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Mortality of coho salmon caught and released using sport tackle in the Little Susitna River, Alaska

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ABSTRACT

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Coho salmon (*Oncorhynchus kisutch*) were caught with sport gear in the estuary of the Little Susitna River, southcentral Alaska. Fish were double marked and released. All coho salmon observed migrating through a weir above the estuary and a portion caught in a sport fishery below the weir were examined for marks. A second group of coho salmon were caught using similar sport gear above the estuary. These fish were handled and marked identically as the fish captured in the estuary, except that they were held in a holding pen at the weir with an equal number of coho salmon dip netted at the weir. Coho salmon which were caught and released in the estuary suffered a significantly higher rate of mortality (69%) than did either the coho salmon caught and held above the estuary (12%) or those which were dip netted and held at the weir (1%). Factors that could influence rates of hook-induced mortality were measured at the time of hooking. Hook location, hook removal, and bleeding significantly affected the measured mortality rate.

INTRODUCTION

In many sport fisheries, anglers are asked to release all or a portion of the fish they catch. This management strategy is commonly called 'catch-and-release' (Pettit, 1977). Catch-and-release is a generally accepted and widely applied management tool in sport fisheries across North America (Reingold, 1975; Pettit, 1977; Johnson and Bjorn, 1978; Hunt, 1981; Anderson, 1982; Jones, 1982; Anderson and Nehring, 1984). It is a tool which enables managers to continue maximizing the opportunity to participate in recreational fisheries while reducing mortality to what can be termed 'catch-and-release

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mortality'. In this way, the economic value of recreational fishing is not jeopardized as the opportunity to participate is not reduced (Clawson, 1965; Gordon et al., 1973). The mortality associated with a catch-and-release fishery is a cost that must be considered when developing a management strategy for specific sport fisheries (Cutter, 1974; Anderson, 1975; Wydoski, 1977).

In contrast to resident fish populations (Klein, 1965; Hunsaker et al., 1970; Wydoski et al., 1976; Dotson, 1982; Schill et al., 1986), little quantitative information is available describing catch-and-release mortality in sport fisheries for Pacific salmon (*Oncorhynchus* sp.) (Warner, 1976, 1978; Warner and Johnson, 1978; Warner, 1979). Many salmon sport fisheries are conducted with bait, a practice which has been shown to result in high mortality rates for resident fish (Hunsaker et al., 1970; Wydoski, 1977; Warner and Johnson, 1978).

The Little Susitna River supports the second largest freshwater sport fishery for coho salmon (*Oncorhynchus kisutch*) in Alaska (Mills, 1988). Fishing effort has tripled and harvests of coho salmon have doubled since 1981. Most of the fishing effort and harvest of coho salmon is concentrated in the estuary of the river (Bartlett and Conrad, 1988). Anglers predominantly fish with bait in the estuary (Bentz, 1987) and release about 13% of the coho salmon caught in the estuary (Bentz, 1987; Bartlett and Conrad, 1988). Managers have raised concern that these released fish suffer high mortality rates (Bentz, 1987).

The objectives of this study were to estimate the short-term (5 day) rate of mortality of coho salmon caught and released in and above the estuary of the Little Susitna River and estimate the effects that several hooking factors have on observed rates of hook-induced mortality.

STUDY AREA

The Little Susitna River is a clearwater tributary to Upper Cook Inlet, Alaska (Fig. 1). The river is approximately 180 km in length and has a drainage area of approximately 1000 km^2. The river has an average stream flow of approximately 6 m^3 s^{-1}, with winter flows typically less than 2 m^3 s^{-1} and peak summer flows near 30 m^3 s^{-1}. During the study, stream flows ranged from 10 to 20 m^3 s^{-1}. In the study area, the river has a channel gradient of approximately 1.0 m km^{-1} and channel widths of approximately 25–30 m. Depths in the study area range from less than 1 to 2 m, depending upon stream flow.

METHODS

Three hundred and eighty-four coho salmon were caught in the estuary using sport gear from 20 July through 18 August 1988. All coho salmon were

