NOTE

Squamous cell carcinoma in rainbow smelt *Osmerus mordax*

Roger Lee Herman

US Fish and Wildlife Service, National Fish Health Research Laboratory, Box 700, Kearneysville, West Virginia 25430, USA

ABSTRACT: Enzootic squamous carcinoma is reported in a freshwater population of rainbow smelt *Osmerus mordax* from a small pond in Maine, USA. The tumors occurred on the upper jaw of males and were destructively invasive. No evidence of virus was found.

The rainbow smelt *Osmerus mordax* is an important forage fish and is commonly used as a baitfish in the USA; it also supports commercial and sport fisheries at many locations. Bait dealers collecting smelt during the 1985 spawning runs in tributaries of a small pond in Maine, USA, found smelt with unusual growths on the head and brought them to the attention of the Maine Department of Inland Fisheries and Wildlife. Samples were sent to the National Fish Health Research Laboratory (NFHRL), Kearneysville, West Virginia, for diagnosis. This paper describes these neoplastic lesions.

Materials and methods. The first 2 affected smelt were received at the NFHRL after fixation, one in 10% formalin, one in Bouin's solution. Later live fish were shipped. Live fish were euthanized with tricaine methanesulfonate and fixed whole in Bouin's solution after the abdominal cavity was opened. Part of one tumor was fixed in 4% phosphate-buffered formalin + 1% glutaraldehyde. Tissues fixed in Bouin's solution were processed into paraffin, sectioned at 4 μ m, and stained with hematoxylin and eosin, Masson's trichrome, Alcian blue-PAS for mucopolysaccharides, or Feulgen for DNA reaction. Material fixed in formalin + glutaraldehyde was processed into Spurr epoxy resin for electron microscopy.

A portion of tumor removed from one euthanized fish was homogenized in phosphate-buffered saline with penicillin and streptomycin, and centrifuged at 1500 $\times$ g for 20 min at 4 °C; the supernatant was then inoculated onto BB, BF-2, FHM, and CHSE-214 cells and incubated at 18 and 25 °C.

Results. Seven of 13 smelt received from Maine had grossly apparent tumors. Five had tumors on the right maxillary and 2 had a tumor that involved both maxillaries, from naris to naris (Fig. 1). The tumor-bearing fish were males 14 to 15 cm in total length (TL). The tumors were raised as much as 5 mm from the body surface and protruded into the mouth. Their color varied among fish. Most were translucent white to gray, the larger tumors tending to have a reddish cast. They were soft but solid to the touch and had an irregular surface.

Sections revealed an invasive neoplasm that eroded bone and cartilage, disrupted the dermis, and obliterated the involved nares (Fig. 2). Nerves were surrounded by neoplastic tissue but not invaded. The neoplastic cells were pleomorphic and epithelioid (Fig. 3); mitotic figures were scattered throughout the tissue. Some areas suggested 'pearl' formation. Portions of the neoplasms were necrotic. The epithelium overlying the neoplasms appeared generally to be intact and separate from the neoplastic tissue but showed a variety of cellular changes, particularly vacuolization. Feulgen stain showed no evidence of DNA inclusions, and an attempt to culture virus was unsuccessful. Electron microscopy revealed no evidence of virus.

The characteristics of these neoplasms are those of squamous cell carcinoma.

Discussion. Although the tumors on smelt in Maine came to notice during the spawning period, they are distinct from the spawning papillomatosis described by Breslauer (1916), or Anders & Möller (1985). The highly invasive characteristic of these carcinomas makes them relatively unique among fish epithelial tumors. Virus is associated with many fish skin tumors (Wolf 1984), but not with tumors in rainbow smelt from Maine. Significant chemical contamination of the pond is unlikely, eliminating an additional suspect cause of many fish

Fig. 1. *Osmerus mordax*. Rainbow smelt from Unity Pond, Maine, USA, showing tumor of the upper jaw between the nares. Bar = 1 cm

Fig. 2. *Osmerus mordax*. Cross section through the upper jaw of rainbow smelt at the plane of the nares, showing destructive invasion on the right side. Bar = 1 mm

Fig. 3. *Osmerus mordax*. Section of rainbow smelt tumor showing pleomorphic, epithelioid cells. Epithelium (arrow) is intact but highly vacuolated. Bar = 20 μ m

skin tumors (Mix 1986). Prevalence of tumor-bearing smelt in the pond is difficult to estimate because the total number of smelt handled by bait dealers is unknown and some affected fish had been discarded before a biologist saw them. In July 1985, the Maine Department of Inland Fisheries collected 20 smelt by trawl, one of which had a tumor. The cause of the squamous carcinomas and their significance to smelt population remains to be determined.

Material from these fish has been deposited at the Registry of Tumors of Lower Animals (Smithsonian Institute, Washington D. C.) as Accession RTLA 3460.

LITERATURE CITED

- Anders, K., Möller, H. (1985). Spawning papillomatosis of smelt, *Osmerus eperlanus* L., from the Elbe estuary. J. Fish Dis. 8: 233-235
- Breslauer, T. (1916). Zur Kenntnis der Epidermoidalgeschwülste von Kaltblütern. Histologische Veränderungen des Integuments und der Mundschleimhaut beim Stint (*Osmerus eperlanus* L.). Arch. mikrosk. Anat. Entw.Mech. 87: 200-263
- Mix, M. C. (1986). Cancerous diseases in aquatic animals and their association with environmental pollutants: a critical literature review. Mar. environ. Res. 20 (1 & 2): 1-141
- Wolf, K. (1984). Fish viruses: their biology, classification, hosts, pathology, and control. In: Kurstak, E. (ed.) Control of virus diseases. Marcel Dekker, Inc., New York and Basel, p. 197-215