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Net marks on Atlantic salmon (Salmo salar) in Norwegian coastal areas. Preliminary report on gross, histological, serological and bacteriological signs.

by Sverre Ola Roald

Directorate for Wildlife and Freshwaterfish, Fish Research Division, Box 63, 1432 Ås-NLH, Norway.

ABSTRACT

In order to study pathological effects of net mark injuries on Atlantic salmon, healthy and injured salmons were caught with bag nets and transferred to a floating cage in brackish water.

During the four months of observation no mortality was observed. The magnesium, sodium and potassium ions in the serum of severely injured fish were significantly increased in concentration, suggested to be caused by the skin lesions. The skin lesions were healed after four months.

Correspondence: S.O. Roald, National Veterinary Institute, Postboks 8156, Oslo 1, Norway

INTRODUCTION

Net mark registrations in Norwegian rivers and coastal areas were initiated in 1977, and this work was expanded in 1978 and 1979 (Hansen & Jensen 1978; Hansen 1979). As a part of these investigations, pathological effects of the injury caused by net marks on the fish were studied.

MATERIAL AND METHODS

During the Norwegian home water fishery season 1979, 70 salmon were obtained alive by help of bag nets in the Vefsnfjord, and transferred to a floating cage in brackish water and kept there for four months until spawning. The salmon were individually tagged and according to their gross injury of the skin classified for record and comparison into one of three categories:

Healthy fish (Group I): In this group no signs of external damage of the skin could be recognized.

Moderately injured fish (Group II). The most striking feature in this group was net marks appearing around the body, especially located in the area between the eyes and caudal edge of the operculum. The net marks approached as a single strip or close-sitting strips forming up to twenty millimetre broad lesions in the skin. The wounds were 2-3 millimetre deep, sharply limited to normal surface and caused loss of scales and skin tissue. Grils injured at the upper part of the dorsal fin were also counted to this group.

Severely injured fish (Group III). The appearance and location of the injury of the skin in this group were essentially the same as in group II. The severely injured salmon however, showed perforations of the skin with traumatic lesions in the musculature and in some cases losses of skin and muscle tissue.

Serum analyses and microbiology.

In connection with capture of the salmon, the fishes were anesthesized (30 % Chlorbutol) and blood samples of 2-5 ml obtained. The blood was allowed to clot in centrifuge tubes at ambient temperature and then spun down at 2000 rpm and the serum removed. Total protein concentration was determined

using the Biuret method (Weichelbaum 1946). Serum albumin levels were measured with an autoanalyser using the bromcresol green technique (Northam & Widdowson 1967). Sodium, potassium, calcium and magnesium were measured with an Atomic Absorption Spectrophotometer (Perkin-Elmer model 107).

Bacterial samples were taken from the whole blood samples and plated on to nutrient agar (Difco) and incubated at 20°C.

Light microscopy.

Skin tissue from three fishes in each group was removed and immediately fixed in 10% neutrally buffered formalin, and routinely processed in paraffin blocks. Sections were stained by hematoxylin and eosin (H & E) and Van Gieson's picrofuchsin.

RESULTS

The water temperature and salinity at the actual location during the entire period is shown in figure 1.

During the four months of captivity no fish died in any of the groups.

Significant differences in the average serum concentrations of magnesium, sodium and potassium were found between group I and group III as shown in Table 1.

No bacteria were isolated from the blood.

The histopathological investigation of the skin lesions caused by net marks in group II showed lesions characterized by irregular areas of necrosis, inflammation with hyperemia and small hemorrhages. Increased mucus production and infiltration of mononuclear cells and granulocytes were observed throughout the lesions. The damage of the integument were limited to stratum spongiosum, with minimal influence on stratum compactum.

In group III the lesions were characterized by loss of scales, inflammation, hemorrhages and diffuse necrosis of dermis and underlying muscles. Hyperplastic epidermis formed the margin of the crater-like lesions.

Development of the skin lesions.

After four months, the dermis was repaired and organized, and the epidermis had the smooth surface of normal skin. In the scars a lack of pigmentation was observed, and due to the loss of tissue, the skin was uneven in the healed areas. Microscopically the regenerated skin was covered by a complete epithelium with development of proliferated dermal papillae, limited by the basement membrane. The scales were shortened and covered by the epidermis.

DISCUSSION

The mean serum concentrations of potassium, sodium and calcium by the uninjured salmons (Group I) are within the range determined by Parry (1961) for Atlantic salmon in sea water. The levels of protein in the sera are slightly lower than some reported by Mulcathy (1969) by salmon in freshwater.

The integrity of the skin-scale-slime complex is especially critical to the survival of salmonids in seawater, in part because the complex provides a relatively impermeable barrier to water and electrolytes (Denton and Saunders 1972). Breaches of this complex could result in losses of body water, changes in ion balance and hemoconcentration. The average values of magnesium, sodium and potassium found in the injured salmons are higher than those found in the control fishes. This is probably caused by inflow of ions or outflow of water through the skin lesions. However, the changes in composition of the blood serum cannot be totally accounted for by a simple hemodilution due to an increased osmotic influx of water, because all the ion-species were not reduced by equivalent proportions. For example, the mean potassium concentration was 48 % higher than that of the control, whereas the corresponding increase for sodium and magnesium were seven per cent and 15 per cent, respectively.

As shown in Fig. 1 the salinity gradually increased from 6 °/oo to 14 °/oo during the first two months of the experimental period. Freshwater animals have a salt concentration of 9 °/oo in their tissues, and concentrations in the water that surround them of 6-14 °/oo therefore represent almost isotonic conditions.

