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Marine Stewardship Council
Fisheries Assessments

Alaska Salmon

Expedited Audit Report

Conformity Assessment Body (CAB)	MRAG Americas, Inc.
Assessment team	Amanda Stern-Pirlot, Ray Beamesderfer, Scott Marshall
Fishery client	Alaska Fisheries Development Foundation
Assessment type	Expedited Audit
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1 EXECUTIVE SUMMARY

This is an expedited audit to review progress in addressing five hatchery-related conditions that remained open in the 2024 MSC Certification Reassessment of the Alaska commercial salmon fishery. [1] These conditions were previously scheduled for closure in 2023 or 2024 but review was delayed by the lengthiness of reassessment process required to resolve stakeholder objections to the certification. One additional condition (#6), regarding information on impacts of Endangered, Threatened and Protected seabirds, was not a subject of this expedited audit and will be reviewed as scheduled in the first normal audit of the new certificate cycle.

Each of these five hatchery-related conditions was closed in this audit, and the respective Performance Indicators (PIs) have been rescored at 80 or higher as a result (see Section 4.4). Audit findings are based on results of dedicated research and monitoring to assess hatchery effects in Alaska salmon Units of Assessment and application of the best available information in decision-making processes of the management system to date. Significant new research findings on Alaska hatchery effects are available since related conditions were set. New information is demonstrably being considered and applied in hatchery management by the ADF&G, Regional Hatchery Planning Teams and the Board of Fisheries.

The MSC fisheries standard for salmon considers the impact of hatchery programs on target salmon stock sustainability under enhancement-specific indicators in Principle 1, impacts on ecosystem structure and function in Principle 2, and related decision-making processes in the management system under Principle 3.

Three conditions in the reassessment addressed potential negative impacts of hatchery enhancement on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks under Principle 1. Conditions were identified for Units of Assessment with significant hatchery enhancement including: 1) Southeast Alaska Chum Salmon, 2) Prince William Sound Pink and Chum Salmon, and 3) Lower Cook Inlet Pink Salmon. Salmon hatcheries pose inherent fishery, genetic, and ecological risks to wild stocks depending on the circumstances of hatchery program implementation. This audit reviewed the extensive scientific literature on hatchery-related risks and impacts in Alaska and elsewhere as the basis for assessment under the MSC fishery standard.

Based on a comprehensive review of the scientific evidence, this audit found that hatchery enhancement activities are highly unlikely to have significant negative impacts on wild Pink and Chum Salmon in Southeast Alaska, Prince William Sound and Lower Cook Inlet at the stock scale which is the basis for the MSC fishery assessment criteria. Hatchery interactions are likely detrimental to some populations in specific areas but localized impacts are not sufficiently large as to impair sustainability of the Units of Assessment at the stock scale. Sustainability was considered both in terms of the ability of the wild stock to continue to produce significant levels of harvest and long-term viability (i.e. lack of any level of related conservation concern for the stock).

Condition 4 calls for demonstrating that a moderate-level analysis of relevant information on hatchery straying and relative fitness is conducted and used by decision makers to quantitatively estimate the impact of enhancement activities on wild stock status, productivity, and diversity of Pink and Chum Salmon in Southeast Alaska, Prince William Sound and Lower Cook Inlet. This condition was met by information on genetic stock structure, straying and relative fitness of hatchery fish produced since 2013 by a comprehensive, long-term Alaska Hatchery Research Project. This information was the basis for conclusions regarding the significance of hatchery impacts addressed in Conditions 1-3 above.

Substantial genetic stock structure has been identified in all salmon species despite long-term hatchery programs and populations remain similar over time with limited levels of introgression of hatchery strays. Chronic low levels of straying by hatchery Pink and Chum Salmon have been documented across broad areas

[1] One remaining condition (#6), regarding information on impacts of Endangered, Threatened and Protected seabirds, was not a subject of this expedited audit and will be reviewed as scheduled in the first normal audit of the new certificate cycle.

with a greater incidence in some areas of proximity to hatcheries and along migratory pathways. However, hatchery strays comprise small proportions of total spawning escapements of all species even in regions where large production programs occur. Relative reproductive success (RRS) has been found to be substantially less for hatchery than wild Pink and Chum Salmon in and outside of Alaska. However, the impact is limited by the low incidence of hatchery straying into most wild populations and differences in distribution of wild and hatchery spawners. Consistent patterns of wild Pink and Chum Salmon escapements which meet or exceed established goals even when the contributions of hatchery strays are removed, provide compelling evidence for negligible levels of hatchery impact on wild stock sustainability.

Condition 5 requires demonstrating that decision-making processes use the precautionary approach and are based on best available information as applied the Pink and Chum Salmon hatchery enhancement programs. This audit found this condition to be met based on a series of related actions including: 1) individual hatchery program evaluations from 2011-2017; 2) a comprehensive review in 2018 of Alaska hatchery procedures, practices, fishery management, and stock assessment in relation to wild stock protection; 3) establishment of an independent science panel for hatchery assessment and recommendations; 4) implementation of a comprehensive, long-term Alaska Hatchery Research Project; 5) convention of a Hatchery Committee in the Alaska Board of Fisheries; and 6) a Commissioner policy decision in 2024 to limit permitted hatchery capacity pending results of the hatchery study. In a specific case of hatchery Chum Salmon straying in Crawfish Inlet of Southeast Alaska, a precautionary approach based on best available information was demonstrated by: 1) annual assessments of hatchery straying; 2) targeted fisheries to reduce the incidence of straying; 3) removal of a nearby escapement index stream subject to hatchery strays; 4) research on potential causes of straying; 4) Board of Fisheries review of related options, 5) a reduction in hatchery releases, and 6) a comprehensive review of Chum Salmon release strategies.

No conditions were identified in the 2024 assessment regarding ecosystem effects under Principle 2. The weight of available scientific evidence demonstrated that hatchery salmon are a significant component of the marine ecosystem; interact directly and indirectly with many prey, competitor and predator species; and must inevitably have some influence on other ecosystem components. However, hatchery salmon from Alaska likely exert a marginal effect on the dynamics of the North Pacific marine ecosystem due to their low percentage contribution to total abundance and biomass. For instance, large even-odd year differences in Pink Salmon abundance are driven by wild production and marginal effects of hatchery Pink Salmon are dwarfed by normal variation in wild Pink Salmon abundance, abundance of other salmon stocks, environmental drivers and other ecosystem elements. While Alaska hatchery fish likely contribute to density-dependent changes in size at age, and survival of salmon in marine waters, it is not apparent that effects rise to a level where ecosystem structure or function has likely been disrupted to a point where there is serious or irreversible harm.

While hatchery-related conditions have been closed, hatchery impacts and the management response to hatchery impacts are of continuing concern in light of strong evidence for negative impacts of hatchery production on wild populations in specific areas of Units of Assessment with large hatchery enhancement programs. Hatchery research is ongoing and substantive management responses to specific problem areas are in the process of being implemented. New information and continuing progress in implementation of hatchery management strategies consistent with established wild fish protection policies will continue to be assessed in annual surveillance audits of this fishery.

MRAG Americas concludes that the Alaska Salmon fishery continues to meet the standards of the MSC and complies with the 'Requirements for Continued Certification.' MRAG Americas recommends the continued use of the MSC certificate through to the end of this certificate cycle subject to satisfactory annual surveillance audits.

2 AUDIT DETAILS

2.1 Surveillance information

1	Fishery name	
Alaska Salmon		
2	**Unit(s) of Assessment (UoA)**	
Species: Pink salmon (*Oncorhynchus gorbuscha*), Chum Salmon (*O. keta*), Sockeye Salmon (*O. nerka*), Chinook Salmon (*O. tshawytscha*), coho salmon (O. kisutch) Locations: Arctic Sea (FAO area 18), Northeast Pacific (FAO area 67), Alaska marine and freshwaters Gears: Drift gillnet, purse seine, troll gear, set gillnet, purse seine, beach seine, fish wheel, dip net Stocks: Populations of Pacific salmon spawning in Alaska, and potentially intercepted populations Client group: Alaska Fisheries Development Foundation See https://afdf.org/asset/669abd6561ce8/2024%20MSC%20Salmon%20Client%20Group.pdf		
3	**Date certified**	**Date of expiry**
	October 1, 2000 (Latest reassessment November 11, 2024)	November 10, 2029
4	**Audit type and number**	
	Expedited audit	
5	**Surveillance level**	
	Not applicable	
6	**Surveillance team leader**	

Ms. Amanda Stern-Pirlot is team leader for the assessment. Amanda is an M.Sc. graduate in Marine Ecology and Fisheries Biology from the University of Bremen, Center for Marine Tropical Ecology (ZMT). She joined MRAG Americas Inc. in 2014 and now serves as Vice President—Science, providing technical oversight of all projects, ensuring MRAG Americas maintains a strong science- and evidence-based ethos. She also oversees our growing portfolio of fisheries certification projects under the MSC, RFM, and FISH Standard for Crew standards. Throughout her career, she has worked with many scientists, conservationists, fisheries managers, and producer groups on international fisheries sustainability issues. With the Institute for Marine Research (IFM-GEOMAR) in Kiel, Germany, she led a work package on simple indicators for sustainability within the EU-funded international cooperation project INCOFISH. This was followed by 5 years in the Standards Department at MSC in London developing standards, and policies and assessment methods informed by best practices in global fisheries management. She was Resources Analyst of the Alaska pollock industry in the North Pacific Fisheries Management Council focusing on bycatch and ecosystem-based management issues and managing the operations of the offshore pollock cooperative. She has co-authored publications on fisheries sustainability in the developing world and the functioning of sustainability standards as an instrument for transforming fisheries to a sustainable basis.

MRAG Americas confirms that Ms. Stern-Pirlot meets the competency criteria in Annex PC for team leader as follows:

- She has an appropriate university degree and more than five years' experience in management and research in fisheries;
- She has passed the MSC team leader training;
- She has the required competencies described in Table PC1, section 2;
- She has passed the MSC Traceability training module;
- She meets ISO 19011 training requirements;
- She has undertaken two fishery assessments as a team member in the last five years, and

- She has experience in applying different types of interviewing and facilitation techniques and is able to effectively communicate with clients and other stakeholders.

In addition, she has the appropriate skills and experience required to serve as a Principle 2 & 3 assessor as described in FCP Annex PC table PC3 as follows

- She has 15 years' experience in research into, policy analysis for, or management of the impact of fisheries on aquatic ecosystems, including at least 2 of the following topics: bycatch, ETP/OOS, habitats, ecosystem interactions
- She has 15 years' experience as a fishery policy analyst and consultant.

MRAG Americas confirms that Ms. Stern-PIrlot has no conflicts of interest in relation to the fishery under assessment.

7	Surveillance team members

Mr. Ray Beamesderfer holds a bachelor's degree in Wildlife and Fisheries Biology from the University of California, Davis, and a Master's in Fishery Resources from the University of Idaho. Ray has special expertise in using quantitative analysis, statistics, and computer modelling to solve difficult fisheries-related questions, and in synthesizing and translating scientific analyses. He has completed a wide variety of projects in fishery management, biological assessment, and conservation/recovery planning. He is the author of numerous reports, biological assessments, management plans, and scientific articles on fish population dynamics, fish conservation, fishery and hatchery management, sampling, and species interactions. Ray has served on fishery assessment teams for salmon fisheries in Alaska and Russia.

MRAG Americas confirms that Mr. Beamesderfer meets the competency criteria in Annex PC for team members as follows:

- He has an appropriate university degree and more than five years' experience in management and research in fisheries;
- He has undertaken at least two MSC fishery assessments or surveillance site visits in the last five years;
- He is able to score a fishery using the default assessment tree including modifications for enhanced salmon fisheries and describe how conditions are set and monitored;
- He has passed the MSC Traceability training module.
- In addition, he has the appropriate skills and experience required to serve as a Principle 1 and 3 assessor as described in FCP Annex PC table PC3 as follows:
- He has over 30 years' experience of applying relevant stock assessment techniques being used by the fishery or was primary author of 2 peer-reviewed stock assessments of a type used by the fishery under assessment;
- He has over 30 years' experience working with the biology and population dynamics of the target species or species with similar biology;
- He has over 30 years' experience as a practicing fishery manager and/or fishery policy analyst and consultant.

MRAG Americas confirms he has no conflicts of interest in relation to the fishery under assessment.

Mr. Scott Marshall earned a B.S. in Fisheries from Oregon State University, and a M.S. in Fisheries Science from the University of Washington. He has held multiple positions in fisheries, including Project Leader at the Fisheries Research Institute (UW); Research Project Leader, Principal Fishery Scientist and SE Region Supervisor for the Division of Commercial Fisheries for the Alaska Department of Fish and Game; staff biologist for Idaho Department of Fish and Game; and Fisheries Administrator in charge of the Lower Snake River Compensation Plan for the US Fish and Wildlife Service. He has served on Scientific and Statistical Committee of the North Pacific Fisheries Management Council and as Co-Chairman of the Transboundary Rivers Panel of the Pacific Salmon commission.

MRAG Americas confirms that Mr. Marshall meets the competency criteria in Annex PC for team members as follows:

- He has an appropriate university degree and more than five years' experience in management and research in fisheries;
- He has undertaken at least two MSC fishery assessments or surveillance site visits in the last five years; and
- He is able to score a fishery using the default assessment tree, including modifications for enhanced salmon fisheries and describe how conditions are set and monitored.

In addition, he has the appropriate skills and experience required to serve as a Principle 2 assessor as described in FCP Annex PC table PC3 as follows:

- He has more than 20 years' experience in research into, policy analysis for, or management of the impact of fisheries on aquatic ecosystems, including at least 2 of the following topics: bycatch, ETP/OOS, habitats, ecosystem interactions.

MRAG Americas confirms he has no conflicts of interest in relation to the fishery under assessment.

8	**Audit time and location**
	A remote expedited audit was held the week of January 6, 2025.
9	**Assessment and review activities**

The expedited audit reviewed progress in closing out conditions. Note that although the deadlines for closing some of these conditions passed, there had not been an audit opportunity to assess them due to recertification taking place in 2023. The first audit of the new certificate cycle would be the first regular opportunity to assess progress, however we have determined an expedited audit should be carried out due to the lengthiness of the reassessment process.

2.2 Version details

Document/Assessment Tree	Version number/Type
MSC Fisheries Certification Process	Version 2.3
MSC Fisheries Standard	Version 2.01
Assessment tree	Salmon
MSC General Certification Requirements	Version 2.6
MSC Surveillance Reporting Template	Version 2.2

3 BACKGROUND / UPDATE

Salmon hatcheries have proven to be tremendously effective in producing fish for fishery enhancement or mitigation purposes in Alaska and throughout the northern Pacific. However, hatcheries may also affect wild salmon populations and ecosystems depending on the circumstances of hatchery program implementation.

The MSC fisheries standard for salmon considers the impact of hatcheries programs on target salmon stock sustainability under enhancement-specific indicators in Principle 1 and on ecosystem structure and function in Principle 2.

Extensive information is available on hatchery impacts from experience and research in both Alaska and elsewhere. This section reviews the available information pertinent to this audit of progress relative to hatchery-related conditions identified in the current certification.

3.1 Salmon Hatcheries in Alaska

Alaska salmon numbers are enhanced by significant hatchery production, particularly in Southeast Alaska and Prince William Sound (Wilson 2024). The modern Alaska hatchery program was initiated in the early 1970s, in response to a period of depressed commercial salmon fisheries in Alaska (Figure 1). The new program was intended to supplement, not supplant, wild stock production. In 1971, the Alaska Legislature created the Fisheries Rehabilitation, Enhancement and Development Division (FRED) of ADF&G to develop a coordinated salmon enhancement program. By the early 1980’s, ADF&G was involved with construction and or operation of about 20 salmon aquaculture facilities.

Following a decline in North Slope oil revenues to Alaska in the 1980’s, Alaska explored the option of private sector operation of State salmon enhancement programs. By the mid-1990’s, most State run salmon aquaculture facilities were taken over by the private non-profit (PNP) sector. State aquaculture facilities that primarily produced fish caught in sport fisheries were transferred to the Division of Sport Fish and by the later 1990’s, the Commercial Fisheries Division neither funded nor operated salmon hatcheries. The Division of Commercial Fisheries continued to provide technical support to all of the salmon aquaculture facilities operated in Alaska such as was provided by FRED Division while in existence, for example, disease screening and production evaluation.

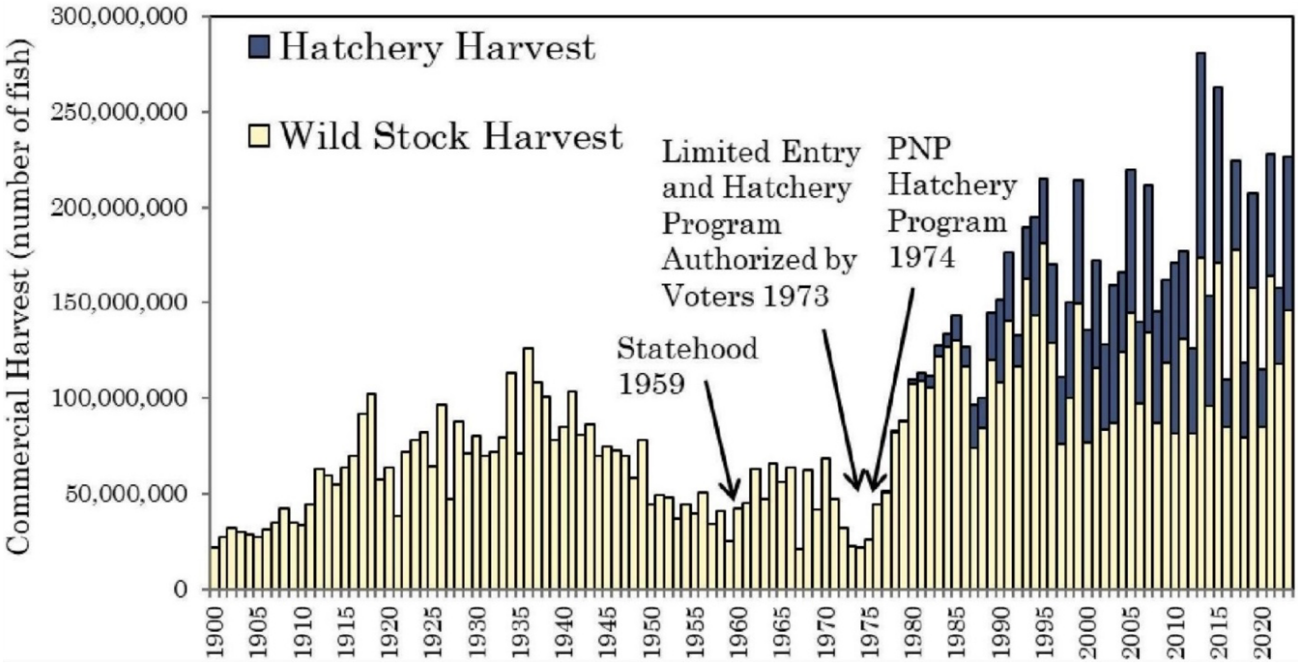

Figure 1. Alaska commercial salmon harvest, 1900 to 2023 (Wilson 2024).

The Alaska salmon enhancement program currently consists of 26 private non-profit salmon hatcheries, which are funded primarily from the sale of a portion of the hatchery returns (Figure 2). Two sport fish hatcheries are operated by the state, one research hatchery by the National Marine Fisheries Service, and one hatchery by the Metlakatla Indian Community.

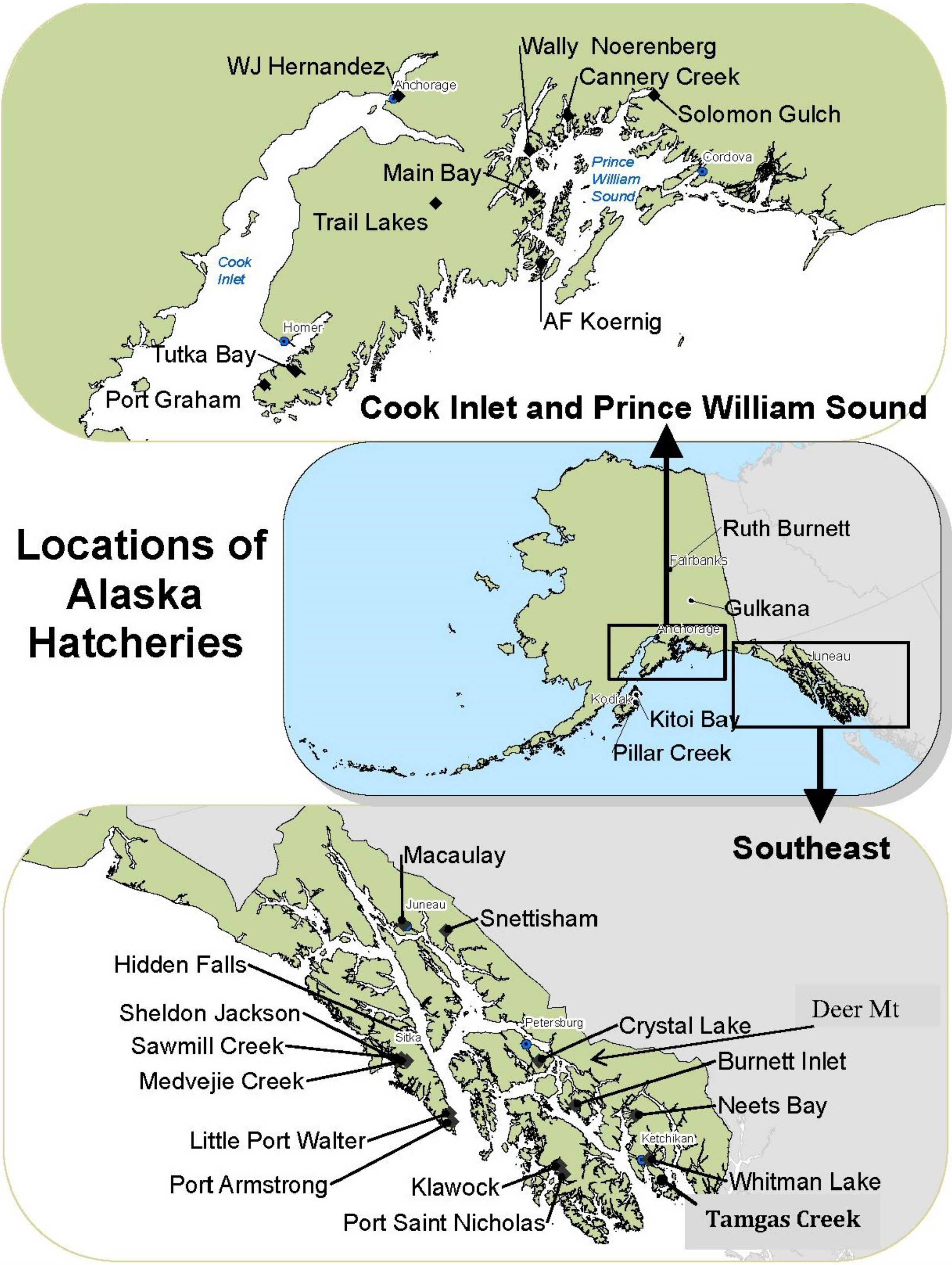

Figure 2. Salmon hatcheries currently operating in Alaska (Wilson 2024).

3.1.1 Hatchery Production

Current Alaska hatchery releases are approximately 1.9 billion fry per year (Table 1, Figure 3). Pink and Chum Salmon are the predominant species produced by Alaska hatcheries, followed by Sockeye, Coho, and Chinook Salmon. Pink and Chum are preferred as the fry migrate to salt water soon after hatching resulting in less cost compared to the other species which require being held and fed in fresh water for an additional year. Prince William Sound (48%) and Southeast Alaska (38%) account for the large majority of Alaska hatchery production (Table 1).

Permitted hatchery capacity for egg take has been approximately 2.5 billion since 2019 (Figure 4). Permitted capacity is currently greater than the annual egg take of approximately 2 billion. Changes in permit allowances over the last 10 years have been relatively small and addressed operator desire to better meet the needs of their constituents and operational constraints such as broodstock availability. Among those changes have been increases in Chum Salmon production in Southeast and in Pink Salmon releases in Lower Cook Inlet as the operators strive to rebuild production to the permitted level.

Comprehensive marking of all Alaska hatchery production has been implemented (Figure 5) to assess contributions to fisheries and natural escapements.

Table 1. Estimated juvenile salmon releases from Alaska hatcheries by region, 2023 (Wilson 2024).

Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast	7,261,652	13,136,100	25,741,166	61,230,372	607,078,640	714,447,930
Prince William Sound	223,336	13,314,031	3,742,165	739,441,201	132,194,513	888,915,246
Cook Inlet	2,032,605	4,986,865	1,561,076	21,017,854	0	29,598,400
Interior	39,649	0	119,288	0	0	158,937
Kodiak	46,503	3,844,287	1,082,732	191,750,551	29,718,848	226,442,921
Total	9,603,745	35,281,283	32,246,427	1,013,439,97	768,992,001	1,859,563,434

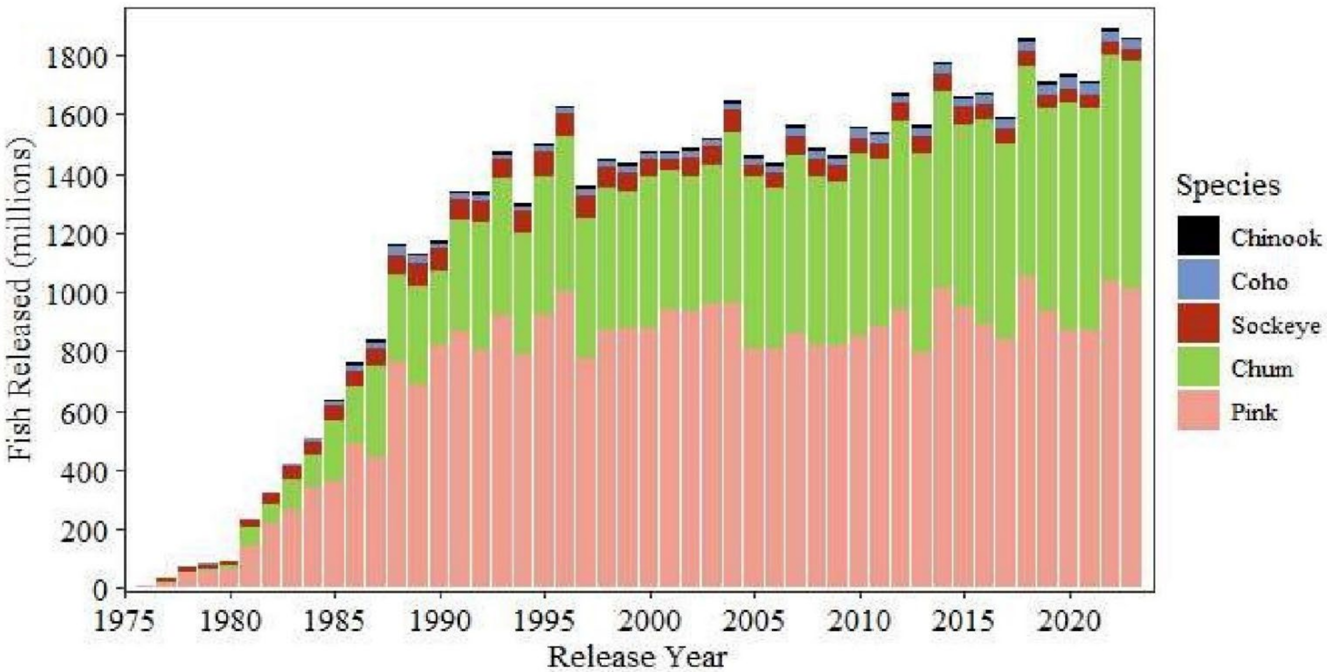

Figure 3. Annual releases of hatchery fish in Alaska by species (Wilson 2024).

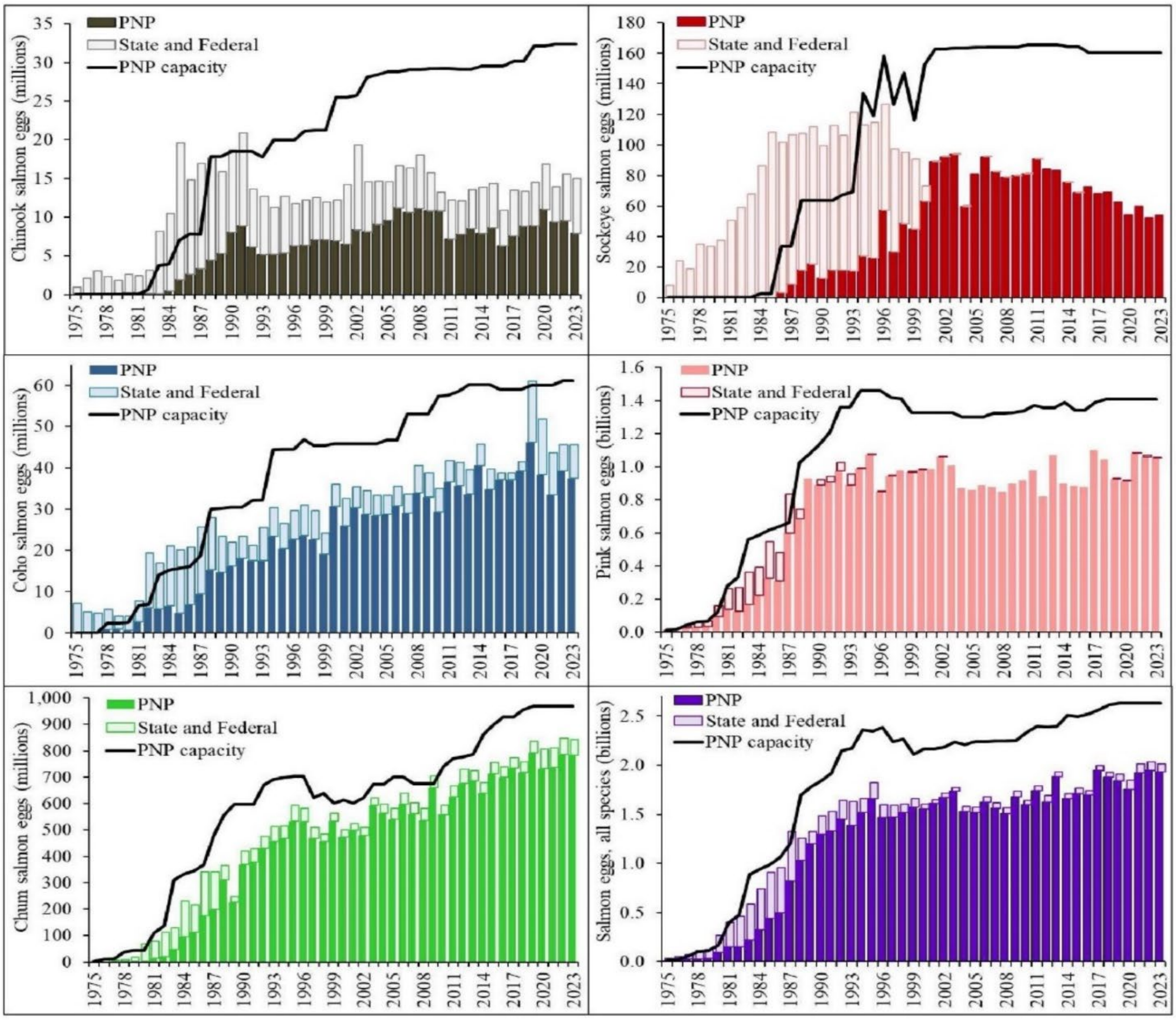

Figure 4. ***Salmon eggs collected at by PNP hatcheries and by state and federal hatcheries, and PNP hatchery permitted capacity by species and total, 1975–2023 (Wilson 2024).***

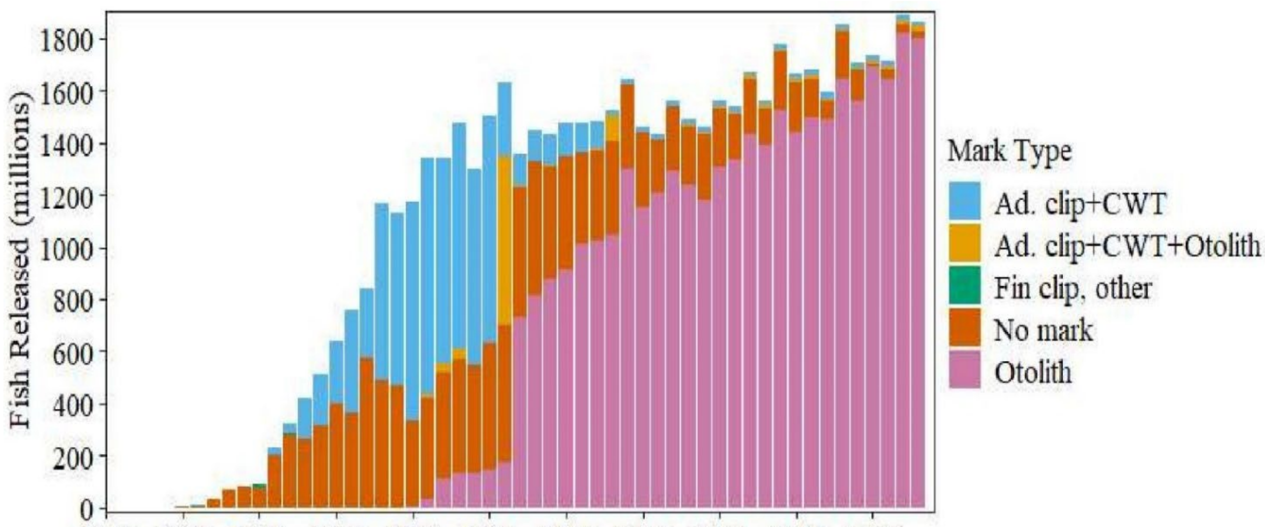

Figure 5. ***Alaska hatchery juvenile salmon releases by mark type (Wilson 2024).***

3.1.2 Hatchery Returns

Annual assessments of hatchery contributions to the fishery harvest are made ADF&G in conjunction with private nonprofit hatchery operators based on comprehensive marking of hatchery production and mark sampling of the commercial fisheries (Thynes et al. 2022; Wilson 2024). Hatcheries contributed about 40 million salmon per year and comprised about 30% of the total commercial salmon harvest in Alaska (Figure 6).

