# NOTES

## SEASONAL SPAWNING CYCLE OF THE BLACK CROAKER, *CHEILOTREMA SATURNUM* (SCIAENIDAE)

Detailed information is lacking on the spawning cycle of the black croaker, *Cheilotrema saturnum*. Previous works (Eigenmann 1892; Skogsberg 1939; Limbaugh 1961; Fitch and Lavenberg 1975) have indicated spawning occurs in spring and summer. This report describes the histological changes occurring in the spawning cycle. Comparisons are made with the spawning cycles of two other sciaenid fishes (*Genyonemus lineatus* and *Seriphus politus*) which were studied by Goldberg (1976). *Cheilotrema saturnum* ranges from Magdalena Bay, Baja California, to Point Conception, Calif. (Miller and Lea 1976).

### Methods

A total of 154 mature female *C. saturnum* were examined from collections made in January, March, July, September 1977 and 1978. Specimens were collected during heat treatment processes at the Scattergood Steam Plant (City of Los Angeles, Department of Water and Power, LADWP), El Segundo (lat. 33°50′ N, long. 118°30′ W), Los Angeles County, Calif. Steam generating plants periodically reverse the flow of cooling water in their intake and discharge pipes and raise the temperature to a level that will kill off entrapped organisms. Immediately after collection, fish were slit along the abdomen and placed in 10% Formalin.[1] Ovaries were embedded in paraffin; sections were cut at 8 $\mu$m and stained with iron hematoxylin. Body and ovary weights were measured on a torsion balance to the nearest 0.01 g. Standard lengths (SL) were measured to the nearest millimeter. Gonosomatic indices (GSI = ovary weight/fish weight × 100) were calculated from measurements made after preservation.

### Results and Discussion

Ovaries were classified histologically into four stages (Table 1). Stage 1 (regressed or regressing ovary): the nonspawning condition consists principally of primary oocytes (<100 $\mu$m in diameter). Stage 2 (previtellogenic): slightly enlarged vacuolated oocytes (100-200 $\mu$m in diameter) predominate prior to onset of yolk deposition. Stage 3 (vitellogenic): yolk deposition in progress. Stage 4 (spawning): mature (ripe) oocytes (>300 $\mu$m) predominate.

Ovaries were regressed (Stage 1) during autumn and winter (Table 1, Figure 1). GSI values began to increase during winter and Stage 2 oocytes became common. In late spring enlarging follicles undergoing yolk deposition (vitellogenesis) were

TABLE 1. Monthly distribution of standard lengths and stages in *Cheilotrema saturnum* spawning cycle, January 1977-November 1978.

| Month | N | Range (mm) | Stage 1 (%) | Stage 2 (%) | Stage 3 (%) | Stage 4 (%) |
|---|---|---|---|---|---|---|
| Jan. | 6 | 160-240 | 100 | 0 | 0 | 0 |
| Mar. | 16 | 181-296 | 87 | 13 | 0 | 0 |
| May | 7 | 167-292 | 43 | 29 | 14 | 14 |
| July | 15 | 194-280 | 0 | 0 | 7 | 93 |
| Sept. | 6 | 160-232 | 83 | 0 | 0 | 17 |
| Nov. | 8 | 171-267 | 100 | 0 | 0 | 0 |
| Jan. | 16 | 166-283 | 100 | 0 | 0 | 0 |
| Mar. | 14 | 172-260 | 50 | 50 | 0 | 0 |
| May | 12 | 168-255 | 0 | 25 | 8 | 67 |
| July | 29 | 161-262 | 0 | 0 | 10 | 90 |
| Sept. | 11 | 165-231 | 64 | 9 | 0 | 27 |
| Nov. | 14 | 167-265 | 100 | 0 | 0 | 0 |

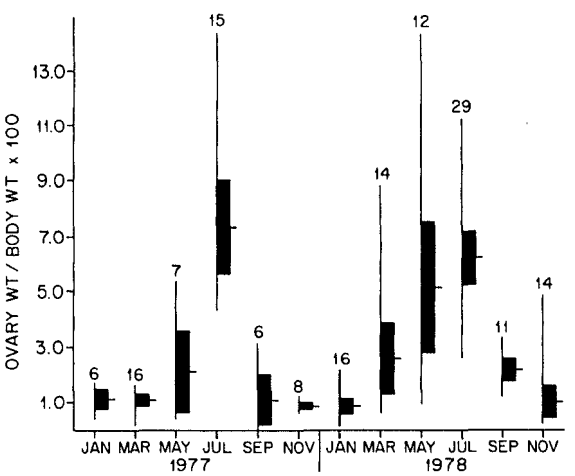


FIGURE 1.—Seasonal gonosomatic indices for *Cheilotrema saturnum*. Vertical line = range; horizontal line = mean; rectangle = 95% confidence interval and sample size above each month.

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

present (Stage 3). Other fish examined at this time were in spawning condition (Stage 4) and contained ovaries with mature yolk-filled oocytes. The peak of spawning activity occurred in midsummer (July). Most spawning was completed by September as GSI values dropped and numbers of spawning females were fewer (Table 1). Atretic oocytes were common in September near the close of the spawning period when oocytes that failed to complete yolk deposition underwent resorption. They were observed in 67% of my combined 1977-78 September samples.

Rather than maturing and spawning one mode (size class) of eggs at a time, it seems that females reach spawning condition and then release batches of mature eggs throughout the spawning season. This is likely, as no summer females were observed with ovaries in postspawning (partly spent or spent) condition. Instead, *C. saturnum* oocyte development appears to be a continuous process during the spawning season, as ovaries at all times contained maturing and large numbers of mature oocytes. I have previously observed this pattern (Goldberg 1976) in *G. lineatus* and *S. politus*.

Postovulatory follicles (transitory remnants of the follicle wall from recently ovulated eggs) were seen in only 2% of my combined 1977-78 July samples. Ovaries containing these structures were in spawning condition. This low percentage is not unexpected in view of their rapid degeneration in teleost fishes (Yamamoto and Yoshioka 1964; Hunter and Goldberg 1980).

The spawning cycle of *C. saturnum* is similar to that of *S. politus*, namely, April-August (Goldberg 1976). Spawning in *G. lineatus* occurs November-April (Goldberg 1976) and is thus distinctly different from that of *C. saturnum* and *S. politus*. According to Feder et al. (1974) three other California sciaenids (*Atractoscion nobilis*, *Menticirrhus undulatus*, and *Roncador stearnsii*) are also summer spawners.


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## POPULATION GROWTH AND CENSUSES OF THE NORTHERN ELEPHANT SEAL, *MIROUNGA ANGUSTIROSTRIS*, ON THE CALIFORNIA CHANNEL ISLANDS, 1958-78

The northern elephant seal, *Mirounga angustirostris*, has received considerable attention because of its dramatic recovery from near extinction in the late 19th century. Bartholomew and Hubbs (1960) reviewed the chronicle of the species from 1818 to 1960 and estimated the total population over its then known range at about 13,000 animals. Since 1960, a number of investigators have reported on the reestablishment of elephant seals on progressively northern islands and on the size of its breeding populations. Such information is now available for the islands of the Pacific coast of North America from Isla Natividad, Baja California,