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Assessing the Feasibility of a Mark-Selective Fishery for Chinook Salmon in the Southeast Alaska Sport Fishery

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Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

SPECIAL PUBLICATION NO. 25-09

ASSESSING THE FEASIBILITY OF A MARK-SELECTIVE FISHERY FOR CHINOOK SALMON IN THE SOUTHEAST ALASKA SPORT FISHERY

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EXECUTIVE SUMMARY

Mark-selective fisheries (MSFs) are an increasingly common fishery management tool utilized in the Pacific Northwest to allow for the selective harvest of hatchery-origin salmon marked with an adipose fin clip. The commonly cited goal of MSFs is to provide or maintain harvest opportunity of hatchery fish while protecting wild stocks that have experienced declines (Peterson and Baltzell 2012, SFEC 2016). Although MSFs have been implemented in other fisheries within the geographic scope of the Pacific Salmon Treaty (PST), they have not occurred in the Southeast Alaska (SEAK) Chinook salmon sport fishery, and the potential implications of implementing an MSF are not well understood.

The Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (DSF) utilized grant funding from the Pacific Salmon Commission (PSC) to examine the feasibility of implementing MSFs in the SEAK Chinook salmon sport fishery. ADF&G contracted a team of researchers from the University of Washington (UW) with experience in SEAK fisheries and community engagement to lead the project and collaborate with ADF&G on all aspects of this study.

OBJECTIVES

1) Review the management, assessment, and hatchery enhancement programs associated with the Chinook salmon sport fishery in SEAK to understand the implications of implementing MSFs as a management tool in SEAK;
2) Estimate the number of adipose-fin clipped (marked) fish in the SEAK Chinook salmon sport fishery by time, area, and stock;
3) Engage SEAK fishing community members to synthesize community and regional perspectives on MSFs;
4) Evaluate potential costs and benefits of MSFs in the SEAK Chinook salmon sport fishery, incorporating community perspectives; and
5) Develop an evaluation template, incorporating objectives 1, 2, 3, and 4, to assess the feasibility of implementing an MSF.

STUDY APPROACH

The first phase of the project focused on a literature review of MSFs in other areas subject to the PST outside Alaska to inform community engagement meetings and the development of the program review. The second phase included development of the program review and beginning the cost-benefit analysis. Community engagement occurred throughout both phases through a series of in-person and online meetings. These meetings were facilitated by the UW research team and provided opportunities for feedback from community members, fishery stakeholders, and ADF&G staff, which was integrated into the feasibility study.

ADF&G staff developed an analysis of the number of marked fish in the SEAK Chinook salmon sport fishery and integrated that analysis and other new information into this technical report. A qualitative cost-benefit analysis drew from information generated throughout the project to describe positive and negative impacts of potential MSF implementation in the SEAK Chinook salmon sport fishery. Finally, the feasibility assessment process utilized for this study was adapted into a feasibility template that other fisheries management agencies could incorporate into their MSF planning process.

RESULTS

Potential benefits and costs of MSF implementation in the SEAK Chinook salmon sport fishery were organized in three categories: ecological, socioeconomic, and institutional.

The primary ecological benefit of an MSF is the potential for reduced fishing mortality of wild Chinook salmon stocks, when compared to a non-selective fishery operating within the same time and area. Ecological costs include direct and incidental mortality and sublethal effects of wild or unmarked fish that are caught and released.

Both socioeconomic benefits and costs were found present when considering MSFs. Benefits were related to providing fishing opportunity and fishery assessment; however, costs were more varied and substantial. This study found very limited public support for MSFs by SEAK community members, Alaska Native organizations, hatchery associations, and other fishery stakeholders.

Potential institutional benefits could include improved data for monitoring Chinook salmon harvest. However, a variety of institutional costs were identified, including costs to management agencies to implement, evaluate, and report on this more complex regulatory approach. These costs would take the form of direct expenditure of staff time and reduced capacity for other management tasks.

This study evaluated whether current and projected mark fractions in the SEAK Chinook salmon sport fishery are sufficient to support a mark-selective fishery. Using catch-sampling and coded wire tag (CWT) recovery data, both current and modeled mark fractions were estimated across different sport fish management areas. The model incorporated stock-specific harvest data and a range of marking scenarios, revealing significant temporal and spatial variation in the percentage of marked fish harvested. Areas with higher contributions from SEAK hatcheries were more sensitive to changes in hatchery marking levels.

The analysis found that inside-waters sport fish management areas (Haines/Skagway, Juneau, Petersburg/Wrangell, Ketchikan) showed the greatest increases in mark fraction when marking levels were adjusted, with Wrangell Narrows—a terminal harvest area in the Petersburg area that is designed to target hatchery-origin fish—exceeding 50% mark fractions under the 50% mark scenario. However, the spatial and temporal resolution of the results in this analysis may be limiting, and data from SEAK commercial fisheries could offer further insights. Overall, the mark fraction analysis suggests that increasing hatchery marking levels, especially in inside areas, could support an MSF, but further refinement of data resolution may be needed for more precise management decisions.

CONCLUSION AND RECOMMENDATIONS

Currently, a regionwide MSF is not likely to provide a net benefit to the SEAK Chinook salmon sport fishery. MSFs applied in specific areas and times where Alaska hatchery stocks are more prevalent in the fishery may be a useful management tool, but there are costs and benefits for each scenario and ADF&G already selectively manages Chinook salmon fisheries in these areas to focus harvest on hatchery fish using time and area controls rather than marks. Providing sport harvest opportunity in these select times and areas provides a similar benefit of focusing harvest on Alaska hatchery-produced stocks, but without the negative impacts of increased incidental mortality, increased complexity of regulation, and fiscal resources to comply with international obligations, which must be considered. The balance of these considerations could be shifted if external processes, such as PST renegotiations, litigation, or Endangered Species Act (ESA) designations, arose in a way that severely limited SEAK sport fishery Chinook salmon harvest opportunity. In the future, should fisheries be severely limited by conservation concerns, MSFs may be a useful tool to maintain Chinook salmon fishing and harvest opportunity. Assessment tools and programs would need to be in place to ensure benefits are realized without negatively impacting wild stocks or compromising assessment and management of the sport fishery itself. These considerations and the specific fishery assessment and community-based issues identified in this feasibility study should be addressed before any MSF is advanced in the SEAK Chinook salmon sport fishery. The MSF feasibility template developed as part of this study provides a systematic approach for management agencies to assess these important planning considerations.

ABSTRACT

In this report, we evaluate the feasibility of implementing a mark-selective fishery (MSF) in the Southeast Alaska (SEAK) Chinook salmon (*Oncorhynchus tshawytscha*) sport fishery. MSFs allow for the selective retention of hatchery-origin salmon marked with an adipose fin clip. Although implemented in other areas and fisheries within the geographic scope of the Pacific Salmon Treaty (PST), the implications of MSFs occurring in the SEAK Chinook salmon sport fishery are not well understood. To assess feasibility, we reviewed relevant ADF&G management, assessment, and enhancement programs; engaged with SEAK fishing communities; and estimated the number of marked fish in the fishery for specific times and areas under different mass marking scenarios. This information was synthesized to examine the costs and benefits of MSFs and inform future evaluations of potential MSFs in SEAK. A regionwide MSF would probably not be beneficial because stock composition varies significantly across time and area, and many other mass-marked (non-Alaska hatchery) stocks transit through SEAK and are commonly intercepted in the sport fishery. Although some locations in SEAK currently may have returns of mass-marked Alaska hatchery-produced fish in sufficient quantity to reasonably implement an MSF, increased harvest opportunity is already provided in these locations by applying increased bag and annual limits in times and areas where Alaska hatchery-produced fish are known to make up the majority of the harvest. MSF may be a tool to increase harvest opportunity in select areas and scenarios; however, the impacts to incidental mortality, complexity of regulation, and cost of compliance with international obligations may outweigh the potential benefits. Additionally, an MSF feasibility template was developed to serve as a starting point for management agencies considering MSF implementation; this template could precede and complement existing Pacific Salmon Commission (PSC) MSF proposal requirements.

Keywords: Chinook salmon, king salmon, *Oncorhynchus tshawytscha,* sport fishery, coded wire tag, mark selective fishery, non-selective fishery, escapement, Southeast Alaska

PROJECT BACKGROUND

The Pacific Salmon Commission (PSC), an international decision-making body with representation from Canada and the United States, was formed in 1985 to implement the Pacific Salmon Treaty (PST), which establishes conservation and management measures to conserve Pacific salmon; to cooperatively achieve optimum production through research, management and enhancement; to allocate harvest in proportion to production; and to prevent overfishing. A key component of Chinook salmon management under the PST is the coded-wire tag program. In response to the proliferation of mark-selective fisheries (MSFs) in the late 1990s when several stock in the Pacific Northwest were identified as conservation concerns, the PSC adopted an "Understanding of the PSC Concerning Mass Marking and Selective Fisheries – 2004 Policy Statement," which established policies and procedures for implementing MSFs. When SEAK wild stocks experienced persistent declines that precipitated fishery restrictions, the use of MSFs was discussed as a management tool to maintain some level of fishing opportunity during times and areas where wild stocks are present. The Alaska delegation involved in the negotiations of the 2019–2028 PST Annex asked ADF&G to explore the possibility of implementing an MSF in the SEAK Chinook salmon (*Oncorhynchus tshawytscha*) sport fishery. Funding was provided through a grant from the PSC's Mark-Selective Fishery Fund to examine the feasibility of implementing MSFs in the SEAK Chinook salmon sport fishery.

Although MSFs have been implemented in other areas and fisheries within the geographic scope of the PST, the implications of an MSF occurring in the SEAK Chinook salmon sport fishery are not well understood. This study provides an evaluation of the feasibility of implementing a MSF in the SEAK Chinook salmon sport fishery.

Through a formal procurement process, ADF&G contracted a team of researchers from UW with experience in SEAK fisheries and community engagement to lead the project and work with

ADF&G on all aspects of the study. They delivered a final report to ADF&G in February 2024.[1] This Special Publication incorporates components of their final report and additional analyses to evaluate MSF feasibility for the Mark Select Fisheries Fund Committee of the PSC.

OBJECTIVES

The goal of this study was to evaluate the feasibility of implementing an MSF in the SEAK Chinook salmon sport fishery within the mandates of the PST and domestic management, and with specific consideration of assessment, monitoring, and community and stakeholder perspectives. The objectives of this study are to:

1) Review the management, assessment, and enhancement programs associated with the Chinook salmon sport fishery in SEAK to understand the implications of implementing MSFs as a management tool in SEAK;
2) Estimate the number of adipose fin clipped (marked) fish in the SEAK Chinook salmon sport fishery by time, area, and stock;
3) Engage SEAK fishing community members to synthesize community and regional perspectives on MSFs;
4) Evaluate potential costs and benefits of MSFs in the SEAK Chinook salmon sport fishery, incorporating community perspectives; and
5) Develop an evaluation template, incorporating objectives 1, 2, 3, and 4, to assess the feasibility of implementing an MSF.

Additionally, the Mark Select Fisheries Fund committee of the PSC, which funded this study, requested specific information on potential SEAK Chinook salmon MSF fishing strata, mark rates, mortality estimates, fishery assessment data sources, catch estimates, and stock composition, as well as identification of the most likely and practicable specific MSF scenarios. We address each of these information needs; however, in several instances the request was beyond the scope of this feasibility study.

STUDY APPROACH AND TIMELINE

The timeline for UW contractor work extended from March 2023 through February 2024 (Figure 1). The first phase of the project focused on a literature review of MSFs in other areas subject to the PST outside Alaska to inform community engagement meetings and the development of the program review. The second phase included development of the program review (Objective 1) and initializing the cost benefit analysis (Objective 4). Community engagement (Objective 3) occurred throughout both phases through a series of in person and online meetings. These meetings provided opportunities for feedback from the community members, fishery stakeholders, and ADF&G staff, which was integrated into the feasibility study and is summarized in this report (Figure 1).

After the UW contractor work was completed, ADF&G staff developed an analysis of the number of marked fish in the SEAK Chinook salmon sport fishery (Objective 2) and integrated that

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[1] Scalisi, E. D., A. H. Beaudreau, M. Catterson, P. Fowler, J. Lum, J. Nichols, R. Nordal, and R. Peterson. 2024. Understanding the feasibility of a mark-selective sport fishery for Chinook salmon in Southeast Alaska. Final Report prepared for Alaska Department of Fish and Game under contract no. IHP 23-035. University of Washington, School of Marine and Environmental Affairs, Seattle, WA.

analysis and other new information into this technical report (Figure 1). A qualitative cost-benefit analysis (Objective 4) drew from information generated throughout the project.

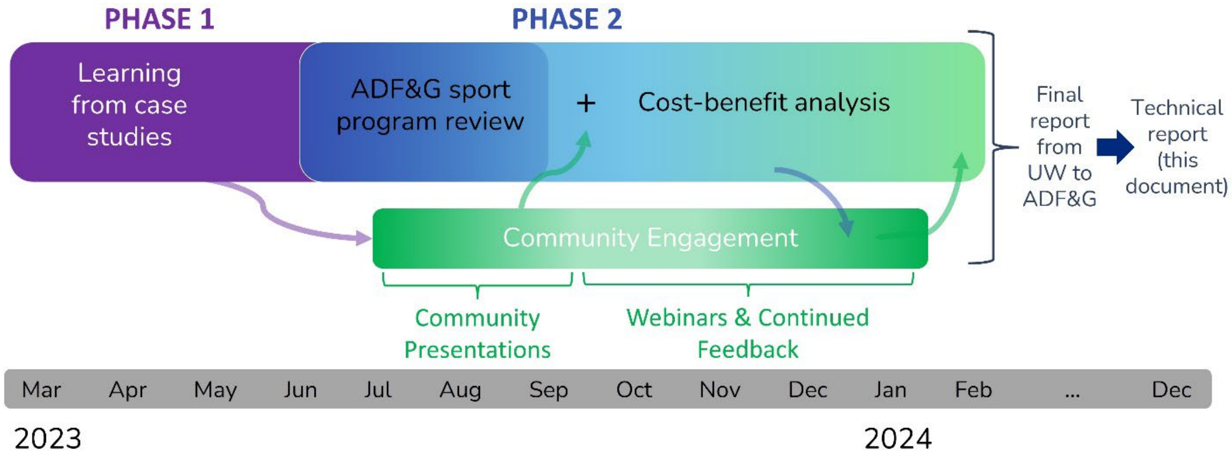

Figure 1.–Project approach and timeline.

INTRODUCTION

Chinook salmon are highly sought after in sport and commercial fisheries in SEAK and have strong social, cultural, and economic importance in the region. ADF&G manages the SEAK sport Chinook salmon fishery according to provisions of the PST and national and domestic policies, each of which share similar overarching principles of meeting escapement goals and providing sustainable levels of harvest opportunity consistent with the sustained yield principle (Fowler et al. 2021). Due to recent declines, conservative management measures have been utilized in SEAK waters to protect wild Chinook salmon stocks experiencing poor productivity, resulting in reduced harvest opportunity for all user groups (Hagerman et al. 2022, Meredith et al. 2022, Salomone et al. 2022). Although MSFs have seen limited application in Alaska, there has been interest in exploring this management tool for use in the Chinook salmon sport fishery in SEAK. The history of MSFs in the Pacific Northwest and Canada are presented to set the stage for understanding the conditions under which MSFs may be feasible or infeasible in SEAK.

MARK-SELECTIVE SALMON FISHERIES IN THE UNITED STATES AND CANADA

Mark-selective fisheries were initially developed in the Pacific Northwest in the late 1990s and early 2000s to allow for fishing opportunity while protecting natural-origin, or wild, stocks that had experienced declines to the point of conservation concern (Peterson and Baltzell 2012, SFEC 2016). Since that time, MSFs have become a widely used management tool for recreational (sport) and commercial Pacific salmon fisheries in the U.S. and Canada (SFEC 2016). The majority of MSFs in the U.S. are in Washington and Oregon for both marine and freshwater sport fisheries. The first Chinook salmon MSF was established in Washington State, following the listing of multiple Chinook and coho stocks for protection under the ESA (50 CFR §223-224, 1999). This context is central for understanding the proliferation of MSFs as a management tool for Chinook and coho salmon over the next decade. By the mid-2000s, most Chinook and coho salmon produced in hatcheries in Washington, Oregon, and Idaho were being mass marked by removal of the adipose fin to allow for use of MSFs (Johnson 2004).

The process for MSF implementation requires coordination between the international governing body (the PSC) and federal, tribal, or state fisheries management agencies. Agencies proposing and implementing MSFs submit a formal proposal to the Selective Fishery Evaluation Committee (SFEC) prior to the start of any new MSF and are required to fulfill yearly reporting requirements. SFEC's charge is to coordinate, evaluate, and report on mass-marking and MSFs to the PSC. The *Management Program* section of this report provides additional details.

Currently, dozens of MSFs are prosecuted annually. For instance, the SFEC received 80 MSF proposals for the 2023 fishing season, including 44 for Chinook salmon (SFEC 2023). Proposals were submitted by federal, state, and tribal governments in British Columbia, Washington, and Oregon; however, no proposals were submitted by Alaska. The only MSF that has occurred in SEAK to date was an experimental commercial troll MSF with a goal to "increase harvest rates on hatchery stocks including those of Alaska origin…while reducing impacts on natural origin Chinook salmon" and was only implemented when the troll fleet was targeting other species and closed to Chinook salmon retention (Hagerman et al. 2017, p. 12).

Overall, the design of MSFs, as well as the monitoring and assessment of these fisheries, are highly specific to time and area.[2] MSFs for Chinook and coho salmon are designed using a variety of regulations, including specifications for gear, timing and locations of fishery openings, and bag limits. For example, in 2023 the ocean salmon fishery along the Washington-Oregon border was open June 24–August 25 (season close date based on quotas), with regulations allowing for a mixed-bag limit of 2 total salmon retained per day; of these, just one may be a Chinook, and any coho retained must be marked (ODFW 2023). Additionally, this fishery has gear restrictions requiring barbless hooks, and size limits (coho minimum length of 16″ and Chinook minimum length of 22″; ODFW 2023). In British Columbia, Canada, several pilot mixed-bag MSFs were implemented in 2023, with the retention of one marked Chinook salmon allowed in specific locations for several weeks at a time during the summer (DFO 2023). These MSF regulations layer on top of standardized salmon regulations in British Columbia that specify a combined daily limit of 4 fish for all species of Pacific salmon, a possession limit of double the daily limit, and an annual limit of 10 Chinook salmon per person (DFO 2024), as well as the use of barbless hooks.

A more extensive history of MSFs outside of Alaska was reviewed by Beaudreau et al. (*In prep*).

SUMMARY OF LESSONS LEARNED FROM MSFs

The SFEC published an extensive report synthesizing benefits and concerns related to MSFs in the Pacific Northwest and British Columbia. Briefly, we summarize the key considerations related to implementation of MSFs highlighted in the report (SFEC 2016) and by other authors, under four broad themes: potential impacts on wild stocks; challenges for the coded-wire tagging (CWT) program, stock assessment, and monitoring; costs of implementation and monitoring; and fishery effects.

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[2] Beaudreau, A. H., E. D. Scalisi, and R. Nordal. Ecological, social, and institutional dimensions of selective fisheries for hatchery-produced Pacific salmon (*Oncorhynchus* spp.) in North America. In preparation for submission to *Reviews in Fisheries Science and Aquaculture*; hereafter cited in text as "Beaudreau et al. *In prep*."

1. Potential impacts on wild stocks

One of the major concerns is the potential impacts of continued fishing activity under MSF regulations on wild (or natural-origin) stocks as opposed to a closure due to conservation concerns. These impacts occur from incidental mortality of caught and released fish (SFEC 2016). In order to successfully implement an MSF with minimal impacts on wild stocks, the encounter rate of marked fish by anglers must be substantially higher than the incidental hook and release mortality rate (Hoffmann and Pattillo 2008). Catch and release mortality can be variable due to effects of handling practices, fish size, temperature, and other factors (e.g., Gjernes et al. 1993). SFEC (2016) recommended better coordination among agencies to develop estimation methods for MSF impacts on unmarked fish.