In Southeast Alaska, hatcheries contributed 92% of the 2023 commercial harvest of Chum Salmon (Wilson 2024). Hatcheries contributed 34% of the coho, 23% of the Chinook, 11% of the sockeye, and 3% of the Pink Salmon, in numbers of fish, to 2023 commercial fisheries by species.

In Prince William Sound, hatcheries contributed 84% of Chum Salmon, 82% of Pink Salmon, 41% of sockeye, 10% of coho, and <1% of the Chinook, in numbers of fish, to 2023 commercial fisheries by species (Wilson 2024).

In Cook Inlet, hatcheries contributed 77% of Pink Salmon, 10% of sockeye, and <1% of chum, coho, and Chinook, in numbers of fish, to 2023 commercial fisheries by species (Wilson 2024).

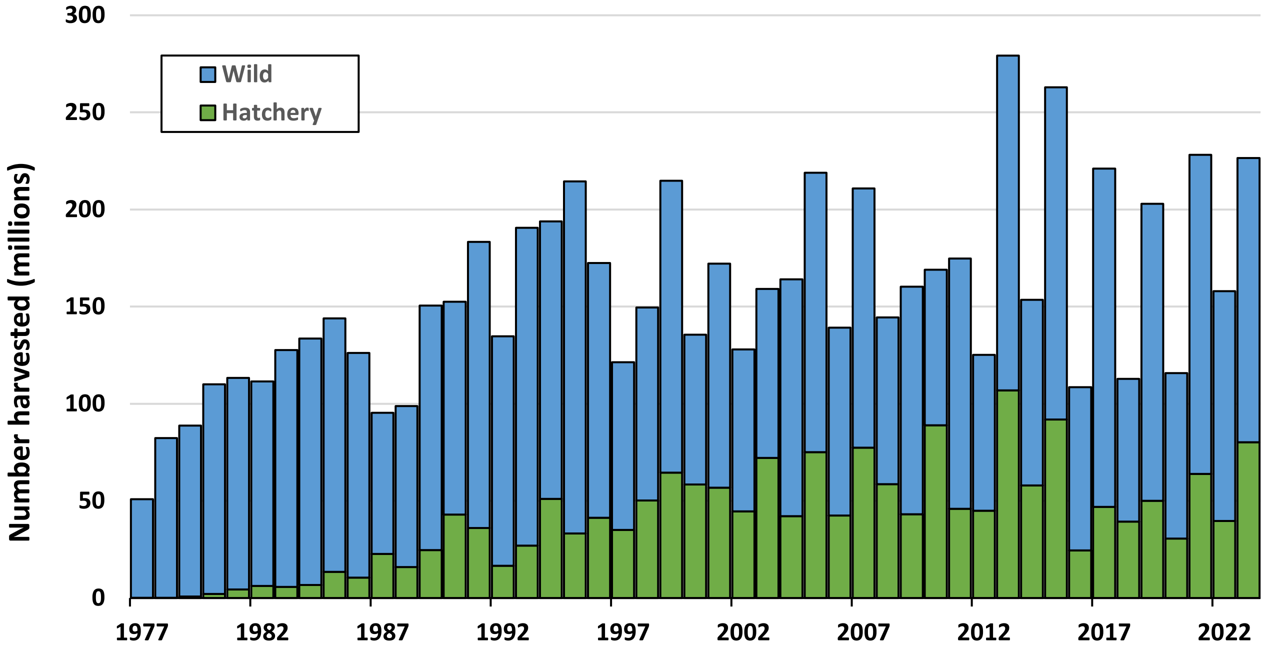

Figure 6. Hatchery and wild contributions to commercial (common property and hatchery cost recovery) salmon harvest (data from Wilson 2024).

3.1.3 Hatchery Management

Alaska has adopted a complex of policies and regulations designed to minimize the potential for adverse effects of the enhancement program on wild stocks (Evenson et al. 2018). The Alaska state constitution, statutes, and regulations mandate that ADF&G manage salmon returns for wild stock conservation (Wilson 2024). The Alaska Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222), the Policy for the Management of Mixed-Stock Salmon Fisheries (5 AAC 39.220), the Salmon Escapement Goal Policy (5 AAC 39.223), and local fishery management plans (5 AAC 39.200) guide fisheries management for the protection of wild salmon stocks. Related guidance is also provided by the FRED Division Statute 1971, the PNP Hatchery Permitting Statute, the Regional Planning Statute 1976, the BOF Hatchery Management Policy, Fish Transport Regulations 1981, the PNP Regulations 1985, the Pathology Policy 1988, Wild and Enhanced Stock Statute 1992, Sockeye Salmon Culture Policy 1994.

The Policy for Management of Sustainable Salmon Fisheries directs that effects and interactions of introduced or enhanced salmon stocks on wild salmon stocks should be assessed; wild salmon stocks and fisheries on those stocks be protected from adverse impacts from artificial propagation and enhancement efforts; and ‘plans and proposals for development or expansion of salmon fisheries and enhancement programs should effectively document resource assessments, potential impacts, and other information needed to assure sustainable management of wild salmon stocks.’

The ADF&G Genetic Policy sets out restrictions and guidelines for stock transport, protection of wild stocks, and maintenance of genetic diversity (Davis et al. 1985; Davis & Burkett 1989). The policy restricts import and transportation of stocks between the major geographic areas; requires use of local broodstock; directs use of large populations of broodstock collected across the entire run and without regard to any physical trait such as size; and limits use of individual donor stocks. Related requirements also include locating hatcheries away from significant wild stocks; priority for wild stocks in fisheries; provisions for marking of hatchery fish; and as necessary, requirements for special studies on hatchery/wild stock interactions.

A state-wide fish health program also provides hatchery oversight with a primary objective of wild fish protection. The state operates two laboratories providing services for state and private non-profit hatcheries. This program also administers associated regulations and a disease policy guiding responses to any outbreaks which might occur. The program conducts routine surveillance, training and diagnostic services in the case of outbreaks (which are rare in the Alaska hatchery system).

Fishery management strategies are designed and implemented to harvest hatchery salmon at high rates while also protecting escapements of wild stocks. Hatcheries are sited in terminal areas which facilitate targeted harvest of returning adults. In high enhancement areas such as Prince William Sound, in-season monitoring of hatchery-wild composition based on otolith sampling is used to maximize harvest of hatchery-origin salmon. Comprehensive marking of Alaska hatchery production has been implemented to facilitate assessment of hatchery contributions to harvest and natural spawning escapements (Figure 7).

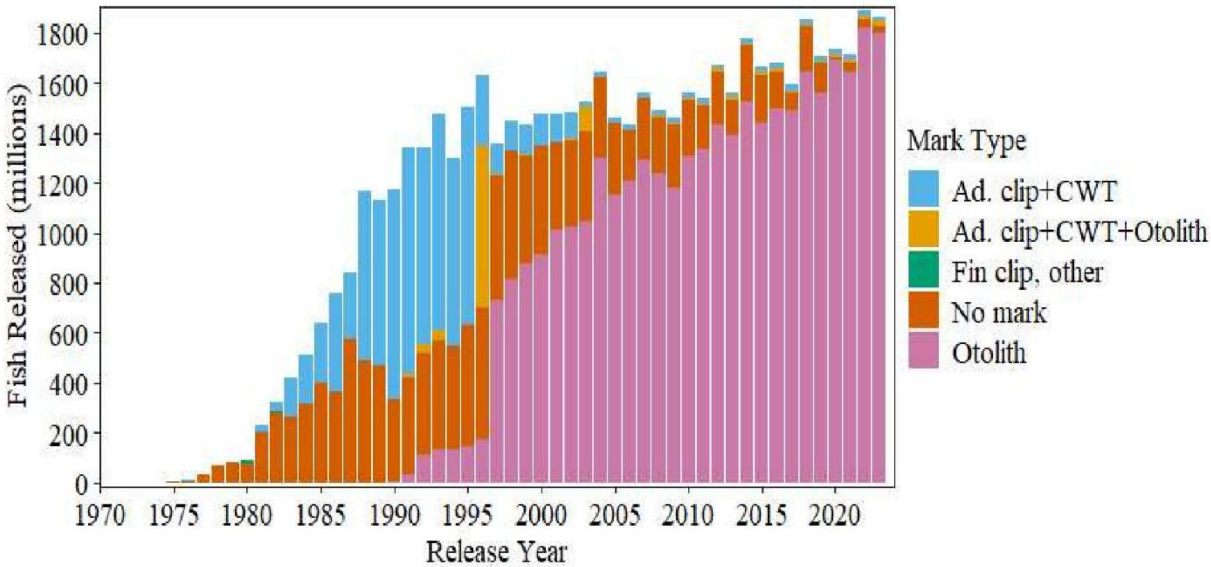

Figure 7. Juvenile salmon released by Alaska hatcheries by mark type, 1970-2023 (Wilson 2024).

Private non-profit hatchery programs in Alaska are subject to extensive regulatory oversight by ADF&G on an annual basis under the authority of the Commissioner. This oversight is facilitated by advisory review of Regional Hatchery Planning Teams in a public process. The Regional Planning Team Review Regulation (5AAC 40.170) provides review criteria which must be considered and include provisions for the protection of the naturally occurring stocks from any adverse effects which may originate from a proposed hatchery. Fishery managers are required to consider the interactions of wild and hatchery salmon stocks when reviewing hatchery management plans and permits. Annual management plans detailing production and returns are prepared by operators for review and approval. All hatchery releases are also subject to fish transport permit requirements. Any new production proposals are subject to new permit applications - new permit applications are not approved if inconsistent with established policies for wild fish protection.

A series of hatchery evaluations from 2011-2017 examined individual hatchery programs throughout the state for consistency with policies and prescribed management practices (Stopha 2012a, 2012b, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2014a, 2014b, 2014c, 2015a, 2015b, 2015c, 2015d, 2015e, 2015f, 2016b, 2016c, 2016d, 2017a, 2017b; Stopha & Musslewhite 2012; Musslewhite 2011a, 2011b). Evaluations reviewed hatchery management plans and permits, assessed program consistency with statewide policies, and identified remedies for any deficiencies found. Management plans and permits were examined for currency, consistency with each other, and accuracy of hatchery operation descriptions. Programs were generally found to be in compliance and issues were addressed as identified.

Evenson et al. (2018) completed a comprehensive review of procedures, practices, fishery management, and stock assessment relevant to the hatchery program for consistency with precautionary plans, permits, and policies that have guided salmon enhancement in Alaska in a manner that protects wild stocks. The review particularly focused on case studies for Southeast Alaska Chinook Salmon and Prince William Sound Pink Salmon. In general, this review concluded that implementation of Alaska's policies, plans, and permits for the test cases were largely consistent with a precautionary approach. Fishery and hatchery management strategies have generally been demonstrated to be effective in differentially harvesting hatchery fish at a substantially greater rate than wild fish while continuing to meet wild spawning escapement goals. The evaluation also identified recommendations for improvements including clarification of the several elements of the genetic policy, improved communication to regulatory bodies and stakeholders, and the need for continuing basic research to better understand homing and effects of straying.

An independent policy analysis of Alaska salmon hatcheries by Eller (2018) similarly concluded that the policy in place does an effective job at minimizing risk and ensuring sustained runs of wild salmon overall. This assessment also identified questions regarding interpretation and guidance for implementation of precautionary management and the genetic policy, research on straying and other effects of hatchery salmon, and the involvement of stakeholders in the decision-making process.

3.2 Hatchery-related Risks

There is inherent fishery, genetic, and ecological risk to wild stocks from enhancement programs (NRC 1996; Brannon et al. 2004; Lichatowich et al. 2006; McClure et al. 2008; Naish et al. 2008; Kostow 2009; HSRG 2009, 2014; Evenson et al. 2018; Anderson et al. 2020). This section reviews hatchery-related risks and references the extensive scientific literature on this subject. Hatchery risks were the basis for assessment of enhancement impacts under the MSC fishery standard in previous certification assessments and the present audit.

3.2.1 Fishery Impacts

Hatchery enhancement can result in overharvest of wild stocks in mixed-stock fisheries. Large-scale releases of hatchery fish have greatly exacerbated the mixed-population fishery problem when less productive wild populations in the mixture are fished at high exploitation rates which can be sustained by hatchery fish (NRC 1996). Large numbers of hatchery-origin salmon straying into natural production areas also have the potential of masking declines in wild abundance when spawning escapement goals are met only by the contribution of hatchery fish.

To ameliorate these risks, hatchery programs in Alaska are typically configured to concentrate and segregate returns in times and areas where fisheries can target hatchery fish at a high rate while avoiding wild fish. Mark-selective fisheries have also been widely implemented in the Pacific Northwest to reduce harvest rates on wild fish. Hatchery Chinook, Coho and steelhead in those areas are marked by clipping the adipose fin prior to release so that harvest hatchery-origin fish may be identified and retained while wild/natural may be released.

Overfishing impacts of hatchery enhancement are considered in Principle 1 of the MSC Fisheries Standard. Related performance indicators are met at the Scoring Guidepost 80 level and no related conditions are identified in the Alaska fishery assessment.

3.2.2 Genetic Impacts

Changes in genetic characteristics of hatchery fish may prove detrimental to wild populations when hatchery and wild fish interbreed (Waples 1991; Busack & Currens 1995; Unwin & Glova 1997; Utter & Epifanio 2002; Wang et al. 2012; Naish et al. 2007; Grant 2012, Withler et al. 2018; NMFS 2019). Population impacts, including genetics, of hatchery enhancement are considered in Principle 1 of the MSC Fisheries Standard and four related conditions were identified in the Alaska fishery assessment – these conditions are the subject of this expedited audit.

Genetic effects of interbreeding with hatchery salmon can substantially reduce the abundance and productivity of wild salmon. The magnitude and type of hatchery risk depends on the status of affected populations and on specific practices in the hatchery program. Even when a hatchery program uses genetic resources that represent the ecological and genetic diversity of the target or affected natural population(s), they may pose a risk to the fitness of the population based on the proportion of natural-origin fish being used as hatchery broodstock (pNOB) and the proportion of hatchery-origin fish spawning in the wild (pHOS; Lynch and O'Hely 2001; Ford 2002; NMFS 2019).

Genetic composition and diversity of wild salmon populations are naturally selected over time to optimize success or "fitness' for the conditions they encounter throughout their life cycle. Because salmon home strongly to their natal streams,[2] populations are often locally adapted to prevailing conditions, so changes in genetic composition can reduce fitness and associated population productivity. Spatial patterns of genetic diversity are reflected in the genetic stock structure of a salmon species where populations returning to different areas are distinguished by genetic differences which can be used to identify places of origin. High levels of genetic stock structure across populations are indicative of local adaption. Lower levels of natural divergence suggest a lower natural fidelity of salmon returning to spawn in their streams of origin.

Hatcheries may alter salmon genetics in ways that are maladapted to success in the wild or by reducing the inherent diversity that allows wild populations to thrive under a wide range of conditions in a dynamic natural environment. Directional selection in a hatchery may result from selective breeding for specific traits – for instance, altering run timing by using only broodstock from only portion of the return. Genetics may also change inadvertently because of domestication where rearing in the hatchery environment selects for characteristics that are successful in the hatchery but less so in the wild. Use of non-local broodstock in the hatchery can introduce genetic characteristics which are less successful in the population to which they are introduced (outbreeding depression). Loss of genetic diversity in the hatchery may also result from reduced numbers of spawner broodstock relative to what would normally occur in the wild (inbreeding depression).

Genetic effects may reduce relative reproductive success (RRS) and productivity of hatchery salmon and steelhead in relation to natural-origin fish. Reduced relative reproductive success of hatchery fish has been documented from Pacific Northwest studies of steelhead (Chilcote et al. 1986; Hulett et al. 1996; Reisenbichler & McIntyre 1977; Blouin 2003; Kostow et al. 2003; McLean et al. 2003, 2004; Araki et al. 2007; Berntson et al. 2011; Christie et al. 2014; Ford et al. 2016), (Coho Fleming & Gross 1993; Ford et al. 2008; Thériault et al. 2011) and Chinook (Ruben et al. 2003; Williamson et al. 2010; Janowitz-Koch et al. 2019). Differences are typically greater where the hatchery stock is substantially different from the wild stock. RRS of highly domesticated stocks were typically 35% or less. However, RRS of hatchery fish produced from natural-origin spawners often approached that of natural-origin spawners.

Assessments of reduced hatchery RRS come predominantly from Chinook Salmon, Coho Salmon and Steelhead, all of which have stream-type life histories which require hatchery rearing throughout the first year of life. Comparable information is limited for species with ocean-type life histories which include pink and chum salmon. Berejikian et al. (2009) estimated RRS of 0.83 for hatchery versus wild Chum Salmon in Hood Canal Washington which is like findings of other studies for hatchery populations founded from local broodstocks. However, initial studies of RRS for Pink salmon in two Prince William Sound streams suggest that

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[2] Homing fidelity appears to vary among salmon species depending on the habitat requirements for spawning and rearing.

reproductive success was significantly lower for hatchery-origin relative to natural origin fish, ranging from 0.03 to 0.47 for females and 0.05 to 0.86 for males (Lescake & Dann 2019; Lescak et al. 2019; Shedd et al. 2022). Quantitative genetic modelling based on Prince William Sound Pink Salmon identified the potential for long-term demographic and evolutionary consequences arising from specific hatchery–wild interactions due to reduced fitness of hatchery fish due to rapid assimilation of hatchery-origin alleles, despite the reduced fitness of hatchery fish attributable to phenotypic mismatches (May et al. 2024). McMahon et al. (2025) identified significant body size, run timing differences between hatchery and wild Pink Salmon spawners in Prince William Sound and reduced variation in traits in hatchery fish. Differences were thought likely to be driven by competitive differences during maturation and broodstock selection practices. This study also suggested that local adaptation may be maintained by phenotypic sorting despite widespread domestication impacts.

Further evidence for the potential negative impact on wild fish of interbreeding with hatchery fish may be found in a number of studies correlating low natural productivity with the incidence of hatchery-origin fish on the spawning grounds. Levin & Williams (2002) found an interspecific negative relationship between the number of hatchery steelhead released and smolt-to-adult survival of Chinook Salmon in the Snake River Basin but no relations for hatchery and wild steelhead. Kostow & Zhou (2006) found a negative relationship between natural productivity of winter steelhead and the abundance of hatchery-origin summer steelhead spawners in Oregon's Clackamas River. Chilcote et al. (2011, 2013) reported that reproductive performance was negatively correlated with the proportion of hatchery fish in spawning populations of steelhead. Buhle et al. (2009) found that the productivity of wild coho salmon decreased as releases of hatchery juveniles increased in 15 populations along the coast of Oregon.

The available science strongly supports the potential and likelihood of significant negative impacts of hatchery fish spawning in the wild under certain situations. However, neither RRS or correlative studies provide direct estimates of the long-term impact of hatchery fish on wild population viability and productivity. Long-term consequences of low hatchery RRS depend on whether the mechanisms underlying reduced relative reproductive success are environmentally driven, and likely ephemeral, or genetically driven, and likely persistent across generations (Shedd et al. 2022). Lower RRS and correlations with hatchery contribution may result from a combination of genetic, ecological and behavioral factors associated with hatchery fish. For instance, hatchery fish have often been observed to spawn in suboptimum habitats because they did not have the opportunity to imprint to the most productive natural habitats. Natural evolutionary processes also continually exert selective pressure against maladaptive characteristics which acts to dampen or counteract potential genetic effects of hatchery production over time. These factors can confound inferences on the magnitude of negative impacts of hatchery spawners on wild populations and related information should be interpreted with caution.

Several studies have found that hatchery interbreeding effects are not significant particularly where hatchery fish are not strongly divergent from the wild. A large-scale, long term Idaho Supplementation Studies (ISS) measured the population effects of dedicated, intentional hatchery supplementation on the abundance and productivity of spring Chinook Salmon during and after supplementation in 27 Snake River streams (13 supplemented and 14 reference streams) over 23 years (Venditti et al. 2015; ISRP 2016). This study documented reduced relative fitness of hatchery Chinook even where locally adapted fish were incorporated into the hatchery broodstock but also found that productivity and abundance generally returned to pre-supplementation levels after supplementation ceased. Scheuerell et al. (2015) similarly reported that natural production of Snake River spring Chinook was not strongly affected by supplementation with hatchery fish. Lister (2013) found that natural-origin productivity was no difference in steelhead productivity between three mixed hatchery-origin plus natural-origin spawning populations and three paired, geographically proximate reference populations composed of exclusively natural-origin spawners. Nelson et al. (2019) found no relationship between the number of hatchery juvenile Chinook Salmon released and adult recruits per spawner (productivity) of 20 Chinook Salmon populations in Washington and British Columbia. Courter et al. (2019) found that a large hatchery summer steelhead program did not have a negative effect on wild winter steelhead recruitment in Oregon's Clackamas River from 1972–2001 and winter steelhead failed to rebound to pre-hatchery numbers following elimination of the hatchery program.

Other information suggests that low relative reproductive success of hatchery-origin fish is not strongly persistent in successive generations of natural spawning. Dayan et al. (2024) found that reproductive success of naturally-spawning, hatchery-origin spring Chinook rebounded to nearly wild stock levels within one generation of return to the wild for an integrated broodstock hatchery program in Oregon's McKenzie River. They also found that a trait positively associated with fitness, age at maturity, is increased among second- relative to first-generation hatchery descendants, suggesting that fitness increases may continue in subsequent generations.

Hatchery-related risks are a function of both the incidence of hatchery-origin spawners interbreeding with wild fish and the genetic characteristics of the hatchery fish relative to the wild population. Related guidance for salmon hatchery evaluation, management and reform has been developed by a Hatchery Scientific Review Group (HSRG) convened in 2000 to evaluate Pacific Northwest hatchery programs (Mobrand et al. 2005; HSRG 2009, 2014). The HSRG established benchmarks for hatchery evaluation related to potential fitness impacts based on proportionate natural influence (PNI) which is a product of the proportion of natural origin spawners (pHOS) and the proportion of natural-origin spawners in the hatchery broodstock (pNOB). These metrics were based on a theoretical quantitative genetic model (Ford 2002). HSRG guidelines have subsequently been widely applied (although not thoroughly tested) including guidelines for enhancement impact evaluations under the MSC fishery standard (see subsequent section for detailed description).

The available information indicates that genetic risks can be ameliorated to some degree by hatchery practices. Two primary strategies have been identified for minimizing detrimental impacts of salmon hatcheries (HSRG 2009, 2014). Integrated hatchery programs aim to be genetically identical to an associated natural population though intentional natural spawning of hatchery-origin fish and hatchery spawning of natural-origin fish. Segregated hatchery programs are intended to be genetically distinct from natural populations by minimizing both the number of hatchery-origin fish that spawn naturally, and the number natural-origin fish used as hatchery broodstock. A variety of hatchery broodstock, spawning, rearing, release and fishery practices are associated with these strategies. For segregated hatchery programs, these generally involve concentrating hatchery returns in times and areas where they can be harvested in large number and limiting the incidence of straying into natural production areas.

3.2.3 Ecological Impacts

Ecosystem impacts of hatchery enhancement are considered in Principle 2 of the MSC Fisheries Standard. Related P2 performance indicators met at the Scoring Guidepost 80 level in the Alaska salmon fishery assessment. No related conditions are identified. Information related to ecological risks of Alaska hatchery enhancement is reviewed below in the interest of providing a comprehensive picture of enhancement risk evaluations conducted in the Alaska assessment.

Salmon hatcheries may also pose ecological risks by increasing competition with wild salmon or other species in freshwater and marine environments (Beamish et al. 1997; Kostow 2009, 2012; Berejikian 2012; Daly et al. 2012; Pearsons & Busack 2012; Rand et al. 2012; Ruggerone et al. 2012); predation effects either directly by preying on other species or indirectly through ecosystem predator-prey interactions (Whitsel et al. 1993; Pearson & Fritts 1999;Flagg et al. 2000;; Simpson et al. 2009; Naman & Sharp 2012); increasing disease transmission to wild stocks (Elliott et al. 1997; Naish et al. 2008; Kennedy et al. 2015); or direct physical alternations of the physical habitat including water quality, water diversion and passage diversions (NMFS 2014a; Anderson et al. 2020).

The significance of ecosystem effect in marine waters of largescale hatchery releases is a subject of continuing debate within the scientific community but there is mounting evidence that high salmon abundance in the ocean results in measurable intra and inter specific competition (Cross et al. 2005; Ruggerone et al. 2023). Since the mid 1980's, combined hatchery releases of salmon by countries around the Pacific rim have increased to about 5 billion salmon per year (Figure 8). Production of natural-origin salmon was also high due to generally favorable ocean conditions in northern regions (Ruggerone & Irvine 2018).

Relative abundance of hatchery and natural salmon in the North Pacific has been assessed by Mahnken et al. (1998) and Ruggerone & Irvine (2018). Pink Salmon dominated adult salmon abundance (67% of total) and biomass (48%), followed by Chum Salmon (20%, 35%) and Sockeye Salmon (13%, 17%). Approximately 60% of Chum Salmon, 15% of Pink Salmon, and 4% of Sockeye Salmon during 1990–2015 were of hatchery origin (Figure 15).

There is a large degree of overlap in the spatial distribution of salmon in the Gulf of Alaska but some differences among species in part due to different temperature preference ranges (Lanagan et al. 2024; McKinnell et al. 2024; Americus 2025). Sockeye generally preferring cooler temperature ranges and are more common in northern areas. Chum salmon exhibited a wide temperature preference range and were more diffusely distributed than other salmon species. Coho and Chinook had the narrowest temperature preference and their distribution was not highly correlated with other salmon species.

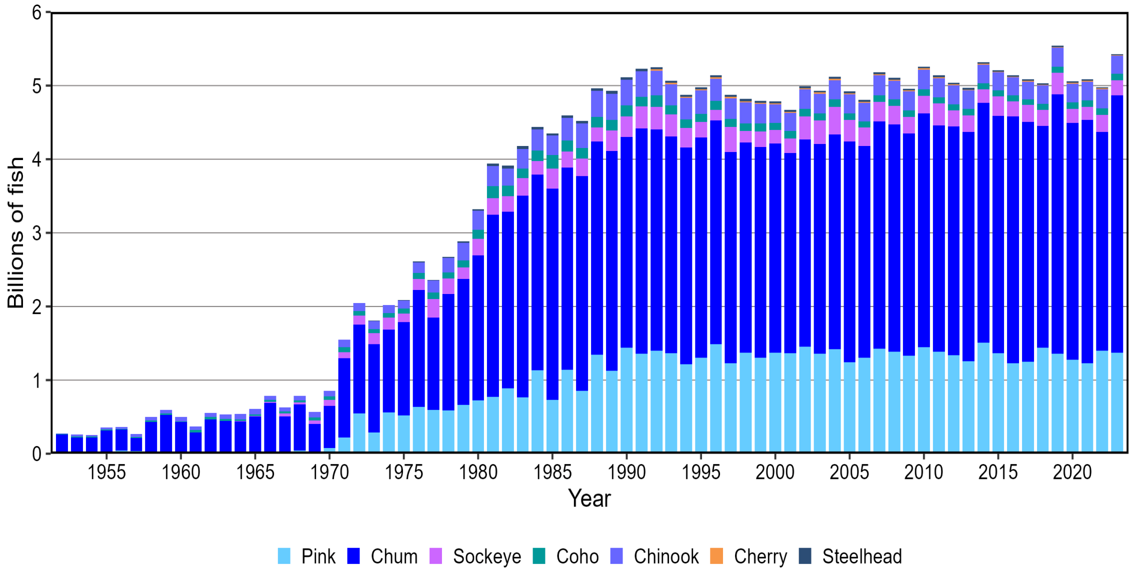


Figure 8. Hatchery releases of Pacific salmon by the United States, Canda, Japan, Korea and Russia (Source: North Pacific Anadromous Fish Commission: https://www.npafc.org/statistics/).

Possible adverse effects of increased abundance, caused in part by enhancement activities, include exacerbating competition for food at sea which may in turn alter food webs and result in reduced growth, increased mortality and a declining age at return (Ricker 1981; Peterman 1991; Ruggerone et al. 2003, 2005, 2010, 2021, 2023; Ruggerone & Goetz 2004; Ruggerone & Nielsen 2004; Lewis et al. 2009; Ruggerone & Connors 2015; Jeffrey et al. 2016; Shaul & Geiger 2016; Batten et. al 2018; Springer et al. 2018; Feddern et al. 2024; Vosbigian et al. 2024).

Ruggerone et al. (2023) reviewed evidence supporting a hypothesis that in odd years, predation by Pink Salmon can initiate pelagic trophic cascades by reducing herbivorous zoo plankton abundance sufficiently that phytoplankton densities increase, with opposite patterns in even years. They postulated that widespread interspecific competition for common-pool prey resources can be dominated by Pink Salmon, as indicated by numerous biennial patterns in the diet, growth, survival, abundance, age-at-maturation, distribution, and/or phenology of ecologically, culturally, and economically important forage fishes, squid, salmon and steelhead trout, seabirds, humpback whales, and endangered southern resident killer whales. This led them to a conclusion that open-ocean marine carrying capacity in the northern North Pacific Ocean and Bering Sea can be mediated by top-down forcing by Pink Salmon and by ocean heating, and that large-scale hatchery production (~40% of the total adult and immature salmon biomass) likely has unintended consequences for wild salmon, including Chinook Salmon, and many other marine species.

Large numbers of hatchery-origin salmon juveniles also have the potential to impact the nearshore marine ecosystems where they are concentrated following release. Concerns were previously identified regarding potential impacts of Prince William Sound enhancement activities on local herring populations (Deriso et al. 2008, Pearson et al. 2012). Specifically, exceptionally high levels of Pink Salmon hatchery releases may cause density dependent mortality of herring that inhibits the recovery of herring abundance. However, a comprehensive review of herring status, threats and extinction risks in Southeast Alaska concluded that the impact of Salmon on herring in Southeast Alaska is not well understood (NMFS 2014a). It also noted that adult herring may also prey upon salmon fry in estuaries and may be one of the largest consumers of Pink Salmon fry in PWS each spring. Further evidence suggested that, at least for juvenile fish, competition may not be significant because juvenile Pink Salmon and age-0 herring exploit different portions of the annual production cycle with Pink Salmon targeting plankton species in the early spring and herring dependent upon summer and fall zooplankton. Several other references support a conclusion that Pink Salmon are not a primary factor in depression of PWS herring stocks (Sturdevant 2012; Sturdevant et al. 2012, 2013).

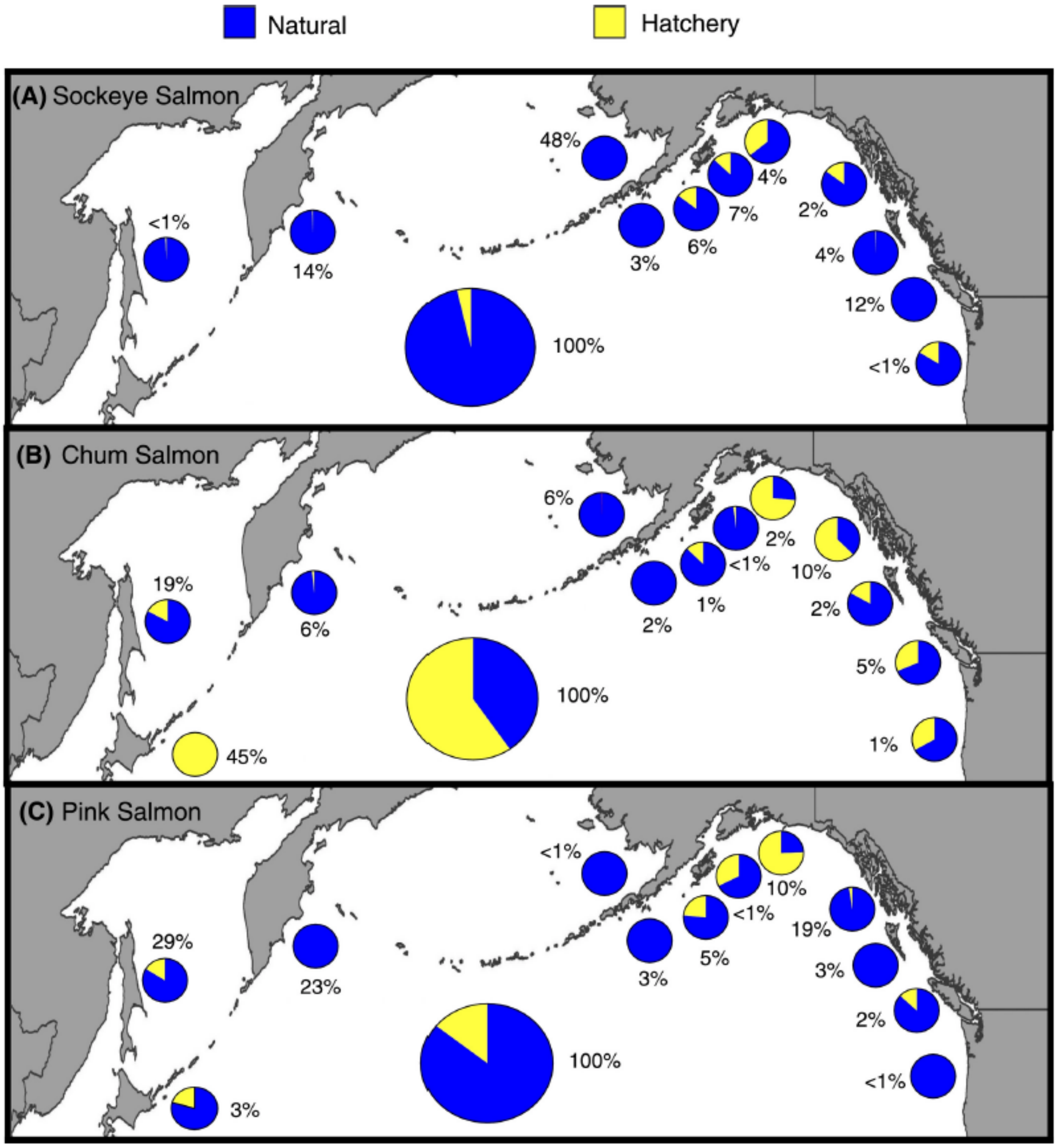


Figure 9. Color-coded proportions of natural- and hatchery-origin adult (A) Sockeye Salmon, (B) Chum Salmon, and (C) Pink Salmon for each region (small Pies) of the North Pacific Ocean in 1990-2015 and for the entire North Pacific Ocean (large pies). Numeric values show the percentage of the total returns from the North Pacific Ocean for each species returning to each region. (Figure 6 in Ruggerone & Irvine 2018).

