mock fish before in irradiation studies in which we either embedded the inoculum evenly throughout the gelatin disc or smeared the same size inoculum on one surface of the gelatin disc (Green and Kaylor 1977). The method might be extended to other applications where some detail or specific effects are to be elucidated.

From Figure 1 it is obvious that 1% calcium ions negate the effect of 0.1% EDTA and reduce the effect of 1% EDTA. An improved effect is noticed when 10 ppm iodophor is coupled with 0.1% EDTA, and this was somewhat expected.

The implied conclusion is that 1% EDTA embedded in ice, free of divalent ions, will reduce the outgrowth of *Pseudomonas* spoilage organisms on iced fish and that the inhibitory effect of 0.1% EDTA combined with 10 ppm iodophor is even greater. The expected results obtained with the mock fish supports their reliability for the intended use, but it is not suggested for use as a substitute for efficacy tests. Therefore, conculsions regarding the effectiveness of inhibitory additives for any specific substrate must ultimately be derived from conventional efficacy tests.

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JOHN H. GREEN

Northeast Fisheries Center Gloucester Laboratory
Present address: *Department of Food Science*
Cornell University
Ithaca, NY 14853

LOUIS J. RONSIVALLI

Northeast Fisheries Center Gloucester Laboratory
National Marine Fisheries Service, NOAA
P.O. Box 61
Gloucester, MA 01930

REPRODUCTIVE CYCLE OF THE PINK SURFPERCH, *ZALEMBIUS ROSACEUS* (EMBIOTOCIDAE)

Embiotocids received early attention from biologists (e.g., Eigenmann 1892) partly because of the viviparous mode of reproduction displayed by fishes of this family. The pink surfperch, *Zalembius rosaceus* (Jordan and Gilbert), is one of the lesser known members of this group. What is most distinctive about *Z. rosaceus* as compared with other embiotocids is the timing of the various events of its annual reproductive cycle. The purpose of this report is to describe this cycle.

Materials and Methods

Specimens were collected off the coast of southern California at depths ranging from 27 to 33 m. Samples were taken from Redondo Beach, Los Angeles County, to San Clemente, Orange County, Calif. Monthly collections were obtained from May 1972 to September 1973 and January and March 1977. Collections were made using otter trawls from the Occidental College RV *Vantuna* and from the RV *Fury II*, operated by the Orange County Board of Education. Specimens from July, August, and September 1973 were provided by the Southern California Coastal Water Research Project. Specimens were also examined in the ichthyology collection of the Los Angeles County Museum of Natural History.

The fish were preserved in 10% Formalin.[1] Gonads were embedded in paraffin. Histological sections were cut at 8 μm and stained with iron hematoxylin followed by eosin counterstain. Gonads were sectioned from the following numbers of females: January (7), February (4), March (11), April (6), May (5), June (10), July (1), August (15), September (18); October (3); December (6); and from 85 males, as shown in Table 1. Sectioned material was collected in 1973 except that for May, June, October, and December 1972.

Results and Discussion

The gonadal morphology and histology of *Z. rosaceus* closely resembles that of the embiotocids *Cymatogaster aggregata* as described by Eigen-

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

mann (1892), Turner (1938), and Wiebe (1968) and *Embiotoca jacksoni* by Lagios (1965).

The seasonal testicular cycle is summarized in Table 1. From August to November, testes are regressed with the seminiferous tubules containing mainly spermatogonia and Sertoli cells. Testicular recrudescence (i.e., renewal of the germinal epithelium to start a new cycle) was evident in December. The testicular cycle was far advanced in one December male whose testes contained small clusters of sperm. The major period of spermiogenesis (sperm formation) occurred from March through June (Table 1). Germinal epithelium was exhausted or greatly reduced in seminiferous tubules of regressing testes which were first observed (Table 1) in June males. In these testes, lumina are typically filled with compact sperm cysts called spermatophores by Wiebe (1968). Some breeding may conceivably continue as late as July because residual sperm cysts lingered into this month in the regressing testes of three males. While the exact duration of the mating season is not known for *Z. rosaceus*, the testicular cycle seems to indicate that it encompasses March–June.

Embryos were observed for the first time in ovarian histological sections from 7 of 15 August females. The gestation period appears to last about 5–7 mo as one December and one January female gave birth while in the otter trawl aboard ship, and females that had recently given birth, as well as several that were still gravid, were found in the January and March 1977 samples. The 23 gravid females that were examined contained a mean of 3.5 young (range 2–6). A sample of 26 near-term young that were removed from females during this period averaged 34 mm SL.

