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SEASONAL SPAWNING CYCLE OF THE PACIFIC BUTTERFISH, *PEPRILUS SIMILLIMUS* (STROMATEIDAE)

There is little information on the reproductive biology of the Pacific butterflyfish, *Peprilus simillimus*, which ranges from Magdalena Bay, Baja California, to the Fraser River, British Columbia, and occurs at depths of 9-91 m (Miller and Lea 1972). It is commercially fished with purse seine, lampera, and bait net (Fitch and Lavenberg 1971). In 1976, 34.18 t were taken in California (Oliphant 1979). Fitch and Lavenberg (1971) reported spawning occurs in spring and extends perhaps into July. Horn (1970) studied the systematics and biology of the genus *Peprilus*. My purpose is to describe histologically the seasonal spawning cycle of the Pacific butterflyfish.

Methods

Fish were collected with the use of a lampera net between depths of 2 and 20 m from the vicinity of Oceanside, southern California (lat. 33°10' N, long. 117°25' W), during the period September 1978 through August 1979. Only female specimens were examined. Fish were fixed and preserved in 10% Formalin.¹ Ovarian histological sections from 232 specimens were cut at 8 μm and stained with iron hematoxylin. Seasonal gonosomatic indices (ovary weight/fish weight × 100) were calculated

¹Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

from preserved fish. Ovaries were histologically classified into four stages (Table 1).

TABLE 1.—Monthly distribution (percent) of ovarian stages in the yearly spawning cycle of *Peprilus simillimus*, September 1978-August 1979.

Month	N	Regressed or regressing	Pre-vitellogenic	Vitellogenic	Pre-spawning
Sept.	25	100	0	0	0
Oct.	18	100	0	0	0
Nov.	15	100	0	0	0
Dec.	17	53	47	0	0
Jan.	21	52	43	5	0
Feb.	19	26	42	16	16
Mar.	20	10	15	0	75
Apr.	20	5	5	0	90
May	16	44	19	0	37
June	20	95	0	0	5
July	17	100	0	0	0
Aug.	24	92	8	0	0

Results

Ovaries were regressed (Stage 1) during autumn (September-November) and consisted of primary oocytes <100 μm in diameter (Table 1). Gonosomatic indices (Figure 1) were reduced at this time. The first signs of ovarian activity for the new spawning cycle were noted during December. This was determined by an abundance of previtellogenic (vacuolated) (Stage 2) oocytes (130-200 μm) which typically appear before yolk deposition begins (Table 1). Enlarging (Stage 3) vitellogenic oocytes (yolk deposition in progress) were first noted in January. The first ripe (prespawning or gravid) (Stage 4) females with ovaries containing

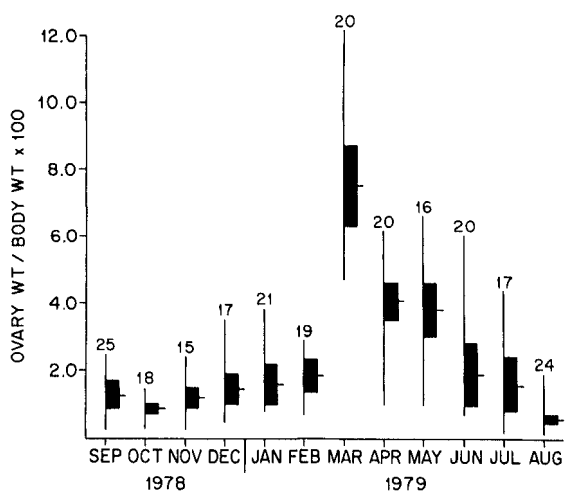


FIGURE 1.—Seasonal gonosomatic indices for *Peprilus simillimus*. Vertical line = range; horizontal line = mean; rectangle = 95% confidence interval. Sample size above each month.

mature yolk-filled oocytes ($>400\ \mu\text{m}$) were collected in February. Since only a small fraction of my February sample was gravid, the spawning period for the majority of the population under study appeared to encompass March-May (Table 1). The smallest reproductively active female measured 114 mm standard length (SL); the largest 172 mm SL. Gonosomatic indices were at maximum sizes in March (Figure 1) and a progressive decrease was indicated through spring with minimal sizes occurring by June. A May increase in the incidences of follicular atresia indicated the end of spawning was near. Atretic oocytes are most abundant near the termination of spawning when oocytes that initiated but failed to complete yolk deposition degenerate.

My observation of follicles in various stages of yolk deposition during the spawning period suggests that successive batches of eggs are matured and spawned. The number of spawnings per individual per season are not known, but the presence of a mode of mature oocytes (imminent spawning), postovulatory follicles (transitory remnant of the follicle wall from a recent spawning), and a vitellogenic oocyte mode for a subsequent spawning indicates that females are capable of spawning more than once per season. Postovulatory follicles were similar in morphology to those reported in other teleosts (Hunter and Goldberg 1980).

Discussion

Peprilus simillimus undergoes a distinctly seasonal spawning cycle characterized by an abrupt increase in ovarian sizes during late winter with spawning essentially completed by the end of spring. Fitch and Lavenberg (1971) reported that spawning may extend into July. Horn (1970) similarly reported that spawning in *P. triacanthus*, *P. burti*, *P. paru*, and *P. simillimus* generally occurs in spring and early summer. This contracted type of cycle differs from that of some southern California fishes that have a considerably longer spawning period. Goldberg (1980) reported that gravid female *Chitonotus pugetensis* and *Icelinus quadriceriatius* (both Cottidae) were found throughout the year with maximum numbers in winter and early spring. The northern anchovy, *Engraulis mordax*, may have the ability to spawn all year but is likely limited by food availability and energy reserves (Brewer 1978; Hunter and Goldberg 1980).

The *P. simillimus* spawning cycle is more reminiscent of northern fishes (Quasim 1956), which have a short reproductive period (generally winter-early spring) with a single spawning. The multiple spawnings over a brief period exhibited by *P. simillimus* may represent a compromise between a short reproductive period with a single spawning (characteristic of high latitude fishes) and a long reproductive period with repeated spawnings typical of tropical fishes (Nikolsky 1963).

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