Regional Information Report No. 5J13-11

An Evaluation of the Armin F. Koernig Hatchery for Consistency with Statewide Policies and Prescribed Management Practices

by

Mark Stopha

NOTE: In the first edition of this report in November 2013, the even-year stock was reported to be from Ewan Creek; however, this was found to be in error. The even-year stock was primarily from Duck and Millard creeks. That portion of the report on pages 10 and 11 was updated in November 2018 to correct the error.

November 2013

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

Symbols and Abbreviations

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

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, 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

REGIONAL INFORMATION REPORT NO. 5J13-11

AN EVALUATION OF THE ARMIN F. KOERNIG HATCHERY FOR CONSISTENCY WITH STATEWIDE POLICIES AND PRESCRIBED MANAGEMENT PRACTICES

by

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November 2013

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

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ABSTRACT

The salmon hatchery program in Alaska is governed by policies, plans, and regulations that emphasize protection of wild salmon stocks. A rotational series of hatchery evaluations will examine each hatchery for consistency with those policies and prescribed management practices. The evaluation includes a review of hatchery management plans and permits, an assessment of each hatchery program's consistency with statewide policies, and recommendations to address any deficiencies found. 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 Armin F. Koernig Hatchery (AFKH) operated by the Prince William Sound (PWS) Aquaculture Corporation. The facility is a pink and chum salmon hatchery located in Port San Juan in Sawmill Bay, Evans Island, Prince William Sound, about 90 air miles west of Cordova, Alaska. The original brood stocks for the hatchery were from PWS streams. Pink salmon gametes are collected from adults returning to the facility and placed in incubators fed by water from a nearby lake. The hatchery is currently permitted to collect up to 162 million pink salmon eggs for incubation, rearing and release at the hatchery. The hatchery is permitted to receive up to 34 million chum salmon eggs from Wally Noerenberg Hatchery in PWS for incubation, rearing and release from AFKH. Pink salmon are released onsite after about 4 weeks of feeding. Chum salmon are fed for 12 weeks before release from the hatchery. From 2006 through 2012, pink salmon runs to AFKH averaged about 8 million fish annually, and chum salmon runs averaged about 250,000 annually. The basic management plan for the hatchery with a description of current permit conditions and operations should be developed to comply with regulation.

Key words: Armin F. Koernig, hatchery evaluation, hatchery, 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 juvenile salmon growth (FRED 1975). A combination of favorable environmental conditions, limited fishing effort, abundance-based harvest management, habitat improvement, and hatchery production gradually boosted salmon catches, and recent commercial salmon harvests (2002–2012) have averaged 170 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, survival of eggs to fry or smolt is highly variable. Estimates of egg to fry survival 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 80% 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 characteristics. 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 salmon is not legal in Alaska; it is prohibited under 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 smolt 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.

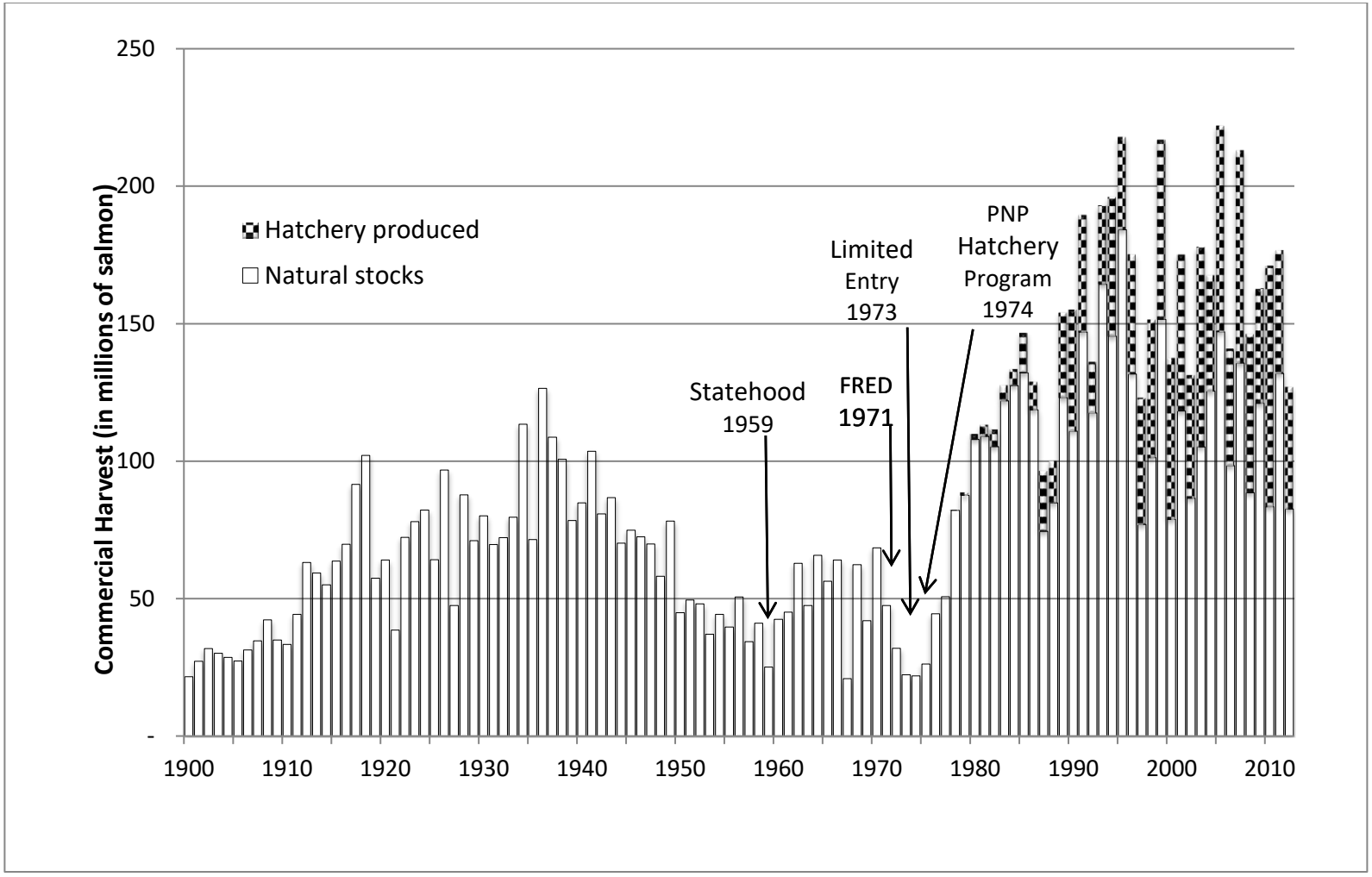

Figure 1.–Commercial salmon harvest in Alaska, 1900–2012.

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 2012, pink salmon accounted for an average 73% of Alaska hatchery salmon returns by number, followed by chum (20%), sockeye (4%), coho (2%) and Chinook (<1%) salmon (Farrington 2003, 2004; White 2005–2011; Vercessi 2012, 2013).

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 (ADF&G 2012).

Today, Alaska typically accounts for just 12% to 15% of the global supply (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[1] of hatchery harvest increased from $59 million in 2003 to $104 million in 2012, with a peak of $204 million in 2010. First wholesale value[2] also showed an increasing trend, with the value of hatchery fish increasing from $188 million in 2003 to $387 million in 2012, with a peak of $509 million in 2010. Pink and chum salmon, on average, accounted for over 75% of the annual hatchery exvessel and first wholesale values from 2003 to 2012.

From 2002 to 2012, hatcheries contributed an average 35% of the total Alaska salmon harvest, in numbers of fish (Farrington 2003, 2004; White 2005–2011, Vercessi 2012, 2013). 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.

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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, 2013.

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.

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 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 (FAO)-based Responsible Fisheries Management criteria in 2011 (Global Trust Certification Ltd 2011). The hatchery evaluations started under the MSC certification continue under the new FAO-based certification 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, 2013c, 2013d, 2013e, 2013f) completed reviews of the Trail Lakes, Port Graham and Eklutna hatcheries in Cook Inlet, and the Cannery Creek, Solomon Gulch, Gulkana, Main Bay and Wally Noerenberg hatcheries in Prince William Sound (PWS). This report is for the Armin F. Koernig Hatchery (AFKH) in PWS. Following completion of reviews of hatcheries in PWS, reviews of hatcheries in Southeast Alaska will follow.

OVERVIEW OF POLICIES

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

A variety of policies guide the permitting of salmon fishery enhancement projects. They include the *Genetic Policy* (Davis et al. 1985), *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2010), and various 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 (Table 1). Policy guidelines include banning importation of salmonids from outside the state for enhancement (except U.S./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 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 discusses the identification and protection of *significant and unique* wild stocks: "Significant or unique wild stocks must be identified on a regional and species basis so as to define sensitive and nonsensitive areas for movement of stocks." In addition, the *Genetic Policy* suggests that drainages be established as wild stock sanctuaries where no enhancement activity is permitted except for gamete removal for broodstock development. The wild stock sanctuaries were intended to preserve a variety of wild types for future broodstock development and outbreeding for enhancement programs.

These stock designations are interrelated with other restrictions of the *Genetic Policy*, including 1) hatchery stocks cannot be introduced to sites where the introduced stock may have 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 those stocks.

Salmon fishery enhancement efforts are guided by comprehensive salmon plans for each region. 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 (Table 2). The policy and associated guidelines are discussed in *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2010), which includes regulations and guidelines

for fish transports, broodstock screening, disease histories, and transfers between hatcheries. As with the *Genetic Policy*, these regulations and guidelines are used by ADF&G fish pathologists and geneticists 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.