The North Pacific marine ecosystem is complex and dynamic changes in physical and ecological conditions over the last few decades have been widely documented in relation to salmon (Willette et al. 1997; Sturdevant & Hulbert 1999; Cooney et al. 2001a, 2001b; Aydin et al. 2007; Gaichas et al. 2008; Sturdevant et al. 1999, 2012a, 2012b, 2013; Sturdevant 2012, 2013; Zador et al. 2015; NPAFC 2016; Connors et al. 2020; Ferriss & Zador 2021; Fitzpatrick 2021; Siddon 2021

A climate regime shift generally increased marine temperatures throughout the North Pacific Ocean in the late 1970s and contributed to a large increase in abundance and productivity of many northern salmon stocks (Beamish 1993; Mantua et al. 1997). At the same time, increasing volatility in annual patterns has led to widely varying patterns among salmon species and stocks produced in different areas of the Pacific. For instance, record warm surface water temperature anomaly throughout the eastern Pacific and the Gulf of Alaska in 2014 and 2015 (the “blob”) severely affected the marine ecosystem and was accompanied by widespread declines in many species across multiple tropic levels including salmon (Suryan et al. 2021; Renner et al. 2024).

These patterns make it particularly difficult to quantify effects of ecological interactions in the natural environment and to distinguish hatchery effects from coincident environmental effects (Rand et al. 2012; HSRG 2014). Pacific salmon productivity is influenced by ocean conditions and interspecific interactions, yet their combined effects are poorly understood (Connors et al. 2020). Environmental patterns, including climate change, are strong drivers of many of ecosystem changes independent of any hatchery salmon effects (Kaeiyama & Edpalina 2003; Kyla et al. 2017). For instance, large increases in productivity and abundance of wild runs of Pacific salmon after the late 1970s regime shift occurred concurrent with the large increase in hatchery salmon production.

Ruggerone & Irvine (2018) estimated that in the North Pacific for the period 1990 – 2015, 60% of the Chum Salmon, 15% of Pink Salmon and 5% of Sockeye Salmon were of hatchery origin. Alaska produced about 68% of the hatchery Pink Salmon and 18% of hatchery Chum Salmon. Japan produced about 75% of the hatchery Chum Salmon. Therefore, Alaska accounted for just 10% of the combined wild and hatchery total of Pink Salmon and 11% of Chum Salmon by number. Alaska-produced hatchery-origin salmon comprise an even lower percentage of the salmon total based on biomass (Templin 2024; Americus et al. 2025). Alaska hatchery-origin Pink Salmon contribute just 2.1% and Chum Salmon contribute 5.3% of the combined total ocean biomass of pink, chum and Sockeye Salmon. Based on these estimates, Templin (2024) concluded that changes in Alaska hatchery production will likely not affect North Pacific-wide marine competition. Templin hypothesized that Alaska hatchery production may plan a large role nearshore with local stocks but provided no supporting evidence of effect.

Based on the weight of available scientific evidence, the 2024 MSC Salmon Fishery Certification assessment concluded that hatchery salmon are a significant component of the marine ecosystem; interact directly or indirectly with many prey, competitor and predator species; and must inevitably have some influence on other ecosystem components. Hatchery Pink Salmon from Alaska likely exert a marginal effect on the dynamics of the North Pacific marine ecosystem due to their low percentage contribution to total abundance. Large even-odd year differences in Pink Salmon abundance are driven by wild production. Marginal effects of hatchery Pink Salmon are dwarfed by normal variation in wild Pink Salmon abundance, abundance of other salmon stocks, environmental drivers and other ecosystem elements. While hatchery fish likely contribute to density dependent changes in size at age, and survival, this concern does not rise to a level where ecosystem structure or function has likely been disrupted to a point where there is serious or irreversible harm.

3.3 Alaska Hatchery Assessments

The significance of hatchery-wild interactions of salmon in Alaska has long been a subject of scientific research and debate. Large increases in Alaska hatchery production beginning in the 1970s led to growing concern for potential negative impacts based on information from hatchery programs in the Pacific Northwest and elsewhere (Grant 2012; Amoroso et al. 2017; Evenson et al. 2018).

Hilborn & Eggers (2000, 2001) suggested that the hatchery Pink Salmon replaced rather than augmented wild production in Prince William Sound due to a decline in wild escapement associated with harvesting hatchery stocks and biological impacts of the hatchery fish on wild fish. However, further assessments failed to support Hilborn and Eggers' interpretation of countervailing trends in abundance of wild and hatchery fish. Proposed mechanisms for negative impacts were not supported by the available data (Mortensen et al. 2000; Wertheimer et al. 2001, 2004). Wild escapements of Pink Salmon were not substantially reduced by harvest of hatchery Pink Salmon. A low overall incidence of hatchery straying into natural spawning areas did not support a hypothesis of significant aggregate effects on wild population fitness. High survival rates of hatchery-origin fish from release to adulthood did not indicate that intra-specific competition was a significant limiting factor.

To assess potential hatchery-wild interactions, a series of hatchery straying assessments were conducted beginning in the 2000s (Wilson 2024). Hatchery Sockeye Salmon straying was studied in Kodiak (Baer and Honnold 2002), the Copper River basin (Bidlack and Valentine 2009) and the Kenai River (Habicht et al. 2013; Stopha 2012). Hatchery Chum Salmon straying was assessed in Southeast Alaska (Piston and Heinl 2012a, 2012b; Josephson et al. 2021; McCarrel et al. 2023), Prince William Sound (Brenner et al. 2012; Knudsen et al. 2021) and Kodiak (Weber 2021, 2022). Hatchery Pink Salmon straying was assessed in Prince William Sound (Knudsen et al. 2021), lower Cook Inlet (Hollowell et al. 2017; Otis et al. 2018, 2020, 2021, 2022, 2023; Otis & Hollowell 2019) and Kodiak (Weber 2021, 2022). Hatchery Chinook Salmon straying was reportedly monitored on several Southeast Alaska systems over an extended period (Wilson 2024).

In 2011, concern about possible impacts on wild stocks of large-scale hatchery production of Pink and Chum Salmon led ADF&G to organize a Science Panel for the purpose of defining the specific issues associated with this concern. This Panel included scientists with broad experience in salmon fishery enhancement, research, and management—from ADF&G, University of Alaska, aquaculture associations, and National Marine Fisheries Service. Three primary questions were identified:

1. What is the genetic stock structure of Pink and Chum salmon in each region?
2. What is the extent and annual variability in straying of hatchery Pink Salmon in Prince William Sound (PWS) and Chum Salmon in PWS and Southeast Alaska (SEAK)?
3. What is the impact on fitness (productivity) of wild Pink and Chum salmon stocks due to straying of hatchery Pink and Chum salmon?

A comprehensive, long-term Alaska Hatchery Research Project was initiated in 2013 to address these questions.[3] Study funding was shared among the PNP operators, salmon processors, and the State of Alaska, and is administered by ADF&G. Field work was conducted by the Prince William Sound Science Center and the Sitka Sound Science Center. This work has produced extensive new information on genetic stock structure, straying and relative fitness in relation to hatchery enhancement (ADF&G 2018, 2022; Americus et al. 2022b, 2025).

Substantial genetic stock structure has been identified in all salmon species which could be impact if hatchery-wild interactions were significant. Divergence among populations was relatively shallow for Pink Salmon (Cheng et al. 2016, 2019, 2022; Jasper et. al. 2013) and most substantial for Sockeye Salmon (Quinn et al. 2012; with Chum Salmon in between (Gilk-Baumer & Templin 2019; Barclay et al. 2024). Significant genetic

[3] http://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesResearch.main

population structure remains despite long-term hatchery programs and populations remain similar over time although there is some indication of introgression of hatchery strays (Templin 2024).

Chronic low levels of straying by hatchery Pink and Chum Salmon across broad areas with a greater incidence in some areas of proximity to hatcheries (Knudsen et al. 2015a, 2015b, 2016, 2021; Josephson et al. 2021). Significant straying of Chinook, Coho and Sockeye hatchery salmon has not been observed and enhancement levels are relatively modest in relation to wild abundance. The highest stray proportions are observed near hatcheries and along migratory pathways (Templin 2024). Hatchery strays typically comprised small proportions of total spawning escapements of all species even in regions where large production programs occur and spawning escapement goals are generally being achieved for wild populations. Relative reproductive success of Pink Salmon has been found to be substantially less than for hatchery than wild Pink Salmon although the basis for this difference is not yet clear (Lescak & Dann 2019; Lescak et al. 2019; McMahon 2021; Shedd et al. 2022; May et al. 2024; McMahon et al. 2025). An assessment of relative reproductive success of hatchery Chum Salmon is ongoing. Study results and their application to assessment conditions are discussed for each unit of assessment in subsequent sections of this audit report.

Research about hatchery and wild chum salmon interactions is ongoing and the impacts of these interactions is not definitive at this time (Vincent-Lang 2025). Pending completion of the Alaska Hatchery Research Project, ADF&G commissioner Vincent-Lang issued a “Hatchery Statement” at the 2024 Cook Inlet Upper Cook Inlet Finfish Board of Fish articulating a policy decision to not increase permitted Pink Salmon egg-take capacity until concerns over hatchery-wild interactions are addressed (Vincent-Lang 2024, Americus 2025). The last increase in permitted Pink Salmon egg take occurred in 2018, in Prince William Sound (+1.5% of statewide pink capacity; Stopha 2019). The last increase in permitted Chum Salmon egg take occurred in 2019, in Southeast Alaska (+1.5% of statewide capacity; Wilson 2020).

3.3.1 Southeast Alaska

Stock Status

Chum Salmon are the primary concern in this audit as they account for the large majority of hatchery production in Southeast Alaska and are subject to a condition under review. Chum Salmon have been documented in some 1,200 streams and rivers in Southeast Alaska (Eggers and Heinl 2008). Based on run timing, SEAK Chum Salmon populations are classified as either Summer or Fall run fish. Summer run Chum Salmon are further classified into one of three stocks based on marine tagging and genetic studies (Figure 10: Kondzela et al. 1994; Eggers and Heinl 2008; Piston & Fish 2024). Wild summer run Chum Salmon are typically caught incidental to directed Pink Salmon fisheries. There are five Fall Chum Salmon stocks and they are typically harvested in near terminal or terminal areas and are actively managed to achieve their respective escapement goal.

Escapement goals have been set for all eight stocks and goals are generally met when productivity is at least average (Figure 12). Seven of the 8 stocks can be said to be reasonably healthy considering that productivity is highly variable. Recent low escapements in the Northern Southeast Outside subregion led to designation as of this group as a Stock of Concern and development of an action plan for consideration by the Alaska Board of Fisheries in their January 2025 Southeast Alaska meeting (Dupuis et al. 2024).

Commercial harvest of wild Chum Salmon in Southeast decreased substantially from the period between the 1920's and 1950s to the 1970's and early 1980's (Figure 11). Since then, productivity of wild summer and fall run stocks has been highly variable. Since the early 1990's, hatchery Chum Salmon has dominated the annual harvest. Market forces, the incidental harvest of summer run fish in the directed Pink Salmon fishery and the availability of large numbers of hatchery Chum Salmon in terminal areas has resulted in significant shifts in fishing patterns makes interpretation of catch data to infer abundance difficult (Dupuis et al. 2024). Large returns of hatchery Chum Salmon have drawn boats out of their historic pattern of fishing wild stocks.

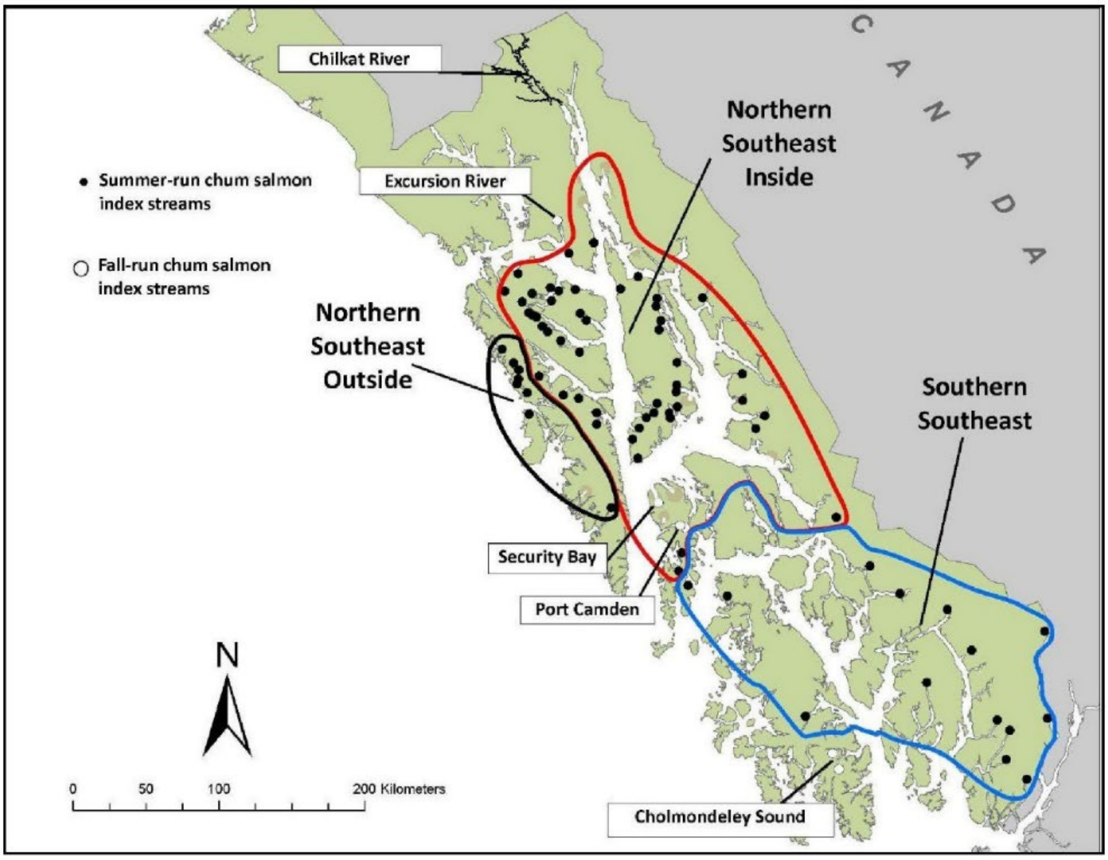


Figure 10. Locations of ADF&G index streams and summer-run Chum Salmon stock groups in Southeast Alaska (from Piston & Fish 2024).

Southern Southeast Inside Summer Run: This stock includes 15 index streams located from Dixion Entrance North to Sumner Strait. Index counts are based on aerial observations. The escapement goal of a minimum index count of 62,000 has been met or exceeded in 16 of the last 20 years. This run is incidentally caught primarily by the purse seine fishery when management is targeting Pink Salmon, as such, management actions are not directed to achieve the escapement goal (Priest et al. 2024). Escapement indices were low during the mid-1960s to late 1970s, increased into the 1990s, and have generally remained above the escapement goal over the past two decades, except for poor escapement years from 2008 to 2010. Escapement indices were above the current escapement goal in each of the past 5 years, 2019– 2023, and the escapement index of 276,000 fish in 2023 was a record high (Piston & Fish 2024).

Northern Southeast Outside Summer Run: This run includes 9 index streams located on Baranof and Chichagof Islands. Index counts are based on aerial observations. The escapement goal of 25,000 has been met 12 of the last 20 years. Escapements have been very low, or below goal since 2017. However, in 2024 the escapement goal was met (Andy Piston, ADFG personal communication). This run is incidentally caught primarily by the purse seine fishery when management is targeting Pink Salmon, as such management actions have not been directed to achieve the escapement goal. Occasionally, specific bays or inlets may be open to target summer-run chum salmon when there is an observed high abundance. Importantly, the summer Chum Salmon run timing is earlier than the Pink Salmon. Because of this, most Chum Salmon have passed prior to the fishing season (Andy Piston, ADFG personal communication).

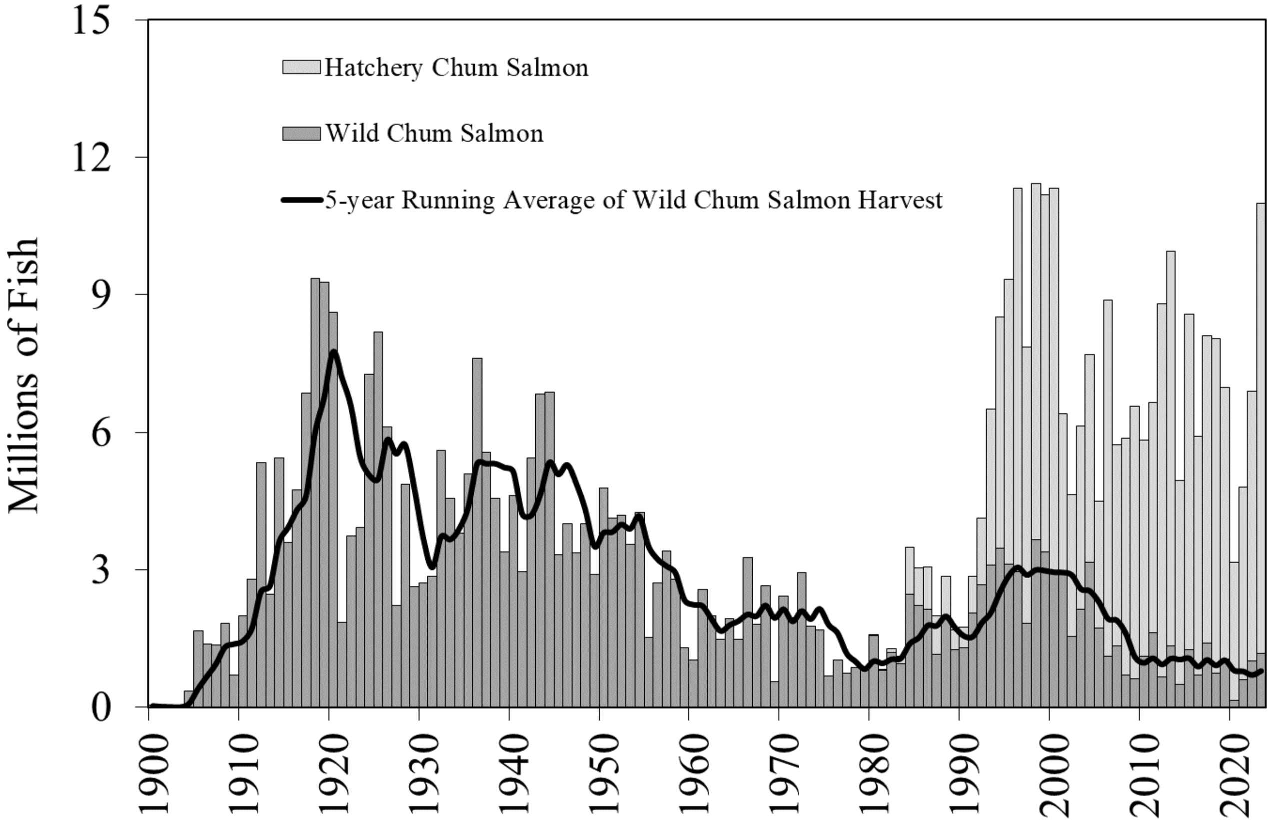


Figure 11. Commercial harvest of wild and hatchery Chum Salmon in Southeast Alaska, 1900 -2023 (from Piston and Finch 2024).

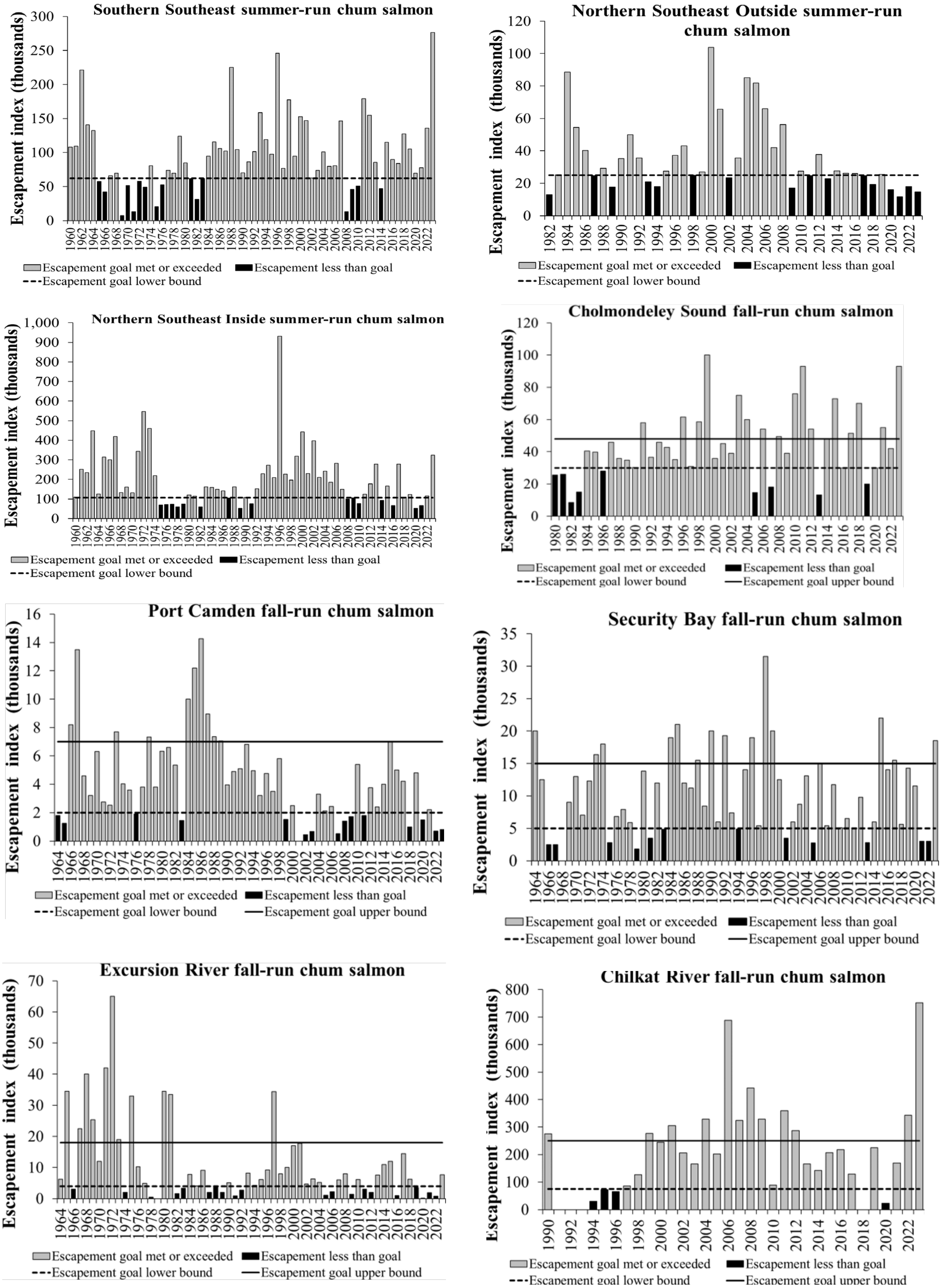


Figure 12. Escapements of Southeast Alaska Chum Salmon, 1982 – 2023 (from Piston and Fish 2024).

ADFG has developed a recommendation to the Board of Fisheries to make the Chum Salmon of the NSE Outside SMU a Stock of Management Concern (Dupuis 2024). Because productivity appears to be the key factor, ADFG is proposing to focus Pink Salmon fishing openings at a fine scale in time and space to better protect the earlier arriving summer Chum Salmon but has also proposed that the Board review the permitted number of Chum Salmon that may be released in Crawfish Inlet to in order to reduce the straying a of hatchery fish into the stream in West Crawfish Inlet.

Northern Southeast Inside Summer Run: This run includes 63 index streams located on the inside waters north of Sumner Strait. Index counts are based on aerial observations. The escapement goal for a minimum index of 107,000 has been met 13 of the last 20 years. This run is incidentally caught primarily by the purse seine fishery targeting Pink and Sockeye salmon as such, management actions are not directed to achieve the Chum Salmon escapement goal. In the most recent evaluation of the escapement goal, three streams were removed due to the presence of high proportions of hatchery chum salmon in the escapement and the desire to track production of only wild summer chum salmon (Priest et al. 2024).

Cholmondeley Sound Fall Run: Cholmondeley Sound is located on the Southeast side of Prince of Whales Island about 20 miles west of Ketchikan. Escapement goals of 38,000 to 48,000, based on aerial counts in two creeks, have been met or exceeded in 16 of the last 20 years. Harvests averaged 42,000 fish in the 1970s and 1980s, increased to an average of 122,000 fish between 1991 and 2004, and decreased to low levels from 2005 through 2010 were very low. Between 2011 and 2023 the harvests averaged just 20,000 fish in years where fisheries occurred. Piston and Fish (2024) noted that because some of the fish also harvested in other mixed stock fisheries prior to reaching the terminal area, a complete accounting of the total harvest is not possible.

Port Camden Fall Run: Port Camden in Located on the north side of Kuiu Island about 40 miles west of Petersburg. Escapement goals of 2,000 – 7,000, based on aerial counts in two creeks, have been met 10 of the last 20 years. Fishing opportunities and effort by the purse seine fleet is managed within Port Camden area specifically to meet the escapement goal (Priest et al. 2024). Commercial harvest occurred in 25 of the 40 years from 1960 until 2000 averaging 12,000. No directed harvest occurred since 2000. Piston and Fish (2024) reported that these fish are likely also harvested in mixed stock fisheries prior to reaching the terminal area.

Security Bay Fall Run: Security Bay is located on the northern tip of Kuiu Island about 40 miles west of Petersburg. The escapement goal is range of 5,000 – 15,000, based on aerial surveys of Salt Chuck Creek, has been met 16 of the last 20 years. Fishing opportunities and effort by the purse seine fleet are managed within Security Bay specifically to meet the escapement goal (Priest et al. 2024). Since 1960, there has been a commercial harvest in Security Bay in only 28 of the last 63 years and many of these catches were less than 5000 fish. The harvest averaged 9,100 fish in years when the terminal fishery was conducted. The largest harvest (71,0000 occurred in 1984. Harvest has occurred in only three of the last ten years and averaged less than 1,000 fish. Piston and Fish (2024) also reported that these fish are likely also harvested in other mixed stock fisheries prior to reaching the terminal area.

Excursion River Fall Run: Excursion Inlet is located about 40 miles Northwest of Juneau. The escapement goal range of 4,000 – 18,000 is based on aerial counts of the Excursion River. The escapement goal has been met in 11 of the last 20 years. Since 1960 there have been commercial harvest in 37 years. From 1960 to 1981 the harvest averaged 95,000. Since 1981, the catch has averaged 30,000. Very large numbers of fish (greater than 100,000) have occurred several times and as have many years of no commercial harvest.

Chilkat River Fall Run: The Chilkat River is located at the north end of Lynn Canal near Haines and is the largest run of fall Chum Salmon in the region. Escapements have been estimated through a fish wheel since 1994. The escapement goal range of 75,000 to 250,000 has been met or exceeded in 19 of the last 20 years. The drift gillnet fishery in Lynn Canal is managed to achieve the escapement goal (Priest et al. 2024). Commercial harvest averaged nearly 300,000 Chum Salmon per year during the 1970s and 1980s but declined to an annual average of 55,000 since 1989. Harvests were lower in many years in the 1990s due in part to fishery restrictions specifically implemented to protect this stock (Piston and Fish (2024). Effort by the gillnet fleet has declined from an average of 3,143 boat days prior to 1990 to 1,633 boat days from 1990 to 2023.

Hatchery Program

Southeast Alaska hatchery releases of Summer Chum salmon have progressively increased from 1980 to present (Figure 13). Twelve hatcheries released 607 million Chum Salmon at 26 locations in 2023 including on facility and remote release sites (Wilson 2024).

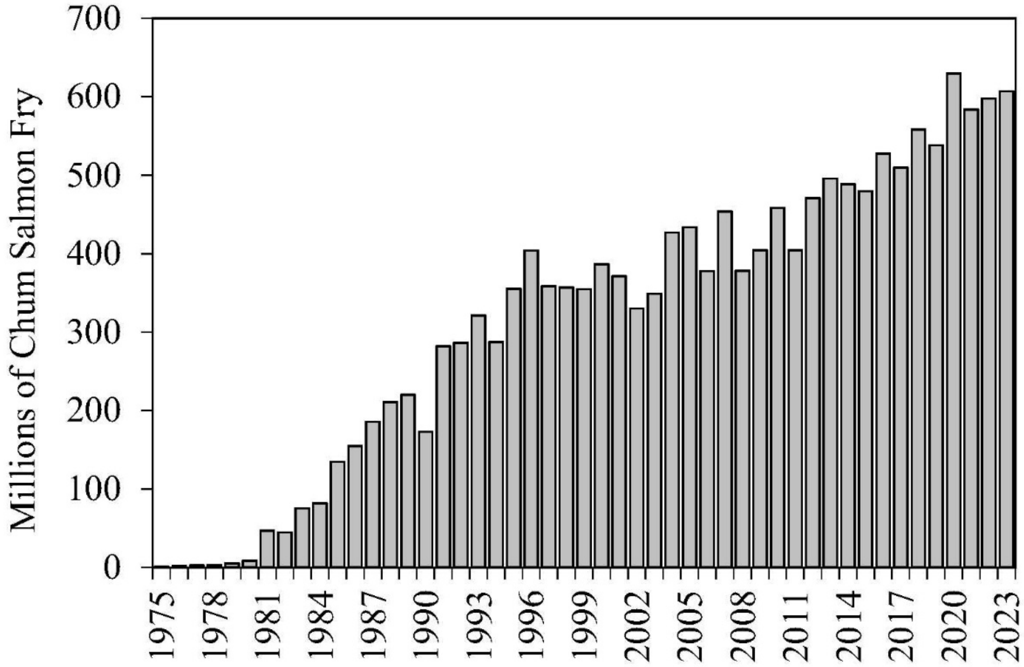


Figure 13. Number of hatchery-produced Chum Salmon fry released annually in Southeast Alaska, 1975-2023 (Piston & Fish 2024).

Release sites are chosen to secure brood stock, harvest adults for cost recovery sale to support hatchery operations and contribute to the region's common property fisheries. Depending on annual run sizes, common property fishing may be permitted in areas where the primary purpose is to obtain brood stock or hatchery cost recovery. The current Fishery Management Plan directs where cost recovery, brood stock and terminal fishing opportunities would be allowed and how the economic benefits of the hatchery program are to be allocated among the seine, troll and gillnet fleets. This plays an important role in choosing specific sites among those ADFG has determined will not significantly impact wild salmon stocks.

Douglas Island Pink and Chum (DIPAC): DIPAC is private non-profit hatchery (PNP) program. It operates the Ladd McCulley Hatchery located on Gastineau Channel near downtown Juneau. There are five release sites for summer run Chum Salmon; all are located in the NSE Inside area. The approximate annual releases include:

12 million summer-run into Gastineau Channel at the hatchery (primary brood stock release site).

48 million summer-run at Amalga Harbor on the east side of Lynn Canal in District 15, just north of Juneau. This is the primary cost recovery site, but some returning fish may be caught in the District 15 drift gillnet fishery and some fish are caught in the Icey and Chatham straits by the seine and troll fleets.

24 million summer-run at Limestone Inlet located about 30 miles southeast of Juneau in Stevens Passage. This release is designed to contribute to the District 11 drift gillnet fishery. Some fish are also caught in the Icey and Chatham straits by the seine and troll fleets.

15 million summer-run at Thane in Gastineau Channel just east of Juneau. This release is designed to contribute to the District 11 drift gillnet fishery. Some fish are also caught in the Icey and Chatham Straits by the seine and troll fleets.

24 million summer-run at Boat Harbor located on the west side of Lynn Canal in District 15 about 45 miles Northwest of Juneau. This release is designed to contribute to the District 15 gill net fishery. Some fish are also caught by the purse seine fishery operating in Icy and Chatham Strait and by the troll fishery operating in Icy Strait.

Northern Southeast Regional Aquaculture Association (NSRAA): NSRAA PNP with its headquarters in Sitka. NSSRA operates three hatcheries for summer run Chum Salmon.

