KUDOA THYRSITIS (MYXOSPOREA, MULTIVALVULIDA) IN ATLANTIC SALMON, SALMO SALAR

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Infections in year-old Atlantic salmon, Salmo salar, by a histozoic myxosporean parasite tentatively identified as Kudoa thyrsitis (Gilchrist, 1924) were detected at the National Marine Fisheries Service's laboratory at Manchester, on Puget Sound, Washington.

In April 1982, 1,200 Atlantic salmon smolts each weighing approximately 55 g were transferred to seawater. Initial losses were attributed to stresses of seawater entry. By September, however, mortality had risen to 0.57% per day. Fresh dead and moribund fish were anemic with uniformly swollen kidneys. Muscle and connective tissue rapidly deteriorated in an aseptic manner after death. Attempts to isolate bacterial pathogens usually associated with diseased salmon in net-pens were unsuccessful.

Mature and maturing myxosporean spores were observed in wet mount preparations of muscle tissue from fresh and fixed specimens. Samples of spleen, kidney, liver, heart and muscle tissue were fixed in buffered 10% formalin, dehydrated and embedded in paraffin. Sections 6 µm thick were cut from each sample and stained with Harris hematoxylin and eosin and with periodic acid Schiff using either a hematoxylin or light green counter stain (Luna 1960).

Samples for transmission electron microscopy were fixed for 2 h in 4% gluteraldehyde in 0.1 M cacodylate buffer at pH 7.4, then washed three times with buffer. The tissues were post-fixed in 1% OsO_4, dehydrated, and embedded in Epon 812[1/] according to the method of Luft (1961). Thin sections were cut, then stained with lead citrate and uranyl acetate. A JEOL 100B[1/] transmission electron microscope was used for examination and photography.

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

The mature spores were stellate in polar view, consisting of four shell valves and four iridescent polar capsules. The polar capsules were pyriform, often with one clearly larger than the other three. Observation with transmission EM revealed the sporoplasm positioned posteriorly to the polar capsules and laterally within the extracapsular space (Fig. 1). Tentative identification of this organism was based upon spore morphology and dimensions (Kabata & Whitaker 1981). Z. Kabata (personal communication) confirmed that the parasite infecting the Atlantic salmon was K. thyrsitis (Myxosporea, Multivalvulida).

Infections were found in muscle tissue only, the spores forming pseudocysts within individual muscle fibers (Figs 2 and 3). The pseudocysts, aggregate masses of spores within the somatic muscle fiber and its surrounding sarcolemma, illicited no visible host response. Extensive damage to surrounding individual muscle fibers, however, was observed. Damage to the tissues is caused by a proteolytic enzyme produced by the parasite (Patashnik, Groninger, Barnett, Kudo & Koury 1982) and by physical disruption of the muscle fibers. Numerous individual spores were observed between muscle fibers and around connective tissue. These spores were presumably from pseudocysts that had ruptured and released their contents.

Pacific hake, Merluccius productus, has developed a defense against K. thyrsitis and a stable relationship has evolved between the parasite and host (Kabata & Whitaker 1981). This defense mechanism, in part, is associated with a gradual deposition of pigment around the spore mass. There was no evidence of such a host response in the infections of Atlantic salmon.

This infection of Atlantic salmon by K. thyrsitis may be analogous to infections by K. paniformis Kabata and Whitaker, 1981 in Pacific hake. Both species of parasite are relatively new to their respective hosts, and sufficient defenses against the infection have not yet evolved. This may account for the elevated mortality of the Atlantic salmon cultured in Puget Sound during the fall of 1982.

The observed gross swelling of the kidney could not be explained histologically. There were no inflammatory changes or edematous lesions present in renal tissue. It is conjectured that the proteolytic enzyme produced by the parasite collects in the nephros, causing the swelling of the kidney, or that myoglobin released by the destruction of muscle tissue produces the same effect.

The authors are aware of only one reference to Kudoa species in Atlantic salmon. Prudhomme & Pantaleon (1959) described an infection by Kudoa histolytica in the flesh of an Atlantic salmon from a fish market in France.

Further investigations into the pathogenic mechanisms of this parasite are planned, depending on other active infections or successful attempts to artificially pass the infection from Pacific hake to Atlantic salmon.

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Figure 1.--Electron micrograph of *Kudoa thyrsitis* spores. Polar capsules (P) and sporoplasm (S) (x 10,000).

Figures 2 and 3.--Pseudocysts within muscle fibers. Figure 2 (x 100); Figure 3 (x 400).