2. Challenges for the CWT program, stock assessment, and monitoring

Under the PST, the parties are required to maintain a CWT program, in which a percentage of hatchery-produced salmon are implanted with tags that have a unique identifying code linked to their hatchery of origin (PST 1985). Coastwide, the target sampling goal for CWT is 20% of the harvest (PSC 2005). The CWT program is a key component of understanding salmon stocks, because it "is the only means currently available to obtain data necessary to estimate and monitor coastwide exploitation rates on individual stocks of coho and Chinook salmon."[4] The SFEC identified the impact of mass-marking on the CWT program as a major concern to program viability (SFEC 2016).

Prior to mass-marking, the adipose fin clip was paired with a CWT to facilitate visual sampling. With the advent of mass-marking, only a fraction of adipose fin clipped fish also contained a CWT. This resulted in complications for sampling because tagged fish could no longer be visibly distinguished from untagged fish. To address this concern, most agencies are now using electronic tag detection (ETD) through the use of tube detectors and handheld wands (SFEC 2016). British Columbia maintains a voluntary program to recover CWTs from sport and First Nations fisheries (DFO 2022). Under the Sport Head Recovery Program (SHRP) fishers voluntarily deposit heads of marked fish into depot collection points (e.g., at boat launches), which are then retrieved by Canada's Department of Fisheries and Oceans for processing (DFO 2022).

Stock assessment is also complicated by mass-marking and MSFs, because the number of estimated parameters and uncertainty in those estimates tends to increase (Peterson and Baltzell 2012, SFEC 2016). The numbers of harvested and released fish by size and mark status must be accounted for, requiring new quantitative methods and additional data inputs (Peterson and Baltzell 2012). Catch monitoring is more extensive in some areas where MSFs are implemented. For example, the Washington Department of Fish and Wildlife monitors recreational harvest through dockside creel sampling, test fishing, on-water or aerial effort surveys, catch record card reporting, and angler-completed voluntary trip reports (McHugh et al. 2009, Peterson and Baltzell 2012, Garber and Kloempken 2022).

3. Costs of implementation and monitoring

MSFs increase costs for agencies and hatcheries due to a range of factors. These include, but are not limited to: (1) initial purchase and continuing maintenance costs of automated tagging trailers; (2) ETD equipment (e.g., tube detectors, handheld wands); (3) handling and shipping larger

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[4] PSC. 2024. Selective Fishery Evaluation Technical Committee. Available from: https://www.psc.org/about-us/structure/committees/technical/selective-fishery-evaluation/. (Accessed February 2024).

numbers of heads from marked fish, most of which do not have CWTs; (4) implementation of double index tag programs (see *Assessment and Monitoring Programs* section); and (5) staffing for mass-marking, monitoring, and CWT recovery. An additional administrative cost is the review and processing of MSF proposals each year by the PSC. Due to these costs and other challenges, Hoffmann and Pattillo (2008) recommended that "alternative management strategies for achieving the same objectives for less cost should also first be considered" prior to implementation of MSFs (p. 594).

4. Fishery effects

A commonly stated goal of MSFs is to provide fishing opportunity that would otherwise be limited or closed entirely due to conservation concerns; however, the extent to which MSFs increase actual harvest depends on the specific mix of marked hatchery and unmarked wild fish. Overall, reductions in retention of unmarked catch since MSFs have been used are indicative "that angler behavior has been modified to harvest selectively for marked fish" (SFEC 2016, p. 11). MSF benefits to anglers can lead to increased public support for resource management agencies and enhancement programs (SFEC 2016).

Conservation and fishery benefits of MSFs can be variable and uncertain. MSFs increase complexity of regulations, which can lead to challenges in compliance and enforcement (SFEC 2016). They can also change angler behavior in ways that affect monitoring and management, such as voluntary release of fish even when they can be retained, increasing the challenge of quantifying MSF impacts (SFEC 2016). Additionally, critiques of MSFs have been expressed by tribal co-managers on the U.S. west coast related to inequitable distribution of benefits arising from MSFs (CRITFC 2014).

SPORT FISH PROGRAM REVIEW: CONSIDERATIONS FOR MSFS

MANAGEMENT PROGRAM

As summarized in the *Overview of the Sport Fisheries for King Salmon in Southeast Alaska through 2020* (Fowler et al. 2021, p. 3), "the marine king salmon sport fishery is managed to achieve 3 primary goals: (1) sustainable SEAK wild stocks, (2) compliance with the provisions of the PST, and (3) providing opportunity for Alaska hatchery-produced king salmon when possible." In accordance with the provisions and agreements of the PST, the *Southeast Alaska King Salmon Management Plan* (*5 AAC 47.055*) directs the management of the Chinook salmon sport fishery in SEAK. This management plan was developed and can be modified by the Alaska Board of Fisheries[5] (BOF). The domestic allocation of Chinook salmon between various fisheries in SEAK is also determined by the BOF through the *Allocation of king salmon in the Southeastern Alaska-Yakutat Area* (5 AAC 29.060). Upon implementation of any MSFs, all current obligations (detailed below) must still be fulfilled, and additional measures will likely be required, with specific details dependent on the corresponding regulations of any planned MSFs.

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[5] ADF&G. 2024. Welcome to the Alaska Board of Fisheries. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=fisheriesboard.main. (Accessed February 2024).

International Management: Pacific Salmon Treaty

The PST "includes provisions for management and conservation of Chinook salmon stocks along the Pacific Coast, north of southern Oregon up to Cape Suckling in SEAK" (PST 2023, summarized by Fowler et al. 2021, p. 7). Every 10 years the PST is renegotiated, with the most recent renegotiation setting provisions for 2019–2028. The PSC was formed in 1985 by the U.S. and Canada to implement the PST.[6] There are 4 regional panels that work to provide technical and regulatory advice to the PSC, 2 of which encompass SEAK: (1) Northern Panel—for stocks originating in rivers situated between Cape Suckling in Alaska and Cape Caution in British Columbia, and (2) Transboundary Panel—for stocks originating from the Alsek, Stikine, and Taku River systems. These panels are informed by technical committees, which "provide the Panels with the timely scientific data and information needed in order to make effective decisions. These committees rely upon information provided by Canadian and United States fishery management agencies." [7] The following PSC Committees are most relevant to the implementation of an MSF:

- Selective Fishery Evaluation Committee (SFEC): Assesses the impacts of mass marking, MSFs, and the viability of the CWT system. Develops tools that agencies can use in proposals and data analysis[8]
- Chinook Technical Committee (CTC): Responsible for evaluating, reviewing, and making recommendations for conduct of fisheries, escapement objectives, and research projects specifically relevant to implementing the Chinook salmon chapter 3 of the PST. Reports to the PSC[9]
- Transboundary Technical Committee: Assembles and refines information on migratory patterns, exploitation, and spawning requirements of relevant transboundary stocks; Examines management regimes to determine suitability of achieving escapement goals; Maintains an enhancement subcommittee; Reports to the Transboundary Panel[10]
- Northern Boundary Technical Committee: Provides stock status information and evaluates management action efficacy for pink, chum, sockeye and coho salmon stocks of interest within the Northern Boundary area. Reports to the Northern Boundary Panel[11]

The PSC is responsible for setting the SEAK all-gear catch limit, which excludes most Alaska hatchery-produced Chinook salmon. Although the specifics of setting the catch limit have changed over time, the PSC establishes the Alaska all-gear catch limit, which is then allocated based on domestic policy (5 AAC 29.060). The PSC has also adopted specific provisions for District 8 (Petersburg/Wrangell-Stikine River) and District 11 (Juneau/Taku River), which have implications for sport fishery management and harvest accounting in these areas.

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6 PSC. 2024. About the Commission. Available from: https://www.psc.org/about-us/. (Accessed February 2024).

7 PSC. 2024. Panels. Available from: https://www.psc.org/about-us/structure/panels/. (Accessed February 2024).

8 PSC. 2024. Selective Fishery Evaluation Technical Committee. Available from: https://www.psc.org/about-us/structure/committees/technical/selective-fishery-evaluation/. (Accessed February 2024).

9 PSC. 2024. Chinook Technical Committee. Available from: https://www.psc.org/about-us/structure/committees/technical/chinook/. (Accessed February 2024).

10 PSC. 2024. Transboundary Technical Committee. Available from: https://www.psc.org/about-us/structure/committees/technical/transboundary/ (Accessed February 2024).

11 PSC. 2024. Northern Boundary Technical Committee. Available from: https://www.psc.org/about-us/structure/committees/technical/northern-boundary/ (Accessed February 2024).

Domestic Management

Domestically, the SEAK Chinook salmon sport fishery is managed by ADF&G following regulatory and statutory authority while complying with the provisions and agreements of the PST. The BOF has provided specific guidance for management of the SEAK sport fishery (*Southeast Alaska King Salmon Management Plan*, 5 AAC 47.055) and the domestic allocation of Chinook salmon between various fisheries (*Allocation of king salmon in the Southeastern Alaska-Yakutat Area,* 5 AAC 29.060).

The annual SEAK all-gear catch limit, established by the PSC, is allocated between fisheries in accordance with *Allocation of king salmon in the Southeastern Alaska-Yakutat Area* (5 AAC 29.060). Under this regulation, "the commercial net fisheries allocation is first subtracted from the SEAK all-gear catch limit (1,000 is first allocated to the set gillnet fishery and the remaining drift gillnet and seine fisheries each are allocated 2.9% and 4.3%, respectively, of the remaining all-gear catch limit) and the remainder is allocated 80% to commercial troll fisheries and 20% to sport fisheries."[12] The "hatchery add-on" provision of the PST stipulates that most Alaska hatchery-produced Chinook salmon harvested by SEAK sport and commercial Chinook salmon fisheries do not count against the annual harvest limit (PST 2023). All wild, natural, and non-Alaska hatchery origin Chinook salmon harvested in SEAK are counted towards the SEAK all-gear catch limit (Fowler et al. 2021).

The *Southeast Alaska King Salmon Management Plan* (5 AAC 47.055) directs ADF&G to "implement specific management actions according to the annual allocation of Chinook salmon to the sport fishery. Emergency order (EO) authority is used to establish bag, possession, and annual limits and other provisions annually in accordance with the management plan" (Fowler et al. 2021, p. 3). Management measures are implemented via EOs, and sport fishing opportunity for Chinook salmon generally increases as the number of fish allocated to the sport fishery increases. EOs can be used to provide opportunity for Alaska hatchery-origin Chinook salmon at times and in areas when these stocks are returning. Special provisions designed to provide additional opportunity for Alaska hatchery-origin Chinook salmon are limited by time and area to focus harvest on the intended stock and avoid interception of nontarget Chinook salmon stocks. These areas, near hatcheries or release sites, may utilize management measures such as increased bag and possession limits, reduced size limits, removal of annual limits, and open time periods when harvest would otherwise be prohibited (Fowler et al. 2021).

The *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) directs ADF&G to provide the BOF with "reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation during regularly scheduled board meetings" (summarized within Meredith et al. 2022, p. 1). Currently in SEAK, the BOF has adopted 3 action plans in response to select Chinook salmon stocks (or aggregate stocks) within SEAK being identified as a stock of concern (i.e., Unuk and Chickamin, Meredith et al. 2022; Northern Southeast Alaska, Hagerman et al. 2022; and Stikine River and Andrew Creek, Salomone et al. 2022). These action plans, developed by ADF&G and adopted by the BOF, provide additional guidance to ADF&G in the implementation of management actions designed to conserve these stocks of concern.

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[12] ADF&G. 2024. Chinook Salmon (Oncorhynchus tshawytscha) Management. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=chinook.management (Accessed February 2024).

Management Considerations for Developing an MSF

Planning and implementation of an MSF will require consideration of domestic and international obligations. The following section provides an overview of the key management considerations for developing an MSF.

International considerations: SFEC requests that domestic managers submit a proposal for any MSF prior to implementation. (SFEC 2004; Appendix A). These proposals include information related to the specifics of management (e.g., time and area, target species, gear) and assessment (e.g. CWT sampling rates, catch monitoring). Several proposal criteria are particularly relevant to management considerations: (1) Determining whether the fishery implemented will be "MSF", "Mark-mixed bag", or "Mark and size-mixed bag" (SFEC 2023); and (2) Detailing "alignment of time/area strata boundaries of regulations and catch estimation and CWT sampling programs", "indicator stocks expected to be impacted by the fishery", and "double index tag (DIT) release groups expected to be impacted by the fishery" (SFEC 2023).

Additionally, SFEC requests 2 postseason tables from agencies annually for all implemented MSFs (Appendix B). The first table is most relevant to assessment (SFEC 2023). The second table requires information on fishery area, sector, start date, end date, and target species, as well as specific MSF regulations, including species, bag limits by mark status and size (if applicable), minimum and maximum size limits, and other regulations.

Domestic considerations: In order to execute an MSF in the sport fishery, regulatory language guiding the management of the fishery must be adopted by the BOF with consideration towards the existing management plan in 5 AAC 47.055 or included in ADF&G's emergency order authority. In order for a proposal to be taken up by the BOF, it must be submitted during the call for proposals for the appropriate meeting and generally accepted between December and April for the upcoming cycle.[13] This step in the process of MSF implementation must occur prior to submission of a proposal to SFEC.

The effects of any executed MSFs on domestic management plans will be highly dependent on the specifics of the proposal made to and approved by the BOF. It might involve changes to sections of the Alaska Administrative Code, including but not limited to the *Southeast Alaska King Salmon Management Plan* (5 AAC 47.055), the *Allocation of king salmon in the Southeastern Alaska-Yakutat Area* (5 AAC 29.060), and modifications to the action plans currently in place to conserve select Chinook salmon stocks in SEAK.

Implementing any MSF fishery for the SEAK Chinook salmon sport fishery will increase the complexity of regulations. This may have impacts on accessibility, angler satisfaction, and compliance. Compliance and enforcement of Alaska's fish and wildlife laws, statutes, and regulations is the primary responsibility of the Division of Alaska Wildlife Troopers.[14]

Although the existing framework of the BOF process incorporates opportunities for the users of the resource and the general public to provide input, additional outreach and collaboration in advance of the BOF process would be beneficial given the complexity of interactions between hatchery facilities, user groups, and domestic and international management obligations. If an MSF is adopted, outreach and education to anglers in SEAK would be paramount for mitigating some

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[13] ADF&G. 2024. Alaska's Fisheries and Game Board Processes. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=process.main. (Accessed February 2024).

[14] https://dps.alaska.gov/AWT/Home

of the challenges of implementing new and more complex regulations. Potential strategic outreach topics may include identification of marked fish, what fish are marked and why, best practices in fish handling to reduce release mortality, additional reporting requirements, and the purpose of MSF fisheries.

Summary of Implications and Considerations for Management

Broadly, any MSF must address international, national, and domestic obligations regarding conservation, allocation, and management of Chinook salmon. Developing an MSF would require the following:

- Proposal to SFEC based on requested timeline with all details complete;
- Proposal to BOF in accordance with BOF schedule, ideally with appropriate stakeholder outreach in advance;
- Public outreach to communicate regulations and educate anglers;
- Upon completion of domestic fishery planning processes, agencies conducting MSFs providing final selective fishery plans to SFEC; and
- Post-season MSF results to SFEC submitted on requested schedule.

STOCK ASSESSMENT PROGRAM

Stock Assessment Overview

The ADF&G SEAK Chinook salmon stock assessment program, which has been in existence since the 1970s, is used to meet multiple domestic, national, and international management obligations including, but not limited to, requirements of stock-specific action plans, Alaska's *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222), and PST obligations. Most often, the mandates set by these policies are based around meeting escapement goals.

Domestic policies require ADF&G to report on salmon stock status and escapement goals to the BOF, document and review existing salmon escapement goals, establish goals for stocks for which escapement can be reliably measured, and prepare scientific analyses with supporting data when goals are created, modified, or recommended for elimination.

At present, 11 of 34 SEAK Chinook salmon stocks have established biological escapement goals (BEGs) and projects designed to monitor escapement (Priest et al. 2024); additionally, 4 of the 34 Chinook salmon stocks are also assessed to estimate exploitation rates (Courtney et al. 2023; Elliott and Peterson 2023; Frost et al. 2023; Williams et al. 2023). Currently, not all SEAK Chinook salmon stocks are monitored because of cost and logistical constraints.

Each stock assessment project is designed to meet management and research objectives using the most appropriate methods for that system. Escapement is quantified in-river using counting methods (e.g., aerial, foot, weir) or statistical methods (i.e., mark–recapture). Index counts, paired with occasional census weir counts or census estimates from mark–recapture studies, are the most common methods used. Notable exceptions include the weir count on the Situk River and mark–recapture projects on the Chilkat, Taku, and Stikine Rivers and, more recently, the Alsek River. The other assessed stocks use index-expanded escapement estimates (Richards et al. 2020).

The pertinent details of Chinook salmon stock assessment are summarized below, followed by a synopsis of the attributes that may be affected by an MSF.

Indicator Stocks and Use of Coded Wire Tag Data

Under the management regime of the PSC, the 11 SEAK Chinook salmon systems consist of 2 types of indicator stocks: escapement indicator stock (EIS) and exploitation rate indicator stock (ERIS). Of the 11 wild stocks monitored for escapement by ADF&G, 6 of the 11 are recognized as EISs, and 4 of the 11 are recognized as ERISs. EIS programs are used to estimate escapements in the stock's region. ERIS programs are designed to calculate production, survival, harvest, and exploitation rates and patterns (Table 1). Information from both of these programs are used to estimate stock productivity and develop forecasts.

Table 1.–Southeast Alaska Chinook salmon indicator stock assessment matrix.

Origin	Stock	ADF&G Escapement Indicator Stock	PST Escapement Indicator Stock	Exploitation Rate Indicator Stock
Wild	Alsek River	yes	yes	no
	Taku River	yes	yes	yes
	Stikine River	yes	yes	yes
	Situk River	yes	yes	no
	Andrew Creek	yes	no	no
	Chilkat River	yes	yes	yes
	King Salmon River	yes	no	no
	Unuk River	yes	yes	yes
	Chickamin River	yes	no	no
	Keta River	yes	no	no
	Blossom River	yes	no	no
Hatchery	Crystal Lake Hatchery	No	No	Yes
	Little Port Walter	No	No	Yes
	Whitman Lake Hatchery	No	No	Yes
	Deer Mountain Hatchery	No	No	Yes
	Neets Bay Hatchery	No	No	Yes

Hatchery releases make up many of the SEAK ERISs because tagging hatchery releases is more efficient than wild stock tagging and can provide more CWT recoveries and contemporary results compared to wild indicator stocks that require complete brood information. SEAK Chinook salmon hatchery exploitation rate indicator releases include Little Port Walter (National Marine Fisheries Service), Crystal Lake (SSRAA), Deer Mountain (SSRAA), Whitman Lake (SSRAA), and historically Neets Bay (SSRAA). However, hatchery indicator programs have limitations because hatchery fish may not have the same life history as wild fish, such as differences in early marine survival due to fish culture and release practices, and may not be representative of their wild stock counterparts. The established wild CWT projects (Chilkat, Unuk, Taku, Stikine), in conjunction with assessed hatchery production, provides the ability to test for representativeness.

ADF&G uses results from its wild ERISs to inform escapement goals, develop forecasts, tailor management actions for stocks of concern, make inseason management decisions, and fulfill PST obligations. SEAK Chinook salmon wild exploitation rate indicator stocks include Unuk River (Southern Southeast Alaska; Frost et al. 2022), Chilkat River (Northern Southeast Alaska; Elliott and Peterson 2022), Taku River (Taku; Williams and Peterson 2022), and Stikine River (Stikine; Courtney et al. 2022). In the PST context, the results from these ADF&G projects are compared against results from the hatchery indicators to assess the utility of hatchery ERISs and in the evaluation of stock status.

