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FISHERIES RESEARCH BOARD OF CANADA

MANUSCRIPT REPORT SERIES

No. 1137

Preliminary Report on Maturity Spawning Season and Larvae Identification of Rockfishes (Scorpaenidae) Collected During 1970

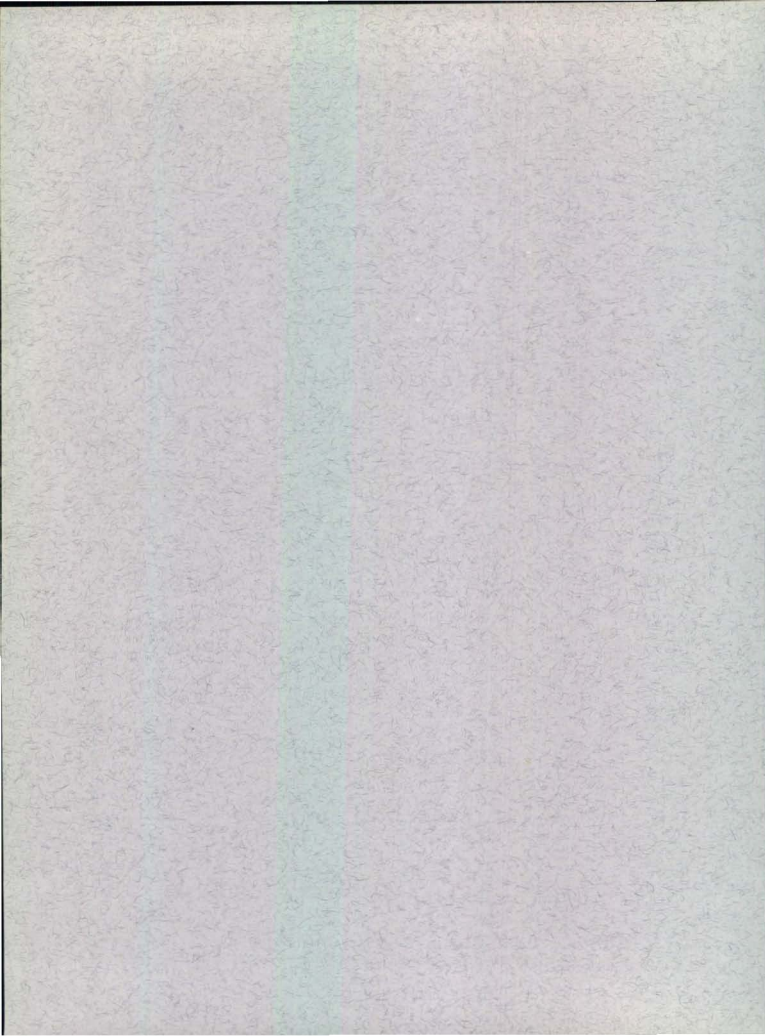
by

W. R. Harling, M. S. Smith and N. A. Webb

Biological Station, Nanaimo, B.C.

April 1971

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INTRODUCTION

During 1970, field studies continued on the maturation, spawning season and larvae identification of rockfish (Scorpaenidae) species. These studies began in 1967 (Westrheim et al., MS, 1967), and continued in 1968 (Westrheim et al., MS, 1968) and 1969 (Harling et al., MS, 1969).

The 1970 studies were directed primarily at the Southeast Alaska region for comparison with the data collected off southwest Vancouver Island during 1967-69 (Fig. 1). However, data were actually collected from five areas -- La Pérouse Bank (southwest Vancouver Island), Queen Charlotte Sound, Langara Island (northwest Queen Charlotte Islands), Southeast Alaska, and off Icy Bay, Alaska.

MATERIALS AND METHODS

Collection of samples

All samples were collected during G.B. REED groundfish cruise no. 70-1 (Harling et al., MS, 1970), 70-2 (Westrheim et al., MS, 1970) and 70-3 (Harling et al., MS, 1970) using standard otter trawls or experimental off-bottom trawls.

Processing of specimens

Procedures used for determining maturity and spawning season, and classifying pre-extrusion larvae were the same as those reported for 1967-69. One exception was the preservative for larvae. Larvae stored in 5% formalin shrivelled and turned opaque after prolonged storage. In 1970, larvae were successfully fixed and stored in a modified Davidson's "A" solution¹. While the new preservative maintained the larvae in better shape, an unforeseen problem arose. The preservative leached tannin from the vial corks, and the tannin stained the larvae so that melanophore patterns could not be distinguished. Fortunately, only a few samples were affected before the leaching was discovered, and corks were replaced with plastic caps.

Shrinkage tests were undertaken for S. alutus larvae stored in both formalin and Davidson's solutions (Table 1). Shrinkage ranged from 7 to 11% after 5-12 days in storage. The relatively low mean length (7.80 mm) for the control lot in formalin sample no. 2 was probably caused by the death of some of the larvae prior to measurement. Larvae were observed to visibly shrink immediately after death.

¹Counts of: 20 parts, 40% unbuffered formalin; 20 parts, glycerin; 30 parts, 95% ethanol; and 30 parts, NaCl solution (30%).

RESULTS

General

A total of 20,520 specimens, comprising 24 species, were examined for gonad development (Table 2). Size composition, by sex, for each species is shown in Appendix Table 1. (A further division is shown for those species which exhibited a significant variation in size composition by geographic area.)

A total of 60 larvae samples, comprising 11 species, were collected during GBR 70-1 and examined later in the laboratory to evaluate the worth of melanophore patterns in species identification.

Shipboard rearing experiments, initiated in 1968 (Westrheim et al., MS, 1968), were continued during GBR 70-1. A total of 139 time-series samples, from 10 species, were collected during this cruise. No larvae were encountered during GBR 70-2 or 70-3.

Maturity

Descriptions of the maturity stages of gonads are listed in Table 3. The numbers of specimens examined, by area, month, species, sex and gonad condition are listed in Appendix Table 2.

