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Recent trends in Alaska Hatchery Salmon Value and Implications for Future Hatchery Production

by

Mark Stopha

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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ABSTRACT

The State of Alaska manages salmon populations to meet spawning (escapement) requirements first, allowing salmon that are surplus to escapement to be harvested in the commercial, sport, subsistence, and personal use fisheries. In practice, this means that the harvest of fish produced from parents that spawn naturally in Alaska's freshwater bodies is at its sustainable maximum, given the imprecisions of population estimation, fisheries management, and assessment of environmental conditions. Options to further increase salmon production include restoring, improving or creating spawning and rearing habitat; providing manmade access for salmon to reach spawning or rearing waters blocked by natural barriers such as waterfalls; improving management precision; and hatchery production.

Hatcheries in Alaska collect gametes, incubate fertilized eggs, and release juveniles to the ocean. Unlike fish farming, Alaska hatcheries neither raise fish to market size nor selectively breed salmon for market demands or hatchery conditions. Hatcheries use local stocks as the original broodstock for production, and improve egg to juvenile survival by protecting developing eggs from predators and natural elements such as freezing. These juveniles are then released into the ocean to exist with their naturally-produced counterparts, returning as adults and harvested with other Alaskan salmon.

Pink and chum salmon are the primary species produced by Alaska hatcheries. Both species require little or no freshwater resident time after hatching before going to sea, and have relatively few disease issues in the hatchery. Pink salmon, with their short two-year life cycle, allow hatcheries a quick economic return on costs of production, while chum salmon require several years at sea. The other three salmon species—Chinook, sockeye, and coho salmon—are more expensive to produce due to their longer freshwater rearing requirements.

Although Alaska's salmon harvest produced nearly half of the world salmon supply in 1980, today, in spite of large increases in harvest, the state contributes 15% or less of world salmon production, as most of the world's salmon are now produced on farms. As a result, Alaskan salmon production no longer significantly influences world salmon prices. Year-round farmed salmon production, competitive pricing with other protein sources, aggressive marketing, and an increasing human population have expanded the demand for all salmon worldwide. Alaska has successfully responded as a minor producer in world markets with improved quality and directed marketing, creating a niche demand and strong prices for its wild salmon. Over the past decade, the average exvessel price per pound for all species combined for Alaska salmon increased from $0.27 per pound in 2003 to $0.80 per pound in 2012, despite large fluctuations in Alaska's annual harvest volume.

The commercial salmon industry is encouraging increased hatchery production to meet rising demand and benefit from strong prices. State fishery managers remain cautious to significantly expanding production, largely due to concerns about sustaining healthy naturally spawning populations across the state. To better understand the relationship between hatchery and naturally spawning populations, the state has embarked on several ambitious research projects to study some of those interactions. Such information will guide the state when considering potential changes in hatchery production.

Key Words: production, harvest, returns, exvessel value, wholesale value, management, releases, research, straying, escapement, pink salmon, chum salmon, coho salmon, Chinook salmon, sockeye salmon

INTRODUCTION

Alaska's modern salmon fisheries enhancement program began in the early 1970s, when state harvests plummeted to record lows (Figure 1). The Alaska Legislature established the Division of Fisheries Rehabilitation Enhancement and Development (FRED) within the Alaska Department of Fish and Game (ADF&G) to develop the state's hatchery system (McGee 2004). Lawmakers also authorized private nonprofit corporations (PNP) 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)*

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 non-utilized 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. Nursery lakes were fertilized to increase juvenile salmon growth (FRED 1975). A combination of favorable environmental conditions, restricted fishing effort, abundance-based harvest management, habitat improvement, and hatchery production gradually boosted salmon catches over the years, from less than 30 million fish in the early 1970s to recent commercial salmon harvests (2002–2012) averaging 170 million fish annually (Figure 1; Vercessi 2012, 2013).

Alaska hatcheries do not grow fish to adulthood, but incubate fertilized eggs and release resulting progeny. By protecting eggs from predators and environmental factors, survival from egg to fry is about eight times higher in hatcheries than in the natural environment (Hansen 1987). Juvenile salmon imprint and return to the release location as mature adults. By state policy, hatcheries 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. Alaska hatcheries also do not selectively breed. Large numbers of broodstock, without regard to size or other characteristic, are used for gamete collection to maintain genetic diversity.

