Skin Lesions of Atlantic Salmon (Salmo salar) in Newfoundland Rivers

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by

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i

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ii

CONTENTS

Abstract/Résumé	iv
Introduction	1
Materials and Methods	1
Results	1
Discussion	2
Acknowledgments	3
References	3

ABSTRACT

Cone, D. K. 1981. Skin lesions of Atlantic salmon (<u>Salmo salar</u>) in Newfoundland rivers. Can. Tech. Rep. Fish. Aquat. Sci. 1018: iv + 9 p.

Bacteriological and histopathological examinations were conducted on 14 grilse found moribund or dead with lesions at fish counting facilities in insular Newfoundland. There was no evidence that the damage to the skin and muscle was the result of parasitic, bacterial or viral pathogens. The pathology and distribution of the lesions on the body suggested that they were mechanical abrasions received from entanglement in commercial fishing nets and/or from collisions with obstacles in the river.

Key words: <u>Aeromonas hydrophila</u>, <u>Pseudomonas fluorescens</u>, fish pathology, net wounds.

RESUME

Cone, D. K. 1981. Skin lesions of Atlantic salmon (<u>Salmo salar</u>) in Newfoundland rivers. Can. Tech. Rep. Fish. Aquat. Sci. 1018: iv + 9 p.

Des analyses bactériologiques et histopathologiques ont été menées sur 14 madeleineaux trouvés moribonds ou morts avec des lésions, dans des installations de dénombrement du poisson de l'île de Terre-Neuve. Aucun signe n'indiquait que les dommages causés à la peau et aux muscles étaient dus à des parasites, des bactéries ou des virus pathogènes. La pathologie et la répartition des lésions sur le corps font croire qu'elles ont été occasionnées par le frottement de filets de pêche commerciale ou à la suite de collisions avec des obstacles dans le cours d'eau.

INTRODUCTION

Outbreaks of infectious diseases involving Atlantic salmon (<u>Salmo salar</u> L.) have occurred recently in some New Brunswick rivers (Pippy and Hare 1969; Weber and Zwicker 1979) and are of obvious concern to future salmonid enhancement programs. The diseases have not been reported from salmon in neighbouring Newfoundland, although fish migrating upstream in various rivers of the province have frequently been seen, or found dead with large lesions on the body surface. This study examines 14 of these salmon in order to establish possible causes of the lesions and their relationship, if any, to the disease outbreaks in New Brunswick.

MATERIALS AND METHODS

Fourteen diseased grilse were collected from fish counting facilities on rivers near the east and west coasts of the island during July and August 1980 (Table 1, Fig. 1). They were collected moribund or dead and shipped frozen or on ice to the laboratory. Wet mounts were prepared from scrapings of the wounds, and for 7 fresh specimens a wire loop was scraped over the damaged skin and streaked on to Tryptic Soy Agar (TSA), TSA + 3% salt, TSA + 5% human blood, and Cytophaga Agar (Anacker and Ordal 1959). The body cavities were opened aseptically and the kidneys tested for the presence of bacteria by making wire loop inoculations onto plates of the above media. Plates were incubated for 5 days at 29 C. Physiological profiles of the resulting isolates were determined by means of routine techniques, and API 20E test strips (Analytical Products, New York) incubated at 29 C. Control profiles were made with strains known to be Aeromonas hydrophila or A. salmonicida. All fish were autopsied for parasites. Samples of organs and skin lesions were fixed in 10% phosphate buffered formalin. Tissue sections were stained either in Delafield's hematoxylin with an eosin counterstain or with the Brown and Brenn gram stain (Humason 1967).

RESULTS

The fish had one to six body lesions. The largest (up to 10 by 20 cm) were on the flanks and were grey or red in color, often oval in shape, with a discolored margin devoid of scales. Lesions on the dorsal surface were irregular in shape and were between the head and the dorsal fin (Fig. 2). The anterior rays of the dorsal fin were usually broken (Fig. 2). Some specimens had localized erosion at the base of the pelvic fin rays. There was sometimes hemorrhaging on the sides and ventral surface of the caudal peduncle which extended to include the anal fin, vent and ventral lobe of the caudal fin. Lines of discolored skin were associated with lesions and hemorrhaging on the flanks of 5 of 14 fish. On two fish these lines were found associated with lesions on the belly (Fig. 3), and on one fish they were adjacent to a small lesion on the head. Lesions were distributed unevenly between the left and right sides of the body, and skin and muscle damage on fish collected moribund resembled that on specimens found dead. The distribution of lesions on the fish examined is summarized in Fig. 4.