Hidden Falls Hatchery (HFH) is located in Kasnyku Bay on Baranof Island in Chatham Strait, 20 miles northeast of Sitka. This hatchery was built by the State of Alaska in 1978-79 and operated by the State until 1988 when operational responsibility was transferred to NSRAA. Recent releases have been about:

50 million summer-run in Kasnyku Bay (NSE Inside)

45 million summer-run in S.E. Cove which is on the Southern tip of Wrangel Island on behalf of Gunnuk Creek Hatchery (NSE Inside)

20 million summer-run in Thomas Bay about 20 miles north of Petersburg on the mainland (NSE Inside)

Medvejie Hatchery is located is located in Silver Bay about 1 mile south of Sitka. All releases are made in Northern SSE Outside area and include about:

33 million at the hatchery of which about 21 million are summer run and about 12 million are fall run.

54 million in Deep Inlet which is about 5 miles southwest of the hatchery of which about 33 million are summer run and 21 million are fall run.

Sawmill Creek Hatchery is located about one mile west of Sitka and releases about 30 million fall run Chum Salmon in Crawfish Inlet which is about 40 miles south of Sitka on the outer coast of Baranoff Island (eggs may be taken at Medvejie and Sheldon Jackson).

Sheldon Jackson Hatchery is located at the Sitka Sound Science Center, is the oldest operating salmon hatchery in Alaska and has been educating and training people in Aquaculture since 1974. it is permitted to release 8 million fall run Chum Salmon.

Port Amstrong Hatchery is owned and operated by Armstrong Keta Inc. The hatchery is located in Port Armstrong which is on Southeastern tip of Baranof Island (NSE Inside SMU). The hatchery releases about 20 million Chum Salmon. About 13 million fish are released on site with the remaining fish released from a towed net pen up to 7.5 miles away toward the tip of Baranof Island.

Southern Southeast Regional Aquaculture Association (SSRAA): SSRAA is a PNP with its headquarters in Ketchikan and operates two hatcheries for Chum Salmon.

Burnett Hatchery is located on Etolin Island Approximately 30 air miles from Wrangell. The hatchery was built by Alaska Aquaculture in the mid-1970's and was acquired by SSRAA in 1997. The facility operated as a coho/sockeye hatchery until 2012 when production was shifted to Chum Salmon and some Coho Salmon. About 90 million Chum Salmon are released annually, including:

30 million summer run and 10 million fall-run at Burnett Inlet on the west side of Etolin Island about 35 miles south of Wrangell (SSE Inside).

25 million summer-run at Anita Bay on the East side of Etolin Island about 20 miles south of Wrangell (SSE Inside).

2 million summer run and 8 million fall-run at Nakat Inlet which is on the mainland just north of the Alaska Canadian Border (SSE Inside).

20 million summer run at Port Asumcion located on the east side of Baker Island. This site is not part of an identified Chum Salmon stock.

Neets Bay Hatchery is located on the northwest tip of Revillagigedo Island about 30 miles north of Ketchikan. Release sites include:

5 million summer-run at the hatchery (SSE Inside).

44 million summer-run at Kendrick Bay located near the southeastern tip of Prince of Whales Island (SSE Inside).

The releases of Summer Chum hatchery production by district are:

NSE Inside about 258 million concentrated around Juneau and on the east side of Baranof Island.

NSE Outside about 128 million located near Sitka and on the west coast of Baranoff Island south of Sitka.

SSE Inside about 126 million at 6 locations.

No hatchery releases of fall Chum Salmon are made in the five fall Chum Salmon areas.

Hatchery Assessment

A series of assessments have identified widespread straying of hatchery Chum Salmon into natural production areas throughout Southeast Alaska at a relatively low rate in most natural production areas with higher rates in certain areas proximal to hatchery release sites.

Piston & Heinl (2012a, 2012b) collected otoliths from chum salmon at wild stock index streams throughout Southeast Alaska from 2008 to 2011 to document the presence and distribution of stray hatchery fish. In 2008-2010, the proportion of hatchery fish was greater than 5% in 21 of 33 index streams: 2 of 5 in the SSE Subregion, 1 of 5 in NSEO Subregion, and 18 of 23 in the NSEI Subregion. The overall estimated proportion of hatchery fish in the NSEI Subregion escapement index was 13.5% (80% CI=12.5%–14.4%) in 2010 and 9.8% (95% CI=8.9%–10.7%) in 2011. The estimated overall proportion of hatchery strays in the NSEO Subregion was less than 2% in all study years. The proportion of hatchery strays in all samples collected from 2008 to 2011 decreased as distance from release sites increased and the proportions were generally highest at streams located within 50 km of the nearest hatchery release site. Considerable year-to-year variation in the proportion of hatchery fish in five of eight streams that had been sampled in prior years. Based on the relatively low observed proportions of hatchery strays, Piston & Heinl (2021b) reported that modification of summer chum salmon escapement indices to account hatchery straying for the would result in little or no change to current escapement goals.

Proportions of hatchery summer run Chum Salmon in Southeast Alaska spawning escapements were assessed in 2013-2015 as part of the Alaska Hatchery Research Project (Josephson et al. 2021). This assessment used a weighting scheme and a method to produce estimates representative of the SMUs and the region. Average annual proportions ranged from 0.016 to 0.081 in the three southeast Alaska management areas and 0.032 to 0.060 across Southeast Alaska (Table 2). The proportion of hatchery strays decreased as the distance from hatchery release sites increased with the highest proportions in streams located within 50 km of the nearest release site. In 10 streams sampled from 2013-2015, 77% of annual observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas. However, small numbers of stray hatchery fish were observed in many streams - pHOS was 1% or less in only 23% of annual observations. Relative reproductive success of hatchery and natural Chum Salmon is currently being assessed by the Alaska Hatchery Research Project, but results are not yet available (ADFG 2018, 2022; Americus 2025).

Hatchery production of Chum Salmon in Southeast Alaska is predominately of the summer run while a substantial portion the natural production of Chum salmon is of the fall run (Piston & Heinl 2020). Thus, estimates of hatchery proportions in the aggregate Southeast Alaska Chum stock are substantially less than those based on summer Chum populations alone.

Table 2. Summary of stray rates by hatchery produced Chum Salmon by year and SMU from Josephson et al. (2021). [4]

Stock	Sampled streams	2013	2014	2015	Average
SSE Inside	5	0.078 (0.025)	0.030 (0.010)	0.036 (0.009)	0.050
NSE Inside	24	0.019 (0.006)	0.034 (0.021)	0.081 (0.030)	0.040
NSE Outside	3	0.016 (0.007)	0.018 (0.014)	0.017 (0.006)	0.017
Average	32	0.032 (0.007)	0.031 (0.013)	0.060 (0.041)	0.041

[4] *Since this work was done, returns from a new release site in Crawfish Inlet have significantly increased the stray rates into one of the three streams in the SSE Outside SMU. This issue is addressed in the next section of this audit.*

3.3.2 Crawfish Inlet of Southeast Alaska

New information was also identified during the previous certification period regarding straying of Chum Salmon from a hatchery release site in Crawfish Inlet, Southeast Alaska. Straying of hatchery chum into a nearby spawning stream contributed to questions regarding use of a precautionary approach in decision-making processes based on best available information as applied the hatchery enhancement. This issue is addressed by Condition 5 for Performance Indicator 3.2.2 which is a subject of this audit.

Hatchery Program

The Northern Southeast Regional Aquaculture Association began releasing Chum Salmon at a new remote acclimation site in Crawfish Inlet in 2015. Crawfish Inlet is a Medvejie Hatchery satellite program (remote release) permitted for 30 million eggs. The goal of the program is to produce 700,000 adult fall run Chum Salmon. Significant numbers of hatchery adults began returning in 2018 and 2019.

This program is intended to provide harvest opportunities for the troll fleet, cost recovery for operating the hatchery and additional common property fishing when run sizes are sufficiently large. The release was sited in part to provide additional harvest for the troll fishery based in Sitka which historically has been underserved by the hatchery programs relative to their desired harvest shares. Crawfish Inlet was identified as a suitable release site based on a comprehensive review of alternatives conducted around 2011. The site was believed to be sufficiently segregated from natural chum spawning areas to provide for significant terminal fishing opportunities on returning fish in an area without natural Chum Salmon spawning streams, hence, little risk of significant straying into natural populations.

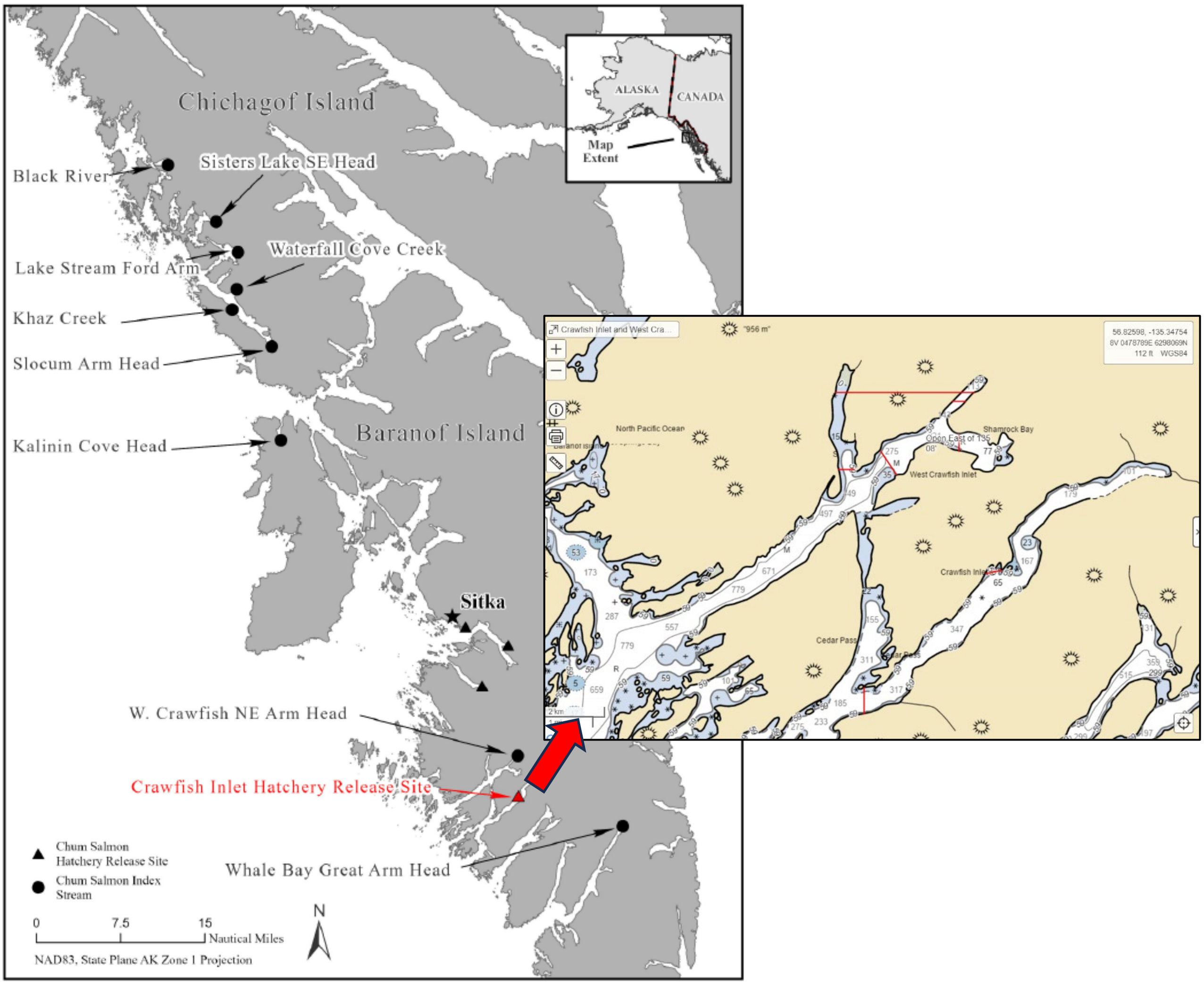


Figure 14. Northern Southeast Outside subregion Chum Salmon index streams and hatchery Chum Salmon release sites in Alaska (Dupuis et al. 2024). Inset shows area of Crawfish and West Crawfish Inlets.

The new Crawfish Inlet hatchery release site substantially increased commercial Chum harvest in the Northern Southeast Outside Subregion in 2018 and 2019 (Piston & Fish 2024). An estimated 3.5 million Crawfish Inlet hatchery Chum Salmon were harvested in 2018 accounting for approximately 69% of the subregion harvest. Total returns of hatchery fish to Crawfish Inlet were 3.5 million in 2018 and 2.1 million in 2019. Since 2019, hatchery chum salmon runs to Crawfish Inlet and West Crawfish Inlet declined from these very high levels but remained productive, with harvests of 1.4 million fish in 2020, 1.2 million fish in 2021, 630,000 fish in 2022, and 1.7 million fish in 2023, accounting for an average of 43% of the subregion's harvest in those years.

Hatchery Assessment

Unexpectedly large numbers of Crawfish Inlet hatchery fish returned in 2018 and 2019, and were observed to stray into wild summer-run Chum Salmon spawning streams in West Crawfish Inlet (Piston & Fish 2024). One of these streams is a wild index stream for stock assessment purposes. West Crawfish Inlet is adjacent to Crawfish Inlet and connect by a small channel at Cedar Pass (Figure 14). Potential impacts of high stray rates include interbreeding of wild fish with less productive hatchery fish during the time period when the summer run wild fish and fall run hatchery fish overlaps and displacement of wild eggs in the gravel when the hatchery fall-run spawns on top of the wild natural summer run, digging up redds.

As summarized in Piston & Fish (2024), otolith sampling conducted at the West Crawfish NE Arm Head index stream prior to 2018 showed relatively low proportions of stray hatchery fish (maximum 4.2% in 2008; Piston and Heinl 2012a), as did the Northern Southeast Outside Subregion index as a whole (<2%; Piston and Heinl 2012a; Josephson et al. 2021). In 2018 and 2019, otolith samples collected from carcasses at West Crawfish NE Arm Head and other nearby streams showed very high proportions of stray hatchery fish were present in escapements (Piston & Heinl 2020). Samples collected at the West Crawfish NE Arm Head index stream in 2022, at peak spawn timing for wild stock chum salmon, were still 64% hatchery strays despite a much smaller return of chum salmon to the Crawfish Inlet release site than in 2018 and 2019 (Table 3). Samples collected on September 6, 2023 found 75% hatchery-origin fish (Scott et al. 2024). Surveys in 2024 identified similarly high hatchery contributions which increased over the course of the Chum Salmon run as wild summer run Chum predominated in early August and hatchery fall run Chum dominated later in the month. This assessment also identified spatial differences in spawning distribution in late August with hatchery fish generally observed lower in the stream than wild fish.

It was initially unclear whether migration and straying patterns observed during the first few years of returns were a typical condition or an artifact of drought conditions and a larger-than-average initial return. However, subsequent assessments have determined that straying into the West Crawfish wild index stream is significant in all years.

Table 3. Proportions of stray hatchery chum salmon from samples collected in streams in the Northern Southeast Outside Subregion of Southeast Alaska from 2018 to 2022 (Piston & Fish 2024).

Year	ADF&G stream number	Stream name	Sample date	Otoliths analyzed	Not marked	Marked	% Marked
2018	113-32-005	West Crawfish NE Arm Head	8/27/2018	92	35	57	62%
2018	113-32-005	West Crawfish NE Arm Head	9/28/2018	87	1	86	99%
2019	113-32-005	West Crawfish NE Arm Head	8/27/2019	63	58	5	8%
2019	113-32-005	West Crawfish NE Arm Head	9/4/2019	95	6	89	94%
2019	113-32-004	West Crawfish North Arm NE	8/29/2019	95	16	79	83%
2019	113-32-004	West Crawfish North Arm NE	9/5/2019	96	7	89	93%
2019	113-22-015	Whale Bay Great Arm Head	8/19/2019	29	29	0	0%
2019	113-22-015	Whale Bay Great Arm Head	8/28/2019	69	26	43	62%
2020	113-62-009	Kalinin Cove Head	9/13/2020	64	63	1	2%
2022	113-32-005	West Crawfish NE Arm Head	8/23/2022	94	34	60	64%
2022	113-22-015	Whale Bay Great Arm Head	8/24/2022	94	94	0	0%

Table 4. ***Composition of spawners by origin, stream reach and sample period in West Crawfish Inlet Chum Salmon index stream (Scott et al. 2024).***

		Est count - (new fish)	NSRAA	No Mark	
13-Aug	Reach 1	200	57	143	
13-Aug	Reach 2	300	125	175	
13-Aug	Reach 3	100	-	100	
		600	**182**	**418**	
20-Aug	Reach 1	350	200	150	
20-Aug	Reach 2	100	38	63	
20-Aug	Reach 3	50	35	15	
		500	**273**	**228**	
27-Aug	Reach 1	100	81	19	
27-Aug	Reach 2	50	44	6	
27-Aug	Reach 3	50	8	42	
		200	**133**	**67**	
			588	**712**	**1,300**
			45%	55%	

NSRAA monitored hatchery fry outmigration in 2023 and 2024 to test a hypothesis that straying was related to migration patterns during the olfactory imprinting phase (Scott et al. 2024). Water quality samples were also collected to identify sources potential imprinting influences. It was hoped that insights into mechanisms for straying could inform identification of effective remedies. No hatchery-origin fry were recaptured in West Crawfish Inlet in either year which led to a conclusion that straying was unlikely due to imprinting to inlet stream outflow during the fry migration stage.

Management Response

NSRAA and ADF&G are jointly working to develop measures to remedy this straying situation (Americus et al. 2022a; 2025).

To date, the primary strategy has been to maximize harvest of the hatchery fish to reduce the incidence of straying. A targeted hatchery cost recovery fishery has also been conducted in addition to common property net and troll fisheries. For instance, targeted cost recovery fishery openings have been used in 2023 and 2024 in West Crawfish Inlet and adjacent areas to intercept hatchery fish building up in other areas (Americus 2025). In 2023, both hatchery cost recovery operations and common property opening were employed in West Crawfish Inlet. In 2024, hatchery cost recovery operations were authorized in West Crawfish but only occurred minimally due to a lack of buildup of fish. No common property openers intended to control hatchery produced chum salmon in West Crawfish Inlet were authorized in 2024.

These fisheries have proven effect in harvesting large numbers of hatchery fish in terminal areas near the hatchery release site and were believed to be effective in reducing very large escapements and stray rates observed during the early years of the hatchery program. However, fisheries have not effectively kept significant numbers of hatchery fish out of the West Crawfish NE Arm Head and other nearby streams.

As a result of high levels of straying, the West Crawfish NE arm index stream has been removed from the annual escapement index so as not to confound assessments of wild stock status (Priest et al. 2024; Piston & Fish 2024).

A variety of additional measures for controlling straying have been considered. Operation of a weir on the West Crawfish Arm Head index stream was previously considered but rejected because it would also exclude the later part of natural summer run fish. The Alaska Board of Fisheries reviewed several options for reducing straying of hatchery-produced Chum Salmon and incidental harvest of wild summer-run Chum Salmon at their January-February 2025 Southeast Alaska meeting as part of an action plan for addressing the NSE Outside summer Chum Salmon designation as a stock of Management Concern in 2024 (Dupuis et al. 2024). Options included reducing the permitted maximum release into Crawfish Inlet or prohibiting releases entirely. The Board of Fisheries recommended a reduction in permitted release number in Crawfish Inlet.

In response to the Northern Outside Southeast Alaska Chum Salmon Stock of Concern designation, the Commissioner of ADF&G issued a statement at the 2025 Board of Fisheries meeting identifying an intent to reduce permitted hatchery Chum Salmon egg take by 25% in 2025 from 30 million to 22.5 million (Vincent-Lang 2025). This reduction in conjunction with increased monitoring, was intended to help better assess and understand the impacts of wild Chum Salmon in the area. In the last 10 years, releases at Crawfish have been an average of 23.3 million chum salmon fry (range 13.4 million–27.8 million) with an average egg-to-release survival of 87% (range 80%–93%). At the reduced permitted egg-take level of 22.5 million, assuming the 10-year average egg-to-release survival, the releases would be 19.7 million fry (range 18.0 million–20.9 million).

Assessments of harvest patterns and hatchery contribution to the fisheries and spawning areas are ongoing. Research into the homing behavior of the Crawfish Inlet enhancement production will continue with monitoring hatchery fry outmigration as well as survey the index stream to evaluate proportion of hatchery origin spawners (Scott et al. 2024). NSRAA plans to continue collaboration with other researchers such as the Sitka Sound Science Center (SSSC), University of Alaska Southeast (UAS), and NOAA to explore methods of improving chum salmon homing accuracy, including testing the feasibility of utilizing a macroalgae (kelp) derived compound for improved imprinting. In 2025, NSRAA plans to implement an acoustic telemetry study to investigate the nearshore homing patterns in adult chum returning to West Crawfish and Crawfish Inlets.

The ADF&G Commissioner has also directed the Joint Southeast Regional Hatchery Planning Team to conduct a review of Chum Salmon release strategies, release numbers, and release locations and report to the commissioner by December 31, 2025, their findings and recommendations regarding what is working well, what is not working well, impacts on wild salmon stocks, and potential improvements to the salmon fishery enhancement program (Vincent-Lang 2025).

3.3.3 Prince William Sound

Stock Status

Pink Salmon are a particular focus of certification conditions in Prince William Sound (PWS) due to large hatchery production programs. Hatchery Pink Salmon contributed 79% on average of the total Pink Salmon return to PWS from 2000-2023 (Figure 15). Pink Salmon runs vary substantially from year to year in the dominant-subdominant brood cycle pattern typical of the species. Abundance of wild Pink Salmon is currently at historically high levels in PWS and across the Pacific.

Status of wild Pink Salmon stocks is based on counts from aerial surveys in 134 streams were selected from across PWS based on these streams having a high proportion of the overall escapement for pink and chum salmon in historical surveys in 214 index streams (Morellla et al. 2024). Status is assessed relative to escapement goals demonstrated to produce sustained yields over an extended period. Sustainable escapement goals for Pink Salmon are established for each of several districts in PWS (Figure 16) and for odd (dominant) and even (subdominant) brood cycles.

Spawning escapements goals have been consistently met or exceeded since 2000 for Pink Salmon throughout PWS including both even and odd year brood cycles (Figure 17, Figure 18). This includes districts with (Eastern, Northern, Southwestern) and without (Montague, Southeastern) significant Pink Salmon hatchery programs. District-specific escapement goals for Pink Salmon were meet or exceeded 93% of the time from 2012-2023. District-specific goals were met 100% of the time in 10 of 16 cases. In five cases, goals were met 83% of the time. In the Eshamy District the odd-year goal was met 67% of the time.

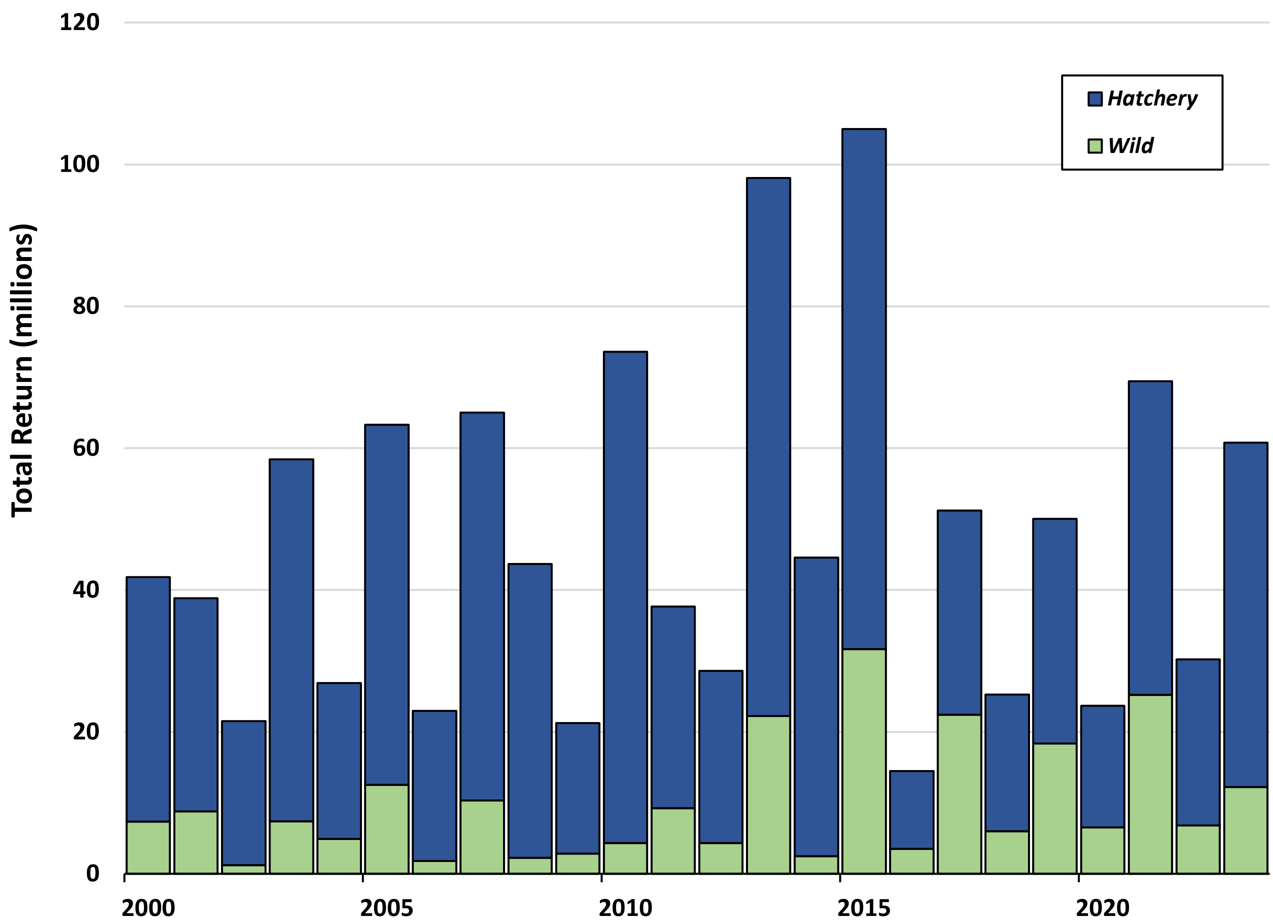


Figure 15. Prince William Sound pink salmon returns by origin, 2000–2023 (data from Botz et al. 2024).

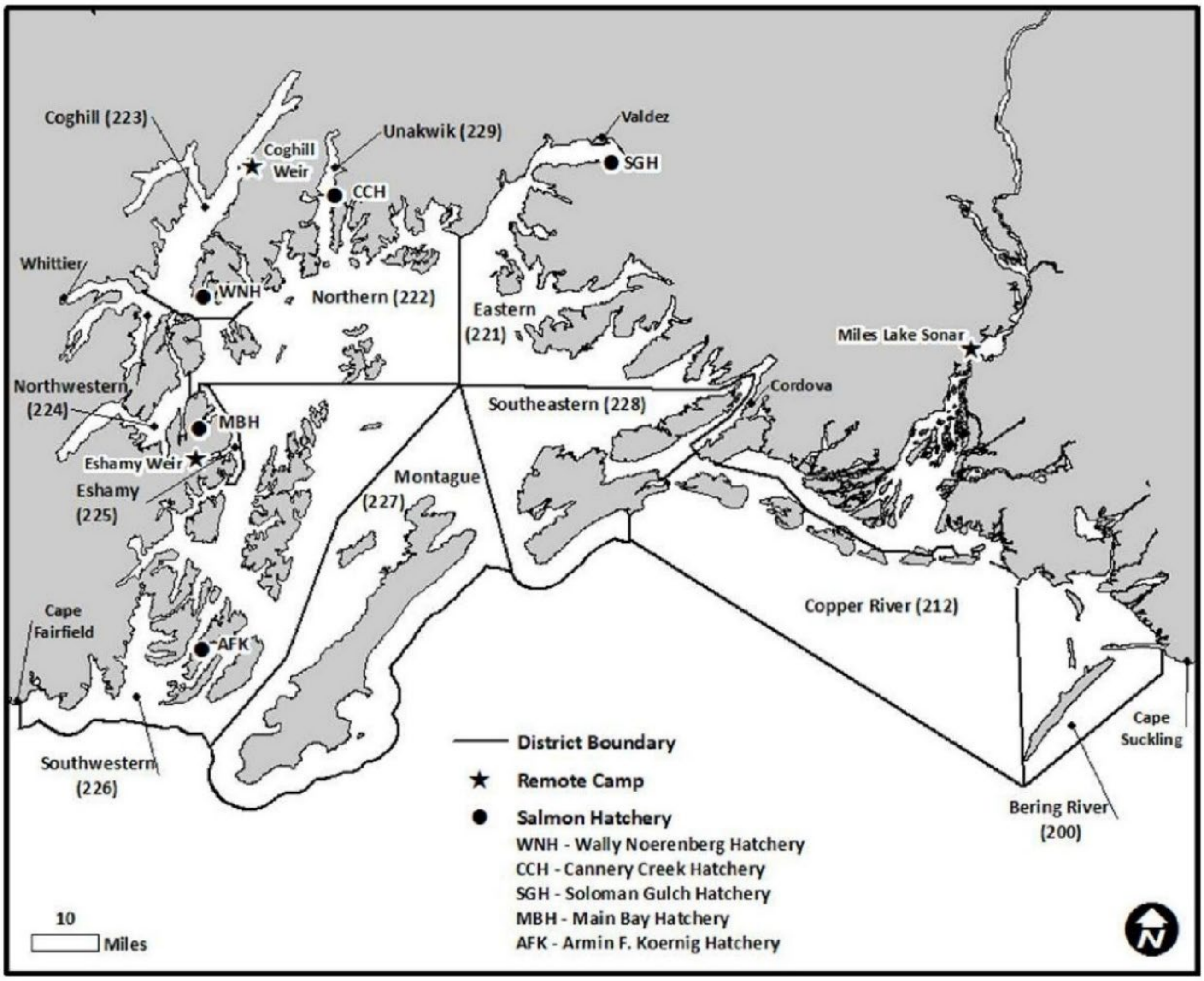


Figure 16. Prince William Sound Management Area showing commercial fishing districts, salmon hatcheries, weir locations, and Miles Lake sonar camp.

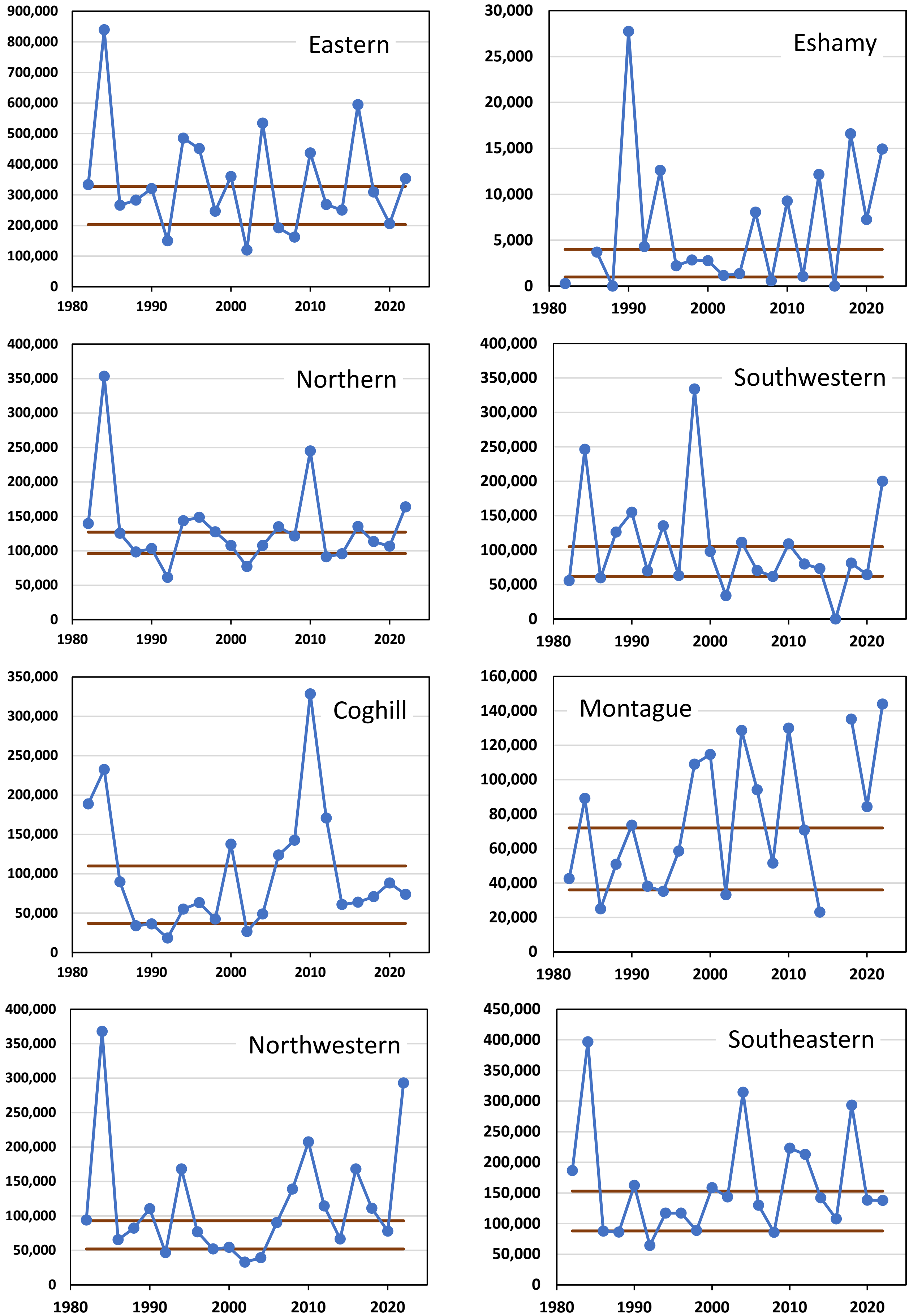


Figure 17. Even year escapement of Pink Salmon in Prince William Sound by District in relation to current escapement goals (data from Morella et al. 2024).

