Regional Information Report No. 5J15-02

An Evaluation of the Sawmill Creek Salmon Hatchery for Consistency with Statewide Policies and Prescribed Management Practices

by

Mark Stopha

August 2015

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

Symbols and Abbreviations

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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, χ^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

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AN EVALUATION OF THE SAWMILL CREEK SALMON HATCHERY FOR CONSISTENCY WITH STATEWIDE POLICIES AND PRESCRIBED MANAGEMENT PRACTICES

by
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The Regional Information Report Series was established in 1987 and was redefined in 2006 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at http://www.adfg.alaska.gov/sf/publications/

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ABSTRACT

The salmon hatchery program in Alaska is governed by policies, plans, and regulations that emphasize protection of wild salmon stocks. A rotational series of hatchery evaluations will examine each hatchery for consistency with those policies and prescribed management practices. The evaluation includes a review of hatchery management plans and permits, an assessment of each hatchery program's consistency with statewide policies, and recommendations to address any deficiencies found.

This report reviews the Sawmill Creek salmon hatchery (SCH) located in Sitka, Alaska. The hatchery was constructed in 2002–2003 by the Northern Southeast Regional Aquaculture Association, a regional private nonprofit aquaculture association. The hatchery serves as a satellite facility to Medvejie Creek Hatchery (MCH). Broodstock is collected at MCH and eggs transferred to SCH for incubation and hatching. Some fry are released at MCH for broodstock returns. Other releases are offsite.

SCH is permitted to produce coho salmon *Oncorhynchus kisutch* and chum salmon *O. keta* primarily for commercial harvest. Coho salmon releases are permitted from MCH and Deep Inlet. Chum salmon releases are permitted from Crawfish Inlet.

A portion of the coho salmon releases are marked with coded wire tags and adipose finclip. All salmon incubated at SCH are thermal otolith marked. Coho and chum salmon are sampled in the commercial fisheries to assess contribution. Three area streams are monitored for straying.

The basic management plan for the hatchery should be updated to reflect current hatchery operations. Language in the Phase III Southeast Alaska Comprehensive Salmon regarding hatchery operations in wilderness areas of the Tongass National Forest should be revisited by the Regional Planning Team for clarification to current federal law. Straying assessment methodology in Salmon Lake and Sawmill Creek should be reexamined to provide more meaningful data to achieve monitoring objectives.

Key words: Sawmill Creek salmon hatchery, hatchery evaluation, hatchery, coho salmon, chum salmon

INTRODUCTION

Alaska's constitution mandates that fish are harvested sustainably under Article 8, section 4: "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the state shall be utilized, developed and maintained on the sustained yield principle, subject to preferences among beneficial uses."

Due in part to historically low salmon harvests, Article 8, section 15 of Alaska's Constitution was amended by popular vote in 1972 to provide tools for restoring and maintaining the state's fishing economy: "No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State. This section does not restrict the power of the State to limit entry into any fishery for purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood and to promote the efficient development of aquaculture in the State." Alaska's salmon hatchery program was developed under this mandate and designed to supplement—not replace—sustainable natural production.

Alaska's modern salmon fisheries enhancement program began in 1971 when the Alaska Legislature established the Division of Fisheries Rehabilitation Enhancement and Development (FRED) within the Alaska Department of Fish and Game (ADF&G; FRED Division 1976). In 1974, the Alaska Legislature expanded the program, authorizing private nonprofit (PNP) corporations to operate salmon hatcheries: "It is the intent of this Act to authorize the private ownership of salmon hatcheries by qualified nonprofit corporations for the purpose of contributing, by artificial means, to the rehabilitation of the state's depleted and depressed salmon fishery. The program shall be operated without adversely affecting natural stocks of fish

in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks" (Alaska Legislature 1974).[1]

Salmon fishery restoration efforts came in response to statewide annual salmon harvests of just 22 million fish in 1973 and 1974, among the lowest catches since 1900 (Figure 1). The FRED Division and PNPs engaged in a variety of activities to increase salmon production. New hatcheries were built to raise salmon, fish ladders were constructed to provide adult salmon access to previously nonutilized spawning and rearing areas, lakes with waterfall outlets too high for adult salmon to ascend were stocked with salmon fry, log jams were removed in streams to enable returning adults to reach spawning areas, and nursery lakes were fertilized to increase the available feed for juvenile salmon (FRED 1975). A combination of favorable environmental conditions, limited fishing effort, abundance-based harvest management, habitat improvement and protection, and hatchery production gradually boosted salmon catches, with recent commercial salmon harvests (2004–2013) averaging 180 million fish.[2]

In Alaska, the purpose of salmon hatcheries is to supplement natural stock production for public benefit. Hatcheries are efficient in improving survival from the egg to fry or smolt stage. In natural production, estimates for pink salmon *Oncorhynchus gorbuscha* egg to fry survival in two Southeast Alaska creeks ranged from less than 1% to 22%, with average survivals from 4% to 9% (Groot and Margolis 1991). Under hatchery conditions, egg to fry survival is usually 90% or higher.

Alaska hatcheries do not grow fish to adulthood, but incubate fertilized eggs and release resulting progeny as juveniles. Juvenile salmon imprint on the release site and return to the release location as mature adults. Per state policy, hatcheries generally use stocks taken from close proximity to the hatchery so that any straying of hatchery returns will have similar genetic makeup as the stocks from nearby streams. Also per state policy, Alaska hatcheries do not selectively breed. Large numbers of broodstock are used for gamete collection to maintain genetic diversity, without regard to size or other characteristic. In this document, *wild* fish refer to fish that are the progeny of parents that naturally spawned in watersheds and intertidal areas. *Hatchery* fish are fish reared in a hatchery to a juvenile stage and released. *Farmed* fish are fish reared in captivity to market size for sale. Farming of finfish, including salmon, is not legal in Alaska (Alaska Statue 16.40.210).

Hatchery production is limited by freshwater capacity and freshwater rearing space. Soon after emergence, all pink and chum salmon *O. keta* fry can be transferred from fresh water to salt water. Most Chinook *O. tshawytscha*, sockeye *O. nerka*, and coho salmon *O. kisutch* must spend a year or more in fresh water before fry develop to the smolt stage and can tolerate salt water. These three species require a higher volume of fresh water, a holding area for freshwater rearing, and daily feeding. They also have a higher risk of disease mortality due to the extended rearing phase. There are economic tradeoffs between the costs of production versus the value of fish at harvest. Although Chinook, sockeye, and coho salmon garner higher prices per pound at harvest, chum and pink salmon are more economical to rear in the hatchery setting and generally provide a higher economic return.

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[1] Alaska Legislature 1974. An act authorizing the operation of private nonprofit salmon hatcheries. Section 1, Chapter 111, SLA 1974, in the Temporary and Special Acts.

[2] Data from http://www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisherySalmon.exvesselquery (accessed 08/12/14).

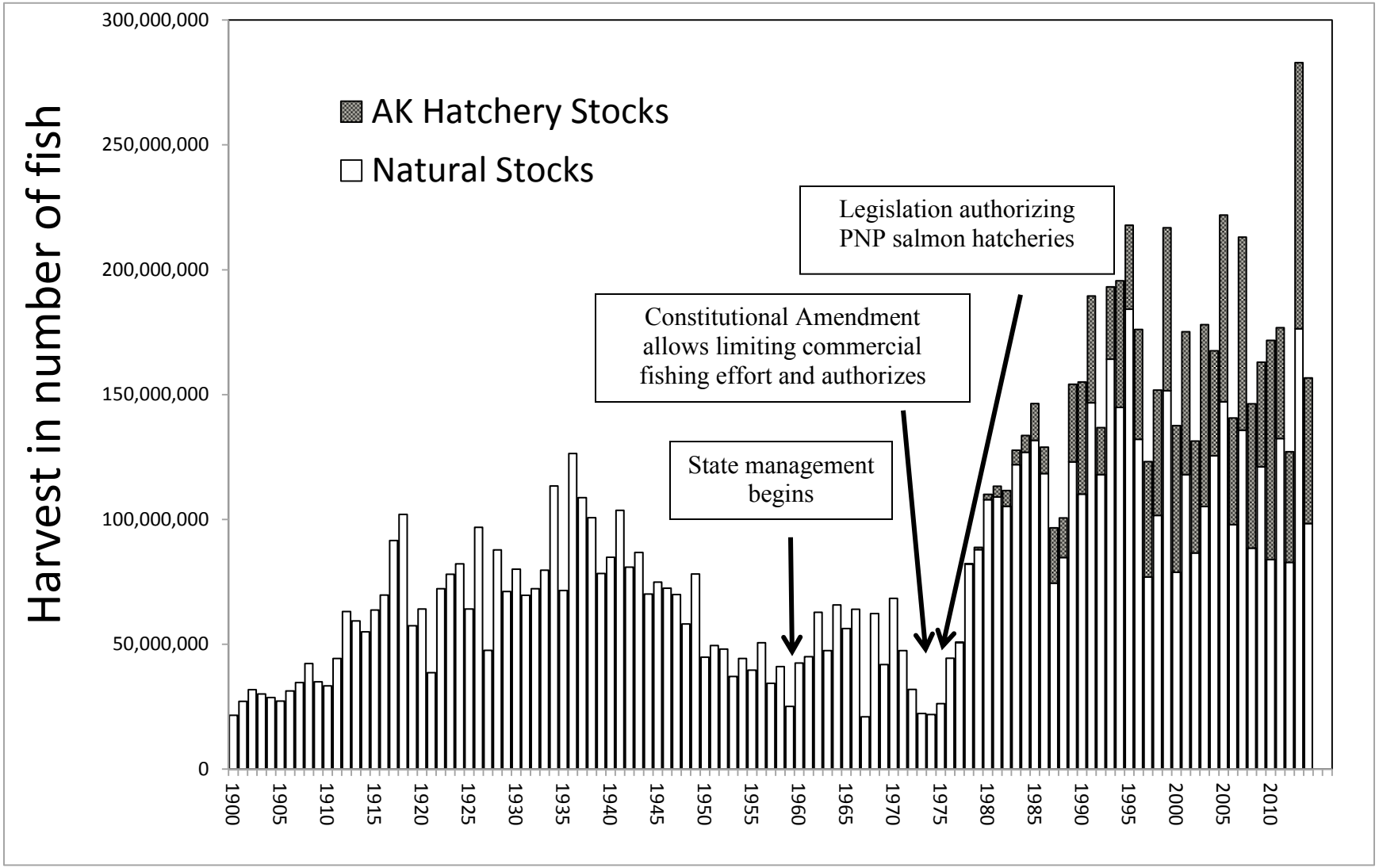

Figure 1.–Commercial salmon harvest in Alaska, 1900–2014.

Source: 1900–1976 from Byerly et al. (1999); 1977–2014 from Vercessi (2015).