In addition, although several *Genetic Policy* guidelines relate to hatchery stock effects on significant wild stocks, to date, significant stocks have only been designated in the Cook Inlet Region (Cook Inlet Regional Planning Team 2007). The absence of significant stock designations elsewhere in the state adds uncertainty to the enhancement review process in applying standards set out in the *Genetic Policy*.

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. Independent PNP corporations, not affiliated with an RAA, also operate hatcheries in several areas of the state. RAAs (but not independent PNP corporations) 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. Both the RAAs and independent PNP hatchery organizations may harvest salmon returning to their hatcheries or release sites (referred to as cost-recovery harvest) 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. Hearings are held before a hatchery is permitted for operation. RPTs hold public meetings to define desired production

goals by species, area, and time 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): 1) hatchery permit with basic management plan (BMP), 2) annual management plan (AMP), 3) fish transport permit (FTP), and 4) annual report (Figure 2).

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. Permits remain in effect unless revoked or withdrawn by the ADF&G commissioner.

Hatchery permits/BMPs may be amended through a permit alteration request (PAR). In PWS, the Phase 3 Comprehensive Salmon Plan guides the review of PARs by the RPT through a Criteria Check List that describes project intent and goals. The Criteria Check List includes objectives that provide for reduced congestion and conflict in the fishery; minimized impact on wild stocks; promotion of the highest possible fish quality; maximization of production; minimization of impacts to historic and traditional fisheries; support of subsistence, sport and personal use needs; encouragement and support of research; and recognition of healthy competition in the fishery.

PARs 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 by the RPT, the PAR is sent to the commissioner without a recommendation. If approved by the commissioner, the permit is amended to include the alteration. Reference to a *permit* or *hatchery permit* in this document also includes approved PARs to the hatchery permit unless otherwise noted.

The AMP outlines operations for the current year. It should "organize and guide the hatchery's operations, for each calendar year, regarding production goals, broodstock development, and harvest management of hatchery returns." (5 AAC 40.840). Typically, AMPs include the upcoming year's egg-take goals, fry or smolt releases, expected adult returns, harvest management plans, FTPs required or in place (described below), 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 proposed FTPs 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, before final consideration by

the ADF&G commissioner. 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 to the Alaska Legislature as required by AS 16.05.092 (e.g., Vercessi 2013).

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

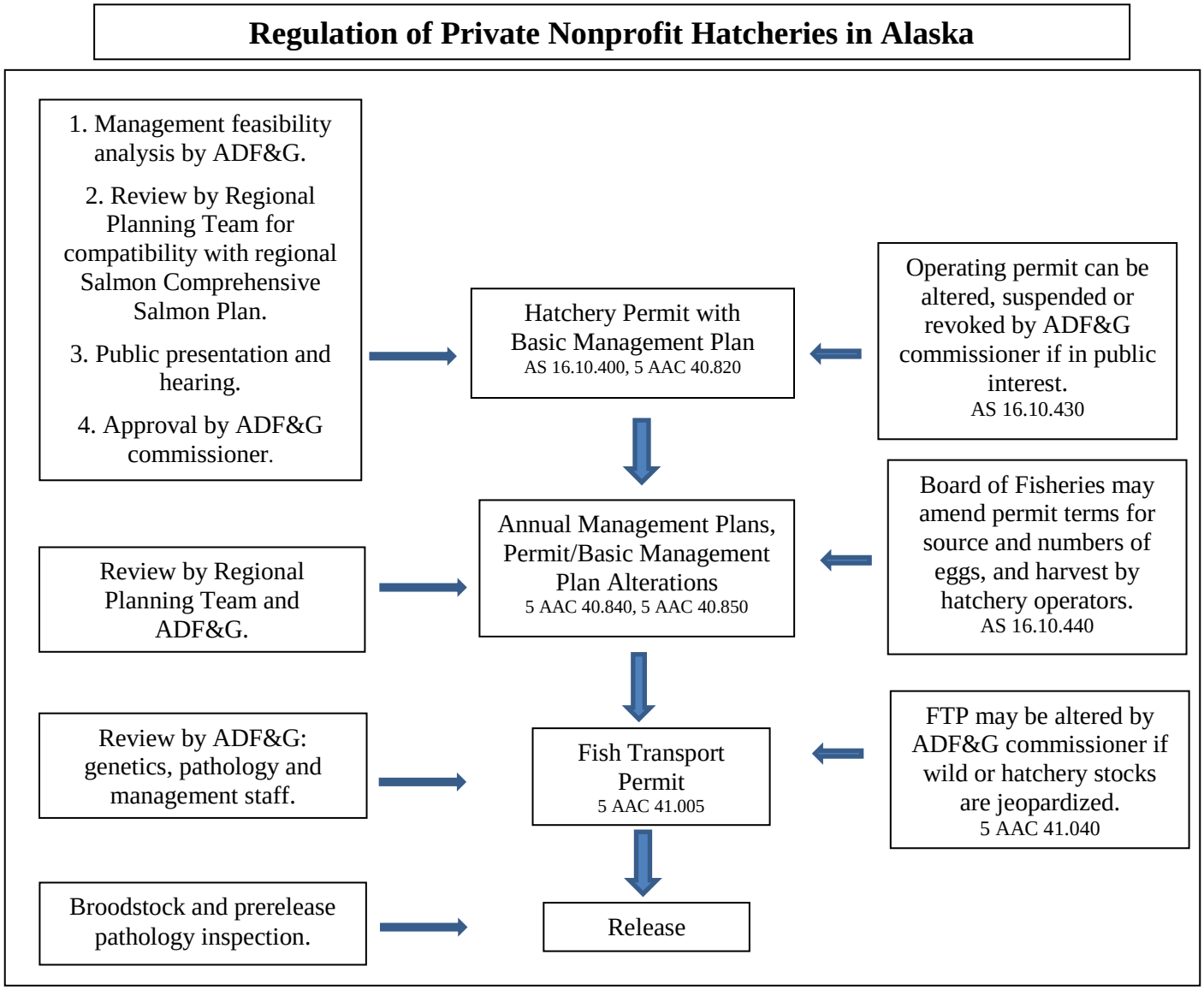

Figure 2.–Diagram of Alaska hatchery permitting process.

ARMIN F. KOERNIG HATCHERY

OVERVIEW

Salmon runs to Prince William Sound (PWS) in the early 1970s were poor due in part to productivity losses from the 1964 earthquake. The Prince William Sound Aquaculture Corporation (PWSAC) formed to develop PWS hatcheries to stabilize pink and chum salmon runs at a "relatively high level", similar to runs that occurred from 1920 to 1950.[3] PWSAC staff also saw hatcheries as safeguards against potential impacts from oil development in the area (Yakutat and Yakutaga), as well as from the Trans-Alaska pipeline terminus in Valdez.[4] The PWSAC Board of Directors has 45 members. Twenty-seven board members are PWS salmon permit holders, elected by PWS salmon permit holders. The remaining 18 seats are designated representatives from municipalities, Alaska Native organizations, processors, sport fisheries, personal use fisheries, and subsistence users and are appointed by the board.[5]

Construction of the Port San Juan Hatchery, later renamed the Armin F. Koernig Hatchery, began in 1979. The facility is located at a former cannery site in Port San Juan on southwestern Evans Island in PWS (Figure 3). Water for hatchery operations is supplied by San Juan Lake and Larsen Creek. PWSAC hoped to use existing structures from the cannery for hatchery production of pink and chum salmon. However, many of the cannery facilities could not be salvaged and had to be torn down and replaced (e.g., pipeline trestles, most dam structures). Due to these higher than anticipated construction costs, funds were only available to produce pink salmon at hatchery start-up.[6]

Odd-year pink salmon stocks were first collected from Ewan Creek in 1975 and eyed eggs were planted in Larsen Creek.[7] The Ewan Creek stock was selected because Ewan Creek had a similar water temperature regime to Larsen Creek and a large enough run to allow a substantial egg take. In addition, a high percentage (75%) of the Ewan stock utilized the waters of Ewan Creek above-high tide for spawning, which would be better suited to the freshwater incubation environment of the hatchery.[8]

In 1977, in addition to Ewan Creek stock returns, broodstock was collected from systems near AFK Hatchery in Sawmill Bay (Stream #666, O'Brien Creek at Port Ashton) and Crab Bay (Stream #667, Hardins Creek), along with natal pink salmon returns to Larsen Creek.[9] Beginning in 1979, odd year hatchery returns were sufficient to meet broodstock needs.

Returns to Ewan Creek were not strong enough for the desired broodstock collections in 1976, and the even year broodstock was collected from Duck and Millard creeks at the head of Galena Bay, about 90 miles northeast of the hatchery, combined with a lesser number of natal returns to

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[3] PNP salmon hatchery application submitted by PWSAC for AFKH. 1975. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[4] Noerenberg, W. H. 1979. Biological Planning Document. Port San Juan and Esther Salmon Hatcheries, Prince William Sound, Alaska. Prince William Sound Aquaculture Corporation. Unpublished document that was part of the PNP Salmon Hatchery Application for AFKH obtained from the files of Sam Rabung, ADF&G PNP Coordinator, Juneau.

[5] http://pwsac.com/about/board-directors/ (accessed 10/24/2012), and Dave Reggiani, PWSAC General Manager, personal communication.

[6] Ibid.

[7] 1975 Annual Report for Port San Juan Hatchery. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[8] PWSAC pre-application for a PNP Hatchery. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau

[9] 1977 Annual Report for Port San Juan Hatchery. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

the Larsen Creek hatchery stream.[10] Beginning in 1978, even year hatchery returns were sufficient to meet broodstock needs.

