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AN ATLAS OF THE EARLY STAGE FISHES IN JAPAN

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INTRODUCTION

Over 3,000 species of fish are known to occur in our country. This amounts to about 15% of the extant species, which are said to number about 20,000. This surprisingly rich ichthyofauna found in a limited area reflects the characteristically great north-south extent of the Japanese archipelago in that it is extremely diverse in composition. Most of these species begin their lives in the waters adjacent to the archipelago, grow up there, and fulfill their characteristic life histories there. On the other hand, many of those which migrate from the south on the Kuroshio occur here only at a certain stage of their development, such as the larval or postlarval stage. In this way, the ichthyofauna which appear so abundant to our eyes can be seen in actuality to be greatly expanded both qualitatively and quantitatively through the development of the individual fish.

Many fishes, particularly marine fishes, pass their early period of development in a planktonic existence which has no relation to their pattern of life as adults. This stage, called by the general term "ichthyoplankton," presents points of especially strong interest that cannot be overlooked, because of the characteristic morphological and ecological adaptations that it shows, and because it coincides with a time of great significance in terms of individual and group movements related to dispersal and survival.

The study of the classification of the early stages of fishes has as its primary purpose the discovery of the early developmental history of each species, organization of their taxonomic characters, and establishment of methods of distinguishing them from similar species. This study has a history of about one century, but with the exception of certain areas and

[Translator's note: "Body length" equals notochord or standard length; "same below" indicates that the same measurement was used throughout a particular section.]

Floor
Translated by Wilvan G. Van Campen of selected pages of the book from the Japanese for the Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA, Honolulu, Hawaii 96822-2396, January 1989.



taxonomic groups, much still remains to be elucidated. In our country, the first comprehensive work in this field was published in 1958. It was *Studies of the Early Stages of Japanese Fishes, First Collection*, by Keitaro Uchida and seven other authors, which assembled morphological development histories, focusing on useful species. Through its excellent figures and text, it had a great influence on subsequent progress in these studies. Next in 1966, Satoshi Mito's *Atlas of Japanese Marine Plankton, Volume 7, Fish Eggs and Early Stages* was published and, together with the above-mentioned work, has been utilized as a basic reference on classification of early stages of fishes. However, both dealt with a very limited number of species, and in 1980, *A Catalog of Literature on the Identification of Eggs and Early Stages of Fishes Occurring in Japanese Waters* was compiled as a supplement to them. In 1986, Takakazu Ozawa's collection of papers on the classification of early stages of pelagic fishes was published and greatly broadened the scope of these studies. Also, in recent years, there has been a succession of publications of guides to the classification and identification of the early stages of fishes in various foreign countries. In 1984, the major work *Ontogeny and Systematics of Fishes* summarized our knowledge up to that point in time, and there was a worldwide increase in interest in the study of the early stages of fishes.

Under these circumstances, and as the editor and others were planning the publication of this *Atlas of the Early Stage Fishes in Japan* in response to increasing calls for a compilation that would encompass present knowledge, it fortunately became possible to obtain the support of the Tokai University Press and great cooperation from first-line researchers all over the country, and the work has finally been brought to completion. The number of species included has reached about 1,100, far exceeding our initial expectations, which is in large part owing to the fact that the authors and others concerned have been willing to furnish their unpublished material. The lack of uniformity in the content from one taxonomic group to another is due to our having gone ahead and included items for which the specific name is unknown, with a view to subjects for future study. Following this policy of broader inclusion, a section on "eggs and hatchling larvae" has been appended at the end of the volume. The work has been written with the intention of avoiding forced identifications and maintaining accuracy, but it cannot be asserted positively that there are no unanticipated errors. We hope that any such errors will be pointed out by our readers so that we may further improve the work.

In the publication of this book, we have had the cooperation of many persons, in addition to the individuals and organizations noted below. We thank all of them from our hearts. We are deeply grateful to Mr. Wataru Yamada, Chief of the Publishing Section of the Tokai University Press, who planned for the publication of this book as a commemorative work in celebration of the 25th anniversary of the founding of the Press, and to Mr. Kazuo Narita, who dealt with us with great patience from the beginning to the end of the editorial process.

December 1987

Muneo Okiyama, Editor

[Acknowledgments omitted]

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Introductory Notes

Species Included and Stages of Development

In principle this book deals with those species listed in *The Fishes of the Japanese Archipelago* (Tokai University Press) for which the early stages (postlarva to juvenile) are known. The content is focused on specimens from Japan, but there are exceptions for species which have a broad distribution. The following division of the early stages of development has been followed.

Yolk-sac larvae: The period from hatching to completion of absorption of the yolk.

Postlarvae: The period from completion of absorption of the yolk to attainment of the definitive number of rays in all of the fins

Juveniles: The period in which the numbers of fin rays are the same as in the adult but body proportions, coloration, ecology, etc., differ considerably from the adult.

In some cases the prolarvae [yolk-sac larvae] and postlarvae have been dealt with together as the larval stage, but prolarvae in the strict sense have been placed together with the egg stage at the end of the volume.

Order and Form of the Discussion

The taxonomic groups have been separated in the order of rank of order, suborder, family, genus, and species, and depending on the amount of information available, we have added discussions, keys, or tables of meristic characters for the higher taxonomic groups above the genus. The discussion of each species has been divided into sections on standard common names, scientific names, meristic characters, morphology, distinction from similar species and distribution, and the author's name and the number of the reference cited are shown in parentheses at the end.

The order of presentation of taxonomic groups, standard Japanese names, scientific names, and meristic characters, in principle, follow *The Fishes of the Japanese Archipelago* (Tokai University Press).

The abbreviations used throughout this work for meristic characters are as follows:

D: dorsal fin, A: anal fin, C: caudal fin, P₁: pectoral fin, P₂: ventral [pelvic] fin, Br: number of branchiostegals, M: number of myomeres, Ph: rows of pharyngeal teeth, GR: number of gill rakers, V: number of vertebrae, Pred.S: number of scales anterior to the dorsal fin, TR: number of scales in a transverse row, TRa: number of scales above the lateral line (transverse row), TRb: number of scales below the lateral line (transverse row), LL: number of scales on the lateral line, LLp: number of scales on the lateral line with pores, LR: number of scales in a longitudinal row, PCL: precaudal length. Other terms and abbreviations peculiar to particular taxonomic groups are given in the discussion of those groups.

Figures

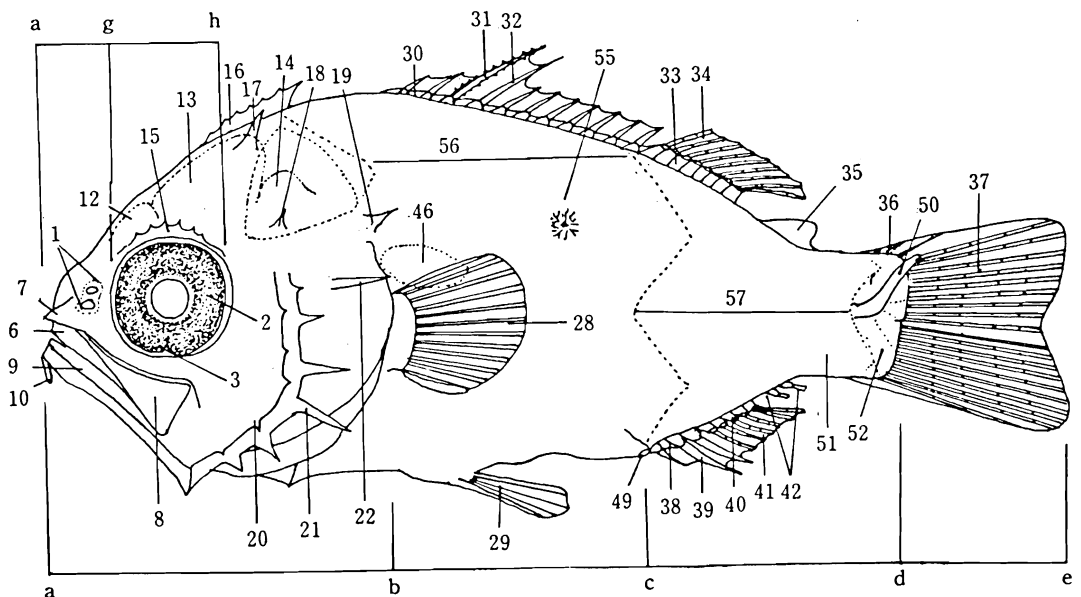
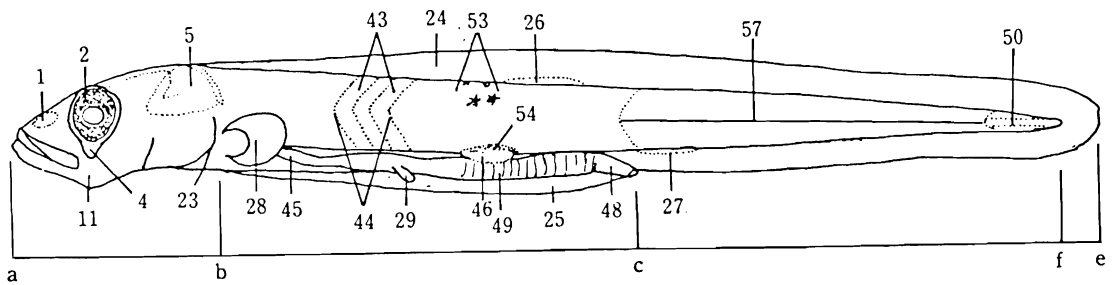
For specimens in representative stages of development, we have as a rule included figures of the whole body from the left side (except for the Pleuronectiformes), and when necessary, we have included partial figures of the dorsal or ventral surfaces. The size of the specimen has been noted directly on the figure as total length (TL) or standard length (SL). The source of the figure is shown in parentheses after the specific name. For specimens obtained by culturing, there is a notation (cultured) on the figure to distinguish them from natural specimens.