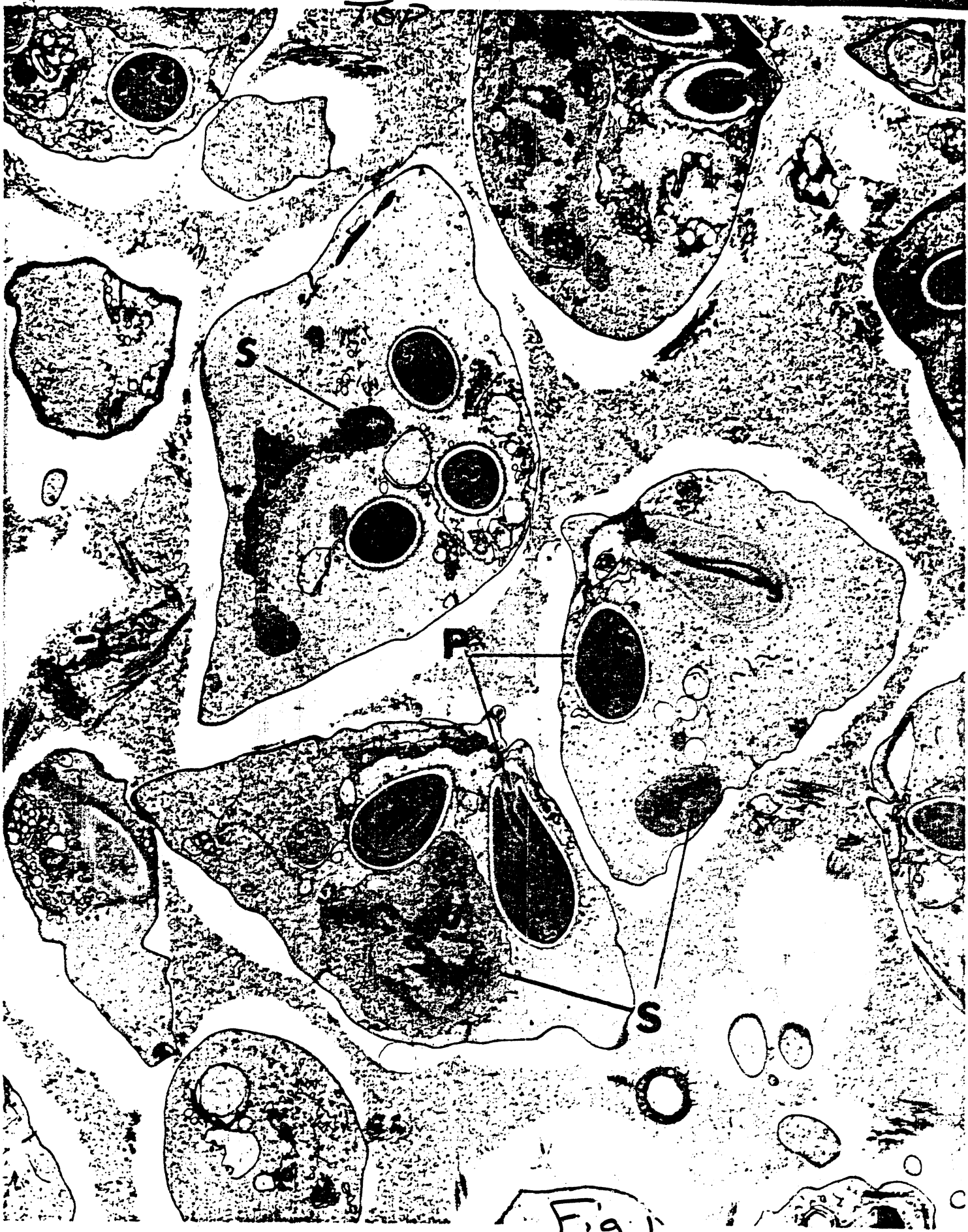

Fig 1.

