**Regional Information Report No. 5J13-03**

# Consideration of Hatchery Projects as a Means of Mitigating Impacts of Declining Chinook Salmon Runs and Supporting Research Activities in Alaska

**by**

**Ron Josephson,**

**Kevin Brennan,**

**John Burke,**

**Gary Fandrei,**

**Bill Heard,**

**John Joyce,**

**Jeff Milton,**

**Eric Prestegard,**

**Sam Rabung,**

**Steve Reifenstuhl,**

**and**

**Dave Reggiani**

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**Alaska Department of Fish and Game** **Divisions of Commercial Fisheries**

## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

**Weights and measures (metric)**

| | |
|---|---|
| centimeter | cm |
| deciliter | dL |
| gram | g |
| hectare | ha |
| kilogram | kg |
| kilometer | km |
| liter | L |
| meter | m |
| milliliter | mL |
| millimeter | mm |

**Weights and measures (English)**

| | |
|---|---|
| cubic feet per second | $ft^3/s$ |
| foot | ft |
| gallon | gal |
| inch | in |
| mile | mi |
| nautical mile | nmi |
| ounce | oz |
| pound | lb |
| quart | qt |
| yard | yd |

**Time and temperature**

| | |
|---|---|
| day | d |
| degrees Celsius | °C |
| degrees Fahrenheit | °F |
| degrees kelvin | K |
| hour | h |
| minute | min |
| second | s |

**Physics and chemistry**

| | |
|---|---|
| all atomic symbols | |
| alternating current | AC |
| ampere | A |
| calorie | cal |
| direct current | DC |
| hertz | Hz |
| horsepower | hp |
| hydrogen ion activity (negative log of) | pH |
| parts per million | ppm |
| parts per thousand | ppt, ‰ |
| volts | V |
| watts | W |

**General**

| | |
|---|---|
| Alaska Administrative Code | AAC |
| all commonly accepted abbreviations | e.g., Mr., Mrs., AM, PM, etc. |
| all commonly accepted professional titles | e.g., Dr., Ph.D., R.N., etc. |
| at | @ |
| compass directions: | |
| east | E |
| north | N |
| south | S |
| west | W |
| copyright | © |
| corporate suffixes: | |
| Company | Co. |
| Corporation | Corp. |
| Incorporated | Inc. |
| Limited | Ltd. |
| District of Columbia | D.C. |
| et alii (and others) | et al. |
| et cetera (and so forth) | etc. |
| exempli gratia (for example) | e.g. |
| Federal Information Code | FIC |
| id est (that is) | i.e. |
| latitude or longitude | lat. or long. |
| monetary symbols (U.S.) | $, ¢ |
| months (tables and figures): first three letters | Jan,...,Dec |
| registered trademark | ® |
| trademark | ™ |
| United States (adjective) | U.S. |
| United States of America (noun) | USA |
| U.S.C. | United States Code |
| U.S. state | use two-letter abbreviations (e.g., AK, WA) |

**Mathematics, statistics**

| | |
|---|---|
| *all standard mathematical signs, symbols and abbreviations* | |
| alternate hypothesis | $H_A$ |
| base of natural logarithm | *e* |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | (F, t, $\chi^2$, etc.) |
| confidence interval | CI |
| correlation coefficient (multiple) | R |
| correlation coefficient (simple) | r |
| covariance | cov |
| degree (angular ) | ° |
| degrees of freedom | df |
| expected value | *E* |
| greater than | > |
| greater than or equal to | ≥ |
| harvest per unit effort | HPUE |
| less than | < |
| less than or equal to | ≤ |
| logarithm (natural) | ln |
| logarithm (base 10) | log |
| logarithm (specify base) | $\log_2$, etc. |
| minute (angular) | ' |
| not significant | NS |
| null hypothesis | $H_O$ |
| percent | % |
| probability | P |
| probability of a type I error (rejection of the null hypothesis when true) | α |
| probability of a type II error (acceptance of the null hypothesis when false) | β |
| second (angular) | " |
| standard deviation | SD |
| standard error | SE |
| variance | |
| population | Var |
| sample | var |

*REGIONAL INFORMATION REPORT 5J13-03*

# CONSIDERATION OF HATCHERY PROJECTS AS A MEANS OF MITIGATING IMPACTS OF DECLINING CHINOOK SALMON RUNS AND SUPPORTING RESEARCH ACTIVITIES IN ALASKA

by

Ron Josephson
Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau

Kevin Brennan
Kodiak Regional Aquaculture Association, Kodiak

John Burke
Southern Southeast Regional Aquaculture Association, Ketchikan

Gary Fandrei
Cook Inlet Aquaculture Association, Kenai

Bill Heard
John Joyce
Auke Bay Laboratories, Ted Stevens Research Institute, Juneau

Jeff Milton
Alaska Department of Fish and Game, Division of Sport Fish, Anchorage

Eric Prestegard
Douglas Island Pink and Chum, Juneau

Sam Rabung
Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau

Steve Reifenstuhl
Northern Southeast Regional Aquaculture Association, Sitka

Dave Reggiani
Prince William Sound Aquaculture Corporation

Alaska Department of Fish and Game
Division of Commercial Fisheries
333 Raspberry Road, Anchorage, AK 99518-1565

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*Ron Josephson*
*Alaska Department of Fish and Game, Division of Commercial Fisheries,*
*1255 W. 8th St. P. O. Box 115526, Juneau, AK 99811-5526*

*Kevin Brennan*
*Kodiak Regional Aquaculture Association, 104 Center St., Kodiak, AK 99615*

*John Burke*
*Southern Southeast Regional Aquaculture Association, 14 Borch St., Ketchikan, AK 99901*

*Gary Fandrei*
*Cook Inlet Aquaculture Association, 40610 Kalilfornsky Beach Rd., Kenai, AK 99611*

*Bill Heard*
*John Joyce*
*Auke Bay Laboratories, AFSC/NMFS/NOAA*
*Ted Stevens Research Institute, 17109 Pt. Lena Loop Rd., Juneau, AK 99801*

*Jeff Milton*
*Alaska Department of Fish and Game, Division of Sport Fish, 333 Raspberry Rd., Anchorage, AK 99518-1565*

*Eric Prestegard*
*Douglas Island Pink and Chum, 2697 Channel Dr., Juneau, AK 99801*

*Sam Rabung*
*Alaska Department of Fish and Game, Division of Commercial Fisheries,*
*1255 W. 8th St. P. O. Box 115526, Juneau, AK 99811-5526*

*Steve Reifenstuhl*
*Northern Southeast Regional Aquaculture Association, 1308 Sawmill Cr. Rd., Sitka, AK 99835*

*Dave Reggiani*
*Prince William Sound Aquaculture Corporation, P. O. Box 1110, Cordova, AK 99574*

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# ABSTRACT

Chinook salmon returns to much of Alaska were at an all-time low level in 2012. As the 2012 return unfolded, it became apparent that additional information and management options were needed, and that hatcheries may provide opportunity to address both of these needs. In October 2012, the Alaska Department of Fish and Game convened a meeting of fisheries scientists, managers, and the public to clarify the issues and problems associated with declining Chinook salmon returns. During this Chinook Salmon Symposium in Anchorage, a portion of the meeting was dedicated to a hatchery panel. This summary report outlines how hatchery production might be used to supplement harvests and help understand the mechanisms behind low returns of Chinook salmon. This paper outlines some options and approaches for protecting and restoring wild stocks of Chinook salmon, while providing additional harvest opportunities, as well as supporting the research needs.



Key words: Chinook salmon, hatchery, enhancement, Chinook Salmon Symposium


# INTRODUCTION

Chinook salmon returns in much of Alaska were at an all-time low level in 2012. This was not a single-year aberration, but rather, the continuation of a series of poor return years. Fishery managers have been addressing this issue through management methods that sought to achieve escapement goals. However, as the 2012 return unfolded, it became apparent that additional information and management options were needed, and that hatcheries may provide opportunity to address both of these needs. To assess the opportunities hatcheries may provide, assistance of the regional hatchery associations and the larger nonregional groups was solicited.

In October 2012, the Alaska Department of Fish and Game (ADF&G) convened a meeting of fisheries scientists, managers, and the public to clarify the issues and problems associated with declining Chinook salmon returns. During this Chinook Salmon Symposium in Anchorage, a portion of the meeting was dedicated to a hatchery panel, with speakers sharing some of the potential benefits, practicalities, challenges, and risks associated with hatchery-based research and enhancement.

Since the Chinook Salmon Symposium in October, the group of general managers and executive officers of Alaska's regional hatchery associations and government scientists that make up the authors of this summary report have spent many hours discussing how hatchery production might be used to supplement harvests and help understand the mechanisms behind low returns of Chinook salmon. The group came together to document the Chinook salmon production opportunities hatcheries provide with the hope of informing organizations, businesses, private individuals, and governments of these opportunities. The group's objective was to identify and outline the most feasible options and best approaches for protecting and restoring wild stocks of Chinook salmon, while providing additional harvest opportunities, as well as supporting the research needs. The discussion in this summary paper is general and conceptual. As stakeholders better define the goals, individual project plans can be drafted with specific objectives and budgets.

# CHINOOK SALMON LIFE HISTORY

In Alaska, the vast majority of Chinook salmon spend their first winter as an egg in the gravel, emerge in the spring as a fry, spend their second winter as a fingerling in fresh water, and emigrate to salt water as a smolt at two years of age. Natural smolts are about 3 to 4 inches in length and weigh less than a half an ounce. At sea, Chinook salmon tend to migrate long distances and do not return to fresh water until they are sexually mature. Males may return at any

age from 3- to 7-year-olds; females seldom mature before they are 5-year-olds, with 6-year-olds being the predominant age of female Chinook salmon. For a thorough discussion of the life history of Chinook salmon, see *Pacific Salmon Life Histories* (Groot and Margolis, 1991).

The survival of Chinook salmon smolts from natural production and hatchery programs is relatively low compared to other species of salmon. In Southeast Alaska, researchers and hatchery operators have found that survivals of naturally produced wild smolts entering the ocean to returning adults averages 3% over an approximate 18-year period; survivals of hatchery-released smolts has averaged 1.7%. In spite of the low average survival, hatchery programs have occasionally had some very good survival years and one hatchery, Little Port Walter, has roughly equaled wild survival rates. Hatchery operators are sometimes puzzled as to why all hatchery programs have not achieved higher survival rates with this prized species.

When comparing survival rates of Chinook salmon from natural production to those from a hatchery program, it is important to realize that survival rates of the early life stages vary. Large losses of wild Chinook salmon in the natural environment do occur between the time of egg deposition and the smolt stage (at least as high as 95%), whereas losses in the hatchery environment are more modest (approximately 20%) during the same life stages.

Using average survivals achieved in Alaska's hatchery program, a million eggs incubated and reared in a hatchery to the smolt stage will produce, on average, a return of 13,600 adult Chinook salmon. The number that would be expected to be harvested would be less than that due to inefficiencies of all gear types, with sport fishing being the least efficient gear for salmon harvesting. Regardless of harvest method, high harvest rates can be achieved if returning adults are concentrated in a relatively small/focused area.

When considering a hatchery program, it is important to note large Chinook salmon that are desired by most harvesters are at least 4-year-olds and generally, 6- or even 7-year-olds.

## General Discussion

Hatcheries can be used to mitigate impacts to fisheries by providing additional fish for harvest. As a general rule, Alaska salmon hatchery programs are designed so that supplemental production and harvest is focused away from natural stocks. Although with careful design and planning, it is known that supplemental harvest opportunities can be provided on rivers with wild stocks of salmon. However, it is important to recognize that it would take at least 5 years from implementation of any Chinook salmon enhancement project before significant numbers of adults would be present for harvest. Planning, permitting, and construction could well add even more time before significant numbers of adults return. If it is found that current ocean conditions are the cause for poor survival, it is possible that even relatively large releases of Chinook salmon fry or smolt would fail to generate significant numbers of returning adult salmon.

