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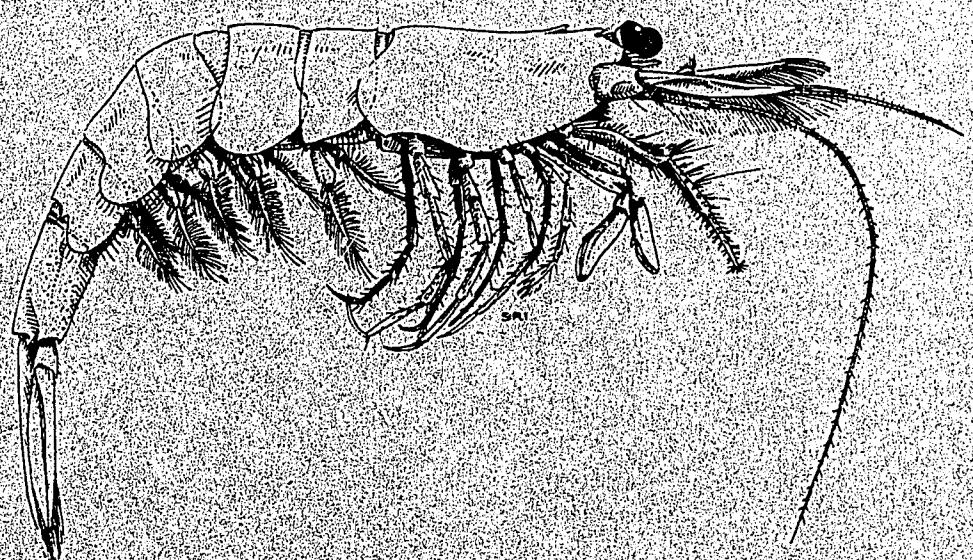
ABSTRACT

Project MER (Marine Ecology Research) is aimed at improving environmental education in the San Francisco Bay Area schools. As part of meeting this goal, it is hoped that students and teachers can see the results of their efforts being put to practical use. This guide is the fourth of a series which was produced to help students and teachers gather data concerning the San Francisco Bay-Delta-Estuary Complex and to organize these data to make a contribution to the literature of science and serve as the groundwork upon which knowledgeable decisions about the environment could be based. Presented in this guide is a key to aid in identifying both the salt- and fresh-water fish that inhabit the Bay. Physical descriptions are accompanied by illustrations. Related documents are SE 016 645--SE 016 647 and SE 016 649--SE 016 650. (JP)

PROJECT M E R

MARINE ECOLOGY RESEARCH



HANDBOOK OF TECHNIQUES
and
GUIDES FOR THE STUDY
of the
SAN FRANCISCO BAY-DELTA-ESTUARY COMPLEX

KEY
TO THE
COASTAL MARINE FISHES OF CALIFORNIA

PART IV

Contra Costa County Department of Education
Floyd Marchus, Superintendent

Alameda County Schools Office
Rock LaFleche, Superintendent

February 1971

The HANDBOOK OF TECHNIQUES AND GUIDES FOR THE STUDY OF THE SAN FRANCISCO BAY-DELTA-ESTUARY COMPLEX was developed and prepared by the staff of the Contra Costa County Department of Education and teachers in Contra Costa and Alameda counties. It is reproduced through the facilities of the Alameda County Superintendent of Schools Office.

Reproduced for use as a course of study for grades 9-14 in aquatic ecology.

For information concerning Project MER or this publication, write to:

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Contra Costa County Department of Education
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Pleasant Hill, California 94523

COVER

Crago franciscorum, the Bay Shrimp, was once the most prevalent shrimp in San Francisco Bay. Today, as the result of changes in Bay waters, it is no longer commercially important.

The line drawing of *Crago f.* was prepared by Margaret Lynn Siri, student of Ed Springer, at Kennedy High School.

FOREWORD

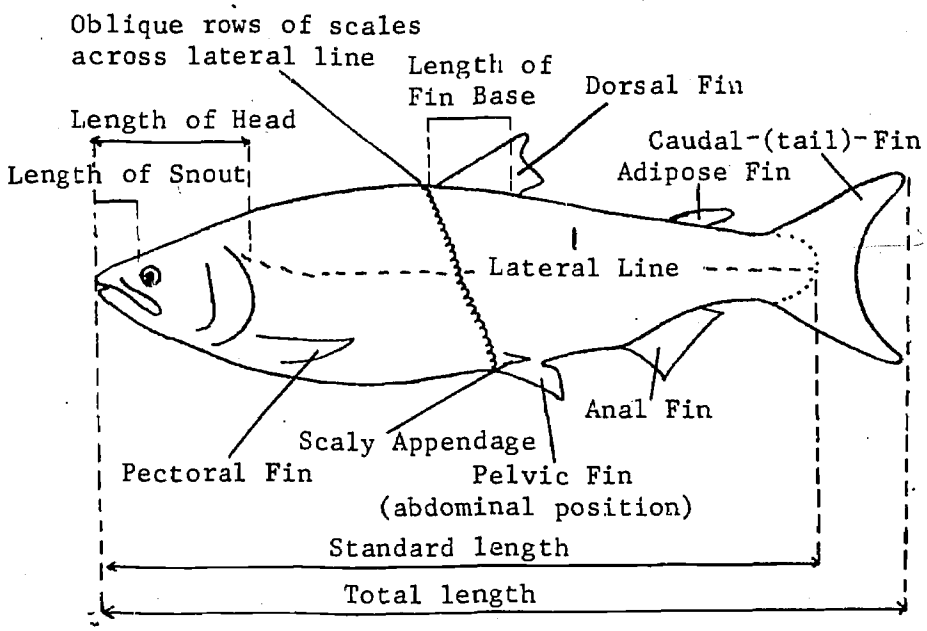
As part of the Monitoring Program of Project MER, periodic sampling of pelegic populations is necessary. A major portion of the organisms encountered will include the fish. Since no key to the fishes found in the San Francisco Bay-Delta-Estuary Complex exists, it is necessary to rely upon a series of more general keys to assist in the identification of the fish.

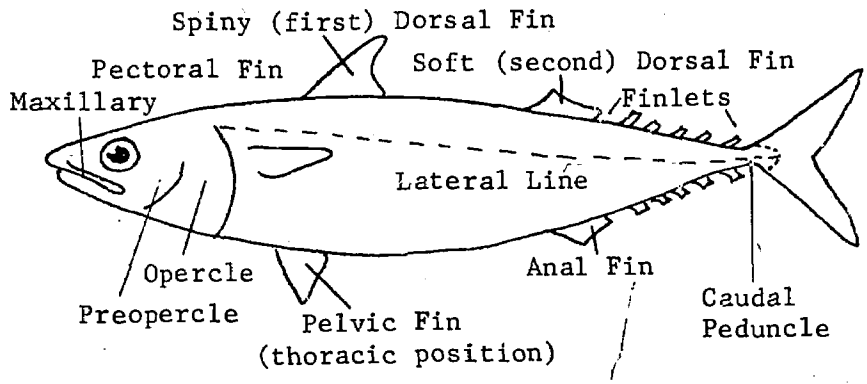
To those who sample at FIELD STATIONS beyond Pittsburg, the first reference which will assist you is the California Fish and Game publication, *KEYS TO THE FRESHWATER AND ANADROMOUS FISHES OF CALIFORNIA*, which has been reprinted by MER with the permission of the California Department of Fish and Game.