Table 4 gives the size interval, by sex, area and month, for each species in which 50% or more of the fish were mature. As in previous years, condition-9 males and condition-2 females have arbitrarily been deemed immature.

No species were examined in sufficient quantity in any one month or area to determine ovary condition by 20-fm depth interval. However, during cruise no. 70-3 an attempt was made to determine variations in the degree of testes development for mature *S. alutus* males with depth. Table 5 summarizes the results. In general, shallow water (<160 fm) specimens were developing more quickly than fish in intermediate (160 fm-200 fm) or deep (>200 fm) water. This variation in development may be related to water temperatures (temperatures decreased with depth during 70-3).

Spawning season

Table 6 lists the estimated spawning time, by area, of selected species collected during 1970. In general, the principal spawning time for each species was later in the year for fish taken in northern waters.

Larvae identification

Table 7 summarizes the pigment characters for each species collected by geographic area during 1970.

Figure 2 shows the melanophore patterns for three species (S. ciliatus; S. entomelas; S. variegatus) not described in earlier reports. In addition, two previously described species (S. ruberrimus and S. zacentrus) are shown to illustrate variations in melanophore patterns within species.

Variations of melanophore patterns often occurred within species collected during 1970 by geographic area, by time, and by sample collected at the same time within a single geographic area.

Variations of pigment patterns by geographic area in S. alutus specimens (Table 7) occurred in the dorsal pigment row (presence or absence of melanophores). Minor differences also occurred in the head and hypural region. A further difference, in the ventral pigment row, is noted between S. alutus specimens collected in 1970 off S.E. Alaska and those collected in 1968 off southwest Vancouver Island (Westrheim et al., MS, 1968). Unlike the 1970 specimens, none of the 1968 S. alutus specimens had less than 16 melanophores in the ventral row.

Two other species (S. ruberrimus and S. zacentrus) collected from Queen Charlotte Sound in 1970 differed from specimens collected off southwest Vancouver Island in 1968. The 1970 S. ruberrimus specimens possess a greater number of (and more distinct) ventral melanophores (Fig. 1). Samples of S. zacentrus collected in 1968 are entirely different from S. zacentrus (A) shown in Fig. 1, but agree very well with S. zacentrus (B).

Table 8 shows the variation among samples, within species, captured in a single geographic area. Of the species examined, S. alutus displayed the greatest variation, primarily in the presence or absence of a dorsal pigment row. Not only were these S. alutus samples from the same area, they were captured in the same tow.

The two S. zacentrus diagrams in Fig. 1 also demonstrate differences in melanophore patterns from specimens captured in the same geographic area (Queen Charlotte Sound) at the same time (June 10-12). S. zacentrus (A) differs from S. zacentrus (B) in the following characters:

- 1) it possesses a dorsal pigment row
- 2) the ventral pigment row does not stop short of the anus by four myotomes
- 3) considerable pigment encircles the yolk sac
- 4) a large melanophore is situated midway between the dorsal and ventral rows
- 5) a greater amount of pigment is evident in the hypural region

Temporal changes in melanophore patterns within species, by geographic area, are shown in Table 9. S. aleutianus, S. entomelas, and S. zacentrus exhibited little or no change, but the remaining seven species displayed varying degrees of change. Most common character variation occurred in the head. Variations also occurred in the dorsal pigment row and hypural region.

Table 10 shows the temporal variation in pigment pattern for larvae sampled from three parent specimens of S. alutus and two of S. helvomaculatus captured in the same geographic area. Again, the variation with time, both within a single parent specimen and among parent specimens is evident.

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Table 1. Mean lengths (cm) and standard deviations (S.D.) for S. alutus larvae before and after storage in two preservatives.

Preservative		Duration of preservation (days)				
		0	5	7	12	
<u>Modified Davidson's solution</u>						
1.	May 8	\bar{L}	8.19	7.61	..	7.54
		N	25	22	..	21
		S.D.	0.18	0.24	..	0.27
2.	May 13	\bar{L}	8.03	..	7.18	..
		N	28	..	23	..
		S.D.	0.23	..	0.32	..
<u>Formalin</u>						
1.	May 8	\bar{L}	8.06	7.37	..	7.19
		N	27	27	..	27
		S.D.	0.17	0.24	..	0.17
2.	May 13	\bar{L}	7.80	..	7.01	..
		N	28	..	23	..
		S.D.	0.25	..	0.22	..

Table 2. Numbers of rockfish (Scorpaenidae) specimens examined for gonad condition, by species and sex, during 1970.

Species	Males	Females	Total
<u>Sebastes</u>			
<u>aleutianus</u>	454	341	795
<u>alutus</u>	6,701	4,626	11,327
<u>aurea</u>	14	21	35
<u>brevispinis</u>	567	244	811
<u>caenaemeticus</u>	98	158	256
<u>ciliatus</u>	9	12	21
<u>crameri</u>	76	151	227
<u>diploproa</u>	29	31	60
<u>elongatus</u>	394	257	651
<u>entomelas</u>	31	28	59
<u>flavidus</u>	92	20	112
<u>goodei</u>	0	1	1
<u>helvomaculatus</u>	409	438	847
<u>paucispinis</u>	21	20	41
<u>pinniger</u>	18	8	26
<u>proriger</u>	608	792	1,400
<u>reedi</u>	111	107	218
<u>ruberrimus</u>	35	41	76
<u>rubrivinctus</u>	287	217	504
<u>saxicola</u>	4	8	12
<u>variegatus</u>	303	389	692
<u>wilsoni</u>	1	0	1
<u>zacentrus</u>	672	914	1,781
<u>Sebastolobus alascanus</u>	326	241	567
Total	11,260	9,260	20,520

Table 3. Description of maturity stages of rockfish (Sebastes) gonads.