Hatchery technology can also be coupled with research needs by providing scientists with a means of putting known numbers of marked fish into wild stock systems with the expectation that they would perform as sentinel fish, migrating and behaving similar to their wild counterparts. These sentinel fish, with their unique mark, could be identified for research purposes throughout their life cycle. Sentinel fish need to be of the same natal stock origin as the system that is stocked.

It is imperative that whatever approach is used, well-developed plans are in place and followed closely to ensure full benefit from such evaluation. These types of projects are likely to be

expensive and in many cases, taking place in areas where we have little or no experience with hatchery-based enhancement. Fishery managers and researchers need to know if a program is working and how well. To assess both hatchery and wild production, it's likely that hatchery operators will need to individually tag large numbers of fish so that fishery managers and researchers can track and assess the effectiveness of these programs. Thirty-thousand has been a recommended minimum number of tags for new projects in Southeast Alaska, but going to 50,000 would likely yield better data and understanding. Final tag ratios and total numbers tagged will ultimately be dependent on study objectives and recovery expectations. All hatchery Chinook salmon should additionally be otolith marked, and serious consideration of a common externally visible mark is strongly recommended (possibly the adipose clip, although that might complicate some coded-wire-tag studies in the area). Clear external marking is the best way to differentiate between enhanced and wild fish as they enter the fishery. Without such external marking, it would be difficult, if not impossible, to execute a selective fishery or even attempt to determine inseason contributions to the harvest. And finally, tissue samples from donor broodstock should be collected and archived to allow future assessment through genetic parental genotyping.

Regardless of the supplementation approach used there will be disease, management, and genetic issues to consider. It is routine for the department's Pathology and Gene Conservation staff to review all proposed enhancement projects for consistency with the state's fish health and genetics policies and guidelines. ADF&G and the state's private nonprofit hatchery operators have adhered to these policies for 35 years and new Chinook salmon programs would be no exception.

# BASIC APPROACHES

Hatchery methods of fishery enhancement include a broad range of approaches. These approaches can be described through the three basic questions discussed below.

### What methods can be used to provide more Chinook salmon for harvesters?

Smolt releases: Production of fish that are ready to go to sea, i.e., smolts. This is the primary approach used by Alaska's current Chinook salmon hatchery programs and results in the highest survivals of any release strategy. Generally, larger-size smolts survive at higher rates, but this adds cost and sometimes results in fewer numbers of smolts produced in a hatchery. This method requires the fewest eggs to achieve significant adult returns.

> Cons: Smolts are expensive to produce and transport to release sites. Other than road-accessible release locations, or in a few cases, boat-accessible sites, this approach may not be feasible as aerial transport of smolts for a great distance is likely to be very costly.

Fry releases: Fry releases have been successful in some locations. Generally, they work better in locations where good rearing habitat exists and naturally rearing Chinook salmon numbers are limited. This approach can be used in concert with a secondary rearing phase, such as net pens, that promotes additional growth and generally improves survival rates.

> Cons: Lower expected survival rates are the biggest detraction from fry plants. In addition, it can be expensive and time consuming to adequately mark enough fry for evaluation purposes. Significantly more eggs are needed due to lower survival rates.

Egg planting: Green or eyed-egg planting and streamside incubators have some utility in certain circumstances where incubation and rearing habitats are good and natural Chinook salmon returns are limited.

> Cons: Survivals are considerably lower than other approaches and evaluation is difficult and often incomplete. External marking of fish is not possible. Not proven to produce significant returning adults. Very large numbers of eggs would be needed to provide measurable contribution to local fisheries.

Lake net-pen rearing: This approach utilizes lakes for summer rearing of hatchery-incubated salmon. Lakes typically warm up quickly in the spring and can provide for very good growth rates with supplemental feeding. Salmon can be reared in net pens at modest capital costs. At the end of summer rearing several options are available. Fish can be released to overwinter in the lake or volitionally move downstream, or covers can be sewn into the nets and the fish held overwinter below the ice cover. This protects them from predators and improves survival before they are released in the spring. It is unclear if appropriate conditions exist for this sort of project to be feasible in much of the state, but it is an approach that has worked well with coho salmon in Southeast Alaska.

> Cons: Capital cost of net pens, nets, and work crew camp if in a remote location. There is some risk of significant losses due to the lack of control over rearing environment and high concentration of fish in pens. While lake rearing has had success in Southeast Alaska, there would be a learning curve for specific techniques that would be needed in the cold Interior winters. There are also questions about Chinook salmon stock behavior and survival adaptations related to this strategy.

Barren lake or river stocking: Smolt or fry releases or net-pen rearing in lakes barren of wild Chinook salmon.

> Cons: Not many opportunities in affected areas. Outcome is highly unpredictable.

Sentinel fish: Occasionally, releases of hatchery-reared fish have been used for research, as well as fishery enhancement purposes. It's generally expected that migration timing, routes, and behavior of hatchery fish is similar to their wild counterparts. This may be more likely if eggs are collected from wild fish, the period of artificial culture is limited, and fish are released to the system from which they came. Uniquely identifiable sentinel fish provide research information and may be available for harvest.

> Cons: The number of returning adults is usually limited and special recovery programs may be needed to meet research information needs.

## What methods can be used to rehabilitate Chinook salmon runs in major river systems?

Rehabilitation of Chinook salmon populations in major river systems through implementation of hatchery programs that are expected to restore numbers of wild fish to desired levels has rarely been used in Alaska on any species of salmon. More commonly, resource managers seek to ensure adequate natural escapement through fishery management, and expect that survivals will improve and runs will be restored.

The basic approach includes collection of salmon eggs from a specific wild stock of Chinook salmon, artificial culture to either the fry or smolt stage, and subsequent release back into the

original system. Using parents from that system assures that the released fish are as closely related to the natural spawning population as possible. With this approach, a balance between eggs collected and fish left to spawn naturally must take place. The purpose of this is to ensure that risks of catastrophic loss during artificial culture are minimized, i.e., enough fish remain to spawn in the wild to maintain the population.

This approach has been used for rehabilitation of severely depressed systems in the Pacific Northwest. Snake River Chinook salmon are one such population. Releasing fish from hatchery broodstocks into wild systems has resulted in returns that spawn naturally with and among wild fish. In some cases, hatchery fish spawn as successfully as wild fish. These actions are usually reserved for situations where the long-term viability of a population is at risk.

### What enhancement methods can be used to help understand some of the outstanding questions regarding declines in Chinook salmon runs in Alaska?

Hatcheries can be used to produce fish from wild stocks that are then released back into their natal habitats. If these fish are marked, either with otolith marks, coded wire tags, acoustic tags or parental genetic marks, the fish could serve as *sentinel* fish, i.e., fish that serve as indicators of migration, survivals, distribution, etc. for the wild stocks. For a hatchery-released fish to serve as a *sentinel* fish, it is generally expected that migration timing, routes, and behavior of hatchery fish released in the wild to be the same as their wild counterparts. This is more likely to be true if collected eggs are from wild stock, the period of artificial culture is limited, and fish are released in the natural system from which they came. Essentially, these are wild fish, as the short time in the hatchery should have little effect on their behavior.

In order to help pinpoint bottlenecks in survival, more intense evaluation would be required. Extensive acoustic tagging or tag–recovery programs could allow tracking during outmigration and early nearshore, and possibly offshore, movement. This type of tagging and tracking activity would be costly and require significant feasibility testing prior to deployment.

The department addressed the subject of Chinook salmon enhancement on the Yukon River in 2010 in response to a legislative query. That response was a good summary of the issues and an option. It is shown in Appendix A.

## RESOURCES

There are limited existing hatchery resources for production of Chinook salmon in Alaska. Most hatcheries are at or near their capacity for production. In Southeast Alaska, Chinook salmon stock abundances do not seem to be as low as elsewhere in the state. Hatchery stocks there are generally in good shape and for the most part, hatcheries are at capacity for Chinook salmon. It's in the rest of the state that there is the most current need for action. The following hatcheries should be considered as resources for any hatchery-based Chinook salmon programs.

1. Eklutna Salmon Hatchery (ESH); Palmer – This hatchery is presently not in production, however the owner, Cook Inlet Aquaculture Association (CIAA), estimates that it could produce 1.2 million 15 gram smolts on an annual basis. There would be some modest capital costs to get the hatchery back in operation.
2. William Jack Hernandez Sport Fish Hatchery (WJHSFH); Anchorage – The department estimates this hatchery can produce 700,000–800,000 additional Cook Inlet origin smolt annually. Current production is roughly 1,700,000. (It's also important to note that the

William Jack Hernandez Hatchery has not met their current egg collection target due to weak returns of broodstock. Additional funding would be needed to aggressively identify and collect broodstock over a longer time period.

3. Ruth Burnett Sport Fish Hatchery; Fairbanks – The department estimates this hatchery could produce 700,000 smolt annually.
4. Fort Richardson State Fish Hatchery; Anchorage – This hatchery has some significant issues with water supply and would require a large capital investment before it could provide additional production.
5. Wally Noerenberg Hatchery (PWSAC); Prince William Sound – Permitted for 4,000,000 eggs. There was a Chinook salmon program at the Wally Noerenberg Hatchery in the 1980s and 1990s in support of stocking in the Prince William Sound area. As many as 640,000 smolts were released per year. A Chinook salmon program was reinitiated in 2012, with a release of 50,000 smolts at Chenega Bay. This hatchery is in a remote bay in Prince William Sound and could best be used for smolt programs in that area.
6. Trail Lakes – Permitted for 4,000,000 eggs, but would displace all sockeye salmon production to do so. (Not a practical possibility.)
7. Pillar Creek; Kodiak – Permitted for 450,000 eggs, but could upgrade facility to accommodate additional production; this could displace some sockeye or coho salmon production. The current Chinook salmon program is sport fish-based, with resulting smolt released along the Kodiak road system for sport harvest. The Chinook salmon stock used at Pillar Creek is Karluk River.

Table 1 shows the number of Chinook salmon eggs that Alaska hatcheries are either permitted to collect in the case of private nonprofit hatcheries, or the physical capacity in the case of the ADF&G hatcheries. In some cases hatcheries may have permits to raise Chinook salmon but other considerations preclude them from actually undertaking such work. Trail Lakes is an example of this, the hatchery permit allows them to take 4 million eggs, however it would take considerable capital expenditure to do any Chinook salmon production there. In the case of Eklutna, as described above, the hatchery could raise Chinook salmon; however Chinook salmon production is not currently on their permit. Adding Chinook salmon to their permit would have to take place before a program change would be approved.

Table 1.–The Chinook salmon egg capacity of Alaskan hatcheries, in millions of eggs, 2012.

| Region/Operator/Location | | Eggs |
|---|---|---|
| Southeast | | |
| SSRAA | Whitman Lake | 1.50 |
| | Neets Bay | 2.00 |
| | Burnett Inlet | 0.00 |
| | Crystal Lake[a] | 2.70 |
| NSRAA | Hidden Falls | 3.80 |
| | Medvejie Creek | 5.20 |
| | Sawmill Creek | |
| AKI | Port Armstrong[b] | 2.00 |
| DIPAC | Macaulay | 1.25 |
| | Sheep Creek | |
| | Snettisham | |
| KTHC | Deer Mountain | 0.13 |
| KNFC | Gunnuk Creek[c] | |
| POWHA | Klawock | |
| | Port Saint Nicholas | 0.77 |
| SSSC | Sheldon Jackson | |
| *Southeast Totals* | | *19.35* |
| Artic Yukon Kuskokwim | | |
| ADFG | Ruth Burnett | 1.00 |
| *Artic Yukon Kuskokwim Totals* | | *1.00* |

| Region/Operator/Location | | Eggs |
|---|---|---|
| Prince William Sound | | |
| PWSAC | Armin F. Koernig | |
| | Wally Noerenberg | 4.00 |
| | Cannery Creek | |
| | Main Bay | |
| | Gulkana | |
| VFDA | Solomon Gulch | 0.30 |
| *Prince William Sound Totals* | | *4.30* |
| Cook Inlet | | |
| PGHC | Port Graham | |
| CIAA | Trail Lakes | 4.00 |
| | Eklutna | |
| | Tutka Bay | |
| ADFG | William Jack Hernandez | 2.25 |
| | Fort Richardson | |
| *Cook Inlet Totals* | | *6.25* |
| Kodiak | | |
| KRAA | Kitoi Bay | |
| | Pillar Creek | 0.45 |
| | *Kodiak Totals* | *0.45* |
| *Statewide Totals* | | *31.35* |

[a] Crystal Lake Hatchery is a state-owned facility under partial contract to SSRAA; it does not have a PNP permit.

