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An Evaluation of the Tutka Bay Lagoon Salmon Hatchery for Consistency with Statewide Policies and Prescribed Management Practices

By

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Alaska Department of Fish and Game

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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	Code		alternate hypothesis	H _A
gram	g	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	base of natural logarithm	e
hectare	ha			catch per unit effort	CPUE
kilogram	kg			coefficient of variation	CV
kilometer	km	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	common test statistics	(F, t, χ^2 , etc.)
liter	L			confidence interval	CI
meter	m		@	correlation coefficient	
milliliter	mL	at		(multiple)	R
millimeter	mm	compass directions:		correlation coefficient	
		east	E	(simple)	r
		north	N	covariance	cov
		south	S	degree (angular)	°
		west	W	degrees of freedom	df
		copyright	©	expected value	E
		corporate suffixes:		greater than	>
		Company	Co.	greater than or equal to	≥
		Corporation	Corp.	harvest per unit effort	HPUE
		Incorporated	Inc.	less than	<
		Limited	Ltd.	less than or equal to	≤
		District of Columbia	D.C.	logarithm (natural)	ln
		et alii (and others)	et al.	logarithm (base 10)	log
		et cetera (and so forth)	etc.	logarithm (specify base)	log ₂ , etc.
		exempli gratia		minute (angular)	'
		(for example)	e.g.	not significant	NS
		Federal Information		null hypothesis	H ₀
		Code	FIC	percent	%
		id est (that is)	i.e.	probability	P
		latitude or longitude	lat. or long.	probability of a type I error	
		monetary symbols		(rejection of the null hypothesis when true)	α
		(U.S.)	\$, ¢	probability of a type II error	
		months (tables and figures): first three letters	Jan,...,Dec	(acceptance of the null hypothesis when false)	β
				second (angular)	"
				standard deviation	SD
				standard error	SE
				variance	
				population	Var
				sample	var
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	registered trademark	®		
ampere	A	trademark	™		
calorie	cal	United States			
direct current	DC	(adjective)	U.S.		
hertz	Hz	United States of America (noun)	USA		
horsepower	hp	U.S.C.	United States Code		
hydrogen ion activity (negative log of)	pH	U.S. state	use two-letter abbreviations (e.g., AK, WA)		
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

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**AN EVALUATION OF THE TUTKA BAY LAGOON SALMON
HATCHERY FOR CONSISTENCY WITH STATEWIDE POLICIES AND
PRESCRIBED MANAGEMENT PRACTICES**

by

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ABSTRACT

The private nonprofit 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 the consistency of each hatchery with those policies and prescribed management practices. The evaluation includes a review of the 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, permits, and similar documents were examined to determine whether they were current, consistent with each other, and accurately described hatchery operations. The consistency with policy was assessed by identifying applicable policies and aspects of hatchery programs relevant to those policies. The hatchery evaluation process began with hatcheries in the Kodiak region and continues with Cook Inlet hatcheries.

The Tutka Bay Lagoon Hatchery is located on the Kenai Peninsula in Kachemak Bay and produces pink salmon to enhance local fisheries. The hatchery's management plans, permits, and operations were reviewed under the hatchery evaluation process. The hatchery's programs appear to be consistent with statewide policies on genetics, fish health, and fisheries management.

Key words: Tutka Bay Lagoon Hatchery, hatchery evaluation, hatchery, Cook Inlet Aquaculture Association, Kachemak Bay, basic management plan, annual management plan, fish transport permit

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." 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 1976). In 1974, the Alaska Legislature expanded the program, authorizing private nonprofit corporations (PNPs) 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 just 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 reach were stocked with salmon fry. Log jams were removed in streams to enable returning adults to reach spawning areas. Nursery lakes were fertilized to increase juvenile salmon growth (FRED 1975). A combination of favorable environmental conditions, limited fishing effort, abundance-based salmon management, habitat improvement, and hatchery

production gradually boosted salmon catches over the years, with recent commercial salmon harvests (2002–2011) averaging 170 million fish (ADF&G 2012).

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, and therefore require fewer spawners than in wild systems to produce equivalent numbers of adult returns. In natural production, survival of eggs to fry or smolt is highly variable. Estimates for pink salmon survival in two Southeast Alaska creeks ranged from less than 1% up to 22%, with average survivals from 4% to 9% (Croot and Margolis 1991). Under hatchery conditions, egg to fry survival is usually 80% or higher.

Alaska hatcheries do not grow fish to adulthood as fish farms do, but release juveniles, usually at a similar time as their wild system counterparts are migrating to the sea. Juveniles imprint on the freshwater source while reared at the hatchery, just as salmon juveniles to their natal stream, and return to the hatchery as mature adults. At hatchery start-up, gametes are collected from naturally occurring salmon stocks, brought to the hatchery, and placed in incubators. Per state policy, hatcheries generally use naturally occurring stocks from close proximity to the hatchery so that any straying of hatchery returns will have similar genetic makeup as the nearby streams they may stray to. Also per state policy, Alaska hatcheries do not selectively breed. Large numbers of broodstock are used for gamete collection, without regard to size or other characteristic, to maintain genetic diversity.

Hatchery production is limited by freshwater capacity and freshwater rearing space. After hatching from the egg, pink and chum salmon fry can be transferred from freshwater to saltwater. Most Chinook, sockeye and coho salmon, on the other hand, must spend a year or more in freshwater before fry develop to smolt and can tolerate saltwater. These species require a higher volume of fresh water and holding ponds for freshwater rearing, as well as higher feed costs and higher risk of disease mortality due to the extended rearing phase. There are economic tradeoffs between the costs of production versus the value of the fish at harvest. Although Chinook, sockeye and coho salmon garner higher prices per pound as adults, chum and pink salmon are more economical to raise in the hatchery and generally provide a higher economic return.

Pink salmon, which have the shortest life cycle of Pacific salmon (two years), provide a quick return on investment and provide the bulk of Alaska hatchery production. From 2002 to 2011, pink salmon accounted for an average 71% of Alaska hatchery salmon returns by number, followed by chum (21%), sockeye (5%), coho (2%), and Chinook salmon (<1%) (Vercessi 2012, White 2005–2011, Farrington 2003–2004; Figure 2).

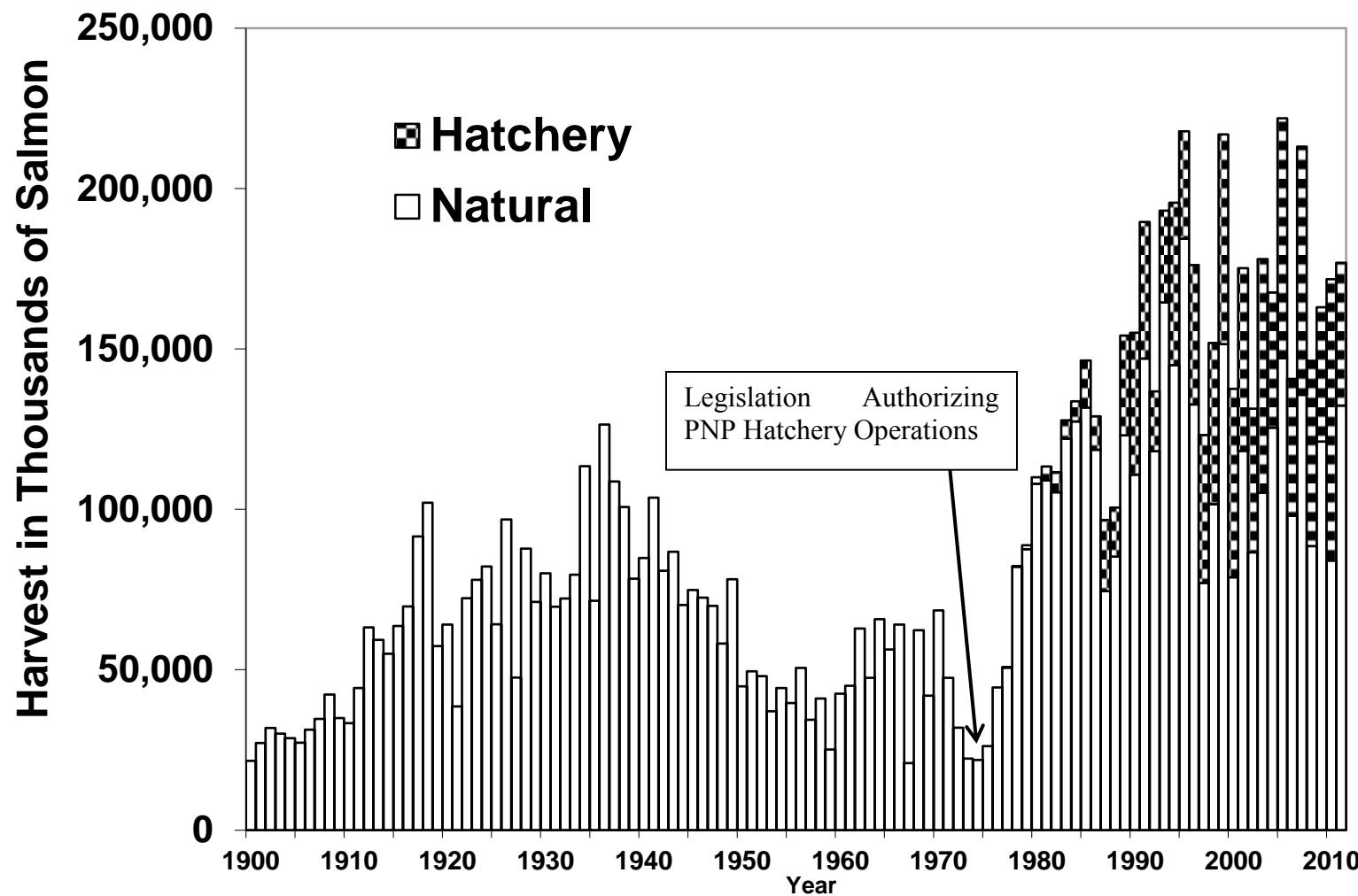


Figure 1.—Commercial salmon harvest in Alaska, 1900–2011.

