Some Aspects of the Life History and Ecology of Atlantic Salmon (*Salmo salar* L.) in the Northwest Atlantic

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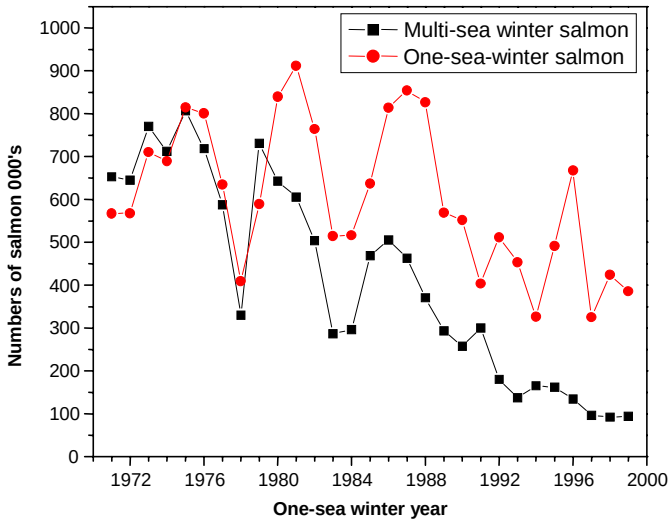
In recent years, the numbers of North American multi-sea-winter and one-sea-winter salmon have been steadily declining with multi-sea-winter salmon declining at a faster rate than one-sea-winter salmon (Fig. 1). Although the source of the mortality and its potential cause(s) remain largely unknown, sea survival rates have declined substantially even with the almost complete closure of commercial fisheries at sea which should have resulted in dramatic increases in returns and survival rates; especially when the fisheries are located close to the natal river and are conducted during the main runs of salmon to the river (Dempson et al. 2001). In North America, there are regions in the southern area of the salmon's range where stocks have become close to being extirpated (Anon. 2002). Due to these declines in overall abundance and near extirpation in some areas, sea research has become particularly important if the cause(s) of the at-sea mortality is to be found.

Exploratory fishing in the Northwest Atlantic was begun by the Department of Fisheries and Oceans Canada in 1965 (Friedland and Reddin 1993). Surface gillnets of various mesh sizes were set out at dawn and fished for up to twelve hours depending on the weather and wave conditions. Nets were sometimes patrolled from a small open boat to obtain live salmon for tagging. Mortalities were sampled for biological characteristics, scales, and stomach contents. Salmon of all sea ages occurred seasonally over most of the Northwest Atlantic and were found concentrated in the Labrador Sea gyre throughout the year, at west Greenland in the summer and autumn, and along the eastern slope of the Grand Banks in the spring. Salmon were distributed as far east as the Irminger Sea (Fig. 2). Post-smolt salmon were first caught at sea in 1987 using gillnets of small mesh sizes not previously fished (Fig. 3). The highest concentration of post-smolts and adult salmon occurred in the mid-Labrador Sea area. Comparison of catch rates by research vessels in the Labrador Sea and by commercial and research vessels at Greenland indicated that in most years, for which there were comparable data, catch rates were similar in the Labrador Sea and at Greenland (Fig. 4). In some years, catch rates were higher in the Labrador Sea. This suggests that a substantial population of salmon exists in the Labrador Sea, comparable to that at West Greenland, and that at least in some years, this population may even exceed that at Greenland because the area utilized by salmon in the Labrador Sea is much larger than at Greenland.

Information collected in the Labrador Sea from age interpretation of scales of captured salmon, salmon caught with tags attached, and the distribution of recaptures of salmon tagged at sea indicated that salmon over the entire range in North America occur in the Labrador Sea. Stomach content analysis suggested that salmon were feeding opportunistically on whatever is abundant in the area. The distribution of salmon as measured by catch rates and temperatures, measured from the research vessels, indicated that salmon are found most abundantly in water with surface temperatures between 4 and 10°C (Fig. 5).

Fig. 1. The number of Atlantic salmon in North America (Anon. 2001).