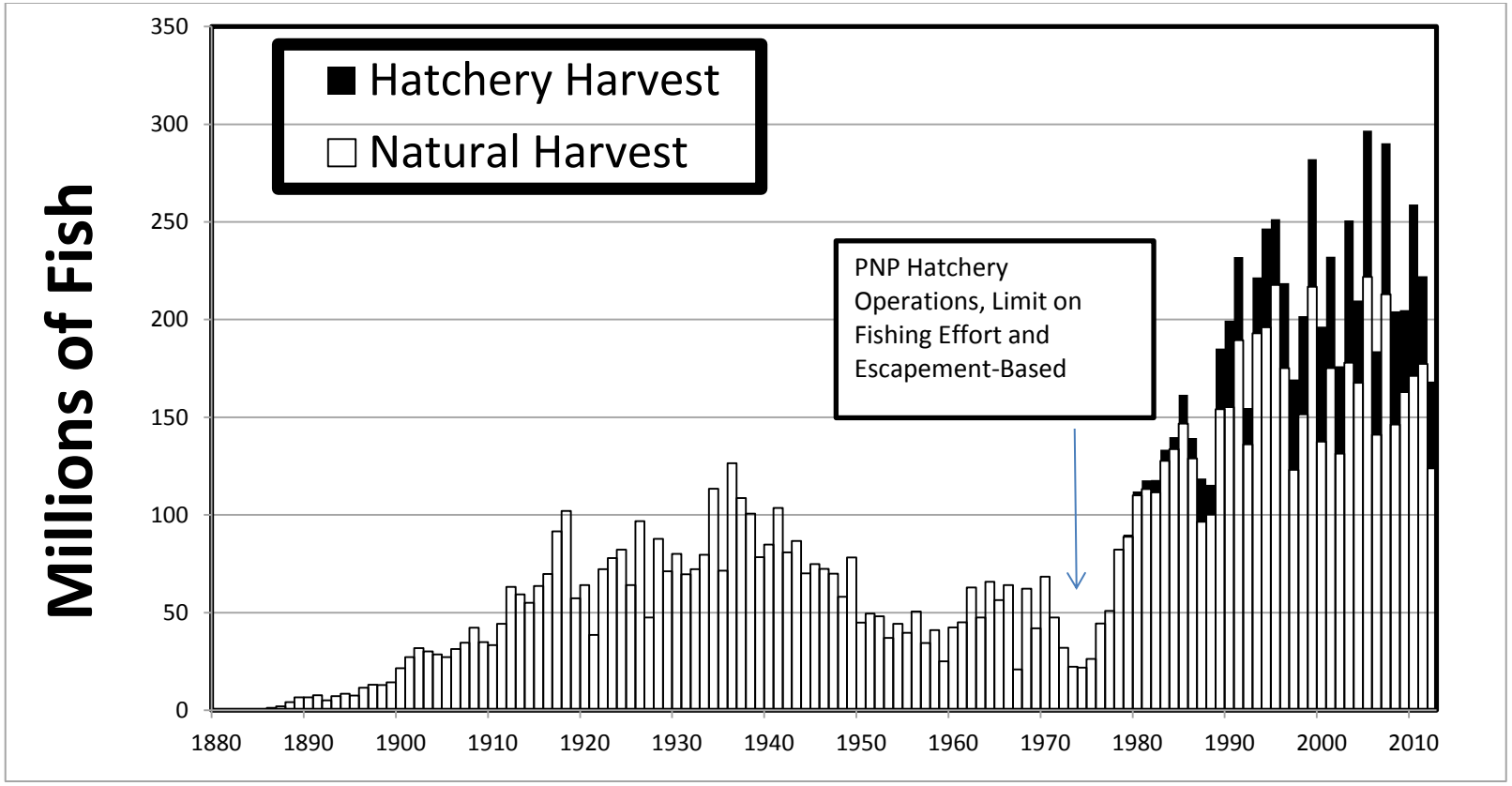

Figure 1.–Commercial salmon harvest in Alaska, 1880–2012.

