHI), the plerocercus stage of which pervades the muscle tissue, its much elongated metabothridial region or "tail" eminating from a bladder-like head. One fish may house three or four of these worms, and encysted forms have been found in several of the study specimens available to me.

Frequently infecting the gills of these fishes are the encysted forms of the digenetic trematode *Köellikeria filicollis* (RUDOLPHI, 1819) according to LEGENDRE (1924: 223), writing with the advice of the Paris parasitologist R. DOLLFUS (see also RAE and WILSON, 1953a: 148). I have not seen such an infestation, but the fishmongers of Vigo regularly display the gills of *Brama* to the prospective customer. Common to the pharynx of *Brama* is the octocotyl *Octobothrium bramae* PARONA and PERUGIA, 1896; the tetrarhynch *Tetrarhynchus rugosus* LEUCKART, 1850, and *T. bicolor* BARTELS, 1840; and to the intestine the bothriocephalan *Dibothrium bramae* ARIOLA, 1899 (LEGENDRE, 1924: 223). An earlier resumé (LUNEL, 1865: 14) also includes *Tetrarhynchus discophorus* from the branchial regions, *Anthocephalus gracilis* from the peritoneum, *Monostoma filicolle* (*Köllikeria filicollis*) from the flesh, *Scolex polymorphus* from the gut, *Echinorhynchus vasculosus* from the abdomen and intestine, and *Anthocephalus macrourus* from the flesh. The synonymy and pathology of parasitism is beyond the scope of this paper and the competence of its author, and the names used above are doubtless in need of revision. The interested reader should consult the papers noted above, the references contained therein, and more recent reviews such as those of YAMAGUTI (1958) and WILLIAMS (1959). Parasitological studies similar to those done on *B. brama* have not been reported for other bramid species; the comparative parasitology may be instructive.

Commercial Importance:—In Spain*, *B. brama* is of considerable commercial importance, the fish being marketed both in fresh and canned form. In the principal fishery, that off the northwestern coast, there may be over a hundred vessels, each about 25 meters long, operating during the height of the season, each setting and hauling about six miles of longline daily.

This longline is similar in design to that used throughout the world for tuna, differing chiefly in the size and number of hooks. A typical hook is of relatively lightweight stock (about 1.1 mm in diameter), about 39 mm in length from end of shank to bottom of curve; 13 mm across the curve, from barb to shank, and

* This information on the Spanish fishery was largely provided by Dr. B. ANDREU and his associates in the Instituto de Investigaciones Pesqueras, Vigo, during my visit there in July 1961.

with a single barb*. Each "basket" of gear, about 300 fathoms (ca. 550 m) of mainline, is equipped with 280 hooks, the basket being supplied at each end with a float and a weight and attached either to a terminal marker or to the next basket in the series. The gangeons vary in length, usually between 40 and 80 cm. The distance between the surface of the water and each hook is normally 50–60 fathoms (ca. 90–110 m) but is reduced to as little as five or six fathoms in summer, and the depth of the water is about 250 fathoms. Twenty-six baskets, or about 7280 hooks, comprise each set. The hooks are baited with sand-launce (*Ammodytes*, which are preferred because they stay on the hook more readily than other available bait species); young pilchard (*Sardina*); or, as a third choice, jack mackerel (*Trachurus trachurus*). Setting, which takes about an hour, begins at dawn; hauling four or five hours thereafter. 2500–5000 fish is considered an ordinary catch for each set; 6000 (about 68 fish per hundred hooks), a good catch.

While this longline is the principal type of gear and that on which the vessel depends for a productive trip, the individual fishermen, during their spare time, jig for *Brama* for their own personal use or profit. The hooks used are normally larger than those of the longline (2.0 mm stock, 58.5 mm total height; 19.5 mm across gape) but are otherwise of the usual sort. Two of these, baitless, are attached to a shiny half-kilogram weight, each by its own three-cm leader, and the line is "jigged" in the usual way.

Although *B. brama* is present throughout Spanish and Portuguese waters, in the Mediterranean, and certainly elsewhere, throught the year, the principal fishery lies 18–25 miles off the northwestern corner of Spain from about 42° N latitude to about 9° W longitude. The center of the fishery during the height of the season (winter) is west of the Cies Islands. During the summer, the fishery is centered off La Coruña; during winter it extends from La Coruña south to Viana and even to Berlenga. Later in the season (March), most of the vessels are working off northern Portugal. After March the vessels can be found from Ria Aveiro to Mondego Cape, Portugal. Vessels from the north coast of Spain ("Cantabrica") fish as far west as Cape Prior (east of Cape Finesterre); those from western ports such as Vigo ("Noroeste" district) from Finesterre south to Miño. The catches from along the Mediterranean Coast and from the Balaeric and Canary Islands are negligible compared with this northwestern-coast fishery.

Published landings data (see Mead and Haedrich, 1965: 45) show clearly that the main fishery is a winter one (December through early May) with a second but lesser peak, at least in the "Noroeste" district, during the fall (September to November). The reality of these apparent seasons is confirmed by biologists in Vigo, who also suggest that the species appears to be more dispersed, and hence less available to the fishery, during the summer months but that the availability to the vessels of the more valuable albacore during this period does reduce the effort devoted to fishing for *Brama* and hence the landings. There is still no evidence to support the notion of north-south mass seasonal migration, but if, as proposed elsewhere in this paper, near-surface temperature controls the normal distribution, one would expect the species to extend its range toward the north during the warmer months.

Fresh *Brama* is usually available in the fresh-fish markets of the coastal cities of northwestern Spain. The fish is both attractive and flavorsome. The fishmonger, who usually displays the gill chamber to the prospective buyer, cleans, trims and skins the fish, which is weighed and sold. The flesh is firm. The texture and flavor most resemble that of the white-meat tuna. I am told, however, that the meat at times can be heavily parasitized. For canning, the larger fish are filleted and laid flat in relatively large cans. The smaller are cut into transverse sections and packed in the manner customary for the scombroid fishes. Central Spain provides the chief market for the canned product, and I have not found it elsewhere in Europe or America. Because of the occasional high incidence of parasitism, tinned *Brama* has been barred from sale in France, which seems unreasonable when one considers the excellence with which a skilled French chef can prepare other foods aesthetically no less offensive.

I have been unable to learn when and under what conditions this fishery was begun, although Alaejos' (1931: 10, 33–34) data suggest that in the Cantabrican region few *Brama* were caught prior to 1920. His re-

* These hooks would be too light to hold tuna or albacore, but I am told that these species are rarely found on the *Brama* grounds. The tuna fisheries, which are of tremendous importance in the area, lie further from shore.

port is also of interest in another connection, for even in the early years of the fishery the landings were subject to substantial seasonal and annual fluctuations.

A succinct summary of the *Brama brama* fishery off Portugal and in the Bay of Cadiz has been provided by ASHTON (1965: 83). The fishing methods are similar to those used off Vigo. The height of the season, however, is between March and December, in contrast to December to May off northwestern Spain.

Fluctuations in Abundance:—All evidence suggests that the abundance of *B. brama* fluctuates considerably from year to year. Certain years have been notable for the intensity of the "invasion" of this fish into northern waters: 1850 (CLARKE, 1900); 1927–1928 (STEPHEN, 1928; EHRENBAUM, 1928; and many others); 1949–1950 (RAE and WILSON, 1951; KRISTENSEN, 1950) and 1952 (RAE and WILSON, 1953) being examples of such years. Similarly, the commercial landings at Santander during the period reviewed by ALAEJOS (1931) showed major fluctuations and the Spanish catch statistics compiled for a different purpose (MEAD and HAEDRICH, 1965: 45) demonstrate like fluctuations. Unfortunately these catch statistics cannot be adjusted for fishing effort, and the northward invasions may reflect hydrographic anomalies rather than abundance of fish, hence the data are suggestive rather than conclusive.

Common Names:—The number of different vernacular names applied to this well-known species which is caught off the coasts of many countries is immense. For example, PALOMBI and SANTARELLI (1953) list over a score in use in various parts of Italy alone. And as one would expect, common names have changed with time. For example, English writers referred to the "hen-fish" and "toothed gilthead" during the early nineteenth century (e.g., TURTON, 1807: 98) but to "RAY's bream" or "RAY's sea bream" more recently. Those interested in the full range of names should first consult the listings by the International Council for the Exploration of the Sea (ANON., 1914, and subsequent revisions), MACLEOD (1956), GERVAIS and BOULARD (1877: 155–158), LOZANO Y REY (1952: 641) and PALOMBI and SANTARELLI (1953). A few of those which seem to be in common current usage follow: England and North America—RAY's bream or RAY's sea bream (the use of "pomfret" in the American Fisheries Society's list of 1960 has in my opinion little merit or historical precedence other than GOODE's comment in 1884 that *B. brama* was called "pomfret" in Bermuda); Denmark and Norway—Havbrasen; Sweden—Hafsbraxen; Germany—Brachsenmakrele; Netherlands—Braam; France—Castagnole (although I reject with reluctance the delightful name "Hirondelle de Mer" which, according to LEGENDRE in 1924, was coined by the tuna fishermen of Concarneau, to whom the species was unfamiliar); Spain—Castañola or Joputa; Portugal—Chaputa or Freira; and Italy—Castagnola. One South Pacific *Brama* is here considered conspecific with *B. brama*, the fish being called hacha or hachita in Chile (MANN, 1954: 233) and RAY's bream in New Zealand and Australia.

Synonyms and References.

North Atlantic*.

Brama marina cauda forcipata RAY, *in* WILLOUGHBY, 1686, appendix p. 77, pl. V-T2 (the first certain record, based on a stranded specimen sent to RAY. I have been unable to identify the several non-binomial pre-Linnean characterizations published by RAY in 1713, BELON, LINNAEUS, ARTEDI, RONDELET and others with any bramid although these were often included within the synonymy of this species by later writers such as PENNANT, 1812, and YARRELL, 1836); PENNANT, 1769:200 (an account of the original RAY-JONSTON specimen from England; called the "lesser sea bream"); PENNANT, 1776:243, pl. 43 (fig. and descr., Gr. Britain); PENNANT, 1812:330–331, pl. 54 (fig. and descr.).

Sparus brama BONNATERRE, 1788:104, pl. 50, fig. 192 (orig. descr., stated to be from PENNANT's British Zoology, vol. 3, p. 240, and based on a RAY specimen taken from the "seas of England" on Sept. 18, 1681; the figured specimen is clearly a *Brama*).

?*Sparus dentatus*, BERKENHOUT, 1789:74 (in catalog of fishes of Gr. Britain. Although this trivial name was applied to several diverse species by the earlier writers, as used by BERKENHOUT, DONOVAN and others, it is said to refer to RAY's specimen from the mouth of the River Tees and thus becomes a junior objective synonym of *Sparus brama* BONNATERRE, 1788).

* Of the temperate-water species of *Brama*, *B. japonicus* and *B. brama* appear to be distinct but the latter may or may not be conspecific with one of the two cold-temperate Southern Hemisphere species. Synonyms and references based on Southern Hemisphere material are therefore kept apart from those wholly or primarily concerned with the North Atlantic population.

Sparus raji Bloch, 1791:95–98, pl. 273 (descr., fig., synonymy); Donovan, 1803, pl. 37 and accompanying text (descr. and color fig.; occur. in Gr. Britain and France; ref. to "Ray's toothed gilt-head"); Oken, 1816:51 (listed).

**Brama raji* Bloch and Schneider, 1801:99–100 (orig. descr., synonymy); Neill, 1808:537–538 (recs. from Firth of Forth, Scotland); Pennant, 1812:331, pl. 54 (part, descr. and synon., range given as Red and Mediterranean Seas and Jamaica as well as Gr. Britain); Montagu, 1818:454 (remarks on confused ident. of the Rayan and Toothed Gilthead of Pennant's Brit. Zool.); Rudolphi, 1819:85–86 (*Monostoma filicolle* parasitic on *Brama*, Naples); Rosenthall, 1821:9, pl. 12, fig. 1 (excellent fig. of skeleton); Schinz, 1822:541–542 (descr., from Bloch and Schneider, 1801); St. Vincent, 1823:260 (descr.); Risso, 1826:433–434 (descr. and remarks); Fox, 1827:233–234 (hist. and nat. hist. occur in Gr. Britain; speculation on off-shore habitat); Schagerström, 1827 (rec. from Hildesborgs; descr.; attributes first coll. to specimen stranded at Middleburg in 1581 and rep. by Jonston, Ray and later Pennant); Cuvier and Valenciennes, 1831:281–294, pl. 190 (general account, history of sp., descr.); Nilsson, 1832:71 (diagnosis and range); Cuvier, 1834:178–179, pl. 31, fig. 1 (descr. and col. fig., discussion and synon.; suggests that Rafinesque's *Lepodus saragus* con-specific; notes that Shaw's *Sparus raii* and *S. castaneola* are both traceable through Lacépède to the single specimen of Bloch and Ray; said to inhabit Mediterranean but to stray into deeper oceans; parasitism of intestine noted); Jenyns, 1835:359-360 (descr., synon., occur. in Gr. Britain); Yarrell, 1836:117–120 (descr., fig., synon.; occur. Gr. Britain); Richardson, 1836:74 (notes occur. along European coast; presumed relationship to Chaetodontidae); Parnell, 1838:209–210 (descr., distrib.); Krøyer, 1838:211–219 (descr. and general account, in Danish); Swainson, 1839:170, 214 (in classif. with Chaetodontidae); Lowe, 1842:8 ("freira" off Madeira; affinities with Coryphaenidae and stromateoids); Rudd, 1845 (strandings at Redcar); Couch, 1846:1406 (2 spec. live-caught at Polperro and near Runnel Stone); O. G. Costa, 1849 (fasc. 61 & 70, pp. 2–15, pl. 52; descr., fig. of details of scales; occur., parasit., synon.); Couch, 1849:xxvii–xxviii (descr., comp. with *B. pinnasquamata* Couch, 1849); Guichenot, 1850:56 ("castagnole commune" descr.; synon.; Mediterranean); Rudd, 1850 (4 on beach at Redcar); Rudd, 1851 (2 strandings at Redcar; notes occur. there only Oct. to Dec.); Harris, 1851 (spec. live-caught in harbor at Gamrie, descr. notes; parasitism and palatability); Gurney, 1851:3058 (stranding at Lowestoft); Logan, 1851:3058–3059 (recs. from Firth of Forth and imprecisely from elsewhere); Rudd, 1852 (4 at Redcar); Gordon, 1852:3459 (rec. from Gamrie, Moray Firth); Nilsson, 1855:121–124 (descr., synon.; recs. of early Scandinavian specimens; vernacular: "Silfvergra Hafsbraxen"); Thompson, 1856:92 (first positive Irish rec.; notes dubious nature of earlier refs. to "hen-fish", a "term applied by our fishermen to one or two other species of somewhat rare occurrence"); Buckland, 1859:60 (fig. and notes on rarity of the "toothed gilt-head"); Doûmet (-Adanson), 1860:365, 498 (listed for "Cette", parasitism by *Monostoma filicolle*); Günther, 1860:408–409 (descr., distrib., synon.); Schlegel, 1862:16–17, pl. 1, fig. 6 (descr., occur.); Troschel, 1863:51–52 (rec.; notes on Madeiran *Taractes longipinnis*); Couch, 1863:129–132, pl. 92 (hist., descr., synon., col. fig.); Lunel, 1865 (part, as synon., localities, incl. extralimital species; descr. and fig., pl. 1, are *B. brama*; good gen. account); Clogg, 1866 (stranding near Liskeard); Capello, 1867:309 (listed as abund. off Portugal during summer); Steindachner, 1868:24–27 (common in fish markets of Genua and Barcelona in June and July, 1864; in those of Malaga, Valencia, Cadiz and Santa Cruz de Tenerife as well but fewer; said to approach coast for spawning; good descr.; common names: "Chaputa", "Freira" (Lisbon), "Castañola" (Barcelona), "Xoputa" (Cadiz), "Pez toston" (Santa Cruz de Tenerife); van Beneden, 1871:44 (parasites); Gurney, 1874:19 (1 stranded on Cromer Beach, Norfolk); Cornish, 1874 (occur. spec. at Penzance); Collett, 1875:46 (general occur.); Cornish, 1875 (live rec. Penzance, cephalopod in stomach); ?Goode, 1877:292 (listed for Bermuda and the basis for later check-list recs.; may be *B. dussumieri*); Malm, 1877:420 (descr. in Swedish, ref. to Skagen spec. of 1876; vernacular "grå hafsbrax"); Gervais and Boulart, 1877:155–158 (plate, descr., synon.; dentition; occur. in France and Spain; vernaculars); Stossich, 1879:45 (listed, with synon., for Adriatic); Winther, 1879:14–15 (refs., occur. in Denmark); Lütken, 1880:492–501 (part, excellent discussion of relationships, distrib., development); Collett, 1880:30 (distrib.); Day, 1880–84:114–117, pl. 41 (general account incl. descr., occur., orig. fig., synonymy, bionomics esp. Gr. Britain); Buckland, 1881:32 (descr., fig.,; England); Moreau, 1881:487–491 (descr., synon., fig., distrib. in Mediterranean); Seidlitz, 1882:124 (diagnosis and occur.); Jordan and Gilbert, 1883:915 (part, type species, *Sparus raji* Bloch, designated; diagnosis; range incl. Newfoundland and Washington State records of Bean); Cocco, 1884:26 (synon.); Goode, 1884:335 (rec. Grand Banks of Newfoundland, the specimen in USNM; notes occur. in Bermuda and origin there of the vernacular "pomfret", cf. "hen-fish" in Nfd.); Lofthouse, 1886 (adult at Redcar); Cornish, 1886 (spec. found in artificial pool during construction at Penzance; notes on color and flavor); Howden, 1887:7 (listed for NE coast Scotland); Howse, 1890 (occur. Northumberland and Durham, Gr. Britain); Cornish, 1891 (spec. live-caught near Penzance); Lilljeborg, 1891:299–309 (descr., general account, literature; in Swedish); Silva, 1892:42, 491 and unnumb. color pl. (notes on occur. in Portugal); Smitt et al., 1893:77–79, pl. 6, fig. 1 (good color fig.; descr. and synon.; juv. labeled "Brazilia" from the older collections in the Royal Museum probably not *B. brama* but *B. dussumieri*; notes summer fishery with longline off Genoa when the species is presumed to congregate near surface for spawning; gives parasitism

* Included here are the several permutations of the trivial name: *raii, rayi, rajii, rayii,* and all of these spelled with an initial capital.

as possible reason for strandings in the north); VINCIGUERRA, 1893:318 (rec., with common names, for Canary Is.); CRANE, 1893 (spec. from Dunganon Co., Waterford, Ireland); LE STRANGE, 1894:421–422 (stranding at Norfolk, England); STEPHENSON, 1894 (stranding at Whitby); LOWE, 1894 (2 recs. for Norwich, England); CLARKE, 1895 (live-caught spec. at Scarborough); GOODE and BEAN, 1896:210–211 (part, these authors tentatively consider all Atlantic and most Pacific nominal species of *Brama*, *Taractes* and *Pterycombus* congeneric; fig.; vernacular, "pomfret"; range and listing of nominal species); JORDAN and EVERMANN, 1896:959 (descr., synon.); PARONA and PERUGIA, 1896 (*Octobothrium bramae* and *Microcotyle acanthurum*, trematode parasites of *Brama* descr. as new from Mediterranean material taken off Genoa); STEPHENSON, 1896 (stranding at Whitby); CLARKE, 1900:208 (questions PARNELL's remarks of 1838 that the species occurred frequently in Firth of Forth; noted marked immigration of 1850 along E coast Britain during and after Nov.); SCOTT, 1900:277 spec. from near Ayr, Scotland); COLLETT, 1902: 44 (rec. from Bergen); GRIFFINI, 1903:422–423 (descr. and fig., vernaculars; Mediterranean); SAEMUNDSSON, 1903:46 (strandings, Iceland; perhaps the first Icelandic records); SAEMUNDSSON, 1903:20 (an Icelandic rec. of 6 IX 01); REGAN, 1903:344 (listed for Madeira; notes on similarity between Madeiran and Medit. fish faunas); EHRENBAUM, 1905–09:24–25 (descr. and fig. of young, from LÜTKEN, 1880); CLARKE, 1907:426 (Cornish recs.); Ingles, 1909:118 (Scottish strandings); FRANCAVIGLIA, 1909 (Mediterranean; full acct. of parasitism by *Anthocephalus reptans*, incidence, toxicity, etc.; parasit. literature rev.); SAEMUNDSSON, 1909:10 (synon., Icelandic recs.; in Icelandic); M'SKIMMIN, 1909:452, 455 (the "hen-fish", choice and rare); LO BIANCO, 1909:703 (recs. of young living pelagically in Gulf of Naples, Oct. to Dec.; notes catches of adults at depth of ca. 400 m); SHEPHERD, 1910 (notes on otolith, fig.); MURRAY and HJORT, 1912:643 (listed for Norwegian waters from papers of COLLETT); OTTERSTRØM, 1912:104–106 (fig., descr.; Denmark); PELLEGRIN, 1913:321 (notes infrequent occur. in Paris fish markets); SUMNER, OSBURN and COLE, 1913:754 (rec. spec. taken in trap at U.S. Bureau of Fisheries "camp", Woods Hole, Mass., 9 VIII 04, "the only record for the region" and still at this date of writing, 1968, the only record from the Cape Cod region); LAMPE, 1914:246 (part, spec. "B"; fig. and descr., 30°21′ N, 14°02′ W; 31 X 01); Anon., 1914:22 (distrib. in NE Atlantic; vernaculars); MEEK, 1916:333 (distrib., incl. seasonal northward occur.; said to come closer to surface in summer; spawning range suggested from juvs. rep. by LÜTKEN, 1880); SCHMIDT, 1918:1–6 (larval and juv. development; figs. of Mediterranean adult and juvs., from LÜTKEN, 1880, and orig. specimens 5.5–14 mm long from Medit.); METZELAAR, 1919:275 (listed only, both sides of Atlantic, from GÜNTHER, 1860, and STEINDACHNER, 1868); SAEMUNDSSON, 1922:180 (strandings and live-captures from Iceland; notes that both occur during warmer half of year, July 15 to January 15); LEGENDRE, 1924 (account of the species off Concarneau; general distribution in Atlantic and Medit. from lit.; discuss. catch made by albacore fishermen off Britany in Sept., 1923, of average size 46–55 cm; notes on fishery, utilization; stomachs contained *Euthemisto*, *Meganyctiphanes* and one myctophid, the food similar to that of the tunas with which they were caught; specimens spawned out; notes on spawning season, parasites, and good review of parasitism in *B. brama*; comm. value and suggested as possible future comm. importance; species given vernacular "Hirondelle de Mer" by fishermen to whom the species was new); CLAUDE, 1925 (primarily a repetition, for more popular consumption, of the review by LEGENDRE, 1924; i.e., occur. and nat. hist. off Britany; figs. added); SHEPPARD, 1925 (stranding in Yorkshire); JENKINS, 1925:74, pl. 22 (descr., distrib. esp. in Gr. Britain; said to spawn south of the equator, which is incorrect); STEVENSON, 1926 (line-caught spec.); SAEMUNDSSON, 1926:123–125, fig. 80 (descr. in Icelandic; fig. from OTTERSTRØM); SAEMUNDSSON, 1927:162 (adult dead on beach, Iceland); MOHR, 1927:137–138 (descr., fig., vernaculars, distrib. in NE Atlantic); SAEMUNDSSON, 1927:13 (synopsis of occur. in Iceland); SHEPPARD, 1928 (stranding in north Yorkshire); SANZO, 1928 (descr. and excellent figs. development, egg to 14.3 mm); NORDGÅRD and DONS, 1928:48 (rec. adult Norway, 63°40′ N); JÄGERSKIÖLD, 1928:20–21 (fig. and recs., NE Atlantic); CLARKE, 1928 (summary of occur. during invasion of 1927–28, Yorkshire); STEPHEN, 1928:28 (Scottish recs., remarks on run of 1927–28); GRIMPE, 1929:163 (North Sea recs., orig. and compiled); SCHAANNING, 1929 (3 Norwegian recs.; descr. and photog.); BREDER, 1929:145 (rep. from No Man's Land, Mass., 1904; max. length given as 6 in.); BIGELOW and SCHROEDER, 1929 (relationships and distrib.); JORDAN, EVERMANN and CLARK, 1930:265 (distrib., synon., vernaculars: sea bream, pomfret, castagnole, rondanin); JÄGERSKIÖLD, 1932:39 (adult from the Kattegat); LE GALL, 1933 (fig. and descr., Mediterranean); BEEBE, 1933:181 (distrib. of young in nets fished off Bermuda 0–400 fms, most abund. in 25-fm tows); GREGORY, 1933:305–306 (fig. of skull; relationship with, e.g., *Coryphaena*); LE GALL, 1933 (descr. and fig.; 400–900 m); CLARKE, 1934 (adult trawled off Scarborough, Yorks.); STEPHEN, 1934:27 (rec. stranding, Firth of Forth); BERNHOFT-OSA, 1935:101 (2 off Norway); NOBRE, 1935:283–284, fig. 125 (synon., descr., vernaculars: Portugal); CLARKE, 1935 (12-in spec. from cod stomach, Yorkshire); FOWLER, 1936:654–656 (synon., descr., common names; descr. from Italian spec.; range given as open Atlantic and Pacific in error); EHRENBAUM, 1936:262 (fig., descr., "brachsenmakrele"; notes on life history from lit.; remarks on large northern invasion of late 1927 and early 1928); JENSEN, 1937 (excellent account seasonal appearance of oceanic fishes in the "transition area" of NE Atlantic; notes on depth and geogr. distrib.; abund.; strandings said to be related to wind force and direction, being most notable with strong inflow of Gulf Stream water coupled with strong westerly winds); HAZELWOOD, 1939 (2 strandings and 1 live-caught off Yorkshire); SAEMUNDSSON, 1939:191 (stranding, Iceland); JENSEN, 1940:194–199 (distrib.; recs. for Denmark mapped); HELLING, 1943:36

(listed for Portugal; synon.); Poll, 1947:242–243 (fig. and descr., Belgium; size); Noronha and Sarmento, 1948: 106, 142 (occur. in Madeira, notes on fishery, vernaculars, parasitism); Soljan, 1948:340–341 (fig., descr.; in Yugoslavian); Gibson, 1949 (rec. and measurements, 2 from Ireland); Saemundsson, 1949:17, 133, 135, 139 (synopsis occur. in Iceland with refs.; occur. in N Atlantic except E and W Greenland noted; rare on S and W coasts of Iceland but absent from NW, N, and E coasts); Meyer, 1949:92 (notes occur. in fall in herring fisheries of S North Sea); Kristensen, 1950 (summary occur. Dutch coast; notes abund. 1927 and 1949; fig.); Holgersen, 1950:89–91 (Norwegian recs.); Bruun and Pfaff, 1950 (rep. as subtropical vagrant; occur. Danish Sound); Marshall, 1951:6 (cites Davies, 1949, on myctophid consumption by *Brama* off S Africa); Rae and Wilson, 1951:83 (rep. large invasion around Scotland, 1949–50); Koefoed, 1952:9–10 (2 juvs. from "Michael Sars" exped.; N Atlantic); Rae and Wilson, 1952 b:56 (adult from Faroes); Rae and Wilson, 1952:107–108 (Scottish recs., 1952); Lozano y Rey, 1952:640–644, pl. 1, fig. 2 (descr. and orig. fig.; general account of occur.; fishery off Spain and Spanish islands; max. depth 500 fms); Rae and Wilson, 1952 c:115–116 (Scottish recs. for 1951; more abund. than usual); Brandes, 1952 (excellent summary distrib. adults in N Atlantic); Rae and Wilson, 1953:146–148 (numerous Scottish recs. for 1952; note heavy invasion in that year; sex ratio in 18 spec. 1:1; 2 Aug. spec. with spent gonads, those "taken in last quarter appeared to be recovering from the effects of spawning"; stomachs empty or with cephalopods and fish (sand eels, flatfish otoliths, whiting and other gadoids); notes on parasitism); Rae and Wilson, 1953 c:138 (North Sea recs.; comment on "the large numbers of Ray's bream in the northern North Sea and the relatively short period of the 'invasion' – mid-October to mid-December"); Brandes, Kotthaus and Krefft, 1953:47 (Icelandic recs.); Rae and Wilson, 1953:39 (adults from Faroes); Verwey, 1953:346 (20 Dutch recs. of which 14 were strandings); Palombi and Santarelli, 1953:40 (descr., depth in Mediterranean 100 to 400 m; good list of various European vernaculars); Bigelow and Schroeder, 1953:362 (repeat Woods Hole and Grand Banks recs.); Willgohs, 1953:122–130 (Norwegian occur.; in Norwegian); Albuquerque, 1954–56:680–682 (descr., fig. from Day; synon., Portugal); Dieuzeide, Novella and Roland, 1954:236–237 (fig. and descr.; said to be rare off Algeria; depth distr. 250–400 m but at surface during the summer spawning season); Rae and Wilson, 1954: 178–179 (1953 Scottish recs., note large numbers at end of Sept. and early Oct. NW Barra Head, NW Eagle I., off Irish coast; stomachs cont. *Argentina* and cephalopods; parasit. muscles by encysted plerocercoid forms of *Gymnorhynchus gigas*); Andriashev, 1954:212–215 (diagnosis, x-ray photog. head cf. *B. japonica*; distrib. incl. rec. Murmansk; good account in Russian); Kotthaus, 1954:117 (adults from North Sea and Norwegian Deep); Rae and Wilson, 1954:117 (Scottish recs.); Brandes, Kotthaus and Krefft, 1954:45 (recs., N Atlantic); de Castro, 1954:171 (Portuguese coast and Madeiran fisheries; vernaculars: "Chaputa", "Freira", "Plumbeta"); Willgohs, 1954 (distrib. off Norway compiled); Kirinčić, 1955: 45–46 (5 adults, 45–56 cm, 400–500 m in Adratic); Healy, 1955 (measurements spec. from Valentia I., Co. Kerry, Ireland); Went, 1956:69 (Irish recs.); Kristensen, 1956 discuss. occur. in Netherlands, in Dutch); Roche, 1956 (Irish rec.); Macleod, 1956:22, 54 (comments on vernaculars: Ray's bream, sea bream, black bream; color notes; ref. to *longipennis* (sic) unclear); Verwey, 1956:96 (North Sea recs.; thought to immigrate via the northern entrance rather than the Strait of Dover); Rae and Wilson, 1956:69 (Scottish recs.); Rae and Wilson, 1956:100–101 (1955 Scottish recs.; notes on spawning and occur.; parasitism; gadoids and cephalopods in stomachs); Rae and Wilson, 1957:103 (recs. from commercial Scottish landings); Went, 1958:246 (recs. from mackerel nets off Smerwick Harbor, Ireland); Hvass and Guibé, 1958:114, fig. 114 (range and color fig.); Rae and Wilson, 1958:96 (adults from off Scotland, 1956); Verwey, 1958:544 (discussion possible reasons for strandings, e. g., low temp. coupled with storm; cites Kristensen, 1956); Holgersen, 1959:127–129 (Norwegian recs.); Went, 1959:74 (Irish recs.); Rae and Lamont, 1959:85 (21 Scottish recs., 1957); Torchio, 1960:306–307 (occur. Ligurian Sea, Mediterranean; frequently taken on longline to 400 m; females ripe in August); Rae and Lamont, 1960:78 (Scottish recs., 1958); McAllister, 1960:27 (part, Canadian Atlantic); Verwey, 1960:547 (3 Dutch recs.); Amer. Fish. Soc., 1960:30 ("official" vernacular, "Pomfret", for this sp. and the Pac. *B. japonica*); Verwey, 1960:563–565 (Dutch stranding and live-capture); Rasmussen and Dannevig, *in* Rollefsen, ed., 1960, fig. 171 (excellent wash figure); Rae and Lamont, 1961:105 (Scottish recs., 1959); Holgersen, 1961 (taxonomic discussion; photog.); ?Blache, 1962:51 (recs. of juvs. trawled in Gulf of Guinea, Pt. Noire, Anno-Bon I.); Went, 1962:34 (Irish recs.); Went, 1963:107 (April and Dec., 1962, Irish recs.); Rae and Lamont, 1963:33 (12 recs. for off Scotland in 1960; notes that flesh usually infested with larval tapeworms); Legendre, Scott, and Bergeron, 1964:75 (the French vernacular "grande castagnole" suggested for use in French-speaking Canada); Leim and Scott, 1966:257–258 (Grand Banks rec. of "grande castagnole" repeated).

Lepidotus catalonicus Asso y del Rio, 1801:38 (orig. descr., Spain); de Buen, 1958:133 (status of name; a non-descriptive resumé of Chilean *Brama*).

Sparus brama Shaw, 1803:405 (listed, with synonymy).

Sparus castaneola Shaw, 1803:424 (diagnosis from Lacépède; according to Cuvier (1834:178–179), both of Shaw's species, *Sparus brama* and *S. castaneola*, are from Ray and Bloch although the trivial name of the latter appears to be based on the Mediterranean vernacular "La Castagnole" which was published by Duhamel (1782:26, pl. 5) and perhaps earlier); Risso, 1810:248 (descr., Nice; lists *Sparus raji* as a synonym).

Sparus niger, MONTAGU, 1804:292–293 (synonymy, and descr. of a British spec.); TURTON, 1807:98 (descr. spec. Swansea Bay, 12 XI 06; ref. to the "toothed gilthead" of PENNANT's British Zoology); PATTERSON, 1897:548 (several recs. from off Yarmouth).

Lepodus saragus RAFINESQUE-SCHMALTZ, 1810 a:54 (orig. descr., Mediterranean); RAFINESQUE-SCHMALTZ, 1810 b:21 (listed for Sicily; vernaculars: "lepodo sarago, saragu impiriali o scaru impiriali; a Catania, pesce luna"); BLEEKER, 1876:299 (designated type of genus; diagnosis; placed in subfamily Lepodontiformes of family Chaetodontoidei).

Chaetodon sp., COUCH, 1822:78–79 (descr. spec. taken alive off Looe, the spec. later serving as type of *Brama pinna-squamata*); COUCH, 1851 (ref. to "*Chaetodon* sp." of COUCH, 1822; comp. with *B. raii* and figured but not named).

Brama marina FLEMING, 1828:210 (descr. and occur in Gr. Britain, synon.).

Brama pinna-squamata COUCH, 1849:xxvi–xxvii (orig. descr. based on the *Chaetodon* sp. of COUCH, 1822; fig.; distinguished from *B. brama* (*B. raii*) by details of squamation on fins).

Chaetodon umbratus CABRERA, 1857, *in* MACHADO Y NUNEZ, 1857:23 (listed only, under heading: "Species denominatae à Cabrera, hactenus mihi ignotae", as follows: "*Chaetodon umbratus*, Cabr. Vulgo la xoputa", and "*Chaetodon umbratus* var. Cabr. Vulgo el randanil"; here considered a synonym based on common name and following STEINDACHNER, 1868, who may have seen specimens).

Pagellus sp., THOMPSON, 1918:63–64 (Scottish recs.; misidentified for THOMPSON by fishery officers according to B. B. RAE, pers. comm. of 17 IV 62).

Brama brama, EHRENBAUM, 1928:709 (general note on the 1929 invasion into the North Sea); BRANDES, KOTTHAUS and KREFFT, 1956:30 (recs. of adults, N Atlantic); KOTTHAUS, 1958:96 (recs., North Sea); BRANDES and KOTTHAUS, 1959:42 (recs. from comm. trawlers, N Atlantic); RODRIGUEZ-RODA, 1960:123 ("japuta" given as vernacular, S Atlantic coast of Spain); BRANDES and KOTTHAUS, 1960:72 (N Atlantic recs., comm. trawlers); BRIGGS, 1960:177 (part, erroneously listed as a species with worldwide distribution); KREFFT, 1960:72 (1958 Icelandic recs.); KREFFT, 1961 (remarks on distr. in N Atlantic with ref. to that of adult *Beryx*); KREFFT, 1962 (spec. from Wyk, Germany; good popular acct. of the species, its occur. in N Atlantic, migrations, nat. hist.); MEAD and HAEDRICH, 1965 (discuss. range, seasonal occur., etc., throughout N Atlantic; cf. *B. japonica*); ASHTON, 1965 (summary of comm. fishery in Bay of Cadiz).

Lepidotus raii, ALAEJOS, 1931:10, 32–33 (synopsis of comm. catch at SANTANDER, Spain, 1921–30; yearly and monthly totals); DE BUEN, 1935:102, pl. 24 (synon. and distrib., fig.).

Lepidotus brama, HIKITA, 1957:47 (listed for North Pacific O., Jap. vernaculars: Shimagatuso or Echiopia); UENO, 1965:2 (referred to Stromateoidei on basis of study, in Japanese, by MATSUBARA, 1963, who apparently found oesophageal sacs in the genus; recorded for off Kushiro, Muroran, Abashiri and Mombetsu, Hokkaido, Japan).

Southern Hemisphere.

Brama australis VALENCIENNES, 1840, pl. 44, fig. 1 and unnumbered text (orig. descr., Valparaiso, Chile, coll. by C. GAY; said to differ from congeners in fin formula but none provided; publ. date here taken from SHERBORN, 1922:555); LÜTKEN, 1880:493 (referred to *B. raii*); BIGELOW and SCHROEDER, 1929:42 (provisionally considered invalid).

Brama chilensis GUICHENOT, 1848:218–219 (orig. descr. based, according to GÜNTHER, 1880:409, on the type specimen of *B. australis* VALENCIENNES, 1940; type loc. Valparaiso; said to be rare and to differ from *B. brama* in numbers of fin rays, none of which are provided); LÜTKEN, 1880:493 (provisionally ref. to *B. raii*); GOODE, 1884:335 (orig. descr. noted only); REED, 1897:11 (listed for Chilean fauna); DELFIN, 1902:74 (vernacular: "hacha", following C. GAY); BIGELOW and SCHROEDER, 1929:42 (provisionally ref. to *B. raii*); DE BUEN, 1958:132 (status of *B. chilensis* vs. *B. australis* for Chilean form).

Toxotes squamosus HUTTON, 1875:313–314 (orig. descr., no fig., the stuffed type specimen returned to the collector (TRAVERS); type loc.: Cook Strait; comp. with *Toxotes jaculator*!); HUTTON, 1876:210–211 (rep. of type descr.); FOWLER and BEAN, 1929:30, 34 (descr. from HUTTON, no spec., family placement accepted!); FOWLER, 1938:177 (referred to synon. of *B. raii* with notes on FOWLER and BEAN, 1929).

Amblytoxotes squamosus BLEEKER, 1876:311 (generic descr.; placed in family Toxoteoidei).

Brama squamosa, HECTOR, 1877 (type said to be in Colonial Mus., cf. HUTTON, 1875, who reported that it was returned to the collector; notes a second fresh specimen taken from Wellington Harbor, 1875; no descr.); HECTOR, 1877: 339–340 (further notes, and fig., of Wellington Harb. spec.); LÜTKEN, 1880 (noted only, from HUTTON); GILL, 1893: 114 (refers *Toxotes squamosus* HUTTON and *Brama squamosa* of HECTOR to Bramidae and to the New Zealand fauna); HUTTON, 1904:44 (listed for New Zealand); SPEIGHT, 1919:40 (rec. spec. from New Brighton, New Zealand); PHILLIPPS, 1924:246–247 (descr., recs. from Napier, Queen Charlotte Sound, and Plimmerton, Australia; ref. to differences in dorsal profile of head; notes on rec. of April, 1872, from Hokitika Beach; type missing from Dominion Mus.); BIGELOW and SCHROEDER, 1929:42 (provisionally ref. to synon. *B. raii*); WEBER and DE BEAUFORT, 1936:195 (allocation of *Amblytoxotes* BLEEKER and its type, *Toxotes squamosus* HUTTON).

Brama raii, ?CASTELNAU, 1879:352 (listed for Port Jackson, Sydney, Australia; presumably from market spec.); JORDAN

and GILBERT, 1883:915 (part, listed for Chile, presumably from GAY or VALENCIENNES); MCCOY, 1887:127–129, pl. 133 (full descr. and fig., Australia, "RAY's sea bream"; occur. off Sydney and in Portland "in considerable number" in April, 1884); DELFIN, 1899:60 (listed for Chile; synon., in part from GÜNTHER, 1860); GILCHRIST, 1902:130 (listed only, S Africa); WAITE, 1904:43 (listed for New South Wales); THOMPSON, 1918:122–123 (listed, with synon., for S Africa); ?MCCULLOCH, 1921:64 (considered single rec. for New South Wales "unsatisfactory"); PHILLIPPS, 1927 b:13 (listed, as rare, for New Zealand); BARNARD, 1927:594–595, pl. 24, fig. 3 (descr., S Africa; fig. of N Atlantic spec. after SMITT et al., 1893, length up to 700 mm; depth of occur. to 500 fms; palatability); PHILLIPPS, 1927 a:35 (listed with synon.; New Zealand); MCCULLOCH, 1929:194 (rec. with synon. for Australia); FOWLER, 1934: 400, 423 ("One in the Australian Museum 63 mm long from Eromanga, New Hebrides (WHITLEY)" on p. 400, and a general ref. to ident. of *Toxotes squamosus* HUTTON with *Brama raii* on p. 423; while WHITLEY, 1938:193, reps. that the spec. on which FOWLER based this record is "a small *Taractes* sp. from Eromanga, New Hebrides, which is withheld for future study. The latter has been recorded as *Brama raii* by FOWLER (Mem. Bishop Mus. XI, 1934, pp. 400 and 423"); FOWLER, 1938:177 (placement of *Toxotes squamosus* HUTTON, a synon.); PARROTT, 1948:156–158 (synon., descr.; 2 spec. taken April, 1921 and 1924 at Kaikoura, Canterbury, New Zealand; counts and meas. 5 N.Z. spec.; notes variability in eye size, position of pectoral, depth of body and caudal peduncle, height of dorsal and extent of vertical fins; notes all New Zealand spec. but one were taken in April); DAVIES, 1949:32–33 (notes on abund. and food habits; S Africa); SMITH, 1949:308 (descr., fig.; rec. for all but coldest S African Seas, to 500 fms); OLSEN, 1958:157 (Tasmanian recs.: stranding at Coles Bay in April, 1955; "tow-line" at Port Davey, 1954; 273 mm spec. similarly taken Storm Bay, 2 III 54; 284 mm spec., Storm Bay, 12 III 54).

Lepodus squamosus, WAITE, 1907:25 (listed for New Zealand).

Brama brama, PHILLIPPS, 1927 a:35 (listed with refs. and synon., New Zealand); GRINDLEY and PENRITH, 1965:284 (recs. juveniles trawl-caught SW Indian Ocean); HEADRICH and NIELSEN, 1967:915 (from tuna stomachs; SE Pacific).

Lepidotus squamosus, WHITLEY, 1938 (lit. citations but nothing diagnostic of Australian species); SCOTT, 1955:136–137 (Tasmanian recs.; stranding at Temma on west coast, July, 1953; long line, 250 fms, ESE Fortescue Bay, Tasmanian Penn., 20 XI 53); WHITLEY, 1964:44 (in Australian check list).

Lepidotus chilensis, Fowler, 1944:77–78 (listed for Chile; states that "WHITLEY has shown that *Lepidotus* Asso 1801 is prior to *Brama* SCHNEIDER, 1801", which WHITLEY did not; synon.); FOWLER, 1945:63–64 (listed, with synon., for Chile).

Lepidotus raii, FOWLER, 1949:74 (Eromanga, New Hebrides; from FOWLER, 1944:190, but clearly based on earlier ref. to "WHITLEY" (FOWLER, 1934:400), the spec. that WHITLEY in 1938 referred to an unidentified *Taractes*; now that WHITLEY and FOWLER are together again I leave to them the study of the identity of this juvenile fish that they have placed before the ichthyologist, in published form, six times without ever having established its relationship to *Brama*, *Taractes*, or any other recognizable genus or species); MANN, 1954:233 (descr., common names; rep. as rare along N and central coasts of Chile; photog.).

Lepidotus australis, DE BUEN, 1958:132–134 (history and synon. *Brama* in Chile; status of *Lepidotus* and *L. catalonicus* of ASSO; no descr. or fig.); DE BUEN, 1958 (descr. and synon. Chilean reps.).

Brama japonica HILGENDORF, 1878.

Plate 3b; Figures 21 to 23.

Study Material:—A series of adults, 300–400 mm long, taken off Washington, British Columbia, and in the Gulf of Alaska during the exploratory fishing programs there, were provided by FERRIS NEAVE and NORMAN J. WILIMOVSKY; these are now in the Museum of Comparative Zoology. Two adults, without precise data, were purchased in the Tokyo Market in December, 1960 and January, 1961, by Dr. T. ABE; these also are now in the MCZ.

Scripps Institution of Oceanography and the University of California at Los Angeles provided juveniles and small adults from off the Pacific Coast between Baja California and central California (Appendix Table 7). I have also seen the larvae and juveniles taken during the surveys of the California Cooperative Oceanic Fisheries Investigations, La Jolla, through the courtesy of Dr. E. H. AHLSTROM and FREDERICK H. BERRY of that laboratory (Appendix Table 8). A few specimens taken by vessels other than the "Dana" but contained in the Carlsberg collections (Appendix Table 7) are also included.

Distinctive Characters:—*Brama japonica* is most closely allied to *B. brama*, from which it differs in having modally fewer vertebrae, and dorsal and anal rays. The most convincing differences, however, are found in juveniles shorter than 100 mm s.l. In young *B. japonica* the greatest depth of the body (Fig. 13)

Table 7. Meristic variation in *Brama japonica*.

Dorsal Fin	**33**	**34**	**35**	**36**
	1	2	14	5
Anal Fin	**27**	**28**	**29**	**30**
	6	13	12	1
Pectoral Fin	**21**	**22**	**23**	
	4	22	10	
Thoracic Vertebrae	**15**	**16**	**17**	
	7	20	4	
Abdominal Vertebrae (excluding urostyle)	**22**	**23**	**24**	**25**
	2	16	11	1
Total Vertebrae (including urostyle)	**39**	**40**	**41**	
	4	17	10	

Table 8. Proportional dimensions, in percent of standard length, of the North Pacific *Brama japonica*.

Number of specimens Standard length (mm)	7 40–50	7 50–100	3 250–300	7 300–400
Fork length (per cent)	118.9–127.5	115.0–119.5	108.0–112.0	111.5–120.0
Greatest depth of body	44.2– 50.6	42.6– 49.7	47.1– 49.0	44.4– 49.8
Least depth of caudal peduncle	7.6– 8.8	7.6– 8.9	6.8– 6.9	5.9– 7.4
Greatest width of body	9.7– 15.4	10.2– 14.2	12.1– 13.1	12.8– 14.8
Greatest width of head	11.4– 15.4	12.8– 15.5	11.4– 12.2	11.4– 13.5
Snout to origin of dorsal fin	41.0– 43.9	37.8– 41.3	36.0– 40.3	37.1– 40.3
Snout to origin of anal fin	51.6– 55.5	52.2– 55.5	53.7– 54.8	52.2– 56.7
Snout to origin of ventral fin	36.9– 40.5	35.9– 39.3	38.6– 40.0	38.2– 41.2
Snout to origin of pectoral fin	27.6– 30.5	27.7– 29.9	29.3– 30.2	28.0– 31.0
Length of base of dorsal fin	51.1– 53.0	53.8– 57.3	58.3– 61.4	55.2– 62.0
Length of base of anal fin	37.4– 41.9	39.8– 44.2	44.4– 47.9	44.1– 47.3
Origin of dorsal fin to insertion of pectoral fin	30.9– 34.5	27.2– 31.4	31.2– 31.4	28.5– 32.5
Base of uppermost pectoral ray to that of lowermost	9.7– 11.8	8.5– 10.2	7.8– 8.2	6.5– 8.3
Base of lowermost pectoral ray to insertion of ventral fin	4.8– 7.4	5.6– 7.9	10.6– 11.5	9.9– 11.7
Insertion of ventral fin to origin of anal fin	15.8– 19.4	16.9– 18.9	16.3– 18.7	15.2– 18.4
Length of pectoral fin	34.3– 38.3	31.8– 36.5	35.5– 43.6	36.0– 46.6
Length of ventral fin	21.2– 26.5	15.1– 24.6	9.2– 9.4	7.9– 9.7
Length of 5th anal ray	16.6– 22.3	12.8– 18.3	9.1– 10.2	7.6– 10.5
Length of 5th-from-last anal ray	11.3– 16.4	9.2– 12.9	6.0– 6.7	5.5– 6.7
Length of 5th dorsal ray	26.5– 32.1	24.1– 31.3	19.2– 19.9	17.0– 22.3
Length of 5th-from-last dorsal ray	12.2– 19.1	10.8– 14.2	6.8– 8.5	5.8– 8.3
Length of upper caudal lobe	36.1– 47.2	39.0– 46.6	*ca.* 32.0	25.9– 32.1
Length of lower caudal lobe	33.7– 42.2	38.5– 46.0	*ca.* 32.0	28.0– 32.4
Length of central caudal ray	19.2– 29.3	17.0– 19.5	11.6– 11.7	9.7– 12.0
Length of head	30.1– 35.4	27.9– 30.4	27.6– 28.0	26.6– 29.8
Length of snout	6.0– 7.8	5.9– 7.9	7.7– 8.4	7.2– 8.7
Diameter of eye, horizontal	10.2– 11.5	8.4– 10.4	6.4– 6.8	5.8– 7.2
Diameter of eye, greatest	10.9– 11.7	8.0– 10.4	6.7– 7.1	6.1– 7.7
Greatest distance between orbit and free edge of subopercle	11.9– 14.0	13.4– 14.5	14.1– 14.8	12.3– 15.0
Width of interorbital space	–	–	8.3– 9.4	8.1– 9.5
Length of upper jaw	14.7– 15.8	14.1– 15.7	13.4– 13.7	11.9– 14.3

and distance between the origin of the dorsal fin and the insertion of the pectoral are less than in *B. brama*. *B. japonica* young also have lower vertical fins but these are difficult to measure satisfactorily and thus of little quantitative use. *B. japonica* young can be distinguished easily from two of its Pacific congeners, *B. orcini*

and *B. myersi*, by its less-deep body, longer ventral fins and higher meristic values (Figs. 14 and 15). The shallow body and high pectoral count (21–23 cf. 19–21) will distinguish *B. japonica* from the adjacent tropical *B. dussumieri*. Unfortunately large *B. dussumieri* and *B. myersi* are unavailable for comparison.

Description of Adult:—Counts, and proportional dimensions, are given in Tables 7 and 8. In general appearance, the body of *B. japonica* is identical to that of *B. brama* (p. 30). The extent and pattern of scale covering is likewise similar, differing only in the fewer rows between the uppermost point of the gill covers

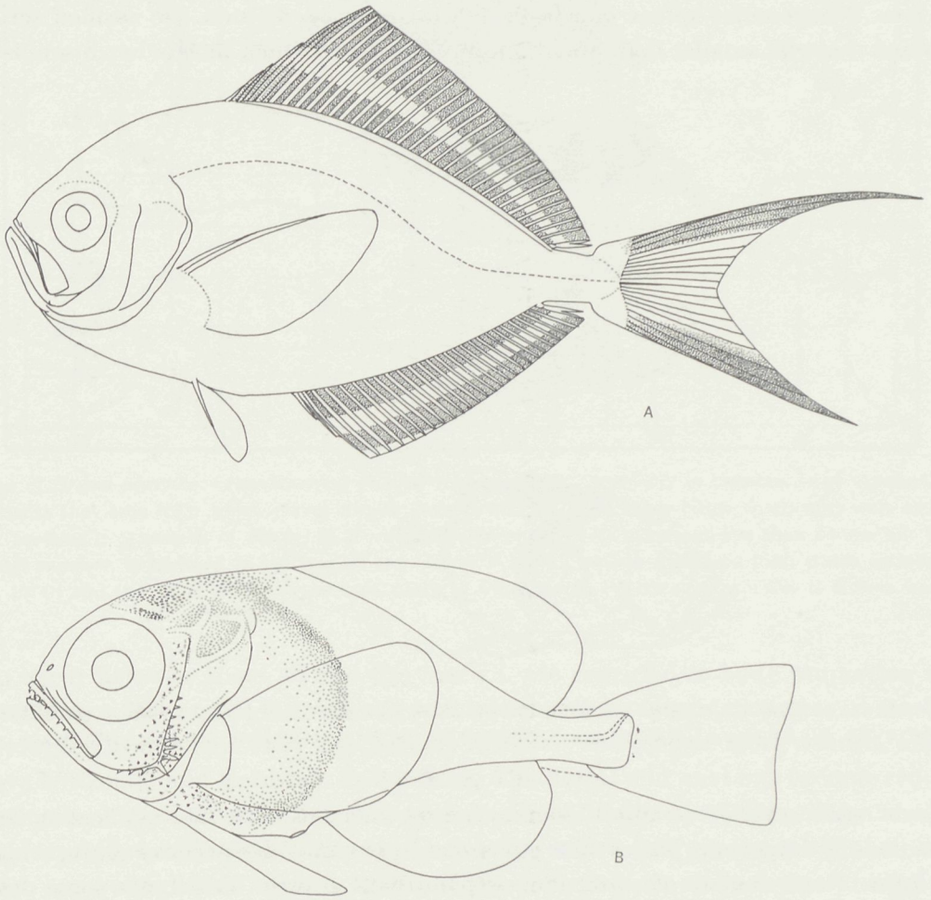


Fig. 21. (A) *Brama japonica*, 86.5 mm s.l., taken 25–30 miles north of Guadalupe I., Baja, California (UCLA W 57–28). (B) A specimen 12.5 mm s.l. (CCOFI Sta. P5009–113.35; 29°12′ N, 115°39′ W). A and B not to scale. Both drawn by N. Strekalovsky.

and the base of the midcaudal rays (65–75, cf. 70–80 in *B. brama*). There may also prove to be a modal difference between *B. brama* and *B. japonica* in number of gill rakers, the total number on the first arch being 17–20 (cf. 15–18 in *B. brama*), and *B. japonica* has a somewhat smaller eye than its Atlantic counterpart. In other respects—dentition, shape of head, branchial structure, color, etc.—no noteworthy differences are shown by the material at hand.

The color is the same as that described for *B. brama* (p. 33).

Development:—The following characters are most useful in separating the early stages from those of other North Pacific bramids: Vertebrae 40–42, ossifying fully only at ca. 10 mm s.l. Dorsal behind vertical of base of pectoral. No dorsal lobe and this fin colorless in juveniles; anal fin also colorless and without lobe. Pectoral set low, as in *B. brama*. Caudal colorless; urostyle straight below ca. 7 mm s.l. Scales absent below 10 mm s.l. As many as ten preopercular spines which begin to form at about 6 mm and begin to be overgrown at about 12 mm. Gill membrane dusky but not black. Teeth on jaws absent below 5.2 mm, increasing in number and size thereafter. No palatine teeth in individuals shorter than 10 mm s.l.

Early development was followed in stained and unstained material taken by "Falstria", "Jutlandia" and "Selandia" and in that various collected by the California Cooperative Oceanic Fishery Investigations. Individuals between 3.2 and about 5 mm s.l. are larval in appearance. In some specimens smaller than 4.2 mm pigmentation is restricted to the eye, the area over the brain, and to a lesser extent to the posterior abdominal peritoneum. At about 6 mm some chromatophores appear on the cheek and gill membrane and around the orbit; and a few spots lie above and below the terminal end of the vertebral column. Aside from the embryonic fin fold, the first fin rudiment to form is the pectoral, at about 4 mm s.l., followed by the pelvic at ca. 6 mm. Preopercular spines and teeth first ossify at ca. 5.5 mm. No ossified serial elements are apparent in stained material smaller than about 5 mm, a length at which most other bramids show complete

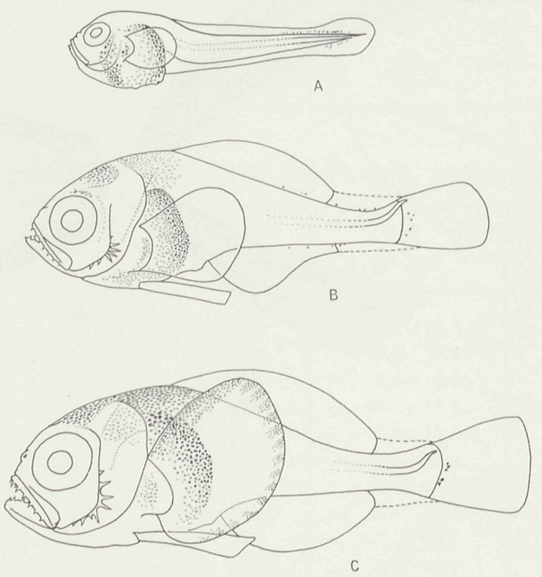


Fig. 22. *Brama japonica*: (A) 6.0 mm s.l. (CCOFI Sta. 5101–100.90; 29°40.5′ N, 120°47′ W). (B) 7.4 mm s.l. (CCOFI Sta. P5009–110.100; 27°04′ N, 120°18′ W). (C) 8.8 mm s.l. (CCOFI Sta. S5710–110.70; 28°36′ N, 118°18′ W). Drawn by N. Strekalovsky.

or nearly complete ossification of vertebral column and fin elements. The first ossification seen, at 3.3 mm, is found in functionally important places: the gill arches, jaws and the pectoral girdle which will support the first fin to form. These centers of ossification expand with growth. At 3.9 mm some ossification of the brain case and suspensorium are apparent, and between 5 and 6 mm the preoperculum with its spines and the branchiostegal rays ossify. These fish are naked, and scales first appear at about 10 mm. First to form are those between, and anterior to, the bases of the ventral fins and those on the flank posterior to the upper end of the gill cleft in the position to be occupied by the lateral line.

Ossification is rapid between 6 and 10 mm and all bony elements and most fin rays take stain by 12 mm. Coloration also spreads, but aside from a few melanophores at the bases of some central caudal rays it is restricted to the body anterior to the rear edge of the abdominal cavity, and to the pectoral but not the ventral fins. By 12 mm these fish are clearly juveniles. The body is separated into dark anterior and pale posterior parts at about the level of the posterior part of the abdominal cavity. The tip of the snout is unpigmented but the head and cheeks are dark. The vertical fins are clear except for a few caudal melanophores. Dorsal and anal fins are large but lack anterior lobes. The pectoral is large and set low, the distance from the base of the lowermost pectoral ray to the origin of the ventral fin being about half the width of the base of the pectoral. The ventrals are inserted under the middle of the pectoral base, in contrast to the more anterior placement at smaller sizes. The only characters more reminescent of larval than of larger specimens are the retention of parts of the embryonic fin folds between the procurrent caudal and the posterior dorsal and anal rays; and the incomplete squamation, which at 12 mm covers less than half the body.

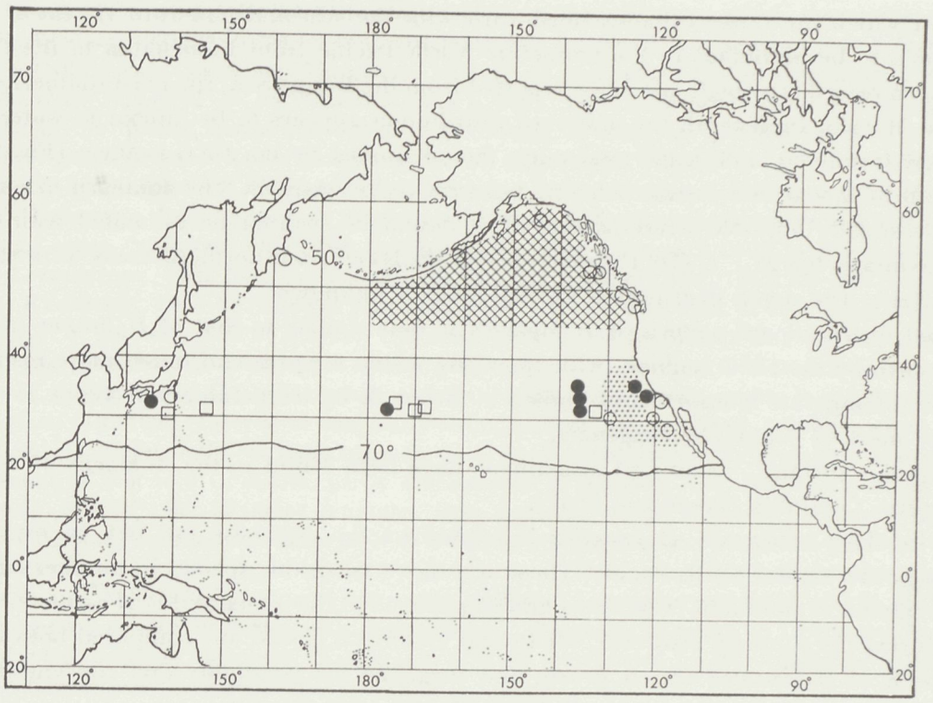


Fig. 23. Distribution of *Brama japonica*. Cross-hatching denotes area producing, especially in summer, large numbers of gill-net caught fish; stippling represents that area from which young shorter than 20 mm s.l. (and a few larger specimens) were caught (largely Calif. Coop. Oceanic Fish. Investig.); ○ records of adults; ● juveniles 20–200 mm s.l.; □ specimens less than 20 mm s.l. The probable total range, winter through summer, is enclosed in the two curves, the 50° F (10° C) isothere poleward from which surface temperatures are always colder than 10° C; and the 70° F (21.1° C) isocryme, south of which north Pacific surface water is always warmer than 21.1° C.

Changes that occur between about 40 and 200 mm s.l. are restricted to body proportion and coloration. The ventral fin remains colorless, but the pectoral, which bears some pigmentation even at much smaller sizes, becomes darker, especially dorsally. They also become relatively shorter and more pointed, and the bases become more nearly horizontal and lie higher on the flank. The dorsal and anal fins become reduced in relative height and, in coloration, pass from the colorless appearance of 20 mm specimens to the wholly black of the adult through the expansion of horizontal bands of coloration which first appear at about 40 mm. The bands of the anal, which are quite distinct up to a length of about 40 mm, lie along the proximal and distal edges of the fin. Those of the dorsal, one along the base and another about halfway out on the fin, are generally indistinct and soon fuse to blacken the fin throughout. Body coloration darkens somewhat with growth and there is greater contrast between the intensity of dorsal cf. ventral pigmentation.

Distribution:—The only data pertinent to spawning range are those associated with the capture of larvae and juveniles. A few specimens from central and eastern Pacific localities are in the "Dana" collections although they were taken by vessels other than "Dana"; and an excellent series from off California and Baja California are represented in the collections of the California Cooperative Oceanic Fishery Investigations. These were taken chiefly during the summer months and were caught near the surface. Surface temperatures at points of capture were between 16.3 and 23.9° C but about three-fourths of the captures were associated with surface temperatures between 18.0 and 20.5° C. The temperature of spawning areas thus appears to be cooler than that of *B. brama* in the eastern North Atlantic, where young were found in waters as cool as 19.3° C but most commonly between 21° and 23.8° C.

