Occurrence of an Atlantic Salmon *Salmo salar* in the Bering Sea

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Reprinted from the
Alaska Fishery Research Bulletin
Vol. 5 No. 1, Summer 1998

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ABSTRACT: An immature male specimen of an Atlantic salmon *Salmo salar* was captured in a bottom trawl south of the Pribilof Islands in the Bering Sea in September 1997; this represents the first known capture of this species in the Bering Sea. We provide information on the size, age, and feeding of this fish and discuss the ecological implications of this occurrence.

INTRODUCTION

Increased worldwide demand for salmon products that can be readily delivered to markets in good condition, when needed, has fostered a substantial number of net-pen culturing facilities in British Columbia and Washington State since the early 1980s. Although 5 Pacific salmon *Oncorhynchus* species are endemic to this region, many salmon farmers have turned to exotic Atlantic salmon *Salmo salar* because they are easier to culture in net pens (McKinnell et al. 1997). Because of accidental spillings or weather-related damage to the rearing facilities, some of these fish have escaped into the marine waters off western North America (Alverson and Ruggerone 1997; McKinnell et al. 1997). Subsequently, there have been numerous captures of Atlantic salmon in commercial salmon harvests, as well as occasional observations in freshwater systems in Washington and British Columbia (McKinnell et al. 1997; McKinnell and Thomson 1997). Although the State of Alaska does not allow net-pen salmon farming, there has been an increasing number of occurrences of Atlantic salmon in commercial fisheries in Alaskan waters since they were first reported there in 1990 (Wing et al. 1992; McKinnell and Thomson 1997). To date, the most distant capture from the main rearing facilities has been the capture of a single fish in 1994 near Nagai Island (55° N, 159° W), in the Shumagin Islands of the Gulf of Alaska (McKinnell et al. 1997). In this paper, we report the first recorded occurrence of an Atlantic salmon in the Bering Sea.

SPECIMEN COLLECTION

An immature male specimen was collected in a Nor'eastern bottom trawl (9.2 m vertical opening, 13.5 m horizontal opening) during a National Marine Fisheries Service research cruise at the head of Pribilof Canyon (56° 16.65' N, 169° 26.07' W) on 11 September 1997. This specimen was 58 cm in standard length and weighed 1.84 kg. Although the tow targeted the bottom layer around 248 m, the fish was probably caught in pelagic near-surface waters either during deployment or retrieval of the trawl.

SPECIMEN IDENTIFICATION AND OBSERVATIONS

The specimen was returned to the Alaska Fisheries Science Center (AFSC) for positive identification where we recorded the following meristic values: D 13, A 10, P_1 12, branchiostegal rays 12, gill rakers on first arch 5+13 = 18, and lateral line scales 109. These counts are within the range observed for Atlantic salmon (Scott and Scott 1988), and the combination of these characters distinguishes *S. salar* from all *Oncorhynchus* and other salmonid species . The specimen has been deposited in the University of Washington fish collection (catalog number UW 042326).

The body of this specimen appeared to contain little fat and displayed a wound on its side that penetrated into the body cavity and was apparently inflicted by a lamprey (Figure 1). Its stomach was more

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Acknowledgments: J.W. Orr, M. Wilson, and M. Zimmerman — assisted at sea and in the laboratory. A. Kendall, S. McKinnell, J.W. Orr, G. Ruggerone, and A. Thomson — reviewed the manuscript.

than half full, which is unusual because most recovered *S. salar* along the West Coast have had empty stomachs (McKinnell et al. 1997). The stomach contained mostly pteropods *Limacina helicina* imbedded within a gelatinous matrix of unknown origin. Scale analysis revealed that this fish was 2 years old, had spent 1 winter at sea, and was of hatchery origin.

DISCUSSION

Capture of this Atlantic salmon specimen in the Bering Sea extends the known Pacific range westward about 595 km, as measured by a straight-line distance, although to enter the Bering Sea, this salmon had to swim at least another 71 km around the Alaska Peninsula and probably through Unimak Pass.

During the summer of 1997, temperature conditions in the Bering Sea and other parts of the North Pacific were extremely anomalous. In the Bering Sea, surface temperatures were 3-4°C above normal much of the summer (Vance et al. *in press*). However, the surface temperature in the area where this specimen was taken (9.6°C) was not exceptionally high for this time of year (Brodeur unpublished data), although the temperature and depth stratum in which this specimen was caught is unknown. Therefore, whether this occurrence was related to the unusually high ocean temperatures present earlier in the summer is unresolved.

In addition to the temperature anomalies, a massive bloom of microscopic plankton (coccolithophores) was reported for the first time in the Bering Sea during the summer of 1997, possibly contributing to an unprecedented number of marine bird mortalities, a poor return of Bristol Bay sockeye salmon, and other ecosystem anomalies (Vance et al. *in press*). One zooplankter that appeared to be favored by this bloom was the pteropod *Limacina helicina*, which occurred in densities much higher than in our previous (1994–1996) fall sampling (Jeff Napp, AFSC, personal communication). Although pteropods have not previously been reported as being an important food for Atlantic

Figure 1. Photograph of anterior portion of Atlantic salmon collected in a bottom trawl near the Pribilof Islands, Bering Sea, in September 1997. Note the spots on the gill cover characteristic of this species and the large wound behind the pectoral fin probably made by a lamprey.

salmon, Pacific salmon do consume them (Brodeur 1990; Davis et al. 1998). Most salmon species appear to be highly opportunistic predators at sea and will consume a wide range of available prey, including those of low energetic value such as pteropods (Davis et al. 1998).

Although Atlantic salmon are believed to be genetically distinct enough not to interbreed successfully with Pacific salmon (e.g., Wing et al. 1992), it is plausible that the large number of escaped fish occurring in some river systems may someday lead to the establishment of a reproductive population in the Pacific Ocean. This is a legitimate concern because introduced species may compete with native populations in fresh water and in the Gulf of Alaska, where the carrying capacity for native Pacific salmon may already have been exceeded (Cooney and Brodeur, *in press*). A more insidious effect on native populations is the potential for these exotic Atlantic salmon to serve as vectors for non-indigenous diseases or parasites to local populations, although the threat does not appear to be substantial at this time (Stephen and Iwama 1997).

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