Discolored skin involved hemorrhaging within the stratum spongiosum and within alveolar tissue beneath the hypodermis. The overlying epidermis ranged

from normal to hyperplastic. The underlying connective tissue was frequently degenerate and spongiose. The stratum compactum was sometimes hyperemic and infiltrated with unidentified host cells. Bizarre arrangements of dense connective tissue and large multinuclear cells occurred regularly within adjacent alveolar tissue. There was damage beneath the hemorrhaging that involved degeneration of connective tissue surrounding muscle fibers and congestion of capillaries.

Small lesions were devoid of epidermis and the exposed stratum compactum was frequently permeated by free erythrocytes. Hemorrhaging and cellular infiltration was often extensive in the underlying hypodermis, but this gradually diminished along fascial planes. Sloughing layers of skin occurred primarily at the periphery of lesions. Deeper damage was minimal.

Large lesions on the flanks included damage to musculature up to 1 cm deep. In some the muscle fibers were exposed with evidence of waterlogging (a bluish tint in hematoxylin and eosin stained sections) while fibers of the underlying bundles were necrotic and overrun by cells resembling monocytes. In other large lesions the exposed surface was comprised of an ulcerated mat of fibroconnective tissue, erythrocytes, and leukocytes. Hyphae of a fungus resembling <u>Saprolegnia</u> were present within the necrotic remains of hypodermis at the periphery of large lesions from two fish.

The gills, heart, spleen, intestine, and kidney appeared normal in both gross morphology and tissue sections. Some fish had vacuolar degeneration of the liver; however, distinct zones of necrosis were absent. Two moribund fish and all of the fish found dead had a bloody fluid in the body cavity and liver discoloration. Several parasites were found internally including light infections of larval nematodes encysted in the liver and mesenteries and heavy infections of Eubothrium in the pyloric caeca.

Two strains of <u>Pseudomonas</u> <u>fluorescens</u> and five strains of <u>Aeromonas</u> <u>hydrophila</u> were isolated. An additional twelve isolates did not resemble any known fish pathogens and are referred to as unknowns. All strains of bacteria varied among rivers. Bacteria such as <u>Cytophaga</u> and <u>Flexibacter</u> were not found in wet mounts prepared from the lesions. A summary of bacteriological findings indicated that many of the fish apparently had sterile kidneys (Table 1).

DISCUSSION

Skin and muscle damage on salmon in Newfoundland is not related to the recent bacterial disease outbreaks involving wild salmon in New Brunswick. It is not furunculosis since A. <u>salmonicida</u> was not isolated, and it is probably not caused by <u>A. hydrophila and P. fluorescens</u> since these bacteria were not consistantly isolated from the fish. The failure to detect bacteria in histological sections of the lesions and organs further suggests it is not the result of a bacterial pathogen, and therefore the strains isolated may have been freshwater residents that invaded an open lesion. Similarly, the fungus seen in some lesions resembles <u>Saprolegnia</u> which is generally regarded to be a secondary parasitic invader (Roberts 1978). The fact that necrosis was not seen in any of the visceral organs and kidney tends to exclude the viruses as a causative agent. The condition is not ulcerative dermal necrosis described from salmon

in the British Isles (Roberts 1978) because the lesions occurred infrequently on the head and usually were distributed asymmetrically. Also, lesions were histologically distinct from UDN lesions.

The lesions have the characteristics of bruises and ulcerated mechanical abrasions that could have been received from entanglement in fishing nets and/or from collisions with natural obstacles in the river. The lines of discoloration to the skin of some of the fish could be interpreted as net marks; the large lesions on the flanks and the aligned lesions on the back and belly may have been caused by entanglement in nets, and broken anterior rays of the dorsal fin and localized abrasion of the pelvic fins could have occurred during escape from a net; damage to the caudal peduncle could conceivably occur when fish thrash themselves free or when a stressed fish makes frequent contact with the river bottom. Murray et al. (1969) tied nylon filament from gill nets around the body of Atlantic salmon and found such stationary pressure caused extensive subdermal hemorrhaging that was invisible externally. Extensive surface damage to the skin would be expected when such pressure is coupled with an active escape from a net.