Pink salmon have the shortest life cycle of Pacific salmon (two years), provide a quick return on investment, and provide the bulk of Alaska hatchery production. From 2004 to 2013, pink salmon accounted for an average 74% of Alaska hatchery salmon returns by number, followed by chum (20%), sockeye (4%), coho (2%) and Chinook salmon (<1%; White 2005–2011; Vercessi 2012–2014).

The salmon marketplace has changed substantially since the hatchery program began. As the first adult salmon were returning to newly built hatcheries in 1980, Alaska accounted for nearly half of the world salmon supply, and larger harvests in Alaska generally meant lower prices to fishermen. Some believed the increasing hatchery production in some parts of the state was depressing salmon prices in others (Knapp et al. 2007). By 1996, rapidly expanding farmed salmon production surpassed the wild salmon harvest for the first time (Knapp et al. 2007) and wild salmon prices declined precipitously as year-round supplies of high quality fresh farmed salmon flooded the marketplace in the U.S., Europe, and Japan. The Alaska fishing industry responded to the competition by improving fish quality and implementing intensive marketing efforts to differentiate Alaska salmon from farmed salmon. By 2004, these efforts paid off through increasing demand and prices.

Today, Alaska typically accounts for just 12% to 15% of the global supply of salmon (Alaska Seafood Marketing Institute 2011). Alaska's diminished influence on world salmon production means that Alaska's harvest volume has little effect on world salmon prices. Prices paid to fishermen have generally increased over the past decade (2004–2013) despite large fluctuations in harvest volume (ADF&G 2014; Stopha 2013a).

Exvessel value[3] of the commercial hatchery harvest increased from $45 million in 2004 to $191 million in 2013, with a peak value for the decade of $204 million in 2010. First wholesale value[4] also showed an increasing trend, with the value of hatchery fish increasing from $138 million in 2004 to a decadal high value of $532 million in 2013. Pink and chum salmon combined accounted for about 80% of both the exvessel value and the first wholesale value of the hatchery harvest from 2004 to 2013.

From 2004 to 2013, hatcheries contributed about a third of the total Alaska salmon harvest, in numbers of fish (White 2005–2011; Vercessi 2012–2014). With world markets currently supporting a trend of increasing prices for salmon, interest in increasing hatchery production by Alaska fishermen, processors, support industries, and coastal communities has increased as well. In 2010, Alaska salmon processors encouraged hatchery operators to expand pink salmon production to meet heightened demand (Industry Working Group 2010).

Alaska's wild salmon populations are sustainably managed by ensuring adequate numbers of adults spawn, and the wild harvest is arguably at its maximum, given fluctuations due to environmental variability and imperfect management precision. Unlike Pacific Northwest systems, such as the Columbia River, where habitat loss, dam construction and urbanization led

[3] Exvessel value for hatchery harvest is the total harvest value paid by fish buyers to fishermen for all salmon from http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch (accessed 02/04/2014), multiplied by the hatchery percent of the commercial harvest in Farrington 2003, 2004; White 2005–2011, and Vercessi 2013.

[4] First wholesale value is the price paid to primary processors for processed fish from ADF&G Commercial Operators' Annual Reports obtained from Shellene Hutter, Fishery Biologist, ADF&G, multiplied by the hatchery percent of the commercial harvest.

to the decline of salmon stocks to the point of endangered species listings, Alaska's salmon habitat is largely intact. ADF&G, with the assistance and sacrifice of commercial, sport, personal use and subsistence users, has been successful in recovery of several populations identified as stocks of concern through restricted fishing and intensive spawning assessment projects. Other than regulatory actions, such as reductions of salmon bycatch in other fisheries or changes in fishing methods that would allow more precise management of escapement, hatchery production is the primary opportunity to substantially increase the harvest.

Alaska's salmon fisheries are among the healthiest in the world. The 2013 season was a record harvest overall, with the 283 million fish commercial harvest comprised of the second highest catch for wild stocks (176 million fish) and the highest catch for hatchery stocks (107 million fish) in Alaska's history (Figure 1). The 2013 season was the first year the hatchery harvest alone exceeded 100 million fish. The 2013 hatchery harvest alone was greater than the entire statewide commercial salmon harvest in 1987 and every year prior to 1980 except for 6 years (1918, 1934, 1936, 1937, 1938 and 1941; Figure 1).

Part of the reason for the rise in price of Alaska salmon was a message of the state's sustainable fisheries management to a growing audience of discriminating buyers. The Alaska Seafood Marketing Institute applied to the Marine Stewardship Council (MSC) for certification as a sustainably managed fishery. In 2000, the MSC certified the salmon fisheries managed by ADF&G as sustainably managed, and the state's salmon fisheries remained the only MSC certified salmon fishery in the world for nearly a decade. Salmon fisheries elsewhere (Annette Islands Indian Reserve salmon; British Columbia pink and sockeye salmon; and Iturup Island, Russia, pink and chum salmon) were later certified for much smaller geographic areas, and in some cases, only for specific salmon species (MSC 2012). Alaska's certification was MSC's broadest and most complex, covering all five salmon species harvested by all fishing gear types in all parts of the state. Achievement of statewide certification was a reflection of the state's commitment to abundance-based fisheries management and constitutional mandate to sustain wild salmon populations.

MSC-certified fisheries are reviewed every five years. When Alaska salmon fisheries were recertified in 2007 (Chaffee et al. 2007), a condition of certification was to "Establish and implement a mechanism for periodic formal evaluations of each hatchery program for consistency with statewide policies and prescribed management practices. This would include a specific evaluation of each program relative to related policies and management practices." (Knapman et al. 2009). The first of these evaluations was published by ADF&G in 2011 (Musslewhite 2011a).

The Alaska Seafood Marketing Institute changed to a new sustainable fishery certification under the Food and Agriculture Organization in 2011 (Global Trust Certification Ltd. 2011). The hatchery evaluations started under the MSC certification program continued as an important systematic assessment of Alaska salmon fishery enhancement and its relation to wild stock production at a time of heightened interest for increased hatchery production and potential impacts on wild salmon production. ADF&G established a rotational schedule to review PNP hatchery programs. Musslewhite (2011a, 2011b) completed hatchery reviews for the Kodiak region in 2011, Stopha and Musslewhite (2012) completed the hatchery review for Tutka Bay Lagoon Hatchery in Cook Inlet, and Stopha (2012a, 2012b, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2013h, 2014a, 2014b, 2014c) completed reviews of the remainder of the Cook Inlet and Prince William Sound hatcheries, and the Macaulay, Sheep Creek and Snettisham hatcheries in

Southeast Alaska. This report is for the Sawmill Creek Hatchery located in Sitka, Alaska. Following completion of reviews of hatcheries in the northern Southeast Alaska region, reviews of hatcheries in southern Southeast Alaska will follow.

OVERVIEW OF POLICIES

Numerous Alaska mandates and policies for hatchery operations were specifically developed to minimize potential adverse effects to wild stocks. The design and development of the hatchery program is described in detail in McGee (2004): "The success of the hatchery program in having minimal impact on wild stocks can be attributed to the development of state statutes, policies, procedures, and plans that require hatcheries to be located away from significant wild stocks, and constant vigilance on the part of ADF&G and hatchery operators to improve the program through ongoing analysis of hatchery performance." Through a comprehensive permitting and planning process, hatchery operations are subject to continual review by a number of ADF&G fishery managers, geneticists, pathologists, and the ADF&G commissioner.

A variety of policies guide the permitting of salmon fishery enhancement projects. They include *Genetic Policy* (Davis et al. 1985), *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2014), and fisheries management policies, such as the Sustainable Salmon Fisheries Policy (5 AAC 39.222). These policies are used by ADF&G staff to assess hatchery operations for genetic, health, and fishery management issues in the permitting process.

The State of Alaska ADF&G genetic policy (Davis et al. 1985; Davis and Burkett 1989) sets out restrictions and guidelines for stock transport, protection of wild stocks, and maintenance of genetic variance. Policy guidelines include banning importation of salmonids from outside the state (except U.S./Canada transboundary rivers); restricting transportation of stocks between the major geographic areas in the state (Southeast, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, Arctic-Yukon-Kuskokwim, and Interior); requiring the use of local broodstock with appropriate phenotypic characteristics; maintaining genetic diversity by use of large populations of broodstock collected across the entire run; and limiting the number of hatchery stocks derived from a single donor stock.

Genetic Policy also recommends the identification and protection of significant and unique wild stocks: "Significant or unique wild stocks must be identified on a regional and species basis so as to define sensitive and nonsensitive areas for movement of stocks." In addition, the genetic policy suggests that drainages be established as wild stock sanctuaries where no enhancement activity is permitted except for gamete removal for broodstock development. The wild stock sanctuaries were intended to preserve a variety of wild types for future broodstock development and outbreeding for enhancement programs.

These stock designations are interrelated with other restrictions of the genetic policy, including (1) Hatchery stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks; (2) A watershed with a significant stock can only be stocked with progeny from the indigenous stocks; and (3) Fish releases at sites where no interaction with, or impact on, significant or unique stock will occur, and which are not for the purposes of developing, rehabilitation, or enhancement of a stock (e.g., releases for terminal harvest or releases in landlocked lakes) will not produce a detrimental genetic effect. Davis and Burkett (1989) suggest that regional planning teams (RPTs) are an appropriate body to designate significant and unique wild stocks and wild stock sanctuaries. To

date, only the Cook Inlet RPT has established significant stocks and wild stock sanctuaries. In addition, the Phase III Comprehensive Salmon Plan (described in the next paragraph) for Southeast Alaska includes a *stock appraisal tool*, which identifies criteria to be used for evaluating the significance of a wild stock that may potentially interact with hatchery releases.

Salmon fishery enhancement efforts are guided by comprehensive salmon plans for each region. These plans are developed by the RPTs, which are composed of six members: three from ADF&G and three appointed by the regional aquaculture association Board of Directors (5 AAC 40.310). According to McGee (2004), "Regional comprehensive planning in Alaska progresses in stages. Phase I sets the long-term goals, objectives and strategies for the region. Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials for the salmon resources in the region. In some regions, a Phase III in planning has been instituted to incorporate Alaska Board of Fisheries approved allocation and fisheries management plans with hatchery production plans."

The Alaska Fish Health and Disease Control Policy (5 AAC 41.080) is designed to protect fish health and prevent spread of infectious disease in fish and shellfish. The policy and associated guidelines are discussed in *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2014). It includes regulations and guidelines for fish transports, broodstock screening, disease histories, and transfers between hatcheries. The *Alaska Sockeye Salmon Culture Manual* (McDaniel et al. 1994) also specifies practices and guidelines specific to the culture of sockeye salmon. As with *Genetic Policy*, these regulations and guidelines are used by ADF&G fish pathologists to review hatchery plans and permits.