ADF&G's use of both wild and hatchery stocks as ERISs forms a bridge between enhancement and wild stock assessment. One of the most important results from the hatchery ERIS projects is the estimate of fishery contribution, which is used by the PST via the SEAK hatchery add-on and domestically in the calculation of the Salmon Enhancement Tax. Data from the hatchery ERIS projects are also used by the PSC Chinook Model to represent wild production (CTC 2023).

Summary of Implications and Considerations for Stock Assessment

Impacts to wild stock ERIS programs and projects: MSF implementation may impact SEAK ERIS projects and necessitate an evaluation of these projects to ensure continued fulfillment of international and domestic obligations. An MSF could violate project assumptions for juvenile CWT projects on the Chilkat, Unuk, Taku, and Stikine Rivers. Specifically, a key assumption of these projects is that marked and unmarked fish have equal probability of survival (Williams and Peterson 2022). The extent to which an MSF would violate this assumption is dependent on where and when the MSF is implemented, including its proximity to the wild indicator stock.

Impacts to hatchery stock assessment: For hatchery stocks, a consideration is whether a DIT program would be needed. DIT programs were developed as a method to estimate release mortality of unmarked fish in a MSF (Johnson 2004, SFEC 2016). DIT programs administer a CWT and adipose clip to one group of hatchery-produced fish and only a CWT (no external mark) to a second group that is released at the same time (SFEC 2016). If it was determined that DIT groups were necessary, a collaborative effort between ADF&G and PNP hatchery operators would be needed for implementation to occur.

Another consideration is the complication a MSF would pose to estimating Alaska hatchery harvest. Estimation of Alaska hatchery harvest employs CWT analysis methods. An MSF would alter the fraction of marked fish over time, violating an assumption of the CWT analysis methods (Benard and Clark 1996). Although solutions could be devised, this violation is likely to increase uncertainty in the Alaska hatchery add-on estimate. This could require additional sampling at the point of hatchery return.

FISHERY MONITORING PROGRAM

Sport Fishery Monitoring

The SEAK sport fishery is monitored to support domestic and international management objectives. Data are collected primarily through 3 programs: Statewide Harvest Survey (SWHS), SEAK Marine Harvest Studies (MHS), and Saltwater (Charter) Logbook. Together, data collected in these programs provide information on fishing participation, effort, spatial distribution and location of fishing, species and numbers of fish caught (fish handled but released) and harvested (fish kept), fish size category (SWHS: Romberg et al. 2018; Saltwater Charter Logbook: Powers and Sigurdsson 2016), and biological information on the catch such as presence of CWTs, genetic tissue, length, and sex (MHS: Jaenicke et al. 2023). The details of each program pertinent to Chinook salmon are summarized below, followed by a synopsis of the attributes that may be affected by an MSF.

Statewide Harvest Survey (SWHS)

The SWHS is a mail survey administered annually by ADF&G since 1977 to a random stratified sample of households with at least one licensed angler (Kirsch et al. 2022). The survey is mailed to approximately 10% of Alaska sport fishing license holders annually and is designed to achieve a response rate sufficient to address statewide and regional needs for harvest estimation (Kirsch et al. 2022). Overall response rates have ranged from 31% to 46% over the last 15 years (Kirsch et al. 2022). Summarized estimates derived from the survey are publicly available through an online reporting tool.[15]

The SWHS generates data annually on sport fishery participation, catch, and harvest in freshwater and saltwater for all areas in the state. The survey breaks apart effort, catch, and harvest by residency (Alaska resident, nonresident) and angler type (guided, unguided; Kirsch et al. 2022). For Chinook salmon, annual estimates of effort, catch, and harvest for freshwater and saltwater are available at the spatial resolution of the 7 SEAK management areas. Due to the mechanics of a mail survey and associated analysis, data produced by the SWHS are not available until at least one year after the survey year. SWHS does not capture biological or mark/tag information for Chinook salmon.

Saltwater (Charter) Logbook Program

Since 1998, all SEAK charter operators and guides have been required to report guided fishing activity in saltwater (Powers 2014). Electronic reporting of logbook data has been mandatory in SEAK since 2021.[16] Detailed trip-level information is collected for guided (charter) saltwater fishing through the logbook program.

The charter logbook program provides a census of guided sport fishing trips in saltwater. A trip is defined as the "time period between the first deployment of fishing gear from a vessel providing sport fishing guide services and the offloading of one or more anglers or any harvested fish from the vessel" (Powers 2014, p. 26). Trip-level data recorded in the logbook include the date fished, hours fished for salmon and bottomfish (recorded separately), statistical area(s) fished for salmon and bottomfish (recorded separately), and information about the charter operation including specific licenses held (Powers 2014).

The logbook program captures information on the number and species of salmon and bottomfish kept and released, separately for each individual angler (Powers 2014, Powers and Sigurdsson 2016). For Chinook salmon, the number of fish kept and released is reported by size class [small (<28 in) and large (≥28 in; Powers 2014). Angler names, license numbers, and residency (Alaska resident or nonresident) are recorded (Powers 2014). Estimates of saltwater effort, catch, and harvest are available at the statistical area, management area, and regional (Southeast) levels annually. Charter logbooks do not capture biological or mark/tag information for Chinook salmon.

Southeast Alaska Marine Harvest Studies (MHS) Program

The SEAK MHS project, also referred to as the marine boat creel survey, includes collection of data at primary sport fishing access points (e.g., boat launches, harbors) through interviews with anglers and biological sampling of their catch (Jaenicke et al. 2023). Data collected include numbers of fish by species (catch, harvest), hours fished, and number of anglers (effort). Biological sampling goals vary depending on the species or specific data needed for assessment and management purposes and may be defined in terms of target sample sizes (e.g., number of biological samples) or sampling rates (e.g., percentage of anglers surveyed). Creel sampling

[15] Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited May 16, 2025). Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/

[16] ADF&G 2024. Professional Licenses Sport Guides and Charters. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=SFGuidesLicense.Logbook (Accessed February 2024).

provides for inseason and early postseason estimates of harvest and catch for multiple species (Jaenicke et al. 2023).

Creel sampling is time- and resource-intensive, so spatiotemporal resolution of sampling varies depending on data needs for assessment and management. The finest temporal resolution for all estimates of effort, catch, and harvest is biweekly (every 2 weeks), with the exception that statistical week reporting is available under limited data-heavy situations (Jaenicke et al. 2023). Spatial resolution is variable, with declining precision at finer scales. The finest spatial resolution for which effort, catch, and harvest are estimated by the MHS program is at the statistical area level, also referred to as a subdistrict. Subdistricts represent the most granular level of fisheries management area definition,[17] with the exception of special harvest areas, which may be encompassed within a single subdistrict.

For Chinook salmon, biological sampling includes inspecting for CWT and collecting of genetic tissue samples and scale samples. The coastwide standard for CWT estimation is to sample 20% of the total regional sport harvest for the presence of CWTs in Chinook salmon (PSC 2005). Creel samplers visually assess every Chinook salmon they encounter for marks, and the heads of marked salmon are removed and shipped to ADF&G's Mark-Tag-Age Laboratory for tag reading (Jaenicke et al. 2023). The MHS program has observed a regional CWT sampling rate of approximately 17% for the last 10 years (2014–2023); spatial variability in the CWT sampling rate is greater than interannual variation (Mike Jaenicke, ADF&G, personal communication, January 2024). CWT data are used in combination with genetic mixed-stock analysis to estimate the percentage of hatchery fish caught in SEAK sport fisheries (Table 2).

The annual regional operational plan of the MHS program (Jaenicke et al. 2023) identifies precision criteria for primary objectives related to estimates of effort, catch, and harvest at varying time and area strata. For Chinook salmon, the following preliminary estimates are generated: (1) total marine sport harvest; (2) total Alaska hatchery and total non-Alaska hatchery contributions, such that the estimates are within 50–90% of the true values 90% of the time for each port; (3) relative Alaska hatchery and relative non-Alaska hatchery contributions, such that the estimates are within 5–25% of the true values 90% of the time for each port; and (4) early season (late April to mid-July) PST harvest of Chinook salmon for commercial salmon Districts 108 (Petersburg/Wrangell) and 111 (Juneau; Jaenicke et al. 2023). Harvests of Chinook salmon at all sampled ports are recorded by angler residency type and by size class of fish (large $\geq$ 28 in, small < 28 in; Jaenicke et al. 2023).

Table 2.– Percent of Alaska-origin hatchery Chinook salmon in SEAK sport fisheries, 2005–2023.

Sport fish management area	Range	Mean
SEAK Sport Fishery (region)	9–40%	22%
Ketchikan area	14–74%	40%
Northern inside area	36–90%	55%
Petersburg and Wrangell area	17–84%	48%
Outside area	2–14%	7%

[17] ADF&G. 2024. Glossary of Coded Wire Tag Terms. Available from: https://mtalab.adfg.alaska.gov/CWT/reports/cwt_glossary.aspx. (Accessed February 2024).

Commercial Fishery Monitoring

Along with data collected in the sport fishery monitoring program, data from the commercial fishery monitoring program contributes to stock and fishery assessments. Commercially harvested Chinook salmon are sampled from commercial fisheries throughout SEAK by the Port Sampling Project (Reynolds Manney et al. 2023). For Chinook salmon, the objectives for data collection include: collecting genetic and scale samples from individual fish during troll retention periods (winter, spring, and summer); and sampling a minimum of 20% of the total commercial harvest for CWTs stratified by gear, fishing area, and statistical week (Reynolds-Manney et al. 2023).

Summary of Implications and Considerations for Monitoring

Upon implementation of an MSF, ADF&G may consider changes to sport fishery monitoring programs to more fully evaluate the MSF and meet PSC requirements. These include:

- SWHS: no anticipated changes to current status
- Charter Logbook Program: add a logbook question to document mark status of harvested and released fish
- Southeast Alaska MHS Program: review sampling needs and staffing levels in locations where MSFs are used to ensure sampling goals for harvest and CWTs can be met; record marked status for released fish (already captured for fish harvested); full electronic sampling for DITs

Implementing an MSF in the sport fishery may also necessitate electronic sampling for marked and unmarked fish in commercial fisheries, especially if a DIT program is required.

Increased reporting and coordination with management: The PSC requires agencies that prosecute MSFs to provide information about the fishery. Preseason proposals and postseason reports would need to be prepared by ADF&G research staff. This includes harvest estimates by size, mark, and retention status; DIT release groups expected to be impacted by the fishery; estimated CWT composition of harvest; and method for catch and release estimation. These tasks are not trivial and will obligate ADF&G beyond domestic accounting needs and likely require additional staff.

Incidental Mortality

Incidental mortality (IM) is mortality caused by the act of fishing, excluding mortality associated with harvest. It can be defined as the difference between harvest (landed catch) and total fishing mortality (CTC 2021). Incidental mortality varies with regulations and can occur in any fishery regardless of retention requirements. An MSF could incur dropoff mortality (mortality of fish that encounter fishing gear but are not landed) and release mortality (mortality of fish that encounter fishing gear that are landed and released), with each IM component composed of legal or sublegal fish.

Estimating IM requires information from several sources and can be partitioned into stock-specific and fishery-specific estimates. Stock assessment programs tag the fish that form the basis of IM estimation in combination with information of recoveries of tagged fish encountered in fishery assessment programs. Fishery assessment programs enumerate the number of fish harvested and released and provide estimation of release mortality rates. The current sport fishery IM rate is 15.9%, which is the sum of the release mortality rate (12.3%) and dropoff mortality rate (3.6%) (CTC 1997, 2004, 2022).

Summary of Implications for Incidental Mortality

Incidental mortality for the SEAK Chinook salmon fishery must, under the PST, be managed to not exceed 59,400 Chinook salmon (2019 PST Agreement, Chapter 3 paragraph 4(g)). MSF implementation would increase incidental mortality in the sport fishery, which may increase the risk of exceeding the PST all-gear IM limit.

IM Rates: An MSF could result in changes to fishing behavior, including retention and release of fish. MSF implementation may also warrant changes to gear regulations impacting IM rates. Therefore, a re-examination of the incidental mortality rates currently used in assessments, potentially including an updated release mortality study, may be informative.

ENHANCEMENT PROGRAM

Southeast Alaska Chinook Salmon Enhancement Overview

Fisheries enhancement is a core function of the ADF&G Division of Sport Fish (DSF). The ADF&G DSF enhancement program uses federal and state funding to support and diversify fishing opportunities in SEAK by releasing Chinook and coho salmon, and triploid rainbow trout at specific fresh and saltwater locations. Each year the ADF&G DSF enhancement program directs approximately $1.2M to release over 2.5M salmon and 50K rainbow trout.[18] These stockings occur through contractual agreements with local private non-profit (PNP) hatchery operators, which are DIPAC in Juneau and SSRAA in Ketchikan and Petersburg. Program details are available for public review and comment each year in the *ADF&G Statewide Stocking Plan for Sport Fish*.[19]

Funding for the numerous salmon enhancement activities occurring in SEAK comes from DSF and other sources including but not limited to an enhancement tax imposed on commercial salmon landings and federal funding. These other funding sources support a greater level of enhanced Chinook salmon production than the DSF program.

Policies Governing Alaska's Enhancement Programs

The *Comprehensive Salmon Enhancement Plan for Southeast Alaska: Phase III* was developed by the Joint Northern/Southern Southeast Regional Planning Team and published in 2004 (Joint Northern/Southern Southeast Regional Planning Team 2004). Phases I and II of the plan were completed in the early to mid-1980s, which established and prioritized specific salmon enhancement objectives for the region consistent with overarching department statewide policies. The Phase III plan assessed future changes to salmon enhancement at a regional scale, specified future goals and objectives for salmon enhancement, and provided a comprehensive overview of the salmon enhancement program in SEAK at the time. The plan has not been updated with regional enhancement and fisheries management information, nor has it been updated to remove potential release sites that are no longer considered appropriate locations.

The Phase III plan also summarizes technical guidelines and best practices for enhancement planning to help provide a systematic approach to the development of new enhancement projects that benefit fisheries and minimally impact wild salmon resources. For potential MSFs, the most relevant areas to this plan include release site selection, harvest contribution, and terminal areas.

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[18] ADF&G. 2024. Hatcheries and Stocking. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=fishingSportStockingHatcheries.stockingPlan (Accessed February 2024).

[19] ADF&G. 2024. Statewide Stocking Plan for Sportfish 2024 (Draft). Available from: https://www.adfg.alaska.gov/static/fishing/pdfs/hatcheries/24intro.pdf (Accessed February 2024).

The *ADF&G Genetic Policy* is a foundational policy that supports and guides many of the enhancement planning best practices outlined since inception of the Phase III plan (Davis et al. 1985).

Impacts of Automated Marking and Tagging Trailers

Marking and tagging rates for some Chinook salmon releases around the SEAK region have increased in recent years due to the use of 2 automated marking and tagging trailers (hereafter "trailers") beginning in 2021–2022. One trailer is located at Macaulay Salmon Hatchery (DIPAC, Juneau) and another is shared between Whitman Lake Hatchery (SSRAA, Ketchikan) and Crystal Lake Hatchery (SSRAA, Petersburg). The 2 trailers were purchased at a cost of $2.7M using funds from the Southeast Alaska Chinook Salmon Fishery Mitigation Program, which was established during 2009 PST negotiations and revised in 2019 renegotiations.[20] NSRAA declined a trailer and continues to mark and tag at historical rates.

SSRAA began using the trailer for mass marking Chinook salmon in 2021 (2020 brood year), whereas DIPAC began in 2022 (2021 brood year). With the use of trailers, Chinook salmon mark rates for both associations increased to 100% (Figure 2). Mark rates for NSRAA releases remain below 20%.

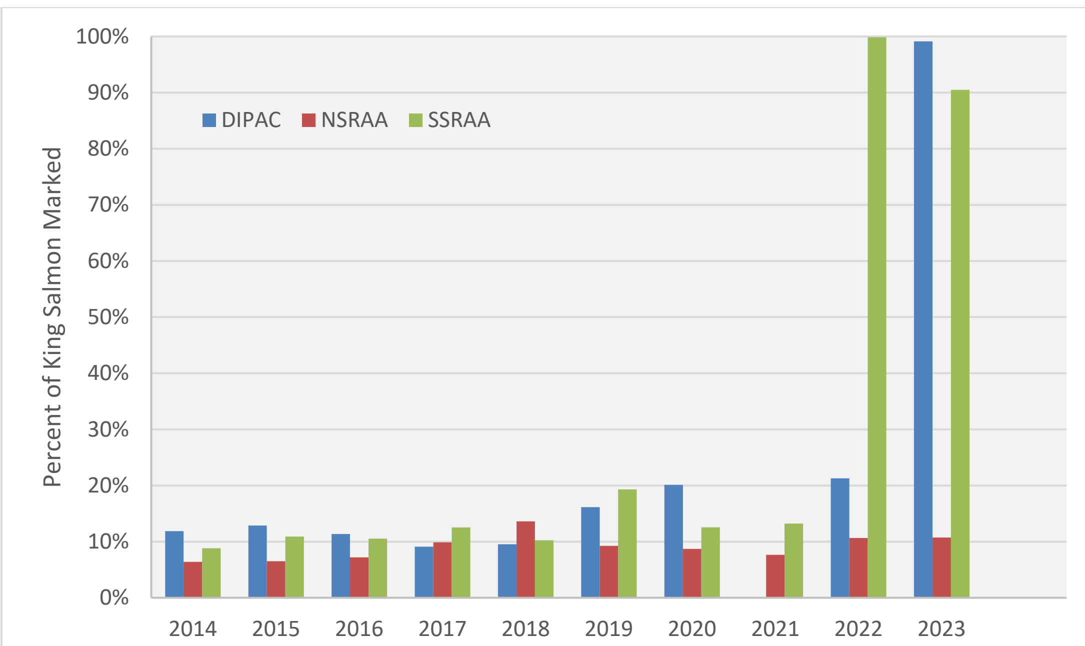

Figure 2.–Southeast Alaska Chinook salmon mark (adipose fin clip) rate for release years 2014–2023 (DFGCWTOTOP Database).

Increased tagging rates, although not a prerequisite for MSF implementation, occurred through the use of these trailers (Figure 3). Coded wire tagging allows estimation of stock composition, which is beneficial to identifying the Alaska hatchery component.

[20] ADF&G. 2024. Southeast Alaska Chinook Salmon Fishery Mitigation Program. Available from: https://www.adfg.alaska.gov/index.cfm?adfg=fisherymitigation.main (Accessed February 2024).

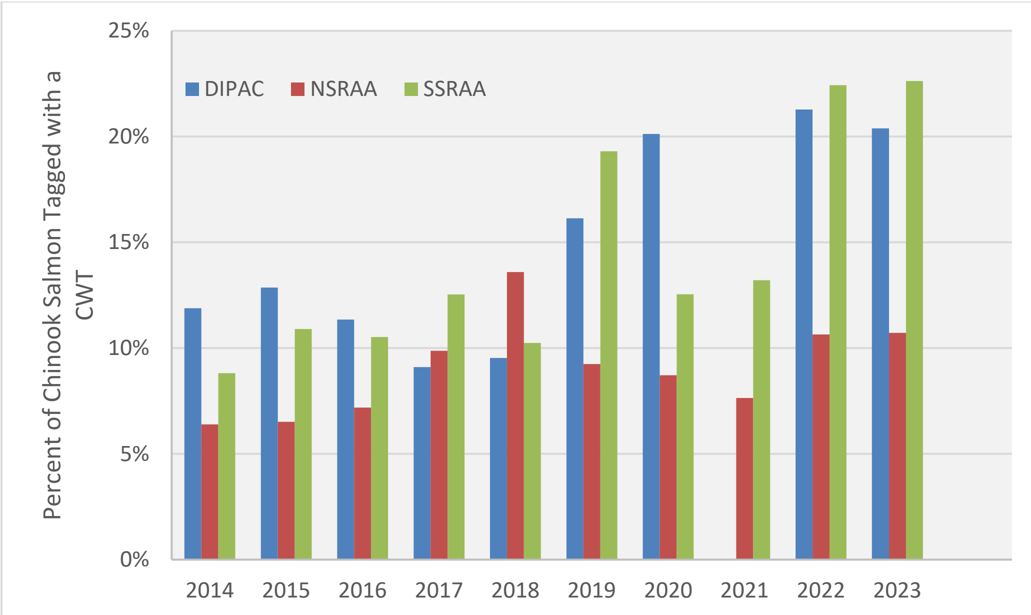

Figure 3.–Southeast Alaska Chinook salmon tag (CWT) rate for release years 2014–2023 (DFGCWTOTOP Database).

