NOAA Technical Memorandum NMFS

NOVEMBER 1991

METHODS USED TO IDENTIFY PELAGIC JUVENILE ROCKFISH (GENUS *SEBASTES*) OCCURRING ALONG THE COAST OF CENTRAL CALIFORNIA

Edited by

Thomas E. Laidig
and
Peter B. Adams

NOAA-TM-NMFS-SWFSC-166

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

NOAA Technical Memorandum NMFS

The National Oceanic and Atmospheric Administration (NOAA), organized in 1970, has evolved into an agency which establishes national policies and manages and conserves our oceanic, coastal, and atmospheric resources. An organizational element within NOAA, the Office of Fisheries is responsible for fisheries policy and the direction of the National Marine Fisheries Service (NMFS).

In addition to its formal publications, the NMFS uses the NOAA Technical Memorandum series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible. Documents within this series, however, reflect sound professional work and may be referenced in the formal scientific and technical literature.

NOAA Technical Memorandum NMFS

This TM series is used for documentation and timely communication of preliminary results, imterim reports, or special purpose information; ~~and~~ the TMs have not received complete formal review, editorial control, or detailed editing.

NOVEMBER 1991

METHODS USED TO IDENTIFY PELAGIC JUVENILE ROCKFISH (GENUS *SEBASTES*) OCCURRING ALONG THE COAST OF CENTRAL CALIFORNIA

Edited by

Thomas E. Laidig
and
Peter B. Adams

National Marine Fisheries Service, NOAA
Southwest Fisheries Science Center
Tiburon Laboratory
3150 Paradise Drive
Tiburon, CA 94920

NOAA-TM-NMFS-SWFSC-166

U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary
National Oceanic and Atmospheric Administration
William E. Evans, Under Secretary for Oceans and Atmosphere
National Marine Fisheries Service
James W. Brennan, Assistant Administrator for Fisheries

CONTENTS

Laidig, Thomas E., and Peter B. Adams
Introduction: Methods Used to Identify Pelagic Juvenile and Larval Rockfish (Genus Sebastes) Occurring along the Coast of Central California 1

Laidig, Thomas E., and Wayne M. Samiere
Pigment Patterns of Juvenile Sebastes flavidus and Sebastes melanops Useful in Identification 7

Silberberg, Kelly R.
Identification of Juvenile Rockfish (Genus Sebastes) Using the Cleithrum 19

Laidig, Thomas E., Wayne M. Samiere, and Ralph C. DeFelice
The Use of the Bones of the Caudal Complex to Identify Juvenile Rockfish (Sebastes spp.) 31

Adams, Peter B., and Wayne M. Samiere
A Computerized "Expert System" to Aid in the Identification of Juvenile Rockfish (Genus Sebastes) 47

Moreland, Sharon L., and Carol A. Reilly
Key to the Juvenile Rockfishes of Central California 59

INTRODUCTION

Rockfish (Sebastes spp.) are a common commercially caught fish group taken along the Pacific coast of North America (PFMC 1990). Rockfish represent 38 percent of the total 1990 groundfish landings (exclusive of Pacific whiting, Merluccius productus) from Washington, Oregon, and California. There are 69 known species of rockfish inhabiting the waters of the Pacific coast of North America (Anderson 1983). Due to the diversity of habitat and species association, fisheries management of this group is complex, with some species managed singularly and others in groups. The management of this group is further complicated by the large fluctuations in recruitment (Leaman and Beamish 1984). In fact, a single dominant year-class can sustain a fishery for a number of years.

A prerequisite to both management and research is the ability to identify individual rockfish species. This presents a problem because rockfish have a complex life history, including internal fertilization, viviparity, pelagic larvae, both pelagic and benthic juveniles, and finally adults. Identifications are most difficult in the pelagic larval and juvenile stages, where the young fish can have completely different pigmentation than in the adult phase. Many methods have evolved throughout the years to differentiate these earlier stages, but pigmentation and meristic differences (Moser et al. 1977; Laroche and Richardson

1980, 1981; Moser et al. 1985; Kendall and Lenarz 1987; Kendall 1991) remain the methods of choice.

In this report, we present information on the methods that are currently being used at our laboratory to identify pelagic juvenile rockfish. We have included papers on the use of pigment patterns to distinguish Sebastes flavidus from S. melanops; use of the cleithra and caudal bones to separate species; and have included two meristic keys, including one computerized. The paper on pigment patterns and the non-computerized key were developed using fresh (and frozen) specimens, while the remaining papers were developed to deal with the particularly difficult task of identifying rockfish from predator stomachs, where pigment patterns have usually been destroyed. In the latter instance, some unusual structures were examined because these structures typically were some of the last structures to be digested and, thus, presented the best opportunity to help us in separating species.

The manuscripts in this report were written to be used independently of one another, but can be combined. An example of one possible combination of articles would be if one had a fresh fish to be identified. First, the fin rays would be counted and the meristic key used to identify the subject fish. If the fish keyed out to be a yellowtail rockfish (S. flavidus), the paper that distinguishes black (S. melanops) and yellowtail rockfish may be used to check if the pigment pattern observed matches the description in that manuscript. Another example may be in

examining a fish found in a predator stomach. If the pigmentation has been destroyed, then one would count the fin rays and gill rakers and use the computerized (or the non-computerized) key. If some of the fins did not have a full complement of rays, it may not be possible to identify this fish by use of the keys alone. Then one should try examining the cleithrum or the caudal complex. This may present enough information to identify the fish to species.

ACKNOWLEDGEMENTS

We would like to thank all the researchers at the Tiburon Laboratory who have contributed to gathering the data for this guide. We would especially like to thank Arthur Kendall and Geoff Moser for reviews.

CITATIONS

Anderson, T.

1983 Identification and development of nearshore juvenile rockfishes (genus Sebastes) in central California kelp forests. M. A. thesis, California State Univ., Fresno, California, 216 p.

Kendall, A. W., Jr.

1991 Systematics and identification of larvae and juveniles of the genus Sebastes. Environ. Biol. Fishes 30:173-190.

Kendall, A. W., Jr., and W. H. Lenarz

1987 Status of early life history studies of northeast Pacific rockfishes. In Proc. Int. Rockfish. Symp. Oct. 1986. Anchorage, Alaska, p. 99-128. Univ. Alaska, Alaska Sea Grant Rep. 87-2.

Laroche, W. A., and S. L. Richardson

1980 Development and occurrence of larvae and juveniles of the rockfishes Sebastes flavidus and Sebastes melanops (Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:901-923.

1981 Development and occurrence of larvae and juveniles of the rockfishes Sebastes entomelas and S. zacentrus (family Scorpaenidae) and occurrence off Oregon, with notes on head spines of S. mystinus, S. flavidus, and S. melanops. Fish. Bull., U. S. 79:231-258.

Leaman, B. M., and R. J. Beamish

1984 Ecological and management implications of longevity in some northeast Pacific groundfishes. Int. North Pac. Fish. Comm. Bull. 42:85-97.

Moser, H. G., E. H. Ahlstrom, and E. M. Sandknop

1977 Guide to the identification of scorpionfish larvae (Family Scorpaenidae) in the eastern Pacific with comparative notes on species of Sebastes and Helicolenus from other oceans. NOAA Tech. Rep. NMFS Circ. 402, 71 p.

Moser, H. G., E. M. Sandknop, and D. A. Ambrose

1985 Larvae and juveniles of aurora rockfish, Sebastes aurora, from off california and Baja California. In Descriptions of early life history stages of selected fishes: From the 3rd international symposium on the early life history of fishes and 8th annual larval conference, p. 55-64. Can. Tech. Rep. Fish. Aquat. Sci. 1359.

PFMC (Pacific Fisheries Management Council)

1990 Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Metro Center, Suite 420, 2000 S. W. First Avenue, Portland, Oregon 97201, 58 p.

Pigment Patterns of Juvenile *Sebastes flavidus* and *Sebastes melanops* Useful in Identification

By

Thomas E. Laidig and Wayne M. Samiere[1]

ABSTRACT

Morphology and pigmentation of juvenile *Sebastes flavidus* and *S. melanops* are compared. All *S. flavidus* were found to have from two to five distinct pigment saddles while *S. melanops* rarely had saddles. Other differences were observed in the pigmentation of the peritoneum and head spination.

[1] Present Address: 21 Vernon St., San Francisco, CA 94132

INTRODUCTION

Sebastes flavidus, yellowtail rockfish, and S. melanops, black rockfish, are two co-occurring species of rockfish that inhabit the nearshore waters of the northeastern Pacific Ocean (Eschmeyer et al. 1983). Sebastes spp. are an important component of the Pacific coast groundfish fishery, contributing 45% of the total landings in 1989, with 43,877 mt (Pacific Fishery Management Council 1990). Sebastes flavidus accounted for approximately 10% of the total rockfish landings with a total of 4,217 mt (Pacific Fishery Management Council 1990). Sebastes melanops is not specifically managed, but is incorporated into the management group termed other rockfish. This group accounted for 4,593 mt or slightly more than 10% of the total rockfish landings (Pacific Fishery Management Council 1990).

Rockfishes are characterized by strong and weak year-classes, and much recent research has focused on estimating the numbers of juveniles as a means of forecasting year-classes (Stephens et al. 1986; Wyllie Echeverria et al. 1990; Moser and Boehlert 1991). This research had been impeded by the difficulty in differentiating between various species at the juvenile stage. Juvenile rockfishes are identified to species by use of meristics and pigmentation (Litvinenko 1974; Richardson and Laroche 1979; Laroche and Richardson 1980, 1981; Anderson 1983; Kendall and Lenarz 1987). Any attributes that help distinguish species

faster and with increased accuracy benefits any early life history study.

In this study, we examined pigmentation differences between two species of juvenile rockfish (S. melanops and S. flavidus) which have very similar meristics. We studied both fresh and preserved specimens to note any change due to preservation. This study will aid in identifying those "hard-to-identify" fish. This study is also envisioned as a fast sorting technique while conducting field work, since rapid and accurate identification techniques are often needed to sort large catches of fish.

METHODS

Fishes used in this analysis were taken from the Gulf of the Farallones (central California) during two cruises, May 30 to June 6, 1985, and May 29 to June 3, 1986, aboard the NOAA R/V David Starr Jordan. Samples were taken at night using an 80-ft Stauffer-modified Cobb midwater trawl at a depth of 10 m (Wyllie Echeverria et al. 1990). All rockfish were removed from the net and frozen for later analysis.

In the laboratory, Sebastes flavidus and S. melanops were separated based on meristics, using the key developed by Moreland and Reilly (1991). Pigmentation (overall body patterns, body coloration, chromatophore type and location, fin pigmentation, and peritoneum pigments) was recorded for each species. After the initial observations, specimens were placed in a 10%

Formalin[1] solution and stored for one to three months. After fixation, similar observations were performed and results were compared to the fresh specimens. All illustrations were drawn by the junior author. Lastly, we examined differences in head spination.

RESULTS

A total of 162 S. flavidus (standard length (SL) = 39-53 mm) and 47 S. melanops (SL = 30-49 mm) were examined.

Pigmentation

In S. flavidus, the melanophores were concentrated into blotches, known as saddles, between the dorsal fin and the lateral line (Fig. 1). Clear areas of little or no melanistic pigment separated the saddles. Typically, three saddles were present, but the number ranged from two to five. The common saddle pattern found one occurring beneath the spiny dorsal fin, one below the soft dorsal fin, and one on the caudal peduncle. The two posterior saddles usually had the shape of an inverted triangle and the anterior saddle was highly variable. The shape and intensity of these saddle marks varied with length; larger specimens (over 45 mm) tended to have darker and more variable saddles.

[1] Use of tradename does not imply endorsement by NMFS.

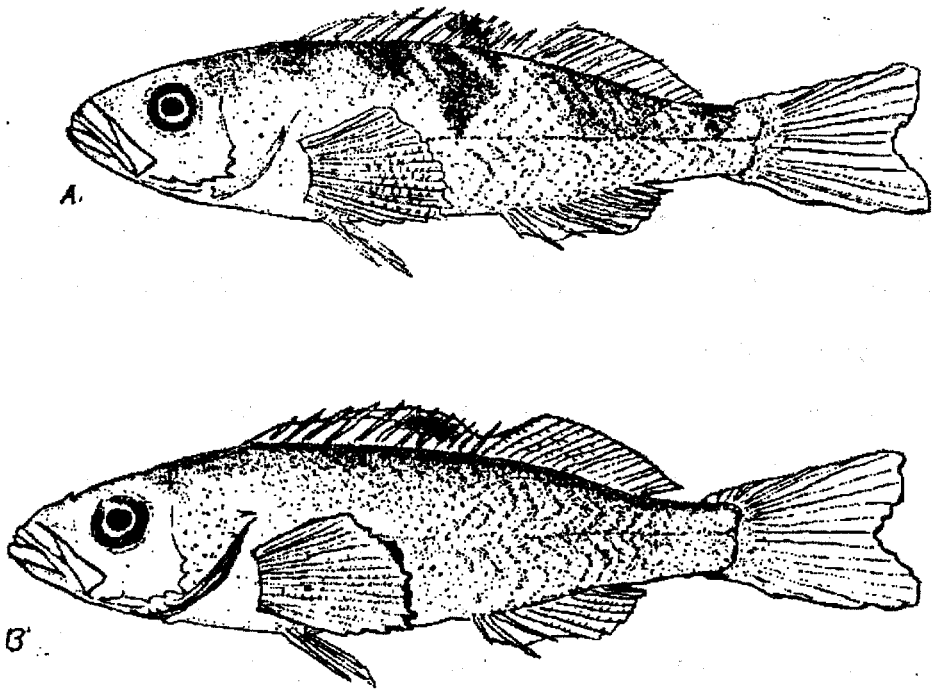


Figure 1. Pelagic juveniles collected off the coast of central California of Sebastes flavidus (A., 45 mm) and Sebastes melanops (B., 45 mm).

The melanophores on S. melanops were uniformly distributed over the sides of the body except where they tended to concentrate between muscle segments (Fig. 1). Only 6 of the 47 S. melanops had one very faint saddle mark below the soft rays of the dorsal fin, extending from the fin base to the lateral line. On the body surface, a dark stripe of pigment ran along the base of the dorsal fin from the nape to the caudal fin.

Fresh specimens of S. melanops were transparent, pale green, while specimens of S. flavidus were beige to light yellow. Dark melanophores covering the body surface of both species were concentrated in the dorsal half. Both species had orange and yellow chromatophores interspersed with the melanophores, with the largest concentrations at the base of the caudal and anal fin and between myomeres.

The intensity of the black spot located in the spinous dorsal fin varied between the two species. In S. melanops, the spot was small and faint. In S. flavidus, the spot was large and intense. This difference was noted in all specimens.

Both species had pigment at the base of each anal spine. Sebastes flavidus had numerous large spots that covered the base of each spine, while S. melanops had much smaller pigment spots, typically, only one tiny chromatophore per spine. These characteristics remained constant throughout the size ranges studied.

Sebastes melanops had pigment on both pectoral fins. There was at least one melanophore per ray, occurring over the entire proximal portion of the fin. In S. flavidus, 40% had no pectoral fin pigment and these fish ranged from 40-44 mm. When pigment was observed, there were only a few melanophores observed (mostly one spot on one fin only), and these were located in the middle of the proximal side of the fin. Fin pigment increased with specimen size.

The color of the peritoneum, as viewed externally, varies somewhat between both species. For S. melanops, the peritoneum typically had scattered black spots with a dark shade between spots. There was also a concentration of pigment around the anus. For S. flavidus, the peritoneum also had scattered black spots, but little or no dark shading was observed between them. No concentration of pigment around the anal vent was found. Each pattern was exclusive to each species, and both patterns persisted for all size ranges examined.

After preservation, the color of each species turned to an opaque white, with S. melanops appearing darker in overall color than S. flavidus because of the many melanophores spread uniformly over the body surface. The chromatophores disappeared, but the melanistic pigments remained, although they faded in intensity. The patterns evident in the fresh specimens were still visible in S. flavidus, but the pigment became much more faint. There wasn't a noticeable difference in pigmentation between specimens stored for one month or three months. However, when samples were stored for a year, the pigment pattern in S. flavidus became hard to distinguish in some specimens.

Head Spination

The only noticeable difference among the head spines of the two species was with the nasal spines. The nasal spines of S. melanops were short and stubby in all individuals, while those of S. flavidus were about twice as long as those of S. melanops.

The spines of S. flavidus were also pointed to a sharp tip (in 86% of the examined fish). This difference persisted for all sizes examined.

DISCUSSION

The presence of the saddle pattern offers the greatest opportunity for rapid and accurate discrimination between S. flavidus and S. melanops. Other differences which may be used to differentiate between these two species are the amount and pattern of the pigmentation of the peritoneum, the differences in the shape and size of the nasal spine, and the intensity of the dorsal spot. The pigmentation on the anal fin ray bases and pectoral fin were less pronounced between the species.

Our observations of saddle pigment patterns of juvenile S. flavidus (also observed by Anderson (1983)) differed from those of Laroche and Richardson (1980), who did not describe the saddle patterns. Since the patterns tend to fade with increased time after preservation, this could account for the difference. There also may be a geographical difference, since Laroche and Richardson (1980) studied fish from off the Oregon coast and we studied fish from off central California.

Differences in meristics still remain the main method for distinguishing rockfish species, but other characteristics are finding increasing use in identifications. As early life history stages of more species are described, pigment will probably

become more important in identifying species. By using the differences in pigmentation described above, the accurate identification between S. flavidus and S. melanops will increase. These differences in pigment will become more important in identification due to the ambiguity of meristics caused by damage of the fins or overlapping counts.

ACKNOWLEDGEMENTS

We would like to thank the crew of the David Starr Jordan and the scientific personnel who aided in the collection of juveniles for this study. We would also like to thank Carol Reilly for helping in identifications of the two species.

CITATIONS

Anderson, T. W.

1983 Identification and development of nearshore juvenile rockfishes (genus Sebastes) in central California kelp forests. M. A. thesis, California State Univ., Fresno, California, 216 p.

Eschmeyer, W. N., E. S. Herald, and H. Hammann

1983 A field guide to the Pacific coast fishes of North America. Houghton Mifflin Co., Boston, 366 p.

Kendall, A. W., and W. H. Lenarz

1987 Status of early life history studies of northeast Pacific rockfishes. In Proc. Int. Rockfish. Symp. Oct. 1986. Anchorage, Alaska, p. 99-128. Univ. Alaska, Alaska Sea Grant Rep. 87-2.

Laroche, W. A., and S. L. Richardson

1980 Development and occurrence of larvae and juveniles of the rockfishes Sebastes flavidus and Sebastes melanops (Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:901-923.

1981 Development and occurrence of larvae and juveniles of the rockfishes Sebastes entomelas and S. zacentrus (family Scorpaenidae) and occurrence off Oregon, with notes on head spines of S. mystinus, S. flavidus, and S. melanops. Fish. Bull., U. S. 79:231-258.

Litvinenko, N. N.

1974 Coloration and other morphological characters distinguishing juvenile Sebastes fasciatus from juvenile Sebastes menitella (Scorpaenidae). J. Ichthyol. 14:591-595.

Moreland, S. L., and C. A. Reilly

1991 Key to the Juvenile Rockfishes of Central California. In Laidig, T. E., and P. B. Adams (eds.), Methods used to identify pelagic juvenile and larval rockfish (Genus Sebastes) occurring along the coast of central California. U. S. Dep. Commer., NOAA Tech Memo. In Prep.

Moser, G. H., and G. W. Boehlert

1991 Ecology of pelagic larvae and juveniles of the genus Sebastes. Environ. Biol. Fishes 30:203-224.

PFMC (Pacific Fisheries Management Council)

1990 Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Metro Center, Suite 420, 2000 S. W. First Avenue, Portland, Oregon 97201, 58 p.

Richardson, S. L., and W. A. Laroche

1979 Development and occurrence of larvae and juveniles of the rockfishes Sebastes crameri, Sebastes pinniger, and Sebastes helvomaculatus (family Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:1-41.

Stephens, J. S., Jr., G. A. Jordan, P. A. Morris, M. M. Singer, and G. E. McGowan

1986 Can we relate larval fish abundance to recruitment or population stability? A preliminary analysis of recruitment to a temperate reef. Calif. Coop. Oceanic Fish. Invest. Rep. 27:65-83.

Wyllie Echeverria, T., W. H. Lenarz, and C. Reilly

1990 Survey of the abundances and distribution of pelagic young-of-the-year rockfishes, Sebastes, off central California. U. S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-147, 125 p.

Identification of Juvenile Rockfish (Genus Sebastes) Using the Cleithrum

By

Kelly R. Silberberg

ABSTRACT

The cleithrum bone, a paired bone which is part of the pectoral girdle, was studied and compared for 10 species of rockfish (genus Sebastes) to find differences that will aid in the differentiation among similar species. The cleithrum bone alone was sufficient to make a positive identification in Sebastes goodei, S. jordani, S. paucispinis, and S. pinniger, while in S. saxicola and S. wilsoni the cleithrum bone exhibited a consistent difference enabling differentiation between the two. The cleithrum bones from S. entomelas, S. flavidus, S. hopkinsi, and S. mystinus were very similar and could not be used to separate these species.

INTRODUCTION

The identification of juvenile rockfish (genus Sebastes) is a difficult task because of the large number of similar species. Identification of juveniles from the stomachs of predators is even more difficult, because depending on the degree of digestion, many of the key characters used for identification may no longer be present. Often, some combination of existing traditional methods (e.g., meristics, morphometrics, and pigment patterns) can be used to narrow down the identification to several possible species, but not to a single species, and although this is useful, it is not enough to make a positive identification.

To assist in identification of juveniles from predator stomachs, we have studied the cleithrum, a paired bone which is part of the pectoral girdle and functions to support the pectoral fin (Fig. 1). The cleithrum, because of its unique shape and distinguishing features, can aid in the differentiation between similar rockfish species, and has been used for identification in other groups of fishes (Evseenko 1981, Yatou and Yamakawa 1983, and Hansel et al. 1988).

Rockfish species used in this study were Sebastes entomelas (widow rockfish), S. flavidus (yellowtail rockfish), S. goodei (chilipepper), S. hopkinsi (squarespot rockfish), S. jordani (shortbelly rockfish), S. mystinus (blue rockfish), S. paucispinis (bocaccio), S. pinniger (canary rockfish), S.

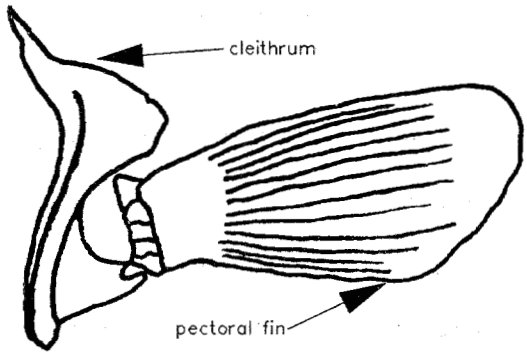


Figure 1. Diagram of cleithrum showing relation to pectoral fin.

saxicola (stripetail rockfish), and S. wilsoni (pygmy rockfish). These species were chosen because they were the most common species found in the stomach contents of chinook salmon (Oncorhynchus tschawytscha), a major predator on juvenile rockfishes off central California. Of these species, S. entomelas, S. flavidus and S. mystinus are the most difficult to differentiate from one another using traditional methods because of their similar meristics. In advanced stages of digestion, S. goodei and S. hopkinsi may also be included in this group. Other species pairs that are difficult to distinguish from each other because of similar meristics are, S. hopkinsi and S. pinniger, and S. saxicola and S. wilsoni. Sebastes jordani and S. paucispinis can always be positively identified because of their unique meristics despite their condition.

METHODS

Juvenile rockfish used in this study were collected off central California, using a midwater trawl during several cruises aboard the R/V David Starr Jordan (see Wyllie-Echeverria et al. 1990 for details on sampling). The rockfish, ranging from 23-80 mm, were frozen at sea and later identified to species using traditional methods. Five to forty rockfish of each species were placed in a solution containing potassium hydroxide and alizarin red S. The potassium hydroxide dissolves away all soft tissues, while the alizarin red S stains all bony structures and enhances structural features, making comparisons easier. After all soft tissues were dissolved, the cleithra were picked out and mounted on microscope slides. The cleithra were observed under magnification, and line drawings of cleithrum from each species were made. All drawings are of the left cleithrum oriented as if viewed laterally from the left side of the fish. Key structures of the cleithrum were labeled for the purpose of identification and comparison (Fig. 2). Structures used in identification are the anterior dorsal spine, dorsal cusp, posterior dorsal spinule, medial arch, and posterior ventral lobe. Although only 10 species were used here, this method could be applied to any of the 100 plus species of Sebastes (Eschmeyer et al. 1983).

