
23 May 2007

References to the data, published in annual ichthyoplankton data reports are given in the introduction to the Atlas. In addition, these data are available in PDF format on the SWFSC web site at [http://swfsc.noaa.gov/publications/swcpub/qryPublications.asp](http://swfsc.noaa.gov/publications/swcpub/qryPublications.asp), enter "ichthyoplankton" in the Subject line and "California Cooperative Oceanic Fisheries Investigations" in the Title line. Checking the ALL YEARS button will produce the entire list of available data.

The report for each year usually is published about 7-9 months after the fall cruise, and includes notes about nomenclature changes, etc. The ultimate goal is to update the old ichthyoplankton identifications to current standards; the database is updated as re-identifications for each cruise are completed.
**Sebastes paucispinis**
(14.0mm larva)

**Sebastes macdonaldi**
(15.4mm transforming specimen)

**Sebastes jordani**
(21.0mm larva)

**Sebastes levis**
(19.1mm transforming specimen)
CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

Atlas No. 26

STATE OF CALIFORNIA MARINE RESEARCH COMMITTEE

Cooperating Agencies:
CALIFORNIA ACADEMY OF SCIENCES
CALIFORNIA DEPARTMENT OF FISH AND GAME
STANFORD UNIVERSITY, HOPKINS MARINE STATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE
UNIVERSITY OF CALIFORNIA, SCRIPPS INSTITUTION OF OCEANOGRAPHY

June, 1978
The CalCOFI Atlas Series

This is the twenty-sixth in a series of atlases containing data on the hydrography and plankton from the region of the California Current. The field work was carried out by the California Cooperative Oceanic Fisheries Investigations, a program sponsored by the State of California under the direction of the State's Marine Research Committee. The cooperating agencies in the program are:

- California Academy of Sciences
- California Department of Fish and Game
- Stanford University, Hopkins Marine Station
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- University of California, Scripps Institution of Oceanography

CalCOFI atlases are issued as individual units as they become available. They provide processed physical, chemical and biological measurements of the California Current region. Each number may contain one or more contributions. A general description of the CalCOFI program with its objectives appears in the preface of Atlas No. 2.

This atlas was prepared by the Data Collection and Processing Group of the Marine Life Research Program, Scripps Institution of Oceanography.

CalCOFI Atlas Editorial Staff:
- Abraham Fleminger, Editor

CalCOFI atlases in this series, through June 1978, are:

7. Fleminger, A., 1967. Distributional atlas of calanoid copepods in the California Current region, Part II.
No. 25. Eber, L. E., 1977. Contoured depth-time charts (0 to 200m, 1950 to 1966) of temperature, salinity, oxygen and sigma-t at 23 CalCOFI stations in the California Current.

1 Usually abbreviated CalCOFI, sometimes CALCOFI or CCOFI.
2 Formerly called U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries.
3 For citation this issue in the series should be referred to as CalCOFI Atlas No. 26.

Library of Congress Catalog Card Number 67-4238.

Elbert H. Ahlstrom, H. Geoffrey Moser and Elaine M. Sandknop

Elbert H. Ahlstrom, H. Geoffrey Moser and Elaine M. Sandknop

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Introduction
This CalCOFI Atlas deals with the distribution and relative abundance of rockfish larvae, Sebastes spp., in California Current waters off California and Baja California on CalCOFI cruises from 1950 through 1975. Larvae of Sebastes spp. are among the more common taken on CalCOFI cruises, usually exceeded only by larvae of the northern anchovy, Engraulis mordax, and the Pacific hake, Merluccius productus.

This is the sixth CalCOFI Atlas dealing with distribution and relative abundance of fish larvae in the California Current region. CalCOFI Atlas No. 9 (Kramer and Ahlstrom, 1968) dealt with larvae of the northern anchovy, Engraulis mordax; No. 11 (Ahlstrom, 1969) with larvae of jack mackerel, Trachurus symmetricus and Pacific hake, Merluccius productus; No. 12 (Kramer, 1970) with eggs and larvae of the Pacific sardine, Sardinops caerulea; No. 17 (Ahlstrom, 1972) with six common mesopelagic fishes; and No. 23 (Ahlstrom and Moser, 1975) with eight kinds of flatfishes. With the appearance of this Atlas, distributional charts of all of the more common kinds of larvae taken in CalCOFI collections will be available in this series. As a group, these species contribute 90% or more of the fish larvae obtained on CalCOFI cruises.

The genus Sebastes is represented by 69 species in the eastern North Pacific (Dr. L. Chen, pers. comm.). Rockfish are ooviviparous, i.e., the female carries fertilized eggs until they hatch and then releases the larvae. Intraovarian and newborn larvae of Sebastes have been described and/or illustrated for 39 of the eastern Pacific species. However, complete developmental series have been described for only S. paucispinis (Moser, 1967), S. macdonaldi (Moser, 1972), S. jordani, S. levis (Moser, Ahlstrom and Sandknop, 1977) and S. melanostomus (Moser and Ahlstrom, 1978).

Sebastes is an arctic to temperate water genus, occurring from as far north as the Bering Sea to approximately as far south as the vicinity of Magdalena Bay, Baja California. Sebastes also occurs in the upper part of the Gulf of California (Moser, Ahlstrom, Kramer and Stevens, 1974; Chen, 1975). The center of distribution of the genus Sebastes is in the eastern North Pacific with the largest complement of species occurring off California. According to Dr. L. Chen (pers. comm.), 35 species of Sebastes occur in the western North Pacific off Japan and Russia. Several species are commercially important in the North Atlantic, and one (or more) species occurs off South Africa and off Chile.

1Southwest Fisheries Center, National Marine Fisheries Service, La Jolla, California.
The only scorpaenid genus with a similar distribution to *Sebastes* in the North Pacific is *Scorpaenotolobus* (Moser, 1974). Four other scorpaenid genera are known to occur in the eastern North Pacific: *Scorpaena, Pontinus, Scorpaenodes* and *Ectreposebastes*, but these prefer or are limited to tropical and subtropical waters (Moser, Ahlstrom and Sandknop, 1977); of these, only larvae of *Scorpaena guttata* occur as far north as California.

Some 40 species of rockfish are taken by commercial and sportfishermen off California. The important constituents of the commercial catch are: the bocaccio, *Sebastes paucispinis*; the chilipepper, *S. goodei*; the vermillion rockfish, *S. miniatus*; and the canary rockfish, *S. pinniger*. The marine sport catch from the California partyboat fleet takes a variety of rockfishes, depending on the location of the sportfishery. The bocaccio is by far the most numerous rockfish in the partyboat catch. In summer, when sportfishermen fish more in kelp beds, the other important rockfishes are the olive rockfish, *S. serranoides*, the blue, *S. mystinus*, and the brown, *S. auriculatus*. In winter when the partyboat fleet fishes more particularly for rockfish over reefs, the chilipepper, vermillion and green-spotted, *S. chlorostictus*, are more often taken. Miller and Gotshall (1965) reported on the average annual catch of sportfish between Oregon and Pt. Arguello, 1958-1961, by all methods of fishing — pier, skindiving, shore, skiff and partyboat; they reported the five most important rockfish in this area as the blue, the black, *S. melanops*, the yellowtail rockfish, *

Table 1. Total rockfish landings in California by commercial fishermen and by sportfishermen on partyboats, 1950 to 1976(77).

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<th>Pounds (in 000's)</th>
<th>Source: CF&amp;G Fish Bull. No.</th>
<th>Dollar value (in 000's)</th>
<th>Rank weight/value</th>
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<th>Total partyboat sport catch (in 000's)</th>
<th>% Rockfish</th>
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Table 2. Numbering scheme for charts of *Sebastes* larvae included in this Atlas.

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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>178</td>
<td>-</td>
</tr>
</tbody>
</table>

1A dash (-) indicates no CalCOFI cruise was made during this month.

2An asterisk (*) indicates that a cruise was made, but *Sebastes* larvae were taken on fewer than 5 stations.

*S. flavidus*, the olive, and the copper, *S. caurinus*. The only rockfish reported separately in the party-boat catch is the cowcod, *S. levius*, which, although prized for its large size, seldom ranks among the top 10 rockfish in partyboat catches.

The commercial catch and partyboat sport catch of rockfishes off California from 1950 through 1977 is given in Table 1. Between 1950-1972, the commercial catch fluctuated between 8 and 16 million pounds (average 11.9 million), but since 1973 the catch has ranged between 21.5 and 24.6 million pounds (average 22.9 million).

