Regional Information Report No. 5J13-05

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

by

Mark Stopha

July 2013

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 GULKANA SALMON HATCHERY FOR CONSISTENCY WITH STATEWIDE POLICIES AND PRESCRIBED MANAGEMENT PRACTICES

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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. Hatchery management plans and permits were examined to determine whether they were current, consistent with each other, and accurately described hatchery operations.

This report reviews the Gulkana Hatchery operated by the Prince William Sound Aquaculture Corporation. The hatchery was established by ADF&G in 1973 to mitigate habitat loss due to road construction. The facility incubates the largest number of sockeye salmon *Oncorhynchus nerka* eggs of any hatchery in the world. The hatchery consists of two sites along the Gulkana River, a tributary to the Copper River near Paxson, Alaska. Sockeye salmon gametes are collected from adults returning to the Gulkana River next to the hatchery sites and placed in outdoor incubators fed by ground water. Progeny are released onsite and at nursery lakes (Summit, Crosswind, and Paxson lakes) with adequate rearing habitat for sockeye salmon fry.

Returning hatchery-produced adults are intermixed with naturally spawned wild sockeye salmon. Therefore, hatchery-produced fish are managed for the same harvest rate as naturally spawned stocks in the commercial, sport, personal use, and subsistence fisheries. Hatchery-produced fry are otolith marked with strontium chloride and the otoliths recovered in the harvest for contribution estimates to the fisheries. Total hatchery runs have comprised between 4% and 29% of the sockeye salmon fisheries in the Copper River watershed since 2000. The lower bound of the wild sockeye salmon escapement goals in the upper Copper River and Copper River delta area have been met in most years since hatchery releases began.

Key words: Gulkana Hatchery, hatchery evaluation, hatchery, sockeye salmon, Prince William Sound Aquaculture Corporation.

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 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 wild stock 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).

Salmon restoration efforts came in response to statewide annual salmon harvests of 30 million fish, among the lowest catches since 1900 (Figure 1, ADF&G 2012). 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 hatchery production gradually boosted salmon catches, with recent commercial salmon harvests (2002–2011) averaging 171 million fish (Vercessi 2013).

In Alaska, the purpose of salmon hatcheries is to supplement wild 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* 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. 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.

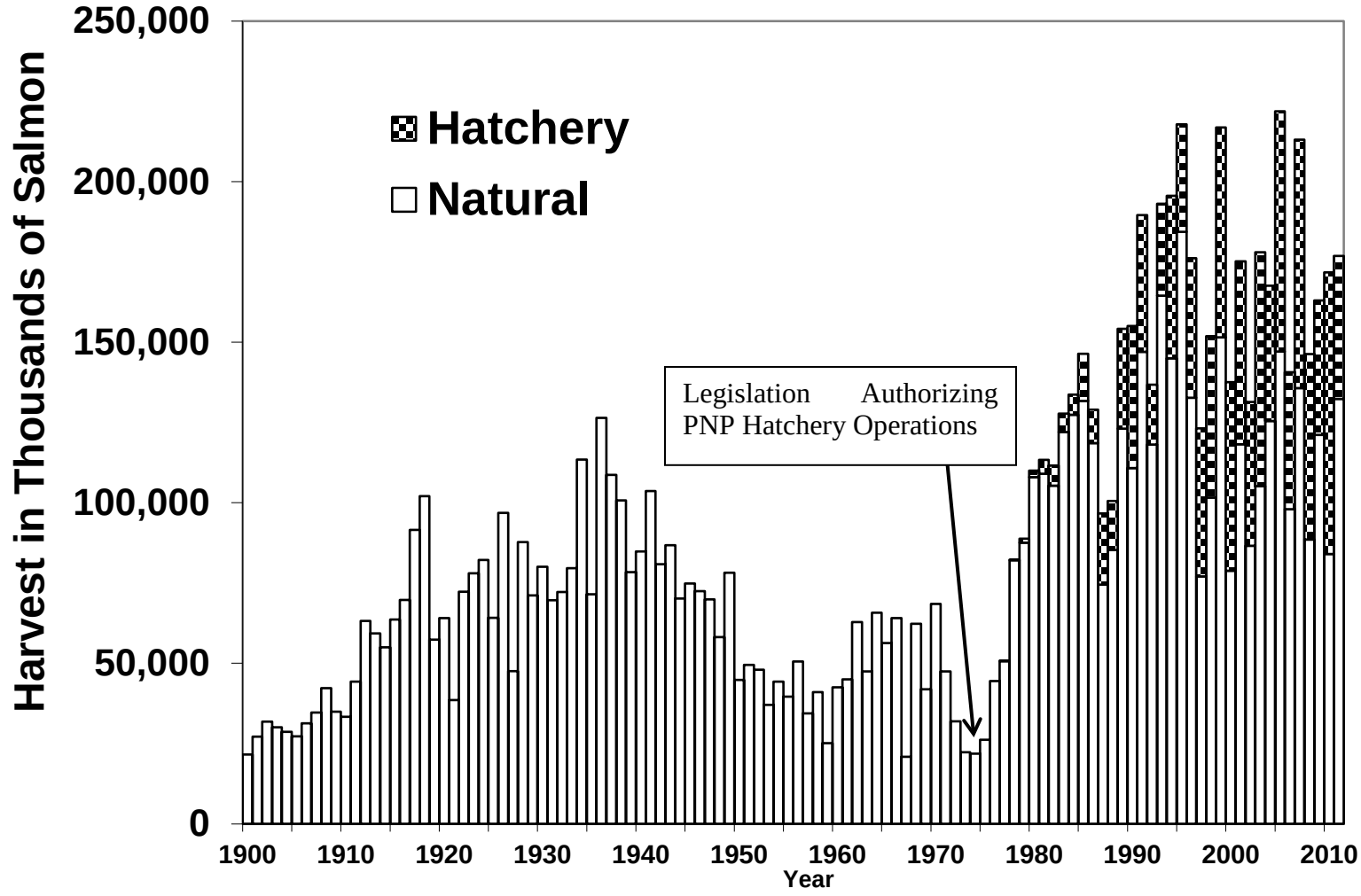

Figure 1.–Commercial salmon harvest in Alaska, 1900–2011.

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 2002 to 2011, pink salmon accounted for an average 71% of Alaska hatchery salmon returns by number, followed by chum (21%), sockeye (5%), coho (2%) and Chinook (<1%) salmon (Farrington 2003, 2004; White 2005–2011; Vercessi 2012).

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 farmed salmon flooded the marketplace in the U.S., Europe, and Japan. Alaska responded to the competition by improving fish quality at harvest 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 despite large fluctuations in harvest volume (ADF&G 2012). The exvessel value of hatchery harvest increased from $46 million in 2002 to $136 million in 2011.[1] First wholesale value also showed an increasing trend, with the value of hatchery fish increasing from $160 million in 2002 to $314 million in 2011.[2] Pink and chum salmon combined accounted for over 75% of both the exvessel value and the first wholesale value of the hatchery harvest from 2002 to 2011. During this period, hatcheries contributed an average 35% of the total Alaska salmon harvest, in numbers of fish (Farrington 2003, 2004; White 2005–2011, Vercessi 2012). 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 to ensure adequate numbers of adults spawn, and the wild harvest is arguably at its maximum, given fluctuations due to environmental variability and imperfect management precision. 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.

Part of the reason for the rise in price of Alaska salmon was a message of 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

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[1] 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 02/04/2012), multiplied by the hatchery percent of the commercial harvest in Farrington 2003, 2004; White 2005– 2011, and Vercessi 2012.

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

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 Alaska Seafood Marketing Institute changed to a new sustainable fishery certification under the Food and Agriculture Organization in 2011. The hatchery evaluations started under the MSC certification 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, 2013a, 2013b) completed reviews of the Trail Lakes, Port Graham and Eklutna hatcheries in Cook Inlet and the Solomon Gulch Hatchery in Prince William Sound (PWS). This report is for the Gulkana Hatchery in the PWS/Copper River region. Following completion of hatchery reviews in the PWS/Copper River region, reviews of Southeast Alaska hatcheries 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 2010), 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 for enhancement (except US/Canada transboundary rivers); restricting transportation of stocks between the major geographic areas in the state (Southeast, Kodiak Island, PWS, 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.

The *Genetic Policy* also requires 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 non-sensitive 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 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 of, or enhancement of a stock (e.g., releases for terminal harvest or 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.

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 2010). 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 the *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), comprised primarily of commercial salmon fishing permit holders, operate most of the PNP hatcheries in Kodiak, Cook Inlet, PWS, 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. RAAs may vote to impose a salmon enhancement tax on sale of salmon by permit holders 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 hatcheries or release sites to pay for operations. Several organizations have tourist and educational programs that contribute to the financial support of their programs, as well.

Public participation is an integral part of the PNP hatchery system, and hearings are held before a hatchery is permitted for operation. RPTs comprised of ADF&G and RAA personnel 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 review applications for new hatcheries to determine compatibility with the comprehensive salmon plan, and also 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 (5 AAC 40.110–990 and 5 AAC 41.005–100) and statute (AS 16.05.092): hatchery permit with basic management plan (BMP), annual management plan (AMP), fish transport permit (FTP), and annual report (Figure 2).

