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## Lymphosarcoma in a Brook Trout

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**ABSTRACT:** A 2-yr-old female brook trout, *Salvelinus fontinalis*, maintained at a state fish hatchery in New York (USA) was culled from the breeding stock. At necropsy, it had a markedly enlarged kidney. On histopathological examination, lymphoblastic lymphoma was diagnosed in several organs including kidney, dorsal musculature, intestines, liver, gill, pseudobranch and ovary. Origin of the tumor was uncertain, although renal involvement could have been the primary site of development.

**Key words:** Brook trout, lymphosarcoma, neoplasia, *Salvelinus fontinalis*, tumor.

Lymphosarcoma or lymphoma is a malignant neoplasm of the lymph and reticuloendothelial tissues. Although lymphoid tumors comprise one of the most common types of tumors in mammals (Moulton and Harvey, 1990), there are relatively few reported cases of naturally occurring lymphoma in fishes. With the exception of esocid lymphosarcoma in northern pike (*Esox lucius*) and muskellunge (*Esox masquinongy*), which has a proposed retroviral etiology (Papas et al., 1976) most of these reports of lymphoma are singly occurring in a population (Bekesi and Kovacs-Gayer, 1986). Neoplasia is primarily seen in aged individuals; because of the relatively short life span of wild fish species combined with the low likelihood that moribund specimens are examined, it is not unusual that there are so few spontaneous tumors reported in feral fish (Machotka, 1989).

This case involves a 2-yr-old reproductively mature female brook trout, (*Salvelinus fontinalis*), which was housed at the Randolph State Fish Hatchery (Cattaraugus County, New York, USA; 42°10'N, 78°55'W). The fish had been spawned in the fall of 1991, and hatched the winter of 1992. As one of the broodstock, this fish had been kept in an outside pond. All of

the broodstock had been examined as part of a routine annual inspection the previous fall. On June 23, 1994, there was a lightning strike at the hatchery. After the storm, the fish were examined. This particular fish was lethargic and had exophthalmia.

The trout was euthanized by a single sharp blow to the cranium. On gross examination, the kidney was markedly enlarged approximately five times normal size. Previously, bacterial kidney disease (BKD) caused by *Renibacterium salmoninarum* had been enzootic at this hatchery until a general disinfection was conducted in 1977. The combination of exophthalmia and an enlarged kidney was cause for some concern. A Gram-stain was prepared from kidney tissue to look for the causative agent, but there was no evidence of *R. salmoninarum*.

The fish was placed in 10% neutral buffered formalin (NBF) and sent to the Fish Diagnostic Laboratory (College of Veterinary Medicine, Cornell University, Ithaca, New York, USA) in August 1994. Kidney, liver, intestines, ovary, muscle, gill and pseudobranch were evaluated. The tissues were embedded in paraffin, sectioned at 5  $\mu$ m and stained with hematoxylin and eosin.

On histopathologic examination, the kidney, liver, intestines, ovary, muscle, gill and pseudobranch were neoplastic. Within the kidney, there was a marked infiltrate of neoplastic lymphocytes which effaced and replaced normal architecture and obliterated tubules (Fig. 1). The dorsal musculature surrounding the kidney had a marked infiltration of neoplastic cells as well (Fig. 2). There were multifocal areas of necrosis, and tumor cells often divided the muscle bundles. The lamina propria of

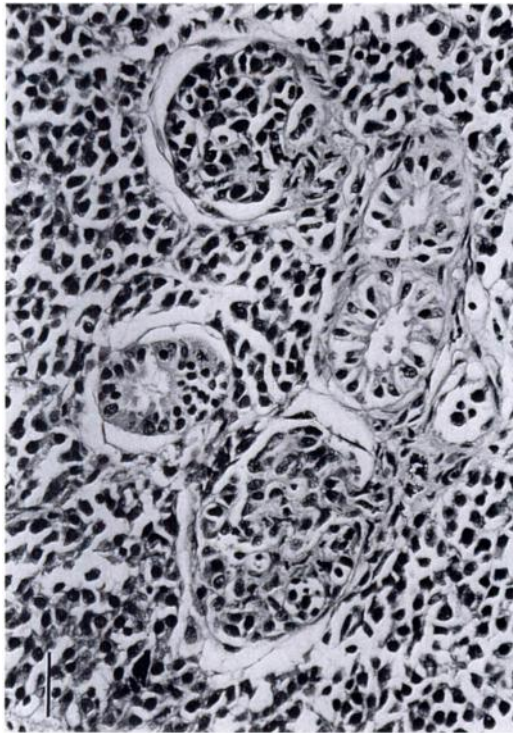


FIGURE 1. Histologic section of brook trout kidney with neoplastic lymphocytic infiltrate. Note the effacement and replacement of normal tubules by these cells. H & E. Bar = 29  $\mu$ m.