The marine sportcatches of rockfishes made from the California partyboat fleet have also increased dramatically in recent years, constituting between 66.7% and 73.1% of the total sportfish catch since 1974. In all fairness it should be pointed out that rockfishes usually are not the principal fish sought by sportfishermen from partyboats; rather barracuda, bonito, yellowtail, albacore, and, of course, salmon, are the preferred species. When these are scarce, or not available, rockfish become the primary sportfish, and the popularity of rockfish is increasing among sportfishermen.

This atlas documents the distribution and relative abundance of *Sebastes* larvae on all CalCOFI cruises made during the 26-year period 1950 through 1975, with the exception of Norpac (5508) and three cruises on which *Sebastes* larvae were taken on fewer than five stations. The cruises not represented by charts are 5609 (0 occurrences), 5808 (1 occurrence) and 6611 (2 occurrences). *Sebastes* larvae were taken on Norpac, but mostly outside the regular CalCOFI coverage. CalCOFI
cruises are designated by month and year, thus 5609 is the cruise made in September 1956. The basic CalCOFI station plan utilized since 1950 is given as chart No. 1. All distribution charts based on cruises are numbered sequentially, beginning with 5002 as chart No. 2 through 7511 as chart 178 (Table 2). Thus, a total of 177 distribution charts are included in this Atlas in addition to the basic station plan.

Although the basic CalCOFI station plan remained the same over the years, the complete pattern was never encompassed on any given cruise. Furthermore, most cruises made from January through July had fairly extensive coverage of the pattern, while many cruises made later in the year were restricted to a portion of the pattern. In some recent years, particularly on 1975 CalCOFI cruises, nearshore stations were added to the pattern and these stations, on the average, yielded more Sebastes larvae than did offshore stations. Despite differences in the extent of coverage and in its intensity, we are using all occupancies made on CalCOFI cruises out to station 90 in our principal summary table (Table 3). All stations occupied seaward of station 90 on any line are excluded.

The poorest year in the series is 1959, the year with the most intensive coverage (2050 stations occupied). The percentage of positive hauls was only 29.6% compared to the long-term average of 42.2%. The average number of rockfish larvae obtained per occupancy was 5.6 larvae compared to the long-term average of 22.3 larvae. Of the years with "monthly" cruises the better ones in the series are 1954, with 57.1% positive hauls and 35.3 larvae per occupancy.
Table 3. (continued)

<table>
<thead>
<tr>
<th>Year occup.</th>
<th>No. sta.</th>
<th>X per occup.</th>
<th>Std. no. I</th>
<th>% Occup.</th>
<th>Total Larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>112</td>
<td>1,144</td>
<td>10.2</td>
<td>360</td>
<td>1,189</td>
</tr>
<tr>
<td>1951</td>
<td>320</td>
<td>4,050</td>
<td>12.6</td>
<td>1,321</td>
<td>5,392</td>
</tr>
<tr>
<td>1952</td>
<td>456</td>
<td>4,968</td>
<td>10.9</td>
<td>2,183</td>
<td>7,152</td>
</tr>
<tr>
<td>1953</td>
<td>429</td>
<td>6,102</td>
<td>14.2</td>
<td>2,131</td>
<td>8,234</td>
</tr>
<tr>
<td>1954</td>
<td>486</td>
<td>9,614</td>
<td>19.8</td>
<td>4,815</td>
<td>14,430</td>
</tr>
<tr>
<td>1955</td>
<td>499</td>
<td>8,532</td>
<td>17.1</td>
<td>2,117</td>
<td>10,649</td>
</tr>
<tr>
<td>1956</td>
<td>458</td>
<td>9,733</td>
<td>21.0</td>
<td>2,135</td>
<td>11,868</td>
</tr>
<tr>
<td>1957</td>
<td>520</td>
<td>7,133</td>
<td>13.7</td>
<td>1,541</td>
<td>8,674</td>
</tr>
<tr>
<td>1958</td>
<td>572</td>
<td>3,292</td>
<td>5.8</td>
<td>2,012</td>
<td>5,304</td>
</tr>
<tr>
<td>1959</td>
<td>706</td>
<td>1,877</td>
<td>2.6</td>
<td>850</td>
<td>2,727</td>
</tr>
<tr>
<td>1960</td>
<td>606</td>
<td>2,248</td>
<td>3.7</td>
<td>1,452</td>
<td>3,693</td>
</tr>
<tr>
<td>1961</td>
<td>287</td>
<td>854</td>
<td>3.0</td>
<td>800</td>
<td>1,734</td>
</tr>
<tr>
<td>1962</td>
<td>294</td>
<td>1,780</td>
<td>6.0</td>
<td>207</td>
<td>3,557</td>
</tr>
<tr>
<td>1963</td>
<td>329</td>
<td>2,738</td>
<td>8.3</td>
<td>250</td>
<td>5,288</td>
</tr>
<tr>
<td>1964</td>
<td>339</td>
<td>1,550</td>
<td>4.6</td>
<td>261</td>
<td>4,026</td>
</tr>
<tr>
<td>1965</td>
<td>340</td>
<td>4,348</td>
<td>12.8</td>
<td>450</td>
<td>6,795</td>
</tr>
<tr>
<td>1966</td>
<td>677</td>
<td>5,396</td>
<td>8.0</td>
<td>840</td>
<td>10,838</td>
</tr>
<tr>
<td>1967</td>
<td>122</td>
<td>388</td>
<td>3.2</td>
<td>62</td>
<td>395</td>
</tr>
<tr>
<td>1968</td>
<td>83</td>
<td>1,124</td>
<td>13.5</td>
<td>89</td>
<td>1,213</td>
</tr>
<tr>
<td>1969</td>
<td>524</td>
<td>3,744</td>
<td>7.1</td>
<td>509</td>
<td>4,253</td>
</tr>
<tr>
<td>1970</td>
<td>290</td>
<td>2,006</td>
<td>6.9</td>
<td>21</td>
<td>2,217</td>
</tr>
<tr>
<td>1971</td>
<td>451</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>1972</td>
<td>290</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>1973-74</td>
<td>451</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>1975-76</td>
<td>451</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>1977-78</td>
<td>451</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>1979-80</td>
<td>451</td>
<td>5,297</td>
<td>11.7</td>
<td>238</td>
<td>7,625</td>
</tr>
<tr>
<td>Total</td>
<td>8,900</td>
<td>1,446</td>
<td>15.0</td>
<td></td>
<td>59,324</td>
</tr>
</tbody>
</table>
Table 4. Summary by 5-year periods of CalCOFI data dealing with larvae of rockfish, *Sebastes* sp.

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of stations occupied</th>
<th>Number of positive stations</th>
<th>% of positive stations</th>
<th>Standard number of larvae</th>
<th>Average number per occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-54</td>
<td>2,768</td>
<td>1,915</td>
<td>69.2</td>
<td>94,773</td>
<td>34.24</td>
</tr>
<tr>
<td>55-59</td>
<td>3,385</td>
<td>1,867</td>
<td>55.2</td>
<td>89,537</td>
<td>26.45</td>
</tr>
<tr>
<td>60-64</td>
<td>2,206</td>
<td>1,275</td>
<td>57.8</td>
<td>73,762</td>
<td>33.44</td>
</tr>
<tr>
<td>65-69</td>
<td>2,390</td>
<td>1,393</td>
<td>58.3</td>
<td>137,227</td>
<td>57.42</td>
</tr>
<tr>
<td>1972+1975</td>
<td>1,324</td>
<td>804</td>
<td>60.7</td>
<td>82,870</td>
<td>62.59</td>
</tr>
<tr>
<td>Total</td>
<td>12,073</td>
<td>7,254</td>
<td>60.1</td>
<td>478,169</td>
<td>39.61</td>
</tr>
</tbody>
</table>

Collections made off California (Lines 40-97)

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of stations occupied</th>
<th>Number of positive stations</th>
<th>% of positive stations</th>
<th>Standard number of larvae</th>
<th>Average number per occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-54</td>
<td>3,188</td>
<td>1,289</td>
<td>40.4</td>
<td>36,688</td>
<td>11.51</td>
</tr>
<tr>
<td>55-59</td>
<td>4,319</td>
<td>1,176</td>
<td>27.2</td>
<td>39,222</td>
<td>9.08</td>
</tr>
<tr>
<td>60-64</td>
<td>3,136</td>
<td>620</td>
<td>19.8</td>
<td>13,386</td>
<td>4.27</td>
</tr>
<tr>
<td>65-69</td>
<td>2,748</td>
<td>606</td>
<td>22.0</td>
<td>16,888</td>
<td>6.15</td>
</tr>
<tr>
<td>1972+1975</td>
<td>1,155</td>
<td>267</td>
<td>23.1</td>
<td>8,894</td>
<td>7.70</td>
</tr>
<tr>
<td>Total</td>
<td>14,546</td>
<td>3,958</td>
<td>27.2</td>
<td>115,078</td>
<td>7.91</td>
</tr>
</tbody>
</table>