Nomenclature of Body Parts and Measurement Methods Names of Body Parts of Larval and Juvenile Fish

The location and names of the principal characters are shown on the diagram. For nomenclature of characters peculiar to certain taxonomic groups, see also Figures 2, 3, 4, 5, 6, and 15, and for nomenclature of eggs and hatchling larvae, see Figure 18.

Methods of Measuring Various Body Parts

See the following diagrams. For measurements peculiar to particular taxonomic groups, see Figures 6 and 16.



1: nares [nostril], 2: eye, 3: eye cleft [choroid fissure], 4: choroid tissue, 5: otic capsule (sac), 6: premaxilla, 7: maxilla tip process, 8: maxilla, 9: lower jaw [dentary], 10: barbel, 11: angle of lower jaw, 12: forebrain, 13: midbrain, 14: hindbrain, 15: supraocular spine, 16: supraoccipital spine, 17: supracranial [parietal] spine, 18: pterotic spine, 19: pseudocleithral [supracleithral] spine, 20: anterior (inner) preopercular spine, 21: posterior (outer) preopercular spine, 22: opercular spine, 23: symphysis of pectoral girdle [cleithrum] 24: dorsal membrane fin [finfold], 25: preanal membrane fin [finfold], 26: dorsal fin base, 27: anal fin base, 28: pectoral fin, 29: ventral [pelvic] fin, 30: base of spinous dorsal fin, 31: serrate dorsal fin spine, 32: smooth dorsal fin spine, 33: base of soft-rayed dorsal fin, 34: soft dorsal fin ray, 35: adipose fin, 36: anterior [procurrent] caudal fin ray, 37: caudal fin, 38: spinous anal fin base, 39: anal fin spine, 40: base of soft-rayed anal fin, 41: soft ray of anal fin, 42: finlets, 43: muscle (flesh) segments [myomeres], 44: muscle partitions [myosepta], 45: esophagus, 46: swim bladder, 47: annular folds of gut [49 in upper figure should be 47], 48: rectum, 49: anus, 50: tip of notochord, 51: caudal peduncle, 52: infracaudal (axillary) [hypural] bone, 53: external (superficial body surface) melanophore, 54: internal melanophore, 55: expandable melanophore, 56: trunk (preanal) [precaudal] myomeres, 57: caudal myomeres.

Total length (a-e): Horizontal distance from tip of snout to end of caudal [fin or finfold].

Body length (a-d): Horizontal distance from tip of snout to posterior edge of subcaudal bone [hypural plate] [standard length].

Notochord length (a-f): Horizontal distance from tip of snout to tip of notochord. Generally used until flexion of distal portion of notochord is completed, but in this book, it is not distinguished from body length.

Preanal length (a-c): Horizontal distance from tip of snout to posterior edge of anus.

Head length (a-b): Horizontal distance from tip of snout to posterior edge of opercular bone. When the opercular bone is not yet developed, measured to posterior edge of otic sac or shoulder girdle (pseudocleithrum) [supracleithrum].

Body depth: Vertical distance across body at base of pectoral fin omitting the fin.

Eye diameter (g-h): Horizontal distance passing through center of colored portion of eyeball.

Snout length (a-g): Horizontal distance from tip of snout to anterior edge of colored portion of eyeball.

Fin ray lengths: Length of longest ray in each fin measured as straight-line distance from fin base to tip.

Length of spines: Straight-line distance from base to tip of fin or body spines.

[Page 355]

Kinmedai Order, Beryciformes

Kinmedai Family, Berycidae

Kinmedai (Kinmedai genus)

Beryx splendens Lowe

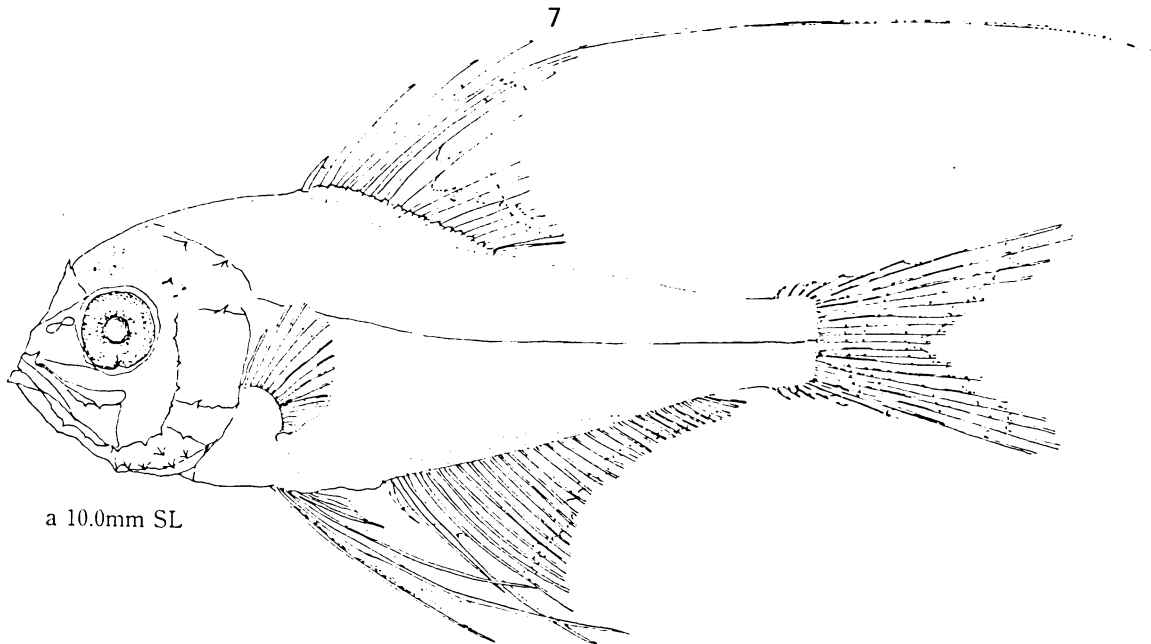
D IV, 13-15; A IV, 26-30; P₁ 16-18; P₂ I, 9-11

Morphology. In a specimen 10.0 mm long, the body is laterally compressed and deep. Body depth is greatest at the origin of the dorsal fin, where it is 38% of body length. Whereas the dorsal surface of the head projects strongly, both the dorsal and ventral aspects of the caudal part are almost straight lines, the ventral edge in particular being occupied for the most part by the base of the ventral fin. The mouth cleft is rather large and placed obliquely, and the tip of the lower jaw projects slightly. The eye is large, about 47% of head length. A naris in process of separating into two can be seen on the short snout. Spines on the head are conspicuously developed; in addition to a huge nasal spine, one or several spines appear on the cranial bone, premaxilla, maxilla, posttemporal, prootic, opercular bones, and the dentary, mainly on their edges. Except for the pectoral fins, all of the fin rays are elongated, particularly the fifth ray of the dorsal, which is about 90% of body length. The second ray of the ventral is 70% of body length. There are few melanophores; apart from a scattering of them on the dorsal surface of the head, they appear only on the edges of the elongated dorsal fin rays and on the ventral fin membranes.

Differentiation from similar species. Distinguished by the characteristic placement of the fins, the nature of the head spines, and the number of fin rays.

Distribution. Pacific Ocean south from Kushiro, Indian Ocean, Atlantic Ocean, Mediterranean Sea. The fish described here was collected off Kochi, Japan.