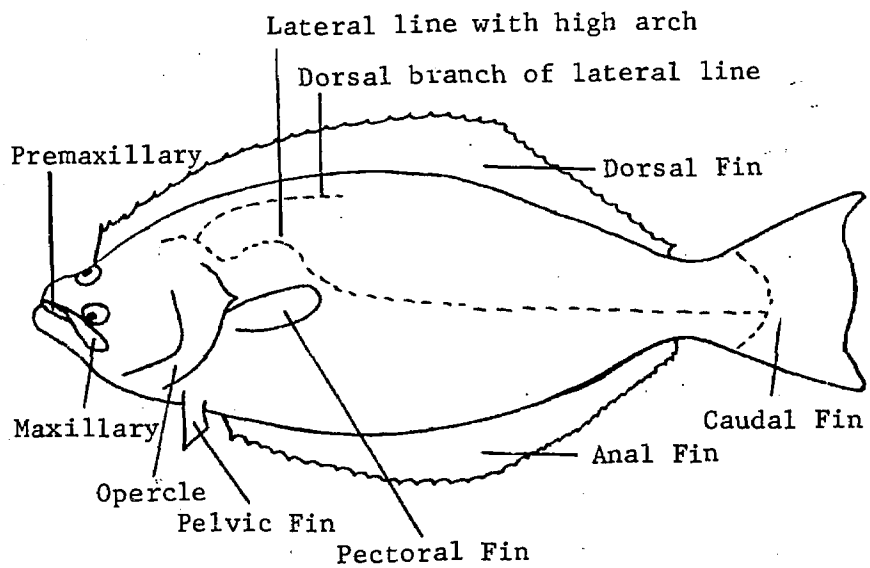
Those sampling in the more saline waters of the Bay can expect to find many oceanic forms which frequent these waters. At the present time, Mr. Dan Miller of the Department of Fish and Game is preparing a *KEY TO THE COSTAL MARINE FISHES OF CALIFORNIA*, which will be published in June of 1971. Mr. Miller has graciously consented to permit MER to copy his Key and use it in conjunction with the Monitoring Program prior to its release to the public. He has noted, for our reference, those families of fish which we may expect to find in our sampling.

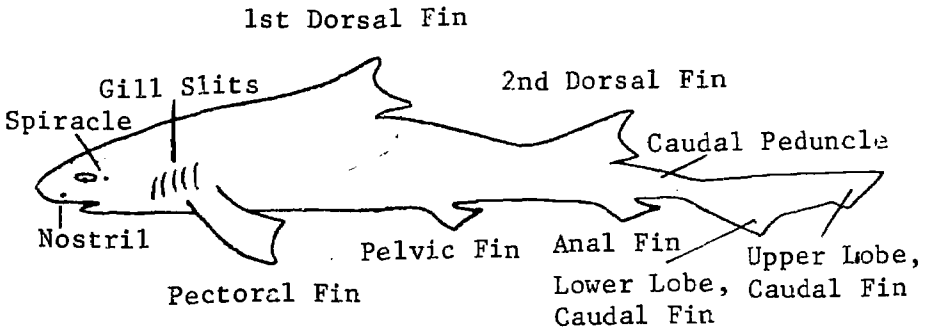
EXTERNAL PARTS OF FISH

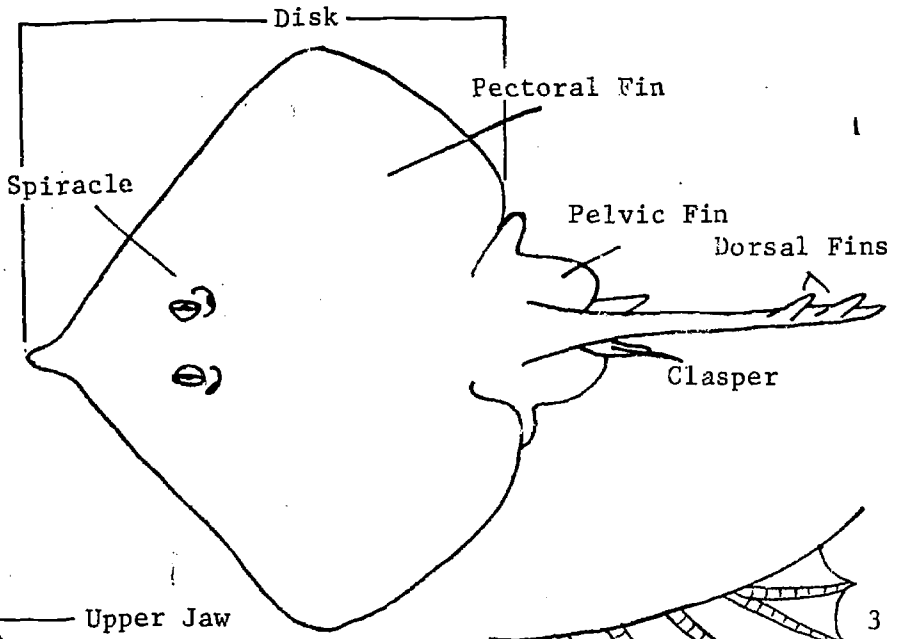
The following diagrams will help you identify the external parts of fish and details of parts of fish. Use these diagrams, in conjunction with the GLOSSARY, to aid in identifcation.

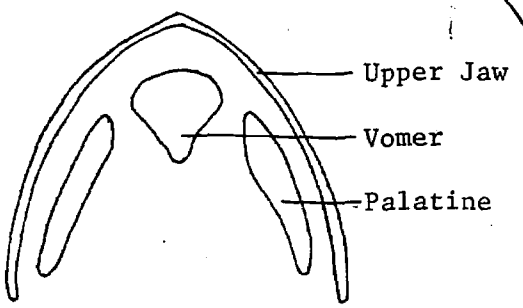

Oblique rows of scales
across lateral line
Length of
Fin Base
Dorsal Fin
Length of Head
Length of Snout
Caudal-(tail)-Fin
Adipose Fin
Lateral Line
Anal Fin
Scaly Appendage
Pectoral Fin
Pelvic Fin
(abdominal position)
Standard length
Total length

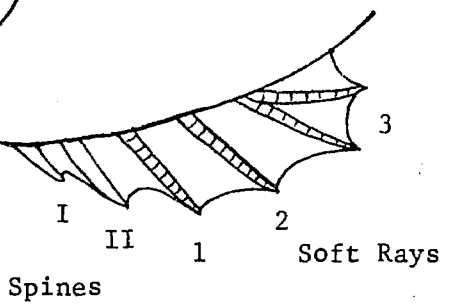

Spiny (first) Dorsal Fin
Pectoral Fin
Soft (second) Dorsal Fin
Maxillary
Finlets
Lateral Line
Opercle
Anal Fin
Caudal
Peduncle
Preopercle
Pelvic Fin
(thoracic position)

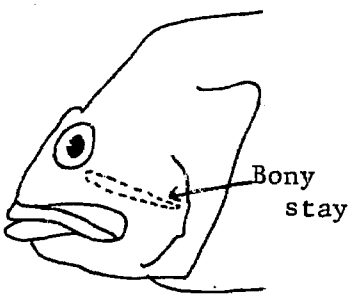

Lateral line with high arch
Dorsal branch of lateral line
Premaxillary
Dorsal Fin
Caudal Fin
Maxillary
Anal Fin
Opercle
Pelvic Fin
Pectoral Fin

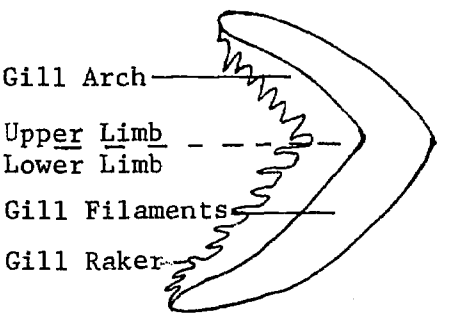

1st Dorsal Fin
Gill Slits
Spiracle
2nd Dorsal Fin
Caudal Peduncle
Nostril
Pelvic Fin
Anal Fin
Upper Lobe,
Caudal Fin
Pectoral Fin
Lower Lobe,
Caudal Fin