There appear to be two trends in the timing of the reproductive cycles of California embiotocids. In the first, breeding occurs mainly during autumn with the young being born in spring and summer. This group includes *Amphistichus argenteus* (Carlisle et al. 1960), *Brachyistius frenatus* (Feder et al. 1974), *Damalichthys vacca* (Feder et al. 1974), *E. jacksoni* (Lagios 1965), *Hyperprosopon argenteum* Rechnitzer and Limbaugh 1952), and *H. ellipticum* (Feder et al. 1974). Young of *D. vacca* may appear as late as October (Feder et al. 1974). In the second group, breeding takes place during the summer with parturition occurring the following spring and summer. This group includes *Amphigonopterus* (= *Micrometrus*) *aurora, Micrometrus minimus* (Hubbs 1921), and *C. aggregata* (Bane and Robinson 1970; Shaw et al. 1974).

The timing of the reproductive cycle of *Z. rosaceus* with mating in the spring and parturition in the winter is a pattern clearly distinct from that currently known for any other California embiotocid. The advantages of this type of cycle are not clear at this time and further studies on the biology of this species will be necessary.

TABLE 1.—Monthly samples of *Zalembius rosaceus* showing percentage of males in various stages of the testicular cycle.

Month	*N*	Spermiogenesis	Partial regression	Total regression	Recrudescence
Jan.	5	0	0	60	40
Feb.	8	50	0	12	38
Mar.	12	75	0	8	17
Apr.	10	100	0	0	0
May	13	100	0	0	0
June	4	75	25	0	0
July	3	0	100	0	0
Aug.	6	0	0	100	0
Sept.	7	0	0	100	0
Oct.	10	0	0	100	0
Dec.	7	14	0	14	72

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STEPHEN R. GOLDBERG
WILLIAM C. TICKNOR, JR.

Department of Biology
Whittier College
Whittier, CA 90608

GALLBLADDER LESIONS IN CULTURED PACIFIC SALMON

This note records observations on a previously unreported biliary lesion in the gallbladders of various samples of coho, *Oncorhynchus kisutch;* chinook, *O. tshawytscha;* and sockeye, *O. nerka,* salmon cultured mainly in Puget Sound, Wash., during 1974–76. There were no obvious signs of distress or physical debilitation in affected fish. The gallbladders were enlarged and impacted with an amorphous yellow or white material which, in some instances, extended into the common bile duct (Figure 1).

Efforts to prove infectious origin were unsuccessful. No bacteria were consistently isolated from gallbladder or hepatic tissues and attempts to demonstrate a viral agent on a chinook cell line were negative. Possibilities of protozoan or helminth parasitism were discounted after microscopic examination of tissues, gallbladder, and intestinal contents.

Normal and impacted gallbladder, liver, and kidney tissues were fixed in 10% buffered Formalin[1] and stained sections were prepared at Northwest and Alaska Fisheries Center (NWAFC), NMFS, NOAA, Seattle, Wash. Excessive vacuolation of the columnar epithelium was evident in affected gallbladders (Figure 2). No lesions were observed in either the livers or kidneys of fish with the gallbladder condition.

Preliminary studies (Table 1) indicate a predominance of an as yet uncharacterized mucopolysaccharide material in impacted gallbladders. Serum bilirubin, cholesterol, and glucose concentrations of coho salmon with impacted gallbladders were not different from those found in normal fish.

TABLE 1.—Composition of material in impacted gallbladders in coho salmon.

Material	Percentage
Solids (dry wt @ 105°C)	30.4
Ash	14.2
Nitrogen	1.25
Reducing sugar (ortho-toluidine method)	11.52

Case History

Impacted gallbladders were first observed in May 1974, when 25 yearling coho salmon from saltwater pens in southern Puget Sound were referred to the disease laboratory at NWAFC Aquaculture Experiment Station near Manchester, Wash., for diagnosis of an unrelated skin infection (Table 2). The condition was detected in four separate lots of coho and chinook salmon in central Puget Sound during the summer growing season of 1974. In July 1975, the lesion was seen in a subsample of 250 chinook salmon smolts in a private freshwater rearing pond in Oregon (Table 2). Several lots of salmon being held for husbandry and disease research at the Aquaculture Experiment Station have also been found to have this condition.

Four thousand 0-age coho salmon smolts (18–20 g) reared on commercially prepared Oregon Moist Pellets (OMP) were transferred to saltwater pens at the Aquaculture Experiment Station in early August 1976 where they continued to receive the same ration. Smolts of the same stock (1,000) were

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