The original chum salmon donor stocks were from PWS watersheds in Port Fidalgo, located about 70 miles northeast of the hatchery.

A public hearing for the hatchery was held by the ADF&G commissioner in Cordova in 1975. Wally Noerenberg, executive director of PWSAC, presented the plans for the hatchery. Public testimony was taken, and there was no opposition to the hatchery.

ADF&G issued PNP salmon hatchery permit number 2 to PWSAC in 1975 for a permitted capacity of 10 million pink salmon eggs and 200,000 chum salmon eggs. A BMP was not issued with the hatchery permit because the permit was issued prior to the BMP provisions in regulation (Appendix A).

PERMIT ALTERATIONS

Permit alterations from 1976 through 1982 incrementally increased permitted egg capacity to 150 million pink salmon and 13 million chum salmon. In 1985, an approved permit alternation provided for an increase in the chum salmon egg take from 13 to 21 million eggs, but only if 10 million of the eggs were transferred to Esther Lake Hatchery—now called Wally Noerenberg Hatchery (WNH). The permit alteration also allowed for an egg take of up to 36 million pink salmon eggs for transfer to WNH, but the permitted pink salmon capacity at AFKH remained at 150 million eggs.

In 1992, a PAR was approved to increase pink salmon capacity to 190 million eggs. In 1999, two PARs were approved that reduced pink salmon capacity from 190 to 160 million eggs, and chum salmon capacity was removed from the permit. According to the ADF&G deputy commissioner, these new capacities more accurately reflected the actual production capabilities of the hatcheries at the time.[11]

In 2003, pink salmon capacity at AFKH was again increased from 160 to 190 million eggs, and was approved with a corresponding decrease in capacity of 30 million pink salmon eggs at WNH. In 2007, pink salmon capacity at AFKH was decreased from 190 to 162 million eggs, with a corresponding 28 million pink salmon egg increase at WNH. Also in 2007, chum salmon production was reinstated, with a permitted capacity of 17 million eggs. In 2010, a PAR was approved to increase chum salmon capacity from 17 to 34 million eggs. PARs to increase pink salmon capacity in 2010 and 2011 were denied due to straying results of recent studies, and because even-year pink salmon escapements were not achieved for stocks in the Southwestern District.[12,13,14]

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[10] 1976 Annual Report for Port San Juan Hatchery. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau. NOTE: in the first edition of this report,, the even-year stock was reported to be from Ewan Creek; however, this was found to be in error and this updated version of the report correctly lists Duck and Millard creeks as the even year stock.

[11] Letter from Robert Bosworth, ADF&G Deputy Commissioner, to Bud Perrine, General Manager, PWSAC, dated February 8, 1999. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[12] Letter from David Bedford, ADF&G Deputy Commissioner, to Dave Reggiani, General Manager, PWSAC, dated September 9, 2010. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[13] Letter from Tim Joyce PWS/Copper River RPT Chairman to Cora Campbell, ADF&G Commissioner, dated June 15, 2011. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[14] Memorandum from Jeff Regnart, ADF&G Division of Commercial Fisheries Director and Charles Swanton, Division of Sport Fish Director, to ADF&G Commissioner Cora Campbell dated August 23, 2011. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

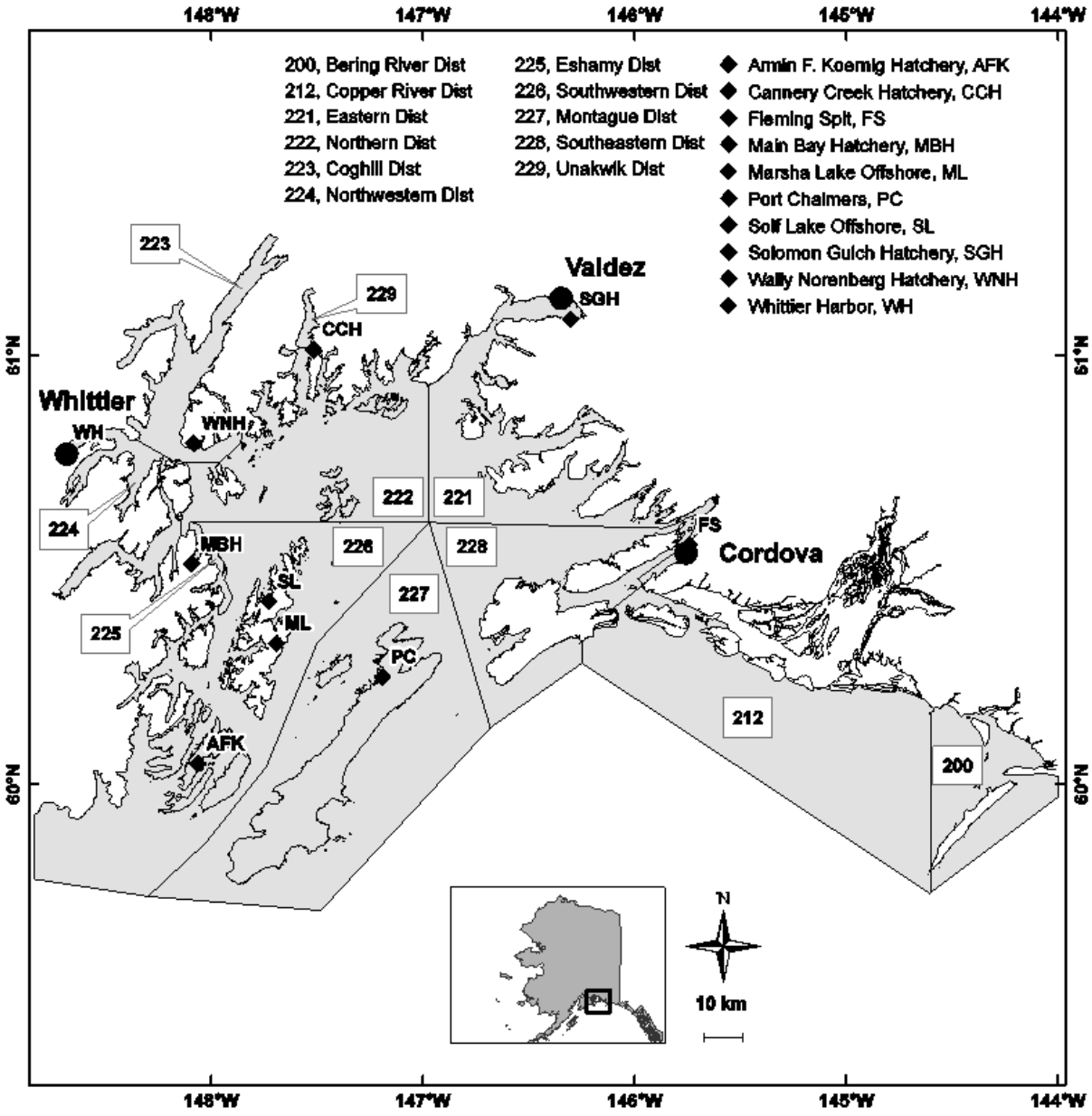

Figure 3.–Armin F. Koernig Hatchery and Prince William Sound fishing districts.

PRODUCTION SUMMARY

The first pink salmon runs to the hatchery occurred in 1976, with the first year of runs exceeding 1 million fish in 1979. Over the past decade (2003–2012), pink salmon egg takes averaged 175 million eggs per year. Fry releases averaged 153 million fry per year over the same period. Annual AFKH pink salmon returns in the past decade ranged from about 3.0 million to nearly 16 million fish (Appendix B).

Chum salmon runs have been intermittent, with consistent runs of over 100,000 fish since 2006. Chum salmon fry releases from AFKH from 2003 to 2012 averaged about 18 million per year.

Adult chum salmon runs to AFKH from 2006 to 2012 averaged about 250,000 fish per year, although there is considerable uncertainty surrounding the adult run numbers due to marking issues (Appendix C).

Beginning in 2003, some chum salmon fry releases, although otolith marked, were not identifiable by release site.[15] In other instances, incomplete data reporting led to uncertainty that fry were released with the intended mark at the correct location.[16] This meant that although the estimated numbers of eggs and fry releases by release site were known, returning adults could not be assigned with certainty as being from a particular release site.

PROGRAM EVALUATIONS

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

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

The hatchery permit and BMP do not expire. The BMP should be updated when any permit amendments are approved through PARs.

In review of permitted capacity, no approved PARs for the period between 1978 and 1980 could be found which increased the pink salmon capacity from 40 to 70 million eggs. These PARs were likely approved, but the paperwork could not be located.

The current AFKH program FTPs were reviewed by ADF&G biologist, fish pathologist, and geneticist before submission to the ADF&G commissioner for approval (Appendix E). During the review in 2010 to extend the effective period of the FTP that allows for moving chum salmon from WNH to AFKH (04A-0046), the ADF&G geneticist did not agree to approval of the permit because problems with marking fish earlier in the project did not provide assessment of homing to the release site. The geneticist recommended that if the permit was approved, it should be limited to 5-year duration, instead of the 10-year duration requested, and include a requirement for a homing study. These terms were incorporated into the final permit approved by the commissioner.