Hatchery production is limited by freshwater volume and rearing space. Soon after hatching from the egg, pink and chum salmon fry can be transferred directly from fresh water incubators to salt water. Chinook, sockeye, and coho salmon, on the other hand, must spend a year or more in fresh water before fry develop to the smolt stage and can tolerate salt water. These species are more expensive to rear, requiring a higher volume of fresh water, a holding area for freshwater rearing, and extended feeding until release. These species also experience a higher risk of disease mortality due to the extended rearing phase.

PNP hatchery facilities and operations are primarily financed by private funding, which may include taxes on fisherman's commercial salmon catch, sale of a portion of the fish returning to the hatchery, and loans from the State of Alaska. Therefore, the cost of production versus the value of the return is the principal economic consideration for the species produced. Although Chinook, sockeye, and coho salmon garner higher prices per pound at harvest, chum and pink salmon cost less to rear and generally provide a higher economic return on production costs.

As a result, most of Alaska's PNP hatchery production is pink and chum salmon. Sockeye, coho and Chinook salmon are also reared, but usually in concert with, and subsidized by, chum and pink salmon production. Government agencies also provide funds to some PNP hatcheries to raise Chinook and coho salmon for hook and line commercial and sport fisheries.

Pink salmon have the shortest life cycle of Pacific salmon (two years), provide the quickest return on investment, and comprise the bulk of Alaska hatchery production. From 2003 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 salmon (<1%; Figure 2, Vercessi 2013). A detailed discussion of Alaska hatchery production by facility can be found in ADF&G annual salmon enhancement program reports, such as Vercessi (2013).

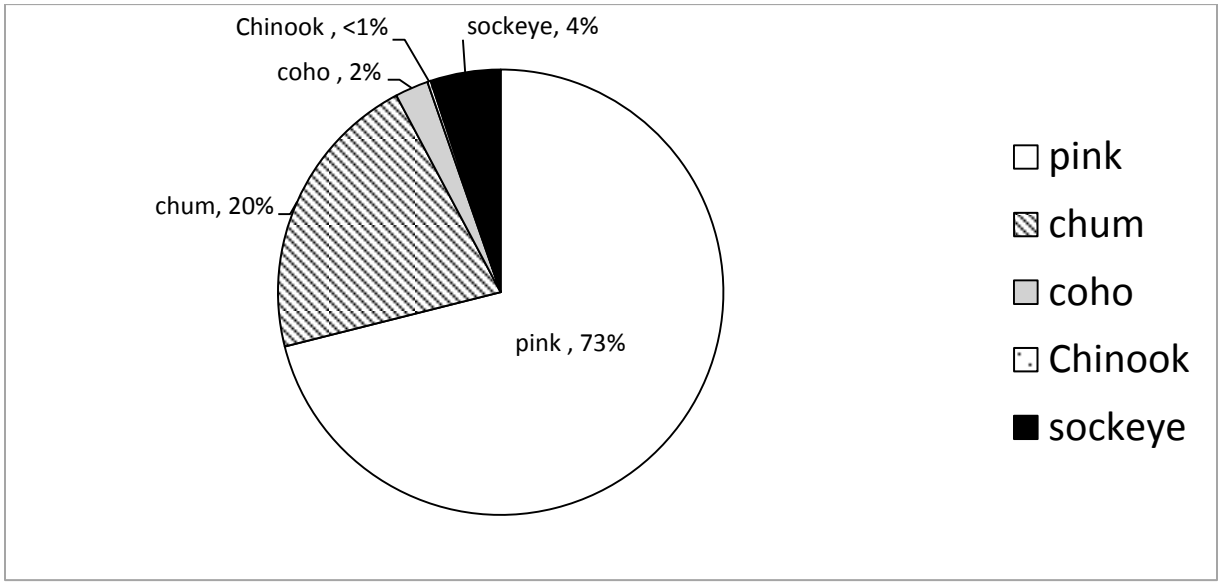

Figure 2.–Composition of Alaska hatchery returns by species, in numbers of fish, 2003–2012 average.

Source: Vercessi (2013).

THE SALMON MARKETPLACE

The salmon marketplace has changed substantially since Alaska's modern 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 of Alaska's wild production in some parts of the state was depressing salmon prices in others (Knapp et al. 2007). By 1996, rapidly expanding worldwide 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. Many Alaska hatchery organizations and commercial fishermen struggled to remain economically solvent during these years of low salmon prices. Several hatcheries suspended operations altogether. In the early 2000s, processors placed fishermen on delivery limits for pink salmon because of limited capacity and a glutted market (Ess 2003) ADF&G biologists cautioned that "traditional markets and outlets may be unwilling or unable to absorb consistent annual harvests of 100 million pink salmon from Alaska" (Johnson et al. 2002).