[b] Port Armstrong can take up to 5.0 million king and coho salmon eggs, in combination, not to exceed 2.0 million king salmon.

## Current Program

The current Alaska hatchery program for Chinook salmon is quite diverse, with programs directed at both sport and commercial users. In Kodiak, the targeted beneficiaries are sport fisherman, but commercial and subsistence users certainly benefit. In Southeast Alaska, the program is more dynamic, with more crossovers between beneficiaries. Table 2 presents the extent of anadromous releases of Chinook salmon in Alaska.

Table 2.– Alaska anadromous Chinook salmon hatchery projects and associated release numbers by year, 2009–2012.

| | | | Release Year | | | |
|---|---|---|---|---|---|---|
| Area | Operator | Project | 2009 | 2010 | 2011 | 2012 |
| Southeast | | | | | | |
| | SSRAA | Whitman Lake | 740,000 | 768,000 | 738,000 | 720,000 |
| | | Neets Bay | 650,085 | 671,350 | 709,000 | 726,150 |
| | | Crystal Lake | 551,980 | 672,900 | 717,825 | 628,300 |
| | | Anita Bay | 547,030 | 553,100 | 456,200 | 441,223 |
| | NSRAA | Hidden Falls | 1,197,354 | 1,307,422 | 598,284 | 480,642 |
| | | Medvejie | 3,980,933 | 2,640,691 | 1,696,344 | 2,906,139 |
| | | Haines | 222,151 | 80,672 | 92,785 | |
| | AKI | Port Armstrong | 552,629 | 276,098 | 250,438 | 249,319 |
| | DIPAC | Macaulay | 216,639 | 223,000 | 193,931 | 213,229 |
| | | Auke Bay | 87,190 | 89,000 | 90,388 | 89,932 |
| | | Fish Creek | 288,579 | 282,000 | 220,635 | 278,640 |
| | | Skagway | 276,262 | 258,000 | 128,619 | 194,603 |
| | KTHC | Deer Mountain | 52,483 | 85,625 | 59,545 | 40,195 |
| | POWHA | Port Saint Nicholas | 252,172 | 303,801 | 152,628 | 96,737 |
| | | Coffman Cove | 247,436 | 188,710 | 304,927 | 53,861 |
| | SSSC | Sheldon Jackson | 45,938 | 90,926 | 8,257 | |
| | MIC[a] | Tamgas Creek | 170,974 | 264,048 | 251,000 | 299,667 |
| | NMFS[a] | Little Port Walter | 209,217 | 237,700 | 187,535 | 150,416 |
| Southeast Totals | | | 10,289,052 | 8,993,043 | 6,856,341 | 7,569,053 |
| Prince William Sound | | | | | | |
| | ADF&G | Whittier | | 108,881 | 100,094 | 96,436 |
| | | Valdez | 107,883 | 113,801 | 113,782 | 102,215 |
| | | PWS – Fleming Spit | 68,173 | 111,383 | 86,428 | 103,515 |
| | PWSAC | PWS – Chenega | | | | 49,700 |
| Prince William Sound Totals | | | 176,056 | 334,065 | 300,304 | 351,866 |
| Cook Inlet | | | | | | |
| | ADF&G | Willow | 111,322 | 155,125 | 140,266 | 151,220 |
| | | Eklutna | 77,785 | 152,014 | 122,962 | 160,347 |
| | | Ship Creek | 282,735 | 332,597 | 314,194 | 329,082 |
| | | Crooked Creek | 115,035 | 106,145 | 64,578 | 52,759 |
| | | Ninilchik | 54,845 | 58,297 | 59,462 | 54,780 |
| | | Halibut Cove | 35,065 | 111,134 | 107,338 | 110,253 |
| | | Homer Spit | 164,234 | 213,503 | 219,787 | 221,547 |
| | | Seldovia | 44,487 | 114,421 | 103,382 | 95,800 |
| | | Seward | | 220,450 | 223,881 | 219,743 |
| Cook Inlet Totals | | | 885,508 | 1,463,686 | 1,355,850 | 1,395,531 |
| Kodiak | | | | | | |
| | KRAA | American River | 51,533 | 78,002 | 10,061 | 39,740 |
| | | Monashka Creek | 79,330 | 81,816 | 38,840 | 34,765 |
| | | Olds River | 54,065 | 78,002 | 10,057 | 39,300 |
| Kodiak Totals | | | 184,928 | 237,820 | 58,958 | 113,805 |
| Statewide Totals | | | 11,535,544 | 11,028,614 | 8,571,453 | 9,430,255 |

[a] Federal hatcheries.

# HATCHERY COSTS

Hatchery production of Chinook salmon is expensive. This species needs a lot of rearing space and water for the best growth. Feed costs are high, as are the labor costs.

All currently operating hatcheries have integrated programs involving multiple species, each with a different strategy and specific costs. Coming up with an average cost to produce a smolt is challenging. A hatchery on the road system that releases smolts directly from the hatchery would have lower costs, whereas a remote hatchery that transports smolts to another release site and rears in net pens at that site might have costs twice as high as the roadside hatchery. For conceptual planning, a cost of $0.50 to $0.75 per smolt released is suggested.

# RESEARCH DIRECTION

Hatchery-supported enhancement might be beneficial to understanding factors affecting survival of Chinook salmon in Alaska, as well as providing some supplemental fishing opportunity. Hatchery operators may view some issues with reduced Chinook salmon production from a different viewpoint than other scientists. We identified the following very basic conceptual approaches that might merit consideration.

## Yukon River

- The Yukon River is such a large, intact river system that has supported such large historic Chinook salmon fisheries that we believe the focus should be on better understanding the survival processes within the river and early marine life for Chinook salmon. Enhancement projects, if implemented, should have an emphasis on increasing our knowledge of Chinook salmon life history in its drainages.
- Requires 5–6 years of releases, minimum.
- Sentinel Program: Release groups need to be large enough to evaluate, perhaps as great as 1 million (which might produce a return of 30,000 fish under our most optimistic projections).
- Evaluation should include coded wire tags, adipose fin clips, otolith marks, parental-based genetic sampling, and possibly, acoustic tagging/tracking.
- Production could come from the Ruth Burnett Sport Fish Hatchery.
- Advantage is there is potential for cooperative evaluation of Whitehorse Rapids program and production capacity is readily available.
- There may be a challenge to access sufficient broodstock and logistics related to transport at release.

## Cook Inlet

- The focus in Cook Inlet should be on bolstering additional harvest opportunity through existing hatchery program, with emphasis on current broodstock collection sites first.

- There is potential for raising 1.2 million additional smolts from the Eklutna Salmon Hatchery. Smolts could be released at Eklutna or at Sheep Creek, Montana Creek, Goose Creek, etc.

- Possibly, the biggest impediment to releasing more hatchery-produced Chinook salmon in the Cook Inlet area is securing broodstock. The current program has not met their goals for a couple years. Some of this could be mitigated by spending more money to run weirs for longer periods of time and increasing crew sizes. Of equal concern are current low survival rates that result in fewer fish available for broodstock.

**Kuskokwim River**

- Similar to the Yukon River, the Kuskokwim River has supported large historic salmon fisheries. Initial projects should be focused on those that will increase our understanding of life history and survival mechanisms at play in this river system.

- There may be opportunities for sentinel stock work on smaller spawning systems.

**Kodiak**

- Harvest and evaluation equally prioritized. The Karluk River is relatively short, clear, and shallow. Due to its relatively small size, evaluation and research of natural Karluk Chinook salmon populations and essential habitats (in fresh water, the lagoon, and nearshore) is simplified.

- Sentinel program on Karluk River; release of Pillar Creek Hatchery origin fry/fingerling/smolt. Release groups can be smaller than for large systems as tag recovery is more likely with an adequate evaluation program; release groups as few as 50,000 smolt (which might produce a return of 1,500 fish under optimistic projections).

- Release Chinook salmon smolts from saltwater net pens in proximity to river. These fish could come from Pillar Creek stock, which has ancestry of Karluk River. Returns would be a good surrogate for ocean distribution patterns, harvest rates in various fisheries, and could provide supplemental harvest to subsistence users at Karluk River. While a few fish could ascend the river and spawn, these could be culled at the nearby ADF&G weir. The expectation is that most, if not all, could be harvested.

- There is Chinook salmon at the Pillar Creek Hatchery that could potentially be released at Karluk this spring, in 2013.

- Evaluation should include coded wire tags, adipose clip or other external mark, otolith mark, and parental-based genetic sampling.

- Production could come from the Pillar Creek Hatchery, or potentially, via construction of a small experimental hatchery at Karluk.

- Advantage is there is potential for cooperative evaluation of the Kodiak road-system Division of Sport Fish program. There are also partnership opportunities with ADF&G, Kodiak Regional Aquaculture Association, Karluk village residents.

### Norton Sound

- The focus in the Norton Sound area should be on bolstering additional harvest opportunity, and in understanding the processes going on within fresh water and the early marine life for Chinook salmon.
- The Norton Sound area does have some recently permitted egg-plant projects. However, these projects are experimental and intended to recolonize spawning areas.
- A local Community Development Quota group is considering a hatchery that might serve as support for Chinook salmon projects.
- With expectation of small numbers of adult returns, many local communities might present opportunities for saltwater net-pen rearing similar to what is suggested as an option at Karluk River. Challenges would be identifying a local broodstock with a large enough return to supply eggs, raising fish to a size large enough for saltwater rearing, and transportation to the saltwater net-pen rearing sites.
- There may be opportunities for sentinel stock work on smaller spawning systems.

## COOK INLET PROJECT OPPORTUNITIES

Cook Inlet has been particularly hard hit by low returns of Chinook salmon. Because it has a relatively well developed hatchery program designed to augment Chinook salmon returns, there is a better opportunity to respond quickly in that area of the state. The section that follows was provided by Sport Fish division and describes some of the potential responses in that region.

### Possible Short-Term Response to Weak Chinook Salmon Returns

There are a number of sites throughout Cook Inlet where the Division of Sport Fish presently stocks Chinook and coho salmon smolts to increase harvest opportunity. The following is a discussion of the sites currently stocked, the numbers of smolt and size at release, the permitted numbers allowed to release, and potential increases in release numbers, costs of producing additional fish, expected adult returns and logistical challenges associated with production, imprinting, egg takes, adult return management, access, conflicts with wild stock management, broodstock capture and holding.

The historic marine survival (MS) rate was 2%, so it is expected that the current smolt release of 1.7 million Chinook salmon would return an aggregate of 35,300 adult salmon. Based on recent adult escapements to brood collection sites current MS is running as low as 0.25% (1/8 of the historic average). With a MS rate this low, a release of approximately 13,600,000 smolt would be required to produce 35,300 returning adults. As brood availability is the prime limiting factor to smolt production it is not possible to achieve this elevated release level even if rearing space were available. Table 3 outlines current Division of Sport Fish, Chinook salmon enhancement programs within Cook Inlet and Prince William Sound.