Maturity	Stage	Description
0	Unknown	
		<u>MALES</u>
1	Immature	String-like, translucent
9	Maturing	String-like, slight swelling, translucent white
8A	Resting	Ribbon-like, small, brown
8B	Mature Developing	Ribbon-like, swelling, brown-white
8C	Developed	Large, white, easily broken
		<u>FEMALES</u>
1	Immature	Small, translucent
2	Maturing	Small, yellow ^a , translucent or opaque
3	Mature	Large, yellow ^a , opaque
4	Fertilized	Large, orange-yellow, translucent
5	Embryos or larvae	Large, translucent yellow with black dots to grey with black dots
6	Spent	Large, flaccid, red. A few larvae may be present
7	Resting	Moderate size, firm, red-grey. Some with black blotches

^aSome species possess creamy rather than yellow ovaries. Among these are: S. aleutianus; S. brevispinis; S. crameri; S. entomelas; S. paucispinis.

Table 4. Size (cm) at 50% maturity by sex, area^a, and month for rockfish (Scorpaenidae) species examined in 1970.

SPECIES	MALES								FEMALES							
	LP		QCS	LI	SA		IB	LP		QCS	LI	SA		IB		
	APR	SEPT	JUNE	MAY	MAR	APR	MAY	MAY	APR	SEPT	JUNE	MAY	MAR	APR	MAY	MAY
<u>aleutianus</u>	<44	<45	-	-	<43	<41	>40	-	-	<47	-	-	<45	-	-	-
<u>alutus</u>	35	34	34	37	34	33	33	31	35	37	<37	>35	34	34	34	31
<u>aurora</u>	<23	-	-	-	-	-	-	-	-	<29	-	-	-	-	-	-
<u>brevispinis</u>	-	-	45	<45	<43	-	-	39	-	-	46	<45	<51	-	-	40
<u>caenaemeticus</u>	<54	<51	-	-	46	-	-	-	<46	52	-	-	<48	-	-	-
<u>ciliatus</u>	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	>36
<u>crameri</u>	<38	<34	-	-	-	-	-	-	-	<39	<42	-	-	-	-	-
<u>diploproa</u>	-	-	26	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>elongatus</u>	-	24	25	-	-	-	-	-	-	<23	<27	-	-	-	-	-
<u>entomelas</u>	-	-	<43	<43	-	-	-	-	-	-	<45	<49	-	-	-	-
<u>flavidus</u>	-	-	<41	<43	-	-	-	-	-	-	-	-	-	-	-	-
<u>goodei</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>helvomaculatus</u>	>19	23	22	<29	<25	<21	<22	-	<19	23	19	<28	<24	<22	<22	-
<u>paucispinis</u>	-	-	<57	-	-	<57	-	-	-	-	<62	-	-	-	-	-
<u>pinniger</u>	-	-	<45	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>proriger</u>	-	<28	29	-	-	-	-	-	-	<30	32	-	-	-	-	-
<u>reedi</u>	-	-	>34	>34	-	>34	-	-	-	-	>34	>35	-	>35	-	-
<u>ruberrimus</u>	-	-	53	-	-	-	-	-	-	-	49	-	-	-	-	-
<u>rubrivinctus</u>	-	-	37	38	>31	>29	34	-	-	-	>43	<47	<40	>32	38	-
<u>saxicola</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>variegatus</u>	-	-	25	-	23	-	-	23	-	-	24	-	24	-	-	21
<u>wilsoni</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>zacentrus</u>	-	-	24	-	23	23	24	22	-	-	27	-	25	26	25	21
<u>Sebastolobus</u> sp.	-	-	22	-	27	-	-	-	-	-	23	-	29	-	-	-

^aLP = La Pérouse Bank (southwest Vancouver Island)

QCS = Queen Charlotte Sound

LI = Langara Island

SA = Southeast Alaska

IB = Icy Bay

Table 5. Variation in the development of S. alutus testes with depth during GBR 70-3.

Depth Interval (fm)	Testes Category						Total No.
	A		B		C		
	No.	%	No.	%	No.	%	
100-119	3	5	59	94	0	-	63
120-139	3	6	47	89	3	6	53
140-159	22	13	147	84	5	3	174
160-179	33	31	72	69	0	-	105
180-199	37	31	81	69	0	-	118
200-219	107	66	55	34	0	-	162
220-239	90	52	82	47	1	1	173
240-259	211	49	223	51	0	-	434

Table 6. Estimated principal spawning time, by area, for selected rockfish (*Sebastes*)^a species collected during 1970.

Area	Month of Principal Spawning		
La Pérouse Bank	Before April <u>aleutianus</u> <u>alutus</u>		After April <u>helvomaculatus</u>
Queen Charlotte Sound	Before June <u>alutus</u> <u>crameri</u>	June <u>brevispinis</u> <u>helvomaculatus</u> <u>proriger</u> <u>variegatus</u> <u>zacentrus</u>	After June <u>elongatus</u>
Langara Island	April-May <u>alutus</u>		
Southeast Alaska	Before March <u>Seb. alascanus</u>	April-May <u>alutus</u>	After May <u>brevispinis</u> <u>helvomaculatus</u> <u>zacentrus</u>
Icy Bay	May <u>alutus</u>		
			After May <u>brevispinis</u> <u>variegatus</u> <u>zacentrus</u>

^aSebastes alascanus is also included in the table.

Table 7. Pigment patterns, by geographic area, of larval rockfish (Sebastes) collected in 1970.