Disk
Pectoral Fin
Spiracle
Pelvic Fin
Dorsal Fins
Clasper


Upper Jaw
Vomer
Palatine


3
I
II
2
1
Soft Rays
Spines


Bony
stay


Gill Arch
Upper Limb
Lower Limb
Gill Filaments
Gill Raker

GLOSSARY*

ABDOMINAL: With reference to the belly.
ADIPOSE FIN: A fleshy finlike structure without rays or spines behind the dorsal fin on the midline of the back.
ANAL FIN: The unpaired fin on the midline of the under surface of the body back of the vent.
ANTERIOR: To the front. Opposite of posterior.
BARBEL: A fleshy projection, usually about the head.
BRANCHIOSTEGALS: Bony rays on the under surface of the head which support the membrane enclosing the gill chambers.
CANINE TEETH: Large, conical teeth.
CAUDAL FIN: The tail fin.
CAUDAL PEDUNCLE: That portion of the body behind the base of the last anal ray and to which is attached the caudal fin.
COMPRESSED: Flattened from side to side; deeper than broad.
CORSELET: A patch of scales behind the base of the pectoral fin.
DEPTH: The greatest vertical distance through the body exclusive of the fins.
DORSAL: (1) The upper part of the body, the back. (2) The dorsal fin.
DORSAL FIN: The unpaired fin(s) on the midline of the back (except the adipose fin, if present).
FINLETS: Small more or less unconnected fins following the dorsal and anal fins. Unlike the adipose fin in being specialized rays and not being fleshy.
FRENUM: Herein, a membrane binding the lower lip to the front end of the lower jaw.
GILL: The breathing apparatus.
GILL ARCH: The bony structure to which the gill rakers and filaments are attached.
GILL COVER: The bony cover protecting the gills.
GILL FILAMENTS: The slender, soft, red structures on the outer side of each gill arch.
GILL MEMBRANE: The skin enclosing the gill chambers; supported by the branchiostegals.
GILL OPENING: The external opening leading to the gills.
GILL RAKERS: The bony, tooth- or comb-like protuberances on the opposite side of the gill arch from the gill filaments. Gill rakers are counted on the first arch; the formula "4 + 13," for example, means 4 rakers above the angle of the arch and 13 below.
GILL SLITS: The openings between gill arches. There may or may not be a small slit or pore behind the fourth gill arch.
HEAD LENGTH: The distance from the tip of the snout to the hind edge of the gill cover.
ISTHMUS: The area under the head and between the gill openings where the gill membranes converge. The gill membranes may be attached to or free from the isthmus.
KEEL: A ridge along the side of the tail or caudal peduncle of some fishes.
LATERAL LINE: A series of pores along the side of the body forming what looks like a dotted line. Absent in some fishes and multiple in others.
LATERAL LINE, DORSAL BRANCH: An extra branch of the lateral line running back from the head, usually near the dorsal fin.
MAXILLARIES: The main bones of the upper jaw.
OPERCLE: The principal and hindmost bone of the gill cover.
OVIPAROUS: Producing eggs that hatch outside the parent's body.
OVOVIVIPAROUS: Producing eggs that hatch inside the parent's body, the young drawing nourishment from the egg yolk; no placental attachment as in viviparous animals.
PALATINES: A pair of bones in the roof of the mouth which extend out and back from the vomer.
PECTORAL FINS: The first or uppermost of the paired fins.
PELVIC FINS: The pair of fins below or behind the pectoral fins. Also called ventral fins.
PERITONEUM: The lining of the abdominal cavity.
POSTERIOR: Behind. Opposite of anterior.
PREMAXILLARIES: The paired bones forming the front of the upper jaw.
PREOPERCLE: The bone of the gill cover in front of the opercle.
PYLORIC CAECA: Appendages in the form of blind sacs at the junction of the stomach and the intestines.
RAY: The supporting rod of a fin; may be spiny or soft.
SCALY APPENDAGE: A triangular projection formed from a scale and found just above the base of the pelvic fin in some fishes.
SNOUT: The part of the head in front of the eyes. Its length is measured from the tip of the upper jaw to the front of the eye.
SOFT DORSAL: The part of the dorsal fin which is supported by rays.
SOFT RAY: The supporting rod of a fin which appears to be composed of many small segments placed end to end; sometimes branched.
SPINE: (1) The unsegmented, usually hard and sharp, rods which support parts of fins. (2) Any sharp projecting point.
SPINY DORSAL: The part of the dorsal fin which is supported by spines.
STANDARD LENGTH: The distance from the tip of the snout (or the tip of the lower jaw if it projects beyond the snout) to the end of the vertebral column.
THORACIC: With reference to the chest region.
VENT: The opening at the end of the digestive tract.
VENTRAL: The lower part of the body. Opposite of dorsal.
VENTRAL FINS: See pelvic fins.
VIVIPAROUS: Giving birth to live young.
VOMER: A bone in the roof of a fish's mouth just behind the middle of the upper jaw.

*Roedel, Phil M., *COMMON OCEAN FISHES OF THE CALIFORNIA COAST*, Fish Bulletin No. 91, State of California Department of Fish and Game, Marine Fisheries Branch, 1953. pp. 150-151

COASTAL MARINE FISHES OF CALIFORNIA

KEY TO THE FAMILIES

SECTION A

1a. No jaws, mouth a sucking dish; gill openings 7–15 .....

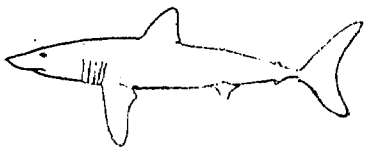
PETROMYZONTIDAE Hagfish, lampreys +

1b. Jaws present 2

2a. Gill openings one 4

2b. Gill openings 5–7 3

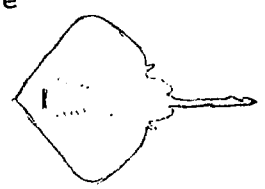
3a. Gill openings on sides of body; pectoral fins not attached to sides of head .....



Sharks +

3b. Gill openings under body; pectorals attached to sides of head .....

underside of skate



Skates and rays +

4a. Gill openings one; eyes on same side of head .....

Flatfish +

4b. One eye on each side of head 5

5a. Pelvic fins absent .....

SECTION B

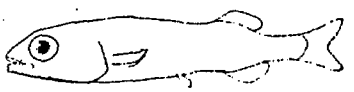
5b. Pelvic fins present 6

6a. Pelvic fins thoracic 9

6b. Pelvic fins abdominal 7

[See introductory pages for placement and structure of pelvic fins]

7a. Pelvics abdominal; one fin on back .....

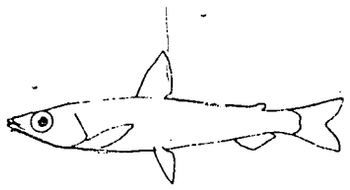


SECTION C

7b. Pelvics abdominal; two fins on back 8

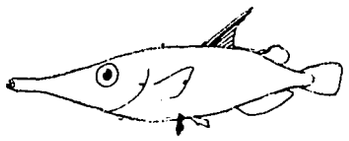
SECTION A (Continued)

8a. First dorsal fin with rays, the second adipose (no rays) ..



SECTION D

8b. Both dorsal fins with rays, the first with spines, the second of soft-rays .....



SECTION E

9a. Pelvics thoracic, strongly modified forming a cone or sucking disk on belly .....

SECTION F

9b. Pelvics thoracic and paired, not as a cone or sucking disk, normal (rays and membranes obvious) or barbel-like or clublike 10

10a. Pelvics with exactly one spine and 5 soft-rays ..... SECTION G

10b. Pelvics with less than 5 rays, the rays either normal or as barbel-like or clublike structures ..... SECTION H

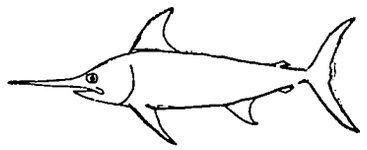
10c. Pelvics with more than 5 soft-rays ..... SECTION I

SECTION B: Pelvic Fins Absent

1a. Body eel-like (distance from tip of lower jaw to base of tail more than 5 times body depth) 10

1b. Body not eel-like (distance from tip of lower jaw to base of tail less than 4 times body depth) 2

2a. Upper jaw flattened, sword-like .....



XIPHIIDAE
Swordfishes

2b. Upper jaw not flattened 3

3a. No caudal fin, body deeply compressed .....

MOLIDAE
Molas
(sunfish)

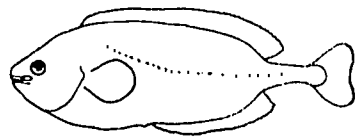
3b. Caudal fin present 4

SECTION B (Continued)

4a. Dorsal fin with spines in anterior portion 8

4b. Dorsal wholly of soft-rays . 5

5a. Dorsal fin covering more than half of dorsal surface (Juvenile has pelvic fins, see SECTION H, 12b page 24) .....



