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AGE, LENGTH, WEIGHT, REPRODUCTIVE CYCLE AND FECUNDITY OF THE MONKEYFACE PRICKLEBACK (*CEBIDICHTHYS VIOLACEUS*)

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Life history characteristics of age, length, weight, reproductive season and fecundity of the monkeyface prickleback (*Cebidichthys violaceus*) were investigated. Most specimens were obtained from poke pole anglers during low tides at Dillon Beach, California. Males and females were aged to 18 years old, with males attaining a larger size. Sexual dimorphic growth occurred after age eight, coincident with maturity in females. A complete length-weight curve was constructed. The age-weight curves for males and females were similar. Females mature as early as four years of age with 100% mature by age eight. Spawning occurs from February through April. Two adult females had an estimated 17,000 and 40,000 mature eggs each.

INTRODUCTION

The monkeyface prickleback (*Cebidichthys violaceus*) known to anglers as the monkeyface "eel", are found in rocky intertidal and subtidal habitats ranging from San Quintin Bay, Baja California (Miller and Lea 1972) to Brookings, Oregon (Barton 1978). They are prime targets of the few sports anglers who "poke pole" in the rocky intertidal zone at low tide (Squire and Smith 1977). Little is known about the life history of this species. This paper presents the life history parameters of length, weight, and age of both sexes, as well as some aspects of ovarian maturity, reproductive season and fecundity of females.

METHODS

A total of 401 fish were examined. Of these, 369 were collected 0.5 to 2 km north of Dillon Beach, California, a "semiprotected coastal habitat" (Hedgpeth 1962, Plate

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1); 26 fish from Bodega Bay, California, a "protected coast"; and six fish from Pacifica, California, an "outer, wave swept coast". Fish were taken from the lower intertidal zone (Ricketts and Calvin 1968) during 99 low tide periods of -0.3 to -2.0 feet.

Collecting began in November 1981 and continued intermittently until July 1987. Data on standard (SL) and total (TL) length, weight, and gonads were obtained from fish caught by the first author and/or fishing partners. However, the fishermen scattered along the rocks usually filleted their catch there, so gonads were often not available. Because the first author could not be present at all fishing sites, different numbers of fish were used in the various analyses.

Otoliths (sagittae) were removed, cleaned, and stored dry in gelatin capsules. The small (±3 mm diameter) otoliths are difficult to extract because the bones of the skull are very thick. The opercle was then evaluated as a structure for aging. The gill covers proved to be easy to dissect with a small wire clipper. Skin and flesh was removed after soaking in a hot solution of a protein-dissolving laundry product (BIZ®). Opercula had very clear growth marks and were stored dry in envelopes. Ages were determined by the second author using a Wild dissecting microscope at 25x and indirect lighting.

Because the otolith is a standard aging structure for marine fishes (Chilton and Beamish 1982), otoliths and opercula from 39 fish were compared to see whether they yielded the same age estimates. The results indicated that they were comparable, and so opercula were used as the standard aging structures. Estimates, using the von Bertalanffy equation of growth parameters, based on both structures from 91 specimens were made. The estimates L_x, k, and t_o were tested for significance for non-linear models with an *F*-test after Ratkowsky (1983).

Early in the study, only TL was measured and a conversion to SL was necessary. This was calculated from 177 observations for which both lengths had been measured. The linear regression is:

$$SL = TL\ (0.931) + 1.416$$

with an R^2 of 0.977.

The age-length data were compiled separately for males and females. Ages determined from opercula were used to estimate parameters of the von Bertalanffy growth model:

$$L_t = L_x\ [1 - e^{-kt_o}]$$

where L = length at age t,
L_x = asymptotic length of the species,
k = growth completion rate, and
t_o = theoretical age at zero length.

Weights were taken for 139 fresh fish ranging from 27 cm and 145 g to 60 cm and 1950 g. Using the equation:

$$W = aL^b$$

where W = weight in g,
L = standard length in cm for males and females,

Table 1. Comparison of age estimates based on otoliths and opercula of 39 fish.

Age	*n*	% Agreement	%± 1yr.	%± 2 yrs.
4	2	100		
5	10	50	50	
6	9	55.6	22.2	22.2
7	5	60	40	
8	4		50	50
9	2	50		50
10	2	50		50
13	1		100	
14	2	50		50
16	2			100

resulted in estimates for the constants a and b. Log transformation of the data was performed in order to compare the linear regression statistics.