Character	<u>alentinianus</u>	<u>alutus</u>	<u>alutus</u>	<u>alutus</u>	<u>ciliatus</u>	<u>cremeri</u>	<u>entomeias</u>	<u>helvomasculatus</u>	<u>protriger</u>	<u>ruberrimus</u>	<u>rubrivinctus</u>	<u>variegatus</u>	<u>variegatus</u>	<u>zacentrus</u>
<u>Ventral pigment row</u>														
present	+ ^b	+	+	+	+	+	+	+	+	+	+	+	+	+
stops short of anus	+	+	+	+	+	+	+	+	+	+	+	+	+	+
multiple or irregular	- ^b	-	-	-	-	-	-	-	-	-	-	-	-	-
stops short of anus by at least 4 myotomes	+	+	+	+	5/10	+	+	+	+	+	4/10	24/25	+	-
usually less than 16 melanophores	+	+	65/87	18/58	? ^d	8/13	?	4/7	15/34	+	-	2/23	1/3	-
<u>Dorsal pigment row</u>														
present	-	3/5 ^c	-	24/85	4/10	-	-	-	-	-	+	-	-	+
stops short of anus	-	3/5	-	24/85	4/10	-	-	-	-	-	+	-	-	+
multiple or irregular	-	-	-	-	-	-	-	-	-	-	+	-	-	+
<u>Head:</u>														
or nape with some pigment	-	2/5	-	-	-	-	-	-	4/45	-	-	-	-	-
with 2 to 5 melanophores	-	2/5	-	-	-	-	-	-	1/45	-	-	-	-	-
with more than 5 melanophores	-	-	-	-	-	-	-	-	-	-	-	-	-	-
lower jaw with some pigment	-	-	-	1/85	-	-	-	-	-	-	-	-	-	-
Hypural region with pigment spot(s)	+	-	-	3/85	9/10	14/15	-	1/10	26/45	-	+	18/25	5/10	+
Average total length of larvae (mm)	4.5	7.2	6.5	6.8	5.8	6.2	4.8	4.3	5.2	4.4	5.7	4.4	4.8	5.0
Number of larvae measured	5	5	95	85	10	15	10	10	45	5	10	25	10	5
Area ^a	L	L	S	I	I	S	L	Q	Q	Q	Q	Q	I	Q

^aAreas: I = Icy Bay; L = Langara Island; Q = Queen Charlotte Sound; S = Southeast Alaska

^b+ = Yes; - = No

^cDenominator = numbers examined; numerator = numbers possessing character

^d? = indeterminate

Table 8. Pigment pattern comparisons within selected larval rockfish (*Sebastes*) species collected from the same area.

Character	Species:										prioriger			variegatus								
	Area:										Queen Charlotte Sound			Queen Charlotte Sound								
	alutux										Queen Charlotte Sound			Queen Charlotte Sound								
Sample No.:	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	1	2	3	4	5
<u>Ventral pigment row</u>																						
present																						
stops short of anus																						
multiple or irregular																						
stops short of anus by at least 4 myotomes																						
usually less than 16 melanophores																						
<u>Dorsal pigment row</u>																						
present																						
stops short of anus																						
multiple or irregular																						
<u>Head:</u>																						
or nape with some pigment																						
with 2 to 5 melanophores																						
with more than 5 melanophores																						
lower jaw with some pigment																						
hypural region with pigment spot(s)																						
Average total length of larvae (cm)																						
Number of larvae measured																						
Fork length of female parent (cm)																						

* = Yes; - = No

^b denominator = numbers of specimens for which a determination could be made; numerator = numbers of specimens possessing the character

c₁ = indeterminate

Table 10. Pigment pattern variations within species of selected rockfish (*Sebastes*) time series in a single geographic area.

Character	Species:		alutus																			
	Area:		Southeast Alaska																			
	Tow No.:		70-1-33					70-1-35					70-1-38									
	Daily Sample No.:		1	2	3	4	5	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6
<u>Ventral pigment row</u>																						
present		+ ^a	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
stops short of anus		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
multiple or irregular		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
stops short of anus by at least 4 myotomes		+	2/5 ^b	4/5	4/5	4/5	+	4/5	2/5	2/5	1/5	+	+	3/5	+	+	+	+	+	+	+	
usually less than 16 melanophores		-	2/5	4/5	4/5	1/5	-	3/5	1/5	1/5	1/5	2/5	+	1/5	-	+	+	4/5	4/5	4/5	+	
<u>Dorsal pigment row</u>																						
present		-	-	-	-	-	-	-	1/5	-	-	-	-	2/5	-	-	-	-	-	1/5	-	
stops short of anus		-	-	-	-	-	-	-	1/5	-	-	-	-	2/5	-	-	-	-	-	1/5	-	
multiple or irregular		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Head:</u>																						
or nape with some pigment		-	-	-	-	-	-	-	-	-	3/5	4/5	4/5	+	+	-	-	-	-	1/5	2/5	
with 2 to 5 melanophores		-	-	-	-	-	-	-	-	-	1/5	1/5	1/5	3/5	1/5	-	-	-	-	1/5	2/5	
with more than 5 melanophores		-	-	-	-	-	-	-	-	-	2/5	3/5	3/5	2/5	4/5	-	-	-	-	-	-	
lower jaw with some pigment		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hypural region with pigment spot(s)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1/5	-	-	-	-	
Average total length of larvae (mm)		6.0	6.3	6.4	6.4	6.6	6.1	6.7	6.6	6.7	6.6	6.6	6.5	6.6	6.4	7.4	7.3	7.4	7.2	7.5	7.5	
Number of larvae measured		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

Table 10 (continued)

Character	Species: <i>helvomaculatus</i>																			
	Area: Queen Charlotte Sound																			
	Tow No.: 70-1-79										70-1-85									
	Daily Sample No.:	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
<u>Ventral pigment row</u>																				
present	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
stops short of anus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
multiple or irregular	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
stops short of anus by at least 4 myotomes	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
usually less than 16 melanophores	3/4	1/3	4/4	2/2	+	4/4	+	4/5	4/4	1/3	3/3	3/5	4/5	2/4	1/5	3/5	4/5	4/5	3/5	
<u>Dorsal pigment row</u>																				
present	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
stops short of anus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
multiple or irregular	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Head:</u>																				
or nape with some pigment	-	-	-	-	-	-	-	-	-	-	-	-	-	2/5	3/5	3/5	+	+		
with 2 to 5 melanophores	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/5	2/5	2/5		
with more than 5 melanophores	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/5	2/5			
lower jaw with some pigment	-	-	-	-	-	1/5	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hypural region with pigment spot(s)	1/5	-	-	-	-	1/5	-	-	-	-	-	+	+	3/5	4/5	+	+	4/5		
Average total length of larvae (mm)	4.3	4.3	4.5	4.6	4.6	4.7	4.5	4.7	4.6	4.3	4.4	4.5	4.5	4.7	4.7	4.6	4.7	4.5		
Number of larvae measured	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