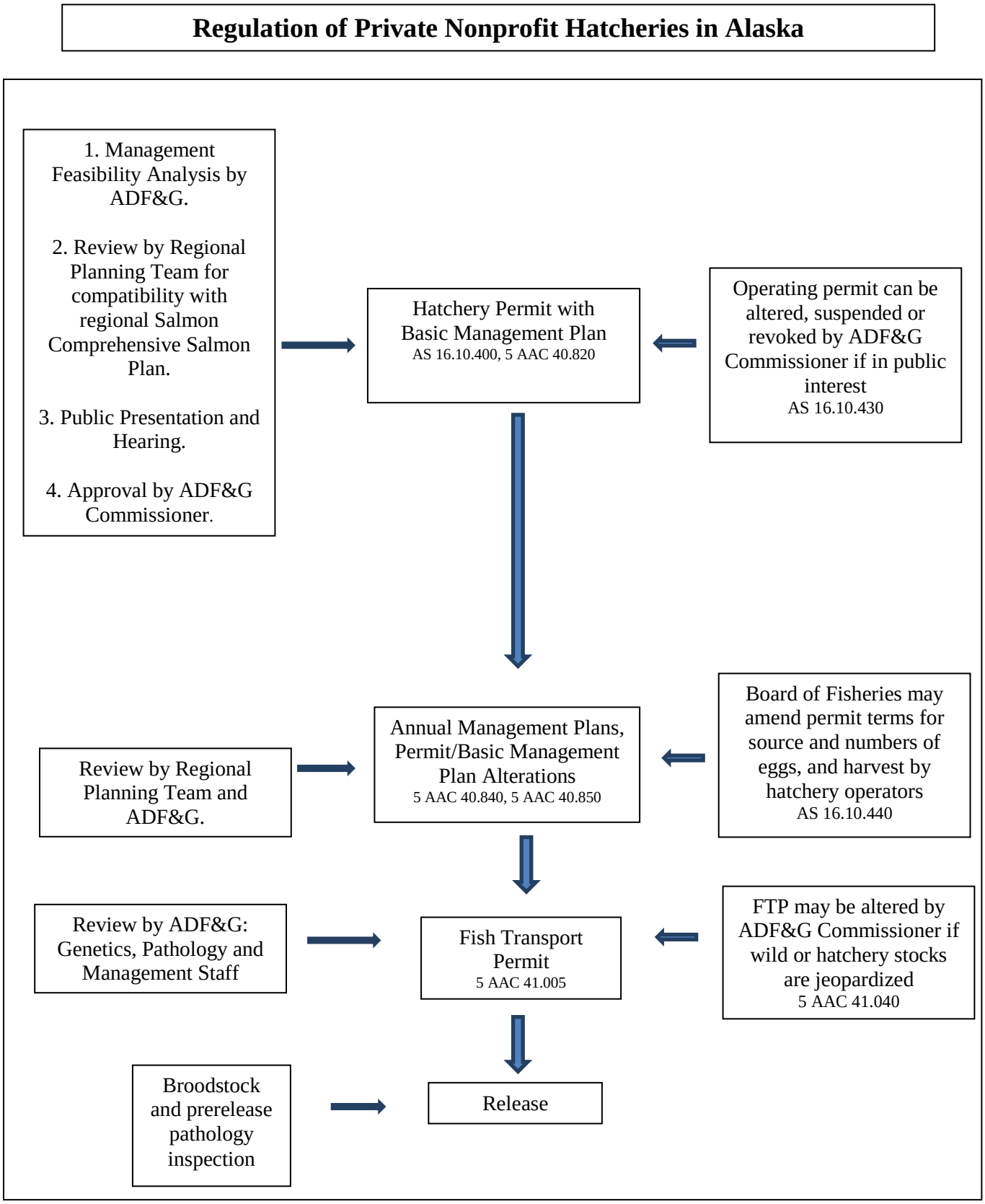

Figure 2.–Diagram of Alaska hatchery permitting process.

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 revoked by the ADF&G commissioner or relinquished by the permit holder.

Hatchery permits/BMPs may be amended through a permit alteration request (PAR). Requested changes are 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 and is in effect until superseded by the following year's AMP. 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 upcoming 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. Information for all hatcheries is compiled into an annual ADF&G report (e.g., Vercessi 2013) 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 cultured, stock lineages, releases, returns, and pathology.

GULKANA HATCHERY OVERVIEW

The Gulkana Hatchery complex is located near Paxson, Alaska along the Richardson Highway about 80 miles south of Delta Junction (Figure 3).

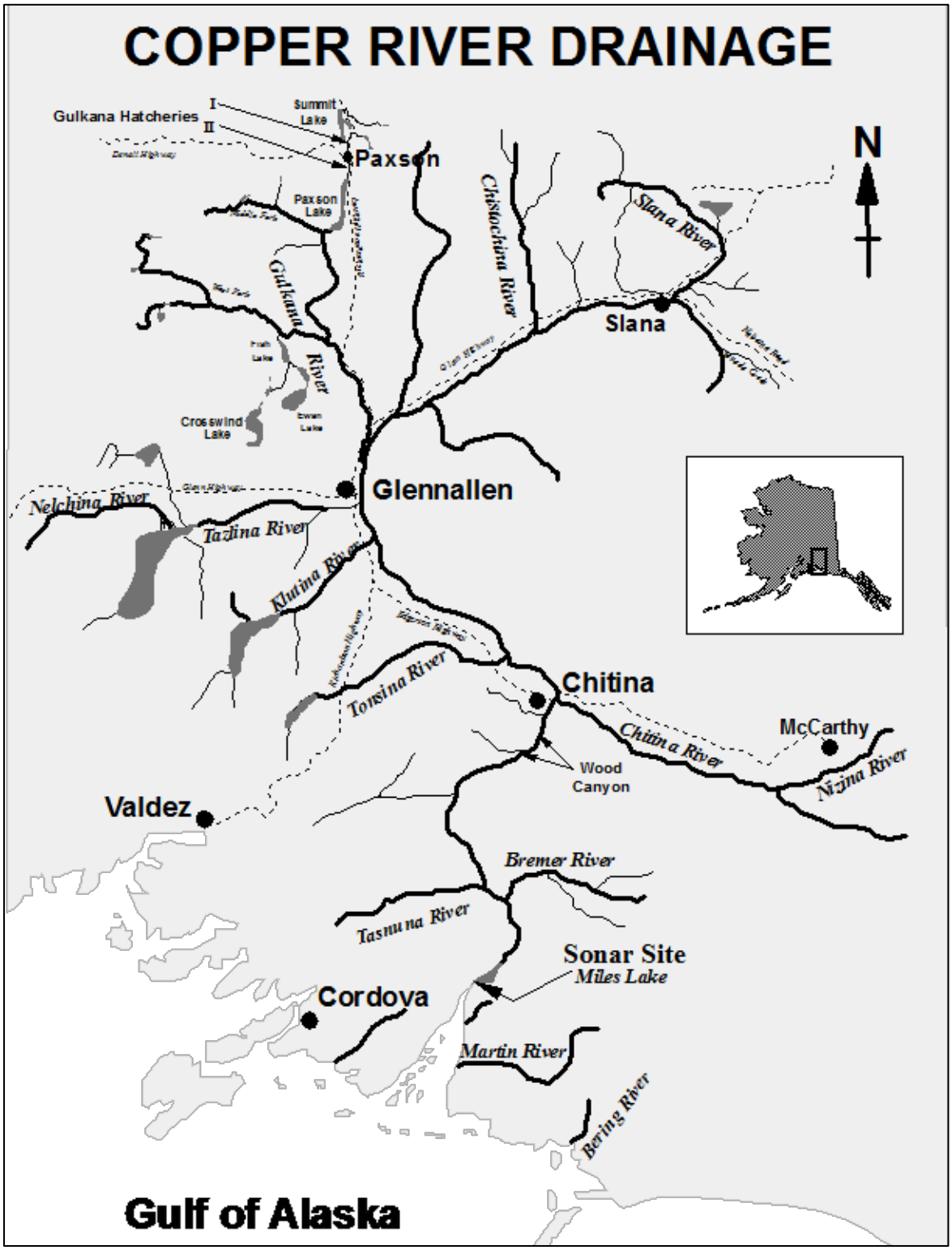

Figure 3.–Gulkana I and Gulkana II hatchery locations.

The Gulkana Hatchery was established in 1973 by the ADF&G FRED Division as a sockeye salmon streamside incubation facility to mitigate spawning habitat lost due to road construction. By 1984, Gulkana Hatchery was incubating the largest number of sockeye salmon eggs of any hatchery in Alaska at 26 million eggs. The hatchery is located in the Copper River Basin, 260 miles from the Gulf of Alaska at the base of the Alaska Range, near the headwaters of the Gulkana River. In 1993, ADF&G contracted the Prince William Sound Aquaculture Corporation (PWSAC) to operate and manage the hatchery at no cost to the state. A history of the early years of the operation can be found in Roberson and Holder (1993).

PWSAC is the RAA for PWS. The PWSAC Board of Directors has 45 members. Twenty-seven board members hold PWS commercial salmon fishing permits, and are elected by PWS commercial salmon fishing permit holders. The remaining 18 seats are designated representatives from municipalities, Alaska Native organizations, fish processors, sport fisheries, personal use fisheries, and subsistence fisheries, and are appointed by the board (website: http://pwsac.com/about/board-directors/ accessed 10/24/2012 and Dave Reggiani, PWSAC General Manager, personal communication).