Over 7 million Chinook salmon were released from SEAK hatcheries in 2023,[21] which is the most recent year for which complete information is available, of which about 3.79M or 53% were marked with an adipose fin clip (Figure 4a). There were 17 locations around SEAK where Chinook salmon releases occurred, and mass marked fish (100%) were released from 10 of those release sites (Figure 4b)[3]. Additional release, marking, and tagging information for all SEAK hatchery Chinook salmon can be found in Appendix F.

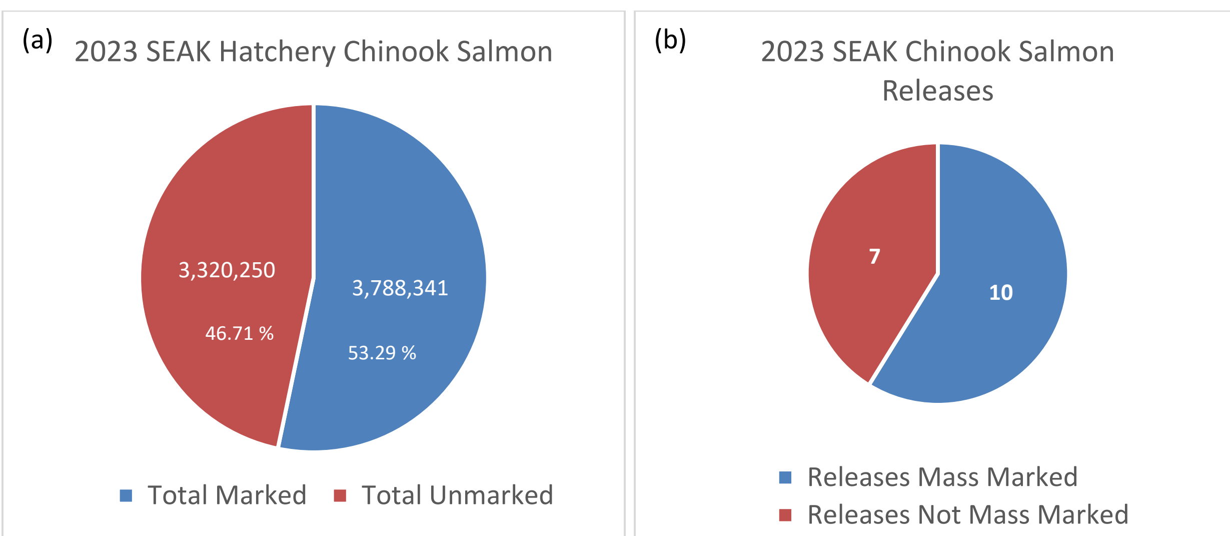

Figure 4.–(a) 2023 Southeast Alaska Chinook salmon release amounts by mark status, and (b) 2023 Chinook salmon releases that were mass marked or not mass marked.

Note: Estimates of marked and unmarked Chinook salmon does not include production by hatchery facilities in Metlakatla.

[21] This estimate of Chinook salmon release by SEAK hatcheries does not include production by hatchery facilities in Metlakatla.

DIPAC and SSRAA (personal communication K. Harms, DIPAC, January–February 2024; T. Frost, SSRAA, January–February 2024) have both noted benefits to using these trailers, most notably the increased marking and tagging efficiency, which can lead to fewer staff hours. Additionally, fish processed through the tagging trailers do not need to be anesthetized, which results in a faster recovery time, reducing handling mortality, compared to fish anesthetized and marked by hand. The ability to process 100% of the Chinook salmon produced at each of these hatcheries also leads to more accurate release numbers, becacuse each individual fish is counted as it goes through the trailer. Higher mark rates may also facilitate the visual identification of hatchery fish in fisheries by anglers, which may increase public understanding of the extent of which hatchery production contributes to sport catch, but this is an untestable assumption, and the department has employed direct education on the subject for over 20 years.

Several costs associated with tagging trailers have been identified by hatchery staff. Financial costs include the cost of insurance for days when the trailer is moved, as well as general upkeep, staffing, and maintenance costs, and one-time costs necessary to integrate the trailer into existing hatchery operations (e.g., DG Fisheries Services and McDowell Group 2019, ADF&G 2020). Although the DIPAC trailer stays in one location year-round, SSRAA's trailer is moved between 2 locations, resulting in relatively higher insurance costs and logistical complexity (ADF&G 2020).

Both DIPAC and SSRAA have recognized efficiencies and other benefits gained by the use of the trailers to mass mark; however, both organizations have expressed concerns and opposition to MSF implementation in the SEAK Chinook salmon sport fishery.

Summary of Implications and Considerations for Enhancement

Rates of marking: Although DIPAC and SSRAA have recently implemented mass-marking using the trailers, other SEAK hatcheries continue to mark other Chinook salmon releases around the region at historic rates. Continuation of historic mark rates for Chinook salmon will impact the feasibility of MSFs in different times and areas. According to a white paper by ADF&G, "for MSFs to be a viable option, mark rates must be high, ideally greater than 50%, to outweigh the costs associated with the increased fishing effort required and the incidental mortality on unmarked fish" (ADF&G 2020, p. 5).

DIT group implementation: MSF implementation may require the use of DIT groups to better assess the incidental mortality associated with the fishery. A DIT group would require administering a CWT and adipose fin clip to one group of hatchery-produced fish and only a CWT (no visual mark) to a second group that is released at the same time (SFEC 2016). This would require coordination between ADF&G staff and the relevant hatchery associations, and possible additional costs to hatcheries and department infrastructure (such as the MTAL and MHS).

Coordination and engagement with hatcheries: Successful implementation of an MSF would require coordination with hatcheries and a stable funding source, because MSFs are heavily contingent upon high mark fractions (ADF&G 2020, Hoffman and Pattillo 2008). Accordingly, ample communication and agreement between ADF&G and hatchery associations would need to occur prior to MSF implementation, and ideally prior to the proposal stage, in order to gain a complete understanding of any changes hatcheries may need to make in order to fully implement a MSF.

MARK FRACTION ANALYSIS

The efficacy of an MSF depends largely on the fraction of marked (i.e., adipose-clipped) fish available to the fishery (the "mark fraction"). A key question in this study was whether the current mark fractions observed in the SEAK Chinook salmon sport fishery are high enough to implement an MSF. A second related question was whether increasing the proportion of Chinook salmon released from the DIPAC and SSRAA hatchery facilities that are marked (the "mark scenario") could raise mark fractions to levels high enough for an MSF. A third question investigated whether a regionwide policy to increase marking levels of all SEAK hatcheries could support an MSF.

To address these questions, catch-sampling data from the SEAK Chinook salmon sport fishery were used to assess the current mark fraction. A model was developed to answer the latter two questions because empirical data were unavailable (i.e., "mass marked" [=100% marking scenario] fish from DIPAC and SSRAA facilities began recruiting into fisheries in 2024, and most other SEAK hatcheries have not been mass marking). The model was calibrated using both catch-sampling and coded wire tag recovery data.

These results were used to evaluate whether current or modeled mark fractions would be high enough to support a MSF. A mark fraction of 50%—meaning one in every 2 fish is adipose-clipped—is generally considered sufficient for meeting the purposes of an MSF because it allows for the harvest of marked fish without causing excessive mortality of unmarked fish. Because this study was a feasibility assessment with no specified management objectives, the 50% mark fraction was used as the benchmark.

METHODS

Both current and modeled mark fractions were estimated using catch-sampling and coded wire tag recovery data from the SEAK Chinook salmon sport fishery. Harvest estimates were obtained from the statewide harvest survey (SWHS[22]) and the SEAK marine harvest studies (MHS) program (Jaenicke et al. 2017). Catch-sampling data were collected by the SEAK MHS program, whereas coded wire tag recovery data were collected by both the MHS program and the ADF&G Mark, Tag, and Age Lab (MTAL).

All data used in this analysis were retrieved from the MTAL database via its online interface (DFGCWTOTOP[23]). Two queries were run: (1) the sport expansion report, which lists catch, sample, and recovery statistics, and (2) the contribution summary report, which provides contribution (harvest) estimates by tag code (stock). Strata without catch-sampling data or before 2005 were excluded from the analysis, as data prior to 2005 were collected at a coarser spatial resolution, limiting the ability to analyze data at the finest spatial resolution. A summary of the data used in this analysis is presented in Table 3.

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[22] Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish. Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/.

[23] DFGCWTOTOP database [Internet]. 1976 – present. Juneau, AK: Alaska Department of Fish and Game, Division of Commercial Fisheries, Mark, Tag and Age Laboratory. [cited May 2025]. Available from: https://mtalab.adfg.alaska.gov/CWT/reports/default.aspx.

Table 3.–Average number of fish by category from catch-sampling and coded wire tag recovery data in the Southeast Alaska Chinook salmon sport fishery, 2005–2023, by sport fish management area.

					Stock		
Sport Fish Management Area	Harvest	Sample	Clips	Tags	SEAK Hatchery	SSRAA/ DIPAC	Other
Craig	2,675.0	739.7	69.1	33.3	4.5	2.3	28.6
Glacier Bay	1,127.5	222.7	30.8	12.2	1.9	0.7	10.1
Haines and Skagway	267.3	55.1	6.7	6.5	4.2	4.0	2.3
Juneau	1,887.7	252.7	20.4	16.7	14.5	9.6	2.2
Ketchikan	3,109.9	451.9	35.1	25.6	16.9	14.4	8.7
Petersburg and Wrangell	1,192.0	198.8	9.7	8.0	5.6	3.8	2.4
Sitka	7,882.8	1,750.8	189.8	78.6	14.1	3.8	64.2
Wrangell Narrows	1,835.1	78.7	8.1	7.6	7.6	7.5	0.0
Yakutat	287.2	77.6	8.6	3.6	0.3	0.1	3.3

The current mark fraction was estimated using catch-sampling data. When estimates were derived by combining multiple strata, the overall mark fraction, $\hat{P}$, was calculated as a weighted average:

$$\hat{P} = \frac{\widehat{Mark}}{\widehat{Harvest}} \tag{1}$$

where:

- $\widehat{Mark}$ is the sum of marked fish harvested, $\widehat{Mark} = \sum_h \widehat{Mark}_h$,
- $\widehat{Harvest}$ is the sum of fish harvested, $\widehat{Harvest} = \sum_h \widehat{Harvest}_h$.

The number of adipose-clipped fish harvested in stratum h, $\widehat{Mark}_h$, was estimated as:

$$\widehat{Mark}_h = \hat{P}_h \widehat{Harvest}_h \tag{2}$$

where:

- $\hat{P}_h = a_h/n_h$ is the estimated proportion of marked fish harvested in stratum h,
- a_h is the number of marked fish sampled in stratum h,
- n_h is the number of fish sampled for marks in stratum h,
- $\widehat{Harvest}_h$ is the estimated number of fish harvested in stratum h.

Modeled mark fractions required additional information, which was obtained using coded wire tag recovery data. Stock-specific (i.e., DIPAC and SSRAA, or all SEAK hatcheries) harvests (equation 3) and harvests of marked fish (equation 4) were estimated using the methods of Bernard and Clark (1996). Equations (1)–(4) were applied to estimate the mark fractions and hatchery contributions separately for each fishery (defined by time and area) and year (2005–2023), based on annual harvest data and stock-specific information. The results from these equations were combined to determine the proportion of marked fish available to a fishery, as expressed in equation (5). Uncertainty in the modeled mark fractions was quantified by applying equation (5) for each fishery across the years 2005–2023 and assessing the resulting interannual variability.

The harvest of fish from stock S, $\widehat{Harvest}_S$, was estimated as:

$$\widehat{Harvest}_S = \sum_j \sum_h \frac{x_{jh}}{\lambda_h \phi_h \theta_j} \tag{3}$$

where:

- x_{jh} is the number of decoded CWTs from cohort *j* recovered in stratum *h*,
- λ_h is the fraction of CWTs successfully processed in stratum *h*,
- ϕ_h is the fraction of fish sampled for CWTs in stratum *h*,
- θ_j is the fraction of a fish released with a CWT and adipose-clip from cohort *j*.

Similarly, the harvest of marked fish from stock *S*, $\widehat{Mark}_S$, was estimated as:

$$\widehat{Mark}_S = \sum_j \sum_h \frac{x_{jh}}{\lambda_h \phi_h} \tag{4}$$

Further details about the notation and variance formulas used for uncertainty estimation are provided in Appendix E1.

Results from equations (1)–(4) were used to inform the calculation of the fraction of marked fish available to a fishery, $\tilde{P}$, modeled as:

$$\tilde{P} = \frac{Harvest_S \rho_S + Mark_{S^C}}{Harvest} \tag{5}$$

where:

- $Harvest_S$ is the harvest of stock *S*,
- ρ_S is the fraction of fish released with an adipose-clip from stock *S*,
- $Mark_{S^C}$ is the harvest of adipose-clipped fish *not* from stock *S*,
- $Harvest$ is the total fish harvested in the fishery.

The tilde on $\tilde{P}$ indicates a model-based mark fraction, as opposed to an empirical estimate, $\hat{P}$, which is directly derived from catch-sampling data. The key term in the model, ρ_S, controls the fraction of fish released an adipose-clip. A value of $\rho_S = 0$ results in no fish from the stock being marked, whereas $\rho_S = 1$ results in all fish being marked (i.e., mass marking). Note that the harvest of adipose-clipped fish *not* from stock *S* can be calculated by subtracting the harvest of marked fish from stock *S* from the total harvest of marked fish: $Mark_{S^C} = Mark - Mark_S$.

Equation (5) was used to evaluate 3 marking scenarios, corresponding to marking 20%, 50%, and 100% of hatchery production. These modeled marking levels were compared against the current (status quo) mark fraction, based on historic marking and tagging guidelines, where approximately 10% of hatchery production is marked. Equation (5) was applied in 2 ways: first, using hatchery production solely from DIPAC/SSRAA facilities only, and second, considering all SEAK hatcheries. The results from equation (5) were then used to examine how varying marking levels might affect the encounters of marked fish in the SEAK Chinook salmon sport fishery.

RESULTS

Current and modeled mark fractions were estimated by time and sport fish management area: Craig, Glacier Bay, Haines and Skagway, Juneau, Ketchikan, Petersburg and Wrangell, Sitka, Wrangell Narrows, and Yakutat. Results are presented in Table 4, Figures 5–6, and Appendix E2.

Empirical estimates highlight significant temporal and spatial variation in the percentage of marked fish harvested by the SEAK Chinook salmon sport fishery. The modeled mark fraction analysis supports these findings, with varying outcomes across different scenarios. Specifically, times or areas with higher contributions from SEAK hatcheries (Table 3, Appendix E2) were more affected by changes in hatchery marking levels.

Substantial spatial variability was observed in the modeled mark fractions (Figure 5–6; Appendix E2). The impact of increasing the marking level was less pronounced in the outside sport fish management areas (Yakutat, Sitka, Craig, Glacier Bay) compared to the inside areas (Haines and Skagway, Juneau, Petersburg and Wrangell, Ketchikan, and Wrangell Narrows), where the mark fractions increased more notably. This is likely due to the differing contributions from SEAK hatcheries in these areas. In the inside areas, only the 100% marking scenario resulted in mark fractions exceeding 50%, with some temporal variability.

Model results by hatchery show that increase marking at DIPAC and SSRAA facilities (Figure 5) led to outcomes similar to those of a regionwide policy (Figure 6). This indicates that the majority of Alaska hatchery-produced Chinook salmon harvested in the SEAK Chinook sport fishery originate from DIPAC and SSRAA.

Wrangell Narrows was the only sport hatchery terminal area isolated in this analysis. As a terminal harvest area, it is designed to target hatchery-origin fish due to its proximity to the hatchery release site. Current mark fractions in Wrangell Narrows align closely with those reported by Crystal Lake Hatchery. The modeled mark fractions increased proportionally with the mark scenario, as expected for a terminal fishery targeting a single stock. Notably, Wrangell Narrows was the only sport management area to exceed 50% mark fractions under the 50% marking scenario.

One limitation of this analysis is the spatial and temporal resolution of the results, which are presented by sport fish management area and sport period. The relatively coarse spatial-temporal resolution reflects the data collection and analysis methods (see Fishery Monitoring Program). Although this resolution is sufficient for current management (see Management Program), it may not support an MSF. An alternative source of information could be data from SEAK commercial fisheries, which are available at a finer spatial and temporal resolution (ADF&G statistical area and week). Although not part of this analysis, commercial fishery data could offer more detailed estimates.

Table 4.–Average estimated mark fractions in the Southeast Alaska Chinook salmon fishery by sport fish management area and Sport Period.

	Sport Period 1		Sport Period 2		Sport Period 3	
Sport Fish Management Area	Average	SD	Average	SD	Average	SD
Craig	8.6%	4.0%	9.4%	4.9%	8.8%	5.8%
Haines and Skagway	10.0%	2.4%	8.2%	3.2%	9.2%	1.2%
Juneau	7.2%	4.5%	9.6%	2.9%	10.8%	4.9%
Glacier Bay[a]	11.7%	5.4%	14.0%	5.9%	12.0%	7.2%
Ketchikan	7.7%	2.0%	8.3%	2.4%	10.2%	5.6%
Petersburg and Wrangell	4.1%	2.8%	8.4%	2.4%	8.8%	3.1%
Wrangell Narrows[b]	13.1%	4.5%	–	–	–	–
Sitka	11.3%	5.0%	12.7%	6.0%	12.6%	6.4%
Yakutat	8.5%	4.2%	9.2%	6.1%	9.4%	1.7%

Note: Exact dates associated with Sport Period change from year to year; however, periods 1–3 correspond roughly to January–May, June–July, and August–December, respectively. Years included in the average vary by sport fish management area.

[a] The Juneau management area encompasses Glacier Bay, which is separated out for finer spatial resolution.

[b] The Petersburg and Wrangell management area encompasses Wrangell Narrows, which is separated out for finer spatial resolution. This finer spatial unit does not differentiate between Sport Periods, and therefore this represents a full calendar year.

