

The Suquamish Tribe's Approach to Successful Chum Salmon Enhancement

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Introduction

The Suquamish Tribe initiated a chum salmon enhancement program in 1977 to rebuild salmon populations in east Kitsap County streams. Most of these streams have small fractions of their historic salmon populations, having been heavily impacted by urbanization and other human activities. The larger streams have low flows that range from 5 to 10 cubic feet per second (cfs). The program objective is to restore Tribal chum salmon fisheries on, and near, the Port Madison Reservation. Cowling Creek Hatchery was constructed to maintain a hatchery run and to support satellite eggboxes installed on selected local streams. Most of the hatchery chum eggs are transferred to these eggboxes. The unfed fry volitionally migrate from the eggboxes, with the adults returning to spawn in their "new" natal streams. The Suquamish Tribe does not direct a terminal fishery on the adult chum returning to Cowling Creek in order to obtain the maximum possible genetic diversity within the hatchery population.

Cowling Creek Hatchery released Hood Canal origin chum in 1977 and 1978, but switched to local Chico Creek stock in 1979 to preserve genetic stock integrity within east Kitsap County. All Hood Canal adult chum returning to the hatchery were destroyed. Chico Creek, located near Bremerton, Washington, was famous for the thirty-nine Orcas that followed, then consumed, most of the chum returning to the stream in 1997. The Chico Creek chum run represents over 90% of wild chum escapement into east Kitsap County

Hatchery Design and Management

Cowling Creek Hatchery was designed to be simple to construct and operate. Pre-cast concrete modules were used to build the intake dams on the north and south forks and the south fork rearing pond dam. The intake dams bypass flood water around the settling pond. The fiberglass hatchery incubators are based on the Netarts design and assembled on site by hand. The rearing pond is a natural in-stream earthen pond (Figure 1). The adult recapture pond was located intertidally with a dam and fish ladder constructed out of sheetpile. The entire hatchery was constructed by staff and is designed for gravity flow operation with minimal electrical requirements. The spawning shed is located a short distance above the recapture pond and adult chum are transported to the racks via a custom fish lift. The fish lift is portable and is also used at the Tribe's Grovers Creek Hatchery to move fall chinook.

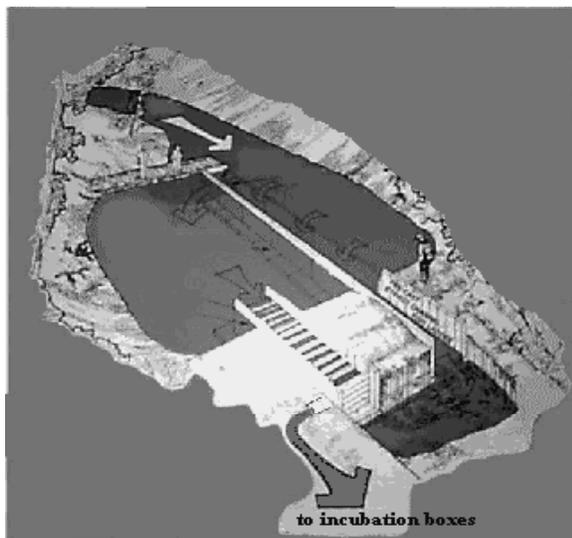


Figure 1. South Cowling Creek Hatchery intake dam schematic

Adult chum return to the hatchery in late October and continue running into December of each year. The adult chum successfully home in on Cowling Creek's low flow of 100 gallons per minute (gpm). The average winter