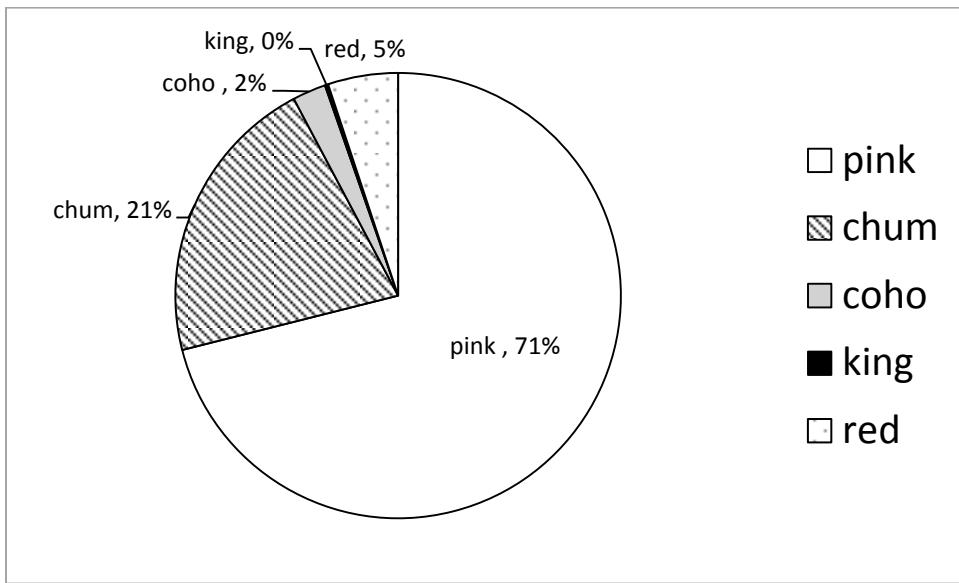


Figure 2.–Composition of Alaska hatchery returns by species, in numbers of fish, 2002–2011 average.

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 exvessel prices (i.e., the price paid by the fish buyer to the 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 e. al 2007), and wild salmon prices declined precipitously as high quality farmed salmon flooded the marketplace in the U.S., Europe, and Japan. Alaska responded to the competition by improving fish quality and implementing intensive marketing efforts to define the differences between Alaska salmon and farmed salmon. By 2004, these efforts paid off through increasing demand and prices.

Today, Alaska typically accounts for just 12% to 15% of the global supply (ASMI 2011a). Alaska's diminished influence on world salmon production means that Alaska harvest volume has little effect on world salmon prices. In fact, since 2003, the value of Alaska salmon has increased substantially, regardless of harvest volume. For example, the pink salmon catch nearly doubled from 2006 to 2007, yet pink salmon prices increased 19% (Table 1). From 2002 to 2011, the pink salmon price increased over 470%, and the chum salmon price increased nearly 400%. Sockeye, coho and Chinook salmon also showed substantial increases (Table 1; ADF&G 2012).

Table 1.—Alaska statewide commercial salmon harvest average exvessel price per pound, 2002–2011. Total harvest, in millions of fish, in parentheses. Exvessel price represents the price paid to harvesters by fish buyers.

Year	Pink Salmon	Chum Salmon	Sockeye Salmon	Coho Salmon	Chinook Salmon
2002	\$0.09 (87)	\$0.19 (16)	\$0.60 (22)	\$0.36 (5)	\$1.30 (0.5)
2003	\$0.09 (124)	\$0.18 (18)	\$0.63 (31)	\$0.48 (4)	\$1.43 (0.6)
2004	\$0.11 (100)	\$0.21 (17)	\$0.62 (45)	\$0.68 (5)	\$1.86 (0.8)
2005	\$0.12 (161)	\$0.27 (12)	\$0.74 (43)	\$0.76 (5)	\$2.22 (0.7)
2006	\$0.16 (73)	\$0.32 (22)	\$0.76 (42)	\$1.03 (4)	\$2.92 (0.6)
2007	\$0.19 (144)	\$0.33 (17)	\$0.80 (48)	\$0.95 (4)	\$3.09 (0.6)
2008	\$0.35 (84)	\$0.59 (18)	\$0.86 (39)	\$1.28 (4)	\$4.43 (0.4)
2009	\$0.27 (97)	\$0.48 (18)	\$0.91 (43)	\$0.93 (4)	\$2.60 (0.4)
2010	\$0.40 (107)	\$0.71 (18)	\$1.20 (41)	\$1.15 (4)	\$3.67 (0.4)
2011	\$0.43 (115)	\$0.75 (17)	\$1.19 (40)	\$1.10 (3)	\$3.36 (0.4)

Source: <http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch>. Accessed 02/04/2012.

Hatchery contributions to the commercial harvest vary by species. Hatcheries produced over two thirds of the commercial chum salmon harvest and an average 40% of the pink salmon harvest from 2002 to 2011. Overall, hatcheries contributed an average 35% of the salmon harvest, in numbers of fish over the past decade (Table 2).

Table 2.—Alaska statewide salmon hatchery contribution to the commercial harvest as a percentage of the total catch, by species, 2002–2011.

Year	Pink Salmon	Chum Salmon	Coho Salmon	Sockeye Salmon	Chinook Salmon	Total
2002	33%	79%	12%	35%	16%	34%
2003	45%	80%	12%	27%	16%	42%
2004	28%	61%	6%	17%	16%	25%
2005	40%	59%	4%	24%	12%	34%
2006	34%	68%	7%	25%	9%	31%
2007	44%	67%	5%	24%	16%	36%
2008	50%	70%	4%	27%	29%	40%
2009	29%	66%	4%	23%	24%	26%
2010	69%	65%	5%	29%	20%	52%
2011	26%	64%	7%	33%	20%	25%
Decade Average:	40%	68%	7%	26%	18%	35%

Source: Hatchery percent of total catch is from Alaska Salmon Enhancement Annual Reports, 2002–2011.

The average exvessel values of pink and chum salmon hatchery harvests over the past decade totaled over \$70 million annually. Although the hatchery harvest fluctuated widely over the past

decade, total value of the hatchery harvest showed an increasing trend. The hatchery harvest exceeded \$100 million for the first time in 2008, and exceeded \$200 million in 2010 (Table 3).

First wholesale value (FWV) represents the value of the product to the processor when it leaves a plant or vessel in Alaska (ADF&G 2011), and captures the economic value of salmon to Alaska's coastal communities. FWV includes the purchase price of the fish paid to the fishermen (exvessel value), as well as costs for transportation of the fish to the processing facility (tender fees), processing costs (labor and overhead), etc. Overall FWV of hatchery fish exceeded \$500 million in 2010, and like exvessel value, showed an increasing trend (Table 3). Pink and chum salmon, on average, contribute over 75%to the statewide hatchery exvessel and FWVs.

In addition to quality control and marketing, strengthening trade ties with China also contributed to higher salmon prices. An increasing portion of Alaska's harvest is gutted, headed, and frozen in state, shipped to China for further processing to fillets and other product forms, then shipped back to the U.S. or other markets for sale or further value-added processing. According to the Alaska Seafood Marketing Institute (ASMI 2011b), "Roughly a third of all Alaska pink salmon was exported to China in recent years to be re-processed and re-exported to markets in the US and Europe; five years ago less than 15% were exported to China." Chum salmon showed similar trends. In the early 2000s, processors placed fishermen on delivery limits for pink salmon because of limited capacity and a glutted market (Ess 2003). By 2010, processing was well established in China, and Alaska salmon processors encouraged hatcheries 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, hatchery production is the primary opportunity to substantially increase the harvest. As prices increase, so, too, does interest in boosting hatchery production.

Part of the rise in price of Alaska salmon was a message of sustainable fisheries management to a growing audience of discriminating buyers. In fact, in 2000, Alaska was the first salmon fishery certified as "sustainably managed" by the independent nonprofit Marine Stewardship Council (MSC), and 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 natural salmon populations.

MSC certified fisheries are reviewed every five years. When Alaska salmon fisheries were recertified in 2007 (Chaffee 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). Hatchery evaluations began with review of the Kodiak region facilities (Musslewhite 2011a and 2011b).

Table 3.—Alaska statewide exvessel and wholesale values of the commercial salmon hatchery harvest in millions of fish, by species, 2002–2011.