Alaska responded to farmed salmon competition by improving fish quality at harvest and implementing marketing efforts to define the differences between Alaska salmon and farmed salmon. By 2004, these efforts began to pay off through increasing demand and prices. Part of Alaska's marketing efforts was a message of sustainable fisheries management to a growing audience of discriminating buyers. In 2000, salmon fisheries managed by the State of Alaska were the first salmon fisheries certified as "sustainably managed" by the independent nonprofit Marine Stewardship Council (MSC) and remained the only MSC certified salmon fisheries 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 (Marine Stewardship Council 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.

Strengthening trade ties with China also contributed to higher salmon prices. An increasing portion of Alaska's harvest is headed, gutted, and frozen in Alaska, shipped to China for further processing to fillets and other product forms, and then shipped back to the US or other markets for sale or further value-added processing. According to the Alaska Seafood Marketing Institute (ASMI 2011a), "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 U.S. and Europe; five years ago less than 15 percent were exported to China." Chum salmon showed similar trends.

Today, Alaska typically accounts for just 12% to 15% of the global supply (ASMI 2011b). Alaska's diminished influence on world salmon production means that Alaska's harvest volume has little effect on world salmon prices. Since 2003, the value of Alaska salmon, and particularly pink and chum salmon, has increased substantially, regardless of harvest volume. For example, the Alaska pink salmon harvest nearly doubled from 2006 to 2007, yet pink salmon prices still increased 19%. From 2003 to 2012, the pink salmon exvessel price (the price paid by the buyer

to the harvester) increased over 450% and the chum salmon price increased over 325%. Sockeye, coho, and Chinook salmon showed substantial price increases as well (Table 1; ADF&G 2012).

As demand for salmon has grown, so has the market for their eggs (often called roe or ikura). Fish farms do not produce roe because farmed salmon are not reared to maturity. Salmon roe is an important aspect of the strong pink and chum salmon prices, as these two species provide the majority of roe produced in the state (ASMI 2012). In addition, pink and chum salmon—even mature fish reaching terminal harvest areas—can be processed into flake product, which can be added to prepackaged rice and soup products. Coated fillets of pink and chum salmon are also produced at pricing well below sockeye salmon, the third most abundant Alaska salmon species (ASMI 2011a).

Table 1.–Alaska statewide commercial salmon harvest average exvessel price per pound, with total harvest in millions of fish in parentheses, 2003–2012. Exvessel price represents the price paid to harvesters by fish buyers.

Year	Pink	Chum	Sockeye	Coho	Chinook	Total
2003	$0.09 (124)	$0.18 (18)	$0.63 (31)	$0.48 (4)	$1.43 (0.6)	$0.27 (178)
2004	$0.11 (100)	$0.21 (17)	$0.62 (45)	$0.68 (5)	$1.86 (0.8)	$0.34 (168)
2005	$0.12 (161)	$0.27 (12)	$0.74 (43)	$0.76 (5)	$2.22 (0.7)	$0.35 (222)
2006	$0.16 (73)	$0.32 (22)	$0.76 (42)	$1.03 (4)	$2.92 (0.6)	$0.47 (141)
2007	$0.19 (144)	$0.33 (17)	$0.80 (47)	$0.95 (4)	$3.09 (0.6)	$0.44 (213)
2008	$0.35 (84)	$0.59 (18)	$0.86 (39)	$1.28 (4)	$4.43 (0.4)	$0.63 (146)
2009	$0.27 (97)	$0.48 (18)	$0.91 (43)	$0.93 (4)	$2.60 (0.4)	$0.57 (163)
2010	$0.40 (107)	$0.71 (18)	$1.20 (41)	$1.15 (4)	$3.67 (0.4)	$0.74 (171)
2011	$0.47 (116)	$0.83 (17)	$1.31 (40)	$1.16 (3)	$3.57 (0.5)	$0.83 (177)
2012	$0.50 (68)	$0.77 (20)	$1.31 (36)	$1.22 (3)	$3.72 (0.3)	$0.88 (127)

Source: Exvessel price by species: http://www.adfg.alaska.gov/static/fishing/PDFs/commercial/84-12exvl.pdf (accessed 3/3/2014) Harvest: http://www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisherySalmon.exvesselquery (Accessed 3/3/2014). Exvessel price for all species combined from Kathy Tide, Research Analyst, ADF&G, Juneau Headquarters, 3/3/2014.