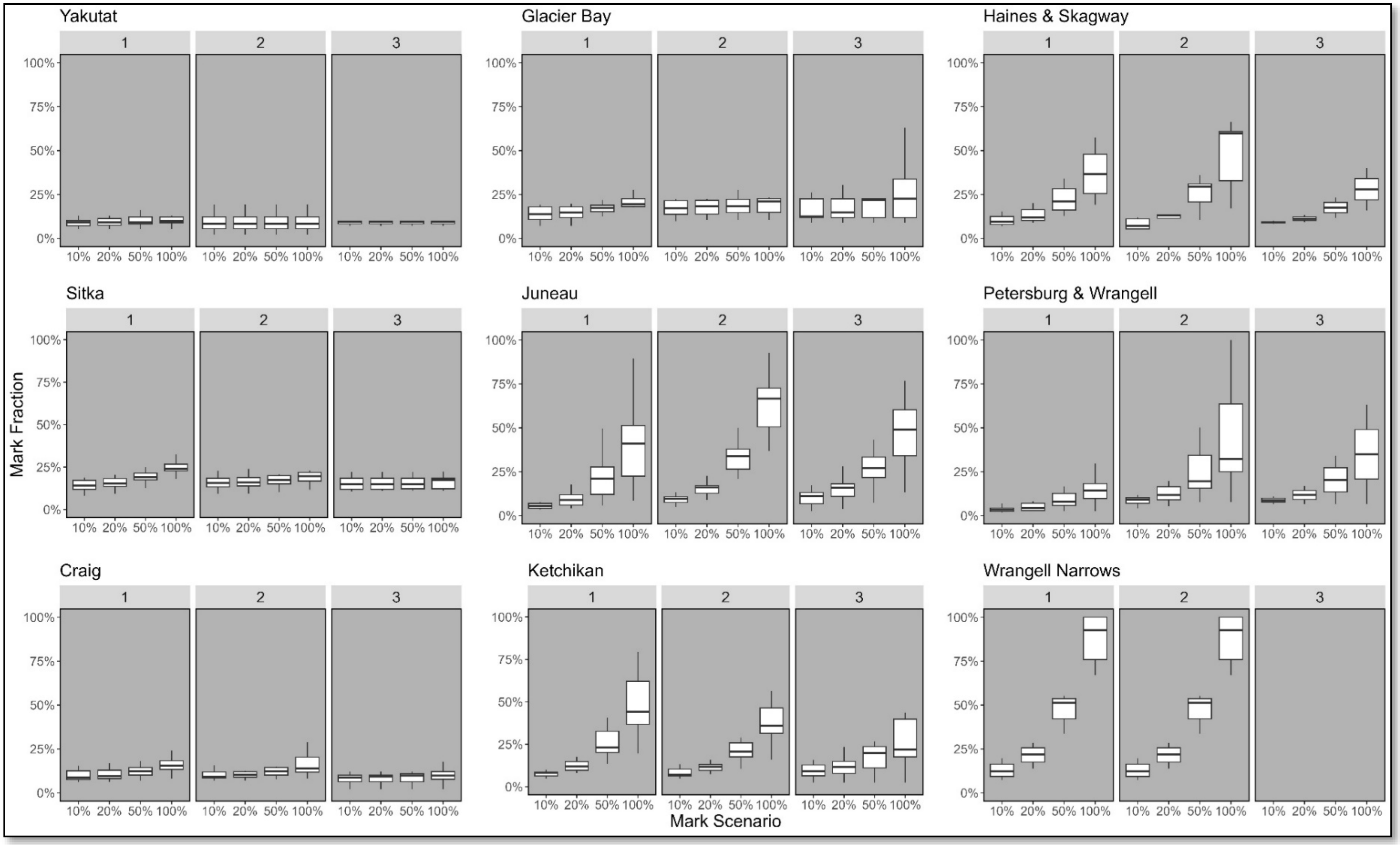

Figure 5.–Boxplots displaying estimated (10%; status quo) and modeled (20%, 50%, and 100% DIPAC and SSRAA mark scenarios) mark fractions by sport fish management area and Sport Period.

Note: Calculation and equations defining mark fractions provided under Model section; mark scenarios are not an estimated quantity, but rather 1 of 4 marking rate levels applied to hatchery production yielding estimates of the expected mark fraction in the sport fishery by area. Exact dates associated with Sport Period change from year to year; however, periods 1–3 correspond roughly to January–May, June–July, and August–December, respectively. Years displayed vary by sport fish management area.

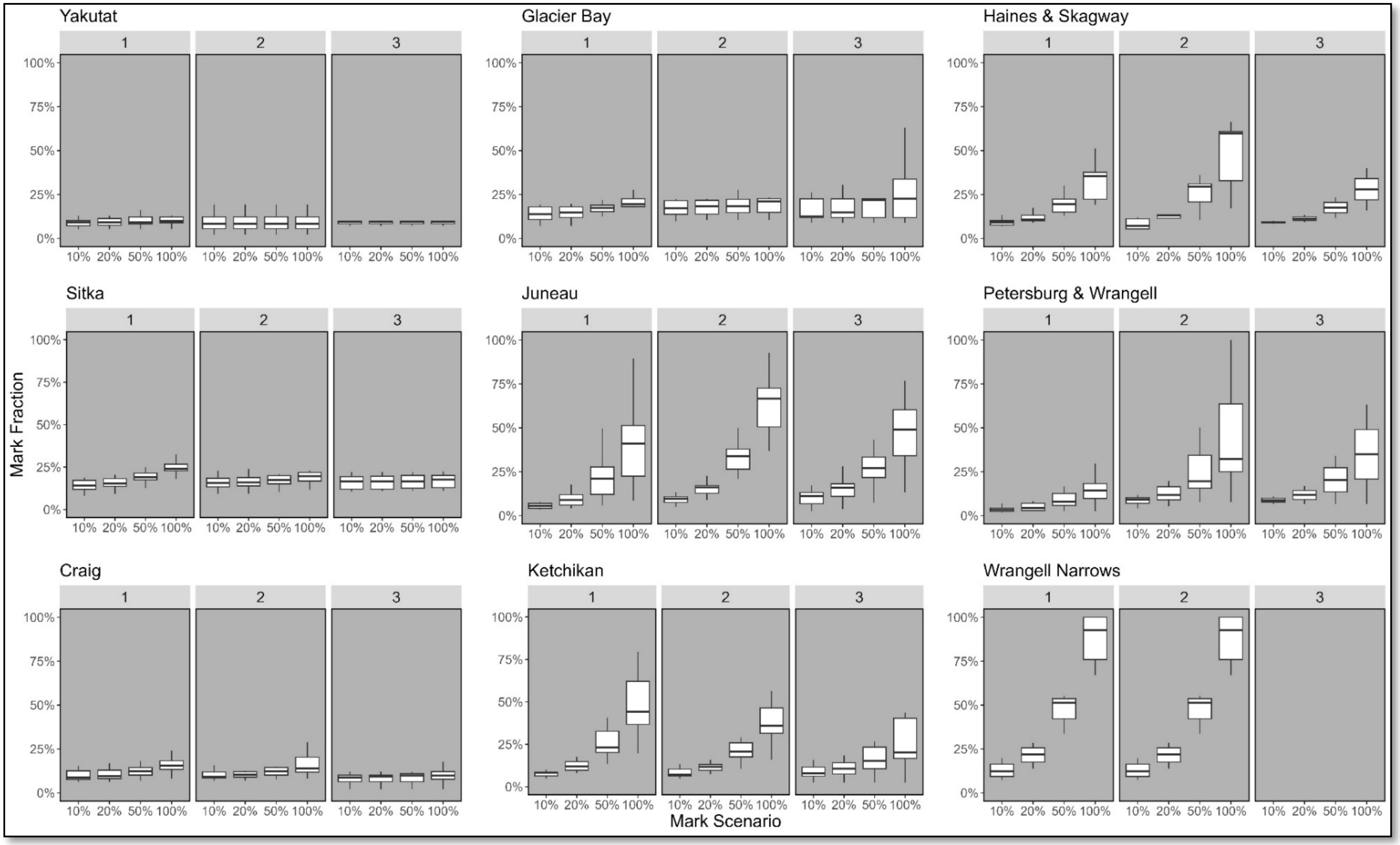

Figure 6.–Boxplots displaying estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK mark scenarios) mark fractions by sport fish management area and Sport Period.

Note: Calculation and equations defining mark fractions provided under Model section; mark scenarios are not an estimated quantity, but rather 1 of 4 marking rate levels applied to hatchery production yielding estimates of the expected mark fraction expected or observed in the sport fishery by area. Exact dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January-May, June-July, and August-December, respectively. Years displayed vary by sport fish management area.

COMMUNITY ENGAGEMENT AND PERSPECTIVES ON MARK-SELECTIVE FISHERIES

A key component of this feasibility study was to engage SEAK fishing community members to gather local perspectives on MSFs. This was done not only to communicate the study goals and findings directly with community members, but also to incorporate their ideas and concerns into the qualitative assessment of potential costs and benefits of MSFs in the SEAK Chinook salmon sport fishery.

METHODS

Two series of community meetings were held in conjunction with each phase of the study (Figure 1). In Phase 1, 4 meetings were held in SEAK communities and 1 meeting online in summer and fall of 2023. During these meetings, the project team presented the goals of the feasibility study and a summary of MSFs in British Columbia, Washington, and Oregon, highlighting their benefits and challenges. In Phase 2, two virtual meetings were held in February 2024 to share findings from the program review and cost-benefit assessment with ADF&G staff and the public. Information about the meetings was shared via an email distribution list of more than 400 individuals and organizations, and through social media channels. Summaries of Phase 1 and Phase 2 meetings were distributed to meeting participants via the email list and are publicly available (Appendix C). These summaries served as the basis for incorporating community perspectives into a synthesis of potential costs and benefits of MSFs.

Meetings were facilitated by UW researchers, and ADF&G staff attended to answer questions and engage in discussion with the public. At each meeting, note-takers (2-3 individuals from UW and ADF&G) took detailed notes during the discussion portion to capture questions and topics raised by participants. The detailed meeting notes were evaluated using thematic analysis, a common method in the social sciences (e.g., Creswell and Creswell 2023), to synthesize key themes from community discussions as well as questions raised at these meetings. Approximately 166 community members attended the meetings, including university and agency researchers and management staff; sport, commercial, personal use, and subsistence fishers; hatchery association employees; and other members of the public (Appendix C).

RESULTS

Meeting participants discussed a variety of topics and questions related to MSFs in the Pacific Northwest (British Columbia, Washington, and Oregon) and their potential use in SEAK. This section summarizes common themes and questions raised by participants at community meetings, which we acknowledge may not necessarily be representative of views held by SEAK community members overall.

A primary concern raised by SEAK community members in meetings held as part of this study was the potential for higher release mortality of wild Chinook salmon under an MSF than directed mortality in the absence of an MSF. Some community members expressed skepticism about the accuracy of release mortality rates currently used in models and noted that mortality can vary by fish size, time of year, angler experience, fish handling, where fish are caught (freshwater or saltwater), and hook type (e.g., barbed vs. barbless; Grover et al. 2002). Community meeting participants suggested that new, Alaska-specific studies on incidental mortality effects of MSFs could be needed prior to MSF implementation to gain a greater understanding of the ecological impacts of an MSF.

Some community members who attended the meetings raised ethical concerns about catch and release fishing (i.e., moral opposition to injuring fish through catch and release) that would reduce their satisfaction. Community members also wondered whether MSF regulations would result in altered fishing behavior, such as shifts in fishing locations and/or increased crowding in areas with MSFs. Speaking from previous experiences fishing under MSF regulations in Washington, several community members expressed that MSFs can result in reduced efficiency and increased costs, including longer time to catch a legal fish, due to various factors such as a high ratio of unmarked to marked fish.

At community meetings, some participants raised concerns that MSFs could disproportionately affect rural and Alaska Native residents by reducing access and increasing costs, complicating regulations, and shifting charter effort into fishing areas currently used by local residents. Several community members commented that subsistence priorities are not adequately recognized with respect to Chinook salmon in SEAK and raised concerns about a lack of Alaska tribal representation in the PST arena.

Some meeting participants expressed concerns that initial increased opportunity afforded by an MSF could lead to greater restrictions in the future, such as retention of only marked hatchery fish. However, community members also noted that an MSF could result in Alaska fishers harvesting more hatchery fish originating in Alaska, thus increasing the return on SEAK hatchery investment. Because the harvest of Alaska hatchery fish does not count towards Alaska's all-gear catch limit set by the PSC, an MSF may provide a way to mitigate Chinook salmon harvest reduction that resulted from the last treaty agreements.[24]

Institutional concerns raised during community meetings were in regard to implementation, feasibility, and applicability within the SEAK context of the SEAK sport fishery. Specifically, these concerns focused on reduced trust in management agencies due to negative perceptions of MSFs by the public, based on previous efforts to implement MSFs in SEAK (e.g., in commercial troll fisheries), and the concern that the investment required to develop an MSF for the sport fishery would eventually lead toward MSFs in all sectors. Many community members commented that the design and outcomes of MSFs elsewhere may have limited applicability to Alaska, noting impacts of habitat degradation, dams, and urbanization that affect Chinook salmon and their fisheries in Washington that are less relevant in Alaska.

Overall, more opposition than support was expressed for the potential use of MSFs as a management tool for the sport fishery. The meetings also provided an opportunity for information sharing between ADF&G staff and community members on relevant details of the current SEAK sport fish program and the potential effects of implementing MSFs. Community members requested technical information to better inform their understanding of how a potential MSF might work, including the percentage of marked fish caught by sport and commercial fisheries and mark rates and number of marked fish released coastwide. When possible, team members provided answers to these questions either during the meetings, or with follow-up emails afterwards.

[24] ADF&G. Southeast Alaska Chinook Salmon Fishery Mitigation Program. Available: https://www.adfg.alaska.gov/index.cfm?adfg=fisherymitigation.main (Accessed February 2024).

Additionally, these questions better informed subsequent presentations. The meeting attendees were given a schedule of expected publications, which include answers to many of these questions.

SYNTHESIS OF COSTS AND BENEFITS OF MARK-SELECTIVE SPORT FISHERIES FOR SEAK CHINOOK SALMON

Assessing the feasibility of MSFs for the SEAK Chinook salmon sport fishery requires consideration of the potential costs and benefits from a programmatic perspective, but also on perceptions of this management tool and its outcomes by communities and other fishery stakeholders. In this section, we bring together findings from a literature review of the history and use of MSFs (see *Introduction*), the program review, the retrospective mark fraction analysis, and community perspectives to synthesize the benefits and challenges of MSFs as a management approach in SEAK.

Cost-benefit analyses are decision-making tools that can take a wide range of forms, from qualitative, descriptive narratives to quantitative approaches that use a common metric (usually monetary) to assess both costs and benefits (Sinden 2015). In environmental management, the range of social, economic, and ecological impacts of particular policies are often evaluated within impact assessment frameworks using a mix of qualitative and quantitative data (e.g., Clay and Colburn 2020). Similarly, thematic analysis of qualitative data has been used to identify trade-offs and incorporate stakeholder and community perspectives in evaluation of fisheries policy and management (Lorance et al. 2011, Rees et al. 2013, Glass et al. 2015). Qualitative analysis may be the most appropriate and informative approach in contexts with high uncertainty about outcomes of a particular policy (Sinden 2015) or that require evaluation of social concerns (Mkindi et al. 2021).

Because the design and impacts of MSFs are highly place-based and context-dependent (Beaudreau et al. *In prep*), we used a qualitative approach to characterize the range of potential impacts, the conditions under which they might be realized, and who might be affected. We synthesized predominant themes emerging from a literature review of MSFs in the United States, the program review, and community engagement. Themes were grouped into 3 categories of impact: ecological, socioeconomic, and institutional (Glass et al. 2015, Clay and Colburn 2020). Ecological impacts include factors such as changes in fishing mortality and sublethal effects on fish stocks (e.g., behavior change). Social impacts may include angler behavior, norms, community relationships, well-being, and equity. Economic impacts consider financial costs of implementation, effects on income or employment, and other effects on local businesses. Institutional impacts encompass bureaucratic processes and agency roles and responsibilities arising from the action. For each category, the potential positive and negative impacts are described. *Positive impacts* are conceptualized as positive outcomes gained or negative outcomes avoided, whereas *negative impacts* include resources expended (i.e., time, financial capital) and other negative outcomes.

ECOLOGICAL IMPACTS

The primary ecological benefit of an MSF is the potential for reduced fishing mortality of wild Chinook salmon stocks, when compared to a non-selective fishery operating in the same time and area. Based on a review of MSFs outside Alaska, a common goal of selective fisheries is to allow for harvest of hatchery fish while alleviating pressure on wild populations (Peterson and Baltzell

2012, DFO 2015, WDFW 2022). Assessing the ecological trade-offs of MSFs on wild stocks is a key aspect of evaluating their effectiveness. Although MSFs are generally designed to alleviate pressure on wild populations, incidental mortality of unmarked (presumed wild) fish that are caught and released has been widely raised as a concern (Hoffmann and Pattillo 2008, CRITFC 2014, SFEC 2016). The extent to which an MSF results in lower mortality on wild Chinook salmon than would have occurred without an MSF depends on the ratios of marked and unmarked fish, marking rates of hatchery-produced fish, fish handling practices, and fishing effort (e.g., Pyper et al. 2012, SFEC 2016).

Additionally, an MSF could result in repeated catch and release of the same individual. Limited information exists regarding the impact of repeated injuries from catch and release. Sublethal effects of MSFs on wild fish, such as impact on spawning success, are also poorly understood.

SOCIOECONOMIC IMPACTS

Broadly, MSFs could benefit the sport fishery by providing fishing opportunity where it otherwise may have been restricted or closed entirely. In Alaska, this could occur as time and/or area openings or bag limit increases. An additional benefit from increased tagging of Alaska hatchery fish, which could happen with or without an MSF, may be improved accounting of the origin of harvested Chinook salmon.

Potential socioeconomic costs were identified by this study, especially based on concerns raised at community meetings. These include potential negative impacts of MSFs on the quality of fishing by complicating regulations, creating crowding issues, increasing the financial cost of harvesting a fish, and decreasing angler satisfaction through catch and release practices. MSFs often result in increased complexity of regulations, which can be difficult for anglers to interpret and complicate enforcement (SFEC 2016).

The harvest of Chinook salmon for food, which is a culturally important activity for all SEAK community members, primarily occurs under sport regulations in SEAK. Alaska Native community meeting participants expressed concerns that MSFs could lead to added challenges in accessing Chinook salmon that may create or exacerbate food security issues in their communities. Tribes in Washington and Oregon have expressed similar concerns about the ability of MSFs to allow for non-treaty fisheries to access a greater share of hatchery salmon, while resulting in the same impacts on wild fish (CRITFC 2024). Depending on the structure of the specific MSF, benefits may be disproportionately distributed geographically between segments of sport fishing anglers or fishery sectors. Shifts in harvest and effort after implementation of an MSF may occur and require modification to management provisions over time, potentially resulting in more restrictive regulations than originally implemented before the MSF.

INSTITUTIONAL IMPACTS

The potential benefits of mass-marking and/or MSFs could extend to management institutions in Alaska, by providing improved data for monitoring Chinook salmon harvest. However, there are costs to management agencies to implement more complex regulations, including direct expenditure of staff time and the opportunity costs for other management tasks. Additionally, increased encounter rates of mass-marked fish can lead to noncompliance by anglers and charter operators to meet reporting and sampling requirements, which can degrade the quality of fishery information collected by these programs. A number of potential impacts on the ADF&G Sport

Fish program in SEAK were identified through the program review and are summarized in Appendix D.

Institutional impacts include issues of implementation, feasibility, and applicability in the context of the SEAK sport fishery. Specifically, reduced trust in management agencies due to negative perceptions of MSFs by the public based on previous efforts to implement MSFs in SEAK (e.g., in commercial troll fisheries), and the concern that the investment required to develop an MSF would eventually lead towards a "total MSF" in all sectors.

DISCUSSION

By conducting this feasibility study, ADF&G was not advocating for the use of MSFs in the SEAK Chinook salmon sport fishery. MSFs have never been employed in SEAK sport fisheries and their use in Alaska has been extremely limited, which contrasts with their increasing use in Pacific Northwest (British Columbia, Washington, Oregon) sport fisheries. The purpose of this study was to better understand the potential impacts of MSF implementation on the SEAK Chinook salmon sport fishery within the context of domestic and international management mandates, and with specific consideration of current assessment and monitoring programs and community perspectives. This study also modeled hatchery mark fractions in the SEAK Chinook salmon sport fishery on relatively coarse geographic and temporal scales to characterize the proportions of marked hatchery fish that would be available to sport fisheries at different marking rates. This assessment of existing hatchery production, marking rates, and potential changes that could be undertaken was intended to help characterize the current feasibility of MSF implementation. However, this analysis was not designed to identify and/or recommend specific MSF scenarios for the SEAK Chinook salmon sport fishery. This feasibility study provides a more complete understanding of the needs, impacts, concerns, and potential benefits of MSF implementation that would inform the evaluation of any future MSF proposals for the SEAK Chinook salmon sport fishery.