Pink Salmon			Chum Salmon		Sockeye Salmon		Coho Salmon		Chinook Salmon		Total	
Year	Exvessel Value	Wholesale Value										
2002	\$9	\$51	\$20	\$66	\$10	\$27	\$5	\$13	\$2	\$3	\$46	\$160
2003	\$19	\$86	\$20	\$57	\$14	\$33	\$4	\$9	\$2	\$4	\$59	\$188
2004	\$11	\$51	\$16	\$50	\$9	\$22	\$5	\$10	\$4	\$6	\$45	\$138
2005	\$27	\$102	\$15	\$38	\$9	\$19	\$6	\$12	\$3	\$4	\$59	\$175
2006	\$15	\$65	\$38	\$109	\$13	\$30	\$8	\$17	\$3	\$4	\$78	\$224
2007	\$43	\$159	\$30	\$86	\$10	\$22	\$6	\$11	\$4	\$6	\$92	\$283
2008	\$52	\$160	\$61	\$146	\$7	\$16	\$12	\$22	\$7	\$9	\$140	\$353
2009	\$23	\$80	\$42	\$96	\$8	\$18	\$6	\$12	\$3	\$5	\$83	\$211
2010	\$112	\$318	\$64	\$136	\$15	\$30	\$10	\$20	\$4	\$5	\$204	\$509
2011	\$44	\$125	\$60	\$128	\$20	\$40	\$8	\$15	\$4	\$6	\$136	\$314
Ave.:	\$35	\$120	\$37	\$91	\$12	\$26	\$7	\$14	\$4	\$5	\$94	\$256

Source: Hatchery percent of total catch is from Alaska Salmon Enhancement Annual Reports, 2002–2011. Exvessel value is the total harvest value paid by fish buyers to fishermen 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 the previous table. First wholesale value is the price paid to primary processors for processed fish from ADF&G commercial operator annual reports. Hatchery harvest values calculated as the percent of hatchery fish in the commercial catch multiplied by the exvessel or first wholesale value of the total catch, by species, from ADF&G 2012 , except for 2011, where the First Wholesale Value was estimated by multiplying the 2010 ratio of the First Wholesale Value to Exvessel Value by the 2011 Exvessel Value, because the First Wholesale Values were not yet reported.

ADF&G changed to a new sustainable fishery certification under the Food and Agriculture Organization in 2011. The hatchery evaluations started under the MSC certification continued as an important systematic assessment of Alaska salmon 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 five-year rotational schedule to review PNP hatchery programs. Musslewhite (2011a, 2011b) completed hatchery reviews for the Kodiak region in 2011. This report for the Tutka Bay Lagoon Hatchery is the first for the Cook Inlet region. Following completion of hatchery reviews in Cook Inlet, reviews of hatcheries in Prince William Sound, Southern Southeast Alaska, and Northern Southeast Alaska will follow.

OVERVIEW OF POLICIES

Numerous Alaska mandates and policies for hatchery operations were specifically developed to minimize potential adverse impacts 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 Alaska Department of Fish and Game (ADF&G) fishery managers, geneticists and pathologists.

A variety of policies guide the permitting process. They include *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) and back ground of the ADF&G *Genetic Policy* (Davis and Burkett 1989) sets out restrictions and guidelines for stock transport, protection of wild stocks, and maintenance of genetic variance. Policy guidelines include banning importation of salmonids from outside the state for enhancement (except transboundary rivers); prohibiting transportation of stocks between the major geographic areas in the state (Southeast, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, AYK and Interior); and maintaining genetic diversity by use of large populations of broodstock collected across the entire run. A maximum of three hatchery stocks can be derived from a single donor stock to maintain genetic diversity.

The *Genetic Policy* also calls for the identification and protection of “significant and unique” wild stocks on a regional and species basis: “Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks.” Davis and Burkett (1989) suggest that regional planning teams (RPT) are an appropriate body to designate those stocks.

The *Genetic Policy* also recommends the designation of watersheds to serve as wild stock sanctuaries to preserve genetic variability. “These sanctuaries will be areas in which no enhancement activity is permitted except gamete removal for broodstock development.”

Salmon fisheries enhancement efforts are guided by comprehensive salmon plans for each region. These plans are developed by the RPTs, which are composed of six members: three from ADF&G and three appointed by the regional aquaculture association (RAA) 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 instance, a Phase III in planning has been instituted to incorporate Alaska Board of Fisheries approved allocation and fisheries management plans with hatchery production plans.”

The *Alaska Fish Health and Disease Control Policy* (5 AAC 41.080) is designed to protect fish health and prevent spread of infectious disease in fish and shellfish. The policy and associated guidelines are discussed in *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2010). It includes regulations and guidelines for wild fish transports, brood stock screening, disease histories, and transfers between hatcheries. The *Alaska Sockeye Salmon Culture Manual* (McDaniel et al. 1994) also specifies practices and guidelines specific to the culture of sockeye salmon. As with the *Genetic Policy*, these regulations and guidelines are used by the principal pathologist and ADF&G geneticist to review hatchery plans and permits.

The *Alaska Policy for the Management of Sustainable Salmon Fisheries* (5AAC 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* (5AAC 39.220), the *Salmon Escapement Goal Policy* (5AAC 39.223), and local fishery management plans (5AAC 39.200). These policies require biologists to consider the interactions of wild and enhanced 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.

A key principle of Alaska policy is to protect wild salmon stocks. The initial rotation of these 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 impacts of multiple 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. RAAs, comprised of commercial salmon permit holders, operate most of the PNP hatchery operations in Kodiak,

Cook Inlet, Prince William Sound, and Southeast Alaska. Each RAA's Board of Directors establish goals for enhanced production, oversee business operations of the hatcheries, and work with ADF&G staff to comply with state permitting and planning regulations. RAAs may vote to implement a salmon enhancement tax on salmon landings in their region to finance hatchery operations. Independent PNP corporations not affiliated with the RAAs also operate hatcheries in several areas of the state. Both the RAA and independent PNP hatcheries may sell salmon returning to their hatcheries, referred to as "cost recovery", to pay for operations. Several hatcheries have tourist and educational programs that support 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 comprised of ADF&G and RAA personnel define production goals by species, area, and time in a Salmon Enhancement Plan (5 AAC 40.300). RPTs review applications for new hatcheries to determine compatibility with the Salmon Enhancement Plan, and make recommendations to the ADF&G commissioner for 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 boards, providing broad public oversight of operations.

Alaska PNP hatcheries operate under four documents required in regulation (5 AAC 40.110–990 and 5 AAC 41.005–100) and statute (AS 16.05.092): hatchery permit with basic management plan, annual management plan, fish transport permit, and annual management report (Figure 3). The hatchery permit authorizes operation of the hatchery, specifies the maximum number of eggs of each species that a facility can incubate, and may identify requested stocks to be used for broodstock. The basic management plan (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.

Hatchery permits/BMPs may be amended through a Permit Alteration Request (PAR). Requested changes are reviewed by the RPT and ADF&G staff, and a recommendation is sent to the commissioner for consideration. If approved, the permit alteration becomes part of the permit. Reference to a "permit" or "hatchery permit" in this document also includes approved PARs to the hatchery permit unless otherwise noted.

The annual management plan (AMP) outlines operations for the current year, and is in effect until superseded by the following year's AMP. It should, by regulation (5 AAC 40.840), "organize and guide the hatchery's operations, for each calendar year, regarding production goals, brood stock development, and harvest management of hatchery returns." Typically, AMPs include the upcoming year's egg take goals, fry or smolt releases, expected adult returns, harvest management plans, fish transport permits (described below) required or in place, and fish culture techniques. The AMP must be consistent with the hatchery permit and BMP.

A fish transport permit (FTP) is required for egg collections, transports, and releases (5 AAC 41.001–41.100). The FTP authorizes the specific activities in the hatchery permit and management plans, including broodstock source, gamete collections, and release sites. All proposed FTPs are reviewed by the ADF&G fish pathologist, fish geneticist, regional resource

development biologist, the Division of Commercial Fisheries regional supervisor, the Division of Sport Fish regional supervisor, and Division of Commercial Fisheries deputy director 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 PNP hatchery files an annual report documenting egg collections, juvenile releases, and hatchery returns for the year. Information for all hatcheries is compiled into an annual ADF&G report (e.g., White 2010) to the Alaska Legislature (AS 16.05.092).

The administration of hatchery permitting, planning and reporting requires regular, direct 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.