Cowling stream flow is 400 gpm with the highest flow recorded to date of 20,000 gpm. Limited natural spawning occurs in the intertidal recapture pond because it is saltwater. Hatchery staff seine the pond every weekday and harvest all adults present, up to 1,000 fish/day. Ratios of male to female Cowling chum remain approximately constant between years (Figure 2). Most of the females are ripe and are ready to be fertilized. Excess ripe eggs and any green eggs are sold to the caviar market. Cowling Creek chum are spawned throughout the entire run, with the eggs of two females fertilized by two males in one small bucket. Stream water is introduced to the bucket and the rinsed eggs are transferred to a 5 gallon bucket for water hardening in a 100 parts per million (ppm) iodophor solution for one hour. The water hardened eggs are transferred to the incubators and remain immersed in ambient temperature surface water. A 1:600 formalin treatment is applied three times a week via a 15 minute drip bottle at the head of each incubator raceway. Fish pathologists inspect 120 adults for viruses and other potential pathogens to certify the stock prior to transferring eggs out of the watershed. Scales are sampled weekly to determine age, and all chum adults are sampled for any tags that may have applied at sea.

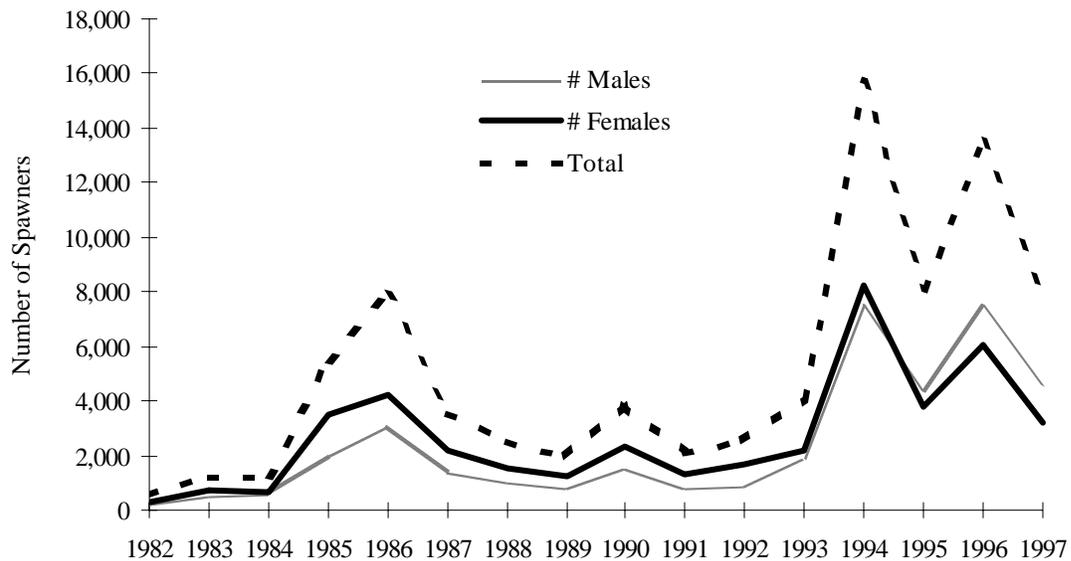


Figure 2. Cowling Creek Hatchery adult chum salmon return by sex, 1982 to 1997

Eyed-up eggs are picked, sorted by spawning date, and approximately 2,000,000 are transferred to the satellite eggboxes in proportion to the adult run timing. Approximately 500,000 are hatched in Cowling Creek incubators for release on station (Figure 3).

