Identification of Juvenile Rockfish (Genus *Sebastes*) Using the Cleithrum

By

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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.

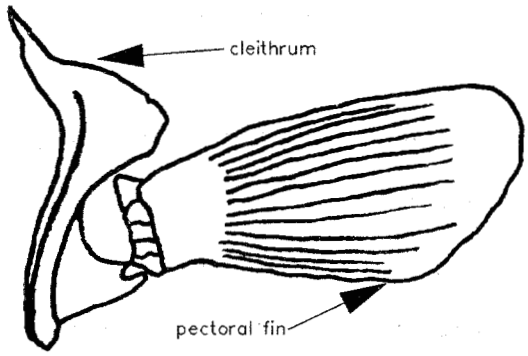

Figure 1. Diagram of cleithrum showing relation to pectoral fin.

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

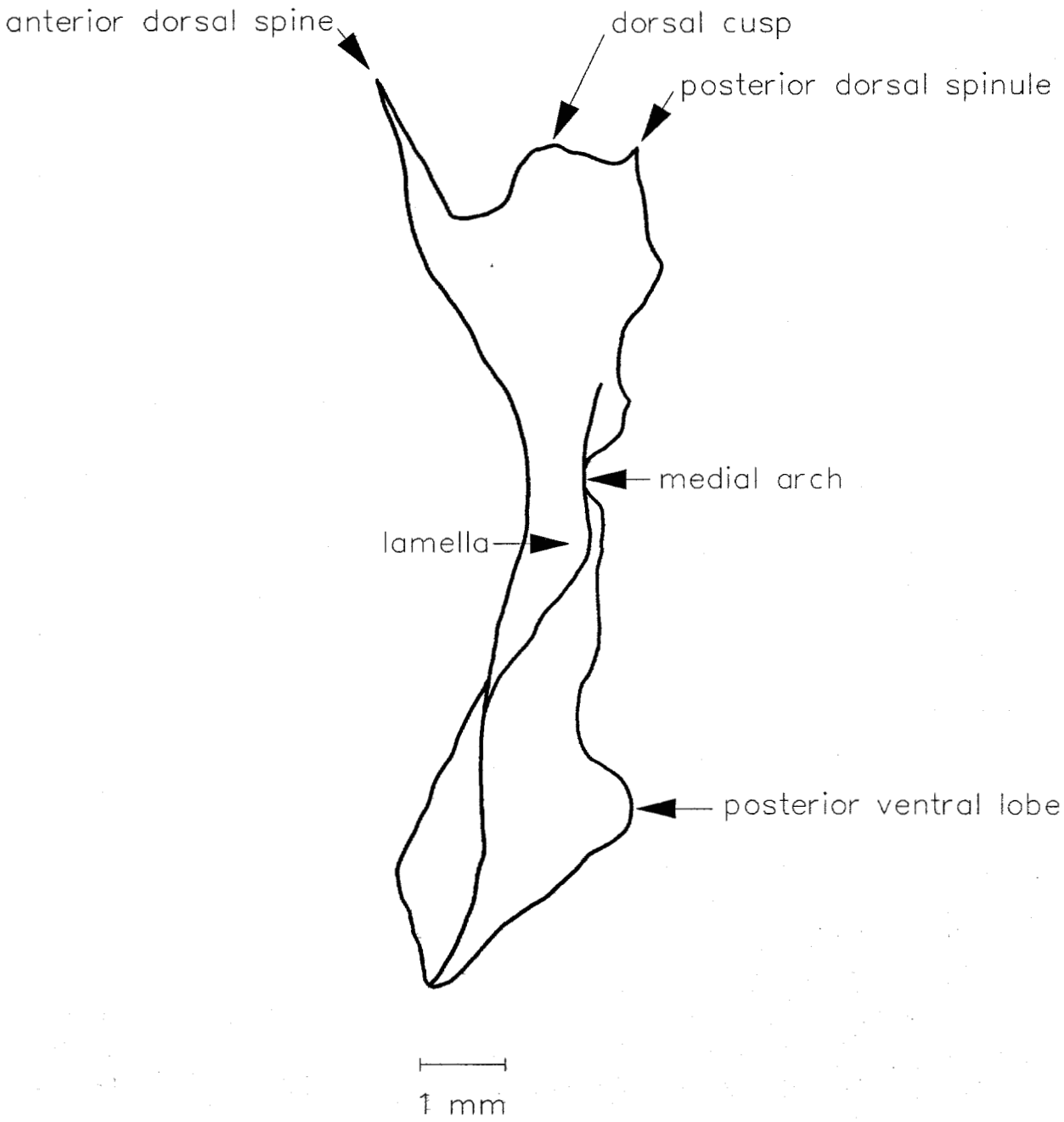

Figure 2. Diagram of left cleithrum showing key structures.