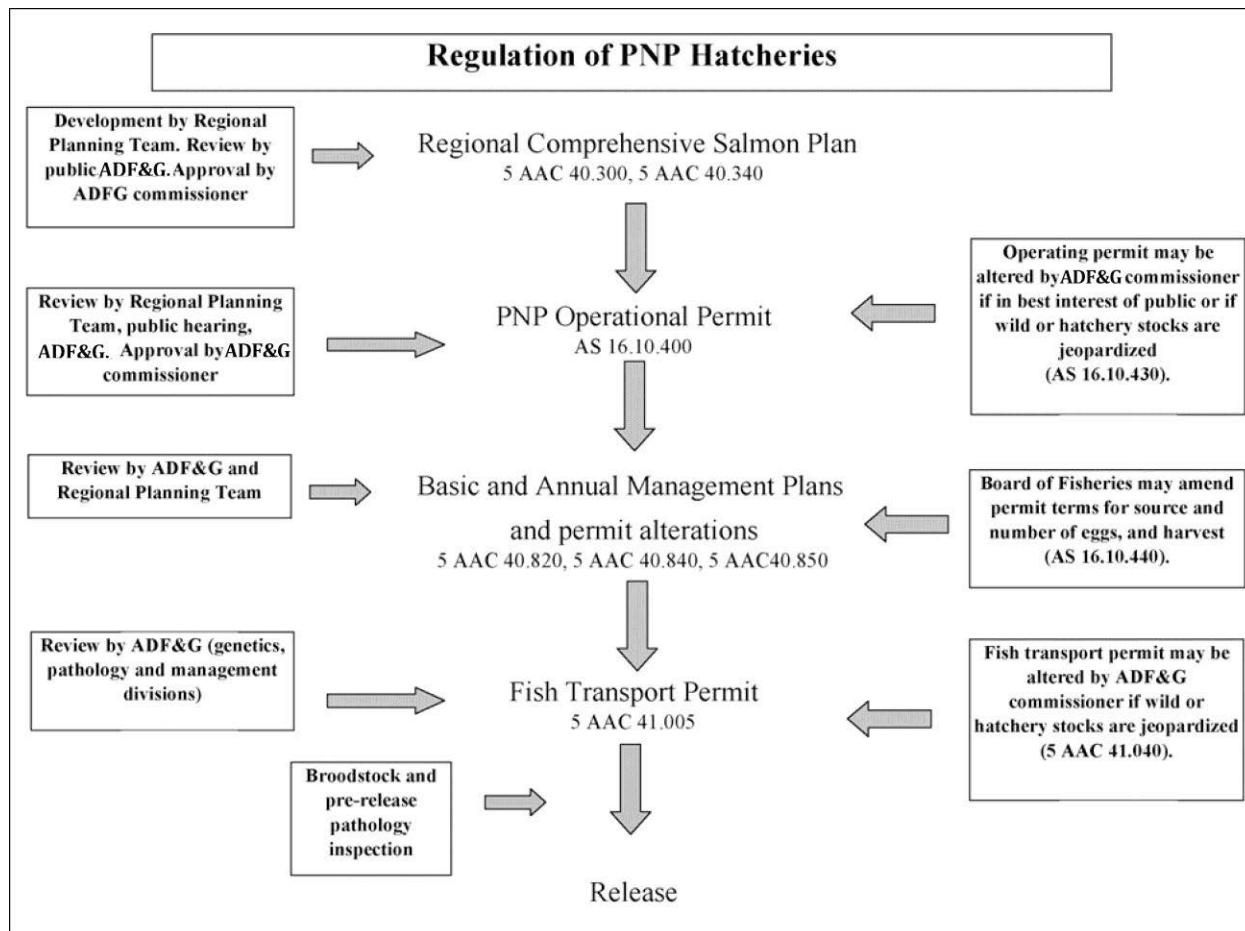


Figure 3.—Schematic of Alaska hatchery regulatory system (McGee 2004).

TUTKA BAY LAGOON HATCHERY OVERVIEW

The Cook Inlet Aquaculture Association (CIAA) is the RAA for Cook Inlet, and operates the Tutka Bay Lagoon Hatchery (TBLH). The CIAA Board of Directors has 24 members. Five board members are elected by commercial fishermen. The remaining seats are appointed by commercial fishing groups (10 seats), local municipalities (7 seats) and other organizations (2 seats). The 5 elected seats and the 10 commercial fishing group seats are held by commercial fishermen.

Tutka Bay Lagoon Hatchery is located in Kachemak Bay near Homer, Alaska (Figures 4 and 5). The State of Alaska constructed the hatchery in 1976. The FRED Division operated the hatchery to enhance pink and chum salmon runs in Tutka Creek, the water source for the hatchery (Boyle and Dudiak 1981). Tutka Creek pink salmon and Port Dick chum salmon were the original brood sources for the hatchery (FRED 1977; FRED 1979; FRED 1980). In 1991, ADF&G contracted with CIAA to operate the hatchery, and in 1994, CIAA took over operations under their own permit (Appendix 1), and the state retained ownership of the facility.

Pink, chum, and sockeye salmon have been produced at TBLH. The original permit allowed a maximum incubation capacity of 125 million pink and chum salmon eggs, with no more than 20 million of the total in chum salmon eggs. The permit was altered in 1994 to allow incubation of 660,000 sockeye salmon eggs for release into Tutka Bay Lagoon (Appendix 1). The sockeye broodstock source was not specified. Chum salmon was removed from the permit at the same time, presumably because chum salmon may be susceptible to Infectious Hematopoietic Necrosis Virus (IHNV) when cultured in the same facility as sockeye salmon, according to McDaniel et al., 1994 (Ted Meyers, ADF&G Fish Pathologist, personal communication).

The first release of pink salmon from TBLH was by ADF&G in 1976 (Appendix 2). When CIAA took over operations in 1991, about 30 million fry were produced annually. From 1994 to 2004, releases averaged 77 million, with a peak release of 105 million in 1996. Adult pink salmon returns exceeded a million fish in several years (Appendix 3). Broodstock collection, cost recovery and common property fisheries of TBLH returns occur in Special Harvest Areas (SHAs) in Tutka Bay and Halibut Cove (Figure 5).

In 2004, CIAA suspended pink salmon operations due to low pink salmon prices. Pink salmon prices later recovered, and CIAA opted to renew the pink salmon program in 2010. CIAA collected eggs from Tutka Creek broodstock in 2011. ADF&G approved PARs for supplemental wild stock egg takes from the Port Dick and Windy Bay systems as a temporary measure until sufficient eggs can be collected from returns to TBLH (Appendix 1). Release of these two stocks is only permitted at Halibut Cove. CIAA will use the sale of adult returns to Halibut Cove to financially support the TBLH project. When returns of Tutka Creek stock to the hatchery provide the full 125 million permitted egg capacity, that stock will be used for both Tutka Bay and Halibut Cove releases.

ADF&G released chum salmon at TBLH from 1979 to 1990 (Appendix 2). The early chum salmon program operated by ADF&G experienced high mortality when transferring fry from fresh to saltwater (McDaniel 1984; McMullen and Kissel 1979). Except for the return of over 9,000 chum salmon in 1982, returns to the hatchery were minimal, ranging from 700 to 2,400 fish from 1986 to 1991 (Appendix 4). The author did not find additional data regarding the Tutka chum program in ADF&G reports.

Sockeye fry incubated at TBLH were released intermittently from 1977 to 1999 (Appendix 2). The ADF&G Mark, Tag and Age Laboratory records indicate sockeye fry were reared in Tutka Bay in 1977 and 1978. The 1977 fry were released to Leisure Lake and the 1978 fry to Tustumena Lake. It was not clear where the eggs were incubated for these releases.

An egg take occurred in 1989 from English Bay Lakes sockeye salmon. Eggs were incubated in TBLH and released as fry to English Bay Lakes in 1990. Egg incubation for English Bay Lakes was moved to Big Lake Hatchery in 1990 (FRED 1991). In 1991, CIAA conducted a one-year experimental release of sockeye fry at TBLH from eggs incubated at Crooked Creek Hatchery. In 1994, CIAA initiated a sockeye salmon project at TBLH, incubating eggs taken from Packer's Lake broodstock (Appendix 1). IHNV in the hatchery water supply in 1998 caused suspension of the program following the 1999 release. Sockeye returns from the 1996 and later releases occurred from 1999 through 2002 (Appendix 5).

From 2005 to 2010, CIAA reared sockeye smolt in Tutka Bay that were reared at Trail Lakes Hatchery under the Trail Lakes Hatchery permit. These releases will be reviewed under the Trail Lakes Hatchery evaluation.