Although distributional data for the adults (Fig. 23) from the central Pacific are sparse, that available suggests a pattern similar to that of the North Atlantic *B. brama* (Mead and Haedrich, 1965). Data from experimental long-line explorations for salmon have been studied by Neave and Hanavan (1960), Kasahara (1961: 14), Hitz and French (1966) and others. The adult population is either truly a migratory one or a

pulsating one in which the range expands northward with the seasonal poleward retreat of the isotherms. Adults are known to be abundant in the temperate North Pacific from Kamchatka to the Gulf of Alaska. The most northern record is a single specimen reported from the Bering Sea; the most southern a few juveniles from off central Mexico. In general, the poleward distribution appears to be limited to waters warmer than 10°C (MEAD and HAEDRICH, 1965), the total range thus delimited by the 10°C isothere (Fig. 23). The range is centered south of that of the Pacific salmons but broadly overlaps it. The southern extent of the range, which unless seasonally adjusted overlaps that of *B. dussumieri*, cannot be estimated with confidence but probably approximates the 21.1°C (70°F) isocryme. Adults taken from northern areas were caught relatively close to the surface. The depth distribution further south is unknown.

The seasonal distributional pattern of *B. japonica* is thus similar to that of *B. brama*—a migratory one limited to the north by the 10°C isothere, with spawning within a warm and much more restricted temperature range in mid-temperate latitudes, and limited to the south by temperatures of about 21°C and perhaps by the presence there of competing congeners.

Food:—Squid, "shrimp", fishes and amphipods have been found in the stomachs of adults caught off the coast of British Columbia (PINCKARD, 1957).

Commercial Importance:—*B. japonica* is landed by the Japanese but not, to my knowledge, by other countries bordering the North Pacific. Those who have taken this species in numbers incidental to the Gulf of Alaska salmon explorations (e.g., HITZ and FRENCH, 1966) have marked it as a potentially commercial species there during the summer. However, MEAD and HAEDRICH (1965: 40) compared both fishery and distributional aspects of *B. japonica* and *B. brama* and suggested the possibility that concentrations analogous to those found off Vigo, Spain may occur off the California coast in winter.

Common Names:—In the American literature the species is commonly called "pomfret" or, to distinguish it from *Taractichthys* and allied forms, the "small-scaled pomfret". Japanese names: Shimagatsuwo (which dates at least from JORDAN and SNYDER, 1901: 69), Etchiopia, and Hama-shimagatsuwo (ABE, 1961: 98).

Synonyms and References.

Brama japonica HILGENDORF, 1878:1 (orig. descr., said to differ from *B. brama* in placement of eyes, convex snout, body form, lesser development of fins and axillary scales); LÜTKEN, 1880:494 (diagnosis, from HILGENDORF, 1878); STEINDACHNER and DÖDLERLEIN, 1884:5, pl. 1 (fig. of type of spec. in Berlin Mus., 45 cm total length; comp. with *B. brama*); JORDAN and SNYDER, 1901:69 (listed for Yokohama, Japan); BIGELOW and SCHROEDER, 1929:42 (tentatively retained as a distinct sp.); P. U. SHMIDT, 1931:44 (2 adults descr., Tokyo fish market); ALPEROVICH, 1940: 77–78 (rec. off Kamchatka in 1938–39; presumed summer feeding migration); VINOGRADOV, 1949:100 (listed as part of NW Pacific faunal association); PANIN, 1951:52–53 (fig., rec. for E shores Kamchatka at surface of Bay of Krouotzk, Aug., 1938 and Sept., 1940; Bay of Avatchinsk, Sept., 1940; normal range given as S Calif. to SE Alaska); ANDRIASHEV, 1954:212–215 (descr., distrib., x-ray photog. of head; said to differ from *B. raii*, i.e., *B. brama*, in vertebral number (41) and particularly in form of snout, the forward part of the head being more circular, with the occipital crest reaching past the premax.); POLUTOV, 1954:100 (occur. off Kamchatka); PINCKARD, 1957:6–8 (review of occur. off British Columbia in gill net catches; greatest abund. at 12–15°C, cf. 11–12°C for salmon; sex; food); HITZ and FRENCH, 1966 (analysis of adult distrib. and abund., Gulf of Alaska); MEAD and HAEDRICH, 1965 (distrib. adults, comp. with distrib. *B. brama*); BERRY and PERKINS, 1966:673 (juveniles and sub-adults trawl-caught off central Calif.); FITCH and LAVENBERG, 1968:99 (cf. *Taractichthys*, rec. for "near Calif.").

**Brama rayi*, ?GÜNTHER, 1878:485 (rec. BM (NH) spec. from Tokyo); GÜNTHER, 1880:66 (spec. from Japan taken by fishing vessel off Inoshima); JORDAN and GILBERT, 1883:915 (part, listed for Washington state, from BEAN); STEINDACHNER and DÖDERLEIN, 1884 (descr. adults, Japan); GOODE, 1884:335 (notes on occur. off Washington and Vancouver I.); JORDAN and SNYDER, 1901:69 (listed for Yokohama, Japan and Atlantic); "shimagatsuwo" as vernacular); JORDAN, TANAKA and SNYDER, 1913:134 (part, listed for Japan; distrib. given as Indian Sea, Chile, Japan; in part from lit.; synonymy); THOMPSON and HIGGINS, 1919:203 (4 spec. in gill net, off San Pedro, Calif.); JORDAN, 1924:82 (rep. spec. from off San Diego, Calif., photog., Santa Catalina I., Calif., and Queen Charlotte Is., British Columbia); FOWLER, 1924:289 (rec. from off San Pedro, Calif.); CRAWFORD, 1927:183–4 (rec. spec. 40 mi off Cape Flattery, ca. 2 × 25); PRITCHARD, 1930:88 (rep. "large and troublesome run" 6 VIII 29 off Seal Point, W coast of

* Includes all variations in the spelling of the trivial name.

Graham I., Queen Charlotte Is., British Columbia; said to be first rep. mass occur. there; cites reps. of Scottish runs of 1928); Tanaka, 1931:24 (listed for southern Japan but not assigned to a faunal prov.); Barnhart, 1936:40 (descr.; rec. S Calif.); Van Cleve and Thompson, 1938:45–46 (rec., said to be most northerly, from salmon trap at Cape Uyak, 57°38′ N, 145°21′ W, on W coast Kodiak I., Sept., 1937; brief descr.; also rep. "considerable numbers" of pomfret caught on trolling spoons 100–600 mi E of Unimak, as many as 70 being taken on a single Aug. day); Cowan, 1938:97 (rec. "pomfret" taken on salmon troll off Cape Cooke, Vancouver I., British Columbia; 27 IX 37); Okada, 1938:172 (part, listed for Honshu, Japan); Fowler, 1938:277 (questionable rec. from Honolulu; not seen by Fowler); Kamohara, 1938:23 (Japan; listed as rare, length 300–400 mm); Clemens and Wilby, 1946:143–144 (descr. and fig.; occur. "pomfret" off British Columbia with range given as S Calif. to NW Alaska); Powell, Alverson and Livingstone, 1952 (rec. captures by gill nets, NE Pacific); Abe, 1952:235–236 (descr. spec. from off Kamchatka); Kamohara, 1952:33 (listed as rare, length 300–400 mm with max. of 1200 mm); Powell and Peterson, 1957 (occur. in gill nets, Gulf of Alaska); ?Kuroda, 1959 (listed for Suruga Bay, Japan; ident. by Suyehiro and Yanagihara problematical (Abe, pers. comm.); in Japanese); Graham, 1959 (mentioned in connection with albacore survey, NW coast of U.S.); Hanavan and Tanonaka, 1959 (occur. adults in gill nets, Gulf of Alaska); Neave and Hanavan, 1960 (analysis of seasonal distrib., Gulf of Alaska; temp. tolerance given as 9° to 17°C); Kasahara, 1961:14 (notes occur. in large numbers in N Pacific; considered "intermediate temperature species", with minimum at ca. 8.5° to 9°C; distrib. partly overlaps that of salmon); Abe, 1961 (part, Japan; key to genera; common names); Hartt, 1962:16 (listed as species taken incidental to the N Pacific purse-seine tagging program); Larkins, 1964 (abund., especially in summer, in NE Pacific gill-net surveys; no distrib. details).

Lepidotus brama, Matsubara, 1955:542, pl. 48, fig. 170 (in key, descr. in Japanese, fig. from Steindachner and Döderlein, 1884); Okada, 1955:178 (descr. and fig.; range suggested as warmer waters of middle of Japan S to East China Sea, suggesting possible confusion with *B. dussumieri*); Tomiyama and Abe, *in* Tomiyama, Abe and Tokioka, 1958:222 (color fig., descr. in Japanese); Kamohara, 1958:26 (part, listed for Kamchatka to S Japan, Korea, Red Sea, Africa, Australia and the Atlantic O.).

Brama dussumieri Cuvier, 1831.

Figures 24 to 27.

Study Material:—The type specimen (a juvenile, MNHN), a series of young and adults shorter than 190 mm, from all oceans, and net-caught larvae from the "Dana" collections form the basis for this account. This material is recorded in Appendix Tables 9 and 10.

Distinctive Characters:—*Brama dussumieri* juveniles and subadults can be distinguished from *B. caribbea*, *B. myseri*, and *B. orcini* by the lower placement of the pectoral fin (Fig. 14), and the longer ventral fin (Fig. 15). In vertebral number, it is similar to *B. myersi* (40 or more), a number greater than those found in *B. caribbea* (fewer than 40). *B. dussumieri* can be separated from *B. japonica* by its relatively greater body depth (Fig. 13), and, in the Atlantic, from *B. brama* by the lower number of rays in the anal fin (28 or fewer cf. 29 or more), modal differences in other meristic characters, and the lack of a lobe in the colorless anal fin. It also has fewer gill rakers on the first arch (15 or fewer) than *B. brama*. *B. dussumieri*, particularly the larger of the available specimens, most closely resembles *B. brama*.

Meristic variation notably greater than that shown by its congeners and observable differences in form and coloration suggest that *B. dussumieri* is polytypic. For this reason, descriptive information is referred to individual specimens or collections from individual oceans rather than combined into a more generalized account.

Snout blunt and little if at all concave above tip of snout. Anterior nostril circular, directed forward, and slightly closer to tip of snout than to orbit Posterior nostril a slit midway between anterior nostril and orbit. Eye elliptical, the horizontal axis shorter than the oblique, the horizontal diameter 3.6–3.7 in length of head. Free edge of preoperculum and operculum evenly rounded and without spines (cf. spinulose preoperculum of juveniles). Branchiostegal rays regularly seven, the membrane completely covered by the opercular flap when the mouth is closed normally. Gill rakers of the usual lath-like shape on the first arch, the number 3 to 5 + 1 + 8 to 11 = 13 to 15, those along middle of lower limb longest, all bearing spines along inner edge. Rakers on successive arches represented by spinulose rudiments.

Length of head 3.5–3.8 in s.l. Upper jaw extending to below center of eye. Toothed border of upper jaw concave in outline, that of lower straight or nearly so. Principal mandibular teeth an inner row of recurved

conical teeth, the row beginning anteriorly with one or two enlarged canines. Lateral to this row and separated from it by a dense band of villi is a second row of teeth which are smaller but of similar shape. Principal teeth of premaxillary in an outer row, the teeth similar in number, size, shape and placement to the outer row of mandibular teeth. Within this row anteriorly, among more villi is a band of smaller and poorly-set recurved teeth. Palatine teeth small but few in a row, but sometimes lacking. A patch of vomerine teeth present but variable, being strong in one specimen but completely lacking in another.

Description of Subadult (Western Atlantic):—Counts and proportional dimensions are given in Tables 9 and 10. Head and body strongly compressed, as in allied forms. Lower jaw terminal. Dorsal profile of head an even curve between snout and origin of dorsal fin. The ventral profile is that of the lower edge of the mandible and subopercle to a point below the anterior half of the eye, at which point the isthmus emerges

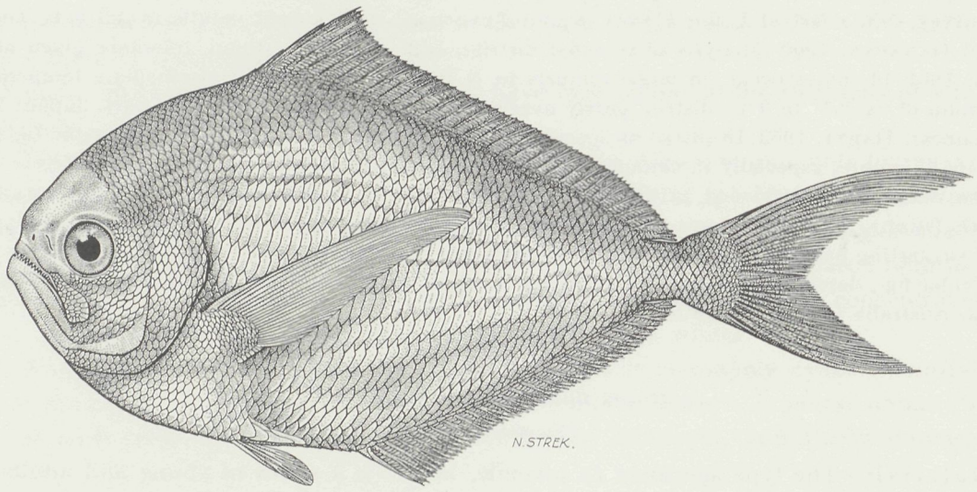


Fig. 24. *Brama dussumieri*, 148.5 mm s.l., from the Gulf of Mexico ("Oregon" Sta. 1583; 28°44′ N, 88°08′ W). Drawn by N. Strekalovsky.

from between the gill covers. Ventral contour of body between isthmus and insertion of ventral fins strongly supported by the underlying bones of the pectoral girdle. From base of ventral fin to origin of anal the ventral profile is nearly straight and parallel to the horizontal axis of the body. Greatest depth of body, under anterior end of base of dorsal, 1.9–2.1 in s.l. Bases of vertical fins slightly convex, converging toward the moderate caudal peduncle, the least depth of which is contained 6.5–6.7 times in greatest depth of body. Dorsal fin with prominent anterior lobe. Anterior anal rays longer than posterior but without discrete lobe. Caudal fin forked, the upper lobe slightly longer than the lower.

Snout, lower jaw, premaxillary (but not maxillary), angle of preoperculum, extreme tips of dorsal and anal rays, much of the surfaces of the paired fins and part of the caudal naked; the head and body otherwise covered by scales of irregular shape but which do not bear vertical spines (cf. young shorter than 100 mm). Lateral line present, incomplete, and indistinct; formed of about 65 scales. Scales in horizontal series between upper end of gill cleft and base of central caudal rays 57–65. Scale covering extending nearly to tips of caudal lobes but overlying only about proximal half of central caudal rays. Bases of pectoral rays with scales, these completely covering the lowermost two or three rays. Lower surface of inner rays of ventral fin partially covered by scales, the innermost ray wholly so. Axillary scales of paired fins well developed, those of ventral fin about two-thirds as long as the fin.

Dorsal fin originating over rear of base of pectoral fin, the predorsal distance 2.4–2.6 in s.l. Three or four graduated simple anterior rays, the rest branched, about the fifth longest. Length of base of dorsal fin about 1.7 in s.l. Anal fin with two or three simple graduated rays in anterior end, without distinct lobe (cf. dorsal fin), the rays gradually becoming shorter posterior to about the fifth ray. Preanal distance 1.8–1.9 in s.l.; length of anal base 2.1–2.2 in s.l. Pectoral fins of these subadults situated relatively high on body,

Table 9. Meristic variation in *Brama dussumieri*.

Dorsal Fin	**33**	**34**	**35**	
Atlantic	5	9	5	
Pacific	21	14	14	
Anal Fin	**26**	**27**	**28**	**29**
Atlantic		10	8	
Pacific	11	20		1
Pectoral Fin	**19**	**20**	**21**	**22**
Atlantic	4	15	5	
Pacific	14	20	9	2
Thoracic Vertebrae	**14**	**15**	**16**	**17**
Atlantic	2	5	2	2
Pacific		2	9	1
Abdominal Vertebrae (excluding urostyle)	**23**	**24**	**25**	**26**
Atlantic		3	1	2
Pacific	1	7	4	
Total Vertebrae (including urostyle)	**40**	**41**	**42**	**43**
Atlantic	2	4	7	1
Pacific	1	9	3	

the axis more nearly horizontal than vertical (cf. juveniles). Prepectoral length 3.4 to 3.6 in s.l., the length of fin 2.4 to 2.6 in s.l. Two lowermost pectoral rays, and those which enter into the leading edge of the fin simple, the rest branched. Ventral fin inserted under posterior half of base of pectoral fin, the preventral distance 2.4 to 2.6 in s.l., the length of ventral fin 2.1 to 2.2 in length of head.

In preservative, these subadults are dark gray, with traces remaining of the metallic luster provided during life by the scales. The vertical fins are dark throughout, but the trailing edge of the caudal fork is lighter than the proximal three-fourths of the lobes. The paired fins are clear.

Diagnosis of juveniles (Atlantic):—Formula: D 33–35, A 26–28, P 19–22, BR 7, Vertebrae 14–17 + 23–26 + 1 = 40–43. Dorsal fin: origin behind vertical of pectoral fin, the origin relatively constant, predorsal scales numerous; three or four graduated rays anteriorly but *no* dorsal lobe in juveniles. Fin colorless in fish shorter than 10 mm, developing thereafter a median band or bands; fin becoming quite dark by 35 mm. Anal fin: origin behind vertical from origin of dorsal fin, constant; anal without pigment to about 30 mm s.l. and without an anal lobe to about 100 mm s.l. Pectoral fin: set low, as in *B. brama* below 15 mm s.l.; intermediate in position and angle of base in large juveniles. Ventral fin: inserted under base of pectoral and extending to or beyond origin of anal fin between 5 and 70 mm s.l. Caudal fin: tip of rays usually pigmented; elevation of urostyle begins at ca. 5 mm. Scales: beginning to form between 6.5 and 7.5 mm; those on caudal peduncle when formed bearing spines of similar size to their neighbors; squamation complete at 15 mm. Preopercular spines: six or more depending on size, present in smallest individuals; completely overgrown by 50 mm. Gill membrane: a few melanophores or completely colorless. Teeth: present at all sizes; palatine teeth ossify at about 7 mm; anterior larval canines present.

Development description of larvae and juveniles:—The description of the developmental stages which follows is based on "Dana" specimens from the tropical Atlantic. Except as noted under "Variation", Indo-Pacific young conform to this description.

4–15 mm: the smallest specimens are those 5.0 mm from the Atlantic and 4.0 mm from the East Indies. Flexure of the urostyle has just begun at 5.0 mm. Pigmentation over the brain and that lining the abdominal cavity is well developed and there is a dark bar extending ventrally below and behind the eye. There are scattered melanophores on the branchiostegal membrane and the body itself is dusky as far posteriorly as the origin of the dorsal fin. There are some fin rays, and a few teeth in each jaw.

Table 10. Proportional dimensions, in percent of standard length, of *Brama dussumieri*.

	East coast of Florida UMML 6962	Gulf of Mexico, ("Oregon")	"Dana" 3998, E. Atlantic, 7°34′S., 8°48′W.	"Chain" 17, RHB 804 E. Atlantic	"Pawnee" Tongue of the Ocean, Bahama Ids. BOC 2795	"Dana" 1225, Strait of Florida, 23°58′N., 83°22′W.	Gulf of Mexico ("Oregon")	"Chain" 17, RHB 804 E. Atlantic	"Dana" 1225, Strait of Florida, 23°58′N., 83°22′W.	Eastern Pacific, 0°00′N., 93°00′W.	Mid-Pacific	Japan (Suruga Bay)	Off Zanzibar (BMNH)	Type of *B. dussumieri* "Equateur"
Number of specimens	1	1	1	1	1	1	1	1	1	7	6	1	1	1
Standard length (mm)	158.0	148.5	92.5	80.6	56.8	46.4	41.2	27.7	20.6	26.0– 43.5	31.7– 88.7	104.0	71.0	54.0
Fork length (percent)	111.5	113.0	113.2	115.3	119.0	123.0	119.1	124.6	125.0	119.5–126.9	112.4–126.0	115.2	113.0	719.4
Greatest depth of body	47.7	52.8	51.9	56.2	57.0	59.7	54.6	56.3	62.7	56.1– 57.6	51.0– 55.3	52.4	53.7	55.3
Least depth of caudal peduncle	7.3	7.9	8.3	8.4	8.6	9.3	8.5	8.3	10.2	8.9– 10.5	7.8– 8.9	8.1	8.6	7.8
Greatest width of body	12.6	13.1	10.8	11.9	13.5	12.9	12.4	11.2	18.9	9.9– 13.8	10.6– 14.6	12.1	11.8	14.5
Greatest width of head	12.7	14.8	13.1	13.7	14.3	15.1	14.6	16.2	20.8	11.3– 15.1	13.3– 16.8	12.1	13.2	14.5
Snout to origin of dorsal fin	38.5	41.7	36.1	40.1	42.1	41.4	43.4	47.0	50.0	42.7– 46.2	39.7– 45.0	38.5	41.4	44.5
Snout to origin of anal fin	53.3	56.8	61.2[1]	57.6	60.4	61.8	57.0	57.0	62.7	54.1– 61.9	55.6– 62.6	55.8	57.7	57.7
Snout to origin of ventral fin	38.0	40.9	45.3[1]	42.2	41.0	41.6	40.3	41.9	38.8	39.8– 42.3	39.0– 43.9	39.8	40.8	39.9
Snout to origin of pectoral fin	28.2	29.4	31.9[1]	30.6	29.6	30.6	28.6	32.5	31.1	28.2– 32.3	26.9– 32.2	28.9	29.6	29.7
Length of base of dorsal fin	57.4	59.8	54.7	55.4	56.3	55.6	54.4	57.4	50.0	50.0– 54.4	49.6– 55.9	57.7	54.0	56.0
Length of base of anal fin	45.3	47.1	46.0	47.8	47.4	46.4	42.5	42.2	42.2	39.5– 46.1	42.9– 46.9	47.1	45.9	47.0
Origin of dorsal fin to insertion of pectoral fin	31.8	36.0	34.6	36.2	36.8	40.7	37.6	37.9	45.1	37.1– 41.2	33.9– 38.6	33.7	36.9	37.0
Base of uppermost pectoral ray to that of lowermost	7.8	7.9	8.2	8.4	9.5	8.8	8.7	9.7	11.6	9.2– 10.8	8.2– 9.2	7.3	7.5	8.9
Base of lowermost pectoral ray to insertion of ventral fin	10.4	11.7	10.6	10.5	10.2	10.3	8.7	8.3	9.7	6.6– 8.6	7.9– 11.2	10.6	9.9	10.8
Insertion of ventral fin to origin of anal fin	18.3	18.9	20.0	19.0	23.4	23.7	22.8	21.7	25.2	20.2– 24.2	21.5– 27.8	21.0	21.4	23.1
Length of pectoral fin	39.0	40.8	32.2	32.8	30.8	33.0	32.9	36.1	36.9	36.5– 40.0	30.6– 34.8	32.7	33.4	31.9
Length of ventral fin	12.0	13.3	14.9	16.0	17.1	20.9	20.9	26.7	28.6	21.2– 30.4	15.4– 24.6	12.0	17.8	18.0
Length of 5th anal ray	9.9	9.0	11.3	13.3	15.1	17.2	17.0	19.5	28.6	16.1– 26.9	11.5– 23.5	10.4	11.3	15.8
Length of 5th-from-last anal ray	6.1	7.8	8.2	10.8	9.5	10.8	12.1	–	17.5	9.4– 21.2	7.9– 9.0	7.4	7.2	7.4
Length of 5th dorsal ray	18.7	17.6	22.7	24.6	25.5	27.8	27.4	24.5	27.7	21.4– 30.6	18.9– 30.3	18.0	20.6	20.5
Length of 5th-from-last dorsal ray	7.5	9.2	13.7	12.0	11.8	14.0	–	13.0	12.1	9.9– 13.0	8.4– 14.8	11.8	11.0	10.2
Length of upper caudal lobe	–	35.6	55.4[2]	50.3	45.2	47.4	45.6	40.4	38.8	44.5– 47.3	ca. 49.0	65.4	54.8	–
Length of lower caudal lobe	–	32.2	35.4	35.4	36.1	–	35.9	35.4	38.8	35.9– 40.2	ca. 36.0	37.5	37.8	–
Length of central caudal ray	11.7	13.3	13.3	15.4	18.5	19.0	19.2	24.5	27.2	23.2– 28.4	12.2– 26.2	15.4	12.7	18.0
Length of head	26.6	28.4	29.0	28.9	29.4	32.8	30.3	34.3	35.0	30.3– 33.9	28.3– 32.9	28.4	28.7	29.7
Length of snout	6.4	8.3	6.5	6.9	7.4	7.6	6.5	7.6	6.8	5.6– 7.6	6.0– 7.9	7.6	7.2	7.0
Diameter of eye, horizontal	7.2	7.9	8.3	8.3	8.1	12.1	11.2	13.0	14.5	9.7– 11.5	7.1– 9.6	7.3	8.3	8.9
Diameter of eye, greatest	8.1	8.7	8.3	8.7	9.3	12.1	11.2	13.0	14.5	9.9– 12.3	8.1– 13.3	8.7	9.2	8.9
Greatest distance between orbit and free edge of subopercle	14.5	15.0	14.7	15.0	15.8	15.3	13.8	15.5	16.0	15.5– 17.3	14.8– 17.1	15.7	16.2	15.6
Width of interorbital space	6.9	9.3	7.5	8.7	10.2	10.6	7.8	10.1	14.1	7.3– 11.2	8.6– 9.7	7.6	8.7	10.0
Length of upper jaw	14.5	14.8	13.8	15.4	15.3	16.6	16.0	17.7	19.9	15.8– 18.1	13.8– 17.1	14.4	15.5	16.6

[1] The mouth was agape in this specimen, hence the apparent discrepancy in these measurements (cf. *Brama caribbea*, table 12).

[2] The length of the upper caudal lobe is variable in all species of *Brama*.

In number, form and arrangement the dentition of 6.7–9.1 mm developing *B. dussumieri* is most similar to that of *B. caribbea*, differing from the latter species in the nature of the larger teeth of the anterior end of the premaxillary. In *B. caribbea* of this size, the anterior outwardly-inclined canines are a third to a half larger than adjacent premaxillary teeth, while in *B. dussumieri* the size discrepancy is slight. Similarly, the development of anterior mandibular canines is more pronounced in *B. orcini* and *B. caribbea* than in *B. dussumieri*. In other respects, tooth development is parallel in two species: increase in number and in size of the anterior premaxillary teeth which lie outside of the mouth as well as those within; a similar increase in the teeth in the anterior end of the mandible, and the loss of the uniformity in size and serial placement

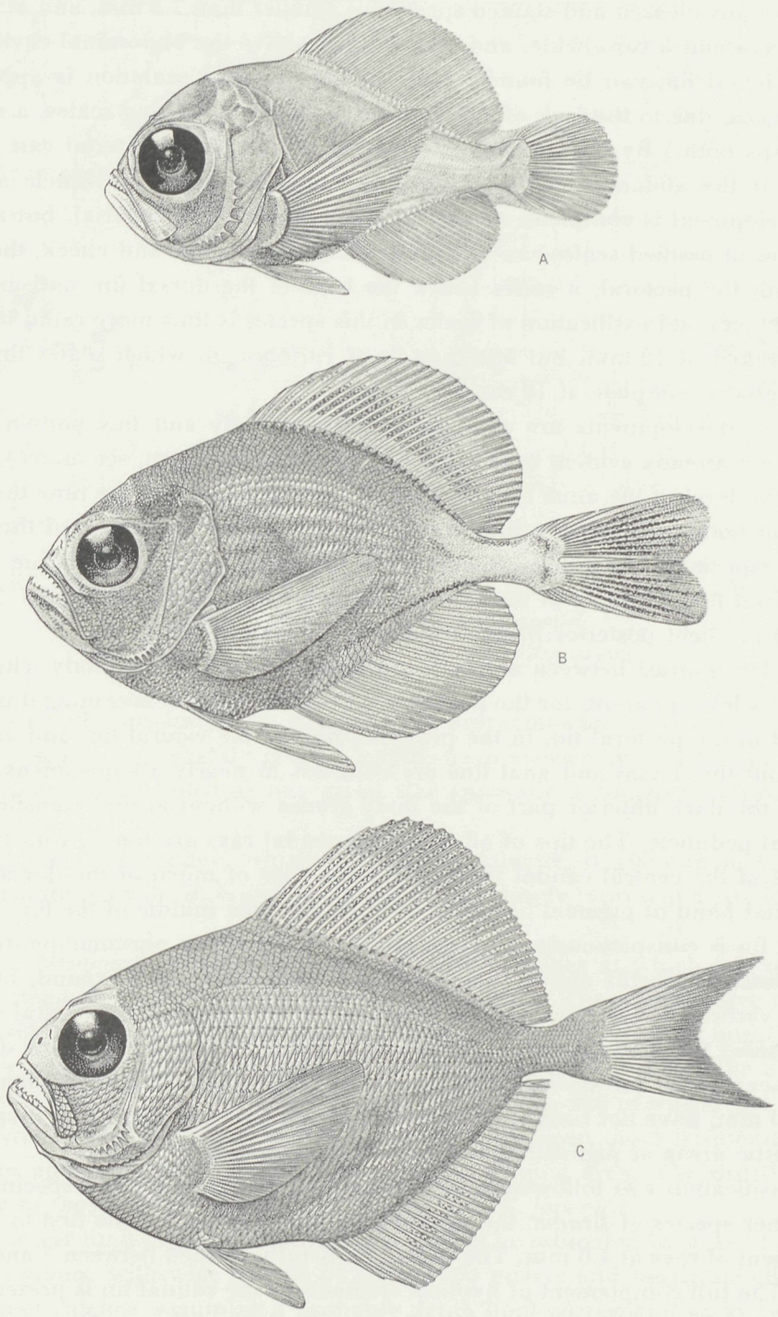


Fig. 25. Young *Brama dussumieri* (not drawn to the same scale). (A) 6.5 mm s.l. ("Atlantis", Sta. RHB 553; 26°35′ N, 79°28′ W). (B) 18.1 mm s.l. ("Chain", Sta. RHB 806; 13°28′ N, 32°48′ W). (C) 38.7 mm s.l. ("Chain", Cr. 17, Sta. 804; 10°52′ N, 29°26′ W). Drawn by N. STREKALOVSKY.

characteristic of the early young. By 9 mm the teeth form two series on each side of each jaw—an anterior row of recurved and outwardly-directed teeth, and an inner series composed of small teeth posteriorly with more enlarged recurved grasping teeth anteriorly.

There are usually two minute palatine teeth in specimens about 7.4 mm long. These increase in number with growth. Upper and lower pharyngeal teeth are among the first to develop.

The first suggestion of squamation is seen between 6.5 and 7.5 mm in unstained (and preferably alcohol-preserved) material as primordial scales and scale pockets along the anterior lateral surface of the body.

No scales are present in any cleared and stained specimens smaller than 7.5 mm, and at this size only a small patch of ossified scales, about 5 rows wide, and situated just above the abdominal cavity and below the anterior quarter of the dorsal fin, can be found. (More of the incipient scalation is apparent in non-stained than in stained specimens, due to the lack of calcification in these developing scales, a decalcification by the preservative, or perhaps both.) By 8.4 mm the squamation of unstained material can be traced posteriorly to about the middle of the abdomen, while at 9–10 mm only the caudal peduncle appears to be naked. At 12.0 mm scale development is complete, as seen in alcohol-preserved material, but in a 12.9 mm stained fish, only a few patches of ossified scales can be found: those of the nape and cheek, those in advance of the ventral fin and beneath the pectoral, a series below the base of the dorsal fin, and another on the caudal peduncle. The development and ossification of scales in this species is thus more rapid than in *Brama brama*, which is still nearly naked at 12 mm, but less than in *B. caribbea*, in which scales first appear at 7.5 mm with squamation essentially complete at 10 mm.

Accompanying these developments are changes in form of body and fins and in pigmentation. From the areas of pigmentation already evident in the smallest specimen (4–5 mm, see above), the pigmented areas spread posteriorly to the level of the anus by a fish length of 6 or 7 mm. By the time the fish attains a length of 9 mm, the head and body anterior to a line drawn between about the middle of the dorsal base and the anus are quite dark (especially in alcohol-preserved specimens). Posterior to this line there are a few melanophores, and the distal fifth of many of the caudal rays bear prominent black spots. The contrast between the dark anterior and the light posterior parts of the body is most striking.

At 10.0 mm the color contrast between anterior and posterior parts of the body which is so conspicuous in smaller individuals is less apparent, for the posterior part of the body is becoming dusky. Some interradial pigment can be found in the pectoral fin, in the proximal part of the ventral fin, and at the tips of the more central caudal rays, but the dorsal and anal fins are colorless in nearly all specimens. Between fish length of 10.0 and 12.5 mm the dark anterior part of the body grades without abrupt transition into the light and nearly colorless caudal peduncle. The tips of all principal caudal rays are black, with less intense pigmentation on the distal half of the central caudal rays. The outer edge of much of the dorsal fin is black, and at about 12.5 mm a second band of pigment begins to form through the middle of the fin. The interradial membrane of the pectoral fin is conspicuously stippled, and there are a few chromatophores on the ventral fin. The anal fin is colorless. At lengths above 12.5 mm, these pigmented areas expand, but no new centers of coloration, save for a vertical bar of more intense coloration at the bases of the central caudal rays, develop.

It must be emphasized that the pigment patterns and length of fish at which these develop are quite variable and, with the exception of the strong contrast between anterior and posterior pigmentation of the body in fish shorter than 10 mm, have not been used as diagnostic characters, although I suspect that in fresh material these characteristic areas of pigmentation would be most useful.

Development of ossification was followed in 33 cleared and alazarine-stained specimens between 4.0 and 21.5 mm s.l. As in other species of *Brama*, the pectoral and ventral fins are the first to form and are present with the full complement of rays at 4.0 mm. The dorsal fin is fully formed between 7 and 9 mm, and the anal fin between 6 and 8. The full complement of hypural elements in the caudal fin is present at 6.0 mm, and the vertebral column is complete at this length or slightly less. Last to ossify are the preterminal vertebrae.

Accompanying growth between 15 and 100 mm are changes in proportion (shortening of vertical fins, relative decrease in length of head, diameter of eye, etc.) and in coloration. At 18 mm, a band of pigment is present in the dorsal fin and scattered melanophores are present in the caudal; body pigment has spread posteriorly to the caudal peduncle, and pigment is present at the base of the caudal rays, but the anal and paired fins are clear. By 40 mm the coloration in the dorsal fin has spread throughout the fin, and a band of melanin, similar to that found in the dorsal fins of smaller fish, is present in the anal. The caudal peduncle and caudal fin are completely pigmented, the pectoral bears melanophores interradially, but the ventral fins remain colorless. At 80–100 mm, scales begin to develop over the vertical fins, those along the anal fin accompanied by pigment. At this size, pigmentation resembles that described for the subadults. (These notes from West African specimens.)

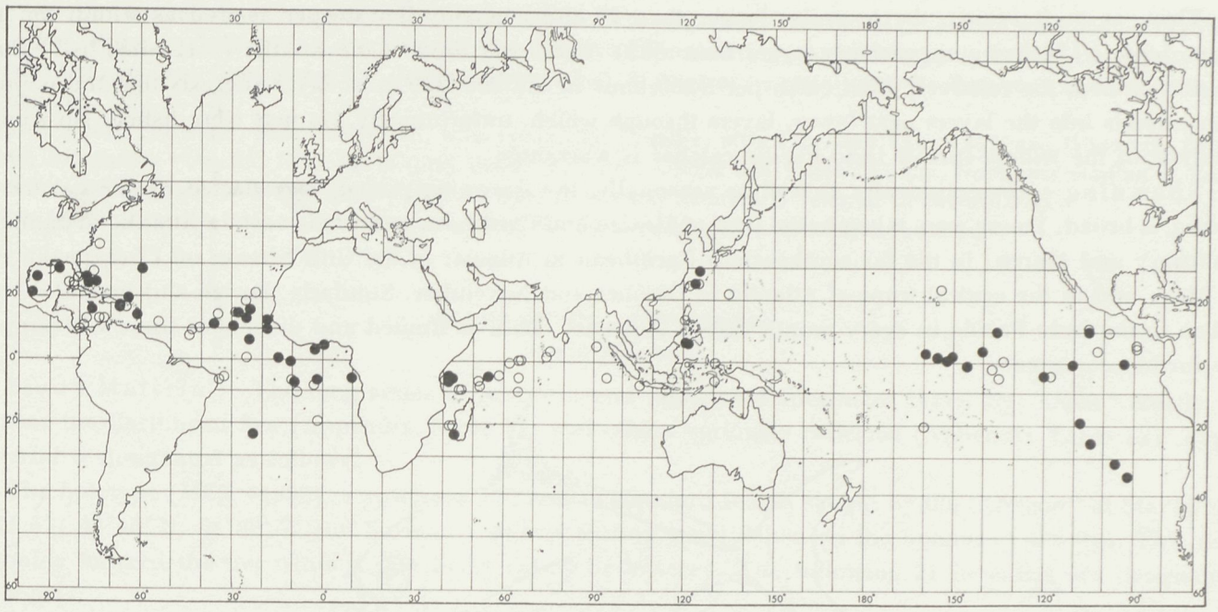


Fig. 26. Distribution of *Brama dussumieri*.
○ shorter than 20 mm s.l. ● longer than 20 mm s.l.

Variation:—Indo-Pacific specimens of *B. dussumieri* are somewhat less deep-bodied between 5 and 8 mm, usually develop scales at a slightly greater length, have shorter ventral fins at least between 6 and 10 mm, and are less heavily pigmented at any given size (possibly a function of preservative) than their Atlantic relatives.

Size:—The largest known specimen, which is from the Atlantic, is 190 mm in s.l. *B. dussumieri* may be a diminutive form compared with *B. brama*, or this fish may simply represent a species, the adult of which is not now known.

Distribution:—*B. dussumieri* is a high-seas species. The localities at which larvae and juveniles have been taken (Fig. 26) extend across the tropical regions of all oceans. The reproductive range, as reflected by the occurrence of juveniles, is probably controlled by conditions near the surface, and the lowermost surface temperature at positive stations was 23.8°C (Atlantic and eastern Pacific). Hence the extent of reproductive range is approximately delimited by the 75°F (23.9°C) isotheres, poleward of which surface waters are always colder than this temperature. Specimens have been taken in mid-ocean more frequently than have those of most species of *Brama* and there is certainly no localized spawning area. The distribution appears to be nearly complementary to those of the temperate *B. brama* and *B. japonica*.

In the Atlantic, the lower limit of vertical distribution cannot be estimated because of the complete absence of fishing, at positive stations, with wire lengths of 400 to 500 meters and negligible effort between 500 and 600 m.w. The few deeper catches, assuming a probable depth limit corresponding to 399 m.w., can be evaluated in terms of net-transit time as follows:

S200 hours of fishing effort above 399 m.w.: 134.25
S200 hauls below 399 m.w.: 43.5
Total transit time during raising and lowering of deep nets through upper 399 m.w.: 11.6 S200-hours.

	< 12 mm	> 12 mm
Catch, 0–399 m.w.	36	12
Catch, 0–399 m.w., per S200-hour	.268	.089
Catch by deep (> 399 m.w.) nets	3	2
Catch by deep nets per S200-hour of transit time above 399 m.w.	.259	.172

Thus, as in *B. brama*, the juveniles longer than 12 mm probably live deeper as well as within the 400 m.w. depth (.172 being appreciably larger than .089). The lower limit of the smaller (< 12 mm) fish cannot be determined, for relatively high catch-per-S 200-hour in the 300–399 m.w. layer suggests that the population extends into the layers next lower, layers through which, unfortunately, no nets were fished. No similar analysis of the widely-spread Indo-Pacific catches is warranted.

Spawning:—Geographically as well as seasonally, the spawning period, as reflected by the catches of young, is broad. Young were taken in the Gulf of Mexico and Caribbean and in the eastern Atlantic in January, February and March; in the far southeastern Caribbean in August; in the Gulf Stream off Chesapeake Bay in May; and in the central tropical Atlantic in October and November. Similarly, larvae and juveniles were taken in the Indo-Pacific in every month except February. Data as limited and diverse as these will support no further comments.

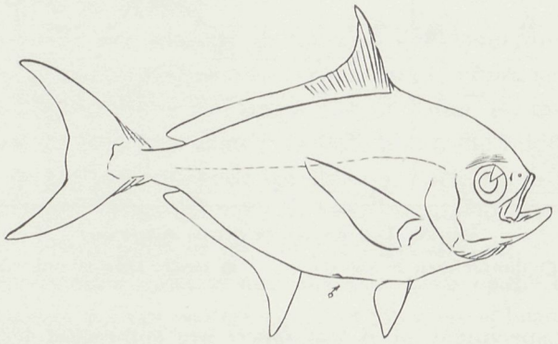


Fig. 27. A tracing of Poey's unpublished figure of the type specimen *Brama agassizi*, the figure generously provided by Pedro Pablo Durate-Bello of Havana.

Note on Synonymy:—The identity of *Brama agassizi* (Poey) (1860 (1858–1861): 204, pl. 13, Figs. 15–16) from off Cuba is not wholly certain, but as Poey closed his description of the 600 mm type with "Sa chair est délicate", we need no longer look to this type for additional details. The most disturbing discrepancy between Poey's account and *B. dussumieri* is the anal count, for "A 2, 21" is more in accord with the species of *Taractes* (*T. rubescens* and *T. asper*) or with *Eumegistus saussuri* Lunel. The white rear border of the caudal fin noted by Poey more closely resembles that of *Taractichthys* than the species of *Brama*. Poey did note the close resemblance between his *B. agassizi* and the "*B. raii*" discussed by Cuvier and Valenciennes (1831:281, Fig. 190), fishes quite distinct in general from *Taractichthys* and *Taractes*, and the number of caudal vertebrae, 24, eliminate these genera and *Eumegistus* and *Brama caribbea* as well. These reasons, together with the fact that *B. brama* as here understood does not live in waters immediately off Cuba, indicate the *B. agassizi* should be listed as a synonym of *B. dussumieri*. A tracing of Poey's unpublished figure was generously provided by Dr. Duarte-Bello of Havana and is reproduced here (Fig. 27). If our allocation is correct, Poey's fish is the largest recorded representative of the species.

Synonyms and References.

Brama dussumieri Cuvier, *in* Cuvier and Valenciennes, 1831:294 (orig. descr., no loc.); Günther, 1860:409 (descr.; "China Sea"); Lunel, 1865:15–16 (from orig. account; descr.; ref. to Günther, 1860:409, which is not of this species; loc.: 85° E, 0° N which is probably from Günther, for Cuv. and Val. reported no loc. and the Paris Mus. catalog lists none); Lütken, 1880:494 (ref. without comment from Cuv. and Val.); ?Karoli, 1882:162 (listed for Canton, China, from Cuv. and Val. 1833); Chu, 1931:108 (listed for China from type account); Fowler, 1936: 186–187 (descr. from Cuv. and Val.; China Sea and Canton, Indian Ocean).

?*Brama agassizi* Poey, 1860 (1856–61):204–206 (orig. descr., 600 mm spec. from off Cuba); Lunel, 1865:18–20 (descr. from Poey, 1860); Poey, 1868:358 (rep. "catalufa de la alto" seen off Cuba but once); Jordan, Evermann and Clark, 1930:265 (listed for Cuba, from Poey).

Tylometopon dussumieri Bleeker, 1873:133 (name only, assigned to "Familia Lampridoidei").

Brama raji (non-Bonnaterre), Lütken, 1880:500 (part, those spec. from 7° and 8° S; seen); Lampe, 1914:245–246 (part,

spec. "A" fig. and descr.; 44 mm; 15°06′ N, 27°44′ W; 7 X 03); PARR, 1933:32 (2 juvs. from off Bahama Is.; meristics); ERDMAN, 1956:328 (2 spec., 3- and 10-in., from off Puerto Rico); ABE, 1961 (part, fig. and radiograph; 140 and 180 mm spec. from Manazuru, Japan; suggests that *B. drachme* (= *orcini*) may be the young of *B. raii*; key to genera).

Taractes orcini, ?FOWLER, 1928:138 (listed, with synon., for Oceania; after CUV. and VAL., 1837, and GÜNTHER, 1876).

Brama leucotaenia FOWLER, 1938:44–45 (orig. descr., fig.; type USNM 98817 seen; 32 mm, from near Basilan I., Sulu. Arch., Philippines; 7 II 08); MEAD, 1957:56 (tentatively but incorrectly referred to *Eumegistus*).

Brama brama, DUARTE-BELLO, 1959:79 (part, listed for Cuba to Bermuda and Massachusetts).

Brama caribbea, new species.

Figures 28 to 31.

Study Material:—The long series of juveniles and adolescent specimens taken by "Dana" chiefly in or near the Caribbean Sea (Appendix Table 11) and others variously collected (Appendix Table 12). Type material is designated as follows:

The holotype (MCZ 44950), a specimen 170 mm in standard length caught by the "Oregon" at Sta. 2011: 7 XI 57; 07°46′ N, 54°36′ W (off Surinam) 40-foot shrimp trawl fished on the bottom at 400 fms. This fish probably entered the net while it was being raised or lowered. The following 21 juveniles are designated paratypes:

17.0 mm	Dana 1215 V	51.4 mm	Oregon 2319
32.5	Oregon 1065	52.7	Dana 1250 I
36.0	Dana 951	55.0	Dana 1285 II
38.5	Dana 952	55.2	Oregon 1486
38.6	Dana 1283 VII	56.0	Dana 951
38.9	Dana 952	56.2	Dana 1267 I
41.9	Dana 1171 VII	62.5	Oregon 2768
42.4	Dana 1283 IX	64.5	Dana 1172 III
43.0	Dana 1288 II	64.5	Dana 1247 IV
45.4	Dana 1189 III	79.8	Oregon 2768
47.0	Oregon 1148		

Distinctive Characters:—*Brama caribbea*, together with *Brama orcini* and *Brama myersi*, belongs to the group of species in which the young as well as the adults have their pectoral fins set relatively high on the body (Fig. 14) and in a position more nearly horizontal than vertical, have relatively short ventral fins (Fig. 15), and have fewer than 60 scales in a horizontal series between upper end of gill opening and base of caudal fin. As neither *Brama myersi* nor *B. orcini* are known from the Atlantic, these differences, together with meristic characters (total number of vertebrae usually 36 (38 or fewer), pectoral 19–21) will suffice for species identification.

Description of holotype:—The proportional dimensions of the 170 mm holotype, an undigested adult specimen, are given in Table 12. The meristic values are as follows:

D 34, A 28, P 21/22, C 1-8-7-1. Gill rakers (first arch; L/R) 5+1+8/5+1+9. B.R. 7. Vertebrae 16+21 +1 = 38. Pored scales in lateral line: ca. 56. Scales in horizontal series: ca. 51. Predorsal scales: ca. 34.

Body deep and strongly compressed, its greatest depth about twice in standard length, and less than that of smaller juveniles. Ventral contour evenly curved between lower jaw and ventral fin, nearly straight and horizontal between origins of ventral and anal fins, and nearly straight along base of anal fin. Dorsal profile of unscaled part of snout irregular; that covered by predorsal scales evenly convex; that between origin of dorsal fin and caudal peduncle slightly and unevenly arched.

Body, bases of unpaired fins and head, save for the lower jaw and snout, covered by scales typical of most adult bramids; they are vertically elongate, imbricate, firmly inserted along the entire elongated vertical edge, and overlapped dorsally and ventrally by scales of the adjacent rows. There are no spines on the scales

and the free margin of each scale, although uneven in outline, is entire. All but the free tips of the dorsal and anal rays are covered by rows of scales inserted on the interradial membrane behind each ray, rows which effectively sheath the posterior parts of these fins when they are depressed. Smaller scales cover nearly all of the caudal lobes, although the tips of the principal caudal rays are not scaled. Except for rows covering their bases, the pectoral and ventral fins are naked. Well-developed axillary scales are associated with these paired fins, the longest beneath the ventral fin being more than half as long as the fin itself. The lateral line, although complete and with pored scales, is not prominent.

The toothed edge of the lower jaw is included but slightly within the upper. The mandible is heavy and the overlying skin is pierced by several irregular series of mucous or sensory pores similar to those which cover the scaleless areas on the snout. The anterior nostril, which is situated midway between tip of snout and anterior edge of orbit, is circular, directed forward, and unadorned. The posterior nostril is a slit. The pre-

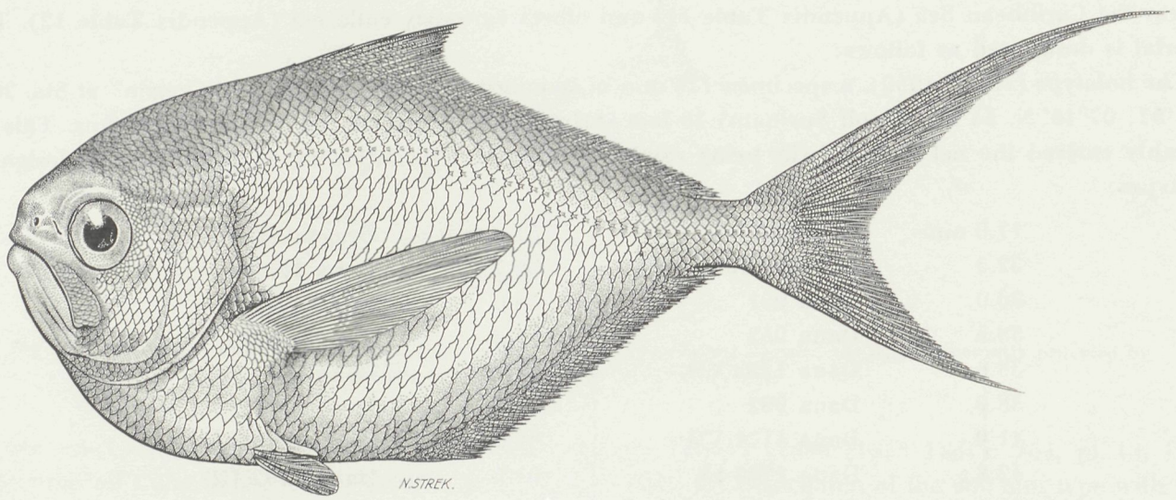


Fig. 28. Holotype of *Brama caribbea*, 170.0 mm s.l., from the western Atlantic, off the coast of South America ("Oregon" Sta. 2001, 07°46′ N, 54°36′ W). Drawn by N. Strekalovsky.

maxillaries are non-protractile and are separated from one another anteriorly by an edentulous fold of skin. The premaxillary teeth themselves are of two types. Along the outer edge of the premaxilla (immediately adjacent to the narrow fringe-bearing lip) is a series of strong, fixed or flexible, recurved canines which extends along nearly the entire length of the bone. Within this series is a band of small teeth, some fixed but others depressible, which are interspersed within a mat of fleshy tubercles. This band is quite broad anteriorly but becomes narrow posteriorly and disappears completely on the posterior third of the premaxillary. Like the upper jaw, the two halves of the mandibles are loosely attached anteriorly (perhaps to allow for the lateral expansion of the gape) and the symphysis bears no teeth. Lateral to the symphysis, the dentaries are well-armed, and the longer recurved canines are the largest teeth on any bone. The largest of these lie along the anterior median edge of the mandible. The uniserial series, of which these are a part, line the entire biting edge of the mandible. These teeth, together with the band of small teeth lateral to them, also lie in a mat of minute fleshy tubercles. There is a small patch of fixed teeth on the vomer, and a single row of depressible teeth on each palatine.

The posterior edges of the preopercle, which is free, and of the opercle and interopercle are evenly curved and finely and weakly serrated but bear no spines. Gillrakers are present on the first arch but are represented on the succeeding arches by low spinulose knobs. The longest raker on the first arch, that at the angle, is but slightly longer than the opposing gill filament; those along the lower limb are about half this length; those on the upper limb decrease evenly in length from the long raker at the angle to the uppermost, a tubercle, which is about as long as it is thick.

The lobe of the dorsal fin is relatively small and flexible, its axis inclined backward at an angle of about

Table 11. Meristic variation in *Brama caribbea*.

Dorsal Fin	**32**	**33**	**34**	**35**
	3	2	17	2
Anal Fin	**27**	**28**	**29**	**30**
	3	18	5	1
Pectoral Fin	**19**	**20**	**21**	
	5	17	4	
Gill rakers on upper limb	**2**	**3**	**4**	**5**
	1	12	15	1
Gill rakers on lower limb	**8**	**9**	**10**	**11**
	4	12	13	1
Gill rakers, total	**12**	**13**	**14**	
	2	11	6	
Thoracic Vertebrae		**15**	**16**	
		17	2	
Abdominal Vertebrae (excluding urostyle)		**20**	**21**	
		12	17	
Total Vertebrae (including urostyle)	**36**	**37**	**38**	
	15	11	1	

thirty degrees from the horizontal, and probably cannot in life be elevated to a vertical position. The posterior two-thirds of the dorsal and the entire anal fin are low and, except for the tips of the rays, covered by skin and scales. The pectoral fins are set relatively high on the body, the base more nearly horizontal than vertical, and the fin shape falciform. The ventral fins are short, extending less than half the distance from their bases to the origin of the anal fin. The ventral spine is splint-like and closely adpressed to the first or outermost ray, which is the longest element in the fin. The caudal fin is deeply forked but not as stiff as that of many larger adult bramids such as *Taractichthys*, and the upper lobe is much longer than the lower. The anus is situated about twice as far from the insertion of the ventral fin as from the anal origin and is set deep among the scales of the ventral midline.

The body is brownish-black in general color, the pigmentation being more intense along the dorsal midline and on the snout than elsewhere. The interradial membranes of the dorsal and anal fins are black, especially distally, but without evidence of horizontal banding. The caudal fin is also dark but the tips of the central caudal rays are more lightly colored. The paired fins are colorless. The lining of the mouth is black.

Diagnostic characters of juveniles:—The characters which in the following diagnosis appear in expanded type will be most useful for the identification of the early forms:

Formula: D usually 34. A usually 28. P usually 20. B R 7. Vertebrae: 15–16 + 20–21 = 36–38. Origin of dorsal fin behind vertical of pectoral fin, remaining relatively constant during development; predorsal scales numerous. Three or four graduated dorsal rays in juveniles, the rays which follow are the longest in the fin but do not form a dorsal lobe in fish shorter than about 60 mm. Pigmentation, beginning in tips of anterior part of fin at 9 mm, proceeds with the formation of two parallel bands in some juveniles, the fin pigmentation generally limited to the anterior half of the fin. Origin of anal fin behind vertical from dorsal origin and constant; the anal fin colorless in juveniles shorter than 50 mm and without anal lobe. Pectoral fin set low, as in *Brama brama*, in fish shorter than 10 mm, its base rising rapidly on body from 10 mm onward, its axis shifting from nearly vertical to nearly horizontal. Ventral fin inserted under base of pectoral, not reaching anal origin in smallest (< 7 mm) juveniles, reaching to or slightly beyond anal origin at about 10 mm, but ventral fin short and failing to reach origin of anal fin in juveniles longer than 10 mm. Caudal fin variously pigmented, usually colored at tips of upper and lower principal

Tabel 12. Proportional dimensions, expressed as percent of standard length, of *Brama caribbea*.

	"Oregon" Sta. 2011	Bimini, B.W.I.	Paratypes, Western Atlantic
Number of specimens	1	1	20
Standard length (mm)	170.0	218.0	32.5– 79.8
Fork length (percent)	114.8	112.0	115.0–121.0
Greatest depth of body	50.8	49.2	51.3– 65.8
Least depth of caudal peduncle	7.8	6.4	7.8– 9.7
Greatest width of body	13.8	11.2	9.8– 12.6
Greatest width of head	13.7	–	12.5– 16.8
Snout to origin of dorsal fin	41.4	40.3	41.4– 48.8
Snout to origin of anal fin, mouth closed	60.4	59.0	58.2– 65.2
Snout to origin of anal fin, mouth agape	–	–	65.3– 70.8
Snout to insertion of ventral fin, mouth closed	44.0	45.0	41.1– 46.0
Snout to insertion of ventral fin, mouth agape	–	–	49.1– 53.1
Snout to insertion of pectoral fin, mouth closed	31.6	32.0	28.4– 32.1
Snout to insertion of pectoral fin, mouth agape	–	–	33.7– 38.0
Length of base of dorsal fin	56.5	53.6	51.8– 54.5
Length of base of anal fin	45.4	46.1	43.3– 50.2
Origin of dorsal fin to insertion of pectoral fin	32.9	34.2	33.1– 43.0
Base of uppermost pectoral ray to that of lowermost	7.1	5.9	7.8– 10.0
Base of lowermost pectoral ray to insertion ventral fin	14.4	14.1	12.7– 16.4
Insertion of ventral fin to origin of anal fin	20.7	18.3	19.5– 23.1
Length of pectoral fin	38.5	37.5	29.2– 36.0
Length of ventral fin	11.1	8.6	9.4– 16.2
Length of 5th anal ray	6.4	6.1	7.2– 12.2
Length of 5th-from-last anal ray	5.6	5.4	5.5– 8.1
Length of 5th dorsal ray	16.2	–	19.5– 24.9
Length of 5th-from-last dorsal ray	8.1	–	4.5– 9.8
Length of upper caudal lobe	54.8	51.1	34.6– 41.1
Length of lower caudal lobe	35.6	33.2	30.0– 32.9
Length of central caudal ray	19.7	11.9	11.5– 19.9
Length of head	30.2	–	28.4– 32.6
Length of snout	7.6	6.3	6.0– 7.5
Diameter of eye, horizontal	8.4	7.7	9.3– 11.9
Diameter of eye, greatest	9.5	9.0	9.4– 11.9
Greatest distance between orbit and subopercle	15.0	17.9	14.6– 16.8
Width of interorbital	9.4	6.5	7.8– 11.4
Length of upper jaw	15.7	14.4	15.0– 17.3

rays. Urostyle elevated in fish shorter than 5 mm. Scales present from about 7 mm. Spines on mid-lateral scales of caudal peduncle similar in size to those adjacent to them. Six or more preopercular spines; that at angle largest, those adjacent graduated in size and all lie in a single plane. All are generally overgrown by 25 mm. The gill membrane is colorless. Teeth are present at all sizes (3.8 mm onward). Palatine teeth present from about 7 mm.

The smallest identifiable specimens are about 3.8 mm in standard length, a size below that at which Mediterranean *Brama brama* are thought to hatch (4.80 mm, Sanzo, 1928). Development is precocious, for even at this small size there is no fin fold; there are at least a few ossified elements in each fin and the full complement in the pectoral; the yolk has been largely resorbed; the urostyle is elevated; and pigmentation has begun to spread on the body. There are about five recurved teeth on the premaxillary, of which the most anterior are larger than the rest, strongly recurved, and directed outward. Similarly, the anterior two teeth on each side of the lower jaw are well developed and recurved, while the two or three teeth on the rami are minute and conical.

Specimens between 3.8 and 5.0 mm which have been preserved in formalin bear sparse pigmentation over the brain, on the cheek behind and below the eye, on and under the branchiostegal membrane, beneath

the operculum, and along the outer sides of both jaws. The dorsal and posterior margins of the abdominal cavity are dark, especially posteriorly, but the body above and behind the visceral mass is colorless. The pigment overlying the heart in some bramids (e.g., *Brama brama*) is lacking, and all paired and vertical fins are colorless.

B. caribbea in this size range can be distinguished from the young of *Brama brama* by the degree of development shown, for in contrast to *B. caribbea* the elevation of the urostyle of *Brama brama* occurs at a body length greater than 5 mm. These young *B. caribbea* usually can be distinguished from the young of *Brama dussumieri* (the geographical ranges and spawning seasons of which nearly coincide) by the relative lengths of the ventral fins—those of *B. dussumieri* generally extending to or beyond the origin of the anal fin while those of *B. caribbea* fall short of that point.

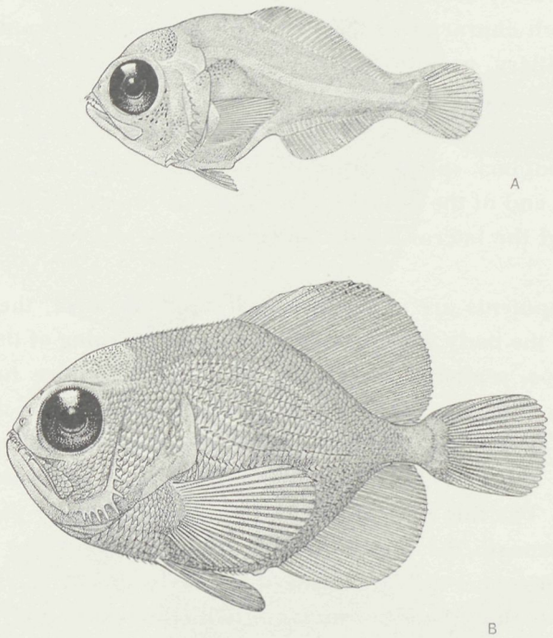


Fig. 29. Young Caribbean *Brama caribbea*. (A) 4.8 mm s.l. (D-1183 II, 13°47′ N, 61°26′ W). (B) 9.2 mm s.l. (D-1215 IV, 16°06′ N, 76°02′ W). Drawn by N. Strekalovsky.

Development between 5.0 and 15.0 mm is rapid, for by 15 mm the fish has its full adult complement of fin rays, ossified vertebral centra, and gill rakers and nearly complete squamation and teeth. Subsequent changes are restricted to modifications in body form and pigmentation and the further development of structures differentiated and functional at lengths generally shorter than 10 mm. The development of the hard parts was followed in a series of 10 alizarine-stained specimens 5.3–12.8 mm long. Ossification proceeds from the anterior to the posterior end, although the hypural fan and urostylar apparatus develop prior to the ossification of the caudal vertebrae which precede them.

The increase in number of teeth below 7 mm s.l. is accompanied by substantial changes in tooth form. In the smaller cleared and stained fish (5.3–6.1 mm), the anteriormost mandibular and premaxillary teeth are about a third longer and heavier than those which lie behind them and are more forwardly inclined. Above about 6 mm a further development of the lesser teeth adjacent to the symphyses of both jaws, and an accompanying shift in tooth position, begins. At 10 mm there are three or four recurved, enlarged, and outwardly inclined teeth on each side of the upper jaw, within which are one or two vertical canines and the anterior of the series of smaller teeth characteristic of the rami. The situation on each side of the lower jaw is similar: a large canine which, although recurved, is nearly vertically oriented and contained within the mouth; a series of three or four outer canines, which lie outside of the mouth, are forwardly inclined and recurved; and an irregular series of smaller teeth on each dentary posterior to the canines. These small lateral

teeth in both jaws soon lose the uniformity in size and serial spacing characteristic of fish 5 or 6 mm long and should be termed a series rather than a row. The development of palatine teeth is irregular, but in certain of the cleared and stained representatives the most anterior of the palatine teeth become ossified at fish lengths of about 7 mm.