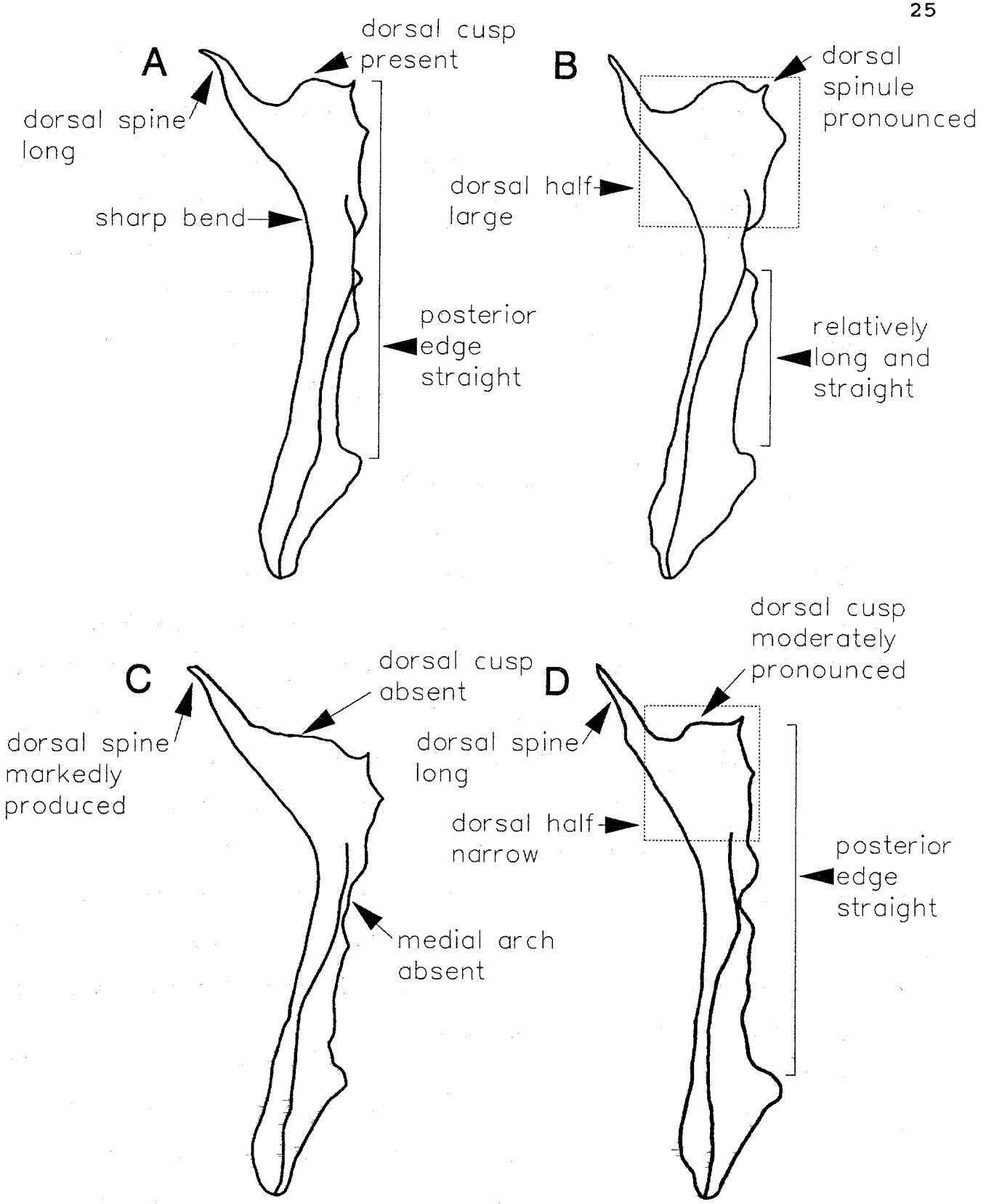

Figure 3. A. *Sebastes goodei*, B. *Sebastes jordani*, C. *Sebastes paucispinis*, and D. *Sebastes pinniger*.