Hatchery production provides a significant contribution to Alaska's wild salmon fisheries. The annual exvessel value of hatchery harvests averaged over $100 million from 2003 to 2012. Although the hatchery harvest volume fluctuated widely, the value of the hatchery harvest showed an increasing trend, exceeding $100 million for the first time in 2008, and exceeding $200 million in 2010 (Table 2).

First wholesale value represents the value of the product to the processor when it is sold from a processing plant in Alaska, and captures the economic value of salmon to Alaska's coastal communities (ASMI 2011b). First wholesale value includes the purchase price of fish paid to the fishermen (exvessel value), costs for transportation of fish from the fishing vessel to the processing facility (tender fees), and processing costs (labor and business overhead). Like exvessel value, the first wholesale value of hatchery fish showed an increasing trend, exceeding $200 million in 2006 and topping $500 million in 2010 (Table 2). Hatchery pink and chum salmon combined contributed an average 78% of the total exvessel value and 83% of the total first wholesale value of all Alaska hatchery salmon harvested from 2003 to 2012 (ADF&G 2012).

Table 2.–Estimated Alaska statewide exvessel and first wholesale values, in millions of dollars, of the commercial salmon hatchery harvest, by species, 2003–2012. Values are gross estimates based on the commercial exvessel value of the salmon harvest by species multiplied by the percentage of hatchery fish in the total commercial harvest.

	Pink Salmon		Chum Salmon		Sockeye Salmon		Coho Salmon		Chinook Salmon		Total	
Year	Exvessel Value	Wholesale Value	Exvessel Value	Wholesale Value	Exvessel Value	Wholesale Value	Exvessel Value	Wholesale Value	Exvessel Value	Wholesale Value	Exvessel Value	Wholesale Value
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	$21	$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	$124	$60	$132	$20	$45	$8	$19	$4	$7	$136	$314
2012	$43	$152	$77	$183	$15	$34	$6	$14	$3	$5	$143	$387
Ave.	$39	$130	$42	$103	$12	$27	$7	$15	$4	$5	$104	$280

Source: Exvessel value is the total harvest value paid by fish buyers to fishermen, from http://www.adfg.alaska.gov/static/fishing/PDFs/commercial/84-12exvl.pdf (accessed 03/03/2014), multiplied by the hatchery percent of the commercial harvest in Table 2 (hatchery percent of total catch is from Farrington (2003, 2004); and White 2005–2011). First wholesale value (FWV) is the price paid to primary processors for processed fish from ADF&G Commercial Operators' Annual Reports, available from ADF&G, Division of Commercial Fisheries, Juneau upon request. *Note*: Hatchery harvest values calculated as the percent of hatchery fish in the commercial catch multiplied by the exvessel or FWV of the total catch, by species.

SALMON MANAGEMENT AND HATCHERY PRODUCTION

Alaska's salmon populations are managed to ensure adequate numbers of adults spawn (escapement). Salmon stocks are arguably managed at their maximum harvest level each year, given fluctuations due to environmental variability and imperfect management precision. Hatchery production provides a means to increase the overall harvest by supplementing the catch.

Fishery managers assess what effect new hatchery production is anticipated to have on their ability to manage for wild stocks, both prior to hatchery permitting and in hatchery planning and management stages. Thermal marking of otoliths (ear bones) in salmon was developed by alternating water temperatures in the hatchery during egg incubation or after hatching (Volk et al. 1990). This allowed hatcheries to mark all of their releases, and provided fishery managers with improved information on hatchery fish run timing, migration routes, and stock composition estimates in the harvest. In 2013, the Kodiak Regional Aquaculture Association reported inducing otolith marks to sockeye salmon through a dry-marking method at the Pillar Creek Hatchery. The dry-marking method removes water from incubators for periods as long as 24 hours to induce otolith marks. Preliminary results of the Kodiak dry-marking method are promising, and where applicable, will reduce marking costs.