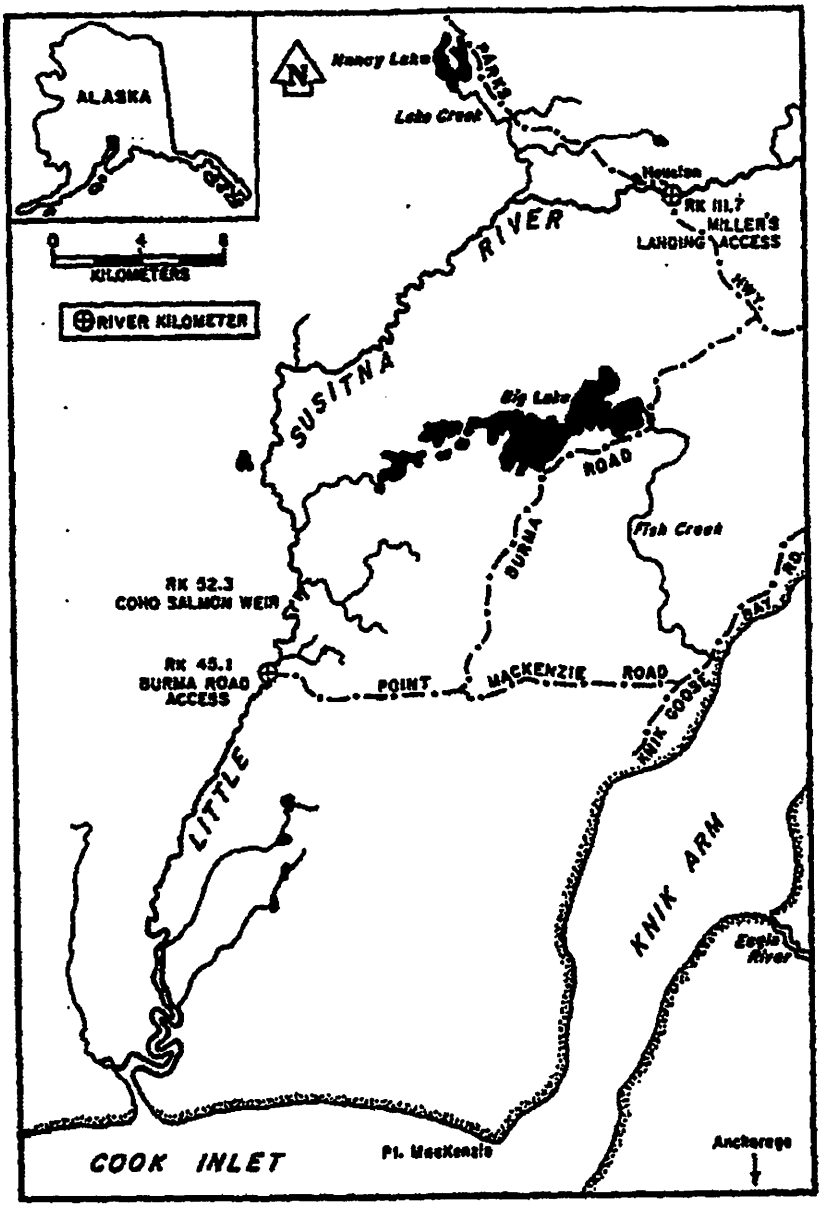

Fig. 1. Study area of the Little Susitna River, Alaska.

captured and released at approximately river kilometer (RK) 32. We were unable to develop a means to capture a control group from this section of the river. Water temperatures during this period ranged from 10 to 13°C. Number 2/0 barbed hooks drifted with clusters of salmon eggs were used to catch fish. This method of fishing was selected over other methods to simulate the typical fishing practices used by anglers fishing the Little Susitna River (Bentz, 1987; Bartlett and Conrad, 1988; Bartlett and Vincent-Lang, 1989). Person-

nel from the Alaska Department of Fish and Game and volunteers from the public participated in the study.

All coho salmon were hooked, played, and landed in a manner similar to that practiced by most anglers fishing coho salmon in the Little Susitna River, with the exception that all deeply embedded hooks were not removed. An unknown percentage of anglers fishing the Little Susitna River remove deeply embedded hooks. We chose to leave deeply embedded hooks in place as removal has been shown to increase mortality (Mason and Hunt, 1967; Hulbert and Engstrom-Heg, 1980). Each landed fish was marked with an individually numbered Floy FT-4 spaghetti tag. Spaghetti tags were inserted posterior to the dorsal fin using a sharp needle and tied securely using a single overhand knot. In addition, each tagged fish received a punched hole in its caudal fin using a paper punch. After marking, each fish was held in the current, then released.

Several variables that could influence hooking mortality were measured or estimated at the time of capture. The hooking factors or variables recorded for each fish were: time played on hook with two categories (less than 1 min or more than 1 min), time handled out of water with two categories (less than 1 min or more than 1 min), estimated amount of scale loss with three categories (less than 10%, 11–25%, or more than 25%), location of the hook with four categories (mouth, gill, gullet, or head outside of the mouth), whether or not the hook was removed (yes or no), whether or not the fish was bleeding when released (yes or no), and a qualitative assessment of the general condition of the fish when released with two categories (vigorous or lethargic).

All coho salmon observed migrating through a weir upstream of the estuary (at RK 52.3) were examined for tags and punched caudal fins. This weir was a complete barrier to migration of adult salmon and all fish were passed through a trap in the weir where they could be counted and/or examined. The weir was constructed of sealed grey PVC, 2.5 cm schedule 40 electrical conduit pipe (about 3.2 cm o.d.) attached to panels. Spacing between conduits was approximately 3.8 cm. Panels were attached to each other and a 1.0 cm cable secured to a railroad rail substrate. The substrate was attached to the bottom using spikes and sandbags. The buoyancy of the sealed pipes allowed the panels to float. The angle of the panels was adjusted, depending on flow, to vary from 30 to 45°. Over these angles, adult coho salmon were not able to pass through, over, or under the panels.

The number of marked coho salmon removed by the sport fishery below the weir was estimated using a creel survey, with all major access points of the fishery being surveyed. All anglers exiting the fishery at each access point were asked how many coho salmon they had harvested and their harvest of coho salmon was examined during randomly selected time periods for tags and caudal punches. The survey used a stratified (by weekly period), two-stage random sample design with approximately 30% of the total available