The Alaska Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) mandates protection of wild salmon stocks in the management of salmon fisheries. Other applicable policies include the Policy for the Management of Mixed-Stock Salmon Fisheries (5 AAC 39.220), the Salmon Escapement Goal Policy (5 AAC 39.223), and local fishery management plans (5 AAC 39.200). These regulations require biologists to consider the interactions of wild and hatchery salmon stocks when reviewing hatchery management plans and permits.

The guidance provided by these policies is sometimes very specific, and sometimes less so. For example, the Alaska Fish Health and Disease Control Policy mandates the use of an iodine solution on salmon eggs transported between watersheds—a prescribed practice that requires little interpretation. In contrast, several policies prioritize the protection of wild stocks from the potential effects of fisheries enhancement projects without specifying or mandating how to assess those effects. These less specific policies provide principles and priorities, but not specific direction, for decision making.

The initial rotation of these evaluation reports will assess the consistency of individual hatcheries with state policies by (1) confirming that permits have been properly reviewed using applicable policies, and (2) identifying information relevant to each program's consistency with state policies. Future reports may assess regional effects of hatcheries on wild stocks and fishery management.

OVERVIEW OF HATCHERY PERMITS AND PLANS

The FRED Division built and operated several hatcheries across the state in the 1970s and gradually transferred operations of most facilities to PNP corporations. Regional aquaculture

associations (RAAs), whose membership is comprised of the commercial salmon fishing permit holders and representatives of other user groups interested in fisheries within the region, operate most of the PNP hatcheries in Kodiak, Cook Inlet, Prince William Sound, and Southeast Alaska. Each RAA's board of directors establish goals for enhanced production, oversee business operations of the hatcheries, and work with ADF&G staff to comply with state permitting and planning regulations. RAA membership may vote to impose a salmon enhancement tax on sale of salmon in their region to finance hatchery operations and enhancement and rehabilitation activities. Independent PNP corporations, not affiliated with an RAA, also operate hatcheries in several areas of the state. Both the RAAs and independent PNP hatchery organizations may harvest salmon returning to their release sites to pay for operations. Such harvests by hatchery operators are called *cost-recovery* fisheries, and are in contrast to *common property* fisheries, which are fisheries open to all commercial fishing permit holders, as well as fisheries open to subsistence and sport harvesters. Several organizations have tourist and educational programs that contribute to the financial support of their programs, as well.

RAA's do not receive a blanket permit for their hatcheries. Each hatchery is permitted separately. Application for a hatchery permit is an extensive process (5 AAC 40.110–40.230). An application consists of the goals of the hatchery, production goals and hatchery site information, water flow and chemistry data, land ownership and water rights, hatchery design, initial proposed broodstock for the hatchery, and a financial plan. ADF&G staff review the application with the applicant, address any deficiencies, and draft a fishery management feasibility analysis for the proposed hatchery. The RPT reviews the hatchery plan to determine if the hatchery operation is compatible with the regional comprehensive salmon plan. A public hearing is then held where the applicant describes the proposed hatchery plan. ADF&G staff present the basic management plan for the hatchery, including fish culture aspects of the proposed hatchery and management of the hatchery return, and public testimony and questions follow the presentations. ADF&G must respond in writing to any specific objections.

Following review by the RPT and the public hearing, the application is sent to the ADF&G commissioner for final consideration. By regulation (5 AAC 40.220) the commissioner's decision is based on consideration of (1) the suitability of the site for making a reasonable contribution to the common property fishery, not adversely affect management of wild stocks, and not require significant alterations of traditional fisheries; (2) the operation of the hatchery makes the best use of the site's potential to benefit the common property fishery; (3) the harvest area size at the hatchery is sufficient in size to provide a segregated harvest of hatchery fish of acceptable quality for sale; (4) proposed donor sources can meet broodstock needs for the hatchery for the first cycle; (5) water sources for the hatchery are secured by permit and are of appropriate quality and quantity; and (6) the hatchery has a reasonable level of operational feasibility and an acceptable degree of potential success.

Public participation is an integral part of the PNP hatchery system. Hearings are held before a hatchery is permitted for operation. RPTs comprised of ADF&G and RAA representatives hold public meetings to define desired production goals by species, area, and time, and document these goals in comprehensive salmon plans (5 AAC 40.300). RPTs hold public meetings to review applications for new hatcheries and to make recommendations to the ADF&G commissioner regarding changes to existing hatchery operations, new hatchery production, and new hatchery facilities. Municipal, commercial, sport, and subsistence fishing representatives

commonly hold seats on both RAA and independent PNP hatchery organization boards, providing broad public oversight of operations.

Alaska PNP hatcheries operate under four documents required in regulation: hatchery permit with basic management plan (BMP), annual management plan (AMP), fish transport permit (FTP), and annual report (Figure 2).

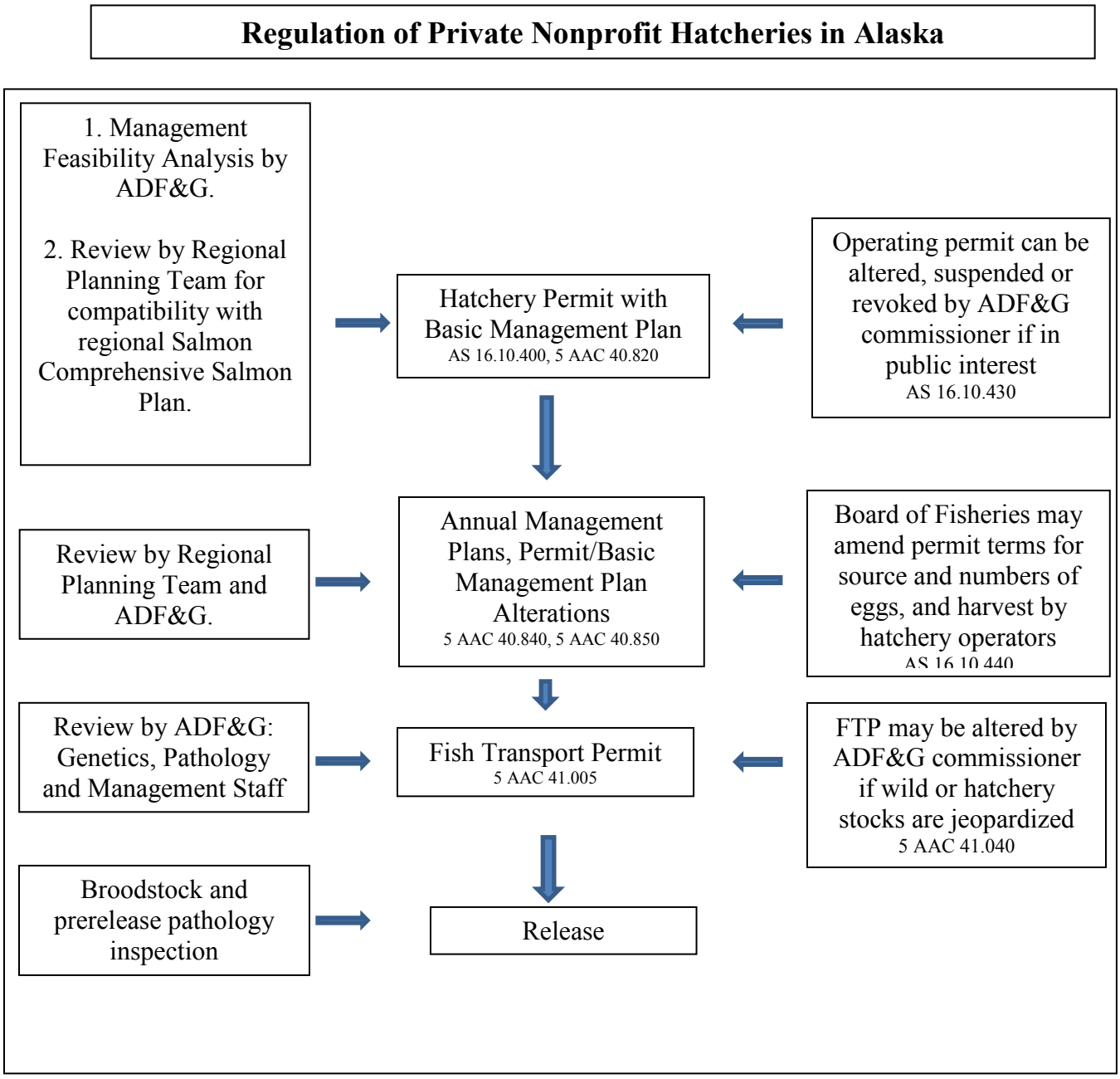

Figure 2.–Diagram of Alaska hatchery permitting process.

The hatchery permit authorizes operation of the hatchery, specifies the maximum number of eggs of each species that a facility can incubate, specifies the authorized release locations, and may

identify stocks allowed for broodstock. The BMP is an addendum to the hatchery permit and outlines the general operations of the hatchery. The BMP may describe the facility design, operational protocols, hatchery practices, broodstock development schedule, donor stocks, harvest management, release sites, and consideration of wild stock management. The BMP functions as part of the hatchery permit and the two documents should be revised together if the permit is altered. The permit and BMP are not transferrable. Hatchery permits remain in effect unless relinquished by the permit holder or revoked by the ADF&G commissioner.

Hatchery permits/BMPs may be amended by the permit holder through a permit alteration request (PAR). Requested changes may be reviewed by the RPT and ADF&G staff and a recommendation is sent to the ADF&G commissioner for consideration. If no agreement is reached through the RPT, the PAR is sent to the commissioner without a recommendation. If approved by the commissioner, the permit is amended to include the alteration. Reference to a permit or hatchery permit in this document also includes approved PARs to the hatchery permit unless otherwise noted.

The AMP outlines operations for the current year. It should "organize and guide the hatchery's operations, for each calendar year, regarding production goals, broodstock development, and harvest management of hatchery returns" (5 AAC 40.840). Typically, AMPs include the current year's egg-take goals, fry or smolt releases, expected adult returns, harvest management plans, FTPs (described below) required or in place, and fish culture techniques. The AMP must be consistent with the hatchery permit and BMP.

An FTP is required for egg collections, transports, and releases (5 AAC 41.001–41.100). The FTP authorizes specific activities described in the hatchery permit and management plans, including broodstock sources, gamete collections, and release sites. All FTP applications are currently reviewed by the ADF&G fish pathologist, fish geneticist, regional resource development biologist, and other ADF&G staff as delegated by the ADF&G commissioner. Reviewers may suggest conditions for the FTP. Final consideration of the application is made by the ADF&G commissioner or commissioner's delegate. An FTP is issued for a fixed time period and includes both the specifics of the planned operation and any conditions added by ADF&G.