(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

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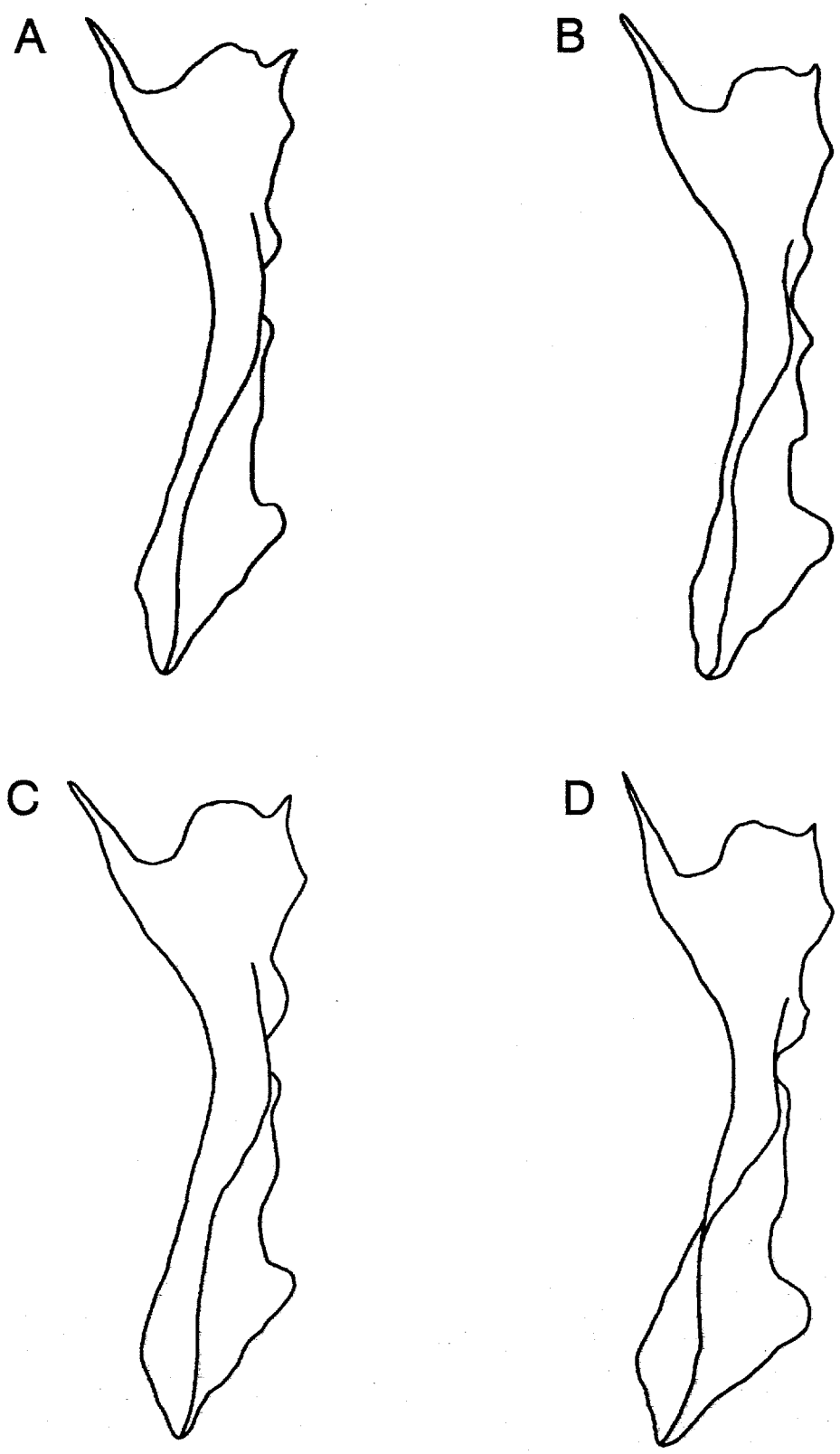

Figure 4. A. *Sebastes entomelas*, B. *Sebastes flavidus*, C. *Sebastes hopkinsi*, and D. *Sebastes mystinus*.