RESULTS

Of the 10 species studied, S. goodei (size range from 34-70 mm), S. jordani (49-80 mm), S. paucispinis (31-55 mm), and S. pinniger (23-34 mm) can be identified on the basis of the cleithrum alone. The cleithrum of these four species are identified by the following characteristics: S. goodei - the posterior edge of the cleithrum is fairly straight from the ventral lobe to the dorsal spinule, there is a sharp bend in the anterior edge at the medial arch, a dorsal cusp is present, and the anterior dorsal spine is relatively long (Fig. 3a); S. jordani - the dorsal half of the cleithrum is large with the posterior dorsal spinule pronounced, and the posterior edge from the ventral lobe to the medial arch is relatively long and straight without undulations (Fig. 3b); S. paucispinis - the dorsal cusp and the medial arch are absent, and the anteriordorsal spine is markedly produced (Fig. 3c); S. pinniger - the posterior edge of the cleithrum is straight from the ventral lobe to the dorsal spinule, the dorsal half of the cleithrum is narrow, the dorsal cusp is moderately pronounced and the anterior dorsal spine is relatively long (Fig. 3d). In the remaining six species, the cleithrum only aided in the differentiation between similar species. The cleithrum bones of S. entomelas (40-64 mm), S. flavidus (38-50 mm), S. hopkinsi (46-55 mm), and S. mystinus (38-53 mm) are virtually indistinguishable with no dependable variations between them

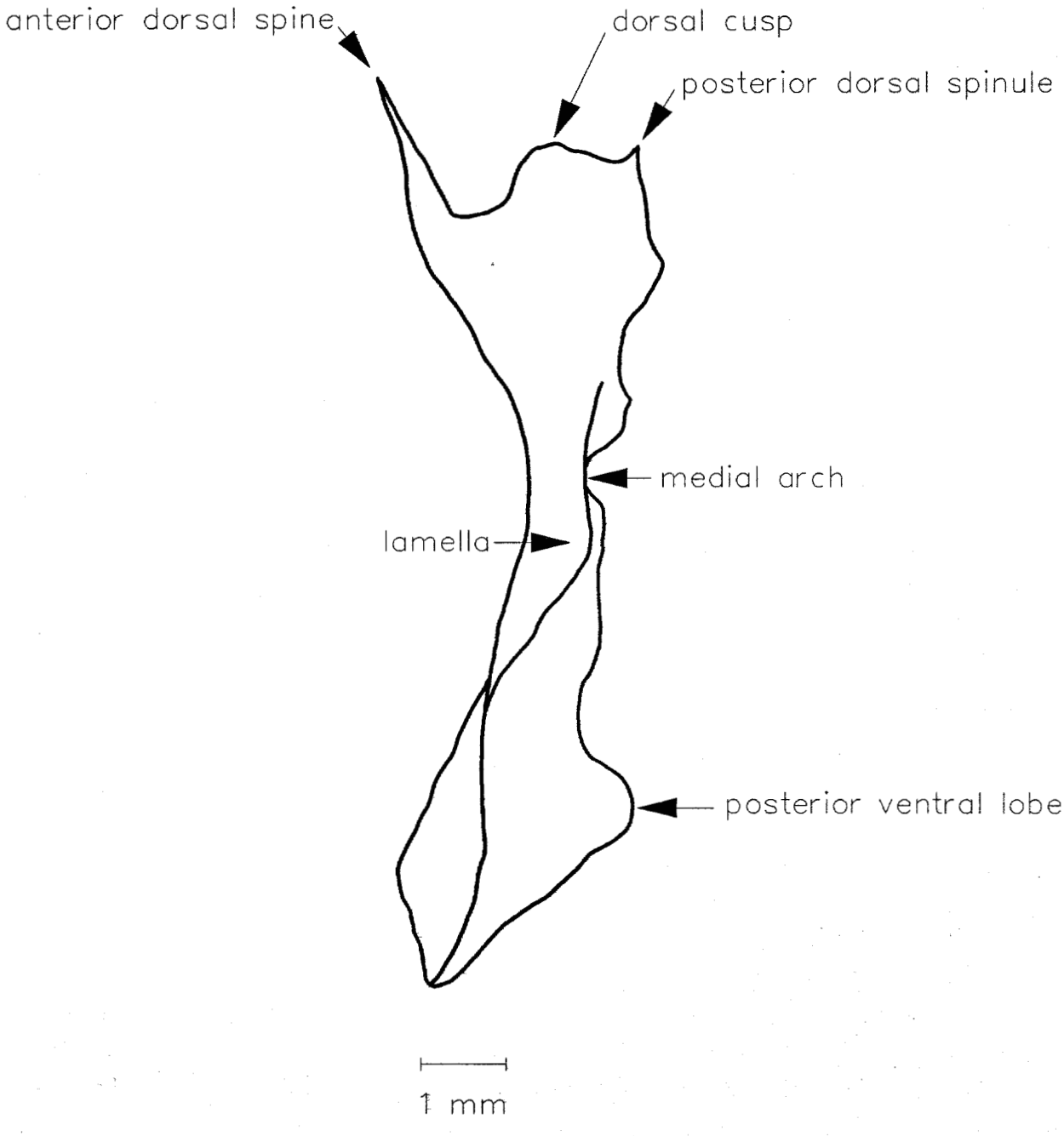


Figure 2. Diagram of left cleithrum showing key structures.

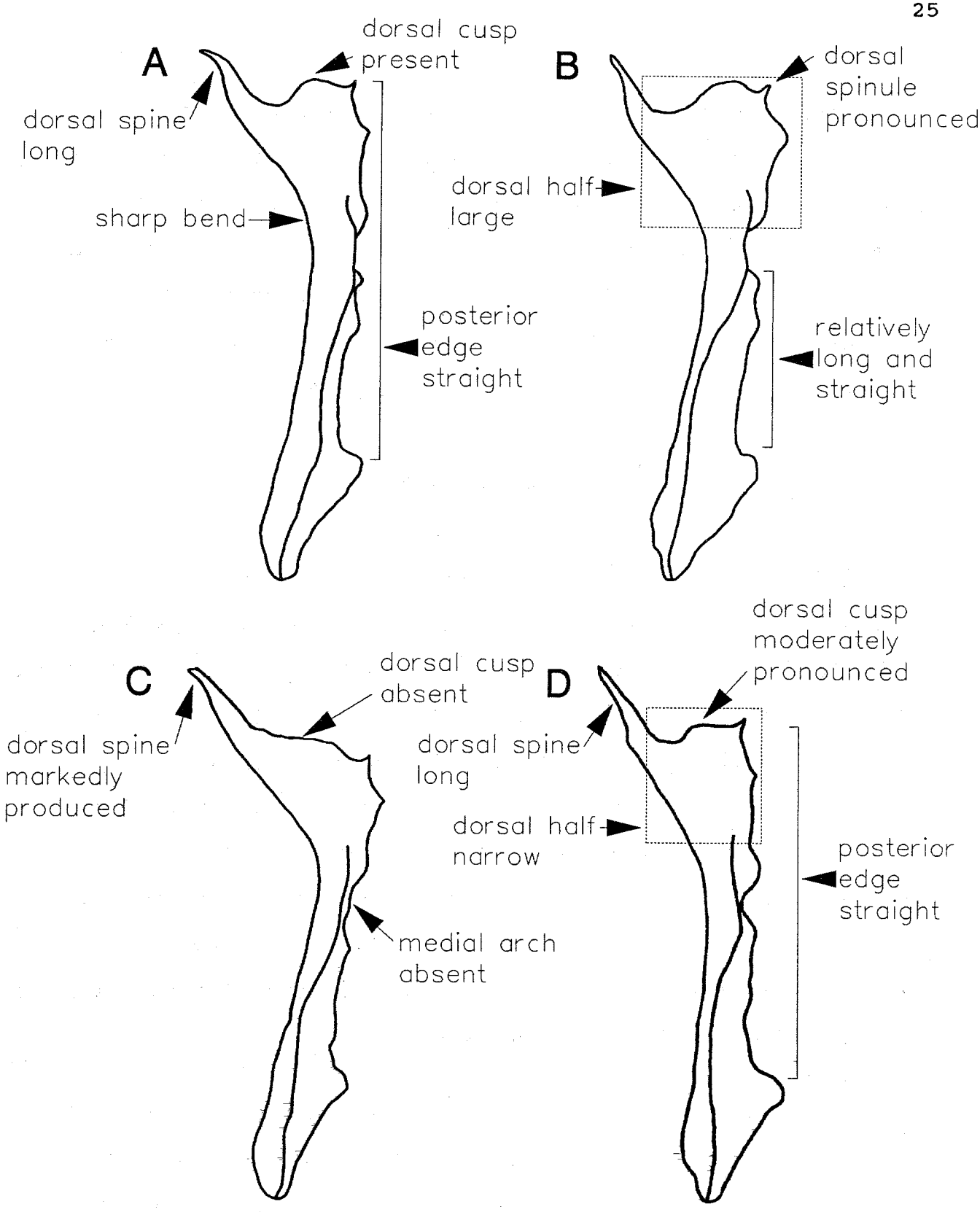


Figure 3. A. *Sebastes goodei*, B. *Sebastes jordani*, C. *Sebastes paucispinis*, and D. *Sebastes pinniger*.

(Fig. 4). The cleithrum of these species exhibit the following characters: the medial arch is well defined, sometimes hidden by the lamella, and the dorsal half of the cleithrum is distinctly triangular in shape with the dorsal cusp strongly marked. The cleithrum of S. saxicola (30-45 mm) and S. wilsoni (35-36 mm) can be separated on the basis of the dorsal cusp, which is much more defined in S. saxicola than in S. wilsoni (Fig. 5).

DISCUSSION

The cleithrum is extremely useful in the identification of juvenile rockfish. Among the 10 species studied, S. goodei, S. jordani, S. paucispinis, and S. pinniger can be identified solely on the basis of the cleithrum. Difficult to separate species pairs - S. hopkinsi and S. pinniger, and S. saxicola and S. wilsoni - can be differentiated based on differences in their cleithrum bones. Comparisons of cleithrum bones from S. entomelas, S. flavidus, S. hopkinsi, and S. mystinus did not reveal any reliable variations that could be used to differentiate them. Further investigation involving more species is needed to expand these conclusions.

ACKNOWLEDGEMENTS

I would like to thank the scientists of the Groundfish Analysis Investigations Task at the NMFS Tiburon Laboratory for supplying the juvenile rockfish used in this study and for conducting the initial identifications.

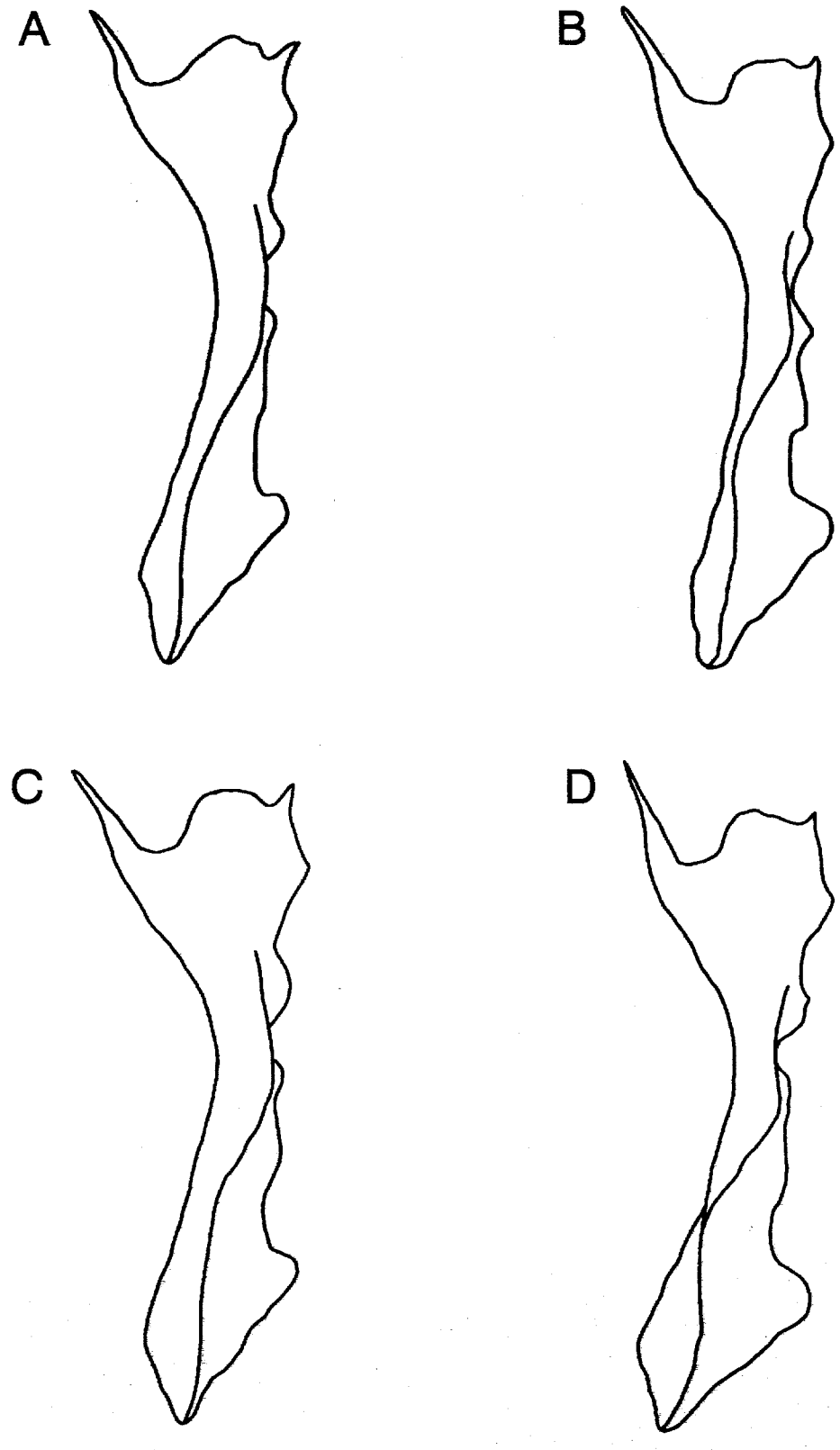


Figure 4. A. *Sebastes entomelas*, B. *Sebastes flavidus*, C. *Sebastes hopkinsi*, and D. *Sebastes mystinus*.

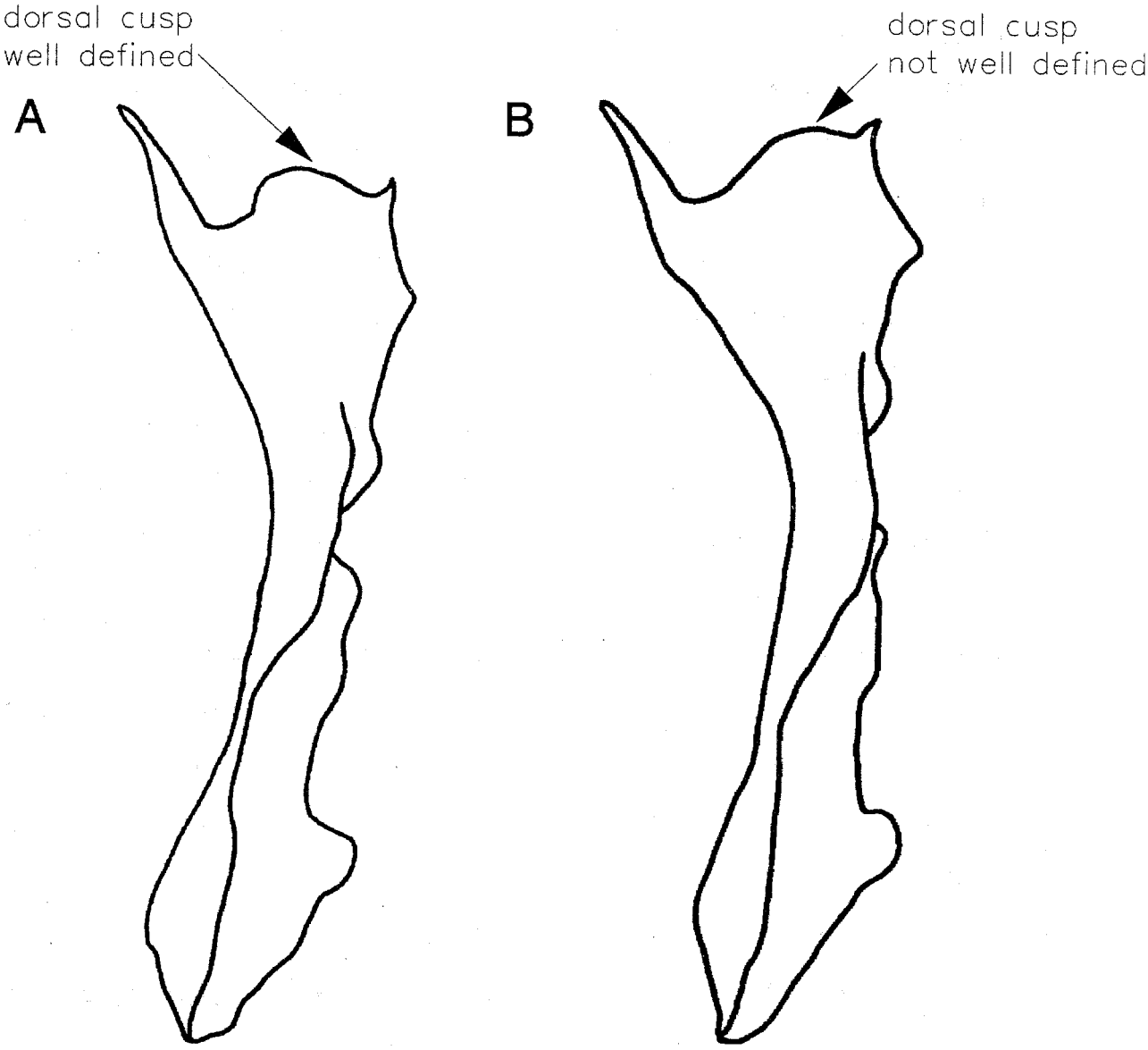


Figure 5. A. *Sebastes saxicola*, and B. *Sebastes wilsoni*.

CITATIONS

Eschmeyer, W. N., E. S. Herald, and H. Hammann

1983 A field guide to Pacific coast fishes of North America. Houghton Mifflin Co., Boston, 336 p.

Evseenko, S. A.

1981 On the sinistral flatfish larvae (Scophthalmidae, Bothidae, Pisces) from the west Atlantic coast. Rapp. P.-V. Reun. Cons. Int. Explor. Mer 178:593-594.

Hansel, H. C., E. S. Duke, P. T. Lofty, and G. A. Gray

1988 Use of diagnostic bones to identify and estimate original lengths of ingested prey fishes. Trans. Am. Fish. Soc. 117:55-62.

Wyllie Echeverria, T., W. H. Lenarz, and C. Reilly

1990 Survey of the abundance and distribution of pelagic young-of-the-year rockfishes, Sebastes, off central California. U. S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-147, 125 p.

Yatou, T., and T. Yamakawa

1983 A new triglid fish, Pterygotrigla multipunctata, from Japan. Jpn. J. of Ichthyol. 30:217-220.

The Use of the Bones of the Caudal Complex to Identify Juvenile Rockfish (Sebastes spp.)

By

Thomas E. Laidig, Wayne M. Samiere[1], and Ralph C. DeFelice

ABSTRACT

The bones of the caudal complex of different rockfish species (Sebastes spp.) were examined for the possibility of differentiating species. The shape of the neural arch and haemal spine of the preural centrum, the epurals, and the parhypural exhibited consistent variability between species to allow identifications of the different species. Many other subtle differences existed between the species.

[1] Present Address: 21 Vernon St., San Francisco, CA 94132

INTRODUCTION

The identification of juvenile fish is based mostly on external characteristics, such as pigmentation and meristics (Kendall 1991). Juvenile rockfish (Sebastes spp.) are some of the most difficult fish to identify to species. This difficulty is greatly increased if identification characteristics are indistinct or disintegrated, as when examining species found in predator stomachs. In these instances, only fragmentary pigmentation and meristics are present. Further identifiable attributes of these prey species need to be determined to enhance the correct classification of each species.

The use of hard structures (excluding fin rays) to separate species has been investigated (Messieh 1972; Litvinenko 1974; McKern et al. 1974; Postuma 1974; Neilson et al. 1985; Rybock et al. 1975; Laroche and Richardson 1980, 1981; Sanchez and Acha 1988; Laidig and Ralston 1991[2]). Since hard structures typically take longer to digest, any identifiable hard structures that could be used in separating species would greatly increase the chances of accurate identifications. Most studies have involved examining head spination or otolith characteristics. However, Sanchez and Acha (1988) examined the caudal complex to

[2] Laidig, T. E. and S. Ralston. 1991. Otolith characters as an aid in identifying larval rockfish (Sebastes spp.). Unpub. ms.

differentiate between species of rockfish, Litvinenko (1974) examined vertebrae for differences in juvenile Sebastes fasciatus and S. menitella, and Rybachuk (1974) used articular bones to identify species found in middens.

In this study, we compared the caudal complexes of different species of juvenile rockfish for use in identification. Caudal complexes were selected because they usually were one of the last elements to be digested and they possessed ample structures in which to examine consistent differences among species.

METHODS

Juvenile rockfish were collected from midwater trawl samples conducted off central California (Wyllie Echeverria et al. 1990). Rockfish were identified (using pigmentation and meristics) and placed in 10% Formalin[3]. After fixation (one to two weeks), the bones were stained, using a mixture of water and alizarin red S. We used a weak solution of potassium hydroxide to dissolve the muscle tissue surrounding the caudal complex and the last few vertebrae while leaving the cartilage intact. Once the bones were free of tissue, they were embedded within resin blocks. At least five specimens of each species were used for comparisons.

Juvenile rockfish were also removed from the stomachs of king salmon, Oncorhynchus tshawytscha. Samples were collected

[3] Use of tradename does not imply endorsement by NMFS.

from four sport fishing boats docked in Sausalito, California, from April 10 to June 13, 1989. Salmon were caught between Half Moon Bay and Bodega Bay, California, most from near the Farallon Islands. Rockfish were identified using pigmentation or meristics. Further preparation of these specimens was as above.

Terminology

A projection was considered an extrusive growth of the bone that created an irregular (non smooth) pattern on the bone edge (Fig. 1). A projection was called a spine if it was longer than wide. A notch was an indentation in the bone, and a deep notch was a depression that was longer than wide. The edge of the boneis the outline of the bone when viewed laterally.

Eleven species of rockfish were used in this study: brown rockfish, Sebastes auriculatus; yellowtail rockfish, S. flavidus; chilipepper, S. goodei; squarespot rockfish, S. hopkinsi; shortbelly rockfish, S. jordani; blue rockfish, S. mystinus; bocaccio, S. paucispinis; canary rockfish, S. pinniger; bank rockfish, S. rufus; stripetail rockfish, S. saxicola; and pygmy rockfish, S. wilsoni.

We examined differences in bones in the caudal fin complex (Fig. 1): epurals, parhypural, hypural plates, preural (penultimate) centrum, and urostyle. We considered only those attributes of each bone that were consistently present for comparisons. The longest axis of each bone in both the frontal and transverse planes were measured, and the dorsal/ventral plane and ratios were computed to standardize comparisons.

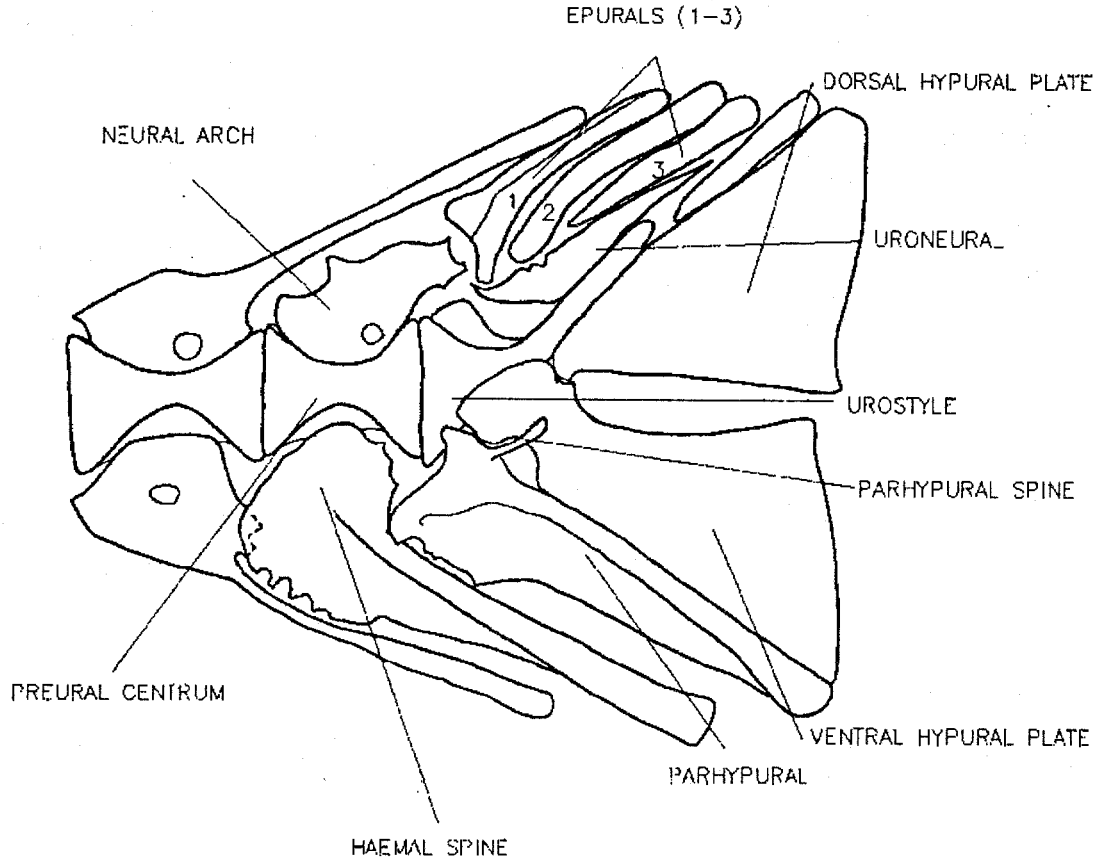
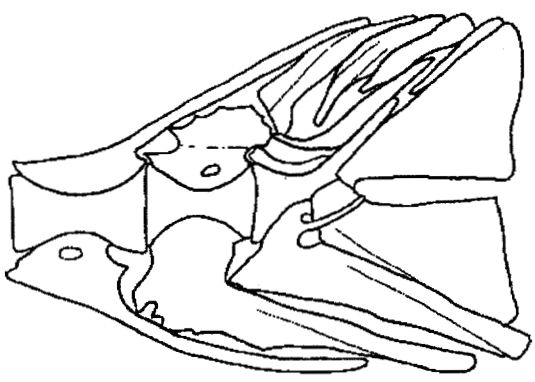


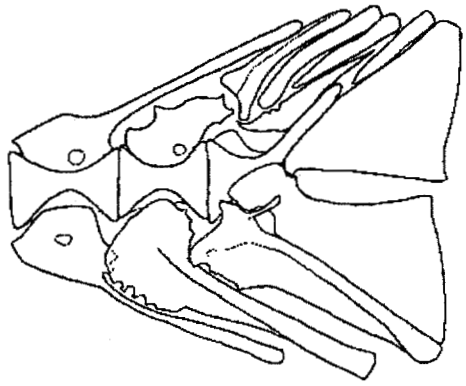
Figure 1. Caudal fin complex of Sebastes paucispinis displaying the different bones examined in this study.