Each hatchery is required to submit an annual report documenting egg collections, juvenile releases, current year run sizes, contributions to fisheries, and projected run sizes for the following year (AS 16.10.470). Information for all hatcheries is compiled into an annual ADF&G report (e.g., Vercessi 2015) to the Alaska Legislature (AS 16.05.092).

The administration of hatchery permitting, planning, and reporting requires regular and direct communication between ADF&G staff and hatchery operators. The serial documentation from hatchery permit/BMP to AMP to FTP to annual report spans generations of hatchery and ADF&G personnel, providing an important history of each hatchery's species produced, stock lineages, releases, returns, and pathology.

SAWMILL CREEK HATCHERY OVERVIEW

The Sawmill Creek Hatchery is located in Sitka, Alaska (Figure 3). The hatchery was constructed in 2002 and 2003 by the Northern Southeast Regional Aquaculture Association (NSRAA).

Figure 3.–Location of Sawmill Creek Hatchery, project sites, and ancestral hatchery broodstocks.

The hatchery is located on Silver Bay between Sheldon Jackson Hatchery and Medvejie Creek Hatchery on the Sitka road system at the site of a former wood pulp mill (Figure 3). The site is now part of the Sawmill Cove Industrial Park and owned by the City and Borough of Sitka. NSRAA holds a long-term lease with the City and Borough of Sitka for both the land and water rights to the hatchery. Sawmill Creek flows from Blue Lake to Silver Bay. The hatchery is supplied by water from the Blue Lake reservoir with Sawmill Creek as a backup supply.

Sawmill Creek serves as a satellite facility to Medvejie Creek Hatchery. When Medvejie Creek Hatchery reached its maximum water usage for production, it could not expand production. Sawmill Creek Hatchery was built to expand production by incubating eggs collected from Medvejie Creek Hatchery broodstock. No releases are allowed at Sawmill Creek Hatchery to avoid potential impacts to resident salmonids in the Sawmill Creek watershed.

The primary objective of the hatchery is to provide additional coho and chum salmon for the commercial salmon fishery. The coho salmon return benefits sport, charter and subsistence fisheries, as well. The facility will also serve as an educational and tourist facility because of its easy road access from Sitka.[5]

SAWMILL CREEK HATCHERY PNP HATCHERY PERMIT

NSRAA applied for a PNP hatchery permit for Sawmill Creek Hatchery in 2006 for a capacity of 4.332 million coho salmon eggs. The proposed donor stock was Plotnikof Lake stock summer-run coho salmon from Medvejie Creek Hatchery. NSRAA began egg collections at Plotnikof Lake in 2002 and anticipated ending egg takes there in 2006 when hatchery returns would provide adequate broodstock.

According to the hatchery application, 4.332 million eggs would be incubated at Sawmill Creek Hatchery. Up to 350,000 hatchlings would be reared to smolt and transported to saltwater net pens at Medvejie Creek Hatchery for imprinting and release. Of the remaining eggs, an estimated 1.7 million hatchlings would survive through the smolt stage and be transferred to saltwater net pens in Deep Inlet in Sitka Sound for imprinting and release.

The ADF&G fishery management feasibility analysis concluded that remote release of all production from the facility allayed concerns for direct returns to the hatchery, since Sawmill Creek contains small populations of coho salmon and other salmonids. ADF&G staff cited several other concerns with the Sawmill Creek Hatchery program. One concern was whether the remotely-released coho salmon would home to their release site, home to Sawmill Creek (where they were reared), or stray to Salmon Lake (Figure 3), a system with an important fall-run coho salmon stock. In addition, tagging studies indicated the harvest rate on the Salmon Lake wild stock was already high at times (up to 72%), and staff expressed concerns that additional fishing pressure on the Sawmill Creek Hatchery returns could increase the harvest rate of Salmon Lake coho salmon. ADF&G staff also raised concerns for harvest of Salmon Lake stock sockeye salmon that could be caught in the Deep Inlet terminal harvest area (Figure 3) during fisheries targeting the returning Sawmill Creek Hatchery coho returns, as the timing of the two runs would likely overlap.

[5] From Sawmill Creek Hatchery application. Unpublished document obtained from Sam Rabung, ADF&G PNP Hatchery Coordinator, Juneau.

ADF&G proposed starting releases at a lower level than that in the application so that straying and harvest rates could be monitored. If staying and harvest rates showed an acceptable range to protect wild stocks, production could be gradually increased.

The NSERPT reviewed the hatchery application in January 2007, and voted unanimously to recommend approval of the hatchery application at a maximum permitted capacity of 4.332 million summer run coho salmon egg and a maximum release of two million smolts. The team also recommended (1) a stepwise release schedule of releases in 2007, 2008 and 2009 (Appendix A); (2) operation of an escapement weir for monitoring Salmon Lake from July through October, 2007 to 2010; (3) snorkel surveys in Sawmill Creek during the coho run to assess straying; and (4) maintenance of a straying rate of 2% or less in any Sitka stream. After 2010, the team recommended that releases could be increased up to the permitted release of 2 million smolts based on the results of fishery management and straying assessments.

A public hearing was held in Sitka for the hatchery application. All written and oral testimony was in favor of the hatchery.

The ADF&G commissioner approved PNP Hatchery number 44 for Sawmill Creek Hatchery in March 2007. The permitted capacity was 4.332 million coho salmon eggs (Appendix A). The basic management plan was approved according the stepwise egg collection plan recommended by the NSERPT. The BMP included conditions such that if stray rates of Plotnikof Lake stock coho salmon were 2% or greater to Sawmill Creek or Salmon Lake, then releases from Medvejie Creek Hatchery and possibly Deep Inlet could be reduced or stopped (Appendix A). Under the initial BMP, live broodstock from Medvejie Creek Hatchery would be transported to Sawmill Creek Hatchery, allowed to ripen, and gametes collected. Eggs destined for Medvejie Creek Hatchery would be incubated to the eyed stage at Sawmill Creek Hatchery and transferred to Medvejie Creek Hatchery for rearing until release. Eggs for Deep Inlet would be reared at Sawmill Creek Hatchery to the smolt stage and then transferred to net pens in Deep Inlet for imprinting and release.

The first PAR for Sawmill Creek Hatchery was submitted in 2009. NSRAA requested to change coho salmon stocks from Plotnikof summer-run stock to Salmon Lake fall-run stock. After six years of trying to develop the Plotnikof stock at Medvejie Creek and Sawmill Creek hatcheries, several issues developed. There was more overlap in return timing with Salmon Lake returns than expected, marine survival was lower than expected, and incidence of bacterial kidney disease was high. Size of returning fish was also small.

The ADF&G geneticist indicated that Salmon Lake stock was a local population and its use was consistent with the genetic policy. He had a concern that hatchery releases could stray to Salmon Lake and influence the wild population.[6]

The PAR was approved in 2009 to change brood stocks (Appendix A). An updated BMP required that all releases from the Medvejie Creek Hatchery release site were to be coded-wire-tagged so that returns could be comprehensively identified when sampled in fisheries and straying assessments. NSRAA was to implement a wild presmolt tagging project for Salmon Lake coho salmon from 2013 to 2015 to determine exploitation rates on the wild Salmon Lake stock. Future efforts were to be made towards developing a sustainable escapement goal for

[6] Comments by ADF&G geneticist William Grant on application for FTP 09J-1018 for the Salmon Lake broodstock project. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

Salmon Lake coho salmon, presumably using wild stock tagged recoveries from harvest sampling and escapement data.

The updated BMP eliminated the transfer of broodstock from Medvejie Creek Hatchery to Sawmill Creek Hatchery for ripening. Gametes for the Medvejie Creek Hatchery release would remain at Medvejie Creek Hatchery for incubation, rearing and release. Gametes for the Deep Inlet program would be transferred from Medvejie Creek Hatchery to Sawmill Creek Hatchery, fertilized, and incubated.

The updated BMP also included a similar provision contained in the initial BMP that a 2% stray rate of Salmon Lake stock coho salmon hatchery releases to either Sawmill Creek or Salmon Lake would trigger a reevaluation of the program. In comments for the FTP for use of the Salmon Lake stock (FTP 09J-1018) the ADF&G geneticist indicated that Salmon Lake stock was a local population and its use was consistent with *Genetic Policy*. He had a concern that hatchery releases could stray to Salmon Lake and influence the wild population.[7]

In 2009, NSRAA staff began collecting brood stock from Salmon Lake. Egg incubation was at Medvejie Creek Hatchery from 2009 to 2012 during the broodstock development phase (FTP 09J-1018). Fry from brood years 2011 and 2012 were moved from Medvejie Creek Hatchery to Sawmill Creek Hatchery for rearing. A portion of the brood year 2012 fry were then transferred back to Medvejie Creek Hatchery for release after Medvejie Creek Hatchery lost most of their coho salmon fry due to water loss in an incubator[8](FTP 14J-1006).[9] The remainder of brood years 2011 and 2012 fry were released at Deep Inlet (FTP 09J-1019, Appendix B).

Beginning in 2012, eggs were collected from returns to Medvejie Creek Hatchery (FTP 12J-1009). Eggs could also be collected from returns to Deep Inlet as a backup (FTP 12J-1023). Up to 4.332 million of the eggs collected at Medvejie Creek Hatchery could be incubated at Sawmill Creek Hatchery, reared to smolt, and transferred to net pens in Deep Inlet for imprinting and release (FTP 12J-1008). The first time eggs were actually incubated at Sawmill Creek Hatchery occurred in 2013, and those eggs were for future release at Deep Inlet.

A second PAR was approved for Sawmill Creek Hatchery in 2014 to add a chum salmon program (Appendix A). Crawfish Inlet was selected after a request by NSRAA to ADF&G to identify potential new salmon fishery enhancement opportunities in northern Southeast Alaska. Crawfish Inlet is an area with no subsistence stocks, limited wild stock production, and provides a large terminal harvest area such that fishing would likely have minimal impacts on other fisheries.[10] Chum salmon eggs would be collected from Medvejie Creek Hatchery returns, incubated at Sawmill Creek Hatchery, and released at Crawfish Inlet, which is located about 40 water miles south of the hatchery on the west Baranof Island coast (Figure 3). The approved stock for the program is Medvejie Creek Hatchery/Nakwasina River stock. The Nakwasina River is located about 10 miles northwest of Sitka (Figure 3).

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[7] Comments by ADF&G geneticist William Grant on application for FTP 09J-1018 for the Salmon Lake broodstock project. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[8] 2013 Medvejie Creek Hatchery Annual Report. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[9] It appears this FTP was issued after the transfer of fry from Sawmill Creek Hatchery back to Medvejie Creek Hatchery.