As ADF&G and hatchery managers became experienced with managing wild stocks and hatchery returns from the mid-1970s through the mid-1990s, hatchery releases steadily increased. By 1995, new projects tended to be small additions to existing programs, such as releasing hatchery fry in a separate location away from the hatchery. Such sites are selected with the intention of allowing harvest of hatchery fish separately, for the most part, from wild stocks. Increased releases in some areas were countered by decreased releases in others after several hatcheries closed when low fish prices and returns did not financially support hatchery operations. Overall, hatchery releases increased steadily from program inception in 1974 until 1993, when releases reached about 1.48 billion juvenile salmon. From 1993 to 2012, releases were relatively stable, ranging from about 1.30 to 1.67 billion juvenile salmon (Figure 3).

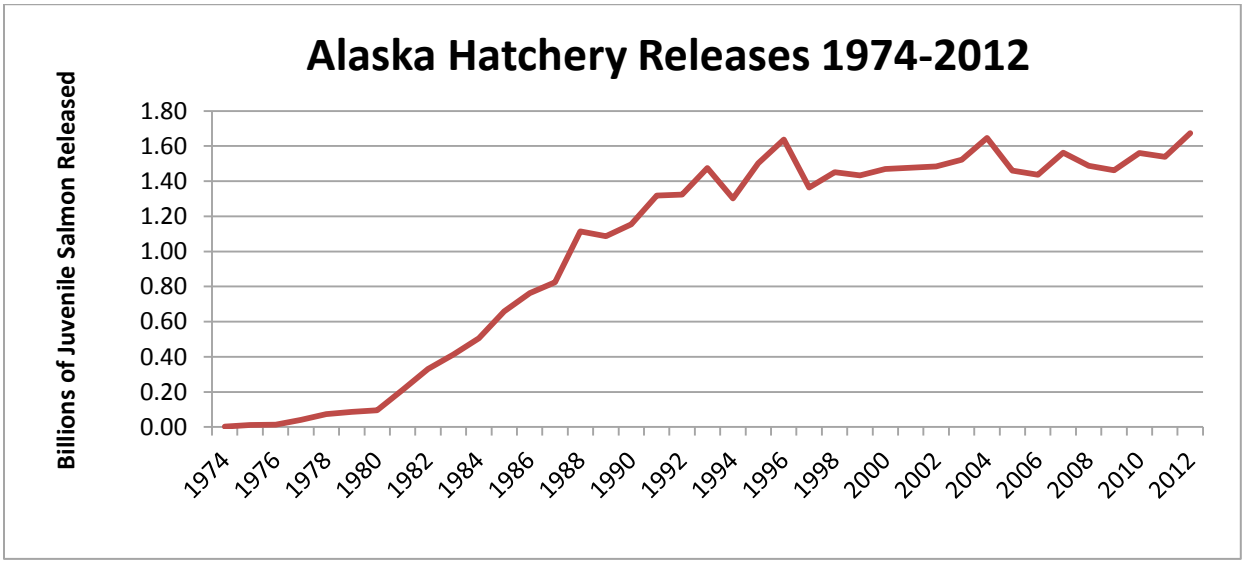

Figure 3.–Juvenile salmon releases from Alaska hatcheries, 1974–2012.
Source: Vercessi (2012, 2013).

Strong world market conditions for Alaska salmon have spurred renewed interest in hatchery production. In 2011, the Cook Inlet Aquaculture Association reopened the Tutka Bay Lagoon Hatchery, which they closed when salmon prices were low. The Cook Inlet Aquaculture Association is assessing reopening two other closed facilities (Port Graham Hatchery and Eklutna Salmon Hatchery) as well (Cook Inlet Aquaculture Association 2011, 2012). The Prince William Sound Aquaculture Corporation received approval to increase pink salmon production at one facility in 2011, and requested increases at two other facilities, which were subsequently not approved. Elsewhere in the state, fishing groups are exploring potential new salmon production in Southeast Alaska, Kodiak, Norton Sound and the Alaska Peninsula.