Collections made off Baja California (Lines 100-137)

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of stations occupied</th>
<th>Number of positive stations</th>
<th>% of positive stations</th>
<th>Standard number of larvae</th>
<th>Average number per occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-54</td>
<td>5,956</td>
<td>3,204</td>
<td>53.8</td>
<td>131,461</td>
<td>22.07</td>
</tr>
<tr>
<td>55-59</td>
<td>7,704</td>
<td>3,043</td>
<td>39.5</td>
<td>128,759</td>
<td>16.71</td>
</tr>
<tr>
<td>60-64</td>
<td>5,342</td>
<td>1,895</td>
<td>35.5</td>
<td>87,148</td>
<td>16.31</td>
</tr>
<tr>
<td>65-69</td>
<td>5,138</td>
<td>1,999</td>
<td>38.9</td>
<td>154,115</td>
<td>30.00</td>
</tr>
<tr>
<td>1972+1975</td>
<td>2,479</td>
<td>1,071</td>
<td>43.2</td>
<td>91,764</td>
<td>37.02</td>
</tr>
<tr>
<td>Total</td>
<td>26,619</td>
<td>11,212</td>
<td>42.1</td>
<td>593,247</td>
<td>22.29</td>
</tr>
</tbody>
</table>

above the long-term average of 60.1%. The abundance of *Sebastes* larvae based on the average number of larvae obtained per occupancy was higher during 1965-1975 than previously. These higher values during the most recent decade could be due, in fact, to more intensive inshore sampling, especially in the Los Angeles Bight area.

In order to follow changes in relative abundance of rockfish larvae in a completely comparable fashion over the 26-year period, 1950-1975, a group of 38 stations that have been occupied continuously over the years off southern California were examined. The station lines involved are 80, 83, 87, 90 and 93. The average abundance of *Sebastes* larvae at these stations was determined for each year. The results for 20 different CalCOFI "years" are presented in Table 6. The value listed for each station during any given year represents the sum of the standardized totals of *Sebastes* larvae taken at that station during the year, divided by the number of occupancies of the station.

The seasonal abundance of rockfish larvae was determined for the southern California area, using the assemblage of stations given in Table 5. A value was obtained for each cruise in the series by dividing the total number of *Sebastes* larvae taken on that cruise by the number of stations occupied. The only month in the series that has a cruise made during each of the 20 CalCOFI years is July. The month of peak abundance is February with 28.2% of the annual total. The three winter months, January-March, contributed 65.1% of the annual
Table 5. Average monthly abundance of rockfish larvae off the Southern California area (Lines 80 through 93 out to station 90) based on average abundance per occupancy for each CalCOFI cruise, 1950-1975, arranged by month.

<table>
<thead>
<tr>
<th>Month</th>
<th>Total No. of all cruises 1950-1975</th>
<th>No. of cruises involved</th>
<th>Average monthly abundance</th>
<th>% of average yearly abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1,582</td>
<td>18</td>
<td>88</td>
<td>20.3</td>
</tr>
<tr>
<td>February</td>
<td>1,579</td>
<td>13</td>
<td>122</td>
<td>28.2</td>
</tr>
<tr>
<td>March</td>
<td>859</td>
<td>12</td>
<td>72</td>
<td>16.6</td>
</tr>
<tr>
<td>April</td>
<td>797</td>
<td>17</td>
<td>47</td>
<td>10.8</td>
</tr>
<tr>
<td>May</td>
<td>369</td>
<td>14</td>
<td>26</td>
<td>6.0</td>
</tr>
<tr>
<td>June</td>
<td>130</td>
<td>11</td>
<td>12</td>
<td>2.8</td>
</tr>
<tr>
<td>July</td>
<td>158</td>
<td>20</td>
<td>8</td>
<td>1.8</td>
</tr>
<tr>
<td>August</td>
<td>43</td>
<td>8</td>
<td>5</td>
<td>1.2</td>
</tr>
<tr>
<td>September</td>
<td>56</td>
<td>8</td>
<td>7</td>
<td>1.6</td>
</tr>
<tr>
<td>October</td>
<td>92</td>
<td>18</td>
<td>5</td>
<td>1.2</td>
</tr>
<tr>
<td>November</td>
<td>139</td>
<td>7</td>
<td>20</td>
<td>4.6</td>
</tr>
<tr>
<td>December</td>
<td>234</td>
<td>11</td>
<td>21</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>6,038</td>
<td>-</td>
<td>433</td>
<td>99.9</td>
</tr>
</tbody>
</table>

catch of rockfish larvae. The summer months represent the period of minimal abundance, with only 4.6% of the larvae taken during the July through September period. Completing the yearly cycle, 19.6% were taken during the spring months of April through June, and 10.6% during the fall months of October through December.

Illustrations and descriptions of four common rockfish are given below. Of these, the bocaccio, *Sebastes paucispinis* is the most important. As already noted, it usually is the most abundant rockfish in both the commercial and sportfish catches. The Mexican rockfish, *S. macdonaldi*, becomes the most abundant species off central Baja California. The shortbelly rockfish, *S. jordani*, although one of the most abundant off California, is a minor element in the catch because of its small size. *S. levis*, the cow rockfish, is a prime sportfish because of its large size but is not common either as larvae or as adults.

**Sebastes paucispinis (Ayres)**

— Bocaccio

**Literature.** Newly hatched larvae of *S. paucispinis* were illustrated by Morris (1956). Moser (1967) gave a complete description of the development of embryos, larvae, and juveniles of this rockfish. The developmental series illustrated here (Fig. 1) is reproduced from Moser, Ahlstrom and Sandknop (1977).

**Distinguishing Features.** As is characteristic of all species of *Sebastes*, eggs are fertilized internally and embryonic development occurs within the ovaries of females. The eggs of *Sebastes* have an outer shell, and probably receive no nutrition from the female other than that enclosed within the egg. Early stage eggs of bocaccio are round and measure 0.85 to 1.0mm in diameter; each has a single large oil globule, ranging from 0.3 to 0.4mm in diameter. As embryonic development proceeds the eggs enlarge and become ovoid in shape; late-stage eggs measure up to 2.0mm in diameter across the major axis. Late-stage embryos develop three areas of pigmentation in the following sequence: initially, melanophores form along the dorso-lateral surface of the gut, followed by a single median series of melanophores along the ventral margin of the tail, and in the most advanced, intra-ovarian embryos melanophores develop on the posterior margins of the pectoral fins. Bocaccio larvae hatch and are extruded from the female at a length of 4.0 to 5.0mm; at this stage they have functional jaws, eyes and pectoral fins.

The larval period extends from hatching to about 15mm SL. We separate the larval period into three stages, which are associated with the development of the caudal fin; the three stages are termed preflexion, flexion, and postflexion stage. These are stages before, during and after the upward flexing of the tip of the notochord. The preflexion stage
Table 6. Relative average abundance of *Sebastes* larvae in the Southern California region, based on 20 years of CalCOFI surveys, 1950-1975 (see text for explanations of listed values).