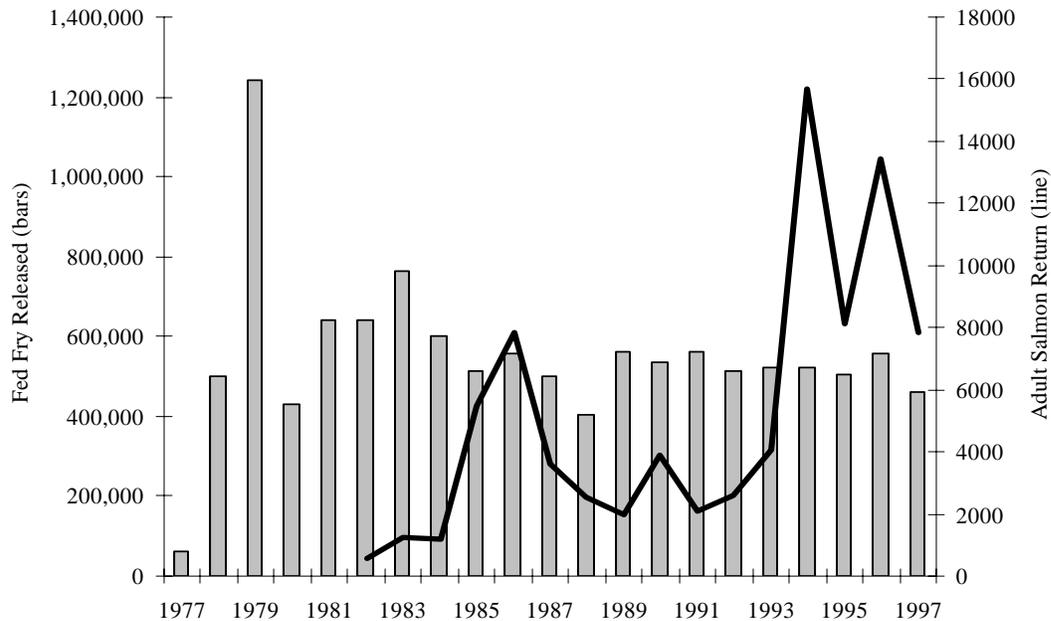


Figure 3. Cowling Creek Hatchery fed fry release and adult salmon return, 1977-1997

The early-emerging chum fry are fed in six-foot diameter ponds for several days until they are actively feeding, then released into the 1,000 ft³ natural pond. All subsequent fry volitionally migrate into the rearing pond without handling except for a few stragglers. The fry initially start feeding at a weight of 0.3 gms and are fed for four to six weeks in an attempt to achieve a 1 gm body weight. Cowling Creek chum fry have not been observed to exhibit a feeding response behavior towards hatchery personnel, but instead randomly school throughout the pond searching for food during their residence in the pond. Several cutthroat trout are usually found in the pond during release, but avian predation is minimized by a birdnet over the pond. Releases occur after midnight on high tide and scuba diving observations verify marine predation is low during the first hours that the fry acclimate to Miller Bay estuary. Approximately one quarter of the chum fry typically display flared gills and may rest near the bottom when they first encounter saltwater. This response may last ten to twenty minutes before the fry regain normal swimming activity, and potentially renders them more vulnerable to predators.

Results

Cowling Creek Hatchery chum scale data can be used to determine adult spawner age ratios (Table 1). Although age 4 adults predominate in the run years observed, no consistent pattern is apparent because the numbers of adults returning each year varies. The age of the adult spawners can be used to generate survival of each brood year (Figure 4). This data set displays the trend for Cowling Creek chum to return in higher proportion as age 4 adults. The average survival to the hatchery rack was 0.5% for the years 1977 to 1989. This survival to rack rate will increase significantly when the age data for brood years 1990 to 1995 is available. Significant non-treaty commercial gillnetting and purse seining occurred from 1987 until 1993 outside of Miller Bay and may have harvested up to half the returning adult chum. The decrease in commercial value for chum salmon resulted in very reduced non-treaty fishing effort after 1993 and may explain the increased hatchery return. No Cowling Creek chum salmon are tagged.

Run Year	% Age 3	% Age 4	% Age 5
1980	100	0	0
1981	13	87	0
1982	27	72	1
1983	48	41	11
1984	41	56	3
1985	82	17	1
1986	24	74	2
1987	27	67	6
1988	35	58	7
1989	45	52	3
1990	4	93	3
1991	47	47	6
1992	10	84	6
1993	63	25	10
1994	17	81	2