CURRENT RESEARCH

ADF&G has embarked on several studies to evaluate Alaska's hatchery programs. One study will review each hatchery to assess compliance with state policies and regulations for genetics, fish health, and protection of wild stocks. The Kodiak and Cook Inlet area hatchery reviews are complete (Musslewhite 2011a, 2012b, Stopha and Musslewhite 2012, and Stopha 2012a, 2012b, 2013a) and hatchery evaluations for most PWS facilities are complete (Stopha 2013b, 2013c, 2013d, 2013e, 2013f). Evaluations will continue for the reminder of facilities in Prince William Sound and Southeast Alaska hatcheries.

Hatchery and wild stock interaction studies are underway as well. The incidence of hatchery-produced salmon straying has been examined in recent years in Southeast Alaska and Prince William Sound (e.g., Bidlack and Valentine 2009, Piston and Heinl 2012a, 2012b; Shaul 2010; Brenner et al. 2012). The state has contracted with Prince William Sound Science Center to collect data and specimens in Prince William Sound and Southeast Alaska as part of a long-range study of the interactions between hatchery and naturally produced stocks. This study will help address questions about the compatibility of hatchery production with sustainable productivity of wild stocks, the extent and annual variability in straying of hatchery-produced pink salmon in Prince William Sound and hatchery-produced chum salmon in Prince William Sound and Southeast Alaska, and the genetic fitness of Alaska pink and chum salmon stocks (www.sitkasoundsciencecenter.org/, accessed 10/16/2012).

DISCUSSION

Although there have been negative reports about hatchery and wild salmon interactions in the Pacific Northwest, Alaska's hatchery program has provided a reliable harvest for Alaska fisheries in the presence of healthy wild stocks. From 2003-2011, escapement goals were met or exceeded for most watersheds in Southeast Alaska and Prince William Sound, where the majority of Alaska hatchery production occurs (Munro and Volk 2012). Furthermore, the Alaska Department of Fish and Game assesses "stocks of concern" when monitored systems do not meet spawning escapements or yield expectations. In 2013, no salmon stocks of concern were listed in Southeast Alaska or Prince William Sound (ADF&G 2013). ADF&G recognizes the importance of the PNP hatcheries and strongly supports the effective and continued operation of hatcheries as demonstrated by ADF&G's renewal of numerous contracts with PNP corporations to operate state-owned hatchery facilities in Cook Inlet, Kodiak, Prince William Sound and Southeast Alaska (Jeff Regnart, ADF&G Director of Commercial Fisheries, personal communication).

When salmon prices dropped in the mid-1990s, many questioned the utility of hatcheries. Markets were glutted with farmed salmon production. Processors in Alaska did not have the

capacity or the markets for large harvests of pink and chum salmon. Alaska hatcheries were closing because low salmon prices were making operations uneconomical.

For a time, it appeared that farmed salmon was the doom of the Alaska salmon fishery. Farmed salmon flesh quality was exceptionally high, was available year round, and priced competitively with other protein sources such as beef, chicken and pork. The Alaska salmon industry responded to farmed salmon competition by improving quality and appealing to a growing base of salmon consumers about the virtues of Alaska salmon, including the high Omega-3 oil content and sustainable harvest from clean waters by the state's small vessel fleet. When farmed salmon opened additional markets worldwide, wild salmon soon followed.

Entry to the commercial salmon fisheries became limited beginning in 1975. A limited-entry permit holder does not have to fish their permit every year to retain it, and as prices plummeted in the late 1990s and early 2000s, participation in the commercial fisheries declined as well. A person might not fish for a variety of reasons, but presumably fishing effort is significantly influenced by profitability. According to the State of Alaska Commercial Fisheries Entry Commission, the percentage of limited entry salmon permits that were actually fished in a year declined from a high of 88% in 1988 to a low of 57% in 2002. A decade later, buoyed by strong salmon prices, sustainable wild stock harvests, and consistent hatchery harvests, the commercial salmon fishery participation rebounded to 72% in 2011.

Many in the Alaska commercial fishing industry are encouraging the state to allow significant increases to hatchery production (e.g., Industry Working Group 2010). State fishery managers remain cautious to significantly expanding production in order to maintain healthy naturally spawning populations across the state. The state is expanding studies of wild and hatchery salmon interactions to better understand those relationships as they occur in Alaska. As these studies provide results, the state will evaluate this information and incorporate the understanding into future decisions regarding hatchery production.

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