The Gulkana Hatchery complex is the most basic hatchery operation of comparable size in Alaska, and is comprised of two facilities. The Gulkana I facility was constructed in 1973 on the east fork of the Gulkana River between Summit and Paxson lakes (Figure 3). The site provides a high quality water source that continues to flow even during temperatures as low as -51 degree Celsius (Roberson and Holder 1993). In 1987, another streamside incubation site, Gulkana II, was established downstream of the Gulkana I site.

Eggs are collected from broodstock in the nearby Gulkana River and placed in incubators with a gravity-fed groundwater supply. Eggs remain in the incubators until hatching, with no picking or shocking of eggs. The facility is not manned year round but is monitored at least three times per week during the winter (Gary Martinek, PWSAC Gulkana Hatchery Manager, personal communication). Emergent fry are captured in aluminum collection boxes as they emigrate from the incubators. Fry are held in a strontium chloride solution for 24 hours to mark their otoliths. Some fry are released directly on site into the Gulkana River and Paxson Lake. The remainder may be held until enough fry accumulate for air drop into Crosswind Lake or until ice conditions allow stocking into Summit Lake (Gary Martinek, Gulkana Hatchery manager, personal communication).

The state operated the hatchery from 1973 until 1993, at which time ADF&G entered into a contract with PWSAC to operate and manage the facility. In 2000, a hatchery permit and BMP was issued to PWSAC to operate the facility as a PNP hatchery, and the facility remained under state ownership. Four year-round staff and up to 16 seasonal staff operate the facility. (2011 Alaska Department of Community and Economic Development Grant Report, Prince William Sound Aquaculture Corporation-Gulkana Hatchery Maintenance and Upgrade, unpublished). The permit and BMP allow a maximum of 35 million sockeye salmon eggs at the Gulkana I facility and 1.75 million eggs at the Gulkana II facility. Permitted fry release sites include Paxson Lake, Summit Lake, Crosswind Lake and onsite release at Gulkana II. Beginning in 2000, all fry releases were otolith marked with strontium chloride. According to the BMP, target production for the Gulkana Hatchery is an average annual hatchery contribution of 15% to 20% of the total wild and hatchery return, which at the time of the writing of the BMP resulted in an average annual hatchery return target of about 300,000 adults. Otolith marking was just beginning when the BMP was issued. The BMP stated that the new marking would allow a complete evaluation of hatchery releases and returns. The BMP indicated that after two

complete brood years returned that had successful otolith marking, the egg take and fry stocking levels could be evaluated to consider any adjustment in production to achieve the target production of 300,000 adults. This evaluation has not occurred to date.

The permit has not been substantively altered since it was issued in 2000 (Appendix A). Two permit alterations were approved in 2006, and both expired in 2009. The first required PWSAC to conduct annual sockeye salmon smolt enumeration at Summit and Crosswind lakes; conduct annual limnology sampling at Crosswind, Paxson, and Summit lakes; and conduct a feasibility study for annual smolt enumeration at Paxson Lake. In addition, the approved PAR increased the maximum permitted stocking level at Crosswind Lake from 7.6 million to 10 million sockeye salmon fry, and decreased the permitted stocking of Paxson Lake from 10.0 million fry to 6.0 million fry. These stocking level changes were based on an evaluation of zooplankton biomass and density in relation to past stocking levels.

The approved PAR also indicated that it "decreases the permitted stocking of Summit Lake to 6 million fry." However, this was not a change to the hatchery permit/BMP, as Summit Lake was already permitted for up to a 6 million fry release in the BMP. PWSAC was permitted to release up to 10 million fry into Summit Lake under FTP 96A-0039 from 1996 to 2006, but the issuance of the hatchery permit/BMP effectively reduced the permitted number to a maximum release of 6 million fish. The 2006 PAR approval appeared to be an attempt to alter the FTP, rather than the hatchery permit.

A second PAR approved in 2006 clarified that PWSAC was required to fund the preparation and analysis of the otoliths that ADF&G collects annually from sockeye salmon harvested in the personal use fishery on the Copper River.

In 2010, a PAR was submitted to continue the PAR approved in 2006, but with increases to the number of fry released into Crosswind Lake (from 10 million to 12 million), Paxson Lake (from 6 to 8 million), and Summit Lake (from 6 to 7.5 million). The PAR also included additional fry release sites at Ten Mile Lake (1.5 million) and Monsoon Lake (1.0 million). In the PAR application, PWSAC staff reported a decline in fry to adult survival from 2000 to 2003, and indicated they thought the decline may have been due to predation by resident fish in the lakes and sea gulls. The increase in fry stockings would come from excess fry that are produced annually as a buffer to mortality caused by sporadic incidence of IHVN. When IHNV is not incurred, these excess fry are normally destroyed.

ADF&G staff did not support the increased fry stockings to the nursery lakes, nor the addition of new release sites. They did not agree that predation was a problem with fry to adult survivals, and argued that stocking sockeye salmon in Monsoon and Ten Mile lakes could potentially expose Chinook salmon spawning downstream of these lakes to INHV carried by adult sockeye salmon returning to the release sites. The geneticist opposed the increased stockings because both new release sites were close to areas with wild spawning sockeye salmon, and increased stockings to the lakes already in use could increase straying when adults returned to the release sites. Analyses of productivity in the nursery lakes in use indicated that higher levels of fry density significantly reduced the zooplankton food crops in these lakes, whereas the levels in place at the time did not. ADF&G staff recommended maintaining the status quo release strategy of the Gulkana hatchery program (Prince William Sound Permit Alteration Requests from Jeff Regnart, Ron Josephson, and James Hasbrouck to John Hilsinger and Charles Swanton, April 19, 2010, memorandum. Obtained from Bert Lewis, Regional Resource Development Biologist; ADF&G; Anchorage).

The PWS RPT recommended continuation of the 2006 PAR provisions, with no changes in permitted fry release numbers nor addition of Monsoon and Ten Mile lake release sites. The PAR was approved by the ADF&G commissioner as recommended by the RPT.

In most years, the full permitted egg capacity of 36.75 million eggs is collected for incubation. Since 1993, sockeye salmon annual releases of juvenile fish ranged from 7 million in 2004 to 32 million in 1998. Reduced releases were usually due to mortalities from IHNV and strontium chloride otolith marking. A record 1.1 million adult sockeye returned in 1999, with a 2002 to 2011 average return of about 300,000 fish per year (Appendix B).

The Copper River commercial sockeye salmon fishery, which occurs in saltwater near the mouth of the Copper River, primarily harvests two groups of stocks: those that travel up the Copper River to spawn (upriver stocks), and those that spawn in lakes and streams near the river terminus (delta stocks). There is considerable overlap in timing among the hatchery, upriver, and delta stocks harvested in the fishery (Merritt and Roberson 1983), and therefore hatchery stocks are managed for the same harvest rate as the wild stocks. Since 2000, Gulkana Hatchery contributions to the total Copper River sockeye salmon returns ranged from 4% to 29% (Appendix C).

Management of the fisheries is based on meeting wild stock escapement and allocation needs under the Copper River District Salmon Management Plan (5 AAC 24.360). Since the hatchery run is intermixed with wild upriver and delta stocks, no terminal fishery for the hatchery stocks is possible. The inriver escapement number [5AAC 24.360 (b)] for the Copper River is the sum of the spawning escapement requirement for the upriver stocks, the Gulkana Hatchery return, allocations for the subsistence, personal use, and sport fisheries, and an estimated number of other salmon species (because the fish sonar counter cannot differentiate the species) that pass the Miles Lake sonar fish counter, located about 30 miles above the Copper River commercial fishing district. The inriver escapement number is then apportioned to anticipated daily sonar counts using historical wild and hatchery fish run timing data. Spawning escapement requirements and subsistence allocations are apportioned using the wild fish run timing. Hatchery broodstock and hatchery surplus are apportioned using the hatchery fish run timing. Personal use and sport fishery requirements are apportioned using the overall timing curve. The commercial fishery is managed primarily based on the anticipated daily counts versus the actual cumulative daily counts past the sonar until early to mid-June, when escapements to later-run Copper River delta index streams become important. Escapements to the delta systems are primarily monitored by aerial surveys.

The Copper River District commercial sockeye salmon fishery has opened in recent years for two fishing periods per week from early May through the end of July. This fishery provides for "pulses" of escapement, dispersing fishing pressure across the over 100 systems that comprise upper Copper River stocks and about 30 systems comprising the Copper River delta stocks (Brady et al. 1990). The length of fishing periods depend upon trends in escapement, harvest, and environmental conditions.

The first escapement goals for upriver stocks were established in 1972 and for delta stocks in 1991 (Fried 1994). Escapement goals were reviewed and updated in 1994 (Fried 1994), 2002 (Bue et al. 2002), 2005 (Evenson et al. 2008), and 2011 (Fair et al. 2011). The 2011 escapement goal was 300,000 to 500,000 fish for the upriver stocks and 55,000 to 130,000 fish for delta stocks. The upriver escapement goal was changed to 360,000 to 760,000 beginning in 2012 (Fair et al. 2011). The lower bound of the escapement goal range in effect was met for upriver stocks

every year from 1981 to 2011. From 1991 to 2011, the lower goal for delta stocks was met in 17 of the 21 years, albeit at the lower end of the range in many years (Appendix D).