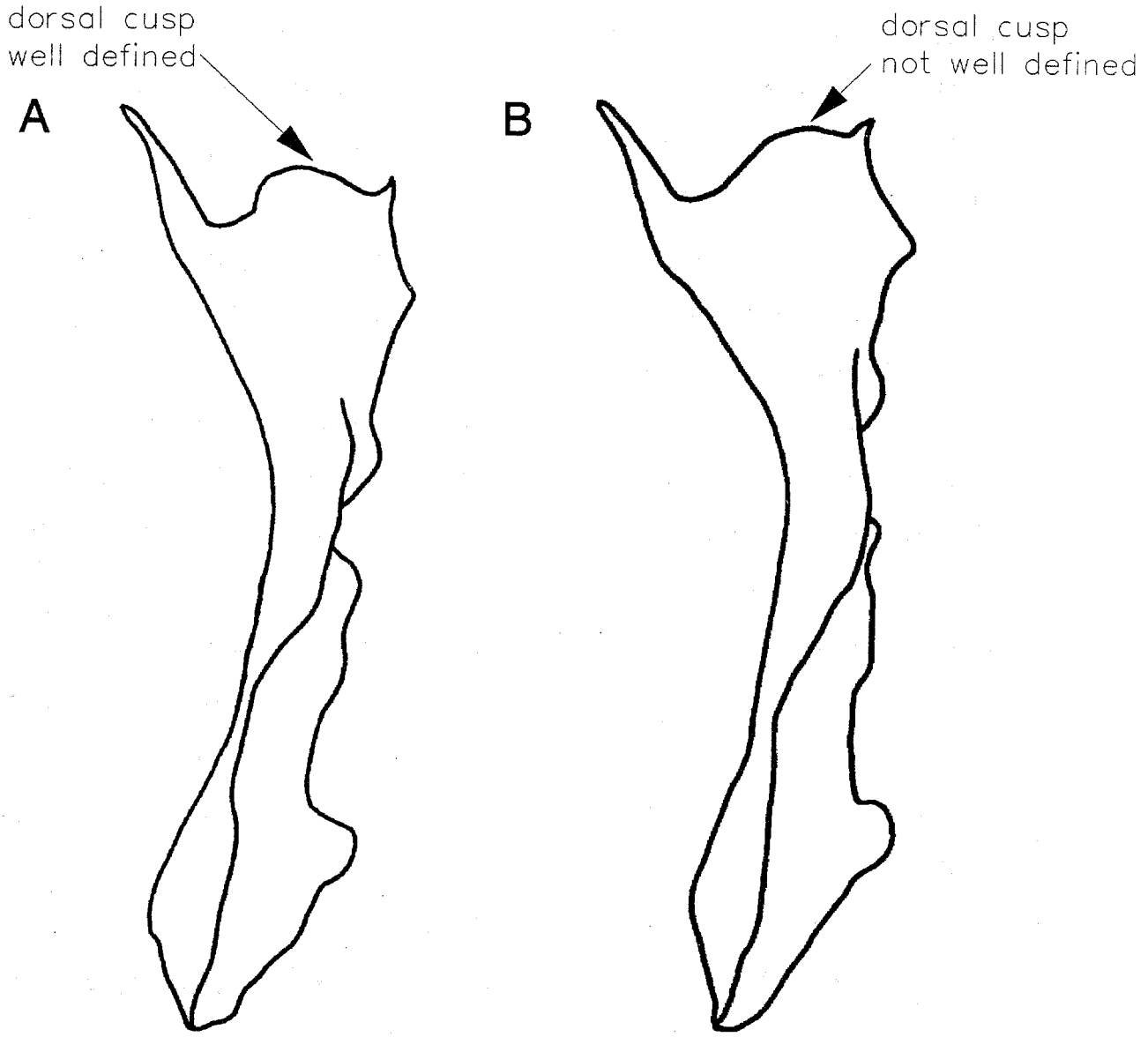

Figure 5. A. *Sebastes saxicola*, and B. *Sebastes wilsoni*.

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

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