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PITUITARY GONADOTROPIC ACTIVITY AND OVARIAN ANTIGENS FOR PREDICTING AGE AT MATURITY OF HIGH SEAS SOCKEYE SALMON

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Previous studies at the National Marine Fisheries Service (NMFS) laboratory in Seattle of a maturity-related lipoprotein (SM antigen) in female sockeye salmon blood (Ridgway, 1961; Hodgins and Utter, 1969) and of gonadotropic hormone (GH) activity in pituitary glands of sockeye and chum salmon (Gronlund, 1969; Gronlund and Hodgins, 1970) have demonstrated that both provide valid criteria for the identification of maturing fish taken at sea several months before spawning. For accurate forecasting of inshore runs from high seas sampling, data on age at maturity of sockeye salmon taken at sea are essential. The possibility of detecting the onset of sexual maturity in sockeye during the year before spawning led us to investigate pituitary GH further and to investigate the relations between antigens in ovaries and the maturation process.

Blood SM antigen can be induced with estrogens (Ames, 1967) in immature male and female sockeye salmon; blood SM antigen can also be induced in immature female rainbow trout but not in immature female coho salmon with pituitary extracts (Gronlund, 1969). The antigen is detected in both the blood and ovaries of maturing female salmon, and its presence in blood of high seas sockeye salmon is consistent with known age-maturity data (Hodgins and Utter, 1969). The GH is detected in extracts of maturing sockeye salmon pituitary glands, and levels of activity—using gonad weight augmentation bioassays—are consistent with other maturity criteria (Gronlund and Hodgins, 1970).

Because of lack of sensitivity, the bioassay by gonad weight augmentation used for GH was not applicable to individual pituitary glands from high seas sockeye, and a more sensitive test was needed if earlier maturity predictions were to be possible using GH as an indicator.

Whereas SM antigen is detectable in the ovaries of all high seas sockeye salmon with SM antigen in blood (SM+), some fish without detectable SM antigen in blood (SM−) did have detectable SM antigen in ovaries. To assess ovarian SM antigen as a maturity factor, we examined the relation between blood and gonad SM antigen.

The purposes of the present studies were to: (1) examine ovarian and serum proteins from maturing sockeye salmon to determine how many ovarian constituents were detected by anti-SM sera and to make preliminary investigations of their physico-chemical properties for use in identification of their roles in the maturation process and (2) investigate a new GH assay procedure based on radioactive phosphorous (^{32}P) uptake by immature salmonid testes. Using this method, we examined the GH activity of individual pituitary glands of high seas sockeye salmon. We also partially characterized the hormone as a first step in the development of immunochemical assay procedures, which are extremely sensitive and can be used to quantitate GH activity in blood as well as in pituitaries.

EXPERIMENTAL PROCEDURES

Ovarian SM Antigen Tests

Salmon captured at sea on 1967–71 cruises of the RV *George B. Kelez* were frozen whole and transported to the NMFS laboratory in Seattle. The fish were partially thawed and ovaries removed. Ovaries were either homogenized with phosphate buffered physiological saline in a glass hand homogenizer, in a mechanical homogenizer, or were cut in small pieces and crushed. All methods gave essentially the same results. The saline extracts were then tested for SM antigen using the immunodiffusion test that was used with blood (Ridgway, Klontz, and Matsumoto, 1962).

Ovarian SM Antigen Purification

Ovaries pooled from female sockeye salmon captured on the high seas and kept in frozen storage were processed by a modification of the method described by Wallace, Jared, and Eisen (1966) for separation and purification of phosvitin—a protein containing a high percentage of phosphorous—from eggs of several vertebrate species including teleosts. As part of this process, a water-insoluble material which they called the "phosvitin-lipovitellin complex" is separated. We previously found that protein material from mature salmon ovaries, serologically cross-reactive with serum SM antigen, is water insoluble. This in-

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