^a + = Yes; - = No

^b Denominator = numbers of specimens examined; numerator = numbers of specimens possessing the character

Appendix Table 1. Size composition, by species, by sex, and area of rockfish (Scorpaenidae) examined for gonad development during 1970.
(Modal frequencies are underlined)

Fork length (cm)	Sebastes aleutianus								S. alutus											
	Male				Female				Male				Female							
	LP ^a	LI ^b	SA ^c	Total	LP	LI	SA	Total	LP	QCS ^d	LI	SA	IB ^e	Total	LP	QCS	LI	SA	IB	Total
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	1	1	..	..	1	1	..	..	..	..	..	..	1	..	..	1	..	2
4	..	..	4	4	..	..	3	3	1	..	..	1	..	2	1	..	..	0	..	1
6	..	..	15	15	..	..	11	11	1	..	..	2	..	3	0	..	..	0	..	0
8	..	..	22	22	..	..	25	25	6	..	0	5	..	11	7	..	1	2	..	10
20	..	..	<u>28</u>	28	..	..	<u>26</u>	26	8	1	0	33	1	43	3	1	0	27	5	36
2	..	..	13	13	..	..	5	5	14	0	3	178	8	203	10	1	6	147	6	170
4	..	..	11	11	..	..	16	16	13	3	17	316	18	367	14	1	9	270	15	309
6	..	..	<u>18</u>	18	..	..	<u>23</u>	23	16	6	<u>22</u>	398	<u>24</u>	466	18	6	<u>17</u>	350	<u>26</u>	417
8	..	..	12	12	..	..	14	14	25	9	12	433	21	500	19	<u>11</u>	13	356	14	413
30	..	..	<u>18</u>	18	..	..	17	17	65	10	17	463	32	587	55	8	20	<u>379</u>	17	479
2	..	..	8	8	..	..	<u>29</u>	29	217	10	<u>56</u>	491	<u>54</u>	828	157	6	34	<u>313</u>	<u>36</u>	546
4	4	..	14	18	..	..	9	9	476	11	36	494	22	1039	313	6	<u>39</u>	151	34	543
6	4	..	13	17	..	..	<u>19</u>	19	<u>772</u>	19	19	<u>625</u>	20	1455	<u>378</u>	7	10	103	<u>52</u>	550
8	3	1	18	22	2	1	15	18	511	22	45	208	11	797	360	8	8	100	23	499
40	1	1	<u>21</u>	23	1	1	<u>16</u>	18	133	<u>24</u>	<u>55</u>	40	2	254	340	13	4	27	4	388
2	5	2	12	19	2	1	9	12	25	15	29	41	..	110	153	<u>15</u>	7	12	..	187
4	11	2	11	24	7	2	<u>12</u>	21	3	3	3	27	..	36	33	<u>13</u>	7	5	..	58
6	18	1	10	29	9	0	2	11	..	..	..	..	..	..	4	3	3	5	..	15
8	27	..	3	30	<u>21</u>	2	4	27	..	..	..	..	..	..	..	1	..	2	..	3
50	<u>33</u>	..	3	36	16	0	1	17	..	..	..	..	..	..	..	..	..	..	..	..
2	25	..	3	28	9	0	0	9	..	..	..	..	..	..	..	..	..	..	..	..
4	25	..	2	27	6	1	1	8	..	..	..	..	..	..	..	..	..	..	..	..
6	19	..	1	20	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
8	8	..	..	8	0	..	..	0	..	..	..	..	..	..	..	..	..	..	..	..
60	3	..	..	3	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
80	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	186	7	261	454	75	8	258	341	2286	133	314	3755	213	6701	1866	100	178	2250	232	4626

Appendix Table 1 (continued)

Fork length (cm)	<i>S. aurora</i>		<i>S. brevispinis</i>		<i>S. caenaematicus</i>		<i>S. ciliatus</i>		<i>S. crameri</i>		<i>S. diploproa</i>		<i>S. elongatus</i>					
	M	F	M	F	M	F	M	F	M	F	M	F	Male			Female		
													LP	QCS	Total	LP	QCS	Total
8	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	1	0	1	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	1	0	1	..	..	..
4	..	..	..	..	..	..	..	..	..	1	..	..	0	2	2	1	3	4
6	..	..	..	..	..	..	..	..	1	<u>5</u>	..	..	3	6	9	1	5	6
8	..	..	..	..	..	..	..	..	0	0	..	1	6	3	9	1	4	5
20	..	..	..	..	..	..	..	..	1	1	..	3	5	<u>36</u>	41	3	<u>25</u>	28
2	..	1	..	..	..	..	..	..	3	1	2	2	8	<u>24</u>	32	7	20	27
4	1	0	1	..	..	..	..	..	0	0	4	5	<u>16</u>	15	31	<u>14</u>	7	21
6	0	0	0	..	..	..	..	1	1	<u>8</u>	<u>11</u>	6	33	39	11	4	15	
8	<u>3</u>	0	0	..	..	1	..	..	2	0	3	6	4	<u>96</u>	100	8	12	20
30	1	3	0	..	1	0	..	1	1	0	2	1	1	76	77	6	59	65
2	1	4	0	..	0	0	1	1	3	4	<u>7</u>	0	..	44	44	<u>8</u>	28	36
4	<u>5</u>	4	2	1	0	1	<u>3</u>	1	3	<u>6</u>	<u>3</u>	0	..	7	7	1	24	25
6	<u>2</u>	<u>6</u>	2	2	2	2	1	<u>4</u>	5	2	..	2	..	..	..	..	4	4
8	1	<u>3</u>	8	4	2	0	2	<u>1</u>	13	4	..	..	..	..	..	..	1	1
40	..	..	16	<u>14</u>	0	0	1	4	<u>33</u>	5	..	..	..	..	..	..	..	..
2	..	..	26	<u>11</u>	0	1	1	..	10	26	..	..	..	..	..	..	..	..
4	..	..	31	15	0	0	..	..	..	35	..	..	..	..	..	..	..	..
6	..	..	69	35	1	3	..	..	..	<u>41</u>	..	..	..	..	..	..	..	..
8	..	..	90	45	0	15	..	..	..	<u>17</u>	..	..	..	..	..	..	..	..
50	..	..	<u>109</u>	<u>48</u>	1	12	..	..	..	2	..	..	..	..	..	..	..	..
2	..	..	<u>74</u>	<u>26</u>	3	22	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	71	16	10	<u>16</u>	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	37	8	12	17	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	22	8	13	<u>22</u>	..	..	..	..	..	..	..	..	..	..	..	..
60	..	..	6	4	<u>15</u>	13	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	2	4	7	11	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	1	0	4	5	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	3	5	3	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	<u>8</u>	<u>6</u>	..	..	..	..	..	..	..	..	..	..	..	..
70	..	..	..	..	4	1	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	3	2	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	2	4	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..
80	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	14	21	567	244	98	158	9	12	76	151	29	31	51	343	394	61	196	257