There are other studies which have related lesions on wild fish to mechanical abrasion received from fishing nets. Le Tendre et al. (1972) correlated damage received by <u>Micropterus</u> <u>dolomieui</u> held in trap nets to outbreaks of furunculosis. Shelton and Wilson (1973) attributed fin damage on some flatfishes to encounters with otter trawls. Roald (1980) studied Atlantic salmon in Norwegian waters and described body damage caused by gill nets; the lesions were similar to those described in the present study and bacteria were not isolated from the blood.

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REFERENCES

- Anacker, R. L., and E. J. Ordal. 1959. Studies on the myxobacterium <u>Chondrococcus</u> columnaris. 1. Serological typing. J. Bact. 78: 25-32.
- Humason, G. L. 1967. Animal tissue techniques. W. H. Freeman and Company, San Francisco., C.A.
- Le Tendre, G. C., C. P. Schneider, and N. F. Ehlinger. 1972. Net damage and subsequent mortality from furunculosis in smallmouth bass. N. Y. Fish and Game J. 19: 73-82.

Murray, A. R., D. R. L. White, and R. S. Whitaker. 1969. Muscle damage in adult Atlantic salmon caught in nylon gillnets. J. Fish. Res. Board Can. 26: 1694-1696.

- Pippy, J.H.C., and G. M. Hare. 1969. Relationship of river pollution to bacterial infection in salmon (<u>Salmo salar</u>) and suckers (<u>Catostomus</u> <u>commersoni</u>). Trans. Amer. Fish. Soc. 4: 685-690.
- Roald, S. O. 1980. Net marks on Atlantic salmon (<u>Salmo salar</u> in Norwegian coastal areas. Preliminary reports on gross, histological, serological and bacteriological signs. ICES C.M. 1980/M:34.

Roberts, R. J. 1978. Fish Pathology. Bailliere Tindall, London.

- Shelton, R. G.J., and K. W. Wilson. 1973. Epidermal lesions in Irish Sea Flatfish. Nature 241: 140-141.
- Weber, J. M., and B. M. Zwicker. 1979. <u>Aeromonas salmonicida</u> in Atlantic salmon (<u>Salmo 'salar</u>): Occurrence of specific agglutinins of three bacterial pathogens. J. Fish. Res. Board Can. 36: 1102-1107.

Location	Sex	Standard length (cm)	Skin lesions	Kidney
Middle Brook	М	47	Pseudomonas	Pseudomonas
			Unknowns	
Middle Brook	F	47.5	Aeromonas	0
			Unknowns	
Torrent River	F	47	Unknowns	0
Torrent River	М	47.5	Unknowns	Unknowns
Torrent River	М	47	Aeromonas	0
			Pseudomonas	
			Unknowns	
Salmon Brook	F	46	Aeromonas	0
			Unknowns	
Salmon Brook	F	47.5	Aeromonas	Unknowns
			Unknowns	
Terra Nova River	- •	46	-	-
Western Arm Brook	F	53	-	0
Western Arm Brook	F	49	-	Aeromonas
				Unknowns
Western Arm Brook	F	51	-	0
Western Arm Brook	F	49.5	-	Aeromonas
				Unknowns
Western Arm Brook	F	55	-	0
Western Arm Brook	М	51.5	-	0

Table 1. Summary of the bacterial isolates (<u>Aeromonas hydrophila</u>, <u>Pseudomonas fluorescens</u>, and unknowns) obtained from the skin lesions and kidneys of Atlantic salmon grilse (<u>Salmo salar</u>) collected moribund or dead from various rivers in Newfoundland during July and August 1980.



Fig. 1. Collection sites of the Atlantic salmon grilse (Salmo salar) examined from Newfoundland. 1) Salmon River, 2) Torrent River, 3) Western Arm Brook, 4) Middle Brook, 5) Terra Nova River.



Fig. 2. Dorsal view of an Atlantic salmon with a lesion anterior of a dorsal fin. Note that the dorsal fin has several broken rays (X 0.7).



Fig. 3. Lateral view of an Atlantic salmon with a lesion anterolateral to a damaged dorsal fin, and three more or less continuous lesions on the belly. Much of the discoloration on the lower half of the flank is presumed to be net marks ($X \ 0.5$).



Fig. 4. Summary of the distribution of lesions on 14 Atlantic salmon found dead or moribund in fish counting facilities of 5 rivers in Newfoundland. The fish measured 46-53 cm (standard length). The lesions are drawn to scale and represent a combination of those present on the left and right sides of the body.