Transactions of the American Fisheries Society 112:567–569, 1983

Protandrous Hermaphroditism in Striped Bass from Coos Bay, Oregon

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Abstract

Eleven of 42 adult striped bass collected from Coos Bay, Oregon, were possibly protandrous. The older hermaphrodites, ages 7 to 10 years, showed increasing signs of pathology associated with egg retention.

Received October 25, 1982 Accepted May 10, 1983

In the early 1880s, 500 striped bass *Morone saxatilis* were introduced from Navesink River, New Jersey, into San Francisco Bay, California. By the end of the nineteenth century, the species supported a thriving fishery in California. In 1914, striped bass were reported for the first time off the Oregon coast (Morgan and Gerlach 1950), presumably having migrated from San Francisco Bay. The Oregon population had grown to 15,000–20,000 fish by 1980 (R. Bender, Oregon Department of Fish and Wildlife, unpublished).

During a survey of parasite and pollutant burdens of striped bass in Coos Bay, Oregon, we had occasion to observe several cases of hermaphroditism, on which we report here. This phenomenon has been noted previously for the species. Morgan and Gerlach (1950) found that 3% of 124 striped bass from Coos Bay were hermaphrodites with functional testes and ovaries, the ovary being larger in some cases and the testis in others; the fish were not aged. Schultz (1931) also described an Oregon striped bass that could have spawned both sperm and eggs. Two cases of hermaphroditism were reported for the congeneric white perch *Morone americana* (Bishop 1920; Dorfman 1976). Dorfman found that a specimen from New Jersey had normal spermatozoa but immature ovaries. None of these authors reported any signs of pathology related to the hermaphroditism. Here, we report both age distributions and pathologies of hermaphroditic striped bass.

Methods

We worked with 42 prespawning striped bass gillnetted from Coos Bay 21–28 May 1980. In connection with our examinations for parasites and pollutants, we examined the gonads of fresh fish. Oviducts were probed for possible occlusions. Sperm were examined microscopically and released into fresh water to determine motility. Egg characters evaluated included diameter, color, development, and amounts of yolk, oil, and perivitelline space. Scales were used to age the fish.

Results and Discussion

Eleven of the 42 adult striped bass were hermaphrodites. Protandry is suggested because young hermaphrodites had ripe, motile sperm and immature eggs whereas older hermaphrodites had normal-appearing eggs and only small patches of testes (Table 1). The sex-ratio shift toward females as the fish aged may be an artifact of field collections because size and sex ratio may depend on sampling location and season (Setzler et al. 1980; Kohlenstein 1981) and because females usually live longer than males (Setzler et al. 1980). The hermaphrodites with small testes and large ovaries, ages 7 to 10 years, showed increased pathology associated with egg retention as annual egg masses were added and the abdominal organs became increasingly more encased in visceral adhesions (Fig. 1). The hermaphrodites had one or more ovarian ducts blocked by adhesions. This blockage, or hormones produced by the testes, may account for the retention of egg masses in the ovaries. In these hermaphrodites, ripe eggs were found in the outermost ovarian sacs. Each egg mass, representing previous spawning seasons, became progressively more degenerated towards the interior of the gonad (Fig. 1). Numerous small, hard, degenerated eggs were embedded in the visceral organs and peritoneum. The oldest hermaphrodites had more constricted stomachs and intestines (Fig. 1) and more swollen abdomens than normal prespawning females. The

TABLE 1.—*Distribution of 42 striped bass from Coos Bay, Oregon, among gender conditions, by age.*

Age, years	Males	Hermaphrodites		Females
		Large testes, small ovaries	Small testes, large ovaries	
4	9	0	0	0
5	0	1	0	0
6	0	0	0	2
7	0	1	1	0
8	3	0	4	5
9	0	0	0	1
10	1	0	4	2
13	1	0	0	2
14–19	0	0	0	5