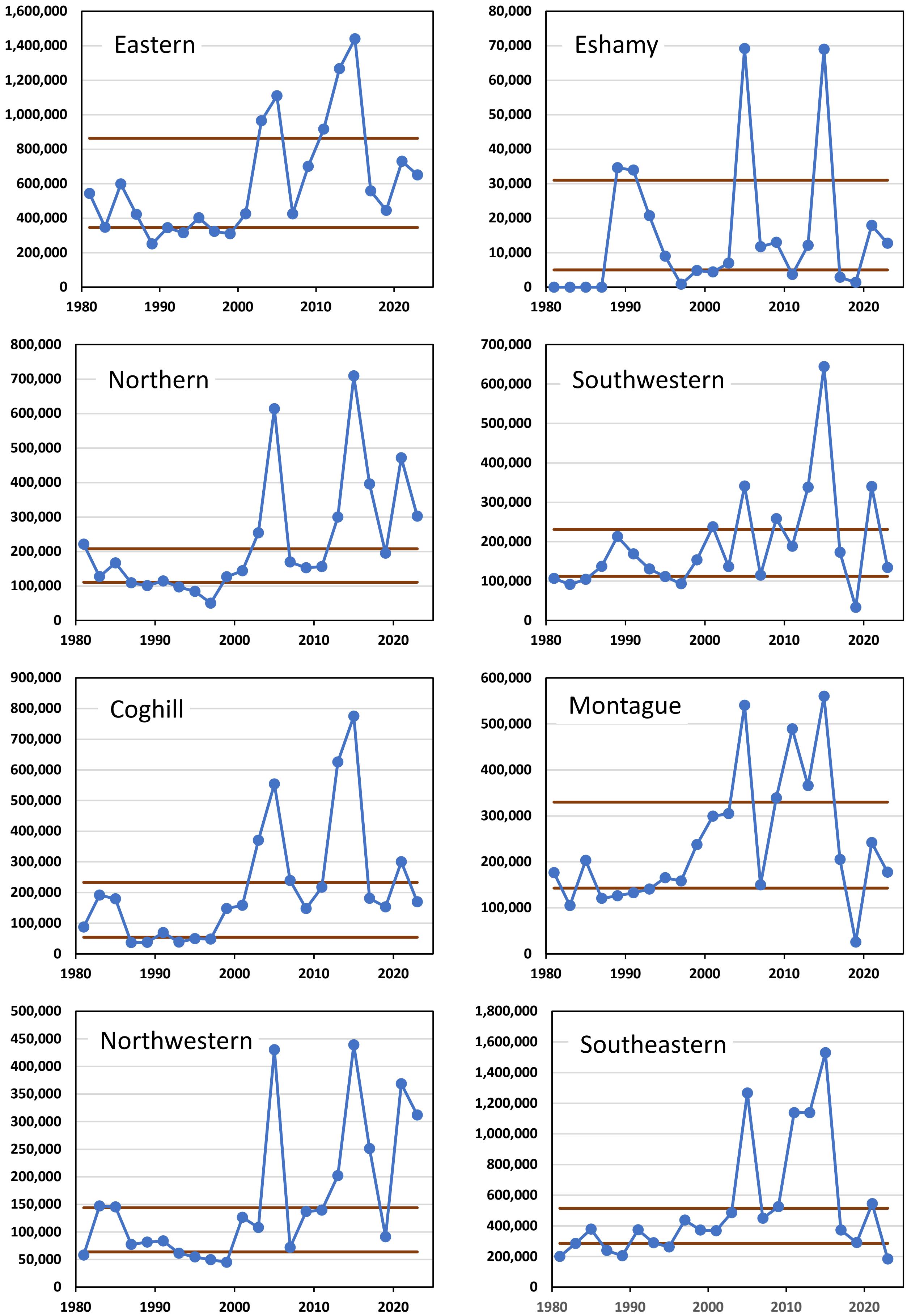


Figure 18. Odd year escapement of Pink Salmon in Prince William Sound by District in relation to current escapement goals (data from Morella et al. 2024).

Hatchery Program

In 2023, there were 889 million juvenile salmon released in the Prince William Sound area: 739 million pink, 132 million chum, 13 million sockeye, 4 million coho, and 223 thousand Chinook salmon (Wilson 2024). Recent release numbers are at record highs (Figure 1).

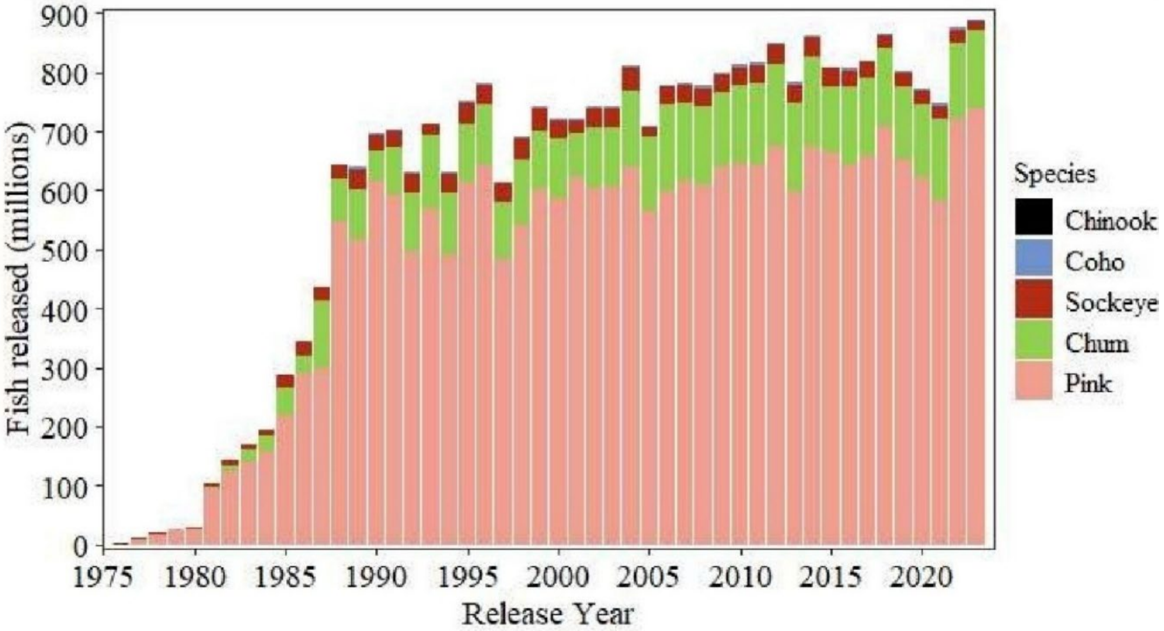


Figure 19. Total salmon released for Prince William Sound Alaska hatchery programs, 1975-2023.

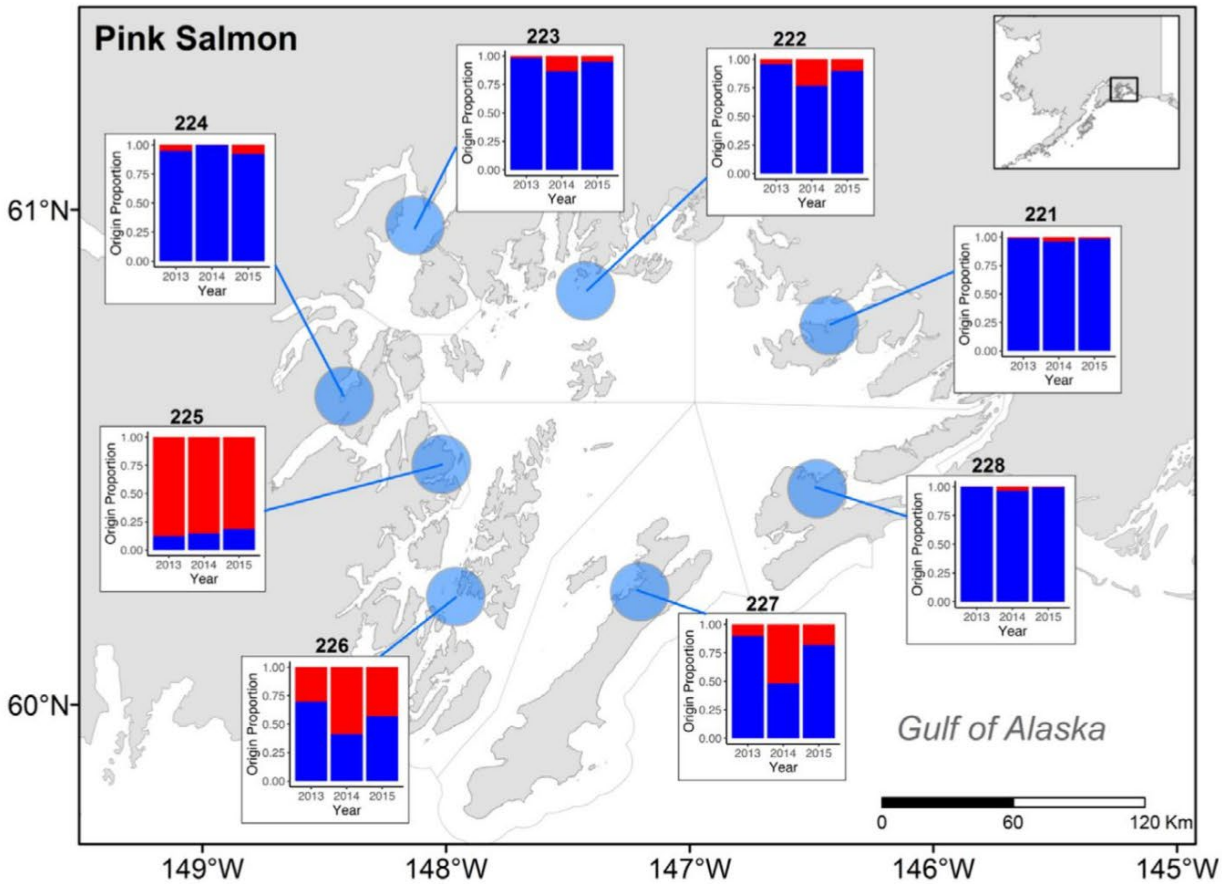
Hatchery Assessment

Building on prior assessments, the Alaska Hatchery Research Project has provided extensive information on genetic stock structure, straying and relative fitness in relation to hatchery enhancement in PWS (ADF&G 2018, 2022; Americus et al. 2022b, 2025).

Genetic stock structure of Pink Salmon exists but divergence among populations is relatively shallow (Cheng et al. 2016, 2019, 2022; Jasper et. al. 2013). Higher levels of divergence were identified for Chum Salmon (Gilk-Baumer & Templin 2019; Barclay et al. 2024). Genetic introgression from the hatchery population into wild stocks has previously been identified for Chum Salmon in PWS but the impact is unclear (Jasper et. al. 2013).

Knudsen et al. (2021) estimated annual proportions of hatchery fish in the preharvest run ranged from 0.55 to 0.86 for Pink Salmon and from 0.51 to 0.73 for Chum Salmon. Commercial fisheries harvested 94–99% of hatchery-origin fish of both species, 27–50% of natural-origin Pink Salmon and 17–20% of natural-origin Chum Salmon. Proportions of hatchery fish across all sampled PWS spawning streams were much lower, ranging from 0.05 to 0.15 for Pink Salmon and from 0.03 to 0.09 for Chum Salmon (Figure 20). In both species, relatively high instream proportions of hatchery fish tended to be geographically localized, while many streams exhibited low proportions. Of the 27 Pink Salmon streams sampled annually from 2013-2015, hatchery-origin strays in natural spawning areas accounted for <5% in 44% of observations and <1% in 20% of observations. Of the 17 Chum Salmon streams sampled annually from 2013-2015, 70% of observations counted less than 5% hatchery contribution and 26% counted less than 1%.

Straying of Prince William Sound hatchery Pink Salmon is not limited to Prince William Sound streams. Stray hatchery Pinks have also been identified in Lower Cook Inlet and Kodiak streams in recent years. Some Lower Cook Inlet streams contained unexpectedly high percentages of Pink Salmon originating from hatcheries in Prince William Sound ranging from 1 to 70% in 2014-2017 (Otis et al. 2018; Otis & Hollowell 2019: Figure 25). The overall average for the study years was 24%. PWS hatchery Pink Salmon were documented in many sample rivers on Kodiak and Afognak in 2020 and 2021 (Weber 2021, 2022). A low incidence of non-local hatchery Chum Salmon was also documented in Kodiak area streams.



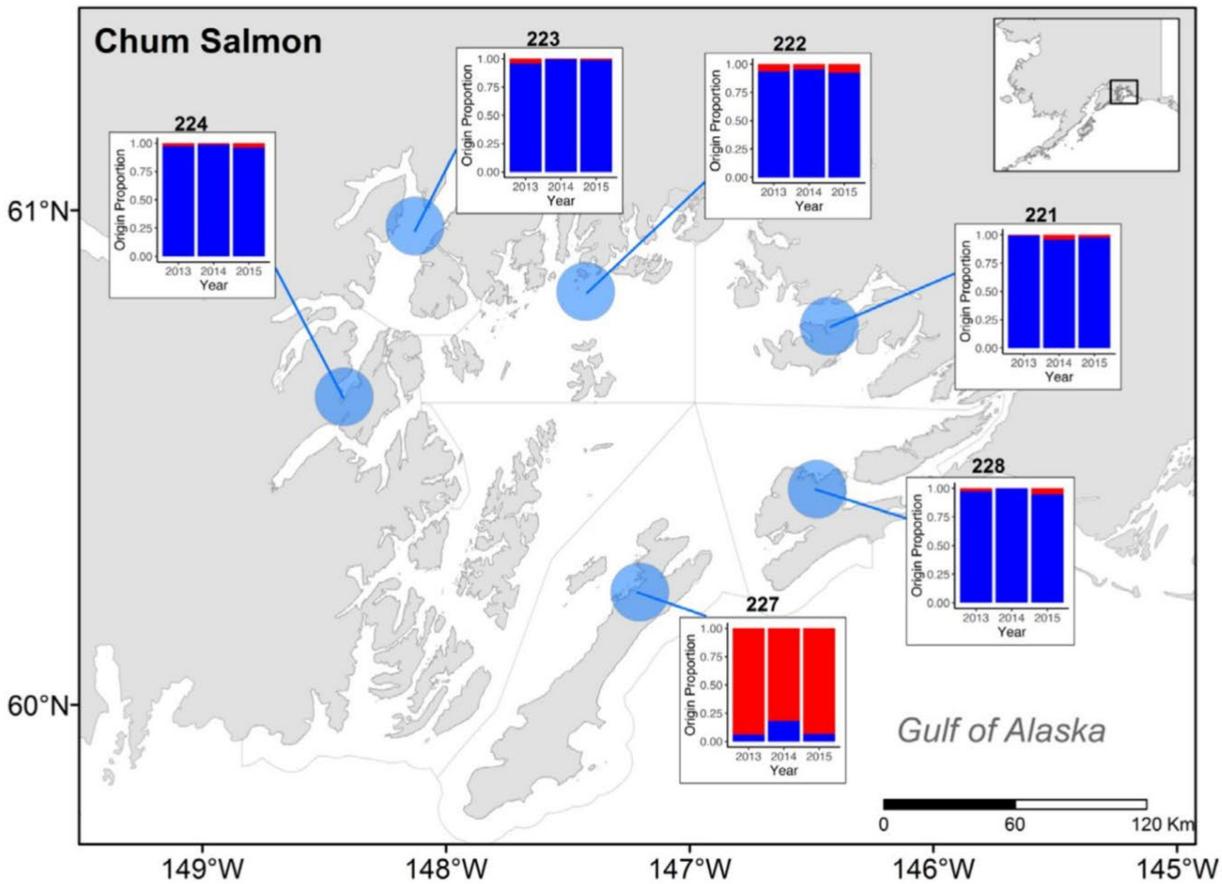


Figure 20. Estimated instream (recipient) spawner hatchery proportions (red) compared to natural proportions (blue) for Pink and Chum Salmon in Prince William Sound (Knudsen et al. 2021).

Initial studies found that relative reproductive success (RRS) of Pink salmon was significantly lower for hatchery-origin relative to natural origin fish, ranging from 0.03 to 0.47 for females and 0.05 to 0.86 for males in two Prince William Sound streams (Lescake & Dann 2019; Lescak et al. 2019; Shedd et al. 2022). Assessments of RRS of both Pink and Chum Salmon are ongoing.

The implications of reduced RRS on wild productivity remain to be determined and will depend on whether the mechanisms underlying reduced RRS are environmentally driven, and likely ephemeral, or genetically driven, and likely persistent across generations (Shedd et al. 2022).

McMahon et al. (2025) identified significant body size and run timing differences between hatchery and wild Pink Salmon spawners in Prince William Sound and reduced variation in traits in hatchery fish. Differences were thought likely to be driven by competitive differences during maturation and broodstock selection practices. This study also suggested that local adaptation may be maintained by phenotypic sorting despite widespread domestication impacts. Quantitative genetic modelling based on Prince William Sound Pink Salmon identified the potential for long-term demographic and evolutionary consequences arising from specific hatchery–wild interactions due to reduced fitness of hatchery fish due to rapid assimilation of hatchery-origin alleles can rapidly, despite the reduced fitness of hatchery fish attributable to phenotypic mismatches (May et al. 2024). However, Cheng et al. (2022) reported that stratified mating may be responsible for the wild-type population structure that has endured in Prince William Sound pink salmon despite over 25 generations of hatchery releases.

Consistently large escapements of natural-origin Pink Salmon documented in PWS streams (Morella et al. 2024) indicate that natural production remains high in streams where hatchery strays are documented at low levels. Three of the four highest wild returns of Pink Salmon to Prince William Sound on record have occurred in the last 10 years (Americus et al. 2022b).

3.3.4 Lower Cook Inlet

Stock Status

Pink Salmon spawning streams are distributed throughout Lower Cook Inlet including Southern, Outer District and Kamishak Districts (Figure 20).

Southern District: There are four streams where escapement counts have been consistently made. For the purposes of this audit, escapements in four streams assessed annually were examined in relation to spawning escapement goals (Barabara, China Poot, Humpy, and Seldovia); Tutka and Port Graham were excluded from the analysis because of large contributions of hatchery origin fish. Escapements were compared to aggregate sustainable escapement goal (SEG) ranges for the index streams (rounded to the nearest 5,000 fish) . An SEG range of 50,000–110,000 was established in 2023. There is a long history of meeting or exceeding the escapement goal with the notable exception of escapements since 2020 (Figure 21).

Outer District: There were 47 years of data collected from 13 streams to estimate the sustainable escapement goal of 105,000 to 235,000 Pink Salmon for the Outer District SMU. The streams assessed annually and used to develop the aggregate Outer District SEG are Desire, Dogfish, Island, James Lagoon, Middle, Port Chatham, Port Dick, Rocky, Slide, South Nuka, Taylor Bay, Windy Left, and Windy Right. The Outer District aggregate SEG range was rounded to the nearest 5,000 fish. The escapement goal has been met or exceeded in most years.

Kamishak District: There were 47 years of data collected from five streams used to estimate the sustainable escapement goal of 35,000 to 150,000 Pink Salmon for the Kamishak District. Index streams assessed annually and used to develop the aggregate Kamishak District SEG are Amakdedori, Brown's Peak, Bruin, Little Kamishak, and Sunday. The Kamishak District aggregate SEG range was rounded to the nearest 5,000 fish. The escapement goal has been met or exceeded in most years.

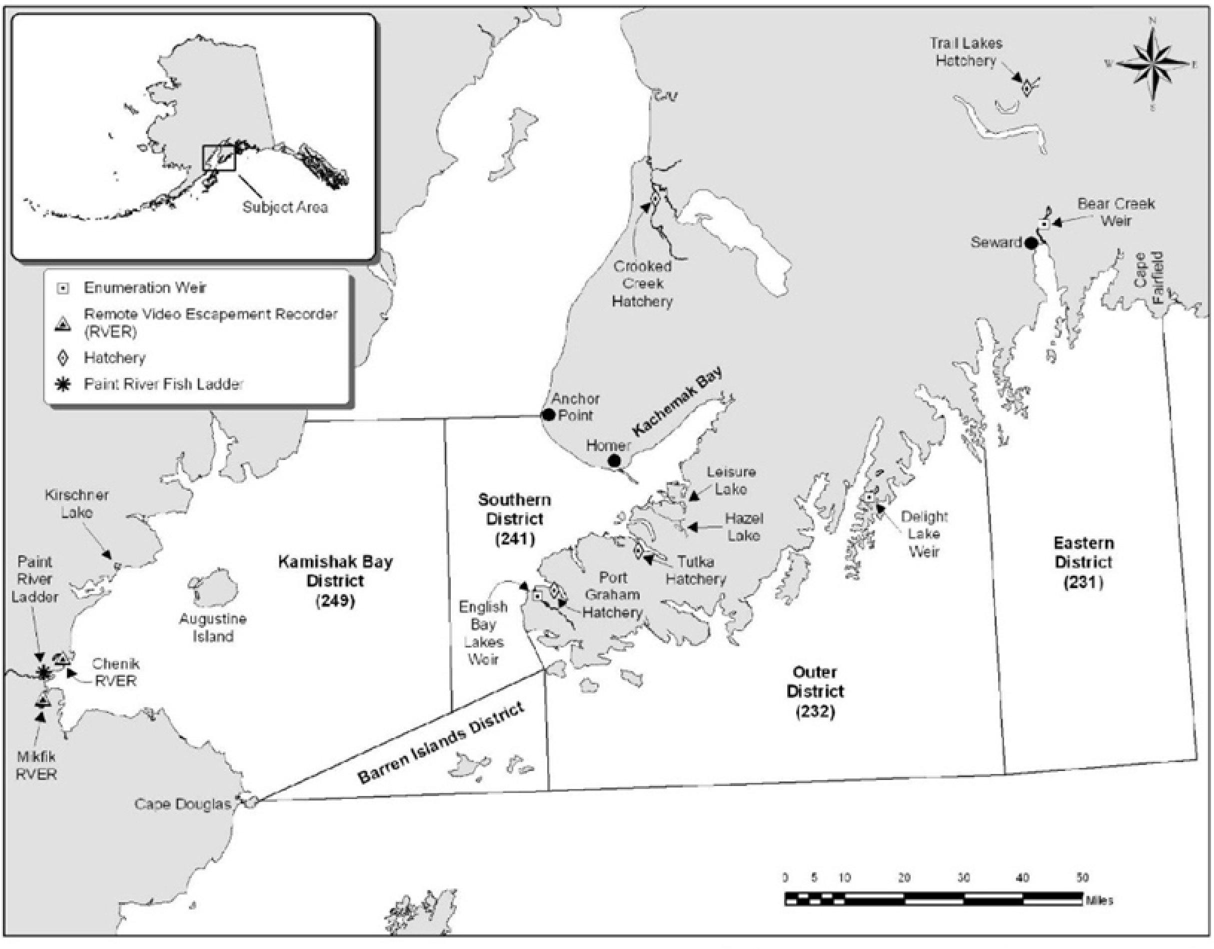


Figure 21. Map of Lower Cook Inlet fishery districts and hatcheries (Otis et al. 2023).

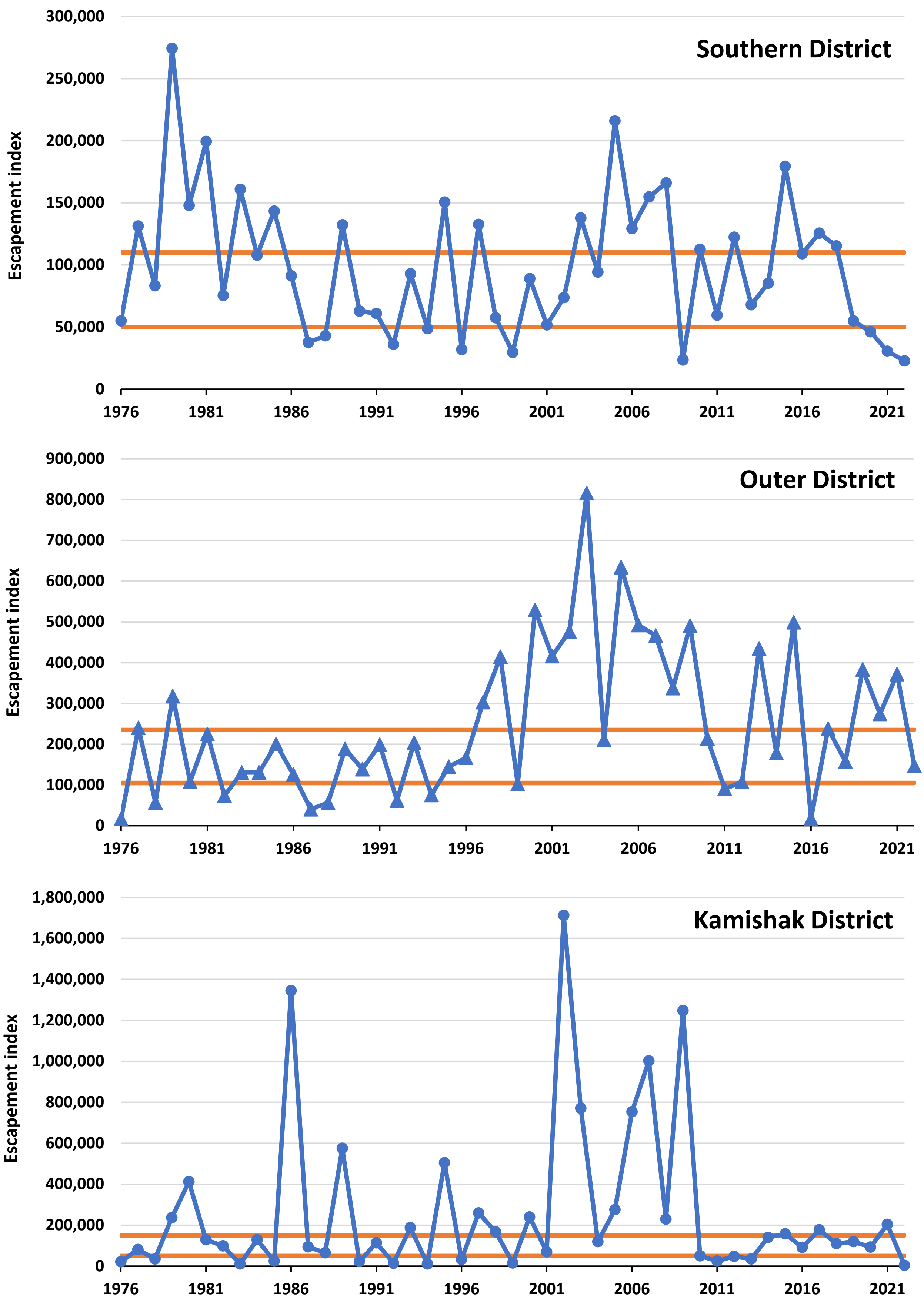


Figure 22. Aggregate escapements of Pink Salmon into Lower Cook Inlet by district in relation to current goals aggregated for streams, 1976 -2022. (Values do not include streams near hatcheries with high contributions of hatchery strays.)

Hatchery Program

In 2023, there were 30 million salmon released from Cook Inlet hatcheries: 21 million pink, 5 million sockeye, 2 million Chinook, and 1.5 million coho salmon (Wilson 2024). Hatchery production of Pink Salmon declined to low levels after hatchery closures around 2005. Tutka Bay and Port Graham Hatcheries were closed for a number years because of financial, staffing and infrastructure issues. Pink Salmon production subsequently increased as closed facilities were brought back online. The otoliths of 100% of the Pink Salmon raised at both facilities have been thermally marked to distinguish wild fish from hatchery fish in the catch and in selected streams.

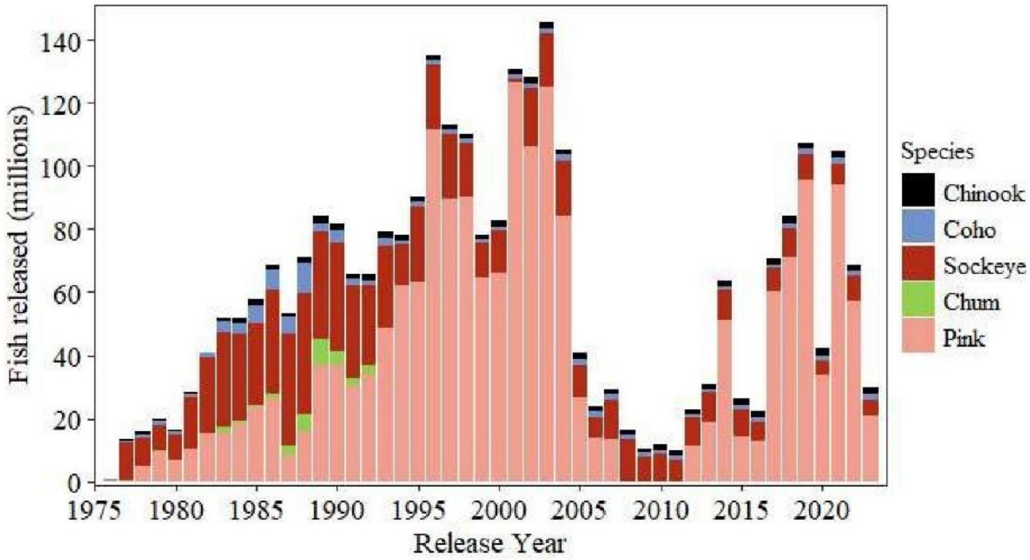


Figure 23. Total salmon released for Cook Inlet hatchery programs, 1975-2023 (Wilson 2024).

Tutka Bay Lagoon Hatchery was built by the State of Alaska in the 1970s and has been operated by the Cook Inlet Aquaculture Association (CIAA) since 1991. The Tutka Bay Lagoon Hatchery was reopened by in 2011 for Pink Salmon production with a permitted capacity of 125 million eggs and began releasing fry in 2012. Releases from Tutka Bay have varied since reopening (Figure 23) but future releases at Tutka Lagoon are not expected to exceed 50 million (Dean Day, CIAA Executive Director, Personal Communication).

Port Graham Hatchery was purchased by CIAA in 2014 and put back into operation. This a Pink Salmon facility with the capacity to rear 84 million eggs based on current water availability. Pink Salmon have been produced at the Port Graham facility intermittently since 2013. The CIAA Board of Directors voted to suspend Pink Salmon releases at Port Graham in 2024.

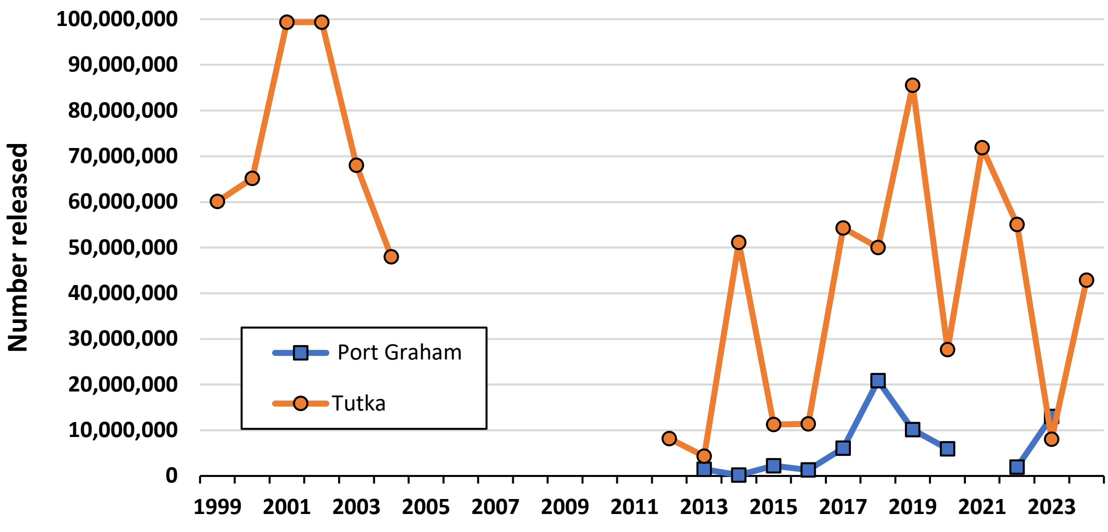


Figure 24. Hatchery releases of Pink Salmon in Lower Cook Inlet by location, 1999 - 2024.

Hatchery Assessment

Stray rates of hatchery Pink Salmon have been estimated in LCI streams based on otolith marks from spawned-out carcasses annually in 2014-2017 (Hollowell et al. 2017; Otis et al. 2018, 2020, 2021, 2022, 2023; Otis & Hollowell 2019). Estimates must be qualified due to nonrandom selection of sample streams and limited sample sizes in some areas but results provide an indication of the scope of hatchery straying in LCI (Otis et al. 2018).

Hatchery-origin Pink Salmon from LCI programs were reported in all 17 sample populations with contributions ranging from 2% to 93% (Figure 24). Hatchery contributions varied substantially among streams and across years. The proportion of hatchery marks originating from LCI hatcheries was highest in samples from streams adjacent to Tutka and Port Graham hatchery release sites (up to 93%). Contributions from LCI hatcheries were much lower in streams that were not in direct proximity to hatchery release sites averaging just 3% and ranging from 0 to 7%. Of the 17 sample streams, 59% averaged less than 5% contribution of LCI hatchery-origin strays in natural spawning areas in 2014-2017.

Tutka Hatchery accounts for the large majority of LCI hatchery Pink Salmon production and strays from this program contributed and very limited straying of these fish was documented outside Tutka Lagoon. Tutka Hatchery Pink Salmon comprised an average of 2.6% of natural spawners in 15 sample streams outside Tutka Lagoon (Table 5). Tutka Hatchery Pink Salmon comprised less than 5% of natural spawners in 82% of samples from 17 streams across four years.