Taken together, the literature review of MSFs in the US, the program review, and community engagement provided a more complete picture of the implications of MSFs for SEAK sport fisheries and are key to assessing feasibility. Potential positive outcomes include reduced fishing mortality for wild stocks (ecological), maintaining fishing opportunity in particular times and/or areas (socioeconomic), and improved data due to increased tagging and sampling (institutional; Table 5).

Table 5.–Potential positive outcomes of MSF implementation, categorized according to ecological, socioeconomic, and institutional impacts.

Positive impacts	Type			Source
	Ecological	Socioeconomic	Institutional	
Reduced fishing mortality for wild stocks	X			LR
Maintain fishing opportunity in particular times and/or areas		X		LR, CE, PR
Improved data quality due to increased tagging			X	CE

Note: The source is indicated for each impact (LR = literature review of MSFs outside Alaska; PR = program review; CE = community engagement). It is important to note that these outcomes—including the magnitude and direction of impact (positive or negative)—will depend on the specific details of the MSF program design and implementation.

Potential negative outcomes include increased release mortality of unmarked wild fish (ecological), reduced efficiency (longer time, and/or higher cost to catch a harvestable fish [socioeconomic]), more complex regulations and impacts to fishing experience (socioeconomic), inequitable distribution of costs and benefits among communities and/or fishery sectors (socioeconomic), intensive data needs and impacts to the CWT and stock assessment programs (ecological, institutional), and diversion of resources and attention away from other priority salmon issues (institutional, socioeconomic; Table 6).

The commonly cited goal of MSFs is to provide or maintain harvest opportunity of hatchery fish while protecting wild stocks. An assumed context for this goal is that the alternative management approach to an MSF would be fishery restrictions due to wild stock conservation concerns or changes to the SEAK Chinook salmon allocation from the PSC. In this context, the purported benefits of MSFs are straightforward: allow anglers to fish and harvest hatchery fish. However, it is unclear that this benefit would be realized in the SEAK Chinook salmon sport fishery. The SEAK sport fishery harvests Chinook salmon across a large geographical area and intercepts a large number of Chinook salmon stocks as they transit through SEAK waters. The contribution of Alaska hatchery-produced stocks is variable in time and location, generally increasing near terminal release locations and following known trends in run timing. Several other mass marked Chinook salmon stocks (non-Alaska hatchery) are intercepted in the SEAK sport fishery and would be indistinguishable to the angler. Harvest of these marked but non-Alaska hatchery produced stocks would not provide intended benefits of an MSF because this harvest would continue to be counted against the Alaska all-gear catch limit. Given these considerations, a regionwide MSF is not likely to provide a net benefit. MSFs applied in specific locations and times where Alaska hatchery-produced stocks are more prevalent in the fishery may be a useful management tool to explore, although there are cost and benefits to consider for each location and scenario. Ample consideration should be given to the negative impacts of increased incidental mortality, increased complexity of regulation, and increased cost of compliance with international obligations to sample and report on MSF fisheries.

Areas of SEAK where harvest opportunity is currently limited by wild stock conservation concerns were also the areas identified by the mark fraction analysis as potentially having high enough rates of marked hatchery fish available under mass marking scenarios to be considered for MSFs. However, ADF&G already selectively manages Chinook salmon fisheries in these areas to focus harvest on hatchery fish using time and area controls rather than marks. Providing sport harvest opportunity in select times and areas provides a similar benefit of focusing harvest on Alaska hatchery-produced stocks, but without the negative impacts of increased incidental mortality, increased complexity of regulation, and cost of compliance with international obligations. MSF implementation at any scale would increase the complexity of monitoring and assessment programs that would be required to collect additional information, possibly at finer geographic and temporal scales to meet reporting requirements to the PSC/SFEC. Current sport fishery assessment programs (MHS, SWHS, and Charter Logbook) would probably need modification or additional components added. Adding components to these programs would require budgetary support and staff capacity for data collection, analysis, and fulfillment of reporting requirements. This data collection burden may be extended to anglers and charter operators who may be required to document and report additional information.

Table 6.–Potential negative outcomes of MSF implementation, categorized according to ecological, socioeconomic, and institutional impacts.

	Type			
Negative impacts	Ecological	Socioeconomic	Institutional	Source
Increased release mortality of unmarked wild fish	X			LR, CE
Sublethal effects of catch and release on wild-origin fish (e.g., reduced spawning success)	X			CE
Impacts to the CWT program; Increased uncertainty in stock assessment and parameter estimation	X		X	LR, PR
Requires additional data and Alaska-specific studies on release mortality			X	CE, PR
Increased complexity of regulations		X	X	LR, CE, PR
Changes in charter fishing behavior affecting harvest experience for unguided residents		X		CE
Reduced efficiency, longer time, and/or higher cost to catch a harvestable fish		X		CE
Ethical concerns about catch and release fishing		X		CE
Inequitable distribution of benefits among segments of sport fishing anglers and fishery sectors		X		CE
Could be used as a tool to reduce opportunity over the longer-term		X		CE
Previous MSFs in SEAK have drawn little support		X	X	CE
Complicates monitoring and assessment; may require increased reporting for anglers		X	X	LR, PR
Could divert resources and attention from more significant salmon issues		X	X	CE

Note: The source is indicated for each impact (LR = literature review of MSFs outside Alaska; PR = program review; CE = community engagement). It is important to note that these outcomes—including the magnitude and direction of impact (positive or negative)—will depend on the specific details of the MSF program design and implementation.

Another increasingly relevant assessment issue is the impacts of mass-marking on the existing CWT sampling program. The significant increase in the number of marked but not tagged Chinook salmon that is occurring due to mass marking in the region requires sampling programs to sort through larger numbers of marked fish to recover CWTs. This is problematic because CWT recovery and analysis is key to PST fishery assessment protocols and harvest estimation. The additional workload necessary for sampling programs to recover CWTs will stress ADF&G staff and budget capacity and will likely impact anglers and charter operators who will be subject to more and longer-duration sampling of their catch. These issues are already occurring in areas of SEAK where mass-marked fish returned in 2024 and appear to be leading to less compliance by anglers and charter operators to sampling protocols.

This study found that there was very limited public support for MSFs by SEAK community members, Alaska Native organizations, hatcheries, or other fishery stakeholders. During the series of community meetings conducted through the course of this project and follow-up communication, the department received a number of negative comments generally expressing concern and a lack of support for MSF. The concerns included: disproportionate cost/benefits to segments of sport anglers and/or fishing sectors, a general dislike of increasing incidental mortality (perceived as waste), changes in harvest and effort patterns that may lead to crowding or increased tensions over Chinook salmon allocation among gear groups, and finally increased complexity of regulations. Notably, without the cooperation and support of the private nonprofit hatchery organizations to mass mark and CWT an adequate proportion of Chinook salmon releases, any MSF is unlikely to occur.

Additionally, the design and structure of this study provided an opportunity to develop a general template for evaluating the feasibility of MSF implementation for a specific fishery (Appendix G). This feasibility template mirrors the approach used in this study and is intended to be a first step taken by management agencies considering implementing an MSF. The template is similar to the SFEC MSF Proposal Template (Appendix A) in some ways but includes components that address feasibility rather than specific characteristics of a proposed MSF. A logical process for a management agency considering an MSF would be to start by completing this feasibility assessment and, if the outcome was a determination that an MSF was feasible, then the agency could get the necessary infrastructure changes and education campaign in place prior to implementation. Although the template was derived from our feasibility study, modeling of anticipated MSF impacts did not occur in our study. This is because information gathered through other components of our study indicated significant challenges to MSF feasibility that rendered the modeling of impacts unnecessary. However, a modeling exercise would help inform assessment of impacts if other feasibility components suggested a MSF was feasible. Specifically, it would help the management agency determine if there was a threshold for acceptable mortality of wild stocks from an MSF.

This study has assessed the feasibility of MSF implementation in the SEAK Chinook salmon sport fishery as it is currently managed and has explicated a variety of costs and concerns that do not support MSFs. However, the balance of these considerations could be shifted if external processes, such as PST renegotiations, litigation, or ESA designations, arose in a way that severely limited SEAK sport fishery Chinook salmon harvest opportunity in the future. In the future if harvest opportunity was severely limited, MSFs may be a useful tool to maintain Chinook salmon fishing and harvest opportunity, but assessment tools and programs would need to be in place to ensure benefits are realized without negatively impacting wild stocks or the sport fishery itself. These considerations and the specific fishery, assessment, and community-based issues identified in this feasibility study should be addressed before any MSF proposal is advanced in the SEAK Chinook salmon sport fishery.

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APPENDIX A: SELECTIVE FISHERY EVALUATION COMMITTEE MSF PROPOSAL TEMPLATE

Appendix A 1.–MSF proposal template form provided by the SFEC.

Template for mark-selective fishery proposals

Mark-Selective Fishery Proposal ID #__________________

Date Received ____________________________________

MARK-SELECTIVE FISHERY PROPOSALS - TITLE

Contact information

Proposing Agency:	
Contact Person:	
Mailing Address:	
Phone Number:	
Fax:	
Email:	

Is the proposal:

new or not yet reviewed by PSC-SFEC _______
substantially changed _______

Purpose/management objective

Describe the management objective of the proposed mark-selective fishery.

Location and time of the proposed mark-selective fishery

Please **include any information when there are breaks or changes in regulations that might impact sampling stratification (see Question 7b below)**

1. **Location of the fishery:**

2. **Year and month(s) when the fishery is proposed to occur:**

-continued-

Other information about the fishery:

3. Target species/stocks (including nontarget PSC species/stocks of concern):

4. Gear to be used:

5. Other regulation details (e.g., size restrictions, bag limits, mixed bag information):

6. Expected mark rate:

Projected impacts BY the fishery

7. Identify all (coast wide) CWT stocks likely to be encountered in this fishery (including individual tag codes if available), whether those stocks were Double Index Tagged (DIT). Appendices F and G provide tables of tagged indicator stocks for coho and Chinook for your convenience. Please note we are interested in tagged impacts alone, untagged hatchery production should not be included.

In-season management

8. Describe your sampling program for sampling for: CWTs, marks and estimation of total catch. Attach your sampling plan if available. At a minimum, include descriptions for the following:
    a. CWT recoveries.
        i. Will there be *random* sampling of CWTs (i.e., fishers exiting fisheries contacted for biological sampling of harvest) or will you be using voluntary programs?
        ii. If *random* will there be ETD or visual identification of tagged fish?
        iii. If ETD in *random* samples, will all tagged fish (marked and unmarked) be processed?
        iv. If *random* what is the expected sample rate for CWTs?
        v. If voluntary programs are used, how is the awareness factor estimated?
    b. Monitoring for retained catch by sample strata for sample expansions. The sample strata and the strata of catch estimation must match the location/time/regulation strata (i.e., whenever there is a change in regulation such as from MSF to non-selective, or change in bag limits, the sampling strata should also change).
    c. Monitoring of mark rate in the MSF (this is the total mark rate, marked fraction in the harvest from the fishery).
    d. Other information, e.g., retained unmarked fish (mixed bag fisheries, or mark recognition error in MSF)

-continued-

Other information.

9. Please include any other information that will be useful for estimation of unmarked tagged mortalities in your MSF. For instance, sources of estimates of unmarked to marked ratios for DIT tagged groups (e.g., in a test fishery, nearby hatchery, non-selective fishery). Please provide any input you wish on methods to estimate the unmarked tagged mortalities for DIT groups, or for appropriate release mortality rates to be used.

APPENDIX B: SFEC POSTSEASON TABLES

Appendix B1.–Postseason reporting table forms provided by SFEC related to MSF reporting.

Table B1-1: CWT Sampling, both non-selective and mark selective fisheries

Column	Description
Region	Fishery Reporting Region
Sector	Troll
	Sport
	Net
	First Nations
	Personal Use
CWT Sampling Method	Direct
	Voluntary
	None
CWT Detection Method	Visual
	Electronic
Heads Processed	All
	Only Marked Fish
	Other (describe)

Note: One entry per region and fishery sector as appropriate; to include information on general sampling programs and exceptions.

-continued-

Table B1-2: MSF information

FISHERY INFORMATION	
Column	**Description**
Contact Information	Name, phone number, email address for additional information
Fishery Area	Area covered by MSF regulation
Sector	Troll
	Sport
	Gillnet
	Seine
	Personal Use
	Other
Start Date (MM/DD/YY)	Starting date for MSF regulation
End Date (MM/DD/YY)	Ending Date for MSF Regulation
Target Species for Fishery	Chinook
	Coho
	Other

-continued-

MSF REGULATIONS	
Column	**Description**
MSF Species	Chinook
	Coho
	Other
Bag limits adult and juvenile by mark status	Describe retention limits (e.g., marked fish only, marked only adults, 1 marked adult, 2 jacks regardless of mark status)
Minimum Size Limit	Minimum size limit for retention. Specify unit of measurement (inches, centimeters) and type of measurement (e.g., total length, fork length)
Maximum Size Limit	Maximum size limit for retention if applicable). Specify unit of measurement (inches, centimeters) and type of measurement (e.g., total length, fork length)
Other regulations	Enter information on other applicable restrictions (e.g., barbless hooks, live boxes, tangle nets, mesh size)

-continued-

CWT SAMPLING	
Column	**Description**
CWT Sampling Method	Direct
	Voluntary
	None
CWT Detection Method	Visual
	Electronic
Heads Processed	All
	Only Marked Fish
	Other (describe)
Mark Rate	Enter method to estimate mark rate (None, Observer, Angler interviews, Samplers)
Method For Catch Estimation	Enter method to estimate catches (None, Catch Slips/Tickets, Phone survey, Observer, Angler interviews, Creel Census, Catch Record Card, Log Books)
Method For Release Estimation	Enter method to estimate releases (None, Catch Slips/Tickets, Phone survey, Observer, Angler interviews, Creel Census, Catch Record Card, Log Books)

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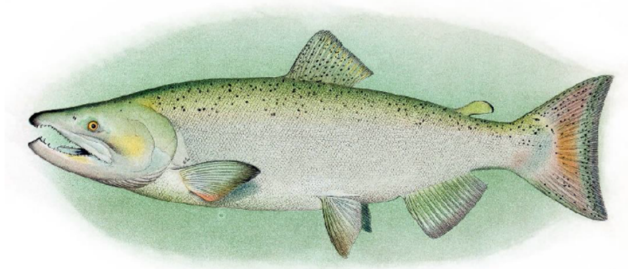
(UN)MARKED FISH	
Column	**Description**
Retained	Number of fish retained (if unavailable, enter NA)
Legal Sized Fish Released	Number of legal-sized fish released (if unavailable, enter NA)
Sub-Legal Sized Fish Released	Number of Sub-Legal Sized fish released (if unavailable, enter NA)
Extra-Legal Sized Fish Released	Number of fish above the maximum size limit released (as applicable, (if unavailable, enter NA).
Extra-Legal Sized Fish Released	Number of fish above the maximum size limit released (as applicable, (if unavailable, enter NA).
RELEASE MORTALITY RATES	
Column	**Description**
Legal and Extra-Legal Sized Fish	Assumed total mortality rate for fish larger than the minimum size limit that are released (immediate and delayed)
Sub-Legal	Assumed total mortality rate for fish smaller than the minimum size limit that are released (immediate and delayed)

APPENDIX C: PUBLICLY DISTRIBUTED DOCUMENTS FROM COMMUNITY MEETINGS

Appendix C1.–Project details provided to public meeting participants in Southeast Alaska.

Understanding the costs and benefits of a mark-selective sport fishery for king salmon in Southeast Alaska: A feasibility study



Background

Along the west coast, some fisheries for king (Chinook) salmon are managed as mark-selective fisheries, where special regulations allow for harvest of adipose fin-clipped hatchery fish. This management tool was established to provide opportunity to harvest hatchery-produced fish when wild-origin salmon populations are at low abundance; however, implementing a selective fishery is not straightforward.

The Alaska delegation involved in the 2019 Pacific Salmon Treaty (PST) negotiations asked the Alaska Department of Fish and Game (ADF&G) to explore the possibility of using a mark-selective fishery for king salmon management in Southeast Alaska, specifically for the sport fishery. This request was made through Alaska's Commissioner to the Pacific Salmon Commission in response to reduced king salmon allocations for all Alaska gear groups under the 2009 and 2019 PST agreements.

ADF&G Division of Sport Fish received funding through a grant from the Pacific Salmon Commission to complete a feasibility study. Through a competitive process, ADF&G contracted a team of researchers from the University of Washington (UW) with experience in community engagement in Southeast Alaska to help do the work. The UW team's role is to gather and synthesize technical information, facilitate community meetings, incorporate community concerns and feedback, and write up the results in a final report that will be shared with ADF&G and the public.

Study Objectives

1. Review mark-selective fishery programs outside of Alaska to understand how mark-selective fisheries have worked in British Columbia, Washington, and Oregon. What have the challenges and benefits been, and for whom?
2. Review the king salmon sport fish program in Southeast Alaska to understand what would need to change *if* a mark-selective fishery was implemented.
3. Engage Southeast Alaska fishing community members to gather local perspectives on mark-selective fisheries.
4. Evaluate potential costs and benefits of mark-selective fisheries in the Southeast Alaska king salmon sport fishery, incorporating community perspectives.

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Community Engagement

In summer and fall of 2023, the project team held four meetings in Southeast Alaska communities and one online meeting. Information about the meetings was shared through email lists provided by ADF&G staff, public radio, posted flyers, and social media. During the meetings, the project team presented the goals of the feasibility study and results from the first phase of the project—a review of mark-selective fisheries (MSFs) in British Columbia, Washington, and Oregon, highlighting their benefits and challenges. Attendees provided feedback, questions, and concerns about MSFs. A goal of these conversations was to better understand community perspectives about potential costs and benefits of MSFs. Detailed questions and feedback from community members are being incorporated into the overall feasibility study.

Meeting Locations	Participation*
Juneau July 17, 2023 (5-6:30 pm) Mendenhall Valley Public Library	18 people attended, including university and agency researchers and management staff (~50%); sport (~40%), commercial (~5%), and personal use or subsistence (~20%) fishers; and other members of the public (~5%). 5 ADF&G and 3 UW project team members were also present.
Ketchikan September 18, 2023 (7-8:30 pm) ADF&G Office	13 people attended, including charter operators (~85%) and local ADF&G staff (~15%). 1 ADF&G and 2 UW project team members were also present.
Klawock / Craig September 19, 2023 (7-8:30 pm) Prince of Wales Vocational & Technical Education Center	48 people attended, including resident sport fishers (~50%), subsistence fishers (~33%), charter operators (~12%), commercial fishers (~10%), hatchery association employees (~2%), and local ADF&G staff (~2%). 2 ADF&G and 2 UW project team members were present.
Sitka September 21, 2023 (7-8:30 pm) University of Alaska Southeast	18 people attended, including local ADF&G staff (~33%), commercial fishers (~22%), charter operators (~17%), subsistence fishers (~11%), hatchery association employees (~11%), and university researchers (~6%). 3 ADF&G and 2 UW project team members were also present.
Online October 4, 2023 (7-9 pm) Zoom link provided	38 people attended, including subsistence or personal use fishers, resident sport fishers, charter operators, commercial fishers, hatchery association employees, and local ADF&G staff. 3 ADF&G and 5 UW project team members (incl. note takers) were also present.

** Percentages do not always add up to 100% because people self-identified with multiple groups.*

Meeting Highlights

Meeting attendees shared a wide range of comments, concerns, and questions about MSFs. Primary themes are highlighted below and were similar across meeting locations. Overall, more opposition than support was expressed for the potential use of MSFs as a management tool for the sport fishery. The strongest concerns were voiced by Prince of Wales community members, who noted a range of potential negative impacts to the local economy, customary and traditional fishing access, and fishing experience if MSFs are implemented.