Table 3.– Current Division of Sport Fish, Chinook salmon enhancement programs within Cook Inlet and Prince William Sound.

| Chinook Salmon Egg take/ Smolt Release Sites in Cook Inlet and Prince William Sound | | | | | | |
|---|---|---|---|---|---|---|
| Location | Permitted Egg take | Permitted Release | Current Release Goals | Target Release Size inches (grams) | Adult Return at 2% MS | Adult Return at 0.25% MS |
| Ninilchik River | 760,000 | 50,000 | 50,000 | 4 (13) | 1,000 | 125 |
| Seldovia | 0 | 105,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Halibut Cove | 0 | 105,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Homer Spit | 0 | 210,000 | 210,000 | 4 (13) | 4,200 | 525 |
| Crooked Creek | 1,740,000 | 150,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Ship Creek | 2,150,000 | 315,000 | 315,000 | 4 (13) | 6,300 | 788 |
| Eklutna Tailrace | 0 | 150,000 | 150,000 | 4 (13) | 3,000 | 375 |
| Deception Creek | 1,570,000 | 200,000 | 150,000 | 4 (13) | 4,000 | 500 |
| Cordova | 0 | 105,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Valdez | 0 | 105,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Whittier | 0 | 105,000 | 105,000 | 4 (13) | 2,100 | 263 |
| Seward | 0 | 210,000 | 210,000 | 4 (13) | 4,200 | 525 |
| Totals | 2,445,000[a] | 1,810,000 | 1,715,000 | - | 35,300 | 4,413 |

*Note:* Enhancement programs in SE and Kodiak are not shown.

[a] Egg take numbers include smolt and catchable production in addition to 50,000 eyed eggs for PWSAC to produce smolt for release in Crab Bay (Village of Chenega).

## Potential Production Increases at Existing Chinook Salmon Release Sites

The William Jack Hernandez Sport Fish Hatchery (WJHSFH) contains rearing space for as many as 2,544,000 Chinook salmon smolt. This would allow an increase over current Chinook salmon smolt production of up to 829,000 more smolt. In light of the fact that current production is limited by broodstock availability, increasing release numbers at brood collection sites would yield the greatest overall benefit. These sites include Ninilchik River, Crooked Creek, Ship Creek and Deception Creek (Table 4). Selection of these sites would spread the beneficial impact across the region, increase availability of broodstock and allow closer management of returning fish to already impacted systems.

Table 4.–Increased release numbers and estimated adult return at brood collection sites.

| Recommended Stocking Increases | | | |
|---|---|---|---|
| Location | Current Release | Proposed Release Goal | Adult Return at 0.25% MS |
| Ninilchik | 50,000 | 212,000 | 530 |
| Crooked Creek | 105,000 | 212,000 | 530 |
| Ship Creek | 315,000 | 636,000 | 1,590 |
| Deception Creek | 150,000 | 212,000 | 530 |

In theory, adult returns from these elevated release numbers (652,000 additional smolt) would provide surplus fish beyond program broodstock needs but would not fully mitigate the impact of the currently poor MS on overall adult return numbers. This would leave an additional 177,000 smolt available for allocation to existing terminal harvest sites.

Benefit from increased release levels would be realized when these fish matured and returned after 3 to 5 years at sea. If ocean conditions were to improve significantly there may be a relative flood of returning adults challenging managers to effectively target harvest activity—a challenge that would likely be welcomed.

Production of Chinook salmon stocks in addition to stocks currently reared at the WJHSFH is not possible due to disease, genetic and isolation challenges.

## Total Estimated Cost to Implement Chinook Salmon Stocking Increases

Annual: $338,620 (Table 5).

Summaries of specific project opportunities for increased or additional Chinook and coho salmon releases in the Cook Inlet area are included in Appendix B. These projects are primarily directed at recreational harvests but some ancillary benefits would occur.

Table 5.–Associated costs with increased production and effort.

| Location | Manpower | Smolt Marking | Production and Stocking |
|---|---|---|---|
| Ninilchik | $25,000 | $17,000 | $50,220 |
| Crooked Creek | $50,000 | $12,000 | $33,170 |
| Ship Creek | $5,000 | $2,000 | $99,510 |
| Deception Creek | $18,500 | $7,000 | $19,220 |
| Total | $98,500 | $38,000[a] | $202,120 |

[a] A one-time cost of ~$25,000 would also be needed to fabricate additional clipping stations.

## Alternatives to Increased Smolt Release Numbers

Alternatives to increasing the number of smolt released would be to adjust the size, time or location at which smolts are released. Adjusting the timing and location of release is always an option regardless of the number or size of smolt. Increasing the size of smolt has been shown to yield an increase in survivals to adult and would allow flexibility within existing egg-take levels. Currently the target release size for Chinook salmon smolt is 13 grams (4 inches). Assuming that no additional eggs become available (due to broodstock limitations) increasing the target release size to 19.5 grams should give these fish a survival advantage. Larger fish can forage on a wider range of food items, they are better able to avoid predators and fewer predators are able to consume them. This strategy addresses concerns related to marine survival and minimizes impacts to current management and production programs. Costs to increase production in this manner are slightly reduced as there would be no increase in tagging. Cost increases would be significant for added feed and transport costs as well as extended field activity to allow maximization of the egg-take effort.

There are some concerns that this strategy can lead to changes in age structure for returning adults favoring early maturing fish or triggering higher than desirable jacking or straying rates. A differential marking and recovery program would need to be implemented to optimize long term release strategies.

**Total Estimated Cost to Maximize Egg-take Effort and Offset Shortfall by Increasing Size at Release**

Annual: $363,620

Summaries of specific project opportunities for increased or additional Chinook and coho salmon releases in the Cook Inlet area are included in Appendix B. These projects are primarily directed at recreational harvests but some ancillary benefits would occur.

# RECOMMENDATIONS

1. CIAA should put its Eklutna Salmon Hatchery into Chinook salmon production and work with Division of Sport Fish to augment releases in the Cook Inlet area. This is likely the most efficient approach, gets fish into the water soon, and the benefits accrue to the largest population area. Harvest pressure on the Cook Inlet systems is substantial and this could ameliorate harvest pressure on weakened wild stocks, to some extent. The state should support this project through a contract with CIAA.
2. The state should initiate a sentinel Chinook salmon project on the Yukon using the Ruth Burnett Sport Fish Hatchery. The Yukon/Kuskokwim rivers seem to have a different set of problems that have persisted for a longer period of time, so the sentinel program is better suited to potentially address, or at least work in concert with, other assessment programs. It appears that the Salcha River stock is the best candidate for a sentinel stock program. Alaska should also work with the Canadian Yukon hatchery managers to see if there is potential to expand their program. We encourage further evaluation of a lake-rearing program as it reduces the demand for fresh water at a hatchery and provides a number of other opportunities.
3. Projects on the Kuskokwim River should wait for preliminary results from actions on the Yukon River and then build off that experience.
4. Kodiak projects should focus on the Karluk River, with hatchery releases in proximity to the river, as well as a sentinel stock program. Additional study of Karluk River Chinook salmon populations should be initiated utilizing partnerships with KRAA, USFWS, the Karluk tribe, and regional native corporations.

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# APPENDIX A: LETTER FROM DIRECTORY HILSINGER TO DAVE GRAY, MARCH 10, 2010

STATE OF ALASKA

SEAN PARNELL, GOVERNOR

DEPARTMENT OF FISH AND GAME
*Division of Commercial Fisheries*

*P.O. BOX 115526*
*JUNEAU, AK 99811-5526*
*PHONE: (907) 465-4210*
*FAX: (907) 465-2604*

March 10, 2010

Dave Gray, Legislative Aide
Alaska State Legislature
State Capitol, Room 3
Juneau, AK 99801-1182

Dear Mr. Gray:

In response to your questions regarding salmon enhancement opportunities on the Yukon River, the staffs of the Alaska Department of Fish and Game (ADF&G) divisions of Commercial Fisheries and Sport Fish have put together the following assessment and recommendations.

## Yukon River Chinook Salmon Enhancement Scoping

On March 1, a number of ADF&G staff met to discuss options for Chinook salmon enhancement on the Yukon River. Sue Aspelund, Sam Rabung, Jeff Milton, John Linderman, Dan Bergstrom, Dani Evenson, Katie Howard, Tom Taube, Steve Hayes, and Ron Josephson participated. These personnel have extensive experience in management and research of Yukon River fisheries as well as planning, permitting, and operation of salmon hatcheries.

### Background

There are two general types of approaches that can be considered for supplementing wild salmon production: one is an effort to return wild salmon stocks, or their habitat, to natural production levels (defined as restoration); the second is expanding a wild salmon stock beyond its natural production level (defined as enhancement). Since escapement goals are generally being met, there must be some other factor limiting returns to the Yukon River. For that reason, increasing the numbers of fish returning will likely require concentrating more on enhancement approaches.

Strategies that focus on producing fish that contribute to existing fisheries during normal fishing times and that will benefit users along the length of the river would likely be most attractive to the public. In that case, the preference will be to produce fish that are transiting most of the river. Many Yukon River Chinook salmon originate in Canada. The U.S./Canada Yukon River Panel (Panel) is comprised of stakeholder representatives and fishery researchers and managers

from the U.S. and Canada that coordinate programs and management of trans-boundary Yukon River salmon stocks. In previous years, the Panel has been opposed to large scale salmon hatchery enhancement programs. The Panel comprises stakeholder representatives and fishery researchers and managers from the U.S. and Canada that coordinate programs and management of trans-boundary Yukon River salmon stocks. It would be advisable for Alaska to undertake salmon enhancement on the Yukon River with Panel review and approval. Additionally, a high degree of public input from Yukon River stakeholders throughout the Alaskan and Canadian portions of the drainage would be advisable before moving forward with any salmon enhancement programs.

The first question to address is how many fish are needed to make a noticeable difference in harvests without jeopardizing wild stocks. Recent Chinook salmon returns during low abundance years have been on the order of 150,000 to 180,000 fish; adding an additional 50,000 fish during such low abundance years should make a noticeable improvement in run strength. At a typical harvest rate of 50%, this would provide 25,000 extra fish for harvest. At the same time, it would increase escapement by about 25,000 fish. In years of low Chinook salmon abundance on the Yukon River, it may not be possible to harvest all the available hatchery fish while still achieving wild stock escapement goals. In years of average to high abundance, these additional fish may not be necessary. In those years, this number of additional fish may result in exceeding escapement goals, which could be counterproductive to users and the resource. In order to prevent this from happening, care would have to be taken in designing the program.

Producing 50,000 Chinook salmon would be an ambitious project. The entire Southeast Alaska return of hatchery Chinook salmon has ranged from 90,000 to 170,000 fish over the last 10 years. Medvejie Creek Hatchery, which is the single largest contributor, has an average return on the order of only 35,000 per year.

An additional issue to consider is how fisherman would harvest enhanced Chinook salmon while protecting wild stocks. In years like 2009, there may not be much harvest opportunity, but in most years we expect that there will be some fishing. Careful selection of release sites and the stock used would provide harvest opportunities that minimize impacts on wild stocks.

**Enhancement Methods**

There are three general types of stocking that are used for enhancement.

1) Planting eggs: Eggs can be planted as freshly fertilized or eyed eggs either directly into the gravel or by use of stream-side incubation boxes. This approach has significant challenges on the Yukon River, including difficulty of access, low survival rates, difficulty in evaluation, and the need for specific ground water conditions. These challenges are great enough to preclude using this approach on a large scale. If a specific stock is weak, this approach can be more thoroughly explored for rebuilding it.

2) Planting fry: Fry can be planted either as newly emergent fry or after some feeding and growth. Both approaches have been used with some success. There are still challenges to collecting eggs and transporting fry, but in general those challenges can be overcome on most systems. Fry planting provides better opportunity for evaluation through marking enhanced production either with a fin mark, otolith mark, or coded wire tag.

One detriment to fry releases is that the fish will potentially compete for rearing habitat and food with wild Chinook salmon. Those impacts are almost impossible to measure, but should be considered.