RESULTS

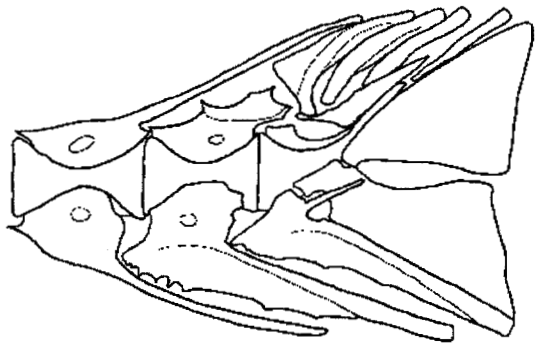
We analyzed the caudal bones of four individuals of S. goodei and S. pinniger, five individuals of S. auriculatus, S. rufus, S. saxicola, and S. wilsoni, and six individuals of S. flavidus, S. hopkinsi, S. jordani, S. mystinus and S. paucispinis



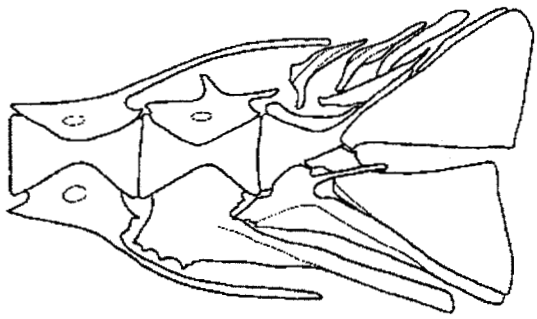
A



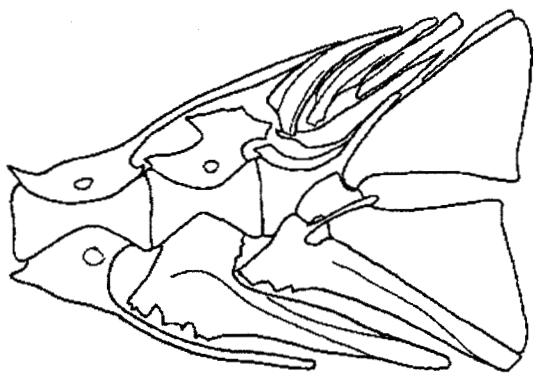
B



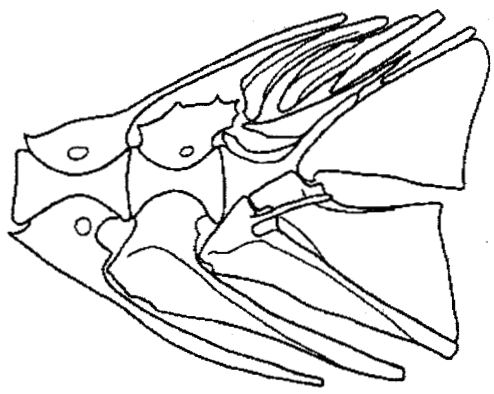
C



D

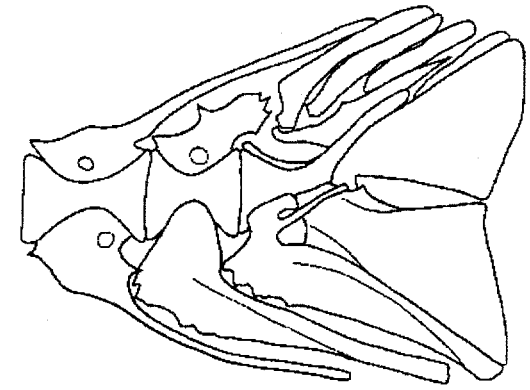


E

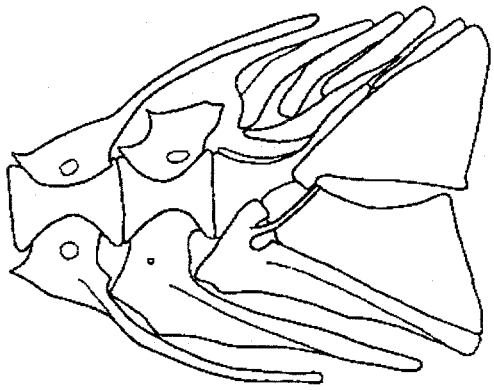


F

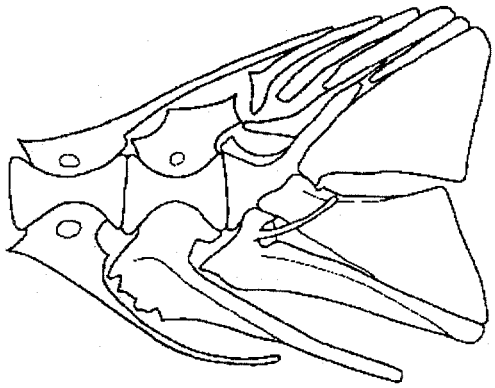
Figure 2. Caudal complex for each of the eleven species studied. A. Sebastes mystinus; B. Sebastes paucispinis; C. Sebastes goodei; D. Sebastes jordani; F. Sebastes hopkinsi; G. Sebastes saxicola.



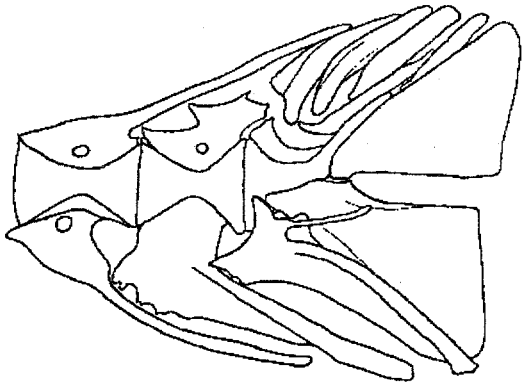
H



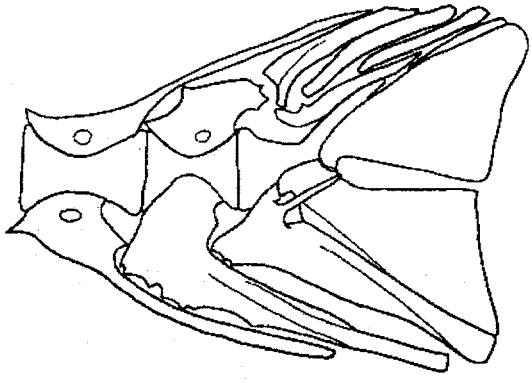
I



J



K



L

Figure 2 (cont). Caudal complex for each of the eleven species studied. H. Sebastes auriculatus. I. Sebastes wilsoni. J. Sebastes pinniger. K. Sebastes rufus. L. Sebastes flavidus.

(Fig 2). The hypural plates, urostyle, and the vertebra anterior to the preural centrum were similar for each species and were not useful for discriminating between species.

Parhypural

Differences were observed in the length of the spine and the number and shape of the projections on the anterior edge. Sebastes jordani and S. hopkinsi had the longest spines (extending into the gap between the hypural plates) (Fig. 1); S. saxicola, S. mystinus, S. flavidus, S. pinniger, and S. wilsoni had intermediate length spines that extended to the dorsal edge of the ventral hypural plate; and S. auriculatus, S. goodei, S. paucispinis, and S. rufus had small spines. Sebastes wilsoni, S. saxicola, S. pinniger, and S mystinus had few projections on the anterior edge (at most three), and the remaining species typically had greater than three anterior projections.

Haemal spine of preural centrum

Sebastes wilsoni, S. pinniger, S. auriculatus,and S. rufus had no projections on the posterior surface. The anteriormost edge was smooth in S. saxicola and S. wilsoni, with only a few projections (Table 1). Sebastes mystinus, S. rufus, S. goodei, S. jordani, S. paucispinis, S. pinniger, and S. hopkinsi had deep notches between the numerous projections.

Haemal spine of the vertebra anterior to the preural centrum

Sebastes goodei, S. rufus, and S. hopkinsi had no projections on the posterior surface. The remaining species had at least one projection on the posterior surface.

Table 1. Counts and measurement ratio for the preural centrum, parhypural, and the preural centrum haemal spine. AnHaPr=number of preural centrum haemal spine anterior projections, AnPa=number of parhypural anterior projections, Hy=dorsal hypural length, Pr=preural centrum length, PrWi=Preural centrum width.

	Range AnHaPr	Ave AnHaPr	Range AnPa	Ave AnPa	Ave Pr/PrWi	Ave Hy/Pr
S. auriculatus	2-3	2.5	3-4	3.4	1.2	1.60
S. flavidus	5-7	6.2	2-4	3.0	1.2	2.44
S. goodei	4-8	5.5	2-4	3.0	1.5	1.78
S. hopkinsi	3-7	4.7	2-4	3.2	1.5	1.86
S. jordani	4-6	4.0	2-4	3.0	1.5	1.81
S. mystinus	3-5	4.0	2-3	2.3	1.3	1.88
S. paucispinis	4-5	4.3	3-5	3.7	1.3	1.68
S. pinniger	3-4	3.7	2-3	2.3	1.4	1.91
S. rufus	3-5	4.0	3-4	3.2	1.3	1.58
S. saxicola	1-5	3.0	2-3	2.6	1.4	1.89
S. wilsoni	1-3	1.8	0-2	1.0	1.0	1.74

Preural Centrum Neural Arch

The dorsal surface of this bone appears flat, with one anteriodorsal projection in S. jordani. Sebastes pinniger and S. wilsoni had four projections. All other species had greater than four projections. The most anterior projection was rounded in S. paucispinis. This bone was very diverse and each species had an individually shaped bone, but these differences are subtle and not easily described.

Epurals

Epural 1 was very wide in S. goodei. It was thinner in the remaining species, but varied among these species. This variability does allow for further separation based on the size of epural 1.

Uroneural

The uroneural had projections on the anteriodorsal edge in S. flavidus, S. paucispinis, and S. auriculatus. The remaining species had no projection.

DISCUSSION

The caudal complexes of the 11 rockfish studied differ substantially, allowing investigators an opportunity to separate these species. Of all the bones examined, the neural arch of the preural centrum had a characteristic shape for each species (Fig. 2). The other bones also contained attributes useful in identifying species. These differences in the caudal complex are combined in a key (Appendix I). This key used only one possible set of characteristics, and many other traits could be substituted, instead of the ones used.

The use of the bones of the caudal complex add another dimension to the ever-increasing science of fish identification. Pigmentation and meristics are still the most reliable features for identification, but, in the past few years, the use of different methods has increased; Sanchez and Acha (1988) studied the bones of the caudal complex to distinguish between two rockfish species, Seeb and Kendall (1991) used electrophoresis to separate rockfish species, Silberberg (1991) use the cleithrum to distinquish rockfish species, and Laidig and Ralston (1991)[2] found that otoliths contained plenty of information to differentiate rockfish species.

We studied only 11 out of the 69 species of rockfish occurring on the Pacific coast of North America (Anderson 1983). Because the caudal complexes are not described for the other 58 species, positive identifications of the examined species cannot be generated by examination of the caudal complex alone. The use of these bones for identifications can be used to separate species when analyses are augmented with partial pigmentation and meristic data.

ACKNOWLEDGEMENTS

We would like to thank the crews of the four sport fishing boats (Salty Lady, New Rayann, Ginnie C II, and Flying Fish) who took the time to collect the salmon stomachs for this study. We would also like to thank the crew and the scientific personnel that collected samples for us aboard the David Starr Jordan.

CITATIONS

Anderson, T. W.

1983 Identification and development of nearshore juvenile rockfishes (genus Sebastes) in central California kelp forests. M. A. thesis, California State Univ., Fresno, California, 216 p.

Kendall, A. W., Jr.

1991 Systematics and identification of larvae and juveniles of the genus Sebastes. Environ. Biol. Fishes 30:173-190.

Laroche, W. A., and S. L. Richardson

1980 Development and occurrence of larvae and juveniles of the rockfishes Sebastes flavidus and Sebastes melanops (Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:901-923.

1981 Development and occurrence of larvae and juveniles of the rockfishes Sebastes entomelas and S. zacentrus (family Scorpaenidae) and occurrence off Oregon, with notes on head spines of S. mystinus, S. flavidus, and S. melanops. Fish. Bull., U. S. 79:231-258.

Litvinenko, N. N.

1974 Coloration and other morphological characters distinguishing juvenile Sebastes fasciatus from juvenile Sebastes menitella (Scorpaenidae). J. Ichthyol. 14:591-595.

McKern, J. L., H. F. Horton, and K. V. Koski

1974 Development of steelhead trout (Salmo gairdneri) otoliths and their use for age analysis and for separating summer from winter races and wild from hatchery stocks. J. Fish. Res. Baord Can. 31:1420-1426.

Messieh, S. N.

1972 Use of otoliths in identifying herring stocks in the southern Gulf of St. Lawrence and adjacent waters. J. Fish. Res. Board Can. 29:1113-1118.

Neilson, J. D., G. H. Geen, and B. Chan

1985 Variability in dimensions of salmonid otolith nuclei: Implications for stock identification and microstructure interpretation. Fish. Bull., U. S. 83:81-89.

Postuma, K. H.

1974 The nucleus of the herring otolith as a racial character. J. Cons. Int. Explor. Mer 35:121-129.

Rybachuk, V. K.

1974 Identification of the species of the genus Sebastes from a bone found by A. Ya. Taranets in middens of the Ilou tribe. J. Ichthyol. 14:798-799.

Rybock, J. T., H. F. Horton, and J. L. Fessler

1975 Use of otoliths to separate juvenile steelhead trout from juvenile rainbow trout. Fish. Bull., U. S. 73:654-659.

Sanchez, R. P., and E. M. Acha

1988 Development and occurrence of embryos, larvae and juveniles of Sebastes oculatus with reference to two southwest Atlantic Scorpaenids: Heliocolenus dactylopterus lahihhei and Pontinus rathbuni. Meeresforsch 32:107-133.

Seeb, L. W., and A. W. Kendall, Jr.

1991 Allozyme polymorphism permit the identification of larval and juvenile rockfishes of the genus Sebastes. Environ. Biol. Fishes 30:191-201.

Silberberg, K. R.

1991 Identification of juvenile rockfish (genus Sebastes) using the cleithrum. In Laidig, T. E., and P. B. Adams (eds.), Methods used to identify pelagic juvenile and larval rockfish (genus Sebastes) occurring along the coast of central California. U. S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC. In Press. p. 19-30.

Wyllie Echeverria, T., W. H. Lenarz, and C. Reilly

1990. Survey of the abundances and distribution of pelagic young-of-the-year rockfishes, Sebastes, off central California. U. S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-147, 125 p.

Appendix I ---- Key to the Caudal Complex

1a The parhypural spine extends into the gap between the hypural plates 2
1b The parhypural spine does not extend into the gap between the hypural plates 3

2a The preural centrum neural arch has two major projections, one pointing dorsally and one pointing posteriorly; the dorsal surface of the neural arch appears flat ..... Sebastes jordani
2b The preural centrum neural arch has no major spines or if one, it points anteriorly; the dorsal surface does not appear flat. ..... Sebastes hopkinsi

3a The anteriormost edge of the preural centrum haemal spine has two or less anterior projections 4
3b The anteriormost edge of the preural centrum haemal spine has six or more anterior projections 6
3c The anteriormost edge of the preural centrum haemal spine has more than two and less than six anterior projections 7

4a Sharp anterior projections on the parhypural; not less than 3 of these anterior projections; parhypural spine does not extend to dorsal edge of the ventral hypural plates .... Sebastes auriculatus
4b No sharp anterior projections on the parhypural; often less than 3 of these anterior projections; parhypural spine extends to dorsal edge of ventral hypural plate 5

5a The length of the preural centrum is approximately equal to the width of the anterior end of the preural centrum .... Sebastes wilsoni
5b The length of the preural centrum is larger than the width of the anterior end of the preural centrum .... Sebastes saxicola

6a The ratio of the dorsal hypural to the preural centrum is greater than 2:1 ..... Sebastes flavidus
6b The ratio of the dorsal hypural to the preural centrum is 2:1 or less 2

7a The posterior edge of the haemal spine of the vertebra anterior to the preural centrum has no sharp projections ... 8
7b The posterior edge of the haemal spine of the vertebra anterior to the preural centrum has sharp projections 10

8a The parhypural spine extends into the gap between the hypural plates ..... Sebastes hopkinsi
8b The parhypural spine does not extend into the gap between the hypural plates 9

9a Bumps along the anterioventral edge of the parhypural; epural 1 very wide ..... Sebastes goodei
9b Anterioventral edge of the parhypural smooth; epural 1 width of medium length ..... Sebastes rufus

10a No sharp anterior projections on the parhypural; often less than three of these anterior projections; parhypural spine extends to dorsal edge of ventral hypural plate 11
10b Sharp anterior projections on the parhypural; not less than 3 of these anterior projections; parhypural spine does not extend to dorsal edge of the ventral hypural plates 13

11a Neural arch of preural centrum with one posteriorly pointing projection; four total projections occurring on the preural centrum neural arch; ventral edge of uroneural smooth 12
11b Neural arch of preural centrum with more than one posteriorly pointing projection; greater than four total projections occurring on the preural centrum neural arch; ventral edge of uroneural with bumps ..... Sebastes saxicola

12a The anterior edge of the haemal spine of the preural centrum with deep notches between sharp projections .... Sebastes pinniger
12b The anterior edge of the haemal spine of the preural centrum without deep notches or sharp projections .. Sebastes wilsoni

13a The preural centrum neural arch has two major spines, one pointing dorsally and one pointing posteriorly; the dorsal surface of the neural arch appears flat .... Sebastes jordani
13b The preural centrum neural arch not as above 14

14a The anterior edge of preural centrum neural arch rounded; parhypural spine short ..... Sebastes paucispinis
14b The anterior edge of preural centrum neural arch pointed; parhypural spine long 15

15a Anterior/ventral edge of uroneural with projections; anterior edge of the preural centrum haemal spine without deep notches 16
15b Anterior/ventral edge of uroneural without projections; anterior edge of the preural centrum haemal spine with deep notches .....Sebastes mystinus

16a Ratio of the lengths of the dorsal hypural to the preural centrum is greater than two; ventral end of epural 2 thin; urostyle sometimes without dorsal projection; anterior end of parhypural develops into a sharp point .... Sebastes flavidus
16b Ratio of the lengths of the dorsal hypural to the preural centrum is less than two; ventral end of epural 2 thick; urostyle always has dorsal projection; the anterior end of the parhypural is not sharp and has a more gradual slope than above ..... Sebastes auriculatus

A Computerized "Expert System" to Aid in the Identification of Juvenile Rockfish (Genus Sebastes)

By

Peter B. Adams and Wayne M. Samiere[1]

ABSTRACT

Identification of pelagic juvenile rockfish (genus Sebastes) is difficult because of the large number of species in the genus and their differences from adults. Identification of juveniles from stomach contents is even more difficult because digestion often eliminates key characters. Under these conditions, we need an identification tool that is completely flexible, that would allow us to use whatever identification characteristics are available, and that would return a list of the possible species. The result of our efforts is the "expert system" JUVROCK which is based on meristics (gill raker counts, dorsal, pectoral, and anal fin ray counts) and the presence or absence of the supraocular spine. The system is described in detail, along with several examples of its use.

[1] Present Address: 21 Vernon St., San Francisco, CA 94132

INTRODUCTION

The identification of juvenile rockfish (genus Sebastes) is extremely difficult because of the large number of species in the genus. Rockfishes number at least 62 species in northeastern Pacific waters and over 100 species worldwide (Eschmeyer et al. 1983). To further complicate identification of specimens, the major taxonomic works (Phillips 1957, Miller and Lea 1972, Hart 1973, Eschmeyer et al. 1983, and Chen 1986) all deal with adult fishes and are not appropriate for pelagic juveniles which have dramatically different color patterns (Anderson 1983). It was only recently that Richardson and Laroche (1979), Laroche and Richardson (1980, 1981), Anderson (1983), and Matarese et al. (1989) published information for pelagic juvenile rockfishes.

When working with specimens from stomach contents, the problems of identifying juvenile rockfish are compounded by digestion. Color pattern, often the key identification factor (Anderson 1983), is almost always missing. Frequently meristics - dorsal, pectoral, or anal fin rays or head spines - are also missing. Fortunately, gill rakers are the most descriptive meristic, and the last to be lost to digestion. Identification techniques used under these conditions must be as flexible as possible, since the combination of meristic data available changes with each specimen. For this reason, dichotomous keys are too restrictive.

What is needed is a flexible tool that allows the identification of juvenile rockfish based on meristics. Computer programs of this type are called "expert systems" (Townsend 1986). It would have to be able to accept whatever combination of meristics that is available and return a list of possible species, ideally with some measure of probability as to which is the most likely. Another desired aspect of an identification tool would be that, once the identification is narrowed down to a group of two or more species, the system could be queried as to the best meristic that would further identify the specimen. One characteristic of computerized keys is that they are much easier to update as new information becomes available. The result of efforts to develop such an identification tool is the "expert system" that we use at the Tiburon Laboratory to identify juvenile rockfish from predator stomach contents.

SOURCES OF DATA

The "expert system" described here is a way of combining and displaying meristic data. The meristics used here are gill raker counts, dorsal, pectoral, and anal fin ray counts, and presence or absence of a supraocular spine. The 45 rockfish species for which we were able to obtain this meristic data and which are included in the key are listed in Appendix I.

Gill raker counts are the meristic which has the greatest ability to discriminate between species or groups of species. Gill raker counts were taken primarily from the same data used by

Moreland and Reilly (1991), but were augmented by data from counts on trawl-caught juveniles and from Chen (1986). Dorsal, pectoral, and anal fin ray counts, and presence or absence of a supraocular spine were taken either from the same data used by Moreland and Reilly (1991) or Chen (1986).

PROGRAM DESCRIPTION AND EXAMPLES

The "expert system" JUVROCK is written in the computer language PROLOG. PROLOG is a highly flexible language that allows the user to query the basic data in many different ways. The program is made up of a number of statements called predicates, one for each meristic type. We will deal with the statement for gill rakers as an example, which has the form

gillraker(count,species,probability),

where count = the number of gill rakers, species = the rockfish species associated with that count, and probability = the probability that an individual with that gill raker count is this particular species. For example, the first gill raker statement is

gillraker(34,alutus,0.60),

which means that for gill raker count of 34, there is 0.60 percent probability that the species is S. alutus. For a rockfish with 34 gill rakers, there are a total of 20 possible solutions (species); the most likely is S. diploproa with a probability of 16.36 percent, closely followed by S. brevispinis

with a probability of 15.46 percent. The meristic data for dorsal, pectoral and anal fin rays have similar statements:

dorsal(count,species,probability),

pectoral(count,species,probability),

anal(count,species,probability),

where the variables have the same meaning as above. The statement for presence and absence of the supraocular spine is

supraoc(occur,species),

where occur = either present or absent, and species = species associated with the presence or absence of the supraocular spine.

The program is queried by entering one or a combination of these statements within the Dialog window. The statements are typed at the prompt Goal: with numbers (meristics) or lowercase words (species) in place of variables that are known and uppercase words in place of variables that are unknown. After the "Enter" key is pressed, the program returns a list of possible species along with probabilities of how commonly that species has this meristic. The system can then be queried further in this way by adding more meristic categories or by inquiring about differences that would separate the most likely species.

The easiest way to understand the use of the program is through example. If a specimen has a gill raker

Dialog

Goal:
gillraker(47,Species,Prob)
Species=jordani, Prob=100
1 Solution
Goal:

Figure 1. First example.

count of 47 (Fig. 1), at the prompt Goal:, type in the gillraker query with a count of 47, an uppercase variable name for the species (Species) and an upper case variable name for the probability (Prob). The program will match the input data and return all possible solutions. In this case, there is only one possible solution, S. jordani, and the probability is 100 percent. A more complicated example (Fig. 2) starts with a query for a gill raker count of 35. This returns 16 possible solutions, of which S. rufus, S. zacentrus, S. mystinus, S. brevispinis, S. serranoides, and S. diploproa are the most likely. A count of 10 anal fin rays in addition to the gill raker count returns only 2 solutions, S. mystinus and S.