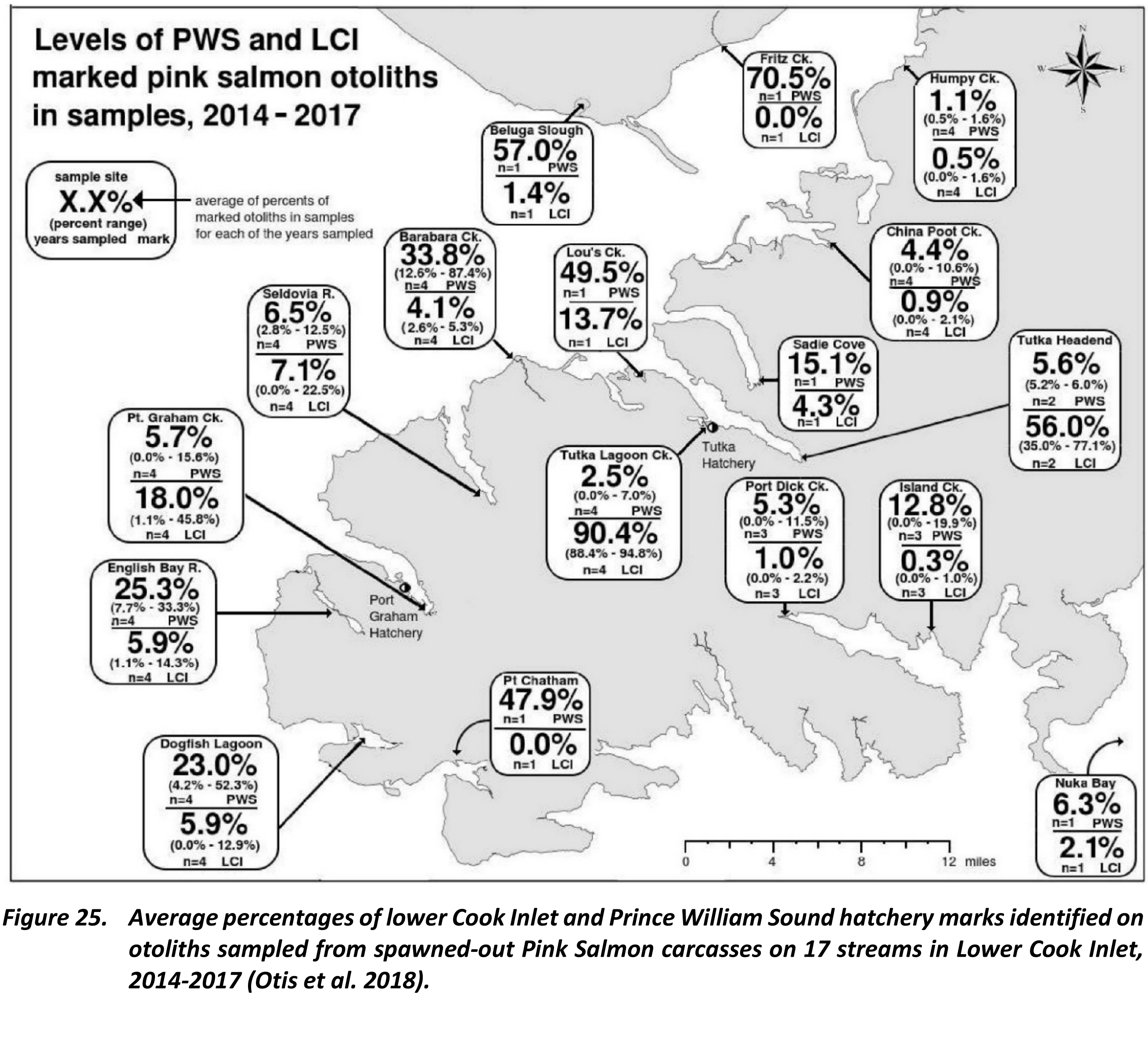


Figure 25. Average percentages of lower Cook Inlet and Prince William Sound hatchery marks identified on otoliths sampled from spawned-out Pink Salmon carcasses on 17 streams in Lower Cook Inlet, 2014-2017 (Otis et al. 2018).

Table 5. Average percentages of Tutka Hatchery marks identified on otoliths sampled from spawned-out Pink Salmon carcasses on 17 streams in Lower Cook Inlet, 2014-2017 (Otis et al. 2018).

Location	2014	2015	2016	2017	All
Fritz Cr	--	--	--	9.5%	9.5%
Humpy Cr	0.0%	1.6%	0.0%	0.5%	0.5%
Beluga Sl	--	--	--	1.4%	1.4%
China Poot Cr	0.0%	0.7%	0.0%	2.1%	0.9%
Sadie Cove	--	--	--	4.3%	4.3%
Tutka Lagoon Cr	82.9%	94.8%	92.3%	88.4%	89.6%
Tutka Headend	--	77.1%	--	35.0%	55.6%
Lou's Cr	--	--	--	12.6%	12.6%
Barabara Cr	1.1%	3.5%	2.2%	2.6%	2.6%
Seldovia R	0.0%	0.0%	1.8%	0.0%	0.5%
Pt Graham Cr	0.0%	0.5%	3.4%	0.0%	1.4%
English Bay R	0.0%	4.2%	0.0%	2.9%	2.0%
Dogfish Lagoon	1.1%	1.1%	0.0%	0.0%	0.5%
Pt Chatham	--	--	--	0.0%	0.0%
Island Cr	--	0.0%	0.0%	1.0%	0.5%
Port Dick Cr	--	0.0%	0.0%	2.2%	0.8%
Nutka Bay	--	1.1%	--	--	1.1%

Significant contributions of Prince Willam Sound hatchery Pink Salmon were widely observed in LCI streams (Figure 24). Contributions averaged 21.9% in sample streams and ranged from 1.1% to 71%. Combined contributions of LCI and PWS hatchery fish averaged 34% and ranged from 2 to 93%. Of the 17 sample streams, just 6% averaged less than 5% contribution of combined LCI and PWS hatchery-origin strays in natural spawning areas in 2014-2017.

Pink Salmon index streams consistently met their escapement goals despite some incidence of hatchery strays, and increased harvest effort on hatchery Pink Salmon (Otis et al. 2018; Otis & Hollowell 2019; 2022, 2023; Munro & Brenner 2022). The effective use of terminal hatchery release sites and fisheries (Otis & Hollowell 2023) substantially reduces the potential for straying by LCI hatchery Pink Chinook and risks of overharvest of wild fish in hatchery-enhanced fisheries.

Wild fish continue to account for most of the spawning escapements. Natural production remains high in streams where hatchery strays are documented at low levels. Catch sampling of hatchery cost recovery fisheries in Lower Cook Inlet determined that over 95% of the harvest in these terminal fishing areas was comprised of hatchery-origin fish.

3.4 MSC Assessment & Guidance

The MSC fisheries standard for salmon considers the impact of hatcheries programs on target salmon stock sustainability under enhancement-specific indicators in Principle 1 and on ecosystem structure and function in Principle 2.

For the Enhancement Outcome Performance Indicator (1.3.1), SC2.9.1 of FS 2.01 directs that this PI be assessed based on relevant studies on enhancement outcomes where available. Where no relevant studies on enhancement outcomes are available, but pHOS and pNOB values are estimated, these shall be used to score this PI in relation to default values appropriate to the species and type of enhancement. Where neither relevant studies nor estimates of pHOS nor pNOB exist, the assessment team shall use expert judgement to score this PI using a precautionary approach.

GSC1 of FS 2.01 identifies guidelines for artificial production based on the percentage of hatchery-origin spawners (pHOS) contributing to natural production in aggregate and among populations for the Stock Management Unit. Default guidelines in FS 2.01 were identified following specific best practice considerations and science developed from fitness modelling and empirical studies of yearling smolts released from the riverine species such as Chinook, coho, and steelhead hatcheries.

The guidance also suggests that impact guidelines for Pink and Chum may be relaxed from these levels due to differences in life history. Pink and Chum Salmon are released at earlier ages (a few months) than Chinook, Coho, Sockeye and Steelhead (typically one year) which might reduce hatchery-related risks. Pink and Chum Salmon are also characterized by a naturally higher incidence of straying and low genetic divergence among populations. Based on this direction, MRAG Americas (2019) identified the following provisional benchmarks for Pink and Chum salmon. These benchmarks are intended to provide guidance in the interim until a more scientifically robust standard may be identified based on research specific to Pink and Chum hatchery effects. Benchmarks are as identified for segregated hatchery populations consistent with hatchery production practices for Pink and Chum Salmon.

Scoring Guidepost	Stock Management Unit	Populations
60	pHOS ≤20%	pHOS <5% in >50% of populations
80	pHOS ≤10%[a]	pHOS <1% in >50% of populations [a]

[a] *Guideline identified in GSC2.9.1.2 for segregated stream-type life histories at the SG 60 level.*

Guidelines are not obligatory but provide useful benchmark for evaluating the potential for negative hatchery impacts due to straying. GSC2.9.1.2 allows for adjusting the default impact guidelines where additional evidence from species-specific studies is considered by the CAB to be more relevant to a specific situation and reasoned argument is made.

Guidelines allow for successful certification while also allowing for some small degree of hatchery effect. The acceptable impact of hatchery enhancement on stock diversity, abundance and productivity is not explicitly identified in the fishery standard but rather addressed with proxy indicators based on hatchery-origin natural spawners and the potential quality of hatchery-origin spawners as reflected in use of natural-origin broodstock.

This assessment applied these provisional benchmarks for Pink and Chum but also recognized the subjectivity of expert judgement involved in the original definition of salmon benchmarks based on the best available information at the time and in the modification of the original benchmarks for application to ocean-type salmon life histories. We also note that subsequent information on genetic diversity, migration, straying and productivity patterns of Chum Salmon and particularly Pink Salmon raise significant questions regarding the applicability of guidelines described above. As a result, the assessment team gave more consideration to Stock Management Unit guidelines than population guidelines.

Therefore, the assessment also considered related quantitative and qualitative information on:

- Scale and locations of hatchery programs in relation to natural production
- Marking of hatchery fish such that they are accounted for in harvest and escapement
- Differential harvest patterns of hatchery and natural fish to avoid overharvest of wild stocks
- Genetic stock structure of the species
- Contribution of hatchery-origin strays on natural spawning grounds
- Relative fitness of hatchery and wild spawners
- Wild stock productivity as reflected in escapements relative to goals.

<u>The significance of impacts was assessed at the Unit of Assessment scale. The test was not zero impact but rather impacts significantly large as to impair sustainability at the stock scale. Sustainability was considered both in terms of the ability of the stock to continue to produce significant levels of harvest and long-term viability (i.e. lack of any level of related conservation concern for the stock). While hatchery enhancement might produce local population-level effects of a limited nature, impacts were considered to be insignificant if they did not appreciably affect stock diversity, abundance or productivity at the UoA scale.</u>

4 EXPEDITED AUDIT RESULTS

4.1 Summary overview

Five hatchery-related conditions were reviewed and closed in this expedited audit. These conditions were identified in the previous (2019) reassessment, having been extended in 2019 from the prior certification period due to long period required to complete a long-term study of hatchery effects over the course of generations of the salmon life cycle.

Milestones for several of these conditions extended through 2023 and conditions were open as of the reassessment site visit and 4th surveillance audit which took place in mid-December of 2022. As the recertification process did not conclude until 2024, the first audit of the new certificate cycle would have been the first regular opportunity to assess progress. However, this expedited audit was conducted due to the lengthiness of the reassessment process.

Table 6: Summary of conditions

	Condition	PI	Status	Original score	Revised score
1	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Chum Salmon enhancement activities in Southeast Alaska do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2024).	1.3.1	Closed	60	80
2	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink and Chum Salmon enhancement activities in Prince William Sound do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity ofwild salmon stocks (by theend of 2023).	1.3.1	Closed	60	80
3	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink Salmon enhancement activities in Lower Cook Inlet do not have significant negative impacts on the local adaptation,reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2023).	1.3.1	Closed	60	80
4	Meet the SG 80 scoring requirements for PI 1.3.3b by demonstrating that a moderate-level analysis of relevant information onhatchery straying and relative fitness is conducted and used by decision makers to quantitatively estimate the impact of enhancement activities on wild stock status, productivity, and diversity of Pink and Chum Salmon in Southeast Alaska, Prince William Sound and Lower Cook Inlet (by the end of 2023).	1.3.3	Closed	70	80
5	Meet the SG 80 scoring requirements for PI 3.2.2c by demonstrating that decision-making processes use the precautionary approach and are based on best available information as applied the Pink and Chum Salmon hatchery enhancement programs (by the end of2023). [Condition is applicable to all UoAs.]	3.2.2	Closed	75	80

6	Meet the SG 80 scoring requirements for PI 2.3.3a and b by demonstrating that quantitative information is adequate to assess theimpact of the UoA on ETP seabirds and to measure trends and support a strategy to manage impacts on ETP seabirds. [Condition is applicable to seabird species in Southeast, Yakutat, Prince William Sound andCopper/Bering UoAs.]	2.3.3	Not assesse d in this expedit ed audit	60	--

4.2 Recommendations

While hatchery-related conditions have been closed, hatchery impacts and the management response to hatchery impacts are of continuing concern in light of strong evidence for negative impacts of hatchery production on wild populations in specific areas of Units of Assessment with large hatchery enhancement programs. New information and continuing progress in implementation of hatchery management strategies consistent with established wild fish protection policies will continue to be assessed in annual surveillance audits of this fishery.

This includes implementation of planned reductions in hatchery releases of Chum Salmon in Crawfish Inlet of Southeast Alaska, continuing assessments of related straying, further reductions if straying is not effectively remedied (as per Commissioner testimony of intent at 2/7/2025 Southeast Alaska Board of Fisheries Meeting) or failure of the Regional Hatchery Planning team to effectively address any significant straying identified from other remote release sites in Southeast Alaska.

We note that re-establishing conditions that have been closed is not an option under the certification process requirements. Thus, failure to continue to pass 80 level scoring guideposts for hatchery-related performance indicators could result in suspension of the certification in the event that hatchery impacts on Units of Assessment are determined to be significant based on new information or f decision-making processes fail to continue to demonstrate a precautionary approach.

4.3 Progress against Conditions

Condition 1 – CLOSED

Performance Indicator	1.3.1 Enhancement Outcomes
Score	~~60~~ **80** (Southeast Alaska)
Justification	Additional information is needed on the relative fitness of hatchery and natural Chum Salmon in order to assess the true impact of low levels of hatchery straying observed across Southeast Alaska summer Chum populations given the inferential nature of pHOS benchmarks identified for Chum salmon based on MSC guidance.
Condition	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Chum Salmon enhancement activities in Southeast Alaska do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2024).
Condition start	This condition was carried over in the reassessment under exceptional circumstance allowances (MRAG 2018). Milestones for this condition were scheduled through 2024 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.
Condition deadline	2024 (now subject to evaluation in this expedited audit)
Milestones	Year 10 (2023): Provide a summary of fitness data collection and any preliminary findings from data collection (scheduled for conclusion in summer of 2023). Year 11 (2024): Provide a final report, including a peer review report demonstrating that it is highly likely that Chum salmon enhancement activities in SEAK do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild Chum salmon stocks.
Progress on condition	Information reported and published for Chum Salmon in Southeast Alaska and elsewhere demonstrates a high likelihood that enhancement activities in Southeast Alaska do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon at the stock scale. While there may be localized effects on specific populations, net effects on the Unit of Assessment are assessed to be marginal and do not significantly impair the sustainability of the stock. Pending conclusion of ongoing assessments of relative reproductive success, this assessment precautionarily assumed significant reductions in hatchery chum based on findings for other salmon species and chum salmon in other areas. The finding was based on the weight of available evidence including genetic information, estimated proportions of hatchery-origin spawners in natural spawning areas and assessments of natural stock productivity. See rationale for rescoring of the related performance indicator for a detailed description of the basis for this determination.
Progress Status	Closed
Remedial Action	Not applicable

Additional information	ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022

Condition 2 – CLOSED

Performance Indicator	1.3.1 Enhancement Outcomes
Score	~~60~~ **80** (Prince William Sound)
Justification	Additional information is needed on the relative fitness of hatchery and natural Pink and Chum Salmon in order to assess the true impact of low levels of hatchery straying observed of Prince William Sound Pink and Chum populations given the inferential nature of pHOS benchmarks identified for Chum salmon based on MSC guidance.
Condition	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink and Chum Salmon enhancement activities in Prince William Sound do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2023).
Condition start	This condition was carried over in the 2018 reassessment under exceptional circumstance allowances (MRAG 2018). Milestones for this condition were scheduled through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.
Condition deadline	2023 (now subject to evaluation in this expedited audit)
Milestones	(2023) In accordance with the milestone timeline in condition 1 from SEAK, the client will provide a comprehensive, peer reviewed report, demonstrating with a high likelihood, that pink and Chum Salmon enhancement activities do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of pink and Chum Salmon wild stocks based on impact on wild fitness.
Progress on condition (2024)	Information reported and published for Pink and Chum Salmon in PWS and elsewhere demonstrates a high likelihood that enhancement activities in PWS do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon at the stock scale. While there may be localized effects on specific populations, net effects on the Unit of Assessment are assessed to be marginal and do not significantly impair the sustainability of the stock. Pending conclusion of ongoing assessments of relative reproductive success, this assessment precautionarily assumed significant reductions in hatchery chum based on findings for other salmon species and chum salmon in other areas. The finding was based on the weight of available evidence including genetic information, estimated proportions of hatchery-origin spawners in natural spawning areas and assessments of natural stock productivity.

	See rationale for rescoring of the related performance indicator for a detailed description of the basis for this determination.
Progress Status	Closed
Remedial Action	Not applicable
Additional information	ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022

Condition 3 – CLOSED

Performance Indicator	1.3.1 Enhancement Outcomes
Score	~~60~~ **80** (Lower Cook Inlet)
Justification	Additional information is needed on the relative fitness of hatchery and natural Pink Salmon in order to assess the true impact of low levels of hatchery straying observed in Lower Cook Inlet Pink Salmon populations given the inferential nature of pHOS benchmarks identified for Chum salmon based on MSC guidance.
Condition	Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink Salmon enhancement activities in Lower Cook Inlet do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2023).
Condition start	This condition was carried over in the 2018 reassessment under exceptional circumstance allowances (MRAG 2018). Milestones for this condition were scheduled through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.
Condition deadline	2023 (now subject to evaluation in this expedited audit)
Milestones	(2023) In accordance with the milestone timeline in condition 1 from SEAK, the client will provide a comprehensive, peer reviewed report, demonstrating with a high likelihood, that pink and Chum Salmon enhancement activities do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of pink and Chum Salmon wild stocks based on impact on wild fitness.
Progress on condition (2024)	Information reported and published for Pink Salmon in LCI and elsewhere demonstrates a high likelihood that enhancement activities in LCI do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon at the stock scale. While there may be localized effects on specific populations, net effects on the Unit of Assessment are assessed to be marginal and do not significantly impair the sustainability of the stock. Pending conclusion of ongoing assessments of relative reproductive success, this assessment precautionarily assumed significant reductions in hatchery chum

	based on findings for other salmon species and chum salmon in other areas. The finding was based on the weight of available evidence including genetic information, estimated proportions of hatchery-origin spawners in natural spawning areas and assessments of natural stock productivity. See rationale for rescoring of the related performance indicator for a detailed description of the basis for this determination.
Progress Status	Closed
Remedial Action	Not applicable
Additional information	ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022

Condition 4 – CLOSED

Performance Indicator	1.3.3 Enhancement Information
Score	70 **80** (Southeast, Prince William Sound, Lower Cook Inlet)
Justification	Contributions of hatchery strays to natural productions areas have now been assessed in all areas (Otis & Hollowell 2019; Josephson et al. 2021; Knudsen et al. 2021; Weber 2021, 2022; Americus et al. 2022b). Additional information on relative reproductive success of hatchery and wild Pink and Chum Salmon is needed from ongoing hatchery studies in order to quantify the impacts to wild production of observed levels of hatchery straying relative to outcome indicators in PI 1.3.1 for Southeast Alaska, Prince William Sound and Lower Cook Inlet.
Condition	Meet the SG 80 scoring requirements for PI 1.3.3b by demonstrating that a moderate-level analysis of relevant information on hatchery straying and relative fitness is conducted and used by decision makers to quantitatively estimate the impact of enhancement activities on wild-stock status, productivity, and diversity of Pink and Chum Salmon in Southeast Alaska, Prince William Sound and Lower Cook Inlet (by the end of 2023).
Condition start	This condition was carried over in the 2018 reassessment under exceptional circumstance allowances (MRAG 2018). Milestones for this condition were scheduled through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.
Condition deadline	2023 (now subject to evaluation in this expedited audit)
Milestones	In 2023, the client will provide a comprehensive, peer reviewed report sufficient to evaluate the effect of pink and Chum Salmon enhancement activities on pink and Chum Salmon wild stock status, productivity and diversity.
Progress on condition (2024)	This expedited audit report includes a comprehensive review of scientific information on hatchery risks and effects including related information in Alaska. This included a series of reports and published peer-reviewed scientific articles

	produced by the Alaska Hatchery Research project as well as the state of the science on hatchery-wild interactions of salmon in other regions.
Progress Status	Closed
Remedial Action	Not applicable
Additional information	ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hilborn & Eggers 2000, 2001; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Mortensen et al. 2000; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022; Wertheimer et al. 2001, 2004

Condition 5 – CLOSED

Performance Indicator	3.2.2 Decision-making Processes
Score	75
Justification	While ADF&G decision-making processes are generally responsive to serious issues identified through research, monitoring, evaluation, and consultation, it is not clear that they do so for all “serious and other important issues.” It is unclear whether the response to every issue (e. g., straying of hatchery Pink or Chum Salmon into West Crawfish, Lower Cook Inlet and Kodiak spawning streams) has been sufficient at level consistent with SG80.
Condition	Meet the SG 80 scoring requirements for PI 3.3.2c by demonstrating that decision-making processes use the precautionary approach and are based on best available information as applied the Pink and Chum Salmon hatchery enhancement programs (by the end of 2023).
Condition start	This condition was identified in 2020 based on new information provided at the first annual surveillance of the previous certification and a number of written stakeholder comments relating to hatchery enhancement activities. Milestones called for completion in 2022 but the condition was extended from to 2023 due to the COVID derogation for management conditions.
Condition deadline	2023 (now subject to evaluation in this expedited audit)
Milestones	(2023) Demonstrate that the management system has effectively responded to serious issues regarding straying of hatchery Pink or Chum Salmon into West Crawfish, Lower Cook Inlet and Kodiak spawning streams in a precautionary manner.
Progress on condition (2024)	Recent experience has also demonstrated application of the precautionary approach in the decision-making process based on best available information regarding potential negative impacts of hatchery enhancement. See rationale for rescoring of the related performance indicator for a detailed description of the basis for this determination (section 4.4, below).
Progress Status	Closed
Remedial Action	Not applicable
Additional information	Americus et al. 2022; Americus 2025; Dupuis et al. 2024; Evenson et al. 2018; Vincent-Lang 2024; Wilson 2024

Condition 6 – Not assessed in this audit

Performance Indicator	PI 2.3.3 ETP species information (a) Some quantitative information must be adequate to assess the UoA related mortality and impact and to determine whether the UoA and associated enhancement may be a threat to protection and recovery of marbled and Kittlitz murrelets. (b) Information is adequate to measure trends and support a strategy to manage impacts on ETP species.
Score	60
Justification	Regarding seabirds, a lack of recent monitoring of seabird encounters, and the opportunistic nature of previous periodic at-sea observations means that information is currently not adequate to monitor trends in encounters in areas where the salmon gillnet fisheries overlap with populations of ETP seabirds (Southeast Alaska, Copper-Bering, PWS, and Yakutat) and SG80 is not met for ETP seabirds in these UOAs.
Condition	Meet the SG 80 scoring requirements for PI 2.3.3a and b by demonstrating that information is adequate to assess the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and rebuilding of ETP seabirds and to measure trends and support a strategy to manage impacts on these seabirds. [Condition is applicable to seabird species in Southeast, Yakutat, Prince William Sound and Copper/Bering UoAs.]
Condition start	November, 2024
Condition deadline	5th anniversary of certification 2028.
Milestones	2024 - By the first annual surveillance, the client must present evidence that a plan is in place to address this condition (no score change expected). 2025 - By the second annual surveillance, the client must present evidence that the plan has been implemented (no score change expected). 2026 - By the third annual surveillance, the client must present evidence that significant progress has been made in plan implementation (no score change expected). 2027-By the fourth annual surveillance, the client must present evidence that further progress has been made in plan implementation (no score change expected). 2028 - By the fifth year of certification and before a subsequent recertification should the fishery attempt it, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80.
Progress on condition (2024)	Not applicable
Progress Status	Not assessed in this expedited audit
Remedial Action	Not applicable
Additional information	Not applicable

4.4 Re-scoring Performance Indicators

PI 1.3.1 – Enhancement outcomes

PI 1.3.1	**Enhancement activities do not negatively impact wild stock(s)**			
Scoring Issue		SG 60	SG 80	SG 100
a	**Enhancement impacts**			
	Guide post	It is **likely** that the enhancement activities do not have significant negative impacts on the local adaptation, reproductive performance or productivity and diversity of wild stocks.	It is **highly likely** that the enhancement activities do not have significant negative impacts on the local adaptation, reproductive performance or productivity and diversity of wild stocks.	There is a **high degree of certainty** that the enhancement activities do not have significant negative impacts on the local adaptation, reproductive performance or productivity and diversity of wild stocks.
	Met?	Yes (all UoCs)	~~No~~ Yes: Southeast Alaska, Prince William Sound, Lower Cook Inlet Yes: Yakutat, Copper/Bering, Upper Cook Inlet, Kodiak, Yukon, Kuskokwim, Kotzebue, Norton Sound, Bristol Bay, Chignik, Peninsula/Aleutian Island	No: Southeast Alaska, Prince William Sound, Lower Cook Inlet, Kodiak Yes: Yakutat, Copper/Bering, Upper Cook Inlet, Yukon, Kuskokwim, Kotzebue, Norton Sound, Bristol Bay, Chignik, Peninsula/Aleutian Island
Rationale				

SG60, SG80 and SG100 standards are met for all UoCs where hatchery enhancement does not occur (Yakutat, Yukon, Kuskokwim, Kotzebue, Bristol Bay, Chignik, Peninsula/Aleutian Island or consists of only of small scall programs (Upper Cook Inlet, Norton Sound). Significant hatchery enhancement programs are currently operated in Southeast Alaska, Copper/Bering, Prince William Sound, Lower Cook Inlet, and Kodiak. Assessments of UoCs with significant hatchery enhancement are detailed in following sections.

<u>Southeast (UoA 1)</u>

SG60: This standard is met for this UoC.

Annual assessments of hatchery contributions to the fishery harvest are made by ADF&G based on comprehensive marking of hatchery production and mark sampling of the commercial fisheries (Thynes et al. 2022; Wilson 2022). The impact of enhancement activities on wild stocks of all five salmon species (i.e., Sockeye, Chinook, Coho, Pink and Chum) is also assessed by regional planning teams composed of representatives from aquaculture associations and ADF&G staff. In 2021, returning hatchery-produced fish accounted for 2% of the Sockeye, 15% of the Chinook, 26% of the Coho, and 0.4% of the Pink Salmon taken in the commercial common property harvest. In 2021, 88% of the common property harvest of Chum Salmon was comprised of hatchery-origin fish.

Enhancement levels of Chinook, Coho and Pink Salmon are relatively modest in relation to wild numbers of these species. The available information indicates that straying of these species is generally low outside of the immediate vicinity of hatcheries which are typically located separate from significant natural production areas. At these levels of production, it is likely that enhancement activities do not have significant negative impacts on wild stocks. Chinook, Coho and Pink Salmon meet this level of performance.

Sockeye Salmon enhancement also occurs in some areas, with releases of both fry and smolts. As with most other species, significant straying into natural production areas has not been identified. Although evidence of potential negative effects of hatchery enhancement in McDonald Lake have occurred in the past, the practice was discontinued (Walker et al. 2018). Therefore, the team has concluded that Sockeye Salmon also meet this performance level.

Chum Salmon hatchery production is significant in Southeast Alaska. However, assessments have determined that the incidence of hatchery straying is very low in the large majority of natural production areas (Piston & Heinl 2012a, 2012b, 2020; Josephson et al. 2021; Americus et al. 2022b). Josephson et al. (2021) reported unbiased estimates of the proportions of hatchery-origin summer Chum spawning in each of the three southeast Alaska management areas in 2013-2015 ranged from 0.016 to 0.081, and the estimated hatchery proportions spawning across Southeast Alaska ranged from 0.032 to 0.060. Hatchery production of Chum Salmon in Southeast Alaska is predominately of the summer run while a substantial portion the natural production of Chum salmon is of the fall run (Piston & Heinl 2020). Thus, estimates of hatchery proportions in the aggregate Southeast Alaska Chum stock are substantially less than those based on summer Chum populations alone.

Reported hatchery-origin spawners were below the SG60 benchmark level of pHOS≤20% identified in this assessment based on MSC guidance for salmon enhancement considerations. The proportion of hatchery strays decreased as the distance from hatchery release sites increased; proportions were highest at streams located within 50 km of the nearest release site. Of the 10 sample streams sampled annually from 2013-2015, 77% of observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas. This number was below the SG60 benchmark level of pHOS <5% in >50% of populations identified in this assessment based on MSC guidance for salmon enhancement considerations.

This information indicates that it is likely that the Chum Salmon enhancement activities in SEAK do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild Chum Salmon stocks in most significant natural production areas.

SG80 - This standard is ~~not~~ met.

~~The 2013 reassessment identified a condition calling for a rigorous review of the hatchery study design. The action plan was revised during subsequent surveillance audits to provide for delivery of interim annual technical reports summarizing results of investigations including straying and genetic findings (IMM 2013). As such, the surveillance team determined that fulfilling this milestone required the completion of peer reviewed publications (wherein research methods will be peer reviewed, along with results) based on annual technical reports. This condition was carried over in the 2018 reassessment under exceptional circumstance allowances (MRAG Americas 2019). Milestones for this condition extended through 2024 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.~~

~~Josephson et al. (2021) published a peer-reviewed article summarizing hatchery study estimates of the proportions of hatchery summer run Chum Salmon in Southeast Alaska spawning escapements in 2013-2015. Estimated proportions ranging from 0.016 to 0.081 in three southeast Alaska management areas and 0.032 to 0.060 across Southeast Alaska met the SG80 benchmark level of pHOS≤10% identified in this assessment based on MSC guidance for salmon enhancement considerations. However, stream-specific estimates did not meet the SG80 benchmark level of pHOS <1% in >50% of populations – a pHOS of 1% was observed in only 23% of annual observations. Note that estimates of hatchery proportions in the aggregate Southeast Alaska Chum stock management unit are less than those based on summer Chum populations alone due to significant numbers of Fall run Chum.~~

~~Additional information is needed on the relative fitness of hatchery and natural Chum Salmon in order to assess the true impact of low levels of hatchery straying observed across Southeast Alaska summer Chum populations given the inferential nature of pHOS benchmarks identified for Chum salmon based on MSC guidance. Americus et al. (2022b) reported that results of relative reproductive success assessments are~~

~~expected to be available in 2024 which is consistent with milestones in the open condition for this PI as discussed above.~~

Proportions of hatchery summer-run Chum Salmon in Southeast Alaska spawning escapements easily meet the SG80 benchmark level of pHOS≤10% for the stock based on estimates of 0.016 to 0.081 in three southeast Alaska management areas and 0.032 to 0.060 across Southeast Alaska reported by Josephson et al. (2021). Low stock-level hatchery proportions are the result of purposeful selection of hatchery release sites to isolate the hatchery fish from significant wild runs. The very large number Chum Salmon systems (some 1200) makes it practically impossible to completely isolate the hatchery fish from all the wild stocks but higher levels of hatchery strays has been observed in only a small fraction of these systems.

Segregated release sites facilitate targeting of the hatchery fish so as "mop up" what is left after the common property fisheries to help minimize straying into local streams. The Alaska Board of Fisheries has established terminal areas where fish that are not caught in the common property fisheries can be effectively harvested without impacting wild stocks in the area. The common property fisheries are managed based on the strength of wild stocks, not on the abundance of hatchery fish. The effectiveness of this strategy is well documented based on comprehensive otolith marking of the hatchery production.

Stream-specific estimates did not meet the SG80 benchmark level of pHOS <1% in >50% of populations – a pHOS of 1% was observed in only 23% of annual observations. However, other information indicates that the observed low levels of hatchery contribution do not significantly impact wild stocks and the assessment team questions the applicability of the provisional population-level guideline for salmon with ocean-type life histories including Chum Salmon. Significant levels of natural straying are reflected a genetic stock structure which is relative shallow in relation to stream-type salmon and steelhead life histories upon which pHOS benchmarks were originally based.

Estimates of hatchery proportions in the aggregate run are substantially less than those based on summer Chum populations alone because the fall run comprises the large majority of wild production and the difference in run timing substantially reduced the potential for interaction. While there are some hatchery releases of the summer-run near fall-run areas in the NSE Inside SMU, any straying of summer run into a fall run streams is unlikely to result in any genetic interaction because of the significant difference time of spawning. The small releases of fall run Chum Salmon that occur in Burnett Inlet and Naket Inlet do not occur near a fall run SMU. For these reasons we conclude that the SEAK hatchery program has no effect on the productivity of these five SMU's.