During the early years of hatchery releases, the total run was estimated by applying a survival rate to releases and assuming hatchery fish were harvested in proportion to their abundance in the fisheries. Thermal marking of otoliths is not practical due to the simple setup of the hatchery. In 1979, ADF&G began tagging smolts from Summit Lake with coded wire tags, and Crosswind Lake smolt tagging began in 1990. Coded-wire tagging was continued through 2001. Fry releases from the hatchery and smolt emerging from Paxson Lake were not coded-wire-tagged. In 2000, PWSAC began otolith marking 100% of fry released into Summit, Crosswind, and Paxson lakes with strontium chloride. Fish are sampled from the commercial and personal use fisheries to estimate hatchery contribution.

PROGRAM EVALUATIONS

Hatchery permit/BMP, AMP, and FTP documents for Gulkana Hatchery 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, and the BMP should be updated when any permit alterations are approved.

When PWSAC took over the hatchery from ADF&G in 1993, operations were guided only by the AMPs and FTPs until the hatchery permit/BMP was issued in 2000. An FTP was not found for the egg takes at Gulkana I for the first years that PWSAC operated the facility from 1994-1996. This may have been an oversight by ADF&G because no FTP was found for the egg takes at Gulkana I prior to 1994, when ADF&G operated the facility.

In 1996, FTPs were issued for Paxson, Summit and Crosswind lakes for annual releases of 10 million fry each (Appendix F). Each year, the stocking rates for each lake were adjusted based on recommendations from the ADF&G Limnology Lab and smolt growth data.[3] When the hatchery permit/BMP was issued to PWSAC in 2000, the stocking levels were changed in the BMP for Summit Lake (6 million) and Crosswind Lake (7.6 million). Subsequent changes in stocking rates in the AMP and changes from approved PARs have not been updated in the BMP.

The current Gulkana Hatchery program FTPs were reviewed and approved by ADF&G personnel. FTPs could not be found for the early years of the program when ADF&G was operating the facility, and FTPs may not have been issued for transfers (Sam Rabung, ADF&G Hatchery Coordinator, personal communication). FTPs issued since PWSAC took over operations in 1993 were renewed as necessary (Appendix E), except that an FTP was not issued for broodstock taken from Crosswind Lake returns. The use of Crosswind Lake and Summit Lake returns for broodstock is provided for in the AMP when returns to the hatchery are not sufficient to meet egg take requirements.

[3] 1998 Annual Management Plan Summary, Gulkana Hatchery I and II. Prince William Sound Aquaculture Corporation. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

The 2011 AMP provides thorough documentation of expected operations for the season, including egg-take and release goals, a listing of current FTPs, expected returns, hatchery return management, plans for otolith marking, and evaluation plans. Egg takes and fry releases reported in the annual report were in close agreement to levels permitted in the FTPs and AMPs for most years (Appendix F).

COMPREHENSIVE SALMON PLAN

The PWS RPT has developed three Comprehensive Salmon Plans (CSP) to date. Phase I was issued in 1983, and served to assemble relevant information regarding the development and protection of salmon resources in the area. The document assessed the region's commercial, sport, and subsistence fisheries resource needs, identified areas for enhancement and rehabilitation to meet those needs, and set 20-year goals for each fishery (Prince William Sound Regional Planning Team, 1983).

Drift gillnet is the only type of commercial fishing gear permitted in the Copper River District where most Gulkana Hatchery fish are harvested. The RPT issued a survey as part the Phase I CSP to ask the fishing community about their desires for fishery enhancement. Drift gillnet respondents ranked the Copper River fishing district as their preferred fishing district, sockeye salmon as their preferred species, and the Copper River as their preferred area for salmon fishery enhancement. Subsistence and personal use respondents listed sockeye salmon as their preferred species. Sport angler respondents ranked the Gulkana River as the favorite destination in the region. Chinook and coho salmon were the preferred species, followed by sockeye salmon.

The second CSP was issued in 1986, and called a Phase II plan (Prince William Sound Regional Planning Team, 1986). Phase II plans were to recommend 5-year goals to achieve the 20-year goals in the Phase I plan. For the Gulkana I site, the Phase II plan recommended increasing the capacity of the facility from 22.5 million eggs to 50 million eggs. Additional objectives included stocking underutilized lakes in the Upper Copper River drainage, providing fishermen with approximately 291,300 harvestable sockeye salmon, and evaluating the production of smolt and adults. A second hatchery site was recommended near Gulkana I, also with a capacity of 50 million eggs, to maximize sockeye salmon production in the underutilized lakes.

Following the Phase II plan, the Gulkana I site capacity increased from 22.5 million eggs to 33 million eggs, and the second site (Gulkana II) was developed in 1987 for a capacity of 1.75 million eggs. The suggested capacity increase to 50 million eggs was not approved at either hatchery site due to ADF&G's concerns about managing the Copper River fisheries for wild stocks. Although the hatchery egg take levels were not increased, the goal of providing 291,300 harvestable sockeye was met in 10 of the 19 years from 1993 to 2011 (Appendix D).

The third CSP, Phase III, was issued in 1994. The purpose of the Phase III plan was to "achieve optimum production of wild and enhanced salmon stocks on a sustained yield basis through an integrated program of research, management, and application of salmon enhancement technology, for the benefit of all user groups." The plan made no recommendations for changes to the sockeye salmon program at Gulkana. The plan did mention a short-lived Chinook salmon program at Gulkana when it was operated by ADF&G. Following a 1991 Chinook salmon egg take, the program was halted by ADF&G for further review. Their analyses indicated that suitable riverine Chinook salmon habitat was fully utilized by wild Chinook salmon, and it appeared unlikely the program would continue (Prince William Sound-Copper River Regional Planning Team 1994).

CONSISTENCY WITH POLICY

The policies governing Alaska hatcheries were divided into three categories for this review: genetics, fish health, and fisheries management. The key elements of the policies in each of those categories are summarized in Tables 1–3. These templates identifying the key elements of state policies were used to assess compliance of the Gulkana Hatchery salmon program with each policy element in Tables 4–6.

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

I. Stock Transport	
Use of appropriate local stocks	This element addresses Section I of the *Genetic Policy*, covering stock transports. The 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.
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. The Regional Planning Teams should establish criteria for determining significant stocks and recommend such stock designations.
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.
Stock Rehabilitation and Enhancement	A watershed with a significant wild stock can only be stocked with progeny from the indigenous stocks. The policy also specifies that no more than one generation of separation from the donor system to stocking of the progeny will be allowed.
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.
Straying Impacts	Prevention of potential detrimental effects of gene flow from hatchery fish straying and interbreeding with wild fish.
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, such as 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.
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 and steelhead.
Use of all segments of donor stock run timing	To ensure all segments of the run have the opportunity to spawn, sliding egg take scales for donor stock transplants will not allocate more than 90% of any segment of the run for broodstock.
IV. Genetics review of Fishery Transport Permits (5 AAC 41.05 – 41.060)	
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 to the commissioner terms or conditions to protect wild or hatchery stocks. The commissioner may prescribe such conditions on a FTP.

Table 2.–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.
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.
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.
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.
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.
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.
Sockeye Salmon Culture Policy	
Alaska Sockeye Salmon Culture Manual	The Sockeye Salmon Culture Policy is designed to control the occurrence of infectious hematopoietic necrosis virus (IHNV) in Alaska. The policy specifies the use of a virus-free water supply; rigorous disinfection procedures; compartmentalization of eggs and fry; and immediate destruction of infected fish, followed by disinfection. The *Alaska Sockeye Salmon Culture Manual* prescribes procedures and fish culture practices developed to control IHNV.

Table 3.–Key elements of Alaska fisheries management policies and regulations relevant to salmon hatcheries and 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.
Use of precautionary approach	Managers should use a conservative approach, taking into account any inherent uncertainty and risks.
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.
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.
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.

Genetics

The donor stock of sockeye salmon was from the Gulkana River adjoining the hatchery. Significant stocks or wild stock sanctuaries have not been defined by the PWS RPT. The facility and incubation techniques were developed before the issuance of the *Genetic Policy*.

A study conducted in 2009 to assess Gulkana Hatchery sockeye salmon straying into upper Copper River tributaries found no evidence of hatchery-marked fish in surveyed wild salmon streams and lakes in the watershed (Bidlack and Valentine 2009).

Table 4.–The current Gulkana Hatchery salmon enhancement program and its consistency with elements of the ADF&G *Genetic Policy* (see Table 1).