Dialog

```
Goal: gillraker(35,Species,Prob)
Species=alutus, Prob=8.02
Species=atrovirens, Prob=0.99
Species=brevispinis, Prob=9.66
Species=chlorostictus, Prob=1.78
Species=crameri, Prob=0.24
Species=diploproa, Prob=8.88
Species=entomelas, Prob=7.09
Species=flavidus, Prob=3.72
Species=goodei, Prob=4.19
Species=macdonaldi, Prob=0.40
Species=melanops, Prob=2.58
Species=mystinus, Prob=10.87
Species=rufus, Prob=15.04
Species=saxicola, Prob=2.65
Species=serranoides, Prob=9.65
Species=zacentrus, Prob=14.26
16 Solutions
Goal: gillraker(35,Species,Prob)
and anal(10,Species,Prob2)
Species=mystinus, Prob=10.87,
Prob2=16.67
Species=serranoides, Prob=9.65,
Prob2=5.56
2 Solutions
Goal: supraoc(Occur,mystinus)
Occur=present
1 Solution
Goal: supraoc(Occur,serranoides)
Occur=absent
1 Solution
Goal: gillraker(35,Species,Prob)
and anal(10,Species,Prob2) and
supraoc(present,Species)
Species=mystinus Prob=10.87,
Prob2=16.67
1 Solution
Goal:
```

Figure 2. Second example.

serranoides. Then, how useful the presence or absence of the supraocular spine would be in distinguishing between these species can be investigated by typing in the supraoc query with the two species names, and, in fact, the presence or absence would distinguish between the two species. Finally, a combination query of gill raker count, anal fin ray count, and presence of the supraocular spine returns only one solution, S. mystinus. Often it will not be possible to identify the specimen to a single species, but even narrowing down the possibility to several species may allow identification when other information such as geographical or depth range, reproductive seasonality, and identification of other specimens within the same collection are used.

We have improved the identification of juvenile rockfish from 63% to over 95%, and the use of this "expert system" has been a major reason. Even the specimens not identified to species are identified to a limited group of species. Documentation and a copy of the program are available from the senior author.

CITATIONS

Anderson, T. W.

1983 Identification and development of nearshore juvenile rockfishes (genus Sebastes) in central California kelp forests. M. A. thesis, California State Univ., Fresno, California, 216 p.

Chen, L.

1986 Meristic variation in Sebastes (Scorpaenidae), with an analysis of character association and bilateral pattern and their significance in species separation. U. S. Dep. Commer., NOAA Tech. Rep. NMFS-45, 25 p.

Eschmeyer, W. N., E. S. Herald and H. Hammann

1983 A field guide to Pacific coast fishes of North America from the Gulf of Alaska to Baja California. Houghton Mifflin Co. Boston, 336 p.

Hart, J. L.

1973 Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180, 740 p.

Laroche, W. A., and S. L. Richardson

1980 Development and occurrence of larvae and juveniles of the rockfishes Sebastes flavidus and Sebastes melanops (Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:901-924.

Laroche, W. A., and S. L. Richardson

1981 Development of larvae and juveniles of the rockfishes Sebastes entomelas and S. zacentrus (Family Scorpaenidae) and occurrence off Oregon, with notes on head spines of S. mystinus, S. flavidus, and S. melanops. Fish. Bull., U. S. 79:231-258.

Matarese, A. C., A. W. Kendall, Jr., D. M. Blood, and D. M. Vinter

1989 Laboratory guide to early life history stages of northeast Pacific fishes. U. S. Dep. Commer., NOAA Tech. Rep. NMFS-80, 652 p.

Miller, D. J., and R. N. Lea

1972 Guide to the coastal marine fishes of California. Calif. Dep. Fish Game Fish Bull. 157, 235 p.

Moreland, S. L., and C. A. Reilly

1991 Key to the juvenile rockfishes of central California. In Laidig, T. E., and P. B. Adams. (eds.), Methods used to identify pelagic juvenile rockfish (Genus Sebastes) occurring along the coast of central California. U. S. Dep. Commer., NOAA Tech. Memo., NMFS. In Prep.

Phillips, J. B.

1957 A review of the rockfishes of California (Family Scorpaenidae). Calif. Dep. Fish Game Fish Bull. 104, 158 p.

Richardson, S. L., and W. A. Laroche

1979 Development and occurrence of larvae and juveniles of the rockfishes Sebastes crameri, Sebastes pinniger, and Sebastes helvomaculatus (Family Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:1-46.

Townsend, C.

1986 Mastering expert systems with Turbo Prolog. Howard Sams & Co., Indianapolis, Indiana, 257 p.

Appendix I. A list of the species of juvenile rockfish (genus Sebastes) included in the computerized "expert system" JUVROCK.

Sebastes alutus
S. atrovirens
S. auriculatus
S. aurora
S. babcocki
S. brevispinis
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. crameri
S. diploproa
S. elongatus
S. entomelas
S. flavidus
S. goodei
S. helvomaculatus
S. hopkinsi
S. jordani
S. levis
S. macdonaldi
S. maliger
S. melanops
S. melanostomus
S. miniatus
S. mystinus
S. nebulosus
S. nigrocinctus
S. ovalis
S. paucispinis
S. pinniger
S. proriger
S. rastrelliger
S. rosaceus
S. rosenblatti
S. ruberrimus
S. rubrivinctus
S. rufus
S. saxicola
S. semicinctus
S. serranoides
S. serriceps
S. wilsoni
S. zacentrus

ADDENDUM TO "METHODS USED TO IDENTIFY PELAGIC JUVENILE ROCKFISH (GENUS SEBASTES) OCCURRING ALONG THE COAST OF CENTRAL CALIFORNIA"

Identification of the Black Dorsal Spot Group

K. Sakuma (Tiburon Laboratory, pers. comm.) has recently examined the morphometric data and pigmentation of the black dorsal spot group of pelagic juvenile rockfish (widow, S. entomelas; yellowtail, S. flavidus; black, S. melanops; and blue rockfish, S. mystinus) to improve identification. These results indicate that blue and widow rockfish are easily identified, but identification between black and yellowtail rockfish is difficult because of overlap of the two species' meristics. Large (>35 mm) black and yellowtail rockfish are correctly identified with a high degree of confidence, because black rockfish have a slight greenish tinge and more uniform coloration. Both black and yellowtail rockfish typically have 8 anal fin rays (Table 1 and 2), rather than black rockfish having 9 and yellowtail rockfish having 8 anal rays as reported by Moreland and Reilly in this volume. Weakly developed preocular spines are found on all four species of juvenile rockfish (Table 3), rather than on just blue and widow rockfish. It appears that head spine development continues through the pelagic juvenile stage at least until settlement. Finally, widow rockfish is the only species of the four that does not develop a distinct dorsal spot, and black and yellowtail rockfish have melanophores at the articulation of the anal fin (Table 4).

Table 1. Meristic counts for the black dorsal spot group (numbers represent number of individuals)

Species	Dorsal Rays					Anal Rays			Pectoral Rays		
	14	15	16	17	18	7	8	9	17	18	19
S. entomelas	22	207	6			8	227		5	228	2
S. flavidus	83	120	1			24	180		30	174	
S. melanops	14	27	4			5	39	1		1	44
S. mystinus		1	19	1	1			22	1	21	

Table 2. Meristic counts for the black dorsal spot group (numbers represent percentages)

Species	Dorsal Rays					Anal Rays			Pectoral Rays		
	14	15	16	17	18	7	8	9	17	18	19
S. entomelas	9	88	3			3	97		2	97	1
S. flavidus	40	59	1			12	88		15	85	
S. melanops	31	60	9			11	87	2		2	98
S. mystinus		5	86	5	4			100	5	95	

Table 3. Occurrence of preocular spines in the black dorsal spot group (1=weakly developed, 2=strongly developed, small individuals were ≤ 35 mm SL, large individuals were > 35 mm SL).

Species	size	Number of individuals 1	2	Percentage 1	2
S. entomelas	small	87	9	91	9
	large		139		100
S. flavidus	small	73		100	
	large	131		100	
S. melanops	small	17		100	
	large	28		100	
S. mystinus	small	4	2	67	33
	large		16		100

Table 4. Occurrence of anal fin ray articulation pigment in the black dorsal spot group (0=absent, 1=present on 3 or less rays, 2=present on 4 or more rays, small individuals were ≤ 35 mm SL, large individuals were > 35 mm SL)

Species	size	Number of individuals 0	1	2	Percentage 0	1	2
S. entomelas	small	96			100		
	large	128	1	10	92	1	7
S. flavidus	small			73			100
	large			131			100
S. melanops	small			17			100
	large			28			100
S. mystinus	small	4	2		67	33	
	large			16			100

Key to the Juvenile Rockfishes of Central California

By

Sharon L. Moreland[1] and Carol A. Reilly[2]

ABSTRACT

This key, based on meristic data, provides help in the identification of 42 species of pelagic juvenile rockfish (genus Sebastes) occurring along the central California coast. It is designed primarily to identify fish over 25 mm standard length, but is helpful in identifying certain species as small as 15 mm. Meristic data are drawn from adult fish and are supplemented with extensive descriptions of the juvenile rockfish obtained during 1983-1991 rockfish recruitment surveys. In addition to a description of each species, appendices are included with additional information about identification of difficult groups of species.

[1]Present address: U. S. Army Corps of Engineers, Regulatory Branch, 211 Main St., San Francisco, CA 94105

[2]Present address: 3818 Linwood Ave., Oakland, CA 94602

TABLE OF CONTENTS

Table of Contents	60
Introduction	61
How to Use This Key	62
Scope	62
Organization	62
Examination of Specimens	64
Fin Ray Key	68
11 Dorsal Rays	68
12 Dorsal Rays	73
13 Dorsal Rays	85
14 Dorsal Rays	105
15 Dorsal Rays	126
16 Dorsal Rays	142
17 Dorsal Rays	152
Citations	154
Appendix I. Description of Species	160
Appendix II. Black Dorsal Spot Group	178
Appendix III. *Sebastomus* Group	179
Appendix IV. AOR (*alutus*, *ovalis*, *rufus*)	180

INTRODUCTION

This key was designed to facilitate the accurate identification of juvenile rockfish that are commonly found off the central California coast. Identification of every specimen may not be possible because, for some species, no juvenile forms are known. Additionally, some species cannot be completely separated by meristics and head spine patterns. If juveniles of these species are not known to have any unique characteristics, they cannot be differentiated. The Sebastomus group is the classic example of such a group.

It is important to note that the meristic data used here to identify juveniles are drawn from adults. If the juvenile population is more variable than the adult, this will result in some fishes being misidentified.

HOW TO USE THIS KEY

Scope

This key was designed for use in identifying juvenile Sebastes off the central California coast. It includes the following species:

S. alutus
S. atrovirens
S. auriculatus
S. aurora
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. crameri
S. diploproa
S. elongatus
S. entomelas
S. eos
S. flavidus
S. goodei
S. helvomaculatus
S. hopkinsi
S. jordani
S. levis
S. maliger
S. melanops
S. melanostomus
S. miniatus
S. mystinus
S. nebulosus
S. nigrocinctus
S. ovalis
S. paucispinis
S. pinniger
S. proriger
S. rastrelliger
S. rosaceus
S. ruberrimus
S. rubrivinctus
S. rufus
S. saxicola
S. semicinctus
S. serranoides
S. wilsoni
S. zacentrus

Organization of the Key

This key is appropriate for identifying fish greater than 15 mm in standard length or whenever meristics and head spines are completely developed. Juvenile pigment patterns are usually not well established until fish are greater than 25 mm and therefore are of limited value in identifying fish smaller than this.

This key is organized by fin ray counts. Accurate counts should be made of the dorsal soft rays, the anal soft rays, and the pectoral rays and then turn to the appropriate section (D = dorsal ray count; A = anal ray count; P = pectoral ray count). After each section, there is a list of the species that "typically" exhibit that combination of meristic characters. Species are included in this list if that particular count of all three meristic characters (D, A, and P) is found in at least 15% of the adults of that species. This meristic data was obtained from available literature which is individually cited for each species in the Appendix I. If you have a group of fish that you believe are all one species, find the mode of each count (D, A, and P) and consider only the species listed as "typical" when using the key. There is also a section that lists species that "may" exhibit this particular combination of meristic characters in some individuals. Species are included here if at least two of the fin ray counts are found in more than 15% of the adults of that species. If you have one specimen or are unsure a group is composed of a single species, consider these species as well as the "typical" species when using the key. A third section on each page lists "unlikely" species. If your identification is seriously in doubt, use this section for further investigation.

Several appendices are provided which give additional information for differentiating the members of difficult groups. References to these appendices are made in the key. Appendix I

provides a brief description of the adults of each species and any available information of the juveniles.

Examination of Specimens

Specimens should be kept under water at all times (brief drying for lateral line pore counts excepted). A good quality dissecting microscope with substage lighting as well as overhead lighting is essential. Probes, forceps, and calipers are the only tools generally needed.

First, look for any distinctive pigment pattern or color. Some of the keys will list a fish as being "distinctive." If "distinctive," refer to the Appendix I and see the pigment pattern description under "Juvenile Characteristics". Another important trait to observe is a black spot on the posterior section of the spinous dorsal fin.

Fin ray numbers should be counted next. Substage lighting helps in obtaining accurate counts of the dorsal and anal fin soft rays. Care must be taken with the last element of both fins. This last element may be branched all the way to the base. It is counted as one element. Count the bases if possible. Pectoral ray counts present less of a problem, but it is possible to overlook a small first ray unless the count is carefully done. Count the pectoral rays on both sides. If the pectoral soft ray count is different on each side of your specimen, use both counts in the key; it should key to the same species.

Once these counts have been obtained, locate the appropriate page(s) in the key (i.e., D = dorsal soft ray count; A = anal soft ray count; P = pectoral soft ray count). Included also are groupings by just dorsal counts and dorsal and anal counts in the event that anal and/or pectoral fin ray counts cannot be accurately obtained. If more than one species have the same meristics, then ideas for their differentiation are included. In instances where there are sections entitled "Key for ...," these refer to the species listed in the two most likely species groups, but not to the "Possible But Unlikely" group.

To identify your specimen, you may also have to obtain gill raker and lateral line pore counts. It is sometimes easiest to remove the first gill arch on the right side for a gill raker count, but this may produce an error since one or two rakers may be left in the opercular cavity or be destroyed by the removal. To avoid this error, hold the operculum up with a finger or a pin and count the rakers in situ. Easier gill raker counts are possible with the introduction of a grain of Alizarin Red S stain into the gill cavity. Lateral line pore counts are made by thoroughly drying the fish and examining under the scope. If pores are not easily visible, apply black washable ink to the lateral line on the right side with a fine water-color brush; then the pores should be easier to count.

Some key instructions refer to head spines, interorbital space and anal fin spines. Head spine configuration of a juvenile Sebastes may differ from that of the adults. In all

species in which the juveniles are known, however, the supraocular and coronal spines have consistent patterns of development from juvenile to adult. Therefore, this key uses these two spines, even in instances where the juvenile form is unknown. If a coronal or supraocular spine appears only on one side, key as "spine present."

Juvenile interorbital spaces are similar to adults. Examine and grade as concave, convex, or flat. This character becomes easier to grade with practice.

The length of the second anal spine changes somewhat with growth. The general pattern is for the second spine to decrease in length relative to the third spine as specimen length increases. If the key indicates ">," it means significantly longer. This character also becomes easier to grade with practice.

Once a specimen is keyed to one or several species, use Appendix I to further clarify your identification. For example, the key may lead you to two or more species with overlapping meristics. The gill raker count of your specimen (or some other character) may eliminate one of the listed species.

Lastly, realize that you will not be able to identify every specimen. Atypical individuals will be found. Until juveniles of every species are completely described, a key of this type cannot differentiate all specimens.

ACKNOWLEDGEMENTS

Much of the work included here relies on work by others. Special thanks must be extended to Tina Wyllie Echeverria. Her extensive unpublished work on Sebastes meristics was the foundation for this effort. Even more basic, however, was her continual support and enthusiasm for this project.

FIN RAY KEY

D=11

There are no species in which the dorsal soft ray count is commonly 11.

Some individuals of several species occasionally show a count of 11:

- S. caurinus
- S. chlorostictus
- S. diploproa
- S. eos
- S. rosaceus
- S. saxicola

D=11 A=5

This combination of meristics is not typical for any species.

Possible but unlikely are:

- S. caurinus
- S. chlorostictus
- S. diploproa
- S. rosaceus
- S. saxicola

D=11 A=6

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

- S. caurinus
- S. chlorostictus
- S. diploproa
- S. eos
- S. rosaceus

Possible but unlikely is:

- S. saxicola

D=11 A=6 P=15

This combination of meristics is not typical for any species.

Possible but unlikely is:

- S. saxicola

D=11 A=6 P=16

This combination of meristics is not typical of any species.

Some individuals of two species may exhibit this combination of characters:

S. chlorostictus	S. rosaceus

These species are difficult to differentiate: see Appendix III.

Possible but unlikely are:

S. caurinus	S. eos
S. diploproa	S. saxicola

D=11 A=6 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. caurinus	S. eos
S. chlorostictus	S. rosaceus
S. diploproa	

To differentiate S. caurinus from members of the Sebastomus group, see Appendices I and III.

Possible but unlikely is:

S. saxicola

D=11 A=6 P=18

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. caurinus S. eos
S. diploproa

Sebastes diploproa is distinctive: see Appendix I. Sebastes eos has deeply concave interorbital space and the second anal spine is >> third and much thicker. Sebastes caurinus has flat to slightly concave interorbital space.

Possible but unlikely are:

S. chlorostictus S. saxicola
S. rosaceus

D=11 A=6 P=19

This is a very unlikely combination of meristics. If found consider:

S. diploproa

D=11 A=7

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. diploproa S. saxicola

Both of these species are distinctive: see Appendix I.

Possible but unlikely are:

S. caurinus S. eos
S. chlorostictus S. rosaceus

D=11 A=7 P=15

This is a very unlikely combination of meristics. If found, consider:

S. saxicola

D=11 A=7 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. saxicola

Possible but unlikely are:

S. caurinus
S. chlorostictus
S. diploproa
S. eos
S. rosaceus

D=11 A=7 P=17

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. diploproa
S. saxicola

Both of these species are distinctive: see Appendix I.

Possible but unlikely are:

S. caurinus
S. chlorostictus
S. eos
S. rosaceus

D=11 A=7 P=18

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. diploproa

Possible but unlikely are:

S. caurinus
S. chlorostictus
S. eos
S. rosaceus
S. saxicola

D=11 A=7 P=19

This is a very unlikely combination of meristics for any species. If found, consider:

S. diploproa

D=11 A=8

No species is likely to exhibit this combination of meristics. Possible but unlikely are:

S. diploproa S. saxicola

D=12

Several species typically exhibit a dorsal soft ray count of 12:

S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. eos
S. helvomaculatus
S. levis
S. rosaceus
S. saxicola

Some individuals of several species may exhibit a count of 12:

S. atrovirens
S. auriculatus
S. aurora
S. babcocki
S. chrysomelas
S. crameri
S. elongatus
S. maliger
S. melanostomus
S. rastrelliger
S. semicinctus

D=12 A=5

This combination of meristics is not typical of any species.

Individuals of several species may exhibit this combination of characters:

S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. helvomaculatus
S. rosaceus
S. saxicola

Possible but unlikely are:

S. aurora
S. crameri
S. elongatus

D=12 A=5 P=15

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. helvomaculatus
S. saxicola

D=12 A=5 P=16

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. chlorostictus
S. helvomaculatus
S. rosaceus
S. saxicola

Sebastes saxicola is distinctive: see Appendices I and III.

Possible but unlikely are:

S. aurora
S. caurinus
S. constellatus
S. elongatus

D= 12 A=5 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. helvomaculatus
S. rosaceus
S. saxicola

To differentiate these species, use Key for D=12 A=5 P=17.

Possible but unlikely are:

S. aurora
S. elongatus

KEY FOR D=12 A=5 P=17

1a Two species are distinctive.....S. diploproa
S. saxicola
1b Not as above.....2

2a Supraocular spine present.....3
2b Supraocular spine absent.....S. caurinus

3a Interorbital flat to slightly concave....S. caurinus
3b Interorbital deeply concave; 2nd anal spine >> 3rd.....S. chlorostictus
S. constellatus
S. helvomaculatus
S. rosaceus

D=12 A=5 P=18

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. caurinus
S. diploproa

Sebastes diploproa is distinctive: see Appendix I.

Possible but unlikely are:

S. aurora
S. chlorostictus
S. constellatus
S. crameri
S. elongatus
S. helvomaculatus
S. rosaceus
S. saxicola

D=12 A=5 P=19

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. crameri
S. diploproa

D=12 A=6

This combination of meristics is typical for several species:

S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. eos
S. helvomaculatus
S. levis
S. rosaceus

Some individuals of several other species may exhibit this combination of characters:

S. aurora
S. babcocki
S. chrysomelas
S. elongatus
S. maliger
S. rastrelliger
S. saxicola

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. crameri
S. melanostomus
S. semicinctus

D=12 A=6 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. helvomaculatus

Possible but unlikely are:

S. auriculatus
S. saxicola

D=12 A=6 P=16

This combination of meristics is typical for three species:

S. chlorostictus
S. helvomaculatus
S. rosaceus

Some individuals of several species may exhibit this combination of characters:

S. carnatus
S. caurinus
S. constellatus
S. elongatus
S. eos
S. saxicola

To differentiate these species, use Key for D=12 A=6 P=17.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. aurora
S. maliger
S. semicinctus

D=12 A=6 P=17

This combination of meristics is typical for several species:

S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. eos
S. helvomaculatus
S. levis
S. rosaceus

Some individuals of several species may exhibit this combination of characters:

S. aurora
S. chrysomelas
S. elongatus
S. maliger
S. saxicola

To differentiate these species, use Key for D=12 A=6 P=17.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. babcocki
S. semicinctus

KEY FOR D=12 A=6 P=17

1a Several species have distinctive pigment patterns: see Appendix I ..... S. babcocki, S. diploproa, S. elongatus, S. levis, S. saxicola

1b Not as above.....2

2a Supraocular spines present.....3

2b Supraocular spines absent; gill rakers 25-36.....S. carnatus, S. caurinus, S. chrysomelas, S. maliger

3a Lateral line pores > 33; second anal spine >> third.....S. chlorostictus, S. constellatus, S. eos, S. helvomaculatus, S. rosaceus

3b Lateral line pores < 33; second anal spine about = third.....S. aurora, S. caurinus

D=12 A=6 P=18

This combination of meristics is typical for several species:

S. caurinus
S. diploproa
S. eos
S. levis

Some individuals of several species may exhibit this combination of characters:

S. aurora
S. babcocki
S. carnatus
S. chlorostictus
S. constellatus
S. helvomaculatus
S. maliger
S. rosaceus

To differentiate these species, use Key for D=12 A=6 P=17.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. chrysomelas
S. crameri
S. elongatus
S. melanostomus
S. rastrelliger
S. saxicola
S. semicinctus

D=12 A=6 P=19

This combination of meristics is not typical for any species.

Some individuals of several species exhibit this combination of characters:

S. babcocki
S. diploproa
S. rastrelliger
S. levis

Sebastes babcocki, S. diploproa, and S. levis are distinctive: see Appendix I.

Possible but unlikely are:

S. auriculatus
S. crameri
S. levis
S. melanostomus

D=12 A=6 P=20

This is an unlikely combination of meristics for any species.

If found, consider:

S. babcocki
S. crameri
S. melanostomus
S. rastrelliger

D=12 A=7

This combination of meristics is typical for three species:

S. diploproa
S. levis
S. saxicola

Some individuals of several other species exhibit this combination of characters:

S. atrovirens
S. auriculatus
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. crameri
S. eos
S. helvomaculatus
S. maliger
S. melanostomus
S. rosaceus
S. semicinctus

Possible but unlikely are:

S. chrysomelas
S. wilsoni

D=12 A=7 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. saxicola

Possible but unlikely are:

S. auriculatus
S. helvomaculatus

D=12 A=7 P=16

This combination of meristics is typical of one species:

S. saxicola

Some individuals of three species may exhibit this combination of characters:

S. chlorostictus
S. helvomaculatus
S. rosaceus

Sebastes saxicola is distinctive: see Appendices I and III.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. carnatus
S. caurinus
S. constellatus
S. eos
S. maliger
S. semicinctus

D=12 A=7 P=17

This combination of meristics is typical for three species:

S. diploproa
S. levis
S. saxicola

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. eos
S. helvomaculatus
S. maliger
S. rosaceus
S. semicinctus

To differentiate these species, use Key for D=12 A=7 P=17.