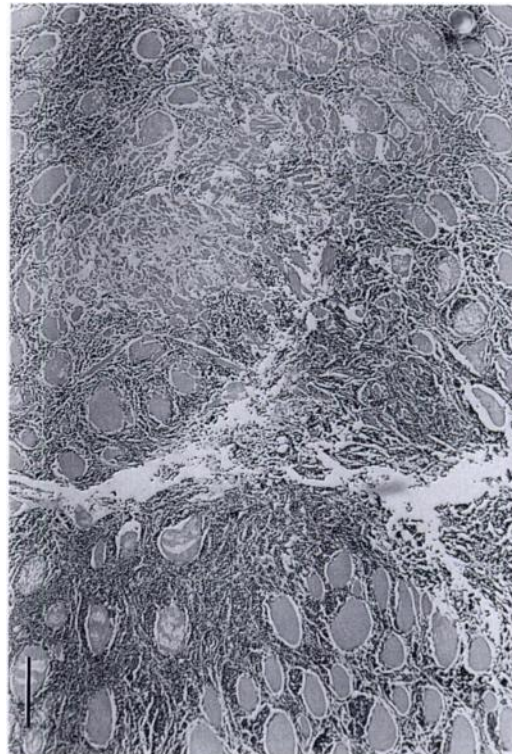


FIGURE 2. Dorsal musculature of brook trout with isolated muscle bundles and effacement and replacement of normal architecture by neoplastic cells. H & E. Bar = 286  $\mu$ m.

the intestine was completely filled with the neoplastic cells (Fig. 3). There was massive replacement of the normal architecture of the liver by tumor cells. Occasionally an isolated island of normal hepatocytes was seen; neoplastic lymphocytes often invaded the portal areas. The ovaries also were affected with multiple foci of neoplastic lymphocytes interspersed among the ova (Fig. 4). The lamellae of the gills were infiltrated by neoplastic lymphocytes, as was the pseudobranch.

Naturally occurring lymphosarcoma is an uncommon disease of wild fish partly because there are no lymph nodes or other lymphoid tissue aggregates in fish. In teleost fish, hematopoiesis primarily occurs in the kidney with some additional occurrence in the spleen and submucosa of the intestines (Dunbar, 1969). Frequently, due to the kidney's role in hematopoiesis, this is the primary location for lymphosarcoma

(Dunbar, 1969). This was the case in this brook trout. The only other reported cases of lymphosarcoma in brook trout were from the common Pisgah Forest trout strain which was propagated extensively throughout the southeastern United States during the 1960's in the fish hatcheries of the U.S. Fish and Wildlife Service (Dunbar, 1969). There may be a genetic susceptibility of this strain of brook trout to lymphoma.

Recent cases of lymphosarcoma were found in an Atlantic salmon (*Salmo salar*), a grayling (*Thymallus thymallus*), and a coho salmon (*Oncorhynchus kisutch*) (Bowser et al., 1987; Hoffmann et al., 1988; Kieser et al., 1991). Additionally, the Esocidae have been studied in great detail due to the retroviral etiology of esocid lymphosarcoma which affects both northern pike and muskellunge (Wolf, 1988).



FIGURE 3. Section of intestine of brook trout with the lamina propria invaded by neoplastic lymphocytes. H & E. Bar = 71  $\mu$ m.

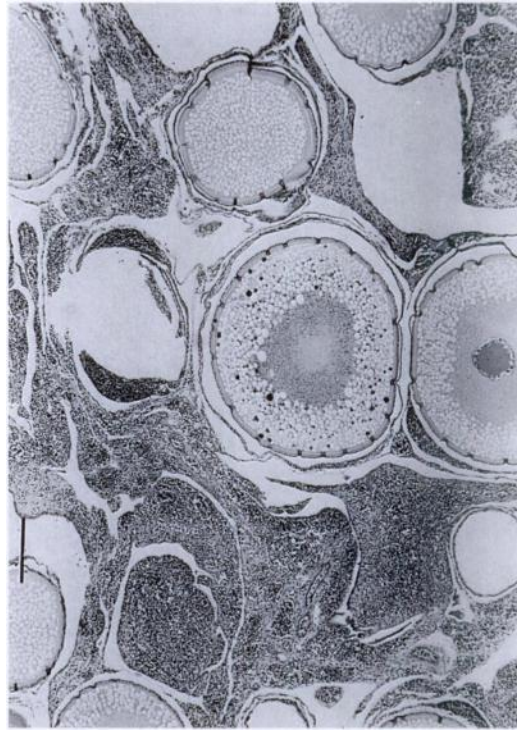


FIGURE 4. Histologic section of brook trout ovary with neoplastic lymphocytes infiltrating between ova. H & E. Bar = 286  $\mu$ m.

Other species reported with lymphosarcoma have included a channel catfish, *Ameiurus (Ictalurus) punctatus* (Bowser et al., 1985) and the pike-perch, *Stizostedion lucioperca* (Bekesi and Kovacs-Gayer, 1986). Medaka, *Oryzias latipes*, a small fish used primarily in research, also have been reported with spontaneous lymphosarcoma (Okihira and Hinton, 1989; Harada et al., 1990).

In his review, Machotka (1989) lists the lymphocytic neoplasms on file at the Registry of Tumors in Lower Animals (Smithsonian Institution, Washington D.C., USA). It is interesting to note that the Salmoniformes represent the largest and most diverse group of species in which lymphosarcoma has been documented. However, this may be because the salmonids have been most extensively cultivated in the United States, and the greatest

amount of information is published on these species.

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