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Pilot Study:

SURVIVAL OF CHINOOK SALMON CAPTURED AND RELEASED BY A
PURSE SEINE VESSEL IN SOUTHEAST ALASKA

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Prepared for:

SOUTHEAST ALASKA SEINERS ASSOCIATION
PURSE SEINE VESSEL OWNERS' ASSOCIATION

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INTRODUCTION

Harvests of salmon by commercial fishers may be constrained by the presence of a "weak" stock or species of salmon in the harvest area. In order to reduce harvests of weak stocks, harvest managers may control harvests through time and area closures or they may impose harvest quotas on the weak stocks.

Another approach to harvest management of weak stocks that mix with healthy stocks is the use of nonlethal harvest methods. Capture of salmon by purse seine vessels is generally believed to be somewhat benign; salmon on the high seas have been captured and released by purse seine vessels for years in order to describe salmon migration patterns (Major et al. 1978, Ruggerone et al. 1991). Thus, mortality of "weak" species captured incidentally by commercial purse seine vessels targeting other stocks could be potentially reduced if an effort was made by fishermen to quickly release the "weak" species. Successful release of "weak" species could enable purse seine fishermen to operate for longer periods and with fewer constraints, if survival of "weak" species captured and released by seiners could be shown to be relatively high.

Commercial purse seine fishermen in Southeast Alaska are confronted by reduced overall catch quotas of chinook salmon because many of these fish are returning to British Columbia, Washington and Oregon where native chinook runs are declining. Limits on catch quotas on chinook salmon can reduce harvests of targeted salmon such as pink and chum salmon which have experienced exceptionally strong runs since the mid-1970s. Thus, purse seine fishermen are interested in the successful release of chinook salmon captured in fisheries that target other species. However, estimates of chinook survival from commercial purse seine vessels are needed, if commercial fishermen are to be allowed credit for the live release of these fish.

The objective of this investigation was to conduct a pilot study to estimate the short-term survival of chinook salmon captured and released by a purse seine vessel targeting chum salmon in Southeast Alaska.

STUDY AREA

The investigation was conducted near the Hidden Falls Hatchery located on Baranof Island bordering Chatham Strait in northern Southeast Alaska (Fig. 1). The area is characterized by precipitous mountains plunging to depths of 100 fathoms or more within 0.5 mile of the shore. Most chinook salmon captured in this study were returning to the hatchery. At the time of this study, approximately 35,000 lbs of chinook salmon were harvested in the hatchery cove (Kasnyku Bay) as part of the hatchery cost recovery program; numerous commercial trollers and several sport boats also targeted the returning chinook salmon. Although chinook salmon were abundant in the area, the most abundant salmon was chum salmon. The investigation was conducted immediately before the first commercial chum salmon opening for purse seine vessels on 23 June. Approximately 3 to 4 million chum salmon were expected to return to Hidden Falls Hatchery in 1996.

METHODS

Survival of chinook salmon was estimated from salmon catches on F/V *Secure* during 21-22 June, 1996. F/V *Secure* is a 58' steel power block seiner. The size of the purse seine was 250 fathoms long and approximately 15 fathoms deep. Mesh size was 3.5 inches (bar). When large catches of salmon were made by the vessel (e.g., ~4,000 lbs or more), the crew employed a technique that effectively separated the catch into smaller bundles before rolling them over the side of the vessel.

The crew of the F/V *Secure* was instructed to fish for salmon as they normally would. They were to search for chinook salmon among the catch, as if they were trying to release them alive. However, instead of releasing chinook salmon overboard, they placed the fish in one of two 200 gallon tanks located on the deck. Seawater was pumped into the two tanks via a small pump (a larger pump burned out at the beginning of the investigation). The high volume deck hose was sprayed into the tanks to insure that oxygen levels were adequate. Initially, we planned to hold only five chinook salmon per tank; but after careful observation of the fish we decided that more salmon could be held for brief periods (up to 1 hr).