Appendix Table 1 (continued)

Fork length (cm)	S. entomelas		S. flavidus		S. goodei		S. helvomaculatus										S. paucispinis			
	M	F	M	F	M	F	Male					Female					M	F		
							LP	QCS	LI	SA	IB	Total	LP	QCS	LI	SA			IB	Total
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	1	2	..	..	..	3	0	2	..	..	..	..	..
6	..	..	..	..	..	..	3	2	..	1	..	6	2	6	..	..	..	..	..
8	..	..	..	..	..	..	7	8	..	1	..	16	5	4	..	1	..	10	..
20	..	..	..	..	..	..	16	6	..	2	..	24	17	3	..	1	..	21	..
2	..	..	..	..	..	..	26	10	..	7	..	43	39	16	..	6	..	61	..
4	..	..	..	..	..	..	12	30	..	6	..	48	15	29	1	18	..	63	..
6	..	..	..	..	..	..	27	25	..	17	..	69	30	31	0	26	1	88	..
8	..	..	..	..	..	..	16	22	..	27	..	65	12	24	1	54	1	92	..
30	..	..	..	..	..	..	1	8	2	53	3	67	..	7	2	45	..	54	..
2	..	1	..	..	..	..	1	5	4	35	..	45	..	4	2	26	..	32	..
4	2	1	..	..	..	..	..	..	3	16	..	19	..	..	..	6	..	6	..
6	3	0	..	1	..	..	..	..	..	3	..	3	..	..	..	..	..	..	..
8	4	0	1	2	..	..	..	..	..	0	..	0	..	..	..	..	..	..	..
40	6	3	1	1	..	..	..	..	..	0	..	0	..	..	..	..	..	..	..
2	0	1	4	2	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..
4	6	1	15	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	5	3	41	4	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
8	4	8	27	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
50	1	5	2	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	4	1	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	2
60	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	0
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	1
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	0
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	4
70	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
80	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	31	28	92	20	0	1	110	118	9	169	3	409	121	126	6	183	2	438	21	20

Appendix Table 1 (continued)

Fork length (cm)	S. wilsoni		S. zacentrus										Sebastolobus alascanus						
	M	F	Male					Female					Male			Female			
			QCS	LI	SA	IB	Total	QCS	LI	SA	IB	Total	QCS	SA	Total	QCS	SA	Total	
10
2	1	..	..	..	1	..	1	..	..	1	..	1	..	..	..	..	..	..	..
4	2	..	2	..	4	2	..	0	..	2	..	..	..	..	..	..	..
6	2	..	10	..	12	0	..	0	..	0	1	..	1	1	..	1	1
8	6	2	13	..	21	0	..	7	..	7	2	7	9	3	5	8	8
20	1	0	29	3	33	0	1	28	3	32	9	1	10	4	3	7	7
2	5	4	85	11	105	5	1	23	7	36	13	8	21	14	3	17	17
4	8	..	204	7	219	4	2	66	8	80	16	14	30	11	14	25	25
6	14	..	192	3	209	4	..	116	33	153	13	26	39	8	17	25	25
8	12	..	45	..	57	10	..	144	23	177	17	28	45	7	19	26	26
30	1	..	8	..	9	15	..	125	15	155	19	43	62	6	19	25	25
2	0	..	1	..	1	45	..	78	12	135	1	26	27	4	21	25	25
4	1	..	..	..	1	61	..	23	5	89	1	28	29	4	22	26	26
6	34	..	8	..	42	..	23	23	2	16	18	18
8	5	..	..	..	5	..	13	13	..	12	12	12
40	8	8	..	11	11	11
2	7	7	..	10	10	10
4	1	1	..	3	3	3
6	1	1	..	0	0	0
8	1	1	1
50	1	1	1
2
4
6
8
60
2
4
6
8
70
2
4
6
8
80
Total	1	0	52	6	590	24	672	185	4	619	106	914	92	234	326	64	177	241	241

^aLP = La Perouse Bank (southwest Vancouver Island)^bLI = Langara Island (NW Queen Charlotte Islands)^cSA = Southeast Alaska^dQCS = Queen Charlotte Sound^eIB = Icy Bay

Appendix Table 2. Numbers of rockfish (*Sebastes*)^a examined, by area, month, species, sex, and gonad condition during 1970.