3) Planting full term smolts: This is the most successful approach in terms of survival to adult and by far the most commonly used technique for Chinook salmon. Infrastructure needs and operational expenses are much greater for rearing of the fish and transport costs are higher. However, the benefits of increased survival to adult generally outweigh the added costs.

**Canadian Programs**

There are two active Yukon River Chinook salmon enhancement programs currently operating in Canada.

One is at Whitehorse Hatchery, which was constructed in 1984 to mitigate impacts of the hydroelectric dam that was installed in 1956. This hatchery produces from 150,000 to 400,000 Chinook salmon fingerlings each year. The fish are reared to about 2 grams and released in various streams upstream of the hatchery and dam. It appears that survival to adult averaged about 1.6% from 1997 through 2006 for fry releases averaging 150,000 fish per year. Whitehorse Hatchery collects eggs from Chinook salmon at the fish ladder. The hatchery is small and it uses well water.

There is another smaller operation at McIntyre Creek that produces up to 100,000 fry a year. This project also collects broodstock from the Whitehorse fish ladder and releases the fry in streams upstream of the hatchery and dam.

Both projects are worth looking at as they are the only active Chinook salmon enhancement programs on the Yukon River.

**Alaska's Clear Hatchery**

In the mid-80s, Clear Hatchery released slightly over 500,000 Chinook salmon fingerlings into Wood and Clear Rivers. A portion of these fish were coded-wire-tagged but no tag return information is available. The hatchery reported an average return of 200 Chinook salmon per year over the years 1985 to 1989. Clear Hatchery was closed in 1997 and has been decommissioned.

**Enhancement Options**

The types of projects most likely to provide a noticeable increase in Chinook salmon returns are hatchery-based. Releasing fish as far upriver as possible is most likely to benefit the greatest number of users. The recommended level of production is 50,000 adults on an annual basis. At a harvest rate of 50%, this would provide 25,000 additional fish harvest and also increase escapement by 25,000 fish. In years when wild stock runs are weak, development of a terminal harvest area (where hatchery fish could be harvested without impacting wild stocks) would likely be necessary to achieve this level of harvest.

Three basic approaches may be considered. About 3,000,000 fingerlings a year could potentially produce 50,000 additional adults. This would require a broodstock of 1,000 fish, or more (600 females plus 400 or more males depending on the genetics requirements). Another option is to stock smolts, which would have a higher survival rate, but would require holding and feeding. Based on smolt to adult survivals in Southeast Alaska, it is likely that about 1,500,000 smolts would be needed to produce 50,000 returning adults.

1. *Canadian Production* – Expansion of Whitehorse Hatchery production to produce Chinook salmon fry for release in the larger of their Chinook salmon rivers. This approach would involve entering into an agreement with Canada. It's not known what total capacity they currently have, but a fifteen-fold increase over current release levels would be needed.

2. *Alaska Production Mid-river Release* – The most upriver stock that is large enough to support an egg take for large scale enhancement would be one of the Tanana River systems. Fry should be released in the system from which the eggs are collected. The Salcha River is the most likely candidate. Mainstem fishermen from Tanana village downstream would benefit as would fishermen in the Tanana River where some terminal harvest could occur.

3. *Alaska Production Upriver Release* – Release of Chinook salmon fingerlings in the stretch of river near the community of Eagle would benefit all Alaska fishermen. If Chinook salmon were held for a short period of time in Mission River, they would likely imprint well enough to at least return to that river for a short period of time. The adults might even stay in the river, which would increase harvest opportunity and reduce straying. Harvest efforts could be concentrated at the terminal area to provide maximum harvest of the available surplus production. A broodstock source would need to be determined.

**Alaska Hatchery Capacity**

Ruth Burnett Sport Fish Hatchery (the new hatchery in Fairbanks) has some available space for the first couple of years of production. That hatchery should have enough space to produce approximately 700,000 - 12 gram Chinook salmon smolts, but purchase of additional incubators would be necessary to handle the required number of eggs. This number of smolts would produce a return of about 21,000 adults and so it would have to be combined with another project in order to reach the goal of 50,000 adults.

There may also be other Alaska hatcheries on the road system that can provide incubation and rearing space. Reactivation of Clear Hatchery can also be considered since there might be adequate amounts of quality water and the availability of heat from the power plant. However, the site was completely decommissioned (raceways filled with concrete, pipe removed from site, and outbuildings demolished) and would have to be completely rebuilt.

**Costs**

Embarking on an enhancement program on the Yukon River is likely a multi-million dollar a year venture. Developing a more precise cost estimate would depend on the particular options chosen.

**Pros and Cons**

Enhancement activities may provide a means of overcoming the poor productivity of Yukon River Chinook salmon stocks. Alaska has substantial experience doing salmon enhancement and has developed the necessary marking and sampling techniques to allow adequate evaluation of enhancement activities. Such activities do, however, carry risks in a mixed stock fishery such as the Yukon River. Enhanced numbers must be kept relatively low to prevent overharvest of wild stocks and presence of hatchery fish will further complicate stock assessment.

The Alaska enhancement program has learned many lessons from enhancement experiences in the Pacific Northwest and tries very hard not to repeat those mistakes. Much of the hatchery production on Columbia River (a mixed stock gauntlet fishery similar to the Yukon River) has been controversial as to benefits and impacts. Placing large scale enhancement efforts on top of wild stocks has not worked well on the Columbia River and has created numerous challenges that are still plaguing managers and agencies. If Alaska does intend to undertake an enhancement effort on the Yukon River, it should be done after careful planning and evaluation and should include stakeholder input as well as a well developed exit strategy.

Hopefully, this assessment helps clarify the scope of the effort and the range of possibilities. Given additional time, we can further refine some of these ideas. Feel free to ask any additional questions if you would like us to go further with this topic.

Sincerely,

John Hilsinger
Director

# APPENDIX B: SPORT FISH DIVISION'S COOK INLET PROJECT OPPORTUNITIES

# Sport Fish Division's Chinook and Coho Salmon Enhancement Projects and Potential Expansion Opportunities

## Detailed Project Narratives

### General Comments

Each of the following project narratives assumes that the considered action is independent of other activities. Some combinations of actions are mutually exclusive or may create unmanageable conflicts.

To comply with current genetics guidelines, all smolt stocked into wild systems would have to be marked and tracked to allow for differential harvest and brood collection. In many cases an aggressive culling operation may be required to maintain the integrity of the native stock. If this were found to be the case, projects costs could increase.

All egg-take goals assumed survival from green egg to smolt to be 75%.

Planning and funding structure will need to be highly flexible due to the unpredictable nature of broodstock availability and potential for unforeseen conflicts to arise.

A prioritized mix of projects and objectives that draw from a pool of funds would likely provide the greatest benefit to all fishery participants.

#### Evaluation

With any project, evaluation is critical to understanding the true costs and benefits. Not discussed below is the potential need to conduct straying studies and size, time and method of imprinting and releasing fish.

### Ninilchik River Chinook Salmon Brood Stock/Stocking Increase Discussion

To maximize smolt production from the Ninilchik stock would require monitoring the entire run of Ninilchik River Chinook salmon and operating the weir from mid-May to early August, which would cost approximately $25K (Table 1). Currently the weir is operating to index escapement and collect broodstock from July 3–31. However, in recent years it has been necessary to extend weir operations into August, the end of the Chinook salmon run, as the July only portion of the run could not support both escapement and broodstock needs. Collecting broodstock from earlier in the run was not practical due to the high mortality associated with long-term holding of Chinook salmon while their gametes ripened.

Realistically, the stock cannot support an increased egg-take goal during years when run sizes are low without sacrificing escapement (Table 2). From 2008–2012 escapements were slightly above or below the sustainable escapement goal and egg-take goals were not reached in 2008 and 2012 (Table 2).

An increased egg-take goal is achievable when run sizes are larger or escapement goals are adjusted; however, it needs to be noted that increased stocking to the Ninilchik River contradicts

the decision that lead to reducing the number of smolt stocked from ~180,000 to ~50,000 beginning in 1995. The Division of Sport Fish made this decision based on the following concerns: 1) the possibility of an unsustainable harvest of wild Chinook salmon from the Ninilchik River; 2) hatchery-reared and wild smolt interaction may be detrimental to the wild population; 3) straying of hatchery fish; and 4) genetic impacts to the wild population.

If stocking levels were increased, culling excess hatchery Chinook salmon at the current weir site may not allow adequate control of hatchery produced fish leading to impacts on the naturally spawning population. The current weir site is located ~4 miles upstream of the mouth and ~2 miles upstream of the area closed to salmon fishing. The division has estimated approximately 35% of the total escapement spawns downstream of the current weir. To census the total escapement and effectively cull hatchery Chinook salmon, an additional weir would need to be installed approximately 2 miles from the mouth and operated throughout the entire run.

Straying rates to nearby streams were not adequately assessed during the high stocking years (1988–1994) because only 9% to 31% of the hatchery fish were code wire tagged. However, escapement sampling in Deep Creek from 1996 to 2004 did detect Ninilchik River strays (n=169). In 1996, 14% of the Chinook salmon examined for missing adipose fins originated from the Ninilchik River (King and Breakfield 1998). From 1997 to 2000, 2% to 4% of the Chinook salmon examined were Ninilchik River strays (King and Breakfield 1999, 2002; Begich 2002; Begich and Evans, 2005). In 2004, during beach seine sampling for coho salmon in Deep Creek from July 27 to September 13, Chinook salmon were also captured and examined for missing adipose fins. Of the 68 Chinook salmon examined, 15 originated from the Ninilchik River.

If a decision is made to increase Ninilchik River stocking, a primary goal should be to develop a weir site that can be used to monitor the total escapement of wild Chinook salmon while effectively culling surplus hatchery fish from the escapement. The new weir site should be operated in conjunction with the existing upstream weir to compare total escapement with escapement index counts. It is also recommended that the straying rate be determined for nearby streams to insure the integrity of those systems.

Appendix Table 1. Cost of operating Ninilchik river weir 1.5 more months.

| Line 100 - Personnel | Amount |
|---|---|
| FWT II-PCN 11-4497 (1.5 mm) | $9,260 |
| FWT II-PCN 11-NEW(1.5 mm) | $9,261 |
| Total | $18,520 |
| Line 300-Contractual | |
| First Aid CPR for new PCN | $100 |
| Vehicle (fuel, operating, service) | $1,000 |
| Freight | $200 |
| Propane | $200 |
| Equipment (minor repairs and maintenance) | $200 |
| Porta potty rental | $500 |
| Total | $2,200 |
| Line 400 Commodities | |
| Groceries and household supplies | $1,500 |
| Clothing (e.g. waders) | $500 |
| Non-Food | $200 |
| Weir materials (contingency and operating cost) | $1,500 |
| 4-Wheeler gas and maintenance | $200 |
| Other repair and maintenance | $200 |
| Generator fuel | $500 |
| Generator oil | $200 |
| Total | $4,800 |
| Grand Total | $25,520 |

Appendix Table 2. Number and escapement of wild and hatchery-reared Chinook salmon counted at the Ninilchik river weir during SEG index monitoring period, 1999–2012.

| | Wild Chinook salmon | | | | Hatchery Chinook salmon | | | |
|---|---|---|---|---|---|---|---|---|
| | | SEG period [a] | | | | SEG period [a] | | |
| Year | Total Run | Weir counts [b] | Escapement counts [c] | Escapement percentage of run | Total run | Weir counts [b] | Escapement counts [c] | Escapement percentage of run |
| 1999 | 1,576 | 1,351 | 1,283 | 81 | 573 | 515 | 447 | 78 |
| 2000 | 1,553 | 1,346 | 1,265 | 81 | 685 | 786 | 618 | 90 |
| 2001 | 1,239 | 1,072 | 897 | 72 | 543 | 601 | 471 | 87 |
| 2002 | 1,340 | 1,073 | 897 | 67 | 395 | 403 | 238 | 60 |
| 2003 | 1,127 | 648 | 517 | 46 | 336 | 293 | 204 | 61 |
| 2004 | 1,393 | 811 | 679 | 49 | 469 | 409 | 342 | 73 |
| 2005 | 2,076 | 1,424 | 1,259 | 61 | 409 | 339 | 286 | 70 |
| 2006 | ND | 1,114 | 1,013 | - | ND | 260 | 191 | - |
| 2007 | ND | 672 | 543 | - | ND | 83 | 63 | - |
| 2008 | ND | 721 | 586 | - | ND | 83 | 62 | - |
| 2009 | ND | 551 | 528 | - | ND | 97 | 69 | - |
| 2010 [d] | ND | 605 | 605 | - | ND | 34 | 34 | - |
| 2011 | ND | 759 | 668 | - | ND | 51 | 25 | - |
| 2012 | ND | 573 | 555 | - | ND | 76 | 0 | - |
| Averages | | | | | | | | |
| 1999–2005 | 1,472 | 1,104 | 971 | 65 | 487 | 478 | 372 | 74 |
| 2006–2012 | | 714 | 643 | | | 98 | 63 | |

*Source*: Booz and Kerkvliet *In prep*.
*Note*: ND=no data, "-"= value cannot be calculated due to limitations of the data.
*Note*: SEG=Sustainable Escapement Goal. The current SEG was established in 2007. The current SEG is 550-1,300 wild Chinook salmon based on escapement counts from 3-31 July (Otis and Szarzi 2007).
[a] SEG period is Chinook salmon counts from 3-31 July.
[b] Weir Counts are the number of Chinook salmon that arrive to the weir during the SEG period.
[c] Escapement counts are [weir counts - (sacrificed for egg take/CWT recovered].
[d] No egg takes were conducted in 2012; egg take goals were not met in 2008 and 2012.