After capturing 10 or more chinook salmon, the F/V *Secure* transported the salmon to a saltwater net pen (40' x 40' x 15' deep) located in a protected cove at the hatchery. Surface water temperature at the net pen was 9.0 °C.

A NRC scientist observed the capture and handling of the chinook salmon, but he did not assist with the search and release of fish into the holding tank. The scientist recorded information on the time of the set, duration of towing (e.g., time from complete net in water to initial net retrieval), hauling time (initial net retrieval to enclosed bag of fish along side of vessel), time in the seine bag (bunt end) prior to being landed, and time on the deck before transfer to the holding tank. Injuries to the fish and scale loss were noted. Salmon placed in the holding tanks were not handled again until transfer to the net pen using a dip net.

Chinook salmon held in the net pen were inspected by the scientist each morning for up to three days after capture. This inspection was accomplished by pulling one side of the net onto the deck until the depth of the pen was <2 m (water clarity was ~4 m). At the end of the study period, all chinook salmon were removed from the net pen, inspected for injuries, scaling and survival, and measured for total length. The salmon were delivered to a tender where total weight was estimated. Chinook and chum salmon captured in this study were used for hatchery cost recovery.

RESULTS AND DISCUSSION

Weather during the study period was mild. Wind was negligible and swell was nonexistent. Air temperature was approximately 65-70°F.

Ninety-one chinook salmon and approximately 6,300 chum salmon (~75,000 lbs) were captured and examined during 16 sets on 21-22 June¹. Approximately 718 salmon, on average, were captured per set (range: 9 to 2,000 fish). The largest

¹One chinook salmon was not placed in the holding tank at the beginning of the study because we wanted to insure that all chinook placed in the holding tank had adequate oxygen and were not stressed; ten fish were already in the holding tanks. This fish was excluded from the study.

chinook catches occurred adjacent to the rocky shore, whereas larger chum catches tended to be farther offshore.

The most critical periods in terms of chinook survival were assumed to be when fish were held in the seine bag next to the boat or dewatered on the boat deck. Time in the bag averaged 2.7 minutes (range: 0.25 - 13.0 minutes). Time on the deck averaged 1.7 minutes (range: 0.2 - 6.0 minutes) (Table 1). Towing and hauling of the seine averaged 13 and 17 minutes, respectively. Time in the onboard holding tanks averaged 44 minutes (range: 16 - 124 minutes). Salmon captured on 21 June and 22 June were held for approximately 1.9 and 2.8 days, respectively.

Ninety chinook salmon out of ninety-one captured (98.9%) survived capture by the purse seine and holding in the net pen. The 95% confidence interval for this survival rate estimate is 93.2% - 99.6%. The fish that died was a small (41 cm), maturing male (jack) that was buried on the deck under many chum salmon. This fish was not observed by the fishermen for 6 minutes after it was landed; approximately 50% of the scales were lost, possibly a result of being thrashed by other fish. It was nearly dead by the time it reached the holding tank.

Of the salmon that survived, all but one were upright within five minutes or less after entering the onboard holding tank. One salmon was lethargic upon entering the net pen; it moved to the bottom of the pen as did most other salmon.

Examination of the captured chinook salmon each morning indicated that all fish that entered the net pen appeared vigorous and healthy. On the last day of the study, we examined and measured each fish. Only one live salmon had some scale loss (~15%). Four fish had slight tears near the mandible that may have been caused by the seine; no bleeding was observed and the injuries did not appear to be serious.

Of the 91 chinook salmon captured, 10 fish (11%) had wounds near the mouth that were likely caused by fish hooks. One fish still had a troll hook in its mouth. These observations indicated that some chinook salmon captured in this study were drop-offs from the commercial troll fishery operating near the hatchery. These fish appeared to be fairly healthy after being captured for a second time.

Average length of chinook salmon captured during this study was 83.3 ± 1.1 cm (mean \pm SE). The range in total chinook lengths was 41-99 cm. Average chinook weight was 14.8 lbs. In comparison, average weight of chum salmon was 11.5 lbs according to reports from the fish tenders.