(Okiyama, Muneo)



a 10.0mm SL

Beryx splendens

[Pages 481-483]

Shiira Family, Coryphaenidae

Ebisu-shiira (Shiira genus)

Coryphaena equiselis Linnaeus

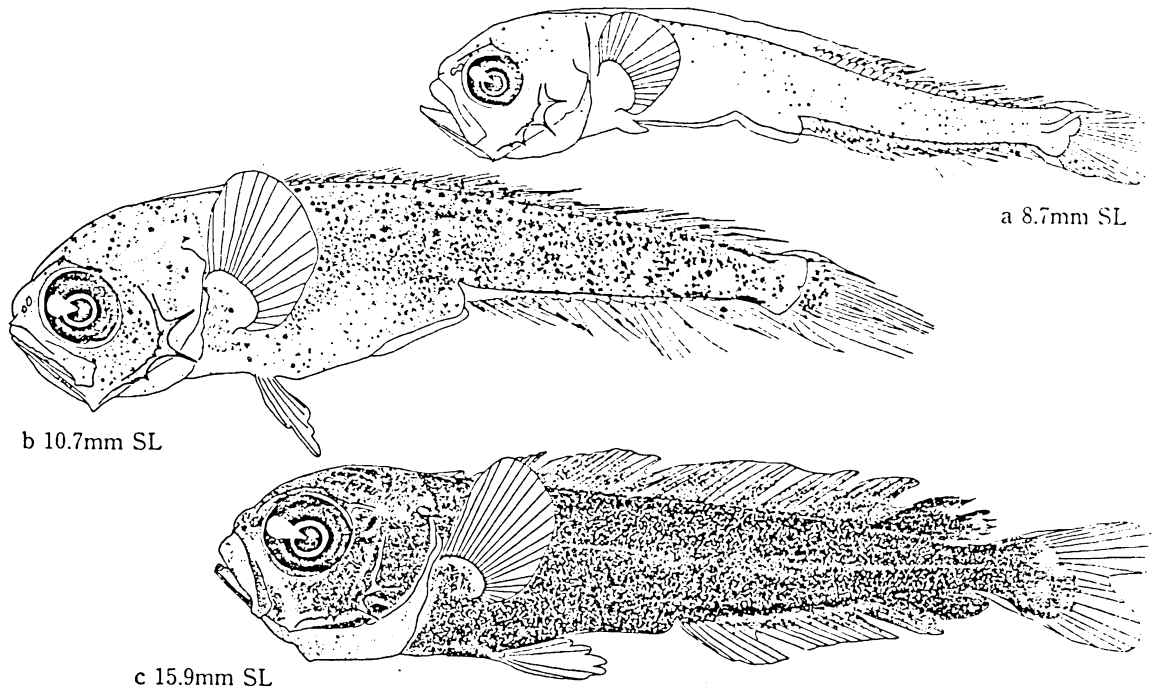
D 48-56; A 24-28; P₁ 18-20; P₂ I, 5; V 33-34; Br 7

Morphology. At the postlarval stage, resembles the shiira, *C. hippurus*, in body shape, position of the anus, and pattern of formation of the fins. The locations and number of bony projections on the head are about the same as in the shiira, but of the three spines appearing on the inner edge of the preopercular bone, the two lower ones are a bit closer to the upper one. The pattern of occurrence of melanophores also resembles that of the shiira, but at sizes greater than 8-9 mm total length, no melanophores appear on the ventral fins; on the caudal fin, they are limited to the area near its base and never extend to the posterior end; and bands are not formed on the sides or, if present, are obscure. At the juvenile stage, the body is slender, and melanophores appear all over--with the exception of the ventral fins, pectoral fins, and posterior half of the caudal fin--being especially deep black on the sides of the body.

Differentiation from similar species. Postlarvae from 8 to 9 mm total body length are easily distinguished from the shiira by the above-noted spines on the inner edge of the preopercle and by the pattern of appearance of melanophores on the ventral fins, the caudal fin, and the sides of the body. With regard to other similar species, see the section on the shiira.

Distribution. In warm seas worldwide. Is thought to occur in southern Japan nearly year-round in the surface layer, somewhat farther offshore than the shiira, but most abundantly in summer and autumn.

(Konishi, Yoshinobu) (Ref.: 271)



Coryphaena equiselis

Shiira (Shiira genus)

Coryphaena hippurus Linnaeus

D 55-65; A 26-29; P₁ 18-20; P₂ I, 5; V 30-31; Br 7

Morphology. Throughout the postlarval and juvenile stages, the body form is elongated. In the initial stage of development, the anus is slightly

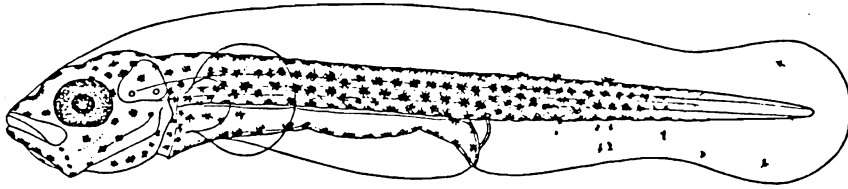
posterior to the middle of the body, but later it moves forward and, at the juvenile stage, is slightly anterior to the middle of the body. Around a total length (same below) of 6.5 mm, the protobases of the dorsal and anal fins begin to appear in the posterior part of the fin membrane, and at 9 mm, the formation of both fins is advancing along the body. The ventral fins appear at 8 mm in membrane form, and all of the fin rays reach their definitive numbers at 16 mm. The bony projections of the head begin to appear first on the inner and outer edges of the preopercle at 6.5 mm. At 9 mm, each of the edges has three spines, the two near the corner of the outer edge being somewhat longer, and one spine can already be seen on the upper edge of the eye orbit. At 13 mm, a new spinule appears on the upper part of the shoulder area. At 6 mm, just after absorption of the yolk, melanophores cover the sides of the body, except for the posterior part of the tail, but thereafter, they become somewhat lighter. Around 9 mm, bands begin to form on the sides of the body, extending to the dorsal and anal fins, and melanophores appear broadly on the caudal fin, except for its upper posterior portion, and a few appear on the ventral fins. At 13 mm, there are 12-14 bands on the sides of the body, and the ventral fins are black. In the juvenile stage, more melanophores have appeared on all parts, except the pectoral fins, and the bands on the sides become obscure.

Differentiation from similar species. In postlarvae before flexion, the body form, location of the anus, and the number of myomeres resemble those of species of the suzuki genus *Lateolabrax*, the takanohadai genus *Goniistius*, and the kobanzame suborder Echenoidei, but it is easy to distinguish them by reference to the pattern of appearance of melanophores on the sides of the body, et cetera. It closely resembles the ebisu-shiira, *C. equiselis*, and the sugi, *Rachycentron canadum*, but postlarvae from 8 to 9 mm total length can be distinguished by the pattern of appearance of melanophores on the sides of the body, the ventral fins and the caudal fin, and from the last further by number of myomeres (25 in the sugi) and the melanophore patterns of the dorsal and anal fins. At sizes smaller than that, they are difficult to distinguish. Differences in the ray counts for the dorsal and anal fins can be used in the juvenile stage.

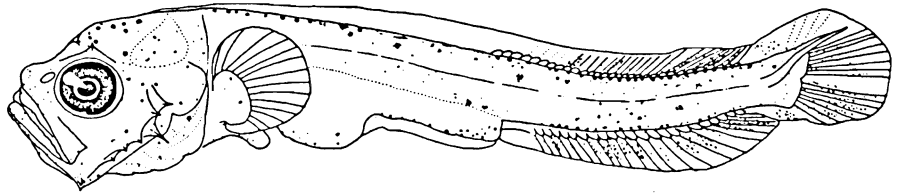
Distribution. In warm seas worldwide. Occurs off southern Japan in coastal surface waters generally year-round (season of greatest abundance, May-September). The juveniles associate themselves with drifting algae.