The 2012 AMP provides documentation of expected operations for the season, including egg-take and release goals, a listing of current FTPs, expected returns, hatchery run management, plans for otolith marking, and evaluation plans. The AMP is consistent with the permit and PARs. Although the AFKH hatchery permit was issued in 1975, prior to adoption of the regulation requiring a BMP in 1985, a BMP is required for current operations, according to staff at the Alaska state attorney general's office.[17]

Egg takes and fry releases reported in the annual report were in close agreement to levels permitted in the hatchery permit, FTPs, and AMPs, until about 2003 for pink salmon and 2010

[15] Ron Josephson, Section Chief, ADF&G Fisheries Monitoring, Permitting and Development, Division of Commercial Fisheries, to Denby Lloyd, ADF&G Commissioner, July 9, 2010 memorandum. Unpublished document obtained from Sam Rabung, ADF&G PNP Coordinator, Juneau.

[16] Dave Reggiani, PWSAC General Manager, personal communication.

[17] Vanessa Lamantia, Assistant Attorney General, Alaska Department of Law, email communication.

for chum salmon, when reported egg takes regularly exceeded permitted levels in some years (Appendices F and G). During the years 2003 to 2012, eggs were re-enumerated at the eyed-egg stage of development and the second egg estimate was greater than the estimate conducted during the egg take (and therefore greater than the permitted level). Eggs in excess of the permitted level were discarded.

The number of eggs is estimated by volume, and the egg take ends when the permitted level is reached. Eggs are re-enumerated during the eyed-egg stage, and the second egg count is the number reported on the annual reports.[18] Permitted egg capacity is based on the number of green eggs placed in the hatchery. If the egg number at the eyed-egg stage continues to exceed permitted capacity, the methodology for estimating the number of eggs at the egg take should be refined so that the number of eggs taken stays within the permitted capacity.

COMPREHENSIVE SALMON ENHANCEMENT PLAN

The PWS RPT has developed three Comprehensive Salmon Enhancement Plans (CSEP) 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 (Prince William Sound Regional Planning Team, 1983). 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. The Phase I plan projected that average annual catches of natural stocks in the commercial fisheries could be about 5 million pink salmon and 543,000 chum salmon, which were the 1960 to 1981 average catches for each species.

Purse seine gear is the only type of commercial fishing gear permitted in the Southwestern District where most AFKH fish are harvested. The RPT conducted a survey as part the Phase I CSEP to ask the fishing community about their desires for enhancement. Purse seine respondents ranked the Southwestern District as their preferred fishing district, and tied for fourth as a preferred district for new enhancement projects. Pink salmon was their preferred species.

The CSEP Phase II was issued in 1986 (Prince William Sound Regional Planning Team 1986). The purpose of the Phase II plan was to recommended 5-year goals to achieve the 20-year goals in the Phase I plan. For AFKH, the Phase II plan made no recommendations regarding hatchery capacity or species.

The Phase III CSEP 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 recommended a guideline potential maximum increase in AFKH pink salmon production from 126 million eggs to the permitted level at the time of 190 million eggs over the following 10-year period if fishery management issues, genetic guidelines and stock interactions allowed (Prince William Sound-Copper River Regional Planning Team 1994). No chum salmon production was recommended in the Phase III document. No further CSEP plans have been issued to date.

The Phase III plan also recommended five biological and economic criteria as the hatchery program in PWS was developed. Two recommendations—that growth rates of juvenile salmon during the early marine period should be density independent over the long term, and that

[18] Dave Reggiani, PWSAC General Manager, personal communication.

abundance of juvenile salmon predators should be independent of juvenile salmon abundance over the long term—are not addressed here because these parameters would likely be affected by more than one hatchery. These issues may be addressed in future enhancement evaluations that address issues on a regional scale. Two recommendations—that straying remain below 2% of the wild-stock escapement over the long term and that wild stock escapement goals must be achieved over the long term—can be assigned to an individual hatchery and are addressed in this document.

The fifth recommendation was that the long-term average cost of hatchery operation, management, and evaluation must remain below 50% of the value of hatchery production, and that the RPT will determine how to calculate costs and values of the hatchery program and establish more definitive decision criteria regarding economic benefits. The RPT has not defined these costs, values and criteria to date.

In addition, the revised charter for the RPT under Phase III Plan states that the RPT will update the Comprehensive Salmon Plan at least once a year, and will provide an updated plan to the commissioner each year. Annual reports have not occurred since issuance of the Phase III Plan.

CONSISTENCY WITH POLICY

Policies governing Alaska hatcheries were divided into three categories for this review: genetics, fish health, and fisheries management. Key elements of the policies in each category are summarized in Tables 1–3. These templates identifying the key elements of state policies were used to assess compliance of the AFKH 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 basis so as to define sensitive and nonsensitive areas for movement of stocks. Davis and Burkett (1989) suggest that regional planning teams (RPTs) are an appropriate body to designate those stocks.
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.
Use of indigenous stocks in watersheds with significant wild stocks	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	Gene flow from hatchery fish straying and interbreeding with wild stocks may have significant detrimental effects on wild stocks. Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks.
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 fish. 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.
Genetics review of Fishery Transport Permits (5 AAC 41.010 – 41.050)	
Review by geneticist	FTP's are reviewed by the geneticist. The genetist may recommend conditions or denial of the permit to protect wild or enhanced stocks.

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 (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.

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 Fish Transport Permit (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

Donor stocks of pink salmon were from stocks in Sawmill Bay, the site of the hatchery, as well as from Ewan Creek about 20 miles northwest of AFKH, and creeks in Galena Bay in Valdez Arm about 90 miles northeast of AFKH. Neither significant stocks nor wild stock sanctuaries have been defined by the PWS RPT.

Numerous straying studies have been conducted at AFKH, although descriptions of the number of streams surveyed and results portrayed in tables were not always clear in the 1980 to 1982 annual reports. From 1979 through 1981, a small portion (<1% of releases) of pink and chum salmon fry from AFKH were fin clipped. Only five marks were recovered during stream surveys from 1980 to 1982, and the small sample sizes during this period made interpretation of results inconclusive.

Joyce and Evans (2000) and Brenner et al. (2012), reported AFKH pink salmon straying in the highest percentages in streams near the hatchery. Brenner et al. (2012) reported that straying, as calculated by weighting the hatchery proportion in a sample by the estimated stream escapement at the time of sampling, in nine Southwestern District streams showed that three streams had less than 5% AFKH strays, three streams had between 14% and 24% AFKH strays, and three streams had 44% and 75% AFKH strays. Strays from AFKH were also found in appreciable numbers in Eshamy District streams, where four streams showed an estimated 25% to 45% AFKH fish.

In 2012, ADF&G awarded the Prince William Sound Science Center a contract for a four-year project to study the extent and annual variability in straying of hatchery pink and chum salmon in PWS, and effects on fitness (productivity) of pink and chum salmon stocks due to straying of hatchery-released salmon.[19]

[19] http://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesResearch.main (Accessed 02/01/2013).

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

I. Stock Transport	
Use of appropriate local stocks	AFKH used PWS pink salmon broodstock from Sawmill Bay drainages (Larsen, O'Brien and Hardins creeks), Ewan Creek stock from about 20 miles northwest of the hatchery, and Duck River stock about 90 miles northeast of the hatchery. Chum salmon releases were from PWS streams in Sawmill Bay, Port Fidalgo, and the WNH stock, which had an ancestry of PWS streams including Wells River, Beartrap Creek, and Fidalgo Bay.
II. Protection of wild stocks	
Identification of significant or unique wild stocks	No stocks have been identified as significant stocks or unique wild stocks in Prince William Sound by the PWS RPT.
Establishment of wild stock sanctuaries	No wild stock salmon sanctuaries are designated for PWS.
Straying Impacts	Straying of AFKH pink salmon was generally highest in streams sampled nearest the hatchery in the Southwestern District, with appreciable stray rates in streams sampled in the Eshamy District (Brenner et al. 2012). Impacts of straying are currently under study by the PWSCC and ADF&G.
III. Maintenance of genetic variance	
Maximum of three hatchery stocks from a single donor stock	AFKH stock pink salmon were used at Main Bay Hatchery and WNH. AFKH stock chum salmon were used at Cannery Creek Hatchery.
Minimum effective population size of 400	The AMP for AFKH requires about 309,000 adult pink salmon and 32,000 adult chum salmon broodstock to meet egg-take goals.
Genetics review of Fish Transport Permits (5 AAC 41.010 – 41.050)	
Review by geneticist	The geneticist reviewed FTPs issued for AFKH programs.

Fish health and disease

FTPs for AFKH programs were approved by the pathologist (Table 5). Pathology records showed no inconsistencies with fish health and disease policies. Appropriate salmon culture techniques are being used, and disease reporting and broodstock screening have occurred as required. The hatchery was been inspected regularly since at least 1978, and no chronic health or mortality issues have been identified (Appendix H).

Table 5.–The current AFKH salmon fisheries 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; amended by Meyers 2010)	
Egg disinfection	Not used.
Hatchery inspections	Hatchery inspections were conducted regularly from at least 1977 through 2011.
Disease reporting	There have been no chronic disease issues at the hatchery
Pathology requirements for FTPs (5 AAC 41.010)	
Disease history	Disease histories are completed as needed.
Isolation measures	No physical transport occurs for onsite release, according to the FTP.
Pathology review of FTPs	FTPs were reviewed and approved by the pathologist.