<p>| Year | 80.51 | 55 | 50 | 70 | 50 | 80 | 95 | 80.40 | 43 | 51 | 55 | 80 | 70 | 50 | 80.50 | 80.35 | 80 | 80 | 80 | 80 | 30 | 48 | 94 | 49 | 23 | 101 |
|------|-------|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|----|----|----|
| 1950 |      | 9  | 15 | 7  | 9  | 0  |    | -     | 78 | 7  | 15 | 2  | 0  | 85 | 126 | 58  | 34  | 2  | 0  | 0  | 0  | 2  | 19  | 20  | 20  | 20  | 20  | 20  |
| 1951 |      | 26 | 15 | 9  | 3  | 2  | &lt;1 | -     | 50 | 60 | 137| 26 | 8  | 1  | 38 | 92  | 281 | 113 | 3  | 2  | 20 |
| 1953 |      | 22 | 61 | 138| 10 | 2  | 3  | 122  | 144| 113| 53 | 7  | 1  | 1  | 51 | 78  | 80  | 6   | 6  | 0  | 3  |
| 1954 |      | 55 | 124| 56 | 6  | 3  | 2  | 58   | 109| 136| 77 | 34 | 11 | 3  | 2  | 88   | 63  | 259 | 14  | 6  | 2  | 0  |
| 1955 |      | 21 | 108| 59 | 16 | 19 | 6  | 10   | 104| 21  | 75 | 29 | 34 | 6  | 61   | 62  | 192 | 63  | 33 | 3  | 2  |
| 1956 |      | 11 | 64 | 59 | 14 | 3  | 1  | 9    | 115| 136| 20 | 41 | 5  | 3  | 1   | 66   | 98  | 236 | 20  | 18 | 7  | 0  |
| 1957 |      | 30 | 487| 94 | 14 | 1  | 2  | 11   | 36 | 264| 30 | 16 | 5  | 1  | 32   | 137 | 26  | 80  | 66 | 33 | 6  |
| 1958 |      | 94 | 85 | 13 | 6  | 2  | 3  | 10   | 103| 46  | 48 | 24 | 5  | 0  | 0   | 44   | 49  | 23  | 10 | 0  | 0  |
| 1959 |      | 19 | 28 | 6  | 2  | 2  | 1  | 7    | 47 | 52  | 37 | 7  | 3  | 1  | 1    | 13   | 28  | 61  | 7  | 9  | 1  |
| 1960 |      | 23 | 28 | 10 | 1  | 1  | &lt;1 | 2    | 64 | 49  | 8  | 7  | 4  | 2  | 0   | 35   | 32  | 38  | 4  | 2  | 0  |
| 1961 |      | 67 | 58 | 10 | 3  | 3  | 0  | 4    | 38 | 68  | 26 | 31 | 6  | 14 | 29  | 6    | 14  | 67  | 18 | 3  |
| 1962 |      | 236| 202| 6  | 2  | 0  | 0  | &lt;1   | 30  | 68  | 52 | 20 | 23 | 2  | 0   | 36   | 41  | 56  | 6  | 1  |
| 1963 |      | 49 | 36 | 4  | 3  | 0  | 0  | 1    | 62  | 42  | 49 | 31 | 0  | 2  | 0   | 47   | 397 | 211 | 9  | 0  |
| 1964 |      | 37 | 37 | 17 | 7  | 2  | 3  | 2    | 51  | 10 | 130| 12 | 3  | 0  | 0   | 44   | 30  | 167 | 12 | 3  |
| 1965 |      | 88 | 26 | 10 | 4  | 1  | 0  | 9    | 50  | 40  | 52 | 3  | 12 | 4  | 0   | 45   | 86  | 319 | 1  | 0  |
| 1966 |      | 140| 36 | 46 | 6  | 1  | 3  | 4    | 113 | 144| 42 | 11 | 2  | 2  | 0   | 45   | 115 | 216 | 6  | &lt;1 |
| 1968 |      | 175| 137| 77 | 4  | 0  | 0  | 20   | 118 | 340| 558| 25 | 0  | 17 | 0   | 46   | 162 | 98  | 58 | 4  |
| 1969 |      | 131| 174| 39 | 1  | &lt;1 | 0  | 2    | 155 | 264| 125| 106| 3  | 10 | 6   | 93   | 337 | 159 | 8  | 35 |
| 1972 |      | 87 | 276| 31 | 84 | 10 | 2  | 1    | 307 | 129| 226| 166| 5  | 15 | 1   | 22   | 19  | 611 | 11 | 3  |
| 1975 |      | 105| 100| 44 | 7  | 0  | 0  | 19   | 101 | 288| 337| 44 | 2  | 3  | 0   | 45   | 49  | 482 | 11 | 11 |
| Total| 1,416|2,091|743 |200 |62 |28 |171 |1,777|2,324|2,089|850|161|128|49 |962 |1,951|3,956|474|173|47|40 |
| No. of occup. | 19 | 20 | 20 | 20 | 20 | 20 | 18 | 19 | 18 | 18 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Avg. abun. | 75 | 105 | 37 | 10 | 3 | 1 | 10 | 94 | 129 | 104 | 42 | 8 | 6 | 2 | 48 | 98 | 198 | 24 | 9 | 2 | 2 |</p>
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extends from hatching to about 7.0mm. Flexion occurs between about 7.0 to 9.0mm; at the completion of flexion the caudal fin base becomes terminal. The postflexion stage extends from 9mm to approximately 15mm.

A prominent morphological feature of scorpaenid larvae is the development of numerous head spines. These reach their most conspicuous development on postflexion larvae of *Sebastes paucispinis* between 10 to 13mm in length. Although spines form on a number of head bones, the most characteristic are the spines on the preopercle and the paired parietal spines and ridges. A number of spines form on the preopercle with the spine at the angle becoming the largest head spine. The paired parietal spines develop early in the larval period and attain their greatest size (20% of head length) in 10 to 13mm larvae in concert with most head spines. In larvae larger than 13mm and in early juveniles the spines regress; only the opercular and preopercular spines persist in juveniles and adults.

Perhaps the most striking morphological features of bocaccio larvae are the paired fins. The pectoral fins are large and fan-shaped at birth. The fins lengthen rapidly during larval development with the dorsal part of each fin growing relatively faster than its ventral part, resulting in an aliform shape. This shape is retained in larvae up to about 10mm in length, after which the posterior margin again becomes vertical. The pectorals reach a maximum relative length of 37% of body length in 13mm larvae and then gradually diminish in relative length during the remainder of the larval and pelagic juvenile stages to about 25% of the body length in late pelagic juveniles. The pelvic fins begin to form as small rounded buds in 5mm larvae and also undergo spectacular development. They lengthen rapidly and reach their greatest relative length of 40% of body length in 13mm larvae. Like the pectorals they diminish to about 25% of body length in pelagic juveniles.

The melanistic pigment which develops on *S. paucispinis* larvae also is a diagnostic character. The three pigment areas described for late-stage embryos persist into the larval period. The single median series of melanistic dashes along the ventral margin of the tail consists of 6 to 14 melanophores (mean of 9). Among 33 species of *Sebastes* larvae obtained from pregnant females, only 2 had a lower number of melanophores in the ventral tail series. These melanophores persist through the flexion stage, then gradually become embedded in the growing hypaxial musculature. Perhaps the most diagnostic pigment is the outer band of pigment on the pectoral fins; a similar band develops on the pelvic fins. These fin pigments persist into the juvenile stage. The larvae also develop pigment on the head, on the caudal fin, and over the base of the hypurals.

The pelagic juvenile stage begins at about 15mm. It is characterized by diminution of parietal and preopercular spines and development of dorsal pigment saddles. The pelagic juvenile stage ends at about 30 to 35mm length, with specimens settling to the bottom as demersal juveniles. Moser (1967) showed that juveniles inhabit waters shallower than 20m during their first year. However, juveniles up to 75mm SL have been collected from a drifting mass of kelp.
Distribution. Adults of *S. paucispinis* range from Kodiak Island, Alaska to as far south as Punta Blanca, Baja California, although the principal distribution of the species is off California; they have been reported offshore to a depth of 320m (Miller and Lea, 1972). Bocaccio larvae are taken in CalCOFI hauls for an 8-month period, November to June, with peak abundance in January and February. Bocaccio larvae are taken as far seaward on CalCOFI cruises as 400km and frequently to 200kms (see Moser et al., 1977, for distribution chart of bocaccio larvae). The distribution of bocaccio larvae is not known north of the California-Oregon border since the CalCOFI sampling pattern usually is terminated at the California-Oregon border.

*Sebastes macdonaldi* (Eigenmann and Beeson)  
— Mexican Rockfish

Literature. Development and geographic distribution of the rockfish *Sebastes macdonaldi* is treated in Moser (1972), and in Moser, Ahlstrom and Sandknop (1977).

Distinguishing Features. Larvae of *S. macdonaldi* are similar in general appearance to those of *S. paucispinis* (Fig.2). They are of similar size at hatching, 4 to 5mm. Early stage larvae are characterized by a low number of melanophores in the series on the ventral midline of the tail with a median count of 8 melanophores (range 6 to 14). Only larvae of *S. melanostomus* and *S. paucispinis* have comparable low counts in this series. They lack melanophores on the dorsal side of the tail. Early larvae of *S. macdonaldi* are also characterized by their small, densely pigmented pectoral fins. Also characteristic is the series of melanophores which extends from the nape to the pectoral fin base, a pattern of pigmentation found on early larvae of only 1 or 2 other species of rockfish. The other pigmented area on preflexion larvae is associated with the gut which is heavily pigmented over its dorsal surface and more sparsely pigmented on the lateral and ventral surfaces.