Water temperature has proven to be an important variable in the ecology of salmon at sea (Friedland and Reddin 1993; Reddin et al. 2000). Experiments with data storage tags (DSTs) were conducted on Atlantic salmon kelts obtained at enumeration facilities on Western Arm Brook, Campbellton and Highlands rivers, Newfoundland in 1998. In total, data on temperature are available from eleven of the returned tags. In order to verify the temperatures

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Fig. 2. Catch rates by Canadian and Danish research vessels from 1965–1985 (reproduced from Reddin and Friedland 1993).

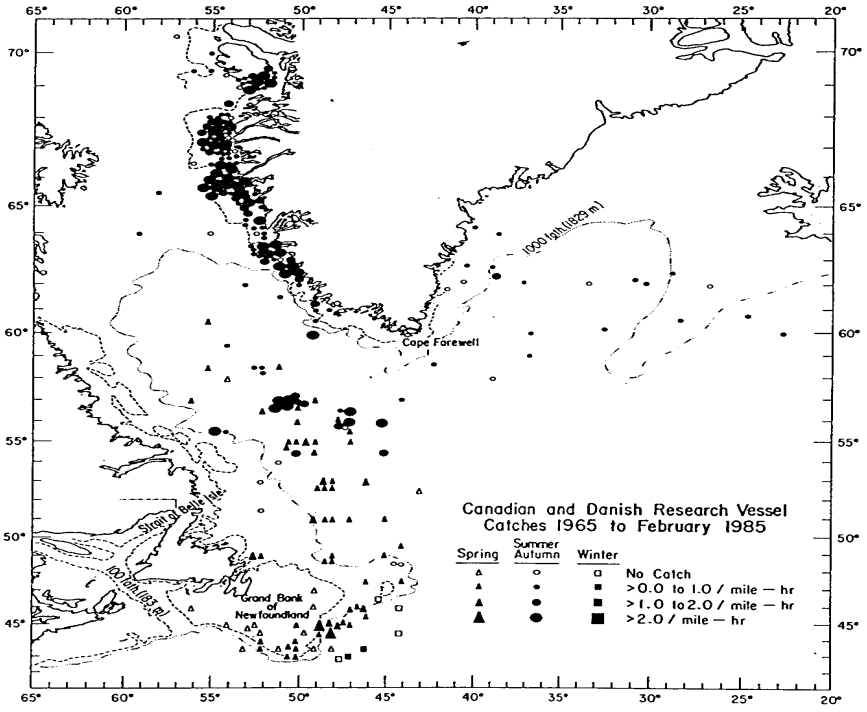
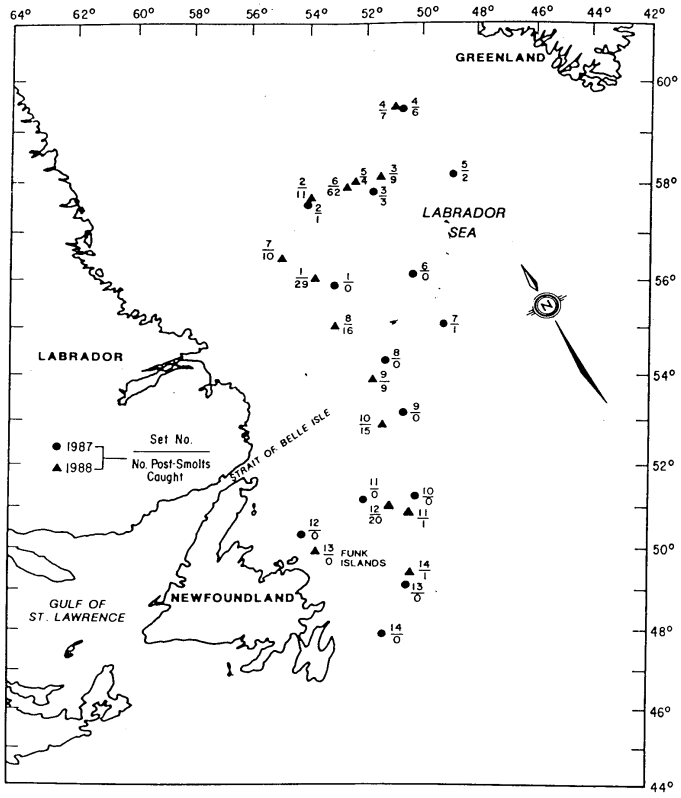