Fisheries management

AFKH is located in the Southwestern District of PWS (Figure 3). ADF&G manages the area fisheries based on management objectives to meet escapement goals and the cost recovery and broodstock requirements at the hatchery under the Armin F. Koernig Management Plan (5 AAC 24.365). Allocation of commercial common property[20] harvest of hatchery fish is based on the Prince William Sound Management and Salmon Enhancement Allocation Plan (5 AAC 24.370). Because AFKH fish return intermixed with other fish, management of the run is based on a variety of factors. Poor spawning escapement may require closures in general fishing areas and shifting harvest to the terminal areas near the hatchery. Returning hatchery fish may be intercepted in other fishing districts and result in insufficient returns to meet broodstock and cost-recovery goals, requiring selected fishing closures near the hatchery to provide for broodstock and cost recovery needs (PWSAC and ADF&G 2012). Except in hatchery terminal fisheries, chum salmon are harvested incidentally to fisheries managed for other salmon species in most of PWS.

Early tagging studies in PWS (McCurdy 1983a, 1983b, 1984) were conducted at AFKH and other areas near established or proposed hatchery special harvest areas to determine the proportion of wild stocks present in the special harvest areas during periods when hatchery harvests and broodstock collection would occur. Tagging studies also provided general stock migratory routes and timing.

All AFKH releases are otolith marked (Table 6). Hatchery contribution is estimated from otoliths sampled from the fisheries and at the hatchery. Pink salmon returning to the hatchery are

[20] Commercial common property harvest refers to fish caught by the commercial fishing fleet.

harvested primarily in the Southwestern District purse seine fishery (Botz et al. 2013). AFKH chum salmon are also likely primarily harvested in the Southwestern District, but chum salmon fry with the same marks were released from multiple sites in recent years, creating uncertainty in estimates of contributions by release site. These marking issues have since been resolved.

Beginning in 1994, ADF&G staff periodically reviewed escapement goals for PWS stocks. Spawning escapement goals were adjusted, as appropriate, based on the accumulation of escapement and production data from previous years. According to the first escapement goal review by Fried (1994), from about 1965 to 1990, pink salmon escapement goals were established for the Southwestern and Eshamy fishing districts combined. From 1990 to 2002, escapement goals were established for the Southwestern District alone (Fried 1994). From 2003 to 2011, PWS pink salmon escapement goals were changed from fishing district-level goals to a PWS area-wide goal, with fishing districts managed for escapement target ranges within the area-wide goal (Bue et al. 2002). Beginning in 2012, escapement goals were again established for each fishing district (Fair et al. 2011).

From the first year of significant returns to AFKH in 1978, pink salmon escapement goals (1978–2002 and 2012) or escapement targets (2003–2011) were met in 25 out the 35 years. Escapement targets were not reached during even-year returns from 2002 to 2010, but the escapement goal was reached in 2012[21] (Appendix D). The even-year escapement target for the Southwestern District was changed from a "target" escapement range of 130,000 to 285,000 as part of the area-wide escapement goal established in Bue et al. (2002) to a district-specific escapement goal range of 70,000 to 190,000 in 2012. The district escapement goals were lowered from the (2003–2011) district target goals because the long time-series of escapement data and their general stationary or increasing characteristics through time suggested that the management targets established in Bue et al. (2002) were set too high relative to the existing sustainable fishery (Fair et al. 2011). In retrospect, applying the new even-year escapement goals back to 2002, the only year where the goal or management target would not have been met was in 2002.

The validity of applying the current escapement goals to escapement levels decades earlier, however, is uncertain, given possible changes in productivity and migratory patterns, continued geologic effects of the 1964 earthquake, possible influence from hatchery-reared fish straying and spawning in wild systems, and changes in fishing patterns targeting hatchery runs.

The Southwestern District chum salmon escapement goal was removed in 2002. There were no reliable estimates of chum salmon catch by district or estimates of catch by hatchery and wild origin with which to estimate escapement goal ranges (Bue et al. 2002; Appendix D). In addition, escapements to the Southwestern District are extremely small relative to escapements elsewhere in PWS, and given the low number of fish observed in escapement surveys and the possible error in the aerial surveys, Bue et al. (2002) recommended dropping the goal entirely.

[21] Tommy Sheridan, ADF&G Area Management Biologist, Cordova, personal communication.

Table 6.–The current AFKH salmon fisheries 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 runs are sampled for presence of hatchery otolith marks to estimate contributions to the fisheries. Although chum salmon were marked, fry with the same marks were released from multiple release sites from the late 1990s through mid-2000s, making evaluation by release site unreliable.[22] The marking issues appear to have been resolved. Straying studies are ongoing in Prince William Sound.
Use of precautionary approach	ADF&G manages the salmon fishery to meet escapement goals.
Salmon Escapement Goal Policy (5 AAC 39.223)	
Establishment of escapement goals	Escapement goals are established for the Southwestern District pink salmon systems.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
Wild stock conservation priority	A management plan is in place for the AFKH run. Special harvest areas for adult salmon returning to the hatchery allows their targeted harvest and minimizes incidental catch of other stocks when necessary.
Fisheries management review of Fish Transport Permits (5 AAC 41.010 – 41.050)	
Review by management staff	FTPs for the AFKH program 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 must include "information pertaining to species; brood stock source; number, age, weight, and length of spawners; number of eggs taken and fry fingerling produced; and the number, age, weight, and length of adult returns attributable to hatchery releases, on a form to be provided by the department." The completed report is due on December 15 and AFKH annual reports have been received for all years.

Alaska hatcheries are required to document the disposal of broodstock salmon carcasses (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 can be used for roe sales without using the carcass; proceeds from any excess must be surrendered to ADF&G. AFKH carcass logs appear to be complete and timely.

[22] Dave Reggiani, PWSAC General Manager, personal communication.

RECOMMENDATIONS

1) A BMP should be drafted to reflect current permitted levels and operations.

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

PWSAC constructed AFKH in response to poor salmon runs to PWS and most of Alaska during the 1970s. Today, the combination of favorable environmental conditions, sustainable management of wild stock systems, and hatchery production supports healthy salmon fisheries in PWS.

With full utilization of virtually the entire hatchery run and strong demand for pink salmon, there is heightened interest in increasing Alaska hatchery production. The processing industry has expanded infrastructure and markets for abundant salmon returns. The advent of thermal-marking otoliths and additions to the time series of harvest, escapement, migration, and timing data have added to management precision for harvesting AFKH runs and providing for adequate spawning escapement.

Addressing the impacts of one hatchery to fisheries management, spawning escapement and genetic effects from straying in PWS are difficult because of the multitude of hatcheries and the preponderance of hatchery-released fish in the PWS catch. Otolith marking issues have also impeded homing studies for remote releases of chum salmon from AFKH and other sites.

Straying of AFKH pink salmon has been documented for over two decades (Sharr et al. 1995, Joyce and Evans 2000, Brenner et al. 2012). Hatchery-released salmon strays were included in aerial survey spawning escapement counts of naturally-spawning pink salmon systems. Current stocks spawning in wild systems are likely a mix of hatchery and naturally spawned stocks. Because hatchery broodstocks are derived from local wild stocks, with large numbers of broodstock used and no selection for broodstock characteristics allowed, it is unknown whether or not there are any effects on fitness from this mixing on the spawning grounds. Garforth et al. (2012), in the first surveillance report for certification of Alaska's salmon fisheries under the FAO-based responsible fisheries management certification, indicated the need for hatchery and wild stock interaction study: "To evaluate whether or not fitness of natural-origin (wild) versus stray hatchery-origin salmon differ when spawning in the wild, survival of both types of fish and their relative spawning success needs to be documented."

A science panel composed of current and retired scientists from ADF&G, University of Alaska, aquaculture associations, and National Marine Fisheries Service, with broad experience in salmon enhancement, management, and wild and hatchery interactions, designed a long-term research project to potentially answer some of these questions. The four-year study entitled *Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska* currently underway is funded by the state of Alaska and administered by ADF&G, with field work conducted by the Prince William Sound Science Center. The study will improve understanding of hatchery and wild stock interactions and provide Alaska-specific scientific guidance for assessing Alaska's hatchery program, including recommendations for

escapement goals, fisheries management, hatchery production levels, and hatchery practices at AFKH and other hatcheries in the state.

ADF&G recognizes the importance of PWSAC within the PWS region and strongly supports the effective and continued operation of PWSAC hatcheries. ADF&G determines PWSAC to be in full compliance with its hatchery permit, annual management plans and other agreements with the department.[23]

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[23] Jeff Regnart, ADF&G Director of Commercial Fisheries, personal communication.

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APPENDIX

Appendix A.–History of AFKH permit and permit alterations, 1975–2012.