CONCLUSIONS

The Hidden Falls area is ideal for conducting an investigation of chinook salmon survival after capture and release by purse seine vessels. Chinook salmon are fairly abundant among large numbers of chum salmon returning to the hatchery. This scenario allowed us to examine chinook survival when captured in large catches of other salmon.

Survival of chinook salmon captured and released by the purse seine vessel in this study was exceptionally high (98.9%), indicating the potential for successfully releasing nontarget chinook salmon when targeting other salmon species.

RECOMMENDATIONS

1. Conduct this study again using different purse seine vessels in order to examine variability of chinook survival among the fleet. Holding of the fish appears to be a viable option given the ideal conditions of the net pen at Hidden Falls Hatchery. Other studies have shown that most mortality occurs during the first 24 hours (Wertheimer 1988, 1989, NRC 1993, Candy et al. in press); however, survival estimates can be more accurate if the fish are held for a longer time period.
2. Consider the use of ultrasonic tags to track chinook salmon after being captured and released in order to evaluate their behavior and survival in a more realistic setting.
3. Salmon may become hardier when approaching the time to enter their natal stream. For example, scale loss is less likely while handling

maturing fish. Because most chinook captured in this experiment were migrating to nearby Hidden Falls Hatchery, a survival study that involved migratory salmon further from their natal stream should be considered.

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net pen facilities for holding the salmon and sleeping facilities for the biologist; Bruce also assisted with sampling of chinook salmon at the end of the study period. Icicle Seafoods transported the biologist via float plane from Hidden Falls Hatchery to Petersburg. The Purse Seiner Vessel Owners' Association (PSVOA) provided insurance for the biologist while on the vessel. This study was funded by the Southeast Alaska Seiners Association through PSVOA.

Table 1. Summary of statistics for Hidden Falls chinook salmon captured by purse seine and held in a net pen.

Time of set	Minutes Towing	Minutes Hauling	Total salmon landed in set	Number chinook	Max minutes in net "bag"	Max minutes on deck	Minutes boat tank	Hours net pen	Total days observed	Comments
<i>20-Jun-96</i>										
9:08	18	19	58	1 6	0.25 2.00	1.0 2.0	96 92	70.5 70.5	3.0 3.0	Gear problems with 1st set of year caused increased time in bag
10:06	19	17	125	3	1.00	1.0	38	70.5	3.0	
12:00	15	15	550	7	1.50	2.5	89	67.5	2.9	
13:02	20	16	100	2	0.50	0.5	24	67.5	2.8	1 king had troll hook in mouth
14:42	13	17	82	6	1.00	1.0	124	64.5	2.8	
15:28	14	18	50	0	0.50					No chinook captured
16:20	15	16	40	1 1	1.00 1.00	0.2 4.0	19 23	64.5 64.5	2.7 2.7	~40 cm chinook not quickly seen
17:50	18	19	300	18 1	0.50 0.50	2.5 8.0	22 17	63.0 63.0	2.6 2.6	1 king had ~ 15% scale loss
<i>21-Jun-96</i>										
7:15	14	15	100	1	1.00	0.2	68	48.5	2.1	
8:02	10	16	400	10	0.50	1.5	23	48.5	2.0	
9:13	15	18	9	2	1.00	0.5	70	47.0	2.0	
10:02	5	19	600	2 4 3	0.50 6.50 9.00	2.0 1.0 0.5	23 22 22	46.5 46.5 46.5	2.0 2.0 2.0	
11:33	5	18	750	0 1	1.25 4.75					No chinook captured in split bag
12:27	13	16	300	1 1	1.00 1.00	0.5 6.0	22 16	44.0 44.0	1.8 1.8	41 cm chinook dead at net pen; 50% scale loss
14:40	4	18	900	0 3 2	2.00 4.25 4.25					No chinook captured in split bag
15:35	11	17	2,000	3 3 2 3 2 2	1.00 4.50 8.00 9.50 12.00 13.00	1.0 0.5 0.5 0.5 0.5 0.5	41 37 34 33 31 30	41.0 41.0 41.0 41.0 41.0 41.0	1.7 1.7 1.7 1.7 1.7 1.7	20 chinook held in boat tanks
Total:			6,364	91						
Mean:	13	17	718	5.7	2.70	1.7	44	50	2.1	
Min:	4	15	9	0	0.25	0.2	16	41	1.7	
Max:	20	19	2,000	18	13.00	6.0	124	71	3.0	