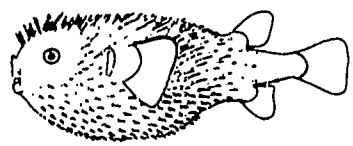
ICOSTEIDAE
Ragfishes

5b. Dorsal fin short, in posterior portion of back. 6

6a. Teeth confluent into two .....

TETRAODONTIDAE
Puffers

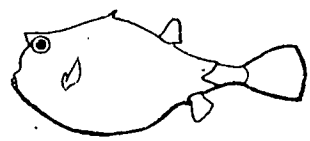
6b. Teeth confluent into one; body covered with spines .....



DIODONTIDAE
Porcupine fishes
(burrfish)

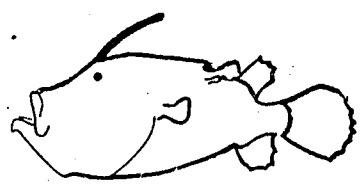
6c. Teeth separate, many 7

7a. Body encased in a bony box .....



OSTRACIIDAE
Boxfishes
(trunkfish)

7b. Body not encased; 3 fleshy knobs in front of dorsal fin .....



CERATIIDAE
Seadevils

8a. From 4a page 7: dorsal fin with spines
Dorsal spines more than 50 ...

ZAPRORIDAE
Prowfishes

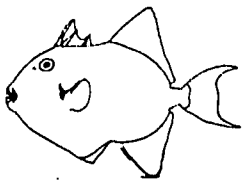
8b. Dorsal spines 8-10; body without scales (one species here, all other sculpins have pelvic fins) .....

COTTIDAE
Sculpins +
(rosylip sculpin)

8c. Dorsal spines 3 or less 9

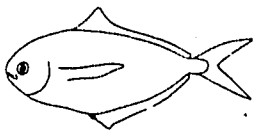
SECTION B (Continued)

9a. Dorsal spines forming an interlocking mechanism, separated from soft-rays .....



BALISTIDAE
Triggerfishes

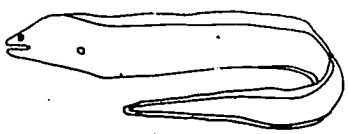
9b. Dorsal spines connected to soft-rayed portion of dorsal fin .....



STROMATEIDAE
Butterfishes +
(Pacific pompano)

10a. From 1a page 6 : body eel-like
Tip of tail with a distinct caudal fin which may or may not be joined to the dorsal and anal fins 17

10b. Caudal rays not forming a distinct fin, or tip of tail without rays 11



MURAENIDAE
Morays

11a. Pectoral fins absent .....

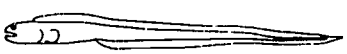
11b. Pectoral fins present 12

12a. Jaws needlelike, greatly elongated and curved outward .....

NEMICHTHYIDAE
Snipe-eels

12b. Jaws not needlelike 13

13a. Teeth molarlike; dorsal fin with spines .....



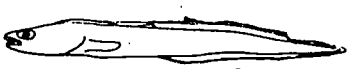
ANARHICHADIDAE
Wolffishes +
(wolf-eel)

13b. Teeth pointed; no spines in dorsal fin 14

14a. Tip of tail without rays . 16

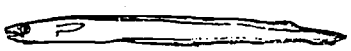
14b. Tip of tail with rays 15

15a. Most of pectoral fin below mid-portion of body; body compressed .....



ZOARCIDAE
Eelpouts +

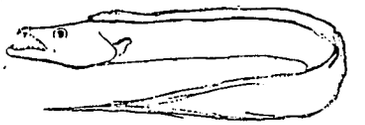
15b. Pectoral fin above mid-body; body round; gill opening a small slit below pectoral fin .....



CONGRIDAE
Conger eels

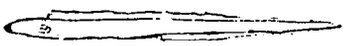
SECTION B (Continued)

16a. Lower jaw longer than upper (Pelvic fins are present on some cutlassfishes as a spine or scale-like structure; caudal fin also present on some. See SECTION H, 14a page 24) .....



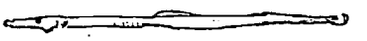
TRICHIURIDAE
Cuttlass-fishes

16b. Lower jaw shorter than upper .....



OPHICHTHIDAE
Snake eels +

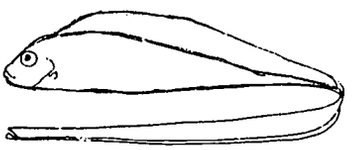
17a. From 10a page 8 ; caudal fin present
Body encased in bony plates .....



SYNGNATHIDAE
Pipefishes +

17b. Body not encased 18

18a. Caudal fin lobes uneven, upper lobe enlarged, fan-shaped; no anal fin (Juveniles of this family have pelvic fins. See SECTION I, 3a page 25) .....



TRACHIPTERIDAE
Ribbonfishes

18b. Caudal fin lobes evenly forked or rounded; anal fin present 19

19a. Caudal fin forked; body without scales .....

AMMODYTIDAE
Sand lances

19b. Caudal fin rounded 20

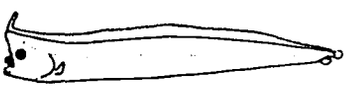
20a. Dorsal fin with spines 22

20b. Dorsal fin with spines 21

21a. Body deeper behind anus (tidepool species) .....

SCYTALINIDAE
Graveldivers +

21b. Body deeper before anus; high crest over eyes (deep water species) .....



LOPHOTIDAE
Crestfishes

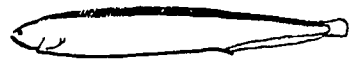
22a. From 20a page 9: dorsal fin with spines
Dorsal fin with spines anteriorly and soft-rays posteriorly .....

CEBIDICTHYDAE
Monkeyface +

22b. Dorsal fin wholly of spines 23

SECTION B (Continued)

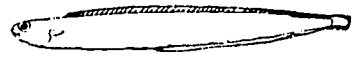
23a. Distance from snout to anal origin greater than distance from anal origin to base of caudal fin .....



PHOLIDAE
Gunnels +

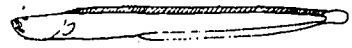
23b. Distance from snout to anal origin less than distance from anal origin to base of caudal fin 24

24a. Mouth horizontal or oblique, more horizontal than verticle; gill membranes free from isthmus .....



STICHAEIDAE
Pricklebacks (cockscomb) +

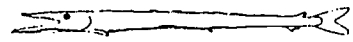
24b. Mouth nearly verticle; gill membranes attached to isthmus .....



CRYPTACANTHODIDAE
Wrymouths

SECTION C: Pelvic Fins Abdominal; One Dorsal Fin

1a. Fin on dorsal surface adipose (no rays and flabby) .....



ANOTOPTERIDAE
Daggertooths

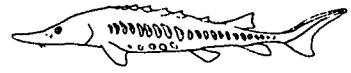
1b. Dorsal fin with soft-rays ... 2

2a. Caudal and dorsal fins broadly rounded .....

CYPRINODONTIDAE
Killifishes

2b. Caudal fin forked 3

3a. Tail heterocercal (upper lobe extended); 5 (rarely 7) rows of bony shields on sides and back .....



ACIPENSERIDAE
Sturgeons +

3b. Caudal fin evenly forked or lower lobe elongated; no bony shields on body 4

4a. Dorsal fin attached posteriorly, much closer to tail than to head 9

4b. Dorsal fin about mid-body; dorsal fin origin well in advance of anal fin origin. 5

SECTION C (Continued)

5a. Lateral line present 8

5b. Lateral line absent 6

GONOSTOMATIDAE
Lightfishes
(bristlemouth)

6a. Photophores present .....

6b. Photophores absent 7

7a. Jaws terminal, even, or lower jaw projecting slightly beyond upper jaw .....

CLUPEIDAE
Herrings +
(sardine, shad)

7b. Snout overhanging lower jaw .....

ENGRAULIDAE
Anchovies +
(anchoveta)

8a. Mouth horizontal, not reaching to below eye; snout overhaning lower jaw .....

ALBULIDAE
Bonefishes

8b. Mouth oblique, reaching to behind eye; jaws about equal, or lower jaw slightly projecting .....

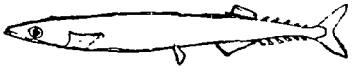
ELOPIDAE
Tarpons
(machete)

9a. From 4a page 10: dorsal fin attached near tail
Photophores present; small barbel under chin .....