Date	Description	Permitted Capacity (millions of eggs)	
		Pink Salmon	Chum Salmon
09/29/1975	PNP hatchery permit number 2 issued to PWSAC to operate the AFKH. Hatchery is permitted for 10 million pink salmon and 200,000 chum salmon eggs. Primary pink donor stream was Ewan Creek, with Totemoff, Bainbridge, Fall, O'Brien and Johnson creeks and Jackpot River as alternate sources. Primary chum donor stream was Coghill River, with Shrode, Jackson, Brizgalof and O'Brien creeks and Chimevisky Lagoon as alternate sources.	10	0.2
07/01/1976	Approved permit alteration to increase pink salmon capacity from 10 to 15 million eggs, and to increase chum salmon capacity from 200,000 eggs to 5 million eggs. Duck River was the primary pink salmon donor source, with Millard and Indian Creeks as alternate sources. Duck River was the primary chum salmon donor source.	15	5
10/20/1976	Denied permit alteration to add 2 million egg coho salmon capacity.	15	5
08/04/1978	Permit alternation approved to change capacity from 15 million pink salmon eggs and 5 million chum salmon eggs to a capacity of 40 million pink and 3 million chum salmon eggs combined. Stated special harvest area (i.e., fish returning to hatchery) was approved broodstock source for pink salmon. Sunny River was the primary donor system for chum salmon, with Fidalgo and Duck rivers, ADF&G Streams 084 and 085, and Keta Creek as alternate sources.	40	3
	(Author could not find approved PAR(s) between 1978 and 1980 that would have increased pink salmon capacity from 40 to 70 million.)		
10/31/1980	Approved permit alteration to increase pink salmon capacity from 70 to 95.5 million eggs.	95.5	3
07/15/1981	Approved permit alteration to increase pink salmon capacity from 95.5 to 115 million eggs and chum salmon capacity from 3 to 13 million eggs. Up to 5 million of the chum salmon eggs could come from wild donor stocks.	115	13
09/14/1981	Approved permit alteration to increase pink salmon capacity from 115 to 150 million eggs	150	13
08/11/1982	Approved permit alteration to increase allowable chum salmon egg take from wild donor stocks from 5 to 10 million eggs	150	13
05/29/1985	Approved permit alteration to allow egg take of 36 million pink salmon and 10 million chum salmon eggs for transfer at eyed stage to Esther Lake Hatchery, which was later renamed Wally Noerenberg Hatchery. The pink salmon permitted capacity for AFKH did not change, and the chum salmon permitted egg capacity was increased from 13 to 21 million, but only if 10 million of the chum salmon eggs were transferred to ELH.	150	13
04/13/1992	Approved permit alteration to increase pink salmon egg capacity from 150 to 190 million eggs.	190	13
02/09/1999	Approved permit alteration to decrease pink salmon egg capacity from 190 to 160 million eggs and reduced the chum salmon capacity from 13 to 2 million eggs.	160	2

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Date	Description	Permitted Capacity (millions of eggs)	
		Pink Salmon	Chum Salmon
03/24/1999	Approved permit alteration to remove chums salmon capacity.	160	0
05/21/2003	Approved permit alteration to increase pink salmon capacity from 160 to 190 million eggs, and coincided with a 30 million egg decrease at WNH.	190	0
06/15/2007	Approved permit alteration to decrease pink salmon capacity from 190 to 162 million eggs, and establishes a chum salmon capacity of 17 million eggs.	162	17
07/12/2010	Approved permit alteration to increase chum salmon capacity from 17 to 34 million eggs.	162	34
09/03/2010	Denied permit alteration request to increase pink salmon capacity from 162 to 190 million eggs.	162	34
08/03/2011	Denied permit alteration request to increase pink salmon capacity from 162 to 190 million eggs.	162	34

Appendix B.–AFKH pink salmon egg takes, fry releases and adult returns. See footnotes for donor stock sources.

Year	Eggs	Fry Released	Total Adult Return
1975	6,254,460	(eggs planted in Larsen Creek)	0
1976	0	1,000,000	0
1977	23,424,000	11,010,577	38,845
1978	28,645,626	16,940,778	154,620
1979	28,401,415	22,774,739	552,955
1980	94,689,000	21,641,757	1,493,489
1981	143,500,000	72,538,000	2,264,854
1982	129,615,000	70,118,000	5,134,363
1983	89,752,270	87,384,533	3,722,502
1984	117,767,702	76,746,000	2,800,000
1985	171,605,297[a]	103,925,000	5,030,616
1986	203,936,075	112,528,515	4,964,000
1987	145,952,427	116,562,088	7,613,161
1988	218,666,908	110,962,557	6,076,493
1989	126,900,222	160,471,718	3,937,926
1990	127,857,935	113,842,866	8,952,035
1991	127,263,120	115,748,552	5,117,569
1992	127,468,664	112,828,925	2,391,140
1993	125,875,325	113,529,568	1,528,425
1994	125,483,203	92,723,581	1,744,142
1995	126,254,629	108,583,112	856,048
1996	60,398,583	108,636,977	1,766,881
1997	119,084,280	51,562,609	6,605,685
1998	160,618,374	105,974,235	6,963,470
1999	161,884,741	133,156,995	8,389,898
2000	159,404,108	142,537,692	6,880,616
2001	173,717,376	150,287,930	4,839,906
2002	175,827,490	155,982,828	7,758,567
2003	193,688,977	146,407,222	7,067,047
2004	148,984,318	174,371,351	4,860,481
2005	198,591,471	131,197,783	10,121,228
2006	195,049,572	159,616,613	5,216,231
2007	160,000,000	179,000,000	15,760,177
2008	161,000,000	144,000,000	6,112,269
2009	201,000,000	145,000,000	10,542,621
2010	165,000,000	149,000,000	13,768,790
2011	164,000,000	148,000,000	3,089,711
2012	162,000,000	150,000,000	3,755,920

Sources: Egg take and release data: PWSAC annual reports, unpublished documents from Sam Rabung, ADF&G PNP coordinator, Juneau; and an internal ADF&G database, Lorraine Vercessi, ADF&G PNP assistant coordinator, Juneau, which may include updated information relayed after annual reports were submitted. Pink salmon adult return data: 1975–1996 from Sharp et al. (2000); 1998–2011 from Botz et al. (2013); 2012 from PWSAC annual report for AFKH, unpublished document from Sam Rabung, ADF&G PNP coordinator, Juneau. Donor stocks were Ewan Creek in 1975; Larsen Creek (the hatchery source water) in 1976; and ADF&G Stream numbers 666 and 667, O'Brien Creek, Crab Bay, Hardins Creek, Sawmill Bay and hatchery returns in 1977. Beginning in 1978, all gametes were collected from hatchery returns.

[a] 50 million of these eggs were transferred to other hatcheries.

Appendix C.–AFKH chum salmon egg takes, fry releases and adult returns. See footnotes for donor sources. All eggs were transferred to WNH 1986 to 1988. In 1996, 1997, and 2007 to 2012, eggs were received from WNH, incubated and released from AFKH at Sawmill Bay. Due to fry with the same otolith marks released from multiple sites, returns to AFKH reported by ADF&G (Botz et al. 2013) differ from the return reported by PWSAC in the WNH annual report, where the returns to AFKH are listed because the eggs were taken under the WNH permit.

Year	Eggs	Fry Released	Total Adult Return
1975			
1976	17,000		
1977	1,445,000	10,000	
1978	441,192	1,014,000	
1979	570,556	247,548	
1980	3,461,000	395,000	3,085
1981	8,593,000	745,668	20,380
1982	11,403,508	7,616,000	1,687
1983	8,487,110	9,484,200	3,881
1984	12,072,688	7,654,000	33,410
1985	2,129,649	10,944,308	31,936
1986	14,070,749	2,039,750	166,250
1987	2,011,208		16,765
1988	4,319,615		119,224
1989	137,202[a]		10,344
1990			
1991			
1992			
1993			
1994			
1995			
1996	11,763,730		
1997	10,960,010	8,524,584	
1998		10,121,106	
1999			25,953
2000			420,206
2001			219,799
2002			54,464
2003[b]		15,661,413	4,881
2004		16,198,524	
2005		15,163,742	1,971
2006		15,797,568	110,336
2007	16,400,000	15,500,555	216,314
2008	17,400,000	15,700,000	510,703
2009	18,600,000	15,100,000	229,833
2010	39,000,000	12,900,000	257,820
2011	37,600,000	30,500,000	120,206
2012	37,800,000	29,400,000	324,448

Sources: Egg take and release data: PWSAC annual reports, unpublished documents from Sam Rabung, ADF&G PNP coordinator, Juneau and from an internal ADF&G database, Lorraine Vercessi, ADF&G PNP assistant coordinator, Juneau, which may include updated information relayed after annual reports were submitted. Donor stocks: Port Fidalgo (Sunny River, Little Keta Cr., Streams #84 and #87) in 1977; Port Fidalgo (Sunny River, Streams #83, #84, and #87a) in 1978 and 1979; in 1980 and 1981, gametes were collected from Sunny River and Streams #83 and 87 and hatchery returns.

[a] Eggs sent to Solomon Gulch Hatchery.

[b] From 2002 to 2006, eggs were taken at WNH, fry transferred to AFK and released. Beginning in 2007, eyed eggs were transferred from WNH to AFKH for incubation, rearing, and release.

Appendix D.–Pink and chum salmon escapement in the Southwestern District and the escapement target for each year. The escapement goal from 1965 to 1990 is for the Southwestern and Eshamy districts combined, and for the Southwestern District only after 1990. From 2003 to 2011, PWS area pink salmon escapement goals were changed from fishing district-level goals to an area-wide goal, with fishing district escapement target ranges within the area-wide goal. Beginning in 2012, escapement goals were established for each fishing district. The range in the third column represents an escapement goal from 1965 to 2002 and 2012, and an escapement target within the area-wide goal from 2003 to 2011. The escapement values in bold indicate the lower escapement goal (1965–2002 and 2012) or escapement target within the area-wide goal (2003–2011) range was not met in that year.