The pectoral fins of *S. macdonaldi* offer an interesting contrast to those of *S. paucispinis*. In early stage larvae the fins are short and compact, with fin length only 8% of body length before flexion, 13% during flexion, and 19% in postflexion larvae. The fin elongates markedly in pelagic juveniles to about 31% body length. The pectorals remain heavily pigmented throughout the larval period although when rays develop the solid pigmentation is restricted to the membrane between the rays; even so, the overall appearance is a dark compact fin with light striations.

The pelvic fins develop pigmentation similar to the pectorals. The pelvic fin buds are formed on larvae as small as 6.4mm, and rays begin to differentiate in 7mm larvae and are fully formed by 9.4mm. Pelvic fin length increases from 4% of body length at the initiation of notochord flexion to 10% at its completion, to 18 to 21% body length in late postflexion larvae and to 21 or 22% body length in pelagic juveniles.
Flexion of the notochord, concurrent with caudal fin formation occurs on larvae between 7.7 to 9.0 mm (Moser et al., 1977, Table 9). Thus, preflexion stage larvae of \textit{S. macdonaldi} are approximately 4.0 to 7.6 mm, and postflexion stage larvae 9.0 to about 15 or 16 mm in length. Transformation into the pelagic juvenile stage is gradual, and the stage appears to be highly protracted, inasmuch as the smallest demersal juveniles known are about 60 mm in length and pelagic juveniles as large as 44.4 mm have been collected.

Larvae of \textit{S. macdonaldi} are relatively deep bodied. Body depth at the base of the pectoral fins averages 23\% of body length before notochord flexion, 33\% during flexion and 34\% in postflexion larvae.

The conspicuous elements of the pigment pattern were discussed above, and can be seen on the illustrations of larvae and early juveniles. Large larvae of \textit{S. macdonaldi} are among the most heavily pigmented of all rockfish species (Moser, 1972). The head, especially, becomes heavily pigmented on late stage larvae, as well as the dorsal portion of the body adjacent to the dorsal fins. The spinous portion of the dorsal fin becomes heavily pigmented on late stage larvae, and saddles of pigment develop laterally and ventrally on pelagic stage juveniles.

\textit{Distribution.} \textit{S. macdonaldi} has the most southerly distribution of any species of \textit{Sebastes} in the eastern North Pacific. Adults have been taken as far north as Pt. Sur, California, and as far south as Morgan Bank, near Cape San Lucas, Baja California. It also occurs in the Gulf of California, and it is the only species of \textit{Sebastes} known to occur both inside and outside the Gulf although the two populations may now be isolated from each other (Chen, 1975).

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Developmental series of \textit{Sebastes jordani}. A. 7.2-mm larva; B. 10.0-mm larva; C. 15.5-mm larva; D. 21.0-mm larva; E. 29.6-mm pelagic juvenile.}
\end{figure}

\textit{Sebastes jordani} (Gilbert) — Shortbelly Rockfish

\textit{Literature.} Morris (1956) described briefly and figured a newly hatched larva of \textit{S. jordani}, 6.8 mm in length, stripped from a pregnant female. Moser, Ahlstrom and Sandknop (1977) described and illustrated a developmental series of \textit{S. jordani}. The illustrations presented here (Fig. 3) were taken from this publication.

\textit{Distinguishing Features.} The common name of shortbelly rockfish is a very descriptive one. A character that separates juveniles and adults of \textit{S. jordani} from all other known species of \textit{Sebastes} is the anterior placement of the anus. There is a wider space between the anus and the origin of the anal fin in \textit{S. jordani} than in other \textit{Sebastes}. This character also can be seen in larvae. Snout-anus distance averages 36\% of body length in preflexion larvae, 42\% during flexion, 51\% following flexion, and 54\% in pelagic juveniles. Comparative mean percentages for larvae of \textit{S. paucispinis} are 41 before flexion, 45 during flexion and 59 following flexion; for \textit{S. macdonaldi} the comparative percentages are 42, 50, and 60.

Newly hatched larvae of \textit{S. jordani} are among the larger observed by us. In size at hatching, pigment pattern and body shape they resemble newly hatched larvae of the \textit{S. marinus} group of the Atlantic.
The pigment patterns on early stage larvae of *S. jordani* differ from the preceding two species in that there are a series of melanophores along the dorsal midline of the tail in addition to the ventral midline series present on all early stage larvae of *Sebastes*. The ventral series begins at the 3rd to 5th postanal myomere and extends to the 14 to 16th postanal myomere. The dorsal midline series is shorter, extending from the 7th to 12th postanal myomere to the 14 to 16th postanal myomere. In addition, early stage larvae of *S. jordani* have the melanistic shield over the gut, and a group of melanophores over the brain. However, the pectoral fins are unpigmented. The development of pigment on later-stage larvae and pelagic juveniles is shown in Figure 3.

Larvae of *S. jordani* are the most slender of any *Sebastes* yet described. Body depth averages 17% of body length before notochord flexion, 21% during flexion, and 23.5% following flexion. Pelagic juveniles 28 to 68mm are slightly more slender, with a mean of 22%. The above body depth values, beginning with flexion, are so similar that *S. jordani* could be characterized as having a constant body depth during much of its early life history period.

The pectoral fins are short, rounded and unpigmented. Larvae of *S. jordani* have the shortest pectoral fins of any larvae of rockfish yet described. Pectoral fin length averages 7% of body length prior to notochord flexion, 8% during flexion, and 11% in early postflexion larvae increasing to 20% in largest larvae and 22% in the largest pelagic juvenile available (ca. 63mm). Pelvic fin buds form during the flexion stage, prior to formation of dorsal and anal fin rays. The complete complement of pelvic fin rays (I,5) is developed on some larvae of 12.5mm long. Pelvic fins are always shorter than pectoral fins. Preflexion larvae of *S. jordani* measure 5.4 to 7.7mm, flexion larvae 8 to 10mm and postflexion larvae 10.5 to 27mm. Thus, *S. jordani* has an extended larval period. Pelagic juveniles remain in the surface waters; they appear to form schools after transformation from the larval stage. They are often seen at the surface under nightlights and can be readily dipnetted; juveniles in the 30 to 50mm size range are commonly dipnetted. The largest specimen collected under lights is about 63mm long.

**Distribution and Abundance.** According to Miller and Lea (1972), *S. jordani* ranges from British Columbia south to Cape Colnett, Baja California. As noted in Moser et al. (1977) a pelagic juvenile was dipnetted off west San Benitos Island at latitude 28°18'N. Distribution of *S. jordani* larvae is illustrated for composite occurrences during CalCOFI year 1966 in Moser et al., 1977. Distribution of larvae of this species extends from the northern limit of the sampling pattern off San Francisco to the vicinity of Ensenada, Baja California. All larvae were taken in the shoreward region of the sampling grid, with largest catches made on stations adjacent to the coast. Off southern California on 1966 CalCOFI cruises, larvae of *S. jordani* contributed 20% of the total catch of *Sebastes* larvae. It obviously is one of the abundant species of rockfishes.

*Sebastes levis* (Eigenmann and Eigenmann)
— Cow Rockfish

**Literature.** A 5mm specimen of larva obtained from a pregnant female cow rockfish and reared to yolk exhaustion is illustrated in Moser (1972, Fig.16-1). Illustrations and discussions of a developmental series through larval and pelagic juvenile stages are given in Moser, Ahlstrom and Sandknop (1977). The illustrations presented here (Fig.4) are reproduced from this publication.

**Distinguishing Features.** The cow rockfish is a choice catch of sportfishermen because this species attains the largest size of any California rockfish. Larvae at the stage of yolk exhaustion are about 5.0mm which is middling in size for early stage rockfish larvae. Notochord flexion occurs between about 7.5 to 10.5mm body length and postflexion larvae are taken up to about 21mm body length, but some specimens transforming into pelagic juveniles are as small as 19mm. Hence larvae of *S. levis* attain a somewhat larger size at transformation than those of *S. paucispinis* or *S. macdonaldi*, but they are considerably smaller at transformation than larvae of *S. jordani*. The pelagic juvenile stage is a relatively long one; individuals between about 19 to 58mm were studied, while the smallest demersal juvenile available was 66.5mm.