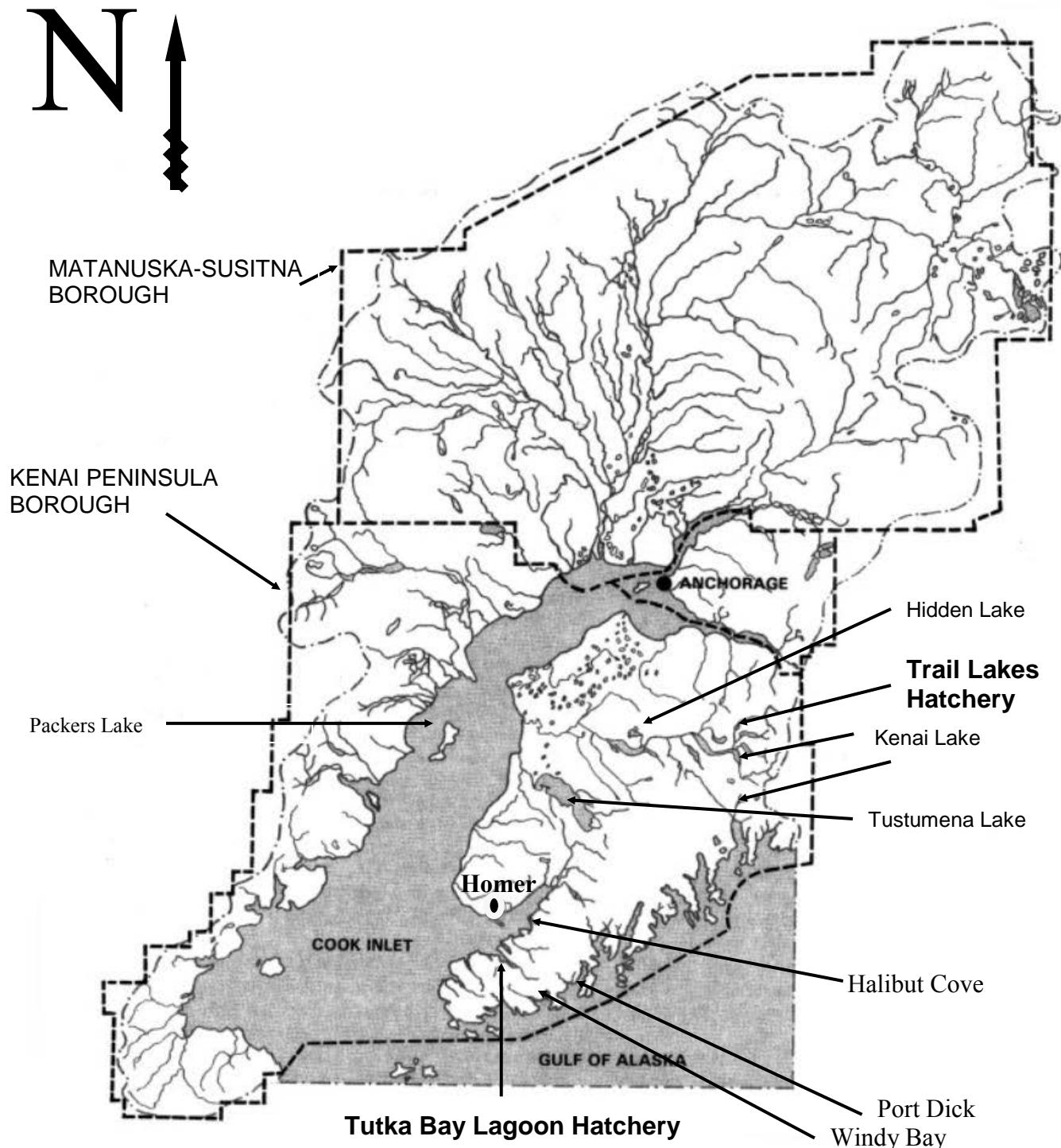


Figure 4.—Tutka Bay Lagoon Hatchery, Trail Lakes Hatchery, and CIAA project locations.

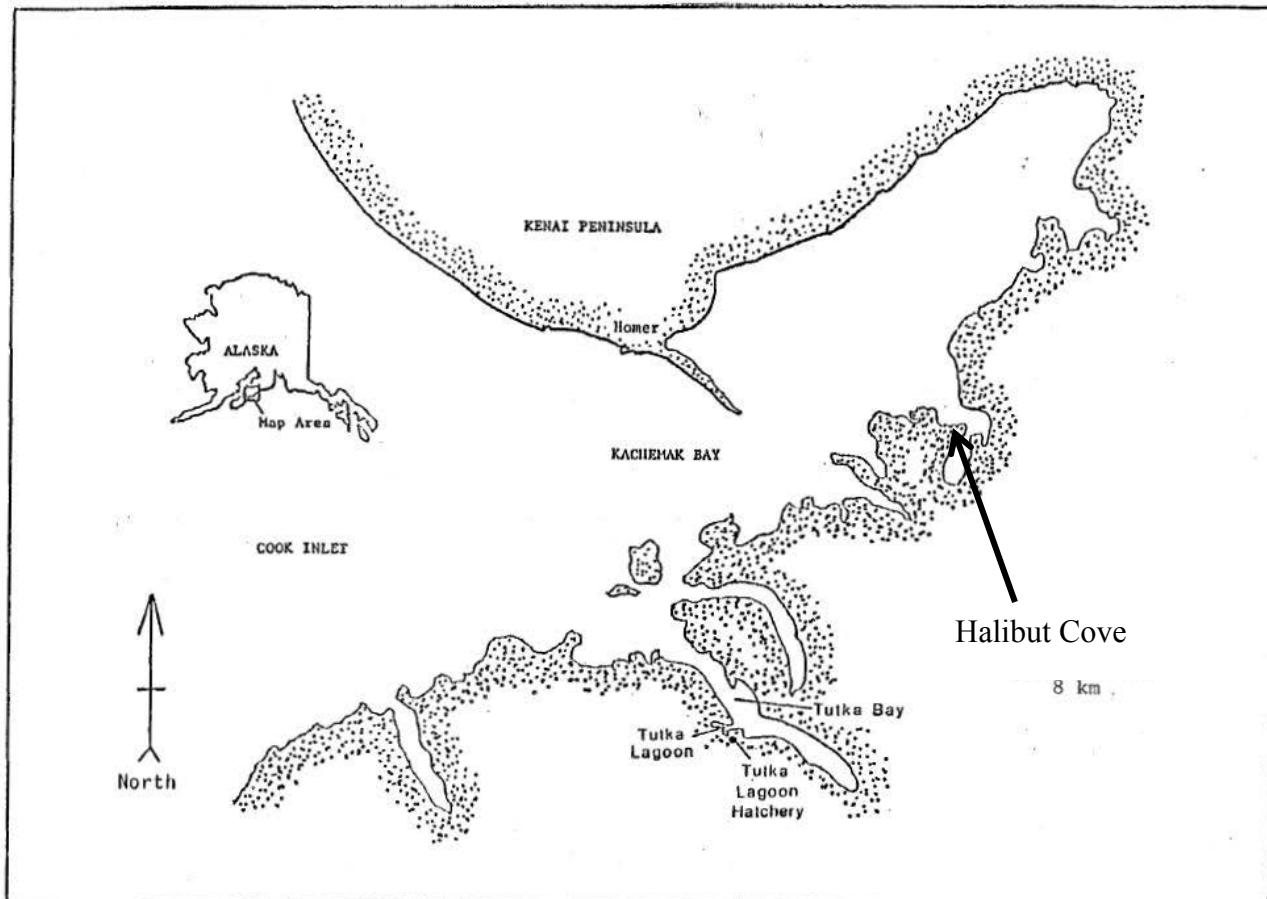


Figure 5.—Tutka Bay Lagoon and Halibut Cove.

PROGRAM EVALUATION

Hatchery permit/BMP, AMP, and FTP documents for TBLH 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. CIAA is diligent in this process, submitting an updated BMP with each PAR.

The 2011 AMP provides thorough documentation of expected operations for the season, including egg take and release goals, expected returns, new construction and maintenance, plans for thermal marking, a list of current FTPs, and potential projects that may occur subject to FTP or PAR approval. The AMP is also consistent with the permit and BMP.

The BMPs for CIAA's projects provide a high level of detail. BMPs are primarily a planning document for initial stages of hatchery operations, describing pertinent details of hatchery permit

conditions such as species, numbers of eggs, broodstock source, and harvest management. After a hatchery is fully operational, the AMP becomes the primary document of current operations and programs. ADF&G is working with CIAA and other PNPs to generalize BMPs when these documents are updated for PAR approvals, moving specific operation details, such as incubator type, from the BMP to the AMP. This will reduce the administrative burden of submitting PARs for approval of routine adjustments to hatchery operations.

The FTP covering pink salmon production at TBLH was renewed several times after the initial FTP was issued in the late 1970s, and expired in 2010. CIAA submitted a renewal request for a 10-year extension of the FTP. However, ADF&G staff requested the extension be limited to five years, with subsequent renewal contingent on the hatchery establishing a thermal otolith marking program for “evaluation of biological interactions” and “quantification of returns.” ADF&G listed no specific plan for using the thermal marking to evaluate the return, nor indicated that a plan would be developed. The FTP was approved with the requested 10-year extension, and CIAA addressed the marking request with a commitment in the 2011 AMP to implement a thermal marking program within five years.

CIAA applied for PARs and FTPs for additional pink salmon broodstock collection sites, as they did not anticipate securing enough gametes from Tutka Creek alone to meet program goals. An FTP and PAR were first approved for gamete collection at Port Dick for release at Halibut Cove only. Port Dick was chosen because of its early run timing, which would provide harvest segregation from the later returning Humpy Creek wild stock near Halibut Cove, and because the Port Dick stock is of sufficient run size to provide adequate broodstock numbers after escapement requirements were met for the system. The 2010 pink salmon return was not as strong as expected, and CIAA submitted a PAR to add Windy Bay as a broodstock source to supplement the Port Dick returns (Figure 4). The PAR was approved on short notice, and the FTP approved for only one year pending further assessment of the Windy Bay stock as part of the Halibut Cove releases. Unlike Port Dick, Windy Bay pink stocks will return to Halibut Cove at about the same time as Humpy Creek pink salmon, and fishery management actions may be required to assure escapement goals to Humpy Creek are met. About 9 million eggs were collected from Tutka Creek and 4 million from Windy Bay in 2011.

HATCHERY PERMITS AND OPERATING PLANS

A comparison of hatchery permit/BMP, AMP, FTPs and annual reports indicates that pink salmon egg takes were above the 125 million permitted level in 1998, and from 2000 thru 2002. Sockeye salmon egg takes exceeded the permitted capacity of 660,000 eggs in 1995 and 1997. The sockeye release limit was not exceeded in any year (Table 4). It should be noted that egg take and release numbers are estimates, and not actual counts.

Table 4.—Comparison of permitted and reported egg takes and releases in hatchery permit, basic management plan, annual management plan, fishery transport permits and annual reports for Tutka Bay Lagoon Hatchery pink and sockeye salmon.