The number of ovaries obtained each month varied widely, depending on occurrence of low tides (< 0.3 ft) during daylight hours and surf conditions. Also, a major factor was the numbers of fishermen on the rocks during spring and summer months.

Gonads were removed from 196 females and brought to the laboratory to estimate the reproductive stage. Four developmental stages were noted on the basis of their characteristic color using Smithe's (1974) color guide. Immature gonads were pearl grey, maturing gonads contained eggs that were orange yellow or spectrum orange, ripe gonads contained eggs that were chrome orange and resting gonads were flacid and pearl grey.

Gonadal weights and estimates of fecundity of two fish were recorded using a Mettler balance and a dissecting microscope (12x), respectively. Testes from 22 males were collected. Immature testes were threadlike, whereas mature testes were swollen and white, while spent testes were grey-brown and roughly triangular in shape.

RESULTS AND DISCUSSION

The technique for age determination using otoliths is widely accepted and defined (Chilton and Beamish 1982). We followed standard aging techniques where one ring represented one year's growth. We found the otolith to have clear growth rings, but they were very small and were difficult to remove. The opercula were much easier to dissect, had equally clear growth rings, and age determination from the otoliths and opercular were similar. In 30 of 39 comparisons (77%), the two structures had ages either matching or within one year of each other (Table 1).

Growth curves compared from data on 91 fish were not significantly different (F = 1.0891, df = 3,177) (Table 2; Fig. 1). Estimated size at age was larger for males than females after age eight (Table 3; Fig. 2). Both sexes were aged up to 18 years

Table 2. von Bertalanffy growth model parameter estimates and standard deviations for monkeyface pricklebacks derived from 4 data sets. Comparisons of aging structures using the same data set and for males and females using all ages determined from the operculum.

Structure/Sex	Age (yr)	Length (cm)	L_x	k	t_o	*n*
Otolith						
Est.	2-18	23-67	72	.10	-1.89	91
S.D.			8	.03	1.08	
Opercle						
Est.	2-18	23-67	71	.10	-2.63	91
S.D.			8	.04	1.31	
Opercle-Females						
Est.	0-18	15-62	62	.14	-1.95	115
S.D.			2	.02	.28	
Opercle-Males						
Est.	0-18	13-67	70	.12	-1.91	74
S.D.			5	.02	.29	

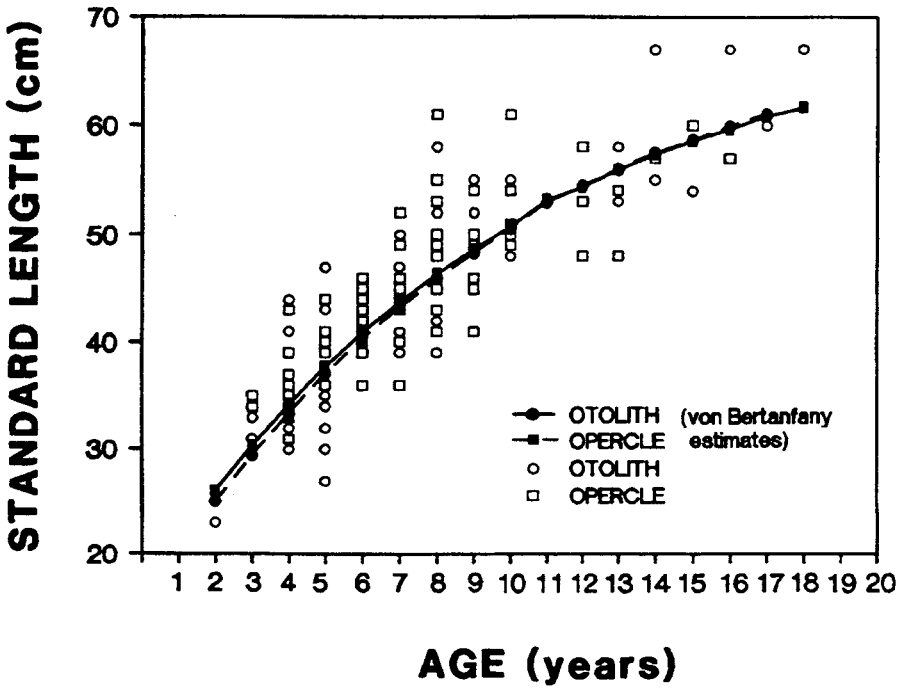

Figure 1. Comparison of growth rates of 91 monkeyface pricklebacks determined from otoliths and opercula.