The large fan-like pectoral fins are the most conspicuous diagnostic feature of *S. levis* larvae. The pectoral is only about 9% of body length at yolk exhaustion, but increases rapidly to about 45% at the completion of flexion and retains this large size during the postflexion stage into the pelagic juvenile stage. Later in this stage the fin shortens. Thus, the pectoral fin is 47% body length in a 33mm pelagic juvenile, 38% in a 47mm specimen, 32% in the largest pelagic juvenile available and only 29% in the 66.5mm benthic juvenile.
The pigmentation of cow rockfish larvae is also an aid to identification. The midline melanophores on the tail are confined to the ventral margin; the number of melanophores falls in the middle of the range observed on 33 species of *Sebastes* (Moser et al., 1977, Table 5), with an average count of 17 and a range of 13 to 22. Newborn larvae have a melanistic shield over the gut, a patch of melanophores over the brain, heavy pigment on the tip of the lower jaw, and a varying pattern of pigment on the pectoral fins depending on stage of larval development. In early stage larvae the pectoral fin is covered with fine melanophores which concentrate into a band at the distal margin. In late preflexion and early flexion larvae, the melanophores over most of the fin are lost and only the marginal band persists. By the completion of flexion, the pigment has again spread over most of the fin and this pigment is retained into the pelagic juvenile stage. Pelagic juveniles have developed 4 or 5 pigment saddles which widen into bands across the body.

**Distribution.** Adult cow rockfish have a comparatively limited geographic range from central California to central Baja California, with the center of distribution off southern California. The larvae are rare in CalCOFI samples and most specimens have been obtained in the California Bight area (Moser et al., 1977, Fig. 12). Cow rockfish larvae are taken from January to June.

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**Acknowledgements**

This contribution utilizes all data available on rockfish larvae from CalCOFI cruises made from 1958 through 1975. Over the years many persons aided in identifying and tabulating rockfish data. We wish to thank particularly Elizabeth Stevens, Susan D’Vincent, John Butler, Barbara Sumida, Lois Hunter, Amelia Gomes, Dennis Gruber, and the late David Kramer. Barbara Sumida also aided us greatly in preparation of this Atlas, including help in preparation of tables.
REFERENCES CITED


Estimates of relative abundance of Sebastes spp. larvae under 10 m² of sea surface during the CALCOFI CRUISE 5002 from 31 January to 19 February 1950. Stations are marked with night, sunrise, day, and sunset dots. The map highlights areas of higher abundance near Cape Mendocino, San Francisco, and Point Conception.
Sebastes spp. larvae

CALCOFI CRUISE 5006

6-23 JUNE 1950

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ○ NIGHT  ● SUNRISE
○ DAY  ● SUNSET

CAPE MENDOCINO

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

Sebastes spp. larvae

5006
Sebastes spp. larvae

CALCOFI CRUISE 5007

7–24 JULY 1950

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae

5007
Sebastes spp. larvae

CALCOFI CRUISE 5008
5-19 AUGUST 1950

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

CAPT SANC FRANCISCO
POINT CONCEPTION
SAN DIEGO

Sebastes spp. larvae
5008
Sebastes spp. larvae

CALCOFI CRUISE 5009
6-22 SEPTEMBER 1950

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

CAPE MENDOCINO

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

90-180°, 330° - NA LARVAE

Sebastes spp. larvae
5009
Sebastes spp. larvae

CALCOFI CRUISE 5101
9-29 JANUARY 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
• NIGHT
○ SUNRISE
○ DAY
○ SUNSET

Sebastes spp. larvae
5101
Sebastes spp. larvae

CALCOFI CRUISE 5102
6-25 FEBRUARY 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5103
8-23 MARCH 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- SUNSET

- 10
- 100
- 1,000

San Francisco
Cape Mendocino
Point Conception
San Diego
Punta Eugenia
Sebastes spp. larvae
CALCOFI CRUISE 5104
2-17 APRIL 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

10
100
1000

Sebastes spp. larvae
5104
Estimates of relative abundance under 10 m² of sea surface

Stations: • Night • Sunrise
○ Day • Sunset

Sebastes spp. larvae
CALCOFI CRUISE 5105
1 - 16 May 1951

Point Conception
San Diego
Punta Eugenia
Cape Mendocino
San Francisco
Sebastes spp. larvae

CALCOFI CRUISE 5106
30 MAY - 20 JUNE 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS:
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae

5106
Sebastes spp. larvae

CALCOFI CRUISE 5107
29 JUNE - 19 JULY 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ● SUNSET

Sebastes spp. larvae

5107
Sebastes spp. larvae

CALCOFI CRUISE 5108
31 JULY - 16 AUGUST 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
• NIGHT  • SUNRISE
○ DAY   ○ SUNSET

Sebastes spp. larvae
5108
Sebastes spp. larvae

CALCOFI CRUISE 5109
30 AUGUST–13 SEPTEMBER 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE ○ DAY • SUNSET

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5111
30 OCTOBER-12 NOVEMBER 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

PUNTA EUGENIA

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5112
25 NOVEMBER – 9 DECEMBER 1951

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
          ● DAY • SUNSET

Sebastes spp. larvae

5112
**Sebastes spp. larvae**

CALCOFI CRUISE 5202

6 - 23 FEBRUARY 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae 5202
Sebastes spp. larvae
CALCOFI CRUISE 5203
5 MARCH - 3 APRIL 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

Sebastes spp. larvae
5203
Sebastes spp. larvae

CALCOFI CRUISE 5204
2 - 28 APRIL 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS - NIGHT - SUNRISE
- DAY - SUNSET

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Sebastes spp. larvae
5204
Sebastes spp. larvae

CALCOFI CRUISE 5205
9 - 26 MAY 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
5205
Sebastes spp. larvae

CALCOFI CRUISE 5206
3 - 21 JUNE 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: NIGHT ○ SUNRISE ○ SUNSET

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

PUNTA EUGENIA

Sebastes spp. larvae

5206
Sebastes spp. larvae

CALCOFI CRUISE 5207
2 - 23 JULY 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  ○ SUNRISE
○ DAY  • SUNSET

Sebastes spp. larvae
5207
Sebastes spp. larvae

CALCOFI CRUISE 5208
8 - 27 AUGUST 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae

5208
Sebastes spp. larvae
CALCOFI CRUISE 5209
4 - 19 SEPTEMBER 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae
5209
Sebastes spp. larvae

CALCOFI CRUISE 5210
8-22 OCTOBER 1952

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ▲ SUNSET

Sebastes spp. larvae
Estimates of relative abundance under 10m² of sea surface for Sebastes spp. larvae during the CALCOFI CRUISE 5211, 6–21 November 1952.
Sebastes spp. larvae

CALCOFI CRUISE 5301

8 - 22 JANUARY 1953

ESTIMATED RELATIVE ABUNDANCE UNDER
10 m² OF SEA SURFACE

STATIONS: • NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae

5301
Sebastes spp. larvae

CALCOFI CRUISE 5302
4 - 26 FEBRUARY 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

PUNTA EUGENIA

Sebastes spp. larvae

5302
Sebastes spp. larvae

CALCOF1 CRUISE 5304
31 MARCH - 19 APRIL 1953

ESTIMATED RELATIVE ABUNDANCE UNDER
10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
          ○ DAY • SUNSET

10
100
1,000
Sebastes spp. larvae

CALCOFI CRUISE 5305
28 APRIL - 30 MAY 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS ● NIGHT ○ SUNRISE
○ DAY ● SUNSET
Sebastes spp. larvae

CALCOFI CRUISE 5306
3 JUNE - 3 JULY 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
       ○ DAY • SUNSET

San Francisco
Point Conception
San Diego
Punta Eugenia
Sebastes spp. larvae

CALCOFI CRUISE 5307
8 - 27 JULY 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ⬤ NIGHT ⬤ SUNRISE
            • DAY ⬤ SUNSET

Sebastes spp. larvae
5307
Sebastes spp. larvae

CALCOFI CRUISE 5308
5 - 30 AUGUST 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
         ○ DAY    ○ SUNSET

San Francisco
Punta Eugenia
Point Conception
Cape Mendocino
San Diego
Sebastes spp. larvae

CALCOFI CRUISE 5309
9 - 19 SEPTEMBER 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
         ○ DAY     • SUNSET

Point Conception

San Francisco

Cape Mendocino

San Diego

Punta Eugenia

Sebastes spp. larvae

5309
Sebastes spp. larvae

CALCOFI CRUISE 5310
7 - 24 OCTOBER 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
5310
Sebasfes spp. larvae

CALCOFI CRUISE 5312
1 - 13 DECEMBER 1953

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebasfes spp. larvae

5312
Sebastes spp. larvae

CALCOFI CRUISE 5401
5 JANUARY - 4 FEBRUARY 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ◇ SUNSET

Sebastes spp. larvae

5401
Sebastes spp. larvae

CALCOFI CRUISE 5403
3 - 19 MARCH 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT ○ SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae

5403
Sebasfes spp. larvae

CALCOFI CRUISE 5404
7 - 20 APRIL 1954

Estimated relative abundance under 10 m$^2$ of sea surface

Stations: • Night • Sunrise
○ Day • Sunset

Sebasfes spp. larvae
5404
ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
• DAY  • SUNSET

