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Source: Journal of Wildlife Diseases, 23(4) : 698-701

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-23.4.698>

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## A Lymphosarcoma in an Atlantic Salmon (*Salmo salar*)

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**ABSTRACT:** A lymphosarcoma that appeared to be of thymic origin and of lymphoblastic type was found in a 3.5-yr-old Atlantic salmon (*Salmo salar*). The fish was from a population of 60 broodfish maintained at a research fish laboratory. A large tumor mass was found under the left operculum. Small tumor nodules were found on the swim bladder and in the abdominal adipose tissue. The location of this neoplasm differed from those of previously described tumors in this fish species.

**Key words:** Atlantic salmon, *Salmo salar*, oncology, lymphosarcoma, case history.

Lymphoid neoplasia has been documented on several occasions in salmonid fishes. Lymphosarcoma of thymic origin has been described for rainbow trout (*Salmo gairdneri*) by Herman (1969) and Warr et al. (1984). Lymphosarcoma, apparently originating from the thymus, was described by Dunbar (1969) in brook trout (*Salvelinus fontinalis*) and in hybrid "splake" (brook trout × lake trout; *Salvelinus namaycush*). In this report we describe a lymphosarcoma that appears to be of thymic origin in the Atlantic salmon (*Salmo salar*). We are aware of four other reports of lymphoma in Atlantic salmon; a lymphosarcoma of the kidneys reported by Haddow and Blake (1933); a lymphoma of the kidneys submitted by D. W. Bruno to the Registry of Tumors in Lower Animals (RTLTA) (National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560, USA) as RTLTA no. 3714; a lymphosarcoma of the muscle reported by Roald and Hastein (1979) and a submission to the Registry of Tumors in Lower Animals by R. L. Herman (RTLTA no. 3458).

A male Atlantic salmon from a yr-class population of 60 broodfish from the same age class was presented to the Fish Diagnostic Laboratory (Department of Avian

and Aquatic Animal Medicine, New York State College of Veterinary Medicine, Cornell University, Ithaca, New York 14853, USA) for examination of a large mass under the left operculum. The fish was 3.5 yr old, weighed 2,305 g and had a total length of 590 mm. None of the remaining fish in the raceway-held population showed a similar lesion.

Upon examination, a spherical mass measuring 52 × 50 × 42 mm was found in the dorsal portion of the left gill chamber (Fig. 1). The dorsal one-fourth of the second gill arch and the dorsal one-half of the third and fourth gill arches were involved in the mass. Following dissection from the fish, the mass weighed 57.6 g. When cut, it was white, moist and firm. Other gross external abnormalities were not observed on the fish.

The abdominal cavity of the fish was opened aseptically and a bacterial culture was attempted from the posterior region of the kidney. All internal organs were then examined. Eight spherical white nodules were found on the swim bladder (Fig. 2). These were white, firm and ranged from 5 to 10 mm in diameter. A single white nodule measuring approximately 10 × 5 × 5 mm was found embedded in the abdominal adipose tissue surrounding the stomach, intestine and caecae. In addition to the large mass associated with the gills, the swim bladder nodules and nodule in the abdominal fat, tissues were collected from the anterior and posterior regions of the kidney and intestine, gill, liver, spleen, and heart. These tissues were fixed in 10% neutral-buffered formalin, embedded in paraffin, sectioned and stained with hematoxylin and eosin stains. Formalin-fixed tissue from the large mass was embedded in glycol methacrylate, sectioned (2 μm) and

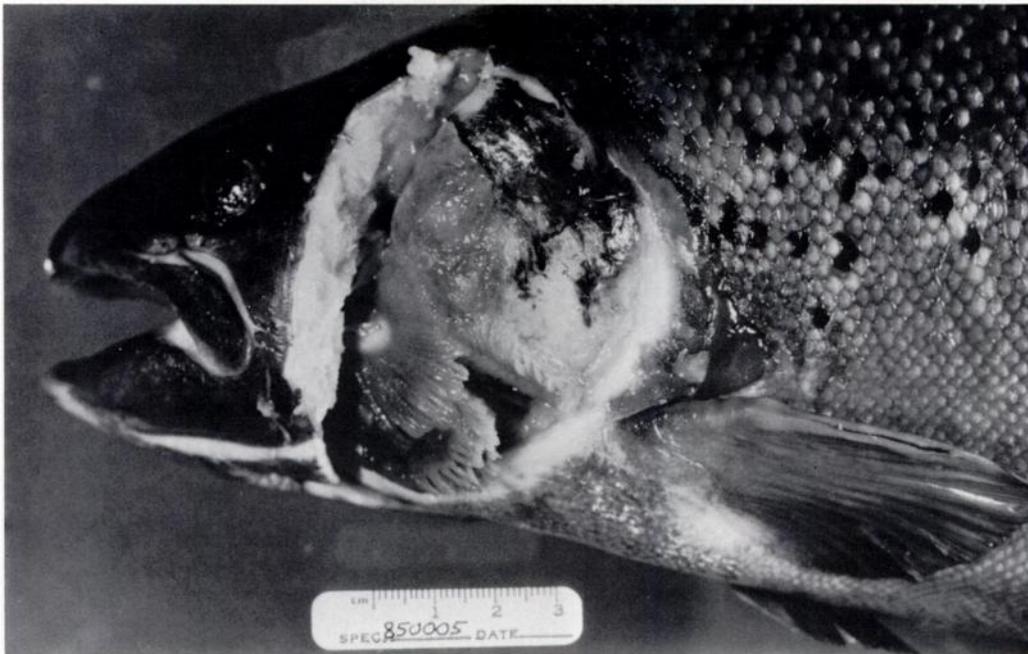


FIGURE 1. Atlantic salmon with a large spherical mass under the left operculum.