(Konishi, Yoshinobu) (Ref.: 271, 585, 600, 1005)

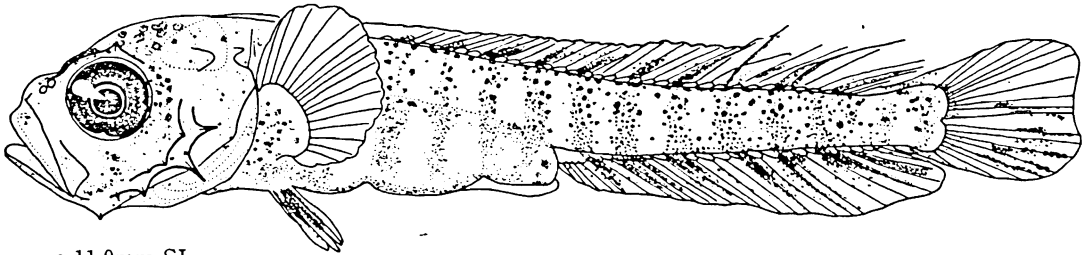
[end of Coryphaenidae]



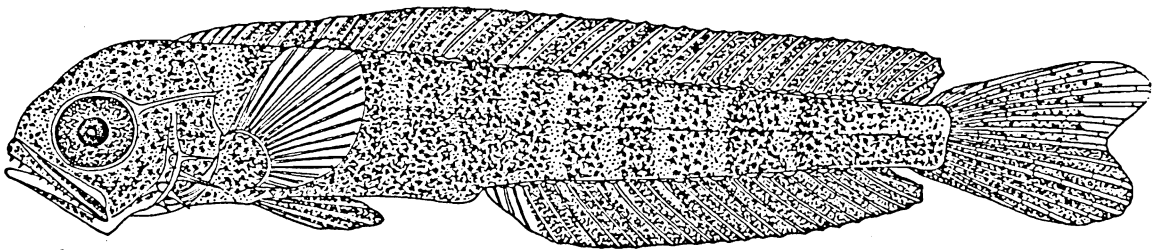
a 5.7mm TL



b 8.4mm SL



c 11.0mm SL



d 20.5mm TL

Coryphaena hippurus (a · d : 水戸, 1966 ; b · c : 平田益良雄原図)

[Pages 485, 487-494]

Shimagatsuo Family, Bramidae

In the postlarval stage, the head, eye, and mouth are remarkably large, the anus is located at 20-40% of the body, and the caudal section is comparatively slender. With some exceptions, the pectoral fins are conspicuously large, and the bases of the dorsal and anal fins are long. The outer edge of the preopercular bone bears numerous small spines, and teeth appear early in the upper and lower jaws. Melanophores are dense from the head to the trunk but comparatively sparse on the caudal portion.

Key to the Shimagatsuo Family

For postflexion larvae and the juvenile stage --

- 1a Posterior end of pectoral either does not reach the origin of the anal fin or is vertically above it . . . hirejiro-manzaiuo, *Taractichthys steindachneri*
- 1b Posterior end of pectoral fins reaches far beyond origin of anal fin 2
- 2a Origin of dorsal fin is posterior to base of pectoral fin. Dorsal and anal soft fin ray counts, respectively, 46 or more and 37 or more 3
- 2b Origin of dorsal fin is posterior to base of pectoral fin. Dorsal and anal soft fin ray counts, respectively, 36 or less and 30 or less 4
- 3a Origin of dorsal fin is above the eye, origin of anal fin is anterior to base of pectoral fin . . . bentenuo, *Pteraclis aesticola*
- 3b Origin of dorsal fin is over the opercle, origin of anal fin is located far posterior to base of pectoral fin . . . ryūgū-no-hime, *Pterycombus petersii*
- 4a Posterior ends of dorsal and anal fins reach far beyond pectoral fin base 5
- 4b Posterior ends of dorsal and anal fins not reaching pectoral fin base . . . shimagatsuo genus, *Brama* 6
- 5a Spinules on outer edge of preopercular bone all point upward . . . chikame-echiopia, *Eumegistus illustris*
- 5b Upward pointing spinules on outer edge of preopercular bone absent or only one . . . manzaiuo genus, *Taractes* 7

- 6a Among spinules on outer edge of preopercular bone, 3 at the angle are notably stronger than the others . . . onaga-shimagatsuo, *B. myersi*
- 6b Spinules on outer edge of preopercular bone about equally stout 8
- 7a Origin of anal fin is far anterior to middle of dorsal fin base . . . manzaiuo, *T. asper*
- 7b Origin of anal fin slightly posterior to middle of dorsal fin base . . . tsurugi-echiopia, *T. rubescens*
- 8a On pectoral fin melanophores appear only on lower part . . . shimagatsuo genus sp., *B. dussumieri*
- 8b Melanophores scattered over whole pectoral fin enclosing the fin rays 9
- 9a Pectoral fin rays 21 or more . . . shimagatsuo, *B. japonica*
- 9b Pectoral fin rays number 19 . . . shimagatsuo genus sp., *Brama* sp.

(Kinoshita, Izumi) (Ref.: 557)

Onaga-shimagatsuo (Shimagatsuo genus)

Brama myersi Mead

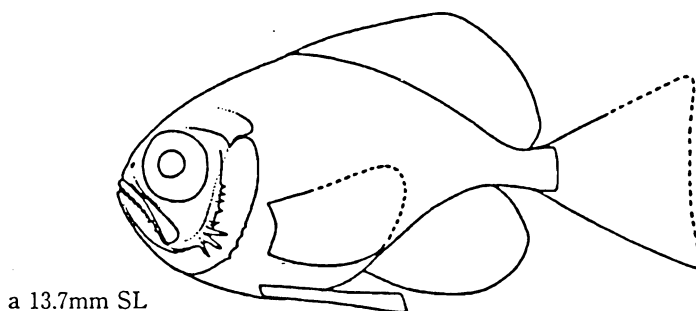
D 32-34; A 28-30; P₁ 19-20; V 16-17 + 23-24 = 39-40

Morphology. The morphology of the postlarval stage is not known but is thought to be not very different from other members of the shimagatsuo genus. At a body length (same below) of 6.8 mm, strong teeth are seen in both jaws. At 9.5 mm, scales are beginning to appear on the anterior part of the trunk. About 10 spines are visible on the outer edge of the preopercular bone. At 11.5 mm, all fin rays are complete and the juvenile stage is attained. In the juvenile stage, the posterior ends of the dorsal and anal fins do not reach the base of the caudal fin. The pectoral fins are positioned comparatively high, the distance between the base of the lowermost soft rays of the pectorals and the origin of the ventrals being about three-fourths the width of the pectoral base. At 11.5 mm, the origins of the ventral fins are anterior to the bases of the pectoral fins, with their posterior ends reaching past the origin of the anal fin, but with growth, the pectoral fins retreat and their length becomes relatively less. At 11.5 mm, about nine spines are visible on the outer edge of the preopercular bone, and at 13.7 mm, the three spines on the angle have become stouter. The pattern of distribution of melanophores throughout the postlarval and juvenile stages is completely unknown.

Differentiation from similar species. This genus can be distinguished from the manzaiuo genus *Taractes*, and the chikame-echiopia, *Eumegistus illustris*, by the length of the dorsal and anal fins, from the hirejiro-manzaiuo, *Taractichthys steindachneri*, by the length of the pectorals, from the bentenuo, *Pteraclis aesticola*, by the body form, and from the ryūgū-no-hime, *Pterycombus petersii*, by the presence or absence of melanophores on the ventral fins. It is thought to be difficult to distinguish this species from others of the same genus in the postlarval stage, but in the juvenile stage, it is thought to be possible using fin ray counts, body shape, preopercular spines, and the relative positions of the pectoral and ventral fins. The development of the body is faster than in the shimagatsuo, *B. japonica*, about the same as in *B. dussumieri*, and much slower than *B. orcini*.

Distribution. Adults occur in the central and southwestern Pacific. The spawning season and other aspects of its life are unknown. Postlarvae and juveniles up to the present time have been collected only off Tanzania in January and December and in the South China Sea in April.

(Kinoshita, Izumi) (Ref.: 557)



Brama myeris (G. W. Mead, 1972)

Shimagatsuo genus sp.

Brama dussumieri Cuvier

D 33-35; A 26-27; P₁ 19-22; V 15-17 + 23-25 = 40-42

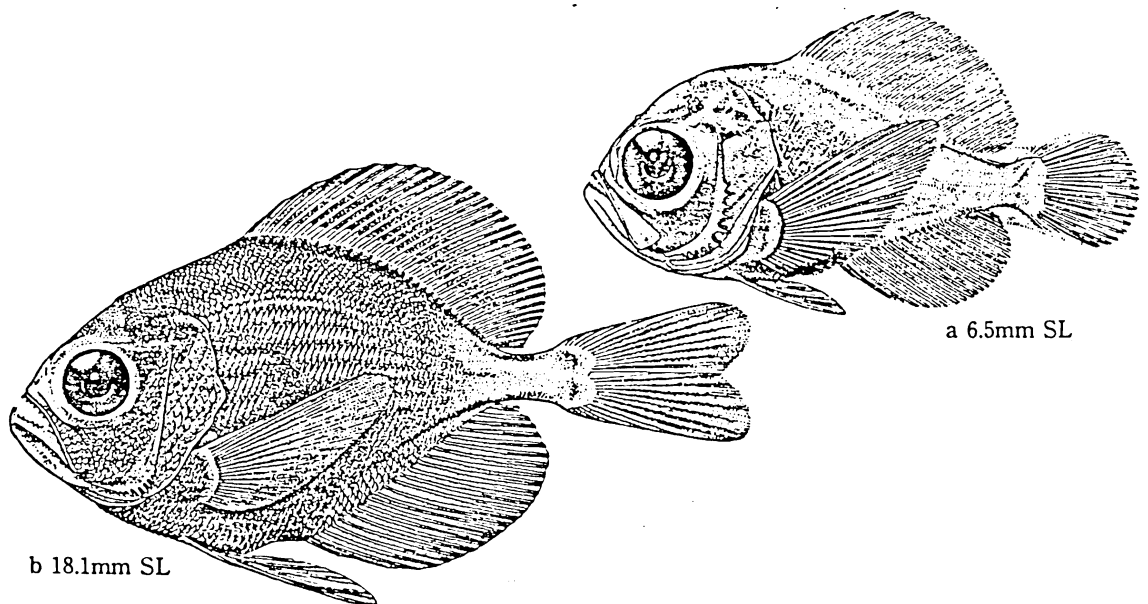
Morphology. The tip of the spinal cord begins to bend at a body length (same below) of 5.0 mm, and at 6.0 mm, it is bent upward. After this, the postlarva shows 10 small spines on the outer edge of the preopercular bone and a few teeth in both jaws. Melanophores are especially developed on the anterior part of the trunk where they appear as a dark band. They also occur on the brain, behind the eye, and on the gill membranes [Translator's note: Possibly a misprint for fin membranes]. The dorsal fin is completely formed at 7-9 mm, and it moves to the juvenile stage. The posterior ends of the dorsal and anal fins do not reach the base of the