The development of scales also can be best followed through the study of stained material. At 7.5 mm, the first scales can be found; these lie about midway between the base of the pectoral fin and the dorsal midline. At 7.7 mm there are primordial scales in about five horizontal series situated over the upper edge of the abdominal cavity, the longest row extending posteriorly to a point beneath the middle of the dorsal fin. (These thin and poorly ossified scales are best seen from a dorsal rather than from a lateral view.) By 8.4 mm, about 9 horizontal scale rows can be counted, a patch of midventral scales appears anterior to the bases of the ventral fins, and the lateral body scales begin to develop the dorsal and ventral scale extensions and the vertically-projecting spines which characterize the larger juveniles of all bramids. By a length of 10 mm the squamation on the cheek, maxillary, occiput, and body is nearly complete, for scales are lacking only from the fin bases, from small areas behind the pectoral fin, between this fin and the ventral fin, and anterior to the anus. The lateral body scales are vertically elongate and the scale spines are prominent. A lateral line, the scales of which have pores but lack spines, is present but incomplete, for it ends posteriorly near the caudal peduncle at a point beneath the end of the dorsal fin. At 12.8 mm only the scales which will later cover certain parts of the fins are absent, and the lateral line is becoming indistinct because of the encroachment of adjacent scale rows.

Accompanying these developments are changes in body and fin form, the most prominent of which are the increase in relative depth of the body and the extension and darkening of the pigmented areas. By 7.0 mm, in formalin-preserved specimens, scattered melanophores cover the entire head, branchiostegal membrane and ventral surface of the body from the isthmus to the ventral fins, and the dorso-lateral body surface back to the level of the origin of the dorsal fin. The areas of most intense dermal pigmentation are those over the brain and on the cheek below the eye. All areas of the abdominal peritoneum are pigmented, the dorso-posterior edge being very dark. The fins remain colorless. The lateral body pigmentation continues to spread posteriorly, reaching a point beneath the middle of the dorsal fin by 8 mm beneath the end of the dorsal by 9.5 mm; lateral pigmentation covers the full extent of the body shortly thereafter. Parallel with this spread of lateral dermal pigmentation is that of deeper melanin, which overlies the vertebrae and associated arches and ribs. By 9 mm the dorsal fins of some individuals become pigmented distally, as do the caudal rays, but pigment in these fins is constant neither in presence nor in extent. In some, a second band of melanophores begins to form in the dorsal fin between fish lengths of 10 and 15 mm. The ventral and anal fins remain clear, but the interradial membrane of the pectoral fin may be stippled, a stippling which, like that in the posterior part of the dorsal fin and the caudal fin, apparently disappears with subsequent growth.

The most notable developmental features between 15 and 30 mm s.l. are the changes in the position of pectoral fin, in the shape of the caudal, and in the extent and degree of pigmentation. At 12 to 15 mm the caudal is truncate or at best slightly concave. Fish 30 mm long have the forked caudal characteristic of the adult. The pectoral fin in specimens smaller than 15 mm is situated in a relatively low position, and its base is broad and more nearly vertical than horizontal. With growth, this fin becomes more nearly horizontal in orientation and comes to lie higher on the flank. The preopercular spines become progressively more overgrown; at 30 mm only the tips of the spines lying near the angle can be found in most specimens. Body pigmentation is more intense and the caudal and dorsal lobes are blacker, but the anal and ventral remain clear.

Growth changes between 30 and 80 mm are few: the progressive decrease in depth in relation to length; the gradual shift dorsad of the pectoral fin base and the accompanying rotation to a more horizontal position; the gradual loss of scale spines; the increase in intensity of pigmentation; the strengthening of the dentition, and the development of scaly sheaths along the bases of the dorsal and anal fins.

The general body coloration of 30–35 mm specimens is uniformly dusky, and a darkening of the dorsal edge has begun (Fig. 30). The tips of the caudal lobes, and that of the dorsal are black, and scattered mel-

anophores can be found in both of these fins, but the pectoral, ventral and anal fins are clear. With growth, the body becomes progressively darker; coloration spreads from the caudal lobes to more proximal parts of the fin and finally to the distal ends of the central caudal rays. The lobe of the dorsal fin similarly darkens and, to a lesser extent, the posterior half of that fin. The anal fin remains clear until the fish attains a length of about 50 mm, at which size basal pigmentation begins over the fin bases beneath the developing scale sheath and expands as the sheath itself develops. The paired fins remain colorless.

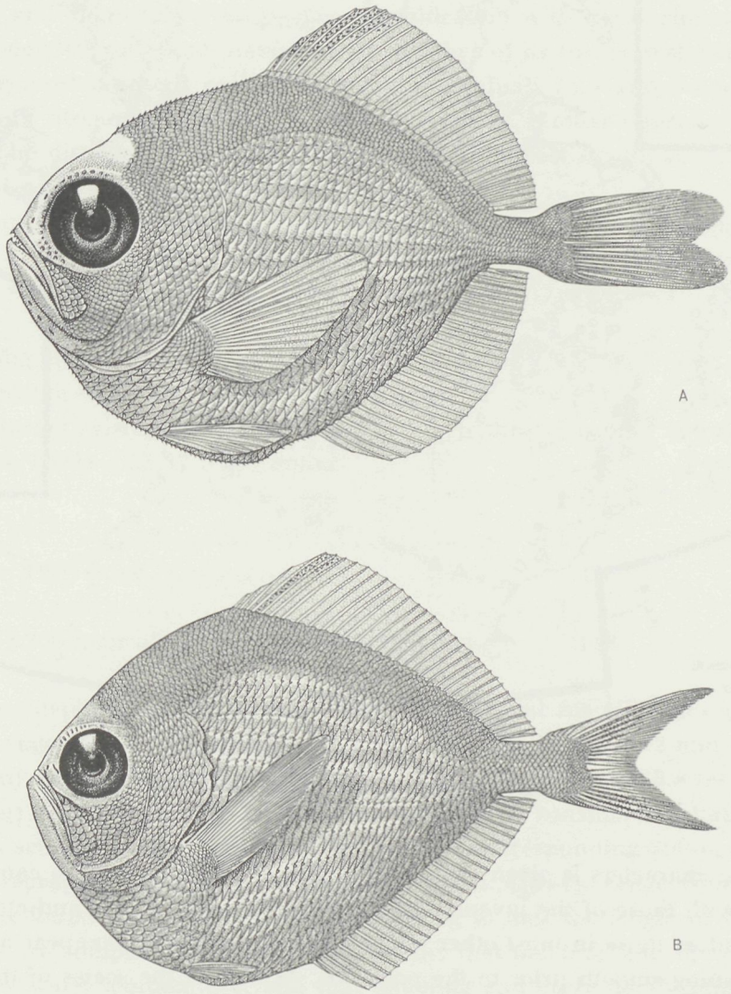


Fig. 30. Young Caribbean *Brama caribbea*. (A) 17.0 mm s.l. (D-1215 V, 16°06′ N, 76°02′ W). (B) 38.0 mm s.l. (D-952, 17°55′ N, 64°48′ W). Drawn by N. Strekalovsky.

Two sources of variation not associated with normal growth must be noted. First, certain of the available specimens were preserved with mouths wide agape, the gill covers and gape angles laterally displaced with the lower jaw projected forward. Such individuals must not be compared with those with mouths closed or but partly open. Such gaping clearly involves the displacement of the tip of the snout as well as the lower part of the head, and certain measurements, notably those from the snout to the origins of the pectoral, ventral and anal fins are strongly affected. The measurements so affected are treated separately in the tabulation of morphemetric data, Table 12. A second source of difficulty has resulted from the method of preservation. The "Dana" material first preserved in alcohol or changed to alcohol soon after initial fixation is heavily pigmented and useful in determining original color pattern. Many specimens which have remained in formalin during the intervening thirty or forty years are bleached nearly to the point of uselessness.

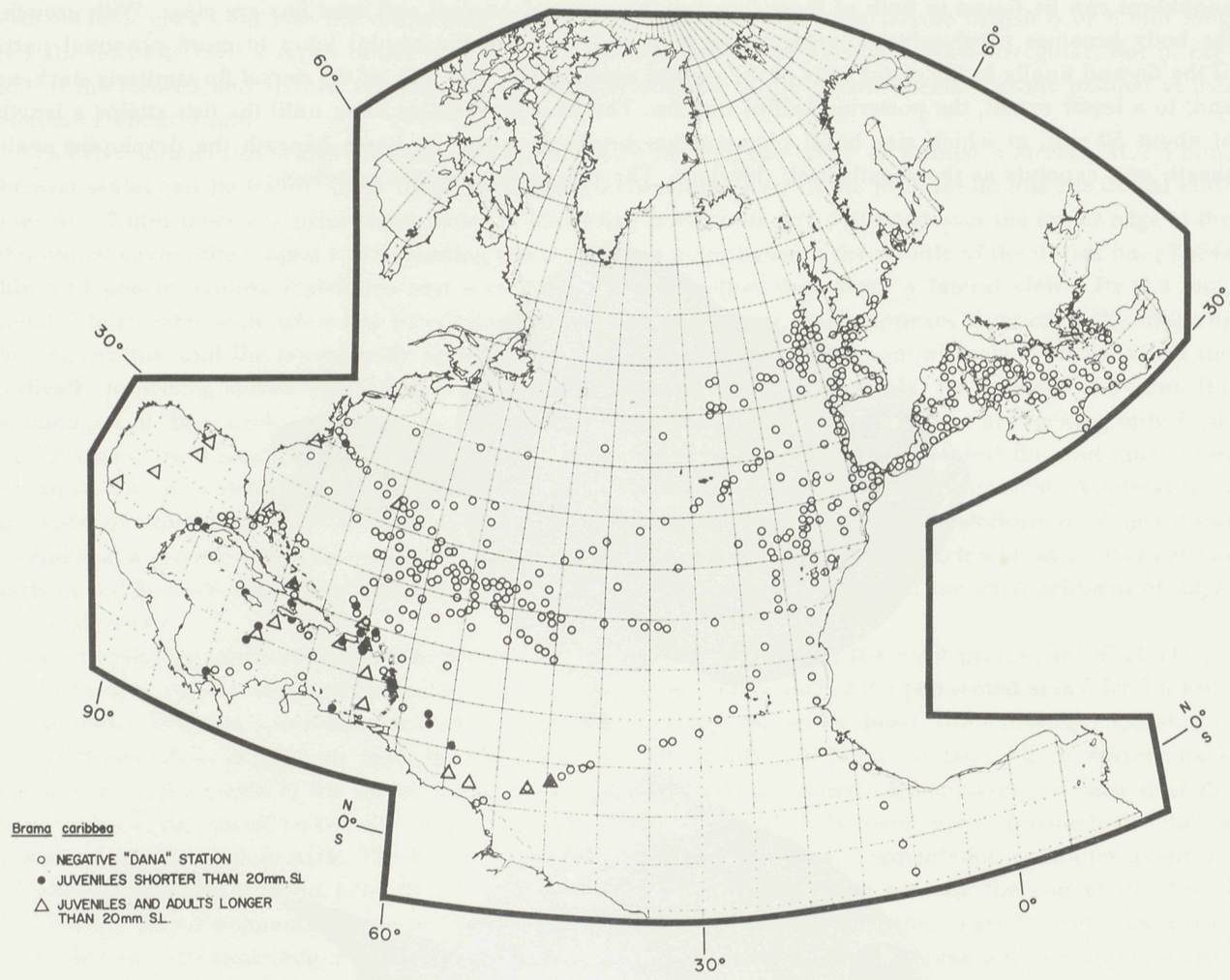


Fig. 31. Distribution of *Brama caribbea*.

Variation in meristic characters is given in Table 11; that of body proportion can be seen by comparing the figures of the type with those of the juveniles (Figs. 28 to 30). The spines and cteni on the scales, which are never as pronounced as those in most other bramid genera, begin to disappear at about 50 mm, the anterior body scales becoming smooth prior to the posterior. At 65 mm the scales of the posterior third of the body remain spiny, but a 79.8 mm fish (from a tuna stomach and perhaps somewhat decalcified) retains no spines whatsoever.

The jaw teeth of these juveniles are similar in pattern and arrangement to those of the type, as described above. The palatine row, clearly evident in the type and a larger (218 mm), partially digested individual, is less distinct and frequently invisible unless the skin is removed from the roof of the mouth. The small patch of vomerine teeth apparent on the two adults could not be found in any of the juveniles shorter than 80 mm.

The definitive number of serial characters are ossified at fish lengths as follows: gill rakers—10 mm s.l.; dorsal fin rays—12 mm; anal rays—8 mm; ventral and pectoral rays—at or before 5 mm; caudal rays—6 mm; vertebrae—7 mm; and full complement of teeth—7 mm.

Size:—The type specimen, and a larger 218 mm individual from the stomach of a marlin and too poor in condition to warrant description, are the largest known specimens of this species.

Spawning:—As nearly all specimens over 75 mm in length were taken in partially-digested condition

from the stomachs of other fishes, there is no available information on the seasonal maturation of the gonads. The spawning area is broad and is reflected by the capture of larvae and small juveniles (Fig. 31). In the Caribbean area, *Brama caribbea* is a winter spawner (late August to May), the spawning activity at several well-fished localities showing that spawning extends throughout these months.

Distribution:—The geographical distribution of *Brama caribbea* is shown in Figs. 31 and 33, and the more detailed data can be found in Appendix Tables 11 and 12. From this distributional plot it is apparent that the center of distribution is the Caribbean. (The three specimens from off West Africa, D-3997 III and D-4000 X, are too few and small to permit positive identification with the Caribbean sample.) The species is also more closely associated with land masses than are either of its two closest Atlantic relatives, *B. brama* and *B. dussumieri*. The most northern capture of small individuals (5.5 and 6.9 mm) was at D-1352 I, a station clearly in the Gulf Stream and that at which two young of another typically tropical bramid, *B. dussumieri*, were caught. The distribution extends southward to off central Brasil, south of which few biological expeditions have fished midwater nets, the "Dana" none at all.

The bathymetric range of individuals smaller than 25 mm extends from depths corresponding to wire lengths of 50 m to 799 m; that of larger juveniles somewhat more shallow. These probable lower limits were estimated in the usual way (again excluding E300 catch and effort), as follows:

S200 hours of fishing effort above 800 m.w.o.: 419
S200 hauls below 800 m.w.o.: 104
Total transit time during raising and lowering of deep nets through upper 800 m.w.
(104×2×1/3×800/1000) = 55.47 S200 hours

	< 12 mm	12–25 mm	> 25 mm
Catch, 0–799 m.w.	201	20	6
Catch, 0–799 m.w., per S200 hour	.478	.0478	.0143
Catch by deep (799 m.w.) nets	7	2	2
Catch by deep nets per S200 hour of transit time above 800 m.w.	.126	.036	.036

The catch at various depth intervals above 800 meters, adjusted for efficiency of net and fishing effort (catch-per-S200 hour) suggest that the depth preferred by fish smaller than 12 mm corresponds to the 300- to 500-m.w. interval, but as few identifiable specimens within a mm or two of 3.8 mm (probably the approximate length at hatching) were caught, this depth estimate cannot be considered reliable. If one half of a wire length of 400 meters is selected as the "preferred depth", the corresponding 200-meter temperatures, taken from the "Dana" hydrographic reports (Schmidt, 1929; Anon., 1934), range from about 14° to 21°C, a similarly broad range is found if temperatures corresponding to half the length of the wire for each of the individual positive nets are compared. If we were to assume that hatching and the presence of the youngest larvae are controlled by water temperature, and that hatching and early development take place at 200 m, larvae should be found throughout most of the Atlantic south of about 40° N. (Water temperatures in the North Atlantic at the 200-meter depth have been plotted by Fuglister, 1954, and Schroeder, 1964). This is quite clearly not the situation here. We can, on the contrary, assume that hatching and development occur near the surface and are controlled by surface temperature. Surface temperatures at localities at which small (<12 mm) larvae were taken range from about 24.8 to 27.6°C, a narrower range than that at 200 meters. The surface winter (spawning season) isotherms (Scripps Inst. Oceanogr., 1944) delimit quite closely the area within which larvae and small juveniles have been caught. Thus it is likely that most of the early larvae will be found within 50 meters or so of the surface. As one might expect, larger fish are more nearly free from such temperature and range restrictions.

Synonyms and References.

Collybus drachme, Kanazawa, 1952:80 (rec. 41.5 mm spec. from Bermuda); Mead, 1957 (fig. and descr. juvs. from Gulf of Mexico).

Brama orcini CUVIER, 1831.

Figures 32 to 34.

Study Material:—In addition to the series of "Dana" specimens, most of which are larvae and young juveniles (Appendix Table 13), I have seen the types of *Brama orcini* (MNHN) and *Collybus drachme* SNYDER (USNM), a single specimen from the temperate northeast Pacific, a series taken chiefly from the stomachs of large predatory fishes during the Central Pacific work of the Pacific Oceanic Fishery Investigations, U.S. Bureau of Commercial Fisheries, and Indo-Pacific juveniles variously collected (Appendix Table 14).

Distinctive Characters:—Large individuals can be distinguished from the only other North Pacific species of which comparable material exists, *Brama japonica*, by the fewer scales in the horizontal series extending from the upper end of the gill cleft to the base of the caudal fin (fewer than 60) and by the high and horizontal position of the pectoral fins.

Juveniles of both *B. caribbea* and *B. myersi* share with *B. orcini* the high pectoral fins, short ventrals, relatively deep body and low and lobeless anal fins. They differ from *B. myersi* by having fewer vertebrae, longer preanal and prepectoral lengths (Fig. 34), and deeper body, especially in smaller individuals (20 to 50 mm). *B. orcini* is clearly most closely related to its Atlantic counterpart *B. caribbea*, from which it differs principally in meristic values.

Description of Adult:—Four specimens, from Hawaii and California, 134–298 mm in standard length, are considered adults (the viscera are decomposed) and form the basis for this description. Counts and proportional dimensions are given in Tables 13 and 14.

Table 13. Meristic variation in *Brama orcini*. The "Central Pacific" category includes four syntypes of *B. Drachme*.

Dorsal Fin	**33**	**34**	**35**	**36**	
California	1				
Central Pacific	1	5	6	2	
Western Pacific and Indian Oceans	1	2	2		
B. orcini, type (Indian Ocean)		1			
Anal Fin		**28**	**29**	**30**	
California		1			
Central Pacific		1	7	4	
Western Pacific and Indian Oceans			4	1	
B. orcini, type (Indian Ocean)		1			
Pectoral Fin		**20**	**21**	**22**	
California		1			
Central Pacific		5	7	1	
Western Pacific and Indian Oceans		3	3		
B. orcini, type (Indian Ocean)			1		
Thoracic Vertebrae		**15**	**16**	**17**	
California			1		
Central Pacific		3	15	1	
Western Pacific and Indian Oceans		1	3	1	
B. orcini, type (Indian Ocean)			1		
Abdominal Vertebrae (excluding urostyle)	**20**	**21**	**22**	**23**	**24**
California			1		
Central Pacific		15	9		1
Western Pacific and Indian Oceans	1	3	1		
B. orcini. type (Indian Ocean)		1			
Total Vertebrae (including urostyle)		**38**	**39**	**40**	
California			1		
Central Pacific		8	15	1	
Western Pacific and Indian Oceans		5			
B. orcini, type (Indian Ocean)		1			

Table 14. Proportional dimensions, in percent of standard length, of adult and juvenile *Brama orcini*.

	Imperial Beach, California (S 10)	23°04′N, 164°54′W (HBL 2670)	23°04′N, 164°54′W (HBL 2670)	02°01′N, 141°21′W (HBL 2660)	02°01′N, 141°21′W (HBL 2660)	Indopacific, Hawaii to Africa	Indopacific, Hawaii to Africa	Holotype of *B. orcini*, "Indian Ocean"
Number of specimens	1	1	1	1	1	5	6	1
Standard length (mm)	298.0	265.0	200	158.0	134.0	58.0– 90.5	30.0– 50.0	34.4
Fork length (percent)	110.0	110.5	109.5	109.5	111.9	115.0–125.0	115.5–120.9	120.9
Greatest depth of body	47.8	49.4	49.0	52.5	51.0	54.9– 61.6	59.9– 68.3	68.0
Depth of body at middle of base of anal fin	32.0	31.2	30.2	34.8	32.2	33.9– 38.5	ca. 42	–
Least depth of caudal peduncle	7.1	7.4	7.4	7.7	7.5	7.2– 9.1	7.9– 9.0	7.6
Greatest width of body	9.7	10.2	11.4	13.1	12.7	11.0– 13.2	9.9– 14.1	16.3
Greatest width of head	10.9	11.8	12.2	13.0	11.8	12.5– 16.6	12.9– 17.8	16.3
Snout to origin of dorsal fin	38.6	37.7	36.8	40.5	38.5	38.5– 45.4	46.4– 49.9	48.8
Snout to origin of anal fin	54.0	53.3	58.0	57.6	60.3	61.5– 65.9	60.6– 67.7	62.8
Snout to origin of ventral fin	38.2	39.6	44.0	42.3	45.8	44.0– 50.8	41.4– 49.3	45.6
Snout to origin of pectoral fin	28.2	29.0	31.0	32.1	32.4	30.7– 35.0	30.8– 35.0	32.3
Length of base of dorsal fin	58.0	58.6	55.1	54.1	56.5	53.4– 55.2	49.3– 53.6	52.6
Length of base of anal fin	50.0	47.7	46.5	47.8	45.9	47.0– 49.7	44.8– 49.4	48.8
Origin of dorsal fin to insertion of pectoral fin	30.0	31.9	31.7	33.0	31.7	35.4– 41.6	38.9– 42.7	43.5
Base of uppermost pectoral ray to that of lowermost	6.2	7.5	6.8	6.6	7.5	8.3– 10.2	8.5– 10.4	9.0
Base of lowermost pectoral ray to insertion of ventral fin	13.3	13.0	14.3	14.3	14.9	15.0– 16.6	13.9– 16.3	16.0
Insertion of ventral fin to origin of anal fin	18.4	17.2	17.5	20.6	18.3	19.1– 24.0	23.8– 26.3	24.7
Length of pectoral fin	34.6	36.1	34.4	35.3	–	30.2– 38.5	32.5– 35.6	29.1
Length of ventral fin	9.5	9.5	9.9	9.4	9.6	11.1– 12.6	12.9– 15.7	13.7
Length of 5th anal ray	5.7	6.8	6.4	6.0	–	7.8– 9.3	11.0– 11.8	–
Length of 5th-from-last anal ray	5.9	6.6	5.6	4.1	–	3.3– 6.6	4.9– 8.2	–
Length of 5th dorsal ray	13.9	17.6	15.0	16.3	–	15.4– 20.3	18.7– 23.8	–
Length of 5th-from-last dorsal ray	7.0	6.0	7.2	–	–	4.5– 7.2	5.3– 8.9	–
Length of upper caudal lobe	42.8	38.8	–	–	–	ca. 32.0	ca. 32–36	–
Length of lower caudal lobe	33.3	30.2	–	–	–	ca. 30–35	ca. 32–36	–
Length of central caudal ray	10.0	10.6	9.5	9.5	11.9	14.6– 22.1	15.6– 20.7	–
Length of head	25.5	26.7	26.9	29.6	29.8	28.4– 33.1	29.6– 33.3	33.3
Length of snout	6.7	7.3	6.9	6.6	6.9	5.6– 7.9	5.8– 8.2	–
Diameter of eye, horizontal	6.4	6.6	7.1	8.0	9.0	8.6– 10.8	10.5– 12.5	11.3
Diameter of eye, greatest	7.2	7.2	8.0	8.8	–	9.0– 11.2	10.5– 12.5	11.3
Least distance between orbit and dorsal midline	6.3	6.2	6.6	5.4	–	4.6– 7.1	5.0– 6.4	–
Greatest distance between orbit and free edge of subopercle	13.6	13.9	14.5	14.6	14.9	14.1– 17.1	14.6– 16.9	16.3
Width of interorbital space	7.3	7.0	7.4	7.0	7.5	6.4– 10.0	9.6– 11.8	8.9
Length of upper jaw	13.4	14.3	15.4	15.0	14.9	15.3– 16.7	15.9– 17.9	17.2

Head and body compressed, the greatest width about 4.0–4.9 in greatest depth, this depth 2.9–3.3 in s.l. Dorsal profile of head rising more steeply than in the adults of other species of *Brama* of which adults are known. The curvature of snout and nape in front of the origin of the dorsal fin is convex throughout. Ventrally, the isthmus emerges from between the rami of the mandible at a point beneath the anterior edge of the orbit and curves evenly to the insertion of the ventral fin. This ventral keel is narrow and rigidly supported by the underlying bone of the pectoral girdle. The profile between ventral insertion and anal fin is nearly straight and parallel to the axis of the body. The bases of the vertical fins converge to the moderate caudal peduncle, the least depth of which is contained 6.6–6.9 in greatest depth of body. The anterior lobe of the dorsal fin is high, that of the anal present but less prominent than that of *B. brama*, *B. japonica*, and *B.* sp.

Also, the posterior margin of the caudal fin is more completely forked than in these three congeners, and the upper lobe is considerably longer than the lower.

Snout and lower jaw, nape, angle of preoperculum and free edge of operculum, most of the paired fins and tips of vertical fins naked; the head, body and fins otherwise covered by scales. Scales of adult without spines, the posterior border of each uneven but smooth. Lateral line present and complete. About 52–54 scales in a horizontal series, counting from the uppermost point of the gill cleft horizontally rearward to the base of the central caudal rays (the range of counts found in *B. orcini*, juveniles and adults, is 48–55). Scales on dorsal and anal fins covering all but the tips of the rays. Squamation of caudal fin complete save for a crescentic area centered on the central caudal rays, the distal half of which is naked. Base of pectoral fin with scales, the fin naked, with 5 or 6 prominent axillary scales. Proximal half of innermost ventral ray,

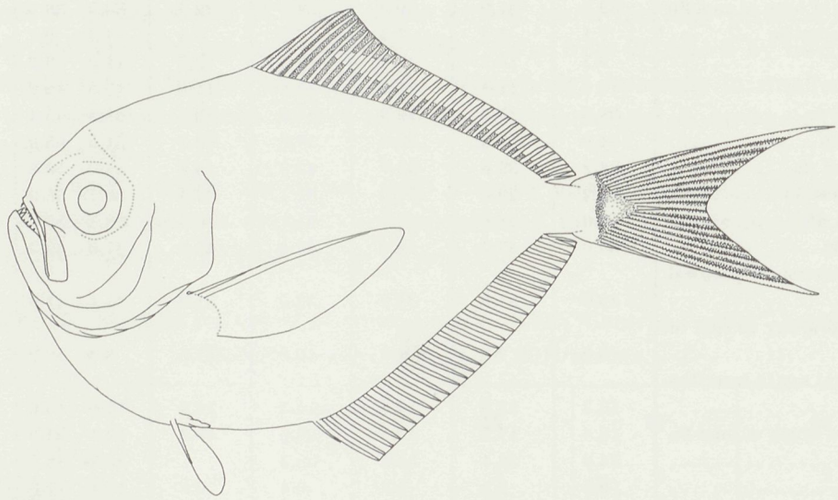


Fig. 32. *Brama orcini*, 65.0 mm s.l., from near the equator southeast of Hawaii ("H. M. Smith", Cr. 35, Sta. 113; 00°01′ N, 143°02.3′ W). Drawn by N. Strekalovsky.

and ventrally the bases of the others, with scales; the fin otherwise naked. Axillary scales long, extending about three-fourths the length of the fin.

Snout blunt, but little if at all concave above tip of lower jaw. Length of snout about equal to horizontal diameter of eye. Horizontal diameter of eye 3.7–4.0 in length of head. Anterior nostrils circular and directed forward, located midway between tip of snout and anterior edge of orbit. Posterior nostril an oblique slit, closer to orbit than to anterior nostril. Cheek broad, free edges of preopercle and gill flap uneven but smooth, striæ representing remains of preopercular spines of the juvenile *B. orcini* still visible anterior to free edge of preopercle. Branchiostegal membrane completely covered by gill flap when mouth is closed normally; branchiostegal rays usually 7 (3 + 4), infrequently 6 or 8. Gill rakers of the usual lath-like shape on first arch, each bearing spines along the inner edge, the number 3–5 + 1 + 8–10 = 12–16. Rakers on successive arches reduced to spinulose knobs.

Length of head 3.6–3.9 in s.l., decreasing in relative size with growth. Upper jaw extends to beneath anterior one-third of eye. Lower jaw included within upper posteriorly but not anteriorly. Tooth-bearing border of upper jaw concave in profile, that of lower jaw straight or nearly so. Principal teeth of lower jaw are a large series along the inner edge of the mandible; these teeth, of which the anterior are the larger, are about twice the length of those found in adults of *B. brama* and *B. japonica*, twice the size of our largest *B. orcini*. Lateral to these is an irregular arrangement of minute teeth which form a row only along the anterior outer edge of the lower jaw. Teeth in upper jaw conical, much smaller than those in the mandible, and lying along the outer edge of the maxillary and pre-maxillary. Within these anteriorly is a patch of minute teeth partially buried in the flesh. No canines in upper jaw. Canines in lower jaw, conspicuous in larvae and

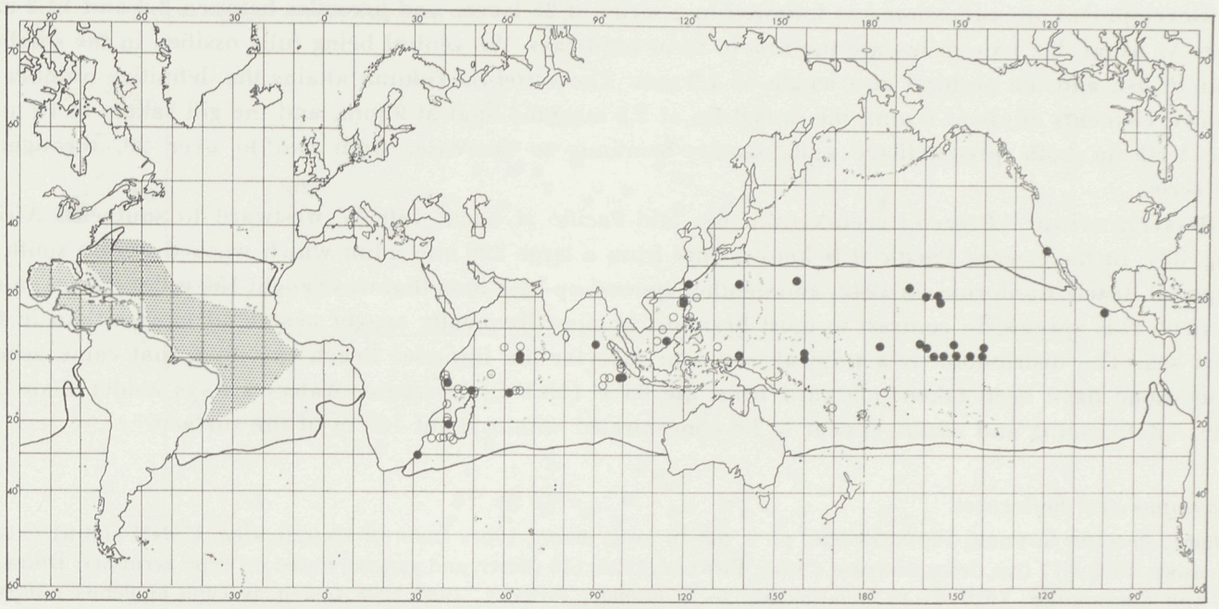


Fig. 33. Distribution of *Brama orcini* (○ shorter than 20 mm s.l.; ● longer than 20 mm s.l.) and of *B. caribbea* (stippled). Also indicated are the 65°F (18.3°C) isocrymes, poleward from which surface waters are always colder than this value.

juveniles, larger but not notably different from the teeth of the principal row. Symphyses of both jaws without teeth. Pharyngeal teeth well developed.

Dorsal fin originating over rear half of base of pectoral fin; the predorsal distance 2.5–2.7 in s.l.; the length of the base of the dorsal 1.7–1.8 in s.l. Height of dorsal lobe similar to that of *B. brama*. Anal lobe low, its height substantially less than half that of *B. brama*. (In this species and *B. japonica*, the anal lobe is from half to two-thirds the height of the dorsal fin lobe.) Preanal length 1.7–1.9 in s.l., this distance decreasing with growth of fish; length of base of fin 2.0–2.2 in s.l. As in juveniles, pectoral fin inserted high on body, the axis of the fin forming an angle less than 45° with the horizontal axis of the body (as in *B.* sp. cf. *B. brama*). Prepectoral length 3.1–3.5 in s.l., decreasing with growth of fish; length of fin 2.8–2.9 in s.l. Ventral fin inserted under middle of pectoral base, the preventral length 2.3–2.6 in s.l., decreasing with growth of fish; the fin length 2.7-3.1 in length of head.

Variation:—Juveniles taken by "Dana" in the Indian Ocean have slightly deeper bodies, longer heads and greater preanal and prepectoral body lengths than do individuals of similar size more recently collected in the mid-Pacific. Such variation may be due mainly to the length of preservation, for differences between the syntypes of *B. drachme* and individuals taken 50 years later in the same Hawaiian area are equally great. *B. orcini*, which appears to be more closely associated with island and shelf areas than its Pacific congeners, may be divisible into subpopulations, but present material does not justify such separation.

Larvae and juveniles:—As the young of *B. orcini* are virtually identical to those of its closest relative, *B. caribbea* as described on p. 63, no description is necessary. In addition to the diagnostic vertebral characters, most of which can be seen in stained material longer than 6 mm, the young *B. orcini* are less heavily pigmented—indeed most specimens for reasons natural or not, are colorless save for the eye. More recently caught material such as the 16–26 mm specimens caught in the Indian Ocean by R. V. "Anton Bruun" allow the following color notes: Surface of body iridescent, the underlying pigment most dense near dorsal profile; melanophores small and sparsely distributed on body posterior to abdominal cavity. Caudal peduncle pale except along dorsal profile but terminating in a vertical black band at the base of the caudal fin. Peritoneum heavily pigmented, especially posteriorly. Head and jaws dusky; gill membrane clear posteriorly but dusky anteriorly. Ventral and anal fins colorless; tip of caudal and anterior part of dorsal pigmented; pectoral with minute melanophores interradially.

Development of ossification was followed in a series of 25 larvae and juveniles between 3.6 and 14.2 mm long. As usual, the paired fins are the first to form hard rays, the ventral being fully ossified in the smallest 3.6 mm fish and the pectoral at a length of 4.2 mm. The vertebral column attains the definitive number of ossified elements at about 6 mm, the dorsal fin at 7.5 mm, the anal at 9 mm, and the gill rakers at 10 mm. The teeth in both premaxillary and dentary continue to increase, from two to over 20, throughout the series.

Distribution:—*B. orcini* occurs from the mid-Pacific at about 140° W westward to southeast Africa (Fig. 33). In the eastern Pacific it is known only from a large 298 mm adult which washed ashore south of Imperial Beach, California, in 1945, and another spewed up by a tuna that was caught 150 miles off Acapulco, Mexico. This species, in contrast to most bramids, is more frequently caught near land masses than in the open sea. The distribution is a tropical one, and save for the Imperial Beach specimen that came ashore dead, none have been taken poleward from the 65°F (18.3°C) isocryme—waters always colder than this value. Both young and adults appear to be concentrated within about 100 m of the surface.

Synonyms and References.

Collybus drachme Snyder, 1904:525–526, pl. 9, fig. 16 (orig. descr., types from off Hawaii, seen, USNM and SU); Gilbert, 1905:617 (rec. from Snyder, 1904); Fowler, 1928:138 (descr. and synon.; based on type account); Bigelow and Schroeder, 1929:42–43 (relationship to *B. brama*); Fowler, 1936:1278 (given as type of genus *Collybus*, considered a synon. of *Brama*); Fowler, 1938:277 (rec. for Honolulu and Niihau, Hawaii); Reintjes and King, 1953:98 (stom. cont. central Pacific yellowfin tuna; probably incl. *B. dussumieri* and *B. myersi* as well); Böhlke, 1953:76 (paratypes in SU collection); Ronquillo, 1953:77 (first Philippine recs.; from stom. tunas and *Coryphaena*); Mead and Maul, 1958:407 (listed with type species); Gosline and Brock, 1960:180, fig. 108 (abundant in Hawaii; descr.); King and Iversen, 1962 (part, material rep. probably also includes *B. dussumieri* and *B. myersi*; common in central Pacific from Hawaii south; note similarity in percentage comp. between midwater trawl catches and stom. cont. tunas; percentage contribution to tuna food, partly from lit., provided: 2 yellowfin estimates, 1.9% and 15.0%; 6% in bigeye tuna; 1.7% in skipjack; 6.3% in albacore); Iversen, 1962 (part, probably incl. *B. dussumieri* and *B. myersi*; notes on imp. as forage fish); Waldron and King, 1963:26 (part, central Pacific; stomach cont. tunas); Grindley and Penrith, 1965 (recs. juvs. off Natal coast of S Africa); Williams, 1966:377 (as *Collybus* sp., food of E African tuna); Munro, 1967:220 (open oceans off New Guinea; the "pygmy pomfret"; group said to be related to the Parastromateidae); ?Fitch and Lavenberg, 1968:99 (ref., near Calif.).

Brama orcini Cuvier, in Cuvier and Valenciennes, 1831:295 (orig. descr.; no loc.); Günther, 1860:409 (descr., distrib.); Lunel, 1865:16 (descr. from Cuv. and Val. and from Günther, 1860); Lütken, 1880:494 (name only, from Cuv. and Val.).

Taractes orcini, ?Günther, 1876:148 (part ?; based on Cuv. and Val. and an additional spec. the ident. of which is uncertain from the "Südsee", ref. to *Brama longipinnis* and *B. raschii*); Fowler, 1928:138 (part, listed with synon. for Oceania, after Cuv. and Val., 1831, and Günther, 1876; identity uncertain at best).

Brama myersi, new species.

Figures 34 to 37.

Study Material:—The holotype, a specimen 82.0 mm in standard length, collected by dip net from the U.S. Bureau of Commercial Fisheries (Honolulu Biological Laboratory), vessel "Charles H. Gilbert", Cruise 48, Sta. 60, 15°14′ N, 159°55′ E; 24 July 1960 (HBL 2655, now USNM).

Paratypes: The remaining specimens enumerated in Appendix Table 16; and those from "Dana" stations D-3613 VI, 3613 VII, and 3626 X in Appendix Table 15.

Distinctive Characters:—As the adult is unknown or unrecognized, the remarks which follow apply only to juveniles shorter than 82.0 mm. *Brama myersi, B. orcini,* and *B. caribbea* form a group of species distinguished from their congeners by the high and more horizontal placement of the pectoral fin (Fig. 14), and the relatively short ventral fins (Fig. 15). The low number of scales (fewer than 60) in a horizontal series and relatively low and lobeless anal fin are also characteristic of *B. orcini* and *B. caribbea*. *B. myersi* can be distinguished from these two by the high number of abdominal and thus of total vertebrae; counts more in accord with those of *B. dussumieri* and *B. brama*. It is also separable from *B. orcini* and *B. caribbea* by its

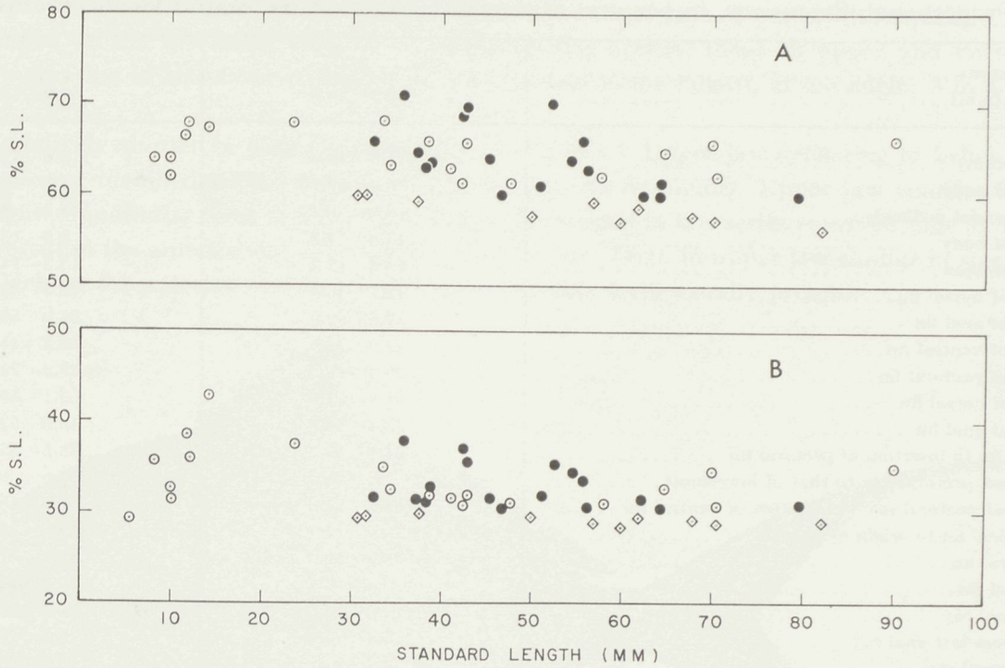


Fig. 34. Relative preanal length (A) and prepectoral length (B) in *Brama caribbea* (●); *Brama orcini* (○); and *Brama myersi* (◇).

foreshortened prepectoral and preanal lengths (Fig. 34). The upper lobe of the caudal fin appears to be more greatly and regularly prolonged than in the other species of *Brama*, but a prolonged lobe occurs sporadically throughout the genus.

Description:—Counts, and proportional dimensions, are given in Tables 15 and 16. Body deep and compressed, the greatest depth 1.8–1.9 in standard length and diminishing with growth. Dorsal profile evenly arched between the slight concavity above the snout and the origin of the dorsal fin. Ventral profile anterior to insertion of ventral fin pronounced and strongly convex, the body rigidly supported by the underlying

Table 15. Meristic variation in *Brama myersi* from central and western Pacific.

Dorsal Fin	**32**	**33**	**34**	**35**	**36**
Northern hemisphere	1	1	5		
Southern hemisphere		1		2	1
Anal Fin	**28**	**29**	**30**	**31**	
Northern hemisphere	1	5	1		
Southern hemisphere		2	1	1	
Pectoral Fin		**19**	**20**		
Northern hemisphere		2	5		
Southern hemisphere		1	3		
Thoracic Vertebrae		**16**	**17**		
Northern hemisphere		6	1		
Southern hemisphere		4			
Abdominal Vertebrae (excluding urostyle)		**23**	**24**	**25**	
Northern hemisphere		6	1		
Southern hemisphere			3	1	
Total Vertebrae (including urostyle)		**40**	**41**	**42**	
Northern hemisphere		4	2		
Southern hemisphere			3	1	

Table 16. Proportional dimensions, in per cent of standard length, of the central Pacific *Brama myersi*.

Number of specimens	4	6
Standard length (mm)	30.9– 50.0	57.0– 82.0
Fork length (percent)	115.5–119.9	112.8–119.9
Greatest depth of body	56.0– 59.1	54.3– 56.3
Least depth of caudal peduncle	9.0– 9.4	8.3– 9.0
Greatest width of body	13.8– 14.8	9.8– 13.2
Greatest width of head	13.8– 17.2	13.2– 14.4
Snout to origin of dorsal fin	42.7– 46.3	40.4– 43.4
Snout to origin of anal fin	57.6– 59.9	56.0– 59.0
Snout to origin of ventral fin	42.0– 48.0	39.2– 41.9
Snout to origin of pectoral fin	29.4– 29.9	28.4– 29.8
Length of base of dorsal fin	51.8– 52.6	53.1– 56.1
Length of base of anal fin	43.4– 50.9	46.0– 52.5
Origin of dorsal fin to insertion of pectoral fin	35.2– 37.9	33.5– 35.2
Base of uppermost pectoral ray to that of lowermost	7.8– 10.4	7.6– 9.0
Base of lowermost pectoral ray to insertion of ventral fin	12.9– 15.6	13.0– 15.4
Insertion of ventral fin to origin of anal fin	20.0– 22.4	17.6– 21.5
Length of pectoral fin	32.4– 35.0	33.4– 37.1
Length of ventral fin	16.0– 18.5	10.4– 15.7
Length of 5th anal ray	10.0– 12.6	10.1– 11.8
Length of 5th-from-last anal ray	6.4– 8.0	5.5– 7.2
Length of 5th dorsal ray	19.2– 22.0	15.2– 20.6
Length of 5th-from-last dorsal ray	8.5– 11.2	5.8– 10.0
Length of upper caudal lobe	57.5– 67.4	52.1– 62.6
Length of lower caudal lobe	29.2– 33.1	27.7– 31.8
Length of central caudal ray	15.8– 19.8	13.5– 20.1
Length of head	31.4– 32.4	28.6– 31.2
Length of snout	5.0– 7.2	6.6– 7.4
Diameter of eye, horizontal	9.6– 12.6	7.0– 9.0
Diameter of eye, greatest	9.6– 12.6	8.5– 10.0
Greatest distance between orbit and free edge of subopercle	12.9– 14.1	13.8– 15.1
Width of interorbital space	9.1– 11.3	7.7– 10.1
Length of upper jaw	14.0– 15.7	14.1– 15.9

bones of the pectoral girdle, the body here protruding from between the gill covers and entering into the ventral profile forward to a point below the front edge of the eye. Ventral profile between origin of ventral fin and insertion of anal convex in young shorter than about 50 mm; quite straight in larger specimens. Bases of dorsal and anal fins nearly straight, converging to the comparatively stout caudal peduncle, the depth of which is contained 6.0 to 6.5 times in greatest depth of body.

Lower jaw, snout, angle of preoperculum, free edge of gill flap, and parts of all fins naked, the body elsewhere covered by typical bramid scales. 53 to 56 scales in a horizontal series, counting from uppermost point of gill opening to base of central caudal rays. Scales with spines and ridges in young, becoming smooth with growth. (In the largest specimen, 82.0 mm, only the more posterior body scales have spines.) Squamation on vertical fins increasing with growth, that on the largest (82.0 mm) specimen covering all but the distal ends of the caudal lobes and the posterior half of the central caudal rays, the anterior lobe or rays and the bases of the posterior rays of the dorsal and anal fins. Pectoral fin naked save for the extreme base of the rays; axillary scales prominent. Bases of rays of ventral fin with scales on the under surface, these extending on to the innermost ray to a greater extent than on to the outer but the fin, in general, is scaleless.

Snout blunt; lower jaw terminal. Eye elliptical, the longest axis oblique. Orbit entering dorsal profile in young shorter than about 35 mm, the forehead becoming elevated and thus excluding the eye from the profile at greater lengths. Interorbital width less than diameter of eye in young, equal to or slightly greater than this diameter by 80 mm. Cheek broad, free edge of opercle irregular in outline but without spines, the preopercular spines being overgrown by 35 mm s.l. Branchiostegal membranes completely hidden by op-

ercular flap when mouth is closed, the number of branchiostegal rays 7, or very infrequently, 6. Gill rakers well developed on the first arch, vestigial on the succeeding arches; those on upper and lower limb of the first arch increasing in size from rudiments at the extremes to the largest, at the angle; 3 to 4 + 1 + 8 or 9 = 12–14.

Head relatively shorter in larger individuals, 3.1–3.5 in s.l. Upper jaw extending to below anterior half of eye, the lower included within the upper laterally but not terminally. Upper jaw concave in profile, the lower straight. Mandibular teeth in a band anteriorly; the longest in this series recurved; one to three recurved canines present in the anterior end of each side of lower jaw. Teeth in upper jaw similar in size and arrangement but lacking the anterior canines. A few small palatine teeth usually present.

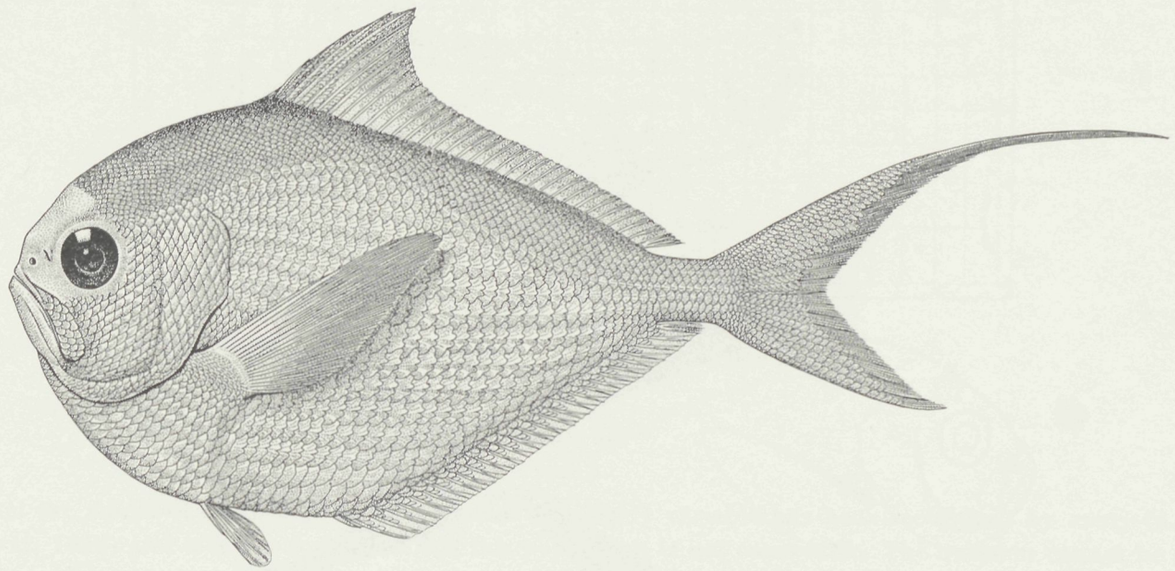


Fig. 35. Holotype of *Brama myersi*, 82.0 mm s.l., from the western central Pacific ("C. H. Gilbert", Cr. 48, Sta. 60, 15°14′ N, 159°55′ E; HBL 2655, USNM). Drawn by N. Strekalovsky.

Dorsal fin originating over or slightly behind rear end of pectoral, the predorsal distance 2.1–2.5 in s.l. Length of base of dorsal fin 1.8–1.9 in s.l. Anterior rays of dorsal longer than the posterior; the transition gradual in specimens shorter than about 50 mm; these anterior rays forming a lobe at greater lengths. About four anterior dorsal rays unbranched and graduated in length, the rest branched. Caudal fin deeply forked, the upper lobe much longer than the lower and filamentous. Anal fin low and without a lobe, preanal length about 1.7 in s.l. Length of base of anal fin variable, 2–2.3 in s.l. First three or four anal rays unbranched and graduated in length, the rest branched, the longest only about half, or less than half, the length of longest dorsal ray.

Pectoral fin inserted relatively high on body, its base more nearly horizontal than vertical. The rays forming the leading edge, and the one or two lowermost rays simple, the rest branched. Prepectoral length 3.3–3.5 in s.l., the fin relatively longer in individuals, 2.7–3.1 in s.l. Ventral fins low, their bases adjacent to ventral profile of body, the fins short (Fig. 15), lying in a horizontal plane parallel to the main axis of the body when expanded, and failing to reach the origin of anal fin.

In alcohol, *Brama myersi* is generally silvery or pale but darker along the base of the dorsal fin and on the scaleless part of the snout. The paired fins and the anal fin are clear. The dorsal fin completely pigmented at 70.0 mm. There is little evidence of horizontal banding in the dorsal fin of the young (cf. *B. japonica* and *B. dussumieri*). The caudal fin, especially the tips of the lobes, is dark except for an area of variable extent in the posterior part of the central rays which is but lightly pigmented.

Two specimens, 6.8 and 9.5 mm s.l. were cleared and stained. All serial elements are ossified. There are no palatine or vomerine teeth but the jaws bear well-ossified teeth the anterior of which are larger than the

posterior, recurved, and directed outward. There are about 9 teeth in the upper jaw and 6 in the lower in the smaller specimen; 12 and 8 respectively in the larger. The smaller is completely naked. The 9.5 mm fish has scales ventrally anterior to the pelvic fins and on the flank behind the upper end of the gill cleft in the area to be traversed by the lateral line. Predorsal scales are beginning to form but are not ossified. Preopercular spines, about ten in number, are well developed. In degree of development, *B. myersi* appears to be more precocious than the more temperate *B. japonica*; less so than the tropical *B. orcini*, and about the same as *B. dussumieri*.

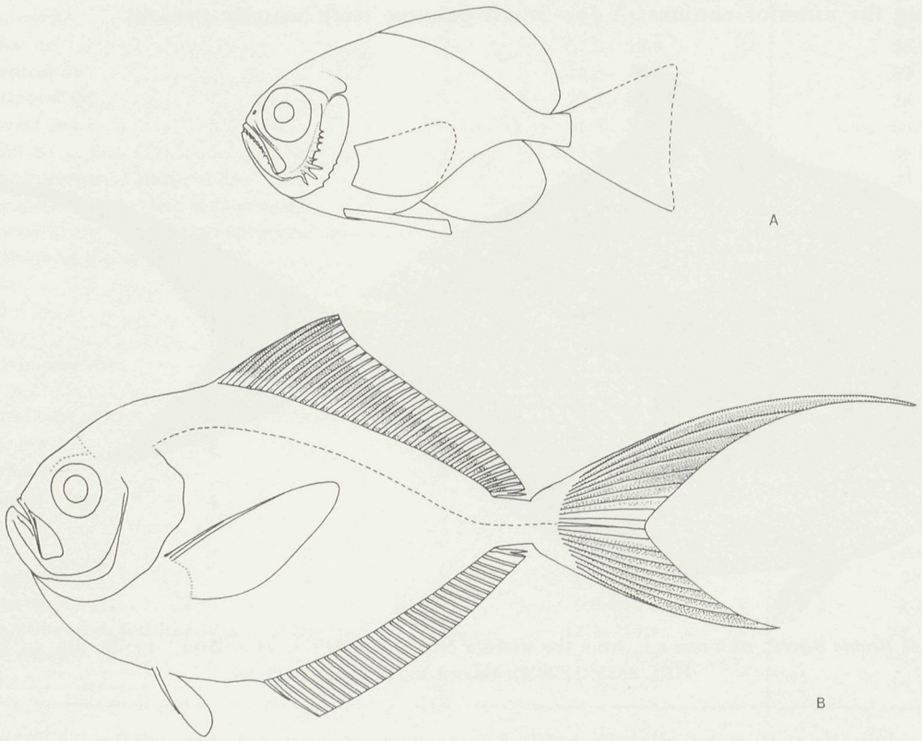


Fig. 36. Young *Brama myersi*, A and B not drawn to scale and pigmentation not shown. (A) 13.7 mm s.l. (D-3690 III; 8°02′ N, 109°36.5′ E). (B) 51.0 mm s.l. ("H. M. Smith", Cr. 9, Sta. 25–12; 17°40′ N, 159°57′ W). Drawn by N. Strekalovsky.

Two larger juveniles, 11.5 and 13.7 mm s.l., are clearly identifiable as *B. myersi* without staining. Except for the eye, both are either colorless or completely faded. Both are fully scaled and in both the fins and fin rays are fully formed. The vertical fins are relatively high compared to those of later stages but without lobes The pectoral, which is somewhat shorter than that in related forms at these lengths, is inserted relatively high on the body, the distance between the base of the lowermost pectoral ray and the insertion of the ventral fin being about three-fourths of the width of the base of the pectoral. The ventral fin, which is inserted ahead of the base of the pectoral at 11.5 mm but under this base at 13.7 mm, is long compared to those of larger fish and extends posteriorly beyond the origin of the anal fin. There are about nine preopercular spines at 11.5 mm. All but the largest, those at the angle, are overgrown by 3.7 mm. Teeth are well developed in both. Those in the lower jaw form a series from the symphysis posteriorly; those of the upper, similar in pattern, occupy the full length of premaxillary.

As *B. myersi* is a newly recognized species known from but few specimens, little can be said of its biology other than that it appears to be a diminutive species of the open oceans.

This species has been named *myersi* in honor of Professor George Sprague Myers of Stanford University.

Distribution:—Central, western and southwestern Pacific and possibly the western Indian Oceans (Fig. 37).

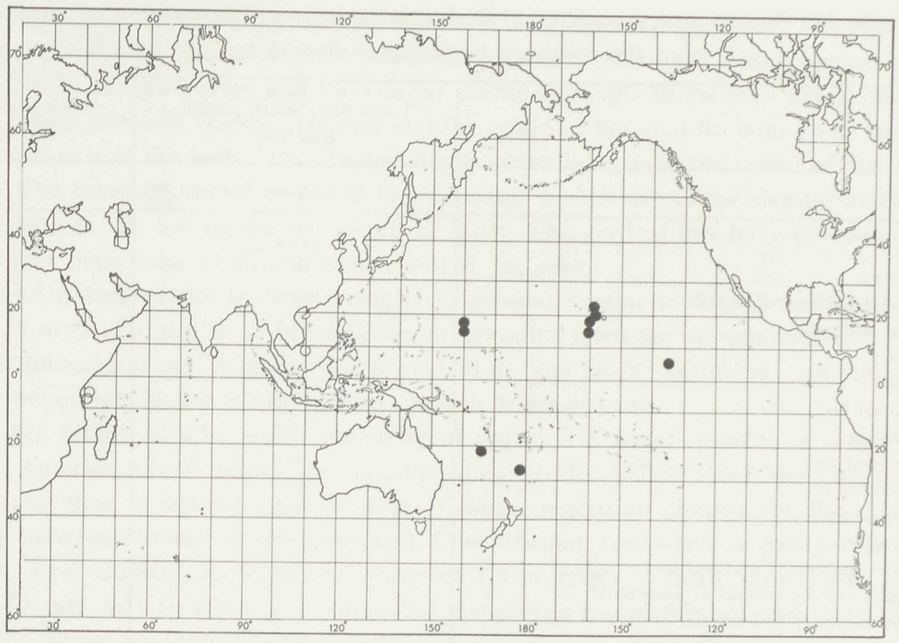


Fig. 37. Distribution of *Brama myersi*.
○ shorter than 20 mm s.l. ● longer than 20 mm s.l.

Brama sp.

Plate 4.

That the adults of south cold-temperate areas are highly variable has been recognized by many (e.g., PARROTT, 1948) and it is my conviction that this population is not conspecific. The question cannot be resolved here for lack of sufficient material—both of adults, and more importantly, of juveniles of a size similar to the more abundant material of the more northern species. *Brama* is well known off the coasts of Australia and South Africa, not uncommon off New Zealand, and at least reported from the poorly-known off-shore waters of Chile (see southern hemisphere references provided under *B. brama*, p. 29). The most common southern *Brama* is closely related to, if not conspecific with, the North Atlantic *B. brama*, a species thus bipolar in the Atlantic but represented in the Pacific by a species pair (*B. brama* and *B. japonica*). I believe the nominal *Brama squamosa* HUTTON, 1875, *B. australis* VALENCIENNES, 1836, and *B. chilensis* GUICHENOT, 1848, to be conspecific with *B. brama*.

But included in the material reported here are two large specimens which appear to be distinct. These are described below but not named, for an adequate diagnosis cannot be formulated on the basis of adults alone. The first specimen, 468 mm s.l., was collected by R. WALTERS on 25 October 1957 at Devonport, New Zealand (Dominion Mus., Wellington). The second, tentatively referred to this species, was caught in Table Bay, South Africa, and sent to the British Museum by J. D. F. GILCHRIST. These are probably conspecific with that reported by GRIFFIN (1928:378, pl. 59, Fig. 4), a 526 mm adult trawled between Te Kaha and White Is., New Zealand, in January 1928. The specimen is said to be in the Auckland Museum.

Distinctive Characters:—Unfortunately, the only other species represented by adults of comparable size are those of *Brama brama*, including individuals from New Zealand. *Brama* sp. differs from these in having the relatively high and horizontal pectorals suggestive of juvenile *B. orcini* and *myersi*. The distance between the lower end of the base of the pectoral fin and insertion of ventral fin is contained 1.4 or 1.5 times in that between insertion of ventral fin and origin of anal (cf. 1.7–1.9 in *Brama brama* of equivalent size). The species is also considerably more compressed than *B. brama*, and the gill filaments (not rakers) appear to be much longer (longer than distance between anterior nostril and orbit, nearly as long as snout; while in *B. brama*, and in *B. japonica* of somewhat shorter length, these filaments are about equal to the distance

Table 17. Counts and proportional dimensions, in percent of standard length, of the southern hemisphere *Brama* sp.

	Table Bay, South Africa, BM(NH)	Devonport, New Zealand DM 2235 holotype
Standard length (mm)	434.0	468.0
Fork length (percent)	111.8	112.0
Greatest depth of body	49.1	49.0
Depth of body at middle of base of anal fin	32.0	32.0
Least depth of caudal peduncle	6.1	6.3
Greatest width of body	11.9	12.8
Greatest width of head	13.8	12.1
Snout to origin of dorsal fin	38.1	39.5
Snout to origin of anal fin	55.6	55.9
Snout to origin of ventral fin	40.0	41.0
Snout to origin of pectoral fin	29.7	30.1
Length of base of dorsal fin	60.3	57.9
Length of base of anal fin	44.2	44.9
Origin of dorsal fin to insertion of pectoral fin	31.5	30.6
Base of uppermost pectoral ray to that of lowermost	7.3	7.7
Base of lowermost pectoral ray to insertion of ventral fin	11.4	13.1
Insertion of ventral fin to origin of anal fin	17.4	18.7
Length of pectoral fin	38.5	37.0
Length of ventral fin	9.3	8.4
Length of 5th anal ray	–	10.5
Length of 5th-from-last anal ray	10.1	7.3
Length of 5th dorsal ray	21.7	17.7
Length of 5th-from-last dorsal ray	10.1	7.3
Length of upper caudal lobe	–	28.4
Length of lower caudal lobe	–	28.2
Length of central caudal ray	11.8	12.0
Length of head	28.8	27.5
Length of snout	7.8	7.7
Diameter of eye, horizontal	7.8	6.1
Diameter of eye, greatest	8.7	6.6
Greatest distance between orbit and free edge of subopercle	14.1	13.5
Width of interorbital space	9.3	8.3
Length of upper jaw	13.9	13.5
Counts:		
Dorsal fin	34	35
Anal fin	27	28
Pectoral fin	22/22	23/23
Gill rakers	5–6 + 1 + 11	–
Branchiostegal rays	7	–
Scales in horizontal series	70	74
Vertebrae	15 + 23 + 1	16 + 23 + 1

from anterior nostril to orbit). Abdominal vertebral (exclusive of urostyle) number 23 in this species, as opposed to 25 and 26 in New Zealand *B. brama*, and 24 to 25 in North Atlantic *B. brama*, the species being more similar in this respect to *B. japonica*. It also has a greater number of scales in a horizontal series than *B. orcini*, *B. caribbea* and *B. myersi* (more than 70 vs. fewer than 60) as well as more pectoral fin rays and vertebrae. The high pectoral count will also distinguish it from *B. dussumieri* (21 or fewer vs. 22 or more) as will the total number of vertebrae (including the urostyle, 39 or 40 cf. 41 or 42 in Pacific *dussumieri*). The species is most closely related to *B. myersi*.