[10] Summary of the Alaska Department of Fish and Game Consideration of NSRAA Request for Potential New Salmon Enhancement Sites/Opportunities. Undated and unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

NSRAA requested a 50 million chum salmon egg capacity for the project. The minutes from the RPT meeting discussing the project illustrate the debate that typically occurs under Alaska's PNP hatchery program when considering new projects, and the considerations that are weighed from fishery management, hatchery business, commercial fishing, and subsistence fishing points of view.

When the PAR was presented for discussion, ADF&G staff indicated that their biggest concern with the project is potential straying into a West Crawfish Inlet chum salmon indicator stream. The stream was sampled in the previous year as part of a regional straying study and found to have very few hatchery fish. Some ADF&G staff wanted to start with lower release numbers and ramp the program up if no problems developed when the fish returned. ADF&G staff indicated that 20 million chum salmon eggs would be a conservative baseline level for evaluation of the new chum salmon program at Crawfish Inlet.

NSRAA staff indicated that the 50 million chum salmon egg number was derived from a business goal of a program that would provide a large enough return to benefit the commercial fishery and provide enough cost-recovery fish to pay for the program. When asked how the 20 million release number was derived, ADF&G staff responded that a projected 500,000 adult chum salmon would return from the release and provide a significant enough return to evaluate the program while also making contributions to the commercial fleet.

An NSRAA gear representative noted that if the return is not large enough to attract gear effort, especially with the troll fleet, then the evaluation of the fishery may not be accurate.

Sitka Tribe of Alaska submitted a letter in opposition to the PAR. Sitka Tribe of Alaska believed the release site would have a negative impact on resident salmon stocks in Crawfish Inlet, on subsistence sockeye salmon returning to Necker Bay, on the Sitka Sound herring stock, and on the wilderness character of the area surrounding Crawfish Inlet.

A department motion to amend the PAR from 50 million to 20 million chum salmon eggs for Crawfish Inlet failed to carry by a vote of 3-3. The votes were split between the ADF&G and industry representatives.

ADF&G staff was willing to agree to amend the PAR for release of progeny from 30 million eggs with the following conditions: (1) NSRAA committed to sampling the West Crawfish Inlet index stream if it was not included in sampling for the regional straying study, (2) the terminal harvest would be sampled for wild stock interception, and (3) NSRAA would be required to harvest hatchery returns in the SHA if there is a buildup of returning hatchery chum salmon after the commercial fishery was over.

The PAR was amended as presented by ADF&G. The NSERPT unanimously approved the amendment to the PAR and then unanimously recommended approval of the amended PAR to the ADF&G commissioner.[11]

The ADF&G commissioner approved the PAR for 30 million Medvejie Creek Hatchery stock chum salmon eggs and added Crawfish Inlet as a release site. The amendment required that Crawfish Inlet chum salmon releases be differentially marked, and provided that NSRAA could be required to remove unharvested chum salmon remaining in the terminal harvest area should a

[11] Draft minutes, Joint Northern/Southern Southeast RPT Meeting, April 8, 2014. Unpublished document received from G. Pryor, ADF&G Regional Resource Development Biologist, Douglas Regional office.

significant number remain after common property fisheries ceased. Straying would be monitored through an ongoing straying study by collecting chum salmon otoliths from streams in West Crawfish Inlet. The ADF&G staff recommendation for sampling of the terminal harvest for wild stock fish was not a condition of the permit amendment but could be added to the AMP. The first chum salmon eggs (828,000 eggs) to begin the project were taken in 2014 (FTP 14J-1017).

In addition to the FTPs cited above, two other FTPs were issued for Sawmill Creek Hatchery in response to a scheduled hatchery water supply shut down in 2014 (Appendix B).

FTP 14J-1006 allowed Salmon Lake stock coho salmon fry to be transported from Sawmill Creek Hatchery to Medvejie Creek Hatchery for rearing and release as a contingency in the event of a water emergency or for inventory adjustments. FTP 14J-1007 permitted transfer of coho salmon fry from the Sawmill Creek Hatchery to net pens in Green Lake in the event there was not enough water at Medvejie Creek Hatchery for a fry transfer from Sawmill Creek Hatchery (Appendix B).

COMPREHENSIVE SALMON ENHANCEMENT PLAN

Three phases of Comprehensive Salmon Plans (CSP) have been developed to date in Southeast Alaska. Phase I[12] and Phase II (Northern Southeast Regional Planning Team 1982)[13] CSPs provided planning focused on increasing salmon production with specific harvest targets for each salmon species. The Phase III CSP (Duckett et al. 2010) focused on integrating hatchery production increases with natural production to sustainably manage fisheries.

With the maturation of the salmon enhancement program, the harvest target objectives in the Phase I and Phase II CSPs were replaced with objectives in the Phase III CSP that supported an overriding goal to enhance the salmon fishery while minimizing the impact of enhancement on wild stocks. These new objectives included (1) minimizing the potential impact of hatchery stocks on wild stocks, (2) maintaining existing production potential for wild and enhanced stocks, (3) assuring that increases in hatchery production are consistent with regionwide goals and allocation plans, and (4) updating the RPT process periodically to provide status reports and recommendations in a timely manner. Like the Phase I and II CSPs, these objectives covered a 20-year horizon.

The Phase III CSP provides *best practice* guidelines for enhancement planning to provide a systematic approach to project formulation and the decision-making process. Four standards are to be documented in developing a fishery supplementation project: (A) the release site has an adequate freshwater supply for imprinting and is not in close proximity to significant wild stocks, (B) fish are adequately imprinted to the release site, (C) releases are marked and contribute to the harvest without jeopardizing the sustainability of wild stocks, and (D) the terminal area enables harvest or containment of all returning adults. These standards were to meet the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) developed by the Alaska Board of Fisheries and ADF&G.

[12] Joint Southeast Alaska Regional Planning Teams. 1981. Comprehensive salmon enhancement plan for Southeast Alaska: Phase I. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[13] Northern Southeast Regional Planning Team. 1982. Comprehensive Salmon Plan, Phase II: Northern Southeast Alaska. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

The Phase III CSP provides a stock appraisal tool for use as a guideline by the RPT and ADF&G biologists when charged with evaluating the biological significance of naturally occurring stocks near a proposed release site. The Phase III CSP states that significance is more complex than a simple production number because some of the region's most viable fisheries depend on aggregates of wild stocks, each of which is not very large. Diversity among wild stocks is a key factor in maintaining production capacity, and the potential to maximize harvest opportunities over time. The tool identified five stock characteristics of consideration: wildness, uniqueness, isolation, population size, population trend and the stock's economic and/or cultural significance.

The Phase III CSP provides a framework for assessment of new projects: "All projects will have an approved evaluation plan to assess impacts and measure success. This plan will describe how the project benefits will be measured and include a method for detecting negative or unintended impacts. An evaluation plan includes (A) fish identification (marking) method to be used; (B) mark–recovery plan for common property and terminal site harvests; (C) identification of potential ecological and genetic impacts that might warrant evaluation, a strategy to detect them, and criteria to determine when measured impacts would warrant project modification; (D) a description of how impacts to fishery management will be evaluated; and (E) a plan for dispersing information about the project. Proposals for new projects should document all evaluation agreements between the hatchery corporation or agency and the department, including any agreements for funding evaluation activities."

As the newest hatchery in Southeast Alaska, the Sawmill Creek Hatchery program was one of the first to be permitted under the Phase III CSP. The hatchery's program development and assessments reflect the Phase III CSP program policies and guidelines.

PROGRAM EVALUATIONS

CONSISTENCY WITH POLICY

The key elements of the policies governing Alaska hatcheries were divided into three categories for this review: genetics, fish health, and fisheries management (Tables 1–4).

Genetics

Sawmill Creek Hatchery utilizes local ancestral coho salmon stocks from Salmon Lake and chum salmon stocks from the Nakwasina River (Table 1, Figure 3). According to the BMP, if sampling in the Salmon Lake drainage show 2% or more coho salmon strays from Sawmill Creek Hatchery releases into Sitka area streams, the program may be reevaluated.

For chum salmon, the release site at Crawfish Inlet was specifically chosen because of the low number of salmon stocks in the inlet. Chum salmon otolith sampling is occurring in West Crawfish Inlet as is part of a regional straying study. After these samplings end, NSRAA may be required to continue sampling in West Crawfish Inlet streams if necessary[14] through the FTP review process.

[14] Memorandum from L. Vercessi, ADF&G PNP Assistant Coordinator to J. Regnart, ADF&G and C. Swanton, ADF&G dated April 30, 2014. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

Table 1.–Key elements of the ADF&G *Genetic Policy*.

I. Stock Transport	
Use of appropriate local stocks	Section I of the *Genetic Policy* prohibits interstate or inter-regional stock transports, and uses transport distance and appropriate phenotypic characteristics as criteria for judging the acceptability of donor stocks. Sawmill Creek Hatchery uses local broodstock for coho and chum salmon projects.
II. Protection of wild stocks	
Identification of significant or unique wild stocks	Significant or unique wild stocks must be identified for each region and species as stocks most important to that region. Regional Planning Teams should establish criteria for determining significant stocks and recommend such stock designations. In Southeast Alaska, no significant stocks have been identified by the RPT. The Phase III CSP provided a stock appraisal tool for use as a guideline by the RPT and ADF&G biologists when charged with evaluating the biological significance of naturally occurring stocks near a proposed release site.
Interaction with or impact on significant wild stocks	Priority is given to protection of significant wild stocks from harmful interactions with introduced stocks. Stocks cannot be introduced to sites where they may impact significant or unique wild stocks. Local indigenous coho and chum salmon stocks were used so that if they strayed, the genetic makeup of the hatchery fish would be similar to the fish in the local systems.
Establishment of wild stock sanctuaries	Wild stock sanctuaries should be established on a regional and species basis. No enhancement activities would be allowed, but gamete removal would be permitted. The guidelines and justifications describe the proposed sanctuaries as gene banks of wild type variability. In Southeast Alaska, no wild stock sanctuaries have been designated by the RPT.
Straying Impacts	Prevention of detrimental effects of gene flow from hatchery fish straying and interbreeding with wild fish. Chum salmon will be assessed for straying under a study that will sample streams in West Crawfish Inlet (Prince William Sound Science Center 2013). Coho salmon straying is assessed through sampling of coho salmon returning to Salmon Lake and snorkel surveys of Sawmill Creek.
III. Maintenance of genetic variance	
Maximum of three hatchery stocks from a single donor stock	A maximum of three hatchery stocks can be derived from a single donor stock. Offsite releases for terminal harvest should not be restricted by this policy if the release sites are selected so that they do not impact significant wild stocks, wild stock sanctuaries, or other hatchery stocks. The Salmon Lake coho salmon and Nakwasina chum salmon stocks are used at Sawmill Creek Hatchery and Medvejie Creek Hatchery.
Minimum effective population size	The policy recommends a minimum effective population size of 400. It also recognizes that small population sizes may be unavoidable with Chinook salmon and steelhead. For brood year 2014, about 13,000 chum salmon and 570 coho salmon were used for broodstock.
Genetics review of Fish Transport Permits (5 AAC 41.010 – 41.050)	
Review by geneticist	Each application is reviewed by the geneticist, who then makes a recommendation to either approve or deny the application. The geneticist may also recommend stipulations to the permit to protect wild or enhanced stocks. The geneticist reviewed the Sawmill Creek Hatchery FTP applications.