I. Stock Transport	
Use of appropriate local stocks	The Gulkana Hatchery uses broodstock from the adjoining Gulkana River. Releases are to the river and two nearby nursery lakes that are upstream (Summit Lake) and downstream (Paxson Lake) from the hatchery sites. A third nursery lake (Crosswind Lake) that drains into the lower Gulkana (West Fork) is also stocked.
II. Protection of wild stocks	
Identification of significant or unique wild stocks	The PWS RPT has not identified significant wild stocks.
Interaction with or impact on significant wild stocks	The PWS RPT has not identified significant wild stocks.
Stock Rehabilitation and Enhancement	The donor stock used at the Gulkana Hatchery is the indigenous stock in the Gulkana River watershed.
Establishment of wild stock sanctuaries	No wild stock sockeye salmon sanctuaries are designated for the Copper River or PWS areas.
Straying Impacts	A study conducted in 2009 to assess Gulkana hatchery sockeye salmon straying into upper Copper River tributaries found no evidence of hatchery-marked fish in surveyed wild salmon streams and lakes in the watershed (Bidlack and Valentine 2009).
III. Maintenance of genetic variance	
Maximum of three hatchery stocks from a single donor stock	Gulkana I and Gulkana II stock are not released from any other hatcheries in Alaska.
Minimum effective population size of 400	The AMP requires about 19,000 fish for the Gulkana I facility and about 1,000 fish for the Gulkana II facility to meet egg-take goals.
Use of no more than 90% of any run segment of donor stock so all segments of donor stock run can spawn	Some broodstock collected during egg takes are from adults that are not the progeny of Gulkana hatchery fish, based on otolith analysis. As broodstock are collected at Gulkana I and Gulkana II from a cross-section of the return, it is unlikely that more than 90% of any segment of the non-otolith-marked adult run will be taken for broodstock.
IV. Genetics review of FTPs (5 AAC 41.010 – 41.050)	
Review by geneticist	The geneticist reviewed and approved the FTPs for the Gulkana sockeye programs with no concerns. However, broodstock were taken from Crosswind Lake returns when broodstock returning to the hatchery were not sufficient to meet egg take requirements. Use of Crosswind returns was provided for in the AMP, but an accompanying FTP was not issued, and therefore not reviewed by the geneticist.

Fish Health and Disease

The FTPs for the Gulkana Hatchery programs were approved by the pathologist (Appendix E). Pathology records showed no inconsistencies with fish health and disease policies. Appropriate sockeye salmon culture techniques are being used, and disease reporting and broodstock screening have occurred as required (Appendix G).

The hatchery was last inspected in 2011. Fish pathology staff indicated that one incubator was lost to IHNV the previous year, and no recommendations were made. During earlier inspections, inspectors commented that the facility was in very good order, and that hatchery personnel were skilled at observing suspected IHNV early, minimizing disease transmission to the remainder of the fish.

Table 5.–The current Gulkana Hatchery salmon enhancement program and its consistency with elements of the Alaska policies on fish health and disease (see Table 2).

Fish Health and Disease Policy (5 AAC 41.080)	
Egg disinfection	Single family delayed fertilization and disinfection during water hardening are used for sockeye salmon.
Hatchery inspections	Hatchery inspections were conducted regularly through 2011.
Disease reporting	Inspection reports indicate occasional losses from IHNV.
Pathology requirements for FTPs (5 AAC 41.010)	
Disease history	The disease history for the Gulkana facilities sockeye salmon stocks are updated as necessary at the request of the ADF&G Fish Pathology Section.
Isolation measures	The isolation measures and transport methods used for sockeye salmon production are described in detail in the FTP application.
Pathology review of FTPs	The FTPs were reviewed and approved by the pathologist.

Fisheries Management

Sockeye salmon returning to the Gulkana Hatchery are harvested in the drift gillnet fishery at the mouth of the Copper River, and in subsistence, personal use and sport fisheries in the upper Copper River and Gulkana River watershed. Since hatchery fish are intermixed with the wild stocks, no targeted fishery occurs on the hatchery returns alone. Hatchery fish are assumed to be harvested at the same rates as the wild stocks. As a result, a large number of hatchery fish that are surplus to broodstock needs sometimes return to the hatchery site and the nursery lakes and go unharvested. Sport fishing bag limits are liberalized near the release sites, and the AMP allows PWSAC to give away up to 50 sockeye salmon per household to Alaska residents at the Crosswind Lake weir site to encourage harvest and utilization of the return.

The evaluation plans in the 2012 AMP include strontium chloride otolith marking of all fry releases. ADF&G staff derives estimates for the commercial and personal fisheries from otolith samples taken in the respective fisheries. ADF&G staff use the hatchery contribution to the personal use fishery as a proxy for hatchery contributions to the upper Copper River sport and subsistence fisheries (Jeremy Botz, ADF&G Copper River fishery manager, personal communication). Beginning in 2013, adult otoliths will be collected from the Glennallen Subdistrict subsistence fishery to specifically estimate hatchery contributions to this fishery. (Jeremy Botz, ADF&G Copper River fishery manager, personal communication).

ADF&G (2009) noted that the annual average hatchery runs from 1995 to 2004 of nearly 383,000 fish were above the guideline of the BMP, and complicated harvest and wild stock management in the Copper River District. Brady et al. (1990) recommended that production of the Gulkana Hatchery remain at "current permitted levels until an adequate evaluation program

to address management concerns was completed." The strontium chloride otolith marking program began in 2000, providing improved estimates of hatchery fish timing and total returns. Since 2002, escapements to both the upper Copper River and the Copper River Delta systems have met the lower bound of their escapement goals during years with Gulkana Hatchery runs ranging from about 89,000 to 581,000 fish (Appendix D).

Table 6.–The current Gulkana Hatchery salmon fishery enhancement program and its consistency with elements of Alaska fisheries management policies and regulations (see Table 3).

Sustainable Salmon Fishery Policy (5 AAC 39.222)	
I. Management principles and criteria	
Assessment of wild stock interaction and impacts	Adult returns are sampled for presence of hatchery otolith markings to estimate contributions to the fisheries. A straying study in 2009 showed no hatchery fish in samples from several Copper River tributaries (Bidlack and Valentine 2009).
Use of precautionary approach	ADF&G manages the fishery to meet wild stock escapement goals.
Salmon Escapement Goal Policy (5 AAC 39.223)	
Establishment of escapement goals	Sustainable Escapement Goals (SEGs) are established for the upper Copper River and Copper River Delta sockeye salmon runs.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
Wild stock conservation priority	Management plans are in place for Copper River sockeye salmon, with spawning escapement and harvest allocations in the inriver goal. Gulkana Hatchery fish are presumably harvested at the same rate as wild stocks, since there is no practical area for a segregated harvest of Gulkana Hatchery fish due to the location of the hatchery and release sites.
Fisheries management review of FTPs (5 AAC 41.010 – 41.050)	
Review by management staff	FTPs for the Gulkana Hatchery programs were reviewed by fisheries management staff.

OTHER REQUIREMENTS

ANNUAL REPORTING AND CARCASS LOGS

All hatcheries are required to submit an annual report to ADF&G that summarizes their production and activities for the year (AS 16.10.470). The annual report includes species, broodstock source, number, age, weight, and length of spawners; number of eggs taken and juveniles produced; and the number, age, weight, and length of adult returns attributable to hatchery releases. The report is due on December 15 and the Gulkana Hatchery annual reports have been received for all years.

Annual report data are based on inseason estimates because not all otoliths sampled in the fishery are analyzed for stock assessment prior to the December 15 annual report deadline. The methodology used by ADF&G for estimating the Gulkana Hatchery sockeye salmon contribution to the fisheries was described in the Fisheries Management section. PWSAC, however, uses different methodology for estimating the inriver portion of the Gulkana Hatchery harvest estimated for the annual report. PWSAC estimates that the commercial fishery harvests about 60% of the total run, based on Brady et al. (1990). Under that assumption, they estimate that 40% of the total hatchery run passes through the commercial fishery and up the river. Their

estimate of the inriver return is simply the hatchery contribution to the commercial fishery divided by 0.6. Their estimate of the sport, personal use and subsistence harvests are the total inriver estimated return minus broodstock and escapement to the nursery lakes. (Dave Reggiani, PWSAC Executive Director, personal communication). Their estimates of inriver catch are often substantially different (usually higher) than ADF&G estimates.

Alaska hatcheries are required to document the disposal of salmon carcasses used for broodstock (5 AAC 93.350). If carcasses are disposed, the hatchery must record the number of males and females each day, and whether they were fertilized, unused, or used for roe sales. A maximum of 10% of the total number of females taken for broodstock can be used for roe sales without using the carcass; the proceeds from any sales in excess of the 10% guideline must be surrendered to ADF&G. Gulkana Hatchery carcass logs appear to be complete and timely.

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 enhancement efforts depends on implementing that system and ensuring policies are followed.

This evaluation of the Gulkana Hatchery was part of the action plan to address conditions for MSC recertification. The action plan called for an evaluation of each of Alaska's hatchery programs for consistency with state policies and prescribed management practices. The Gulkana Hatchery operations are covered under existing permits that have been reviewed by an array of state officials. Safeguards are in place to prioritize escapement goals in for the Copper River upriver and delta wild stocks.

The Gulkana Hatchery is the largest sockeye salmon hatchery program in the world. The program was established by ADF&G during a time of depressed salmon returns and prior to most of the genetic, fishery management and fish health policies in place today. Although the Gulkana Hatchery sites have the water capacity to incubate at least double the current permitted levels, production has not increased because of the uncertainty in managing for upriver and delta wild stocks. Hatchery-released fish comingle with wild stocks during their return, and a segregated terminal harvest is not possible.