# Crooked Creek Chinook Salmon Broodstock/Stocking Increase Discussion

## Task

Evaluate issues/resources needed to double Crooked Creek naturally produced Chinook salmon egg-take goals to produce 210,000 Chinook salmon smolt to be released back into Crooked Creek.

## History/Background Information

Prior to 2005 Chinook salmon at Crooked Creek were manually sampled and sorted for broodstock in the existing tail race of the facility. The tail race was large enough to accommodate migrating Chinook salmon on a daily basis, regardless of what time the fish moved into the facility (i.e., midday to early morning). A gate was closed to the upstream passage pond/raceway such that fish became trapped in the tail race. Personnel sampled, passed upstream or collected broodstock the following day. Fish deemed acceptable for broodstock were passed into an adjacent holding pond. Handling fish increased mortality rates, not only in broodstock collection but as well as in fish being passed upstream. Personnel did not work on weekends.

Since 2005 to present day, an underwater camera and fish passage chute equipped with a digital video system (DVR) was installed into the fish passage pond/raceway. This pass thru system greatly reduces fish handling, work load and staff needs because only fish held for sampling or for broodstock are handled. This pass thru system significantly reduced handling mortality. In addition the DVR system was allowed to operate continuously to pass Chinook salmon thru the facility each day, including weekends when fish were not sampled or collected for broodstock.

A structural failure to one of the holding ponds/raceways in 2008 raised safety concerns about the disrepair of the tail race. An engineering report completed in 2009 identified the tail race as a life safety hazard. Personnel are presently prohibited from working within this section of the facility.

To overcome facility disrepair and complete project objectives a separate sampling/trapping structure was fabricated. This structure was placed in the broodstock holding pond/raceway. This has resulted in a significant net loss of about 75% in the total amount of area Chinook salmon can be trapped, sampled and sorted. Since this new sampling/trapping structure is located within the broodstock pond/raceway the total amount of area Chinook salmon can be held for broodstock is significantly reduced by approximately 30%.

Previous (pre-1999) smolt releases were directly into Crooked Creek without imprinting. Since 2000 smolt are held in one holding pond/raceway while the DVR pass thru system is operated in the other pond/raceway for adults and resident fish.

## Challenges

Approximately 50% of the area previously available to trap, sample, sort and hold broodstock is no longer available because of facility disrepair. With a smaller area there are environmental concerns (dissolved oxygen and water temp) which may lead to increased mortality rates.

Fish returning to the weir during the early part of the run are typically *green* and do not hold well as broodstock and die before maturity as compared to later in the run when fish are more likely to be *ripe*. Therefore only ripe fish are held because we do not have the capacity to hold green fish to maturity. During the first week of July or later is when we typically begin to hold 100% ripe broodstock ready to spawn.

Fish movement into the facility generally occurs through the evening and into early morning hours. Without an automated pass thru DVR system fish passage, run-time migration will be delayed because the small trap area will necessitate that it be closed each night to prevent over-filling/crowding of Chinook salmon. The fish could be trapped in the tail race but the life safety issue with the falling wall would need to be addressed if we require personnel to work in the tail raceway.

For us to collect additional broodstock and cull surplus hatchery fish, operations at Crooked Creek would be changed substantially.

- The DVR system would be discontinued
- Fish handling and handling mortality would increase because 100% of the run would be trapped, netted, sorted for passage, broodstock, culling and sampling.
- Staffing increase would mean additional technicians would be needed to work evenings and weekends to collect, sort, cull and sample adult Chinook salmon.
- Overtime by existing staff would also need funding.
- Funding will need to be put aside for Department of Transportation costs (truck, fuel and maintenance), cellular phones, personal protective equipment and miscellaneous equipment and supplies. Freezers and totes would also need to be purchased to accommodate culling of hatchery-produced fish. Oxygen tanks would need to be rented as a fail safe to use with existing aerating equipment.

Increasing the number of smolt released will also be challenging. We currently hold smolt one week or longer and to the best of our knowledge are at capacity. Imprinting additional numbers of smolt or holding 50% more means higher densities, higher biomass. We are uncertain if we can do this because of capacity. New gates, damming boards and smolt panels will need to be constructed accruing additional costs. Aerating equipment and oxygen systems should also be purchased in the event there are environmental problems (i.e., water flow into the facility).

Egg-take procedures and personnel costs for egg takes should remain similar for Soldotna staff although repeated or several egg-take events are likely to occur (i.e., 3 egg takes instead of 1). Otolith collection of naturally produced fish is slated to be discontinued after 2013 alleviating an extra task. CWT tag recoveries will continue to be collected until 2015 when returning hatchery-produced fish should not be tagged. CWT recoveries of culled surplus hatchery-produced fish will require funding for shipment to the tag lab and will be an additional task at Crooked Creek.

## Budget Increase

**Base Project Total: $108,400 (includes 9 mos. of FB I (64.1k)**

| PCN | Title | (range) | Step | MO | MH | OT | HAZ | GR | SW | SB | Salary |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11-4125 | FB I | 14 | F/G | | | 110 | | | | | $5,829 |
| 11-4149 | FWT II | 9 | C/C | | | 30 | | | | | $1,007 |
| 11-4214 | FWT II | 9 | A/A | | | 30 | | | | | $950 |
| NEW | FWT II | 9 | A/A | 1.5 | 2.0 | 20 | | | 150 | | $8,889 |
| NEW | FWT II | 9 | A/A | 1.5 | 2.0 | 20 | | | 150 | | $8,889 |
| NEW | FWT II | 9 | A/A | 1.5 | 2.0 | 20 | | | 150 | | $8,889 |
| | | | | | | | | | | Total: | $34,453 |

*Note*: Salary calculations are based on the FY14 RQ Salary Calculator in TAZ.

| Account Code | Description | Comments | Amount |
|---|---|---|---|
| 73226 | Freight | CWT shipping | $750 |
| 73404 | Cellular phones | Telecommunications (cellular phones) | $200 |
| 73421 | SEF Fuel A87 | DOT vehicle expenses | $1,200 |
| 73424 | SEF SVC/PRT A87 Maintenance | DOT maintenance | $500 |
| 73428 | SEF F/C A87 | DOT lease accrual | $1,000 |
| 74482 | Clothing and protective gear | Waders/boots/rain jackets/gloves | $2,200 |
| 74525 | Non lab supplies | Freezer/totes/aerating system/sunshade | $3,500 |
| 74691 | Building materials | Aluminum gates/smolt screens/dam boards | $1,200 |
| 74753 | Bottled gas | Bottled oxygen/bottle rentals | $4,000 |
| | | Total | $14,550 |

**Additional staff and overtime as well as estimated equipment needs increase costs as follows:** Estimated Project Increase Total: $49,003 (no contingency).

## Management Recommendations

In order to achieve the sustainable escapement goal of 650 to 1,700 naturally produced Chinook salmon, and to achieve the increased collection of naturally produced broodstock spawning pairs as well as hatchery-produced spawning pairs for egg-take increases, changes to current regulations will be needed. Standard regulations include the use of bait and multiple hooks starting May 16 through the course of the early run. Standard regulations provide opportunity to harvest naturally produced Chinook salmon on only Tuesdays, Thursdays, and Saturdays. The daily bag limit during these days is one naturally produced Chinook salmon per day. The daily bag limit of hatchery-produced Chinook salmon throughout the season is two fish per day.

Harvest of Chinook salmon has averaged 1,726 fish from 2008 to 2011. The average number of naturally produced to hatchery-produced Chinook salmon as measured in the Kasilof River creel survey from 2008 to 2010 was 333. Savings of naturally produced Chinook salmon to the weir would be approximately 560 fish (Table 3). Escapements have been at or below the lower end of the goal of 650 fish, 3 of the last 4 years. To achieve the escapement goal and to increase the egg takes from mature/spawning Chinook salmon, we recommend eliminating harvest opportunity of naturally produced Chinook salmon for 2013. A reduction in the standard daily bag limit of hatchery-produced Chinook salmon from two a day to one a day is also recommended. This would increase the likelihood of doubling the run of Chinook salmon to the

Crooked Creek facility in 2013 and avoid a scenario similar to 2012 when no naturally produced Chinook salmon were obtained for egg takes, and only a few hatchery-produced Chinook salmon were available due to a low run to the weir of each type (633 naturally produced fish and 163 hatchery produced fish). These escapements occurred in a year when the sport fishery was restricted to achieve escapement.

Appendix Table 3. Historical summary of early-run Kasilof River/Crooked Creek Chinook salmon stocks, 1996–2012.

| | Harvest[a] | | | Run to Weir[b] | | | Total Run | | | Spawning Escapement[b] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Total | Naturally Produced | Hatchery-Produced | Total | Naturally Produced | Hatchery-Produced | Total | Naturally Produced | Hatchery-Produced | Total | Naturally Produced | Hatchery-Produced |
| 1996 | 5,295 | ND | ND | 2,224 | ND | ND | 7,519 | ND | ND | 764 | ND | ND |
| 1997[c] | 5,627 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1998[c] | 4,202 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1999 | 7,597 | ND | ND | 1,791 | 1,559 | 232 | 9,388 | ND | ND | 1,397 | ND | ND |
| 2000 | 8,815 | ND | ND | 1,416 | 1,224 | 192 | 10,231 | ND | ND | 1,077 | ND | ND |
| 2001 | 7,488 | ND | ND | 2,586 | 2,122 | 464 | 10,074 | ND | ND | 2,315 | ND | ND |
| 2002[d] | 4,791 | ND | ND | 3,326 | 2,526 | 800 | 8,117 | 2,526 | 800 | 2,708 | ND | ND |
| 2003[d] | 3,090 | 0 | 3,090 | 4,127 | 2,923 | 1,204 | 7,217 | 2,923 | 4,294 | 3,597 | ND | ND |
| 2004[d] | 2,407 | 0 | 2,407 | 4,873 | 2,641 | 2,232 | 7,280 | 2,641 | 4,639 | 4,356 | 2,196 | 2,160 |
| 2005[e] | 2,665 | 572 | 2,093 | 3,168 | 2,108 | 1,060 | 5,833 | 2,680 | 3,153 | 2,936 | 1,909 | 1,027 |
| 2006[e] | 2,489 | 1,057 | 1,432 | 2,646 | 1,589 | 1,057 | 5,135 | 2,646 | 2,489 | 2,569 | 1,516 | 1,053 |
| 2007[e] | 2,654 | 1,107 | 1,547 | 1,527 | 1,038 | 489 | 4,181 | 2,145 | 2,036 | 1,452 | 965 | 487 |
| 2008[e] | 1,984 | 832 | 1,129 | 1,414 | 1,018 | 396 | 3,398 | 1,850 | 1,525 | 1,181 | 879 | 302 |
| 2009[e] | 1,532 | 576 | 956 | 929 | 674 | 255 | 2,461 | 1,250 | 1,211 | 734 | 617 | 117 |
| 2010[e,f] | 1,333 | 273 | 1,060 | 1,352 | 1,090 | 262 | 2,685 | 1,363 | 1,322 | 1,348 | 1,088 | 260 |
| 2011[e,g] | 2,054 | ND | ND | 933 | 677 | 256 | 2,987 | ND | ND | 782 | 654 | 128 |
| 2012[h] | *NA* | ND | ND | 796 | 633 | 163 | *NA* | ND | ND | 731 | 631 | 100 |
| Mean (2008–2012) | 1,726 | 560 | 1,048 | 1,085 | 818 | 266 | 2,883 | 1,488 | 1,353 | 955 | 774 | 181 |

*Source:* Cope 2011, 2012; Howe et al. 2001a-d, Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b; G. B. Jennings, Sport Fish Program Coordinator, ADF&G, Anchorage, personal communication.