MELANOSTOMIATIDAE
Scaleless
dragonfishes

9b. Photophores absent 10

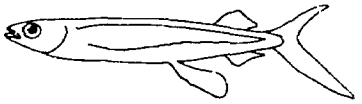
10a. Dorsal and anal fins followed by 5 to 7 finlets .....



SCOMBERESOCIDAE
Sauries

10b. No finlets after dorsal fin 11

11a. Pectoral fins enlarged into flight organs .....



EXOCOETIDAE
Flyingfishes

11b. Pectoral fins not greatly enlarged 12

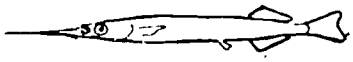
12a. Jaws strongly modified, forming a beak 13

12b. Jaws about equal, not forming a beak; body very soft .....

ALEPOCEPHALIDAE
Slickheads

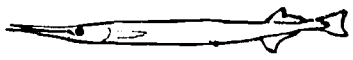
SECTION C (Continued)

13a. Lower jaw greatly projecting beyond upper jaw .....



HEMIRAMPHIDAE
Halfbeaks

13b. Both jaws elongated, forming a beaklike, strongly toothed structure .....



BELONIDAE
Needlefishes

SECTION D: Pelvic Fins Abdominal With Two Fins on Back; a Dorsal Fin With Rays, the Other Adipose

1a. Photophores present on body or under head 9

1b. Photophores absent 2

2a. Rayed dorsal fin long and high, extending over most of back .....

ALEPISAURIDAE
Lancet fishes

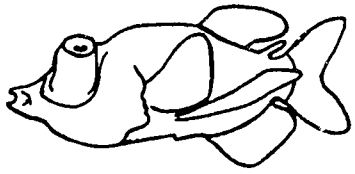
2b. Rayed dorsal fin shorter than head length 3

3a. A single stout spine at origin of dorsal fin; barbels under chin .....

ARIIDAE
Sea Catfishes

3b. Dorsal fin without a single stout spine at origin; no barbels under chin 4

4a. Eyes bulbous, projecting upwards; nose pointed .....



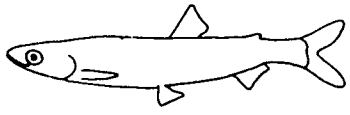
OPISTHOPROCTIDAE
Spookfishes

4b. Eyes not projecting upwards 5

5a. Dorsal fin origin well in advance of pelvic origin 7

5b. Dorsal fin origin about opposite or posterior to pelvic fin origin 6

6a. Jaws extening to under or slightly beyond eye; jaw teeth few, small .....



OSMERIDAE
Smelts +
(eulachon, whitebait)

6b. Jaws extending to well behind eye; jaw teeth large, caninelike .....

SYNODONTIDAE
Lizardfishes +

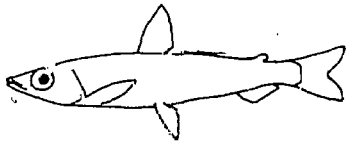
SECTION D (Continued)

7a. No axillary process at base of pelvic fin .....

SALMONIDAE
Trouts (salmon, steelhead)

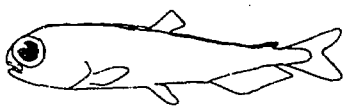
7b. No axillary process at base of pelvic fin..... 8

8a. Branchiostegals more than 4; scales persistent; jaws not reaching to half the distance from snout to eye .....



ARGENTINIDAE
Argentines

8b. Branchiostegals 2 - 4; scales easily rubbed off; jaws reaching to or nearly to the anterior edge of eye .....



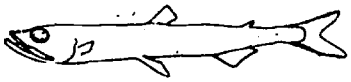
BATHYLAGIDAE
Blacksmelts

9a. From 1a page 12: photophores present
Photophores in a duct between lower jaw and pelvic fins; scales tubelike structures along lateral line, otherwise scaleless .....

PARALEPIDIDAE
Barracudinas

9b. Photophores on side of head or on body 10

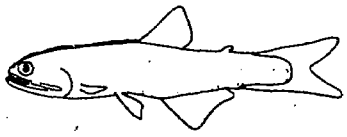
10a. Photophores only under eyes, small; bright spot on side of eye .....



SCOPELARCHIDAE
Pearleyes

10b. Photophores on body 11

11a. Photophores not arranged in parallel rows .....



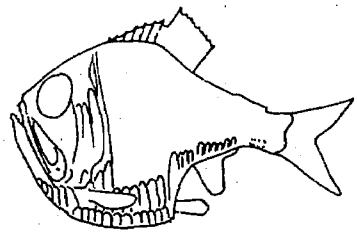
MYCTOPHIDAE
Lanternfishes (lampfish)

11b. Photophores arranged in parallel rows 12

12a. Teeth fanglike

CHAULIODONTIDAE
Viperfishes

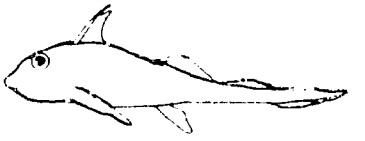
12b. Teeth not fanglike; body greatly compressed with vertebral processes protruding through back in front of dorsal fin .....



STERNOPTYCHIDAE
Hatchetfishes

SECTION E: Pelvic Fins Abdominal With Two Fins on Back; Both Fins With Rays

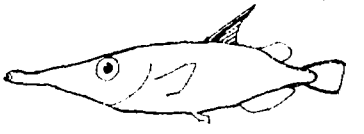
1a. First dorsal fin with a strong, venomous spine at origin; gill covers and bone structures weak and pliable .....



CHIMAERIDAE
Chimaeras
(ratfish)

1b. No single stout spine at origin of first dorsal fin; first dorsal entirely of weak spines, the second dorsal of soft-rays 2

2a. Snout elongated, tubular, with small jaws at tip .....



CENTRISCIDAE
Snipefishes

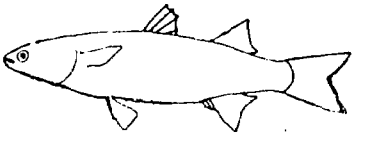
2b. Snout not tubular 3

3a. Lower jaw projecting; teeth large, caninelike .....

SPHYRAENIDAE
Barracudas

3b. Jaws about equal; teeth small or absent 4

4a. Anal spines 3; black horizontal stripes on body .....



MUGILIDAE
Mullets

4b. Anal spines one; jaws highly protractile, translucent strip along mid-body appearing as a lateral line .....

ATHERINIDAE
Silversides +
(jacksmelt, topsmelt, grunion)

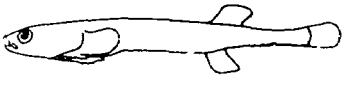
SECTION F: Pelvic Fins Thoracic, Strongly Modified Into a Cone or Sucking Disk on Belly

1a. Pelvics united into a cone; two dorsal fins .....

GOBIIDAE
Gobies +

1b. Pelvics forming a sucking disk; one dorsal fin 2

2a. Gill membranes united but free from isthmus; dorsal fin far back, covering less than 1/3 of dorsal surface ..



GOBIESOCIDAE
Clingfishes +

2b. Gill membranes joined to isthmus; dorsal fin covering over 1/2 of dorsal surface ..

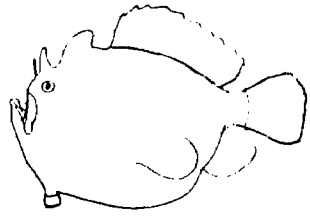
LIPARIDIDAE
Snailfishes +

SECTION G: Pelvic Fins Thoracic With Exactly One Spine and Five Soft-rays

1a. Gill openings in front of pectoral fins 3

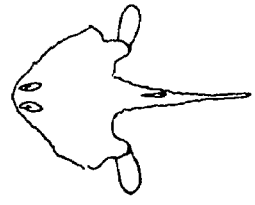
1b. Gill openings small, behind, above or below pectorals 2

2a. Gill openings in or behind lower axil of pectoral fin; mouth large .....



ANTENNARIIDAE
Frogfishes

2b. Gill openings in or behind upper axil of pectoral; mouth small; body strongly depressed .....