Year	Hatchery Permit including PARs		Basic Management Plan in effect		Annual Management Plan		FTP's		Annual Report	
	Eggs	Eggs	Release	Eggs	Release	Eggs ^a	Release ^b	Eggs	Release ^c	
Pink Salmon (in millions)										
1994	125	125		125				89.2	61.1	
1995	125	125		125		125		125.6	63.0	
1996	125	125		125		125		116.0	105.0	
1997	125	125		125		125		117.4	89.0	
1998	125	125		125		125		129.0	90.0	
1999	125	125		125		125		114.1	60.1	
2000	125	125		125		125		131.5	65.1	
2001	125	125		125		125		144.7	99.3	
2002	125	125		125		125		159.4	99.3	
2003	125	125		125		125		95.4	68.0	
2004	125	125		125		125			48.0	
2005	125	125		125		125				
2006	125	125		125		125				
2007	125	125		125		125				
2008	125	125		125		125				
2009	125	125		125		125				
2010	125	125		125		125				
2011	125	125		125		125		13.6		
Sockeye Salmon (in thousands)										
1994	660	660	330	660				550	0	
1995	660	660	330	660	330	660	330	729	0	
1996	660	660	330	660	330	660	330	500 ^d	75	
1997	660	660	330	660	330	660	330	667	245	
1998	660	660	330			660	330			
1999	660	660	330			660	330		100	
2000	660	660	330			660	330			
2001	660	660	330			660	330			
2002	660	660	330			660	330			
2003	660	660	330			660	330			
2004	660	660	330							
2005	660	660	330							
2006	660	660	330							
2007	660	660	330							
2008	660	660	330							
2009	660	660	330							
2010	660	660	330							
2011	660	660	330							

^a FTP's state combined total from all pink salmon egg takes from Port Dick, Windy Bay and Tutka Bay will not exceed 125 million total eggs.

^b Pink salmon release numbers stated in the FTPs are the “resulting fry” of the egg take; no specific fry number is listed.

^c No fish were released from Tutka in 2011.

^d Sockeye eggs transferred from Trail Lakes Hatchery to Tutka Bay.

COMPREHENSIVE SALMON ENHANCEMENT PLAN

With regard to TBLH, the 1981 Phase I Cook Inlet Comprehensive Salmon Enhancement Plan states:

“Overall production is expected to increase at this facility, and in the process there will be a change in emphasis so that by the year 2000 chum salmon will be approximately 36 percent of the annual production. Assuming funding and staffing support annual production is expected to reach 360,000 adult pink salmon and 200,000 adult chum salmon.” (CIRPT 1981).

Production goals were met for pink salmon prior to suspension of the program, but not for chum salmon (Appendix 4). The chum salmon program was abandoned in favor of sockeye production in 1994. Pink salmon production is expected to surpass goals of the Phase I plan when the program again reaches permitted capacity.

The Phase II Cook Inlet Comprehensive Salmon Enhancement Plan (CIRPT 2007) established criteria for *significant stocks* by species and run size as follows: Chinook salmon: 400 fish; sockeye salmon: 2,000 fish; coho and chum salmon: 800 fish; and pink salmon: 5,000 fish. Significant pink salmon stocks in and near Kachemak Bay include Tutka, Barabara, China Poot, Jakolof and Humpy creeks and Seldovia and Port Graham rivers. English Bay Lakes sockeye salmon, located about 15 miles southwest of Tutka Bay, is the only significant sockeye salmon stock in Kachemak Bay. Clearwater Creek coho salmon are a significant stock, as are chum stocks in Seldovia and Port Graham rivers.

The CIRPT established wild stock sanctuaries in the Phase II plan based on the concepts set out in the *Genetic Policy*. A total of seven Chinook, six sockeye, five coho, four chum, and five pink salmon stocks were designated in the Cook Inlet region, but none of these stocks are in or near Kachemak Bay.

Pink salmon from Windy Creek and Port Dick watersheds, located in the Resurrection Bay unit, were permitted as broodstock to restart the TBLH pink salmon program. Windy Bay is a significant stock and Port Dick Creek is both a significant stock and a wild stock sanctuary.

CONSISTENCY WITH POLICY

The policies governing Alaska hatcheries were divided into three categories for this review: genetics, fish health, and fisheries management. The key elements of the policies in each of those categories are summarized in Tables 5 through 7. These templates were used to assess compliance of the TBLH salmon program with each policy element in Tables 8 through 10.

Table 5.–Key elements of the ADF&G *Genetic Policy*.

I. Stock Transport	
<i>Use of appropriate local stocks</i>	This element addresses Section I of the <i>Genetic Policy</i> , 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	
<i>Identification of significant or unique wild stocks</i>	Significant or unique wild stocks must be identified for each region and species as stocks most important to that region. The Regional Planning Teams should establish criteria for determining significant stocks and recommend such stock designations.
<i>Interaction with or impact on significant wild stocks</i>	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.
<i>Use of indigenous stocks in watersheds with significant wild stocks</i>	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. This means that only progeny from eggs taken from natural broodstock from the watershed may be used, and not progeny of broodstock returning to a hatchery or release site.
<i>Establishment of wild stock sanctuaries</i>	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.
III. Maintenance of genetic variance	
<i>Maximum of three hatchery stocks from a single donor stock</i>	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.
<i>Minimum effective population size</i>	The policy recommends a minimum effective population size of 400. It also recognizes that small population sizes may be unavoidable with Chinook and steelhead.
<i>Use of all segments of donor stock run timing</i>	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 brood stock.
Genetics review of Fishery Transport Permits (5 AAC 41.010 – 41.050)	
<i>Review by geneticist</i>	Each application is reviewed by the geneticist, who then makes a recommendation to either approve or deny the application. The geneticist may also add terms or conditions to the permit to protect wild or enhanced stocks.

Table 6.—Key elements of Alaska policies and regulations pertaining to fish health and disease.

Fish Health and Disease Policy (5 AAC 41.080; amended by Meyers (2010))	
<i>Egg disinfection</i>	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.
<i>Hatchery inspections</i>	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.
<i>Disease reporting</i>	The occurrence of fish diseases or pathogens listed in 5AAC 41.080(d) must be immediately reported to the ADF&G Fish Pathology Section.
Pathology requirements for Fishery Transport Permits (FTP) (5 AAC 41.010 – 41.050)	
<i>Disease history</i>	Applications for FTPs require either a complete disease history of the stock or broodstock inspection if the disease history is not available.
<i>Isolation measures</i>	Applications must list the isolation measures to be used during transport, including a description of containers, water source, depuration measures, and plans for disinfection.
<i>Pathology review of FTPs</i>	Each application is reviewed by the pathologist, who then makes a recommendation to either approve or deny it. The pathologist may also add terms or conditions to the permit to protect fish health.
Sockeye Salmon Culture Policy	
<i>Alaska Sockeye Salmon Culture Manual</i>	The Sockeye Salmon Culture Policy is designed to control the occurrence of infectious hematopoietic necrosis virus (IHNV) in Alaska. The policy specifies the use of a virus-free water supply; rigorous disinfection procedures; compartmentalization of eggs and fry; and immediate destruction of infected fish, followed by disinfection. The <i>Alaska Sockeye Salmon Culture Manual</i> prescribes procedures and fish culture practices developed to control IHNV.

Table 7.—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	
<i>Assessment of wild stock interaction and impacts</i>	As a management principle, the effect of enhanced stocks on wild stocks should be assessed. Wild stocks should be protected from adverse impacts from enhanced stocks.
<i>Use of precautionary approach</i>	Managers should use a conservative approach, taking into account any inherent uncertainty and risks.
Salmon Escapement Goal Policy (5 AAC 39.223)	
<i>Establishment of escapement goals</i>	Management of fisheries is based on scientifically-based escapement goals that result in sustainable harvests.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
<i>Wild stock conservation priority</i>	The conservation of wild stocks consistent with sustained yield is the highest priority in management of mixed-stock fisheries.
Fisheries management review of FTPs (5 AAC 41.010 – 41.050)	
<i>Review by management staff</i>	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 ADF&G Commissioner. Department staff may recommend approval or denial of the permit, and recommend permit conditions.

Genetics

Tutka Creek pink salmon are a significant stock in the salmon enhancement plan, and only this stock is released at Tutka Bay Lagoon (Table 8). Gametes from Windy Bay and Port Dick egg collections are incubated separately from the Tutka Creek gametes at TBLH for release only at Halibut Cove. Humpy Creek is a significant stock near Halibut Cove, so full harvest of the enhanced returns is imperative to minimize straying. The Windy Bay stock has similar run timing to Humpy Creek, and fishery management actions may be necessary to assure adequate escapement to Humpy Creek. The pink salmon program uses thousands of fish for brood stock for each release, well in excess of the 400 minimum effective population size prescribed in the *Genetic Policy*.

The Windy Bay and Port Dick systems are near each other on the southeastern Kenai Peninsula, and somewhat distant (about 80 water miles) from the Halibut Cove release site to the northwest (Figure 3). The geneticist expressed concern in comments on the Port Dick FTP about the distance between the brood sources and release site: “First, we are concerned by the distance of Port Dick from the release site at Halibut Cove. Little is known about the genetic population structure of pink salmon in this area and hence little is known about the extent of the genetic risk to pink salmon populations in lower Cook Inlet.” Similar comments were made for the Windy Bay FTP. The geneticist recommended the FTP for Port Dick be limited to five years to “allow for an evaluation of this program.” The FTP for Windy Bay was limited to one year. Evaluation plans in FTPs for Port Dick and Windy Bay state “CIAA will monitor the return for marked fish as directed by ADF&G”. However, no plans were indicated to look for the thermal marks, such as sampling streams for straying or sampling the commercial catch to estimate hatchery contribution.

Table 8.—The Tutka Bay Lagoon Hatchery and its consistency with elements of the ADF&G *Genetic Policy* (See Table 5).