Possible but unlikely are:

S. auriculatus
S. babcocki
S. chrysomelas

KEY FOR D=12 A=7 P=17

1a Several species have distinctive pigment patterns: see Appendix I.....*S. auriculatus*
S. babcocki
S. diploproa
S. levis
S. melanostomus
S. saxicola
S. semicinctus

1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....*S. atrovirens*
S. carnatus
S. caurinus
S. maliger

3a Second anal spine >> third; inter-orbital space deeply concave.....*S. chlorostictus*
S. constellatus
S. eos
S. helvomaculatus
S. rosaceus

3b Second anal spine about equal to third; orbital space flat to slightly concave...*S. caurinus*
S. maliger

D=12 A=7 P=18

This combination of meristics is typical for two species:

S. diploproa *S. levis*

Some individuals of other species may exhibit this combination of characters:

S. auriculatus
S. babcocki
S. caurinus
S. eos
S. helvomaculatus
S. saxicola

To differentiate these species, use Key for D=12 A=7 P=17.

Possible but unlikely are:

S. atrovirens
S. carnatus
S. chlorostictus
S. chrysomelas
S. constellatus
S. crameri
S. maliger
S. melanostomus
S. rosaceus
S. semicinctus

D=12 A=7 P=19

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. crameri
S. diploproa
S. levis
S. melanostomus

To differentiate these species, use the Key for D=12 A=7 P=17.

Possible but unlikely is:

S. auriculatus

D=12 A=7 P=20

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. crameri

Possible but unlikely are:

S. babcocki
S. melanostomus

D=12 A=8

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. diploproa
S. levis
S. saxicola

These species are distinctive: see Appendix I.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. babcocki
S. maliger
S. melanostomus
S. semicinctus

D=12 A=8 P=15

This combination of meristics is not typical of any species.

Possible but unlikely are:

S. auriculatus
S. saxicola

D=12 A=8 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. saxicola

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. maliger
S. semicinctus

D=12 A=8 P=17

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. diploproa
S. levis
S. saxicola

All of these species are distinctive: see Appendix I.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. babcocki
S. maliger
S. semicinctus

D=12 A=8 P=18

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. diploproa S. levis

Both of these species are distinctive: see Appendix I.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. babcocki
S. maliger
S. melanostomus
S. saxicola
S. semicinctus

D=12 A=8 P=19

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. auriculatus
S. babcocki
S. diploproa
S. levis
S. melanostomus

D=12 A=8 P=20

No species is likely to exhibit this combination of characters.

If found, consider:

S. babcocki S. melanostomus

D=13

Many species typically have a dorsal soft ray count of 13:

S. atrovirens
S. auriculatus
S. aurora
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. crameri
S. diploproa
S. elongatus
S. eos
S. helvomaculatus
S. levis
S. maliger
S. melanostomus
S. miniatus
S. nebulosus
S. rastrelliger
S. rosaceus
S. rubrivinctus
S. semicinctus
S. wilsoni

Other species exhibit this count less frequently:

S. goodei
S. hopkinsi
S. jordani
S. melanops
S. nigrocinctus
S. ovalis
S. paucispinis
S. pinniger
S. proriger
S. ruberrimus
S. saxicola
S. zacentrus

D=13 A=5

This combination of meristics is not typical of any species.

Some individuals of several species may exhibit this combination of characters:

S. aurora
S. caurinus
S. chlorostictus
S. constellatus
S. crameri
S. diploproa
S. elongatus
S. helvomaculatus
S. rosaceus
S. wilsoni

Possible but unlikely are:

S. ruberrimus
S. saxicola

D=13 A=5 P=15

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. helvomaculatus
S. saxicola

D=13 A=5 P=16

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. chlorostictus
S. elongatus
S. helvomaculatus
S. rosaceus

Sebastes elongatus is distinctive; see Appendices I and III.

Possible but unlikely are:

S. aurora
S. caurinus
S. constellatus
S. saxicola
S. wilsoni

D=13 A=5 P=17

This combination of meristics is not typical of any species.

Some individuals of several species may exhibit this combination of characters:

S. aurora
S. caurinus
S. chlorostictus
S. constellatus
S. diploproa
S. elongatus
S. helvomaculatus
S. rosaceus
S. wilsoni

To differentiate these species, use Key for D=13 A=5 P=17.

Possible but unlikely are:

S. ruberrimus
S. saxicola

KEY FOR D=13 A=5 P=17

1a Two species have distinctive spines and pigment patterns: see Appendix I.....S. diploproa
S. elongatus
1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....5

3a Lateral line pores <31.....S. aurora
3b Lateral line pores > 32.....4

4a Second anal spine >> third.....S. chlorostictus
S. constellatus
S. helvomaculatus
S. rosaceus
4b Second anal spine about = third.....S. caurinus

5a Gill rakers > 36; second anal spine > third.....S. wilsoni
5b Gill rakers < 33.....S. caurinus

D=13 A=5 P=18

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. aurora
S. caurinus
S. diploproa

Sebastes diploproa is distinctive: see Appendix I. Sebastes aurora has gill rakers 26-30, lateral line pores < 31. Sebastes caurinus has gill rakers 26-32, lateral line pores 37-45.

Possible but unlikely are:

S. chlorostictus
S. constellatus
S. crameri
S. elongatus
S. helvomaculatus
S. rosaceus
S. ruberrimus
S. saxicola
S. wilsoni

D=13 A=5 P=19

This combination of meristics is typical for one species:

S. crameri

Possible but unlikely are:

S. diploproa
S. ruberrimus

D=13 A=5 P=20

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. crameri

Possible but unlikely is:

S. ruberrimus

D=13 A=6

This combination of meristics is typical of several species:

S. aurora
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. diploproa
S. elongatus
S. eos
S. helvomaculatus
S. levis
S. maliger
S. nebulosus
S. rastrelliger
S. rosaceus
S. wilsoni

Some individuals of several other species may exhibit this combination of characters:

S. atrovirens
S. auriculatus
S. crameri
S. melanostomus
S. rubrivinctus
S. semicinctus
S. zacentrus

Possible but unlikely are:

S. hopkinsi
S. proriger
S. ruberrimus
S. saxicola

D=13 A=6 P=15

This combination of meristics is not typical of any species.

Some individuals of one species may exhibit this combination of characters:

S. helvomaculatus

Possible but unlikely are:

S. auriculatus
S. saxicola

D=13 A=6 P=16

This combination of meristics is typical for several species:

S. chlorostictus
S. elongatus
S. helvomaculatus
S. rosaceus

Some individuals of several species may exhibit this combination of characters:

S. aurora
S. carnatus
S. caurinus
S. constellatus
S. eos
S. maliger
S. wilsoni

To differentiate these species, use the Key for D=13 A=6 P=17.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. hopkinsi
S. miniatus
S. pinniger
S. proriger
S. rubrivinctus
S. saxicola
S. semicinctus
S. zacentrus

D=13 A=6 P=17

This combination of meristics is typical for several species:

S. aurora
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. diploproa
S. elongatus
S. eos
S. helvomaculatus
S. levis
S. maliger
S. nebulosus
S. rosaceus
S. wilsoni

Some individuals of several other species may exhibit this combination of characters:

S. atrovirens
S. babcocki
S. miniatus
S. rubrivinctus
S. semicinctus
S. zacentrus

To differentiate these species, use Key for D=13 A=6 P=17.

Possible but unlikely are:

S. auriculatus
S. hopkinsi
S. proriger
S. ruberrimus
S. saxicola

KEY FOR D=13 A=6 P=17

1a	Several species have distinctive pigment and spine patterns: see Appendix I.....	S. auriculatus S. babcocki S. crameri S. diploproa S. elongatus S. levis S. miniatus S. rubrivinctus S. semicinctus
1b	Not as above.....	2
2a	Supraocular spines present.....	3
2b	Supraocular spines absent.....	5
3a	Interorbital space quite concave; second anal spine >> third.....	S. chlorostictus S. constellatus S. eos S. helvomaculatus S. rosaceus
3b	Interorbital space flat to slightly concave.....	4
4a	Lateral line pores < 31; gill rakers 24-30.....	S. aurora
4b	Lateral line pores > 34; gill rakers 25-35.....	S. caurinus S. crameri S. maliger S. nebulosus
5a	Gill rakers > 36.....	S. wilsoni
5b	Gill rakers < 35.....	6
6a	Gill rakers 22-25; lateral line pores 42-47.....	S. rastrelliger
6b	Not as above.....	S. atrovirens S. carnatus S. caurinus S. chrysomelas S. maliger S. nebulosus S. zacentrus

D=13 A=6 P=18

This combination of meristics is typical for several species:

S. aurora
S. babcocki
S. caurinus
S. diploproa
S. eos
S. levis
S. maliger
S. nebulosus

Some individuals of several species may exhibit this combination of characters:

S. auriculatus
S. carnatus
S. chlorostictus
S. chrysomelas
S. constellatus
S. elongatus
S. helvomaculatus
S. miniatus
S. rastrelliger
S. rosaceus
S. wilsoni

To differentiate these species, use Key for D=13 A=6 P=17.

Possible but unlikely are:

S. atrovirens
S. crameri
S. hopkinsi
S. melanostomus
S. proriger
S. ruberrimus
S. rubrivinctus
S. saxicola
S. semicinctus
S. zacentrus

D=13 A=6 P=19

This combination of meristics is typical for two species:

S. babcocki
S. rastrelliger

Some individuals of several species may exhibit this combination of characters:

S. crameri
S. diploproa
S. levis
S. melanostomus
S. nebulosus

To differentiate these species, use Key for D=13 A=6 P=17, considering only these species.

Possible but unlikely is:

S. auriculatus
S. ruberrimus

D=13 A=6 P=20

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. crameri
S. rastrelliger

Sebastes babcocki is distinctive; Sebastes crameri is distinctive when > 50 mm (see Appendix I) and has gill rakers > 27. Sebastes rastrelliger has gill rakers < 27.

Possible but unlikely are:

S. ruberrimus
S. melanostomus

D=13 A=7

This combination of meristics is typical for several species:

S. atrovirens
S. auriculatus
S. babcocki
S. crameri
S. diploproa
S. levis
S. maliger
S. melanostomus
S. miniatus
S. nebulosus
S. rubrivinctus
S. semicinctus
S. zacentrus

Some individuals of several species may exhibit this combination of characters:

S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. eos
S. helvomaculatus
S. hopkinsi
S. nigrocinctus
S. pinniger
S. proriger
S. rosaceus
S. ruberrimus
S. saxicola
S. wilsoni

Possible but unlikely are:

S. goodei
S. melanops
S. ovalis

D=13 A=7 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. auriculatus

Possible but unlikely are:

S. helvomaculatus
S. saxicola

D=13 A=7 P=16

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. auriculatus
S. chlorostictus
S. helvomaculatus
S. maliger
S. miniatus
S. rosaceus
S. rubrivinctus
S. saxicola
S. semicinctus
S. zacentrus

To differentiate these species, use Key for D=13 A=7 P=17.

Possible but unlikely are:

S. carnatus
S. caurinus
S. constellatus
S. elongatus
S. eos
S. goodei
S. hopkinsi
S. pinniger
S. proriger
S. wilsoni

D=13 A=7 P=17

This combination of meristics is typical for several species:

S. atrovirens
S. diploproa
S. levis
S. maliger
S. miniatus
S. nebulosus
S. rubrivinctus
S. semicinctus
S. zacentrus

Some individuals of several species may exhibit this combination of characters:

S. auriculatus
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. eos
S. helvomaculatus
S. hopkinsi
S. levis
S. pinniger
S. proriger
S. rosaceus
S. saxicola
S. wilsoni

To differentiate these species, use Key for D=13 A=7 P=17.

Possible but unlikely are:

S. goodei
S. ovalis
S. ruberrimus

KEY FOR D=13 A=7 P=17

1a Several species have distinctive pigment and spine patterns: see Appendix I.....*S. auriculatus*
S. babcocki
S. crameri
S. diploproa
S. elongatus
S. goodei
S. levis
S. melanostomus
S. miniatus
S. pinniger
S. ruberrimus
S. rubrivinctus
S. saxicola
S. semicinctus

1b Not as above.....3

2a Supraocular spines present.....3
2b Supraocular spines absent.....6

3a Interorbital space quite concave, second anal spine >> third.....*S. chlorostictus*
S. constellatus
S. eos
S. helvomaculatus
S. rosaceus

3b Interorbital space flat to somewhat concave, second anal spine > or = to third..4

4a Gill rakers < 35.....*S. caurinus*
S. crameri
S. maliger

4b Gill rakers > 34.....5

5a Gill rakers usually 35-40.....*S. hopkinsi*
5b Gill rakers usually 40-44.....*S. pinniger*

6a Gill rakers 36-43.....*S. proriger*
S. wilsoni

6b Gill rakers usually < 36.....7

7a Gill rakers 32-37; second anal spine > third, thicker.....*S. zacentrus*
7b Gill rakers 24-33.....*S. atrovirens*
S. carnatus
S. caurinus
S. chrysomelas
S. maliger
S. nebulosus

D=13 A=7 P=18

This combination of meristics is typical for several species:

S. auriculatus
S. babcocki
S. diploproa
S. levis
S. maliger
S. miniatus
S. nebulosus

Some individual of several species may exhibit this combination of characters:

S. atrovirens
S. caurinus
S. crameri
S. eos
S. melanostomus
S. ruberrimus
S. rubrivinctus
S. semicinctus
S. zacentrus

To differentiate these species, see Key for D=13 A=7 P=17.

Possible but unlikely are:

S. carnatus
S. chlorostictus
S. chrysomelas
S. constellatus
S. goodei
S. helvomaculatus
S. hopkinsi
S. melanops
S. nigrocinctus
S. ovalis
S. pinniger
S. proriger
S. rosaceus
S. saxicola
S. wilsoni

D=13 A=7 P=19

This combination of meristics is typical for three species:

S. babcocki
S. crameri
S. melanostomus

Some individuals of several species may exhibit this combination of characters:

S. auriculatus
S. diploproa
S. levis
S. nebulosus
S. nigrocinctus
S. ruberrimus

All of these species except S. crameri and S. nebulosus are distinctive. Sebastes crameri usually has supraocular spines. Sebastes nebulosus usually does not. See Appendix I.

Possible but unlikely are:

S. melanops
S. ovalis
S. pinniger

D=13 A=7 P=20

This combination of meristics is typical for one species:

S. crameri

Some individuals of two species may exhibit this combination of characters:

S. babcocki
S. melanostomus

Sebastes babcocki and S. melanostomus are distinctive; Sebastes crameri is distinctive when > 30 mm: see Appendix I.

Possible but unlikely are:
S. melanops
S. ruberrimus
S. nigrocinctus

D=13 A=8

This combination of meristics is typical for one species:

S. miniatus

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. auriculatus
S. babcocki
S. diploproa
S. goodei
S. levis
S. maliger
S. melanops
S. melanostomus
S. nebulosus
S. ovalis
S. rubrivinctus
S. semicinctus
S. zacentrus

Possible but unlikely are:

S. hopkinsi
S. jordani
S. paucispinis
S. pinniger
S. ruberrimus
S. saxicola

D=13 A=8 P=15

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. auriculatus
S. paucispinis
S. saxicola

D=13 A=8 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. miniatus

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. goodei
S. hopkinsi
S. maliger
S. paucispinis
S. pinniger
S. rubrivinctus
S. saxicola
S. semicinctus
S. zacentrus

D=13 A=8 P=17

This combination of meristics is typical for one species:

S. miniatus

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. diploproa
S. goodei
S. levis
S. maliger
S. nebulosus
S. rubrivinctus
S. semicinctus
S. zacentrus

To differentiate these species use Key for D=13 A=8 P=17.

Possible but unlikely are:

S. auriculatus
S. babcocki
S. hopkinsi
S. ovalis
S. pinniger
S. ruberrimus
S. saxicola

KEY FOR D=13 A=8 P=17

1a Six species are distinctive: see Appendix I.....S. diploproa
S. goodei
S. levis
S. miniatus
S. rubrivinctus
S. semicinctus

1b Not as above.....2

2a Supraocular spines present.....S. nebulosus
2b Supraocular spines absent.....3

3a Second anal spine > third: 2x thick.....S. zacentrus
S. maliger

3b Second anal spine about = third.....S. atrovirens
S. nebulosus

D=13 A=8 P=18

This combination of meristics is typical for one species:

S. miniatus

Some individuals of several species may exhibit this combination of characters:

S. auriculatus
S. babcocki
S. diploproa
S. levis
S. maliger
S. melanops
S. nebulosus
S. ovalis

If specimen > 35 mm and has a black spot on its spinous dorsal fin, it is S. melanops. If it is not > 35 mm or lacks a black spot, use Key for D=13 A=8 P=18, but discount S. melanops.

Possible but unlikely are:

S. atrovirens
S. goodei
S. hopkinsi
S. jordani
S. melanostomus
S. pinniger
S. ruberrimus
S. rubrivinctus
S. saxicola
S. semicinctus
S. zacentrus

KEY FOR D=13 A=8 P=18

1a Several species have distinctive spines and pigment patterns: see Appendix I.....S. auriculatus
S. babcocki
S. diploproa
S. levis
S. miniatus

1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....S. maliger
S. nebulosus

3a Interorbital space slightly concave; gill rakers usually < 31.....S. nebulosus
3b Interorbital space flat to slightly convex; gill rakers usually > 30.....4

4a Lateral line pores 35-43.....S. maliger
4b Lateral line pores 45-55.....S. ovalis

D=13 A=8 P=19

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. babcocki
S. melanops
S. melanostomus

Sebastes babcocki and S. melanostomus are distinctive: see Appendix I.

Possible but unlikely are:

S. auriculatus
S. diploproa
S. jordani
S. levis
S. nebulosus
S. ovalis
S. pinniger
S. ruberrimus

D=13 A=8 P=20, 21

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. babcocki
S. jordani
S. melanops
S. melanostomus
S. ruberrimus

D=13 A=9

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. jordani
S. melanops
S. ovalis
S. paucispinis

Possible but unlikely are:

S. goodei
S. pinniger

D=13 A=9 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. paucispinis

D=13 A=9 P=16

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. goodei
S. paucispinis
S. pinniger

D=13 A=9 P=17

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. babcocki
S. goodei
S. ovalis
S. pinniger

D=13 A=9 P=18

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. babcocki
S. melanops
S. ovalis

Sebastes babcocki is distinctive: see Appendix I. Sebastes ovalis has gill rakers usually < 34, and usually has supraocular spines. Sebastes melanops has gill rakers usually > 33, and usually lacks supraocular spines.

Possible but unlikely are:

S. goodei
S. jordani
S. pinniger

D=13 A=9 P=19

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. babcocki
S. melanops

Sebastes babcocki is distinctive: see Appendix I.

Possible but unlikely are:

S. jordani
S. ovalis
S. pinniger

D=13 A=9 P=20, 21

These combinations of meristics is not typical for any species.

Some individuals of one species may exhibit these combinations of characters:

S. jordani

Possible but unlikely are:

S. babcocki
S. melanops

D=13 A=10

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. jordani

Possible but unlikely are:

S. melanops S. paucispinis

D=13 A=11

This combination of meristics is not typical for any species.

Possible but unlikely is:

S. jordani

D = 14

Several species typically have a dorsal soft ray count of 14:

S. alutus
S. atrovirens
S. babcocki
S. crameri
S. flavidus
S. goodei
S. helvomaculatus
S. hopkinsi
S. jordani
S. maliger
S. melanops
S. miniatus
S. nebulosus
S. nigrocinctus
S. ovalis
S. paucispinis
S. pinniger
S. proriger
S. ruberrimus
S. rubrivinctus
S. semicinctus
S. wilsoni
S. zacentrus

Some individuals of several species may exhibit a count of 14:

S. auriculatus
S. aurora
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. diploproa
S. elongatus
S. entomelas
S. levis
S. melanostomus
S. rastrelliger
S. rosaceus
S. rufus

D=14 A=5

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. constellatus
S. crameri
S. helvomaculatus
S. ruberrimus
S. wilsoni

To differentiate these species, use Key for D=14 A=5.

Possible but unlikely are:

S. aurora
S. caurinus
S. chlorostictus
S. diploproa
S. elongatus
S. rosaceus

KEY FOR D=14 A=5

1a Two species are distinctive: see Appendix I.....*S. crameri*
S. ruberrimus
1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines usually absent.....*S. wilsoni*

3a Second anal spine >> third, thicker; interorbital space deeply concave.....*S. constellatus*
S. helvomaculatus
3b Second anal spine = or slightly longer than third; interorbital space flat to convex.....*S. crameri*

D=14 A=6

This combination of meristics is typical for several species:

S. babcocki
S. constellatus
S. helvomaculatus
S. maliger
S. nebulosus
S. wilsoni

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. atrovirens
S. aurora
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. crameri
S. diploproa
S. elongatus
S. hopkinsi
S. levis
S. proriger
S. rastrelliger
S. rosaceus
S. ruberrimus
S. rubrivinctus
S. semicinctus
S. zacentrus

Possible but unlikely are:

S. auriculatus
S. melanostomus

D=14 A=6 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. helvomaculatus

Possible but unlikely is:

S. auriculatus

D=14 A=6 P=16

This combination of meristics is typical for one species:

S. helvomaculatus

Some individuals of several species may exhibit this combination of characters:

S. chlorostictus
S. constellatus
S. elongatus
S. maliger
S. rosaceus
S. wilsoni

To differentiate these species, use Key for D=14 A=6 P=16.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. aurora
S. carnatus
S. caurinus
S. hopkinsi
S. miniatus
S. proriger
S. rubrivinctus
S. semicinctus
S. zacentrus

KEY FOR D=14 A=6 P=16

1a One species is distinctive: see Appendix I.....*S. elongatus*
1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....4

3a Second anal spine >> third; interorbital space deeply concave.....*S. chlorostictus*, *S. constellatus*, *S. helvomaculatus*, *S. rosaceus*
3b Second anal spine = third; interorbital space flat to slightly concave.....*S. maliger*

4a Gill rakers 28-34.....*S. maliger*
4b Gill rakers 37-43.....*S. wilsoni*

D=14 A=6 P=17

This combination of meristics is typical for several species:

S. constellatus
S. helvomaculatus
S. maliger
S. nebulosus
S. wilsoni

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. aurora
S. babcocki
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. diploproa
S. elongatus
S. hopkinsi
S. levis
S. miniatus
S. proriger
S. rosaceus
S. rubrivinctus
S. semicinctus
S. zacentrus

To differentiate these species, see Key for D=14 A=6 P=17.

Possible but unlikely are:

S. alutus
S. auriculatus
S. ruberrimus

KEY FOR D=14 D=6 P=17

1a Several species have distinctive pigment patterns: see Appendix I.....*S. babcocki*
S. diploproa
S. elongatus
S. levis
S. miniatus
S. rubrivinctus
S. semicinctus

1b Not as above.....2

2a Supraocular spine present.....3
2b Supraocular spine absent.....6

3a Second anal spine > third, thicker; interorbital space deeply concave.....*S. chlorostictus*
S. constellatus
S. helvomaculatus
S. rosaceus

3b Second anal not as above; interorbital space flat to slightly concave...4

4a Gill rakers < 32.....5
4b Gill rakers > 33.....*S. hopkinsi*

5a Lateral line pores 24-30.....*S. aurora*
5b Lateral line pores 37-48.....*S. caurinus*
S. nebulosus

6a Second anal spine > third.....7
6b Second anal spine = or < third.....8

7a Gill rakers usually 34-37.....*S. zacentrus*
7b Gill rakers usually 33-42.....*S. wilsoni*

8a Gill rakers 36-42; lateral line pores 46-53.....*S. proriger*
8b Gill rakers 24-36.....*S. atrovirens*
S. carnatus
S. caurinus
S. chrysomelas
S. maliger
S. nebulosus

D=14 A=6 P=18

This combination of meristics is typical for three species:

S. babcocki
S. maliger
S. nebulosus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. aurora
S. caurinus
S. constellatus
S. diploproa
S. helvomaculatus
S. levis
S. miniatus
S. ruberrimus
S. wilsoni

To differentiate these species, use Key for D=16 A=6 P=18.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. carnatus
S. chlorostictus
S. chrysomelas
S. crameri
S. elongatus
S. hopkinsi
S. melanostomus
S. proriger
S. rastrelliger
S. rosaceus
S. rubrivinctus
S. semicinctus
S. zacentrus

KEY FOR D=14 A=6 P=18

1a Several species have distinctive pigment and spine patterns: see Appendix I.....S. babcocki
S. diploproa
S. levis
S. miniatus
S. ruberrimus

1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....6

3a Second anal spine >> third; gill rakers 24-33.....S. constellatus
S. helvomaculatus

3b Not as above.....4

4a Gill rakers usually > 32.....S. alutus
4b Gill rakers usually < 32.....5

5a Lateral line pores 24-30.....S. aurora
5b Lateral line pores 37-45.....S. caurinus

6a Gill rakers 25-32.....S. caurinus
S. maliger
S. nebulosus

6b Gill rakers 37-43.....S. wilsoni

D=14 A=6 P=19

This combination of meristics is typical for one species.

S. babcocki

Some individuals of four species may exhibit this combination of characters:

S. crameri
S. nebulosus
S. rastrelliger
S. ruberrimus

Sebastes babcocki and S. ruberrimus are distinctive; Sebastes rastrelliger has no supraocular spines and gill rakers number 22-23; Sebastes nebulosus lacks supraocular spines and gill rakers number 23-31; Sebastes crameri has supraocular spines and gill rakers number 28-32.

Possible but unlikely are:

S. auriculatus
S. diploproa
S. levis
S. melanostomus

D=14 A=6 P=20

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. babcocki
S. crameri

Sebastes babcocki is distinctive; Sebastes crameri is distinctive when > 30 mm: see Appendix I.