Table 1. Cowling Creek Hatchery chum age by run year, 1980 to 1994

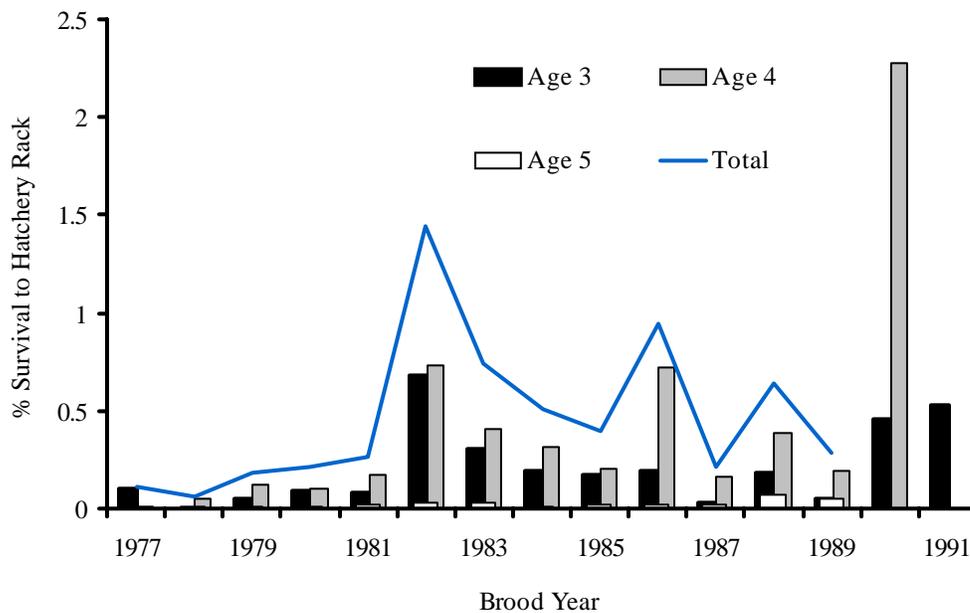


Figure 4. Cowling Creek Hatchery % survival to hatchery rack by brood year, 1977 to 1991

Cowling Creek Hatchery satellite chum eggbox releases have stabilized or increased escapement to Dogfish, Big Scandia, and Barker Creeks even with directed terminal fisheries on these streams (Figure 5). Chico Creek chum reflect primarily wild escapement, but one of its tributaries, Dickerson Creek, has a substantial eggbox component to its escapement. Dickerson Creek had two blocking culverts rendering it impassable to chum salmon for decades. There were few spawning adult chum in Dickerson Creek even after fish ladders were installed in the early 1980's. The first significant Dickerson Creek chum returns coincided with the expected returns from the eggbox releases. The majority of the chum returning to Dickerson Creek in the mid to late 1980's displayed the same behavior observed below the Dogfish, Big Scandia, and Barker Creek eggboxes: the adults attempt to swim up the eggbox water source instead of staying in the main stream channel. The main streams generally have flows 25-50 times greater than the eggbox tributaries. Most of the chum will finally spawn in the main stem instead of the tributary.