Year	Pink Salmon	Pink Salmon Escapement Goal/Target	Chum Salmon	Chum Salmon Escapement Goal
1965	**65,380**	112,500–135,000	**1,829**	3,400–4,250
1966	115,570	112,500–135,000	**2,180**	3,400–4,250
1967	**42,950**	112,500–135,000	6,200	3,400–4,250
1968	172,770	112,500–135,000	**580**	3,400–4,250
1969	**57,890**	112,500–135,000	**0**	3,400–4,250
1970	**66,790**	112,500–135,000	**550**	3,400–4,250
1971	**79,140**	112,500–135,000	**1,430**	3,400–4,250
1972	**29,530**	112,500–135,000	4,010	3,400–4,250
1973	**52,320**	112,500–135,000	**1,020**	3,400–4,250
1974	160,980	112,500–135,000	**240**	3,400–4,250
1975	**77,270**	112,500–135,000	**1,280**	3,400–4,250
1976	**32,639**	112,500–135,000	**0**	3,400–4,250
1977	179,682	112,500–135,000	**400**	3,400–4,250
1978	**110,363**	112,500–135,000	**500**	3,400–4,250
1979	286,489	112,500–135,000	**0**	3,400–4,250
1980	**81,095**	112,500–135,000	**2,500**	3,400–4,250
1981	137,759	112,500–135,000	**650**	3,400–4,250
1982	134,827	112,500–135,000	**1,300**	3,400–4,250
1983	145,779	112,500–135,000	**2,000**	3,400–4,250
1984	304,859	112,500–135,000	**0**	3,400–4,250
1985	152,429	112,500–135,000	**500**	3,400–4,250
1986	**69,388**	112,500–135,000	**1,987**	3,400–4,250
1987	129,192	112,500–135,000	**1,150**	3,400–4,250
1988	118,359	112,500–135,000	**2,055**	3,400–4,250
1989	168,518	112,500–135,000	10,891	3,400–4,250
1990	136,721	130,000–159,000	3,945	3,400–4,250
1991	176,887	105,000–128,000	**2,075**	3,400–4,250
1992	**64,652**	130,000–159,000	**2,940**	3,400–4,250

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Year	Pink Salmon	Pink Salmon Escapement Goal/Target	Chum Salmon	Chum Salmon Escapement Goal
1993	**98,573**	105,000–128,000	**1,250**	3,400–4,250
1994	143,479	130,000–159,000	**2,225**	3,400–4,250
1995	**82,490**	105,000–128,000	**2,250**	3,400–4,250
1996	**63,337**	130,000–159,000	**2,231**	3,400–4,250
1997	112,010	105,000–128,000	**800**	3,400–4,250
1998	280,335	130,000–159,000	**1,602**	3,400–4,250
1999	163,347	105,000–128,000	**2,393**	3,400–4,250
2000	131,648	130,000–159,000	11,440	3,400–4,250
2001	176,503	105,000–128,000	5,187	3,400–4,250
2002	**35,554**	130,000–159,000	3,985	3,400–4,250
2003	130,356	100,000–225,000	12,373	No goal recommendation[a]
2004	**108,192**	130,000–285,000	1,810	No goal recommendation
2005	272,572	100,000–225,000	1,951	No goal recommendation
2006	**118,205**	130,000–285,000	7,293	No goal recommendation
2007	116,130	100,000–225,000	4,095	No goal recommendation
2008	**70,291**	130,000–285,000	3,090	No goal recommendation
2009	239,357	100,000–225,000	9,917	No goal recommendation
2010	**126,489**	130,000–285,000	10,523	No goal recommendation
2011	232,302	130,000–285,000	801	No goal recommendation
2012	90,000	70,000–190,000	930	No goal recommendation

Sources: Escapement numbers from Botz et al. (2013). Escapement goals: From 1965 to 2002 from Fried (1994); 2003 from Ashe et al. (2005a); 2004 from Ashe et al. (2005b); 2005 from Hollowell et al. (2007); 2006 from Botz et al. (2008); 2007 from Lewis et al. (2008); 2008 from Bell et al. (2010); 2009 from Botz et al. (2010); 2010 from Botz et al. (2012); 2011 from Botz et al. (2013). 2012 from Tommy Sheridan, ADF&G Area Manager, Cordova, personal communication.

[a] Escapement goal recommendation dropped in 2003 because there were no reliable estimates of chum salmon catch by district of origin or whether fish were hatchery or wild, with which to estimate escapement goal ranges.

Appendix E.–Summary of Fishery Transport Permit for AFKH.

FTP Number	Issued	Expiration	Summary and reviewer comments.
None	1978	None listed	Allowed collection of 3 million chum salmon eggs from Sunny River brood stock for incubation and release of resulting fry at AFKH.
None	1979	1980	Allowed collection of 1.5 million pink salmon eggs from Swanson Creek for incubation AFKH. Half the eggs would be planted in Hobo Creek at the eyed stage, and the other half would be incubated until emergence and released as fry at Hobo Creek. A fish pass was built on Hobo Creek in 1978 to previously unavailable pink salmon habitat, and this plan was to provide an initial stocking for the system.
None	1979	1979	Allowed collection of 5 million chum salmon eggs from an 8 stream list for incubation and release of resulting fry at AFKH.
None	1979	1979	Allowed collection of 5 million chum salmon eggs from Jonah Creek, with Siwash Bay, Coghill, Duck and Sunny rivers, Vlasoff Creek and Constantine harbors as alternate sites. This may be the same FTP as listed earlier on an updated form. Chum salmon egg incubation and release of resulting fry at AFKH.
80-18	1979	1979	Allowed collection of 1.5 million pink salmon eggs from Swanson Creek for incubation AFKH. The resulting fry to be released as fry at Hobo Creek. This may have superseded the earlier FTP for Hobo Creek.
80-177	1980	1980	Allowed collection of 5 million pink salmon eggs from Duck River, incubated to eyed stage at AFKH, transferred to Cannery Creek Hatchery (CCH), and the resulting fry released at Hobo Creek.
80-50	1981	1981	Allowed transport of 2 million pink salmon fry from AFKH to Main Bay Hatchery (MBH) for release to initiate the pink salmon broodstock program at MBH.
81-186	1981	2001	Allowed collection of 7 to 13 million chum salmon eggs and release of resulting fry at AFKH.
81-187	1981	2001	Allowed collection of 115 million pink salmon eggs and release of resulting fry at AFKH. Permit amended in 1981 to increase egg take from 115 to 150 million eggs.
81-188	1981	1983	Allowed collection of 5 million Port Fidalgo complex wild stock chum salmon eggs and release of resulting fry at AFKH. FTP amended to increase egg take to 10 million eggs in 1982.
81-284	1981	1981	Allowed collection and incubation to eyed-egg state of 10 million pink salmon eggs from AFKH return, transfer of eyed eggs to CCH until emergence, and resulting fry transferred, reared and released at MBH.
82A-1036	1982	1985	Allowed collection and incubation to eyed-egg state of 45 million pink salmon eggs from AFKH return, transfer for rearing and release at MBH.

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FTP Number	Issued	Expiration	Summary and reviewer comments.
88A-1054	1988	1988	Allowed collection and incubation to eyed-egg state of 6 million chum salmon eggs from AFKH return, transfer for rearing and release at CCH.
88A-1055	1988	1988	Allowed collection and incubation to eyed-egg state of 75 million pink salmon eyed-eggs from AFKH return, transfer for rearing at CCH.
89A-0006	1989	1989	Allowed release of up to 53 million pink salmon fry that were collected at AFKH and incubated at CCH under 88A-1055, then reared in saltwater pens and released at AFKH.
89A-0007	1989	1989	Allowed release of up to 11 million pink salmon fry that were collected at AFKH and incubated at CCH under 88A-1054, then reared in saltwater pens and released at MBH.
90A-0009	1990	2000	Allowed release of up to 1 million chum salmon fry from eggs that were collected at AFKH and WNH, incubated at WNH, transferred at eyed stage and incubated at Solomon Gulch Hatchery, and released at Chalmers River.
91A-0061	1991	1991	Application to transport 3.6 million pink salmon eggs from Solomon Gulch Hatchery to AFKH to test for early run timing was not allowed.
91A-0062	1991	1991	Application to transport 3.6 million pink salmon eyed-eggs of Solomon Gulch Hatchery origin from AFKH to WNH to test for early run timing was *not allowed*.
96A-0041	1996	2021	Allowed collection and incubation to eyed-egg state of 127 million pink salmon eyed eggs from AFKH returns for incubation, rearing and release at AFKH. In 1998, FTP amended to increase egg collection maximum from 127 to 160 million. In 2003, FTP amended to increase egg collection maximum from 160 to 190 million. In 2006, FTP amended with expiration date advanced until 2011. In 2007, FTP amended to decrease maximum egg collection from 190 to 162 million. In 2011, FTP amended with expiration date advanced until 2021.
04A-0046	2004	2015	FTP issued to WNH for transfer of 34 million eggs taken at WNH, transferred, reared and released at AFKH. FTP required a homing study.
09A-0071	2009	2010	Allowed transfer of 35 million pink salmon eggs from AFKH to WNH for incubation and release from WNH when WNH did not meet egg take goals. WNH and AFKH have common donor stock sources.

Appendix F.–Comparison of permitted and reported egg takes in hatchery permit, basic management plan, annual management plan, fishery transport permits and annual reports for AFKH pink salmon. Numbers are in millions and rounded.