It is therefore suggested that the traumatic damage to the integument described may represent a greater osmotic influence on salmon at higher as well as lower salinity than under the present conditions.
Further research is needed to obtain more information about the pathological effects of net fishery.

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Figure 1. Salinity and water temperature at one meter depth by the floating cage.

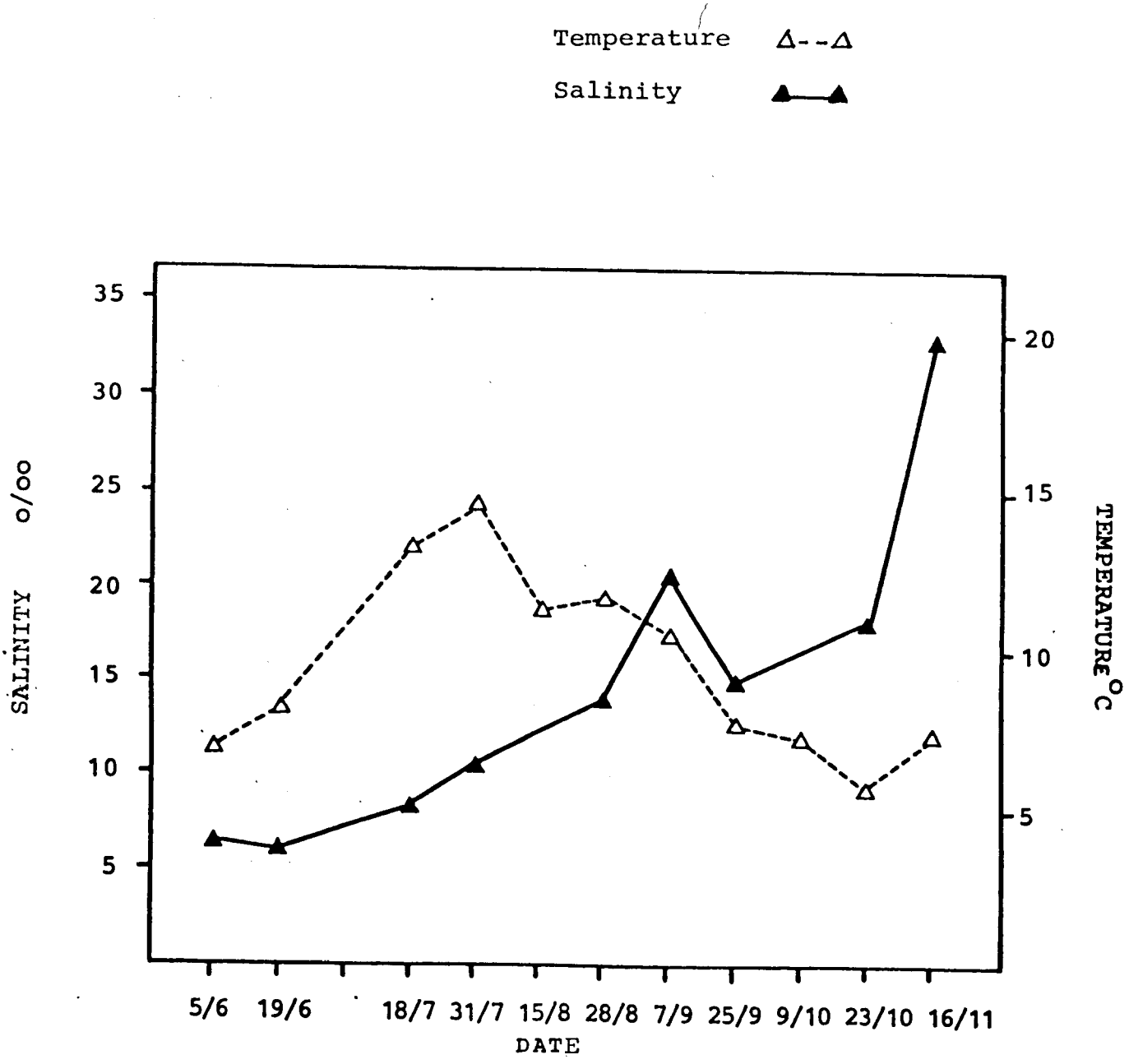

Table 1. Composition of the blood serum of healty, moderate injured and severe injured Atlantic salmon. Results expressed as mean ± S.E.M. (n). A t' test comparison was made between the groups and significant differences are denoted *p < 0.05, ** p < 0.02, ***p < 0.01.

Sample	T.prot.(n) G/l	Alb. (n) G/l	Glob. (n) G/l	Ca (n) mM/l	Mg (n) mM/l	Na (n) mM/l	K (n) mM/l
Healty (Group I)	51,4 ± 8,8 (39)	24,4 ± 4,2 (44)	27,9 ± 7,0 (44)	4,5 ± 1,07 (44)	1,38 ± 0,25 (44)	170 ± 11 (44)	2,16 ± 1,24 (44)
Moderate injured (Group II)	51,9 + 5,9 (16)	23,8 + 3,3 (17)	28,6 + 4,3 (17)	4,5 + 0,71 (17)	1,47 + 0,27	175 + 10 (16)	2,67 + 0,98 (16)
Severe injured (Group III)	51,1 + 5,3 (9)	23,9 + 2,7 (9)	25,6 + 3,9 (9)	4,6 + 0,49 (9)	1,60* + 0,27 (9)	182*** + 8 (9)	3,21** + 0,69 (9)