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The meetings also provided an opportunity for information sharing between ADF&G staff and community members on relevant details of the current Southeast Alaska sport fish program and the potential effects of implementing MSFs. Technical information discussed included the percentage of marked fish caught by sport and commercial fisheries; mark rates and number of marked fish released coastwide; differences in feasibility of MSFs in inside waters versus outside waters of Southeast Alaska; and the current use of mass marking trailers by Southern Southeast Regional Aquaculture Association and Douglas Island Pink and Chum, Inc., including their efficiency and cost. These topics will be examined in detail during the next phase of the feasibility study (Obj. 2, above).

In addition, feedback was provided by participants to the project team about ways to improve outreach and engagement with a broader group of community members moving forward. In response to these recommendations, the team improved their outreach for the online meeting and has compiled an email distribution list of more than 400 individuals and organizations. Tlingit and Haida Central Council communications staff helped to distribute the online meeting announcement through social media and other online channels.

Key Themes from Community Discussions

Ideas about potential applications or benefits of MSFs

- MSFs could be a way to maintain or increase fishing opportunity in years with low returns of wild fish, during periods of non-retention of wild fish, or in specific areas near hatcheries
  - > May be most feasible on a small scale
- Improved data due to increased marking and tagging can help with accounting
  - > May result in Alaska fishers harvesting more hatchery fish originating in Alaska
- Alaska hatchery fish do not come out of PST allocation, so may provide a way to mitigate king salmon harvest reduction that resulted from the last treaty agreements

Concerns about release mortality

- Concerns about MSF impacts on wild fish due to increased release mortality from catch and release of unmarked fish
- Questions raised about the accuracy of release mortality rates currently used in models
  - > Mortality varies by fish size, time of year, angler experience, fish handling, where fish are caught (freshwater or saltwater), hook type (e.g., barbed vs. barbless)
  - > No information on the impacts of repeated catch and release of the same individual
  - > May necessitate new Alaska-specific studies prior to MSF implementation
- Limited information on sublethal effects of MSFs on wild-origin fish, such as impact on spawning success

Concerns about impacts of MSFs on fishing experience

- Potential for increased complexity of regulations, as in other places with MSFs (e.g., WA)
- Possible shifts in fishing locations and/or increased crowding in areas with MSFs
- Reduced efficiency, longer time, and/or higher cost to catch a harvestable fish (e.g., due to increased travel time to new fishing areas, more time until a marked fish is caught, etc.)
  - > Participants noted that most fish caught in their areas are currently unmarked
- Lower satisfaction due to above factors, as well as ethical concerns about catch and release fishing
  - > The number of unmarked fish that are caught and released can be high if mark rates are low

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- Several attendees shared personal experiences of operating charter businesses under MSF regulations in WA, and the many issues they experienced (described in the bullets above)

Concerns about equitable access

- Harvest of king salmon for customary and traditional use (subsistence) occurs under sport regulations, so any added challenges in accessing king salmon for subsistence is a concern
- Concerns that MSFs would negatively and disproportionately affect rural and Alaska Native residents
  - > For example, could further complicate regulations and shift charter effort into fishing areas currently used by local residents
- Fears that initial increased opportunity afforded by a MSF could lead to greater restrictions in the future, such as retention of *only* marked hatchery fish
  - > In WA, MSFs get shut down if rates of handling wild fish are too high
- Concerns that any potential benefits of MSFs would not be afforded to both sport and commercial fisheries

Concerns related to implementation, feasibility, and applicability

- Studies of MSFs have been done in other contexts, and these may not be applicable broadly to Southeast Alaska
- What has worked in WA, or other places, may not work in AK
  - > Some participants shared prior experiences with MSFs in Alaska (e.g., in commercial troll fisheries) and indicated there was little support for them overall
- MSFs for sport fisheries would impact subsistence and commercial fisheries, which needs to be taken into account when considering overall feasibility of a MSF program
  - > Concerns that new tagging trailers will lead to a "total MSF" in all sectors

Broader concerns about king salmon fisheries and management

- MSFs will do little to address larger scale king salmon issues, such as impacts of trawl bycatch
  - > The benefits to this tool are not clear with respect to reducing mortality for wild king salmon
- Subsistence priorities are not adequately recognized with respect to king salmon in Southeast Alaska
- Importance of direct engagement with tribes and tribal organizations by ADF&G to discuss potential impacts of MSFs, along with other broader concerns
  - > There is also a lack of Alaska tribal representation in the Pacific Salmon Treaty arena

Emerging Questions

Meeting attendees asked a wide range of questions about the project origin and goals, mortality rates associated with MSFs, conservation impacts of MSFs, current creel sampling rates, nonlethal/sublethal effects of MSFs on wild-origin fish, details of current king salmon allocation, and more. Categories of frequently asked questions are listed below. The project team addressed some of these questions during the meetings, particularly those related to the study itself; however, they are working to address the remaining questions during the next phase of the project.

Questions related to this study

- What motivated the study and who is funding it?
- What are the goals of the funder (PSC) and ADF&G in pursuing this project?
- What are the project team member roles, including the role of UW?
- What impact will community feedback have on the end product of this study?

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- Why is this feasibility study directed only at sport and not commercial fisheries?
- How will this study address potential impacts on customary and traditional use of king salmon (subsistence)?

Questions related to release mortality

- What release mortality rate is used and how was it determined? What relevant parameters were considered (e.g., fish size, hook type, etc.)?
- How would release mortality differ for guided versus unguided fishing, particularly considering the high concentration of non-resident, guided anglers in some areas?
- How would a possible change in fishing behavior related to MSF implementation affect release mortality?

Questions related to MSF implementation and feasibility

- Would an MSF actually increase opportunity in reality and not just on paper? Does Alaska release enough hatchery-produced king salmon to see a benefit from MSFs?
- Mark rates are low and some wild stocks are marked in Southeast Alaska; is an MSF really feasible in this area?
  > Would mark rates have to be near 100% in order for this to be effective?
- What would MSF sport regulations in Southeast Alaska actually look like (e.g., area, timing, bag limits)?
  > What is the functional difference between MSFs and additional opportunities provided in terminal harvest areas?
- How would an MSF change fishing behavior? Could this be avoided? How would it be accounted for in management?
- Most hatcheries in the Southern U.S. are federally funded, which is part of what makes MSFs possible. How would a program like this work with private non-profit hatcheries in AK? How would funding of MSFs work? Who would be responsible?
- Will there be pushback from other parties in the Pacific Salmon Treaty arena if Alaska is to propose a new MSF?
- Would allowing MSFs in Southeast Alaska open the door for them to be used extensively?

For more information, contact:

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How can you share your questions and ideas?

1. Attend future meetings—we will hold two online meetings in early 2024 to share a project update and seek additional feedback. Please contact Anne if you would like to be added to our email list.
2. Email or call Judy or Anne directly.
3. Provide anonymous feedback through this online form. Only project team members will see your responses, which will be anonymous and not linked to your name *unless* you choose to provide your contact information.

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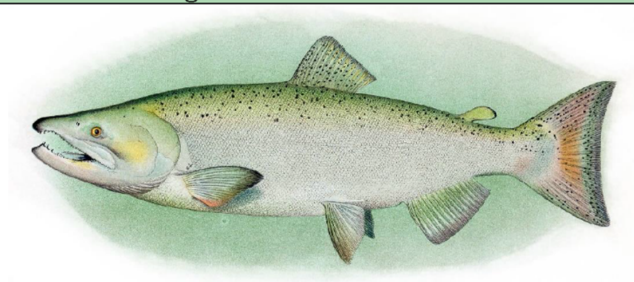
March 2024
PROJECT UPDATE

Understanding the feasibility of a mark-selective sport fishery for king salmon in Southeast Alaska



Background and Objectives

Mark-selective fisheries (MSFs) allow for the selective retention of hatchery-origin salmon that are marked with an adipose fin clip. Although MSFs have been implemented in other areas and fisheries within the geographic scope of the Pacific Salmon Treaty, the implications of an MSF occurring in the Southeast Alaska king salmon sport fishery are not well understood. Alaska Department of Fish and Game (ADF&G) Division of Sport Fish received funding through a grant from the Pacific Salmon Commission to study the feasibility of using MSFs to allow for additional opportunity to harvest hatchery-produced king salmon. ADF&G contracted a team at University of Washington (UW) to complete the project work.

The study objectives were to:

1. Review mark-selective fishery programs *outside* of Alaska to understand how mark-selective fisheries have worked in British Columbia, Washington, and Oregon;
2. Review the management, assessment, and enhancement programs associated with the king salmon sport fishery in Southeast Alaska to understand what would need to change *if* an MSF was implemented;
3. Engage Southeast Alaska fishing community members to gather local perspectives on mark-selective fisheries; and
4. Evaluate potential costs and benefits of mark-selective fisheries in the Southeast Alaska king salmon sport fishery, incorporating community perspectives.

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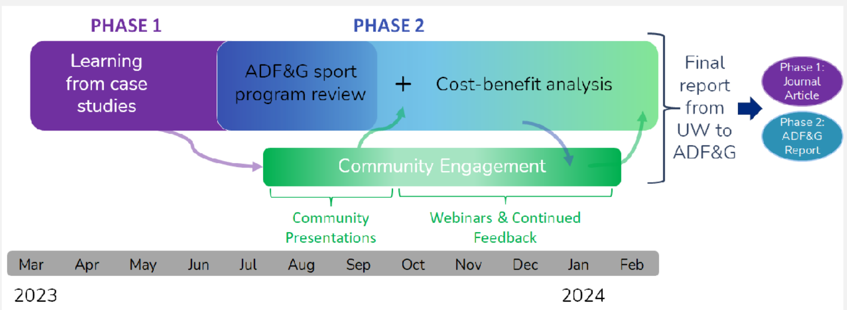
Project Timeline

Phase 1 of the project began in March 2023 and was focused on learning from MSF case studies (Objective 1) to inform community engagement meetings and the development of the sport fish program review. Phase 2 included the sport fishery program review (Objective 2) and cost benefit analysis (Objective 4). Community engagement (Objective 3) occurred throughout both phases through a series of in person and online meetings. These meetings provided opportunities for feedback from the public and ADF&G staff, which was integrated into the feasibility study.

The contract period for the UW team extended from March 2023 through February 2024. UW submitted their final report to ADF&G in February 2024, and will continue collaborating with the ADF&G team to publish the results, which will be available to the public. The report will undergo technical review prior to publication, with intended final publication by the end of 2024. Two publications are in progress: one will focus on the case studies outside Alaska (Phase 1), and a second will include the review of Southeast Alaska king salmon management, assessment, and enhancement and the analysis of MSF costs and benefits (Phase 2).



Project approach and timeline. This timeline includes the contract period for the UW team (Mar 2023-Feb 2024). Publications will be prepared and finalized over the period from March to December 2024.

Phase 1 Community Meetings

In summer and fall of 2023, the project team held four meetings in Juneau, Ketchikan, Prince of Wales, and Sitka, as well as one online meeting. During the meetings, the project team presented the goals of the feasibility study and results from the literature review of MSFs in British Columbia, Washington, and Oregon, highlighting their benefits and challenges. Attendees provided feedback, questions, and concerns about MSFs. A goal of these conversations was to better understand community perspectives about potential costs and benefits of MSFs and to elicit questions that would help to further guide the feasibility study.

> You may view a recording of the presentation at this link. A written summary of the Phase 1 meetings is here.

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Phase 2 Online Meetings

We held two virtual meetings in February 2024 to share findings from the program review and cost-benefit assessment with ADF&G staff and the public. Information about the meetings was shared with an email distribution list of ~400 people compiled during Phase 1 of the project. The first meeting (2/7/24 12-1:30 pm) was attended by 5 members of the project team, 2 notetakers, and 20 members of the public, the second meeting (2/8/24 7-8:30 pm) was attended by 7 members of the project team, 2 notetakers, and 11 members of the public.

During these meetings the project team presented the goals of the feasibility study along with results from the Phase 2 of the project. Phase 2 results included a summary of the potential ecological, socioeconomic, and institutional costs and benefits of an MSF based on the literature review, program review, and community feedback to date. **The presentation may be viewed here.** Attendees provided feedback and asked questions about the project results, as well as broader questions about MSFs.

Similar to the first phase of meetings, these meetings provided an opportunity for information sharing between ADF&G staff and community members on relevant details of the current Southeast Alaska sport fish program and the potential effects of implementing MSFs. ADF&G staff answered questions relating to marked SEAK wild stocks, including the reasoning behind marking wild stocks, the specific stocks marked, and mark rates.

ADF&G staff reiterated during the discussion that the ADF&G Sport Fish Division is not championing the use of MSFs by doing this study. Rather, the purpose of this study is to better understand the potential impacts of MSFs – both positive and negative – on Southeast Alaska fisheries and their management. This feasibility study provides more comprehensive knowledge of MSFs that ADF&G can use to provide input and guidance if there is a need or a proposal for an MSF in the future.

Summary of questions and comments from Phase 2 meetings

- Participants asked about the origin of king salmon caught in the sport fishery, which is highly variable depending on time and area. The table below shows the percentage of Alaska-origin hatchery Chinook salmon in Southeast Alaska sport fishery harvest, from 2005 to 2021. The information is summarized from the technical memorandum "*Harvest of Southeast Alaska Wild-Origin Chinook Salmon in the Southeast Alaska Troll and Sport Fisheries*."

Fishery Area	Range (2005-2021)	Average (2005-2021)
SEAK Sport Fishery (region)	16-42%	24%
Ketchikan area	14-62%	45%
Northern inside area	38-80%	52%
Petersburg and Wrangell area	18-86%	51%
Outside area	4-15%	7%

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- A number of the comments and questions focused on the potential effects of an MSF on hatcheries, and hatcheries' ability to influence MSFs. Some Southeast Alaska hatcheries are currently mass-marking 100% of their king salmon by clipping the adipose fin. Hatchery staff present at the meeting noted that the costs of maintaining fish tagging and marking trailers, as well as staff time, could be a future limitation to their mass-marking program. ADF&G staff noted that any MSF would require the cooperation of hatchery operators, and that hatchery decisions are primarily driven by their Board of Directors, meaning ADF&G cannot require a hatchery operation to mark all of their fish or increase production.

- Meeting participants also asked a variety of questions relating to the logistics of MSF implementation, and highlighted concerns about potential overlap with tagged and marked wild stocks (e.g., Chilkat, Taku, Stikine, and Unuk rivers). It was discussed that while the percentage of marked wild fish is low, it may not make sense to put an MSF in close proximity to these wild stock natal river systems.

- A question was asked about how MSFs would affect the incidental mortality magnitude (or exceed the cap for incidental mortality limits set by the Pacific Salmon Commission for the SEAK king salmon fishery); however, this is not possible to answer definitively without knowing the details of how an MSF would be designed, such as its location, timing, and specific regulations. The current king salmon sport fishery incidental mortality rate used for analysis is approximately 16% (Source: Chinook Technical Committee of the Pacific Salmon Commission; Report TCCHINOOK (22)-01).

- A question was also asked about how increased mark rates would result in better data. An ADF&G staff member replied that with an increase in mark rates, even without increasing the tag rate, additional information is gained from every fish that is sampled or harvested about whether it is of hatchery origin. Although there is some natural adipose fin loss in salmon, it is very minor; most fish without adipose fins are clipped from a hatchery.

Project Contacts

For general information about the study:

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APPENDIX D: SUMMARY OF POTENTIAL IMPACTS OF AN MSF ON THE ADF&G SPORT FISH PROGRAM IN SOUTHEAST ALASKA

Appendix D1.–Programmatic impacts to the Department of Sport Fish as a result of MSF implementation in the sport fishery.

Program area impacted	Requirement/consideration	Details	Other information
Management	Proposal to SFEC by June 1 of the year prior to implementation of new or substantially changed mass-marking/MSF project proposals	Proposal is evaluated for the following: 1) Fishery regulation 2) CWT sampling method 3) CWT detection method 4) CWT composition estimation method 5) Alignment of time/area strata boundaries of regulations and catch estimation and CWT sampling programs 6) Catch estimation by size/mark/retention status 7) PSC Indicator stocks expected to be impacted by the fishery 8) DIT release groups expected to be impacted by the fishery	Plans for proposed fishery information provided to SFEC will require coordination with assessment and monitoring programs
Management	Proposal to BOF (from ADF&G or outside organization/group) with proposed fishery details	Proposal to include fishery regulation details; will occur after SFEC proposal is approved	No specific requirements for BOF proposal, may include time/area, bag limits, etc.
Management	Plan to fulfill postseason reporting requirements for SFEC Postseason tables submitted to SFEC yearly on requested schedule	Table 1: information on CWT sampling method, CWT detection method, and number of heads processed by region and sector Table 2: information on fishery area, sector, start date, end date, and target species, as well as specific MSF regulations, including species, bag limits by mark status and size (if applicable), minimum size limit, maximum size limit, and other regulations	Will require coordination with research (assessment and monitoring) program

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Appendix D1.–Page 2 of 3.

Program area impacted	Requirement/consideration	Details	Other information
Management	Plan to fulfill postseason reporting requirements for SFEC Post season tables submitted to SFEC yearly on requested schedule	Table 1: information on CWT sampling method, CWT detection method, and number of heads processed by region and sector Table 2: information on fishery area, sector, start date, end date, and target species, as well as specific MSF regulations, including species, bag limits by mark status and size (if applicable), minimum size limit, maximum size limit, and other regulations	Will require coordination with research (assessment and monitoring) program
	Public outreach and education; could start as early as BOF proposal, and potentially ongoing	If BOF proposal is from ADF&G, may consider outreach prior to meeting to gain public support Education and outreach will communicate regulations and reporting requirements (if changed), as well as reason for management tool	MSFs often increase regulation complexity, making education and outreach important for this tool to be successful
Assessment & Monitoring	Navigating ERIS program in the context of an MSF	An MSF would alter the fraction of marked, as well as marked and tagged, fractions in such a way that would violate project assumptions for juvenile CWT projects on the Chilkat, Unuk, Taku, and Stikine rivers	Will be highly dependent on location of MSF, and of specific indicator stock
Assessment & Monitoring	Calculation and reporting of SFEC MSF proposal and reporting requirements	For proposal: harvest estimation method by size, mark, and retention status; DIT release groups expected to be impacted by the fishery; and CWT composition estimation results For postseason reporting: method for catch estimation; method for release estimation	none
Assessment & Monitoring	Quantifying Southeast Alaska Hatchery Add-on	Alaska does not count a portion of its hatchery catch against its PST allocation; the calculation falls into the stock assessment category	Changes may be made based off of MSF

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Appendix D1.–Page 3 of 3.

Program area impacted	Requirement/consideration	Details	Other information
Assessment & Monitoring	Quantifying Southeast Alaska Hatchery Add-on	Alaska does not count a portion of its hatchery catch against its PST allocation; the calculation falls into the stock assessment category	Changes may be made based off of MSF
Assessment & Monitoring	Statewide Harvest Survey changes	In current status, no anticipated changes	May reconsider based on any significant changes during SWHS modernization
Assessment & Monitoring	Saltwater (Charter) Logbook Program changes	Consider adding a logbook question to document mark status of released Chinook salmon	none
Assessment & Monitoring	Southeast Alaska Marine Harvest Studies Project changes	Dependent on location of MSF, increase staffing or move existing staff in order to meet sampling goals; capture marked status for released fish	None ; address potential issues of noncompliance due to increase marked fish in the harvest. Implement ETD?
Enhancement	Coordination and engagement with hatcheries	Feasible MSFs will rely on willing and engaged hatcheries (i.e., DIPAC has stated they will cease mass marking should an MSF occur, this may limit possible MSF locations)	none

APPENDIX E: MARK FRACTION, CODED WIRE TAG CONTRIBUTIONS, AND MARKED CODED WIRE TAG CONTRIBUTIONS: ESTIMATION METHODS AND RESULTS

Appendix E1.–Mark fraction, coded wire tag contributions, and marked coded wire tag contributions: estimation methods.