Possible but unlikely are:

S. melanostomus
S. rastrelliger
S. ruberrimus

D=14 A=7

This combination of meristics is typical for several species:

S. atrovirens
S. babcocki
S. constellatus
S. crameri
S. flavidus
S. hopkinsi
S. maliger
S. miniatus
S. nebulosus
S. nigrocinctus
S. pinniger
S. proriger
S. ruberrimus
S. rubrivinctus
S. semicinctus
S. zacentrus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. auriculatus
S. diploproa
S. goodei
S. helvomaculatus
S. levis
S. melanops
S. melanostomus
S. ovalis
S. rufus
S. wilsoni

Possible but unlikely are:

S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. entomelas
S. rosaceus

D=14 A=7 P=15

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. auriculatus
S. helvomaculatus

D=14 A=7 P=16

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. helvomaculatus
S. hopkinsi
S. maliger
S. miniatus
S. pinniger
S. proriger
S. rubrivinctus
S. semicinctus
S. zacentrus

To differentiate these species, see Key for D=14 A=7 P=17.

Possible but unlikely are:

S. auriculatus
S. carnatus
S. caurinus
S. chlorostictus
S. constellatus
S. goodei
S. rosaceus
S. wilsoni

D=14 A=7 P=17

This combination of meristics is typical for several species:

S. atrovirens
S. hopkinsi
S. maliger
S. miniatus
S. nebulosus
S. pinniger
S. proriger
S. rubrivinctus
S. semicinctus
S. zacentrus

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. constellatus
S. diploproa
S. flavidus
S. goodei
S. helvomaculatus
S. levis
S. ruberrimus
S. wilsoni

If specimen > 35 mm, lacks a distinctive pigment pattern, and has a black spot on its spinous dorsal fin, it is S. flavidus. If not, use Key for D=14 A=7 P=17. If specimen > 45 mm and lacks the dorsal spot, discount S. flavidus and S. pinniger.

Possible but unlikely are:

S. alutus
S. auriculatus
S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. entomelas
S. ovalis
S. rosaceus

KEY FOR D=14 A=7 P=17

1a	Several species have distinctive pigment and spine patterns: see Appendix I.....	S. babcocki S. diploproa S. goodei S. levis S. miniatus S. pinniger S. ruberrimus S. rubrivinctus S. semicinctus
1b	Not as above.....2	
2a	Supraocular spines present.....3	
2b	Supraocular spines absent.....4	
3a	Gill rakers usually < 33.....	S. constellatus S. helvomaculatus S. nebulosus
3b	Gill rakers > 33.....	S. hopkinsi S. pinniger
4a	Second anal spine > third; thicker.....5	
4b	Second anal spine ≤ third.....6	
5a	Gill rakers 37-43.....	S. wilsoni
5b	Gill rakers 32-38.....	S. zacentrus
6a	Preocular spines weak or absent.....	S. flavidus
6b	Preocular spines present.....7	
7a	Gill rakers usually > 36.....	S. proriger
7b	Gill rakers usually < 36.....	S. atrovirens S. maliger S. nebulosus

D=14 A=7 P=18

This combination of meristics is typical for several species:

S. babcocki
S. flavidus
S. maliger
S. miniatus
S. nebulosus
S. ruberrimus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. atrovirens
S. auriculatus
S. crameri
S. diploproa
S. hopkinsi
S. levis
S. melanops
S. nigrocinctus
S. ovalis
S. pinniger
S. proriger
S. rubrivinctus
S. rufus
S. semicinctus
S. zacentrus

If specimen > 35 mm, shows a black spot on the spinous dorsal fin, and lacks a distinctive pigment pattern, use Appendix II. If not, use Key for D=14 A=7 P=18. If specimen > 45 mm and lacks a dorsal spot, discount S. flavidus, S. melanops, and S. pinniger.

Possible but unlikely are:

S. carnatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. entomelas
S. goodei
S. helvomaculatus
S. melanostomus
S. rosaceus
S. wilsoni

KEY FOR D=14 A=7 P=18

1a Several species have distinctive pigment and spine patterns: see Appendix I.....S. auriculatus
S. babcocki
S. diploproa
S. levis
S. miniatus
S. nigrocinctus
S. pinniger
S. ruberrimus
S. rubrivinctus
S. semicinctus

1b Not as above.....2

2a Supraocular spines absent.....3
2b Supraocular spines present.....5

3a Second anal spine > third, thicker.....S. zacentrus
3b Second anal spine < or = third.....4

4a Lateral line pores ≥ 45.....S. flavidus
S. melanops
S. proriger

4b Lateral line pores < 45.....S. alutus
S. atrovirens
S. maliger
S. nebulosus

5a Gill rakers usually ≤ 30.....S. nebulosus
5b Gill rakers usually > 30.....S. alutus
S. crameri
S. hopkinsi
S. ovalis
S. pinniger
S. rufus

D=14 A=7 P=19

This combination of meristics is typical for three species:

S. babcocki
S. crameri
S. nigrocinctus
S. ruberrimus

Some individuals of several species may exhibit this combination of characters:

S. flavidus
S. melanops
S. melanostomus
S. nebulosus
S. pinniger

If specimen > 35 mm, has a black spot on its spinous dorsal fin and lacks a distinctive pigment pattern, it is S. flavidus or S. melanops. See Appendix II. If not, use Key for D=16 A=7 P=19. If specimen > 35 mm and lacks a dorsal spot, discount S. flavidus, S. melanops, and S. pinniger.

Possible but unlikely are,

S. auriculatus
S. diploproa
S. entomelas
S. levis
S. ovalis
S. rufus

KEY FOR D=14 A=7 P=19

1a Five species have distinctive pigment patterns: see Appendix I.....S. babcocki
S. melanostomus
S. nigrocinctus
S. pinniger
S. ruberrimus

1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....4

3a Gill rakers usually > 39.....S. pinniger
3b Gill rakers usually < 40.....S. crameri
S. melanops

4a Gill rakers < 32.....S. nebulosus
4b Gill rakers > 31.....S. flavidus
S. melanops

D=14 A=7 P=20

This combination of meristics is typical for one species:

S. crameri

Some individuals of two species may exhibit this combination of characters:

S. babcocki
S. nigrocinctus

Possible but unlikely are:

S. melanops
S. melanostomus
S. ruberrimus

D=14 A=8

This combination of meristics is typical for several species:

S. alutus
S. flavidus
S. goodei
S. melanops
S. miniatus
S. ovalis

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. babcocki
S. entomelas
S. hopkinsi
S. jordani
S. maliger
S. nebulosus
S. paucispinis
S. pinniger
S. ruberrimus
S. rubrivinctus
S. rufus
S. semicinctus
S. zacentrus

Possible but unlikely are:

S. auriculatus
S. diploproa
S. levis
S. melanostomus

D=14 A=8 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. paucispinis

Possible but unlikely is:

S. auriculatus

D=14 A=8 P=16

This combination of meristics is not typical for any species.

Some individuals of three species may exhibit this combination of characters:

S. alutus	S. miniatus
S. goodei	S. paucispinis

Sebastes miniatus, S. goodei, and S. paucispinis are distinctive: see Appendix I.

Possible but unlikely are:

S. atrovirens	S. pinniger
S. auriculatus	S. rubrivinctus
S. hopkinsi	S. semicinctus
S. maliger	S. zacentrus

D=14 A=8 P=17

This combination of meristics is typical for two species:

S. goodei	S. miniatus

Some individuals of several species may exhibit this combination of characters:

S. alutus	S. ovalis
S. atrovirens	S. pinniger
S. flavidus	S. rubrivinctus
S. hopkinsi	S. semicinctus
S. maliger	S. zacentrus

If specimen > 35 mm, has a black spot on its spinous dorsal fin, and lacks a distinctive pigment pattern, it is S. flavidus. If > 35 mm, has a dorsal fin spot, and has a distinctive pattern, it is S. pinniger. If not as above, use Key for D=14 A=8 P=17 and discount S. flavidus and S. pinniger.

Possible but unlikely are:

S. auriculatus	S. entomelas
S. babcocki	S. levis
S. diploproa	S. nebulosus

KEY FOR D=14 A=8 P=17

1a	Five species are distinctive: Appendix I.	S. goodei S. miniatus S. pinniger S. rubrivinctus S. semicinctus
1b	Not as above.....3	
2a	Supraocular spines present.....3	
2b	Supraocular spines absent.....4	
3a	Lateral line pores 24-30.....	S. alutus
3b	Lateral line pores > 44.....	S. hopkinsi S. ovalis
4a	Second anal spine thicker, longer than third.....	S. zacentrus
4b	Not as above.....5	
5a	Gill rakers usually > 39.....	S. pinniger
5b	Gill rakers usually < 39.....	S. atrovirens S. flavidus S. maliger S. nebulosus S. ovalis

---

D=14 A=8 P=18

This combination of meristics is typical for several species:

S. alutus
S. flavidus
S. melanops
S. miniatus
S. ovalis

Some individuals of these species may have these meristics:

S. babcocki
S. entomelas
S. goodei
S. maliger
S. nebulosus
S. ruberrimus
S. rufus

If specimen > 35 mm (45 mm in S. entomelas) and has a black dot on the spinous dorsal fin, see Appendix II. If not, use Key for D=14 A=8 P=18. If the specimen > 45 mm and lacks a dorsal spot, discount S. entomelas, S. flavidus, and S. melanops.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. diploproa
S. hopkinsi
S. jordani
S. levis
S. melanostomus
S. pinniger
S. rubrivinctus
S. semicinctus
S. zacentrus

KEY FOR D=14 A=8 P=18

1a Four species have distinctive pigment patterns: see Appendix I.....S. babcocki
S. goodei
S. miniatus
S. ruberrimus

1a Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....4

3a Gill rakers usually 26-30.....S. nebulosus
3b Gill rakers usually > 30.....S. alutus
S. entomelas
S. ovalis
S. rufus

4a Gill rakers usually < 34.....S. alutus
S. maliger
S. nebulosus
4b Gill rakers usually > 33.....S. alutus
S. flavidus
S. melanops

D=14 A=8 P=19

This combination of meristics is typical for one species:

S. melanops

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. flavidus
S. ovalis
S. ruberrimus

If specimen > 35 mm and has a black spot on it's spinous dorsal fin: see Appendix II, and consider S. flavidus and S. melanops. If not, use Key for D=14 A=8 P=18. If specimen > 35 mm and lacks a dorsal spot, discount S. flavidus and S. melanops.

Possible but unlikely are:

S. auriculatus
S. diploproa
S. entomelas
S. jordani
S. levis
S. melanostomus
S. nebulosus
S. pinniger
S. rufus

D=14 A=8 P=20

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. jordani S. melanops

Sebastes jordani is distinctive: see Appendix I.

Possible but unlikely are:

S. babcocki S. ruberrimus
S. melanostomus

D=14 A=9

This combination of meristics is typical for several species:

S. alutus S. ovalis
S. jordani S. paucispinis
S. melanops

Some individuals of several species may exhibit this combination of characters:

S. babcocki S. goodei
S. flavidus S. pinniger

Possible but unlikely are:

S. entomelas S. rufus

D=14 A=9 P=15

This combination of meristics is typical for one species:

S. paucispinis

D=14 A=9 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. paucispinis

Possible but unlikely are:

S. goodei S. pinniger

D=14 A=9 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. alutus	S. ovalis
S. goodei	S. pinniger

Sebastes goodei has distinctive pigmentation. Sebastes pinniger is distinctive > 40 mm; gill rakers are usually > 39. Sebastes alutus and S. ovalis have gill rakers < 39: see Appendix IV.

Possible but unlikely are:

S. babcocki	S. flavidus
S. entomelas	

D=14 A=9 P=18

This combination of meristics is typical for two species:

S. alutus	S. melanops

Some individuals of several species may exhibit this combination of characters:

S. babcocki	S. jordani
S. flavidus	

If specimen > 35 mm and has a black spot on it spinous dorsal fin: see Appendix II, and consider S. flavidus and S. melanops. If not, use Key for D=14 A=9 P=18. If the specimen > 35 mm and lacks a black dorsal spot, discount S. flavidus and S. melanops.

Possible but unlikely are:

S. entomelas	S. pinniger
S. goodei	S. rufus

KEY FOR D=14 A=9 P=18

1a Two species are distinctive: Appendix I..S. babcocki
S. jordani
1b Not as above.....2

2a Supraocular spines present.....S. alutus
2b Supraocular spines absent.....3

3a Lateral line pores usually < 50.....S. melanops
3b Lateral line pores usually > 50.....S. flavidus

D=14 A=9 P=19

This combination of meristics is typical for one species:

S. melanops

Some individuals of three species may exhibit this combination of characters:

S. babcocki
S. jordani
S. ovalis

Sebastes babcocki and S. jordani are distinctive. Sebastes melanops has gill rakers usually > 33. Sebastes ovalis has gill rakers usually < 34.

Possible but unlikely are:

S. entomelas
S. flavidus
S. pinniger
S. rufus

D=14 A=9 P=20, 21

This combination of meristics is typical for one species:

S. jordani

Some individuals of one species may show these merisitics:

S. melanops

Possible but unlikely is:

S. babcocki

D=14 A=10

Individuals of three species may exhibit this combination of characters:

S. jordani
S. melanops
S. paucispinis

Sebastes jordani is distinctive. Sebastes melanops has gill rakers 32-39. Sebastes paucispinis has gill rakers < 32.

D=14 A=11

This combination of meristics is found in only one species:

S. jordani

D=15

Several species typically exhibit a dorsal soft ray count of 15:

S. alutus
S. babcocki
S. entomelas
S. flavidus
S. hopkinsi
S. jordani
S. melanops
S. mystinus
S. nigrocinctus
S. ovalis
S. pinniger
S. proriger
S. ruberrimus
S. rufus
S. serranoides

Some individuals of several species may exhibit these meristics:

S. atrovirens
S. auriculatus
S. chlorostictus
S. crameri
S. goodei
S. melanostomus
S. miniatus
S. paucispinis
S. rubrivinctus
S. wilsoni
S. zacentrus

D=15 A=5

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit these meristics:

S. ruberrimus

Possible but unlikely are:

S. chlorostictus
S. crameri
S. wilsoni

D=15 A=6

This combination of meristics is typical for one species:

S. babcocki

Some individuals of several species may exhibit these meristics:

S. alutus
S. chlorostictus
S. hopkinsi
S. proriger
S. ruberrimus
S. wilsoni

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. crameri
S. melanostomus
S. rubrivinctus
S. zacentrus

D=15 A=6 P=15

This combination of meristics is not typical for any species.

Possible but unlikely is:

S. auriculatus

D=15 A=6 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. chlorostictus

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. hopkinsi
S. miniatus
S. proriger
S. rubrivinctus
S. wilsoni
S. zacentrus

D=15 A=6 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. chlorostictus
S. hopkinsi
S. proriger
S. wilsoni

To differentiate these species, use Key for D=15 A=6 P=17.

Possible but unlikely are:

S. alutus
S. atrovirens
S. auriculatus
S. miniatus
S. ruberrimus
S. rubrivinctus
S. zacentrus

KEY FOR D=15 A=6 P=17

1a One species is distinctive: see Appendix I.....*S. babcocki*
1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....*S. proriger*
S. wilsoni

3a Interorbital space concave; gill rakers usually < 35; lateral line pores 35-43.....*S. chlorostictus*
3b Interorbital space flat to slightly concave: gill rakers usually > 34; lateral line pores 49-55.....4

4a Lateral line pores 49-55.....*S. hopkinsi*
4b Lateral line pores < 47.....*S. proriger*
S. wilsoni

D=15 A=6 P=18

This combination of meristics is typical for one species:

S. babcocki

Some individuals of two species may exhibit this combination of characters:

S. alutus *S. ruberrimus*

Sebastes babcocki and *S. ruberrimus* are distinctive: see Appendix I.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. chlorostictus
S. crameri
S. hopkinsi
S. melanostomus
S. miniatus
S. proriger
S. rubrivinctus
S. wilsoni
S. zacentrus

D=15 A=6 P=19

This combination of meristics is typical for one species:

S. babcocki

Some individuals of one species may exhibit these meristics:

S. ruberrimus

Possible but unlikely are:

S. auriculatus
S. crameri
S. melanostomus

D=15 A=6 P=20

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. babcocki

Possible but unlikely are:

S. crameri
S. melanostomus
S. ruberrimus

D=15 A=7

This combination of meristics is typical for several species:

S. babcocki
S. flavidus
S. hopkinsi
S. nigrocinctus
S. pinniger
S. proriger
S. ruberrimus
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. atrovirens
S. auriculatus
S. crameri
S. entomelas
S. melanops
S. melanostomus
S. miniatus
S. ovalis
S. rubrivinctus
S. zacentrus

Possible but unlikely are:

S. chlorostictus
S. goodei
S. wilsoni

D=15 A=7 P=15

This combination of meristics is not typical for any species.

Possible but unlikely is:

S. auriculatus

D=15 A=7 P=16

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. hopkinsi
S. pinniger
S. proriger

Sebastes hopkinsi and S. pinniger usually have supraoculars; S. hopkinsi has lateral line pores > 46. Sebastes pinniger is distinctive if > 35 mm; lateral line pores 39-43. Sebastes proriger usually lacks supraocular spines.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. chlorostictus
S. goodei
S. miniatus
S. rubrivinctus
S. wilsoni
S. zacentrus

D=15 A=7 P=17

This combination of meristics is typical for several species:

S. hopkinsi
S. pinniger
S. proriger

Some individuals of several species may exhibit this combination of characters:

S. atrovirens
S. babcocki
S. flavidus
S. miniatus
S. ruberrimus
S. rubrivinctus
S. zacentrus

If specimen >35 mm and has a dark dorsal spot, it is S. flavidus. If not, use Key for D=15 A=7 P=17 and don't consider S. flavidus.

Possible but unlikely are:

S. alutus
S. auriculatus
S. chlorostictus
S. entomelas
S. goodei
S. ovalis
S. wilsoni

KEY FOR D=15 A=7 P=17

1a Several species have distinctive patterns
See Appendix I.....*S. babcocki*
S. miniatus
S. pinniger
S. ruberrimus
S. rubrivinctus

1b Not as above.....2

2a Supraocular spines present.....3
2b Supraocular spines absent.....4

3a Gill rakers usually < 40.....*S. hopkinsi*
3b Gill rakers usually > 40.....*S. pinniger*

4a Lateral line pores < 46.....*S. atrovirens*
S. zacentrus
4b Lateral line pores > 45.....*S. flavidus*
S. hopkinsi
S. proriger

D=15 A=7 P=18

This combination of meristics is typical for four species:

S. babcocki
S. flavidus
S. ruberrimus
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. auriculatus
S. entomelas
S. hopkinsi
S. melanostomus
S. melanops
S. miniatus
S. nigrocinctus
S. ovalis
S. pinniger
S. proriger

If specimen > 35 mm (45 mm for *S. entomelas*), has a black spot on the spinous dorsal fin, and lacks a distinctive pigment pattern, use Appendix II to distinguish *S. entomelas*, *S. flavidus*, and *S. melanops*. If not, use Key for D=15 A=7 P=18. If specimen > 45 mm and lacks a black dorsal fin spot, discount *S. entomelas*, *S. flavidus*, *S. melanops* and *S. pinniger*.

Possible but unlikely are:

S. atrovirens
S. chlorostictus
S. crameri
S. goodei
S. rubrivinctus
S. wilsoni
S. zacentrus

KEY FOR D=15 A=7 P=18

1a Five species have distinctive pigment or head spine patterns: see Appendix I.....S. auriculatus
S. babcocki
S. melanostomus
S. miniatus
S. nigrocinctus
S. pinniger
S. ruberrimus

1b Not as above.....2

2a Supraocular spines present.....S. alutus
S. entomelas
S. hopkinsi
S. ovalis
S. pinniger
S. rufus

2b Supraocular spines absent.....S. alutus
S. entomelas
S. flavidus
S. melanops
S. proriger

These species are difficult to differentiate if small. If > 35 mm, they will still be quite difficult. See Appendices I, II, and IV.

D=15 A=7 P=19

This combination of meristics is typical for three species:

S. babcocki
S. nigrocinctus
S. ruberrimus

Some individuals of several species may exhibit this combination of characters:

S. crameri
S. flavidus
S. melanops
S. melanostomus
S. pinniger
S. rufus

If specimen > 35 mm and has a black spot on its spinous dorsal fin, it is S. flavidus, S. melanops, or S. pinniger: see Appendix II. If not, use Key for D=15 A=7 P=19 and discount S. flavidus, S. melanops, and S.pinniger.

Possible but unlikely are:

S. auriculatus
S. entomelas
S. ovalis

KEY FOR D=15 A=7 P=19

1a Several species are distinctive:
see Appendix I.....S. babcocki
S. crameri
S. nigrocinctus
S. ruberrimus
S. melanostomus
S. pinniger

1b Not as above.....2

2a Supraocular spine absent.....3
2b Supraocular spine present.....4

3a Lateral line pores usually > 50.....S. flavidus
3b Lateral line pores usually < 50.....S. melanops

4a Gill rakers 38-45.....S. pinniger
4b Gill rakers 28-35.....5

5a Lateral line pores usually > 49.....S. rufus
5b Lateral line pores usually < 49.....S. crameri

D=15 A=7 P=20

This combination of meristics is not typical for any species:

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. crameri
S. nigrocinctus
S. ruberrimus

All have distinctive pigment patterns: see Appendix I.

Possible but unlikely are:

S. melanops
S. melanostomus

D=15 A=8

This combination of meristics is typical for several species:

S. alutus
S. entomelas
S. flavidus
S. melanops
S. ovalis
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. goodei
S. hopkinsi
S. jordani
S. miniatus
S. mystinus
S. pinniger
S. ruberrimus
S. serranoides

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. melanostomus
S. paucispinis
S. rubrivinctus
S. zacentrus

D=15 A=8 P=15

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. auriculatus
S. paucispinis

D=15 A=8 P=16

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. goodei
S. hopkinsi
S. miniatus
S. mystinus
S. paucispinis
S. pinniger
S. rubrivinctus
S. zacentrus

D=15 A=8 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. entomelas
S. flavidus
S. goodei
S. hopkinsi
S. miniatus
S. mystinus
S. ovalis
S. pinniger
S. serranoides

If specimen > 35 mm (45 mm for S. entomelas), has a black spot on its spinous dorsal fin, and lacks distinct patterns: see Appendix II and consider S. entomelas, S. flavidus, S. mystinus and S. serranoides. If not, use Key for D=15 A=8 P=17. If specimen > 45 mm and lacks a black dorsal spot, discount S. entomelas, S. flavidus, S. mystinus, S. pinniger, and S. serranoides.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. babcocki
S. ruberrimus
S. rubrivinctus
S. zacentrus

KEY FOR D=15 A=8 P=17

1a Three species have distinctive pigment patterns: see Appendix I.....S. goodei
S. miniatus
S. pinniger

1b Not as above.....2

2a Supraocular spines present.....S. alutus
S. entomelas
S. hopkinsi
S. ovalis
S. mystinus
S. pinniger
S. serranoides

2b Supraocular spines absent.....S. alutus
S. flavidus
S. ovalis
S. serranoides

These species will be very difficult to differentiate if small. If > 35 mm, it will still be quite difficult. See Appendices I, II, and IV.

D=15 A=8 P=18

This combination of meristics is typical for several species:

S. alutus
S. entomelas
S. flavidus
S. melanops
S. ovalis
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. miniatus
S. mystinus
S. ruberrimus
S. serranoides

If specimen > 35 mm (45 mm for S. entomelas) and has a black spot on its spinous dorsal fin, use Appendix II. If not, use Key for D=15 A=8 P=18. If specimen > 45 mm and lacks a black dorsal spot, discount S. entomelas, S. flavidus, S. melanops, S. mystinus, and S. serranoides.

Possible but unlikely are:

S. atrovirens
S. auriculatus
S. goodei
S. hopkinsi
S. jordani
S. melanostomus
S. pinniger
S. rubrivinctus
S. zacentrus

KEY FOR D=15 A=8 P=18

1a Three species have distinctive pigment patterns: see Appendix I.....S. babcocki, S. miniatus, S. ruberrimus

1b Not as above.....2

2a Supraocular spines present.....S. alutus, S. entomelas, S. ovalis, S. mystinus, S. rufus

2b Supraocular spines absent.....S. alutus, S. flavidus, S. melanops, S. ovalis, S. serranoides

These species will be very difficult to differentiate if small. If > 35 mm, it will still be quite difficult. See Appendices I, II, and IV.

D=15 A=8 P=19

This combination of meristics is typical for one species:

S. melanops

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. entomelas
S. flavidus
S. ovalis
S. ruberrimus
S. rufus

If specimen > 35 mm and has a dark spot on its spinous dorsal fin, see Appendix II and consider S. entomelas, S. flavidus, and S. melanops. If not, use Key for D=15 A=8 P=18 and do not consider S. entomelas, S. flavidus, or S. melanops.

Possible but unlikely are:

S. auriculatus
S. jordani
S. melanostomus
S. mystinus
S. pinniger
S. serranoides

D=15 A=8 P=20

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit this combination of characters:

S. jordani
S. melanops

Sebastes jordani is distinguishable at all sizes by the position of the anus.