Salmon Lake Straying Assessment

According to the BMP, NSRAA will operate a weir at Salmon Lake weir annually from 2009 to 2017 for the detection of strays from either Medvejie Creek Hatchery or Deep Inlet. From 2009 to 2014, a total of 18 adipose finclipped coho salmon were recovered at Salmon Lake at the weir or during mark–recapture sampling (Table 2).

Beginning in 2012, adipose finclipped fish observed at the weir had a secondary tag inserted and were released below the weir. Beginning in 2013, for every adipose finclipped fish mentioned in the previous sentence released below the weir, an additional coho salmon with its adipose fin was marked and released below the weir as well. After fish were released below the weir, some returned and were recovered at the weir, some fish passed through the weir undetected and were recovered during mark–recapture experiments in the lake, some were recovered at Medvejie Creek Hatchery, and others were not seen again.

Of interest is that in three of the five years, most of the adipose finclipped fish sampled at the weir had no accompanying coded wire tag. Possibilities for these fish include fish that had received a coded wire tag and later lost the tag, fish that were adipose finclipped and had no coded wire tag inserted, or fish with a naturally missing adipose fin.

Also of note is that the Salmon Lake weir is not a fish-tight weir. A floating weir designed to adjust to high water events is used at Salmon Lake, and occasionally this type of weir allows fish to pass undetected through the weir. Tag recoveries from 2012 to 2014 in Table 2 represents only adipose-clipped fish that were (1) tagged, released downstream, and counted again through the weir; or (2) tagged, released downstream, passed through the weir undetected, and caught in mark–recapture sampling.

In addition, the 2010 project report data for the weir does not agree with results from the ADF&G Mark, Tag and Age lab, where coded wire tags are read that are recovered from Alaska salmon fisheries. NSRAA's weir report indicates that four adipose finclipped fish were recovered and identified as originating from Sheldon Jackson Hatchery and Medvejie Creek Hatchery. The Mark, Tag and Age lab data indicates that one tag was from a Sheldon Jackson Hatchery fish, and the other three heads contained no tags.

Table 2.–Coho salmon hatchery recoveries at the Salmon Lake Weir or in Salmon Lake, 2009–2014.

Year	Coho salmon inspected at Salmon Lake weir	Coho salmon captured at Salmon Lake weir, marked and released below weir	Recaptured			Not Recaptured	Tag origin
			Salmon Lake Weir	Medvejie Creek Hatchery	Other		
2009	1,424		2				MCH and SJH
2010	1,068		4				1 SJH and 3 with no tag
2011	667		3				1 MCH and 2 with no tag
2012	678	4 – Ad clipped	2	1	0	1	No tags in 2 fish at weir. Tag recovered from MCH was lost.
2013	1,024	3 – Ad clipped	1	1	0	1	2 MCH
		3 – Non ad clipped	2	0	0	1	
2014	721	15 – Ad clipped	3	2[a]	2[b]	10	3 MCH and 1 DI at weir. 1 lost.
		15 – Non ad clipped	1	0[c]	0	14	

Source: Scott Wagner, NSRAA Operations Manager, personal communication.

Note: KEY: MCH=Medvejie Creek Hatchery, SJH= Sheldon Jackson Hatchery, NT= No tag found, DI=Deep Inlet, CWT=coded wire tag.

[a] An additional adipose-clipped fish was misidentified at the weir as unmarked, floy tagged, and passed through the weir as part of the spawning escapement. The fish was later caught in mark–recapture beach seining in the lake and found that it was, in fact, an adipose clipped fish.

[b] Two adipose-clipped fish were recovered in beach seine sampling at Salmon Lake that had passed the weir unnoticed and were not floy tagged. These are not included in the 15 adipose-finclipped fish that were captured at the weir, tagged, and released below the weir. Therefore, at least 17 adipose-finclipped fish had been to the weir: the 15 identified, floy tagged, and released downstream; the additional fish that was misidentified, floy tagged and passed above the weir in footnote 1; and the additional 2 fish that passed the weir unnoticed.

[c] An additional fish with no adipose finclip was floy tagged and passed through the Salmon Lake weir into the escapement. This fish later emigrated from the lake unnoticed, was collected in Medvejie Hatchery, and the otolith indicated it was a nonadipose-clipped hatchery fish from Deep Inlet (Scott Wagner, NSRAA Operations Manager, personal communication).

Sawmill Creek Assessment

Snorkel surveys of Sawmill Creek are required under the BMP. Although the BMP indicated that surveys were to begin in 2012, the first survey was not conducted until 2014 because that was the first year of expected returns of fish reared at Sawmill Creek, according to NSRAA staff.[15] A total of 671 coho salmon were observed in 13 surveys from August to December. Two adipose finclipped coho salmon were possibly seen in passing, but further investigation did not confirm that the fish were clipped nor were the fish recovered.

[15] Scott Wagner, NSRAA Operations Manager, personal communication.

Fish Health and Disease

FTPs for the Sawmill Creek Hatchery program were approved by the pathologist (Table 3). Pathology staff plan to inspect the facility in 2016.[16]

Table 3.–Key elements of Alaska policies and regulations pertaining to fish health and disease.

Fish Health and Disease Policy (5 AAC 41.080)	
Egg disinfection	Within 48 hours of taking and fertilizing live fish eggs or transporting live fish eggs between watersheds, all eggs must be treated with an iodine solution. This requirement may be waived for large scale pink and chum salmon facilities where such disinfection is not effective or practical.
	Eggs are disinfected as necessary according to ADF&G regulations and guidelines.
Hatchery inspections	According to AS 16.10.460, inspection of the hatchery facility by department inspectors shall be permitted by the permit holder at any time the hatchery is operating.
	Hatchery inspections will begin in 2016.
Disease reporting	The occurrence of fish diseases or pathogens listed in 5 AAC 41.080(d) must be immediately reported to the ADF&G Fish Pathology Section.
	There are no chronic disease issues at the hatchery. Bacterial kidney disease (BKD) is endemic to the Salmon Lake coho salmon stock.
Pathology requirements for Fish Transport Permits (FTPs) (5 AAC 41.005–41.060)	
Disease history	Applications for FTPs require either a complete disease history of the stock or a broodstock inspection and certification if the disease history is not available.
	Samples were submitted as requested by the fish pathologist for disease history.
Isolation measures	Applications must list the isolation measures to be used during transport, including a description of containers, water source, depuration measures, and plans for disinfection.
	Isolation procedures were described on the FTP.
Pathology review of FTPs	Each application is reviewed by the pathologist, who then makes a recommendation to either approve or deny it. The pathologist may also recommend to the commissioner terms or conditions to the permit to protect fish health. Transports of fish between regions are discouraged.
	FTPs were reviewed by the pathologist.

Fisheries Management

Production and harvest management at Sawmill Creek Hatchery will evolve over time as more information about migration routes of returning hatchery fish, timing of hatchery returns, and status of local wild stocks such as those in Salmon Lake and West Crawfish Inlet are assessed (Table 5). Egg takes and release numbers at Medvejie Hatchery and Deep Inlet remain limited until study results for straying into Salmon Lake and Sawmill Creek evaluation is sufficient for protection of these stocks. A total of about 41,000 coho salmon have returned from releases through 2014 (Appendix C).

[16] Jayde Ferguson, ADF&G Fish Pathologist, personal communication.

The chum salmon fishery in Crawfish Inlet is unlikely to impact fisheries management due to its remote location and the lack of substantial wild stocks in the inlet. A West Crawfish index stream will be monitored for straying.

Table 4.–Key elements of Alaska fisheries management policies and regulations relevant to salmon hatcheries and fishery enhancement.

Sustainable Salmon Fishery Policy (5 AAC 39.222)	
I. Management principles and criteria	
Assessment of wild stock interaction and impacts	As a management principle, the effects and interactions of introduced or enhanced salmon stocks on wild stocks should be assessed. Wild stocks should be protected from adverse impacts from artificial propagation and enhancement efforts. Salmon escapements are monitored to area systems. Harvest rates and straying of hatchery fish are monitored to Salmon Lake.
Use of precautionary approach	Managers should use a conservative approach, taking into account any inherent uncertainty and risks. Sawmill Creek Hatchery salmon return timing, migration corridors, and impacts to local stocks and fisheries management will be assessed before further increases to salmon production are approved.
Salmon Escapement Goal Policy (5 AAC 39.223)	
Establishment of escapement goals	Management of fisheries is based on scientifically-based escapement goals that result in sustainable harvests. Escapement goals are established for Northern Outside chum salmon stocks and for Sitka Sound and Ford Arm Lake coho salmon stocks.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
Wild stock conservation priority	The conservation of wild stocks consistent with sustained yield is the highest priority in management of mixed-stock fisheries. Salmon fisheries are managed to achieve escapement goals.
Fisheries management review of FTPs (5 AAC 41.010–41.050)	
Review by management staff	All proposed FTPs are reviewed by the regional supervisors for the Divisions of Commercial Fisheries and Sport Fish, the deputy director of Commercial Fisheries, and the local Regional Resource Development Biologist before consideration by the commissioner of ADF&G. Department staff may recommend approval or denial of the permit, and recommend permit conditions. The FTPs for the Sawmill Creek Hatchery program were reviewed by fisheries management staff.

Table 5.–Annual harvest (catch and broodstock) of Medvejie Creek Hatchery salmon released in Sitka Sound and spawning escapement counts of systems or stock groups with escapement goals, 1980–2013.