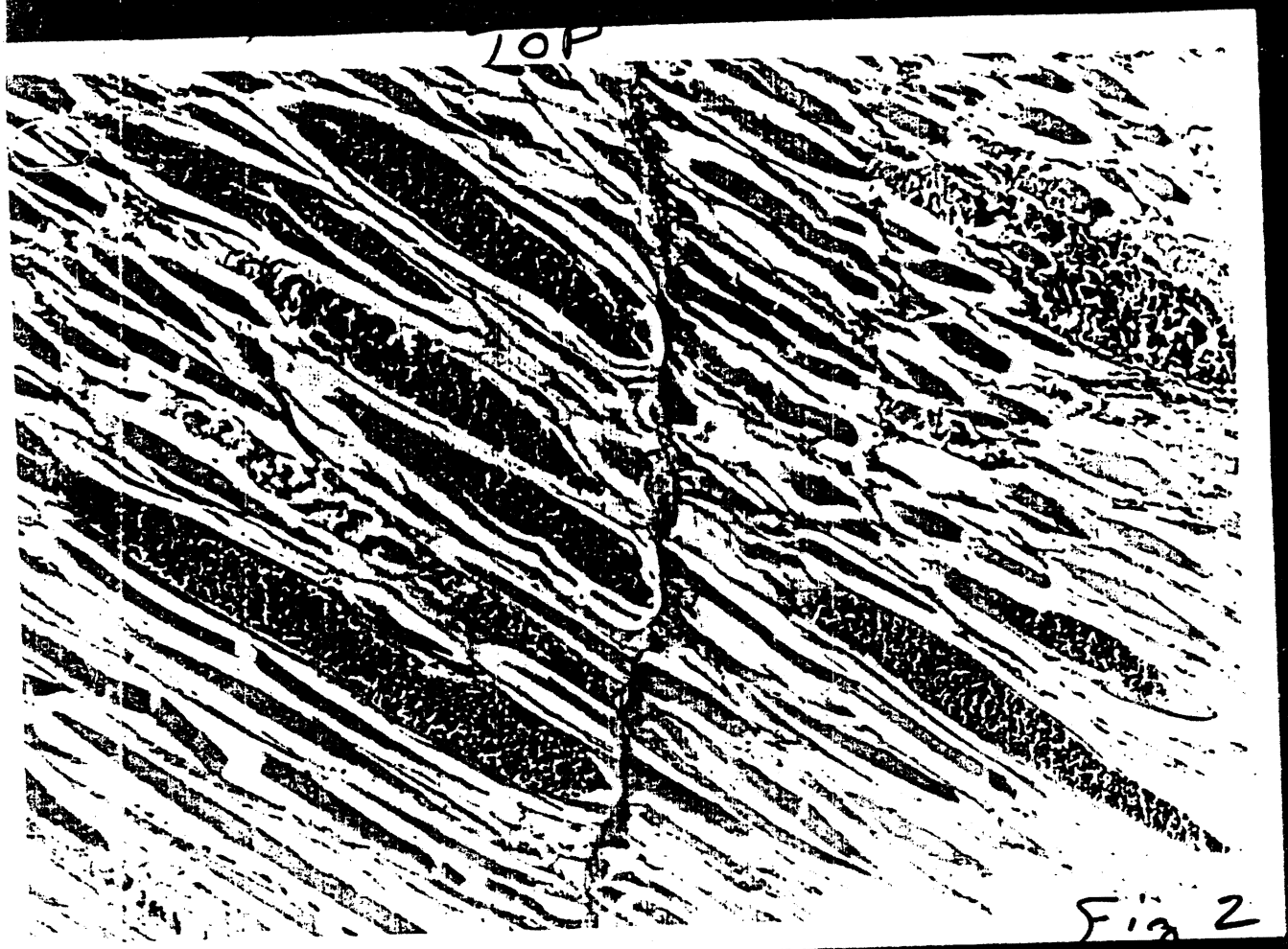

Fig 2

Top

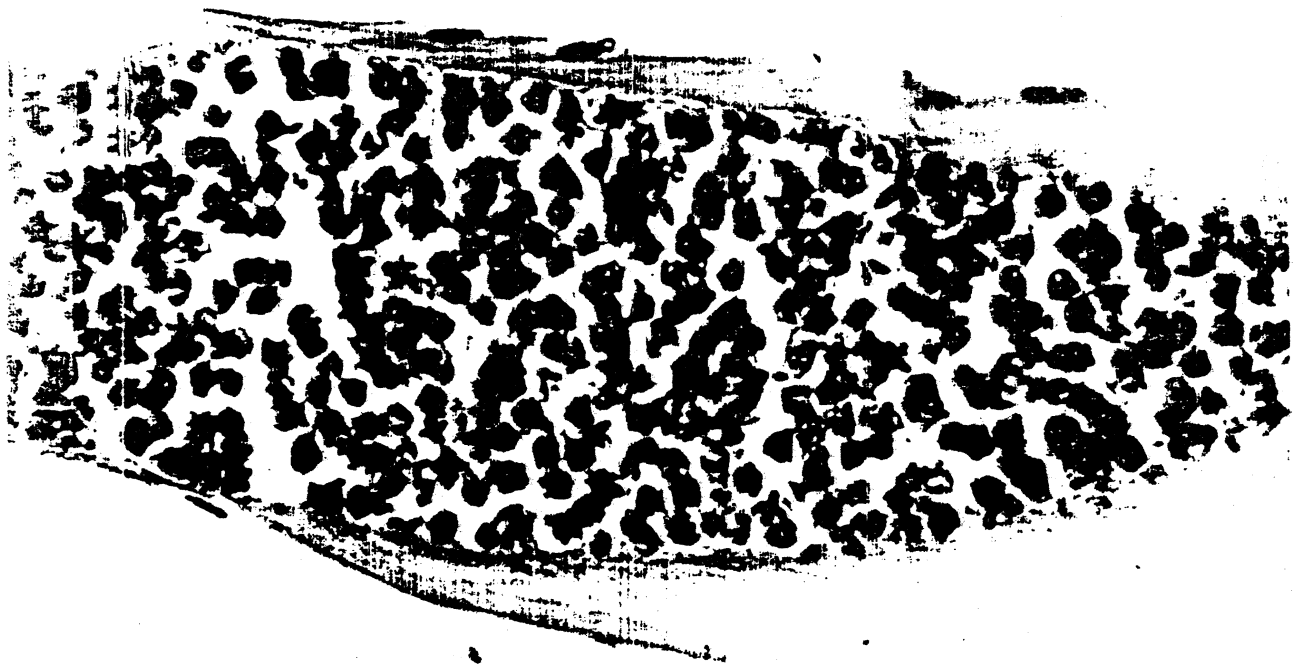

Fig 3.