Description of Adult:—Counts and proportional dimensions are given in Table 17. Body strongly compressed, its greatest width 3.8–4.1 in greatest depth. Lower jaw terminal. Dorsal profile of head evenly curved from snout to origin of dorsal fin, there being but a very shallow concavity above the tip of the upper

jaw. The dorsal midline is more sharply crested than in *B. brama* and *B. japonica*. The ventral profile is that of the lower edge of the mandible to a point below the anterior half of the eye, at which point the isthmus emerges from between the gill covers and the ventral profile descends in an even arc to the insertion of the ventral fin. The profile between ventral insertion and the origin of the anal fin is more or less straight but not parallel to the main axis of the body. The greatest depth of the body is at the origin of the dorsal, this depth about 2.0 in s.l. The bases of dorsal and anal fins converge posteriorly to the slender caudal peduncle, the least depth of which is 7.8–8.0 in greatest depth of body. The vertical fins have prominent lobes, these in general being higher than those of *Brama brama* and *B. japonica*.

The degree and nature of the scale covering is in general similar to that described for *Brama brama*. There are 70 to 74 rows of scales in a horizontal series, counting from the uppermost point of the gill opening to the base of the midcaudal ray. A lateral line is evident in both adult specimens: complete in the New Zealand specimen; incomplete in the South African (British Museum) fish.

Snout blunt, but little if at all concave above tip of upper jaw, snout equal to or longer than horizontal diameter of eye. Anterior nostril nearly circular, the opening directed forward, the nostril situated slightly closer to tip of snout than to anterior edge of orbit. Posterior nostril an oblique slit, the upper end of which is about midway between anterior nostril and orbit. Cheek broad, free edges of preopercle and gill flap uneven but smooth. Eye elliptical, its horizontal diameter 4.5 in length of head in the New Zealand specimen, 3.7 in head in the South African adult. Branchiostegal membrane completely covered by gill flap when mouth is closed normally; seven branchiostegal rays. Gill rakers of the usual lath-like shape on the first arch, each bearing spines along the inner edge, the number 5 or $6+1+11 = 17$ or 18; the rakers increasing in length toward the angle. (The evisceration suffered by the South African (BMNH) fish included the branchial basket.) Rakers on successive arches progressively shorter, thicker and more spiny.

Length of head 3.5–3.6 in s.l. Upper jaw extends to below about center of eye. Lower jaw included within the upper posteriorly but not anteriorly. Tooth-bearing border of upper jaw concave in profile, that of the lower jaw straight or nearly so. Principal mandibular teeth on inner row; these teeth are conical and recurved. Lateral to this row, as well as many small and irregularly-spaced teeth, is a row similar in shape to the inner row, the teeth about two-thirds the length of the inner teeth. These outer teeth are longer, and the size difference between the teeth of inner and outer row less extreme than the condition in *B. brama* and *B. japonica*. A few larger canines present along the inner edge of the mandible lateral to the symphysis. Outer teeth of upper jaw in a row, the teeth similar in size and shape to similar rows in the mandible. Median to this row is a band of lesser teeth. Symphysis of each jaw toothless. No canines in upper jaw. A series of minute palatine teeth present. Pharyngeal teeth well developed.

Dorsal fin originating somewhere over base of pectoral fin, the predorsal distance 2.5–2.6 in s.l., the length of the base of fin 1.7–1.8 in s.l. Dorsal lobe higher than anal. Preanal length about 1.8 in s.l., the length of base of anal fin about 2.2 in s.l. Pectoral fin situated high on body, as in all known adults of the species of *Brama* and juveniles of *B. orcini, B. myersi, B. caribbea*, and to a lesser extent, *B. dussumieri*. Base of pectoral fin forming an angle of less than 45° with horizontal axis of body (cf. adult and juvenile *B. brama* and *B. japonica*). Prepectoral distance 3.3–3.4 in s.l. Length of pectoral fin 2.6–2.7 in s.l. Ventral fin inserted under posterior half of base of pectoral fin; the preventral distance 2.4–2.5 in s.l.; the length of the fin 3.1–3.3 in length of head.

The color of the preserved specimens is similar to that of *Brama brama*.

Probable Distribution:—New Zealand, Australia, and South Africa.

Genus **Taractichthys** Mead and Maul, 1958.

Taractes (*Taractichthys*) Mead and Maul, 1958:407; type species, by original designation, *Brama longipinnis* Lowe, 1843.

Generic Synonym:

Argo L. Döderlein, 1883, *in* Steindachner and Döderlein, 1883:34, the legend for pl. 7; type species, by monotypy, *Argo steindachneri* L. Döderlein, 1883, loc. cit.; a junior synonym, also preoccupied in molluscs by *Argo* Herrmannsen, 1846.

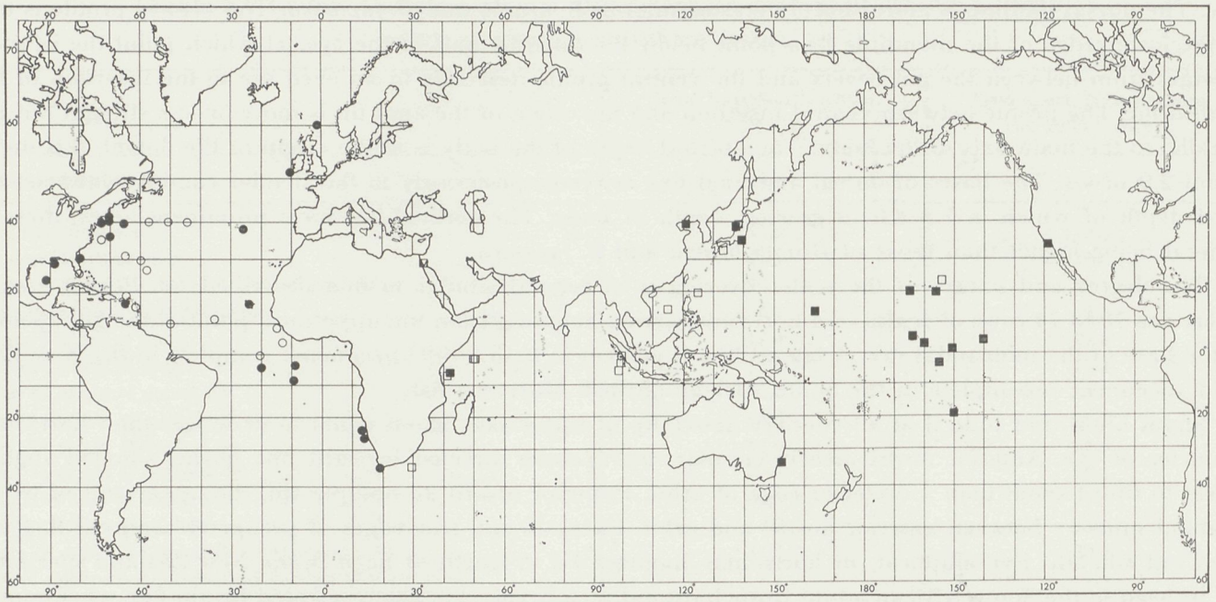


Fig. 38. Distribution of *Taractichthys longipinnis* and *T. steindachneri*.

T. longipinnis
○ shorter than 20 mm s.l.
● longer than 20 mm s.l.

T. steindachneri
□ shorter than 20 mm s.l.
■ longer than 20 mm s.l.

Characters:—Dorsal fin originating behind head and falcate, the anterior lobe high but changing markedly in shape and height with growth (Fig. 39); most dorsal and anal elements branched; both fins moderately stiff, erect, and covered with scales, and not depressible into a groove. No anterior dorsal or anal ray notably thicker than its neighbor. Ventral fins short and inserted under anterior half of base of pectoral fin. Pectoral fin extending beyond lobe of anal fin. Caudal fin broad and stiff, its contour evenly concave or, in small adults, slightly biconcave. Transverse caudal grooves well developed.

Dorsal profile of head between eyes strongly arched and rounded. Inner lower edges of mandible posterior to symphysis of lower jaw not touching each other; a scale-bearing patch of the isthmus visible between them. Posterior nostril a slit. Dorsal ends of thoracic ribs greatly expanded.

Scales with strong spines which persist in large individuals (ca. 400 mm) but the scales of larger specimens are smooth. Spines on scales of caudal peduncle antrorse when present but none are notably enlarged. No scaleless area above and behind eye. Adult without lateral line. Midlateral series of scales on caudal peduncle unarmed, bordered above and below by rows of scales bearing spines of the usual size. Last scale on caudal peduncle distinctly larger than anteriormost scale on central caudal rays.

Range:—Known from most tropical and temperate seas but nowhere common.

Species:—Two here recognized: *Taractichthys longipinnis* Lowe from the Atlantic, and the Indo-Pacific *T. steindachneri* (Döderlein).

Key to Species

A Scales in horizontal series, from upper end of gill cleft to base of caudal fin, more than 38.

T. longipinnis (Lowe, 1843) p. 85.
Atlantic

AA Scales in horizontal series, from upper end of gill cleft to base of caudal fin, 38 or fewer.

T. steindachneri (Döderlein, 1883) p. 91.
Indo-Pacific

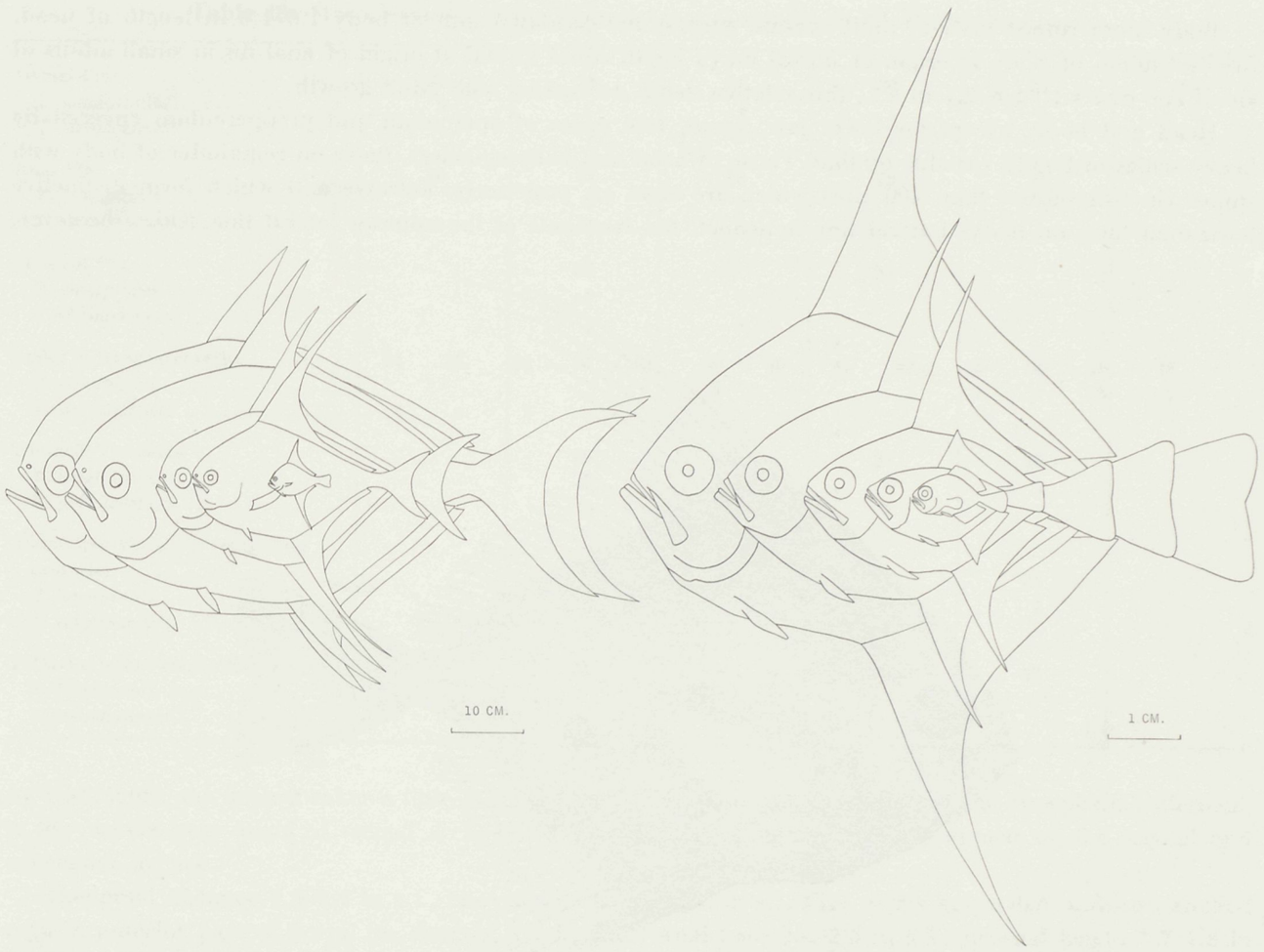


Fig. 39. Changes in body form accompanying growth in *Taractichthys*. These profiles were drawn from the following specimens: Left figure—the South African adult of about 706 mm, illustrated by BARNARD (1948:374 and pl. 10); the 618 mm adult from off Nova Scotia described by BIGELOW and SCHROEDER (1929:41–50 and pl.); about 268 mm, taken from BARNARD (1948); and a South African adult specimen of about 268 mm, taken from BARNARD (1948, loc. cit.); and a 74 mm juvenile taken from the stomach of a yellowfin tuna which was caught in the Gulf of Mexico ("Oregon" Sta. 1043; USNM 158169).
Right figure—the same 74 mm profile shown at left, drawn to a different scale; a 51.3 mm fish taken from the stomach of a bluefin tuna caught by the U.S. Bureau of Fisheries vessel "Delaware" off the American Atlantic coast at 38°58′ N, 66°26′ W; a 36.1 mm fish from the stomach of an Atlantic albacore (*Thynnus alalunga*) which was caught by "Delaware" on 10 VI 57, off the American coast at 37°45′ N, 66°32′ W; a 21.0 mm fish, also from an albacore stomach, which was collected by "Delaware" on 9 IX 57 at 36°15′ N, 71°49′ W; a 10.6 mm net-caught specimen from D-1202 IV (9°40′ N, 79°56′ W).

Taractichthys longipinnis (LOWE, 1843).

Plate 5a; Figures 38 to 41.

Study Material:—Nine adults, 290–590 mm; a series of juveniles, chiefly from the stomachs of tunas and similar fishes, and the 19 larvae and young juveniles from the "Dana" collections (Appendix Tables 17 and 18).

Distinctive Characters:—Separable from *T. steindachneri* by certain meristic features, and by minor morphometric ones of dubious significances such as diameter of eye (Table 19). Among the meristic values Table 18), the number of scales in horizontal series between upper end of gill opening and base of caudal is most useful (more than 38, usually 42–45 cf. 38 or fewer with a mode at 36 in *T. steindachneri*).

Description of Adult:—Counts and proportional measurements of selected adults are recorded in Tables 18 and 19.

Body more robust than in most bramid genera, the greatest width of body 1.6–1.8 in length of head. Greatest depth of body at origin of dorsal fin (a depth equal to that at origin of anal fin in small adults of about 350 mm s.l.) 1.6–2.1 in s.l., this relative depth decreasing with adult growth.

Head and body, except for lower jaw, snout, free edges of operculum and preoperculum covered by heavy scales of highly variable outline. Those of head and belly spineless, those on remainder of body with spines (in fish shorter than 400 mm) which are erect or, posteriorly, antrorse and which form distinctive horizontal lines on body. Lateral line indistinct, the remnants of the anterior lateral line scales, however,

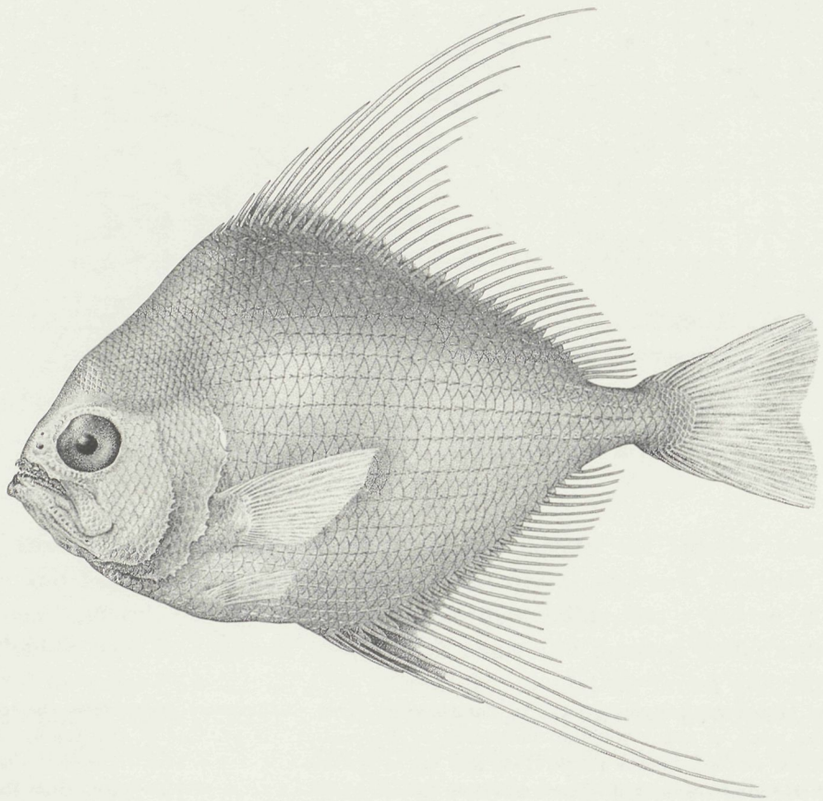


Fig. 40. *Taractichthys longipinnis*, juvenile, 74.0 mm s.l., from the Gulf of Mexico ("Oregon", Sta. 1043). Drawn, with some reconstruction, by J. Roemhild.

with pores. Bases of paired fins with small, smooth scales. Caudal lobes almost fully scaled. Distal two-thirds of central caudal rays, and lesser amounts of the rays distal to this central ray, naked. Axillary scales present and prominent, the series beneath the ventral fin about two-thirds as long as the fin or sometimes longer.

Snout rounded; lower jaw terminal. Snout 3.2–3.8 in head. Posterior nostril a slit situated closer to orbit than to anterior nostril, which is located closer to tip of snout than to edge of orbit. Eye nearly round in small adults, vertically elliptical in the large. (There appears to be a considerable difference between the eyes of *T. longipinnis* and *T. steindachneri* at 300–400 mm: nearly circular, the greatest diameter 4.5–4.9 in length of head in *T. longipinnis*; strongly elliptical, the greatest diameter about 3.9 in head in *steindachneri*.)

Bands of pointed, conical and recurved teeth in jaws, the inner anterior premaxillary and mandibular teeth the longest. A narrow band on palatine but none on vomer. Toothless areas at symphyses of jaws present but very narrow. Some teeth external to mouth when mouth is closed. Tongue toothless.

Gill openings beginning dorsally on a horizontal with upper half of eye; branchiostegal membranes joined to each other anterior to a vertical from front of eye; and from there forward covered by a scaly gular fold. Gill rakers on first arch of the usual lath-like shape, graduated in size and accompanied above and below

Table 18. Meristic variation in *Taractichthys longipinnis* and *T. steindachneri*.

Dorsal Fin	**33**			**34**			**35**			**36**			**37**			**38**								
T. longipinnis	2						1			4			5			2								
T. steindachneri	1			4			3			4			1											
Anal Fin	**26**			**27**			**28**			**29**			**30**											
T. longipinnis				2			2			3			2											
T. steindachneri	3			7			1																	
Pectoral Fin				**20**			**21**			**22**														
T. longipinnis				1			9			2														
T. steindachneri				1			4			4														
Scales in horizontal series	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**											
T. longipinnis						1	1		3	2	1	3	1											
T. steindachneri	3	3	3	2	2																			
Thoracic Vertebrae				**19**			**20**			**21**			**22**											
T. longipinnis				2			1			4			2											
T. steindachneri				2			5			3														
Abdominal Vertebrae (excluding urostyle)				**22**			**23**			**24**			**25**											
T. longipinnis										5			2											
T. steindachneri				2			3			6			1											
Total Vertebrae (including urostyle)				**44**			**45**			**46**			**47**											
T. longipinnis				1			2			3			1											
T. steindachneri				3			7			2														

by rudiments; the longest raker a little more to slightly less than half the length of the opposite gill filament. A few rakers near angle of second arch, but otherwise only spinulose platelets appear on the second and successive arches.

Predorsal distance 2.2–2.4 in s.l., base of this fin 1.7–2.0 in s.l. Five or six graduated and unbranched rays in anterior part of dorsal fin, four or five in anal. Anal base 2.0–2.5 in s.l.; preanal length 1.7–1.8 in s.l. Vertical fins strongly falcate; decreasing in relative height with growth. Ventral fin short, its length 3.8–4.4 in head, decreasing in relative length with growth; preventral length 2.7–3.0 in s. l. Prepectoral length 2.9–3.4 in s.l.; length of fin 2.4–2.8 in s.l.; the fin set at about a 45° angle to horizontal axis of body. Caudal fin stout, the central rays usually the shortest but occasionally longer than those above and below. Precaudal pits well developed. Anus in posterior quarter of space between origins of ventral and anal fins.

In preservative, the body is black; the pectoral and distal part of the ventral fins white; and there is a crescentic light border on the caudal fin. The linings of the mouth and pharynx show little pigment.

Development:—Early stages, 4.0–15 mm s.l. can be distinguished from other Atlantic bramids of similar size by the following combination of characters, the most useful of which appear in expanded type:

Formula: D 35–38; A 27–30; P 20–22; BR 7. Vertebrae 19–21 + 24–25 + 1 = 44–47. Origin of dorsal fin on a vertical between base of pectoral and origin of anal fin. No anterior lobe and no pigment at these sizes. Rays fully formed at about 6 mm s.l. About six graduated anterior rays. Origin of anal fin on a vertical behind origin of dorsal fin; no lobe, no pigment, and parallel in degree of development to dorsal. Base of pectoral fin nearly vertical. Insertion of ventral fin under preoperculum to 15 mm s.l., shifting slightly posteriorly thereafter; sometimes extending to, but rarely beyond, origin of anal fin and colorless. Caudal fin and caudal peduncle colorless. Body squamation complete at 8–9 mm s.l. (stained series not available). Diagnostic fringe-like appearance of preopercular spines evident at 7 mm or less, formed of short and uniform spines along anterior and ascending arms. Teeth: confined to three, four or fewer long recurved canines in anterior end of each half of upper and lower jaw and without teeth in posterior half of jaws to ca. 10 mm s.l.; a few minute teeth developing on these posterior parts between 10 and 15 mm s.l.

Table 19. Counts, and proportional dimensions in per cent of standard length, of adult and juvenile *Taractichthys longipinnis* and *T. steindachneri*.

	T. longipinnis				*T. steindachneri*			
	Browns Bank, 50 mi. s.e. Nova Scotia	M/V *Delaware*, 39°44′N 70°00′W	M/V *Delaware*, 39°44′N 70°00′W	M/V *Oregon* Gulf of Mexico	Pacific; Coast of California	Pacific; probably 121°40′W 4°48′N (Abe 61-124)	Pacific; Tokyo Market (Abe 61-2)	Sagami Bay, Japan (Abe 59-40)
Standard length (mm)	605.0	335.0	318.0	71.5	590.0	525.0	326.0	110.0
Fork length (percent	110.0	111.8	114.2	–	110.0	109.2	110.5	115.0
Greatest depth of body	53.7	59.1	60.7	59.1	50.8	46.7	56.8	57.2
Least depth of caudal peduncle	7.3	6.6	7.9	9.1	6.8	6.1	6.8	7.3
Greatest width of body	20.7	17.9	17.6	19.6	20.3	19.1	19.3	20.0
Greatest width of head	17.4	17.3	18.9	18.9	17.8	17.1	17.8	18.5
Snout to origin of dorsal fin	44.8	45.1	45.1	44.7	44.0	41.0	43.6	42.3
Snout to origin of anal fin	59.5	55.5	57.2	57.8	57.6	54.1	59.9	59.0
Snout to insertion of ventral fin	38.0	32.8	34.0	33.3	34.7	34.9	35.9	34.3
Snout to insertion of pectoral fin	33.8	29.8	31.5	33.5	31.8	29.5	31.6	31.1
Length of base of dorsal fin	51.2	57.9	59.1	60.9	55.0	52.8	57.1	55.2
Length of base of anal fin	41.5	50.7	50.3	48.2	39.8	41.9	46.6	44.3
Origin of dorsal fin to insertion of pectoral fin	38.0	38.2	41.2	39.3	36.4	33.7	37.5	37.4
Width of base of pectoral fin	7.1	8.1	8.2	8.0	8.1	8.0	8.0	8.7
Base of lowermost pectoral ray to insertion of ventral fin	10.9	11.9	11.0	13.4	11.5	9.9	11.3	12.2
Insertion of ventral fin to the origin of anal fin	23.5	23.0	24.2	25.9	25.2	21.3	25.8	27.9
Length of pectoral fin	38.9	36.1	36.1	–	41.8	40.4	40.8	24.8
Length of ventral fin	7.4	7.5	8.5	13.0	7.5	6.7	10.1	11.3
Length of longest anal ray	29.4	59.7	62.2	67.4	31.0	27.1	47.3	62.6
Length of 5th-from-last anal ray	5.3	7.2	6.6	–	4.7	4.9	5.8	9.0
Length of longest dorsal ray	30.3	56.7	59.7	59.4	27.5	29.5	47.9	49.7
Length of 5th-from-last dorsal ray	5.0	6.0	7.5	–	4.6	4.8	5.5	9.9
Length of upper caudal lobe	–	30.8	34.2	–	28.3	28.8	31.3	22.1
Length of lower caudal lobe	–	31.7	34.2	–	–	29.5	30.7	25.1
Length of central caudal ray	10.0	12.8	14.1	–	10.2	9.2	10.7	14.9
Length of head	33.1	29.8	32.0	34.3	30.5	28.6	30.7	32.2
Length of snout	10.2	9.0	8.5	8.5	9.6	8.2	9.2	8.5
Diameter of eye, horizontal	6.6	6.0	6.0	9.8	6.8	5.7	6.1	7.5
Diameter of eye, greatest	8.6	6.6	6.6	9.8	8.6	6.3	8.0	8.3
Distance between eye and mid-dorsal line	9.4	8.4	9.7	6.3	8.6	8.2	7.7	6.5
Distance between eye and free edge of subopercle	16.5	16.1	16.0	18.2	16.6	16.2	16.9	16.7
Breadth of interorbital space	12.4	12.8	12.3	12.2	13.7	12.0	11.3	12.9
Length of upper jaw	16.5	14.3	15.4	17.5	15.6	12.8	15.3	16.8
Counts:								
Dorsal fin	$36^1/_2$	$36^1/_2$	$36^1/_2$	$38^1/_2$	$35^1/_2$	$35^1/_2$	$34^1/_2$	$36^1/_2$
Anal fin	$28^1/_2$	$30^1/_2$	$29^1/_2$	$28^1/_2$	$27^1/_2$	$27^1/_2$	$27^1/_2$	$27^1/_2$
Pectoral fin	21	21	21	21	22	21	22	22
Gill rakers (first arch)	2+1+5	2+1+6	1+1+6	3+1+8	2+1+8	3+1+6	2+1+6	3+1+7
Scales in horizontal series	45	39	42	45	37	38	36	35

Description of larvae:—These notes are made from larvae 5.1–20.0 mm s.l. in the "Dana" collections. As the number of specimens is small, few were stained and ossification of bone and fin rays was not followed. All of these larvae are badly faded.

At 5.1 mm the urostyle is horizontal; the abdominal cavity is heavily laden with yolk, rays have formed in the anterior half of the dorsal and anal fins and in the caudal below the urostyle; and fin-ray formation

in the pectorals and pelvics is complete. The eye is large and circular and the relatively broad head characteristic of juveniles of the 10–30 mm size range is already apparent. The interorbital width is equal to or greater than the diameter of the eye, in contrast to the condition at this size in most bramid young. There are no scales or scale pockets.

Elevation of the urostyle occurs at between 5.5 and 6.5 mm s.l. Body form in this size range is variable, apparently depending on the rate of absorbtion of the yolk. At these sizes fin-ray formation is essentially complete and scales or their primordia can be seen on the shoulder. The typical fringe-like series of preopercular spines has formed. Yolk remains abundant, and no other food has been found in the gut.

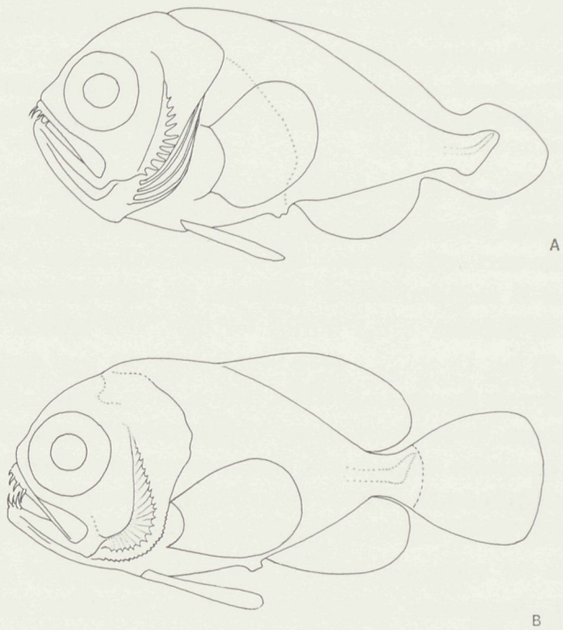


Fig. 41. Young *Taractichthys longipinnis*. A and B not drawn to same scale. (A) 5.5 mm s.l. (D-896; 39°44′ N, 57°21′ W). (B) 10.0 mm s.l. (D-855 XIV; 29°15′ N, 59°45′ W). Drawn by N. Strekalovsky.

At 6.5 the first signs of pigmentation, other than the eye, can be found on some specimens: a few melanophores on the gular fold and a light even coloration of the anterior half of the body. The sharp demarcation separating the white caudal peduncle and attached fin from the darker body anteriorly is evident and the fish, although yolky, has the appearance of a juvenile rather than a larva. At 7 mm the yolk no longer distends the abdomen ventrally, and the fish is feeding.

Aside from lateral teeth which accompany the anterior canines and the incomplete scale covering on the vertical fins, a 10 mm specimen is structurally an adult: fully scaled, well ossified, and prepared for the great morphometric transformations accompanying juvenile and subadult growth. All fins remain colorless. Between 10 and 20 mm s.l. few changes of note occur. The interorbital becomes narrower relative to the diameter of the eye; the ventral fin, extending to anal origin at 10 mm, fails to reach that point; spination on scales increases; and minute teeth develop on the posterior parts of the premaxillaries. In some individuals of 20 mm s.l. some pigmentation of the ventral fin can be found—coloration due to increase in intensity in juveniles, decrease in subadults, and reappearance in larger adults. (In *T. steindachneri* the body is very dark, that part of the caudal peduncle adjacent to the base of the caudal a sharply contrasting white.)

Changes accompanying growth of the juveniles between 20 and 200 mm s.l. are those of form of body and fins; scale development on the vertical fins, which begins at about 35 mm but is not yet complete at 110 mm, and in coloration, particularly the darkening of the dorsal and anal fins. The ventral fin, variously dark as adults, is colorless below a fish length of 100 mm.

Distribution:—Larvae and young shorter than 20 mm are tropical and restricted neither to the shelf

nor to the high seas. The distribution appears to be both geographically and seasonally random and includes the eastern, western and central Atlantic (Fig. 38).

The adults, although nowhere abundant, are widespread in tropical and temperate regions. The largest known specimens were taken at the most northern localities: Brown's Bank southwest of Cape Sable, Nova Scotia (Bigelow and Schroeder, 1929); off Co. Kerry, Ireland (Scharff, 1915); and the stranding at Sand Voe, North Roe, Shetland (Wheeler, 1962; Rae, 1961; this fish being over a meter in total length). Along the American coast, longline fishing for tuna has produced adults from warm tuna water off New England south to the offings of Virginia and presumably further; and from the Gulf of Mexico. On the European side, the species is well known from Great Britain and from off the Atlantic coast of Spain and Portugal but not the Mediterranean; and from Madeira, perhaps the Azores (Hilgendorf, 1888) and South Africa. These populations are probably continuous with one another.

Young between 20 and 150 mm s.l. are known only from the western Atlantic and only from stomach contents of tunas and *Alepisaurus*. Localities are chiefly in the Gulf Stream south of 38° N, and in the Gulf of Mexico.

While typically oceanic, adults have occasionally been taken in shallow water. An incident of considerable interest occurred off Point Pleasant, Ocean County, New Jersey, following a northeast storm on 24 November 1968*. Water temperature in the surf was between 45° and 50°F (7.3–10°C). Surf fishermen there reported sighting a "school" of about ten *T. longipinnis* close to shore, the high dorsal of these fishes protruding above the surface of the sea. One was hooked, using worms for bait, and landed at Island Beach State Park**. Two others each weighing 18–20 lbs. (8–9 kgs.) were beached by the surf and picked up alive on the shore. These strandings occurred at Ocean Beach and Ortley Beach, New Jersey. In addition to providing further records from the New Jersey coast, these observations include the first suggestion that *T. longipinnis* may be a schooling species, and that its lower temperature tolerance may be about the same as that of *B. brama*, i.e., 10°C (50°F; see Mead and Haedrich, 1965). Walford and Wicklund (1968, pls. 11–12) show clearly that a band of water colder than 10°C and surrounded both laterally and below by warmer waters, which provide a suitable environment for temperate bramid species, forms off the New Jersey coast in November and spreads during December. An oceanic fish forced inshore by storm conditions would come to be in waters too cold for effective activity and thus prone to mishaps such as that which befell these beached individuals.

Commercial Importance:—Although the large adults are landed when caught incidental to the Japanese high-seas tuna fishery, the species is of limited commercial value.

Common Names:—Only in Spain and Portugal is the species well enough known to have been christened by the fishermen; the names are apparently identical in the two countries as follows: Capelo, Cangulo, Chaputa, and Freira de Natura or Freira.

The English name "Long-finned bream" was apparently coined by Scharff (1915) for his Irish example. The American Fisheries Society (1960:30) has chosen "bigscale pomfret" as the "official" North American vernacular.

Synonyms and References.

Brama longipinnis Lowe, 1843:82 (orig. descr., 18$^{1}/_{4}$- in. spec. from off Madeira; type apparently lost and no fig.); Lowe, 1844:390 (redescr. from Lowe, 1843); Günther, 1860:410 (descr., from Lowe, 1843); Troschel, 1863:51–52 (notes discovery of expanded ribs in Madeira specimen of *Brama*, a generic characteristic of *Taractichthys*); Lunel, 1865: 16–17 (descr., from Lowe, 1843); Lütken, 1880:494 (mentioned cf. *T. asper* and *T. raschi*; from Lowe); Scharff, 1915 (20- in. spec. gaffed 18 V 14 off Valencia I., Co. Kerry, Ireland; descr., photogr., and notes on identity); Meek, 1916:333 (part, rec. from Madeira, Ireland, Iceland and Norway, those from the latter two locs. *T. asper*); Jenkins, 1925:75 (rec. and descr. Irish spec. from Scharff, 1915); Nobre, 1935:288–299, fig. 126 (synon., descr., Portugese

* Information generously provided on 11 XII 68 by Walter Murawski, New Jersey Division of Fish and Game, Nacote Creek Research Station, Star Rte., Absecon, New Jersey.

** This specimen was kindly donated to the Museum of Comparative Zoology by the angler, Mr. Kenneth Irons of Hamilton Square, New Jersey.

occur.; tentatively considered distinct from *T. princeps*; photog. clearly *T. longipinnis*); WENT, 1959:76 (listing only, Ireland).

Brama princeps JOHNSON, 1863:36–38 (orig. descr.; Madeira; no fig.; type ca. 32- in. long in BM (NH), seen; notes on occur. in Madeira; vernacular: "freira do alto"); LÜTKEN, 1880:494 (synon. with *T. longipinnis*); OSORIO, 1888:7 (listed as rare for Portugal; 2 spec. from Lisbon merchant); SMITT et al., 1893:70 (ref. to *T. longipinnis*); NOBRE, 1935:285–288 (synon. and vernaculars from JOHNSON, 1863).

Taractes asper (not of LOWE), HILGENDORF, 1888:208 (spec. from Azores said to be dep. in Mus. Ponta Delgada, Azores).

Taractes longipinnis, BARNARD, 1927:595–596 (synon. and descr.; max. length 825 mm; 350 mm spec. from off Simonstown, False Bay, S Africa in 1876; notes on ident. *T. raschii*); FOWLER, 1936:653–654 (part, not fig. or descr. which more closely resemble *Taractes asper*; W African locs.; synon.); BARNARD, 1948:373–377, pl. 10 (excellent descr., figs., growth changes; ident. S African adults); NORONHA and SARMENTO, 1948:106–107, 152 (caught rarely at Madeira); LOZANO y REY, 1952:644–646 (part, fig. and descr. of *T. "raschi"* attributed to LOWE but from SMITT et al.; Spanish and Portugese recs. from lit. probably include both *T. longipinnis* and *Taractes asper* (= *raschii*); DE CASTRO, 1954 (coast of Portugal and Madeiran fisheries; *princeps* in synon.; vernaculars: "chaputa", "cangulo", "capelo", "freira", "freira-de-natura"); MEAD, 1957 (descr. and fig. W Atlantic young and adults); BRIGGS, 1960: 177 (part, listed as species with worldwide distrib.); Amer. Fish. Soc. 1960:30 ("official" vernacular "bigscale pomfret" for both Atl. and Pac. forms); MCALLISTER, 1960:27 (listed for Canada on rec. "JOHNSON's sea bream" rep. as *T. princeps* by BIGELOW and SCHROEDER, 1953); HOLGERSEN, 1961 (relationships to *Taractes raschii*; fig. from SCHARFF, 1915); BLACHE, 1962:51 (recs., presumably juvs., from stomachs of *Neothunnus albacora*; Gulf of Guinea off Pt. Noire and Cape Lopez); LEGENDRE, SCOTT and BERGERON, 1964:75 ("castagnole de Madère" proposed as new French-Canadian vernacular); J. L. B. SMITH, 1966:71–72 (2 recs. SW Africa; notes on identity); LEIM and SCOTT, 1966:258–259 (rec. Brown's Bank from BIGELOW and SCHROEDER, 1929; vernacular: "castagnole de Madère").

Taractes princeps, BIGELOW and SCHROEDER, 1929 (descr. and fig. large adult NW Atlantic; excellent discuss. relationships); VLADYKOV and MCKENZIE, 1935:86 (name given is *T. princeps* but fig. a *Brama* and lit. ref. is to an elasmobranch paper); HELLING, 1943:37 (rec. 660 mm spec., Faro, Portugal; vernaculars); SCHROEDER, 1952:27 (notes on recovery from a fish retailer in Boston of spec. rep. BIGELOW and SCHROEDER, 1929); BIGELOW and SCHROEDER, 1953:361–362 descr. and fig. from BIGELOW and SCHROEDER, 1929); SPRINGER and BULLIS, 1956:73 (rec. from coll. R.V. "Oregon" in Gulf of Mexico); FOWLER, 1956 (descr., fig., and general remarks on spec. from shallow estuarian waters of New Jersey); MEAD, 1957 (referred to *T. longipinnis*).

Lepidotus princeps, DE BUEN, 1935:103 (listed for S Atlantic coast of Spain).

Taractes (*Taractichthys*) *longipinnis*, MEAD and MAUL, 1958 (diagnosis and relationships; key and synon.; descr. and fig. 30 mm spec. from Madeira); WHEELER, 1962 (rec., descr., and discussion; 852 mm spec. stranded 23 IX 61 at Sand Voe, North Roe, Shetland).

Taractichthys longipinnis, WILLIAMS, 1966 (as food of E African tuna).

Taractichthys steindachneri (DÖDERLEIN, 1883).

Plate 5b; Figure 42.

Study Material:—This account is based on a 590 mm adult from the coast of California and several of similar size, largely without localty data, from the Tokyo Market (through T. ABE); a 111 mm Japanese specimen; and a series of juveniles from the Pacific and Indian Oceans. These, and the 14 small specimens in the "Dana" collections, are enumerated in Appendix Tables 19 and 20.

Distinctive Characters:—This species is separable from the Atlantic *T. longipinnis* by meristic characters, the most significant being the lower number of scales in a horizontal series from upper end of gill cleft to the base of the caudal fin (34 to 38 vs. 39 or more).

Description:—Except in meristic values (Table 18) and in certain minor features mentioned in the description of *T. longipinnis*, juveniles and adults of the two species are identical. Proportional dimensions of adults are provided in Table 19.

Size and age:—FITCH and LAVENBERG (1968:98) have provided at least a little information on age and growth. Their largest individual "a 2-footer, weighed 24 pounds but the species doubtless grows to a larger size". Based on the examination of otoliths, they determined that a 16-1/2″ fish that weighed three pounds was about 18 months old and a larger 20-inch specimen was thought to be about eight years old.

Distribution:—The known of young and adults is shown in Fig. 38. The adults are clearly wide ranging in the tropics and are commonly caught in the Japanese longline fishery. Juveniles 30–150 mm s.l. are similarly widespread, from Japan to the Pacific east of Hawaii and west to Zanzibar and south to New South Wales. Larvae and post-larvae are known from the coast of Africa from the Cape north to waters off northern Madagascar from the Indo-Australian region, and from the central Pacific near Hawaii. The species is not yet known from the southeastern Pacific.

Commercial Importance:—*T. steindachneri* is landed and sold when caught incidental to the Japanese longline tuna fishery.

Common Names:—The English named "bigscale pomfret" was apparently coined by Fitch (1953). Jordan, Tanaka and Snyder (1913:134) list as Japanese vernacular names "Manzai-uwo" and "Eboshidai"; and Abe (1962:105) adds "Hiredjiro-manzaiuo".

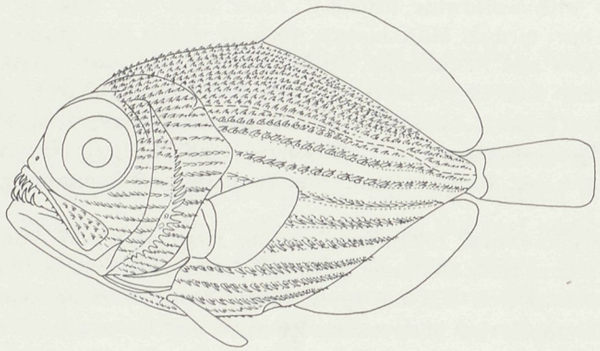


Fig. 42. *Taractichthys steindachneri*, juvenile 17.0 mm s.l., from the central Pacific ("Tethys" Exp., Sta. 24; ca. 22°40′ N, 154°20′ W).

Synonyms and References.

Argo steindachneri Döderlein, *in* Steindachner and Döderlein, 1883:34, pl. 7 (orig. descr. limited to legend on an excellent figure; Tokyo, Japan).

Brama longipinnis, Steindachner and Döderlein, 1884 (*Argo steindachneri* in synon.; descr.; Japanese vernacular: "ebo shidai").

Taractes steindachneri, Jordan and Snyder, 1901 (Yokohama; "manzai"); Jordan, Tanaka and Snyder, 1913:134 (listed for Tokyo; vernaculars: "manzai-uwo", "eboshidai"); Bigelow and Schroeder, 1929:44 (referred to *T. longipinnis*); Tanaka, 1931:24 (listed for S Japan but not assigned a faunal province); Kamohara, 1938:22 (rep. 170 mm spec. from Susaki); Okada, 1938:172 (listed for Honshu, Japan); Fowler, 1938:277 (rec. for Honolulu, unverified); Kamohara, 1952:33 (repeats Susaki rec.); Matsubara, 1955:542 (key and descr. in Japanese); Kamohara, 1958:26 (listed, range: Tokyo to Kochi, Japan, and Hawaii); Okada and Suzuki, 1958 (82 mm spec. taken at 200 fms off Owashi, Mie Pref., Japan; photog. and descr.; synon.; vernacular: "manzai-uo").

Taractes princeps, Kamohara, 1938:23 (descr. and fig.; rep. as rare, in markets); Kamohara, 1950:98–99 (descr. in Japanese; fig.); Kamohara, 1952:33 (descr., fig.; 600–830 mm specimens in markets).

Taractes miltonis Whitley, 1938:193 (orig. descr. from spec. taken off New South Wales, Australia; no differences between type and Atlantic specimens noted); Mead, 1957 (referred to *T. longipinnis*); Whitley, 1964:44 (in check list of Australian fishes).

Taractes longipinnis, Fitch, 1953:546 (590 mm adult from surf at Corona del Mar, Calif.; comp. with Atlantic spec. of Bigelow and Schroeder, 1929); Kamohara, 1958:26 (part, listed with synon.; range: Kochi, Japan to Africa and Atlantic); Tomiyama and Abe, *in* Tomiyama, Abe and Tokioka, 1958:222 (color fig., descr. in Japanese); Gosline and Brock, 1960:180 (rec. from Hawaii, 2-ft. spec.); Abe, 1961 (in key to genera; notes on abundance in Japan); Radovich, 1961:19, 36–37 ($25^1/_2$-in. spec. from surf at Manhattan Beach, Santa Monica Bay, Calif.; 25 X 58); Fitch and Lavenberg, 1968:97–98 (fig. and descr., Calif. records; age est. from otoliths).

Taractichthys longipinnis, Abe, 1962:105–108 and figs. p. 114 (figs. and descr. Japanese juvs. and adults); Honma and Mizusawa, 1965:56 (rec. and fig. 420 mm spec. from off Niigata Pref., Sea of Japan; "noh'machi"); ?Smith, 1949: 309 (S Africa).

Genus **Pterycombus** Fries, 1837.

Pterycombus Fries, 1837:14–22, pl. 2; type species by monotypy, *Pterycombus brama* Fries, 1837.

Generic Synonyms:

Centropholis Hilgendorf, 1878:1–2; type species, by monotypy, *Centropholis petersii* Hilgendorf, 1878.

Centropholoides J. L. B. Smith, 1949:313; type species, by original designation, *Pterycombus falcatus* Barnard, 1927: 599, = *P. petersii* Hilgendorf, 1878.

Characters:—Dorsal fin originating over head but separated from scaleless area on snout by scales which cross the dorsal profile. Dorsal and anal fins high and sail-like, without distinct anterior lobes, without scales, wholly depressible into grooves formed by enlarged scales along the bases of the fins and formed of elements most of which are unbranched. No anterior dorsal or anal ray notably thicker than its neighbor. Ventral fin short and inserted in advance of base of pectoral fin. Caudal fin forked and moderately stiff; transverse precaudal grooves absent.

Dorsal profile of head between eyes moderately rounded. Inner lower edges of mandible posterior to symphysis of lower jaw not touching each other so that a scale-bearing patch of isthmus is visible between them. Posterior nostril a slit. Thoracic ribs greatly expanded.

Scales with small spines which persist in large individuals. No scaleless area above and behind eye. Adult without lateral line. Midlateral scales on caudal peduncle unmodified, these scales not abruptly larger than those on midcaudal rays.

Range:—Known as adult or young from all major tropical and temperate seas except the eastern Pacific.

Species:—Two, the Indo-Pacific *P. petersii* and the north and central Atlantic *P. brama* are here recognized. The few small southeastern Atlantic specimens may represent a third but the scarcity and size of available material precludes satisfactory comparison.

Key to Species

A Dorsal rays 48–43, modally 51. Vertebrae (incl. urostyle) 48–51. Young (ca. 100 mm) with longest dorsal and anal rays longer than half s.l., and with eye about 3.2 in length of head ..... *P. brama* Fries, 1837, p. 93
North and Central Atlantic

AA Dorsal rays 48 or 49. Vertebrae (incl. urostyle) 45–48. Young (ca. 100 mm) with longest dorsal and anal rays shorter than half s.l., and with eye about 2.7 or 2.8 in length of head... *P. petersii* (Hilgendorf, 1878), p. 101
Japan, Indo-Australia, Eastern and Southern Africa

Pterycombus brama Fries, 1837.

Plate 6; Figures 43 to 46.

Study Material:—eight eastern Atlantic and one western Atlantic (Newfoundland) adults, 227.5–368 mm s.l. in the collections in Stavanger, Bergen, Oslo, Paris, Hamburg, Vigo (Instituto de Investigaciones Pesqueras), MCZ and USNM. This series includes the type of *Pterycombus ledanoise* (Belloc), 353 mm s.l., and the two specimens which formed the basis for the description of *P. goodei* (Jordan), but not the type of *P. brama* Fries. Specimens of intermediate size, chiefly from the stomachs of tunas, were obtained off the American coast during the explorations of the U.S. Bureau of Commercial Fisheries vessels, and those in the Woods Hole Oceanographic Institution. Early juveniles and larvae, chiefly western Atlantic, are from the "Dana" collections; and an additional series was provided by the Marine Laboratory, University of Miami. Available data on these and the 64 juveniles caught by "Dana" are recorded in Appendix Tables 21 and 22.

Distinctive Characters:—*P. brama* is very similar to the Indo Pacific *P. petersii*, from which it differs in average number of dorsal rays (51 cf. 47 in *P. petersii*) and vertebrae (49 cf. 47), the ranges, however, overlapping. Juveniles are strikingly different in proportion, particularly in the higher vertical fins (see Table 20 and the diagnosis of *P. petersii*, p. 101).

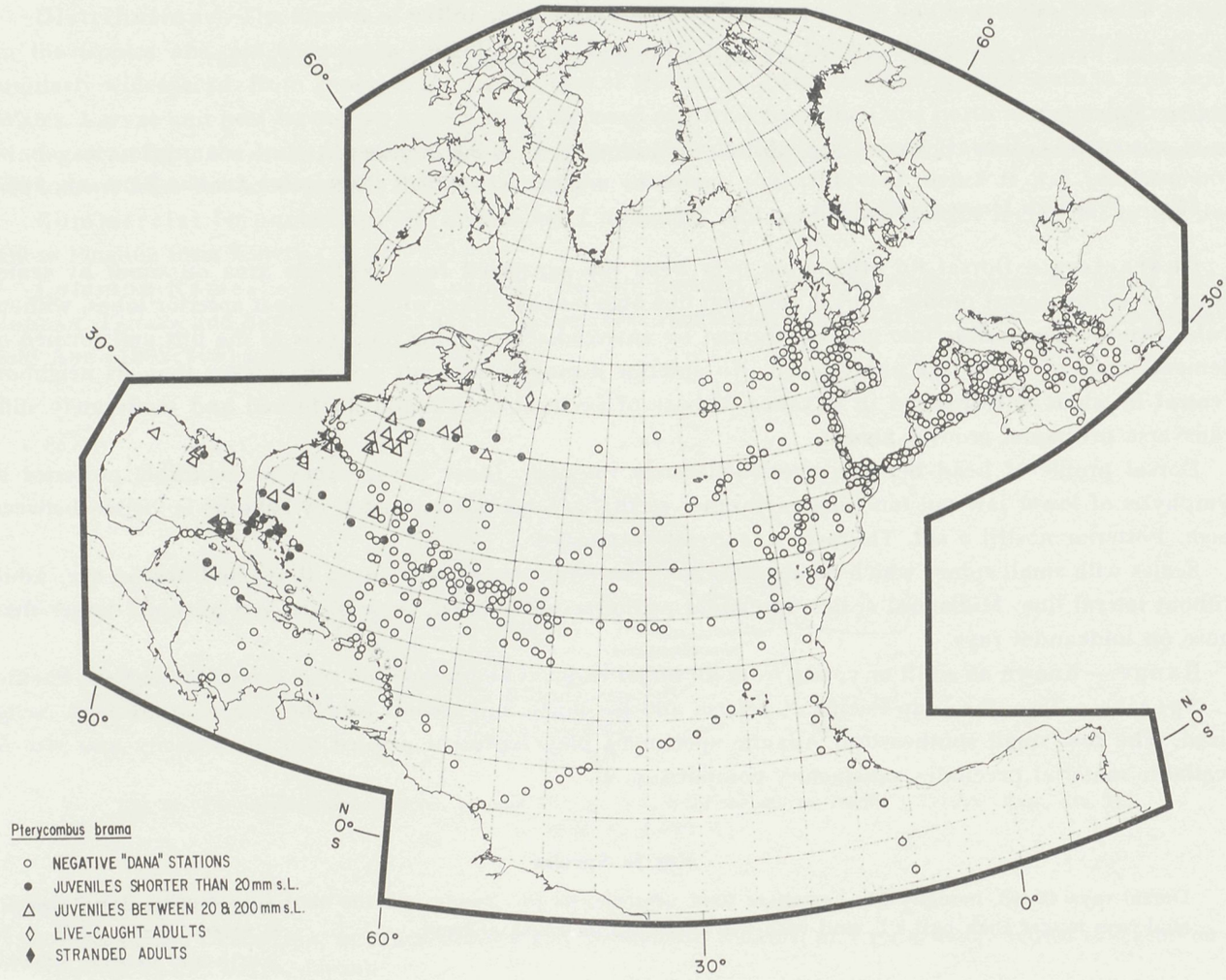


Fig. 43. Distribution of *Pterycombus brama*.

Description of Adults:—Counts and proportional dimensions in per cent of standard length are provided in Table 20.

Body more compressed than the head, its greatest width above the insertion of the pectoral fin. Greatest width of head, behind orbit, 1.9–2.5 in length of head. Greatest depth of body at about posterior edge of base of pectoral, this depth 2.1–2.5 in length. Least depth of caudal peduncle 3.8–4.5 in head. Head, exclusive of snout, mandible and preoperculum covered with scales. Scales on head cycloid and without vertical spines; those on anterior part of body with rudimentary spines but also with smooth free edges; those on posterior half of body with smaller spines the more anterior of which are retrorse, those more posterior antrorse. These spines diminish with growth of fish. 48 to 53 scales in horizontal series, from upper end of gill cleft to base of midcaudal ray, the scales on base of caudal fin diminishing in size gradually posteriorly. About 15 horizontal rows of scales, counting obliquely upward and backward from insertion of ventral fin to base of dorsal but excluding the sheath of scales at bases of the vertical fins. Prominent axillary scales beneath ventral fin; small ones beneath the pectorals. Ten or 11 predorsal scales lying in mid-dorsal line anterior to the origin of the dorsal fin. Scales forming sheaths for dorsal and anal fins generally corresponding in number to the underlying fin rays. No lateral line evident (in contrast to the juveniles). Dorsal and anal fins naked. Ventral surface of ventral fins with scales. Extreme base of pectoral fin, caudal lobes except for their tips, and proximal half of central caudal rays with scales.

Head 3.5–4.2 in standard length, decreasing in relative length with growth. Snout short, blunt, convex

Table 20. Proportional dimensions and counts taken from *Pterycombus brama* and *P. petersii*.

	Western Atlantic off Cape Hatteras (tuna stomach)	Bermuda	Grand Banks[1]	Vigo Spain	Vigo Spain	Varangerfjord Norway	Norway no other data	Norway no other data	West coast of Norway (Egersund)	Type of *P. ledanoisi* W. Africa	Cape Hatteras N. Carolina (MCZ)	South Africa (SAM)	Sagami Bay Japan (Abe 61–107)	South Africa (SAM; holotype) of *P. falcatus*	Sea of Japan (Abe 61–367)
Standard length (mm)	123.0	174.0	232.0	243.0	268.0	284.0	285.0	308.0	314.0	353.0	102.0	100.0	166.5	244.0	275.0
In percent of standard length:															
Fork length		110.1	108.5	112.1	111.8		114.0	110.4	110.0		–	–	–	110.7	111.5
Total length (incl. lower jaw)				130.0	130.6	128.0	131.1	134.8	124.2		–	–	–	–	–
Greatest depth of body	35.8	34.2	42.3	42.4	41.2	42.2	46.7	44.3	45.9	48.0	35.9	35.5	37.1	38.9	43.3
Depth of body at mid-point of base of anal fin		22.6	24.8	29.4	31.9	31.0	33.6	32.5	35.8	34.0	23.1	23.5	26.4	26.2	32.5
Least depth of caudal peduncle	6.4	5.6	6.3	5.7	6.4	6.2	7.2	7.0	6.7	6.5	6.7	6.5	5.7	6.3	6.1
Greatest width of body	9.7	9.2		10.1	10.4	11.4		12.2		13.0	11.8	11.7	11.1	7.7	11.6
Greatest width of head	9.7	10.2	11.4	10.5	11.5	12.5		14.4	13.7	14.5	12.2	12.6	11.1	9.2	12.2
Snout to origin of dorsal fin	14.0	12.8		17.7	17.4	18.9	20.2	22.0	21.2	21.7	16.3	20.8	15.9	15.8	20.1
Snout to origin of anal fin	30.7	28.4		35.8	35.8	34.6	40.4	36.7	38.7	40.2	27.4	34.4	30.0	32.1	35.1
Snout to insertion of ventral fin	25.6	23.1		30.0	29.2	29.4	34.6	31.2	32.2	32.0	22.5	28.5	24.0	26.1	29.3
Snout to insertion of pectoral fin	25.0	23.4		26.7	25.9	26.4	30.1	28.1	28.3	29.5	23.8	25.3	22.1	24.1	26.4
Length of base of dorsal fin	78.7	80.0	73.9	76.7	77.0	77.0	75.8	73.7	72.8	74.0	80.0	74.8	76.8	77.0	76.3
Length of base of anal fin	69.6	70.9	72.8	69.1	69.0	68.0	68.8	65.0	65.0	64.6	69.8	69.4	70.2	71.0	68.0
Distance between origin of dorsal fin and insertion of pectoral fin	22.6	22.1	27.0	25.6	25.2	25.5	28.3	27.6	27.7	27.9	23.3	23.5	22.0	23.7	26.0
Width of base of pectoral fin		4.0	4.3	4.8	5.0	4.6	5.1	4.9	4.9	5.3	4.8	4.4	4.3	4.7	4.9
Distance between base of lowermost pectoral ray and insertion of ventral fin	10.7	11.1	14.0	13.0	13.8	13.7	16.0	14.8	15.7	15.1	11.9	9.8	10.7	13.5	13.3
Distance between insertion of ventral fin and origin of anal fin	7.7	6.2	6.4	7.2	7.1	7.0	6.3	7.0	7.1	8.7	5.7	7.2	6.6	6.9	6.9
Length of pectoral fin		24.0	31.2	28.4	27.9	27.1	28.0	26.0	28.5	25.8	–	22.9	21.0	24.4	24.6
Length of ventral fin		8.2	6.7	7.8	7.8	6.6	7.4	6.8	6.9	6.1	9.2	9.6	7.1	7.3	6.9
Length of 5th anal ray		78.4	61.0	51.6	40.7	40.6	30.9	31.7	32.8	20.8	62.3	26.6	55.0	58.0	41.5
Length of longest anal ray		78.4	61.0	51.6	40.7	41.4	33.6	31.7	32.8	20.8	62.3	26.6	55.0	58.0	42.2
Length of 5th-from-last anal ray		14.4	7.7+	14.4	13.1	11.8	10.5	11.0	11.9	7.0	14.7	9.0	10.0	7.0	8.0
Length of 5th dorsal ray		6.0	5.0	3.6	4.1		4.5	3.1	3.9	4.0	6.9	8.0	4.3	3.5	3.3
Length of longest dorsal ray		75.3	57.1	48.6	39.2	39.4	29.1	33.1	29.9	22.4	54.6	33.8	48.0	63.5	41.4
Length of 5th-from-last dorsal ray		14.4	9.0	15.7	14.1	11.3	9.1	9.6	9.3	8.1	11.2	8.0	9.3	7.3	9.1
Length of upper caudal lobe		22.9		30.9	29.8	27.4	30.4	ca.33.2	ca.29.9		–	–	–	–	–
Length of lower caudal lobe		22.9		29.8	30.6	26.1	29.6	ca.29.2	ca.29.0		–	–	–	–	–
Length of shortest central caudal ray		10.1	10.6	12.1	11.8	9.6	11.9	11.7	10.6	12.3	–	–	–	10.7	11.8
Length of head	24.4	23.1	25.4	25.7	25.2	25.5	23.8	27.2	26.1	28.9	24.5	26.7	22.0	23.2	25.4
Length of snout		5.2	5.6	6.1	6.2	6.5	6.3	ca.6.0	5.7	7.1	4.9	6.1	5.4	4.7	6.4
Horizontal diameter of eye		7.4	9.4	7.9	7.8	8.4	10.5		9.8	10.5	7.6	9.1	6.9	7.7	8.4
Greatest diameter of eye		7.7	10.3	9.4	9.7	9.9	11.4		10.8	11.9	7.7	9.9	7.5	8.2	10.2
Least distance between eye and nearest point on dorsal midline		4.0	4.2	4.9	5.4	5.8	5.3	ca.4.8	4.6	5.7	3.1	3.7	4.0	3.6	5.6
Greatest distance between free edge of suboperculum and orbit		10.6	11.5	12.6	12.2	13.0	13.3	ca.11.5	13.3	13.9	11.4	11.3	10.2	11.2	12.8
Width of interorbital space		6.0	6.9	6.6	8.1	8.4		ca.7.0	8.6	9.4	5.3	6.0	6.6	6.0	8.3
Length of upper jaw	13.0	12.6	15.1	14.8	14.2	15.8	16.8	16.1	16.1	17.3	13.9	15.0	12.0	12.9	15.3
Counts:															
Dorsal fin	$50^1/_2$	$51^1/_2$	$52^1/_2$	$52^1/_2$	$50^1/_2$	$51^1/_2$	$51^1/_2$	$51^1/_2$	$45^1/_2$	$50^1/_2$	$51^1/_2$	$49^1/_2$	$49^1/_2$	$48^1/_2$	$48^1/_2$
Anal fin	$41^1/_2$	$41^1/_2$		$42^1/_2$	$42^1/_2$	$41^1/_2$	$41^1/_2$	$40^1/_2$	$41^1/_2$	$40^1/_2$	$42^1/_2$	$40^1/_2$	$40^1/_2$	$40^1/_2$	$39^1/_2$
Pectoral fin (left/right)	21	21/21	20/21	20/–	20/21	22/22	22/–	20/21	22/–	22/21	22/22	21/–	–/22	20/21	22/21
Gill rakers, upper limb	1	1	1	1	1	1	1	1	1	0[2]	2	1	1	1	1
Gill rakers, lower limb	7	6	6	5	5	6	6	6	6	6	7	6	5	6	6
Gill rakers, total (incl. one, always present, inserted in both limbs)	8	8	8	7	7	8	8	8	8	7	10	8	7	8	8
Number of graduated rays at anterior end of dorsal fin		9	10	12	11	10	11	11	11	11	9	11	11	8?	11
Number of graduated rays at anterior end of anal fin		4	3	4	4	4	3	3	4	5	4	4	4	3	4
Approximate number of scales in a horizontal series, from upper end of gill cleft to base of caudal fin		49	48	50	50	52	53	52	53	51	50	49	50	47	47
Number of predorsal scales		10	10	11	10	11	10	10	11	11	11	10	10	10	11

[1] The values listed in this column should be held suspect. The specimen, archaic, eviscerated, twisted, frayed, broken and generally (particularly anteriorly) distorted, is included here only because of its size (unique in collections) and because it has sometimes, although erroneously, been considered the holotype of *Pterycombus goodei* (Jordan).