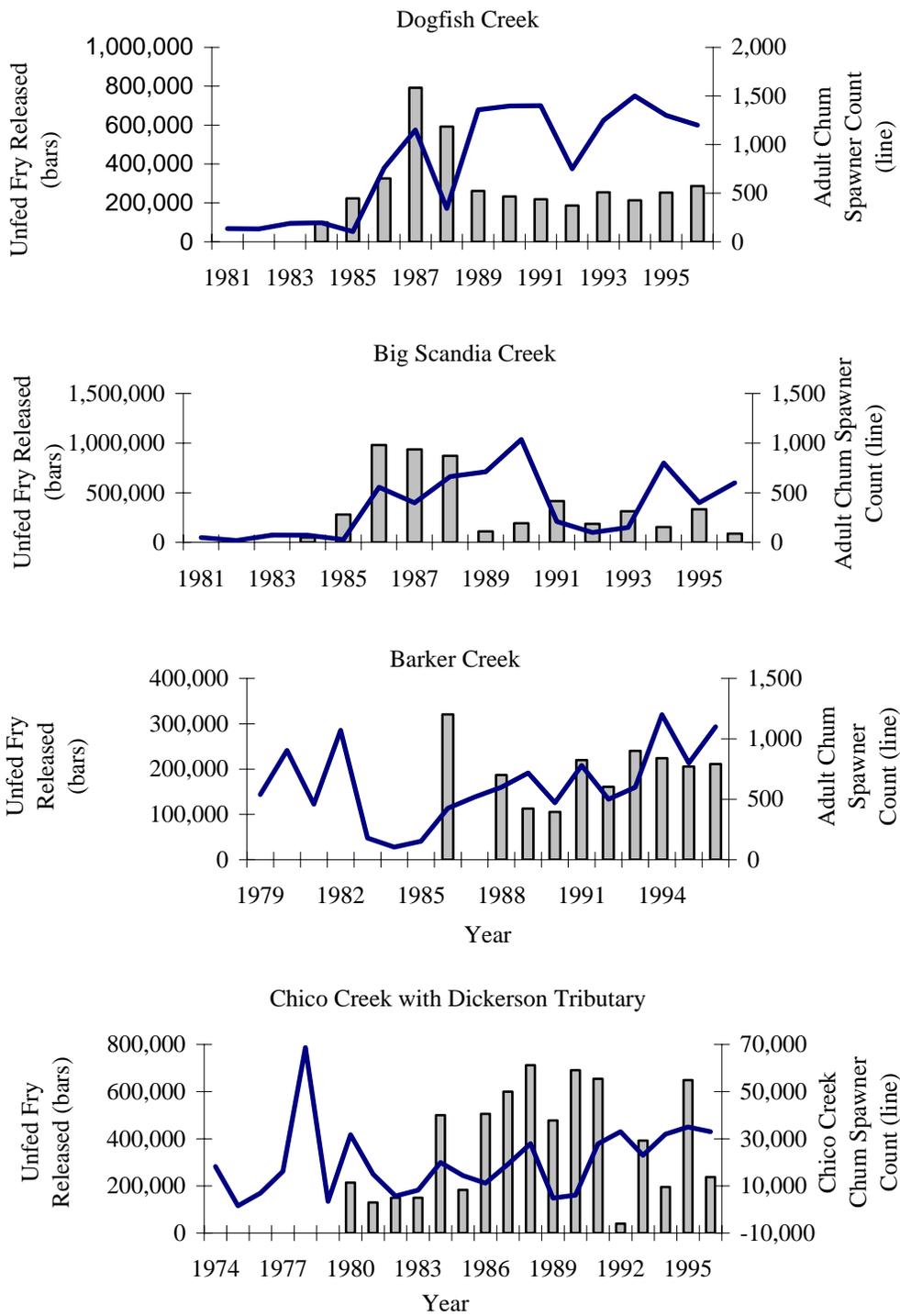


Figure 5. Unfed fry eggbox releases and adult spawner counts

The other satellite eggbox sites have smaller releases but show similar patterns except Clear Creek. Clear Creek, located near Silverdale, has had consistently low survival from two chum eggbox release sites. Chinook and coho reared in Clear Creek also have very low survival, and natural salmon spawning is almost nonexistent. Possible explanations include pollution, but exact causes are unknown at this time.

Survival of the satellite eggbox unfed volitional releases is estimated to be 0.1 to 0.2% back to the stream. Increased eggbox production since the mid-1980's have coincided with an increased commercial catch (Figure 6; also see Figure 7 for the value of the Tribal catch). This relationship may not be significant overall because east Kitsap's primary chum production is wild Chico stock. The relationship is significant in Liberty Bay, fed by Big Scandia and Dogfish Creeks, because a Tribal chum fishery has been reestablished for the first time in decades.

Orca predation had a significant impact on the Chico Creek run in 1997 by consuming an estimated 20,000 adult chum. Escapement into Chico Creek for 1997 will probably be less than 5,000 adults, below the desired escapement of 16,000 to 18,000 adults. Orca had not been observed feeding upon Chico chum for four decades. If the Orca return more frequently, their impact to the wild Chico chum population could be significant given the urbanizing watershed.