Pending conclusion of ongoing assessments of relative reproductive success of Chum Salmon, this assessment precautionarily assumed a likely reduction in hatchery Chum Salmon spawning in the wild based on findings for other salmon species and chum salmon in other areas. Theoretical models indicate that hatchery-origin alleles can rapidly assimilate into natural populations, despite the reduced fitness of hatchery fish attributable to phenotypic mismatches (May et al. 2024). However, other work indicates that reductions in RRS in first generation hatchery fish may be substantially ameliorated by natural spawning in successive generations (Dylan et al. 2024). We note that reduced RRS is an indicator of the potential for negative hatchery impacts on wild population viability and productivity but that actual long-term impacts depend on whether the mechanisms underlying reduced relative reproductive success are environmentally driven, and likely ephemeral, or genetically driven, and likely persistent across generations (Shedd et al. 2022).

We estimate that the impact of assumed reductions in hatchery RRS on Southeast Alaska Chum Salmon stocks is highly likely to be limited by observed low levels of hatchery straying into natural production areas. Consider for instance, a 50% reduction in hatchery RRS combined with a 6% aggregate hatchery contribution would produce just a net 3% reduction in natural production in any given year and less than that if the demographic contributions of hatchery-origin spawners were considered.

The most compelling evidence for negligible levels of hatchery impact on wild sustainability is found in the consistent pattern of wild Chum Salmon escapements which meet or exceed established goals. If hatchery impacts were significant, we would expect an increasing difficulty in meeting spawning escapement goals as stock productivity was eroded but no such pattern is apparent. Escapement goals have been met for all eight stock units and are generally met when productivity is at least average. Seven of the 8 stock units can be said to be reasonably healthy considering that productivity is highly variable. The single exception for the NSE Outside stock is not correlated with a higher incidence of hatchery contribution to natural spawning. Escapement assessment of wild stocks are not confounded by hatchery strays because streams with significant numbers of hatchery fish are excluded from escapement indices.

New information was also identified during surveillance audits in the previous certification period regarding straying of Chum Salmon from a hatchery release site in Crawfish Inlet, Southeast Alaska. ~~According to the Northern Southeast Alaska Regional Aquaculture Association (NSRAA) website: The Crawfish Inlet chum program is a Medvejie Hatchery satellite program (remote release) permitted for 30 million eggs. The goal of the program is to produce 700,000 adult Chum Salmon for common property harvest. Crawfish was expected to be an excellent opportunity for the troll fishery based in Sitka which historically has been underserved by the hatchery programs relative to their desired harvest shares.~~

~~Crawfish Inlet was identified as a suitable release site based on a comprehensive review of alternatives around 2011. The site was sufficiently segregated from natural chum spawning areas to provide for significant terminal fishing opportunities on returning fish in an area without natural Chum Salmon spawning streams, hence, little risk of significant straying into natural populations. However, large numbers of Crawfish Inlet hatchery fish were subsequently observed to return via West Crawfish Inlet which is connected to Crawfish Inlet by a small channel. Several chum spawning streams are located in West Crawfish Inlet and significant numbers of hatchery Chum Salmon have been observed straying into these streams. One of these streams is also a wild index stream for stock assessment purposes. The local wild population is a summer run stock. The Medvejie hatchery stock is a fall run stock. There is therefore little interbreeding opportunity of the two runs. However, the hatchery fall-run spawns on top of the wild natural summer run, digging up redds and likely reducing abundance. This is clearly a situation where hatchery production has negatively impacted a wild stock. The impact is not large relative to the large scale of wild production of Chum Salmon. However, it is inconsistent with the certification standard as well as Alaska Hatchery Policy.~~

~~NSRAA and ADF&G are jointly working to implement measures to remedy this straying situation (Americus et al. 2022a). A primary strategy will be to maximize harvest of the hatchery fish to reduce the incidence of straying. A targeted hatchery cost recovery fishery is being conducted in addition to common property net and troll fisheries. It is unclear whether migration and straying patterns observed to date are a typical condition or an artifact of recent drought conditions and a larger-than-average initial return. Recent fishery measures appear to have been largely effective under normal conditions in harvesting hatchery Chum Salmon in this area before significant straying can occur. Assessment of harvest patterns and hatchery contribution to the fisheries and spawning areas is ongoing. NSRAA has advised the assessment team that additional measures, such as weirs on the spawning streams, will be considered where necessary to reduce hatchery strays to acceptable levels.~~

Significant numbers of hatchery Chum Salmon have been observed straying into a nearby streams including a wild index stream for stock assessment purposes. This is clearly a situation where hatchery production has negatively impacted a wild population. The stock level impact is negligible given the local nature of the effect. Therefore, this issue is addressed under PI 3.2.2 and it related condition regarding decision-making processes.

SG100 - ~~This standard is not met based on failure to achieve SG80.~~ Not achieved for this UoA where contributions of hatchery Pink and Chum salmon to natural spawning populations have been identified but the impact of enhancement activities on wild-stock status, productivity, and diversity has not been quantified with a high degree of certainty.

Prince William Sound (UoA 4)

SG60 -This standard is met for this UoC.

PWS hatcheries release large numbers of Pink and Chum Salmon. These hatchery programs are effectively managed as segregated programs which are maintained as reproductively distinct or genetically segregated from wild production. While hatchery broodstock were originally established from local wild populations and hatcheries generally operate to avoid genetic bottlenecks or selection, hatchery broodstock are now almost entirely hatchery-origin fish. This has the potential of unintentional or unnatural selection to cause hatchery and wild populations to diverge over time.

The significance of hatchery-wild Interactions PWS Pink Salmon has long been a subject of scientific debate (Brenner et al. 2012; Americus et al. 2022b). Hilborn and Eggers (2000, 2001) suggested that the hatchery Pink Salmon replaced rather than augmented wild production in PWS due to a decline in wild escapement associated with harvesting hatchery stocks and biological impacts of the hatchery fish on wild fish. However, Wertheimer et al. (2001) found that a close review of the evidence does not support the Hilborn and Eggers' interpretation of countervailing trends in abundance of wild and hatchery fish appear to superficially support. Other data did not support proposed mechanisms for negative impacts (Mortensen et al. 2000; Wertheimer et al. 2001, 2004). Wild escapements of Pink Salmon were not substantially reduced by harvest of hatchery Pink Salmon and a low incidence of hatchery straying into natural spawning areas did not support a hypothesis of significant effects on wild population fitness. High survival rates of hatchery-origin fish from release to adulthood suggested that intra-specific competition is not a significant limiting factor.

To address these uncertainties, Alaska began a comprehensive, long-term research program in 2013 on straying and relative fitness of hatchery and wild Pink and Chum Salmon in Prince William Sound and Southeast Alaska (Knudsen et al. 2016, 2021; ADF&G 2018; Knudsen et al. 2021; Americus et al. 2022b). Knudsen et al. (2021) reported hatchery-origin stray rates and total run characteristics for Pink Salmon and Chum Salmon returning to Prince William Sound in 2013–2015. Estimated annual proportions of hatchery fish in the preharvest run ranged from 0.55 to 0.86 for Pink Salmon and from 0.51 to 0.73 for Chum Salmon. Commercial fisheries harvested 94–99% of hatchery-origin fish of both species, 27–50% of natural-origin Pink Salmon and 17–20% of natural-origin Chum Salmon. Proportions of hatchery fish across all sampled PWS spawning streams were much lower, ranging from 0.05 to 0.15 for Pink Salmon and from 0.03 to 0.09 for Chum Salmon. Reported hatchery-origin spawners of both Pink and Chum Salmon in Prince William Sound met the SG60 benchmark level of pHOS≤20% identified in this assessment based on MSC guidance for salmon enhancement considerations.

In both species, relatively high instream proportions of hatchery fish tended to be geographically localized, while many streams exhibited low proportions. Of the 27 Pink Salmon streams sampled annually from 2013-2015, 44% of observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas. This number did not meet the SG60 benchmark level of pHOS <5% in >50% of populations identified in this assessment based on MSC guidance for salmon enhancement considerations. However, consistently large escapements of natural-origin Pink Salmon are reported in PWS streams (Munro & Brenner 2022) which suggests that natural production remains high in streams where hatchery strays are documented at low levels. Three of the four highest wild returns of Pink Salmon to Prince William Sound on record have occurred in the last 10 years (Americus et al. 2022b). Of the 17 Chum Salmon streams sampled annually from 2013-2015, 70% of observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas. This number met the SG60 benchmark level of pHOS <5% in >50% of populations identified in this assessment based on MSC guidance for salmon enhancement considerations.

The relatively low incidence of hatchery-origin Pink and Chum Salmon to natural spawning and consistently high production of natural-origin fish indicates that it is likely that enhancement activities in PWS do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild stocks in most significant natural production areas.

SG80 – This standard is ~~not~~ met.

The 2013 reassessment identified a condition calling for a rigorous review of the hatchery study design. The action plan was revised during subsequent surveillance audits to provide for delivery of interim annual technical reports summarizing results of investigations including straying and genetic findings (IMM 2013). As such, the surveillance team determined that fulfilling this milestone required the completion of peer reviewed publications (wherein research methods will be peer reviewed, along with results) based on annual technical reports. This condition was carried over in the 2018 reassessment under exceptional circumstance allowances (MRAG 2018). Milestones for this condition extend through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.

Knudsen et al. (2021) published a peer-reviewed article summarizing hatchery study estimates of hatchery-origin stray rates and total run characteristics for Pink Salmon and Chum Salmon returning to Prince William Sound in 2013–2015. Estimated proportions for Pink Salmon averaging 0.10 over three years of sampling equalled the SG60 benchmark level of pHOS≤10% identified in this assessment based on MSC guidance for salmon enhancement considerations. Only 20% of Pink Salmon stream estimates counted less than 1% contribution of hatchery-origin strays in natural spawning areas which does not meet the SG80 benchmark level of 50%. Estimated proportions for Chum Salmon ranging from 0.03 to 0.09 met the SG60 benchmark level of pHOS≤10% in every sample year. Only 26% of Chum Salmon stream estimates counted less than 1% contribution of hatchery-origin strays in natural spawning areas which does not meet the SG80 benchmark level of 50%.

Straying of Prince William Sound hatchery Pink Salmon is not limited to Prince William Sound streams. Stray hatchery Pinks have also been identified in Kodiak and Lower Cook Inlet streams in recent years. Some Lower Cook Inlet streams contained unexpectedly high percentages of Pink Salmon originating from hatcheries in Prince William Sound from 1 to 70% from 2014-2017 (Otis et al. 2018; Otis & Hollowell 2019). The overall average for the study years was 23.8%.

Based on observed hatchery-origin stray rates in relation to provisional benchmarks and related information, it cannot be concluded with a high likelihood that enhancement activities in PWS do not have significant negative impacts on of wild stocks of Pink and Chum in PWS.

Additional information on the relative reproductive success (RRS) of hatchery and wild spawners from the ongoing Alaska Hatchery Research Project is expected to inform further assessments of the actual impact of low levels of hatchery straying on wild stocks of Pink and Chum. Initial studies of RRS for Pink Salmon in two Prince William Sound streams suggest that reproductive success was significantly lower for hatchery-origin relative to natural origin fish (Lescake & Dann 2019; Lescak et al. 2019; Shedd et al. 2022). RRS, measured as sampled adult off spring that returned to their natal stream, was significantly lower for hatchery- vs. natural-origin parents in both lineages, ranging from 0.03 to 0.47 for females and 0.05 to 0.86 for males. The assessment of RRS in PWS Pink Salmon is ongoing. The implications of reduced RRS on wild productivity remain to be determined and will depend on whether the mechanisms underlying reduced RRS are environmentally driven, and likely ephemeral, or genetically driven, and likely persistent across generations.

Genetic introgression from the hatchery population into wild stocks has previously been identified for Chum Salmon in PWS but the impact is unclear (Jasper et. al. 2013). RRS of Chum Salmon is being assessed in Southeast Alaska with results expected to be available in 2024 (Americus et al. 2022b).

Reported hatchery-origin spawners of both Pink and Chum Salmon in Prince William Sound met the SG80 stock benchmark level of pHOS≤10% identified in this assessment based on MSC guidance for salmon enhancement considerations. Annual estimates of proportions of hatchery fish across all sampled PWS spawning streams ranged from 0.05 to 0.15 for Pink Salmon and 0.03 to 0.09 for Chum Salmon (Knudsen et al. 2021). In both species, relatively high instream proportions of hatchery fish tended to be geographically localized, while many streams exhibited low proportions.

Segregated release sites facilitate targeting of the hatchery fish so as "mop up" what is left after the common property fisheries to help minimize straying into local streams. The Alaska Board of Fisheries has established terminal areas where fish that are not caught in the common property fisheries can be effectively harvested without impacting wild stocks in the area. The common property fisheries are managed based on the strength of wild stocks, not on the abundance of hatchery fish. The effectiveness of this strategy is well documented based on comprehensive otolith marking of the hatchery production.

Stream-specific estimates did not meet the SG80 benchmark level of pHOS <1% in >50% of populations for Pink Salmon but did for Chum Salmon. Of the 27 Pink Salmon streams sampled annually from 2013-2015, 44% of observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas. Of the 17 Chum Salmon streams sampled annually from 2013-2015, 70% of observations counted less than 5% contribution of hatchery-origin strays in natural spawning areas.

Other information indicates that the observed low levels of hatchery contribution do not significantly impact wild stocks and the assessment team questions the applicability of the provisional population-level guideline for salmon with ocean-type life histories including Pink and Chum Salmon. Significant levels of natural straying are reflected a genetic stock structure which is relative shallow in relation to stream-type salmon and steelhead life histories upon which pHOS benchmarks were originally based.

Relative reproductive success of Pink Salmon two Prince William Sound streams has been found to be significantly lower for hatchery-origin relative to natural origin fish, ranging from 0.03 to 0.47 for females and 0.05 to 0.86 for males (Lescake & Dann 2019; Lescak et al. 2019; Shedd et al. 2022). Pending conclusion of ongoing assessments of relative reproductive success of Chum Salmon, this assessment precautionarily assumed a likely reduction in hatchery Chum Salmon spawning in the wild based on findings for other salmon species and chum salmon in other areas.

Theoretical models indicate that hatchery-origin alleles can rapidly assimilate into natural populations, despite the reduced fitness of hatchery fish attributable to phenotypic mismatches (May et al. 2024). However, other work indicates that reductions in RRS in first generation hatchery fish may be substantially ameliorated by natural spawning in successive generations (Dylan et al. 2024). We note reduced RRS is an indicator of the potential for negative hatchery impacts on wild population viability and productivity but that actual long-term impacts depend on whether the mechanisms underlying reduced relative reproductive success are environmentally driven, and likely ephemeral, or genetically driven, and likely persistent across generations (Shedd et al. 2022).

We estimate that the impact of assumed reductions in hatchery RRS on PWS Pink and Chum Salmon stocks are highly likely to be limited by observed low levels of hatchery straying into natural production areas. Consider for instance, a 70% reduction in hatchery RRS combined with a 10% aggregate hatchery contribution would produce just a net 7% reduction in natural production in any given year and less than that if the demographic contributions of hatchery-origin spawners were considered.

The most compelling evidence for negligible levels of hatchery impact on wild sustainability is found in the consistent pattern of wild Pink and Chum Salmon escapements which meet or exceed established goals. If hatchery impacts were significant, we would expect an increasing difficulty in meeting spawning escapement goals as stock productivity was eroded but no such pattern is apparent. Escapement assessments of wild stocks are not confounded by hatchery strays because streams with significant numbers of hatchery fish are do not occur in the large majority of index streams.

SG100 - ~~This standard is not met based on failure to achieve SG80.~~ Not achieved for this UoA where contributions of hatchery Pink and Chum Salmon to natural spawning populations have been identified but the impact of enhancement activities on wild-stock status, productivity, and diversity has not been quantified with a high degree of certainty.

Lower Cook Inlet (UoA 5)

SG60 -This standard is met for this UoC.

Pink Salmon are currently produced at Port Graham and Tutka Bay Lagoon hatcheries in Lower Cook Inlet (Otis et al. 2018; Otis & Hollowell 2019). Both hatcheries recently resumed operations after previous closures due to various financial, staffing and infrastructure issues. The Tutka Bay Lagoon Hatchery was reopened by Cook Inlet Aquaculture Association (CIAA) in 2011 for Pink Salmon production and began releasing fry in 2012. CIAA also acquired the inactive Port Graham Hatchery (PGH) in 2014 and began raising Pink Salmon at that location, with the first release occurring in 2015. Together, these hatcheries are permitted to take 250 million green eggs, resulting in future anticipated releases of 200 million fry in LCI. Programs are currently in the process of building to the permitted capacity. The otoliths of 100% of the Pink Salmon raised at both facilities are now thermally marked, allowing managers to determine the origin (hatchery and release site) of marked fish.

Smaller hatchery releases of Sockeye, Chinook and Sockeye Salmon also occur in Lower Cook Inlet. Sockeye Salmon fry plants occur in lakes of barren systems with limited spawning capacity (CIRPT 2007). Coho and Chinook Salmon are released primarily for harvest by sport users.

Following resumption of Pink Salmon hatchery programs, spawning escapement was sampled to determine the percentage of strays in local streams (Otis et al. 2018; Otis & Hollowell 2019, 2023). This information was intended for use by ADF&G staff in managing the Tutka and Port Graham hatcheries to minimize straying and impacts to wild Pink Salmon. Primarily this would occur through the Cook Inlet Area Regional Planning Team tasked with overseeing hatchery operations in the Lower Cook Inlet area and advising the ADF&G Commissioner regarding hatchery operations.

Straying of both Lower Cook Inlet and Prince William Sound hatchery Pink Salmon was documented in LCI streams (Otis et al. 2018; Otis & Hollowell 2019). The annual percent of sampled carcasses with marked otoliths in varied substantially among streams and across years. The proportion of hatchery marks originating from LCI hatcheries was highest in samples from streams adjacent to hatchery release sites (up to 95%). Levels of LCI hatchery fish in spawning escapements averaged from 0% to 7.1% from 2014-2017 in streams that were not in direct proximity to hatchery release sites. The overall average for the study years was 2.6%. Collections from some streams also contained unexpectedly high percentages of Pink Salmon originating from hatcheries in Prince William Sound from 1 to 70% from 2014-2017. The overall average for the study years was 23.8%.

Interpretation of these results should be considered with caution due to the limited number of sample years and non-random selection of sample streams (Otis et al. 2018; Otis & Hollowell 2019). The study was considered to be pilot effort and a more comprehensive effort has been implemented according to formal annual operational plan for sampling to provide a robust statistical design for this assessment (Otis et al. 2020, 2021, 2022). This project is also collecting tissue samples, paired with otoliths, so unmarked fish can be used to develop a genetic baseline to examine Pink Salmon stock structure in Lower Cook Inlet. Otoliths are being prepared and read, in preparation for further analysis.

While straying of Pink Salmon from hatcheries has been documented, it generally appears to be a localized issue and hatchery contributions are relatively low in natural production areas segregated from hatchery release sites. The reported percentage of hatchery-origin spawners from LCI Pink Salmon programs of 2.6% in aggregate for LCI stream not adjacent to hatchery release sites met the SG60 benchmark level of pHOS≤20% identified in this assessment based on MSC guidance for salmon enhancement considerations. Of the 13 streams sampled in 2014-2017, 66% averaged less than 5% contribution of LCI hatchery-origin strays in natural spawning areas. This number met the SG60 benchmark level of pHOS <5% in >50% of populations. The incidence of higher percentages of PWS strays in LCI streams is a function of PWS hatchery programs and is addressed under the PWS UoC for this PI.

Despite some incidence of hatchery strays, Pink Salmon index streams consistently met their escapement goals despite increased harvest effort on hatchery Pink Salmon (Otis et al. 2018; Otis & Hollowell 2019; Hollowell 2022, 2023; Munro & Brenner 2022). Wild fish continue to account for most of the spawning escapements. Natural production remains high in streams where hatchery strays are documented at low levels. The effective use of terminal hatchery release sites and fisheries substantially reduces the incidence of straying by LCI hatchery Pink Chinook and risks of overharvest of wild fish in hatchery-enhanced fisheries. Catch sampling of hatchery cost recovery fisheries in Lower Cook Inlet determined that over 95% of the harvest in these terminal fishing areas was comprised of hatchery-origin fish.

The relatively low incidence of hatchery-origin Pink Salmon from LCI hatcheries in most natural spawning areas and consistently high production of natural-origin fish indicates that it is likely that enhancement activities in LCI do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild stocks in most significant natural production areas.

SG80 - The fishery ~~does not meet~~ **meets** this level of performance.

~~The 2018 reassessment included a condition for demonstrating a high likelihood that the enhancement activities in Lower Cook Inlet do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild stocks based on low hatchery contributions and/or impact on wild fitness (MRAG Americas 2019). Milestones for this condition extend through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on hatchery-wild interactions in the Alaska Hatchery. The study is being conducted in Prince William Sound and Southeast Alaska but results are expected to be broadly applicable to other areas. The extended timeline was due to long period required to complete a long-term study over the course of generations of the salmon life cycle.~~

~~Otis & Hollowell (2019) reported on results of sampling LCI streams for the percentage of hatchery strays. Straying of both Lower Cook Inlet and Prince William Sound hatchery Pink Salmon was documented in LCI streams (Otis &Hollowell 2019). Estimated proportions of LCI hatchery-origin Pink Salmon averaging 2.6% in LCI streams met the SG80 benchmark level of pHOS≤10% identified in this assessment based on MSC guidance for salmon enhancement considerations. Only 33% of Pink Salmon stream estimates counted less than 1% contribution of hatchery-origin strays in natural spawning areas which does not meet the SG80 benchmark level of 50%. The incidence of higher percentages of PWS strays in LCI streams is a function of PWS hatchery programs and is addressed under the PWS UoC for this PI.~~

~~Based on observed hatchery-origin stray rates in relation to provisional benchmarks and related information, it cannot be concluded with a high likelihood that enhancement activities in LCI do not have significant negative impacts on of wild stocks of Pink Salmon in LCI. Additional information on the relative reproductive success (RRS) of hatchery and wild spawners from the ongoing Alaska Hatchery Research Project is expected to inform further assessments of the actual impact of low levels of hatchery straying on wild stocks of Pink Salmon.~~

Reported hatchery-origin spawners of Pink Salmon in LCI did not meet the SG80 benchmark level of pHOS≤10% in aggregate or a pHOS <1% in >50% of populations. Combined contributions of LCI and PWS hatchery fish averaged 34.3% and ranged from 1.6 to 92.9%. Of the 17 sample streams, just 6% averaged less than 5% contribution of combined LCI and PWS hatchery-origin strays in natural spawning areas in 2014-2017.

Straying from LCI hatcheries was very low except in a few streams adjacent to Tutka and Port Graham hatchery release sites (pHOS up to 92.9%). Contributions from LCI hatcheries were much lower in streams that were not in direct proximity to hatchery release sites averaging just 3% and ranging from 0 to 7%. Of the 17 sample streams, 59% averaged less than 5% contribution of LCI hatchery-origin strays in natural spawning areas in 2014-2017. However, significant contributions of Prince Willam Sound hatchery Pink Salmon were widely observed in LCI streams, averaging 22% in sample streams and ranging from 1% to 71%.

Relative reproductive success of Prince William Sound hatchery salmon has been found to be significantly less than that of natural-origin fish. As an index of potential net impact, we estimate that a 70% reduction in hatchery RRS combined with a 34% aggregate hatchery contribution would produce just a net 24% reduction in natural production in any given year and less than that if the demographic contributions of hatchery-origin spawners were considered.

At the same time, Pink Salmon escapements in LCI consistently meet or exceed established goals in all districts in the majority of years, even when the contributions of hatchery strays are removed. Wild Pink Salmon abundance and productivity in LCI and throughout the Pacific is currently at record high levels although numbers can vary considerably from year to year. Thus, current stock assessments do not support the hypothesis for significant negative impacts based on estimates of hatchery-origin spawners and relative reproductive success alone. Continuing high returns and escapements at or above goals based on sustained yields provide strong evidence that enhancement activities are highly likely not to have significant negative impacts on this stock.

SG100 - ~~This standard is not met based on failure to achieve SG80~~. Not achieved for this UoA where contributions of hatchery Pink Salmon to natural spawning populations have been identified but the impact of enhancement activities on wild-stock status, productivity, and diversity has not been quantified with a high degree of certainty.

References
ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage		
Overall Performance Indicator score	Southeast	~~60~~ **80**
	Yakutat	100
	Prince William Sound	~~60~~ **80**
	Copper/Bering Districts	100
	Lower Cook Inlet	~~60~~ **80**
	Upper Cook Inlet	100
	Bristol Bay	100
	Yukon River	100
	Kuskokwim	100
	Kotzebue	100
	Norton Sound	100
	Kodiak	80
	Chignik	100
	Peninsula/ Aleutian Is.	100
Conditions	~~**1, 2, 3**~~	
~~**Condition 1.**~~	~~**Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Chum Salmon enhancement activities in Southeast Alaska do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2024).**~~	
~~**Condition 2.**~~	~~**Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink and Chum Salmon enhancement activities in Prince William Sound do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2023).**~~	
~~**Condition 3.**~~	~~**Meet the SG 80 scoring requirements for PI 1.3.1 by demonstrating a high likelihood that Pink and Chum Salmon enhancement activities in Lower Cook Inlet do not have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of wild salmon stocks (by the end of 2023).**~~	

PI 1.3.3 – Enhancement information

PI 1.3.3		**Relevant information is collected and assessments are adequate to determine the effect of enhancement activities on wild stock(s)**		
Scoring Issue		SG 60	SG 80	SG 100
b	Use of information in assessment			
	Guide post	The effect of enhancement activities on wild stock status, productivity and diversity are taken into account qualitatively.	A **moderate-level analysis** of relevant information is conducted and used by decision makers to quantitatively estimate the impact of enhancement activities on wild-stock status, productivity, and diversity.	A **comprehensive analysis** of relevant information is conducted and routinely used by decision makers to determine, with a high degree of certainty, the quantitative impact of enhancement activities on wild-stock status, productivity, and diversity.
	Met?	Yes (all UoCs)	~~No~~ ~~Yes~~: Southeast Alaska, Prince William Sound, Lower Cook Inlet Yes: Yakutat, Copper/Bering, Upper Cook Inlet, Kodiak, Yukon, Kuskokwim, Kotzebue, Norton Sound, Bristol Bay, Chignik, Peninsula/Aleutian Island	No: Southeast Alaska, Prince William Sound, Kodiak, Lower Cook Inlet Yes: Yakutat, Copper/Bering, Upper Cook Inlet, Yukon, Kuskokwim, Kotzebue, Norton Sound, Bristol Bay, Chignik, Peninsula/Aleutian Island
Rationale				

All guideposts are met for UoCs without significant hatchery enhancement programs (Yakutat [UoA 2], Copper/Bering [UoA 3], Upper Cook Inlet [UoA 6], Yukon [UoA 12], Kuskokwim [UoA 11], Kotzebue [UoA 14], Norton Sound [UoA 13], Bristol Bay [UoA 10], Chignik [UoA 8], Peninsula/Aleutian Island [UoA 9]). Scores for the remaining UoCs (Southeast Alaska [UoA 1], Prince William Sound [UoA 4], Lower Cook Inlet [UoA 5], Kodiak [UoA 7]) are as follows:

~~SG80 - This standard is not met for Southeast Alaska, Prince William Sound or Lower Cook Inlet. The standard is met for Kodiak. This standard is met.~~

~~A series of related conditions were identified in the previous reassessment allowances (MRAG 2018). Milestones for this condition extended through 2023 and this condition was open as of the 2022 surveillance audit, pending completion and peer review of a report on the comprehensive hatchery-wild interaction study for Southeast Alaska Chum Salmon. The extended timeline was due to long period required to complete a long-term study of hatchery-wild Pink and Chum Salmon interactions and relative fitness.~~

~~Contributions of hatchery strays to natural productions areas have now been assessed in all areas (Otis & Hollowell 2019; Josephson et al. 2021; Knudsen et al. 2021; Weber 2021, 2022; Americus et al. 2022b). Additional information on relative reproductive success of hatchery and wild Pink and Chum Salmon is needed from ongoing hatchery studies in order to quantify the impacts to wild production of observed levels of hatchery straying relative to outcome indicators in PI 1.3.1 for Southeast Alaska, Prince William Sound and Lower Cook Inlet. Numbers of hatchery fish produced in Kodiak hatcheries and information on mark sampling of catch and escapements are such that further analyses of hatchery impacts are not needed at this SG level.~~

SG80 – This standard is met for all UoAs including those where significant hatchery enhancement occurs. Hatchery salmon contributions to fisheries and corresponding harvest rates are documented annually based on comprehensive marking programs that have been implemented for Alaska hatchery production and mark sampling programs in affected fisheries (Wilson 2024). Potential impacts of Alaska hatchery enhancement activities on wild-stocks have been subject of extensive research and analysis since 2000 (Hilborn & Eggers 2000, 2001; Mortensen et al. 2000; Wertheimer et al. 2001, 2004). A comprehensive, long-term Alaska Hatchery Research Project was initiated in 2013 to assess genetic stock structure, straying and relative fitness in relation to hatchery enhancement (ADF&G 2018, 2022; Americus et al. 2022b, 2025).

A series of hatchery straying assessments were conducted beginning in the 2000s to assess potential hatchery-wild interactions. Hatchery Sockeye Salmon straying was studied in Kodiak (Baer and Honnold 2002), the Copper River basin (Bidlack and Valentine 2009) and the Kenai River (Habicht et al. 2013; Stopha 2012). Hatchery Chum Salmon straying was assessed in Southeast Alaska (Piston and Heinl 2012a, 2012b; Knudsen et al. 2015a, 2015b, 2016, 2021; Josephson et al. 2021; McCarrel et al. 2023), Prince William Sound (Brenner et al. 2012; Knudsen et al. 2015a, 2015b, 2016, 2021) and Kodiak (Weber 2021, 2022). Hatchery Pink Salmon straying was assessed in Prince William Sound (Knudsen et al. 2015a, 2015b, 2016, 2021), lower Cook Inlet (Hollowell et al. 2017; Otis et al. 2018, 2020, 2021, 2022, 2023; Otis & Hollowell 2019) and Kodiak (Weber 2021, 2022). Hatchery Chinook Salmon straying was reportedly monitored on several Southeast Alaska systems over an extended period (Wilson 2024).

Genetic stock structure has been identified in all salmon species which could be impacted if hatchery-wild interactions were significant including Pink Salmon (Cheng et al. 2016, 2019, 2022; Jasper et. al. 2013), Chum Salmon (Gilk-Baumer & Templin 2019; Barclay et al. 2024) and Sockeye Salmon (Quinn et al. 2012. Relative reproductive success of hatchery and wild fish has been assessed for Pink Salmon and is being assessed for Chum Salmon (Lescak & Dann 2019; Lescak et al. 2019; McMahon 2021; Shedd et al. 2022). Phenotypic, phenological and genetic differences between hatchery and wild Pink Salmon has been assessed in relation to reproductive success in Prince William Sound (McMahon et al. 2025). Potential for long-term demographic and evolutionary consequences arising from specific hatchery–wild interactions due to reduced fitness of hatchery fish have been assessed based on quantitative genetic modelling (May et al. 2024).

This information is sufficient and has been demonstrably applied by decision makers to support a moderate-level analysis of quantitatively estimates the impact of enhancement activities on wild-stock status, productivity, and diversity.

SG100 - ~~Not achieved based on SG80 scores Southeast Alaska, Prince William Sound and Lower Cook Inlet. No achieved for Kodiak because moderate level analyses completed to date are not considered comprehensive.~~ Not achieved for Southeast Alaska, Prince William Sound, Lower Cook Inlet and Kodiak where contributions of hatchery Pink and Chum salmon to natural spawning populations have been identified but the impact of enhancement activities on wild-stock status, productivity, and diversity has not been quantified with a high degree of certainty.

References

ADF&G 2018, 2022; Americus et al. 2022; Americus 2025; Barclay et al. 2024; Cheng et al. 2016, 2019, 2022; Gilk-Baumer & Templin 2019; Hollowell et al. 2017; Jasper et. al. 2013; Josephson et al. 2021; Knudsen et al. 2015a, 2015b, 2016, 2021; Lescak & Dann 2019; Lescak et al. 2019; May et al. 2024; McCarrel et al. 2023; McMahon 2021; McMahon et al. 2025; Otis & Hollowell 2019; Otis et al. 2018, 2020, 2021, 2022, 2023; Piston and Heinl 2012a, 2012b; Shedd et al. 2022; Weber 2021, 2022

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	Southeast	~~70~~ **80**
	Yakutat	100
	Prince William Sound	~~70~~ **80**
	Copper/Bering Districts	100

	Lower Cook Inlet	~~70~~ **80**
	Upper Cook Inlet	100
	Bristol Bay	100
	Yukon River	100
	Kuskokwim	100
	Kotzebue	100
	Norton Sound	100
	Kodiak	80
	Chignik	100
	Peninsula/ Aleutian Is.	100
Condition number (if relevant)	**4**	

~~**Condition 4. Meet the SG 80 scoring requirements for PI 1.3.3b by demonstrating that a moderate-level analysis of relevant information on hatchery straying and relative fitness is conducted and used by decision makers to quantitatively estimate the impact of enhancement activities on wild-stock status, productivity, and diversity of Pink and Chum Salmon in Southeast Alaska, Prince William Sound and Lower Cook Inlet (by the end of 2023).**~~

PI 3.2.2 – Decision-making processes

PI 3.2.2		**The fishery-specific and associated enhancement management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery**		
Scoring Issue		SG 60	SG 80	SG 100
C	Use of precautionary approach			
	Guide post		Decision-making processes use the precautionary approach and are based on best available information.	
	Met?		~~No~~Yes for all UoAs	
Rationale				

SG 80 – This standard is ~~not~~ met. Decision-making processes generally use best available information and typically balance the socio-economic needs with the precautionary approach to maintain sustainable fisheries. Evidence for this is shown from consistent achievement of established escapement goals overall, and where this is not the case, management has responded by closing fisheries where appropriate and designating Stocks of Concern which require specific management and monitoring action. The precautionary approach is mandated by specific precisions in the Sustainable Salmon Fishery Policy adopted by the Board of Fisheries. The scientific basis for fishery management is continually being refined based on an extensive research program.