[2] In this large specimen, the "rudiment" on the upper limb is nearly one-fourth as long as the raker at the angle; i.e. nearly of a size countable as a well-developed raker.

and evenly rounded (slightly concave only when the mouth is forced completely open). Eye large, its horizontal diameter 2.6–3.2 in length of head; its greatest (oblique) diameter 2.4–2.8 in head. Nostrils just above a horizontal with tip of snout. Lower jaw massive, the toothed border meeting but not included within the upper when the mouth is closed. Mandibular teeth in two series; the outer confined to the anterior half of the jaw, irregularly spaced, and recurved; the inner a single row of evenly spaced teeth on the rami but expanding into a broader band toward the symphysis. A few larger retrorse teeth near symphysis. Teeth on premaxillary similar in size and shape to those of the mandible, forming a band which is broader anteriorly than posteriorly. Tongue without teeth.

Gill clefts long, the uppermost point of opening on or just below a horizontal with uppermost edge of eye. First gill arch with one raker above angle, one based in both epibranchial and ceratobranchial, and five to seven on ceratobranchial. Gill rakers about equal in length to opposite gill filaments. There are a few low spinulose rudiments above and below these rakers on the first arch, and on the following arches, all of which lack true rakers.

Free edges of opercular flap thin and without spines or serrations, the free edge of the upper part of the gill flap, however, formed of scales.

Predorsal distance 4.2–5.7 in standard length, this relative distance decreasing with growth. Dorsal fin, when depressed, lying within a groove formed by vertically-elongated scales. No dorsal lobe, the anterior 9 to 12 rays graduated. (The relative height of both dorsal and anal fins decreases with increasing length of fish.) Fifth-from-last dorsal ray 3.8–4.2 into length of longest dorsal element. Preanal distance 2.4–2.9 in standard length, the fin similar in shape to the dorsal but with about five graduated anterior rays. Length of longest anal ray .5–1.4 in length of head, this fin, like the dorsal, becoming relatively shorter with increasing size of fish. Fifth-from-last anal ray 2.9–3.6 in length of longest anal ray. Last five or six anal rays and about three dorsals simply branched, the rest apparently unbranched.

Ventral fins inserted in advance of vertical from base of pectoral fin, under or behind angle of preoperculum. Preventral distance 2.8–3.4 in standard length. Length of ventral fin 3.1–4.7 in head (becoming relatively shorter with growth), its tip just reaching or falling short of origin of anal fin, its five rays coterminal and branched. Prepectoral distance 3.3–3.8 in standard length, the pectoral insertion under about the ninth dorsal ray and the rays, except those forming the leading edge, branched. Caudal lobes about equal in length, the posterior edge evenly concave, the distance between the tips of the lobes about equal to the distance between the snout and the origin of the anal fin.

In preservative, the head and flanks are dark but covered by silvery scales. The lower jaw, snout, and head below and before the origin of the dorsal fin are darker than the rest of the fish. The dorso-posterior part of the eye and the iris are black. The tongue, roof of the mouth, and lips are dusky. The interradial membranes of the dorsal and anal fins are pigmented, the anterior part of these fins being nearly black, the posterior parts being almost colorless except near the tips of the rays. The pectoral fin, except for some darkness along the leading edge is but faintly pigmented (this duskiness more readily seen on the surface of the fin nearest the flank of the fish). Ventral fin usually black, but in some specimens the pigment is restricted to the inner four elements, as in the juveniles. The caudal lobes, and the bases of the central caudal rays are dark, but there is a crescentic lightly pigmented area along the tips of the central caudal rays.

Diagnostic characters of young:—The following combination of characters, the most useful of which are in expanded type, will distinguish early juvenile (5.0 to 20.0 mm s.l.) *P. brama* from similar young of other North Atlantic species.

Formula: D 48–53; A 48–43; P 20–23; BR 7; Vertebrae 21–23 + 24–27 + 1 = 48–51.

Dorsal fin: origin about over pectoral base in small fish, moving forward nearly to the vertical of the posterior rim of the orbit; dorsal origin separated from the scaleless nape by about 10 predorsal scales or, prior to scale formation, by a predorsal body surface more heavily pigmented than that of head. No anterior lobe. Anterior 8 to 13 spines graduated in length; none of these notably thicker than any other. Dorsal fin without pigment in specimens shorter than 12–15 mm; first pigment forming

in proximal half of rays 10 to 20, spreading anteriorly, posteriorly and distally, but incomplete on last rays at a s.l. of 20 mm.

Origin of anal fin under posterior end of abdominal cavity in smallest specimens, moving to beneath base of pectoral by 20 mm; no anterior anal lobe. Anal fin colorless below ca. 14 mm, pigment then spreading from the proximal parts of rays 2 to 10. Posterior few rays unpigmented at 20 mm. Axis of pectoral base vertical in young, nearly vertical at 20 mm; fin base becoming relatively more narrow and higher on body with growth. Ventral fin: inserted slightly in advance of vertical from pectoral base but behind that from eye. Fin extends beyond origin of anal fin above 7.0 mm s.l.; ventral fin black at all lengths, the pigment generally restricted to outer four elements. Caudal fin: colorless at all sizes.

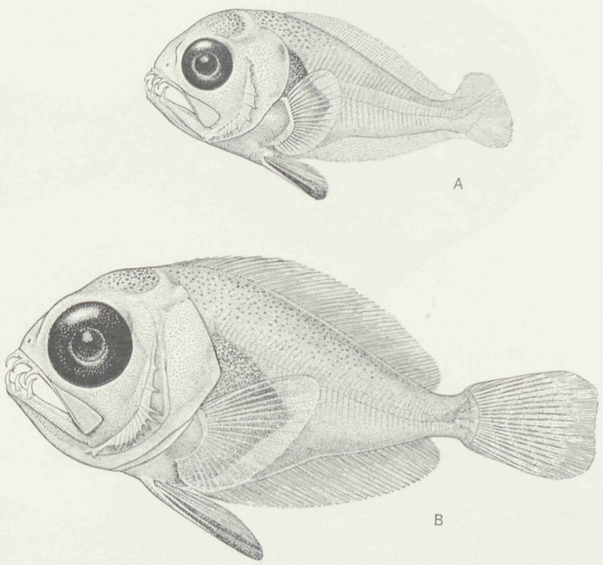


Fig. 44. Young of *Pterycombus brama*. (A) 5.4 mm s.l.; (B) 7.5 mm s.l.; both from D-891 (29°28′ N, 69°25′ W). Drawn by N. Strekalovsky.

Scales of dorsal and anal fin sheath visible at 7.0 mm, corresponding in number with fin rays. First scale pockets visible on body at about 6.0 mm. Spines on scales of mid-lateral line of caudal peduncle not larger than those in adjacent rows.

A series of evenly graduated preopercular spines; forming a fringe rather than discrete spines, and becoming largely overgrown by a length of 15 mm. Gill membrane: colorless.

Teeth: confined to recurved anterior canines below 10 mm, the teeth in posterior part of jaws appearing at about 12 mm, initially smaller than the anterior "baby teeth". None on palatine or vomer.

Description of juvenile:—The smallest representative of this species, a 4.4 mm fish in poor condition, fortunately shows a few features which together distinguish the species: the anterior origin of the dorsal fin fold (as in *Pteraclis*) and the pigmented ventral fin. The body is nearly half as deep as long, the urostyle is straight, and the yolk is largely absorbed although there is but one tooth in each half of each jaw. Between 4.4 and 5.4 mm, elevation of the urostyle occurs; there is an increase in the number of teeth (all in the anterior half of the jaws); the numbers of ossified pectoral and ventral fin rays and of branchiostegal rays and ceratohyal gill rakers are the definitive ones; and the dense pigmentation covers the abdominal cavity and head and body above and anterior to it. The ventral fins are their characteristic black, and melanophores can be found elsewhere on the head and gular region. There is no pigmentation posterior to the abdominal cavity.

Because of the few specimens of lengths at which ossification occurs, the development of ossified elements, seen in stained material, could not be followed. The smallest stained specimen, 7.3 mm, lacks scales but shows all other meristic features, fin rays, gill rakers, and vertebrae in ossified form.

A few primordial scales can be found on the flanks of specimens 7.5–8.0 mm. The full complement, in ossified or unossified form, can be found on all individuals 10 mm long, although 10 mm stained specimens demonstrate the lack of ossified scales in the regions of the nape and caudal peduncle.

At 12 mm, pigmentation of the body is nearly complete, the coloration spreading posteriorly and anteriorly from a second center on the caudal peduncle. The ventral fin remains its characteristic black. All other fins are colorless in specimens smaller than about 13 mm, at which size the membranes of the dorsal and anal fins show heavy black pigmentation, the colored areas spreading distally and posteriorly through these fins, the process not complete until the fish has attained a length of about 25 mm. The caudal and pectorals remain colorless.

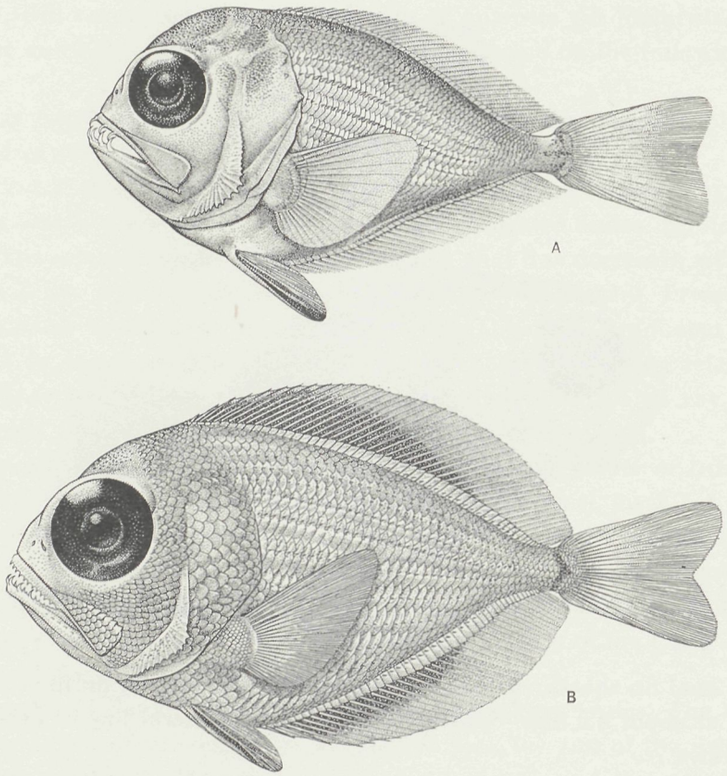


Fig. 45. Young of *Pterycombus brama*. (A) 9.7 mm s.l. (D-1231 III; 26°37′ N, 55°50′ W). (B) 16.9 mm s.l. (D-1230 VII; 23°13′ N, 82°21′ W). Drawn by N. Strekalovsky.

Specimens shorter than 10 mm bear from one to three teeth in each half of each jaw. These are relatively large and recurved and restricted to the anterior half of the jaw. At about 10 mm, smaller teeth form along the rear parts of the jaw. The total number rapidly increases from 3 (at 10 mm) to 5 at 12 mm and 22 at 28 mm in the premaxillary; and from 3 to about 19 at similar sizes in the mandible. No palatine or vomerine teeth were found in any specimens, stained or unstained.

Range and Abundance:—Localities at which *P. brama*, young and adults, have been reported, are shown in Fig. 43 and recorded in detail in Appendix Tables 21 and 22. The map does not clearly convey the proper picture of distribution, for not indicated is a measure of the abundance of small young. Of the 86 net caught young, only 6 were taken in the Sargasso Sea in the quadrant east-to-south of Bermuda, enough to establish the presence of spawning adults there but not sufficient to include this open ocean area within the major spawning grounds. Of the specimens representing the eastern Atlantic records (marked with a "?" on the chart), two are exceedingly small; one was lost during staining, and another is an old specimen reported by Lütken (1880), the data for which I consider uncertain. These may be *P. brama*, they may possibly represent *P. petersii* which have come north from South Africa with the Benguela Current, or they

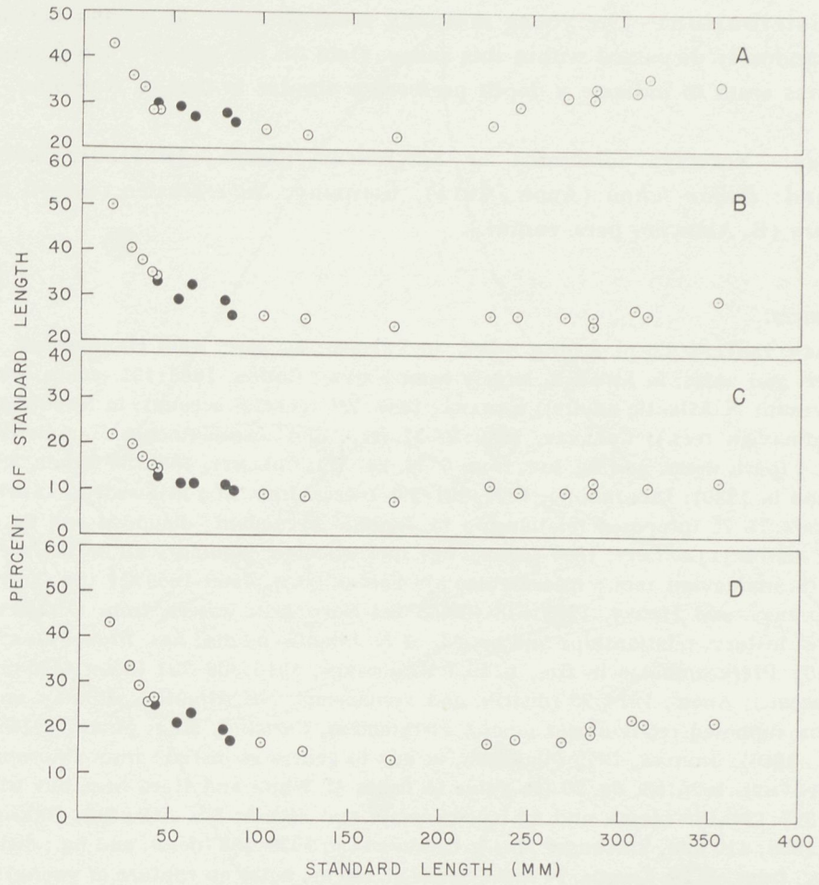


Fig. 46. (A) Relative depth of body, (B) length of head, (C) greatest diameter of eye, and (D) predorsal distance in young and adult *Pterycombus brama*.

may represent a distinct species. The presence of viable adults in the eastern Atlantic between Cape Bojado and Spain is certain, although no young are known with certainty and the species appears to be absent from the Mediterranean.

Adults are not infrequently caught incidental to the fishery for *B. brama* off northwestern Spain. One or two are usually taken in each longline set during the winter but seldom if at all during the summer. It is less common than the other bramid species similarly caught, *Taractes raschii*. To the fishermen here, *Pterycombus* is known as "Voladora", one of the few true common names for this fish. However, they consider it the male of the commercial *B. brama*, which is rather astonishing since the catch of *Brama* includes ripe males during at least part of the season. Such males were abundant in the Vigo market in July 1961*.

Of the few adults known from north of Great Britain, about a third are live captures and the occurrence of *P. brama* there is probably a seasonal one comparable to that studied in greater detail for *B. brama* (p. 39).

The abundant western Atlantic material is more informative. Although most of the "Dana" larvae were caught during February, young have been caught during each month of the year except April, June and September; *P. brama* probably spawn throughout the year. Spawning is most intensive nearer the edge of the shelf than further off shore, and the principal spawning grounds are off the east coast of Florida in the Gulf Stream and adjacent parts of the Caribbean and Gulf of Mexico. Juveniles are relatively abundant in the Stream from off Cape Hatteras north to off Newfoundland. The larger fish from Bermuda and the Grand Banks and perhaps the North Sea adults as well probably came across the Atlantic in Gulf Stream water.

* Information contributed by Dr. B. Andreu and his associates in the Instituto de Investigaciones Pesqueras, Vigo, Spain.

Bathymetric Distribution:—The young normally seem to occur at depths between about 25 and 300 meters and are randomly dispersed within this range. Data on the adults is too fragmentary to warrant discussion, but captures seem to indicate a depth preference similar to that of *B. brama*. *P. brama* is not a deep-living fish.

Common Names:—Norway: *Sölvbrasen* or Sølvbrasme (Anon., 1914:23); Sweden: *Fengömmar* (Anon., 1914); Finland: *Ruijan lahna* (Anon., 1914); Germany: *Silberbrassen* (coined by Meyer, 1949); Spain (Vigo): *Voladora* (B. Andreu, pers. comm.).

Synonyms and References.

Pterycombus brama Fries, 1837:14–22, pl. 2 (orig. descr., in Swedish; fig. spec. from Hammerfest, Norway); Nilsson, 1855:124–128 (descr. and notes, in Swedish, largely from Fries); Couch, 1863:131 (comp. with *Brama*); Lilljeborg, 1864 (gen. account N Atlantic adults); Esmark, 1869:521 (general account, in Swedish); Collett, 1875:47 (summary of Scandinavian recs.); Collett, 1880:30–31 (rep. and measurements Hammerfest spec.); Lütken, 1880:501, pl. 4, fig. 4 (part, descr. and fig. juv. from 8° N, 24° W); Collett, 1885:59 (adult, 380 mm, rep. without descr. from Egersund in 1880); Lilljeborg, 1891:291–298 (descr. from lit.; in Swedish); Smitt, Fries, Ekström and Sundevall, 1893:71–75 (proposed relationship to Jurassic pycnodont; diagnosis and fig.; adult from Fries, juv. from Lütken; distrib.); Collett, 1897 (descr., figs. incl. skeleton; summary all northern recs. from lit.); Collett, 1902:45–48 (Scandinavian recs.; measurements); Ehrenbaum, 1905–1909:24 (fig. and descr. young from Lütken, 1880); Murray and Hjort, 1912:643 (listed for Norwegian waters, from Collett); Shufeldt, 1912 (excellent account of history, relationships and osteol. of N Atlantic adults; figs. from Fries; notes on expanded ribs; proposes family Pterycombidae in ftn., p. 46); Pellegrin, 1913:323–324 (descr. 450 mm spec. from Paris market; notes on occur.); Anon., 1914:23 (distrib. and vernaculars, NE Atlantic); Jordan and Thompson, 1914: 245–246 (remarks on supposed relationships among *Pterycombus*, *Caristius*, etc.); Meek, 1916:333 (notes on Lütkens recs. of juvs., 1880); Jordan, 1919 (diagnosis, in key to genera as distinct from *Centropholis*, fig. from Shufeldt, 1912); Knipovich, 1926:88, fig. 50 (in guide to fishes of White and Kara Seas but without spec. locs.; in Russian); Mohr, 1927:138–139 (descr. and fig.; vernaculars and distrib. NE Atlantic); Bernhoft-Osa, 1935:101 (Egersund spec. of 1880; 410 mm, Stavanger Mus.); Ehrenbaum, 1936:263 (descr. and fig.; distrib. in Scandinavia; notes two large spec. from off La Coruña, N coast Spain at 180 m; notes on capture of young); Fowler, 1936:657 (synon. and fig.; from Fries, Smitt et al.; and two juvs. rep. by Lütken, 1880); Mayer, 1949 (adult from near Norwegian Deep at 190 m; fig., descr.; distrib. notes); Bruun and Pfaff, 1950:41 (rep. as vagrant from sub-tropics; occur. rarely Norwegian and Swedish side of Skagerrak); Bahr, 1951 (rec. 40 cm spec. from northern North Sea); Arté, 1952:101–102 (refs., outline fig. and measurements 4 spec. taken in *Brama* fishery off NW Spain; said to occur not uncommonly; vernacular: "Voladoras"); Andriashev, 1954:216–217 (descr., fig., distrib., synon.); Rasmussen and Dannevig, *in* Rollefsen, 1960, fig. 173 (good fig. of poor spec.); Nielsen, 1963:148, 160 (rec. adult from Danish comm. landings).

Pteraclis carolinus (non-Cuv. and Val.), Goode and Bean, 1896:212–213, pl. 59 (descr. from Cuv. and Val., 1831; fig. from a spec., USNM 37861, coll. by "Albatross" at Sta. 2660, 28°40′ N, 78°46′ W at 504 fms, that later served as the type of *Centropholis goodei* Jordan); Jordan and Evermann, 1896:956 (part, the Goode and Bean spec. but not the descr.).

Centropholis goodei Jordan, 1919:333, pl. 58 (orig. descr. based on the *Pteraclis carolinus* of Goode and Bean, 1896, pl. 59, fig. 218; not redescribed); Jordan, Evermann and Clark, 1930:266 (listed with synon., Gulf Stream).

Centropholis ledanoisi Belloc, 1926:271–274 (orig. descr. and photog. based on 3 spec.: 1 caught N of Grande Sole Bank, ca. 49°53′ N at 360 m on 20 VI 23; 2 others in 1924 and 1925 off Cape Bojador, western Africa, but without exact locality; according to Belloc, 1927, one spec. dep. in ichthyol. coll. Musée d'Hist. Nat. de La Rochelle, another retained in Lab. de l'Office des Pêches a La Rochelle; and the *third spec., from Cape Bojador, which is here designated the lectotype*, is in MNHN, Paris, and has been comp. by me with Norwegian, Spanish and American reps.); Belloc, 1927:239–243 (rep. type descr.; additional loc. data).

Pterycombus goodei, Caldwell and Briggs, 1957:2–3 (recs. juvs. from Gulf of Mexico and Caribbean; notes on classification); Duarte-Bello, 1959:79 (listed, S Carolina to Cayman and Gulf of Mexico but not specifically for Cuba).

?*Pterycombus falcatus*, Blache, 1962:51 (recs. from stomachs of *Neothunnus albacora* caught S of Cape Lopez, off Pt. Noire and W of Mayumba, Gulf of Guinea; reps. of the tropical east-central Atlantic population, the status of which is uncertain).

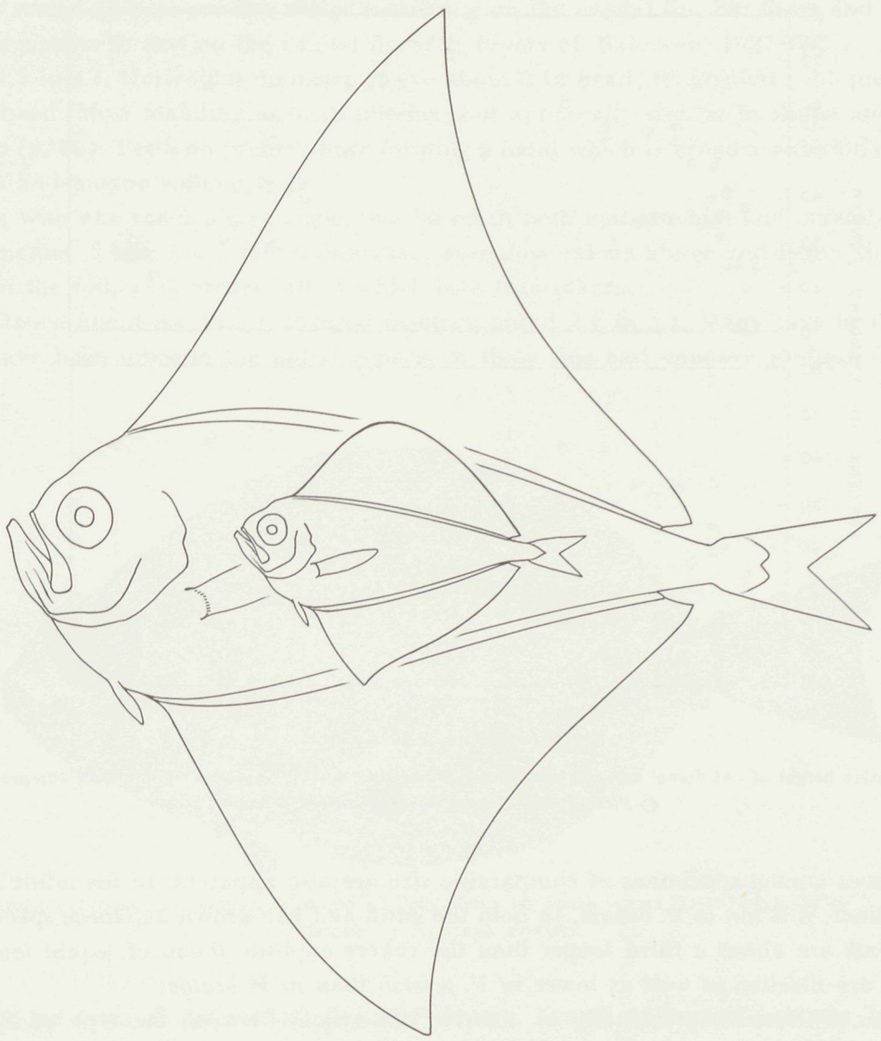


Fig. 47. *Pterycombus petersii* HILGENDORF, from South Africa: the 244 mm s.l. holotype of *Pterycombus falcatus* (SAM 11965); and a smaller juvenile, 100 mm s.l. long (SAM 23155). Drawn by N. STREKALOVSKY.

Pterycombus petersii (HILGENDORF, 1878).

Plate 7; Figures 47 to 50.

Study Material:—Two adults, one 275 mm s.l., from the Sea of Japan and the second, the 244 mm holotype of *P. falcatus* BARNARD, from South Africa (SAM 11956). Juveniles, all from the stomachs of tunas and similar predators, from off Zanzibar, South Africa, and the southwestern Pacific north of New Zealand yielded locality data but little other information.

A half-grown 166 mm fish from Sagami Bay, about 50 young all but one shorter than 12.2 mm, and five juveniles caught in the Indian Ocean by the "Anton Bruun" complete the list. Of the "Dana" specimens, four are from the eastern central Atlantic, one was taken south of Japan, another in the eastern Indian Ocean, and the rest in the western Indian Ocean from northern Madagascar to South Africa. Aside from the "Dana" specimens, the collection from Japan was variously assembled and loaned to me by Dr. T. ABE of Tokyo; those from Zanzibar are in the British Museum (Natural History) and those from South Africa in the South African Museum. See Appendix Tables 23 and 24 for data.

Distinctive Characters:—*P. petersii* usually has fewer dorsal rays (mean of 47 cf. 51) and vertebrae (47 vs. 49), but the ranges overlap. The young of about 100 mm have much lower vertical fins than do those of *P. brama*; two such are compared in Table 20.

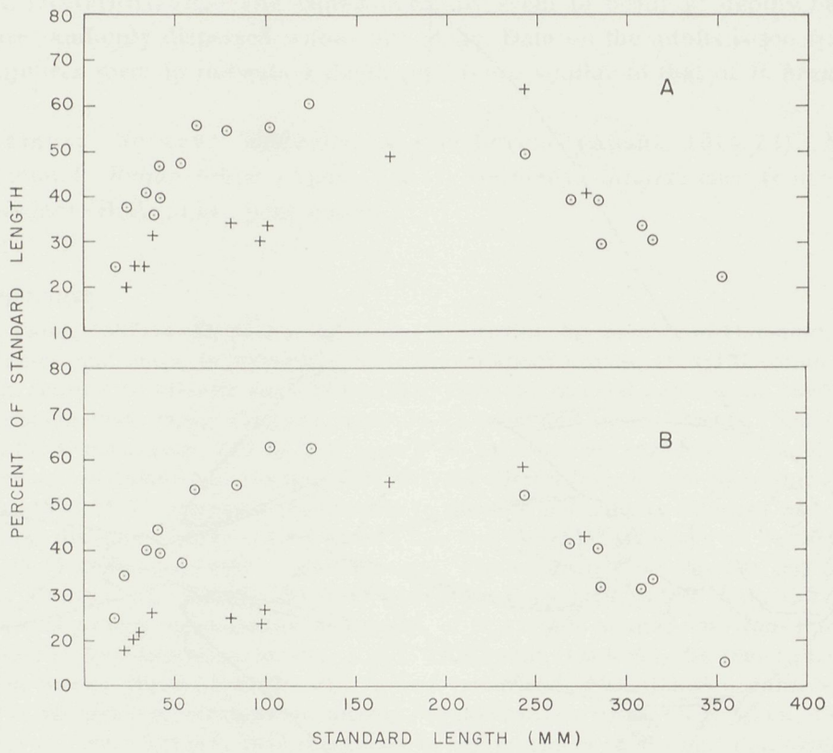


Fig. 48. Relative height of (A) dorsal and (B) anal fins in young and adult *Pterycombus brama* and *Pterycombus petersii*. ○ *Pterycombus brama*; + *Pterycombus petersii*.

Other differences among specimens of comparable size are also apparent. In the adult Japanese fish the lateral line is distinct; it is not in *P. brama*. In both the adult and half-grown Japanese specimens the lengths of the gill filaments are about a third longer than the rakers opposite them, cf. equal length in *P. brama*. The vertical fins are blacker as well as lower in *P. petersii* than in *P. brama*.

There are also differences, principally in anterior dimension, between the type of *P. falcatus* and its North Atlantic congener: predorsal distance 6.3 in s.l. in *falcatus* (cf. 4.2–5.7 in *P. brama*); preanal 3.1 (cf. 2.4–2.9); preventral 3.8 in s.l. (cf. 2.8–3.4); prepectoral 4.1 in s.l. (cf. 3.3–3.8). Allometry and expected differences between specimens hook-caught in Japan in 1961 and beach cast forty years earlier in South Africa could account for much. Neither the separation of *Pterycombus* into more than a single species nor the union of *P. falcatus* with *petersii* is based on convincing evidence.

Description:—Counts, and proportional dimensions of all known specimens longer than 100 mm are provided in Table 20. Except as noted in the above diagnosis, the description of the Japanese *P. petersii* adult conforms to the general description of *P. brama* on p. 93. Instead of another identical description here, I add a brief account of the holotype of *P. falcatus*, as follows.

P. falcatus: The following description is taken from the 244 holotype, SAM 11956. Counts and proportional dimensions are given in Table 20.

Greatest width of head, behind upper edge of orbit, about 2.5 in length of head. Greatest depth of body at posterior end of base of pectoral fin, this depth 2.6 in length. Least depth of caudal peduncle 3.7 in length of head. Head, exclusive of snout, mandible and free edge of preoperculum covered with scales. Scales on head cycloid and without vertical spines. Body scales with vertical median spines, those on the posterior part of the fish larger than those on the anterior, the spines on the posterior 9 or 10 vertical rows of scales antrorse. About 15 horizontal rows of scales, counting obliquely upward and backward from the insertion of the ventral fin to the base of the dorsal but excluding the sheath of scales at the bases of the vertical fins. No lateral line evident. Extreme base of pectoral fin, a part of the caudal lobes, and proximal half of central

caudal rays with scales. (There are few scales remaining on the caudal fin, but these and the scale pockets indicate scalation similar to that on the caudal fin of *P. brama* cf. BARNARD, 1927:600.)

Head about 4.3 in s.l. Horizontal diameter of eye about 3 in head; its greatest (oblique) diameter about 2.8 in length of head. Most mandibular teeth missing, but apparently similar in shape and arrangement to those in *P. brama* (p. 96). Teeth on premaxillary forming a band which is broader anteriorly than posteriorly. Vomer, palatines and tongue without teeth.

First gill arch with one raker above angle, one based in both epibranchial and ceratobranchial, and six on the ceratobranchial. There are a few rudimentary spinulose rakers above and below these rakers on the first arch, and on the following arches, all of which lack true rakers.

Predorsal distance about 6.3 in s.l. Preanal distance about 3.1 in s.l. Many rays in these fins broken, but there may have been lobes in the anterior parts of these fins and concave profiles, in contrast to the

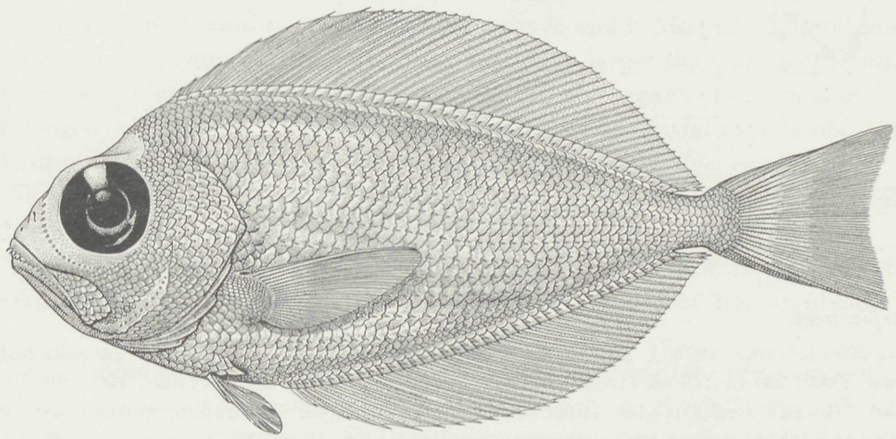


Fig. 49. Juvenile *Pterycombus petersii*, 37.0 mm s.l. long, from off South Africa (D-3971 III; 35°49′ N, 23°09′ W). Drawn by N. STREKALOVSKY.

more evenly rounded form of the vertical fins of *P. brama*. Length of longest anal ray 1.7 in s.l.; longest dorsal 1.6. Because of condition, the degree of branching, if any, in the posterior rays of these fins cannot be determined. Ventral fins inserted in advance of a vertical from base of pectoral fin. Preventral distance 3.8 in s.l.; the length of the fin about 3.2 in length of head. Prepectoral distance about 4.1 in s.l., both fins damaged but about equal to distance from snout to insertion of pectoral. Caudal fin badly broken.

No trace of color remains on this specimen.

Juveniles among study specimens, nearly all of which are smaller than 20 mm, are not notably different than those of *P. brama* and the characters used to distinguish this species from other North Atlantic bramids (p. 7) will separate *P. petersii* from other Indo-Pacific forms.

Range:—Adults, and large juveniles 100 mm s.l. or longer, are known from off Enoshima and Odawara both near Sagami Bay on the Pacific coast of Japan, from off Cape Nyudozaki in the Sea of Japan, and from the mid-North Pacific (36° N, 174° E; MATSUBARA, 1955; KURONUMA, 1941), and from an uncertain South African locality, probably Table Bay (BARNARD, 1927). Juveniles 15–100 mm were, with one exception, taken from tuna stomachs. There is one southwestern Pacific record (28°33′ S, 177°28′ W); the rest are African: the Indian Ocean off Zanzibar south and thence east and south into the southwestern Indian Ocean to 34° S and perhaps farther. Smaller juveniles and larvae have been caught east of Formosa and west of Sumatra and from African waters north of Madagascar south and into the Atlantic. Bathymetric range of adults unknown; that of juveniles probably above about 200 meters.

Common Names:—Japan: Ryuguu-no-tsukai (JORDAN, TANAKA and SNYDER, 1901:133).

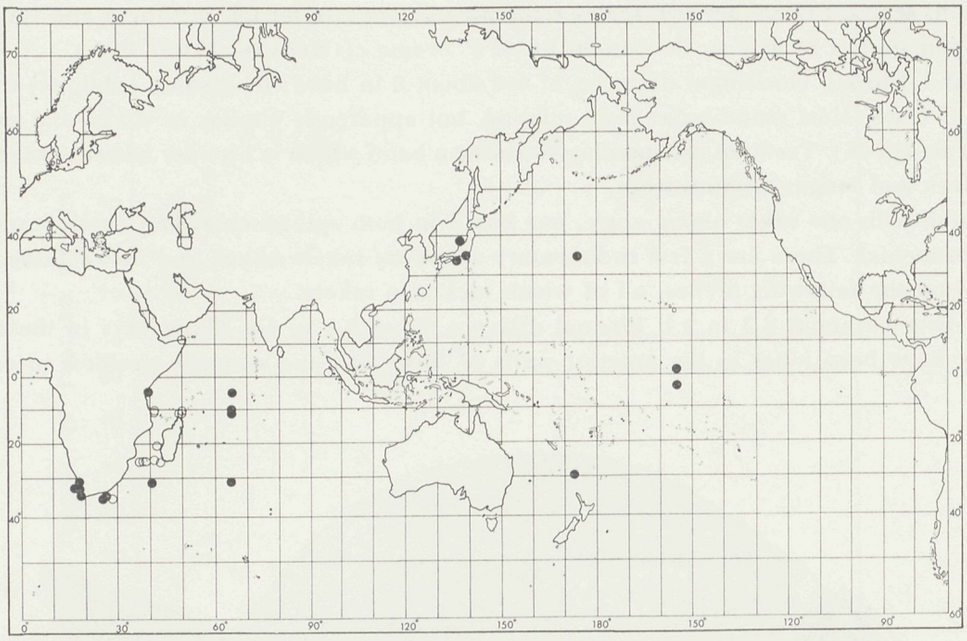


Fig. 50. Distribution of *Pterycombus petersii*.
○ shorter than 20 mm s.l. ● longer than 20 mm s.l.

Synonyms and References.

Centropholis petersii Hilgendorf, 1878:1–2 (orig. descr., no fig.; comp. with *Pteraclis* and *Taractes* but not *Pterycombus*; Japan); Lütken, 1880:500 (notes on Hilgendorf's account); Jordan and Snyder, 1901:69 (listed for Enoshima, Japan); Jordan, Tanaka and Snyder, 1913:133 (listed for Sagami Sea, Japan, vernacular: "ryugu-no-tsukai"); Jordan, 1919 (genus held distinct from *Pterycombus*); Belloc, 1926:273–274 (comp. with *C. ledanoisi* Belloc from E Atlantic); Belloc, 1927:240–243 (comp. with *C. ledanoisi* Belloc); Okada, 1938:173 (listed for Sagami Bay, Japan); Kuronuma, 1941:56–59 (descr. and photog. 237 mm spec. from albacore stom., 36° N, 174° E, 100 fms); Matsubara, 1955:543, pl. 49 (rec., in Japanese, from Steindachner and Döderlein, 1884); Kamohara, 1962:2 (photog., descr. 140 mm juv. from Kannoura, Jan., 1962; rec. 165 mm juv. from off Hitaka, Wakayama Pref., Japan; synon.); Honma and Mizusawa, 1965:57 (rec. and fig. 192 mm spec. from Niigata Pref., Sea of Japan; "oyashirazu").

Pteraclis (*Centrophophis*) *petersii*, Steindachner and Döderlein, 1884:175–176, pl. 2 (descr. of type; 21 cm, in Univ. Mus., Berlin; type loc. Enoshima, Japan; excellent fig.).

Pterycombus falcatus Barnard, 1927:599–600, pl. 25 (orig. descr. 300 mm spec. rep. without exact loc. but presumed to have been cast ashore in Table Bay, S Africa; type in SAM, seen and comp. with *P. brama* from N Atlantic); McCann, 1953:10–12 (presumed to be the male of *Pteraclis velifera*, in error); Williams, 1966:377 (as food of E African tuna).

Centropholoides falcatus, Smith, 1949:313 (S Africa, the combination repeated in later eds.).

Pterycombus petersi, Abe, 1961 (in key to genera; note on position and size of ventral fins; Japan).

Pteraclis Gronow, 1772.

Pteraclis Gronow, 1772:43–47, fig. 1; type species, by original description, *Pteraclis pinnata* Gronow, 1772; ? = *Coryphaena velifera* Pallas, 1769.

Generic Synonyms:

Pteridium Scopoli, 1777:454; type species, by original designation, *Coryphaena velifera* Pallas, 1769.

Oligopodus Lacépède, 1800:511; type species, by monotypy, *Coryphaena velifera* (Pallas, 1769); not *Oligipodes* Cuvier, 1817:328–329, based on *O. niger* Risso, 1810:142, which appears to be an ophidioid; or *Oligopus* Risso, 1826:538, which is apparently also based on *O. niger* Risso, 1810.

Pteraclidus RAFINESQUE, 1815:82 (replacement name for *Pteraclis* GRONOW); type species, by monotypy, *Coryphaena velifera* PALLAS, 1769.

Bentenia JORDAN and SNYDER, 1901:306; type species, by original designation, *Bentenia aesticola* JORDAN and SNYDER, 1901.

Characters:—Dorsal fin originating on snout and not preceded by scales which cross the dorsal profile. Dorsal and anal fins enormous, high and sail-like, without distinct anterior lobes, without scales, wholly depressible into grooves formed by enlarged scales along the bases of the fins, the fins composed of elements all of which are unbranched except the terminal few. One of the anterior dorsal and anterior anal rays at least twice as thick as its neighbors. Ventral fin short and inserted under rear edge of eye. Caudal fin forked and moderately flexible; no transverse precaudal grooves.

Head markedly convex between the eyes. Inner lower edges of mandible behind symphysis of lower jaw meeting or nearly meeting each other. Posterior nostril circular. Thoracic ribs unspecialized and not expanded.

Spines on scales persistent in adults. No scaleless area above and behind eye. Lateral line absent in adult. Mid-lateral scales of caudal peduncle unmodified and distinctly larger than those over mid-caudal rays.

Peculiar to *Pteraclis* are certain features attributed here to the organically poor and deep-water habitat rather than to phylogeny: reduction, in the adult, of the number of ventral rays to about 1–3; reduction in both length and number of gill rakers; and the generally poor ossification compared to all other bramid genera; and the highly variable nature of features such as the shape of the profile of the head and, to a lesser extent, the number of branchiostegal rays.

Range and Habitat:—*Pteraclis* has been reported from tropical and adjacent warm-temperate regions of all major oceans (Fig. 51). These are high-seas fishes that are taken but accidently and rarely near shore.

Species:—The nominal species of *Pteraclis* as here understood fall into two categories: those with, and those without, zoological basis of some kind. In the latter category go the following, all admittedly replacement names: *pinnata* GRONOW, 1772; and *guttatus* VALENCIENNES, *in* CUVIER and VALENCIENNES, 1833.

The following nominal species were actually based on specimens:

– *velifera* PALLAS, 1769; usually attributed to "Indian Ocean" or "Southern Indian Ocean" although CUVIER (1834:206) states that "PALLAS says that his is from the Moluccas", a statement which I do not find in PALLAS. The type locality is thus uncertain. Specimens attributed to *velifera* have been reported from California, Hawaii, Australia and New Zealand, Reunion Island, Mozambique and both coasts of South Africa. Some of these are provisionally and somewhat arbitrarily referred to *P. aesticola* here.

– *ocellatus* VALENCIENNES, *in* CUVIER and VALENCIENNES, 1833; Mozambique.

– *trichipterus* VALENCIENNES, *in* CUVIER and VALENCIENNES, 1833; from an unknown locality but doubtless Indo-Pacific as the type was collected by QUOY and GAIMARD.

– *aesticola* JORDAN and SNYDER, Japan.

– *velifera australiae* WHITLEY, 1935; New South Wales, Australia.

– *carolinus* VALENCIENNES, *in* CUVIER and VALENCIENNES, 1833; "Coast of Carolina".

– *papilio* LOWE, 1843; Madeira.

Of these six, *aesticola*, *velifera* and *velifera australiae* were described from adults, the others from young. I have seen the types of VALENCIENNES; I have not seen that of *velifera australiae*; and those of *aesticola* and *papilio* are lost. Most taxonomists concur with SMITH (1949), who believes that there will be shown to exist but a single worldwide species of *Pteraclis*. Yet published accounts yield variation in meristic values such as these: dorsal fin rays, 34 (NOBLE and BLODGETT, 1952) to 56 (PALLAS' type description of *P. velifera*); anal fin rays, 32 (again NOBLE and BLODGETT) to 51 ("*guttatus*" of CUVIER and VALENCIENNES, 1833); ventral fin, 0 (GRONOW, fide CUVIER and VALENCIENNES, 1833) to 1–5 (*aesticola* JORDAN and SNYDER, 1901). I cannot order the nominal forms into a reasonable list of species, but I think the unification of all into a single cosmopolitan species unwarranted on distributional as well as on morphological grounds. Recognized here are three species: the Atlantic *P. carolinus* (of which LOWE's *P. papilio*, if indeed it was a pteraclid, is con-

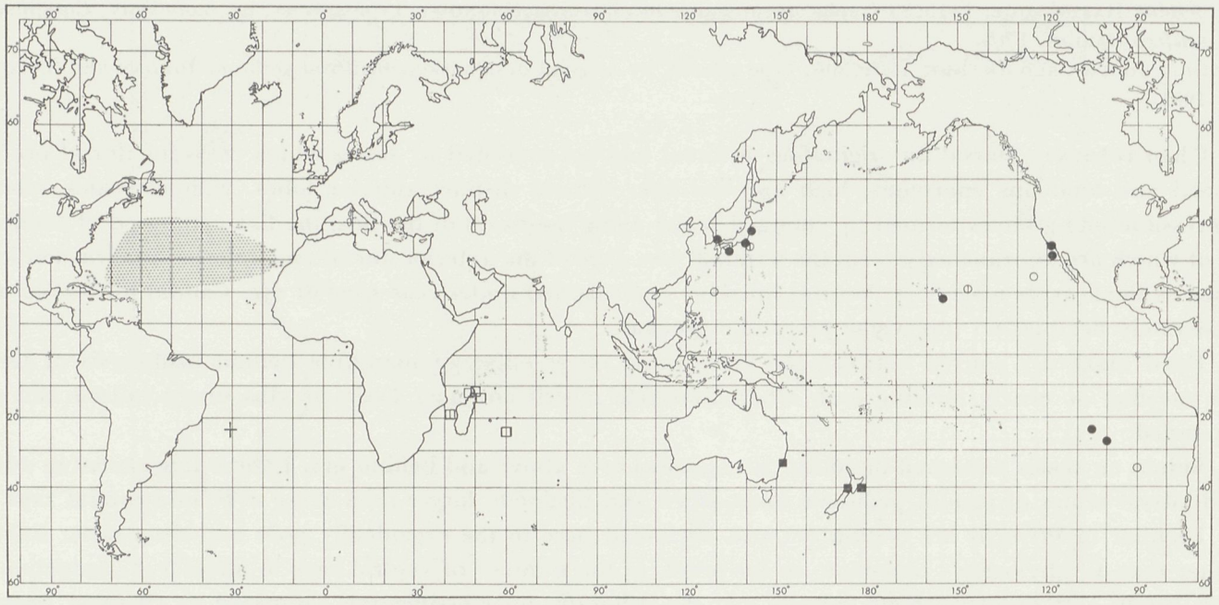


Fig. 51. Distribution of *Pteraclis*. The total range of the North Atlantic *Pteraclis carolinus* is stippled (see Fig. 53 for detailed distribution). The cross in the southwestern Atlantic represents the 38.0 mm s.l. problematical "Walther Herwig" specimen. Individual captures of *Pteraclis aesticola* and *Pteraclis velifera* are designated as follows:

P. aesticola	*P. velifera*
○ 0–20 mm s.l.	□ 0–20 mm s.l.
⊕ 20–100 mm s.l.	⊞ 20–100 mm s.l.
● more than 100 mm s.l.	■ more than 100 mm s.l.

sidered a synonym); the Indo-Pacific and South African *P. velifera*; and *P. aesticola* from the North Pacific. Morphological diagnostic characters are few, but the geographical implications of the "Dana" Atlantic collections merit comment here.

The larvae taken in abundance by "Dana" (Fig. 53 and Appendix Table 25 and 28) came primarily from the Sargasso Sea in the west central North Atlantic and generally from the same nets from which JOHANNES SCHMIDT took his larval *Anguilla* eels. Specimens taken at the edge of this area by "Dana", "Atlantis I" and "Discovery II" and those reported by LÜTKEN (1880) and LOWE (1843) are larger. They are young, farther away from the spawning grounds. No small juveniles are known from elsewhere in the North Atlantic. If there is such a thing as a Sargasso fauna, *Pteraclis* is a component of it. If other such areas exist, *Pteraclis* and *Anguilla*, both worldwide genera but not evenly distributed through the world's oceans, may be represented. JESPERSEN (1942), working with "Dana" *Anguilla* leptocephalids, has delineated four such places, spawning areas for *Anguilla*, in the Indo-Pacific: one off Madagascar (an area near that which yielded the few Indo-Pacific juvenile *Pteraclis*), another in the eastern Indian Ocean west of Sumatra (no *Pteraclis*), another in the eastern Indo-Malayan region and the waters north of New Guinea and off the Philippines (an area including the presumed type locality of *P. velifera* according to CUVIER), and the last in the southwestern Pacific north of New Zealand. Adult *Pteraclis* are much more abundant in three areas than elsewhere, although they are everywhere rare. Passive drift with surface currents from JESPERSEN's *Anguilla* areas would account for these: to New Zealand from the South Pacific via the South Equatorial Current; to Japan from the deeps east of the Philippines via the Kuroshio; and to South Africa from waters near Madagascar via the Agulhas Current. This is, of course, speculation, but there are taxonomic implications. In contrast to *Taractichthys*, *Taractes*, and most species of *Brama*, the young of which are broadly distributed throughout the oceans, and *B. orcini* and *caribbea*, and the species of *Pterycombus*, which seem to prefer spawning grounds somewhere near the edge of the continental shelf, *Pteraclis* may restrict its spawning to specific and widely-separated Sargasso-like situations with consequent reproductive isolation. But the few small specimens caught

between Hawaii and Baja California and from off both coasts of South America must also be considered. The possibility is intriguing but does not lend itself to analysis.

Without comparable material from all localities I cannot write a key to species the characters of which are mutually exclusive. The following synopsis of meristic values, those for *P. aesticola* taken in part from the literature, is apologetically offered:

Synopsis of Species

A Branchiostegal rays 8; dorsal fin 48–54; anal fin 42–47; pectoral fin 18–19; vertebrae 24–25 + 24–27 + 1 = 49–52
P. carolinus Valenciennes, 1833, p. 107
North Atlantic

AA Branchiostegal rays 7; dorsal fin 54–57; anal fin 47–50; pectoral fin 20; vertebrae 20–21 + 30–33 + 1 = 51–54
P. velifera Pallas, 1769, p. 115
Indo-Pacific*

AAA Branchiostegal rays 7; dorsal fin 46–55; anal fin 40–43; pectoral fin (reportedly) 15–20; vertebrae 45
P. aesticola (Jordan and Snyder, 1901), p. 118
Japan and ?North Pacific**

Pteraclis carolinus Valenciennes, 1833.

Figures 51 to 57.

Study Material:—One subadult from Madeira; about 880 larvae and early juveniles, 2.6–24.6 mm s.l., in the "Dana" collections; and about 35 additional juveniles variously taken in the North Atlantic between the eastern edge of the Gulf Stream off the United States and Madeira (Appendix Tables 25, 26 and 27).

The genus is represented in the South Atlantic by a single juvenile 38.0 mm s.l. Its relationship to *Pteraclis carolinus* is uncertain and it is not included in the descriptive account. It is deposited in the collections of the Institut für Seefisherei, Hamburg; it was made available by Dr. Gerhardt Krefft of that Institution, and was taken in a "CMB" midwater trawl by the "Walther Herwig".

Distinctive Characters:—See synopsis of species, above.

Description of Subadult:—The following description was taken from a specimen 237 mm s.l. that was caught off Madeira (Fig. 52):

Body more compressed than head, greatest body width about 3.4 in greatest depth. Greatest width of head 3.1 in length of head. Depth of body 4.3 in s.l.; least depth of caudal peduncle 5.4 in head length. Snout, lower jaw, and all fins except for the proximal part of the caudal naked; head and body otherwise covered with scales. Those on head are weakly serrated but without spines; those of body similar but with vertical median spines which are larger posteriorly than anteriorly. Deep troughs for the reception of dorsal and anal fins formed from scales bordering the bases of these fins. Lateral line, if present, without modified scales. No scales on dorsal midline between origin of dorsal fin and snout, or between origins of ventral and anal fins. No axillary scales beneath paired fins.

Length of head 4.5 in s.l. Snout protruding beyond tip of upper jaw (the shape of this contour is variable in other *Pteraclis* and *Pterycombus*). Horizontal diameter of eye 5.3 in head, an oblique diameter slightly greater than the horizontal. Symphysis of lower jaw in advance of upper; the maxillary extending to a point below rear edge of lens. Mandibular teeth needle-shaped and lying in two rows, those of the inner larger than those of outer. A pair of larger fangs present anteriorly. Premaxillary teeth of similar shape but forming a band which is broader near the toothless symphysis anteriorly. Eight prominent teeth on vomer, about six on palatine, none on tongue. Gill flap joined to isthmus below anterior edge of eye; without spines, and terminating not far ahead of base of pectoral fin. Gill rakers few and feeble, 1 + 1 + 6 on first arch with rudi-

* Based on four New Zealand adults.

** From Jordan and Snyder, 1901; Tanaka, 1927; and Kuronuma, 1941.

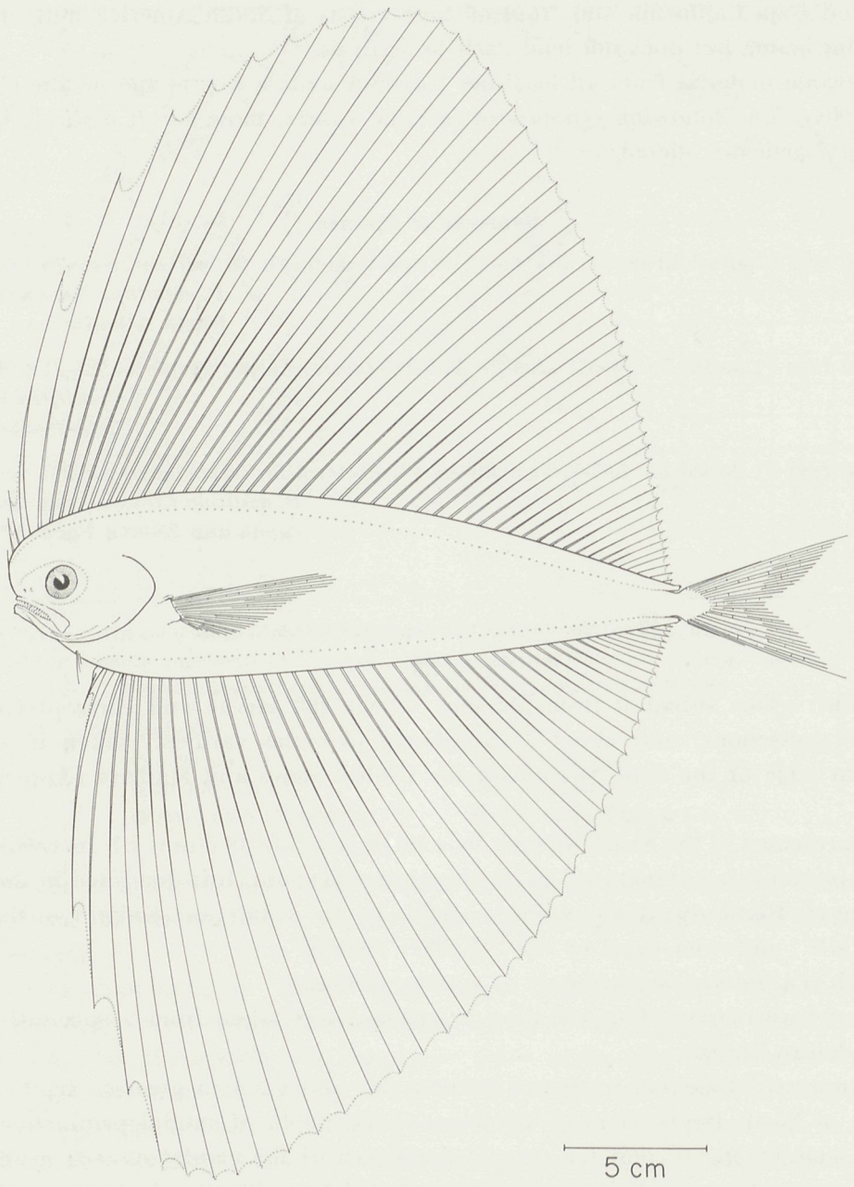


Fig. 52. A small adult specimen of *Pteraclis carolinus*, 237 mm in standard length, from the Funchal fish market; MMF No. 18434. Drawn by D. Bourne.

mentary rakers above and below. Longest gill raker about a quarter of the length of the opposite gill filament. Subsequent gill arches rugose but without rakers. Pseudobranch prominent.

Dorsal fin originating at anterior tip of head, its base less than 1.1 in s.l.; its longest fin ray contained 1.1 in s.l. Anal origin under gill flap; preanal distance 6.8 in s.l.; length of base of anal fin 1.2 in s.l.; length of longest anal ray 1.1 in s.l. Second anal and fourth dorsal rays about six times as thick as the succeeding rays. Preventral length 8.2 in s.l.; insertion of fin under eye, its length 5.3 in head; and composed of a spine and five rays difficult to count without careful dissection. Prepectoral length 4.3 in s.l.; length of the fin 3.9 in s.l. Caudal fin forked, the lobes approximately equal.

In alcohol, the body is pale with some darkening dorsally. Pectoral fin and caudal lobes dusky. Vertical fins black.

Meristic Variations:—The classification of the species of *Pteraclis* remains nearly chaotic because of the rarity of adult Atlantic specimens and of Indo-Pacific representatives of all sizes. No comparative eval-

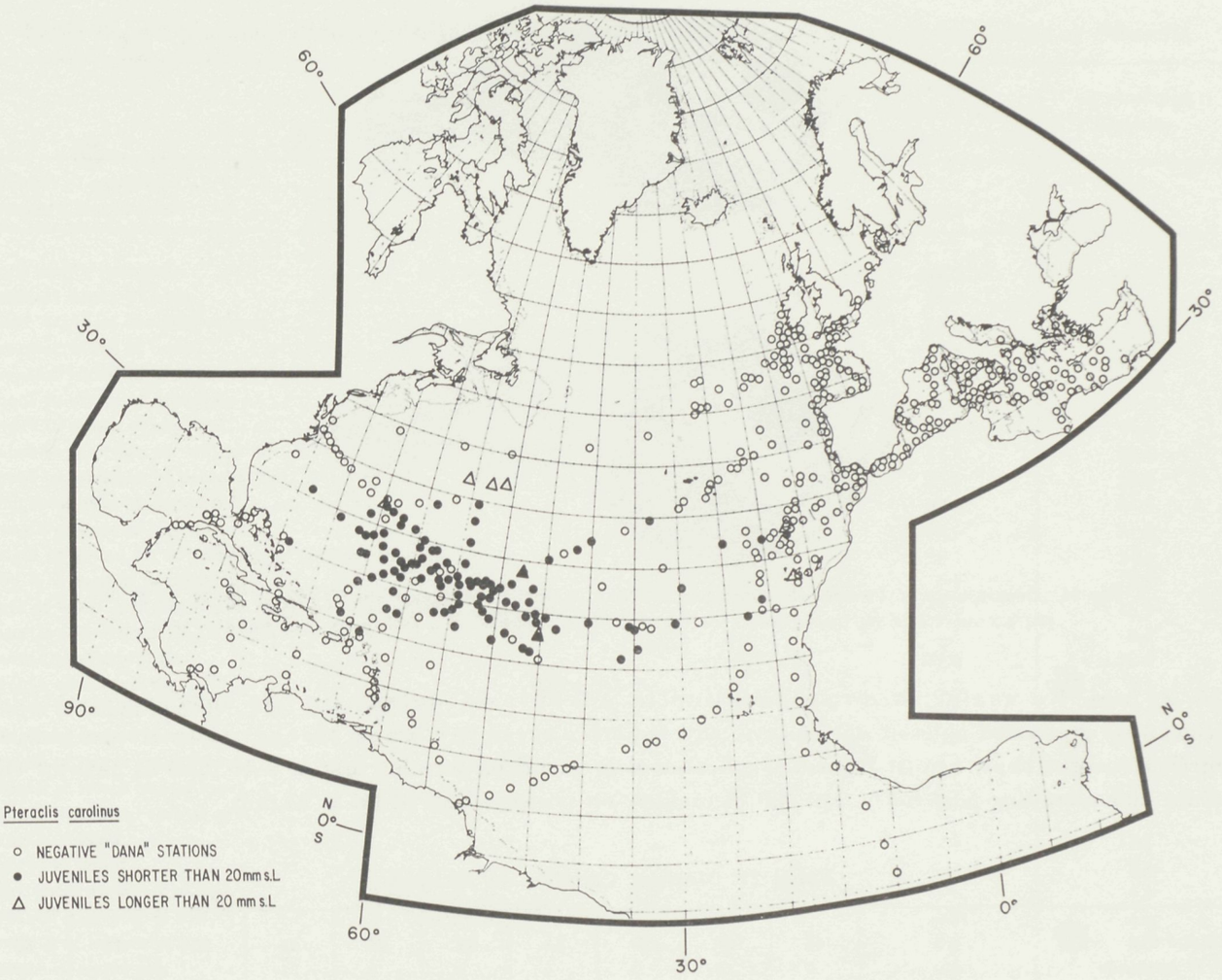


Fig. 53. Distribution of the North Atlantic *Pteraclis carolinus*.

uation of meristic variation has been possible. The abundant larvae and juveniles of *P. carolinus* caught by "Dana", however, permit at least an approximation of meristic variation in that species. Most of these "Dana" young are so small that the definitive number of serial elements has not formed or ossified. Through the examination of about 50 specimens 4.0–16.0 mm s.l. that were cleared and stained with alizarine, the approximate length at which each serial character ceases to increase in number could be estimated and the range of values, taken from individuals of greater length, determined. These ranges follow, the length in parentheses being the approximate length at which that character assumes the definitive number: D (8 mm) 48–54; A (7 mm) 42–47; P (6 mm) 18 or 19, rarely 20; V (7 mm) I-5; principal rays in caudal fin (8 mm) I-8-7-I; total caudal rays (8 mm) 25, rarely 26; branchiostegal rays (<4.0) 8; thoracic vertebrae 24 or 25, rarely 23; caudal vertebrae excluding urostylar apparatus 24–27; total vertebrae including urostyle (7 mm) 49–52; scales in horizontal series (10 mm) 50–54.

Distinctive Characteristics of Larvae and Juveniles:—The following combination of characters, the more important are given in expanded type, will distinguish the young of *Pteraclis carolinus* from those of other Atlantic bramids:

The high number of dorsal and anal rays, of branchiostegal rays, and of vertebrae (see above); origin of dorsal fin behind vertical of pectoral fin at 3.5 mm, progressing forward, with growth of fish, to lie over center of eye at about 14 mm and over or in advance of anterior edge of orbit at

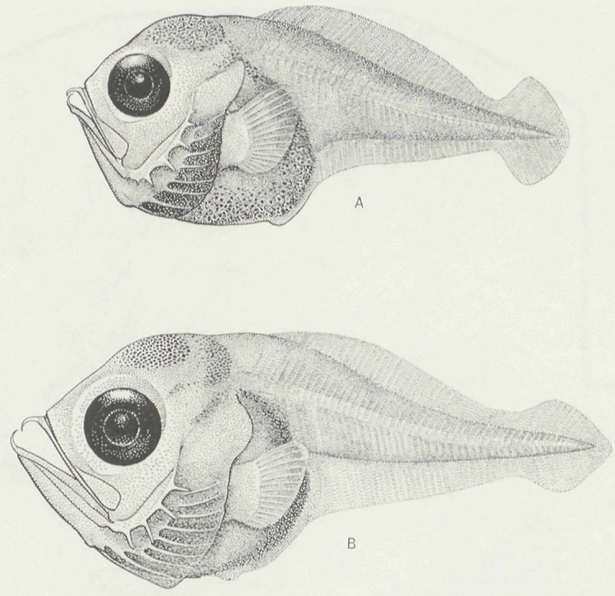


Fig. 54. Development of *Pteraclis carolinus*. (A) 3.5 mm s.l., from the Sargasso Sea (D-872; 27°07′ N, 63°21′ W). (B) 4.2 mm s.l., from the Sargasso Sea (D-883; 30°53′ N, 54°07′ W). Drawn by N. Strekalovsky.