Sebastes spp. larvae
CALCOFI CRUISE 5405
5-24 MAY 1954

Sebastes spp. larvae
5405
Sebastes spp. larvae

CALCOFI CRUISE 5406
2-23 JUNE 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae

5406
Sebastes spp. larvae

CALCOFI CRUISE 5407
7-21 JULY 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT ○ SUNRISE
○ DAY ▴ SUNSET

San Diego
Punta Eugenia
Point Conception
San Francisco
Cape Mendocino

Sebastes spp. larvae
5407
Sebastes spp. larvae

CALCOFI CRUISE 5408
18 AUGUST–10 SEPTEMBER 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
         O DAY        • SUNSET
Sebastes spp. larvae

CALCOFI CRUISE 5410
6-24 OCTOBER 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

[Map showing the estimated relative abundance of Sebastes spp. larvae in the area around Cape Mendocino and Point Conception.]
Sebastes spp. larvae

CALCOFI CRUISE 5412
30 NOVEMBER-16 DECEMBER 1954

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT ○ SUNRISE
○ DAY □ SUNSET

Sebastes spp. larvae
**Sebastes** spp. larvae

CALCOFI CRUISE 5501

13-29 JANUARY 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
            ○ DAY ● SUNSET

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**Sebastes** spp. larvae

5501
Sebastes spp. larvae

CALCOFI CRUISE 5502
9-23 FEBRUARY 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ● DAY ○ SUNSET

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5503
8-22 MARCH 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
5503
Sebastes spp. larvae

CALCOFI CRUISE 5504
5-22 APRIL 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
● NIGHT
○ SUNRISE
○ DAY
○ SUNSET

San Francisco
Cape Mendocino
Point Conception
San Diego
Punta Eugenia

Sebastes spp. larvae
5504
Sebastes spp. larvae

CALCOFI CRUISE 5505
12 MAY - 7 JUNE 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5506
11-28 JUNE 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS - NIGHT - SUNRISE
- DAY - SUNSET

10
100
1,000

Sebastes spp. larvae

5506
Sebastes spp. larvae

CALCOFI CRUISE 5507
8 - 23 JULY 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

SAN FRANCISCO
CAPE MENDOCINO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
Sebastes spp. larvae
CALCOFI CRUISE 5509
10 - 25 SEPTEMBER 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
   ○ DAY • SUNSET

Sebastes spp. larvae
5509
Sebastes spp. larvae

CALCOFI CRUISE 5510
16 - 30 OCTOBER 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

10
100
1,000

Sebastes spp. larvae
5510
Sebastes spp. larvae

CALCOFI CRUISE 5511
8 - 20 NOVEMBER 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS - NIGHT - SUNRISE
- DAY - SUNSET

SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
Sebastes spp. larvae

CALCOFI CRUISE 5512
29 NOVEMBER – 16 DECEMBER 1955

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae 5512
Sebastes spp. larvae

CALCOFI CRUISE 5601
5 - 18 JANUARY 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
Sebastes spp. larvae

CALCOFI CRUISE 5602
3 - 18 FEBRUARY 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
○ NIGHT  ● SUNRISE
○ DAY  ● SUNSET

San Francisco
Point Conception
San Diego
Punta Eugenia

Sebastes spp. larvae
5602
Sebastes spp. larvae

CALCOFI CRUISE 5603
5 - 19 MARCH 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

SAN DIEGO
PUNTA EUGENIA
POINT CONCEPTION
CAPE MENDOCINO
SAN FRANCISCO

Sebastes spp. larvae
5603
Sebastes spp. larvae

CALCOFI CRUISE 5604
8 - 27 APRIL 1956

ESTIMATED RELATIVE ABUNDANCE UNDER
10 m² OF SEA SURFACE

STATIONS: • NIGHT ◼ SUNRISE
○ DAY ◼ SUNSET

Sebastes spp. larvae
5604
Sebastes spp. larvae

CALCOFI CRUISE 5605
5 - 21 MAY 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
       ○ DAY ● SUNSET

Sebastes spp. larvae
5605
Sebastes spp. larvae

CALCOFI CRUISE 5607
7 - 24 JULY 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

San Francisco
Point Conception
San Diego
Punta Eugenia

Sebastes spp. larvae
5607
Sebastes spp. larvae

CALCOFI CRUISE 5608
13 - 18 AUGUST 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae

5608
Sebastes spp. larvae

CALCOFI CRUISE 5610
28 SEPTEMBER - 5 OCTOBER 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
• NIGHT
○ DAY
○ SUNRISE
○ SUNSET

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

PUNTA EUGENIA

Sebastes spp. larvae

5610
Sebastes spp. larvae

CALCOFI CRUISE 5611
30 OCTOBER - 5 NOVEMBER 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
• NIGHT
• SUNRISE
○ DAY
○ SUNSET

Sebastes spp. larvae

5611
Sebastes spp. larvae

CALCOFI CRUISE 5612
5 - 12 DECEMBER 1956

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS - NIGHT - SUNRISE
- DAY - SUNSET

Sebastes spp. larvae
5612
Sebastes spp. larvae

CALCOFI CRUISE 5701
6 - 19 JANUARY 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

Sebastes spp. larvae
5701
Sebastes spp. larvae

CALCOFI CRUISE 5702
7 - 21 FEBRUARY 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
- NIGHT
- SUNRISE
- DAY
- SUNSET

San Francisco
Cape Mendocino
Point Conception
San Diego
Punta Eugenia
Sebastes spp. larvae

CALCOFI CRUISE 5703
7 - 30 MARCH 1957

Estimated relative abundance under 10 m² of sea surface

Stations
- Night
- Sunrise
- Day
- Sunset

San Francisco
Cape Mendocino
Point Conception
San Diego
Punta Eugenia
Sebastes spp. larvae

CALCOFI CRUISE 5704
11-30 April 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS

- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae

5704
Sebastes spp. larvae

CALCOFI CRUISE 5708
16 - 21 AUGUST 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10m^2 OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
5708
Sebastes spp. larvae

CALCOFI CRUISE 5709
12 - 21 SEPTEMBER 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
□ DAY ○ SUNSET

Sebastes spp. larvae
5709
Sebastes spp. larvae

CALCOFI CRUISE 5710
4 OCTOBER - 8 NOVEMBER 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  ⊙ SUNRISE
             ○ DAY  ○ SUNSET

10
100
1,000
Sebastes spp. larvae

CALCOFI CRUISE 5711
16 - 25 NOVEMBER 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
• DAY • SUNSET

Sebastes spp. larvae
CALCOFI CRUISE 5712
15 - 20 DECEMBER 1957

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
○ NIGHT  ● SUNRISE
● DAY  ○ SUNSET

Sebastes spp. larvae

5712
CALCOFI CRUISE 5801
8 JANUARY - 2 FEBRUARY 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS - NIGHT    - SUNRISE
            - DAY      - SUNSET

Sebastes spp. larvae

5801
Sebastes spp. larvae

CALCOFI CRUISE 5803
27 FEBRUARY - 21 MARCH 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT ● SUNRISE ○ DAY □ SUNSET

SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA

Sebastes spp. larvae

5803
Sebastes spp. larvae

CALCOFI CRUISE 5804
30 MARCH - 27 APRIL 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ○ SUNSET

PUNTA EUGENIA

SAN DIEGO

POINT CONCEPTION

SAN FRANCISCO

CAPE MENDOCINO
**Sebastes spp. larvae**

CALCOFI CRUISE 5806

4-26 JUNE 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

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*Sebastes* spp. larvae

5806
Sebastes spp. larvae

CALCOFI CRUISE 5807
30 JUNE - 22 JULY 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

10
100
1,000

Sebastes spp. larvae
5807
Estimates of relative abundance of Sebastes spp. larvae under 10 m² of sea surface during the CALCOFI CRUISE 5809, 4-19 September 1958.