~~However, it is unclear whether decision-making processes are sufficiently precautionary in every case where issues are identified including those related to enhancement issues (e. g., straying of hatchery Pink or Chum Salmon into West Crawfish, Lower Cook Inlet and Kodiak spawning streams) has been sufficient at level consistent with SG80. These examples concern an issue with enhanced UoAs but the concern is broadly applicable to the management system as it is applied to all UoAs.~~

Recent experience has also demonstrated application of the precautionary approach in the decision-making process based on best available information regarding potential negative impacts of hatchery enhancement:

- Every individual hatchery program was evaluated from 2011-2017 for consistency with policies, permits and prescribed management practices specifically intended to protect wild salmon stocks. Issues of non-compliance were addressed as identified.
- A comprehensive review was completed in 2018 of Alaska hatchery procedures, practices, fishery management, and stock assessment relevant to the hatchery program for consistency with precautionary plans, permits, and policies that have guided salmon enhancement in Alaska in a manner that protects wild stocks. The evaluation identified recommendations for improvements including clarification of the several elements of the genetic policy, improved communication to regulatory bodies and stakeholders, and the need for continuing basic research to better understand homing and effects of straying. Recommendations have been implemented.
- In 2011, concern about possible impacts on wild stocks of large-scale hatchery production of Pink and Chum Salmon led ADF&G to organize a Science Panel for the purpose of defining the specific issues associated with this concern. This panel continues to provide independent review of hatchery assessments and related recommendations.
- A comprehensive, long-term Alaska Hatchery Research Project was conducted from 2013-present to assess the magnitude of hatchery impacts based on investigations of genetic stock structure, straying and relative fitness in relation to hatchery enhancement.
- A Hatchery Committee was convened in the Alaska Board of Fisheries to review and consider current information in considering and adopting regulations to allocate resources between user groups; establish fish reserves and conservation areas, fishing seasons, quotas, and bag limits size restrictions, means and methods, habitat protection, stock enhancement; and to develop commercial, subsistence, sport and personal use fisheries.
- Pending completion of the Alaska Hatchery Research Project, the ADF&G commissioner issued a “Hatchery Statement” in 2024 articulating a policy decision to not increase permitted Pink Salmon egg-take capacity until concerns over hatchery-wild interactions are addressed (Vincent-Lang 2024).

In a specific case of hatchery Chum Salmon straying in Crawfish Inlet of Southeast Alaska:

- Annual assessments of hatchery straying into a nearby escapement index stream were implemented to determine the magnitude and nature of issue.
- Targeted hatchery cost recovery and common property net and troll fisheries have been implemented to maximize harvest of the hatchery fish to reduce the incidence of straying. These fisheries have successfully reduced escapements of large numbers of hatchery Chum Salmon.
- The West Crawfish NE arm index stream has been removed from the annual escapement index so as not to confound assessments of wild stock status
- Fry outmigration patterns were assessed to identify potential factors in the olfactory imprinting life stage that might contribute to straying. Additional telemetry studies are planned to assess adult migration patterns in relation to straying.
- In response to the Northern Outside Southeast Alaska Chum Salmon Stock of Concern designation, the Commissioner of ADF&G issued a statement at the 2025 Board of Fisheries meeting identifying an intent to reduce permitted hatchery Chum Salmon egg take by 25% in 2025 (Vincent-Lang 2025). This reduction in conjunction with increased monitoring, was intended to help better assess and understand the impacts of wild Chum Salmon in the area. The proposed reduction was supported by the regional aquaculture association in 2/7/2025 testimony to the Board of Fisheries.
- The Alaska Board of Fisheries reviewed options for reducing straying of hatchery-produced Chum Salmon and incidental harvest of wild summer-run Chum Salmon at their February 2025 Southeast Alaska meeting as part of an action plan for addressing the NSE Outside summer Chum Salmon

designation as a stock of Management Concern in 2024. The Board of Fisheries effectively supported the Commissioner's planned reduction in permitted release number in Crawfish Inlet. Board members spoke to the importance of protecting wild stocks as the first priority, adequately enforcing the existing genetics management policy and identifying criteria for acceptable levels of straying.

- The Commissioner also directed the Joint Southeast Regional Planning Team to conduct a review of Chum Salmon release strategies, release numbers, and release locations and report to the commissioner by December 31, 2025, their findings and recommendations regarding what is working well, what is not working well, impacts on wild salmon stocks, and potential improvements to the salmon fishery enhancement program (Vincent-Lang 2025).

These actions demonstrate a precautionary approach in decision-making processes including those related to enhancement issues.

References

Clark et al. 2006

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage	
Overall Performance Indicator score	~~75~~ **80**
Condition number (if relevant)	~~**5**~~

~~**Condition 5. Meet the SG 80 scoring requirements for PI 3.3.2c by demonstrating that decision-making processes use the precautionary approach and are based on best available information as applied the Pink and Chum Salmon hatchery enhancement programs (by the end of 2023). [Condition is applicable to all UoAs.]**~~

The resulting updated Principle-Level scores are given below:

UoC	SEAK	Yak	C-B	PWS	LCI	UCI	Kodiak	Chignik	Pen/AI	Bristol	Yukon	Kusko	Kotz	Norton
Principle 1	87.5	96.9	96.9	93.7	87.5	92.5	87.5	93.7	98.7	98.1	92.5	97.5	96.9	93.1
Principle 2	85.3	89.7	86.7	85.3	86.7	88.0	88.0	90.7	90.7	90.7	90.7	90.7	90.7	90.7
Principle 3	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2

5 Evaluation Processes & Techniques

The process as defined in the MSC Fishery Certification Process v2.e was followed in this audit. Information supplied by the clients and management agencies was reviewed by the assessment team ahead of audit meetings, and discussions with the clients and management agencies centered on the content within the provided documentation. In cases where relevant documentation was not provided in advance of the meeting, it was requested by the assessment team and subsequently supplied during or shortly after the meeting.

5.1 Site visit

The audit was conducted remotely by Zoom conference during January 10-24, 2025. The audit team consisted of Amanda Stern-Pirlot (team leader), Ray Beamesderfer and Scott Marshall, all of whom were members of the assessment team. The meeting itinerary and participants can be found in Table 7 and Table 8.

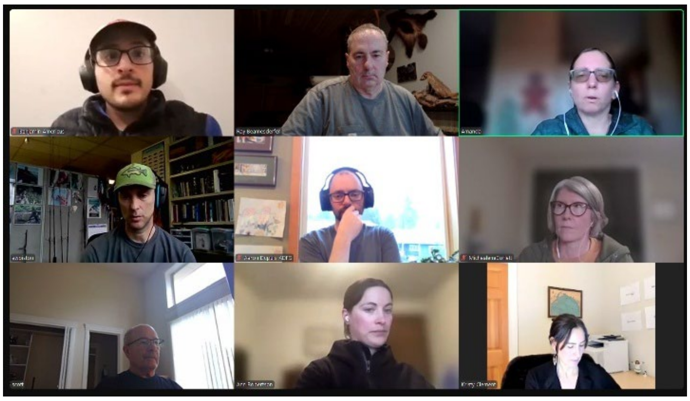
Table 7. Audit meetings.

	Date	Subject
1	1/10/2025	Southeast Alaska chum status & management
2	1/23/2025	Alaska hatchery research project & management
3	1/24/2025	Northern Southeast Regional Aquaculture Associations
4	1/29/2025	Audit conclusions Alaska Fishery Development Foundation

Table 8. Audit meeting attendees.

Name	Affiliation	1	2	3	4
Amanda Stern Pirlot	MRAG Audit team leader	X			X
Michealene Corlett	MRAG audit team support	X			X
Scott Marshall	Audit team member	X			X
Ray Beamesderfer	Audit team member	X	X	X	X
Kristy Clement	AFDF	X			X
Ann Robertson	AFDF	X	X	X	X
Ben Americus	AFDF	X			X
Aaron Dupuis	Alaska Dept. Fish & Game	X			
Andy Piston	Alaska Dept. Fish & Game	X			
Forest Bowers	Alaska Dept. Fish & Game		X		
Bill Templin	Alaska Dept. Fish & Game		X		
Kristen Gruenthal	Alaska Dept. Fish & Game		X		
Kyle Shedd	Alaska Dept. Fish & Game		X		
Sara Gilk-Baumer	Alaska Dept. Fish & Game		X		
Scott Wagner	Northern Southeast Aquaculture Association			X	
Taylor Scott	Northern Southeast Aquaculture Association			X	

1. Southeast Alaska chum status & management



2. Alaska hatchery research project & management

3. Northern Southeast Regional Aquaculture Associations

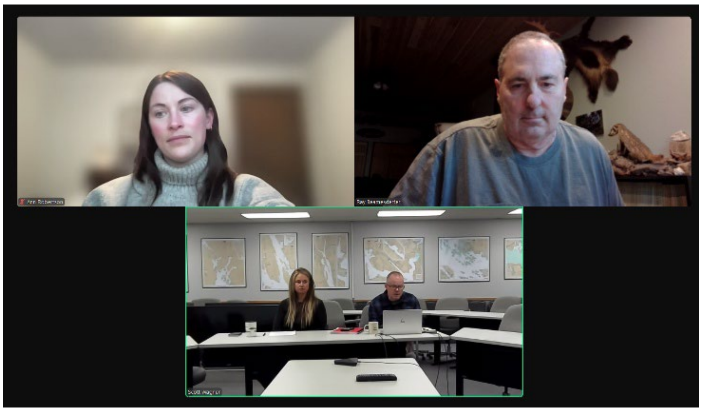


Figure 26. Screen shots of audit meeting attendees.

5.2 Stakeholder participation & Input

Thirty days prior to the surveillance audit, all stakeholders from the full assessment and previous surveillance audits were informed of the meeting and the opportunity to provide information to the auditors in advance of, or during, the meeting. The notification of the surveillance audit was also published on the MSC website on 6 December 2024.

Stakeholder input was received from a consortium of Canadian conservation organizations (*Raincoast Conservation Foundation, SkeenaWild Conservation Trust, Watershed Watch Salmon Society*) and is addressed as follows.

Raincoast Conservation Foundation, SkeenaWild Conservation Trust, Watershed Watch Salmon Society

General comments	Evidence or references	CAB response	Response Code
In the last 2 decades, more than 1.4 billion hatchery salmon have been released annually in Alaska, with just under 1.9 billion released in 2023 (ADF&G 2023). This is 4.2 times more hatchery salmon released by Alaska than by all other facilities releasing hatchery salmon into the northeast Pacific Ocean combined (ie by WA, OR, ID, CA & BC; Ruggerone & Springer 2024). Currently, 83% of chum salmon catch and 43% of pink salmon catch in the Gulf of Alaska are of hatchery origin (Ruggerone & springer 2024). In Alaska, the catch ratio of hatchery to wild is 5:1 This production, especially of pink salmon, has been linked to significant declines in: sockeye productivity in BC (Connors et al. 2020, 2024), altering the age composition of sockeye in SEAK (McPhee et al. 2024), sockeye salmon growth in Alaska (Rand & Ruggerone 2024), a decline in Chinook salmon stomach fullness (Davis 2003, Ruggerone et al. 2023), Chinook salmon abundance and size in BC and Alaska (Ruggerone et al. 2023), length at age of SEAK Chinook, and suppressing the natural reduction in density effects on growth & survival when the abundance of wild salmon is low (Ruggerone & Irving 2018, Ruggerone et al. 2023). The impacts of large-scale hatchery production are also not limited to salmon species, affecting fisheries, wildlife and food webs throughout the North Pacific Ocean (Ruggerone et al. 2023). These results provide highly plausible mechanisms of evidence across multiple scales and species that there are negative effects of high pink salmon abundance, and that Alaska's industrial scale enhancement activities exacerbate these effects on wild salmon. It would be extremely difficult for the CAB or the client to conclude objectively that these activities do not have significant negative impacts. This is applicable to all UoAs with conditions related to hatchery influence under review in this surveillance audit.	Connors et al. 2020 Climate and competition influence sockeye salmon population dynamics across the Northeast Pacific Ocean; Connors et al. 2024 Adapting management of Pacific salmon to a warming and more crowded ocean; McPhee et al. 2024 Hatchery supplementation provides a demographic boost but alters age composition of sockeye salmon in Auke Lake, Southeast Alaska; Rand & Ruggerone Biennial patterns in Alaskan sockeye salmon ocean growth are associated with pink salmon abundance in the Gulf of Alaska and the Bering Sea; Davis 2003 Feeding Ecology of Pacific Salmon (Oncorhynchus spp.) in the Central North Pacific Ocean and Central Bering Sea, 1991-2000; Ruggerone et al. 2023 From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems; Ruggerone & Irvine 2018 - Numbers and Biomass of Natural- and Hatchery-Origin Pink Salmon, Chum Salmon, and Sockeye Salmon in the North Pacific Ocean, 1925–2015	Based on the weight of available scientific evidence, the 2024 MSC Salmon Fishery Certification assessment concluded that hatchery salmon are a significant component of the marine ecosystem; interact directly or indirectly with many prey, competitor and predator species; and must inevitably have some influence on other ecosystem components. However, hatchery Pink Salmon from Alaska likely exert a marginal effect on the dynamics of the North Pacific marine ecosystem due to their low percentage contribution to total abundance. Alaska accounted for just 10% of the combined wild and hatchery total of Pink Salmon and 11% of Chum Salmon by number in the North Pacific based on estimates in Ruggerone & Irvine (2018). Alaska-produced hatchery-origin salmon comprise an even lower percentage of the salmon total based on biomass (Templin 2024; Americus et al. 2025) – just 2.1% of Pink Salmon and 5.3% for Chum Salmon of the combined total ocean biomass of pink, chum and Sockeye Salmon. Large even-odd year differences in Pink Salmon abundance are driven by wild production. Marginal effects of hatchery Pink Salmon are dwarfed by normal variation in wild Pink Salmon abundance, abundance of other salmon stocks, environmental drivers and other ecosystem elements. While hatchery fish likely contribute to density dependent changes in size at age, and survival, this concern does not rise to a level where ecosystem structure or function has likely been disrupted to a point where there is serious or irreversible harm.	Not accepted (information for PI score has not changed)

Performance Indicator	Condition	Input detail	Evidence or references	CAB response	Response Code
1.3.1 Enhancement outcomes SEAK	1	In 2023, SEAK released 607 million hatchery chum salmon (ADF&G 2023; Alaska salmon fisheries enhancement annual report, 2023). In Crawfish Inlet (where straying hatchery chum was examined in 2019, major increases in straying (from a chum hatchery release earlier in Crawfish Inlet), were observed in two of the nine wild salmon index streams in this northern outside SEAK region. The proportion of stray hatchery chum in West Crawfish NE Arm Head index stream was 94% in September, and consisted of more than 10,000 hatchery fish who spawned or attempted to spawn in the wild stock index stream (Piston and Heini. 2020). Without Alaskan guidelines for the percentage of Hatchery Origin Spawners, MSC developed provisional benchmarks for pink and chum. To meet the SG 60 in an SMU pHOS must be < 20%. To meet SG 60 at the population level, pHOS must be <5% in more than 50% of populations. To meet the SG 80 in an SMU, pHOS must be < 10% and to meet SG 80 in a population. Based on the extent of information provided by ADFG, it would appear that there will be many cases where the PHOS benchmarks not being met at either the 80 or 60 SG, and that ADFG has not otherwise done the work to show that these benchmarks are met. These increases in straying hatchery fish present challenges for monitoring wild stock escapements and assessing escapement goal performance as required by the sustainable salmon fisheries policy (Piston and Heinl 2019, Chum Salmon Stock Status and Escapement Goals in Southeast Alaska through 2019), as well as the viability of wild chum populations. There would be major impacts on local reproductive performance and productivity in the wild salmon population here, especially considering the hatchery returns overlap the tail of the wild chum population, likely causing impacts such as redd superimposition. The report clearly identifies that further research is needed to determine the consequences of these interactions. This is only one location - and other locations would have similar conditions especially close	ADF&G 2023; Alaska salmon fisheries enhancement annual report, 2023. https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2024.05.pdf Piston, A. W., and S. C. Heinl. 2020. Chum salmon stock status and escapement goals in Southeast Alaska through 2019. Alaska Department of Fish and Game, Special Publication No. 20-10, Anchorage. Evenson, D. F., C. Habicht, M. Stopha, A. R. Munro, T. R. Meyers, and W. D. Templin. 2018. Salmon hatcheries in Alaska – A review of the implementation of plans, permits, and policies designed to provide protection for wild stocks. Alaska Department of Fish and Game, Special Publication No. 18-12, Anchorage. Josephson et al. 2021, Proportions of Hatchery Fish in Escapements of Summer-Run Chum Salmon in Southeast Alaska, 2013-2015) McCarrel et al. 2023, Sitka Sound Science Center Interactions of Wild and Hatchery Chum Salmon in Southeast Alaska Figure 1: Average weight of catch for each species of salmon from 1980-2023 for the 3 Units o Assessment reported on the ADFG Catch statistics website. Figure 2: Average weight of catch for each species of salmon from 2015-2023 for the 3 Units of Assessment reported on the ADFG Catch statistics website.	This expedited audit report includes a comprehensive review of scientific information on hatchery risks and effects including related information in Alaska as referenced by this stakeholder comment. Outcome indicators were assessed based on provisional guidelines for artificial production based on the percentage of hatchery-origin spawners (pHOS) contributing to natural production in aggregate and among populations for the Stock Management Unit as identified in FS2.01 GSC1 of FS 2.01 identifies guidelines. Guidelines are not obligatory but provide useful benchmark for evaluating the potential for negative hatchery impacts due to straying. the assessment also considered related quantitative and qualitative information on: • Scale and locations of hatchery programs in relation to natural production • Marking of hatchery fish such that they are accounted for in harvest and escapement • Differential harvest patterns of hatchery and natural fish to avoid overharvest of wild stocks • Genetic stock structure of the species • Contribution of hatchery-origin strays on natural spawning grounds • Relative fitness of hatchery and wild spawners • Wild stock productivity as reflected in escapements relative to goals. The assessment also considered potential confounding effects of hatchery strays in assessments relative to wild escapement goals and specific concerns regarding Chum Salmon straying in Southeast Alaska's Crawfish Inlet Additional details may be found in the revised scoring rationale for this PI. Ecosystem impacts in marine waters of hatchery enhancement are considered in Principle 2 of the MSC Fisheries Standard. Related P2 performance indicators met at the Scoring Guidepost 80 level in the 2024 Alaska salmon fishery assessment. Based on	Not accepted (information for PI score has not changed)

		to enhancement facilities (see example Josephson et al. 2021, Proportions of Hatchery Fish in Escapements of Summer-Run Chum Salmon in Southeast Alaska, 2013-2015). Chum enhancement in SEAK has increased since the 2013-2015 study period. This level of straying and hatchery influence would eliminate any wild population within a short time span. There are also reports that hatchery chum in SEAK are getting smaller, a phenomenon with consequences for reproductive capacity and productivity. For example, in Fish Creek, ADF&G state that 83.3% of chum sampled were hatchery origin and the average lengths of returning chum in 2023 were small compared to the average size of males and females observed over the past decade (McCarrel et al. 2023, Sitka Sound Science Center Interactions of Wild and Hatchery Chum Salmon in Southeast Alaska). Figure 1 shows the average weight (lbs) of Chinook, chum, coho, pink, and sockeye salmon from 1980-2023 using ADFG data. There are clear declines in the average weight of catch across all species in all areas, including SEAK chum. Longer-term declines in pink salmon are not evident from 1980 on, however, there is a recent trend over the last 10 years of decline in average catch weight (Figure 2). See supplemental attachment for figures. This provides indirect evidence that there are likely profound impacts of competition on the high seas that are reducing the size of salmon returning. This explicitly means that enhancement activities are likely affecting the productivity of wild salmon. SEAK chum enhancement is a large part of this - representing the vast majority of North American chum releases. The onus provided by the condition in the Surveillance Audit requires the client and CAB to demonstrate that industrial scale enhancement of chum in SEAK is not likely to be causing detrimental effects on wild salmon, which is unlikely to be shown with enough confidence to meet a SG 80 score.		the weight of available scientific evidence, the assessment concluded that hatchery salmon are a significant component of the marine ecosystem; interact directly or indirectly with many prey, competitor and predator species; and must inevitably have some influence on other ecosystem components. Hatchery Pink Salmon from Alaska likely exert a marginal effect on the dynamics of the North Pacific marine ecosystem due to their low percentage contribution to total abundance.	
1.3.1 Enhancement outcomes	2	Prince William Sound is North America's biggest producer of hatchery salmon releasing just under 740,000,000 pink salmon and 132,000,000 chum in 2023 (ADFG 2023). 2023 marks the highest release year on	ADF&G 2023; Alaska salmon fisheries enhancement annual report, 2023.	This expedited audit report includes a comprehensive review of scientific information on hatchery risks and	Not accepted (informati on for PI

<table>
<tr>
<td>Prince William Sound</td>
<td></td>
<td>record for pink and total salmon releases. The concerns identified to date regarding the ecological, social, and economic consequences to other salmon species and to wild fish from this scale of production are not being addressed and arguably ignored.

Analysis conducted on the catch increases from the hatchery pink production shows it has not yielded the benefits that other areas of Alaska with less pink hatchery production have experienced. Using other regions of Alaska as reference sites, Amorso et al (2017) estimated that the PWS hatchery program had increased the total catch by an average of 17 million fish, of which 8 million have been allocated to pay hatchery operating expenses. They estimate that the maximum sustainable yield (MSY) of wild spawning fish in PWS has increased slightly (28%), while in regions of Alaska without pink salmon hatchery programs the MSY has tripled. These results point to the negative impacts of large-scale pink hatchery production on the productivity of local wild stocks. Given this evidence alone we argue it is highly likely that pink salmon enhancement activities are harming wild salmon productivity.

Furthermore, multiple studies have also documented hatchery fish straying into wild streams (ADF&G 2018; Salmon Hatcheries in Alaska - A review of the implementation of plans, permits, and policies designed to provide protection for wild stocks). Across PWS districts, hatchery proportions in wild streams ranged from 0% to 90%. Evidence shows that PWS hatchery fish are also straying to streams outside PWS. For example, pink salmon from PWS have been observed in streams across Lower Cook Inlet. PWS hatchery pink salmon were present in every Lower Cook Inlet stream sampled. Some LCI streams had up to 70% of their pink abundance contributed by PWS hatchery fish. Overall, straying Prince William Sound hatchery pinks composed 15% of the pink salmon escapement in Lower Cook Inlet in 2017.

Given the hatchery proportions observed and the shallower population structure of pink salmon relative to other Pacific salmon, it is likely that the straying hatchery fish are introgressing genes (ADF&G 2018). A 2024 PWS study (May et al. 2024) found that while enhancement</td>
<td>ADF&G 2018 https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2019.01.pdf

Amoroso, Ricardo O., Michael D. Tillotson, and Ray Hilborn. 2017. Measuring the net biological impact of fisheries enhancement: pink salmon hatcheries can increase yield, but with apparent costs to wild populations. Canadian Journal of Fisheries and Aquatic Sciences. 74(8): 1233-1242. https://doi.org/10.1139/cjfas-2016-0334

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Rand, Peter and Gregory T Ruggerone. 2024. Biennial patterns in Alaskan sockeye salmon ocean growth are associated with pink salmon abundance in the Gulf of Alaska and the Bering Sea, ICES Journal of Marine Science, Volume 81, Issue 4, May 2024, Pages 701–709, https://doi.org/10.1093/icesjms/fsae022

Connors et al. 2020 Climate and competition influence sockeye salmon population dynamics across the Northeast Pacific Ocean; Canadian Journal of Fisheries and Aquatic Sciences 77(6):943-949. https://cdnsciencepub.com/doi/10.1139/cjfas-2019-0422

Connors et al. 2024 Adapting management of Pacific salmon to a warming and more crowded ocean; ICES Journal of Marine</td>
<td>effects including related information in Alaska as referenced by this stakeholder comment.

Outcome indicators were assessed based on provisional guidelines for artificial production based on the percentage of hatchery-origin spawners (pHOS) contributing to natural production in aggregate and among populations for the Stock Management Unit as identified in FS2.01 GSC1 of FS 2.01 identifies guidelines. Guidelines are not obligatory but provide useful benchmark for evaluating the potential for negative hatchery impacts due to straying. the assessment also considered related quantitative and qualitative information on:
• Scale and locations of hatchery programs in relation to natural production
• Marking of hatchery fish such that they are accounted for in harvest and escapement
• Differential harvest patterns of hatchery and natural fish to avoid overharvest of wild stocks
• Genetic stock structure of the species
• Contribution of hatchery-origin strays on natural spawning grounds
• Relative fitness of hatchery and wild spawners
• Wild stock productivity as reflected in escapements relative to goals.

The assessment also considered potential confounding effects of hatchery strays in assessments relative to wild escapement goals.

Additional details may be found in the revised scoring rationale for this PI.</td>
<td>score has not changed)</td>
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		bolstered natural population sizes towards local carrying capacities, hatchery introgression reduced variation in adult return timing by up to 20%. Their results indicate that hatchery-origin alleles can rapidly assimilate into natural populations, despite the reduced fitness of hatchery fish, and demonstrate the potential for long-term demographic and evolutionary consequences arising from specific hatchery–wild interactions. PWS enhancement activities likely have significant negative impacts on the local adaptation, reproductive performance and productivity or diversity of other wild salmon stocks, not just in pink and chum salmon within PWS but within other species throughout the Northeast Pacific. While the milestone for this report implies that the impact from hatchery production in this region is to be assessed on the productivity and diversity of pink and chum salmon, the condition is written to imply that the impacts are to be evaluated on all wild salmon stocks; the condition does not narrow the recipients of these effects to pink and chum salmon. The evidence that follows speaks to impacts on all wild salmon. In the last 2 decades, more than 1.4 billion hatchery salmon have been released annually in Alaska, with just under 1.9 billion released in 2023 (ADF&G 2023). This is 4.2 times more hatchery salmon released by Alaska than by all other facilities releasing hatchery salmon into the northeast Pacific Ocean combined (ie by WA, OR, ID, CA & BC; Ruggerone & Springer 2024). Currently, 83% of chum salmon catch and 43% of pink salmon catch in the Gulf of Alaska are of hatchery origin (Ruggerone & springer 2024). In Alaska, the catch ratio of hatchery to wild is 5:1 This production, especially of pink salmon, has been linked to significant declines in: sockeye productivity in BC (Connors et al. 2020, 2024), altering the age composition of sockeye in SEAK (McPhee et al. 2024), a decline in Chinook salmon stomach fullness (Davis 2003, Ruggerone et al. 2023), Chinook salmon abundance and size in BC and Alaska (Ruggerone et al. 2023), length at age of SEAK Chinook, and suppressing the natural reduction in density effects on growth & survival when the abundance of wild salmon is low	Science, fsae135, https://doi.org/10.1093/icesjms/fsae135 McPhee et al. 2024 Hatchery supplementation provides a demographic boost but alters age composition of sockeye salmon in Auke Lake, Southeast Alaska; Evolutionary apapalications https://doi.org/10.1111/eva.13640 Davis 2003 Feeding Ecology of Pacific Salmon (Oncorhynchus spp.) in the Central North Pacific Ocean and Central Bering Sea, 1991-2000; https://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2018-2019/july_petitions/davis.pdf Ruggerone et al. 2023 From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems; Mar Ecol Prog Ser https://www.int-res.com/articles/feature/m719p001.pdf Ruggerone & Irvine 2018 - Numbers and Biomass of Natural- and Hatchery-Origin Pink Salmon, Chum Salmon, and Sockeye Salmon in the North Pacific Ocean, 1925–2015. Marine and costal fisheries https://doi.org/10.1002/mcf2.10023		

		(Ruggerone & Irving 2018, Ruggerone et al. 2023). The impacts of large-scale hatchery production are also not limited to salmon species, affecting fisheries, wildlife and foodwebs throughout the North Pacific Ocean (Ruggerone et al. 2023). These results provide highly plausible mechanisms of evidence across multiple scales and species that there are negative effects of high pink salmon abundance, and that Alaska's industrial scale enhancement activities exacerbate these effects on wild salmon. It would be extremely difficult for the CAB or the client to conclude objectively that these activities do not have significant negative impacts.			
1.3.1 Enhancement outcomes Lower Cook Inlet	3	In 2023, the Cook Inlet region released 21,000,000 pink salmon. Studies on pink salmon straying and introgression have demonstrated in Prince William Sound, excessive hatchery production is having negative impacts within Alaska and beyond. As stated above, streams across Lower Cook Inlet in 2017 had up to 70 percent of their returns composed of releases from Prince William Sound hatcheries with PWS hatchery pink salmon present in every Lower Cook Inlet stream sampled. Overall, Prince William Sound hatchery pinks composed 15% of the pink salmon escapement in Lower Cook Inlet in 2017. This is in addition to any straying of hatchery pink salmon produced within the LCI region, but we have not found any published studies on LCI pink straying in peer-reviewed literature or ADFG's reports. As stated above, the consequences of such straying are likely to cause introgressive genetic hybridization of wild fish (ADF&G 2018). In PWS, hatchery introgression reduced variation in adult return timing by up to 20%. The findings from PWS indicate that hatchery-origin alleles can rapidly assimilate into natural populations, despite the reduced fitness of hatchery fish, and demonstrate the potential for long-term demographic and evolutionary consequences arising from specific hatchery–wild interactions.	ADF&G 2023; Alaska salmon fisheries enhancement annual report, 2023. https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2024.05.pdf	This expedited audit report includes a comprehensive review of scientific information on hatchery risks and effects including related information in Alaska as referenced by this stakeholder comment. Outcome indicators were assessed based on provisional guidelines for artificial production based on the percentage of hatchery-origin spawners (pHOS) contributing to natural production in aggregate and among populations for the Stock Management Unit as identified in FS2.01 GSC1 of FS 2.01 identifies guidelines. Guidelines are not obligatory but provide useful benchmark for evaluating the potential for negative hatchery impacts due to straying. the assessment also considered related quantitative and qualitative information on: • Scale and locations of hatchery programs in relation to natural production • Marking of hatchery fish such that they are accounted for in harvest and escapement • Differential harvest patterns of hatchery and natural fish to avoid overharvest of wild stocks • Genetic stock structure of the species • Contribution of hatchery-origin strays on natural spawning grounds • Relative fitness of hatchery and wild spawners • Wild stock productivity as reflected in escapements relative to goals.	Not accepted (information for PI score has not changed)

				The assessment also considered potential confounding effects of hatchery strays in assessments relative to wild escapement goals. Additional details may be found in the revised scoring rationale for this PI.	
1.3.3b Enhancement Information SEAK, PWS & LCI	4	We cannot find a comprehensive peer reviewed paper(s) by the client that evaluate the effects of enhacement activites on pink and chum salmon in Alaska. All indpendent papers we have found identify signifcant concerns from the level of enhancement that is occuring in Alaska, not just to pink and chum salmon, but other species of salmon and other species of wildlife within and beyond Alaska. Reports by ADF&G twith titles that suggest an examination of wild-hatchery interactions lack analysis on such interactions or their effects.		This expedited audit report includes a comprehensive review of scientific information on hatchery risks and effects including related information in Alaska. This included a series of reports and published peer-reviewed scientific articles produced by the Alaska Hatchery Research project as well as the state of the science on hatchery-wild interactions of salmon in other regions. This assessment does not support the subjective description of the available information by this stakeholder.	Not accepted (information for PI score has not changed)
3.2.2 c Decision making process (All)	5	Despite the serious implications of industrial-scale hatchery production occurring in Alaska and the call for review of these enhancement activities within and outside of Alaska, including from fisheries scientists (Connors et al 2024, Peterman et al, 2012, Irvine et al. 2020) and the Alaska Board of Fisheries, hatchery production in 2023 was the highest in the state's history, with no adaptive response being expressed by the state. The precautionary approach requires caution when scientific knowledge is uncertain, and not using an absence of adequate information as a reason to postpone or not take action to avoid serious harm to wild salmon. Increasing hatchery production in the absence of adequate knowledge of the impacts to wild salmon is not precautionary. Further, any adaptive appraoch or response to the substantial evidence on the level of harm that is occurring from Alaska's enhancement practices, does not appear to be applied to their enhancement programs. As such, we would argue that decision-making by Alaska that demonstrates a precautionary or adaptive approach based on the best available science would be described as, at best, wanting.	Connors, B. GT. Ruggerone 2, JR. Irvine. 2024. Adapting management of Pacific salmon to a warming and more crowded ocean ICES Journal of Marine Science, 2024, Vol. 0, Issue 0, 1–10. https://doi.org/10.1093/icesjms/fsae135 Peterman, Randal, Carrie A. Holt1 and Murray R. Rutherford. 2012 The Need for International Cooperation to Reduce Competition Among Salmon for a Common Pool of Prey Resources in the North Pacific Ocean. North Pacific Anadromous Fish Commission Technical Report No. 8: 99-101, 2012 Irvine, JR, T. Beacham, C. Freshwater, S.C.H. Grant, S.G. Hinch, C. Holt, B. Hunt,B. Johnson, M. MacDuffee, V. Minke-Martin, J. Pendray, and J. Reynolds. 2020.Update on Canadian Research Relevant to the 2016–2020 North Pacific Anadromous Fish Commission (NPAFC) Science Plan. NPAFC https://www.npafc.org/published-documents-2020/ https://fishermensnews.com/fisheries-board-takes-up-proposal-to-lower-salmon-production-at-alaska-hatcheries/	Recent experience has also demonstrated clear application of the precautionary approach in the decision-making process based on best available information regarding potential negative impacts of hatchery enhancement. Corresponding activities are detailed in rescoring rationale of the related performance indicator.	Not accepted (information for PI score has not changed)

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