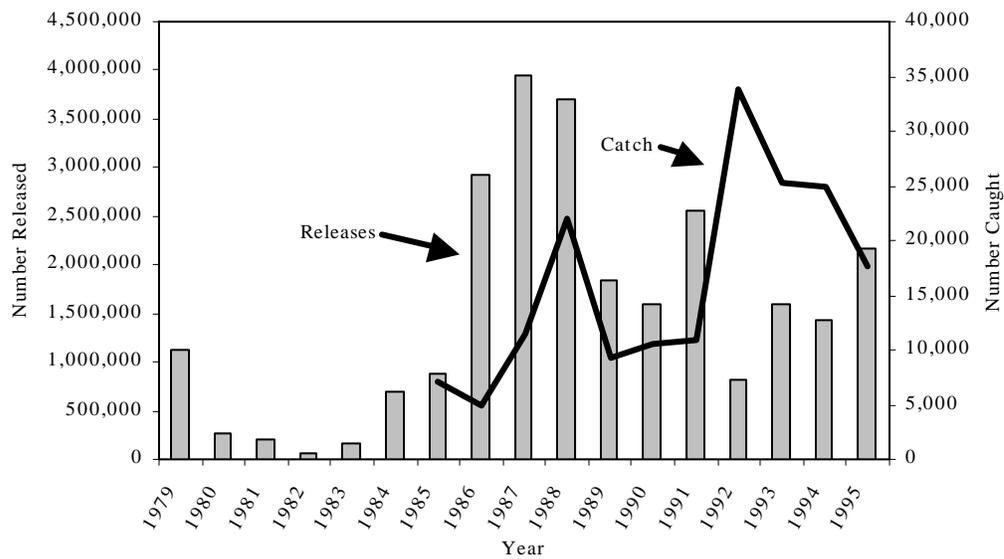


Figure 6. Suquamish Tribe Area 10E commercial chum harvest and east Kitsap chum enhancement

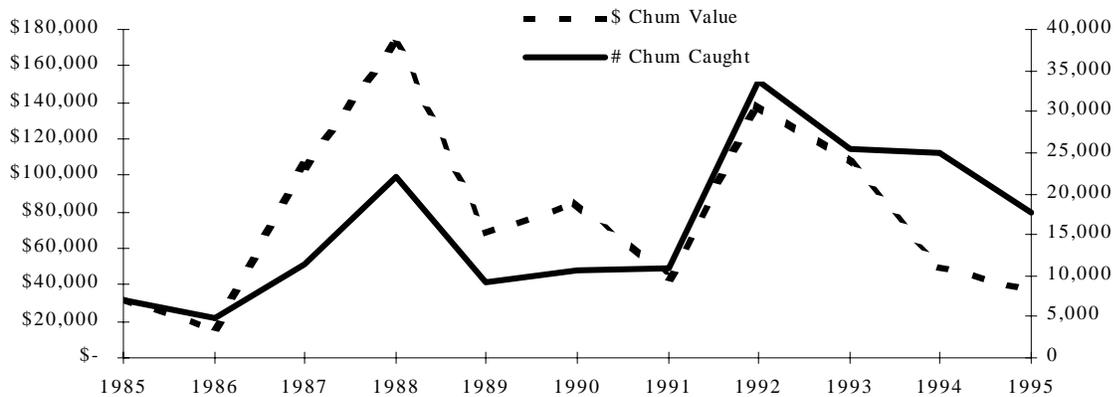


Figure 7. Suquamish Tribe Area 10E commercial chum harvest and value

All of the streams with eggboxes are presently undergoing projects related to restoration and barrier removal. The Boy Scouts, sports groups, tribes, local cities, county government, WDFW, USFWS, and other agencies are involved, and these projects will probably increase with the current emphasis on the Wild Salmonid Policy. The eggboxes were originally intended to “seed” streams, then be removed as chum salmon management is based on natural production. However, Kitsap County’s urbanization rate has been rapid and the impacts are quickly felt within the small watersheds. The Tribe is presently evaluating the costs and benefits of a longer-term eggbox program as well as implementing a feeding strategy to increase the survival rate of selected enhanced chum populations.