Improved hatchery practices led to improved survivals in the hatchery and expanded releases to nursery lakes over time. In some years, over 100,000 adult sockeye salmon in excess to broodstock requirements reach the hatchery and release areas and die unharvested. The carcasses do provide marine-derived nutrients to the watershed that support food sources for the introduced sockeye salmon fry (Gary Martinek, PWSAC Gulkana Hatchery Manager, personal communication). In 1994, cabin owners on Crosswind Lake, however, reported increased bear activity and damage to their cabins as a result of more fish in the lake (Copies of letters by cabin owners to PWSAC, ADF&G files of Sam Rabung, ADF&G PNP Coordinator, Juneau). PWSAC installed a weir in 1996 to limit passage of adults to mitigate the issue.

The Alaska Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) requires a precautionary approach in managing "artificial propagation" that includes prudent foresight that takes into account the "uncertainties in salmon fisheries." Technological advances, such as strontium chloride otolith marking, and additions to the time series of harvest, escapement, and timing data have added to management precision in estimating stock

composition and timing for inseason management of the Copper River sockeye salmon fisheries. However, significant uncertainty remains each season with regard to accuracy of forecasted runs, year-to-year variation in run timing of sockeye salmon stocks, and stochastic weather events that can affect aerial surveys for escapement monitoring and installation and operation of the Miles Lake sonar. Gulkana Hatchery has remained at its current permitted egg-take level since PWSAC took over operations in 1993, and ADF&G managers have consistently met wild stock escapement goals while adding millions of Gulkana Hatchery sockeye salmon to the commercial, subsistence, personal use and sport fish harvests over the last 40 years.

ADF&G recognizes the importance of PWSAC within the PWS region and strongly supports the effective and continued operation of PWSAC hatcheries. The department determines PWSAC to be in full compliance with its hatchery permit, annual management plans and other agreements with the department. Evidence of the department's confidence in PWSACs capabilities is demonstrated by the recent renewal of the operations contract for Gulkana Hatchery (Jeff Regnart, ADF&G Director of Commercial Fisheries, personal communication).

RECOMMENDATIONS

1) The BMP should be updated to reflect PARs approved after the BMP was issued.
2) Methods for estimating personal use, subsistence and sport harvests should be described in the Annual Report.
3) When stipulations in the BMP or AMP require annual reporting of limnology or similar data for Gulkana Hatchery or any hatchery, ADF&G should develop a standard reporting form for the data that would be submitted each year with the annual report data. This would provide public information on evaluation projects, and allow ADF&G to systematically compile annual data on the projects for later analyses and reporting in the Alaska Salmon Enhancement Program annual reports. Otherwise, data may remain scattered, unpublished and difficult to acquire and compile for historic documents such as this report.
4) FTPs should be requested for use of Crosswind and Summit Lake hatchery returns as a backup broodstock source for the Gulkana I facility in the event either source is needed.

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APPENDICES

Appendix A.–History of Gulkana Hatchery complex hatchery permit, basic management plan, and permit alteration requests, 2000– 2010.

Date	Description	Permitted Capacity, (millions of green eggs)
07/05/2000	PNP hatchery permit number 42 issued to PWSAC to operate the Gulkana Hatchery complex (Gulkana I and Gulkana II) as a central incubation facility for production of sockeye salmon for release in the Copper River drainage. Hatchery permitted for 36.75 million sockeye salmon eggs—35 million at Gulkana I and 1.75 million sockeye salmon eggs at Gulkana II.	36.75
	Basic Management Plan stated that Paxson Lake was approved for a maximum release of 10 million fry, Summit Lake for 6 million fry, Crosswind Lake for 7.6 million fry, and onsite release of 1.31 million at Gulkana II. Releases were only to occur with an approved evaluation plan in place. The evaluation plan included a coded wire tag and/or otolith marking program to assess distribution and timing of hatchery fish and to measure fishery contribution, marine survival, and straying. A mark–recapture project at Paxson and Crosswind lakes was to assess smolt survival, hatchery contribution to the smolt outmigration, and a smolt population estimate. Monitoring of zooplankton, funded by PWSAC was to be conducted at Summit, Paxson, and Crosswind lakes to determine appropriate stocking levels. Data, findings, evaluations, and recommendations were required to be provided to ADF&G in a timely manner.	36.75
01/13/2005	PAR denied to increase releases to Crosswind Lake from 7.6 million fish to 10 million fish, and to increase the capacity of Gulkana II facility to 1.2 million Chinook salmon eggs. ADF&G did not have adequate data to assess hatchery contribution in the Copper River fisheries to allow an increase in releases.	36.75
05/01/2006	PAR approved to increase permitted stocking of Crosswind Lake to an annual maximum of 10 million sockeye fry, decrease permitted stocking of Paxson Lake to an annual maximum of 6 million fry, and decrease the permitted stocking of Summit Lake to an annual maximum of 6 million sockeye salmon fry. Conditions of PAR approval included a 3-year duration of the approval, requirement of PWSAC to conduct an annual sockeye salmon smolt enumeration for both Summit Lake and Crosswind Lakes, requirement of PWSAC to conduct annual limnological sampling of Crosswind, Paxson, and Summit lakes, PWSAC required to conduct a feasibility study with cost analysis for annual sockeye salmon enumeration at Paxson Lake and required ADF&G to annually collect appropriate numbers of otoliths from sockeye salmon harvested in the personal use fisheries on the Copper River and PWSAC required to analyze the otoliths for marks.	36.75
06/16/2006	PAR approved that required PWSAC to fund the analysis of otoliths for marks in the 05/01/2006 approved PAR.	36.75
06/22/2010	PAR approved to permit releases of 10 million fry at Crosswind Lake, and 6 million fry each in Paxson and Summit lakes.	36.75

Appendix B.–Egg collection numbers, releases, and returns for the Gulkana I and Gulkana II facilities, 1973–2011.

Year	Gulkana I Egg Take (millions)	Gulkana II Egg Take (millions)	Gulkana I Release (millions)	Gulkana II Release (millions)	Total Egg Take (millions)	Total Releases (millions)	Total Adult Return
1973	0.23	-			0.23		
1974	1.27	-	0.18		1.27	0.18	
1975	1.28	-	0.89		1.28	0.89	
1976	1.29	-	0.63		1.29	0.63	
1977	1.36	-	0.63		1.36	0.63	318
1978	1.32	-	0.58		1.32	0.58	2,095
1979	3.56	-	1.04		3.56	1.04	4,724
1980	6.23	-	2.45		6.23	2.45	5,211
1981	9.17	-	5.25		9.17	5.25	8,736
1982	10.93	-	8.03		10.93	8.03	9,666
1983	13.03	-	9.78		13.03	9.78	14,283
1984	26.77	-	10.82		26.77	10.82	20,427
1985	31.64	-	20.85		31.64	20.85	54,829
1986	28.69	-	23.59		28.69	23.59	54,159
1987	33.40	0.32	22.40		33.72	22.40	78,800
1988	35.12	1.10	21.22	0.19	36.22	21.41	132,288
1989	35.41	1.08	25.76	0.78	36.42	26.54	236,984
1990	30.10	1.36	25.56	0.83	31.46	26.38	91,429
1991	36.05	1.37	22.10	0.79	37.43	22.89	152,338
1992	19.29	1.79	26.06	1.11	21.08	27.17	131,228
1993	35.18	1.79	12.45	1.17	36.97	14.16	262,274
1994	36.06	1.92	26.27	1.52	37.97	27.79	173,721
1995	36.02	1.82	28.31	1.43	37.84	29.74	229,115
1996	35.49	1.86	28.85	1.52	37.35	30.37	477,812
1997	35.70	1.80	30.40	1.39	37.51	31.79	404,787
1998	35.55	1.80	30.96	1.31	37.35	32.27	676,977
1999	34.96	1.78	29.37	1.35	36.74	30.73	1,119,171
2000	13.88	1.76	20.97	1.36	15.64	22.34	474,606
2001	32.40	1.76	12.61	1.34	34.16	13.95	312,866
2002	34.89	1.82	24.50	1.40	36.71	25.90	424,558
2003	35.06	1.57	24.97	1.28	36.63	26.24	202,782
2004	6.58	1.75	26.02	1.32	8.33	27.34	93,515
2005	34.69	1.80	5.58	1.43	36.48	7.01	215,186
2006	34.80	1.45	18.75	1.47	36.25	20.22	287,266
2007	28.70	1.75	20.86	1.14	30.45	22.00	131,579
2008	31.70	1.75	20.64	1.34	33.45	21.98	88,718
2009	33.10	1.75	20.66	1.34	34.85	22.00	133,047
2010	30.10	1.75	20.68	1.33	31.85	22.01	434,608
2011	34.70	1.75	20.64	1.34	36.45	21.98	580,917

Sources: Egg take and release data from 1973 to 1992 and 2008 from ADF&G hatchery information database. 1973 to 1993 release data from http://pwsac.com/about/hatcheries/gulkana-hatchery/ (accessed 10/18/2012). Egg take and release data from 1993 to 2007 and 2009 to 2011 from annual reports submitted by PWSAC. Total adult return data from Jeremy Botz, Copper River fishery manager, ADF&G, Cordova database, personal communication.

Note: PWSAC total return numbers are usually higher than ADF&G numbers because PWSAC uses a different accounting method for estimating the number of fish harvested in the Copper River personal use, subsistence and sport fisheries. ADF&G derives estimates for the commercial and personal fisheries from otolith samples taken in those fisheries. No otolith samples are taken from the upper river sport or subsistence fisheries, and ADF&G uses the hatchery contribution to the personal use fishery as a proxy (Jeremy Botz, ADF&G Copper River fishery manager, personal communication). Commercial fishery otolith data are processed and used inseason, while personal use, subsistence, and sport harvest contributions are estimated postseason (Jeremy Botz, ADF&G Copper River fishery manager, personal communication). PWSAC estimates the sport, personal use and subsistence harvests based on a harvest rate of 0.60 (Brady et al.1990; Dave Reggiani, PWSAC Executive Director, personal communication).