	Medvejie Creek Hatchery Total Return				Escapement			
Year	Chum	Chinook	Coho	Total	Sockeye[a]	Coho[b]	Chum[c]	Pink[d]
1980				-				30,206
1981				-				375,311
1982				-	456		10,000	117,368
1983				-	2540		21,000	277,769
1984	1,600			1,600	11579		78,000	252,929
1985	39,300			39,300	10669	1117	31,000	545,041
1986	181,743	47		181,790	9,798	510	30,000	97,392
1987	132,403	233		132,636	14,251	1,834	17,000	100,126
1988	42,510	415		42,925	3,252	1,220	19,000	10,886
1989	131,307	495		131,802	31,570	683	15,000	13,286
1990	118,946	2,367		121,313	73,181	311	28,000	12,207
1991	53,962	7,291	11,811	73,064	45,510	549	36,000	57,623
1992	343,728	15,594	8,646	367,968	10,326	526	25,000	24,168
1993	1,635,231	18,763	21,936	1,675,930	25,018	566	16,000	19,841
1994	1,307,610	12,826	60,785	1,381,221	39,710	1,510	14,000	2,887,883
1995	1,287,743	13,039	29,845	1,330,627	34,798	1,899	19,000	237,776
1996	2,819,499	27,815	12,774	2,860,088	19,209	1,474	30,000	708,268
1997	2,595,025	34,542	2,305	2,631,872	28,898	1,961	50,000	1,038,900
1998	3,019,966	21,030	19,410	3,060,406	52,039	1,487	19,000	1,334,879
1999	3,662,701	19,728	17,550	3,699,979	57,754	1,451	52,000	1,615,142
2000	3,571,709	26,607	1,172	3,599,488	3,032	809	96,000	514,239
2001	1,020,368	31,730	4,037	1,056,135	3,665	1,242	58,000	689,227
2002	768,555	41,838	6,962	817,355	23,943	1,686	19,000	972,882
2003	1,107,909	47,332	8,663	1,163,904	68,893	1,101	30,000	1,447,610
2004	2,161,220	65,551	11,677	2,238,448	77,263	1,124	86,000	847,000
2005	1,725,312	28,055	21,547	1,774,914	65,653	1,668	77,000	1,474,000
2006	2,303,503	10,317	7,056	2,320,876	103,953	2,647	57,000	693,000
2007	803,582	30,600	5,439	839,621	66,938	1,066	34,000	667,000
2008	927,034	45,399	3,245	975,678	10,146	1,117	46,000	631,000
2009	787,827	19,631	840	808,298	12,851	1,156	15,000	689,000
2010	1,562,680	21,875	1,057	1,585,612	17,119	1,273	24,000	767,000
2011	368,683	39,684	-	408,367	21,806	2,222	23,000	929,467
2012	656,172	26,367	6,135	688,674	40,903	1,157	28,000	732,000
2013	2,239,714	41,363		2,281,077	48,355	1,248	Y	1,413,000
				Escapement Goal:	7,000–25,000	500–800	19,000	21,000–70,000

Source: Harvest data from NSRAA.org website.

[a] Sockeye salmon escapement is for Redoubt Lake (goal range 7,000–25,000).

[b] Coho salmon escapement is for Sitka Sound systems (goal range 400–800; see Shaul and Tydingco 2006).

[c] Chum salmon escapement is for the northern outside stock group (escapement goal 19,000; see Eggers and Heinl 2008).

[d] Pink salmon escapement is for the Sitka Sound stock group (goal range 21,000–70,000; see Heinl et al. 2008).

Since Sawmill Creek Hatchery is essentially an extension of the Medvejie Creek Hatchery coho salmon program, management for coho salmon can be inferred from returns to Medvejie Creek Hatchery and Deep Inlet, where Sawmill Creek Hatchery releases will occur.

Salmon escapements to Salmon Lake and other Sitka Sound systems have been monitored since statehood (1960). Other systems in Sitka Sound with escapement goals have met goals in most years since the first significant harvests of Medvejie Creek Hatchery returns beginning in about 1986 (Table 5).

No escapement goals are in place specifically for the Salmon Lake system for any species, but pink salmon escapement counts at Salmon Lake are included in the Sitka Sound stock group of pink salmon stocks that do have a goal. From 1980 to 2012, escapement goals in the Sitka Sound pink salmon stock group were met or exceeded in 30 of 33 years. Sitka sound chum salmon stocks are included in the escapement goal for the northern southeast outside stock grouping; from 1982 to 2013, the escapement index goal was met in of 26 of 32 years. The Sitka Sound coho salmon stock group escapement goal has been met every year except one since 1985. The sockeye salmon escapement to goal Redoubt Lake (Figure 3) from 1982 to 2013 was met in 27 of 32 years.

An escapement goal has not been established for Salmon Lake coho salmon. Exploitation rates were estimated from 1983 to 1989, and from 2004 to 2005 through tagging of emigrating smolt (Schmidt 1996; Tydingco et al. 2008). Ford Arm Lake, located about 45 air miles northwest of Sitka, is a wild coho salmon indicator stock for the outer coast of northern Southeast Alaska and has an established escapement goal. ADF&G staff annually assess adult escapement and annual exploitation rates of the Ford Arm stock based on coded wire tag recoveries of adults that were tagged as smolts (Skannes and Hagerman 2014). Estimated exploitation rates were much higher at Salmon Lake than at Ford Arm Lake in 1988 and 1989, but similar to or lower than Ford Arm Lake in the other years. The average exploitation rate at Salmon Lake was 54% versus 59% for Ford Arm Lake for the years of Salmon Lake estimates. The average exploitation rate at Ford Arm Lake for all years assessed (1984–2012) was 52% (Table 6).

Table 6.–Exploitation rates of Salmon Lake and Ford Arm Lake coho salmon stocks.

Year	Salmon Lake Exploitation Rate	Ford Arm Lake Exploitation Rate
1983	36%	54%
1984	35%	Not assessed
1985	57%	52%
1986	55%	61%
1987	47%	45%
1988	72%	47%
1989	74%	62%
2004	62%	64%
2005	52%	51%
Average	54%	59%
Range	35–74%	45–64%

An escapement weir was operated annually at Salmon Lake from 2001 to 2005 (ADF&G) and from 2007 to date (NSRAA). Estimated escapements based on weir counts and mark–recapture experiments in the lake show no clear trends in relation to the magnitude of the all-species return to Medvejie Creek Hatchery (Figure 4).

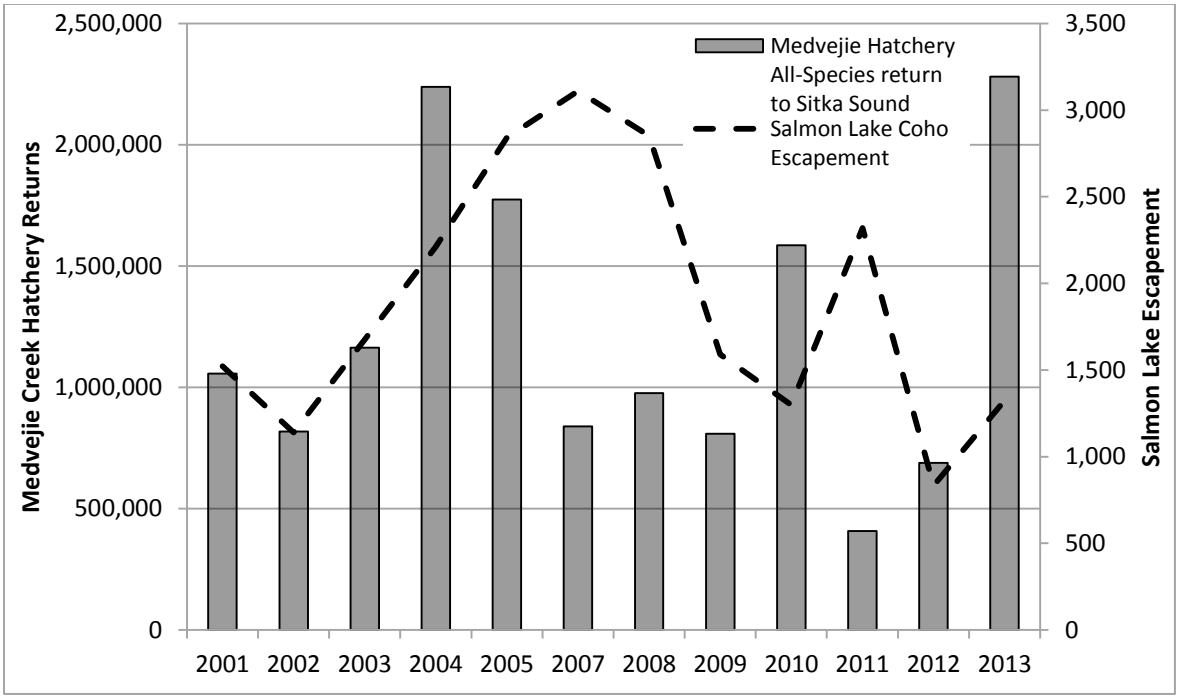

Figure 4.–Escapement to Salmon Lake and the total return of all species of salmon to Medvejie Creek Hatchery Sitka Sound release sites, 2001–2004 and 2007–2013. The escapement weir was not operated in 2006. Unbiased escapement estimates were not available for 2004, 2011 and 2012.

Salmon Lake Coho Salmon Stock Assessment

According to the BMP, NSRAA will carry out annual tagging of juvenile Salmon Lake coho salmon from 2013 to 2015. No tagging occurred in 2013, as smolt emigration was apparently earlier than expected and no juvenile coho salmon were captured.[17] The tagging operation was attempted in 2014, and only seven juvenile coho salmon were tagged. Tagging operations will be attempted again in 2015. Juvenile tagging will include adipose and pelvic fin removal so the fish can be differentiated from adipose finclipped fish that were tagged elsewhere. This allows returning adults that were tagged as smolts at Salmon Lake to be passed through the weir.[18]

Coho salmon in the commercial, sport, and cost-recovery fisheries, at the Salmon Lake weir, and at the hatchery racks will be sampled for coded wire tags. Comparative data will be used to determine exploitation rates for the naturally produced and hatchery-produced Salmon Lake

[17] Scott Wagner, NSRAA Operations Manager, personal communication.

[18] Ibid.

stocks. Data from Salmon Lake coho salmon tag recoveries will also to be used to establish an escapement goal.

CONSISTENCY IN PERMITTING

Hatchery permit/BMP, AMP, and FTP documents for Sawmill Creek Hatchery operations were reviewed to determine that they met the following guidelines:

- They are current.
- They are consistent with each other.
- They are an accurate description of current hatchery practices.

The hatchery permit and BMP do not expire. The BMP should be updated when any permit amendments are approved through PARs. FTPs for all egg takes and transfers are in place and current. The snorkel survey required in the BMP is not listed in the AMP. The coho smolt tagging program described in the BMP is not the same as that prescribed in the AMP.