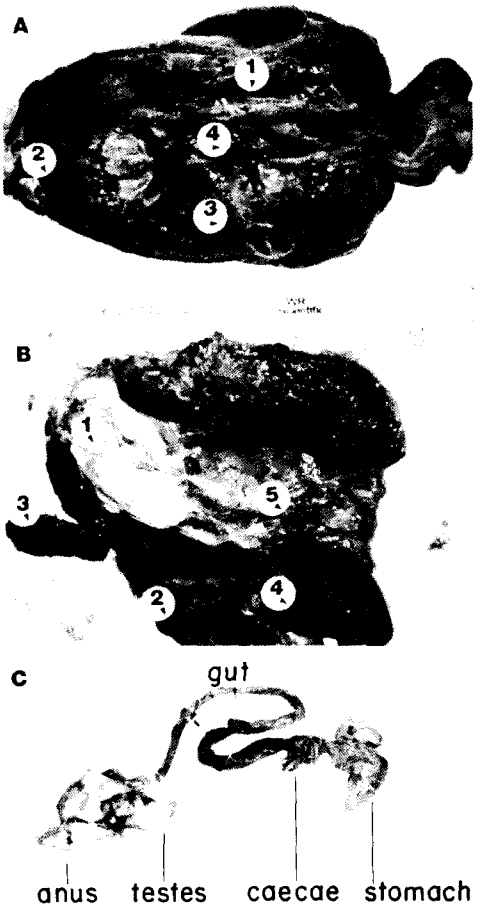

FIGURE 1.—*Gonads of a typical 10-year-old hermaphroditic striped bass.* **A.** *Digestive and reproductive tracts encased in visceral adhesion: (1) intestine; (2) ripe ovarian sac; (3–4) degenerated egg masses.* **B.** *Egg masses retained from previous spawns: (1) testes; (2) ripe eggs; (3–5) successive degenerated egg mass.* **C.** *Digestive and reproductive systems.*

four oldest hermaphrodites, 10 years old, had retained their eggs for up to 5 years. Female striped bass normally mature at age 4 or 5. The absence of hermaphrodites older than 10 years suggest that continual reabsorption of egg masses may prove fatal. Alternatively, if the Coos Bay fish are protandrous, the hermaphrodites may resorb their degenerative egg masses and become normal females. This distinction cannot be made without further field collections. If the hermaphrodites, whether protandrous or simultaneous, die as a result of the pathology associated with egg retention, this type of hermaphroditism may, in time, be selected against. However, in this relatively small, isolated, and recently established population, if a functional male hermaphrodite fertilizes normal females, or if a hermaphroditic female releases some eggs, this trait can be transmitted. In comparison, only two hermaphrodites were identified from more than 500 adult striped bass collected from the larger population in San Francisco Bay, which may reflect the larger gene pool or different environmental conditions in California.

In the past, the genus *Morone* periodically has been placed in the family Serranidae (Miller and Lea 1972), which contains species that undergo protogynous sex reversal. If striped bass are protandrous, this may be additional justification for the removal of this species from that family.

Acknowledgments

We thank Rees Bender, Oregon Department of Fish and Wildlife; Marvin Jung, California State Water Resources Control Board (CSWRCB); and Brian Jarvis, National Marine Fisheries Service for their help with the Coos Bay collections. This work was sponsored by CSWRCB.

References

BISHOP, S. C. 1920. A case of hermaphroditism in the white perch, *Morone americana* (Gmelin). Copeia 1920:20–21.

DORFMAN, D. 1976. Occurrence of a hermaphro-

ditic white perch, *Morone americana*. Progressive Fish-Culturist 28:45.

KOHLENSTEIN, L. C. 1981. On the proportion of the Chesapeake Bay stock of striped bass that migrates into the coastal fishery. Transactions of the American Fisheries Society 110:168–179.

MILLER, D. J., AND R. N. LEA. 1972. Guide to the coastal marine fishes of California. California Department of Fish and Game Fish Bulletin 157.

MORGAN, A. R., AND A. R. GERLACH. 1950. Striped bass studies on Coos Bay, Oregon in 1949 and 1950. Oregon Fish Commission Contribution 14.

SCHULTZ, L. P. 1931. Hermaphroditism in the striped bass. Copeia 1931:64.

SETZLER, E. M., AND EIGHT COAUTHORS. 1980. Synopsis of biological data on striped bass, *Morone saxatilis* (Walbaum). NOAA (National Oceanic and Atmospheric Administration) Technical Report NMFS (National Marine Fisheries Service) Circular 433.