Possible but unlikely are:

S. babcocki
S. melanostomus
S. ruberrimus

D=15 A=8 P=21

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. jordani

D=15 A=9

This combination of meristics is typical for several species:

S. alutus
S. jordani
S. melanops
S. mystinus
S. ovalis
S. serranoides

Some individuals of several species may exhibit this combination of characters:

S. babcocki
S. entomelas
S. flavidus
S. paucispinis
S. pinniger
S. rufus

Possible but unlikely is:

S. goodei

D=15 A=9 P=15

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. paucispinis

D=15 A=9 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. mystinus

Possible but unlikely are:

S. goodei
S. paucispinis
S. pinniger

D=15 A=9 P=17

This combination of meristics is typical for two species:

S. mystinus *S. serranoides*

Some individuals of three species may exhibit these meristics:

S. alutus *S. pinniger*
S. ovalis

If specimen > 35 mm, lacks distinctive patterns, and has a black dorsal spot, see Appendix II (consider *S. mystinus* and *S. serranoides*). If specimen > 35 mm and lacks a black dorsal spot, it is *S. alutus* or *S. ovalis*: see Appendix IV.

Possible but unlikely are:

S. babcocki *S. flavidus*
S. entomelas *S. goodei*

KEY FOR D=15 A=9 P=17

1a Supraocular spines usually present.....*S. alutus*
S. mystinus
S. ovalis
S. pinniger
1b Supraocular spines usually absent.....*S. serranoides*

D=15 A=9 P=18

This combination of meristics is typical for several species:

S. alutus *S. ovalis*
S. melanops *S. serranoides*
S. mystinus

Some individuals of several species may exhibit these meristics:

S. babcocki *S. jordani*
S. entomelas *S. rufus*
S. flavidus

If specimen >35 mm (45 mm for *S. entomelas*) and has a dark dorsal fin spot, use Appendix II. If not, use Key for D=15 A=9 P=18. If specimen > 35 mm and lacks a dorsal spot, discount *S. entomelas*, *S. flavidus*, *S. melanops*, *S. mystinus*, and *S. serranoides*.

Possible but unlikely is:

S. goodei

KEY FOR D=15 A=9 P=18

1a Two species are distinctive: see Appendix I.....*S. babcocki*
S. jordani

1b Not as above.....2

2a Supraocular spines present.....*S. alutus*
S. entomelas
S. mystinus
S. ovalis
S. rufus

2b Supraocular spines absent.....*S. alutus*
S. flavidus
S. melanops
S. serranoides

D=15 A=9 P=19

This combination of meristics is typical for one species:

S. melanops

Some individuals of several species may exhibit these meristics:

S. babcocki
S. jordani
S. mystinus
S. ovalis
S. serranoides

Sebastes babcocki and *S. jordani* are distinctive. *Sebastes ovalis* usually has supraocular spines. If not, see Appendix II to differentiate *S. melanops*, *S. mystinus*, and *S. serranoides*.

Possible but unlikely are:

S. entomelas
S. flavidus
S. goodei
S. pinniger
S. rufus

D=15 A=9 P=20, 21

This combination of meristics is typical for one species:

S. jordani

Some individuals of one other species exhibit these meristics:

S. melanops

Possible but unlikely is:

S. babcocki

D=15 A=10

This combination of meristics is typical for one species:

S. jordani

Some individuals of three species may exhibit this combination of characters:

S. melanops
S. mystinus
S. serranoides

Sebastes jordani can be differentiated from the other species by the position of the anus. Otherwise, see Appendix II and consider S. melanops, S. mystinus and S. serranoides.

Possible but unlikely is:

S. paucispinis

D=15 A=11

This combination of meristics can be found in two species:

S. jordani
S. serranoides

Sebastes jordani is distinctive: see Appendix I.

D=16

Several species typically exhibit a dorsal soft ray count of 16:

S. entomelas
S. hopkinsi
S. jordani
S. mystinus
S. rufus
S. serranoides

Some individuals of several species may exhibit this character:

S. alutus
S. babcocki
S. flavidus
S. melanops
S. ovalis
S. pinniger
S. proriger
S. ruberrimus
S. zacentrus

D=16 A=5

This combination of meristics is not typical for any species. Possible but unlikely is:

S. ruberrimus

D=16 A=6

This combination of meristics is not typical for any species.

Some individuals of two species may exhibit these meristics:

S. hopkinsi

Possible but unlikely are:

S. alutus
S. proriger
S. ruberrimus
S. zacentrus

D=16 A=7

This combination of meristics is typical for two species,

S. hopkinsi
S. rufus

Some individuals of several species may exhibit these meristics:

S. babcocki
S. entomelas
S. flavidus
S. pinniger
S. proriger
S. ruberrimus
S. zacentrus

Possible but unlikely are:

S. alutus
S. melanops
S. ovalis

D=16 A=7 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. hopkinsi

Possible but unlikely are:

S. pinniger
S. proriger
S. zacentrus

D=16 A=7 P=17

This combination of meristics is typical for one species:

S. hopkinsi

Some individuals of three species may exhibit this combination of characters:

S. pinniger
S. proriger
S. zacentrus

To differentiate these species, use Key for D=16 A=7 P=17.

Possible but unlikely are:

S. alutus
S. babcocki
S. entomelas
S. flavidus
S. ovalis
S. ruberrimus

KEY FOR D=16 A=7 P=17

1a Supraocular spines present.....2
1b Supraocular spines absent.....3

2a Lateral line pores 49-55.....S. hopkinsi
2b Lateral line pores 39-43.....S. pinniger

3a Lateral line pores usually > 46.....S. proriger
3b Lateral line pores usually < 46.....S. zacentrus

D=16 A=7 P=18

This combination of meristics is typical for one species:

S. rufus

Some individuals of several species may exhibit these meristics:

S. babcocki
S. entomelas
S. flavidus
S. hopkinsi
S. ruberrimus

If specimen > 45 mm and has a black dorsal spot, it is either S. entomelas or S. flavidus: see Appendix II. If not, use Key for D=16 A=7 P=18 and do not consider S. entomelas or S. flavidus.

Possible but unlikely are:

S. alutus
S. melanops
S. ovalis
S. pinniger
S. proriger
S. zacentrus

KEY FOR D=16 A=7 P=18

1a Two species are distinctive: see Appendix I.....S. babcocki, S. ruberrimus
1b Not as above.....2

2a Supraocular spine present.....3
2b Supraocular spine absent.....S. flavidus

3a Gill rakers usually 31-34.....S. rufus
3b Gill rakers usually > 33.....S. entomelas, S. hopkinsi

D=16 A=7 P=19

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit these meristics:

S. babcocki
S. ruberrimus
S. rufus

All of these species except S. rufus are distinctive: see Appendix I.

Possible but unlikely are:

S. entomelas
S. flavidus
S. melanops
S. ovalis
S. pinniger

D=16 A=7 P=20

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. babcocki
S. melanops
S. ruberrimus

D=16 A=8

This combination of meristics is typical for two species:

S. entomelas
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. flavidus
S. hopkinsi
S. jordani
S. melanops
S. mystinus
S. ovalis
S. serranoides

Possible but unlikely are:

S. babcocki
S. pinniger
S. ruberrimus
S. zacentrus

D=16 A=8 P=16

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. hopkinsi
S. mystinus
S. pinniger
S. zacentrus

D=16 A=8 P=17

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. entomelas
S. hopkinsi
S. mystinus
S. serranoides

To differentiate these species: see Appendix II.

Possible but unlikely are:

S. alutus
S. babcocki
S. flavidus
S. ovalis
S. pinniger
S. ruberrimus
S. zacentrus

D=16 A=8 P=18

This combination of meristics is typical for two species:

S. entomelas
S. rufus

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. flavidus
S. hopkinsi
S. melanops
S. mystinus
S. ovalis
S. serranoides

If specimen > 35 mm (45 mm for S. entomelas) and has a black spot on its spinous dorsal fin, use Appendix II and consider S. entomelas, S. flavidus, S. melanops, S. mystinus, and S. serranoides. If not, use Key for D=16 A=8 P=18. If the specimen > 45 mm and lacks the black spot, do not consider the black spot group.

Possible but unlikely are:

S. babcocki
S. jordani
S. pinniger
S. ruberrimus
S. zacentrus

KEY FOR D=16 A=8 P=18

1a Supraocular spines present.....S. alutus
S. entomelas
S. hopkinsi
S. mystinus
S. ovalis
S. rufus

1b Supraocular spines absent.....S. alutus
S. flavidus
S. melanops
S. serranoides

If specimen is small, it is very difficult to differentiate these species. If specimen > 45 mm and clearly not of the black dorsal spot group, it will still be somewhat difficult. S. alutus should be less deep-bodied than S. ovalis and S. rufus; see Appendices II and IV.

D=16 A=8 P=19

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. entomelas
S. melanops
S. rufus

If specimen > 35 mm (45 mm for S. entomelas) and has a black spot on its spinous dorsal fin, see Appendix II and consider S. entomelas and S. melanops. If < 35 mm, use Key for D=16 A=8 P=18. If specimen > 45 mm and does not have a black dorsal fin spot, it is S. rufus.

Possible but unlikely are:

S. babcocki
S. flavidus
S. hopkinsi
S. jordani
S. mystinus
S. ovalis
S. pinniger
S. ruberrimus
S. serranoides

D=16 A=8 P=20,21

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. jordani

Possible but unlikely are:

S. babcocki
S. melanops
S. ruberrimus

D=16 A=9

This combination of meristics is typical for several species:

S. jordani
S. mystinus
S. serranoides

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. entomelas
S. melanops
S. ovalis
S. rufus

Possible but unlikely are:

S. babcocki
S. flavidus
S. pinniger

D=16 A=9 P=16

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. mystinus

Possible but unlikely is:

S. pinniger

D=16 A=9 P=17

This combination of meristics is typical for two species:

S. mystinus	S. serranoides

Possible but unlikely are:

S. alutus	S. flavidus
S. babcocki	S. ovalis
S. entomelas	S. pinniger

D=16 A=9 P=18

This combination of meristics is typical for two species:

S. mystinus	S. serranoides

Some individuals of several species may exhibit these meristics:

S. alutus	S. melanops
S. entomelas	S. ovalis
S. jordani	S. rufus

If specimen > 35 mm (45 mm for S. entomelas) and has a black dorsal fin spot, see Appendix II and consider S. entomelas, S. mystinus and S. serranoides. If not, use Key for D=16 A=9 P=18 and discount S. entomelas, S. mystinus and S. serranoides.

Possible but unlikely are:

S. babcocki	S. pinniger
S. flavidus	

KEY FOR D=16 A=9 P=18

1a One species is distinctive: see Appendix I.....S. jordani
1b Not as above.....2

2a Supraocular spines present.....S. alutus
S. entomelas
S. mystinus
S. ovalis
S. rufus
2b Supraocular spines absent.....S. alutus
S. melanops
S. serranoides

These species will be very difficult to differentiate if < 45 mm. Sebastes alutus should be less deep-bodied than S. ovalis and S. rufus: see Appendix IV.

D=16 A=9 P=19

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. jordani
S. melanops
S. mystinus
S. serranoides

Sebastes jordani is distinctive; see Appendices I and II.

Possible but unlikely are:

S. babcocki
S. entomelas
S. flavidus
S. ovalis
S. pinniger
S. rufus

D=16 A=9 P=20,21

This combination of meristics is typical for one species:

S. jordani

Possible but unlikely are:

S. babcocki
S. melanops

D=16 A=10

This combination of meristics is typical for one species:

S. jordani

Some individuals of two species may exhibit this combination of characters:

S. mystinus
S. serranoides

Sebastes jordani is distinctive in the position of the anus. For the remaining species, use Appendix II.

Possible but unlikely is:

S. melanops

D=16 A=11

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. jordani	S. serranoides

Sebastes jordani is distinctive: see Appendix I.

D=17

This combination of meristics is not typical for any species.

Some individuals of five species may exhibit this character:

S. alutus
S. mystinus
S. ovalis
S. rufus
S. serranoides

D=17 A=6

This combination of meristics is not typical for any species.

Possible but unlikely is:

S. alutus

D=17 A=7

This combination of meristics is not typical for any species.

Some individuals of one species may exhibit this combination of characters:

S. rufus

Possible but unlikely are:

S. alutus
S. ovalis

D=17 A=8

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. alutus
S. ovalis
S. rufus

To differentiate these species: see Appendix IV.

Possible but unlikely are:

S. mystinus
S. serranoides

D=17 A=9

This combination of meristics is not typical for any species.

Some individuals of several species may exhibit this combination of characters:

S. alutus	S. ovalis
S. mystinus	S. serranoides

If specimen > 35 mm and has a black spot on its spinous dorsal fin, see Appendix II and consider S. mystinus and S. serranoides. If it > 35 mm and lacks a black dorsal spot, it is S. alutus or S. ovalis: see Appendix IV. If < 35 mm, use Key for D=17 A=9.

Possible but unlikely are:

S. rufus

KEY FOR D=17 A=9

1a Supraocular spines present.....2
1b Supraocular spines absent.....3

2a Interorbital space convex.....S. mystinus
2b Interorbital space flat, concave.....S. ovalis

3a Lateral line pores usually > 50.....S. ovalis
S. serranoides
3b Lateral line pores usually < 30.....S. alutus
S. mystinus

D=17 A=10

This combination of meristics is not typical for any species.

Possible but unlikely are:

S. mystinus	S. serranoides

CITATIONS

1. Alverson, D. L., and A. D. Welander

1952. Notes on the scorpaenid fishes of Washington and adjacent areas, with a key for their identification. Copeia 3:138-143.

2. Alverson, D. L., and S. J. Westrheim

1961. A review of the taxonomy and biology of the Pacific ocean perch and its fishery. Rapp. P.-V. Reun. Cons. Int. Explor. Mer 150:12-27.

3. Allen, M. J., and R. Voglin

1976. Regional and local variation of bottom fish and invertebrate populations. South. Calif. Coastal Water Res. Proj. Annu. Rep. 1976:217-221.

4. Anderson, T.

1983. Identification and development of nearshore juvenile rockfishes (genus Sebastes) in central California kelp forests. M. A. thesis, California State Univ., Fresno, California, 216 p.

5. Barsukov, V. V.

1964. Key to the fishes of the family Scorpaenidae. In Moiseev, P. A., (ed.), Soviet fisheries investigations in the northeast Pacific, Part III. U. S. Dep. Commer., Clearinghouse Fed. Sci. Tech. Inform., Springfield, VA, USA. ITT 67-51205:226-262.

6. Boehlert, G. W.

1977. Timing of the surface-to-benthic migration in juvenile rockfish, Sebastes diploproa, off southern California. Fish. Bull., U. S. 75(4):887-890.

7. Boehlert, G. W.

1981. The effects of photoperiod and temperature on laboratory growth of juvenile Sebastes diploproa and a comparison with growth in the field. Fish. Bull., U. S. 79(4):789-794.

8. Chen, L.-C.

1986. Meristic variation in Sebastes (Scorpaenidae), with an analysis of character association and bilateral pattern and their significance in species separation. U. S. Dep. Commer., NOAA Tech. Rep. NMFS-45, 25 p.

9. DeLacy, A. C., C. R. Hitz, and R. L. Dryfoos

1964 Maturation, gestation, and birth of rockfish (Sebastodes) from Washington and adjacent waters. Wash. Dep. Fish. Fish. Res. Pap. 2(3):51-67.

10. Hart, J. L.

1973 Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180, 740 p.

11. Hitz, C. R., and A. C. DeLacy

1961 Variations in the occurrence of coronal spines in Sebastodes auriculatus (Girard). Copeia 1961(3):279-282.

12. Hitz, C. R., and A. C. DeLacy

1965 Clearing of yolk in eggs of the rockfishes, Sebastodes caurinus and S. auriculatus. Trans. Am. Fish. Soc. 774094(2):194-195.

13. Laroche, W. A. , and S. L. Richardson

1980 Development and occurrence of larvae and juveniles of the rockfishes Sebastes flavidus and Sebastes melanops (Scorpaenidae) off Oregon. Fish. Bull., U. S. 77(4):901-924.

14. Laroche, W. A. , and S. L. Richardson

1981 Development of larvae and juveniles of the rockfishes Sebastes entomelas and S. zacentrus (Family Scorpaenidae) and occurrence off Oregon, with notes on head spines of S. mystinus, S. flavidus, and S. melanops. Fish. Bull., U. S. 79(2):231-258.

15. Lea, R. N.

1983 Sebastodes atrorubens Gilbert, 1898, a junior synonym of Sebastes atrovirens (Jordan and Gilbert, 1880), with notes on individual variation in the species. Bull. South. Calif. Acad. Sci. 82(3):147-149.

16. Matarese, A. C., A. W. Kendall, Jr., D. M. Blood, and B. M. Vinter

1989 Laboratory guide to early life history stages of northeast Pacific fishes. U. S. Dep. Commer., NOAA Tech. Rep. NMFS-80, 652 p.

17. Mitchell, C. T., and J. R. Hunter

1970. Fishes associated with drifting kelp, Macrocystis pyrifera, off the coast of southern California and northern Baja California. Calif. Fish Game 56(4):288-297.

18. Morris, R. W.

1956 Early larvae of four species of rockfish, Sebastodes. Calif. Fish Game 42:149-153.

19. Moser, H. G., and E. H. Ahlstrom

1978. Larvae and pelagic juveniles of blackgill rockfish, Sebastes melanostomus, taken in mid water trawls off southern California and Baja California. J. Fish. Res. Board Can. 35:981-996.

12. Moser, H. G., E. H. Ahlstrom, and E. M. Sandknop

1977 Guide to the identification of scorpionfish larvae (Family Scorpaenidae) in the eastern Pacific with comparative notes on species of Sebastes and Helicolenus from other oceans. U. S. Dep. Commer., NOAA Tech. Rep. NMFS Circ. 402, 71 p.

21. Phillips, J. B.

1957 A review of the rockfishes of California (family Scorpaenidae). Calif. Dep. Fish Game Fish Bull. 104, 158 p.

22. Richardson, S. L., and W. A. Laroche

1979 Development and occurrence of larvae and juveniles of the rockfishes Sebastes crameri, Sebastes pinniger, and Sebastes helvomaculatus (Family Scorpaenidae) off Oregon. Fish. Bull., U. S. 77:1-46.

23. Rosenblatt, R. H., and L.-C. Chen.

1972 The identity of Sebastes babcocki and Sebastes rubrivinctus. Calif. Fish. Game 58:32-36.

24. Westrheim, S. J.

1958 On the biology of the Pacific Ocean perch, Sebastes alutus (Gilbert). M. S. Thesis, Univ. Washington, Seattle, 106 p.

25. Westrheim, S. J.

1968 First records of three rockfish species (Sebastodes aurora, S. ciliatus, and Sebastolobus altivelis) from waters off British Columbia. J. Fish Res. Board Can. 25:2509-2513.

26. Westrheim, S. J.

1975 Reproduction, maturation, and identification of larvae of some Sebastes (Scorpaenidae) in the northeast Pacific Ocean. J. Fish. Res. Board Can. 32:2399-2411.

27. Westrheim, S. J., W. R. Harling, and D. Davenport

1968 Preliminary report on maturity, spawning season and larval identification of rockfishes (Sebastodes) collected off British Columbia. J. Fish. Res. Board Can. Manuscr. Rep. 951, 23 p.

28. Wyllie Echeverria, T.

1987 Thirty-four species of California rockfishes: maturity and seasonality of reproduction. Fish. Bull., U. S. 85(2):229-250.

APPENDIX I
DESCRIPTION OF SPECIES

SEBASTES ALUTUS - PACIFIC OCEAN PERCH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range: 14-17		typical: 14-15
Anal Soft Rays, range: 6-9		typical: 6-9
Pectoral Rays, range: 17-18		typical: 18
Gill rakers, range: 30-38		typical: 33-35
Lateral line pores, range: 44-51		
Interorbital space: flat to convex		
Head spines, supraocular: +, -		coronal: -
Second anal spine, re third:	2x thick, <	
Vertebrae: 26,27	Parturition: April	

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 1, 5, 10, 16, 21, 24, 25, 28

SEBASTES ATROVIRENS - KELP ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range: 12-15		typical: 13-14
Anal Soft Rays, range: 6-8		typical: 7
Pectoral Rays, range: 16-18		typical: 17
Gill rakers, range: 28-36		typical: 31-33
Lateral line pores, range: 37-44		
Interorbital space: strongly convex		
Head spines, supraocular: -		coronal: -
Second anal spine, re third:	2x thick, -	
Vertebrae: 26	Parturition:	

Juvenile Characteristics:

Small Juveniles have 5 narrow brown bars, 40-50 mm fish become an even tan or brown. Not seen from Tiburon Laboratory studies.

References: 4, 21, 28

SEBASTES AURICULATUS - BROWN ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-15	typical:	13
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	15-19	typical:	18
Gill rakers, range:	21-30	typical:	25-28
Lateral line pores, range:	42-49		
Interorbital space:	flat to convex		
Head spines, supraocular:	-	coronal:	+
Second anal spine, re third:	2x thick, =		
Vertebrae:	26	Parturition:	May and June

Juvenile Characteristics:

A blotch of dark pigment is visible on the operculum of all but the smallest juveniles. It is a very subtle feature in small fish: it is readily noticeable by 50 mm. Small fish have a noticeable greenish cast and a distinct line of darker pigment just under the dorsal fins (both spinous and soft). Coronal spines will separate this species from others with the same meristics in California.

References: 10, 11, 16, 21, 28

SEBASTES AURORA - AURORA ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13
Anal Soft Rays, range:	5-6	typical:	6
Pectoral Rays, range:	16-18	typical:	17-18
Gill rakers, range:	24-30	typical:	25-28
Lateral line pores, range:	27-31		
Interorbital space:	slight convex to slight concave		
Head spines, supraocular:	+	coronal:	+,-
Second anal spine, re third:	1x thick, ≥		
Vertebrae:		Parturition:	August

Juvenile Characteristics:

Reportedly barred as juveniles. Not seen from Tiburon Laboratory studies.

References: 10, 16, 19, 21, 25, 28

SEBASTES BABCOCKI - REDBANDED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-16	typical:	13-14
Anal Soft Rays, range:	6-9	typical:	7
Pectoral Rays, range:	17-20	typical:	19
Gill rakers, range:	25-33	typical:	30-31
Interorbital space:	flat to concave		
Head spines, supraocular:	+, -	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:		Parturition:	May

Juvenile Characteristics:

A red-banded pigment pattern, is clearly present on specimens > 35mm. Not seen from Tiburon Laboratory studies.

References: 3, 8, 10, 16, 21, 23, 25, 28

SEBASTES CARNATUS - GOPHER ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13
Anal Soft Rays, range:	6-7	typical:	6
Pectoral rays, range:	16-18	typical:	17
Gill rakers, range:	27-32	typical:	28-31
Lateral line pores, range:	36-42		
Interorbital space:	convex, mid concave		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, -		
Vertebrae:	26	Parturition:	March

Juvenile Characteristics:

25 mm fish have dark brown bars with bridge between 2nd and 3rd bars just under dorsal fin. Fins become orange with growth. Not seen from Tiburon Laboratory studies.

References: 4, 8, 16, 21, 28

SEBASTES CAURINUS - COPPER ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-14	typical:	12-13
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17-18
Gill rakers, range:	26-32	typical:	28-30
Lateral line pores, range:	39-45		
Interorbital space:	concave to convex		
Head spines, supraocular:	+,-	coronal:	-
Second anal spine, re third:	2x thick, =		
Vertebrae:		Parturition:	July

Juvenile Characteristics:

At 25 mm, five red-brown bars, fins become orange with growth. Posterior third of lateral line becomes "clear" about 50 mm. Orange chromatophores visible on body with fresh or frozen specimens.

References: 3, 8, 10, 11, 16, 21, 28

SEBASTES CHLOROSTICTUS - GREENSPOTTED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-15	typical:	12-13
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	29-36	typical:	31-34
Lateral line pores, range:	35-40		
Interorbital space:	deeply concave		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2, 3x thick, ≥		
Vertebrae:	26, 27	Parturition:	June

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 8, 21, 28

SEBASTES CHRYSOMELAS - BLACK AND YELLOW ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13
Anal Soft Rays, range:	6-7	typical:	6
Pectoral Rays, range:	17-18	typical:	17
Gill rakers, range:	24-31	typical:	26-30
Lateral line pores, range:	35-40		
Interorbital space:	deeply concave		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, =		
Vertebrae:		Parturition:	February-March

Juvenile Characteristics:

25 mm with five brown bars; develops to black bars with yellow fins.

References: 4, 21, 28

SEBASTES CONSTELLATUS - STARRY ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	12-14
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	24-30	typical:	27-29
Lateral line pores, range:	37-43		
Interorbital space:	deeply concave		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick, ≥		
Vertebrae:	25,26	Parturition:	April

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 8, 21, 28

SEBASTES CRAMERI - DARKBLOTCHED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-15	typical:	13-14
Anal Soft Rays, range:	5-7	typical:	7
Pectoral Rays, range:	18-20	typical:	18-20
Gill rakers, range:	28-35	typical:	30-33
Lateral line pores, range:	40-50		
Interorbital space:	flat to convex		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick, ≤		
Vertebrae:		Parturition:	January

Juvenile Characteristics:

20 mm fish have 2 pigment "saddles," 25mm fish show 5 "saddles," 40 mm dorsal fin show heavy black spot. Benthic juveniles > 60 mm show a decrease in pigment intensity, especially a decrease in yellow chromatophore. Small fish have black and yellow pigment on pectoral fins. The presence of nuchal spines will distinguish this species from S. levis.