Appendix C.–Total estimated sockeye salmon runs to the Copper River, 2000–2011.

Year	Copper River Upriver Wild Return	Copper River Delta Wild Return	Gulkana Hatchery Complex Total Return	Total Return	Gulkana Portion of Total Return
2000	642,000	514,000	477,000	1,634,000	29%
2001	1,5767,000	380,000	308,000	2,265,000	14%
2002	1,372,000	393,000	427,000	2,192,000	19%
2003	1,380,000	413,000	203,000	1,996,000	10%
2004	1,354,000	371,000	93,000	1,819,000	5%
2005	1,754,000	307,000	217,000	2,277,000	10%
2006	1,774,000	531,000	288,000	2,593,000	11%
2007	2,265,000	565,000	133,000	2,962,000	4%
2008	852,000	203,000	86,000	1,141,000	8%
2009	1,261,000	325,000	136,000	1,722,000	8%
2010	974,000	289,000	453,000	1,716,000	26%
2011	2,004,000	513,000	581,000	3,098,000	19%

Source: 2000–2010 data from Appendix A3 in Botz et al. (2012). 2011 data Jeremy Botz, Copper River fishery manager, ADF&G, Cordova database, personal communication. Numbers rounded.

Appendix D.–Copper River sockeye salmon escapement, target escapement goals and Gulkana hatchery total sockeye return. Upriver counts were by sonar beginning in 1978, and aerial survey before 1978. Delta counts are aerial surveys for all years.

Year	Copper River Upriver Escapement	Copper River Upriver Escapement Goal	Copper River Delta Escapement	Copper River Delta Escapement Goal	Gulkana Hatchery Total Return
1974	29,417	300,000	27,993		
1975	11,190	300,000	42,560		
1976	24,276	300,000	54,500		
1977	72,763	300,000	51,595		318
1978	194,372	300,000	83,450		2,095
1979	248,709	300,000	123,900		4,724
1980	283,856	300,000	159,800		5,211
1981	534,263	300,000	111,850		8,736
1982	467,306	300,000	106,770		9,666
1983	545,724	300,000	115,750		14,283
1984	536,806	300,000	168,840		20,427
1985	436,313	300,000	142,050		54,829
1986	509,275	300,000	75,295		54,159
1987	483,478	300,000	60,698		78,800
1988	488,398	300,000	53,315		132,288
1989	607,869	300,000	51,700		236,984
1990	581,859	300,000	73,345		91,429
1991	579,412	300,000	90,500	74,000-105,000	152,338
1992	601,952	300,000	76,827	74,000-105,000	131,228
1993	833,387	300,000	**57,720**	74,000-105,000	262,274
1994	599,265	300,000	76,370	74,000-105,000	173,721
1995	906,239	300,000	**65,470**	74,000-105,000	229,115
1996	1,148,079	300,000	**57,070**	74,000-105,000	477,812
1997	866,957	300,000	87,500	74,000-105,000	404,787
1998	850,951	300,000	100,975	74,000-105,000	676,977
1999	587,497	300,000	100,945	74,000-105,000	1,119,171
2000	300,194	300,000	98,045	74,000-105,000	474,606
2001	509,519	300,000	**71,065**	74,000-105,000	312,866
2002	581,469	300,000	75,735	74,000-105,000	424,558
2003	471,090	300,000-500,000	73,150	55,000-130,000	202,782
2004	448,075	300,000-500,000	69,385	55,000-130,000	93,515
2005	528,816	300,000-500,000	58,406	55,000-130,000	215,186
2006	600,378	300,000-500,000	98,896	55,000-130,000	287,266
2007	624,437	300,000-500,000	88,285	55,000-130,000	131,579
2008	491,516	300,000-500,000	67,340	55,000-130,000	88,718
2009	477,327	300,000-500,000	69,292	55,000-130,000	133,047
2010	524,692	300,000-500,000	82,835	55,000-130,000	434,608
2011	621,545	300,000-500,000	76,507	55,000-130,000	580,917

Sources: Upriver and delta escapements: Botz et al. (*In prep*), Johnson et al. (2002), Donaldson et al. (1993), and Randall et al (1983). Escapement goals: 1974–2002 from Fried (1994), 2002–2005 from Bue et al. (2002) and 2006–2011 from Evenson et al. (2008). Delta escapement goals: 1991–2005 from Bue et al. (2002) and 2006–2011 from Evenson et al. (2008). Total Gulkana Hatchery Complex return data, Jeremy Botz, Copper River fishery manager, ADF&G, Cordova database, personal communication.

Note: Numbers in bold are years in which the escapement did not meet the lower escapement goal for that year.

Appendix E.–Summary of Fish Transport Permits for Gulkana Hatcheries.

FTP Number	Issued	Expiration	Summary and reviewer comments.
87A-0020	DENIED		Proposed egg take of Chinook salmon denied due to potential of IHNV transmission to or from the Gulkana sockeye returns, which would occur both above and below the proposed Chinook broodstock site at Monsoon Lake. Also, small incurrence of BKD in Chinook could be transmitted to other salmonids. Pathologist requested samples for disease analysis before he would approve the FTP.
87A-0021	1987	1997	Egg take FTP at Gulkana II. Phase I 2.5 sockeye salmon million eggs. Phase II 15.0 million eggs. Phase III 50 million eggs.
87A-0038	1987	1993	Proposed egg take starting at 60,000 with eventual broodstock development to 2.5 million Chinook salmon eggs denied under 87A-0020 was approved later in 1987 after more information acquired. Pathologist believed risk of INNV was less than originally perceived. Advised sockeye policy egg-take procedures when culturing Chinook salmon. Original FTP was extended from December 1987 until 1993.
88A-1023	1988	1997	Transport up to 500,000 sockeye salmon fry from the Gulkana Hatchery to Harding Lake in an attempt to establish a kokanee sport fishery.
92A-0024	1992	2002	Transport up to 12 million sockeye salmon fry into Summit Lake from the Gulkana Hatchery I.
92A-0025	1992	2002	Transport up to 10 million sockeye salmon fry into Paxson Lake from the Gulkana Hatchery I.
92A-0026	1992	2002	Transport up to 15 million sockeye salmon fry into Crosswind Lake from the Gulkana Hatchery I.
96A-0034	1996	2016	Transport up to 10 million sockeye salmon fry into Crosswind Lake from the Gulkana Hatchery I. FTP extended in 1996 to 2011, and in 2011 to 2016.
96A-0038	1996	2016	Transport up to 6 million sockeye salmon fry into Paxson Lake from the Gulkana Hatchery I. FTP initially approved for release of 10 million fry in 1996 and extended in 2006 until 2011. The FTP extension in 2011 until 2016 reduced the release from 10 million to 6 million.
96A-0039	1996	2016	Transport up to 6 million sockeye salmon fry into Summit Lake from the Gulkana Hatchery I. FTP initially approved for release of 10 million fry in 1996 and extended in 2006 until 2011. The FTP extension in 2011 until 2016 reduced the release from 10 million to 6 million.
97A-0048	1997	2016	Allows up to 35 million sockeye salmon eggs taken at East Fork Gulkana River. FTP extended in 1998 until 1999, and in 1999 until 2000, and in 2000 until 2010, and in 2010 until 2020.
97A-0049	1997	2016	Allows up to 1.75 million sockeye salmon eggs taken at East Fork Gulkana River. FTP extended in 1998 until 1999, and in 1999 until 2000, and in 2000 until 2010, and in 2010 until 2020.

Appendix F.–Comparison of permitted and reported egg takes and releases in hatchery permit, basic management plan, annual management plan, fish transport permits, and annual reports for the Gulkana Salmon Hatchery complex sockeye salmon projects, 1994–2011. Numbers, in millions, rounded.