Table 3. Estimated length at age from the von Bertalanffy growth equation for male and female monkeyface pricklebacks. The size range (CM SL) and numbers sampled of each age group are included.

	Males			Females		
Age	Mean size	Range	*n*	Mean size	Range	*n*
0	14	12-16	4	15	14-18	5
1	20	16-25	5	21	18-23	7
2	26	23	1	27	23	1
3	30	33	1	32	31-35	3
4	35	31-44	12	36	32-41	20
5	39	32-36	16	39	27-47	11
6	42	36-44	18	42	36-45	19
7	45	36-50	11	45	41-52	10
8	48	41-58	14	47	39-61	12
9	50	46-55	4	49	41-55	5
10	53	48-61	6	51	50-55	4
11	55	-	0	53	48	1
12	56	53-58	2	54	53-58	2
13	58	48-54	2	55	57-76	3
14	59	55-67	2	56	54-60	2
15	60	-	0	57	-	0
16	61	57-76	2	57	-	0
17	62	60	1	58	-	0
18	-	-		59	67	1
Totals			101			106

with maximum estimated standard lengths of 62 cm for females and 67 cm for males. Estimated length at age is presented in Table 3. Burge and Schultz (1973) presented ages for 12 specimens, which fall into the ranges of ages determined in this study.

Weight data for each sex were compared and the statistics were not significantly different ($P< 0.01$) (Table 4). These data were pooled with weight data on small fish (Edwards 1981) in order to construct a complete weight-length curve (Fig. 3). The 11 weights reported by Burge and Schultz (1973) and the three from Fitch and Lavenberg (1971) fall into the ranges obtained in this study.

Nineteen testes were examined. Eight were from immature males <25 cm, three swollen testes collected in May and June and eight spent testes were collected from May through July.

Fecundity was estimated for two females. One caught 5 February 1982 was seven years old, 41 cm SL, and contained approximately 17,500 mostly mature eggs. A second female caught on 12 March 1982 was 11 years old, 61 cm SL, and contained approximately 46,000 mostly mature eggs.

Examination of ovaries indicated that the sample consisted of 67 immature and 137 mature fish. Age at first maturity was four years (36 cm); 50% were mature at