caudal. At this time, scales begin to appear on the anterior part of the trunk. The development of melanophores in the juvenile stage is as follows. At 9 mm, they appear on the caudal fin over a scope up to one-fifth from its posterior end. At 10 mm, those on the tail become dense, and the whole body becomes blackish. At 10-12.5 mm, they appear on the outer edge of the dorsal fin and on the lower part of the pectoral fin membranes; they become rather sparse on the anterior part of the trunk and do not appear at all on the caudal peduncle. Beyond 12.5 mm, two dark stripes appear conspicuously on the dorsal fin, and a few melanophores occur on the ventral fins. At 18 mm, they also become dense on the caudal peduncle, are scattered all over the caudal fin, and also occur on its base.

Differentiation from similar species. For comparison with other species of this family, see the onaga-shimagatsuo, *B. myersi*. For other species of the same genus, see the sections on those species.

Distribution. The adults occur in tropical seas worldwide. The larvae and juveniles occur in areas with surface water temperatures of 23.90°C or higher. In the Pacific, they appear on both sides of the Equator from 20°S to 25°N. They appear in May-June in the Sea of Japan and from April to January in the eastern Pacific.

(Kinoshita, Izumi) (Ref.: 557)



Brama dussumieri (G. W. Mead, 1972)

Shimagatsuo (Shimagatsuo genus)*Brama japonica* Hilgendorf

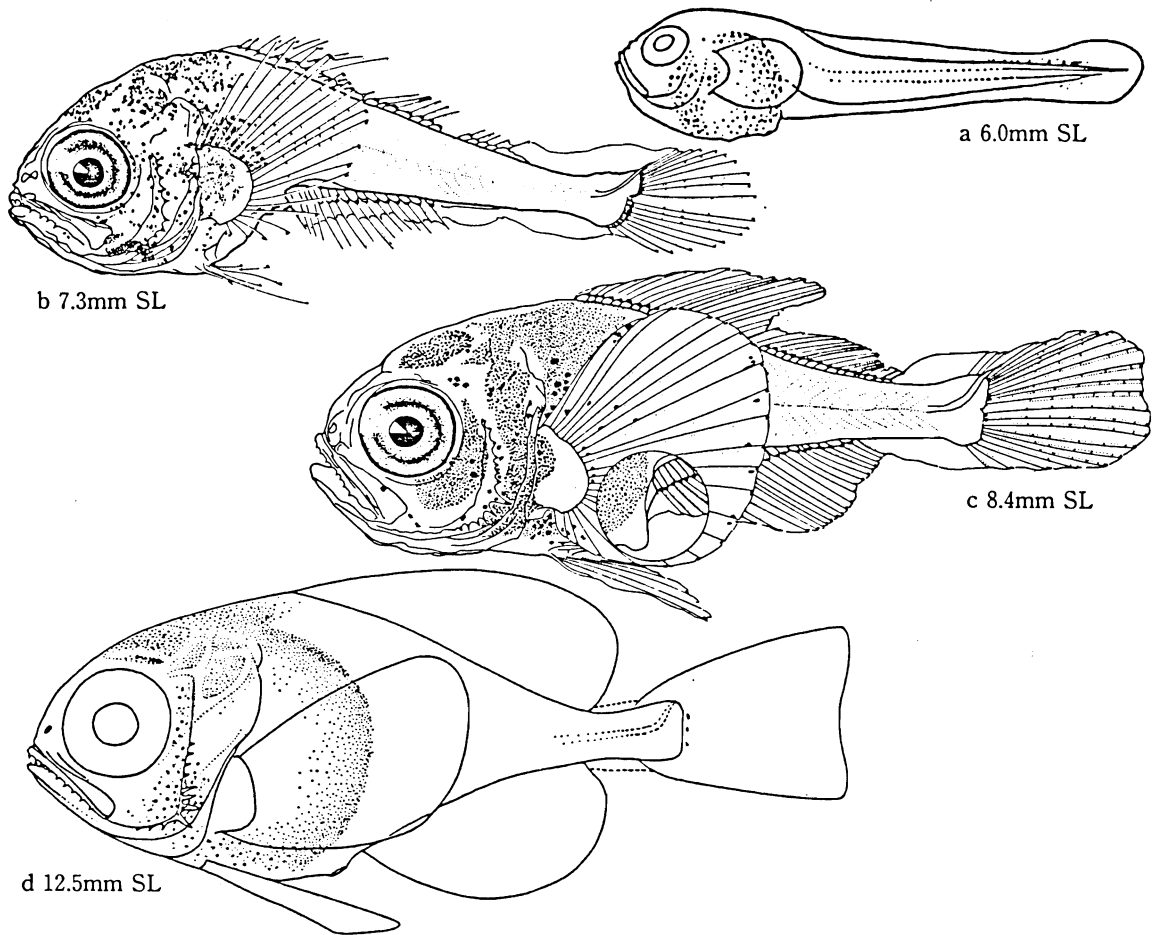
D 33-36; A 27-30; P₁ 21-23; V 15-17 + 22-26 = 38-40

Morphology. Postlarvae previous to the flexion of the spinal cord have the anus opening at about 30% of the body. At a body length (same below) of 4 mm, the primitive bases of the pectorals are visible, and at 6 mm, the spinules which began to appear on the outer edge of the preopercle at 5.5 mm have come to number 10. At this time, the primitive bases of the ventral fins also appear. Up to 4.2 mm, there are no melanophores other than on the eye and the brain; at 6 mm, they appear as dots on the head and above and below the caudal end of the spinal cord. At 7 mm, the caudal end of the spinal cord begins to flex, and at 7.3 mm, it has nearly completed its upward flexion. After that, the fins other than the dorsal and anal are nearly completed, the pectorals being particularly large. Teeth are visible on the upper jaw. Melanophores appear on the top of the head, and as growth proceeds, they become more dense on the anterior part of the trunk; at 8.4 mm, they appear also on the membranes of the pectoral fins. At 10 mm, scales begin to appear, and at 12 mm, all of the fins are completely formed and the fish moves into the juvenile stage; however, the membrane fin remains on the caudal peduncle. The posterior ends of the dorsal and anal fins do not reach the base of the caudal fin. The distance between the origin of the ventrals and the base of the lowermost soft rays of the pectoral fins is about one-half the breadth of the pectoral fin base.

Differentiation from similar species. For comparisons with other genera of this family, see the section on the onaga-shimagatsuo, *B. myersi*. Can be distinguished from other species of this genus by the earlier upward flexion of the caudal end of the spinal cord, the relative positions of the ventral and pectoral fins, the shape of the body, and the ray counts of the dorsal, anal, and pectoral fins.

Distribution. Adults occur in temperate zone areas of the North Pacific. Postlarvae and juveniles appear in Japanese waters from late February to mid-May.

(Kinoshita, Izumi) (Ref.: 557)



Brama japonica (a · d : G. W. Mead, 1972 ; b · c : 木下原図)

Shimagatsuo genus sp.

Brama sp.