*Note:* ND = no data collected.

[a] 1996–2003 data from Statewide Harvest Survey; 2004–2010 data from inseason creel survey. Data does not include harvest from Kasilof River personal use fishery. 2011 data will not be available until Fall 2012 SWHS estimates are completed.

[b] Excludes age-0.1 fish 1999–2012; Return includes broodstock, facility mortalities, and escapement.

[c] Weir not operational.

[d] Retention of naturally produced Chinook salmon prohibited by EO for part of the 2002 season. The hatchery contribution to the harvest was not estimated for 2002 due to nonrepresentative sampling and an unmarked fraction of fish, and for 2003 because the creel sampling design did not allow for harvest estimates to be generated. Prior to 2004, hatchery returns were not marked at a rate of 100%.

[e] Retention of naturally produced Chinook salmon limited to Tuesdays and Saturdays in 2005, then changed by EO in 2006–2007 to include Thursdays; in 2008 regulations were changed to allow retention of naturally produced Chinook salmon on Tuesdays, Thursdays, and Saturdays only, with a limit of 2 Chinook salmon per day of which only one may be naturally produced ~ annual limits apply.

[f] Retention of naturally produced Chinook salmon prohibited by EO from 6/5/10–6/17/10.

[g] Creel survey discontinued in 2011.

[h] Retention of naturally produced Chinook salmon prohibited by EO from 6/15/12–6/30/12. Bait and multiple hooks prohibited by EO from 6/22/12 to 6/30/12.

# Eklutna Tail Race (Terminal Harvest Site) Stocking Increase Discussion (Chinook and coho salmon)

***Existing fishery:*** The existing sport fishery has averaged about 16,000 angler days in the last 10 years split between fishing for Chinook and coho salmon. The average catch and harvest of Chinook salmon over this period was 950 and 500, respectively. Catch and harvest for coho salmon was 5,700 and 4,300, respectively. The fishery is prosecuted nearly entirely from the shore. A recently upgraded parking area complete with dumpsters and latrines is the primary access site for bank anglers. The fishery is prosecuted almost completely from shore.

***Existing release:***

Chinook salmon: During the last 5 years ADF&G has released an average of 125,000 10 g Chinook salmon smolt with a presumed smolt to adult survival of 1%. The bulk of these fish are harvested within the fresh water fishery. Assuming a low survival rate, tripling the number released would afford the best potential for achieving the existing return goal of 4,000 Chinook salmon. This terminal Chinook salmon fishery poses little threat to wild stock fish as the nearest wild stocks are a considerable distance away and located in different watersheds.

Coho salmon: During the last 5 years ADF&G has released an average of 90,000 20 g coho salmon smolt with a presumed smolt to adult survival of 4%. The bulk of these fish are harvested within the fresh water fishery and it appears that this fishery has the capacity to support double the current harvest level and an increase in angler days of effort without compromising the local wild stocks that are proximate to this location.

***Broodstock:***

Chinook salmon: We have taken an average of 1.1 million Chinook salmon eggs over the last 5 years with a permitted capacity of 2.15 million from Ship Creek. If broodstock were available we could take and rear an additional 335,000 Chinook salmon eggs for the Eklutna project. With these additional eggs the Eklutna release could be increased from 150,000 to about 400,000 annually. Potential additional angler opportunity could be an additional 4,000 angler days and harvest of 3,500 fish annually with a program that persists for the next 5 years. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

Coho: We have taken an average of 1.1 million coho salmon eggs over the last 5 years with a permitted capacity to take 11.5 million. If broodstock were available we could take and rear an additional 267,000 coho salmon eggs specifically for the Eklutna project to accomplish a release of about 200,000 annually. Potential additional angler opportunity could be an additional 4,000 angler days and harvest of 3,500 fish annually with a program that persists for the next 5 years. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:***

Chinook salmon: Currently we spend approximately $100,000 on the Chinook salmon program, which is all related to hatchery brood collection and rearing expenses. An additional $250,000 in hatchery expenses plus $14,000 for costs associated with imprinting Chinook salmon smolt at the

Tailrace (added to Palmer Area office egg-take budget) would be needed to accommodate increased releases at this site. Total annual costs would be $265,000 to allow for this increase in opportunity.

Coho: Currently we spend approximately $100,000 on this coho salmon program, which is all related to hatchery brood collection and rearing expenses. An additional $50,000 in hatchery expenses would be needed to accommodate increased releases at this site. Total annual costs would be $100,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez or Eklutna Hatchery if the latter was upgraded via capital investment to get the hatchery back in operation.

## Willow\Deception Creek Stocking Increase Discussion (Chinook salmon)

***Existing fishery:*** The existing sport fishery has averaged about 22,000 angler days in the last 10 years. The average catch and harvest of Chinook salmon over this period was 7,500 and 2,000, respectively. Approximately 40% of the annual harvest is hatchery fish. The fishery is prosecuted nearly entirely from shore. A large parking area maintained by DNR Parks and complete with dumpsters and latrines is the primary access site for bank anglers. This access is designed for high volume day use and camping.

***Existing release:*** During the last 5 years we have released 134,000 11g Chinook salmon smolt with a presumed smolt to adult survival of 1%. The bulk of these fish are harvested within the fresh water fishery. Assuming a low survival rate, tripling the number released would afford the best potential for achieving the existing return goal of 4,000 Chinook salmon without compromising the local wild stocks that are proximate to this location.

***Broodstock:*** We have taken an average of 346,000 Chinook salmon eggs over the last 5 years with a permitted capacity to take 1,570,000 from Deception Creek. If broodstock were available we could take and rear an additional 335,000 Chinook salmon eggs for the Deception Creek release and increase that release to about 400,000 annually. Potential additional angler opportunity could be an additional 4,000 angler days and harvest of 3,500 fish annually with a program that persists for the next 5 years. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** Currently we spend approximately $100,000 on the Chinook salmon program related to hatchery rearing expenses plus $12,500 to operate a brood collection weir on Deception Creek. An additional $250,000 in hatchery expenses plus an additional $18,500 for increased cost of operating the brood collection weir would be needed to accommodate increased releases at this site. Total annual costs would be $268,500 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Potential for New Stocking Projects

Several new stocking locations have been considered: Goose Creek, Sheep Creek, Montana Creek, King River, Little Susitna River, Fox River, Stiriski Creek, Resurrection River, Kenai River, and Deep Creek. Most if not all of these locations would present regulatory and logistical challenges due to the presence of wild Chinook salmon stocks. This would also increase the number of individual stocks being reared beyond the isolation capacity of the WJHSFH. To support production and release of additional Chinook salmon stocks and greater numbers of fish, the Eklutna Hatchery (owned by CIAA) or the Fort Richardson Hatchery would need to be returned to full operational capacity, upgraded to provide temperature control and additional staff would be required to care for the fish and new weirs and field crews would need to be mobilized to collect eggs and segregate returning adults. To complete structural improvements etc. would take at 1 full year and the ability to enact a fast track construction contract. It is estimated that cost for this capital work could range between $1 and $3 million depending on long term expectations for these programs. (CIAA has completed some preliminary engineering for the Eklutna Hatchery.)

# Detailed Project Narrative

### Little Susitna River Discussion

***Existing fishery:*** The existing sport fishery has averaged about 30,000 angler days in the last 10 years, about half of which is associated with Chinook salmon fishing. The average catch and harvest of Chinook salmon over this period was 4,500 and 2,300, respectively. No hatchery fish currently return to this system. Boat and bank angling is accommodated by two major access sites, one of which is the Little Susitna Public Use Facility. The facility, owned by the department and operated by DNR Parks, is the primary access site and is designed for high volume day use and camping and includes a concrete hardened boat launch.

***Existing release:*** None. Chinook salmon have never been stocked into the Little Susitna River.

***Broodstock:*** Initially, broodstock would be collected at the weir currently being operated on the lower river for Chinook and coho salmon. Later, brood would be collected via weir operated on a tributary of the upper Little Susitna River, such as Government Creek or Nancy Lake Creek. If broodstock were available we could take and rear 400,000 Chinook salmon eggs to accomplish a release of about 300,000 smolt annually. Potential additional angler opportunity could be an additional 10,000 angler days and presuming a smolt to adult survival of 1%, harvest could increase by 3,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** A small broodstock weir would cost about $10,000 to build and $30,000 to operate ($40,000 first year, $30,000 subsequent years) during the month of July and early August annually (cost based off projected expenses of a similar program at Deception Creek). Hatchery expenses would approximate $300,000 for this program. Total annual costs would be ~$330,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Montana Creek Discussion

***Existing fishery:*** The existing sport fishery has averaged about 17,000 angler days in the last 10 years, about two thirds of which is associated with Chinook salmon fishing. The average catch and harvest of Chinook salmon over this period was 3,700 and 1,100, respectively. No hatchery fish currently return to this system. A large parking area maintained by DNR Parks and complete with dumpsters and latrines is the primary access site for bank anglers. This access is designed for high volume day use and camping.

***Existing release:*** None. Chinook salmon have never been stocked into Montana Creek.

***Broodstock:*** Broodstock would be collected initially (2013 and 2014) via weir planned to be operated on the lower mainstem as part of a separate project funded by the Alaska Energy Authority to assess Chinook and coho salmon abundance on the Susitna River. Smolt could potentially be stocked into Sawyer Creek, a small tributary to lower Montana Creek where Chinook salmon likely do not currently exist. Subsequent years' brood, beginning in 2016 could be collected via weir within Sawyer Creek. If broodstock were available we could take and rear 400,000 Chinook salmon eggs to accomplish a release of about 300,000 annually. Potential additional angler opportunity could be an additional 10,000 angler days and presuming a smolt to adult survival of 1%, harvest could increase by 3,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** A broodstock weir would cost about $10,000 to build and $30,000 to operate ($40,000 first year, $30,000 subsequent years) during the month of July and early August annually (cost based off projected expenses of a similar program at Deception Creek). Hatchery expenses would approximate $300,000 for this program. Total annual costs would be $330,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Sunshine Creek Discussion

***Existing fishery:*** The existing sport fishery has averaged about 3,000 angler days in the last 10 years, about half of which is associated with Chinook salmon fishing. The average catch and harvest of Chinook salmon over this period was 210 and 120, respectively. No Chinook salmon are known to spawn in this system. Presently, Chinook salmon caught near the mouth area are destined for upstream fisheries. No hatchery fish currently return to this system. A small parking area owned by the Borough is the only access to this site. All fishing is from the bank along a small section of the stream.