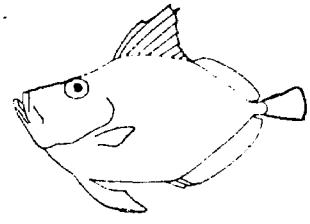
OGCOCEPHALIDAE
Batfishes

3a. From 1a page 15 SECTION G
First dorsal fin modified into a sucking disk on top of head .....

ECHENEIDAE
Remoras
(suckerfish, whalesucker)

3b. First dorsal not a disk 4

4a. Body compressed, ovate, with bony shields along base of dorsal and anal fins .....



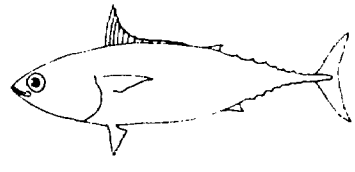
ZEIDAE
Dories

4b. Body elongate, without bony shields along base of dorsal and anal fins 5

5a. Dorsal fin followed by one finlet or none 7

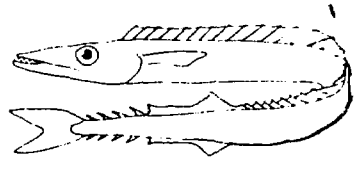
5b. Dorsal fin followed by 2 or more finlets 6

6a. Keels present on caudal peduncle; caudal fin rays covering hypurals .....



SCOMBRIDAE
Mackerels +
(tuna, skip-jack, bonito, escolar, sierra)

6b. No keels on caudal peduncle; caudal rays not covering hypurals .....



GEMPYLIDAE
Snake mackerels
(oilfish)

SECTION G (Continued)

7a. Dorsal fin with spines and soft-rays, or wholly of spines 10

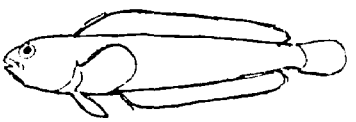
7b. Dorsal wholly of soft-rays .. 8

8a. Strong spine at upper limit of gill cover; eyes on top of head; mouth verticle .....

URANOSCOPIDAE
Stargazers

8b. No strong spine on gill cover 9

9a. Tail rounded; lateral line straight .....

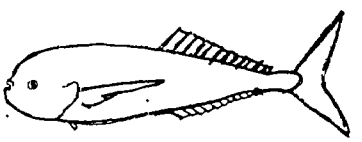


BATHYMASTERIDAE
Ronquils

9b. Tail forked; lateral line wavy .....

CORYPHAENIDAE
Dolphins

10a. From 7a page 16: spines in dorsal fin
Dorsal and anal fins with spines only, no soft-rays ..



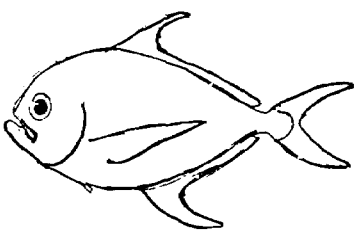
LUVARIDAE
Louvars

10b. Dorsal fin with both spines and soft-rays 11

11a. Dorsal fin with 5 or more spines 13

11b. Dorsal fin with only 3 or 4 spines 12

12a. Snout blund; area over eye enlarged; dorsal fin rays highest in anterior portion of fin .....



BRAMIDAE
Pomfrets
(fanfish)

12b. Snout elongate; dorsal rays highest in posterior portion of fin .....

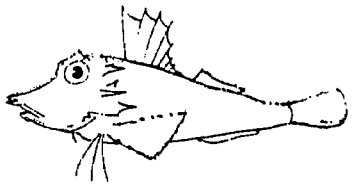
CENTROLOPHIDAE
Medusafish

13a. Lowermost rays of pectoral fin not detached from fin .. 15

13b. Lowermost rays of pectoral detached and threadlike or barbel-like 14

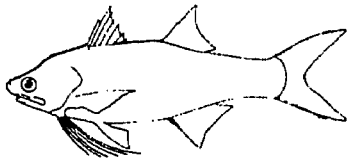
SECTION G (Continued)

14a. Three lowermost pectoral rays detached .....



TRIGLIDAE
Searobins

14b. Four to 9 lowermost pectoral rays detached .....

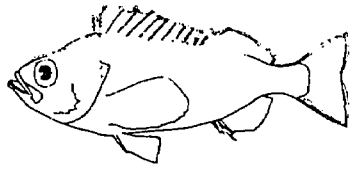


POLYNEMIDAE
Threadfins
(bobos)

15a. Suborbital stay absent . 19

15b. Suborbital stay present 16

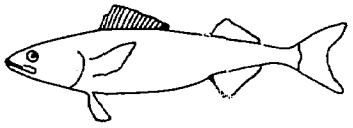
16a. Ridges and spines on head; at least 2 sharp spines (usually 5 or 6) on preopercle; strong spines in dorsal and anal fins; 4 to 11 anal soft-rays .....



SCORPAENIDAE
Rockfishes +
(scorpionfishes,
thornyheads)

16b. No heavy ridges or spines on head or preopercle; fin spines weak, flexible; 12 or more anal soft-rays 17

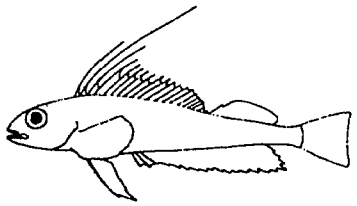
17a. Dorsal fins widely separated; two nostrils on each side of head .....



ANOPLOPOMATIDAE
Sablefish +

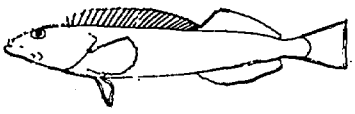
17b. Dorsal fin continuous with a notch between spinous and soft-rayed portions; one nostril on each side of head 18

18a. First 3 or 4 dorsal fin spines greatly elongated .....



ZANIOLEPIDAE
Combfishes +

18b. Anterior dorsal fin spines not elongated as in 18a .....



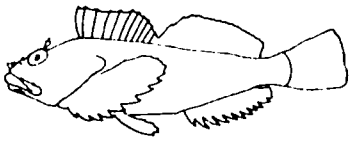
HEXAGRAMMIDAE
Greenlings +

19a. From 15a page 17: Suborbital stay absent
Anal fin with spines ... 21

19b. Anal fin without spines 20

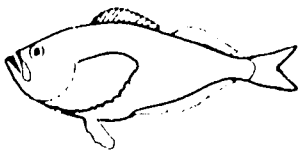
SECTION G (Continued)

20a. Body partly or wholly without scales; mouth nearly horizontal .....



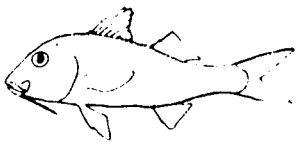
COTTIDAE
Sculpins +
(cabezon)

20b. Body fully scaled; mouth verticle; lips peculiarly fringed .....



TRICHODONTIDAE
Sandfishes

21a. Throat with 2 long barbels placed just behind chin .....



MULLIDAE
Goatfishes

21b. Chin without barbels ... 22

22a. Three or 4 anal spines .... 30 page

Rarely a mojarra will have two anal spines, see 40a page 22

22b. One or 2 anal spines 23

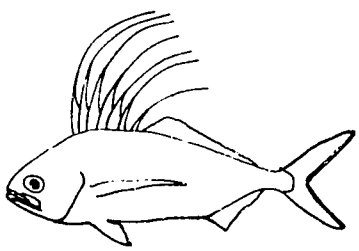
In some families these anal spines are very weak and may be mistaken for soft-rays

23a. One or 2 anal spines isolated from soft-rayed portion; tail crescent shaped ..... 31 page

All Carangids have three anal spines except some very old in which one or two spines may disappear

23b. All anal spines connected to soft-rayed portion by membranes 24

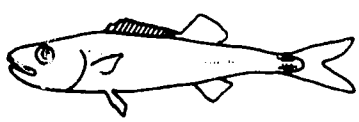
24a. First 7 dorsal spines greatly elevated; pelvic fins appear to have 6 soft-rays, the 5th being divided deeply at base of fin .....