Month	Species	Males						Females								
		1	9	8	8A	8B	8C	Total	1	2	3	4	5	6	7	Total
<u>La Pérouse Bank</u>																
March	aleutianus	1	1	5	..	..	..	7	0	1	0	0	0	0	0	1
	caenaemeticus	0	0	2	..	..	..	2	0	1	0	0	0	0	5	6
April	aleutianus	3	9	59	..	..	..	71	4	2	0	0	0	3	9	18
	alutus	47	58	151	..	..	..	256	9	43	0	0	4	17	54	127
	aurora	0	0	7	..	..	..	7	0	0	0	0	0	0	0	0
	brevispinis	0	1	0	..	..	..	1	0	3	1	0	0	0	0	4
	caenaemeticus	0	0	7	..	..	..	7	0	0	0	0	1	1	5	7
	crameri	0	0	4	..	..	..	4	0	0	0	0	0	0	0	0
	diploproa	0	3	4	..	..	..	7	4	6	1	1	0	0	0	12
	elongatus	0	0	0	..	..	..	0	0	0	1	0	0	0	0	1
	flavidus	0	0	1	..	..	..	1	0	0	0	0	0	0	0	0
helvomaculatus	7	6	9	..	..	..	22	7	4	1	22	0	0	0	34	
rubrivinctus	0	3	2	..	..	..	5	1	0	1	0	0	0	0	2	
August	alutus	1	1	0	..	..	..	2	0	0	4	0	0	1	0	5
	rubrivinctus	0	1	0	..	..	..	1	0	0	0	0	0	0	0	0
September	aleutianus	6	7	..	7	80	8	108	9	5	6	0	0	0	36	56
	alutus	232	376	136	507	768	9	2028	225	655	799	7	0	0	48	1734
	aurora	0	0	..	0	6	1	7	0	0	2	0	0	1	18	21
	brevispinis	0	0	..	3	1	0	4	0	0	0	0	0	0	5	5
	caenaemeticus	0	0	..	1	38	0	39	0	37	0	0	0	0	67	104
	crameri	2	4	..	13	36	8	63	6	5	57	0	0	0	42	110
	diploproa	2	1	..	0	1	1	5	3	1	0	1	0	4	5	14
	elongatus	13	23	..	1	13	1	51	15	3	0	0	0	0	42	60
	entomelas	0	0	..	0	8	0	8	1	0	0	0	0	0	2	3
	flavidus	0	0	..	0	0	0	0	0	0	0	0	0	0	2	2
	helvomaculatus	27	14	..	3	44	0	88	25	3	0	0	0	0	59	87
	paucispinis	0	0	..	0	1	0	1	0	1	0	0	0	0	1	2
	proriger	1	0	..	19	46	33	99	3	4	0	0	0	0	111	118
	saxicola	0	0	..	2	0	0	2	0	1	7	0	0	0	0	8
<u>Queen Charlotte Sound</u>																
June	alutus	35	9	89	..	..	..	133	32	12	0	0	0	24	32	100
	brevispinis	30	25	353	..	..	..	408	20	17	5	35	10	2	35	124
	crameri	6	1	1	..	..	..	8	15	0	0	0	0	2	22	39
	diploproa	0	3	14	..	..	..	17	2	2	0	1	0	0	0	5
	elongatus	53	34	256	..	..	..	343	61	10	9	75	29	0	12	196
	entomelas	0	0	5	..	..	..	5	0	0	0	0	0	0	9	9
	flavidus	1	5	82	..	..	..	88	10	0	0	0	0	0	6	16
	goodei	0	0	0	..	..	..	0	0	0	0	0	0	0	1	1
	helvomaculatus	16	8	94	..	..	..	118	20	3	0	38	50	10	5	126
	paucispinis	0	0	14	..	..	..	14	0	2	0	0	0	0	11	13
	pinniger	1	2	15	..	..	..	18	3	0	0	0	0	0	5	8
	proriger	40	96	369	..	..	..	505	136	102	0	41	113	76	204	672
	reedi	45	0	19	..	..	..	64	51	0	0	0	0	0	2	53
	ruberrimus	23	2	10	..	..	..	35	14	2	0	8	6	0	10	40
	rubrivinctus	31	19	64	..	..	..	114	63	9	0	0	1	5	7	85
	saxicola	0	1	1	..	..	..	2	0	0	0	0	0	0	0	0
	variegatus	2	12	69	..	..	..	83	5	1	0	11	121	18	1	157
	wilsoni	1	0	0	..	..	..	1	0	0	0	0	0	0	0	0
zacentrus	17	8	27	..	..	..	52	14	3	1	29	128	5	5	185	
Seb. alascanus	14	10	68	..	..	..	92	21	2	28	12	0	0	1	64	

Appendix Table 2 (continued)