References: 3, 10, 16, 21, 22, 27, 28

SEBASTES DIPLOPROA - SPLITNOSE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-14	typical:	12-13
Anal Soft Rays, range:	5-8	typical:	6-7
Pectoral Rays, range:	17-19	typical:	17-18
Gill rakers, range:	32-37	typical:	33-36
Lateral line pores, range:	33-43		
Interorbital space:	flat to concave		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, =		
Vertebrae:	26	Parturition:	June

Juvenile Characteristics:

Juveniles are distinctively pigmented even at very small sizes, they are evenly dark grey-pink. Spinous dorsal is pigmented: soft dorsal,anal and pelvics are pigmented with clear edges.

References: 3, 6, 7, 8, 10, 16, 17, 21, 28

SEBASTES ELONGATUS - GREENSTRIPED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13
Anal Soft Rays, range:	5-6	typical:	6
Pectoral Rays, range:	16-18	typical:	16-17
Gill rakers, range:	28-34	typical:	30-33
Lateral line pores, range:	40-45		
Interorbital space:	slightly concave		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:	26	Parturition:	May

Juvenile Characteristics:

Juveniles have a distinctive pigment pattern of elongate blotches. Yellow pigment present on the head and operculum; black pigment on head, operculum, and on dorsal ridge below dorsal fins and spines. Black pigment also on lateral line but only on the posterior quarter of body length. This pigment begins past the anal fin and extends to the caudal fin. They are not at all deep bodied.

References: 3, 10, 16, 21, 27, 28

SEBASTES ENTOMELAS - WIDOW ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	14-16	typical:	15-16
Anal Soft Rays, range:	7-10	typical:	8
Pectoral Rays, range:	17-19	typical:	18
Gill rakers, range:	33-40	typical:	34-37
Lateral line pores, range:	51-58		
Interorbital space:	convex to concave		
Head spines, supraocular:	+, -	coronal:	-
Second anal spine, re third:	1x, =		
Vertebrae:		Parturition:	February

Juvenile Characteristics:

Slender-bodied at all sizes. Small fish only lightly pigmented; they have large melanophores on the dorsal ridge under the dorsal fin, and they have about four tiny melanophores on the ventral surface near the caudal fin. By 40 mm most of body is pigmented. By 56 mm 2 eye bars are present and body pigment has blotched pattern. By 45 mm black spot on posterior part of spinous dorsal fin is clear; becomes a fringe of pigment in large individuals.

References: 4, 8, 10, 14, 16, 21, 28

SEBASTES EOS - PINK ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-13	typical:	12-13
Anal Soft Rays, range:	6-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17-18
Gill rakers, range:	26-33	typical:	27-30
Lateral line pores, range:	34-40		
Interorbital space:	concave		
Head spines, supraocular:	+	coronal:	-, +
Second anal spine, re third:	2,3x thick, ≥		
Vertebrae:	Parturition:		

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 8, 21, 28

SEBASTES FLAVIDUS - YELLOWTAIL ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	14-16	typical:	14-15
Anal Soft Rays, range:	7-9	typical:	7-8
Pectoral Rays, range:	17-19	typical:	18
Gill rakers, range:	31-39	typical:	35-38
Lateral line pores, range:	49-56		
Interorbital space:	convex		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26	Parturition:	January-February

Juvenile Characteristics:

No preocular spines. In small fish, pectoral and pelvic fins are moderately pigmented; body gradually becomes evenly pigmented with growth. Black spot on posterior of spinous dorsal fins clear at 35 mm. One cheek bar present at 60 mm. Fresh specimens have many yellow chromatophores. The presence of orange pigment spots along the anal fin base (when viewed ventrally) will distinguish this species from S. serranoides.

References: 4, 8, 10, 13, 16, 17, 21, 27, 28

SEBASTES GOODEI - CHILIPEPPER

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	13-14
Anal Soft Rays, range:	7-10	typical:	8
Pectoral Rays, range:	16-19	typical:	17
Gill rakers, range:	31-39	typical:	34-37
Lateral line pores, range:	50-57		
Interorbital space:	flat to convex		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26	Parturition:	January

Juvenile Characteristics:

Juveniles are distinctively marked with three bars that start under the dorsal fin and tend toward the head. All sizes of juveniles are very slender bodied. Juveniles < 30 mm have some black pigment on pelvic and pectoral fins. Yellow pigment on small (15 mm) fish on pectoral fin base.

References: 3, 4, 10, 18, 21, 28

SEBASTES HELVOMACULATUS - ROSETHORN ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	12-13
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	15-17	typical:	16-17
Gill rakers, range:	27-33	typical:	28-31
Lateral line pores, range:	35-41		
Interorbital space:	deeply concave		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:	26	Parturition:	

Juvenile Characteristics:

By 25 mm, juveniles show a distinct patch of pigment on the caudal peduncle and a faint pigment saddle under the spinous dorsal fin. Pelvic fins extend to 1st spine of anal fin. Never develops striking bars as do the rest of this group. Not seen from Tiburon Laboratory studies.

References: 8, 10, 16, 21, 22, 28

SEBASTES HOPKINSI - SQUARESPOT ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-16
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	34-41	typical:	37-40
Lateral line pores, range:	49-55		
Interorbital space:	strongly convex		
Head spines, supraocular:	+, -	coronal:	-
Second anal spine, re third:	2x thick, ≥		
Vertebrae:		Parturition:	March

Juvenile Characteristics:

Slender-bodied juveniles. Pre-, supra-, and postoculars spines present. Spinous dorsal dark with light edge, never develops dark spot; otherwise pigment much like S. flavidus. Some yellow-orange melanophores on body of fresh specimens. Large juveniles (45 mm) have red-orange hue and dark pigment on the membranes between the pectoral, dorsal and anal fins. Second anal spine is distinct: very spear-shaped and curved. Head spines are very "thorn-like."

References: 3, 21, 28

SEBASTES JORDANI - SHORTBELLY ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-16
Anal Soft Rays, range:	8-11	typical:	8-10
Pectoral Rays, range:	18-22	typical:	20-21
Gill rakers, range:	40-49	typical:	43-46
Lateral line pores, range:	52-59		
Interorbital space:	flat to convex		
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26, 27	Parturition:	February

Juvenile Characteristics:

Juveniles of this species are quite distinctive. They are very slender bodied. The anus is located more anteriorly than in any other rockfish; there is a definite space between the anus and the 1st spine of the anal fin. The caudal fin is distinctly pink in fresh specimens. Small fresh specimens have many orange chromatophores on the body.

References: 3, 4, 10, 16, 18, 20, 21, 28

SEBASTES LEVIS - COWCOD

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	12-13
Anal Soft Rays, range:	6-8	typical:	6-7
Pectoral Rays, range:	17-19	typical:	17-18
Gill rakers, range:	29-32	typical:	30-32
Lateral line pores, range:	45-52		
Interorbital space:	flat to convex		
Head spines, supraocular:	+,-	coronal:	-
Second anal spine, re third:	1,2x thick, =		
Vertebrae:	26	Parturition:	December

Juvenile Characteristics:

Juveniles are distinctive. They have quite large yellow pectoral fins; at 33 mm these fins are about 50% body length; at 60 mm about 30%. Five faint pigment bars develop by 30 mm and are retained on larger juveniles and adults. Nuchal spines absent; this will distinguish this species from S. crameri.

References: 3, 20, 21, 28

SEBASTES MALIGER - QUILLBACK ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13-14
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	28-34	typical:	30-33
Lateral line pores, range:	35-43		
Interorbital space:	varies		
Head spines, supraocular:	-,+	coronal:	-
Second anal spine, re third:	2x thick, =		
Vertebrae:		Parturition:	April

Juvenile Characteristics:

Rather evenly pigmented with line of more intense pigment under soft dorsal fin. Spinous dorsal is very "quill-like."

References: 10, 21, 28

SEBASTES MELANOPS - BLACK ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-15
Anal Soft Rays, range:	7-10	typical:	8-9
Pectoral Rays, range:	18-20	typical:	18-19
Gill rakers, range:	32-39	typical:	35-38
Lateral line pores, range:	46-53		
Interorbital space:	convex to flat		
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:	1x, thick	=	
Vertebrae:	26	Parturition:	February

Juvenile Characteristics:

Slightly more intense pigment than others of the group but lacks any distinct pattern on the body. Black dorsal spot apparent by 35 mm. Two cheek bars by 76 mm or smaller. Faint yellow chromatophores on fins of fresh specimens. Flesh has distinct "green" cast as opposed to a "white" cast for S. flavidus. Head is more pointed than S. flavidus. Sometimes a supraocular spine is found only over one eye. Larger juveniles are quite reddish-black.

References: 4, 9, 10, 13, 16, 20, 21, 26, 28

SEBASTES MELANOSTOMUS - BLACKGILL ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-15	typical:	13
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	18-20	typical:	19
Gill rakers, range:	29-35	typical:	31-33
Lateral line pores, range:	29-317		
Interorbital space:	flat to slight concave		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick,	≤	
Vertebrae:	26-27	Parturition:	February

Juvenile Characteristics:

Juveniles are distinctively pigmented. 25 mm fish have 2 bars under the spinous dorsal and 1 under the soft dorsal. Pigment fills in between the bars gradually; by 45 mm completely pigmented but bars still visible as darker pigment. Not seen from Tiburon Laboratory studies.

References: 16, 19, 21, 28

SEBASTES MINIATUS - VERMILLION ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	13-14
Anal Soft Pays, range:	6-8	typical:	7-8
Pectoral Rays, range:	16-18	typical:	17-18
Gill rakers, range:	35-43	typical:	37-41
Lateral line pores, range:	40-47		
Interorbital space:	flat to convex		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	1x, thick =		
Vertebrae:	26	Parturition:	November

Juvenile Characteristics:

Intensely pigmented body and fins, except caudal fin in very small fish. Splotches of pigment on pectoral fins near the base. Deep bodied. Becomes less intensely pigmented with age; grey-black becomes red with increased size.

References: 3, 10, 16, 21, 28

SEBASTES MYSTINUS - BLUE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	15-17	typical:	15-16
Anal Soft Rays, range:	8-10	typical:	8-9
Pectoral Rays, range:	16-19	typical:	17-18
Gill rakers, range:	31-38	typical:	33-36
Lateral line pores, range:	49-56		
Interorbital space:	strong convex		
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26	Parturition:	January

Juvenile Characteristics:

Dark spot is very intense in color. Dark pigment "cheek" lines present on large specimens. Pigment present on membranes of the anal fin in medium to large fish.

References: 3, 4, 8, 10, 14, 16, 21, 28

SEBASTES NEBULOSUS - CHINA ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-14	typical:	13-14
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	17-19	typical:	18
Gill rakers, range:	25-31	typical:	27-30
Lateral line pores, range:	37-48?	typical:	38-41?
Interorbital space:	flat to concave?		
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:	2x thick, ≥		
Vertebrae:	26	Parturition:	January

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 10, 28

SEBASTES NIGROCINCTUS - TIGER ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	14-15
Anal Soft Rays, range:	7	typical:	7
Pectoral Rays, range:	18-20	typical:	19
Gill rakers, range:	27-32	typical:	28-31
Lateral line pores, range:	41-50		
Interorbital space:	concave		
Head spines, supraocular:	+, -	coronal:	-, +
Second anal spine, re third:	2x thick, ≤		
Vertebrae:	Parturition:		

Juvenile Characteristics:

Coronal spines often present. Distinct black bands over yellow-gold found by 33 mm.

References: 10, 11, 21, 28

SEBASTES OVALIS - SPECKLED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-17	typical:	14-15
Anal Soft Rays, range:	7-9	typical:	8-9
Pectoral Rays, range:	17-19	typical:	18
Gill rakers, range:	30-37	typical:	31-33
Lateral line pores, range:	47-55		
Interorbital space:	convex		
Head spines, supraocular:	+, -	coronal:	-
Second anal spine, re third:	2x thick, ≤		
Vertebrae:	Parturition:		February

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 21, 28

SEBASTES PAUCISPINIS - BOCACCIO

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	14
Anal Soft Rays, range:	8-10	typical:	9
Pectoral Rays, range:	14-16	typical:	15
Gill rakers, range:	26-31	typical:	28-30
Lateral line pores, range:	54-58		
Interorbital space:	convex		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	1x, thick <		
Vertebrae:	26	Parturition:	February

Juvenile Characteristics:

Dark pigment on posterior portion of pectoral and pelvic fins is noticeable in juveniles up to 70 mm. Pectorals are very long in fish about 25 mm, reaching to 1st anal spine. Large mouth obvious at all sizes.

References: 3, 4, 10, 16, 18, 21, 28

SEBASTES PINNIGER - CANARY ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-15
Anal Soft Rays, range:	7-8	typical:	7
Pectoral Rays, range:	16-19	typical:	17
Gill rakers, range:	38-46	typical:	41-44
Lateral line pores, range:	39-44		
Interorbital space:	flat to convex		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26	Parturition:	February

Juvenile Characteristics:

Small fish (< 20 mm) have black pigment on the pelvic and/or pectoral fins and yellow pigment on base of pectoral fins. 25 mm fish show developing saddles of pigment under dorsal fins. 30 mm fish show black spot on spinous dorsal fin; appearance of very white fish with bright black spot; deeper bodied than other black dorsal spot fish. 40 mm fish show very distinct pigment pattern.

References: 4, 10, 16, 21, 22, 28

SEBASTES PRORIGER - REDSTRIPE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-15
Anal Soft Rays, range:	6-7	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	36-43	typical:	37-39
Lateral line pores, range:	46-53		
Interorbital space:	concave to convex		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, =		
Vertebrae:	27	Parturition:	

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 5, 8, 10, 16, 21, 28

SEBASTES RASTRELLIGER - GRASS ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13
Anal Soft Rays, range:	6	typical:	6
Pectoral Rays, range:	18-20	typical:	19
Gill rakers, range:	22-25	typical:	25
Lateral line pores, range:	42-47		
Interorbital space:	strong convex		
Head spines, supraocular:	-	coronal:	-
Head spines, Second anal spine, re third:	1-2x thick, =		
Vertebrae:		Parturition:	

Juvenile Characteristics:

Small fish have a silvery appearance with a thick, dark line along dorsal margin below dorsal fins. Larger fish (25-30mm) have dark pigment on anal, pectoral, and dorsal fins with several uneven vertical bars on posterior portion of body.

References: 21, 28

SEBASTES ROSACEUS - ROSE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-14	typical:	12-13
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	29-34	typical:	30-33
Lateral line pores, range:	36-42		
Interorbital space:	strong concave		
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:	26-27	Parturition:	April

Juvenile Characteristics:

Not seen from Tiburon Laboratory studies.

References: 8, 21, 28

SEBASTES RUBERRIMUS - YELLOWEYE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	14-15
Anal Soft Rays, range:	5-8	typical:	7
Pectoral Rays, range:	16-20	typical:	18-19
Gill rakers, range:	24-31	typical:	26-29
Lateral line pores, range:	39-46		
Interorbital space:	concave		
Head spines, supraocular:	+	coronal:	-, +
Second anal spine, re third:	2x thick, =		
Vertebrae:	26	Parturition:	June

Juvenile Characteristics:

Bright yellow eye is obvious at all sizes. 175 mm fish are red to brown-black with 2 pink stripes-one on lateral line and one below snout and eye, and over base of pectoral fin.

References: 1, 10, 21, 28

SEBASTES RUBRIVINCTUS - FLAG ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	13-14
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	26-30	typical:	28-29
Lateral line pores, range:			
Interorbital space:			
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:			
Vertebrae:		Parturition:	July

Juvenile Characteristics:

Adult pattern completely formed by 40 mm. Not seen from Tiburon Laboratory studies.

References: 3, 8, 28

SEBASTES RUFUS - BANK ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	14-17	typical:	15-16
Anal Soft Rays, range:	5-9	typical:	7
Pectoral Rays, range:	18-19	typical:	18
Gill rakers, range:	31-35	typical:	32-35
Lateral line pores, range:	49-56		
Interorbital space:			
Head spines, supraocular:	+	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:		Parturition:	December-January

Juvenile Characteristics:

Dark pigment on caudal fin edge and entire dorsal fin. Very speckled body pigment, more yellowish than S. entomelas.

References: 16

SEBASTES SAXICOLA - STRIPETAIL ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	11-13	typical:	12
Anal Soft Rays, range:	5-8	typical:	7
Pectoral Rays, range:	15-18	typical:	16-17
Gill rakers, range:	29-35	typical:	31-34
Lateral line pores, range:	36-42		
Interorbital space:	flat to slight concave		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:		Parturition:	July

Juvenile Characteristics:

Five bars on body and caudal peduncle. Bar under soft-rayed dorsal fin is an inverted triangle and is darkest of the five. Pigment continuous from body into the dorsal fins.

References: 3, 8, 16, 21, 28

SEBASTES SEMICINCTUS - HALFBANDED ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	12-14	typical:	13-14
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	37-41		
Lateral line pores, range:	42-47		
Interorbital space:			
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:			
Vertebrae:		Parturition:	

Juvenile Characteristics:

Five saddles-bars on body and caudal peduncle. Bar under posterior of spinous dorsal fin is diamond-shaped and darkest. Body more slender than S. saxicola.

References: 3, 8

SEBASTES SERRANOIDES - OLIVE ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	15-17	typical:	15-16
Anal Soft Rays, range:	8-10	typical:	9
Pectoral Rays, range:	17-19	typical:	17-18
Gill rakers, range:	31-36	typical:	32-35
Lateral line pores, range:	50-56		
Interorbital space:	convex		
Head spines, supraocular:	-, +	coronal:	-
Second anal spine, re third:	1x thick, <		
Vertebrae:	26	Parturition:	February

Juvenile Characteristics:

Usually one supraocular spine above left eye. Subtle dark pigment on lateral line. Pectoral fins pigmented at 48 mm.

References: 3, 4, 8, 21, 28

SEBASTES WILSONI - PYGMY ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-15	typical:	13-14
Anal Soft Rays, range:	5-7	typical:	6
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	37-43	typical:	38-42
Lateral line pores, range:	37-45		
Interorbital space:	flat		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	2x thick, >		
Vertebrae:		Parturition:	

Juvenile Characteristics:

35 mm fish have broken pigment pattern on the side of the body under the spinous dorsal fin and a broad deep bar of pigment under the soft dorsal fin.

References: 8, 10, 21, 28

SEBASTES ZACENTRUS - SHARPCHIN ROCKFISH

Meristics and Morphometrics of the adult:

Dorsal Soft Rays, range:	13-16	typical:	13-14
Anal Soft Rays, range:	6-8	typical:	7
Pectoral Rays, range:	16-18	typical:	17
Gill rakers, range:	32-37	typical:	34-37
Lateral line pores, range:	38-47	typical:	40-44
Interorbital space:	flat to slight convex		
Head spines, supraocular:	-	coronal:	-
Second anal spine, re third:	1-2x thick, ≥		
Vertebrae:	27-28	Parturition:	

Juvenile Characteristics:

Rather deep-bodied; moderately long pectorals and pelvics. Develops five indistinct saddles of pigment on dorsal surface in benthic individuals.

References: 8, 10, 14, 16, 21, 28

APPENDIX II
BLACK DORSAL SPOT GROUP

Several species of juvenile Sebastes (> 35 mm; 45 mm for S. entomelas) have a black spot on the posterio-distal edge of their spinous dorsal fin. These species are:

S. entomelas
S. flavidus
S. melanops
S. mystinus
S. pinniger
S. serranoides

Sebastes pinniger differs from the others in having a deeper body shape and a distinctive pigment pattern (see Appendix I). The other five species are difficult to differentiate as juveniles.

Sebastes hopkinsi may be confused with the five remaining species. It lacks a black dorsal spot, but is otherwise quite similar to the five species in this group in body proportion and pigment pattern. Meristics will differentiate this species in most cases.

The table below will help differentiate most individuals. The value reported is the percent of adult fish showing the character. This table shows meristic frequencies for California. Frequencies may differ in other areas.

SPECIES	DORSAL RAYS					ANAL RAYS					PECTORAL RAYS				
	13	14	15	16	17	6	7	8	9	10	16	17	18	19	20
S. entomelas			89	11			5	90	5			1	98	1	
S. flavidus		60	40				11	88	1			1	98	1	
S. melanops	1	22	63	14			6	26	66	2			29	71	
S. mystinus			18	73	9			2	97	1		2	93	5	
S. serranoides			38	61	1			6	91	3		64	34	2	
S. pinniger	7	76	15	2				98	2		1	87	11	1	
S. hopkinsi	4	15	60	21			8	88	4		4	93	3		

The chart below is based on Richardson and LaRoche (1979), LaRoche and Richardson (1980, 1981), and data from our studies. It emphasizes modal meristics and head spination. Most specimens can be identified, but atypical individuals may not be correctly identified. Supraoculars = supraocular spines, A = anal fin ray count, P = pectoral fin ray count.

SUPRAOCULARS PRESENT		SUPRAOCULARS ABSENT		
A=8	A=9	A=8		A=9
P=18		P=18	P=19	P=17
S. entomelas	S. mystinus	S. flavidus	S. melanops	S. serranoides

APPENDIX III
SEBASTOMUS GROUP

The Sebastomus group is a group of very closely related Sebastes species that are somewhat difficult to differentiate, even as adults. They are almost completely unknown as juveniles. The central California members of this group are:

S. chlorostictus
S. constellatus
S. eos
S. helvomaculatus
S. rosaceus

The Sebastomus group has been most thoroughly studied by L. C. Chen, and his published meristic frequencies provide the only practical way to differentiate some of the juveniles (Chen 1971).

Some of the members of this group are strongly barred as juveniles (Moser and Ahlstrom 1978). One member of the group, S. helvomaculatus, has been described (Richardson and LaRoche 1979) and is not barred, but rather evenly pigmented. The table below may help differentiate juveniles.

Meristics of five members of the Sebastomus group reported as percent of adult fish showing the character

SPECIES	DORSAL RAYS				ANAL RAYS			PECTORAL RAYS			
	11	12	13	14	5	6	7	15	16	17	18
S. chlorostictus	1	72	25	1	4	95	1		8	91	1
S. eos	3	76	21			95	5		1	30	69
S. helvomaculatus		13	81	6	1	96	3	2	81	17	
S. constellatus		10	79	11	2	97	1	5	93	2	
S. rosaceus	1	31	67	1	2	97	1		10	87	3

APPENDIX IV
AOR (ALUTUS-OVALIS-RUFUS)

Sebastes alutus, S. ovalis, and S. rufus are not well known as juveniles. Only S. rufus has been seen from our studies (see Appendix I). Fin ray counts of these three species overlap to a great extent. Therefore, differentiating these species will be very difficult. Sebastes alutus will likely have a more slender body shape that the other two species. The following chart may help differentiate some individuals.

SPECIES	DORSAL RAYS					ANAL RAYS				PECTORAL RAYS		
	13	14	15	16	17	6	7	8	9	17	18	19
S. alutus		X	X	O	O	O	O	X	X	O	X	O
S. ovalis	O	X	X	O	O		O	X	X	X	X	O
S. rufus		O	X	X	O		X	X	X	O	X	O

X = typical; O = occasional

RECENT TECHNICAL MEMORANDUMS

Copies of this and other NOAA Technical Memorandums are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22167. Paper copies vary in price. Microfiche copies cost $4.50. Recent issues of NOAA Technical Memorandums from the NMFS Southwest Fisheries Science Center are listed below:

NOAA-TM-NMFS-SWFSC- 156 Research plan for marine turtle fibropapilloma results of a December 1990 workshop.
G.H. BALAZS and S.G. POOLEY (Editors)
(February 1991)

157 Documentation of the 1980 data verification programs and common subroutines for fixed-format data: Porpoise data management system.
C.W. OLIVER and R.L. BUTLER
(March 1991)

158 Report of a marine mammal survey of the eastern tropical Pacific aboard the research vessel *David Starr Jordan*, July 28-December 6, 1990.
P.S. HILL, R.C. RASMUSSEN and T. GERRODETTE
(May 1991)

159 Report of a marine mammal survey of the eastern tropical Pacific aboard the research vessel *McArthur*, July 28-December 6, 1990.
P.S. HILL, A. JACKSON and T. GERRODETTE
(May 1991)

160 Report of ecosystem studies conducted during the 1990 eastern tropical Pacific dolphin survey on the research vessel *David Starr Jordan*.
V.A. PHILBRICK, P.C. FIEDLER, S.B. REILLY, R.L. PITMAN, L.T. BALLANCE, G.G. THOMAS and D.W. BEHRINGER
(May 1991)

161 Report of ecosystem studies conducted during the 1990 eastern tropical Pacific dolphin survey on the research vessel *McArthur*.
V.A. PHILBRICK, P.C. FIEDLER, S.B. REILLY, R.L. PITMAN, L.T. BALLANCE and D.W. BEHRINGER
(May 1991)

162 Predicting sablefish age using otolith characteristics.
A. McBRIDE and J.E. HIGHTOWER
(August 1991)

163 CHARTOPS: simulating short-term use of the tuna purse-seine fleet to survey dolphin schools in the eastern tropical Pacific Ocean.
E.F. EDWARDS and P. KLEIBER
(August 1991)

164 Results of the southern California sportfish economic survey.
C.J. THOMSON and S.J. CROOKE
(August 1991)

165 Status of Pacific oceanic fishery resources of interest to the USA for 1991.
STAFF OF THE SOUTHWEST FISHERIES SCIENCE CENTER
(September 1991)