20–24 mm. No scales in dorsal midline in advance of dorsal fin. No anterior dorsal lobe; about four graduated anterior dorsal rays; the fourth dorsal ray much thicker than its neighbors in fish longer than about 12 mm. Pigmentation in dorsal fin forming first at 8–10 mm, in anterior end of fin and spreading posteriorly, but still incomplete on posterior end of fin at 25 mm.

Table 21. Meristic variation in *Pteraclis*.

Dorsal Fin	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**
P. carolinus	2	2	2	1	4	3	1			
P. velifera							1	1	1	1
P. aesticola		1								
Anal Fin	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	
P. carolinus	2	1	3	3	3	1				
P. velifera						1	1	1	1	
P. aesticola		1								
Pectoral Fin				**18**	**19**	**20**				
P. carolinus				8	17	1				
P. velifera						5				
P. aesticola						1				
Thoracic Vertebrae			**20**	**21**	**22**	**23**	**24**	**25**		
P. carolinus						5	15	5		
P. velifera			2	2						
P. aesticola										
Abdominal Vertebrae (excluding urostyle)	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
P. carolinus	3	7	13	2						
P. velifera							2	1		1
P. aesticola										
Total Vertebrae (including urostyle)	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
P. carolinus					3	8	12	3		
P. velifera							1	1	1	1
P. aesticola	1									

Table 22. Proportional dimensions, in percent of standard length, of six adult specimens of *Pteraclis*.

	P. velifera, New Zealand	*P. aesticola*, Pacific of Baja California, S.I.O.	*P. carolinus*, Madeira
Number of specimens	4	1	1
Standard length (mm)	302.0–458.0	368.0	237.0
Fork length (percent)	105.8–107.0	102.2	109.0
Greatest depth of body	20.1– 21.7	21.0	23.4
Least depth of caudal peduncle	3.2– 3.6	3.5	4.0
Greatest width of body	5.2– 6.2	6.8	6.5
Greatest width of head	5.7– 6.7	6.5	7.2
Snout to origin of dorsal fin	3.8– 4.4	3.6	4.2
Snout to origin of anal fin	14.4– 18.1	15.7	14.8
Snout to insertion of ventral fin	11.4– 14.6	11.8	12.0
Snout to insertion of pectoral fin	20.5– 22.5	23.5	23.0
Length of base of dorsal fin	94.8–100.2	90.9	96.5
Length of base of anal fin	82.3– 90.0	78.0	81.6
Origin of dorsal fin to insertion of pectoral fin	22.5– 23.4	23.7	24.5
Width of base of pectoral fin	3.7– 4.1	3.9	4.0
Base of lower pectoral ray to insertion of ventral fin	13.2– 14.0	15.2	16.8
Insertion of ventral fin to origin of anal fin	3.5– 4.3	3.6	3.2
Length of pectoral fin	21.4– 25.2	20.9	25.9
Length of ventral fin	3.5– 4.7	2.3	4.2
Length of longest anal ray	66.8– 81.2	75.0	75.4
Length of longest dorsal ray	81.4– 92.3	80.0	91.0
Length of upper caudal lobe	15.1– 17.6	14.5	17.1
Length of lower caudal lobe	15.1– 16.8	17.8	17.1
Length of central caudal ray	5.3– 8.1	7.2	8.8
Length of head	18.5– 20.4	19.8	22.7
Length of snout	4.3– 4.6	5.4	4.8
Horizontal diameter of eye	4.3– 5.1	4.5	4.2
Greatest diameter of eye	4.6– 5.3	4.9	4.8
Breadth of interorbital	4.1– 4.3	5.2	5.7
Length of upper jaw	8.0– 8.9	9.6	9.3
Counts:			
Dorsal fin	54–57	–	–
Anal fin	47–50	50	52
Pectoral fin	20	20	18/19
Gill rakers on first arch (excluding tubercles)	1+1+5–6	1+1+7	1+1+5
Branchiostegal rays	7	8	8
Vertebrae	51–54	45	51
Scales in horizontal series between upper end of gill cleft and base of midcaudal ray	55–99	50	54

Origin of anal fin under posterior end of abdominal cavity at 3.5 mm, this origin advancing with growth so as to lie anterior to a vertical from the pectoral fin at about 6 mm. No anterior anal lobe. Pigmentation in anal fin first forming at 8–10 mm, in anterior part of fin, and spreading posteriorly. Last few rays still unpigmented at 25 mm.

Axis of base of pectoral fin nearly vertical at all sizes; insertion of ventral fin in advance of vertical from base of pectoral when ventral fin first formed, moving forward to lie beneath eye by 10 mm. Ventral fin extending beyond origin of anal at all sizes, the second ray becoming long and filamentous; the elements I-5 but difficult to count in unstained material because the spine is a short stout splint while the fourth and fifth rays are thin and hairlike. Ventral fin colorless below 10 mm, the pigmentation restricted to the distal end of the extended filamentous ray or rays between 10 and 25 mm. Caudal fin colorless at all sizes.

Scales of dorsal and anal fin sheaths visible at about 7.5 mm, these scales corresponding, one to one, with fin rays. Body scales apparent at about 7 mm; the spines on scales in the midlateral series of the caudal peduncle not larger than those in adjacent rows. Preopercular spines simple, of unequal length, and about 6 in number; gill membrane black at all sizes. Teeth confined to anterior half of each jaw at about 3.5–8 mm, 1–6 in number, these larval teeth heavy, recurved and directed outward; number of teeth in-

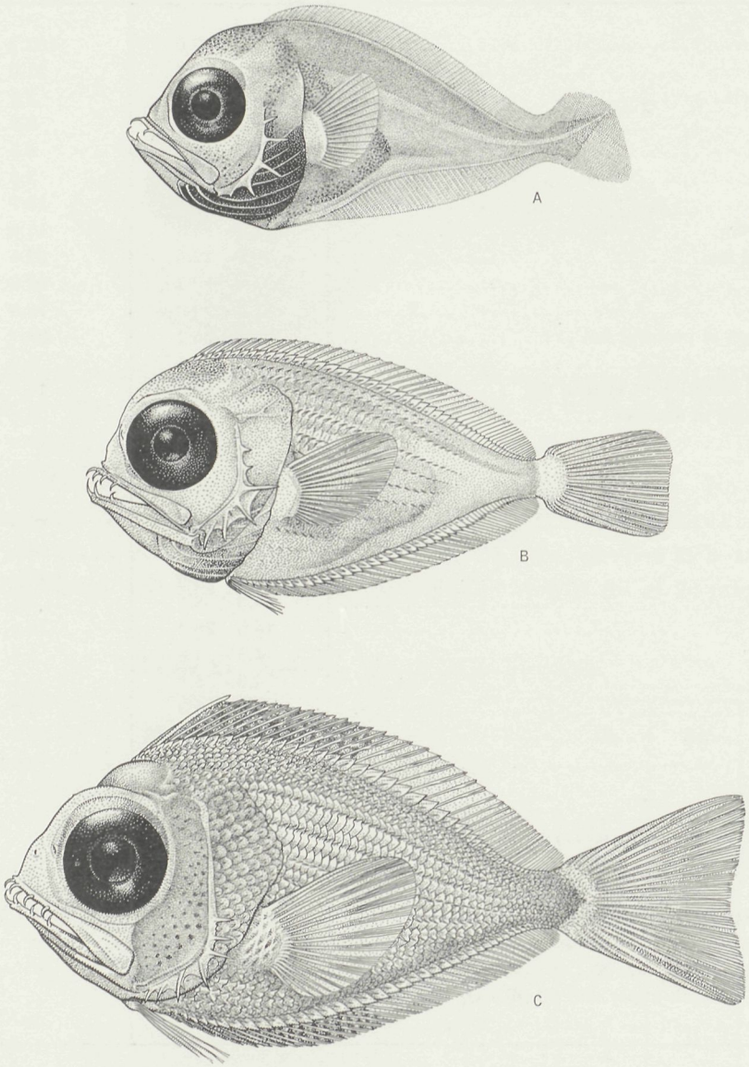


Fig. 55. Development of *Pteraclis carolinus*, continued. A, B, C not drawn to same scale. (A) 5.5 mm s.l. (D-855 XXIV; 29°15′ N, 59°45′ W). (B) 8.0 mm s.l. (D-858; 29°31′ N, 64°00′ W). (C) 10.0 mm s.l. (D-1331 XII, 26°37′ N, 55°50′ W). Drawn by N. Strekalovsky.

creasing rapidly above 10 mm; no teeth on vomer or palatine of any young, and the posterior part of the premaxillary is toothless.

Description of Young:—The "Dana" specimens range in length from about 3.5–24.6 mm. In the smaller of these, the urostyle is straight, the greatest depth of the head and body is somewhat less than half the body length, and the pigmentation, except for that of the eye, is confined to the head, branchiostegal membrane, and anterior parts of the body and the peritoneum. A pair of strong teeth has been found in the anterior end of both upper and lower jaws of all but the smallest individuals, but no food was found in the stomach of any fish of this size and the gut is distended with yolk. Ossification, using alizarine absorption as a criterion, is confined to the jaws and the tips of the anterior teeth, the parasphenoid and parts of the frontal, all cerato-

branchials and branchiostegal rays, parts of the basioccipitals and exoccipitals, and a few anterior vertebral centra, the pharyngeals with their pair of minute but ossified teeth, the preopercular and part of the hyomandibular, and the posttemporal and pectoral girdle except for the postcleithra and the pectoral radials. The development of ossification, other than that of the serial elements discussed above, was not followed further.

Elevation of the urostyle occurs variously between 4.8 and 6 mm, a growth interval also characterized by the apparent absorption of the yolk, a deepening of the body from less than half to slightly more than half

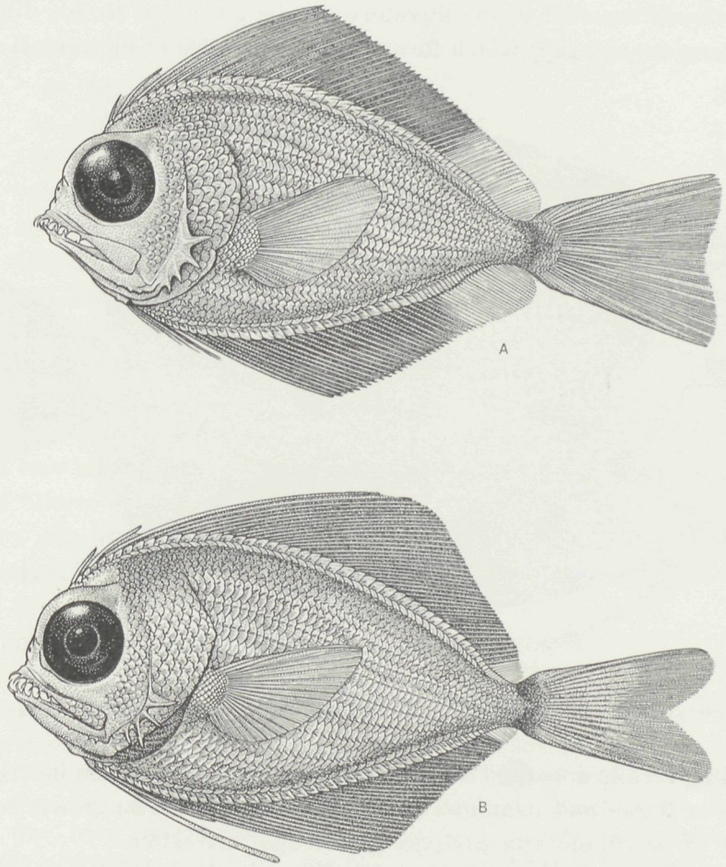


Fig. 56. Development of *Pteraclis carolinus*, continued. A, B not drawn to same scale. (A) 12.5 mm s.l. (D-1328 V; 27°05′ N, 52°11′ W). (B) 14.5 mm s.l. (D-938; 26°27′ N, 54°38′ W). Drawn by N. Strekalovsky.

of body length, the division of the fin fold into distinct vertical fins and the development of rays in all fins except the ventral, and a notable increase in pigmentation. The anterior half of the fish is now dusky and there are in some, although not all, specimens a few melanophores on the caudal peduncle above and below the first few preterminal vertebrae. The posterior point of the abdominal cavity is black, as is that in most bramids of comparable size; and the branchiostegal membrane in suitably preserved specimens is quite dark, again a feature diagnostic of young *Pteraclis*. (I have never seen a freshly caught young *Pteraclis*, but the prominence of this black gill membrane is suggested by the name given by William Beebe to *Pteraclis* when they were first found by him in the plankton taken south of Bermuda: the "black-gilled fishlet".)

The suggestion of scale pockets can be seen in some individuals as small as 5.8 mm. The development of squamation, however, is so irregular that no account will be attempted. The order of development, which is complete in most individuals at lengths below 10 mm, is more regular. First to form are the scales lying on the flank in the vicinity of the pectoral fin. This patch spreads posteriorly. Simultaneously, scales begin to form along the anterior end of the base of the dorsal, and later (at ca. 8–9 mm) in that of the anal fin.

The last scales to form are those of the cheek, and the areas near the mid-dorsal and mid-ventral lines above and below the caudal peduncle. All scales of the flank, head and fin sheaths bear strong pointed spines, and these spines, in contrast to those of some bramid species, are all retrorse.

The development of most fins can be seen in figures 54–57, but a word on that of the ventral fin is in order. This fin develops relatively late. It is completely absent in fish as large as 6.5 mm and not until a length of about 7.0 mm can the definitive count be ascertained consistently even in stained preparations. Beyond that length, the elements invariably number six, a spine, and five soft and divided rays. The spine is minute and splint-like, much shorter than the soft rays in larger juveniles and somewhat difficult to find. It seems likely that some of the lesser counts reported in the literature can be attributed to this difficulty. It is the second element (the first, or outermost, soft ray) which forms the leading edge of the ventral fin and which becomes

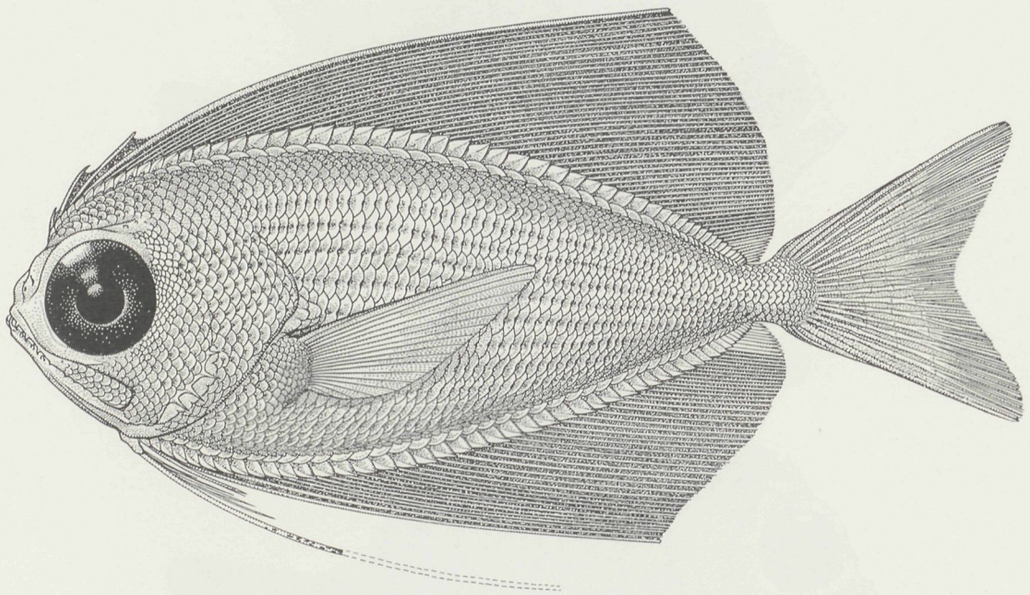


Fig. 57. Juvenile *Pteraclis carolinus*, 24.6 mm s.l. (D-1362 IV, 28°57′ N, 47°24′ W). Drawn by N. Strekalovsky.

long and filamentous with juvenile growth. This ray spans the distance between its origin and that of the anal fin at a fish length of 8 or 9 mm and continues its disproportionately fast growth to become about half as long as the fish itself at 18 or 20 mm and perhaps even longer thereafter.

Ossification of the rays of the dorsal and anal fins proceeds from the anteriormost to the posterior elements, but at lengths below about 11 mm the posterior rays are considerably longer than the anterior. At about 11 mm the anterior rays exceed the posterior in length and that anterior ray which forms the leading edge of most of the fin, usually the fourth ray, begins to thicken.

Between 10 mm and the largest juvenile in the "Dana" series (24.6 mm) *Pteraclis carolinus* assumes a more reasonable adult appearance through the relative reduction in size of eye, length of head and depth of body, and prominence of preopercular spines, and the increase in number and regularity in serial arrangement of the teeth. Pigmentation proceeds caudad, so that progressively larger parts of the body and vertical fins become colored. Pigmentation of the posterior parts of the body takes place before that of the adjacent fins, and the transition from pigmented to unpigmented area is more gradual. That in the dorsal and anal fins is most pronounced, and the dark anterior part of the fin stands in marked contrast to the clear posterior section. The center of pigmentation on the caudal peduncle overlying the preterminal vertebrae, first seen in some 6–8 mm specimens, spreads forward to join the developing pigment of the flank. That part of the tail adjacent to the bases of the caudal fin rays, and the caudal fin itself, are unpigmented at least until the fish approaches 20 mm in length, a condition similar to that seen in *Taractichthys* and *Pterycombus* as well but not in *Brama*.

Three specimens caught by "Atlantis I" east of Bermuda extend the size series available from 27.0 to 41.3 mm. The only notable features shown by these larger specimens are the extension of coloration to the distal edge of the gill membrane and onto the caudal fin, and the further elongation of the ventral fin which, at 30 mm, reaches a vertical from the end of the pectoral fin although it is relatively shorter, perhaps because of breakage, in the largest 41.3 mm, specimen.

Depth Distribution of Young:—Larvae and juveniles are most abundant near the surface (0–50 m, or depths corresponding to less than 100 m.w.o.) but occur down to 400 m and perhaps below. There appears to be little stratification by fish length or by abundance below 50 m and the catches per S-200 hour are as follows:

m.w.o.	fish per S-200 hour
0– 49	3.8
50– 99	3.0
100–149	1.6
150–199	1.5
200–299	1.2
300–399	1.1
400–499	1.6
500–599	1.1
600–799	1.3

Range:—The species is known principally from the Sargasso Sea and is abundant there as larvae and juveniles (Fig. 53). It is rare but recorded from the eastern Atlantic as far as Madeira (Lütken, 1880; Lowe, 1843; Mead, 1964; and "Dana" collections). If the "Walther Herwig" catch is conspecific, the range includes part of the southwestern Atlantic (see "Study Material" above). Young have been taken during all months of the year except November, December and January, but are apparently most abundant from March through June.

Vernacular:—"Fanfish", an appropriate name of unknown origin.

Synonyms and References.

Pteraclis carolinus Valenciennes, *in* Cuvier and Valenciennes, 1833:368–369 (Orig. descr.; type coll. by Bosc from "Caroline"; type in MNHN, 91.5 mm, seen); Richardson, 1836:83 (ref. to his "fourth tribe of Scombroideae"; Atlantic, presumably from Cuv. and Val., 1831); Günther, 1860:411 (diagnosis, from Cuv. and Val.); Lütken, 1880:502, pl. 4, fig. 3 (juv. from central Atlantic descr.; spec. seen; recorded by auth. as "*Pteraclis* sp."); Jordan and Gilbert, 1883:455–456 (descr. from Cuv. and Val., "coast of South Carolina"); Jordan and Evermann, 1896:956 (part, descr., from Cuv. and Val., 1833, not the spec. of Goode and Bean, 1896); Jordan, 1919 (noted, from Cuv. and Val.; retained in *Pteraclis*); Jordan, Evermann and Clark, 1930:266 (listed for coast of S Carolina after Cuv. and Val.; *P. trichipterus* listed as synon.).

Pteraclis papilio Lowe, 1843:83 (orig. descr., no fig.; type lost); Lowe, 1844:391 (redescr. from Lowe, 1843); Günther, 1860:410–411 (diagnosis, from Lowe, 1843); Jordan, 1919 (suggested inclusion within *Bentenia*); Noronha and Sarmento, 1948:152 (rec. for Madeira apparently based on Lowe, 1843); Albuquerque, 1954–56 (Madeira, the rec. again that of Lowe, 1843).

Pteraclis velifera (Pallas, 1769).

Plate 8; Figure 58.

Study Material:—I have seen four adults, 302–458 mm s.l., that were stranded or cast ashore in New Zealand and are now in the Dominion Museum, Wellington; three small juveniles from the "Dana" collections (Appendix Table 28); and an additional 12.0 mm juvenile tentatively referred here that was taken by R. V. "Anton Bruun" in the Indian Ocean during Cruise 3, International Indian Ocean Expedition (Sta. AE 26B; 5–6 IX 63; 25°52′ S, 60°00′ E to 26°07′ S, 60°07′ E; 0–1420 m, 10-ft IKMT). Two additional specimens, both old and in very poor condition, were examined in the Paris Museum. These are the 53.8 mm

Pteraclis ocellatus of VALENCIENNES which was collected by QUOY and GAIMARD off Mozambique; and the ca. 81 mm specimen, which has almost completely disintegrated and is of unknown origin, that was collected by QUOY and GAIMARD and described by VALENCIENNES as *Pteraclis trichipterus.*

Distinctive Characters:—See "Synopsis of Species", p. 107.

Description of Adult:—Proportional dimensions, in per cent of standard length (taking as the anterior point of such length the tip of the upper jaws at the anterior end of the premaxillaries, not a point on

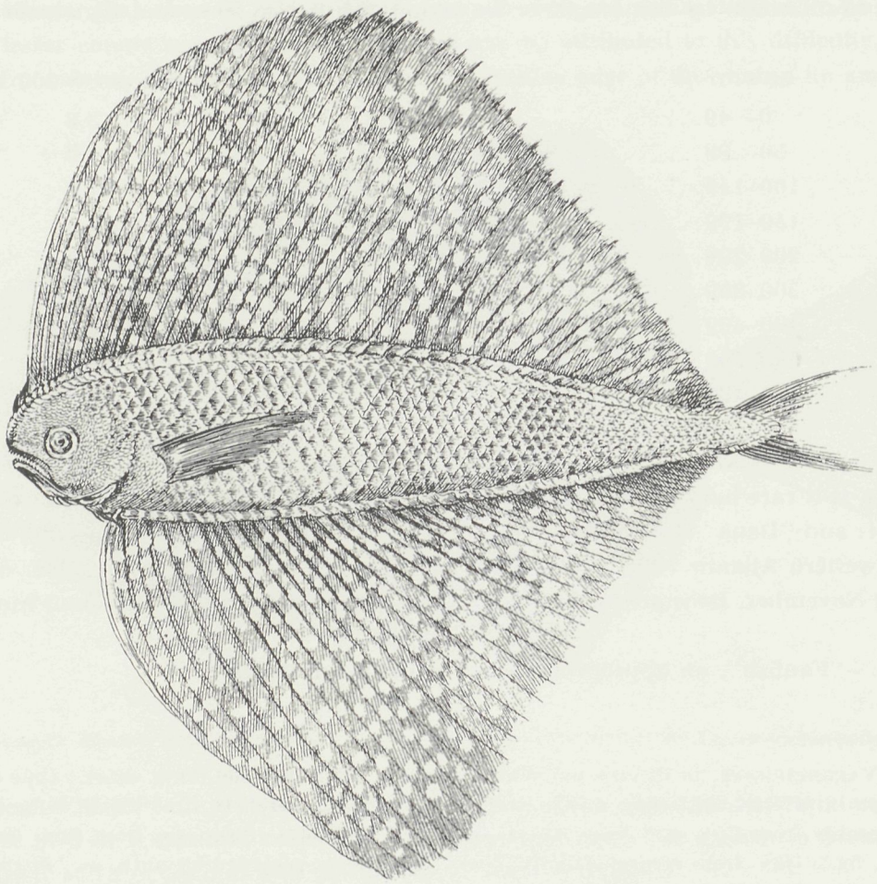


Fig. 58. Type of *Pteraclis velifera* (from PALLAS: 1769).

the forehead, which is frequently terminal) and counts taken from the four New Zealand adults are recorded in Table 22.

Body strongly compressed, its greatest depth three or four times its thickness; the head slightly thicker than the body. Greatest depth of body, at base of pectoral fin, 4.6–5.0 in s.l.

Head and body, except for lower jaw and snout ahead of eye, covered by thin adherent scales with irregular, but not spinulose, free edges and short vertical spines. Base of caudal and pectoral fins with scales which are similar but smaller and spineless. Tips of caudal lobes, all but bases of pectoral fins, and ventral fins without scales. Vertical fins naked, their bases lined by sheaths of body scales which form grooves for the reception of these fins when they are depressed. About 55 to 59 scales in a horizontal series from upper end of gill cleft to base of midcaudal ray. Lateral line present anteriorly but indistinct. No modified axillary scales beneath paired fins.

Contour of snout variable and rising vertically from symphysis of premaxillary or somewhat inclined posteriorly or anteriorly, the forehead rather than the jaws being terminal in the latter instance. Length of snout 4.0–4.5 in head. Nostrils on the same horizontal, circular, the posterior nostril nearer the anterior

than the edge of orbit, the nostrils separated from each other by a distance slightly less than the greatest width of the maxillary. Eye irregular in size and outline, the oblique axis usually greater than the horizontal, which is 3.9–4.3 in length of head. Midpoint of eye on a horizontal with tip of upper jaw. Tip of lower jaw extending well anterior to upper with mouth open; coterminal with it or nearly so with mouth closed. Teeth of upper and lower jaws similar in size and shape, conical and recurved. Those on mandible in two rows; those of premaxillary in a band which is broader anteriorly than posteriorly. Three or four similar teeth usually but not invariably present on vomer (sometimes superficially obscured by the broad sheet of skin roofing the anterior part of the mouth); five or six, lying in a row, on the palatine. Symphyses of both jaws without teeth; anterior ends of premaxillaries broadly separate from one another. Tongue toothless save for forward extensions of the spine-like structures on the gill arches. Pharyngeals strongly toothed.

Gill openings long, extending forward to beneath anterior third of eye. Gill membrane joined to the isthmus and to each other anteriorly but not overlapping. Branchiostegal rays seven or, according to the accounts of Whitley and Barnard, eight. A few (0 or 1 + 1 + 5 or 6) short gill rakers on first arch about a third the length of the opposite gill filament, and of the usual lath-like shape. Above and below these, and on the successive arches, occur patches or rows of spinulose platlets. Gill flaps thin, the free edges of the opercular bones smooth.

Dorsal fin beginning on snout above tip of premaxillary, on a horizontal with, or a little above, upper edge of orbit, its origin covered by the scaly sheath with which the base of the entire fin is flanked. Anterior three rays thick but shorter than the length of upper jaw; the fourth both thick and long, the remainder thin and hair-like. Dorsal rays increasing in length to the 11th to 14th, which is 1.1 or 1.2 in s.l. Length of base of dorsal slightly less to a little more than s.l. (We have here the anomalous situation in which the base of a dorsal fin is "longer" than the standard length of the fish. In *Pteraclis*, the pitch of the forehead is variable. If "standard length" is taken from the tip of the upper jaw, in an individual in which the forehead is inclined strongly forward, the origin of the dorsal fin is well anterior to the anterior point of the "standard length" measurement. The discrepancy is not wholly offset by the short distance between posterior termination of dorsal fin and base of midcaudal rays.) Ray decreasing in length posteriorly. Rays simple except for the last and, questionably, the two in advance of it.

Anal fin similar in shape, originating under or slightly in advance of operculum, the first ray thick and short, the second thicker and long, and all successive rays filamentous. Longest anal ray, the fifth or sixth, 1.2–1.5 in s.l. All rays, except for the last, and questionably, the one ahead of it, unbranched. Both dorsal and anal fins fully hidden within the scaly sheath when depressed.

Ventral fin short, the longest ray reaching to or beyond the origin of the anal fin and less than twice as long as diameter of eye. Ventral fin rays apparently I-3 or I-4, filamentous and weak; but if stained juveniles were examined, a count of I-5 would not be astonishing (cf. stained specimens of *P. carolinus*). Pectoral fin pointed and inserted on a level with lower third of eye, its base forming an angle of about 45° with the horizontal. Prepectoral distance 4.5–4.9 in s.l., the length of the fin 4.1–4.7 in s.l. Central pectoral rays branched, the upper and lower simple. Caudal fin relatively small and forked, the lobes equal in length or nearly so.

Anus located closer to base of ventral rays than to anal origin; both anus and its associated papilla lie within the forward extension of the sheaths of scales bordering the base of the anal fin.

The preserved specimens are dark brown, tending toward black dorsally, on the snout and on the base of the pectoral fin, and on the eye. Mouth and pharynx colorless. Vertical fins black, with clear spots that are variable in intesity and placement.

If *Pteraclis velifera australiae* from New South Wales is conspecific, as is assumed here, fresh specimens can be described thus: "general colour frosty silvery, luminous in the dark. Fins dark blue, with pale turquoise spots posteriorly; eye very dark blue with a silvery iris," (Whitley, 1935). While the silvery sides and blue dorsal and anal are in accord with other descriptions of fresh material (Smith, 1949, pl. 67, fig. 87; Noble and Blodgett, 1952; and an unpublished color photograph of a New Zealand fish supplied by J. A. F. Garrick), these fishes are probably not bioluminescent.

Range:—Southern hemisphere, southwestern Pacific to Australia and New Zealand and through the Indian Ocean to South Africa.

Synonyms and References.

Coryphaena velifera Pallas, 1769:19–24, pl. 3, fig. 1 (orig. descr., good fig.; Australian Indian Ocean); Bonnaterre, 1788:60–61, pl. 34, fig. 128 (descr. and fig. from Pallas); Linnaeus (Gmelin), 1789:1193–1194 (descr., after Pallas, 1769).

Pteraclis pinnata, Gronow, 1772:43–47, fig. 1 (descr., Indian Ocean; fig. which is not that of Pallas); Gray, 1854: 170–171 (descr., from Gronow, 1772).

Oligopodus veliferus, Lacépède, 1800:509–515 (descr. from Pallas, 1769, and Bonnaterre, 1788).

Pteraclis velifera, Oken, 1816:23 (listed only, with generic synonyms); Schinz, 1822:527–528 (descr., from Pallas, 1769); Cuvier, 1834:206, pl. 32, fig. 2 (part, listed, from Pallas but attributed to the Carolinas: "Bosc assures us that he caught it in Carolina; Pallas says that his is from the Molluccas. They may be different species."); Günther, 1860:411 (synon., diagnosis from Pallas); Ogilby, 1893:65 (recorded New Zealand spec. in Australian Mus., no descr.); Hutton, 1904:44 (listed for New Zealand); Waite, 1907:25 (listed for New Zealand); Jordan, 1919; pl. 55 (diag. of genus; fig. from Bonnaterre, synon.); Barnard, 1927:598 (descr. from old spec. taken in St. Helena Bay, S Africa; said to be referable to Jordan's *Bentenia*, with one spine in dorsal and anal enlarged); Phillipps, 1927:13, 35 (listed as rare for New Zealand; synon.; vernacular: bat-fish); J. L. B. Smith, 1949:313, pl. 67 (color notes and fig., 20-in. spec. from off E London, S Africa; rec. from off Mozambique and from "west coast"); Smith, 1949:313, pl. 67, fig. 870 (S Africa); McCann, 1953:10–12 (figs. and descr., New Zealand; *Pterycombus falcatus* erroneously presumed to be the male); ?Haedrich and Nielsen, 1967:915 (as *Pteraclis* sp., from tuna stomach).

Pteraclis ocellatus Valenciennes, *in* Cuvier and Valenciennes, 1833:363–367 (orig. descr.; Mozambique; type in MNHN seen, 53.8 mm s.l.); Valenciennes, 1841, pl. 66, fig. 2 and unnumb. text (color fig. and detail of scales; "de la Mer des Indes"; text p. 145 ref. to *P. velifera* Pallas); Günther, 1860:411 (diagnosis, from Cuv. and Val., 1833); Bleeker, 1874:98 (listed only, for Madagascar and Mozambique); Sauvage, 1891:518 (listed, from Cuv. and Val., for Madagascar); Barnard, 1927:597–598 (rec., from Cuv. and Val., 1831; Mozambique Channel); Fowler, 1936:1279 (*Pteraclis ocellatus* Swainson given as type of *Pteraclis* Gronow, by monotypy; I fail to see why, for Swainson, 1839:47–48 referred only to "*Pteraclis* sp." and the type species, *Coryphaena velifera* Pallas, had been fixed long before Fowler).

Pteraclis trichipterus Valenciennes, *in* Cuvier and Valenciennes, 1833:367 (orig. descr.; no loc. but probably Indo-Pacific as it was coll. by Quoy and Gaimard; spec. ca. 81 mm s.l. in MNHN, seen; very poor condition); Bleeker, 1874:98 (listed only for Madagascar, Borbonia).

Pteraclis trichipterus vel *ocellatus*, Guichenot, 1863:26 (listed only for Reunion I.; probably from Cuv. and Val. specimen in Paris).

Pteraclis trichopterus, Sauvage, 1891:518 (listed for Madagascar; presumably the *P. trichipterus* of Cuv. and Val., 1833).

Pteraclis (*Bentenia*) sp., Whitley, 1931:146–147 (rec. and descr. New Zealand spec. in Australian Mus.).

Pteraclis velifera australiae Whitley, 1935:238–239 (orig. descr., no fig.; 450 mm female from Port Jackson, New South Wales; type in Australian Mus.); Whitley, 1964:44 (in check list of Australian fishes).

Pteraclis aesticola (Jordan and Snyder, 1901).

Plate 9.

Study Material:—I am positive of the identication of none of the material examined and have seen none from the western Pacific, the type locality. The specimens provisionally placed here, none from the "Dana" cruises, are recorded in Appendix Table 29.

Distinguishing Characters:—See "Synopsis of Species", p. 107.

Description:—As this species is variable, the identity of Pacific material uncertain, and adults from the type locality unavailable, I repeat here the figure and the description of Tanaka (1927:770–775, pl. 167; our Pl. 9) which was based on the specimen designated neotype by Kuronuma (1941:55):

"Head 4.94 in length without caudal; depth exclusive of sheath of vertical fins 4.64; same inclusive of the sheath 3.75; longest rays of pectoral 4.64; orbit 3.8 in head; interorbital 5.64; snout 5.64; postorbital part of head 1.98; depth of caudal peduncle 6.58; maxillary 2.19; breadth of its distal extremity 11.3; mandible 1.97; upper rays of caudal 1.36. B 7; D about L; A about XLIII; P 1.14; V 5; C 3, 1, 15, 1, 3; scales in a

longitudinal series from upper end of gill opening to base of caudal 51; in a transverse series at the deepest part of body 2 (on sheath), 8, 2 (on sheath).

Body oblong-elongate, very much compressed, very thin, abruptly tapering posteriorly; caudal peduncle very short, slender, much compressed; upper and lower outlines almost equally curved, but the latter much more strongly so in front of base of pectoral. Head shortish, with very gently curved profile which declines almost vertically downward on anterior part of snout; eye large, lateral, its posterior border a little nearer posterior border of opercle than tip of snout; interorbital very prominent, somewhat keel-like; snout shortish, somewhat overlapping the upper lip by the abrupt vertical declining of its anterior part; nostrils two, anterior one more circular and a little larger; preorbital very narrow; maxillary extending below middle of eye. Mouth directed very obliquely upward; lower jaw much projecting beyond the upper when the mouth is open, but scarcely so when it is closed; jaws laterally with two rows of slender, slightly curved, pointed teeth, the band a little broadened near tip; vomer and palatines with a few similar teeth; tongue smooth; preopercle broadly rounded, with smooth edges; opercle with very broadly rounded flap. Gill openings very wide, continued forward below; the membranes separate, free from isthmus; gills 4, a slit behind the last; pseudobranchiae very well developed; gill rakers on first gill arch flattened from side to side, spinose, pointed, 1 (besides several rudiments) + 7 (besides about 13 rudiments) in number, even the longest short, 3.47 in diameter of orbit. Dorsal inserted above middle of snout, its rays all unarticulated, very long, hair-like, anteriormost three rays very short, the fourth much stouter than the others; anal inserted a little behind posterior border of eye, its rays also unarticulated, first ray stout but very short; second also stout, the rest similar in form and structure to most rays of dorsal, rays of both fins reaching a little beyond the base of caudal when laid posteriorly; pectoral low down, unsymmetrical in form, pointed but not falcate, upper rays much longer, its longest rays a little longer than length of head; ventrals close together, very short, jugular in position and in front of anal, the distance from their origin to that of anal 1.3 in orbit diameter, rays themselves 3.47 in same; vent farther distant from the origin of ventral than from that of anal, but nearer to tip of the former fin than to the latter; caudal deeply forked. Scales rather large, thin, firm, each scale with many parallel striæ; both dorsal and anal with well developed scaly sheath; head including maxillary closely scaled, except lower jaw and chin, which are naked; chin medianly with a longitudinal strip of scales in a single row; lateral line obsolete; anterior part of snout and lower jaw with many muciferous pores.

Color in formalin grayish with silvery iridescence, much whiter below, both dorsal and anal dark black, leaving rays pale; pectoral and caudal dark dusky, lower part of the former and posterior margin of the latter pale; ventral pale.

Described and figured from a specimen 430 mm long as measured to tip of upper lobe of caudal, secured near Odawara, Prov. Sagami, by the Kanagawaken Fisheries Experiment Station."

Range:—The species probably occurs throughout the northern and southeastern Pacific (Fig. 51).

Common Names:—"Fanfish" (North America); Benten-uwo (Japan).

Synonyms and References.

Bentenia aesticola Jordan and Snyder, 1901:306, pl. 16, fig. 6 (orig. descr. and photog.; Kuroshio current off Kashima near Mito, Hitachi, Japan; 18-in. type lost by fire according to Tanaka, 1927:775); Jordan, Tanaka and Snyder, 1913:133 (listed, from Jordan and Snyder, 1901; vernacular: "benten-uwo"); Jordan, 1919 (in key; diagnosis, fig.); Okada, 1938:172 (listed for Honshu and Shikoku, Japan); Kuronuma, 1941:50–56, pl. 1 (diagnosis and descr. genus and species; fig.; rec. Onahama, Fukushima Pref. and Nabeta, Shimoda-wan, Izu Penn., Japan; 171 mm s.l.; comp. with Tanaka, 1927, spec.); Matsubara, 1955:542, pl. 49 (diagnosis in Japanese; fig. from Kuronuma, 1941); Tomiyama and Abe, *in* Tomiyama, Abe and Tokioka, 1958:223 (fig.; descr. in Japanese); Tanaka, 1927:770–775, pl. 167 (fig., descr., synon.; 430 mm spec. from off Onahama, Japan); Kamohara, 1938:23 (rep. 450 mm spec. from off Susaki, Japan); Kamohara, 1952:34 (same spec.); Iversen, 1962:481 (spec. from albacore stom., central Pacific).

Pteraclis velifera, Noble and Blodgett, 1952:565–566 (51 cm spec. caught by surf-fisherman, Sept. 1951, San Luis Obispo Co., Calif.; fig. and descr.); Kamohara, 1958:26 (listed, with range: Mie Pref. to Kochi and Tottori Pref. to Korea); Gosline and Brock, 1960:180 (single spec. recorded from Hawaii: ca. 4-in. taken from stom. *Katsuwonus pelamis* caught off Hilo, Hawaii); Berry and Perkins, 1966:673 (rec. 9.5 mm spec. from midwater trawl fished off Baja California).

SUMMARY

A provisional classification of the Bramidae, an oceanic family of acanthopterygian fishes, has been developed from a study of most existing material and relevant literature. The analysis was based in large measure on juveniles and an attempt, partially successful, was made to identify juveniles with their generally dissimilar adult forms. Identifiable larval and juvenile forms were described and figured. Such natural history notes as could be inferred with reasonable confidence from taxonomic and distributional data were included, as were the vernacular names in current use and extensive although not exhaustive synonymies.

The bramid species were allocated among six genera: *Eumegistus, Taractes, Brama, Taractichthys, Pterycombus* and *Pteraclis.* The phyletic unity of these six remains in doubt and this question, together with that of the origin of the group, deserves further study.

Eumegistus, apparently the most primitive genus, appears to be a deep water shelf species, is probably benthic, and is confined to the waters around large islands. Both adults and young are uncommon. *E. brevorti* (Poey) is known from off Cuba; *E. illustris* Jordan and Jordan from the western and central Pacific.

Taractes rubescens (Jordan and Evermann) and *T. asper* Lowe are sympatric, circumtropical, and oceanic species that, together with *Taractichthys,* are both large and relatively uncommon. Larvae are rare; juveniles are more common. Distributional circumstances suggest that both prefer water warmer than 10°C. The genus is of some commercial importance although at present it is caught only incidentally.

Prior to this study the nominal species of *Brama* were considered to be conspecific. While the analysis developed here is unsatisfactory, it is, however, clear that *Brama* includes two species complexes. *Brama brama* Bonnaterre, a commercial species off Spain, is bipolar in distribution in the Atlantic, occurs in the temperate South Pacific, and is replaced in the temperate North Pacific by *B. japonica* Hilgendorf. A third member of this complex is described, but not named, from adult material from the temperate South Pacific. All of these species are large and have their pectoral fins set relatively low on the body. The second complex, tropical forms, include the pseudopelagic allopatric species pair *B. caribbea* Mead and *B. orcini* Cuvier; the circumtropical and variable *B. dussumieri* Cuvier; and the central Pacific *B. myersi* Mead. All are small and relatively abundant as juveniles.

The Indo-Pacific *Taractichthys steindachneri* (Döderlein) and the Atlantic *T. longipinnis* (Lowe) differ but slightly and the juveniles, here described, are indistinguishable from one another. Young are uncommon. The adults are large, possibly schooling fishes that are now taken incidental to the tuna fisheries.

The two allopatric species of the fanfish genus *Pterycombus, P. brama* Fries and *P. petersii* (Hilgendorf), appear to be pseudopelagic, for they characteristically are found off the continental shelves rather than on the high seas. Larval and juvenile stages of the former are described, chiefly from material from the Caribbean and the Gulf Stream.

Adults of the second genus of fanfishes, *Pteraclis,* are too few to permit an adequate definition of the species. The Atlantic population, confidently identified with *P. carolinus* Valenciennes, spawns in the Sargasso Sea and the abundant juveniles in the "Dana" collections are described. The Indo-Pacific material, small in quantity, is allocated somewhat arbitrarily to *P. velifera* Pallas and *P. aesticola* (Jordan and Snyder).

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APPENDIX TABLES 1–29

Appendix Table 1. Specimens of *Taractes rubescens* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M.W.O.	Latitude	Longitude
3558 V.....	1	38.5	18 IX 28	1000	0°18′ S	99°07′ W
4005 XI.....	1	24.5	12 III 30	50	13°31′ N	18°03′ W

Appendix Table 2. Specimens of *Taractes rubescens* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
E. L. Diaz	–	1	115.5	13 II 64	E. Pacific, Cadillac Bank, 03°19′ N, 90°50′ W	Stomach contents (SIO)
"Sirocco"	–	1	690.0	–	ca. south of Mississippi R. delta, Gulf of Mexico	Longline (MCZ)
"Oregon"	1473	1	51.3	26 III 56	Gulf of Mexico; 24°48′ N, 91°40′ W	Stomach of *Alepisaurus*
–	–	1	96.0	–	Off Pensacola, Florida; Gulf of Mexico	Stomach of red snapper (holotype, USNM)
"H. M. Smith"	–	1	27.5	17 V 50	Off Upolu Point, Hawaii	Stomach of pelagic octopod, *Elodonella*, which in turn was taken from stomach of *Alepisaurus*
"Geronimo" Cr. 2	153	1	32.0	21 VIII 63	06°05′ S, 10°43′ E	IKMT (TABL)
"Geronimo" Cr. 2	236	1	136.0	8 IX 63	04°03′ S, 10°22′ E	IKMT (TABL)
"Calamar" Cr. 67-1	16	1	590.0	26 I 67	11°58′ N, 61°06′ W	Longline (MCZ, from W. Rathjen)
"Anton Bruun" Cr. 16	620C	1	42.0	27 V 66	02°16′ S, 88°47′ W to 02°26′ S, 88°46′ W	IKMT; 0-300-0 m (MCZ)

Appendix Table 3. Specimens of *Taractes asper* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M.W.O.	Latitude	Longitude
941.....	1	30.0	21 IV 21	1000	27°31′ N	59°52′ W
947.....	1	14.9	27 IV 21	900	23°10′ N	66°15′ W
3722 IV.....	1	10.0	29 V 29	100	25°11′ N	122°35′ E
3733 II.....	1	9.1	26 VI 29	600	13°32′ N	121°21′ E

Appendix Table 4. Study specimens of *Taractes asper* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
–	–	1	334	1860	Vargefjord, off Alten, Finmark	Live caught; type of *T. raschi*; COLLETT, 1875:46 (Oslo Mus.)
–	–	1	403	before 1861	Vargefjord, off Alten, Finmark	Live caught; ESMARK, 1862; COLLIN, 1874:418
–	–	1	450	IX 1870	Vestmannaeyjar I., Iceland	Washed ashore by southeast gale; COLLIN, 1874 (UZM)
–	–	1	278	IX 1870	Vestmannaeyjar I., Iceland	Stranded (UZM)
–	–	1	137	V 27	Madeira	Stomach of *Aphanopus carbo* caught on longline; type of *Trachyberyx barretoi* ROULE (Monaco Mus.)
–	–	1	301	18 VI 51	Tampen, Norway	Stranded (Zool. Mus., Univ. Bergen)
T. Abe	–	2	383, 400	XII 55	Pacific; ca. 30° N, 145° W	Tokyo market; commercial landings (ABE 55-137/8; MCZ)
T. Abe	–	1	280	–	Ryotsu Bay, Sado I., off Nigata, Japan	–
–	–	1	308	24 I 59	Vindafjord, Co. Rogaland, Norway; 59°27′ N, 6°01′ E	Bottom trawl; HOLGERSEN, 1959: 129, 1961 (Stavanger Mus.)
–	–	1	69.5	VII 59	Off California, 33°10′ N, 122°25′ W	Albacore stomach; RADOVICH, 1961 (UCLA)
–	–	1	169	1960	Off Ninomiya, Sagami Bay, Japan	Handline, 750 ft over 2000 (ABE 1960–1720; MCZ)
"Chain" Cr. 17	RHB 806	1	15.6	3–4 V 61	13°28′ N, 32°48′ W to 13°36′ N, 33°00′ W	IKMT; 0–39 fms (MCZ)
–	–	1	19.0	20 VIII 62	Off South Africa; 25°00′ S, 39°35′ E	IKMT; 300 fms (SAM)
–	–	3	19.0–46.4	23 VIII 62	Off South Africa; 37°30′ S, 31°45′ E	IKMT; 200 fms (SAM)
–	–	1	270	–	Off Vigo, Spain	Longline; from commercial *Brama* fishery
–	–	3	345–367*	–	Off northwestern Spain	Longline *Brama* fishery; ARTÉ, 1952 (1 in MCZ)
–	–	2	55.0, 55.7	–	Madeira	Stomachs of *Alepisaurus* and *Aphanopus* caught by longline (MMF 3324; BM, NH)
–	–	1	398	–	"Japanese Seas"	Commercial landings, Tokyo market (ABE 50-1498; MCZ)

Appendix Table 5. North Atlantic specimens of *Brama brama* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
829	1	20.8	13 IV 20	300	25°07′ N	19°20′ W
830	3	5.8–13.0	15 IV 20	50	24°44′ N	22°32′ W
830	3	7.3–8.6	„	100	„	„
1119 IV	1	11.2	23 IX 21	50	36°08′ N	0°30′ W
1122 I	2	7.0, 11.9	25 IX 21	150	37°12′ N	1°08′ E
1122 II	1	10.4	„	200	„	„
1122 III	1	8.5	„	150	„	„
1122 IV	1	10.3	„	100	„	„
1122 V	1	8.1	26 IX 21	300	„	„
1122 VI	1	11.9	„	200	„	„
1122 VII	9	5.0–8.5	26 IX 21	150	„	„
1124 I	1	8.0	27 IX 21	250	37°15′ N	2°55′ E
1124 II	1	13.3	„	200	„	„
1124 III	3	6.0–8.6	„	150	„	„
1141 III	1	13.5	14 X 21	200	34°15′ N	16°53′ W
1141 IV	1	5.7	„	100	„	„
1147 III	1	7.4	20 X 21	300	32°00′ N	20°01′ W
1148 I	1	15.0	20 X 21	500	32°55′ N	21°51′ W
1345 V	1	9.5	16 V 22	150	35°07′ N	72°38′ W
1353 I	1	26.9	23 V 22	700	33°51′ N	66°43′ W
1366 VII	2	8.0, 9.8	9 VI 22	50	32°30′ N	40°04′ W
1368 IV	1	102.9	11 VI 22	300	34°40′ N	33°16′ W
1369 III	1	106.4	12 VI 22	600	35°44′ N	29°33′ W
1372 VI	1	128.8	14 VI 22	100	37°23′ N	26°02′ W
1374 I	1	131.2	14 VI 22	1000	37°40′ N	26°00′ W
4009 VII	1	10.2	18 III 30	3500	24°36.5′ N	17°27′ W
4010 IV	1	28.0	19 III 30	100	27°19′ N	16°41′ W
4010 V	1	9.3	„	50	„	„
4017 IX	1	21.3	27 III 30	300	29°13′ N	14°12′ W
4018 IV	1	54.4	29 III 30	100	31°30′ N	12°12′ W
4018 V	1	81.3	„	50	„	„
4023 VIII	1	79.0	8 IV 30	200	35°06′ N	7°01′ W
4023 XII	1	104.0	9 IV 30	200	„	„
4023 XVI	1	99.6	„	200	35°17′ N	6°56′ W
Southern hemisphere specimens referred to *Brama brama* in the "Dana" collections.						
3663 III	1	8.8	23 II 29	3000	33°33′ S	154°04′ E
3663 V	1	8.6	„	1000	„	„
3663 X	2	7.8, 8.5	„	50	„	„

Appendix Table 6. Juvenile specimens of *Brama brama* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
				North Atlantic		
"Thor"		2	4.9, 6.2	22 VIII 10	39°59′ N, 14°31′ E	Y 200, 25 m.w.o.
"Thor"	10	1	43.1	12 III 11	33°55′ N, 43°40′ W	
"Thor"	134	1	6.9	15 VII 10	37°37′ N, 10°17′ E	
"Thor"	199	1	5.1	15 VIII 10	39°32′ N, 10°49′ E	
"Thor"	200	1	5.1	26 VIII 10	39°18′ N, 10°11′ E	P 100
"Thor"	205	1	11.5	27 VIII 10	39°16′ N, 5° 52′ E	
"Pangan"	385	1	7.4	9 XI 11	35°10′ N, 18°10′ E	S 150, 138 m.w.o.
"Samui"	763	1	9.6	16 III 14	29°40′ N, 50°10′ W	S 150, 280 m.w.o.
"Delaware"		1	87.9	6 IV 57	33°40′ N, 59°40′ W	Stomach of *Thunnus thynnus* (MCZ)
"Delaware"		1	76.5	29 III 57	29°40′ N, 69°05′ W	Stomach of *T. alalunga* (MCZ)
W. Beebe		1	137.0	14 VII 31	Bermuda	Net (SU)
W. Beebe		1	96.5	8 VIII 35	Bermuda	Tuna stomach (SU)
W. Beebe		1	75.6	27 V 29	Bermuda	Net (SU)
"Michael Sars"	45	1	17.5	28–29 V 10	28°42′ N, 20°00′ W	3 m net, 3000 m.w. (KOEFOED, 1952)
"Michael Sars"	39 A	1	96.0 t.l.	20–21 V 10	26°03′ N, 15°00′ W	Young-fish trawl, 300 m.w.o. (KOEFOED, 1952)
				Southern Hemisphere		
"Anton Bruun" Cr. 13	19	1	26.4	15–16 I 66	33°51′ S, 85°00′ W to 34°01′ S, 84°58′ W	IKMT, 0-200-0 (MCZ)
"Discovery"	419	3	11.3–16.8	30 VIII 30	36°29′ S, 18°16.25′ E to 36°29′ S, 18°15.25′ E	Net, 0–84 m (BMNH)
"Discovery"	448	1	32.7	10 X 30	39°03′ S, 16°11.75′ E	Net, 0–161 m (BMNH)
–	35	1	52.6	19 VIII 62	25°55′ S, 39°30′ W	IKMT, 500 m (SAM)

Appendix Table 7. Larval and juvenile study specimens of *Brama japonica* other than those from the California Cooperative Fishery Investigations (Append. Table 8).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Falstria"	4778	2	9.2, 10.9	7 IV 33	32°13′ N, 167°25′ W	183 m.w.o.
"Falstria"	4779	2	6.3, 9.9	19 IV 33	30°44′ N, 145°55′ E	183 m.w.o.
"Falstria"	4781	2	23.7, 26.5	3 VII 33	32°43′ N, 135°02′ E	183 m.w.o.
"Falstria"	4797	1	14.4	18 I 34	30°43′ N, 136°28′ E	201 m.w.o.
"Jutlandia"	4774	2	10.5, 10.9	29 III 33	31°10′ N, 171°35′ W	–
"Jutlandia"	4775	1	4.9	11 IV 33	30°20′ N, 138°00′ E	220 m.w.o.
"Selandia"	4788	6	3.2–11.6	17 V 33	32°55′ N, 173°10′ W	220 m.w.o.
"Nancy Rose"	–	1	290.0	15 VIII 49	off Guadalupe I., Mexico	(W49-402)
"N. B. Scofield"	–	7	32.5–66.0	2 II 54	35°05′ N, 136°55′ W	(W54-202)
"N. B. Scofield"	–	3	43.7–84.7	17 V 55	31°40′ N, 135°00′ W	(W55-232)
–	–	1	368.0	–	off California	(W55-252)
–	–	1	298.0	3 VI 56	Baja, California, 60 mi S. Guadalupe I., Mexico	(W56-209)
R. G. Hamilton	–	2	54.7, 86.0	3–6 I 57	25–30 mi N. Guadalupe I., Mexico	(W57-28)
R. G. Hamilton	–	2	38.3, 43.4	7–15 I 57	15 mi SW Guadalupe I., Mexico	(W57–83)
Calif. Fish and Game Dept.	–	2	174.0, 185.0	29 VIII 58	33°55′ N, 122°00′ W	1960 fms; albacore stomach (W58-365)
Calif. Fish and Game Dept.	–	1	334.0	–	Davidson Sea Mount, off Monterey, Calif.	(W58-368)
–	–	1	368.0	–	31°20′ N, 120°16′ W	(SIO)
"Jeanellen"	–	1	317.0	14 VII 57	S. of U.S. Navy Dumping Grounds, San Diego, Calif.	(SIO)
"N. B. Scofield"	–	5	24.5–66.5	–	33°38′ N, 135°00′ W	*Alepisaurus* stomach (SIO)
"J. R. Manning"	25-5	1	90.5	–	31°24′ N, 175°07′ W	(SIO)
"John N. Cobb"	C6208-70.80	3	215.0–220.0	9–10 VIII 62	35°14′ N, 123°52′ W–35°07.5′ N, 123°58.5′ W	Midwater trawl, 24–0 m, (SIO)
"John N. Cobb"	C6208-80.180	1	52.5	23 VIII 62	30°07′ N, 129°16′ W–30°05′ N, 129°19′ W	Midwater trawl, 403–0 m, (SIO)
"Horizon"	H6204-70.200	1	15.5	31 III 62	31°15′ N, 132°07.8′ W	Midwater trawl, 1,676–0 m

Appendix Table 8. Larvae and juveniles of *Brama japonica* taken off California and Baja California by the California Cooperative Oceanic Fishery Investigations.

CCOFI Station No.	Number of Specimens	Length (mm)	Date	N. Lat.	W. Long.	Surf. Temp. (C°)
C 4906-69.125 (708)	1	5.5	1 VI 49	33°53′	127°01′	16.72
C 4908-126.122 (1209)	2	3.3, 3.6	7 VIII 49	24°07′	120°03′	23.9
C 4908-102.74 (1005)	1	13.3	12 VIII 49	29°50.5′	119°33′	18.9
C 4908-103.111 (1009)	1	4.5	13 VIII 49	28°31′	121°52′	20.5
H4909-47.133	6	3.2–5.8	8 IX 49	37°21′	130°36′	19.8
H4909-58.127	2	3.6, 4.0	9 IX 49	35°43′	128°35′	20.0
H4909-59.117	3	4.2–6.2	10 IX 49	35°58′	127°51′	19.9
C 4909-102.84	4	3.0–4.4	12 IX 49	29°31′	120°09′	20.1
C 4909-92.117	3	3.6–5.5	14 IX 49	30°12′	123°37′	19.7
H4910-57.146 (610)	9	3.2–6.3	8 X 49	35°18′	130°11′	18.8
H4910-81.117 (807)	1	8.8	16 X 49	32°05′	124°55′	18.6
H4910-81.127	1	4.2	16 X 49	31°47′	125°38′	18.8
C 5007-80.130	1	3.6	11 VII 50	31°49′	125°56′	17.49
C 5007-90.120	1	5.9	11 VII 50	30°24.5′	124°04.5′	16.75
C 5008-70.130	3	2.9–5.2	12 VIII 50	33°35′	127°14.5′	18.87
C 5008-80.110	1	3.6	16 VIII 50	32°28′	124°23′	18.14
C 5008-90.90	1	3.6	17 VIII 50	31°35.5′	121°56.5′	17.56
C 5008-90.120	1	3.5	17 VIII 50	30°31′	123°58.5′	18.71
C 5009-70.120	1	4.9	8 IX 50	34°01′	126°38′	18.76
C 5009-90.130	2	3.6, 3.9	16 IX 50	30°02′	124°32.5′	20.08
C 5009-90.145	2	2.9, 3.2	16 IX 50	29°31.5′	125°40′	20.08
C 5009-90.160	1	3.9	16 IX 50	29°07′	126°30′	20.35
P 5009-113.35	1	12.5	16 IX 50	29°12′	115°39′	19.11
C 5009-90.80	1	10.5	17 IX 50	31°48.5′	121°18′	19.06
C 5009-90.100	4	4.4–5.5	17 IX 50	31°04.5′	122°40′	19.39
P 5009-110.100	1	3.6	18 IX 50	27°40′	120°18′	20.44
D 5010-70.130	K 6 2	5.2, 7.5	11–19 X 50	33°33′	127°16.5′	Ranges:
	K16 1	7.8				19.24–20.15
C 5011-130.70	1	4.5	14 XI 50	25°13.5′	115°55.5′	20.96
C 5101-100.60	1	6.5	14 I 51	30°43.5′	118°56′	16.30
C 5101-100.90	2	5.8, 6.2	15 I 51	29°40.5′	120°47′	17.16
C 5111-80.100	2	5.9, 9.8	6 XI 51	32°49′	123°54′	17.80
C 5406-103.80	1	3.9	18 VI 54	29°25.5′	119°46′	17.0
P 5507-107.75	1	4.1	19 VII 55	29°05′	119°02.5′	
H-05705-100.80	1	4.5	17 V 57	30°00′	120°06′	
O 5705-107.80	1	5.5	22 V 57	28°52′	119°20′	
S 5710-110.70	1	8.8	6 X 57	28°36′	118°18′	20.74
P 5710-83.90	1	9.8	24 X 57	32°37.5′	122°37′	18.77
P 5710-93.80	1	3.9	2 XI 57	31°11′	120°52′	19.44
P 5710-97.80	1	5.5	3 XI 57	30°35′	120°28′	19.84
P 5710-103.60	1	5.9	7 XI 57	30°08.5′	118°26′	19.20
P 5710-103.70	1	5.5	7 XI 57	29°47′	119°04.5′	19.58
P 5805-107.75	1	4.7	13 V 58	29°06′	119°01′	
P 5807-77.90	1	2.7	10 VII 58	33°46′	123°39.5′	18.00

Appendix Table 9. Specimens of *Brama dussumieri* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
			Atlantic			
854	1	35.5	8 VI 20	150	27°53′ N	59°23′ W
1157 IV	1	9.2	27 X 21	100	21°57′ N	22°58′ W
1159 VII	2	9.3, 14.0	29 X 21	300	17°55′ N	24°35′ W
1161 III	1	17.9	5 XI 21	600	14°52′ N	28°04′ W
1161 IV	1	25.6	„	300	„	„
1161 V	6	5.4–21.5	„	100	„	„
1163 V	1	10.2	7 XI 21	100	12°59′ N	32°49′ W
1165 II	1	46.9	9 XI 21	1000	12°11′ N	35°49′ W
1166 V	1	12.3	11 XI 21	100	10°16′ N	40°41′ W
1166 VI	1	29.0	„	50	„	„
1168 V	2	7.7, 9.2	12 XI 21	100	9°30′ N	42°41′ W
1171 V	2	6.9, 7.1	13 XI 21	100	8°19′ N	44°35′ W
1184 IV	2	5.1, 6.5	25 XI 21	300	15°08′ N	61°31′ W
1202 II	1	8.9	10 I 22	300	9°40′ N	79°56′ W
1225 IV	2	5.8, 6.5	2 II 22	100	23°58′ N	83°22′ W
1225 V	3	6.7–46.1	„	50	„	„
1228 IV	2	8.6, 9.6	3 II 22	100	23°35′ N	81°54′ W
1228 V	1	4.5	„	50	„	„
1229 IV	1	9.6	4 II 22	100	23°13′ N	82°21′ W
1231 IV	1	4.8	6 II 22	100	24°30′ N	80°00′ W
1231 V	1	8.8	„	50	„	„
1269 IV	1	10.0	15 III 22	2000	17°13′ N	64°58′ W
1269 XI	1	5.2	16 III 22	100	„	„
1289 IX	1	12.6	15 IV 22	700	17°43′ N	64°56′ W
1352 I	2	6.5, 8.2	21 V 22	300	35°42′ N	73°43′ W
1352 II	4	5.2–7.3	„	200	„	„
3547 I	5	5.0–6.9	24 VIII 28	300	11°00′ N	77°40′ W
3981 V	1	8.4	19 II 30	50	19°16′ S	1°48′ W
3997 III	1	13.5	27 II 30	300	11°00′ S	7°36′ W
3997 IV	3	6.1–7.6	„	100	„	„
3998 IV	1	5.0	1 III 30	100	7°34′ S	8°48′ W
3998 VIII	1	92.5	„	4000	„	„
3999 III	1	13.2	2 III 30	300	3°45′ S	10°00′ W
4000 IV	1	24.4	4 III 30	100	0°31′ S	11°02′ W
4000 VIII	1	7.1	„	4000	„	„
4004 IV	1	21.5	11 III 30	100	10°21′ N	17°59′ W
4762	2	5.3, 7.5	11 II 33	293	8°13′ S	2°54′ E
			Indo-Pacific			
3561 VII	1	7.5	24 IX 28	600	4°20′ S	116°46′ W
3561 IX	18	5.5–9.5	„	100	„	„
3561 X	5	5.8–9.5	„	50	„	„
3579 IV, V	2	5.4–7.8	23 X 28	100, 50	20°56′ S	160°03′ W
3676 II	1	8.5	22 III 29	600	5°52′ S	131°14′ E
3684 II	1	28.1	3 IV 29	600	6°37′ N	122°24′ E
3685 III	1	21.7	5 IV 29	300	7°22′ N	121°16′ E
3712 V	5	4.0–8.8	18 V 29	50	12°44′ N	110°45′ E
3723 III	12	5.4–16.4	30 V 29	300	25°30.5′ N	125°28′ E
3723 V	2	5.9, 9.5	„	50	„	„
3727 I	3	18.4–24.2	10 VI 29	300	25°27′ N	121°30′ E
3727 II	22	6.1–26.1	„	200	„	„
3727 III	2	9.8, 12.6	„	100	„	„
3728 IV	22	3.8–5.8	12 VI 29	100	24°15′ N	122°00′ E
3733 III	1	7.5	26 VI 29	300	13°32′ N	121°21′ E
3775 I	6	4.5–6.6	29 VII 29	400	0°02′ S	131°18′ E

(To be continued.)