FIGURE 2. Swim bladder of an Atlantic salmon in which several small nodules are embedded.

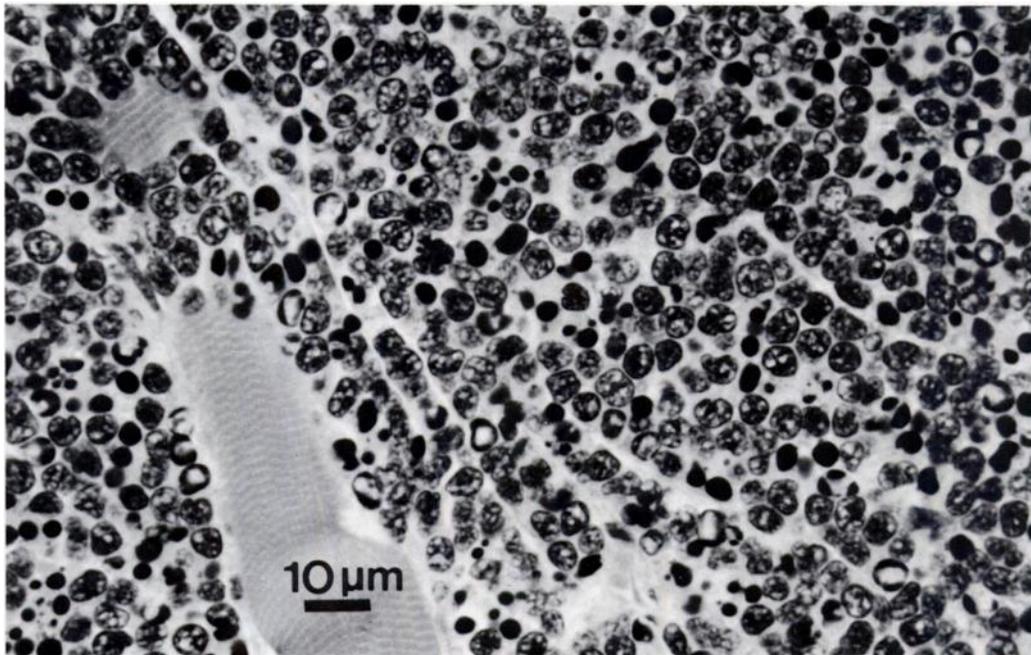


FIGURE 3. Histological section of the gill-associated mass from an Atlantic salmon showing lymphoblasts infiltrating muscle tissue, 2  $\mu$ m section; H&E.

stained with hematoxylin and eosin. Tissue from the large mass was fixed also in 3% glutaraldehyde and processed for examination (Weakey, 1972) with a Philips 301 transmission electron microscope.

Microscopic examination of wet mounts of gill tissue revealed no significant parasites. Bacterial cultures from the posterior region of the kidneys were negative for growth after 5 days. Microscopic examination of sectioned material from the gill-associated mass revealed mononuclear cells that resembled lymphoblasts that infiltrated between muscle fibers (Fig. 3). The cells were packed closely and had round to angular nuclei that contained dispersed chromatin. Occasional cells had cleaved nuclei. Nucleoli were not prominent. Cytoplasm was sparse and weakly basophilic. There were scattered mitotic figures. Similar cells were observed in the nodules located on the swim bladder and in the abdominal fat. Several foci of mononuclear cells, not visible with the naked eye, were found also when swim bladder tissue was examined

microscopically. Electron microscopic examination revealed cells consistent in appearance with lymphocytes. The cells had few mitochondria and numerous ribosomes. Nuclei were slightly indented and contained chromatin that tended to be margined. Viruses were not observed in tissues examined by electron microscopy.

This case differed in distribution of lymphoid tissue from the four other known cases of lymphoma in Atlantic salmon. Haddow and Blake (1933) and Bruno (RTLA no. 3714) found a lymphosarcoma in the kidneys. Roald and Hastein (1979) reported a lymphosarcoma of the muscle. In RTLA no. 3458, Herman (pers. comm.) found a large mass, similar to that found in this report, under the left operculum in the vicinity of the thymus. He found also that the kidneys were swollen and the blood vessels were filled with large numbers of lymphocytes. In the present report, we did not observe an involvement of the kidneys, but we did observe a number of foci of lymphoid tissue on the swim bladder and

one nodule in the mesentery. Although lymphoid cells were observed in blood vessels, the degree of leukemia was not as severe as that observed in RTLA no. 3458. The neoplasm we observed is presumed to be of thymic origin due to location of the large mass in the gill chamber. The thymus gland which is composed of lymphoid tissue is normally dorsal to the gill arches at the junction of the operculum and the body. Slides and formalin-fixed tissues from the Atlantic salmon we examined were cataloged into the Registry of Tumors in Lower Animals as RTLA no. 3468.

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*Received for publication 3 April 1987.*