I. Stock Transport	
<i>Use of appropriate local stocks</i>	TBLH was built by ADF&G on a stream with an existing run of pink salmon, which would not be permitted today. The indigenous run was used as the donor stock for the hatchery.
II. Protection of wild stocks	
<i>Identification of significant or unique wild stocks</i>	Tutka Creek pink salmon, the brood source for the TBLH, is a significant stock. Barabara Creek is a nearby significant pink salmon stock to the TBLH release site, and Humpy Creek is a significant stock to the Halibut Cove release site. Tutka Creek, Windy Creek and Port Dick Creek, brood sources for the Halibut Cove release, are significant stocks.
<i>Interaction with or impact on significant wild stocks</i>	Straying is addressed with intensive harvest of returning fish in special harvest areas (SHAs) adjacent to release sites. ADF&G can further restrict fishing to meet escapement goals to significant stocks near SHAs (Barabara Creek and Humpy Creek). The incidental harvest of Barabara Creek pink salmon is limited by closing the adjacent area to seining, and with mesh size restrictions on nearby set gillnetters. Port Dick and Windy Bay pink salmon return in mid-July, providing some degree of temporal separation to the Humpy Creek pink salmon return timing in late July and August. Achieving minimum SEGs are required prior to taking brood stock from significant stocks in Tutka Creek, Port Dick and Windy Bay. A planned marking program will enable estimates of straying.
<i>Use of indigenous stocks in watersheds with significant wild stocks</i>	Tutka Creek is the indigenous stock in the watershed and used as the donor stock for the hatchery per the <i>Genetic Policy</i> .
<i>Establishment of wild stock sanctuaries</i>	Port Dick Creek is a pink salmon wild stock sanctuary. No gametes or fry from brood stock taken from Port Dick will be returned to the stream per the <i>Genetic Policy</i> .
III. Maintenance of genetic variance	
<i>Maximum of three hatchery stocks from a single donor stock</i>	Tutka Creek, Port Dick and Wind Bay pink salmon are only used at TBLH. Tutka Creek stock is the only stock released at Tutka.
<i>Minimum effective population size</i>	CIAA will use more than 400 adult broodstock to achieve pink salmon egg take goals.
<i>Use no more than 90% of any run segment of return</i>	Broodstock will only be taken after the lower SEG is met at Tutka Creek, Port Dick, and Windy Bay. Brood stock collections are from a cross-section of the run, and are unlikely to take more than 90% of any part of the run.
Genetics review of FTPs (5 AAC 41.010 – 41.050)	
<i>Review by geneticist</i>	In the review of pink salmon FTPs 11A-0056, 11A-0057 and 11A-0078, the principal geneticist stated some concern about the distance between the brood stock sources at Port Dick and Windy Bay, and the release site at Halibut Cove. He emphasized the need to harvest all fish returning to Halibut Cove to minimize straying to lower Cook Inlet streams.

Fish Health and Disease

All of the requirements of the fish health and disease policies have been met (Table 9). The facility was regularly inspected by the pathology section through 2002, and no major issues have been identified. The pathologist has reviewed and approved the FTPs, found no fish health concerns, and indicated he will conduct a hatchery inspection as the new program progresses.

The IHNV endemic in the hatchery supply water led to the suspension of sockeye production at the hatchery in 1999. Since 2005, TBLH has served solely as a saltwater release site for sockeye smolt reared in the Trail Lakes Hatchery. This program is administrated under the Trail Lakes Hatchery permit, and will be presented under that hatchery's evaluation.

Table 9.—The Tutka Bay Lagoon Hatchery and its consistency with elements of Alaska policies on fish health and disease (See Table 5).

Fish Health and Disease Policy (5AAC 41.080; amended by Meyers 2010)

<i>Egg disinfection</i>	Disinfection is not required for pink salmon facilities, but was recommended by the state fish pathologist in early pathology reports.
<i>Hatchery inspections</i>	Hatchery inspections were conducted every other year from 1992 to 2002. The state will renew pathology inspections as the program progresses.
<i>Disease reporting</i>	No reportable diseases were noted in pathology reports for pink salmon. Mortality incident reports were submitted in 2000 and 2001 after egg survivals to the eyed stage were below performance standards, but these incidents were not attributed to reportable diseases.
	IHNV in the hatchery water supply resulted in suspension of sockeye salmon egg incubation at TBLH.

Pathology requirements for FTPs (5AAC 41.010)

<i>Disease history</i>	The disease history for Tutka Creek stock was complete when the program was suspended. The Port Dick and Windy Bay stock disease history is unknown. No broodstock from Port Dick were collected in 2011. Windy Bay pathology samples were collected during the 2011 egg take as required by the FTP.
<i>Isolation measures</i>	The isolation measures and transport methods used for pink salmon production are described in detail in the FTP application.
<i>Pathology review of FTPs</i>	The FTPs for the pink salmon program were reviewed and recommended for approval by the pathologist.

Fisheries Management

SHAs in Tutka Bay and Halibut Cove provide adequate area for a segregated harvest of the hatchery return after the fish enter Kachemak Bay (Table 10, Figure 4). Wild stocks are monitored by ADF&G for adequate escapement, with fishing time liberalized or restricted according to wild stock escapement levels.

Table 10.—The Tutka Bay Lagoon Hatchery and its consistency with elements of Alaska fisheries management policies and regulations (See Table 6).

Sustainable Salmon Fishery Policy (5 AAC 39.222)	
I. Management principles and criteria	
<i>Assessment of wild stock interaction and impacts</i>	A thermal marking program of all released fish will be implemented by the fifth year of resuming hatchery operations. No plan for evaluating enhanced fish contribution or straying was prescribed by ADF&G in approving the FTP.
<i>Use of precautionary approach</i>	ADF&G may restrict fishing to meet wild stock escapement goals in area streams.
Salmon Escapement Goal Policy (5 AAC 39.223)	
<i>Establishment of escapement goals</i>	Humpy, China Poot, Barabara, Tutka, Port Dick, Windy Right, Windy Left creeks and Seldovia and Port Graham Rivers have established sustainable pink salmon escapement goals (SEGs).
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
<i>Wild stock conservation priority</i>	The lower SEG must be met before any broodstock is taken at Tutka Creek or Port Dick. Windy Creek brood stock will be purchased during a regular commercial fishing period. Port Dick brook stock can be similarly purchased. The use of SHAs for TBLH origin pink salmon allows their targeted harvest and minimizes incidental catch of other stocks.
Fisheries management review of FTPs (5 AAC 41.010 – 41.050)	
<i>Review by management staff</i>	The FTPs for TBLH program were reviewed and approved by fisheries management staff.

Barabara Creek pink salmon may be incidentally harvested by purse seine and set gillnet gear in the Tutka Bay subdistrict where TBLH releases would be targeted. Barabara Creek has a sustainable escapement goal (SEG) range of 1,900 to 9,000 pink salmon, and ADF&G records indicate the lower SEG escapement level was achieved every year since 1989 (Hammarstrom and Ford 2011).

As noted in the BMP, Humpy Creek, near the Halibut Cove SHA, has an SEG range of 21,650 to 85,550 fish, and may require ADF&G management action to achieve adequate escapement. Humpy Creek has achieved the lower SEG every year for the past decade except 2009, which occurred in a year of no enhanced pink salmon returns in the area. Pink salmon escapements to other local streams appear to be stable, with most above their lower SEG every year (Hammarstrom and Ford 2011).

A trend of low escapements in recent years to Tutka Creek may impede a quick return to full capacity at TBLH. Fried (1994) indicated escapement goals used in 1994 were based on historical escapements, but made no mention of hatchery fish consideration in the escapement goal. The hatchery was not in operation when the current SEGs were established, although

escapements counted after 1978 were an unknown mix of hatchery and wild fish (Otis 2001). Pink salmon returns to Tutka Creek did not achieve the lower SEG of 6,500 fish from 2006 to 2010, (Hammarstrom and Ford 2011) but rebounded to 20,000 fish in 2011, exceeding the upper SEG of 17,000 (Glenn Hollowell, personal communication).

OTHER REQUIREMENTS

ANNUAL REPORTING AND CARCASS LOGS

PNP 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.” CIAA annual reports have been received for all years.

Alaska hatcheries are also required to document the disposal of the carcasses of salmon used for brood stock (5 AAC 93.350). The hatchery must record the number of males and females used 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; the proceeds from any excess must be surrendered to ADF&G. TBLH carcass logs appear complete and timely for recent years.

DISCUSSION AND RECOMMENDATIONS

Alaska hatchery and salmon fishery enhancement programs are governed by a comprehensive permitting system to protect wild stocks, provide increased harvest opportunities, and support economic development in coastal communities. The operation of TLBH is largely consistent with state policies and prescribed management practices. The Cook Inlet RPT plays an active role in hatchery oversight and planning, and is the sole RPT to date to identify significant stocks and wild sanctuary stocks in their Regional Salmon Enhancement Plan.

The operation of TLBH is covered under existing permits. CIAA updates their BMP with any approved PAR, and works closely with ADF&G in conducting their operations. CIAA and ADF&G staff are currently working to edit the BMP to a concise summary of facility design, donor stocks, harvest management, and consideration of wild stock management to reduce the need for PARs for minor changes to hatchery operations.

TBLH and Halibut Cove have extensive terminal fishing areas. Safeguards are in place to assure escapement goals are met in the wild stock systems where brood stock is taken. Wild stocks in streams near terminal harvest areas appear healthy, with escapement goals met in most years. Full harvest of enhanced fish is important to minimize straying to nearby significant stock pink salmon systems.