Appendix Table 9 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
			Indo-Pacific			
3800 V	1	8.5	18 VIII 29	50	7°53′ S	116°18′ E
3804 IV	7	4.4–8.8	30 VIII 29	100	9°09′ S	114°47′ E
3806	5	5.30–6.8	2 IX 29	150	7°58′ S	106°36′ E
3851 IV	1	6.0	15 X 29	100	5°27′ S	93°50′ E
3904 III	1	15.7	18 XI 29	2500	5°18′ N	90°55′ E
3915 II	1	4.1	3 XII 29	600	3°14′ N	75°21′ E
3915 III	1	13.6	„	300	„	„
3916 III	1	10.8	4 XII 29	300	1°45′ N	73°03′ E
3918 III	5	8.1–16.6	7 XII 29	300	0°35′ N	66°09′ E
3918 IV	4	4.4–7.3	„	100	„	„
3918 V	3	5.7–9.5	7 XII 29	50	„	„
3919 III	5	4.7–10.8	8 XII 29	300	0°07′ S	63°56′ E
3920 IX	7	4.9–7.5	9 XII 29	100	1°12′ S	62°19′ E
3920 X	6	5.5–7.4	„	50	„	„
3921 VII	1	8.2	11 XII 29	200	3°36′ S	58°19′ E
3924 II	1	5.0	14 XII 29	600	5°01′ S	54°46′ E
3924 IV	1	36.4	„	100	„	„
3925 II	1	5.4	16 XII 29	600	7°13′ S	52°22′ E
3925 IV	1	5.7	„	100	„	„
3925 V	8	4.1–5.7	„	50	„	„
3926 I	1	8.2	16 XII 29	600	8°27′ S	50°54′ E
3926 III	1	5.0	„	200	„	„
3926 IV	7	5.4–8.8	„	100	„	„
3937 I	1	6.6	22 XII 29	500	9°26′ S	46°05′ E
3938 II	1	6.8	23 XII 29	400	9°10′ S	45°17′ E
3941 III	1	6.6	24 XII 29	300	7°24′ S	41°31′ E
3956 II	1	5.0	10 I 30	300	21°13′ S	42°26′ E
3956 IV	1	6.3	„	100	„	„
3957 I	1	35.5	11 I 30	500	21°30′ S	42°32′ E
3957 II	3	6.8–14.9	„	300	„	„
3958 II	1	85.8	11 I 30	300	23°11′ S	42°54′ E

Appendix Table 10. Specimens of *Brama dussumieri* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
				Atlantic		
"Chain" Cr. 17	RHB 804	3	27.8–80.7	1–2 V 61	10°52′ N, 29°26′ W to 11°00′ N, 29°36′ W	IKMT; 0–27 fms (MCZ)
"Chain" Cr. 17	RHB 806	1	18.5	3–4 V 61	13°28′ N, 32°48′ W to 13°36′ N, 33°00′ W	IKMT; 0–39 fms (MCZ)
"Chain" Cr. 17	IKT 6	1	33.1	4 IV 61	00°05′ N, 14°15′ W	IKMT; 0–1200 m.w.o. (MCZ)
"Chain" Cr. 35	RHB 954	1	5.3	8 II 63	11°50′ N, 53°44′ W to 11°48′ N, 53°43′ W	IKMT; depth (w.a.) 0–112 m (MCZ)
"Chain" Cr. 35	RHB 972	4	7.2–15.3	23 II 63	00°03′ N, 25°00′ W to 00°15′ N, 25°00′ W	IKMT; 0–87 m (MCZ)
"Chain" Cr. 35	RHB 981	1	5.8	1 III 63	05°42′ S, 32°25′ W	IKMT; depth (w.a.) 0–120 m (MCZ)
"Chain" Cr. 35	RHB 982	1	7.5	1–2 III 63	06°51′ S, 33°34′ W	IKMT; depth (w.a.) 0–85 m (MCZ)
"Chain" Cr. 49	RHB 1102	1	32.5	13 VI 65	13°44′ N, 61°14′ W to 13°53′ N, 61°26′ W	IKMT; (TDR) depth 0–190–200 m (MCZ)
"Chain" Cr. 49	RHB 1106	2	49.8, 65.2	15 VI 65	17°30′ N, 67°14′ W to 17°38′ N, 67°24′ W	Marinovich Trawl; (TDR) 0–350 m (MCZ)
"Chain" Cr. 60	RHB 1259	1	13.1	28 V 66	13°29′ N, 71°36′ W to 13°26′ N, 71°49′ W	IKMT; 0–42–47 m (MCZ)
"Chain" Cr. 60	RHB 1262	1	10.2	28 V 66	13°00′ N, 73°26′ W to 12°58′ N, 73°34′ W	IKMT; 0–62–68 m (MCZ)
"Chain" Cr. 60	RHB 1274	1	10.6	5 VI 66	13°07′ N, 78°23′ W to 13°18′ N, 78°21′ W	IKMT; 0–100–109 m (MCZ)
"Chain" Cr. 60	RHB 1291	1	13.9	12 VI 66	22°54′ N, 91°36′ W to 22°40′ N, 91°45′ W	IKMT; 0–47–57 m (MCZ)
"Chain" Cr. 60	RHB 1307	1	13.8	22 VI 66	27°01′ N, 90°02′ W to 27°07′ N, 89°56′ W	IKMT; 0–85–95 m (MCZ)
"Walther Herwig"	183/66	4	181–190	17 V 66	06°30′ N, 24°33′ W	CMB midwater trawl; 0–50 m (ISH)
"Walther Herwig"	192/66	1	78.8	22 V 66	23°02′ S, 33°19′ W	CMB midwater trawl; 0–180 m (ISH)
"Kuroshio Maru"	–	1	20.9	25 IX 65	04°15′ N, 01°42′ W	Stomach of yellowfin tuna (TABL)
"Gerda"	–	1	22.6	7 V 58	18 mi E of Miami, Fla.	Plankton net, 639–693 m (UMML)
"Gerda"	14	1	31.1	6 V 59	17°19′ N, 76°29.5′ W to 17°30′ N, 76°35′ W	3-ft IKMT; 0–300 m.w.o. (UMML)
"Albatross"	–	1	51.6	7 III 1885	Gulf of Mexico	(USNM)
"Oregon"	1484	1	41.2	3 IV 56	20°50′ N, 95°53′ W	Stomach of *Alepisaurus*
"Oregon"	1583	1	148.5	20–21 VII 56	28°44′ N, 88°08′ W	Otter trawl
"Atlantis"	RHB 553	1	6.5	7–8 II 54	26°35′ N, 79°28′ W to 26°38′ N, 79°19′ W	IKMT; 0–280 fms (MCZ)
"Pawnee"	9	1	56.8	1 III 27	23°55′25″ N, to 77°09′10″ W	Midwater trawl (BOC)
"Pawnee"	33	1	38.4	22 III 27	24°10′40″ N, to 75°36′40″ W	Midwater trawl (BOC)
"Geronimo" Cr. 2	95	1	28.0	8 VIII 63	06°52′ S, 01°46′ W	Midwater trawl (TABL)
"Geronimo" Cr. 2	153	1	87.5	21 VIII 63	06°05′ S, 10°43′ E	Midwater trawl (TABL)
"Geronimo" Cr. 2	–	1	24.5	–	11°44′ N, 17′56′ W	Midwater trawl (TABL)
"Geronimo"	–	1	–	–	04°09′ N, 00°32′ E	Stomach of tuna (TABL)
Andria	–	2	11.5, 12.7	–	07°06′ S, 11°30′ N	(UZM; Lütken, 1880)
–	–	1	41.5	22 IX 12	13°00′ N, 25°08′ W	Stomach of albacore (AMNH)
				Indo-Pacific		
F. Williams	–	1	50.0	4 V 58	off Zanzibar	Stomach of yellowfin tuna (BM, NH)
F. Williams	–	1	71.0	17 IX 58	off Zanzibar	Stomach of *Alepisaurus* (BM, NH)
F. Williams	–	1	50.7	5 XI 58	off Zanzibar	Stomach of yellowfin tuna (BM, NH)
T. Abe	–	1	104	–	Manazuru, Japan	(Abe no., 59-501; MCZ)

(To be continued.)

Appendix Table 10 (continued).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
				Indo-Pacific		
Blunt, et al.	–	11	23.8–42.3	16 X 55	off Ecuador, 0°00′ N, 93°00′ W	(UCLA; W 56-163)
"J. R. Manning" Cr. 20	26	2	37.5, 51.8	1 VI 54	02°47.1′ N, 158°55.4′ W	IKMT (MCZ)
"J. R. Manning" Cr. 14	37	1	68.5	18 III 53	04°12′ N, 140°20′ W	Stomach of yellowfin tuna (USNM)
"H. M. Smith" Cr. 11	35	1	53.5	28 IX 51	02°01′ N, 149°53′ W	IKMT (HBL)
"H. M. Smith" Cr. 31	89	2	34.0, 40.4	5 XI 55	04°13′ S, 120°06′ W	IKMT (MCZ)
"H. M. Smith" Cr. 31	170	1	88.7	3 XII 55	01°41′ S, 145°53′ W	IKMT (MCZ)
"H. M. Smith" Cr. 35	121	1	31.7	5 IX 56	00°27.9′ N, 151°13.8′ W	IKMT (MCZ)
"C. H. Gilbert" Cr. 15	66	1	83.5	15 V 54	01°58′ N, 155°16′ W	Stomach of yellowfin tuna (HBL)
Dussumier	–	1	64.0	–	"Equateur"	Holotype (MNHN 703)
Tethys Exp.	11	2	7.2, 8.2	28 VI 60	01°32.5′ N, 132°12′ W to 01°25′ N, 132°51′ W	IKMT; 0–2750 m (SIO)
Tethys Exp.	13	1	14.0	1 VII 60	05°01.9′ S, 135°03′ W to 04°58′ S, 135°36′ W	IKMT; 0–2750 m (SIO)
Tethys Exp.	14	1	15.0	2 VII 60	02°31′ S, 137°04.4′ W to 02°12′ S, 137°28′ W	IKMT; 0–2500 m (SIO)
Tethys Exp.	24	1	13.2	5 VIII 60	22°31.8′ N, 154°06.3′ W to 22°41.0′ N, 153°35.4′ W	IKMT; 0–3000 m (SIO)
Naga Exp.	–	2	4.5, 8.4	13 V 61	22°19.7′ N, 134°46.7′ E	
"Anton Bruun" Cr. 6	340 B	2	12.5, 13.7	31 V 64	05°55′ S, 64°48′ E to 06°08′ S, 64°58′ E	IKMT; 0–746 m (MCZ)
"Anton Bruun" Cr. 6	342 A	3	6.2–13.0	2 VI 64	09°57′ S, 64°55′ E	IKMT; 0–580 m (MCZ)
Scot Exp.	TO-5801-29	2	10.6, 27.5	5 V 58	10°17.5′ N, 105°18′ W	5-ft nekton net, 0–450 m.w.o. (SIO)
Scot Exp.	TO-5801-33	1	9.7	7 V 58	09°54′ N, 98°40′ W	5-ft nekton net, 0–450 m.w.o. (SIO)
Scot Exp.	TO-59-1-32	1	33.5	11 II 59	08°58′ N, 88°22′ W	5-ft nekton net (SIO)
E. Belcher	–	1	43.5	–	"China Seas"	(BM, NH)
Midpac Exp.	8-529	1	148.5	8 VIII 50	10°27.4′ N, 135°57.7′ W	IKMT; 0–240 fms (SIO)
Shellback Exp.	48	1	40.2	7 VI 52	00°08′ S, 110°40′ W	IKMT (SIO)
Shellback Exp.	SB 172	1	5.2	5 VIII 52	07°15′ N, 88°46′ W	meter net, 295 m.w.o. (SIO)
Shellback Exp.	SB 173	1	12.4	6 VIII 52	06°22′ N, 88°54.5′ W	meter net, 330 m.w.o. (SIO)
Shellback Exp.	SB 199	1	3.8	16 VIII 52	03°54.5′ N, 101°56′ W	meter net, 299 m.w.o. (SIO)
Shellback Exp.	SB 206	1	5.5	20 VIII 52	11°00′ N, 105°29′ W	meter net, 450 m.w.o. (SIO)
"Shoyo Maru"	–	5	40.2–52.4	19 I 63	19°37.7′ S, 108°27.7′ W	Stomach contents of tuna caught on longline (SIO)
"Shoyo Maru"	–	1	37.8	22 I 63	24°51.5′ S, 103°16′ W	Stomach contents of tuna caught on longline (SIO)
"Shoyo Maru" Cr. 12	24	1	54.0	26 I 63	31°35.7′ S, 96°17′ W	Stomach of *Alepisaurus* caught on longline (SIO)
"Shoyo Maru" Cr. 12	25	1	68.5	27 I 63	34°55′ S, 92°43′ W	Stomach of *Alepisaurus* caught on longline (SIO)
"La Rafale" (B. B. Collette)	27	22	124.0–178.0	27 XI 63	ca. 08°57′ N, 09°10′ N, 14°59′ W, 15°39′ W	Surface; Guinean Trawling Survey 1, transect 6 (MCZ)

Appendix Table 11. Specimens of *Brama caribbea* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
901	2	4.7, 8.2	22 II 21	100	17°55′	64°48′
901	4	3.6–11.7	„	200	„	„
902	1	7.5	25 II 21	50	19°34′	64°06′
949	1	13.1	28 IV 21	300	21°40′	66°55′
951	2	36.0, 56.0	1 V 21	400	20°20′	65°20′
952	3	4.1–5.2	12 V 21	200	17°55′	64°48′
952	2	5.3, 6.0	„	300	„	„
952	7	4.2–7.0	13 V 21	400	„	„
952	1	38.5	„	600	„	„
952	1	38.9	„	700	„	„
952	1	5.1	„	800	„	„
1171 IV	1	17.8	13 XI 21	300	8°19′	44°35′
1171 VII	1	41.9	„	6000	„	„
1172 III	1	64.5	14 XI 21	300	7°22′	46°51′
1178 II	1	8.8	19 XI 21	600	10°24′	54°38′
1178 III	4	8.2–10.2	„	300	„	„
1180 I	5	9.5–16.2	20 XI 21	600	12°11′	57°12′
1180 II	7	4.7–7.6	„	300	„	„
1181 III	1	12.4	21 XI 21	3000	13°07′	57°20′
1181 IV	1	4.8	„	2000	„	„
1183 I	1	14.4	24 XI 21	4500	13°47′	61°26′
1183 II	1	4.8	„	3500	„	„
1183 V	1	9.2	„	500	„	„
1183 VIII	4	5.0–5.8	„	300	„	„
1184 III	1	11.7	25 XI 21	600	15°08′	61°31′
1184 IV	2	5.0, 5.9	„	300	„	„
1186 IV	1	3.7	30 XI 21	2000	17°54′	64°54′
1186 V	1	13.5	„	1000	„	„
1186 VIII	4	4.6–6.1	1 XII 21	300	17°58.5′	64°41′
1188 IV	1	7.1	7 XII 21	300	17°43.7′	64°57′
1189 II	1	7.8	8 XII 21	4000	17°58.5′	64°41′
1189 III	1	45.4	„	3000	„	„
1189 VIII	10	4.8–10.7	„	300	„	„
1190 III	3	7.5–8.7	12 XII 21	100	17°58.5′	64°45′
1190 IV	1	7.5	12 XII 21	50	„	„
1190 VII	1	5.7	13 XII 21	300	„	„
1191 I	2	10.3, 12.2	14 XII 21	600	17°49′	64°54′
1191 II	5	5.5–9.3	„	300	„	„
1191 III	2	4.0, 6.1	„	100	„	„
1191 V	5	4.5–9.6	15 XII 21	600	„	„
1191 VI	1	5.6	„	300	„	„
1191 VII	1	7.5	„	100	„	„
1192 V	5	5.5–11.7	„	600	17°43.4′	64°54.3′
1192 VI	22	4.2–8.4	„	300	„	„
1192 IX	4	6.6–9.9	16 XII 21	600	„	„
1192 X	4	4.2–6.8	„	300	„	„
1192 XI	1	6.5	„	100	„	„
1194 VII	1	9.5	21 XII 21	300	17°58.5′	64°41′
1194 X	2	4.0, 4.5	22 XII 21	315	„	„
1195 III	1	5.6	3 I 22	300	19°01′	65°23′
1196 III	3	9.6–13.3	4 I 22	300	17°43′	64°56′
1198 III	1	6.5	4 I 22	500	17°43′	64°56′
1198 IV	2	6.4, 8.2	„	200	„	„
1202 II	5	6.0–11.1	10 I 22	300	9°40′	79°56′
1214 IV	6	6.6–8.2	26 I 22	300	14°21′	76°50′
1215 III	2	7.5, 15.8	27 I 22	600	16°06′	76°02′

(To be contiuued.)

Appendix Table 11 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
1215 IV	11	7.5–11.3	„	300	„	„
1215 V	1	17.0	„	600	„	„
1215 VI	1	5.5	„	100	„	„
1216 III	3	10.0–12.2	28 I 22	300	18°22′	78°38′
1223 I	1	10.1	1 II 22	1000	22°06′	84°58′
1223 VI	1	20.4	„	500	„	„
1243 III	1	22.0	16 II 22	300	21°04′	73°48′
1243 IV	1	4.4	„	100	„	„
1245 III	3	6.4–23.0	17 II 22	300	19°35′	73°27′
1245 V	3	5.1–6.2	17 II 22	50	19°35′	73°27′
1247 III	1	8.4	20 II 22	300	17°57′	72°51′
1247 IV	7	5.3–64.4	20 II 22	100	„	„
1250 I	1	52.7	26 II 22	1000	17°54′	67°30′
1250 III	13	5.4–11.3	„	300	„	„
1253 III	5	9.1–11.1	2 III 22	300	17°43′	64°56′
1256 II	1	10.2	4 III 22	800	17°43′	64°56′
1257 IV	1	9.0	6 III 23	300	17°43′	64°56′
1266 IV	2	6.8, 6.8	13 III 22	300	17°45′	64°55.5′
1267 I	1	56.2	14 III 22	4500	17°56′	64°50′
1268 IV	1	5.2	15 III 22	100	17°43′	64°56′
1269 III	1	14.6	15 III 22	3000	17°13′	64°58′
1269 VIII	1	14.5	16 III 22	800	„	„
1269 IX	3	10.1–12.8	„	600	„	„
1269 X	2	6.1, 8.4	„	300	„	„
1269 XI	2	6.7, 8.5	„	100	„	„
1270 III	1	5.2	16 III 22	700	17°43′	64°56′
1272 III	1	11.7	23 III 22	300	17°43′	64°56′
1273 IV	3	4.9–9.1	24 III 22	300	17°43′	64°56′
1274 IV	1	20.0	27 III 22	300	17°43′	64°56′
1283 VII	1	38.6	5 IV 22	4000	14°38′	61°16′
1283 IX	1	42.4	„	3000	„	„
1284 III	2	8.1, 12.0	6 IV 22	300	14°38′	61°16′
1286 II	4	8.3–55.0	7 IV 22	600	15°17′	61°29′
1286 III	2	5.2, 7.3	„	300	„	„
1286 IV	1	8.2	„	100	„	„
1287 II	1	23.6	8 IV 22	600	16°04′	61°52′
1288 II	1	43.0	10 IV 22	1200	16°04′	61°52′
1291 IV	1	5.7	15 IV 22	300	17°43′	64°56′
1292 IV	1	13.4	16 IV 22	300	17°43′	64°56′
1292 V	1	5.8	„	100	„	„
1293 IV	1	11.4	17 IV 22	300	17°43′	64°56′
1352 I	2	5.5, 6.9	21 V 22	300	35°42′	73°43′
3545 IV	1	14.5	17 VIII 28	2000	14°37′	61°17′
					S	W
3997 III	1	8.7	27 II 30	300	11°00′	7°36′
4000 X	1	9.2	4 III 30	2000	0°31′	11°02′

Appendix Table 12. Specimens of *Brama caribbea* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Gerda" Carib 2	–	2	10.0, 19.9	2 V 59	17°36′ N, 66°16.5′ W to 17°34.5′ N, 66°23′ W	3-ft IKMT (UMML)
"Gerda" Carib 3	–	2	8.5, 9.0	2 V 59	17°34′ N, 66°26′ W to 17°31′ N, 66°23′ W	3-ft IKMT (UMML)
"Gerda" Carib 4	–	8	11.4–14.0	2 V 59	17°31′ N, 66°33′ W to 17°25′ N, 66°55′ W	3-ft IKMT (UMML)
"Gerda" Carib 8	–	1	19.6	3 V 59	16°26′ N, 69°23′ W to 16°21′ N, 69°30′ W	3-ft IKMT (UMML)
"Gerda" Carib 12	–	4	10.1–12.5	6 V 59	16°44′ N, 76°12.5′ W to 16°48.5′ N, 76°21′ W	3-ft IKMT (UMML)
"Gerda" Carib 14	–	2	16.9, 18.7	6 V 59	17°19′ N, 76°29.5′ W to 17°30′ N, 76°35′ W	3-ft IKMT (UMML)
"Gerda" Carib 20	–	1	20.1	10 V 59	17°02′ N, 74°40′ W to 17°00′ N, 74°29′ W	3-ft IKMT (UMML)
"Oregon"	1043	1	46.8	11 V 54	24°16′ N, 92°00′ W	Stomach contents of tuna taken on longline (USNM)
"Oregon"	1065	1	32.5	21 V 50	20°34′ N, 95°37′ W	Tuna stomach (MCZ)
"Oregon"	1148	1	47.0	8 XI 54	29°03′ N, 88°02′ W	Night light (MCZ)
"Oregon"	1377	1	47.8	24 VIII 55	27°43′ N, 88°43′ W	Stomach contents of tuna taken on longline (MCZ)
"Oregon"	1486	1	55.2	4 IV 56	22°25′ N, 97°00′ W	Stomach contents of *Alepisaurus* taken on longline (MCZ)
"Oregon"	2011	1	170.0	7 XI 57	07°46′ N, 54°36′ W	Otter trawl (MCZ)
"Oregon"	2191	2	21.8, 28.0	22 VII 60	34°35′ N, 76°54′ W	Midwater trawl (MCZ)
"Oregon"	2319	1	51.4	14 IX 58	07°05′ N, 52°45′ W	Otter trawl (MCZ)
"Oregon"	2768	4	37.8–64.1	14 IV 60	12°36′ N, 63°40′ W	Tuna stomach (MCZ)
"Oregon"	2794	2	11.5, 13.9	29 IV 60	23°30′ N, 80°05′ W to 23°38′ N, 80°30′ W	Stramin net (MCZ)
"Oregon"	5625	2	85.0, 175.0	27 IX 65	11°12′ N, 67°40′ W	Stomach contents of fish caught on longline (MCZ)
"Crawford" Cr. 37	39	1	ca. 170	–	15°19′ N, 64°04′ W	Stomach of *Thunnus obesus*, caught on longline (MCZ)
"Crawford" Cr. 62	15	2	33.5, —	5 VIII 61	22°54′ N, 75°15′ W	Stomach of yellowfin tuna, caught on longline (MCZ)
"Chain" Cr. 11	2	1	12.0	2 II 60	ca. 17°N, 71° W	IKMT (MCZ)
"Chain" Cr. 25	483-37	1	28.8	14 IV 62	20° N, 65° W	Meter net (MCZ)
"Chain" Cr. 35	RHB 980	1	27.1	28–29 II 63	03°55′ S, 30°38′ W	IKMT 0–257 m (MCZ)
"Chain" Cr. 49	RHB 1107	3	7.0–16.5	16 VI 65	19°52′ N, 69°46′ W to 19°51′ N, 69°56′ W	Midwater trawl (MCZ)
"Chain" Cr. 60	RHB 1252	5	6.1–10.8	24 V 66	16°45′ N, 64°18′ W to 16°37′ N, 64°26′ W	IKMT; 0–(76–84)–0 m (MCZ)
"Chain" Cr. 60	RHB 1253	11	12.3–15.8	25 V 66	16°38′ N, 64°27′ W to 16°29′ N, 64°33′ W	IKMT; 0–(110–133)–0 m (MCZ)
"Chain" Cr. 60	RHB 1254	1	38.9	26 V 66	15°11′ N, 66°59′ W to 15°07′ N, 67°11′ W	IKMT; shallow fraction, 0–(325-355)–0 m (MCZ)
"Chain" Cr. 60	RHB 1254	1	8.9	„	„	IKMT; deep fraction, 0–(325–355)–0 m (MCZ)
"Chain" Cr. 60	RHB 1257	1	25.5	27 V 66	13°51′ N, 70°15′ W to 13°42′ N, 70°36′ W	IKMT; 0–(485–550)–0 m (MCZ)
"Chain" Cr. 60	RHB 1258	2	18.9, 19.9	27 V 66	13°32′ N, 71°24′ W to 13°29′ N, 71°36′ W	IKMT; 0–(165–210)–0 m (MCZ)
"Chain" Cr. 60	RHB 1261	1	13.4	28 V 66	13°04′ N, 73°12′ W to 13°00′ N, 73°26′ W	IKMT; 0–(275–300)–0 m (MCZ)
"Chain" Cr. 60	RHB 1267	1	19.4	29 V 66	12°38′ N, 74°11′ W to 12°32′ N, 74°13′ W	IKMT; 0–(195–225)–0 m (MCZ)

(To be continued.)

Appendix Table 12 (continued).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Chain" Cr. 60	RHB 1277	10	11.6–20.0	6 VI 66	16°12′ N, 78°00′ W to 16°18′ N, 78°12′ W	IKMT; 0–(183–198)–0 m (MCZ)
"Chain" Cr. 60	RHB 1282	13	13.5–24.6	7 VI 66	17°07′ N, 79°32′ W to 17°04′ N, 79°26′ W	IKMT; 0–(140–185)–0 m (MCZ)
"Chain" Cr. 60	RHB 1290	2	9.6, 10.8	11 VI 66	21°17′ N, 85°22′ W to 21°24′ N, 85°35′ W	IKMT; 0–(113–124)–0 m (MCZ)
"Chain" Cr. 60	RHB 1311	1	12.5	24 VI 66	24°06′ N, 84°14′ W to 24°01′ N, 83°58′ W	IKMT; 0–(310–365)–0 m (MCZ)
"Discovery"	293	1	17.9	24 VIII 27	04°18′15″ N, 16°51′00″ W	Young-fish trawl (BMNH)
"Discovery"	706	1	9.0	21 X 31	03°26.2′ S, 32°08.3′ W	TYFB 354–0 m (BMNH)
–	–	1	218.0	22 III 50	Bimini, Bahamas	Blue marlin stomach (AMNH)
"Anton Bruun" Cr. XIX	20	2	2.0, 81.5	9–10 X 66	14°55′ N, 76°45′ W to 15°38′ N, 76°53′ W	10-ft IKMT; 0–4500 m.w.o. (MCZ)
"Anton Bruun" Cr. XIX	829	1	12.7	15–16 X 66	21°41′ N, 85°31′ W to 22°13.5′ N, 85°30′ W	10-ft IKMT; 0–4500 m.w.o. (MCZ)
"Delaware"	66-2-77	8	27.5–65.5	26 III 66	37°24′ N, 67°32′ W	Stomach of bluefin tuna (MCZ)
"Delaware"	65-3-8-66	1	30.0	8 IV 65	35°56′ N, 72°32′ W	Stomach of bluefin tuna (MCZ)
"Delaware"	65-3-4	1	54.2	1 IV 65	35°54′ N, 72°51′ W	Stomach of albacore (MCZ)
"Delaware"	65-3-8-54	2	33.5, 47.0	8 IV 65	35°56′ N, 72°32′ W	Stomach of yellowfin tuna (MCZ)
"Delaware"	65-3-4-28	1	45.5	5 IV 65	34°50′ N, 74°45′ W	Stomach of yellowfin tuna (MCZ)
"Delaware"	66-2-8-92	4	50.6–55.4	26 III 66	37°24′ N, 67°32′ W	Stomach of bluefin tuna (MCZ)
"Evergreen"	–	1	14.7	19 II 66	00°56′ N, 29°20′ W	Stomach of yellowfin tuna (St. Peter and Paul Rocks) (TABL)
–	GE-6-11-2/1	3	22.7–37.5	6 VIII 65	16°57′ N, 65°07′ W	Stomach of yellowfin tuna (TABL)
–	GE-7-91-2	4	10.8–14.8	16 III 66	12°25′ N, 64°20′ W	Stomach of yellowfin tuna (TABL)
–	GE-6-11-182	3	15.5–31.0	6 VIII 65	16°57′ N, 65°07′ W	Stomach of yellowfin tuna (TABL)
"Walther Herwig"	193/66	1	191.0	26 V 66	25°27′ S, 36°56′ W	Midwater trawl, 160–0 m (ISH)
"Walther Herwig"	183/66	1	66.0	17 V 66	06°30′ N, 24°33′ W	Midwater trawl, 50–0 m (ISH)
"Walther Herwig"	187/66	6	22.7–54.0	20 V 66	05°34′ S, 26°58′ W	Midwater trawl, 320–0 m (ISH)
"Walther Herwig"	190/66	2	44.3, 113.5	25 V 66	17°36′ S, 28°53′ W	Midwater trawl, 660–0 m (ISH)

Appendix Table 13. Specimens of *Brama orcini* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
3563 V.	8	5.8–8.4	29 IX 28	50	7°45.5′ S	131°22′ W
3582 VI.	1	6.0	27 X 28	100	15°36′ S	168°57′ W
3587 XI.	1	7.1	2 XI 28	300	11°00′ S	172°37′ W
3593 VII.	1	5.3	10 XI 28	600	17°27′ S	179°33′ E
3593 VIII.	1	8.5	„	300	„	„
3682 III.	1	5.0	29 III 29	300	1°42′ N	124°29′ E
3683 VIII.	5	3.1–5.5	3 IV 29	300	4°08′ N	123°00′ E
3687 I.	1	43.0	8 IV 29	1000	7°14′ N	115°23′ E
3689 VIII.	2	10.2, 10.9	9 IV 29	300	7°13.5′ N	111°49′ E
3715 IV.	1	5.4	22 V 29	100	18°18′ N	119°36′ E
3716 I.	1	38.9	22 V 29	4000	19°18.5′ N	120°13′ E
3718 IV.	2	4.8, 5.5	25 V 29	100	20°04′ N	123°59′ E
3718 V.	1	5.7	„	50	„	„
3720 II.	1	5.2	25 V 29	100	21°10.5′ N	124°37′ E
3720 III.	1	6.8	„	50	„	„
3728 III.	2	4.7, 48.8	12 VI 29	300	24°15′ N	122°00′ E
3728 V.	1	6.0	„	50	„	„
3729 II.	1	3.8	14 VI 29	600	20°03.5′ N	120°50′ E
3733 III.	1	6.0	26 VI 29	300	13°32′ N	121°21′ E
3746 II.	2	10.0, 11.4	9 VII 29	600	3°50′ N	131°42′ E
3751 I.	1	90.5	12 VII 29	1000	3°40.5′ N	137°53′ E
3751 II.	1	11.7	„	600	„	„
3752 II.	2	15.0, 21.5	13 VII 29	600	2°10′ N	138°20′ E
3759 I.	3	4.2–4.4	16 VII 29	400	0°40.5′ S	134°15′ E
3759 III.	1	4.4	„	200	„	„
3759 XVI.	4	ca. 4.5	17 VII 29	200	0°31′ S	134°06′ E
3766 XIV.	3	13.6–15.3	23 VII 29	450	1°13′ S	138°42′ E
3775 II.	1	4.2	29 VII 29	300	0°02′ S	131°18′ E
3814 I.	2	17.5, 20.0	9 IX 29	600	4°38′ S	99°24′ E
3815 VI.	3	9.5–9.8	10 IX 29	300	3°36′ S	97°37′ E
3849 I.	1	4.7	13 X 29	600	8°11′ S	92°41.5′ E
3850 II.	1	5.9	14 X 29	300	6°01′ S	93°12′ E
3851 I.	1	14.2	15 X 29	600	5°27′ S	93°50′ E
3851 II.	4	4.6–8.8	„	300	„	„
3856 III.	1	5.4	17 X 29	200	4°45.5′ S	98°28′ E
3860 XVII.	1	13.6	20 X 29	400	2°57′ S	99°36′ E
3860 XIX.	1	5.5	„	200	„	„
3860 XX.	1	6.8	„	600	„	„
3872 I & II.	3	6.1–9.2	26 X 29	600, 500	4°40′ S	100°29′ E
3902 II.	1	10.8	17 XI 29	600	6°05′ N	95°30′ E
3904 III.	1	25.2	18 XI 29	2500	5°18′ N	90°55′ E
3916 III.	3	9.9–12.2	4 XII 29	300	1°45′ N	73°03′ E
3917 VIII.	1	10.2	5 XII 29	300	1°45′ N	71°05′ E
3919 III.	1	8.8	8 XII 29	300	0°07′ S	63°56′ E
3920 VIII.	3	5.5–23.5	9 XII 29	300	1°12′ S	62°19′ E
3922 V.	2	5.0, 5.4	12 XII 29	50	3°45′ S	56°33′ E
3928 II.	1	3.8	18 XII 29	300	11°20′ S	50°10′ E
3928 III.	2	4.2, —	„	200	„	„
3928 IV.	3	3.1–5.7	„	100	„	„
3929 I.	1	8.0	18 XII 29	600	12°11′ S	50°18′ E
3929 II.	1	10.2	„	500	„	„
3930 IV.	1	6.0	19 XII 29	200	11°55′ S	49°55′ E
3931 II.	2	6.1, 10.9	19 XII 29	500	12°09′ S	49°34′ E
3932 VI.	1	33.7	20 XII 29	600	11°35′ S	49°45′ E
3935 I.	1	6.8	21 XII 29	500	10°50′ S	48°30′ E
3935 II.	2	4.2, 10.9	„	400	„	„

(To be continued.)

Appendix Table 13 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
3935 III	1	6.6	21 XII 29	300	10°50′ S	48°30′ E
3936 II	4	4.0–4.7	22 XII 29	400	10°28′ S	47°30′ E
3936 III	2	4.1, 4.9	„	300	„	„
3938 III	1	7.5	23 XII 29	300	9°10′ S	45°17′ E
3941 II	3	4.7–6.3	24 XII 29	400	7°24′ S	41°51′ E
3941 V	1	5.4	„	100	„	„
3942 IV	1	6.0	25 XII 29	200	6°47′ S	41°27′ E
3943 II	1	4.4	25 XII 29	400	5°30′ S	30°40′ E
3944 II	1	4.7	26 XII 29	400	4°45′ S	40°10′ E
3951 III	2	4.7, 4.7	7 I 30	300	14°16′ S	41°48′ E
3952 I	2	5.2, 6.3	8 I 30	500	15°05′ S	41°53′ E
3952 III	1	4.9	„	300	„	„
3953 I	1	9.5	8 I 30	500	16°12′ S	42°04′ E
3955 I	1	4.6	9 I 30	500	18°30′ S	42°18′ E
3956 I	2	6.1, 6.1	10 I 30	500	21°13′ S	42°26′ E
3956 III	2	5.2, —	„	200	„	„
3956 V	2	3.6, 4.4	„	50	„	„
3957 II	1	70.0	11 I 30	300	21°30′ S	42°32′ E
3959 III	1	5.5	12 I 30	200	23°40′ S	43°02′ E
3960 II	3	4.8–7.5	13 I 30	200	25°23′ S	42°52′ E
3961 I	1	5.0	14 I 30	300	24°57′ S	40°18′ E
3962 II	1	7.8	14 I 30	600	24°33′ S	38°26′ E
3964 V	2	6.8, 7.5	15 I 30	50	25°19′ S	36°13′ E
4820	1	5.1	11 III 38	201	13°56′ N	117°00′ E

Appendix Table 14. Study specimens of *Brama orcini* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
Dussumier	–	1	34.4	–	"Indian Ocean"	(MNHN, type of *B. orcini*)
Snyder	–	4	41.1–70.7	–	Honolulu Market	Stomach of *Coryphaena* (syntypes of *Collybus drachme*, USNM)
F. Williams Cr. 142	–	2	42.5, 59.0	31 X 58	ca. 20 mi off Zanzibar, 3–8° S. Lat.	Tuna stomach (BMNH)
"J. R. Manning" Cr. 2	–	1	40.5	20 V 50	ca. 01°55′ N, 157°30′ W	Skipjack stomach (HBL, USNM)
"J. R. Manning" Cr. 12	21	2	134.0, 158.0	6 IX 52	02°01′ N, 141°21′ W	Tuna stomach (HBL, MCZ)
"J. R. Manning" Cr. 20	22	1	20.9	30 V 54	03°53.2′ N, 158°47.8′ W	Tuna stomach (HBL, MCZ)
"Tenyru Maru 2"	–	7	20.5–58.0	12 IX 51	ca. 02°43′ N, 159°52′ E	Tuna stomach (HBL)
"Broadbill"	–	2	96.0, 101.5	14 X 52	ca. 21°15′ N, 156°30′ W	Tuna stomach (HBL, MCZ)
"C. H. Gilbert" Cr. 48	66	6	61.0–107.0	27 VII 60	20°48.5′ N, 160°04′ E	Tuna stomach (HBL, USNM)
"H. M. Smith" Cr. 2	–	–	200.0, 265.0	18 I 50	ca. 23°04′ N, 164°51′ W	Tuna stomach (HBL, MCZ)
"H. M. Smith" Cr. 9	–	1	41.6	30 V 51	06°18′ N, 162°35′ W	Tuna stomach (HBL, USNM)

(To be continued.)

Appendix Table 14 (continued).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"H. M. Smith" Cr. 11	8	1	120.0	31 VIII 51	06°02′ N, 149°55′ W	Tuna stomach (HBL)
"H. M. Smith" Cr. 11	10	1	74.0	21 IX 51	04°04′ N, 139°57′ W	Tuna stomach (HBL)
"H. M. Smith" Cr. 11	14	1	135.0	6 IX 51	02°03′ N, 153°09′ W	Tuna stomach (HBL, USNM)
"H. M. Smith" Cr. 12	2	1	–	24 X 51	21°01′ N, 159°14′ W	Tuna stomach (HBL)
"H. M. Smith" Cr. 35	113	1	65.0	2 IX 56	00°01.9′ N, 143°02.3′ W	(HBL, MCZ)
"H. M. Smith" Cr. 35	118	1	17.0	4 IX 56	01°58.6′ N, 148°42′ W	Tuna stomach (HBL, USNM)
Giacalone	–	1	116.0	1 V 65	150 mi west of Acapulco, Mexico	Spit up by yellowfin tuna (through J. Fitch, Calif. Fish and Game)
Naga Exped.	60-248	1	14.4	6 III 60	10°32.5′ N, 112°53.5′ E	2-m stramin net (SIO)
Naga Exped.	61-299	1	30.0	7 V 61	18°31′34″ N, 119°50′36″ E	2-m stramin net; 0–200 m.w.o. (SIO)
Naga Exped.	32	1	45.1	17 VII 59	16°27′ N, 157°12′ E	2-m stramin net; 0–400 m.w.o. (SIO)
Equipac Exped.	–	1	55.5	17 IX 56	05°00′ N, 174°52′ W	meter net, 1000 m.w.o. (SIO)
–	37	1	21.6	23 VIII 62	30°30′ S, 31°45′ E	IKMT; 200 m; 930 m.w.o. (SAM)
"Shóyó Maru"	16	2	220.0, 225.0	13 I 63	off Chile	Tuna stomach (SIO)
"Tethys" Exped.	10	1	18.0	24 VI 60	10°26′ N, 128°22′ W to 10°03′ N, 128°39′ E	0–1540 fms (SIO)
"Anton Bruun" Cr. 3	11	1	15.6	18 VIII 63	03°55′ N, 60°08′ E to 03°25′ N, 60°08′ E	10-ft IKMT; 0–275 m (APB 7031; MCZ)
"Anton Bruun" Cr. 6	335 B	3	12.3–18.9	26 V 64	03°46′ N, 65°05′ E to 03°27′ N, 65°07′ E	10-ft IKMT; 0–275 m (APB 7196; MCZ)
"Anton Bruun" Cr. 6	336 B	1	26.5	27 V 64	01°50′ N, 65°06′ E to 01°37′ N, 65°07′ E	10-ft IKMT; 0–275 m (APB 7202; MCZ)
"Anton Bruun" Cr. 6	337 B	1	25.5	28 V 64	00°14′ S, 65°03′ E to 00°29′ S, 65°08′ E	10-ft IKMT; 0–275 m (APB 7215; MCZ)
"Anton Bruun" Cr. 6	342 A	1	11.8	2 VI 64	09°57′ S, 64°55′ E to 10°01′ S, 64°19′ E	10-ft IKMT; 0–250 m (APB 7251; MCZ)

Appendix Table 15. Specimens of *Brama myersi* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
3613 VI	2	57.0, 60.0	28 XI 28	4000	22°43′ S	166°05.8′ E
3613 VIII	1	68.0	„	3000	„	„
3626 X	1	70.7	13 XII 28	500	27°00′ S	177°41′ W
3690 III	1	13.7	10 IV 29	300	8°02′ N	109°36.5′ E
3942 II	1	11.5	25 XII 29	400	6°47′ S	41°27′ E
3947 II	2	6.8, 9.5	4 I 30	200	4°21′ S	42°56′ E

Appendix Table 16. Study specimens of *Brama myersi* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"C. H. Gilbert" Cr. 12	16D	1	58.9	15 I 53	20°35′ N, 157°32′ W	Trawl (HBL, USNM)
"C. H. Gilbert" Cr. 48	60	1	82.0	24 VII 60	15°14′ N, 159°55′ E	Dip net, surface (HBL, holotype, USNM)
"C. H. Gilbert" Cr. 48	62	1	61.3	25 VII 60	17°28′ N, 160°03′ E	(HBL)
"H. M. Smith" Cr. 4	12-10	1	37.7	15 V 50	22°38′ N, 158°31′ W	Trawl; 100 m (HBL, MCZ)
"H. M. Smith" Cr. 9	24-12	1	30.9	29 VI 51	14°40′ N, 161°49′ W	200-m oblique tow (HBL)
"H. M. Smith" Cr. 9	25-12	2	31.8, 50.0	30 VI 51	17°40′ N, 159°57′ W	200-m oblique tow (HBL, MCZ)
"H. M. Smith" Cr. 35	56	1	25.0	16 VIII 56	06°17′ N, 134°39.8′ W	(HBL, MCZ)

Appendix Table 17. Specimens of *Taractichthys longipinnis* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
855 XIV	1	10.1	9 VI 20	500	29°15′ N	59°45′ W
872	2	5.8, 6.0	28 VI 20	150	27°07′ N	63°21′ W
896	1	5.2	16 VIII 20	100	39°44′ N	57°21′ W
897	1	ca. 6.0	18 VIII 20	150	40°07′ N	51°02′ W
1165 III	1	6.9	9 XI 21	600	12°11′ N	35°49′ W
1190 II	1	7.7	12 XII 21	300	17°58.5′ N	64°45′ W
1192 X	1	5.3	16 XII 21	300	17°43.4′ N	64°54.3′ W
1202 IV	1	10.8	10 I 22	100	9°40′ N	79°56′ W
1287 IV	3	6.6–7.9	8 IV 22	100	16°04′ N	61°52′ W
1296 V	1	ca. 8.0	19 IV 22	100	17°43′ N	64°56′ W
1352 II	1	6.6	21 V 22	200	35°42′ N	73°43′ W
3999 III	1	21.5	2 III 30	300	3°45′ S	10°00′ W
4000 III	2	13.5, 15.0	4 III 30	300	0°31′ S	11°02′ W
4001 IV	2	5.1, –	6 III 30	100	3°56′ N	12°32.5′ W

Appendix Table 18. Specimens of *Taractichthys longipinnis* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Oregon"	1043	1	74.0	11 V 54	24°16′ N, 92°00′ W	Stomach contents *Th. albacares*
„	1112	1	357.0	14 VII 55	28°50′ N, 88°11′ W	Longline
„	1173	2	371.0, 376.0	25 VIII 54	28°54′ N, 88°02′ W	Longline
„	1317	1	349.0	11 VI 55	28°23′ N, 88°43′ W	Longline
"Wanderer"		1	618.0		Browns Bank, ca. 50 mi SW Cape Sable, Nova Scotia	otter trawl
"Admiral"		1	335.0	16–20 I 61	off Virginia, U.S.; 100 fms	bottom trawl haul; USNM
"Delaware"		3	46.4–50.2	9 VI 57	38°58′ N, 66°26′ W	Stomach contents *Th. thynnus*
"Delaware"		1	8.0	„	„	Stomach contents of *T. longipinnis* from stom. *Th. thynnus*
"Delaware"		2	21.1, 35.8	10 V 57	37°45′ N, 66°32′ W	Stomach contents *Th. alalunga*
"Delaware"		1	20.0	9 X 59	36°15′ N, 71°49′ W	„ „
"Delaware"		2	290.0, 340.0	25 IX 57	39°44′ N, 70°00′ W	Longline
"T. N. Gill" Cr. 7	Reg. 26, 27	4	27.3–34.2	26 VI 54	30°20.5′ N, 80°01.5′ W	Stomach contents *Th. atlanticus*
"Gladisfen"	Net 403	1	10.5	2 IX 29	32°12′ N, 64°30′ W	Beebe-Bermuda; (SU)
"Ombango"		1	20.0	13 VI 65	02°53′ S, 08°16′ E	Stomach of skipjack (TABL); near Annobon I.
"Chain" Cr. 35	RHB 957	1	16.5	9 II 63	09°55′ N, 50°18′ W to 09°48′ N, 50°10′ W	10-ft IKMT; 0–67 m
"Geronimo" Cr. 2	145	1	39.5	20 VIII 63	08°03′ S, 09°06′ E	(TABL)
"Atlantis II" Cr. 13	RHB 1050	1	15.7	29 IX 64	39°31′ N, 43°33′ W to 39°30′ N, 43°45′ W	10-ft IKMT; 0–53 m
"Chain" 60	RHB 1253	1	24.5	25 V 66	16°38′ N, 64°27′ W to 16°29′ N, 64°33′ W	IKMT; 0–110–133 m (MCZ)
"Chain" 60	RHB 1315	1	16.8	25–26 V 66	25°46′ N, 79°47′ W to 26°10′ N, 79°46′ W	IKMT; 0–57–71 m (MCZ)
I. Irons and W. Murawski	–	1	570.0	24 XI 68	Ocean Co., New Jersey	One of several seen, caught by hook and line

Appendix Table 19. Specimens of *Taractichthys steindachneri* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude	Longitude
3714 IV	1	10.2	20 V 29	100	15°22′ N	115°20′ E
3720 I	1	8.6	25 V 29	300	21°10.5′ N	124°37′ E
3821 III	2	4.0, 4.2	14 IX 29	300	0°51.5′ S	99°24.5′ E
3856 I	2	8.0, 8.1	17 X 29	400	4°45.5′ S	98°28′ E
3856 II	2	6.5, 7.1	„	300	„	„
3860 XI & XV	1	6.0	20 X 29	300	2°57′ S	99°36′ E
3932 V	1	6.0	20 XII 29	200	11°35′ S	49°45′ E
3932 VIII	1	5.5	„	400	„	„
3934 IV, IX, XIV, XIX	1	6.6	20–21 XII 29	300	11°24′ S	50°05′ E
3941 I	1	6.7	24 XII 29	500	7°24′ S	41°51′ E
3970 I	1	6.0	28 I 30	300	34°09′ S	27°38′ E

Appendix Table 20. Specimens of *Taractichthys steindachneri* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"H. M. Smith" Cr. 9	–	1	40.0	30 V 51	06°18′ N, 162°35′ W	Tuna stomach (HBL; USNM)
"H. M. Smith" Cr. 11	10	1	74.0	2 IX 51	04°04′ N, 139°57′ W	Tuna stomach (HBL)
"H. M. Smith" Cr. 11	22	1	31.0	19 IX 51	01°59′ N, 151°24′ W	Tuna stomach (HBL; MCZ)
"J. R. Manning" Cr. 11	21	1	58.0	6 II 52	ca. 02°40′ S, ca. 155°08′ W	Tuna stomach (HBL; USNM)
"Tenyru Maru"		2	35.0, 50.5	12 IX 55	02°43′ N, 159°52′ W	Tuna stomach (HBL; MCZ)
"C. H. Gilbert" Cr. 48	49	1	42.5	19 VII 60	12°51′ N, 163°13′ E	Tuna stomach (HBL)
"C. H. Gilbert" Cr. 48	78	1	130.0	1 VIII 60	19°41′ N, 165°35′ W	Tuna stomach (HBL; USNM)
–	–	7	39.0–116.0	–	"Pacific Ocean"	Tuna stomach (HBL)
– Cr. 142	–	3	16.0–36.5	1958	off Zanzibar	Tuna stomach (BMNH)
Tethys Exp.	24	1	17.0	5 VIII 60	22°31.8′ N, 154°06.3′ W to 22°41.0′ N, 153°35.4′ W	10-ft IKMT; 0–3000 m (SIO)
–	–	1	111.0	XII 58 to 5 V 59	off Manazuru, Sagami Bay, Japan	Trap net (Abe no. 59-40; MCZ)
–	–	2	326, —	XII 60 to I 61	Tokyo Market	(Abe no. 1961-2; 1960-1512; MCZ)
"Tosui Maru"	–	1	525.0	3 III 61	Toyko Market, probably 40°48′ N, 121°40′ W	(Abe no. 1961-124; MCZ)
–	–	1	590.0	22 IV 53	surf at Corona del Mar, Calif.	(Fitch, 1953:546; MCZ)
"Menelik II"	–	1	11.4	9 VIII 68	27°54′ N, 34°25′30″ E to 27°51′ N, 34°23′ E	500 m.w.o. (MCZ)

Appendix Table 21. Specimens of *Pterycombus brama* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
			Western North Atlantic			
857	1	7.5	13 VI 20	50	30°47′	65°27′
873	1	7.5	29 VI 20	50	27°04′	65°23′
878	2	5.4, 7.5	9 VII 20	50	33°24′	61°05′
891	3	5.3–7.5	24 VII 20	50	29°28′	69°25′
891	1	12.7	„	150	„	„
891	1	7.8	„	200	„	„
892	1	5.7	25 VII 20	100	30°49′	73°30′
896	1	5.5	16 VIII 20	100	39°44′	57°21′
897	1	5.5	18 VIII 20	50	40°07′	51°02′
897	1	5.8	„	100	„	„
1216 IV	2	5.3, 6.2	28 I 22	100	18°22′	78°38′
1218 II	1	10.9	30 I 22	800	20°08′	82°59′
1225 III	10	9.0–24.0	2 II 22	300	23°58′	83°22′
1228 IV	1	6.0	3 II 22	100	23°35′	81°54′
1229 II	1	13.4	4 II 22	600	23°13′	82°21′
1229 III	2	9.0, 9.1	„	300	„	„
1229 IV	6	4.6–8.3	„	100	„	„
1230 III	1	7.8	5 II 22	1000	23°13′	82°21′
1230 VII	5	10.4–22.4	„	600	„	„
1231 III	2	8.5, 9.5	6 II 22	300	24°30′	80°00′
1231 IV	3	4.9–5.8	„	100	„	„
1238 IV	1	8.0	11 II 22	100	26°13′	78°48′
1239 VI	2	11.8, 20.2	12 II 22	600	25°50′	76°55′
1239 VII	2	11.0, 14.3	„	500	„	„
1239 IX	1	6.5	„	100	„	„
1239 X	1	5.2	„	50	„	„
1239 XIII	1	10.0	„	3000	„	„
1241 IV	1	9.1	13 II 22	300	25°18′	74°00′
1242 IV	1	6.0	14 II 22	100	24°05′	74°36′
1330 II	1	8.9	4 V 22	700	26°37′	54°45′
1334 VI	1	4.4	7 V 22	50	27°28′	59°29′
1352 II	1	8.4	21 V 22	200	35°42′	73°43′
			Eastern Central Atlantic, provisional identifications			
1159 VIII	1	4.5	29 X 21	100	17°55′ N	24°35′ W
1162 III	1	11.7	6 II 21	300	13°35′ N	30°11′ W
3997 IV	1	6.0	27 II 30	100	11°00′ S	7°36′ W
4001 III	1	36.9	6 III 30	300	3°56′ N	12°32.5′ W

Appendix Table 22. North Atlantic specimens and records of *Pterycombus brama* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
–	–	1	–	before 1834	Hammerfest; 70°40′ N, 23°44′ E	Stranded; not seen; COLLETT, 1896:6–7 (Riks. Mus.)
–	–	1	–	1837	Altenfjord; 70° N, 22°30′ E	Stranded; not seen; COLLETT, 1896:6–7
–	–	1	318	XI 1850	near Bergen	Stranded; not seen; COLLETT, 1896:6–7 (Bergen Mus.)
–	–	1	339	1861	Finmarken	(Oslo Mus.)
–	–	1	320	1861	Finmarken	Not seen; COLLETT, 1896:6–7 (Bergen Mus.)
–	–	1	–	1861	Finmarken	Not seen; COLLETT, 1896:6–7 (Upsala Mus., dried)
–	–	1	–	1861	Finmarken	COLLETT, 1896:6–7
–	–	1	290	1861	Varangerfjord; 70° N, 30° E	COLLETT, 1896:6–7 (Oslo Mus.)
–	–	1	295	29 X 1866	Varangerfjord	Salmon net in shallow water; COLLETT, 1896:6–7 (Oslo Mus.)
–	–	1	293	28 XI 1877	Hammerfest; 70°40′ N, 23°44′ E	Stranded; COLLETT, 1896:6–7 (Tromsø Mus.)
–	–	1	315	1880	Egersund, Norway; 58° N, 6° E	COLLETT, 1896:6–7 (Stavanger Mus.)
–	–	1	340	X 1895	Nord-Reisen; 69°45′ N, 21° E	Not seen; COLLETT, 1896:6–7 (Stuttgart Mus.)
–	–	1	290	IV 1895	Alderen, Nordland	Floating at surface; not seen; COLLETT, 1896:6–7 (Trondhj. Mus.)
–	–	1	–	1 VIII 1899	Karlsø; ca. 70° N, 19° E	Stranded; not seen; COLLETT, 1902:45
–	–	1	–	20 VIII 23	N of Grand Sole Bank; ca. 49°53′ N	Commercial trawl at 360 m; BELLOC, 1926:271 as *Centropholis ledanoisi* BELLOC; not seen
–	–	2	353, —	1924–5	off Cape Bojador, W. Africa; ca. 27°N, 14° W	Commercial trawler; BELLOC, 1926: 271 as *Centropholis ledanoisi* BELLOC
–	–	1	–	12 II 49	edge of Norwegian Deep; 59° N, 3°26′ E	Commercial trawler; not seen; MEYER, 1949
P. Arté	–	4	–262–355	22 II 52 to 26 III 52	*Brama*-fishery off NW Spain	Market spec. caught on longline; ARTÉ, 1952:101–2
–	–	1	–	14 IX 60	off Lindesnaes, S tip Norway, ca. 57° N, 7° E	Skeleton (UZM)
–	–	1	227.0	–	Grand Banks, Newfoundland	Commercial trawler (USNM)
–	–	1	174.0	10 IV 58	Bermuda	(UMML)
"Albatross"	2660	1	45.8	–	28°40′ N, 78°46′ W	(USNM)
"Combat"	290	1	41.6	–	33°13′ N, 76°55′ W	40-ft bottom trawl
"Combat"	–	3	102.0–123.0	20 VI 60	50 mi SE Cape Hatteras, N. Carolina	Stomach of *Thunnus obesus* caught on longline at 60 fms
"T. N. Gill" Cr. 9	62–63	3	24.0–26.5	12 V 34	32°59′ N, 76°40′ W	Stomach of *Katsuwonus pelamis*
"T. N. Gill" Cr. 9	9–10	1	8.7	17 XI 54	28°24′ N, 79°56′ W	High-speed plankton net
"T. N. Gill" Cr. 9	Sp. 6–7	1	18.0	11 V 57	28°15′ N, 77°01′ W	Stomach of *Thunnus albacares*
"Oregon"	1124	1	16.9	18 VII 54	28°36′ N, 87°58′ W	Night light and dip net (MCZ)
"Oregon"	1377	1	57.6	24 VIII 55	27°43′ N, 88°43′ W	Stomach of tuna caught on longline (MCZ)
"Oregon"	1436	4	26.5–42.2	27 I 56	19°30′ N, 81°50′ W	(MCZ)
"Oregon"	1588	2	24.0, 61.5	23 VII 56	28°17′ N, 88°33′ W	Stomach of *Alepisaurus* sp. caught on longline (MCZ)

(To be continued.)

Appendix Table 22 (continued).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Oregon"	4614	1	78.0	20 I 64	27°46′ N, 94°13′ W	40-ft shrimp trawl (MCZ)
–	–	3	27.0–135.0	13 VI 60	off Oregon Inlet, N. Carolina	Stomach of *Coryphaena hippurus* (MCZ)
"Atlantis I"	RHB 551	1	9.5	6 II 54	26°25′ N, 79°45′ W to 26°37′ N, 79°44′ W	10-ft IKMT; 31 fms (MCZ)
"Atlantis II" Cr. 13	RHB 1004	1	18.0	4 IX 64	41°29′ N, 60°14′ W to 41°26′ N, 60°08.5′ W	10-ft IKMT; 0–(330–395)–0 m (MCZ)
"Atlantis II" Cr. 13	RHB 1010	2	5.8, 6.3	5 IX 64	41°31′ N, 55°11′ W to 41°32′ N, 55°03′ W	10-ft IKMT; 0–(22–30)–0 m (MCZ)
"Atlantis II" Cr. 13	RHB 1011	7	7.2–27.0	6 IX 64	41°33′ N, 54°55′ W to 41°35′ N, 54°44′ W	10-ft IKMT; 0–(35–55)–0 m (MCZ)
"Atlantis II" Cr. 13	RHB 1012	2	8.5, 8.8	6 IX 64	41°39′ N, 54°03′ W to 41°36′ N, 53°58′ W	10-ft IKMT; 0–(490)–0 m (MCZ)
"Atlantis II" Cr. 13	RHB 1021	1	10.8	9 IX 64	42°24′ N, 46°11′ W to 42°33′ N, 46°00′ W	10-ft IKMT; 0–(145–172)–0 m (MCZ)
"Crawford" Cr. 56	57B	1	16.4	25 IX 60	40°49′ N, 64°57′ W	Stomach of *Alepisaurus* sp. caught on longline (MCZ)
"Delaware"	–	1	33.1	30 III 57	31°05′ N, 66°40′ W	Stomach of *Thunnus alalunga* caught on longline (MCZ)
"Delaware"	–	5	38.0–58.0	9 VII 57	38°58′ N, 66°26′ W	Stomachs of *Thunnus thunnus* and *Acanthocybium solandri* caught on longline (MCZ)
"Delaware"	–	2	23.6, 25.6	10 VI 57	37°45′ N, 66°32′ W	Stomach of *Thunnus albacares* caught on longline (MCZ)
"Delaware"	–	1	ca. 120.0	13 VI 57	40°04′ N, 68°12′ W	Stomach of *Thunnus thynnus* caught on longline (MCZ)
"Delaware"	–	1	26.6	2 X 57	36°42′ N, 70°00′ W	Stomach of *Alepisaurus* sp. caught on longline (MCZ)
"Delaware"	–	1	78.1	19 X 57	29°42′ N, 77°12′ W	Stomach of *Thunnus* sp. caught on longline (MCZ)
"Delaware"	–	1	28.6	14 VIII 58	38°35′ N, 68°14′ W	Stomach of *Alepisaurus* sp. caught on longline (MCZ)
"Delaware"	–	2	62.0, —	–	28°17′ N, 88°33′ W	Stomach of *Alepisaurus* sp. caught on longline at 50 fms (MCZ)
"Delaware" Cr. 59-6	6	1	96.0	25 V 59	38°37′ N, 68°24′ W	Stomach of tuna caught on longline (MCZ)
"Delaware" Cr. 63-11	3	3	27.0–62.8	20 XI 63	41°18′ N, 60°00′ W	Stomach of *Alepisaurus ferox* caught on longline (MCZ)
"Delaware" Cr. 63-11	4	2	23.8, 24.4	21 XI 63	40°45′ N, 62°18′ W	Stomach of albacore tuna caught on longline (MCZ)
"Delaware" Cr. 65-13	–	5	16.8–33.3	10 XII 65	37°32′ N, 69°32′ W	Stomach of tuna caught on longline (MCZ)
"Delaware" Cr. 66-2	9-106	5	26.2–47.7	27 III 66	37°14′ N, 65°54′ W	Stomach of albacore tuna caught on longline (MCZ)
"Delaware" Cr. 66-2	–	3	27.1–59.0	III 66	37°–39° N, 65°–55° W	Stomachs of various tunas caught on longline (MCZ)
"Delaware" Cr. 66-2	12-117	1	33.4	31 III 66	39°34′ N, 55°20′ W	Stomach of albacore tuna caught on longline (MCZ)
"Cap't. Bill III"	65-1	6	38.8–68.8	11–12 V 65	38°12′ N, 69°57′ W to 38°10′ N, 69°37′ W	Midwater trawl (MCZ)
"Gerda"	NG11-F5	1	11.5	10 XII 50	24°03.5′ N, 82°04.1′W	Stramin net (UMML)
"Gerda"	NG-38F	3	3.2–5.5	14 I 52	25°43′ N, 76°56′ W	Stramin net at 46 m (UMML)
"Gerda"	SL14-F1	1	7.0	20 III 53	25°45′ N, 79°56′ W	Stramin net at 66 m (UMML)
"Gerda"	Supl. 26	2	13.1, 14.9	9 XI 55	25°35′ N, 77°22.4′ W	Stramin net at 10 m (UMML)
"Gerda"	SL46-A4	1	10.0	25 X 56	25°35′ N, 79°20′ W	Stramin net at 388 m (UMML)
"Gerda"	Supl. 122	1	8.0	–	10 mi E of Miami, Florida	Stramin net, surface (UMML)

(To be continued.)