Fig. 3. Locations of capture of post-smolts in the Northwest Atlantic in 1987-88 (reproduced from Reddin and Short 1990).



recorded by the DSTs, kelts were tagged and held in a freshwater fluvarium. Water temperatures recorded by these DSTs were accurate. Comparison of the temperature profiles obtained using DSTs indicated that there were differences in the water temperatures experienced by salmon from different rivers and among salmon from the same river. Information collected by data storage tags is important for determining the marine ecology of salmon, adjusting marine climate change models for salmon and, in freshwater, water temperature protocols for opening/closing angling fisheries due to high water temperatures. Movements vertically in the water column were inferred from the daily temperature patterns and indicated extensive diurnal movements. The DST-tagged salmon spent most of their time in water from 5 to 17°C (Fig. 6).

In summary, there is a lot of information available to use as background for further studies on the ecology of salmon in the sea. This information should be utilized to design experiments to test hypotheses related to why natural mortality rates are apparently so high for salmon at sea in recent years.

Fig. 4. Catch rates by research vessels in the Labrador Sea and by commercial vessels and research vessels at Greenland.

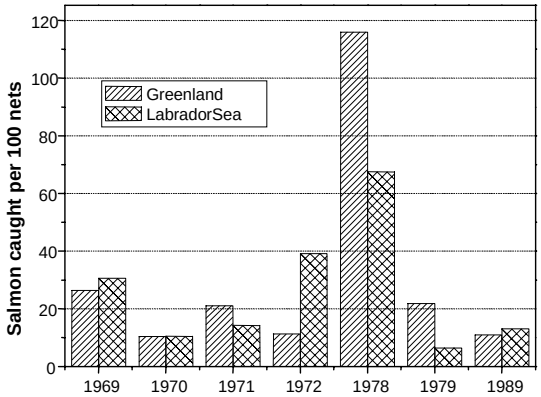


Fig. 5. Relationship between catch rate for salmon in the Northwest Atlantic and sea surface temperature.

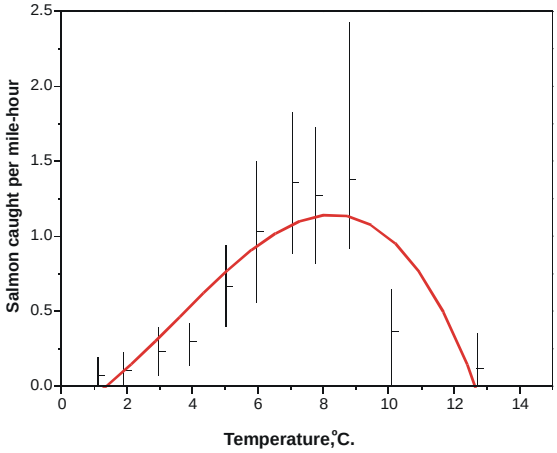
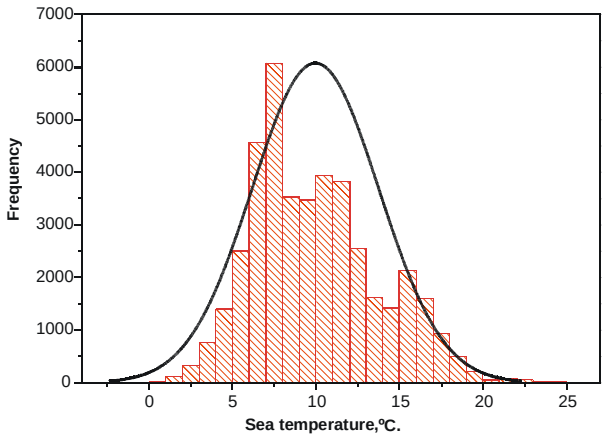


Fig. 6. Sea temperatures experienced by Atlantic salmon kelts tagged with data storage tags in 1998 at Highlands and Campbellton rivers and Western Arm Brook, Newfoundland.



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