Stations:
- Black circles: Night (0-6 AM)
- White circles: Sunrise (6 AM - 12 PM)
- Solid circles: Day (12 PM - 6 PM)
- Crosses: Sunset (6 PM - 0 AM)

Locations:
- Cape Mendocino
- San Francisco
- Point Conception
- San Diego
- Punta Eugenia
Sebastes spp. larvae

CALCOFI CRUISE 5810
8 OCTOBER - 6 NOVEMBER 1958

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT ○ SUNRISE
○ DAY ● SUNSET

SAN FRANCISCO

CAPE MENDOCINO

POINT CONCEPTION

SAN DIEGO

PUNTA EUGENIA

Sebastes spp. larvae

5810
Sebastes spp. larvae

CALCOFI CRUISE 5901
7-30 JANUARY 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
            ○ DAY ● SUNSET

10
100
1,000

Sebastes spp. larvae

5901
Sebastes spp. larvae

CALCOFI CRUISE 5902
6 - 28 FEBRUARY 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ○ SUNSET

Sebastes spp. larvae

5902
Sebastes spp. larvae

CALCOFI CRUISE 5903
12 - 28 MARCH 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT ○ SUNRISE
○ DAY ○ SUNSET

Sebastes spp. larvae

5903
Sebastes spp. larvae

CALCOFI CRUISE 5905
7-26 MAY 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae
5905
Sebastes spp. larvae

CALCOFI CRUISE 5906
3 - 30 JUNE 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
          ○ DAY    • SUNSET

Sebastes spp. larvae
5906
**Sebastes** spp. larvae

CALCOFI CRUISE 5908

13 - 30 AUGUST 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

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**Sebastes** spp. larvae

5908
Sebastes spp. larvae

CALCOFI CRUISE 5909
9 - 27 SEPTEMBER 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS:
- NIGHT
- SUNRISE
- DAY
- SUNSET

Sebastes spp. larvae
5909
Sebastes spp. larvae

CALCOFI CRUISE 5910
9 – 29 OCTOBER 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT ○ SUNRISE
○ DAY • SUNSET

San Francisco
Point Conception
San Diego
Punta Eugenia
Cape Mendocino
Sebastes spp. larvae

CALCOFI CRUISE 5911
17 - 25 NOVEMBER 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae

5911
Sebastes spp. larvae

CALCOFI CRUISE 5912

9 - 19 DECEMBER 1959

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae

5912
Sebastes spp. larvae

CALCOFI CRUISE 6002
11 FEBRUARY - 3 MARCH 1960

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m$^2$ OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
          ○ DAY    • SUNSET

Sebastes spp. larvae
6002
Sebastes spp. larvae

CALCOFI CRUISE 6003
10 - 29 MARCH 1960

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae

6003
Sebastes spp. larvae

CALCOFI CRUISE 6004
29 MARCH - 30 APRIL 1960

ESTIMATED RELATIVE ABUNDANCE UNDER
10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae

6004
Sebastes spp. larvae

CALCOFI CRUISE 6005
13 – 29 MAY 1960

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
○ DAY ● SUNSET

Sebastes spp. larvae
6005
Sebastes spp. larvae

CALCOFI CRUISE 6009
9 – 21 SEPTEMBER 1960

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE
○ DAY • SUNSET

Sebastes spp. larvae

6009
Sebastes spp. larvae

CALCOFI CRUISE 6010
22 SEPTEMBER - 22 OCTOBER 1960

ESTIMATED RELATIVE ABUNDANCE UNDER 10m OF SEA SURFACE

STATIONS: NIGHT, DAY

SUNRISE, SUNSET

Sebastes spp. larvae

6010
Sebastes spp. larvae

CALCOFI CRUISE 6101
5 JANUARY - 20 FEBRUARY 1961

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
○ NIGHT
● SUNRISE
○ DAY
● SUNSET

10
100
1,000
10,000
Sebastes spp. larvae

CALCOFI CRUISE 6104
4 APRIL - 12 MAY 1961

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
          ○ DAY       • SUNSET

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Sebastes spp. larvae

6104
Sebastes spp. larvae
CALCOF CRUISE 6110
10 OCTOBER - 12 NOVEMBER 1961

Sebastes spp. larvae
6110
Sebastes spp. larvae

CALCOFI CRUISE 6307
10 JULY - 7 AUGUST 1963

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

Sebastes spp. larvae
6307
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

**Sebastes spp. larvae**

**CALCOFI CRUISE 6401**

9 JANUARY – 4 MARCH 1964

**ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE**

**STATIONS:** ● NIGHT ○ SUNRISE ○ DAY ○ SUNSET

The contouring of abundances at closely spaced stations off Point Conception reflects more concentrated sampling than was taken throughout the remainder of the CalCOFI program. The main chart shows abundances derived from stations occupied regularly.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in town, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

The contouring of abundance at closely spaced stations off Point Conception reflects more concentrated sampling than was taken throughout the remainder of the California pattern. The main chart shows abundance derived from stations occupied regularly.

Sebastes spp. larvae
CALCOFI CRUISE 6407
15 JUNE - 4 AUGUST 1964

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT o SUNRISE ○ DAY o SUNSET
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tow, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6504
31 MARCH - 24 APRIL 1965

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
          ○ DAY • SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tow, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

Sebastes spp. larvae
6504
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in Iowa, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6602
15 FEBRUARY - 6 MARCH 1966

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS
● NIGHT
● SUNRISE
● DAY
● SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6605
5 - 29 MAY 1966

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS
○ NIGHT
○ SUNRISE
○ DAY
○ SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
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The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6712
7 - 20 DECEMBER 1967

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0". When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6801
7-26 JANUARY 1968

ESTIMATED RELATIVE ABUNDANCE UNDER 10\textsuperscript{m2} OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE ○ DAY ● SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the stations represent abundance at special inshore stations. When no larvae appear in town, stations are marked "O." When present, abundance at those stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tow, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
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*Sebastes* spp. larvae
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contour of abundance shown on this chart.

*Sebastes* spp. larvae

CALCOFI CRUISE 6906

9–28 JUNE 1969

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS • NIGHT • SUNRISE

• DAY • SUNSET

10

100

2

*Sebastes* spp. larvae

6906
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
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Sebastes spp. larvae

CALCOFI CRUISE 6908
6 AUGUST – 8 SEPTEMBER 1969

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.

*Sebastes* spp. larvae

CALCOFI CRUISE 6909
11 SEPTEMBER - 7 OCTOBER 1969

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT  • SUNRISE
          • DAY   • SUNSET

The map shows the estimated relative abundance of *Sebastes* spp. larvae during the CALCOFI CRUISE 6909, conducted from 11 September to 7 October 1969. The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 6910
9 OCTOBER – 8 NOVEMBER 1969

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
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Sebastes spp. larvae

CALCOFI CRUISE 7202
1 FEBRUARY - 2 MARCH 1972

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 7203
3 - 27 MARCH 1972

ESTIMATED RELATIVE ABUNDANCE UNDER
10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
○ DAY • SUNSET

The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tow, stations are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 7205
12 APRIL - 8 JUNE 1972

ESTIMATED RELATIVE ABUNDANCE UNDER 10m² OF SEA SURFACE

STATIONS: ● NIGHT ○ SUNRISE
            ○ DAY ○ SUNSET

Sebastes spp. larvae
7205
The numbers to the right of the shoreline represent abundance at special inshore stations. When no larvae appear in tows, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated-abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
Sebastes spp. larvae

CALCOFI CRUISE 7210
25 SEPTEMBER - 14 NOVEMBER 1972

ESTIMATED RELATIVE ABUNDANCE UNDER 10 m² OF SEA SURFACE

STATIONS: • NIGHT • SUNRISE
○ DAY • SUNSET

PORT ANGELES

ASTORIA

CAPE MENDOCINO

SAN FRANCISCO

POINT CONCEPTION

SAN DIEGO

Sebastes spp. larvae

7210
The numbers to the left of the shoreline represent abundance at special inshore stations. When no larvae appear in tow, stations are marked "O." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used in formulating the contours of abundance shown on this chart.
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The numbers to the left of the shoreline represent abundance at special inshore stations. When no larvae appear in these stations, they are marked "0." When present, abundance at these stations is indicated by the number to the right of the estimated abundance key. The special inshore stations are too closely spaced to be shown by station circles and their values were not used to formulate the contours of abundance shown on this chart.
These maps are designed to show essential details of the area most intensively studied by the California Cooperative Oceanic Fisheries Investigations. This is approximately the same area as is shown in color on the front cover. Geographical place names are those most commonly used in the various publications emerging from the research. The cardinal station lines extending southwestward from the coast are shown. They are 120 miles apart. Additional lines are utilized as needed and can be as closely spaced as 12 miles apart and still have individual numbers. The stations along the lines are numbered with respect to the station 60 line, the numbers increasing to the west and decreasing to the east. Most of them are 40 miles apart, and are numbered in groups of 10. This permits adding stations as close as 4 miles apart as needed. An example of the usual identification is 120.65. This station is on line 120, 20 nautical miles southwest of station 60.

The projection of the front cover is Lambert’s Azimuthal Equal Area Projection. The detail maps are a Mercator projection.
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