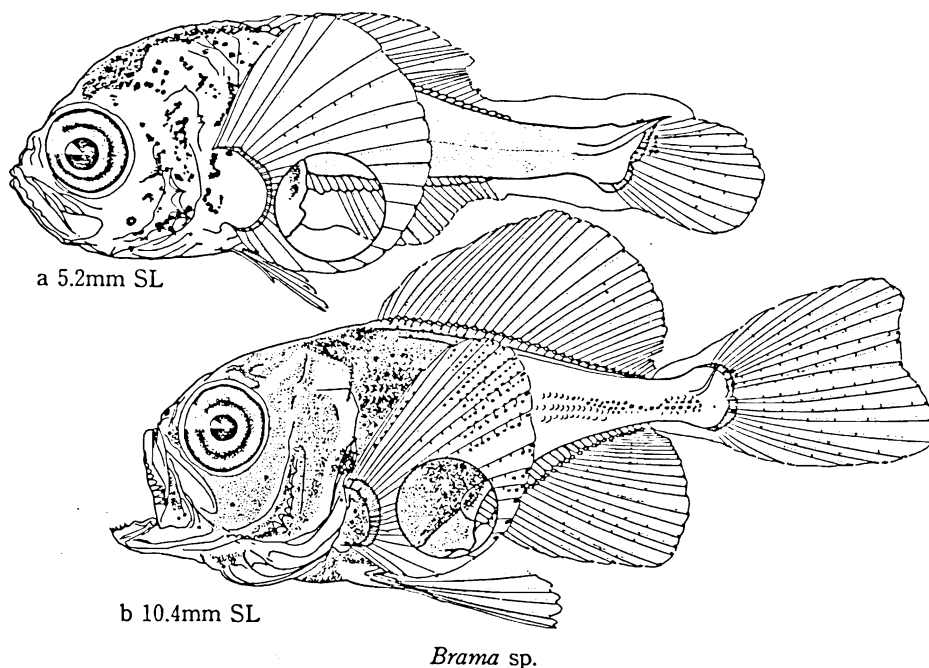
D 33; A 27; P₁ 19

Morphology. The shape of the body in the postlarva is almost the same as in other members of the shimagatsuo genus. Five small spines are visible on the outer edge of the preopercular bone. Melanophores are dense from the head to the central part of the trunk and are also present on the pectoral fin bases, in the body cavity, on the dorsal edge of the tip of the tail, and around the caudal fin base. At a body length of 10.4 mm, the dorsal and anal fins are complete and the juvenile stage commences; scales appear on the central part of the sides of the body. The small spines on the outer edge of the preopercle increase to 14. Melanophores become denser on the central trunk and are scattered radially on the membrane of the pectoral fins between the fin rays.

Differentiation from similar species. In this specimen, the development of the spinal cord and fins is clearly earlier than in a shimagatsuo, *B. japonica*, of the same size, and it has a different body form from the onaga-shimagatsuo, *B. myersi*, and *B. dussumieri*. A species with the same combination of dorsal, anal, and pectoral fin ray counts is not to be found among the members of the shimagatsuo genus. For this reason, it is dealt with here as shimagatsuo genus species.

Distribution. This specimen was collected in May off the Enshū-nada [Pacific coast of central Honshū].

(Kinoshita, Izumi)



Manzaiuo (Manzaiuo genus)

Taractes asper Lowe

D 31-34; A 23-26; P₁ 18-20; V 17-18 + 23-24 = 42-43

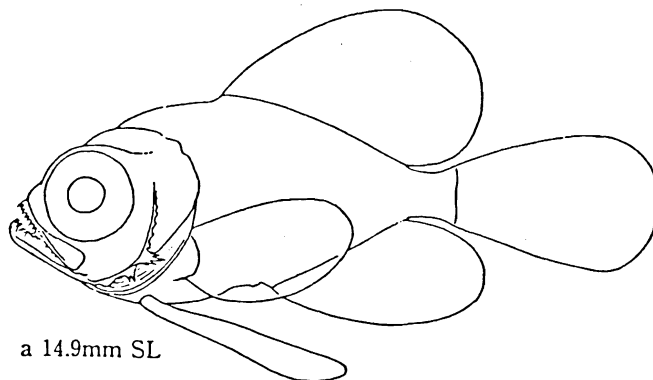
Morphology. At a body length of 9.1 mm, the fish is moving into the juvenile stage. The origin of the dorsal fin is located at about the middle of the body, and that of the anal fin is below the eighth soft ray of the base of the dorsal. The posterior ends of the dorsal and anal fins reach past the base of the caudal fin. The pectoral fins are large, with broad bases, and placed low. The origins of the ventral fins are located directly anterior

to the bases of the pectorals, and the posterior ends of the ventrals reach far beyond the origin of the anal fin. Several small spines are visible on the outer edge of the preopercular bone. Teeth on the anterior parts of both jaws are comparatively small but are well developed on the posterior half of the premaxillae. The small spines which form the anterior body of the scales are densely present on the head and the central part of the trunk. At a body length of 14.9 mm, the origins of the dorsal and ventral fins have moved slightly forward. The pectoral fins have become relatively somewhat smaller. The spinules on the outer edge of the preopercle form two characteristic groups, one pointing posteriorly and one pointing downward. Nothing at all is known about the melanophores.

Differentiation from similar species. For a comparison with the shimagatsuo genus *Brama*, see the section on the onaga-shimagatsuo, *B. myersi*. Can be distinguished from the chikame-echiopia, *Eumegistus illustris*, by the form of the spinules on the outer edge of the preopercle and the length of the ventral fins; from the hirejiro-manzaiuo, *Taractichthys steindachneri*, the bentenuo, *Pteraclis aesticola*, and the ryūgū-no-hime, *Pterycombus petersii*, by body shape, length of the posterior ends of the dorsal and anal fins, and the fin ray counts. It is thought that it can be distinguished from a fish of the same genus, the tsurugi-echiopia, *T. rubescens*, by the form of the spinules on the preopercle, the relative positions of the dorsal and anal fins, and the form of the lateral line.

Distribution. The adults are distributed in the North Pacific and the North Atlantic, and it also appears in the Sea of Japan. The spawning season is thought to be in winter. Up to now, juveniles less than 20 mm body length have been collected in the Pacific from waters east of Taiwan in May and from southwest of Luzon in June. Examples of 20-60 mm body length have been collected off California in April.

(Kinoshita, Izumi) (Ref.: 557)



a 14.9mm SL

Taractes asper (G. W. Mead, 1972)

Tsurugi-echiopia (Manzaiuo genus)

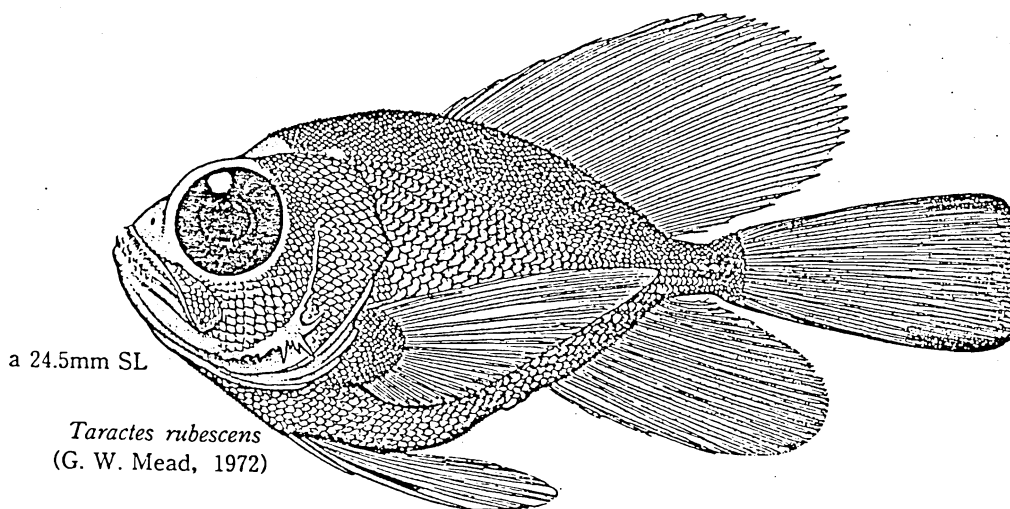
Taractes rubescens (Jordan et Evermann)D 30-32; A 21-23; P₁ 19-22; V 18-19 + 21-23 = 39-41

Morphology. At a body length of 24.5 mm, the origin of the anal fin is located below the 12th ray of the dorsal, and the posterior ends of the dorsal and anal fins reach far beyond the base of the caudal. The lateral line describes a smooth curve. Comparatively large coronate scales are present on the caudal peduncle. These characters are thought to appear at a body length between 8 and 10 mm. Of the spinules on the outer edge of the preopercle, some pointing upward, some obliquely to the rear, and some pointing downward appear grouped on the angle of the bone. Melanophores are distributed on the bases of the ventral fins, on the tips of the rays in the anterior part of the dorsal fin, and on the upper and lower tips of the caudal fin.

Differentiation from similar species. See the sections on the onaga-shimagatsuo, *B. myersi*, and the manzaiuo, *T. asper*.