RECOMMENDATIONS

1. The BMP should be updated for several items.
    a. Add the chum salmon program.
    b. Section 2.5 of the current BMP indicates in the first paragraph that straying will be assessed by carcass sampling and in the second paragraph that straying may be assessed based on live fish and carcass sampling for at least the first three years of returns of Salmon Lake stock. The language should be made consistent or clarified.
    c. The BMP indicates that the juvenile coho salmon tagging program in Salmon Lake would occur in the fall. However, NSRAA is conducting the program in the spring. The BMP should be changed to reflect the current practice.
2. The smolt tagging project at Salmon Lake was not successful in tagging enough fish for statistically meaningful results in 2013 and 2014. The 2015 season was a substantial improvement, and NSRAA staff estimate they marked about 2% of the outmigration.[19] ADF&G and NSRAA staff should determine what steps are necessary to continue the program until sufficient numbers of smolt are tagged over a number of years to determine exploitation rates as stated in the BMP. Adequate tagging information can also contribute to development of a sustainable escapement goal as stated in the FTP for the program.
3. The Phase III CSP language regarding de facto wild stock sanctuary status in wilderness areas of the Tongass National Forest should be revisited by the RPT. The Phase III CSP states that "In Southeast, enhancement activities are generally prohibited in all Forest Service lands/drainages classified as "wilderness," although such activities may be possible provided a strong need has been identified. In most respects, these areas are essentially de facto sanctuaries." Unfortunately, no document or regulation was cited for this statement. The statement appears to directly conflict with federal law. Since 1980, the federal government has clearly provided for hatchery activities in designated

[19] Scott Wagner, NSRAA Operations Manager, personal communication.

wilderness areas of the Tongass National Forest under the Alaska National Interest Lands Conservation Act[20] and reaffirmed such provisions in 2008 under the Tongass Land and Resource Management Plan (United States Department of Agriculture 2008, Chapter 3). The Crawfish Inlet project consists of net pens located adjacent to and surrounded by the South Baranof Wilderness area of the Tongass National Forest. The U.S. Forest Service has acknowledged that aquaculture projects, including facilities associated with hatcheries, may be considered for wilderness areas within the Tongass National Forest.[21] The U.S. Forest Service also indicated that "optimum sustained yield levels will be considered synonymous with the long-term harvest goals documented in the State of Alaska Comprehensive Salmon Plans and other state fisheries plans."[22]

4. Several recommendations are made for the straying assessments.

    a. Although straying to Salmon Lake appears to be low, the number of adipose finclipped fish recovered without a coded wire tag makes accurate assessment impossible. Since all coho salmon released from Sawmill Creek Hatchery are otolith marked, any fish recovered at Salmon Lake without an adipose fin that is found to be missing a coded wire tag should have the otolith removed and read.

    b. Assessment of *straying* should be reviewed. In 2014, adipose finclipped coho salmon passed through the weir undetected, and were later caught during mark–recapture sampling in the lake. An assumption could be made that adipose finclipped fish that were marked at the weir and released downstream could also pass the weir undetected.

        Only a small number of marked fish are encountered at the weir. The straying threshold for reassessment of the project in the BMP is also small (2%), and therefore any marked fish that are released downstream and then pass the weir undetected could be a significant bias to the stray estimate. Other methods of estimating stray rate should be considered to replace or supplement the current program.

        In addition, *cause for concern* stray rates should be considered as an average over a number of years because individual year estimates may be unduly stochastically influenced by the effects of tagged fish passing undetected through the weir and adipose-clipped fish missing a coded wire tag as described above.

    c. The original BMP indicated that the straying evaluation at Salmon Lake was for genetic concerns regarding the Plotnikof Lake stock produced at Medvejie and Sawmill Creek hatcheries straying to Salmon Lake. A 2% straying threshold was established as a trigger for reevaluation of hatchery practices and production. When the donor stock was changed from Plotnikof Lake to Salmon Lake, any hatchery release straying to Salmon Lake would have similar genetic makeup.

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[20] United States Congress. Alaska's National Interest Lands Conservation Act. Public Law 96-487, Section 1315 (b) Dec. 2, 1980.

[21] Letter from D. Martin, Acting District Ranger, U.S. Forest Service to S. Wagner, Operations Manager , NSRAA, dated June 4, 2014. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[22] Letter from C. Goularte, District Ranger, U.S. Forest Service to L. Speerstra, Dept. of the Army, Sitka Field Office, dated February 11, 2014. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

The Phase III CSP states that an "acceptable rate of straying for a proposed project will be defined in relation to specific neighboring wild stocks. Setting the acceptable rate will depend on many factors, including (but not limited to) the likelihood of temporal overlap on the spawning grounds, significance of the wild stock, and how closely the two stocks are related."

When the BMP was updated after the PAR was approved to change broodstock from Plotnikof Lake to Salmon Lake (2009), the stray rate to trigger a reevaluation of the project remained at 2%, despite the change in broodstock. The 2% stray level as a *cause for concern* should be reconsidered because of the change to Salmon Lake stock.

5. Sampling of postspawned fish in Sawmill Creek should be considered if the snorkel surveys continue to provide uncertain results. In the 2014 survey, a total of 105 postspawn fish were observed during 11 survey events. All coho salmon released from Sawmill Creek are otolith thermal marked. Otolith sampling of the postspawn fish would provide more definitive results over attempts to identify and collect adipose finclipped fish during snorkel surveys.

DISCUSSION

Alaska hatchery and fisheries enhancement programs are governed by a comprehensive permitting system designed to protect wild stocks and provide increased harvest opportunities. The success of fishery enhancement efforts depends on implementing that system and ensuring policies are followed. Today, the combination of favorable environmental conditions, sustainable management of wild stock systems, and hatchery production supports economically healthy salmon fisheries in Southeast Alaska.

Garforth et al. (2012), in the first surveillance report for certification of Alaska's salmon fisheries under the Food and Agriculture Organization-based responsible fisheries management certification, indicated the need for hatchery and wild stock interaction study: "To evaluate whether or not fitness of natural-origin (wild) versus stray hatchery-origin salmon differ when spawning in the wild, survival of both types of fish and their relative spawning success needs to be documented."

Prior to Garforth et al. (2012), the executive directors of most of the Alaska PNP hatchery operations met in 2009 with the ADF&G commissioner expressing the need for such a study. The following year, plans for funding and implementing the study were initiated. A science panel composed of current and retired scientists from ADF&G, University of Alaska, aquaculture associations, and National Marine Fisheries Service—with broad experience in salmon enhancement, management, and wild and hatchery interactions—designed a long-term research project to potentially answer some of these questions. The proposed study length was about 11 years, with four years initially funded.[23] The study, entitled *Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska*, is currently underway.

Study funding is shared between the PNP operators, State of Alaska, and Alaska salmon processors, and administered by ADF&G. Field work is conducted by the Sitka Sound Science Center and Prince William Sound Science Center. One of the study index streams in West

[23] Steve Reifenstuhl, NSRAA Executive Director, personal communication.

Crawfish Inlet will be used to monitor strays from the Crawfish Inlet chum salmon release from Sawmill Creek Hatchery. This will complement the stray monitoring for coho salmon occurring in Sawmill Creek and Salmon Lake. These studies will improve understanding of hatchery and wild stock interactions and provide Alaska-specific scientific guidance for assessing Alaska's hatchery program, including recommendations for escapement goals, fisheries management, hatchery production levels, and hatchery practices in the state.

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APPENDIX

Appendix A.–Sawmill Creek Hatchery PNP hatchery permit history.

Date	Permit	Permitted Capacity (millions) Coho	Chum
3/11/2007	Permit issued for 4.332 million coho salmon eggs. Broodstock source is Plotnikof Lake. Release sites at Medvejie Creek Hatchery and Deep Inlet. Stepwise smolt releases allowed as follows: 2007: 10,000 from Bear Cove and 220,000 from Deep Inlet; 2008 20,000 from Bear Cove and 170,000 from Deep Inlet; 2009: 50,000 from Bear Cove and 500,000 from Deep Inlet. Increases from 2008 forward contingent on low stray rates to Salmon Lake and Sawmill Creek. If stray rate is 2% or greater in Salmon Lake, releases from Medvejie Creek Hatchery will be reduced or stopped. If stray rate is 2% or greater at Sawmill Creek, releases from Medvejie Creek Hatchery and possibly Deep Inlet will be reduced or stopped.	4.332	
6/10/2009	Permit alteration approved to change coho salmon broodstock source from Plotnikof Lake stock to Salmon Lake stock.	4.332	
5/7/2014	Permit alteration approved to add 30 million Medvejie Creek Hatchery stock chum salmon capacity for release at West Crawfish Inlet.	4.332	30

Appendix B.–Sawmill Creek Hatchery fish transport permit (FTP) history.

FTP No.	Issued	Expiration	FTP Summary
09J-1018	2009	2013	Collect up to 325,000 eggs from up to 130 wild stock females at Salmon Lake for incubation. Release of up to 50,000 smolt at Medvejie Creek Hatchery (Bear Cove). All fish will be coded-wire-tagged and thermally marked. NSRAA to implement a wild presmolt coded wire tagging project from 2013 to 2015.
09J-1019	2009	2013	Transfer, rear and release at Deep Inlet up to 200,000 Salmon Lake stock coho salmon smolts that were incubated at Medvejie Creek Hatchery. At least 30,000 of the Deep Inlet releases will be tagged. NSRAA to implement a wild presmolt coded wire tagging project from 2013 to 2015.
12J-1008	2012	2022	Collect 4.332 million green coho salmon eggs from Salmon Lake stock coho salmon returns to Medvejie Creek Hatchery to be transported, fertilized, incubated, and reared at Sawmill Creek Hatchery for release at Deep Inlet. All fish will be thermally marked and at least 30,000 of the releases will be coded-wire-tagged.
12J-1023	2012	2022	Collect and transport adult coho salmon from Deep Inlet to Medvejie Creek hatchery for use as broodstock for collection of up to 4.330 million green eggs. This is a back up to 12J-1008.
14J-1006	2014	2024	Allows Salmon Lake stock coho salmon fry to be transported from Sawmill Creek Hatchery to Medvejie Creek Hatchery for rearing and release as a contingency in the event of a water emergency or for inventory adjustments.
14J-1007	2014	2024	A 1-year FTP that permitted transfer of fry from the hatchery to net pens in Green Lake. This FTP was a backup to FTP 14J-1006 in the event there was not enough water at Medvejie Creek Hatchery.
14J-1017	2014	2024	Collect up to 30 million Medvejie Creek Hatchery stock chum salmon eggs for incubation at Sawmill Creek Hatchery then rearing and release at Crawfish Inlet.

Appendix C.–Hatchery production at Sawmill Creek Hatchery.

Brood Year	Species	Egg Take	Release	Release Site	Adult Return[a]
2009	Coho	265,991	54,720	Bear Cove	1,279
			167,826	Deep Inlet	4,911
2010	Coho	174,903	50,421	Bear Cove	5,571
			116,130	Deep Inlet	12,253
2011	Coho	222,015	53,026	Bear Cove	5,038
			158,968	Deep Inlet	12,466
2012	Coho	470,880	72,114	Bear Cove	
			269,449	Deep Inlet	
2013	Coho	1,506,768			
2014	Coho	941,876			
	Chum	15,037,740			

[a] Does not include coho jack returns.