NEMATISTIIDAE
Roosterfishes

24b. Anterior dorsal spines not elevated as in 24a above 25

25a. Caudal peduncle with two keels; one anal spine; body covered with hard-grooved scales .....

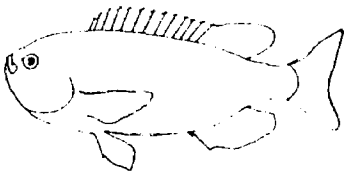


TETRAGONURIDAE
Squaretails

25b. Caudal peduncle without keels 26

SECTION G (Continued)

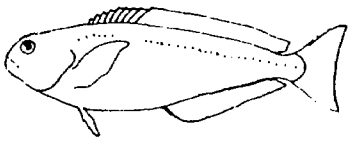
26a. Lateral line terminating below insertion of dorsal fin, not extending onto caudal area .....



POMACENTRIDAE
Damselfishes
(garibaldi, blacksmith)

26b. Lateral line terminating at base of tail or extending onto middle rays of caudal fin 27

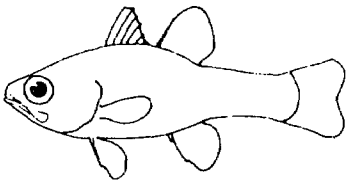
27a. Dorsal fin continuous, nearly same height throughout .....



BRANCHIOSTEGIDAE
Tilefishes +
(ocean whitefish)

27b. Dorsal fins 2, separated or nearly so 28

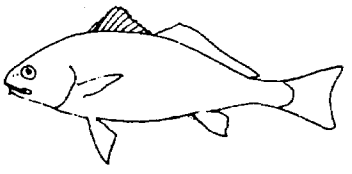
28a. Caudal peduncle about same length as distance from origin of first dorsal to insertion of soft-rayed portion; a single strong spine at origin of 2nd dorsal fin .....



APOGONIDAE
Cardinalfishes

28b. Caudal peduncle much shorter than length of dorsal fin; spine (or spines) at origin of 2nd dorsal fin weak, pliable 29

29a. Lateral line extending onto middle rays of caudal fin; tail slightly forked, or pointed, not broadly rounded .....

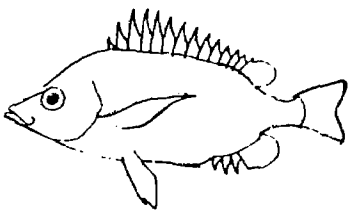


SCIAENIDAE
Croakers +
(white sea bass, queenfish, corbina, bairdiella)

29b. Lateral line not extending onto middle rays of caudal fin; tail broadly rounded

ELEOTRIDAE
Sleepers

30a. From 22a page 18: 3 or 4 anal spines
Anal spines 4 (rarely a surfperch may have 4 anal spines, see 34a .....

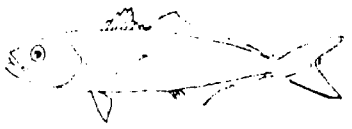


PENTACEROTIDAE
Armorheads

30b. Anal spines three ... 31

SECTION G (Continued)

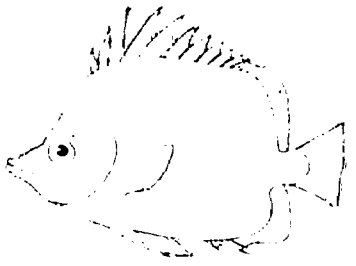
31a. Two anal spines isolated from fin, retractable; tail crescent shaped, with length of lobes more than 5 times the depth of the caudal peduncle .....



CARANGIDAE
Jacks +
(scad, pilot-fish, pompano, yellowtail, jack mackerel, moonfish, leatherjacket)

31b. Anal spines connected to soft-rayed portion; length of caudal lobes less than 3 times depth of caudal peduncle 32

32a. Snout pointed, with small jaws at tip; teeth very fine, brushlike .....



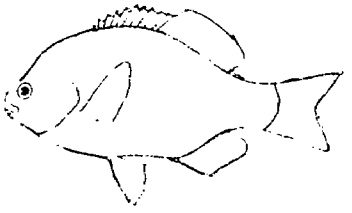
CHAETODONTIDAE
Butterfly-fishes

32b. Snout not pointed as in 32a above 33

33a. Sheath of scales extending out onto dorsal fin above a deep furrow 34

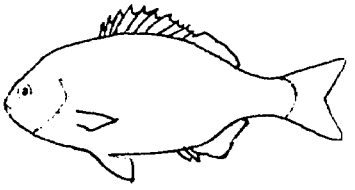
33b. No sheath of scales extending out onto dorsal rays .. 35

34a. Anal soft-rays more than 10; maxillary fully exposed when mouth is closed .....



EMBIOTOCIDAE
Surfperches

34b. Anal soft-rays 10; maxillary partly hidden by bone above when mouth is closed .....



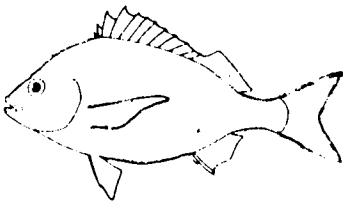
KYPHOSIDAE
Sea chubs
(zebra perch)

35a. From 33b page 20: no sheath of scales extending out onto dorsal fin Maxillary fully exposed or only slightly covered by edge of bone above when mouth is closed 39

35b. Maxillary mostly hidden by sliding under bone above when mouth is closed 36

SECTION G (Continued)

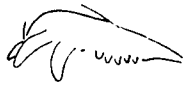
36a. Anterior teeth minute and numerous, not caninelike or incisorlike; anal rays 10 or 11; lateral line extends out onto caudal rays .....

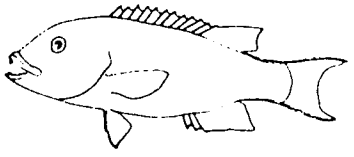


POMADASYIDAE
Grunts
(salema,
sargo) +

36b. Anterior teeth either caninelike or incisorlike; lateral line not extending out onto caudal rays; anal rays 12 or more 37

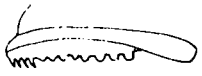
37a. Anterior teeth caninelike; dorsal fin spines shorter than dorsal soft-rays .....



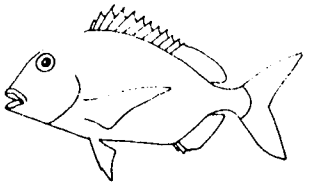


LABRIDAE
Wrasses +
(senorita,
sheephead)

37b. Anterior teeth incisorlike or conical 38

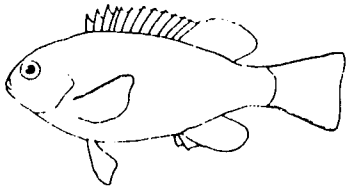


38a. Dorsal fin spines longer than dorsal soft-rays; side jaw teeth molarlike .....



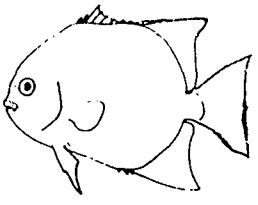
SPARIDAE
Porgies

38b. Side teeth not molarlike; dorsal fin spines about equal to or shorter than dorsal soft-rays .....



KYPHOSIDAE
Sea chubs +
(opaleye,
halfmoon)

39a. From 35a page 20: maxillary exposed when mouth closed Gill membranes broadly united to isthmus; most dorsal spines nearly separated .....



EPHIPPIDAE
Spadefishes

39b. Gill membranes free from isthmus 40

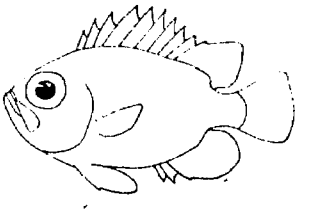
SECTION G (Continued)

40a. Premaxillaries excessively protractile, with their basal processes long, folding into a groove at top of cranium .....

GERRIDAE
Mojarras

40b. Premaxillaries not as in 40a 41

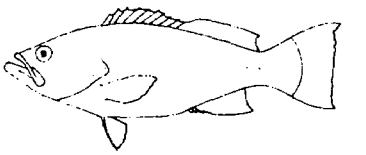
41a. Soft-rayed portion of anal fin longer than soft-rayed portion of dorsal fin .....