Distribution. Adults are distributed in tropical areas of the Pacific and the Atlantic. In Japanese waters, it appears in Suruga Bay and around Okinawa. Up to the present, juveniles have been collected from the Pacific near the Galápagos Islands in August and in Hawaiian waters in May.

(Kinoshita, Izumi) (Ref.: 557)



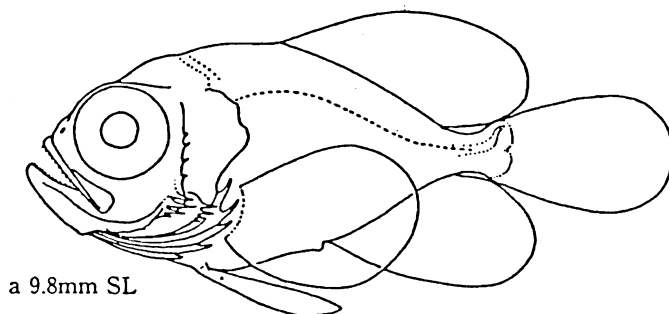
Chikame-echiopia (Chikame-echiopia genus)*Eumegistus illustris* Jordan et JordanD 33-35; A 24; P₁ 20-22; LL 48-50; V 17 + 23

Morphology. At a body length (same below) of 9.0 mm, the fish has reached the juvenile stage. The origin of the dorsal fin is located posterior to the base of the pectorals, and the origin of the ventrals is below the preopercular bone (below the base of the pectoral at 14 mm). The posterior ends of the dorsal and anal fins reach past the base of the caudal fin. The spinules on the preopercular and interopercular bones each form characteristic upward-directed groups on the angles of the bones. Below 10 mm, the scales have not appeared. Sharp teeth can be seen on the jaws, particularly the lower jaw, the more anterior ones being comparatively small. Melanophores are well developed from the head along the sides of the body to slightly posterior to the origin of the anal fin.

Differentiation from similar species. Can be distinguished from the hirejiro-manzaiuo, *Taractichthys steindachneri*, the bentenuo, *Pteraclis aesticola*, and the ryūgū-no-hime, *Pterycombus petersii*, by the lengths of the fins, the fin ray counts, and the pattern of the spinules on the outer edge of the preopercular bone. For comparisons with other members of the shimagatsuo family, see the preceding sections.

Distribution. Individuals of 20 mm and larger appear in Japanese waters and Hawaii. Juveniles under 20 mm have so far been collected only in waters north of New Guinea in July.

(Kinoshita, Izumi) (Ref.: 557)



Eumegistus illustris
(G. W. Mead, 1972)

Hirejiro-manzaiuo (Hirejiro-manzaiuo genus)

Taractichthys steindachneri (Döderlein)

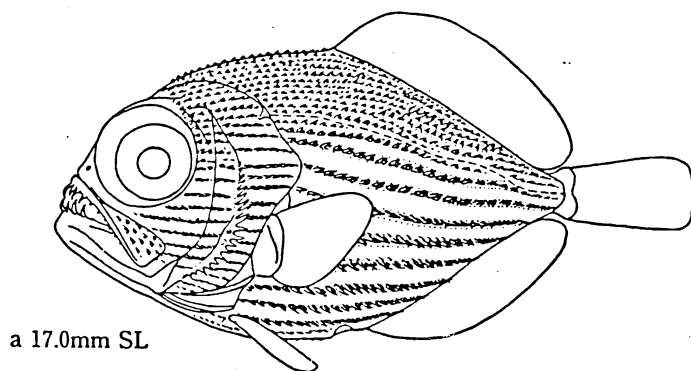
D 33-37; A 26-28; P₁ 19-22; LL 34-38; V 19-21 + 22-25 = 43-45

Morphology. At a body length of 17.0 mm, the fish has reached the juvenile stage. The origin of the dorsal fin is posterior to the pectoral fin base, and the origin of the anal fin is slightly posterior to the origin of the dorsal fin. All of the fins are comparatively small. The posterior ends of the dorsal and anal fins reach to the caudal fin base. There are about 19 small spines lined up regularly on the outer edge of the preopercular bone. The canine teeth on the anterior parts of the upper and lower jaws are sharp. About 20 rows of scales with small spines run longitudinally from the head to the tail and are also distributed on the maxillary and supramaxillary bones. Melanophores are densely distributed over the whole body except for the caudal peduncle.

Differentiation from similar species. Can be distinguished from the bentenuo, *Pteraclis aesticola*, and the ryūgū-no-hime, *Pterycombus petersii*, by the relative positions of the dorsal and anal fins and the form of the scales. For comparisons with other members of the shimagatsuo family, see the preceding sections.

Distribution. Adults are distributed in tropical and temperate waters of the Indo-Pacific region, except the southeastern Pacific. In Japanese waters, they appear in Sagami Bay and off Niigata. Spawning is thought to take place near the Equator from autumn to winter. Up to now, the post-larvae and juveniles have been collected from the South China Sea northeast of Luzon (May), Hawaii (August), and Tosa Bay (month unknown).

(Kinoshita, Izumi) (Ref.: 557)



Taractichthys steindachneri (G. W. Mead, 1972)

Ryūgū-no-hime (Ryūgū-no-hime genus)

Pterycombus petersii (Hilgendorf)D 47-49; A 37-40; P₁ 19-22; V 45-47

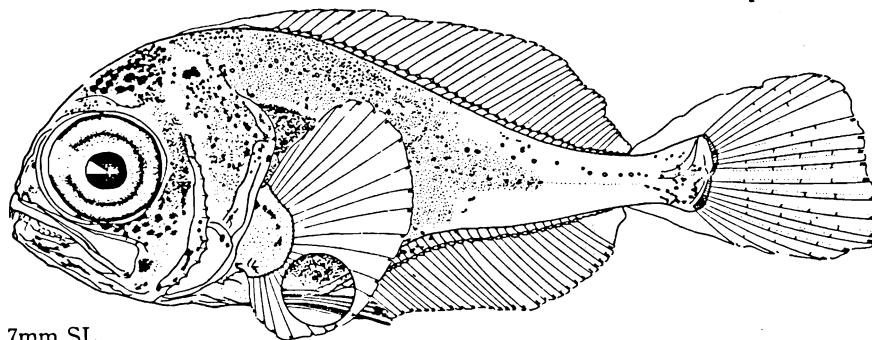
Morphology. At a body length (same below) of 7.7 mm, the postlarva shows a smooth curve of the lateral profile from the snout to the caudal peduncle. The origins of the dorsal and ventral fins are above and below the pectoral fin base, and the origin of the anal fin is situated below the first soft ray of the dorsal fin. The posterior ends of the dorsal and anal fins do not reach the base of the caudal fin. The posterior ends of the ventral fins reach the origin of the anal fin. On the outer edge of the preopercular bone, about 14 small spines are lined up in a pattern of folds. Sharp canine teeth have appeared in the upper and lower jaws. Melanophores are distributed from the head over three-fourths of the body and are particularly dense on the top of the head and on the cheeks. They also appear on the bases of the pectoral fins, on the dorsal and lateral surfaces of the body cavity, on the lower posterior part of the caudal peduncle, and on the fin membrane between the first and second and the second and third soft rays of the ventral fins. At 8.8 mm, the dorsal fin is completed, and the fish moves into the juvenile stage; the whole body is covered with scales. At 13.3 mm, the ventral fins do not reach the origin of the anal fin.

Differentiation from similar species. In the postlarvae and juveniles of the bentenuo genus, *Pteraclis carolinus*, of the Atlantic, the origins of the dorsal and anal fins are located anterior to the pectoral fin base, and the origins of the ventral fins are placed directly in front of the origin of the anal fin. There are six to eight small spines visible on the outer edge of the preopercular bone. It may well be that *P. aesticola* also has these morphological characters and they could serve as points for distinguishing it from this species. For comparison with other members of the shimagatsuo family, see the preceding sections.

Distribution. The adults are distributed in the Indo-Pacific and are also seen in the Sea of Japan. The early stages occur in Japanese waters and around Madagascar and in December-February, and they appear in the central part of the Indian Ocean in May-June.