Month	Species	Males						Females								
		1	9	8	8A	8B	8C	Total	1	2	3	4	5	6	7	Total
<u>Langara Island</u>																
May	aleutianus	2	1	4	..	..	..	7	5	0	0	0	3	0	0	8
	alutus	120	55	139	..	..	..	314	81	61	0	0	4	20	12	178
	brevispinis	3	0	20	..	..	..	23	0	0	11	10	0	0	1	22
	entomelas	11	1	4	..	..	..	16	5	2	0	1	6	0	0	14
	flavidus	0	0	3	..	..	..	3	0	2	0	0	0	0	0	2
	helvomaculatus	0	0	9	..	..	..	9	1	1	0	1	1	2	0	6
	paucispinis	0	0	0	..	..	..	0	0	0	0	0	0	1	2	3
	reedi	5	0	0	..	..	..	5	7	0	0	0	0	0	0	7
	rubrivinctus	1	4	4	..	..	..	9	8	0	0	1	3	1	1	14
	zacentrus	4	1	1	..	..	..	6	3	1	0	0	0	0	0	4
<u>Southeast Alaska</u>																
March	aleutianus	131	5	24	..	..	..	160	154	0	0	4	0	0	3	161
	alutus	913	104	361	..	..	..	1378	536	238	2	89	26	0	5	896
	brevispinis	2	9	73	..	..	..	84	12	21	19	0	0	0	1	53
	caenaematicus	1	0	37	..	..	..	38	4	0	1	16	0	1	12	34
	crameri	0	0	1	..	..	..	1	0	0	0	0	2	0	0	2
	entomelas	0	0	1	..	..	..	1	0	0	0	0	0	0	1	1
	helvomaculatus	2	3	52	..	..	..	57	5	0	46	0	0	0	1	52
	proriger	0	0	0	..	..	..	0	0	1	0	0	0	0	0	1
	reedi	6	0	0	..	..	..	6	7	1	0	0	0	0	0	8
	ruberrimus	0	0	0	..	..	..	0	0	0	1	0	0	0	0	1
	rubrivinctus	18	1	2	..	..	..	21	16	1	2	2	1	0	0	22
	variegatus	27	30	36	..	..	..	93	12	41	43	0	0	0	0	96
	zacentrus	6	36	107	..	..	..	149	4	13	114	1	0	0	1	133
	Seb. alascanus	40	30	164	..	..	..	234	54	0	0	0	0	102	21	177
	April	aleutianus	17	4	8	29	20	0	0	0	0	0	0
alutus		824	41	688	..	..	..	1553	644	93	0	0	56	4	5	802
brevispinis		1	1	13	..	..	..	15	4	1	3	0	0	0	0	8
caenaematicus		1	0	5	..	..	..	6	1	0	0	1	0	0	0	2
ciliatus		0	0	1	..	..	..	1	0	0	0	0	0	0	0	0
helvomaculatus		0	0	50	..	..	..	50	3	3	27	18	0	0	0	51
paucispinis		0	0	6	..	..	..	6	0	0	1	0	0	0	1	2
proriger		3	0	1	..	..	..	4	0	0	1	0	0	0	0	1
reedi		35	0	1	..	..	..	36	33	3	0	0	0	0	1	37
rubrivinctus		38	0	2	..	..	..	40	27	0	0	1	0	0	0	28
zacentrus	60	57	163	..	..	..	280	81	29	90	23	0	0	0	223	
May	aleutianus	62	4	6	..	..	..	72	76	0	0	0	0	0	1	77
	alutus	446	87	291	..	..	..	824	341	89	1	0	23	86	12	552
	brevispinis	0	0	12	..	..	..	12	2	1	4	3	0	0	0	10
	caenaematicus	1	1	4	..	..	..	6	1	0	0	0	0	2	2	5
	ciliatus	0	0	0	..	..	..	0	0	0	0	1	0	0	0	1
	entomelas	0	1	0	..	..	..	1	1	0	0	0	0	0	0	1
	helvomaculatus	1	0	61	..	..	..	62	1	0	2	74	3	0	0	80
	reedi	0	0	0	..	..	..	0	2	0	0	0	0	0	0	2
	rubrivinctus	34	8	56	..	..	..	98	51	4	0	3	6	1	1	66
	variegatus	1	0	0	..	..	..	1	1	0	0	0	0	0	0	1
zacentrus	21	121	19	..	..	..	161	42	0	14	194	6	0	3	263	
<u>Icy Bay</u>																
May	alutus	80	44	89	..	..	..	213	77	19	0	0	99	27	10	232
	brevispinis	3	7	10	..	..	..	20	10	0	5	2	0	0	0	17
	ciliatus	2	1	5	..	..	..	8	5	1	0	0	5	0	1	12
	helvomaculatus	0	0	3	..	..	..	3	0	0	0	1	1	0	0	2
	variegatus	16	47	63	..	..	..	126	18	2	0	34	81	0	0	135
	zacentrus	5	9	10	..	..	..	24	5	0	3	95	3	0	0	106

^aTwo samples of *Sebastolobus alascanus* are also included in the table.

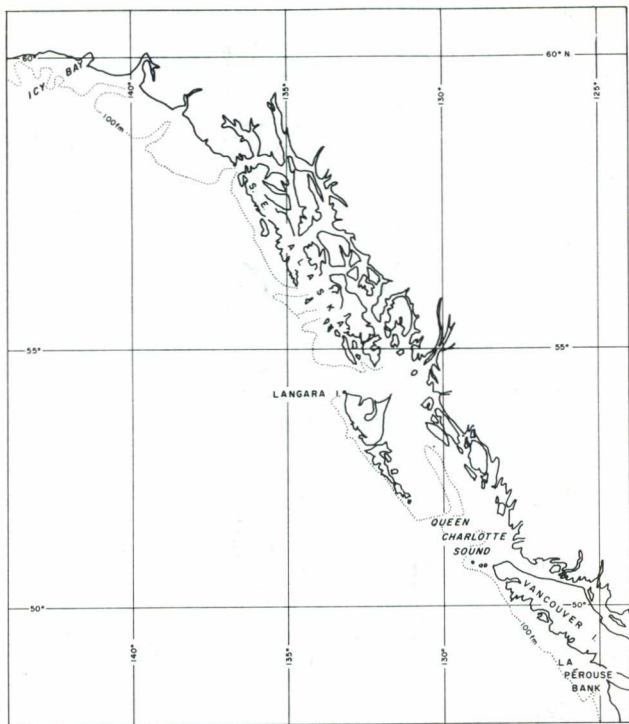


Fig. 1. Collection areas for rockfish maturity data and larvae during 1970.

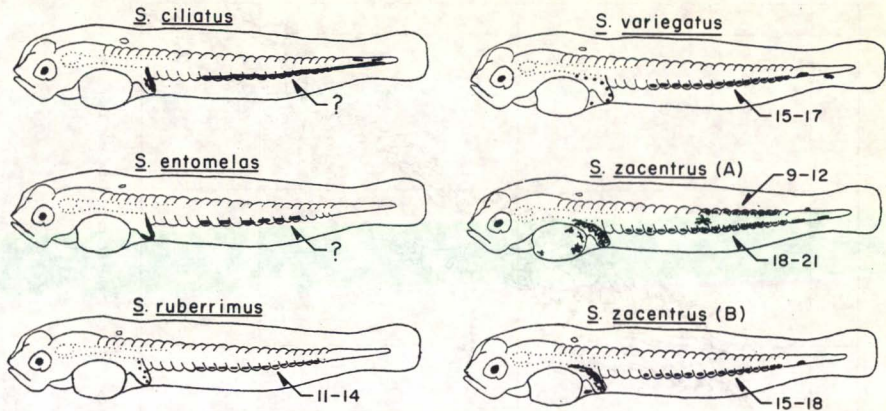


Fig. 2. Schematic portrayal of larvae melanophore patterns for five rockfish (*Sebastes*) species collected during 1970. (Range values based upon 5 specimens from each species.)