***Existing release:*** None. Chinook salmon have never been stocked into Sunshine Creek.

***Broodstock:*** If broodstock were available we could take and rear 70,000 Chinook salmon eggs to accomplish a release of about 50,000 annually. Potential additional angler opportunity could be an additional 1,500 angler days and presuming a smolt to adult survival of 1%, harvest could increase by 500 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would

occur in July 2013 on an adjacent system such as Montana Creek with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** Likely no weir would be needed if brood could be collected from an adjacent system the first year and from upper tributaries to Sunshine Creek in subsequent years. Brood could not come from adjacent systems with established escapement goals, if those goals are not being made. Cost for Palmer staff time and gear for brood collection would approximate $15,000. Hatchery expenses would approximate $50,000 for this program. Total annual costs would be $65,000 to allow for this increase in opportunity.

***Rearing location****:* William Jack Hernandez Hatchery or Eklutna Hatchery.

## Caswell Creek Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 1,900 angler days in the last 10 years, about half of which is associated with Chinook salmon fishing. The average catch and harvest of Chinook salmon over this period was 500 and 100, respectively. No Chinook salmon are known to spawn in this system. Presently, Chinook salmon caught near the mouth area are destined for upstream fisheries. No hatchery fish currently return to this system. Access is off the Parks Highway to a parking and campsite area maintained by the department. Amenities include campsites, vault latrine, and trail access to the creek. All fishing is from the bank along a small section of the stream.

***Existing release:*** None. Chinook salmon have never been stocked into Caswell Creek.

***Broodstock:*** If broodstock were available we could take and rear 70,000 Chinook salmon eggs to accomplish a release of about 50,000 annually. Potential additional angler opportunity could be an additional 1,500 angler days and presuming a smolt to adult survival of 1%, harvest could increase by 500 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 on an adjacent system such as Deception Creek with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** Likely no weir would be needed if brood could be collected from an adjacent system with an established stocking program such as Willow Creek. Brood could not come from adjacent systems with established escapement goals if those goals are not being achieved. Cost for Palmer staff time and gear for brood collection would be negligible if brood were collected from Deception Creek. Hatchery expenses would approximate $50,000 for this program. Total annual costs would be $50,000 to allow for this increase in opportunity.

***Rearing location****:* William Jack Hernandez Hatchery or Eklutna Hatchery.

## King River Discussion

***Existing Fishery:*** No fishery currently exists. An unknown, but likely small number of Chinook salmon are produced by this system which drains into the Matanuska. No hatchery fish currently return to this system. Access is off the Glenn Highway to a parking and campsite area which is owned by the Borough and not maintained. Fishing would be entirely shore based, likely near the mouth. This would be an experimental fishery in the sense that it is unknown whether fish would hold near the mouth long enough to be susceptible to the fishery; an unknown number

could easily escape the fishery to spawn upstream if fish did not stage in the Matanuska prior to ascending King River.

***Existing release:*** None. Chinook salmon have never been stocked into King River.

***Broodstock:*** If broodstock were available from Ship Creek we could take and rear 135,000 Chinook salmon eggs to accomplish a release of about 100,000 annually. Potential angler opportunity could be about 2,000 angler days and presuming a smolt to adult survival of 1%, harvest could increase by 1,000 fish annually with a program that persists for the next 5 years. The bulk of these fish would be harvested within the fresh water fishery. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** Likely no weir would be needed if brood could be collected from Ship Creek. Hatchery expenses would approximate $100,000 for this program. Total annual costs would be $100,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

# Coho Salmon Stocking Sites in Upper Cook Inlet

## Little Susitna River Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 30,000 angler days in the last 10 years, about half of which is associated with coho salmon fishing. The average catch and harvest of coho salmon over this period was 17,300 and 11,700, respectively. No hatchery fish currently return to this system. Boat and bank angling is accommodated by two major access sites, one of which is the Little Susitna Public Use Facility. The facility, owned by the department and operated by State Parks, is the primary access site and is designed for high volume day use and camping and includes a concrete hardened boat launch.

***Existing release:*** None. Coho salmon have been stocked into the Little Susitna River in the past. Smolt were initially (1985) released into Nancy Lake which drains by Nancy Lake Creek into the Little Susitna. This project would require beaver dam removal and annual pike suppression in Nancy Lake if Nancy Lake and its tributaries (Lilly Creek) were to be used for releases or brood collection as was done in the past. Wild stock coho salmon exist in the Little Susitna; however, none were thought to return to Lilly Creek prior to past stocking efforts.

***Broodstock:*** Broodstock would be collected via a tributary of the Little Susitna River, such as Nancy Lake Creek or Lilly Creek. If broodstock were available we could take and rear 200,000 coho salmon eggs to accomplish a release of about 150,000 annually. Potential additional angler opportunity could be an additional 6,000 angler days and presuming a smolt to adult survival of 4%, harvest could increase by 6,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. An egg take would occur in September 2013 with smolt release occurring in June 2015. If smolts were released from this program in spring 2015 the first adult returns would be available to this fishery in 2016. Marking would be via otolith banding or CWT if required.

***Additional cost:*** Broodstock collection would cost about $15,000 to fund two people for one month in September. Hatchery expenses would approximate $150,000 for this program. Total annual costs would be $165,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Sunshine Creek Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 3,000 angler days in the last 10 years, about half of which is associated with coho salmon fishing. The average catch and harvest of coho salmon over this period was 3,500 and 2,100, respectively. No hatchery fish currently return to this system that does produce a relatively small return of coho salmon. The fishery is prosecuted nearly entirely from shore. Public can access this fishery off the Parks Highway at mile 102.5 with borough maintained access. There is a small gravel parking area with a foot trail to Sunshine Creek.

***Existing release:*** None. Coho salmon have never been stocked into Sunshine Creek. This project would require beaver dam removal.

***Broodstock:*** If broodstock were available we could take and rear 100,000 coho salmon eggs to accomplish a release of about 75,000 smolt annually. Potential additional angler opportunity could be an additional 1,500 angler days and presuming a smolt to adult survival of 4%, harvest could increase by 3,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. An egg take would occur in September 2013 with smolt release occurring in June 2015. If smolts were released from this program in spring 2015 the first adult returns would be available to this fishery in 2016. Marking would be via otolith banding or CWT if required.

***Additional cost:*** We would spend approximately $15,000 for the cost of brood collection plus $75,000 for hatchery rearing expenses. Total annual costs would be $90,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Willow Creek (coho salmon) Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 22,000 angler days in the last 10 years, about half of which associated with coho salmon fishing. The average catch and harvest of coho salmon over this period was 6,600 and 3,600, respectively. No hatchery fish currently return to this system that does produce a relatively small return of coho salmon. The fishery is prosecuted nearly entirely from shore. A large parking area maintained by State Parks and complete with dumpsters and latrines is the primary access site for bank anglers. This access is designed for high volume day use and camping.

***Existing release:*** None. Willow Creek has never been stocked with coho salmon.

***Broodstock:*** The weir currently used for the Chinook salmon program could be used to collect coho brood from the existing wild stock in Deception Creek. If broodstock were available we could take and rear 160,000 coho salmon eggs to accomplish a release of about 120,000 annually into Deception Creek. Presuming a smolt to adult survival of 4%, harvest could increase by 4,800 fish annually with a program that persists for the next 5 years. If smolts were released from this program in spring 2014 the first adult returns would be available to this fishery in 2016. An

egg take would occur in July 2013 with smolt release occurring in May 2014. Marking would be via otolith banding or CWT.

***Additional cost:*** A broodstock weir would cost about $30,000 to operate August through September. Hatchery expenses would approximate $120,000 for this program. Total annual costs would be $150,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Montana Creek Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 17,400 angler days in the last 10 years, about half of which is associated with coho salmon fishing. The average catch and harvest of coho salmon over this period was 5,500 and 3,200, respectively. No hatchery fish currently return to this system that does produce a return of coho salmon. The fishery is prosecuted nearly entirely from shore. Public can access this fishery off the Parks Highway at various campgrounds, including one state facility with dumpsters, latrines, and trails; and foot access off Yoder Road.

***Existing release:*** None. Coho salmon have never been stocked into Montana Creek

***Broodstock:*** Broodstock would be collected initially (2013 and 2014) via weir planned to be operated on the lower mainstem as part of a separate project funded by the Alaska Energy Authority to assess Chinook and coho salmon abundance on the Susitna River. Smolt could potentially be stocked into Sawyer Creek, a small tributary to lower Montana Creek. Wild stock coho likely utilize Sawyer Creek for spawning. Subsequent years' brood, beginning in 2016 could be collected via weir within Sawyer Creek. If broodstock were available we could take and rear 150,000 coho eggs to accomplish a release of about 120,000 annually. Potential additional angler opportunity could be an additional 4,000 angler days and presuming a smolt to adult survival of 4%, harvest could increase by 4,800 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. An egg take would occur in September 2013 with smolt release occurring in June 2015. If smolts were released from this program in spring 2015 the first adult returns would be available to this fishery in 2016. Marking would be via otolith banding or CWT if required.

***Additional cost:*** A broodstock weir would cost about $10,000 to build and $30,000 to operate ($40,000 first year, $30,000 subsequent years) August through September. Hatchery expenses would approximate $120,000 for this program. Total annual costs would be $150,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.

## Caswell Creek Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 1,900 angler days in the last 10 years. The average catch and harvest of coho salmon over this period was 900 and 530, respectively. No hatchery fish currently return to this system that does produce a relatively small return of coho salmon. The fishery is prosecuted nearly entirely from shore. Public can access this fishery off the Parks Highway at mile 84.9 via state maintained facility complete with temporary latrines and parking.

***Existing release:*** None. Coho salmon have not been stocked into Caswell Creek.

***Broodstock:*** Broodstock would be collected from Caswell Creek. If broodstock were available we could take and rear 135,000 coho salmon eggs to accomplish a release of about 100,000 smolt annually. Potential additional angler opportunity could be an additional 1,500 angler days and presuming a smolt to adult survival of 4%, harvest could increase by 4,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. An egg take would occur in September 2013 with smolt release occurring in June 2015. If smolts were released from this program in spring 2015 the first adult returns would be available to this fishery in 2016. Marking would be via otolith banding or CWT if required.

***Additional cost:*** We would spend approximately $100,000 on the coho salmon program related to hatchery rearing expenses plus $15 for brood collection. Total additional costs would be $115,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery

## Cottonwood Creek Discussion

***Existing Fishery:*** The existing sport fishery has averaged about 2,500 angler days in the last 10 years. The average catch and harvest of coho salmon over this period was 1,000 and 700, respectively. No hatchery fish currently return to this system that does produce a relatively small return of coho salmon. The fishery is prosecuted nearly entirely from shore, canoe, and with limited off-road vehicle access. Public can access this fishery off the Hayfield Road at the southwest end of Fairview Loop Road.

***Existing release:*** None. Coho salmon have been stocked in the past (1977–1991) with broodstock coming primarily from Big Lake (Fish Creek system) and secondarily from Cottonwood Lake.

***Broodstock:*** Broodstock would be collected from Cottonwood Lake. If broodstock were available we could take and rear 135,000 coho salmon eggs to accomplish a release of about 100,000 smolt annually. Potential additional angler opportunity could be an additional 1,500 angler days and presuming a smolt to adult survival of 4%, harvest could increase by 4,000 fish annually with a program that persists for the next 5 years. The bulk of these fish are harvested within the fresh water fishery. An egg take would occur in September 2013 with smolt release occurring in June 2015. If smolts were released from this program in spring 2015 the first adult returns would be available to this fishery in 2016. Marking would be via otolith banding or CWT if required.

***Additional cost:*** We would spend approximately $15,000 for the cost of brood collection plus $100,000 for hatchery rearing expenses. Total annual costs would be $115,000 to allow for this increase in opportunity.

***Rearing location:*** William Jack Hernandez Hatchery or Eklutna Hatchery.