(Kinoshita, Izumi) (Ref.: 557)

[End of Bramidae]



a 7.7mm SL

Pterycombus petersii

[Pages 493-495]

Hachibiki Family, Emmelichthyidae

Rōsoku-chibiki (Rōsoku-chibiki genus)

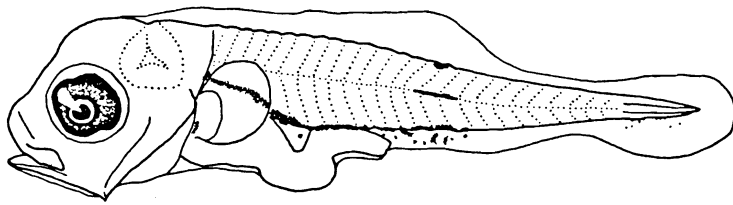
D X-XI-I, 10-12; A III, 9-10; P₁ 19-21; P₂ I, 5; V 24; Br 7

Morphology. In the early stage of development, the body form is rather slender, but later, the body depth increases and it becomes laterally compressed. The head and eye are large, the mouth is oblique, and the anus is near the center of the body. At a body length of 6.2 mm, the rays of the dorsal, anal, and ventral fins have reached their definitive numbers, but the dorsal fin has a single base, unlike that of the adult (the separation into two bases is thought to occur after the early stage). The bony projections on the head are not very conspicuously developed; at a body length of 4.5 mm, one small spine on the inner edge of the preopercular bone and three spines on its outer edge can be seen. Thereafter, the numbers increase until each edge has six spines, and one small spine each appears on the upper posterior end of the main opercular bone and the upper part of the shoulder area. In the early stage of development, there are melanophores on the dorsal and ventral surfaces directly posterior to the anus and on the lateral midline. Thereafter, those located at the posterior end of the dorsal and anal fin bases and on the lateral line between them are characteristic. Elsewhere, they are seen on the tip of the lower jaw, the dorsal surface of the head, the otic area, and on the dorsal and lateral surfaces of the gut. From body lengths around 6 mm, they appear rather heavily on the main opercular bone, around the bases of the ventral fins, and on the ventral fin membranes.

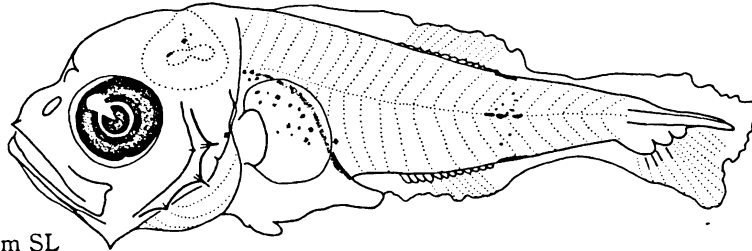
Differentiation from similar species. It resembles species of the ishidai genus *Oplegnathus*, the suzumedai family Pomacentridae, and the eboshidai family Nomeidae, but it is easily distinguished from the first two if attention is paid to the pattern of occurrence of the melanophores and the ray counts of the dorsal and anal fins and from the last one by the number of myomeres (30 plus in the Nomeidae) and the degree of development of the ventral fins. The hachibiki, *Erythrocles schlegelii* (total length, 7 mm), lacks the characteristic melanophores on the caudal portion, as described above, and the seven to nine spines on the inner and outer edges of the preopercular bone are somewhat more numerous.

Distribution. Warm waters of the central and western Pacific Ocean. Appears in early summer near the surface, somewhat offshore on the Pacific side of southern Japan.

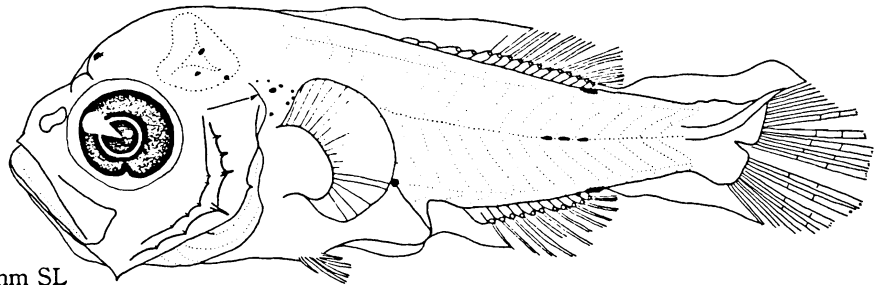
(Konishi, Yoshinobu)



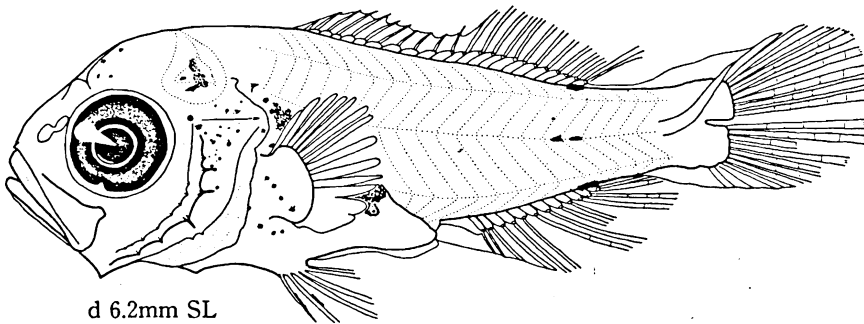
a 3.3mm SL



b 4.5mm SL



c 5.2mm SL



d 6.2mm SL

Emmelichthys struhsakeri

Hachibiki (Hachibiki genus)

Erythrocles schlegelii (Richardson)

D X-I, 1012; A III, 9-10; P₁ 18-20; P₂ I, 5; V 24; Br 7

Morphology. In the early stage (after reaching about 7 mm total length), the body is at first laterally compressed, and body depth is great; head and eye large; thereafter, body becomes slender. Position of the anus is about at the center of body, later moving somewhat posterior. The bony projections of the head appear on the inner and outer edges of the preopercle and the upper rear end of the main opercular bone. At a total length

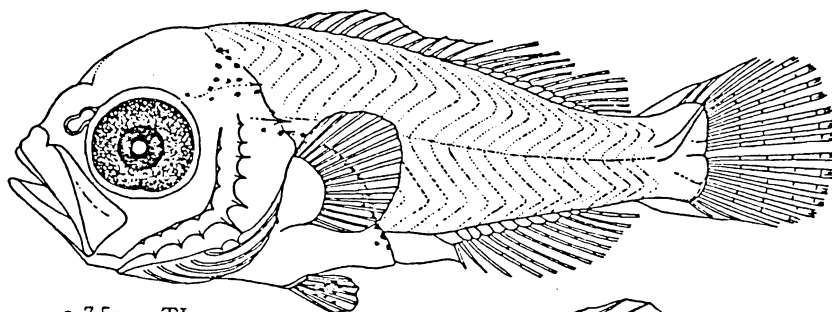
(same below) of 7 mm, there are seven to nine small spines on the inner and outer edges of the former and two small spines on the latter. At 14.5 mm, the spinules are hard to see on the inner edge of the preopercle, while those on the outer edge have increased in number and present a serrate form. Melanophores at 7 mm are scattered on the sides of the posterior part of the head and on the dorsal surface of the gut and form a line buried in the muscles along the base of the anal fin, but in general, they are rather scanty. Later they spread from the forward part of the body toward the rear, and around 15 mm, they form two bands extending to the anal region. At 27 mm, there are six bands over the whole side of the body, the spiny portion of the dorsal fin and the ventral fins have become dark, and the bands extend onto the soft ray portions of the dorsal and anal fins.

Differentiation from similar species. Resembles the *ishidai*, *Oplegnathus fasciatus*, the *ishigakidai*, *O. punctatus*, and the *oyabiccha*, *Abudefduf vaigiensis*, but is easily distinguished if attention is paid to body form, pattern of appearance of melanophores, and dorsal and anal fin ray counts. With respect to *Emmelichthys struhsakeri*, see the section on that species.

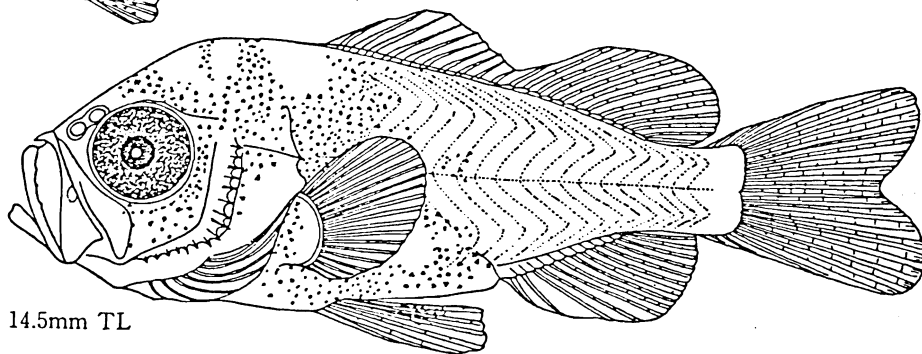
Distribution. Southern Japan, southern part of the Korean peninsula, southern Africa. Occurs near the surface in June-July in the Satsunan sea area [south of Kyushu].

(Konishi, Yoshinobu) (Ref.: 636)

[End of Emmelichthyidae]



a 7.5mm TL



b 14.5mm TL

Erythrocles schlegelii (水戸, 1966)