		BMP		AMP		Fish Transport Permit				Annual Report	
Year	Site	Eggs	Fry	Eggs	Fry	FTP No	Eggs	Fry	Expires	Eggs	Fry
1994	Gulkana I			35		None found			UNKNOWN	36.1	
	Gulkana II			1.75	1.31	87A-1021	50		1997	1.9	1.5
	Paxson L.				10	92A-0025		10			9.5
	Summit L.				6.3	92A-0024		12	2002		7.6
	Crosswind L				10	92A-0026		15	2002		9.1
1995	Gulkana I			35		None found			UNKNOWN	36.0	
	Gulkana II			1.91	1.43	87A-1021	50		1997	1.8	1.4
	Paxson L.				10	92A-0025		10			10.9
	Summit L.				7	92A-0024		12	2002		7.4
	Crosswind L				10	92A-0026		15	2002		10.0
1996	Gulkana I			36		None found			UNKNOWN	35.5	
	Gulkana II			1.82	1.365	87A-1021	50		1997	1.9	1.5
	Paxson L.				10	96A-0038		10	2006		10.7
	Summit L.				7	96A-0039		10	2006		8.4
	Crosswind L				10	96A-0034		10	2006		9.7
1997	Gulkana I			35		97A-0048	35		1998	35.7	
	Gulkana II			1.75	1.39	97A-0049	1.75		1998	1.8	1.4
	Paxson L.				10	96A-0038		10	2006		10.9
	Summit L.				7	96A-0039		10	2006		9.0
	Crosswind L				10	96A-0034		10	2006		10.5
1998	Gulkana I			35		97A-0048	35		1999	35.5	
	Gulkana II			1.75	1.35	97A-0049	1.75		1999	1.8	1.3
	Paxson L.				10	96A-0038		10	2006		10.3
	Summit L.				7	96A-0039		10	2006		10.2
	Crosswind L				10	96A-0034		10	2006		10.5
1999	Gulkana I			35		97A-0048	35		2000	35.0	
	Gulkana II			1.75	1.35	97A-0049	1.75		2000	1.8	1.4
	Paxson L.				10	96A-0038		10	2006		10.2

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		BMP		AMP		Fish Transport Permit				Annual Report	
Year	Site	Eggs	Fry	Eggs	Fry	FTP No	Eggs	Fry	Expires	Eggs	Fry
	Summit L.				7	96A-0039		10	2006		9.2
	Crosswind L				10	96A-0034		10	2006		10.0
2000	Gulkana I	35		35		97A-0048	35		2010	13.9	
	Gulkana II	1.75	1.31	1.75	1.34	97A-0049	1.75		2010	1.8	1.4
	Paxson L.		10		10	96A-0038		10	2006		9.3
	Summit L.		6		7	96A-0039		10	2006		3.3
	Crosswind L		7.6		10	96A-0034		10	2006		8.3
2001	Gulkana I	35		35		97A-0048	35		2010	32.4	
	Gulkana II	1.75	1.31	1.75	1.32	97A-0049	1.75		2010	1.8	1.3
	Paxson L.		10		7.7	96A-0038		10	2006		6.5
	Summit L.		6		0.5	96A-0039					
	Crosswind L		7.6		4.2	96A-0034					
2002	Gulkana I	35		35		97A-0048	35		2010	34.9	
	Gulkana II	1.75	1.31	1.75	1.32	97A-0049	1.75		2010	1.8	1.4
	Paxson L.		10		10.0	96A-0038		10	2006		10.5
	Summit L.		6		6.0	96A-0039		10	2006		5.8
	Crosswind L		7.6		7.6	96A-0034		10	2006		8.2
2003	Gulkana I	35		35		97A-0048	35		2010	35.1	
	Gulkana II	1.75	1.31	1.75	1.32	97A-0049	1.75		2010	1.6	1.3
	Paxson L.		10		10.0	96A-0038		10	2006		10
	Summit L.		6		6.0	96A-0039		10	2006		6.6
	Crosswind L		7.6		7.6	96A-0034		10	2006		8.4
2004	Gulkana I	35		35		97A-0048	35		2010	6.6	
	Gulkana II	1.75	1.31	1.75	1.31	97A-0049	1.75		2010	1.7	1.3
	Paxson L.		10		10.0	96A-0038		10	2006		11.1
	Summit L.		6		6.0	96A-0039		10	2006		6.6
	Crosswind L		7.6		7.6	96A-0034		10	2006		8.4
2005	Gulkana I	35		35		97A-0048	35		2010	34.7	
	Gulkana II	1.75	1.31	1.75	1.31	97A-0049	1.75		2010	1.8	1.4
	Paxson L.		10		1.8	96A-0038		10	2006		1.9

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		BMP		AMP		Fish Transport Permit				Annual Report	
Year	Site	Eggs	Fry	Eggs	Fry	FTP No	Eggs	Fry	Expires	Eggs	Fry
	Summit L.		6			96A-0039		10	2006		0
	Crosswind L		7.6		3.1	96A-0034		10	2006		3.7
2006	Gulkana I	35		35		97A-0048	35		2010	34.8	
	Gulkana II	1.75	1.31	1.75	1.31	97A-0049	1.75		2010	1.5	1.5
	Paxson L.		10		4.7	96A-0038		10	2011		4.1
	Summit L.		6		6.0	96A-0039		10	2011		4.7
	Crosswind L		7.6		10.0	96A-0034		10	2011		10.0
2007	Gulkana I	35		35		97A-0048	35		2010	28.7	
	Gulkana II	1.75	1.31	1.75	1.31	97A-0049	1.75		2010	1.75	1.1
	Paxson L.		10		4.7	96A-0038		10	2011		4.9
	Summit L.		6		6.0	96A-0039		10	2011		6.0
	Crosswind L		7.6		10.0	96A-0034		10	2011		10.0
2008	Gulkana I	35		35		97A-0048	35		2010	31.9	
	Gulkana II	1.75	1.31	1.75	1.31	97A-0049	1.75		2010	1.75	1.3
	Paxson L.		10		4.7	96A-0038		10	2011		4.7
	Summit L.		6		6.0	96A-0039		10	2011		6.0
	Crosswind L		7.6		10.0	96A-0034		10	2011		10.0
2009	Gulkana I	35		35		97A-0048	35		2010	33.1	
	Gulkana II	1.75	1.31	1.75	1.3	97A-0049	1.75		2010	1.75	1.3
	Paxson L.		10		4.7	96A-0038		10	2011		4.7
	Summit L.		6		6.0	96A-0039		10	2011		6.0
	Crosswind L		7.6		10.0	96A-0034		10	2011		10.0
2010	Gulkana I	35		35		97A-0048	35		2020	30.1	
	Gulkana II	1.75	1.31	1.75	1.3	97A-0049	1.75		2020	1.75	1.3
	Paxson L.		10		4.7	96A-0038		10	2011		4.7
	Summit L.		6		6.0	96A-0039		10	2011		6.0
	Crosswind L		7.6		10.0	96A-0034		10	2011		10.0
2011	Gulkana I	35		35		97A-0048	35		2020	34.7	
	Gulkana II	1.75	1.31	1.75	1.3	97A-0049	1.75		2020	1.75	1.3
	Paxson L.		10		4.7	96A-0038		6	2016		4.7
	Summit L.		6		6.0	96A-0039		6	2016		6.0
	Crosswind L		7.6		10.0	96A-0034		10	2016		10.0

Appendix G.–Summary of ADF&G hatchery inspection reports of the Gulkana Hatchery complex.

Year	Summary
1994	IHN in 5 boxes at Gulkana I and eggs destroyed. Recommended bringing in some Gulkana II eggs as there was no INH there. Recommended consideration of increasing egg take by mean losses due to IHN to maximize production. Facility clean and well organized.
1996	IHNV in 9 totes at Gulkana I and eggs destroyed. Recommended replacing wood boxes as funding permits. Staff continue to make changes to improve program, including gradually replacing wood boxes with plastic totes. Staff submit samples rapidly if an incubator is suspect. Good disinfection procedures and sockeye salmon culture techniques are followed.
1998	IHNV in 1 tote at Gulkana I and fry destroyed. All wooden boxes have been replaced by plastic totes at Gulkana I, and recommended replacing wood boxes at Gulkana II. Raceways installed for short term rearing of fry to go to Crosswind Lake. Facility continues to make improvements, with INH losses declining.
2000	IHNV in 3 totes and 3 raceways and eggs/fry destroyed at Gulkana I. One raceway lost to excess chlorine, and alevins lost in 1 incubator due to freezing. Wood boxes replaced by aluminum boxes. Strontium chloride administered under an INAD permit. Problems being worked out in the marking process. Late ice-out in Summit and Crosswind Lakes necessitated extended holding of fry in raceways at high density. Hatchery personnel have thorough understanding of sockeye culture policy and take appropriate precautions. Recommended purchase of TDG meter to monitor gases during marking and rearing. Re-evaluate temperature and crowding stress during marking.
2002	IHNV in 2 totes and eggs destroyed. Strontium chloride marking process now going fairly smoothly. Fry now reared for 5 weeks prior to stocking into Summit Lake. Plans for replacement of wooden tables and floors with disinfectable materials. Recommended bird netting over outdoor raceways and minimize potential splashing between raceways.
2004	IHNV in 10 totes and fry destroyed at Gulkana I. Hatchery staff skilled at observing suspected IHNV incubators. New building for counting, eggtake and strontium marking that is easy to clean. Recommended enclosing raceway rearing area, and minimize splashing between raceways. Advised that if Chinook salmon are reared at Gulkana II that great care be taken to keep sockeye salmon from Gulkana I separated from the Chinook salmon when marking with strontium chloride.
2006	IHNV in 4 incubators and fry destroyed at Gulkana I. Excessive fungus in some incubators. Barium chloride and manganese chloride tested for marking as an alternative to strontium chloride. Recommended eliminating wood floors or covering with material that can be disinfected at Gulkana II.
2009	No IHNV, but three incubators had greater than normal mortality. Testing to see if different strontium chloride marks can be made for each release lake. Two personnel took the ADFG fish health class offered last year. Hatchery personnel continue to consistently produce large numbers of sockeye salmon fry with commendable success under harsh weather conditions. Recommended containing effluent to prevent splashing between raceways and so hatchery personnel do not walk in raceway effluent. Recommended eliminating wood floor in incubation building.
2010	IHNV in one incubator last year. Hatchery personnel have been at site for a long time and have an excellent understanding of the area and the fisheries.