Appendix Table 22 (continued).

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
"Gerda"	Supl. 187	3	10.8–14.4	6 V 58	10 mi E of Miami, Florida	2-m stramin net at 40–51 m (UMML)
"Gerda"	Supl. 189	2	6.5, 12.1	6 V 58	10 mi E of Miami, Florida	2-m stramin net at 34.5 m (UMML)
"Gerda"	Supl. 190	1	7.4	6 V 58	10 mi E of Miami, Florida	2-m stramin net at 224–248 m (UMML)
"Gerda"	Supl. 191	4	6.0–10.6	6 V 58	10 mi E of Miami, Florida	2-m stramin net at 38 m (UMML)
"Chain" Cr. 60	RHB 1290	1	10.1	11 VI 66	21°17′ N, 85°22′ W to 21°24′ N, 85°35′ W	10-ft IKMT; 0–(113–124)–0 m (MCZ)
"Chain" Cr. 60	RHB 1315	3	7.8–9.8	25–26 VI 66	25°46′ N, 79°47′ W to 26°10′ N, 79°46′ W	10-ft IKMT; 0–(57–71)–0 m (MCZ)
"Chain" Cr. 60	RHB 1316	3	8.4–12.7	26 VI 66	29°53′ N, 79°46′ W to 29°59′ N, 79°20′ W	10-ft IKMT; 0–(33–46)–0 m (MCZ)

Appendix Table 23. Specimens of *Pterycombus petersii* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M.W.O.	Latitude	Longitude
3723 III	1	12.2	30 V 29	300	25°30.5′ N	125°28′ E
3828 I	1	6.2	18 IX 29	300	01°53′ N	96°07′ E
3927 IV	2	5.7, 6.7	17 XII 29	100	10°55′ N	50°15′ E
3928 III	1	7.5	18 XII 29	200	11°20′ S	50°10′ E
3928 IV	4	6.2–10.0	„	100	„	„
3928 V	5	5.6–7.8	„	50	„	„
3929 III	1	6.8	18 XII 29	400	12°11′ S	50°18′ E
3931 I	1	17.0	19 XII 29	600	12°09′ S	49°34′ E
3931 III	1	5.5	„	300	„	„
3932 II	1	7.7	20 XII 29	500	11°35′ S	49°45′ E
3934 III, VIII, XIII	1	15.5	20–21 XII 29	400	11°24′ S	50°05′ E
3934 IV, IX, XIV, XIX	1	7.0	„	300	„	„
3934 V, X, XV, XX	1	15.0	„	200	„	„
3949 III	3	5.4–7.5	6 I 30	300	11°33′ S	41°44′ E
3949 V	1	5.7	„	50	„	„
3950 I	1	4.5	7 I 30	500	12°23′ S	41°43.5′ E
3957 II	1	10.3	11 I 30	300	21°30′ S	42°32′ E
3957 IV	1	10.8	„	100	„	„
3957 V	1	5.0	„	50	„	„
3959 III	1	9.0	12 I 30	200	23°40′ S	42°03′ E
3959 IV	3	4.9–6.7	„	100	„	„
3960 II	2	4.5, 11.8	13 I 30	200	25°23′ S	42°52′ E
3962 III	1	7.2	14 I 30	300	24°33′ S	38°26′ E
3963 II	1	6.6	15 I 30	200	24°30′ S	37°48.5′ E
3963 III	2	6.6, 7.0	„	150	„	„
3964 IV	2	5.7, 9.6	15 I 30	100	25°19′ S	36°13′ E
3964 V	5	4.5–7.5	„	50	„	„
3970 I	1	9.8	28 II 30	300	34°09′ S	27°38′ E
3970 II	4	5.7–8.7	„	200	„	„

Appendix Table 24. Study specimens of *Pterycombus petersii* other than those in the "Dana" collections.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Standard Length	Date	Locality	Gear and Remarks
T. Abe	–	1	275.0	VI 61	Sea of Japan off Cape Nyudozaki	Trawl caught (Abe 61-367)
T. Abe	–	1	166.0	29 I 59	Komekami, near Odawara; Sagami Bay, Japan	Trap caught (Abe 61-107)
T. Abe	–	1	80.7	2 VIII 60	28°33′ S, 177°28′ W	Stomach of yellowfin tuna (Abe 60-960)
–	–	10	30.0–62.0	IX–X 58–59	03°–08° S lat. off Zanaibar	Stomachs of yellowfin tuna caught on longline (BMNH)
"Discovery II"	1375	1	23.3	25 V 34	34°30.8′ S, 26°19′ E	Net fished at 0–210 m (BMNH)
–	–	1	31.0	–	off South Africa	Tuna Stomach (SAM)
"Discovery II"	1763	2	9.6, 14.2	5 V 36	32°03.5′ S, 40°45.2′ E	Net fished at 0–2000 m (BMNH)
–	–	1	244.0	1927	probably Table Bay, S. Africa	Cast ashore; holotype of *P. falcatus* Barnard (SAM)
"C. H. Gilbert" Cr. 15	60	1	71.5	12 IV 54	02°56′ S, 155°11′ W	Stomach of *T. germo* (HBL)
"C. H. Gilbert" Cr. 15	66	1	98.0	15 IV 54	01°58′ N, 155°16′ W	Stomach of *T. germo* (HBL; USNM)
–	–	1	97.0	–	45 mi W of Slangkop, S. Africa	(SAM)
–	–	1	87.2	–	120 mi W of Slangkop, S. Africa	(SAM)
–	–	1	49.0	–	45 mi W of Slangkop, S. Africa	(SAM)
–	–	1	22.0	–	60 mi WSW of Cape Recife, S. Africa	(SAM)
–	–	1	28.0	–	45 mi WNW of Dassen I., S. Africa	(SAM)
–	–	1	67.0	–	60 mi W of Cape Columbine, S. Africa	(SAM)
–	–	5	24.3–58.7	–	120 mi W of Slangkop, S. Africa	(SAM)
"Anton Bruun" Cr. 6	340 B	1	14.2	31 V 64	05°55′ S, 64°48′ E to 06°08′ S, 64°58′ E	IKMT; 0–700–0 m (MCZ)
"Anton Bruun" Cr. 6	342 A	2	12.4, 13.5	2 VI 64	09°57′ S, 64°55′ E to 10°01′ S, 64°19′ E	IKMT; 0–580–0 m (MCZ)
"Anton Bruun" Cr. 6	343 A	1	17.0	4 VI 64	12°10′ S, 64°54′ E to 12°11′ S, 64°11′ E	IKMT; 0–800–0 m (MCZ)
"Anton Bruun" Cr. 6	351 C	1	10.8	28 VI 64	31°25′ S, 65°08′ E to 31°45′ S, 65°08′ E	IKMT; 0–540–0 m (MCZ)

Appendix Table 25. Specimens of *Pteraclis carolinus* in the "Dana" collections.

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
830	1	7.0	15 IV 20	100	24°44′	22°32′
834	1	10.6	20 IV 20	300	24°20′	35°31′
836	1	6.4	22 IV 20	50	24°29′	40°02′
836	1	5.5	„	100	„	„
837	4	4.3–5.5	24 IV 20	50	23°40′	43°26′
838	1	5.5	25 IV 20	100	24°31′	44°38′
839	1	4.8	26 IV 20	0	24°31′	46°46′
839	1	4.4	„	50	„	„
839	4	7.9–11.3	„	300	„	„
840	1	5.2	27 IV 20	0	25°29′	48°03′
841	1	4.5	27 IV 20	50	25°42′	48°59′
841	1	5.5	„	100	„	„
842	4	4.3–4.7	28 IV 20	50	25°48′	49°22′
842	1	10.0	„	200	„	„
842	1	6.2	„	300	„	„
843	1	6.0	28 IV 20	100	25°59′	50°56′
844	4	4.2–4.3	29 IV 20	100	25°49′	51°55′
844	5	5.0–7.1	„	150	„	„
844	1	9.8	„	200	„	„
845	4	4.4–6.3	30 IV 20	50	24°46′	54°08′
845	1	8.3	„	300	„	„
846	2	4.7, 5.5	1 V 20	100	23°40′	55°22′
846	1	4.2	„	150	„	„
849	1	4.4	3 VI 20	200	19°00′	63°53′
851	1	6.4	5 VI 20	50	22°23′	60°46′
855 IV	1	4.6	9 VI 20	50	29°15′	59°45′
855 V	10	3.8–9.0	„	100	„	„
855 XVI	1	9.8	„	200	„	„
855 XVII	1	5.0	„	150	„	„
855 XIX	4	4.4–5.8	„	50	„	„
855 XX	5	6.6–7.9	„	0	„	„
855 XXI	2	5.0, 5.3	„	150	„	„
855 XXIV	12	4.5–8.1	10 VI 20	0	„	„
855 XXVII	6	4.8–8.0	„	50	„	„
855 XXVIII	5	4.0–6.2	„	0	„	„
856 VII	2	—, 6.0	11 VI 20	100	30°47′	60°33′
856 VIII	1	5.2	„	50	„	„
856 IX	3	4.0–7.5	„	25	„	„
857	2	3.5, 4.3	13 VI 20	25	30°47′	62°27′
857	1	6.7	„	200	„	„
858	4	3.6–5.5	14 VI 20	25	29°31′	64°00′
858	1	4.5	„	50	„	„
858	3	5.6–6.5	„	100	„	„
858	1	6.4	„	150	„	„
858	5	7.8–8.9	„	200	„	„
859	2	3.0, 3.5	15 VI 20	25	29°02′	65°09′
859	5	3.5–4.6	„	50	„	„
859	6	4.2–5.5	„	100	„	„
859	1	6.0	„	150	„	„
859	2	5.4, 5.7	„	200	„	„
862	1	5.1	20 VI 20	50	31°36′	62°25′
863	11	3.6–5.6	21 VI 20	50	30°43′	60°46′
863	1	5.7	„	100	„	„
863	3	4.1–6.5	„	150	„	„
864	2	4.7, 5.5	22 VI 20	50	30°02′	59°10′
864	2	5.0, 5.1	„	100	„	„
864	1	7.8	„	150	„	„

(To be continued.)

Appendix Table 25 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
865	14	5.0–8.6	23 VI 20	0	29°19′	57°43′
865	2	4.0, 4.5	„	50	„	„
865	1	6.5	„	150	„	„
865	2	7.0, 7.5	„	200	„	„
866	13	4.4–8.0	23 VI 20	50	28°32′	56°38′
866	2	7.0, 7.1	„	100	„	„
866	1	6.8	„	150	„	„
867	1	6.0	24 VI 20	150	28°15′	56°29′
868	2	3.4, 4.1	24 VI 20	75	27°10′	55°52′
868	2	4.7, 5.3	„	125	„	„
870	5	3.8–5.6	26 VI 20	50	27°29′	59°20′
870	5	4.7–8.0	„	100	„	„
870	1	6.5	„	150	„	„
870	6	3.1–5.9	„	50	„	„
870	1	8.9	„	100	„	„
871	1	4.0	28 VI 20	50	27°15′	61°35′
871	1	6.0	„	100	„	„
871	1	8.0	„	150	„	„
872	15	3.0–9.5	28 VI 20	75	27°07′	63°21′
872	9	3.3–9.0	„	100	„	„
872	2	3.8, 9.0	„	110	„	„
872	2	6.5, 6.5	„	150	„	„
873	19	4.9–8.9	29 VI 20	50	27°04′	65°23′
873	5	5.5–8.7	„	100	„	„
873	5	5.6–7.9	„	150	„	„
874	11	2.6–8.6	30 VI 20	50	27°09′	66°09′
874	2	5.5, 6.3	„	150	„	„
875	3	3.5–8.5	1 VII 20	150	28°58′	67°09′
876	1	11.0	2 VII 20	100	30°58′	66°14′
876	2	3.6, 7.0	„	110	„	„
879	7	4.5–7.2	10 VII 20	50	33°46′	58°56′
881	6	4.7–8.5	13 VII 20	50	34°42′	54°00′
881	1	4.5	„	100	„	„
881	3	2.7–5.4	„	150	„	„
882	1	5.6	13 VII 20	50	33°00′	54°02′
882	1	5.0	„	100	„	„
882	1	5.3	„	150	„	„
883	2	4.2, 4.5	14 VII 20	50	30°53′	54°07′
883	1	6.7	„	150	„	„
884	2	4.3, 6.7	15 VII 20	25	28°49′	54°10′
884	1	6.7	„	50	„	„
884	6	3.8–5.6	„	100	„	„
884	2	5.0, —	„	150	„	„
885	1	5.0	16 VII 20	50	26°46′	54°14′
885	2	5.5, 5.5	„	100	„	„
885	4	4.5–5.3	„	150	„	„
886	1	4.6	17 VII 20	100	24°40′	54°19′
886	3	5.0–5.8	„	150	„	„
887	4	5.0–6.3	19 VII 20	150	26°19′	58°58′
888	4	5.0–6.5	20 VII 20	25	27°31′	61°32′
888	3	4.5–5.6	„	50	„	„
888	3	4.0–6.0	„	100	„	„
888	5	4.7–11.7	„	150	„	„
889	8	4.0–5.7	21 VII 20	25	28°20′	63°50′
889	9	3.5–5.6	„	50	„	„
889	1	4.0	„	100	„	„
890	4	3.3–5.1	22 VII 20	50	28°44′	66°04′

(To be continued.)

Appendix Table 25 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
891	4	3.4, 3.5, —, —	24 VII 20	50	29°28′	69°25′
891	1	5.6	„	100	„	„
891	5	—, 6.7, 7.4, —, —	„	150	„	„
892	2	3.3, —	25 VII 20	100	30°49′	73°30′
902	1	6.4	25 II 21	50	19°34′	64°06′
904	1	6.4	27 II 21	200	22°31′	62°07′
905	1	4.8	28 II 21	100	24°27′	61°32′
905	2	3.5, 4.0	„	150	„	„
906	3	3.5–4.5	2 III 21	50	25°50′	61°09′
906	4	5.0–5.9	„	150	„	„
907	2	3.5, 4.3	3 III 21	100	27°24′	60°09′
907	3	4.0–4.5	„	200	„	„
908	1	5.8	4 III 21	200	28°20′	59°16′
909	1	5.5	5 III 21	50	29°00′	58°15′
909	4	4.1–7.2	„	100	„	„
909	1	8.7	„	200	„	„
910	1	5.0	7 III 21	10	27°43′	57°22′
910	2	—, 4.5	„	50	„	„
910	2	4.0, 4.0	„	100	„	„
910	1	5.0	„	100	„	„
910	2	5.3, 5.7	„	200	„	„
911	1	5.0	8 III 21	100	26°34′	57°02′
911	1	4.3	„	200	„	„
914	1	5.0	14 III 21	100	22°31′	54°14′
914	2	4.8, 6.1	„	150	„	„
914	5	4.5–6.2	„	200	„	„
915	1	9.5	15 III 21	10	23°57′	54°50′
915	1	6.4	„	100	„	„
915	1	5.0	„	150	„	„
915	3	5.0–8.4	„	200	„	„
915	1	3.2	„	50	„	„
916	12	4.3–8.1	16 III 21	10	25°34′	54°27′
916	2	4.6, 6.5	„	100	„	„
916	2	4.5, 5.9	„	200	„	„
916	4	5.7–8.0	„	300	„	„
917	4	6.5–8.5	17 III 21	10	27°24′	53°23′
917	1	4.4	18 III 21	25	„	„
917	1	4.5	„	50	„	„
917	3	5.6–9.3	„	100	„	„
917	3	4.3–4.5	„	150	„	„
917	1	4.1	„	200	„	„
917	1	5.3	„	500	„	„
917	1	4.6	„	800	„	„
918	27	4.7–9.6	19 III 21	50	27°31′	51°10′
918	15	4.9–7.9	„	100	„	„
918	1	9.8	„	150	„	„
919	1	4.3	20 III 21	100	26°34′	50°40′
920	1	4.1	22 III 21	300	25°01′	52°07′
920	1	5.7	„	1000	„	„
921	1	4.6	23 III 21	10	24°28′	51°41′
921	1	7.0	„	300	„	„
922	1	4.5	24 III 21	10	23°56′	50°49′
922	2	4.0, 5.0	„	50	„	„
922	1	6.6	„	100	„	„
923	1	6.0	27 III 21	150	22°47′	48°53′
925	2	5.3, —	30 III 21	50	21°27′	46°52′

(To be continued.)

Appendix Table 25 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
925	1	15.5	30 III 21	200	21°27′	46°52′
926	1	9.8	31 III 21	300	21°15′	46°10′
928	1	4.9	3 IV 21	50	22°43′	45°18′
928	1	5.8	„	100	„	„
928	1	9.3	„	200	„	„
928	1	21.1	„	300	„	„
929	1	5.0	4 IV 21	100	24°10′	45°33′
929	2	5.9, 6.4	„	200	„	„
929	1	9.8	„	300	„	„
930	2	4.3, 6.8	5 IV 21	100	24°50′	45°46′
930	1	10.4	„	200	„	„
931	1	5.1	6 IV 21	50	26°10′	46°32′
931	1	6.9	„	150	„	„
931	3	7.5–10.5	„	300	„	„
932	1	5.0	7 IV 21	50	27°23′	46°24′
932	2	4.5, 5.0	„	100	„	„
932	3	7.3–7.5	„	200	„	„
932	3	9.1–9.8	„	300	„	„
933	1	6.3	10 IV 21	200	27°40′	48°40′
933	2	7.5, —	„	300	„	„
934	1	4.5	11 IV 21	10	27°00′	49°50′
935	1	6.9	12 IV 21	10	24°44′	51°25′
935	1	6.2	„	50	„	„
936	5	4.0–6.0	13 IV 21	50	26°50′	52°08′
936	2	6.1, 6.7	„	100	„	„
936	1	4.7	„	400	„	„
937	1	6.0	15 IV 21	200	27°04′	53°27′
937	1	5.9	„	300	„	„
937	3	4.9–14.0	„	500	„	„
938	2	4.7, —	16 IV 21	100	26°27′	54°38′
938	2	11.8, 14.5	„	300	„	„
938	1	18.0	„	600	„	„
939	1	8.9	18 IV 21	100	26°10′	56°30′
940	1	6.5	19 IV 21	10	27°20′	57°50′
940	2	6.6, 6.7	„	50	„	„
940	4	7.0–7.5	„	100	„	„
940	6	5.0–8.8	„	150	„	„
940	1	5.3	„	300	„	„
941	1	7.4	20 IV 21	10	27°31′	59°52′
941	5	5.5–6.5	„	50	„	„
941	4	5.0–6.9	„	100	„	„
941	6	7.1–10.8	„	200	„	„
942	10	4.0–9.2	21 IV 21	100	26°57′	60°58′
942	2	7.0, 10.0	„	200	„	„
943	3	5.0–6.1	22 IV 21	100	26°20′	62°00′
944	13	4.7–9.3	23 IV 21	10	25°40′	63°10′
944	2	6.0, 9.5	„	100	„	„
945	1	6.2	24 IV 21	10	25°00′	64°10′
945	2	7.3, 10.0	„	300	„	„
945	1	13.5	„	400	„	„
946	7	4.5–7.6	25 IV 21	50	24°20′	65°30′
946	1	5.1	„	100	„	„
946	1	7.2	„	400	„	„
950	2	5.5, 8.7	29 IV 21	200	20°50′	66°30′
950	1	8.0	„	400	„	„
1035 I	2	3.0, 4.4	9 X 13	10	27°39′	52°50′
1035 II	1	3.6	„	25	„	„

(To be continued.)

Appendix Table 25 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
1145 X	1	18.5	19 X 21	100	32°07′	16°50′
1147 IV	1	10.5	20 X 21	200	32°00′	20°01′
1155 I	1	9.0	24 X 21	400	26°15′	20°53′
1241 II	1	5.7	13 II 22	500	25°18′	74°00′
1320 II	1	9.0	27 IV 22	800	23°18′	56°58′
1320 IV	1	10.0	„	300	„	„
1321 I	2	12.8, 5.9	28 IV 22	500	24°13′	54°36′
1322 IV	1	6.6	29 IV 22	300	27°02′	53°39′
1322 X	2	5.0, 5.8	„	200	„	„
1322 XVII	1	6.9	30 IV 22	1000	„	„
1322 XX	1	9.7	„	700	„	„
1322 XXIX	3	6.9–8.6	„	200	„	„
1322 XXXIII	1	6.2	1 V 22	700	„	„
1322 XXXVI	8	5.1–12.8	„	200	„	„
1322 XXXVII	2	5.0, 5.2	„	150	„	„
1322 XXXVIII	5	5.0–10.0	„	100	„	„
1322 XXXIX	23	4.5–8.0	„	50	„	„
1323 I	1	11.8	1 V 22	700	27°17′	54°35′
1323 XIV	1	12.3	„	700	„	„
1325 I	1	9.6	2 V 22	900	27°20′	51°54′
1325 II	2	6.0, 10.0	„	700	„	„
1325 IV	1	10.7	„	600	„	„
1326 III	1	8.5	2 V 22	300	27°14′	51°25′
1327 III	2	7.8, 8.0	3 V 22	300	27°34′	51°47′
1327 IV	2	7.5, 7.5	„	200	„	„
1328 V	1	12.5	3 V 22	400	27°05′	52°11′
1329 IV	1	18.0	4 V 22	400	26°37′	53°22′
1330 VII	1	6.6	4 V 22	0	26°37′	54°45′
1331 III	1	5.7	5 V 22	600	26°37′	55°50′
1331 XII	5	7.8–13.5	„	100	„	„
1332 II	1	4.4	5 V 22	600	26°58′	56°58′
1332 IV	2	8.2, 9.9	„	400	„	„
1332 IX	1	8.8	„	400	„	„
1332 X	1	5.9	„	300	„	„
1332 XII	1	6.1	„	100	„	„
1332 XV	3	4.7–9.3	6 V 22	300	„	„
1332 XVIII	3	5.4–8.6	„	50	„	„
1334 II	1	7.0	7 V 22	600	27°28′	59°29′
1334 III	3	9.8–10.9	„	300	„	„
1334 VII	1	4.3	„	1000	„	„
1335 IV	1	8.8	8 V 22	200	28°02′	62°26′
1335 VI	1	8.5	„	100	„	„
1335 VII	2	7.2, 13.6	„	50	„	„
1366 VIII	1	7.6	9 V 22	500	28°15′	63°40′
1337 VI	1	16.1	9 V 22	600	29°36′	64°01′
1337 X	2	7.5, 10.0	„	100	„	„
1337 XI	3	5.7, —, —	„	50	„	„
1355 I	5	4.3–5.6	30 V 22	200	31°48′	63°38′
1355 II	6	4.3–6.3	„	100	„	„
1355 III	2	5.4, 7.0	„	50	„	„
1356 III	2	8.5, 11.5	1 VI 22	300	29°56′	59°33′
1356 IV	6	4.6–7.0	„	200	„	„
1356 V	4	4.6–6.3	„	150	„	„
1356 VII	6	4.6–8.4	„	50	„	„
1358 X	4	7.4–9.0	„	300	„	„
1358 XI	3	6.7–7.1	„	200	„	„
1358 XII	5	5.5–7.0	„	150	„	„

(To be continued.)

Appendix Table 25 (continued).

Station	Number of Specimens	Standard Length	Date	M. W. O.	Latitude N	Longitude W
1358 XIII	2	4.1, 7.2	1 VI 22	100	29°56′	59°33′
1358 XIV	1	5.8	„	50	„	„
1359 III	1	12.8	3 VI 22	500	27°35′	55°03′
1360 III	1	8.3	4 VI 22	300	26°56′	53°09′
1360 V	4	4.7–5.5	„	150	„	„
1360 VI	2	4.0, 4.7	„	100	„	„
1360 VII	5	3.5–4.5	„	50	„	„
1360 X	1	9.0	„	600	„	„
1361 II	1	7.1	4 VI 22	200	27°07′	51°10′
1362 III	1	9.2	6 VI 22	300	28°57′	47°24′
1362 IV	5	4.0–24.6	„	200	„	„
1362 V	1	7.9	„	150	„	„
1362 VII	3	4.9–6.2	„	50	„	„
1363 VI	1	8.2	7 VI 22	100	30°25′	44°46′
1363 VII	4	3.8–8.5	„	50	„	„
1365 VII	15	5.8–9.8	8 VI 22	50	31°47′	41°41′
1366 VI	4	6.3–9.4	9 VI 22	100	32°30′	40°04′
1366 VII	5	5.5–8.1	„	50	„	„
1368 VII	1	8.7	11 VI 22	50	34°40′	33°16′
3539 II	1	9.8	4 VIII 28	200	32°03′	24°44′
3539 III	3	6.8–9.2	„	100	„	„
3542 I	6	5.0–5.5	10 VIII 28	300	24°52′	44°40′
3543 I	1	3.6	12 VIII 28	300	21°50′	50°12′
3543 II	1	4.5	„	200	„	„
3543 III	1	5.0	„	100	„	„

Appendix Table 26. Study specimens of *Pteraclis carolinus* other than "Dana" and New York Zoological Society material.

Vessel or Collector	Station	Number of Specimens	Length (mm)	Date	Locality	Gear and Remarks
"Atlantis I"	1040	1	27.0	14 VIII 31	37°04′ N, 50°57′ W	Plankton net (MCZ)
"Atlantis I"	1041	1	29.8	15 VIII 31	36°55′ N, 52°41′ W	Plankton net (MCZ)
"Atlantis I"	1042	1	41.3	16 VIII 31	36°57′ N, 55°32′ W	Plankton net (MCZ)
–	–	6	30.0	1863	?31° N, ?40° W	Albacore stomach (LÜTKEN, 1880, UZM)
–	–	1	11.1	1870	23°30′ to 24°20′ N, 35°18′ to 34°50′ W	(LÜTKEN, 1880; UZM)
–	–	1	8.1	–	28° N, 29°54′ W	(UZM)
–	–	3	7.1–8.0	10 IX 1871	24° to 25° N, 28° to 33° W	(UZM)
–	–	1	11.8	1862	22° N, 34°30′ W	(UZM)
–	–	1	8.0	20 IV 1872	21° N, 36°30′ W	(UZM)
–	–	2	6.5, 7.0	1870	23°30′ to 24°20′ N, 35°13′ to 34°50′ W	(UZM)
"Discovery II"	4741	1	17.2	19 IX 61	32°22′ to 32°21.5′ N, 16°57.5′ to 16°47.5′ W	IKMT; 0–100 m (MMF)
"Discovery II"	4743	1	26.0	20 IX 61	32°34′ N to 32°28′ N, 16°45′ W to 16°54′ W	IKMT; 0–170 m (MMF)
"Discovery II"	4758	2	15.5, 19.1	30 IX 61	28°01′ N to 28°12′ N, 16°46.5′ W to 16°56′ W	IKMT; 0–170 m (MMF)
"Chain"	RHB 1119	2	9.1, 25.0	19 VI 65	26°22′ N, 70°16′ W to 26°30′ N, 70°18′ W	IKMT; 0–55 m (MCZ)
"Walther Herwig"	192/66	1	38.0	25 V 66	23°02′ S, 33°19′ W	Midwater trawl, 180–0 m (ISH)

Appendix Table 27. Specimens of *Pteraclis carolinus* collected by WILLIAM BEEBE and the Department of Tropical Research, New York Zoological Society in the cylinder of water, eight miles in diameter, south of Bermuda (32°12′ N, 64°38′ W). Specimens now in California Academy of Sciences.

Standard length (mm)	Present Stanford Univ. catalog number	BEEBE net number	Date	Depth (meters)	Duration Hours	Duration Minutes	Diameter of net (meters)
12.2	10348	157	8 VI 29	2012	3	45	2
11.7	45020	174	15 VI 29	1646	4	02	1
21.0	43317	178	17 VI 29	1280	4	02	1
11.2	43316	791	9 VII 30	914	4	26	1
4.7	45011	1032	23 VI 31	45	5	00	1
3.5	45007	1039	26 VI 31	0	4	10	1
3.5, 5.7	45006, 45010	1041	26 VI 31	92	4	10	1
4.6, 9.8	45008, 45021	1052	6 VII 31	549	5	05	1
6.3	45022	1054	7 VII 31	45	5	00	1
7.2	21310	1074	11 VII 31	45	5	46	1

Appendix Table 28. Specimens provisionally identified as *Pteraclis velifera* in the "Dana' collections.

Station	Number of Specimens	Standard Length	Date	M.W.O.	Latitude	Longitude
3927 II	1	8.2	17 XII 29	300	10°55′ S	50°15′ E
3928 V	1	8.8	18 XII 29	50	11°20′ S	50°10′ E
3932 VI	1	8.1	20 XII 29	600	11°35′ S	49°45′ E

Appendix Table 29. Study specimens provisionally referred to *Pteraclis aesticola*.

Vessel or Collector; Cr. no.	Station	Number of Specimens	Length (mm)	Date	Locality	Gear and Remarks
"Commodore"	–	1	415.0	IX 51	Beach south of Santa Rosa Creek, San Luis Obispo Co., California	Stranded (mounted, in San Diego Nat. Hist. Soc.)
–	–	1	368.0	12 VIII 63	32°05′ N, 118°15′ W	Purse seine (SIO)
–	–	1	198.0	24 I 63	27°45.3′ S, 100°11.9′ W	Tuna stomach (SIO)
–	–	1	170.0	21 I 63	23°25.5′ S, 104°36.8′ W	Tuna stomach (SIO)
"H. M. Smith" Cr. 29	19	1	27.2	17 V 65	32°08′ N, 147°20′ W	*Coryphaena* stomach (HBL)
–	–	1	9.2	17 IV 65	25°34.7′ N, 124°07′ W	IKMT; 0–(2000) m (SIO)
Naga Exped.	–	1	7.5	11 V 61	20°47.5′ or 20°51.9′ N, 129°09.9′ or 129°04′ E	IKMT; 5350 m.w.o. (SIO)
"Anton Bruun" Cr. XIII	23	2	6.5, 12.0	18–19 I 66	33°49′ S, 90°07′ W to 33°48′ S, 90°19′ W	IKMT; 0–700 m (MCZ)

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PLATES

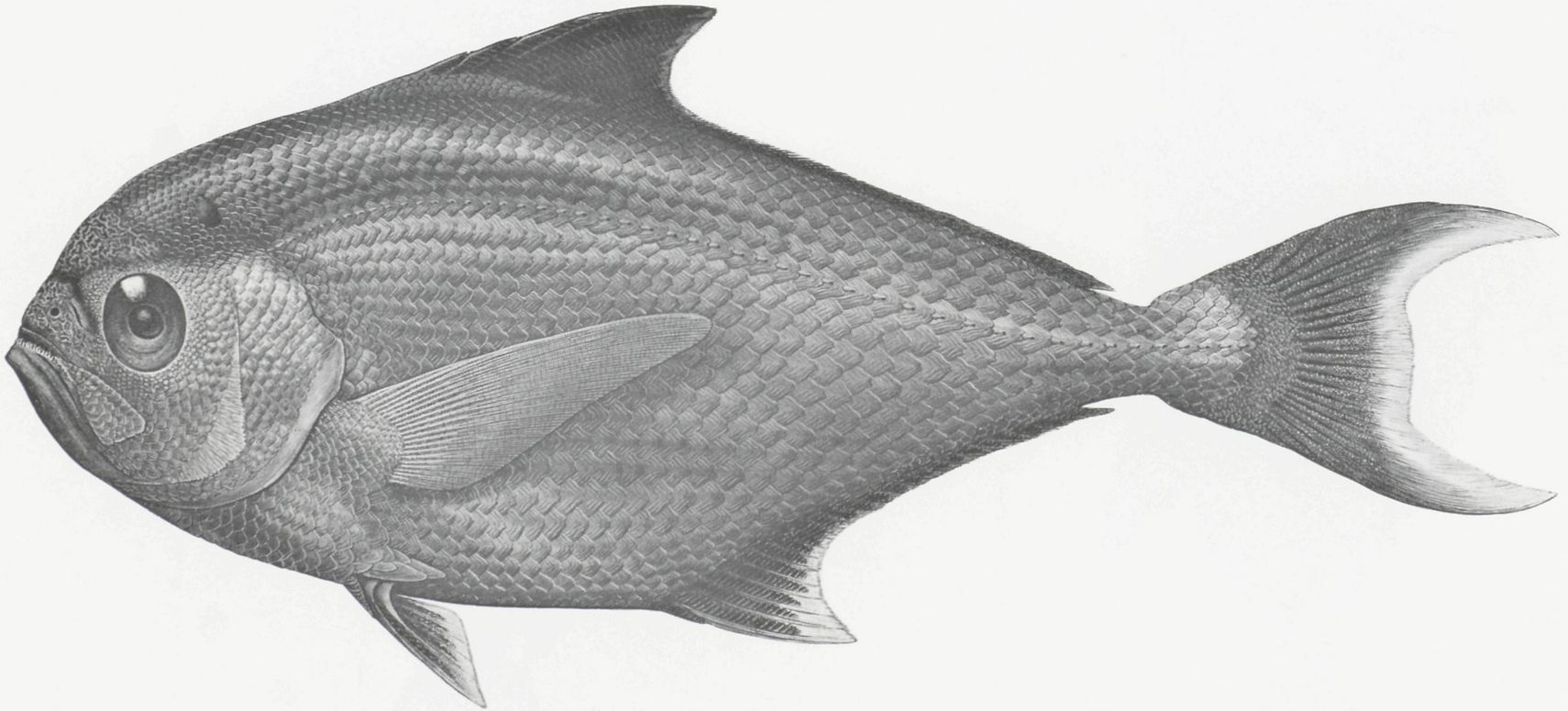


Plate 1.

Eumegistus illustris, 470 mm s.l., from off Hawaii. Drawn by N. Strekalovsky.

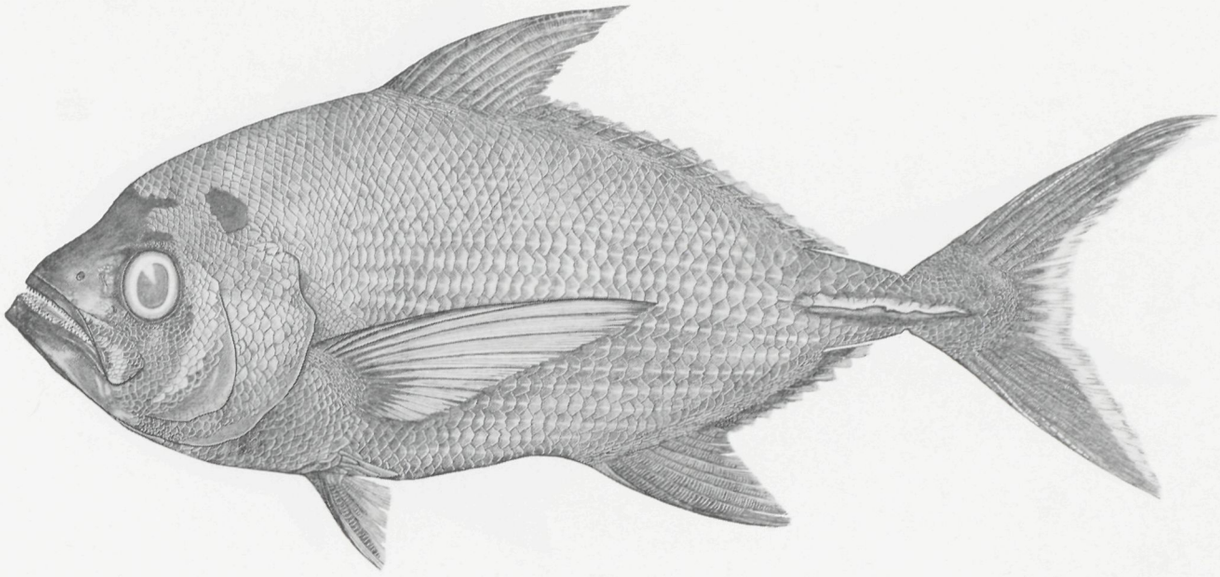


Plate 2a.

Taractes rubescens, an adult 635 mm s.l., from the Gulf of Mexico. Drawn by M. H. Carrington.

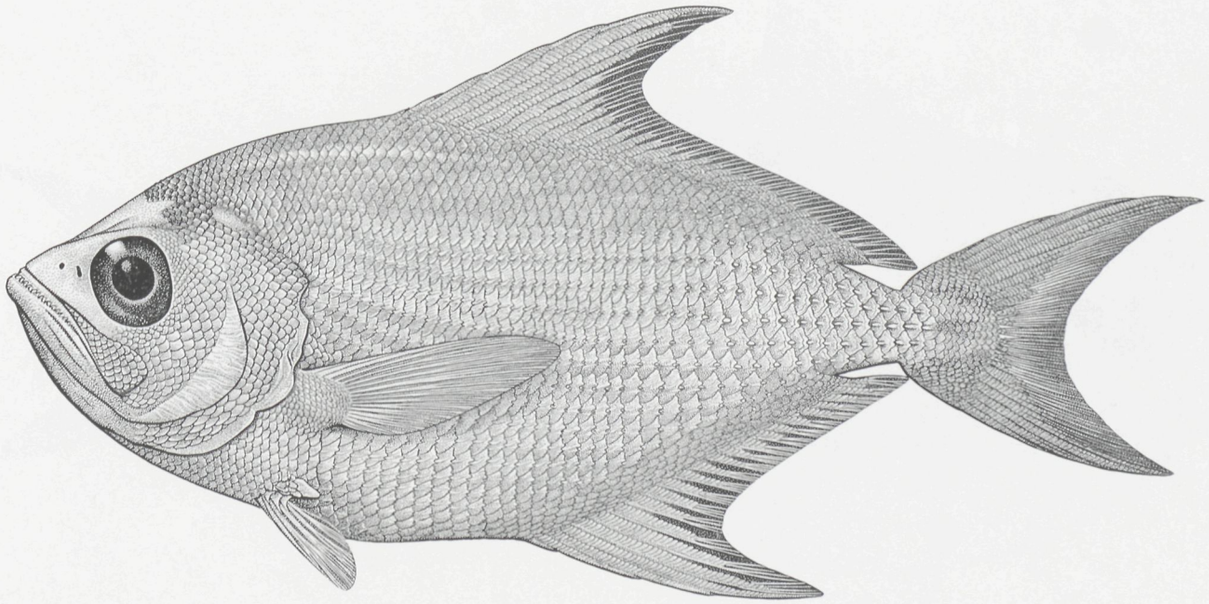


Plate 2b.

Taractes asper, an adult 308.0 mm s.l., from Vindafjord, Co. Rogaland, Norway (59°27′ N, 6°01′ E). Drawn by N. Strekalovsky.

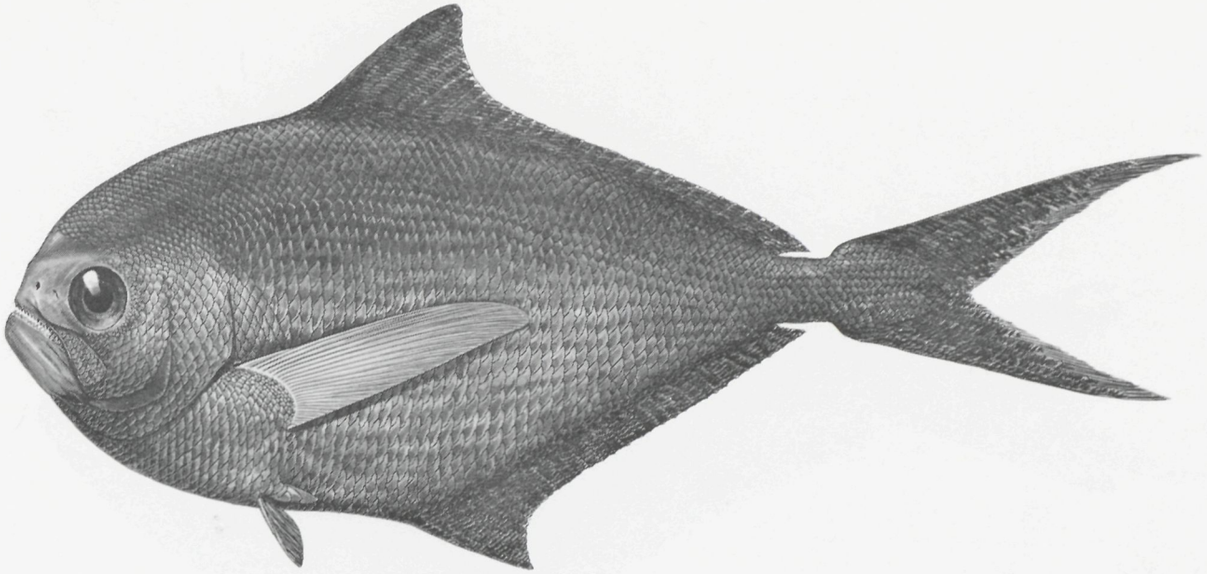


Plate 3a.

Brama brama, 405 mm s.l., from off Vigo, Galicia, Spain. Drawn by N. Strekalovsky.

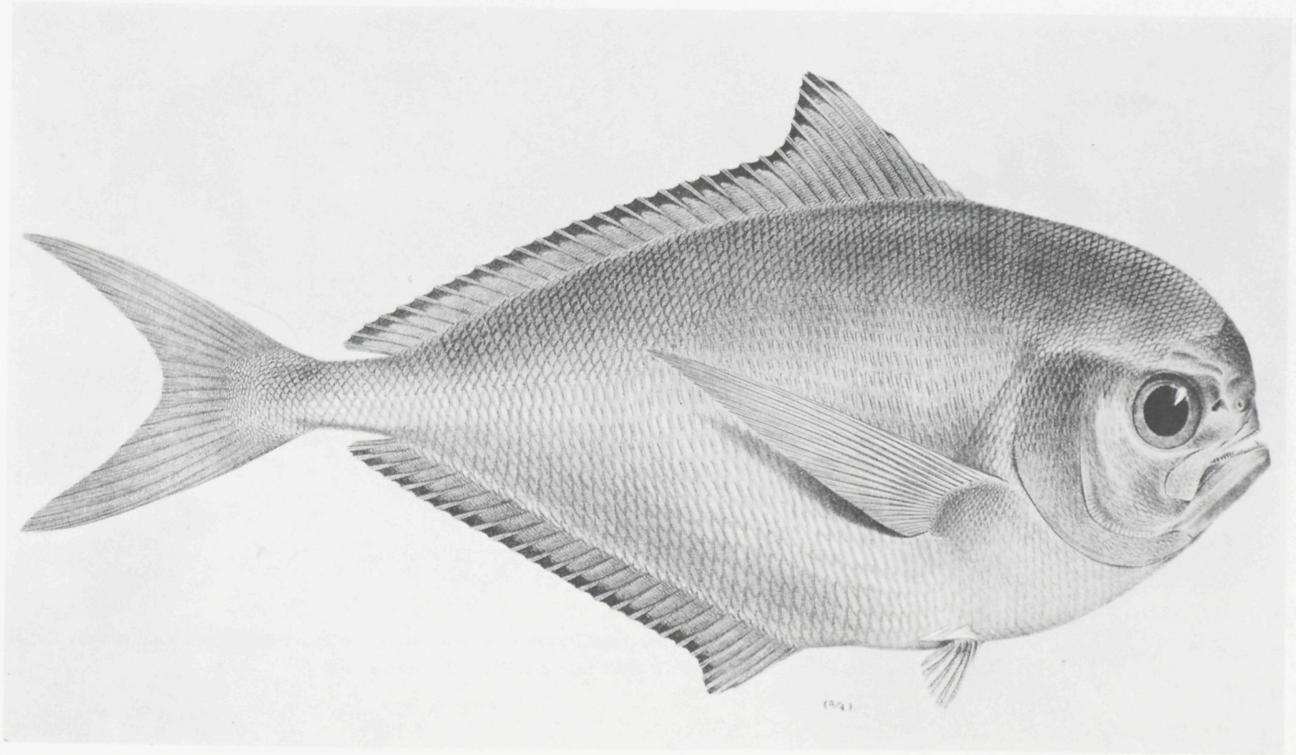


Plate 3b.

Type of *Brama japonica* Hilgendorf, 1878 (from Steindachner and Döderlein, 1884, pl. 1).



Plate 4.

Adult *Brama* from the Southern Hemisphere. Above, *Brama brama*, a 478 mm specimen stranded at Palliser Bay, New Zealand (DM 2233); below, *Brama* sp., 468 mm s.l., from Devonport, New Zealand (DM 2235).

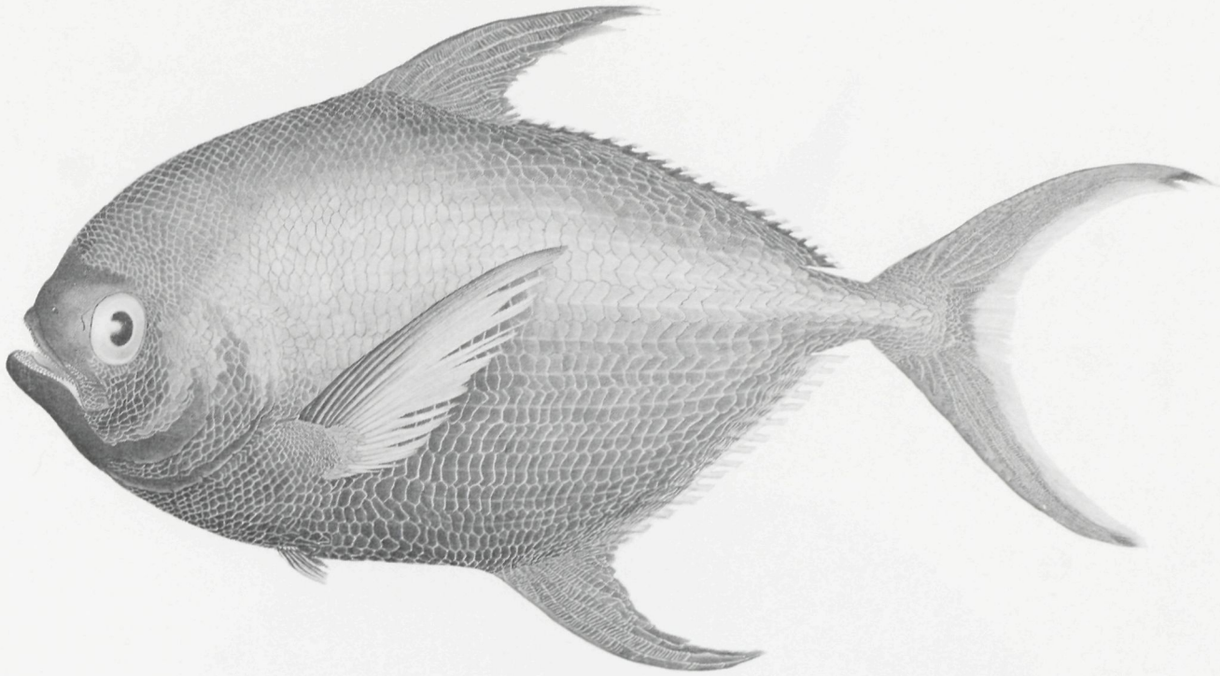


Plate 5a.

Taractichthys longipinnis, an adult 618 mm s.l., from the western North Atlantic (from Bigelow and Schroeder, 1929).
Drawn by H. Saunders.

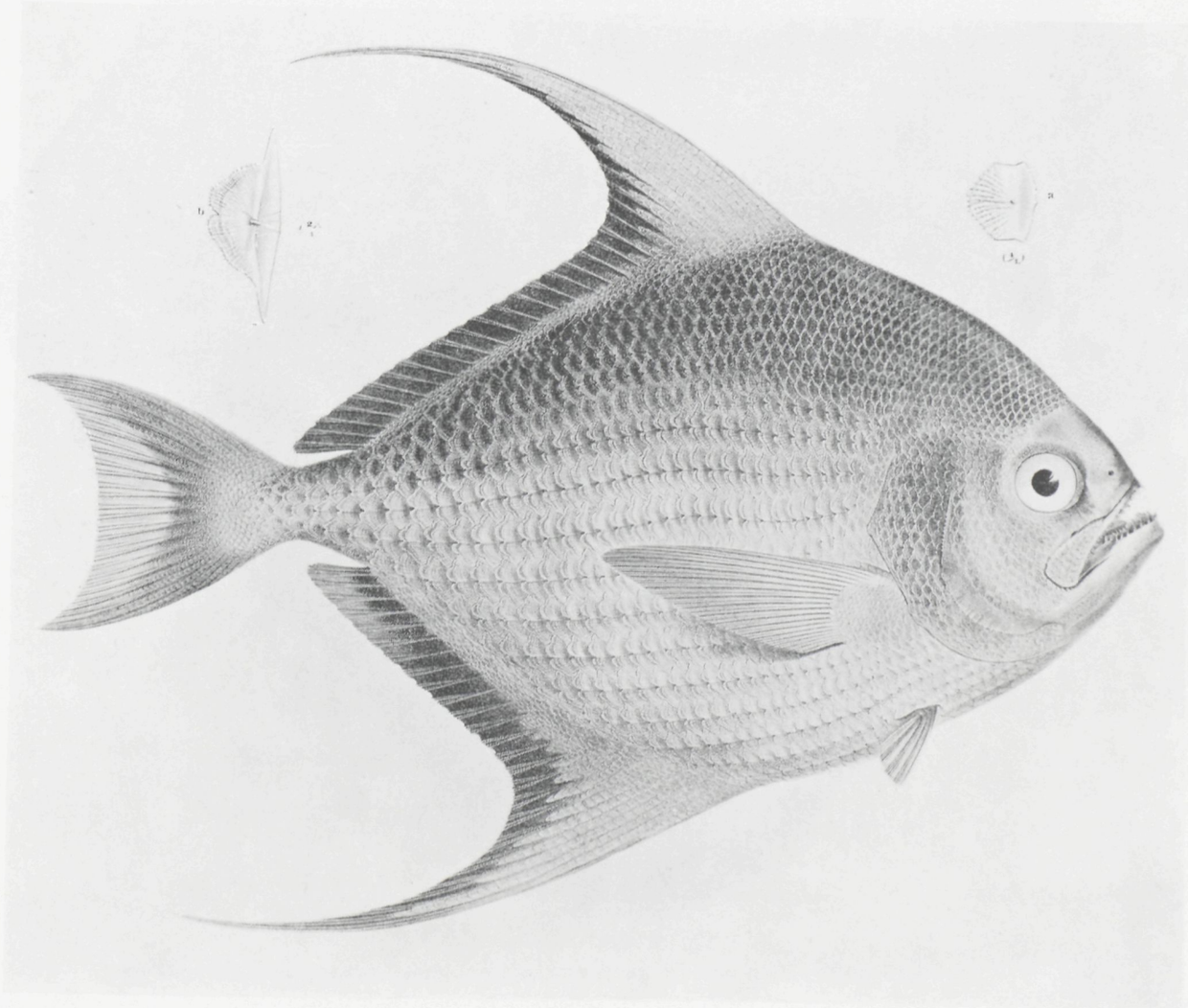


Plate 5b.

Taractichthys steindachneri, holotype, a subadult 195 mm s.l., from Japan (from Steindachner and Döderlein, 1883).
Drawn by E. Konopicky.

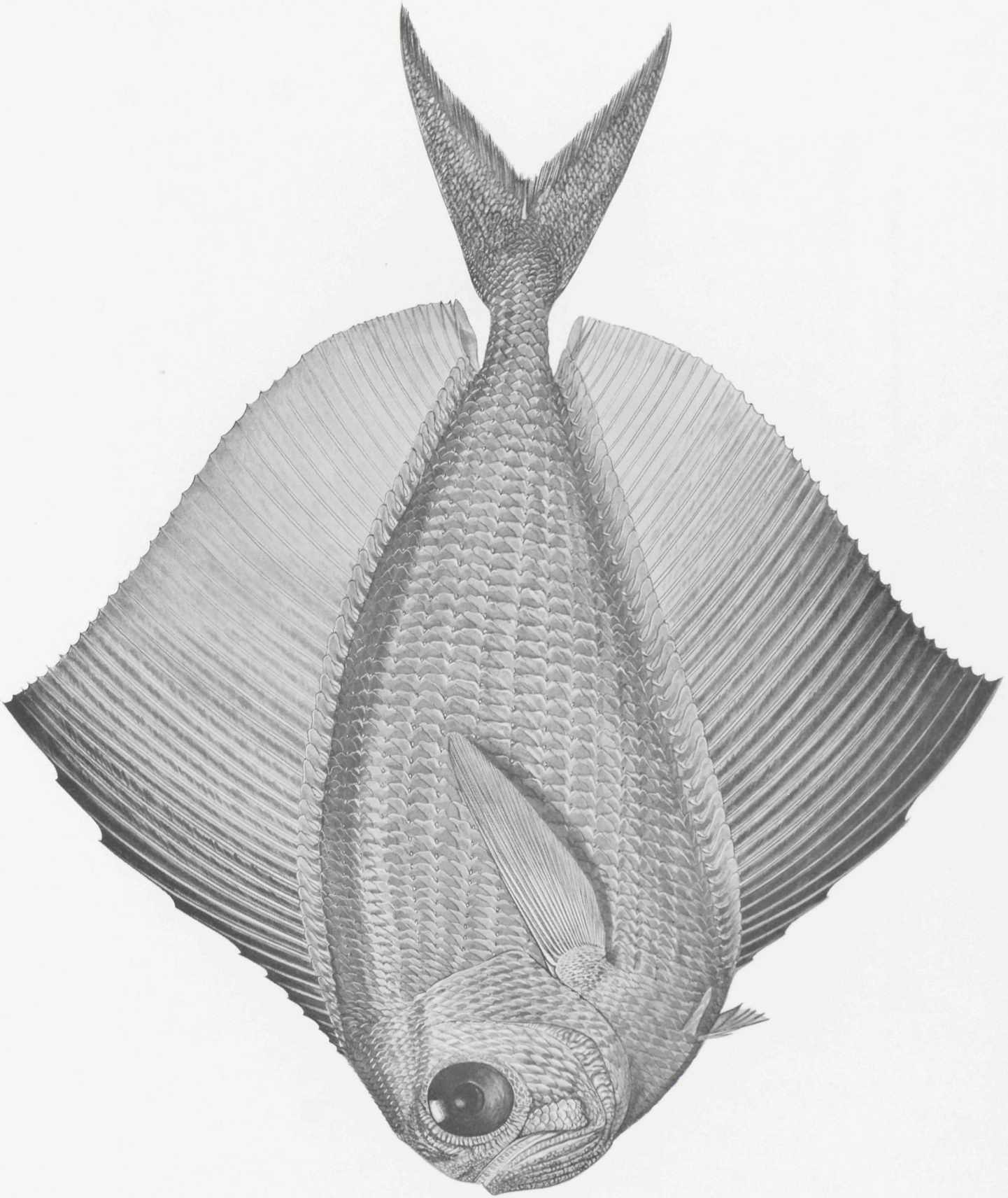


Plate 6.

An adult *Pterycombus brama* caught by the longline fishery off Vigo, Spain (MCZ). Drawn by N. Strekalovsky.

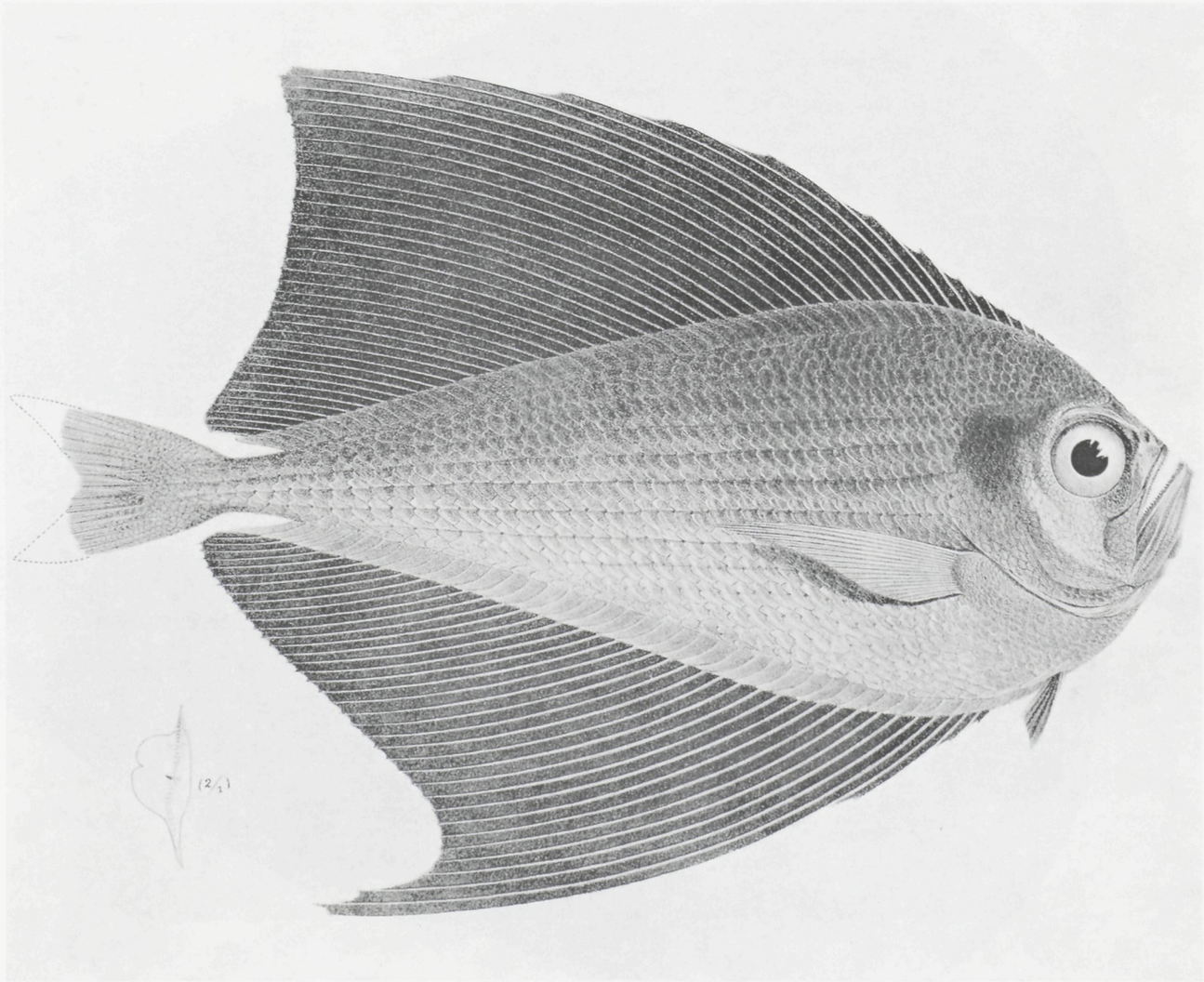


Plate 7.

Pterycombus petersii (HILGENDORF, 1878), holotype, 75 mm s.l., from Japan (from STEINDACHNER and DÖDERLEIN, 1884, pl. 2).

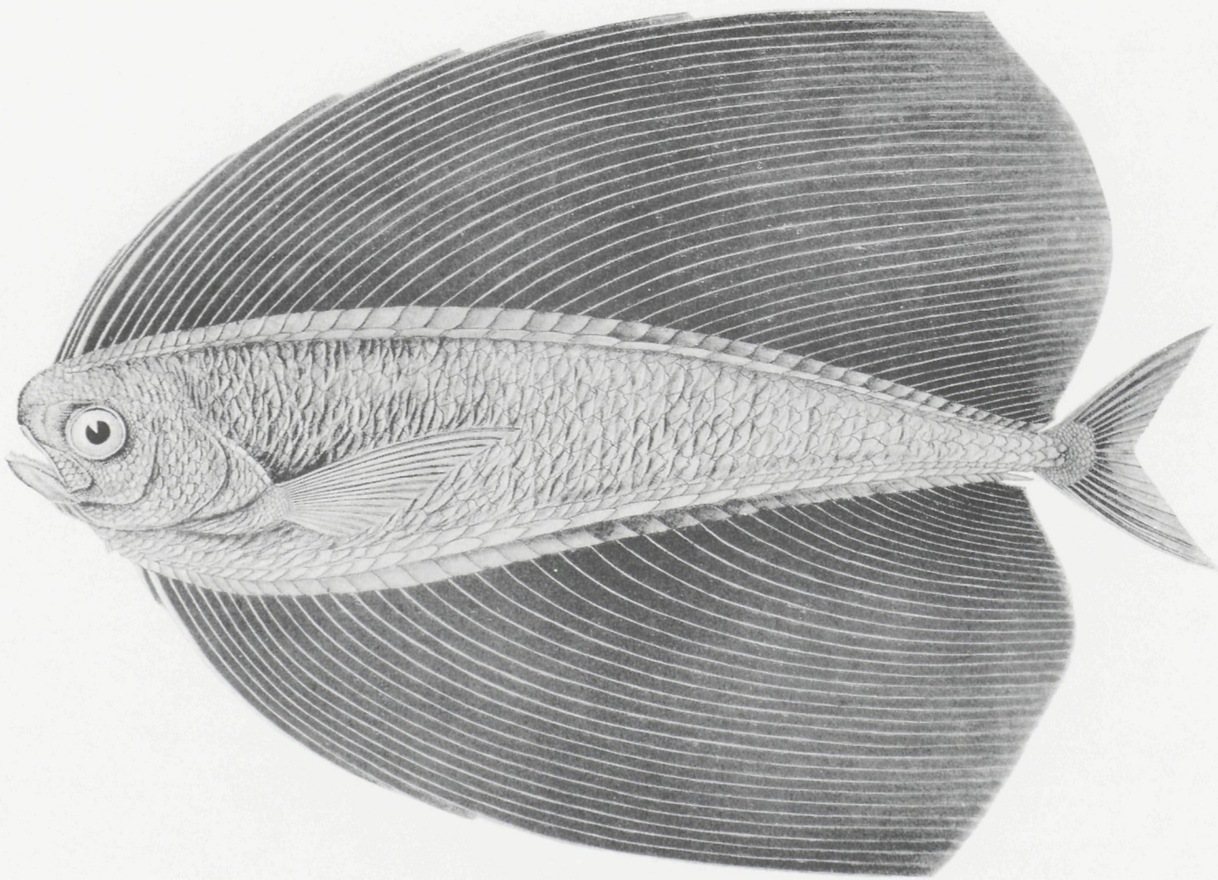


Plate 9.

Pteraclis aesticola, 171 mm s.l. from off Japan, the neotype designated by Kuronuma, 1941:55 (from Tanaka, 1927, pl. 167).

(continued from page 2 of cover)

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