ADF&G staff reviewing the TBLH FTP conditioned approval of the permit on establishment of a thermal marking program “so that biological interactions and harvests may be evaluated”, and CIAA has committed to initiate a pink salmon otolith marking program within five years. However, ADF&G did not identify specific concerns with respect to wild stock interaction or harvest management, nor develop a plan to assess these concerns.

Thermal marking at Tutka Bay will be done with diesel boilers at a significant expense in additional infrastructure, fuel, training, and labor, as well as increased air pollution and fuel spill risk. To justify the costs and associated risks of thermal marking, ADF&G should (1) specify the biological or harvest management issue of concern, (2) define a detailed evaluation plan for addressing the concerns, (3) develop a budget and funding source with CIAA to carry out the plan, and (4) provide a flexible timeframe to allow CIAA to adjust their operational and monitoring plans accordingly.

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APPENDIX

Appendix 1.—History of Tutka Bay Lagoon Hatchery Permit and Hatchery Permit Alterations, 1994–2011.

Date	Description	Permitted Capacity (green eggs)		
		Pink	Chum	Sockeye
1/5/1994	Original permit number 32 issued to CIAA. Permitted combined total of 125 million pink and chum salmon eggs, with no more than 20 million chum. Broodstock sources were from TBLH returns. The hatchery was built and operated by ADF&G since 1978 and so had pre-existing returns to the hatchery.	125 million	20 million	0
7/11/1994	Permit alteration allowing 660 thousand sockeye salmon eggs for release into Tutka Lagoon and removing chum salmon capacity. Sockeye broodstock source was not listed.	125 million	0	660,000
05/20/2011	Permit alteration adding Port Dick as a pink salmon broodstock source.	125 million	0	660,000
08/10/2011	Permit alteration adding Windy Bay as a pink salmon broodstock source.	125 million	0	660,000

Appendix 2.—Releases from Tutka Bay Lagoon Hatchery, 1976–2010. Release numbers are from the State of Alaska Tag Lab, unless otherwise noted.

Year	Pink Salmon Released	Sockeye Salmon Released	Chum Salmon Released
1976	250,000 ^a		
1977	318,000	91,000	
1978	4,821,000	400,000 ^b	
1979	9,244,000		797,000
1980	6,795,000		
1981	10,269,000		8,000
1982	15,475,000		15,000
1983	15,233,000		1,118,000
1984	18,142,000		141,000
1985	23,537,000		26,000
1986	26,235,000		18,000
1987	8,241,000		446,000
1988	15,589,000		3,211,000
1989	36,977,000		2,164,000
1990	36,685,000	355,000 ^c	1,509,000
1991	30,000,000		
1992	31,950,000		
1993	48,700,000		
1994	61,100,000		
1995	63,000,000		
1996	105,000,00	75,000	
1997	89,000,000	245,000	
1998	90,000,000		^d
1999	60,132,000	100,000	
2000	65,121,000		
2001	99,336,000		
2002	99,371,000		
2003	67,967,000		
2004	47,964,000		
2005		96,000 ^e	
2006		260,000 ^e	
2007		144,000 ^e	
2008		483,000 ^e	
2009		301,000 ^e	
2010		278,000 ^e	

^a1976 release number from CIAA 2011 AMP.

^b Emergent fry released to Tustumena Lake and Halibut Cove.

^c Fed fry released to English Bay Lake.

^d Fry infected with IHNV and destroyed so no smolt for release in 1998.

^e Trail Lakes Hatchery-reared smolt released to Tutka Bay.

Appendix 3.—Estimated number and use of adult pink salmon returning from Tutka Bay Lagoon Hatchery releases, including remote release sites, 1979–2005.

Return Year	Commercial	Sport/ Subsistence/ Personal Use	Brood/Other/ Escapement	Cost Recovery	Total
1979	-	-	369,000	-	369,000
1980	-	-	315,000	-	315,000
1981	963,000	5,600	47,000	-	1,016,000
1982	181,000	2,000	64,000	-	247,000
1983	577,000	4,900	62,000	-	644,000
1984	230,000	8,000	42,000	-	280,000
1985	464,000	8,000	54,000	-	525,000
1986	380,000	8,000	53,000	-	441,000
1987	84,500	600	4,000	-	89,000
1988	836,000	14,000	77,000	-	927,000
1989	877,600	20,700	63,000	-	961,000
1990	167,400	2,800	107,000	-	277,000
1991	204,800	3,700	120,000	-	328,000
1992	98,000	4,500	95,000	276,000	473,000
1993	228,000	7,200	129,000	409,000	774,000
1994	604,000	5,500	169,000	959,000	1,737,000
1995	1,211,000	3,000	186,000	1,213,000	2,613,000
1996	17,000	-	138,000	423,000	578,000
1997	115,000	5,000	274,000	2,379,000	2,772,000
1998	508,000	1,900	171,000	788,000	1,468,000
1999	222,000	2,000	180,000	858,000	1,262,000
2000	9,000	2,000	180,000	1,044,000	1,234,000
2001	109,000	2,000	183,000	422,000	716,000
2002	5,000	-	156,000	806,000	967,000
2003	3,000	1,500	238,000	616,000	859,000
2004	2,000	1,500	18,000	1,175,000	1,196,000
2005	5,000	-	134,000	1,632,000	1,770,000

Source: Data from the ADF&G database, which is data collected from annual hatchery operator reports and subsequent updates or corrections.

Appendix 4.—Estimated number and use of adult chum salmon returning from Tutka Bay Lagoon releases, 1982–1991.

Return Year	Commercial	Sport/Subsistence/ Personal Use	Brood/ Escapement	Cost Recovery	Total
1982	7,400		1,800		9,200
1983					
1984					
1985					
1986	500		200		700
1987	2,200		200		2,400
1988	2,000		200		2,200
1989	2,000				2,000
1990	1,000		1000		2,000
1991	800		100		900

Source: Data from the ADF&G database, which is data collected from annual hatchery operator reports and subsequent updates or corrections.

Appendix 5.—Estimated number and use of adult sockeye salmon returning from Tutka Bay Lagoon releases, 1999–2010.

Return Year	Commercial	Sport/Subsistence/ Personal Use	Brood/Other/ Escapement	Cost Recovery	Total
1999	18,700		16,300	100	35,100
2000			1,500	900	2,400
2001	500		150		650
2002	400				400
2003					
2004					
2005					
2006					
2007					
2008			5,500	14,500	20,000
2009			3,500	11,500	15,000
2010			6,000	38,000	44,000

Source: Data from the ADF&G database, which is data collected from annual hatchery operator reports and subsequent updates or corrections. Returns from 2008 to 2010 are from eggs incubated at Trail Lakes Hatchery under that hatchery's permit.

Appendix 6.—History of Tutka Bay Lagoon Hatchery Fishery Transport Permits, 1995–2011.

Issue Date	FTP Number	Expiration	Description
05/25/1995	95A-0051	12/31/2005	Collect up to 125 million eggs from pink salmon returning to Tutka Hatchery. Release surviving short term reared fry at Tutka Bay Lagoon.
06/1/1995	95A-0052	12/31/2003	Collect up to 660,000 eggs from Packers Lake sockeye. Transport to Tutka Hatchery for incubation and rearing. Release up to 330,000 age-1 smolt at Tutka Bay Lagoon.
11/20/1996	96A-0087	12/31/1996	A one-time transport of approximately 500,000 eyed sockeye eggs of Packers Lake origin from Trail Lakes Hatchery to Tutka Lagoon Hatchery. This one-year activity was necessitated by the ongoing realignment of CIAA projects among three hatcheries instead of four.
9/14/2011	00A-0073	12/31/2016	Collect up to 125 million eggs from pink salmon returning to Tutka Bay Lagoon. Allows transport and release of Tutka Hatchery pink salmon at up to a mile distance from the hatchery as a predation avoidance measure. Originally permitted through 12/31/2010 and amended for permitting through 12/31/2016.
07/1/2011	11A-0056	6/30/2019	Authorizes collection and transport of adult pink salmon from Port Dick to TBLH, collection and incubation of eggs at TBLH, and short-term rearing and release of resulting progeny in Halibut Cove Lagoon. Maximum egg take of 120 million eggs. Total from all egg takes at Tutka Bay not to exceed the permitted capacity of 125 million.
07/1/2011	11A-0057	6/30/2019	Authorizes instream collection of gametes in Port Dick for transport to TBLH for incubation and short-term rearing and release of resulting progeny in Halibut Cove Lagoon. Maximum egg take of 120 million eggs. Total from all egg takes at Tutka Bay not to exceed the permitted capacity of 125 million.
07/1/2011	11A-0060	12/31/2016	Authorizes collection of Tutka Bay Lagoon/Tutka Creek broodstock, the collection and incubation of eggs at TBLH, and short-term rearing and release of resulting progeny in Tutka Bay Lagoon/Tutka Bay. Maximum egg take of 125 million eggs. Total from all egg takes at Tutka Bay not to exceed the permitted capacity of 125 million.
07/1/2011	11A-0078	06/30/2012	Authorizes the collection and transport of adult pink salmon from Windy Bay to TBLH as an alternative brood source for Port Dick. Maximum egg take of 120 million eggs. Total from all egg takes at Tutka Bay not to exceed the permitted capacity of 125 million.