Year	Permit	AMP	FTP Number	FTP Permitted Level	Annual Report
1975	10				6.3
1976	15				14.3[a]
1977					23.4
1978	40				28.7
1979	[b]	34.2	02/28/1979	1.5	28.4
1980	95.5	64	80-177	5	94.7
1981	150	95	81-187	150	143.5
			81-284	10[c]	10
1982	150	129.8	81-187	150	101.1
			82A-1036	45[d]	28.5
1983	150	108	81-187	150	89.8
1984	150	114	81-187	150	117.8
1985	150	114	81-187	150	171.6
1986	150	137	81-187	150	204.0
1987	150	126	81-187	150	146.0
1988	150	126	81-187	150	218.7
			89A-0006	75[e]	53
1989	150	126	81-187	150	127
1990	150	126	81-187	150	127.9
1991	150	Missing AMP	81-187	150	127.3
1992	190	126	81-187	150	127.5
1993	190	126	81-187	150	125.9
1994	190	127	81-187	150	125.5
1995	190	127	81-187	150	126.3
1996	190	0[f]		[g]	60.4
1997	190	0[j]	97A-0033	118	119.1
1998	190	160	96A-0041	160	160.6
1999	160	160	96A-0041	160	161.9
2000	160	160	96A-0041	160	159.4
2001	160	160	81-187	150	173.7
2002	160	160	96A-0041	160	175.8
2003	190	190	96A-0041	190	193.7
2004	190	190	96A-0041	190	149.0
2005		190	96A-0041	190	198.6
2006	190	190	96A-0041	190	195.0
2007	162	162	96A-0041	162	160.0
2008	162	162	96A-0041	162	161.0
2009	162	160[i]	96A-0041	162	167.4
			09A-0071	35	33.3
2010	162	162	96A-0041	162	165.0
2011	162	162[j]	96A-0041	162	164.0
2012	162	162	96A-0041	162	162.0

[a] 1976 Annual Report not found. Egg number from Lorraine Vercessi, ADF&G PNP Assistant Coordinator, Juneau, personal communication.
[b] Approved PAR(s) presumably issued between 1978 and 1980 not found that increased pink salmon capacity from 40 to 70 million, prior to the 1980 approved PAR that increased pink salmon capacity from 70 to 95.5 million eggs.
[c] 10 million egg take in addition to 150 million in FTP 81-187. The 10 million eggs were for transfer to CCH.
[d] 45 million egg take in addition to 150 million in FTP 81-187. The 45 million eggs were for transfer to MBH.
[f] No egg take at AFK. AMP stated that 66 million pink salmon eyed eggs would be transferred from WNH to AFK.
[h] No egg take at AFK. AMP stated that 118.1 million pink salmon eyed eggs would be transferred from WNH to AFK.
[i] An additional 20 to 30 million eggs were to be taken for transfer at eyed-stage to WNH.
[j] 2011 AMP called for 190 million egg take pending approval of a PAR; however, the PAR was denied.
[e] 53 million eggs taken at AFK, transported and incubated at CCH, and transport back to AFK for rearing and release.
[g] Eggs transferred from WNH to AFK. FTP for transfer was not approved until the following year (97A-0033).

Appendix G.–Comparison of permitted and reported egg takes in hatchery permit, basic management plan, annual management plan, fishery transport permits and annual reports for AFKH chum salmon. Numbers are in millions and rounded.

Year	Permit	AMP	FTP No	FTP	Annual Report
1975	0.2				
1976	5				
1977	5				1.4
1978	3		07/28/1978	3	0.4
1979	3	5.6	07/05/1979	5	0.6
1980	3	5.0	07/28/1978	3	3.5
1981	13	12	81-186	13	3.1
			81-188	10	5.5
1982	13	11	81-186	13	0.14
			81-188	10	11.4
1983	13	10	81-186	13	0.78
			81-188	10	7.7
1984	13	11.1	81-186	13	12.1
1985	21	11	81-186	13	2.1
1986	21	11	81-186	13	14.1
1987	21	20	81-186	13	2.0
1988	21	23	88A-1055	6	4.3
1989	21	10	81-186	13	0.14
1990	21	0	81-186	13	
1991	21	0	81-186	13	
1992	21	0	81-186	13	
1993	21	0	81-186	13	
1994	21	0	81-186	13	
1995	21	0	81-186	13	
1996	21	[a]	81-186	13	11.8
1997	21	[b]	81-186	13	11.0
1998	21	0	81-186	13	
1999	0	0	81-186	13	
2000	0	0	81-186	13	
2001	0	0	81-186	13	
2002	0	0			
2003	0	0			
2004	0	0	04A-0046	15.6 [c]	16.2 [c]
2005	0	0	04A-0046	15.6 [c]	15.2 [c]
2006	0	0	04A-0046	15.6 [c]	15.8 [c]
2007	17	16.4[d]	04A-0046	16.4	16.4
2008	17	16.4[d]	04A-0046	16.4	17.4
2009	17	16.4[d]	04A-0046	16.4	18.6
2010	34	15.6[e]	04A-0046	34	39.0
2011	34	31.1[f]	04A-0046	34	37.6
2012	34	31.1[f]	04A-0046	34	37.8

[a] No egg take at AFK. AMP stated that 37.5 million chum salmon eyed eggs would be transferred from WNH to AFK.

[b] No egg take at AFK. AMP stated that 11.1 million chum salmon eyed eggs would be transferred from WNH to AFK.

[c] Numbers are fry released, not eggs taken.

[d] AMP stated 16.4 eyed eggs to be transferred from WNH to AFK.

[e] AMP stated 15.6 eyed eggs to be transferred from WNH to AFK.

[f] AMP stated 31.1 eyed eggs to be transferred from WNH to AFK.

Appendix H.–Summary of pathology inspections at AFKH.

Year	Inspection Notes
1977	Parasitology diagnostic report showed no parasitic organisms.
1978	Hatchery clean and in good condition. Recommend disinfect fish and egg mortalities in bleach solution prior to disposal in effluent. Change hatchery records from notebooks to tabular form for ease of review.
1980	Hatchery clean, neat and in good order. Personnel cooperative and helpful. No recommendations. No parasites found during fish exam.
1981	Pathology report indicated gas bubble disease caused by gas supersaturation.
1982	Past problems with supersaturation have been remedied. Pink and chum salmon fry in several incubators in stress, likely from ammonia build up due to incubator densities. Stress should abate when fry transferred to saltwater pens.
1983	Recommend removal of dead fry with fungus from each incubator, increase water flow to address dead zones, and install floor drains so water does not pool on floor.
1985	Hatchery clean and well organized. Majority of problems caused by air entrainment in incubators causing dead spots. Recommend disinfect utensils used between use with pink and chum salmon, and do not recirculate water between pink and chum salmon if possible. Astroturf in channels of incubators may aid to reduce growth of *Sphaerotilus*.
1986	Small proportion of chum salmon fry with blue sac, perhaps due to soft water. Hatchery clean and well organized with disinfectant footbaths at entrances. Staff adjusting water and incubators to reduce air entrainment, which has reduced growth of *Sphaerotilius*, which does not currently seem to be a significant problem. Recommend disinfect utensils between stocks and do not pass water through more than one stock.
1987	Need for maintenance for air entrainment in incubators may indicate nearing super saturation in water. Noted equipment sanitation, utensil disinfection, proper mortality disposal, and fungus control. Recommended total dissolved gas data collection and redesign of dewatering device..
1988	Need for maintenance for air entrainment in incubators may indicate nearing super saturation in water. Noted equipment sanitation, utensil disinfection, proper mortality disposal, and fungus control. Facility clean and well organized.
1989	No issues reported.
1990	Eggs now required to be surface disinfected for 10 minutes at 100 ppm 1 hour after hardening. Exemption can be applied for in large pink salmon facilities. Facility clean and well organized.
1992	Minor mortality from saltwater gill disease in pink salmon. Facility clean and well organized. Malachite green now illegal for use in hatchery and should be discontinued.
1994	Unknown mortality in incubators (thought to be low dissolved oxygen) and in netpens at about 17% (osmoregulatory difficulties likely). Half hatchery now on seawater fungus control. Recommend switch the other half from malachite green to seawater for fungus control. Consider running seawater challenges on small groups of fish prior to discharging the fish to seawater netpens.
1996	Pink salmon contracted *Vibrio anguillarum* in the net pens due to unusually warm weather. Because obtaining an INAD permit and medicated feed to treat vibriosis would have taken at least a week, hatchery staff decided to release all groups. Hatchery clean and well organized. Staff is conscientious in trying to prevent mortality and deals with it when it occurs. Recommend carrying out plan to discontinue malachite green and replace it with hydrogen peroxide prior to upcoming eggtake. Also, try some different strategies to reduce dropout mortality.

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Year	Inspection Notes
1998	About 4% mortality at ponding of pink salmon. Recommend reevaluation of hydrogen peroxide administration to improve fungus control in lower incubator stacks; add particulate filter for hatchery water supply to reduce organic and sediment load; analyze hatchery water supply to determine possible options to improve water quality, such as addition of seawater to increase conductivity; and place disinfectant footbaths at incubation room entrances.
2000	Higher than anticipated mortality green to eye in one row of incubators over past several years. To address issue, problematic incubators will not be utilized until after eye this year. Improvements since last inspection include new egg take building adjacent to incubation room. Disinfectant footbaths utilized during egg take. Pipeline realigned and joints refitted. Recommendations include use of footbaths throughout incubation and use of total dissolved gas meter for routine gas checks.
2002	Higher than anticipated mortality green to eye in some lots. External flexibacteria in seawater net pens. Significant buildup of fungus and brown algae in head boxes, and hatchery may try adding baffles in headboxes next year to reduce buildup. Recommendations include use of footbaths throughout incubation and use of total dissolved gas meter for routine gas checks.
2005	New filtering and UV sterilizing system online to disinfect seawater, allowing addition of seawater to pink salmon incubators to increase water hardness and sea-ready pink salmon before transfer to net pens. No recommendations.
2007	Lost 300,000 fish due to outmigration line breaking in high winds. Recommend remove and enumerate mortality from net pens daily. Keep pens and net pen walkways clean of excess food and debris.
2009	Chum salmon incubation initiated last year. Recommendations include disinfecting eggs received from another facility, keeping pens and net pen walkways clean of old food and debris, removing and enumerating mortality from net pens regularly, and having employees in teams on net pens for improved safety.