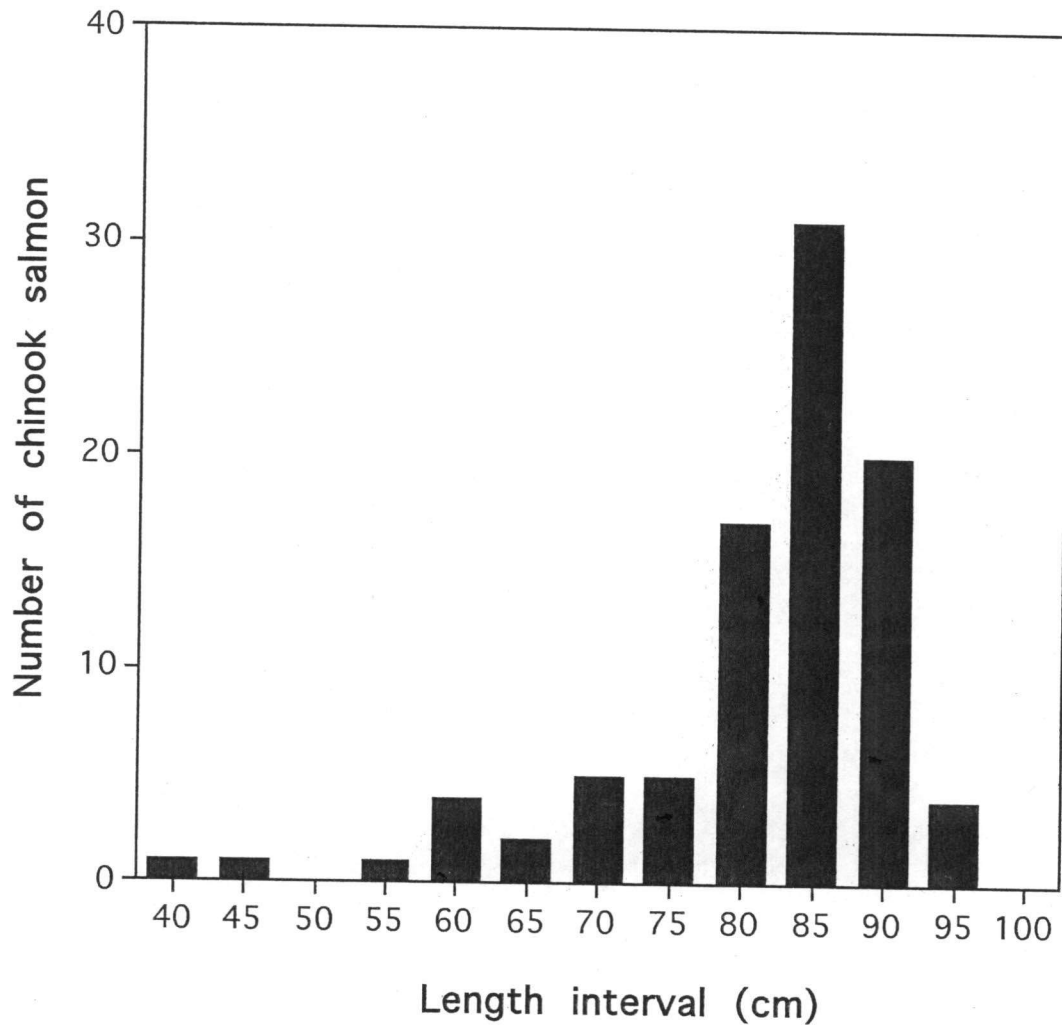


Fig. 2. Length frequency distribution of chinook salmon captured near Hidden Falls Hatchery, 1996. Length intervals are 5 cm beginning with the value show on the axis.