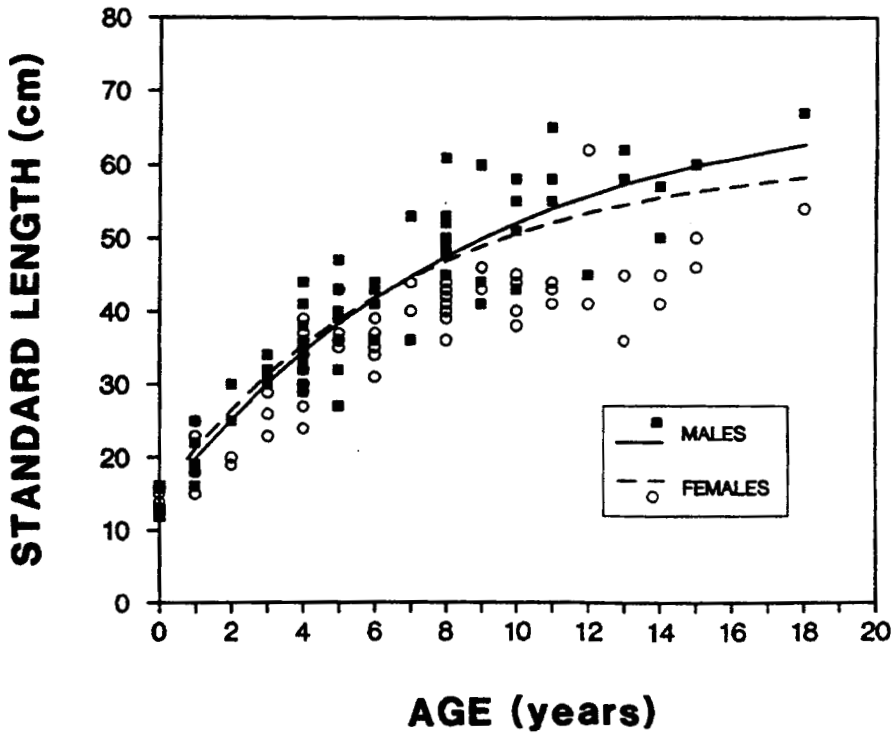

Figure 2. Comparison of growth rates of 171 male and female monkeyface prickebacks determined from opercula.

Table 4. Weight at length parameters for males, females and for sexes combined from this study, and fish <20 mm from Edwards (1981), where Weight = a(Length)b. Linear regression statistics for log transformed data where *ln*(Weight) = a(*ln*Length) + b. Growth curves for males and females are not significantly different ($P < 0.01$).

	a	b	*n*	r^2
$W + aL^b$				
Males	0.006797	3.072	62	
Females	0.0325	2.654	77	
Sexes Combined	0.01289	2.900	139	
This study plus Edwards (1981)	0.00965	2.971	174	
*ln*W=b+a(*ln*L)				
Males	0.0735	3.382	62	0.90334
Females	0.0712	3.393	77	0.85512
Sexes Combined	0.0714	3.399	139	0.87767

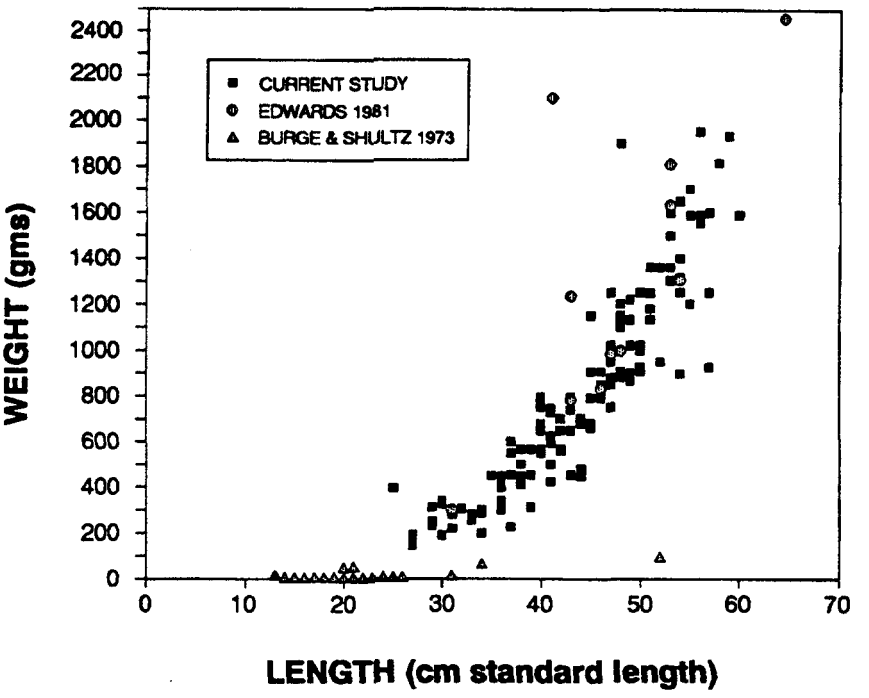

Figure 3. Weight-length relationships from this study and the literature.

five years (39 cm), and 100% were mature at seven years (45 cm). Reproductive activity began in January with the peak months of spawning in February, March and April.

Mature ovaries were collected March-May, maturing ones December-June, and spent ovaries February-August and one in December. The average age of 21 fish with mature ovaries dropped from 11 years (6) to 10 years (7), 8 years (6) and 6 years (2). This indicates that older fish spawned earlier than the younger ones. The small sample of testes indicates a similar pattern.

These data are similar to those reported on the Black Prickleback (*Xiphister atropurpureus*) by Wourms and Evans (1974). They suggest that this species, which also spawns in late winter and spring, are less apt to be exposed to environmental risks of wave shock, reduced salinity and high or low water temperatures.

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