PRIACANTHIDAE
Bigeyes
(catalufa)

41b. Soft-rayed portion of anal fin shorter than soft-rayed portion of dorsal fin 42

42a. Three spines on opercle, the third a small spine below the major spine .....



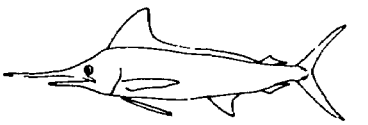
SERRANIDAE
Sea basses +
(cabrilla,
grouper)

42b. Two spines on opercle .....

PERCICHTHYIDAE
Temperate +
basses
(striped bass,
giant sea bass)

SECTION H: Pelvic Fins Thoracis With Less Than Five Soft-rays; The Rays Either Normal or Modified Into Barbel-like or Clublike Structures

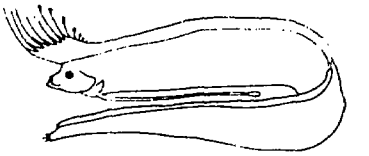
1a. Upper jaw prolonged into a spear .....



ISTIOPHORIDAE
Bill fishes
(marlin, sail-
fish)

1b. Upper jaw not as a spear 2

2a. Pelvic fins as long filaments; anterior dorsal fin rays greatly elevated .....

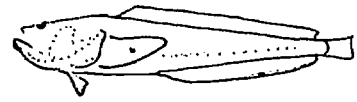


REGALECIDAE
Oarfishes

2b. Pelvic fins not as long filaments 3

SECTION H (Continued)

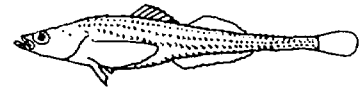
3a. Photophores present on sides and belly .....



BATRACHOIDIDAE
Toadfishes +
(midshipman)

3b. No photophores on body 4

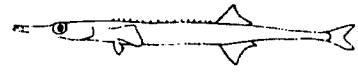
4a. Body encased in bony plates .....



AGONIDAE
Poachers +

4b. Body not encased in bony plates 5

5a. Dorsal fin preceded by isolated spines .....



GASTEROSTEIDAE
Sticklebacks +
(tubesnout)

5b. No isolated spines in dorsal fin 6

6a. Dorsal fin wholly of soft-rays 12

6b. Dorsal fin entirely of spines or of spines and soft-rays 7

7a. Dorsal fin with both soft-rays and spines 10

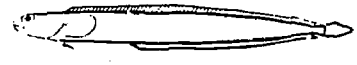
7b. Dorsal fin wholly of spines . 8

8a. Body not eel-like; anterior dorsal spines elevated .....

CLINIDAE
Clinids
(reef fin-
spot)

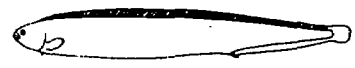
8b. Body eel-like; dorsal fin spines about same height .. 9

9a. Distance from snout to anal origin less than distance from anal origin to base of caudal fin .....



STICHAEIDAE
Pricklebacks +
(warbonnet,
whitebarred
blenny)

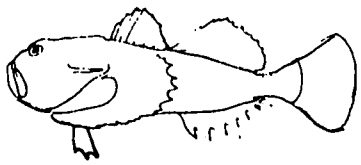
9b. Distance from snout to anal origin greater than distance from anal origin to base of caudal fin .....



PHOLIDAE
Gunnels +

SECTION H (Continued)

10a. From 7a page 23: dorsal fin with both soft-rays and spines
Body partly or wholly without scales; no anal spines .....



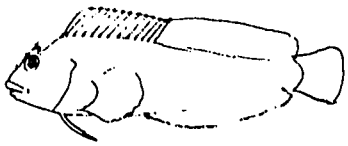
COTTIDAE
Sculpins +
(Irish Lord)

10b. Body scaled; anal fin with spines 11

11a. Gill membranes free from isthmus; more spines than soft-rays in dorsal fin except for Chaenopsis .....

CLINIDAE
Clinids +
(kelpfish, fringeheads, pikeblenny)

11b. Gill membranes attached to isthmus; more soft-rays than spines in dorsal fin .....



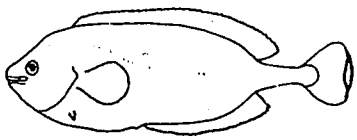
BLENNIIDAE
Combtooth blennies

12a. From 6a page 23: dorsal fin wholly of soft-rays
Gill membranes joined to isthmus; pelvic fins club-like .....

ZOARCIDAE
Eelpouts +

12b. Gill membranes free from isthmus (or slightly joined to isthmus in BROTULIDAE) 13

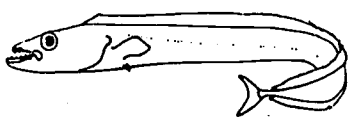
13a. Body oblong; dorsal rays less than 60 .....



ICOSTEIDAE
Ragfishes +

13b. Body elongate; dorsal rays more than 60 14

14a. Pelvic fin soft-rays not barbel-like, appearing as a small scale or spine; tail forked .....



TRICHIURIDAE
Cutlassfishes

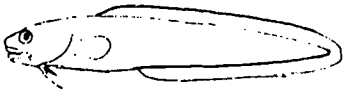
14b. Pelvic fin rays as barbel-like structures; caudal fin rounded (if present) 15

SECTION H (Continued)

15a. Pelvic fins attached under shoulder girdle; the two pelvic soft-rays completly joined by a membrane .....

BROTULIDAE
Brotulas +

15b. Pelvic fins attached under eyes or on chin; the two pelvic soft-rays joined only at base of fin .....



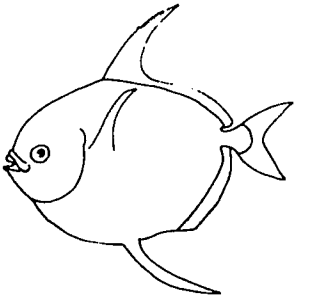
OPHIDIIDAE
Cusk-eels +

SECTION I: Pelvic Fins Thoracic With More Than Five Soft-rays

1a. Body elongate, much longer than deep 3

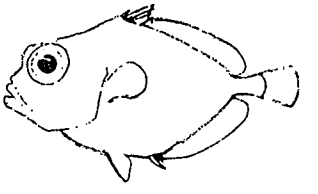
1b. Body ovate, compressed 2

2a. No spines in fins; tail strongly forked .....



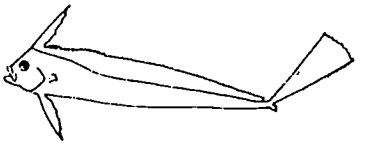
LAMPRIDAE
Opahs

2b. Strong spines in dorsal and anal fins; tail rounded .....



OREOSOMATIDAE
Oreos
(popeye dory)

3a. Anal fin absent; caudal fin uneven, the upper lobe fan-shaped .....



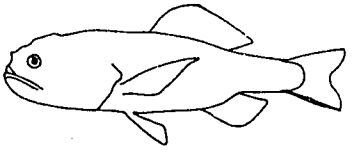
TRACHIPTERIDAE
Ribbonfishes
(king-of-the-salmon)

3b.

4a. Spines present in anal fin 5

4b. No spines in anal fin 6

5a. One dorsal fin .....



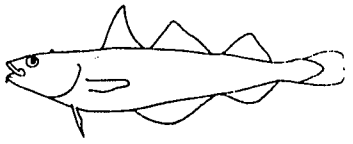
MELAMPHAIDAE
Bigscales

5b. Two dorsal fins (See family NEMATISTIIDAE, 24a page 18)

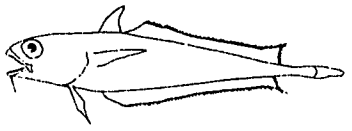
SECTION I (Continued)

6a. Tail pointed, no caudal fin; barbel present under chin .....  MACROURIDAE Grenadiers (rattails)

6b. Caudal fin present 7

7a. Two anal fins; three dorsal fins .....  GADIDAE Codfishes +

7b. One anal fin (may be deeply notched); two dorsal fins . 8

8a. Barbel on lower jaw; pelvics filamentous .....  MORIDAE Codlings

8b. No barbels under chin; pelvics normal .....  MERLUCCIIDAE Hakes +

+ Families known to frequent Bay area waters.