Methods for Estimating the Mark Fraction, Coded Wire Tag Contributions, and Marked Coded Wire Tag Contributions

This appendix outlines the methods used to estimate both empirical (current or status quo) and modeled mark fractions, based on data collected from the SEAK Chinook salmon sport fishery, as detailed in the *Mark Fraction Analysis* section. It provides detailed descriptions of the calculations for mark fractions and coded wire tag contributions, as well as the derivation and application of variance in the estimation process. The final section discusses the relationship between empirical and modeled mark fractions.

Mark Fraction Estimation Method

The current mark fraction was estimated using catch-sampling data. When estimates were derived by combining multiple strata, the overall mark fraction, $\hat{P}$, was calculated as a weighted average:

$$\hat{P} = \frac{\widehat{Mark}}{\widehat{Harvest}} \qquad \text{(E1)}$$

where:

- $\widehat{Mark}$ is the sum of marked fish harvested, $\widehat{Mark} = \sum_h \widehat{Mark}_h$,
- $\widehat{Harvest}$ is the sum of fish harvested, $\widehat{Harvest} = \sum_h \widehat{Harvest}_h$,

and where the number of adipose-clipped fish harvested in stratum *h*, $\widehat{Mark}_h$, was estimated as:

$$\widehat{Mark}_h = \hat{P}_h \widehat{Harvest}_h \qquad \text{(E2)}$$

where:

- $\hat{P}_h = \frac{a_h}{n_h}$ is the proportion of marked fish harvested in stratum *h*,
- a_h is the number of marked fish sampled in stratum *h*,
- n_h is the number of fish sampled for marks in stratum *h*, and
- $\widehat{Harvest}_h$ is the number of fish harvested in stratum *h*.

The variance of the estimated proportion of marked fish in stratum *h*, $var(\hat{P}_h)$, was calculated as:

$$var(\hat{P}_h) = \frac{\hat{P}_h(1 - \hat{P}_h)}{n_h - 1}$$

The variance of the estimated number of marked fish harvested in stratum *h*, was calculated using the formula for the variance of a product of independent random variables (Goodman 1960):

$$var(\widehat{Mark}_h) = \widehat{Harvest}_h^{\,2} var(\hat{P}_h) + \hat{P}^2{}_h var(\widehat{Harvest}_h) - var(\hat{P}_h) var(\widehat{Harvest}_h)$$

and by the equation for the variance of a sum of independent random variables:

$$var(\widehat{Mark}) = \sum_h var(\widehat{Mark}_h) \qquad \text{(E3)}$$

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and similarly:

$$var(\widehat{Harvest}) = \sum_h var(\widehat{Harvest}_h) \quad \text{(E4)}$$

and by the delta method:

$$var(\hat{P}) \approx \widehat{Mark}^2/\widehat{Harvest}^2[var(\widehat{Mark})/\widehat{Mark}^2 + var(\widehat{Harvest})/\widehat{Harvest}^2] \quad \text{(E5)}$$

if $\widehat{Mark} > 0$ and 0 otherwise. Bootstrap methods (Efron and Tibshirani 1993) were used to generate 95% confidence intervals for the estimated mark fraction, $\hat{P}$, and used to evaluate the uncertainty in the estimate. Mark fraction estimates with 95% confidence interval widths greater than 40% were removed from further analysis, which removed strata with low sample sizes or high uncertainty in the estimated harvest.

Coded Wire Tag Contribution Estimation Method

The contribution (harvest) of hatchery-origin fish from stock *S*, $\widehat{Harvest}_S$, as well as the harvest of marked hatchery-origin fish from stock *S*, $\widehat{Mark}_S$, and their associated variances were estimated using coded wire tag recovery data analysis methods outlined by Bernard and Clark (1996). The harvest of hatchery-origin fish from stock *S*, from stock *S*, $\hat{H}_S$, was estimated as:

$$\widehat{Harvest}_S = \sum_j \sum_h \frac{x_{jh}}{\lambda_h \phi_h \theta_j} \quad \text{(E6)}$$

where:

- x_{jh} is the number of decoded CWTs from cohort j recovered in stratum h,
- $\lambda_h = \frac{a'_h d'_h}{a_h d_h}$ is the fraction of CWTs successfully processed in stratum h,
- a_h is the number of marked fish sampled in stratum h,
- a'_h is the subset of a_h that reach the ADF&G lab,
- d_h is the number of heads in stratum h with CWTs detected at the ADF&G lab,
- d'_h is the subset of d_h that were successfully decoded,
- $\phi_h = \frac{n_h}{\widehat{Harvest}_h}$ is the fraction of fish sampled for CWTs in stratum h,
- n_h is the number of fish sampled for CWT (marks) in stratum h,
- $\widehat{Harvest}_h$ is the number of fish harvested in stratum h,
- $\theta_j = t_j/T_j$ is the fraction of a fish released with a CWT and adipose-clip from cohort j,
- t_j is the number of juvenile fish released with a CWT and adipose-clip from cohort j, and
- T_j is the number of juvenile fish released from cohort j.

with variances calculated using the large-sample approximation for hatchery-produced salmon in a recreational fishery as described in Bernard and Clark (1996).

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Marked Coded Wire Tag Contribution Estimation Method

Similarly, the harvest of marked hatchery-origin fish from stock S, $\widehat{Mark}_S$, was estimated as:

$$\widehat{Mark}_S = \sum_j \sum_h \frac{x_{jh}}{\lambda_h \phi_h} \quad \text{(E7)}$$

with variances calculated using the large-sample approximation for hatchery-produced salmon in a recreational fishery described in Bernard and Clark (1996), and by letting $\theta_j = 1$.

Relationship Between Empirical and Modeled Mark Fractions

To understand the relationship between empirical and modeled mark fractions, equation (5) from the *Mark Fraction Analysis* section can be re-written as:

$$\tilde{P} = \frac{[(Harvest_S - Mark_S)\gamma_S + Mark]}{Harvest} \quad \text{(E8)}$$

where:

- $Harvest_S$ is the harvest of stock S,
- $Mark_S$ is the harvest of adipose-clipped fish from stock S,
- γ_S is the change to the current mark fraction of stock S,
- $Mark$ is the harvest of all adipose-clipped fish in the fishery, and
- $Harvest$ is the total fish harvested in the fishery.

When $\gamma_S = 0$ (no change), equation (8) simplifies to $\tilde{P} = \frac{Mark}{Harvest} = \hat{P}$, which yields the current mark fraction. This relationship, although less obvious in equation (5) due to its structure, demonstrates how empirical and modeled mark fractions are related. Note that this same result can be obtained from equation (5) by letting $\rho_S = \frac{Mark_S}{Harvest_S}$, the fraction of fish released with an adipose-clip from stock S. However, caution is advised when interpreting this as the fraction of fish released with an adipose-clip, because multiple cohorts are combined and marking levels often vary across them.

Table E2-1. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Craig-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	195.8	18.7	97.1	2,425.0	264.7	20.2	207.5	5,654.0	0.0	0.0	27.5	1,718.0
2006	229.4	24.6	59.0	2,192.0	186.0	30.5	117.0	5,905.0	0.0	0.0	39.5	1,750.0
2007	364.7	23.5	94.1	2,706.0	195.2	21.6	129.7	5,100.0	0.0	0.0	30.0	1,403.0
2008	484.4	48.6	97.2	1,320.0	0.0	0.0	124.6	1,698.0	0.0	0.0	0.0	29.0
2009	90.0	11.8	100.1	1,213.0	310.4	24.5	153.1	2,933.0	0.0	0.0	47.1	459.0
2010	121.8	12.8	51.2	1,481.0	228.4	26.4	286.0	3,265.0	0.0	0.0	153.6	879.0
2011	264.7	23.8	192.8	2,687.0	307.6	28.6	419.6	4,745.0	27.8	2.4	58.5	953.0
2012	150.7	9.1	102.9	1,065.0	429.1	23.7	759.7	4,317.0	0.0	0.0	127.8	625.0
2013	124.1	9.3	273.5	1,666.0	219.7	19.1	573.6	4,049.0	0.0	0.0	81.9	687.0
2014	131.6	20.8	484.9	3,824.0	124.3	11.3	1,265.5	6,275.0	0.0	0.0	115.2	647.0
2015	202.2	29.3	285.4	3,448.0	393.0	36.1	633.3	7,400.0	72.9	2.9	97.2	2,110.0
2016	539.6	43.5	488.5	5,330.0	40.2	5.4	910.2	7,345.0	0.0	0.0	55.4	871.0
2017	135.2	18.8	222.4	2,976.0	204.6	41.5	500.1	5,791.0	20.8	2.4	82.7	1,297.0
2018	133.9	33.7	107.8	1,523.0	395.0	41.6	214.9	2,475.0	3.2	3.2	73.1	728.0
2019	141.2	23.3	132.0	1,602.0	69.0	9.2	186.4	2,716.0	0.0	0.0	7.3	362.0
2020	172.3	19.4	191.0	1,371.0	297.0	40.0	627.5	6,110.0	0.0	0.0	47.8	510.0
2021	224.5	30.2	431.3	3,561.0	297.1	38.6	436.6	4,492.0	0.0	0.0	0.0	12.0
2022	238.6	34.8	258.7	1,918.0	331.8	46.2	339.0	2,175.0	0.0	0.0	44.3	367.0
2023	69.9	15.1	156.7	2,581.0	47.1	7.2	252.0	3,539.0	54.7	6.5	91.5	1,040.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively.

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Table E2-2. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Craig-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	4.0%	4.8%	7.3%	11.3%	3.7%	4.2%	5.6%	8.0%	1.6%	1.6%	1.6%	1.6%
2006	2.7%	3.7%	6.8%	12.0%	2.0%	2.3%	3.2%	4.6%	2.3%	2.3%	2.3%	2.3%
2007	3.5%	4.9%	9.1%	16.1%	2.5%	2.9%	4.1%	5.9%	2.1%	2.1%	2.1%	2.1%
2008	7.4%	11.0%	22.0%	40.4%	7.3%	7.3%	7.3%	7.3%	0.0%	0.0%	0.0%	0.0%
2009	8.3%	9.0%	11.1%	14.7%	5.2%	6.3%	9.6%	15.0%	10.3%	10.3%	10.3%	10.3%
2010	3.5%	4.3%	6.7%	10.8%	8.8%	9.4%	11.5%	14.9%	17.5%	17.5%	17.5%	17.5%
2011	7.2%	8.2%	11.2%	16.1%	8.8%	9.5%	11.5%	14.7%	6.1%	6.4%	7.3%	8.8%
2012	9.7%	11.1%	15.6%	23.0%	17.6%	18.6%	21.8%	27.0%	20.5%	20.5%	20.5%	20.5%
2013	16.4%	17.2%	19.5%	23.3%	14.2%	14.7%	16.4%	19.1%	11.9%	11.9%	11.9%	11.9%
2014	12.7%	13.0%	14.0%	15.6%	20.2%	20.4%	21.0%	22.0%	17.8%	17.8%	17.8%	17.8%
2015	8.3%	8.8%	10.5%	13.3%	8.6%	9.1%	10.7%	13.4%	4.6%	5.0%	6.1%	7.9%
2016	9.2%	10.2%	13.3%	18.5%	12.4%	12.4%	12.6%	12.9%	6.4%	6.4%	6.4%	6.4%
2017	7.5%	7.9%	9.2%	11.4%	8.6%	8.9%	9.9%	11.5%	6.4%	6.5%	7.0%	7.8%
2018	7.1%	7.8%	10.0%	13.7%	8.7%	10.3%	15.0%	23.0%	10.0%	10.0%	10.0%	10.1%
2019	8.2%	9.1%	11.5%	15.6%	6.9%	7.1%	7.8%	9.1%	2.0%	2.0%	2.0%	2.0%
2020	13.9%	15.2%	18.9%	25.1%	10.3%	10.7%	12.1%	14.5%	9.4%	9.4%	9.4%	9.4%
2021	12.1%	12.7%	14.5%	17.6%	9.7%	10.4%	12.3%	15.5%	0.0%	0.0%	0.0%	0.0%
2022	13.5%	14.7%	18.2%	24.1%	15.6%	17.0%	21.4%	28.7%	12.1%	12.1%	12.1%	12.1%
2023	6.1%	6.3%	7.0%	8.2%	7.1%	7.2%	7.6%	8.2%	8.8%	9.3%	10.9%	13.4%
Average	8.5%	9.5%	12.4%	17.4%	9.4%	9.9%	11.6%	14.5%	7.9%	7.9%	8.2%	8.5%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively.

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Table E2-3. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Glacier Bay-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	59.0	9.1	63.5	1,549.0	47.7	12.2	93.3	1,002.0	17.9	17.7	53.1	792.0
2006	184.2	34.5	88.1	1,571.0	139.1	11.5	49.8	1,384.0	3.8	3.8	18.9	533.0
2007	565.5	52.2	109.1	2,192.0	57.1	12.5	62.6	1,349.0	8.5	8.5	93.0	1,822.0
2008	518.2	93.1	138.9	978.0	246.0	22.0	71.5	693.0	NA	NA	NA	NA
2009	229.7	17.7	93.2	1,504.0	0.0	0.0	132.9	1,254.0	0.0	0.0	56.2	519.0
2010	68.3	5.2	36.1	474.0	23.4	4.7	184.9	1,193.0	0.0	0.0	27.9	405.0
2011	148.1	14.9	236.5	1,482.0	3.3	3.3	214.4	1,333.0	0.0	0.0	57.0	339.0
2012	91.0	10.5	131.1	708.0	0.0	0.0	180.6	967.0	0.0	NA	NA	103.0
2013	73.5	NA	NA	1,910.0	52.6	NA	NA	2,590.0	0.0	NA	NA	447.0
2014	38.5	8.1	447.1	2,449.0	51.4	4.2	543.9	2,544.0	0.0	0.0	61.1	271.0
2015	281.4	25.6	299.6	2,563.0	0.0	0.0	440.9	2,005.0	84.5	NA	NA	210.0
2016	0.0	0.0	173.9	979.0	0.0	0.0	127.6	860.0	0.0	0.0	14.3	162.0
2017	144.5	17.0	108.0	853.0	6.1	6.0	190.5	1,286.0	0.0	0.0	52.0	439.0
2018	0.0	0.0	26.1	365.0	284.5	25.9	285.4	1,453.0	45.0	7.4	22.1	177.0
2019	89.2	10.8	62.1	783.0	105.3	7.3	96.4	1,019.0	0.0	NA	NA	54.0
2020	0.0	0.0	0.0	26.0	0.0	NA	NA	1,219.0	0.0	NA	NA	254.0
2021	109.8	NA	NA	1,437.0	0.0	0.0	241.3	2,280.0	NA	NA	NA	NA
2022	137.8	18.5	368.9	1,932.0	0.0	NA	NA	1,049.0	0.0	NA	NA	204.0
2023	88.4	9.5	257.2	1,732.0	0.0	0.0	656.5	2,933.0	0.0	NA	NA	388.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-4. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Glacier Bay-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	4.1%	4.5%	5.5%	7.3%	9.3%	9.7%	10.9%	12.9%	6.7%	6.7%	6.7%	6.7%
2006	5.6%	6.7%	9.8%	15.1%	3.6%	4.6%	7.7%	12.8%	3.5%	3.5%	3.5%	3.5%
2007	5.0%	7.6%	15.4%	28.4%	4.6%	5.0%	6.1%	7.9%	5.1%	5.1%	5.1%	5.1%
2008	14.2%	19.0%	33.5%	57.7%	10.3%	13.9%	24.7%	42.6%	NA	NA	NA	NA
2009	6.2%	7.8%	12.5%	20.3%	10.6%	10.6%	10.6%	10.6%	10.8%	10.8%	10.8%	10.8%
2010	7.6%	9.1%	13.5%	20.9%	15.5%	15.7%	16.2%	17.1%	6.9%	6.9%	6.9%	6.9%
2011	16.0%	17.0%	19.9%	24.9%	16.1%	16.1%	16.1%	16.1%	16.8%	16.8%	16.8%	16.8%
2012	18.5%	19.8%	23.6%	29.9%	18.7%	18.7%	18.7%	18.7%	NA	NA	NA	NA
2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2014	18.3%	18.4%	18.8%	19.5%	21.4%	21.6%	22.2%	23.2%	22.5%	22.5%	22.5%	22.5%
2015	11.7%	12.8%	16.1%	21.7%	22.0%	22.0%	22.0%	22.0%	NA	NA	NA	NA
2016	17.8%	17.8%	17.8%	17.8%	14.8%	14.8%	14.8%	14.8%	8.8%	8.8%	8.8%	8.8%
2017	12.7%	14.3%	19.3%	27.6%	14.8%	14.8%	14.8%	14.8%	11.8%	11.8%	11.8%	11.8%
2018	7.1%	7.1%	7.1%	7.1%	19.6%	21.6%	27.6%	37.4%	12.5%	14.9%	21.9%	33.8%
2019	7.9%	9.0%	12.4%	17.9%	9.5%	10.5%	13.7%	19.1%	NA	NA	NA	NA
2020	0.0%	0.0%	0.0%	0.0%	NA	NA	NA	NA	NA	NA	NA	NA
2021	NA	NA	NA	NA	10.6%	10.6%	10.6%	10.6%	NA	NA	NA	NA
2022	19.1%	19.8%	21.8%	25.3%	NA	NA	NA	NA	NA	NA	NA	NA
2023	14.8%	15.4%	16.9%	19.4%	22.4%	22.4%	22.4%	22.4%	NA	NA	NA	NA
Average	11.0%	12.1%	15.5%	21.2%	14.0%	14.5%	16.2%	18.9%	10.6%	10.8%	11.5%	12.7%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-5. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Haines and Skagway-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	110.7	30.0	56.2	613.0	264.7	NA	NA	354.0	0.0	0.0	12.8	102.0
2006	67.2	27.3	54.6	455.0	191.6	NA	NA	356.0	20.2	NA	NA	127.0
2007	192.6	30.2	59.5	589.0	201.7	25.9	38.9	324.0	0.0	0.0	0.0	52.0
2008	71.2	NA	NA	151.0	47.4	14.6	14.6	277.0	0.0	NA	NA	7.0
2009	12.8	NA	NA	311.0	116.0	10.5	10.5	194.0	215.0	NA	NA	215.0
2010	44.2	8.8	26.4	269.0	401.0	NA	NA	401.0	39.4	NA	NA	72.0
2011	45.5	NA	NA	776.0	221.4	NA	NA	407.0	0.0	0.0	0.0	70.0
2012	22.3	3.2	12.6	171.0	133.8	15.7	15.7	253.0	0.0	0.0	0.0	136.0
2013	120.0	NA	NA	229.0	83.2	NA	NA	125.0	82.0	16.4	21.8	218.0
2014	75.6	9.4	16.1	233.0	45.9	6.7	20.0	180.0	0.0	0.0	0.0	33.0
2015	0.0	0.0	0.0	10.0	75.1	NA	NA	76.0	17.0	NA	NA	17.0
2016	29.0	NA	NA	29.0	NA	NA	NA	NA	0.0	NA	NA	6.0
2017	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-6. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Haines and Skagway-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	9.2%	10.6%	15.0%	22.3%	NA	NA	NA	NA	12.5%	12.5%	12.5%	12.5%
2006	12.0%	13.0%	15.9%	20.8%	NA	NA	NA	NA	NA	NA	NA	NA
2007	10.1%	13.2%	22.4%	37.7%	12.0%	18.0%	36.1%	66.2%	0.0%	0.0%	0.0%	0.0%
2008	NA	NA	NA	NA	5.3%	6.6%	10.5%	17.1%	NA	NA	NA	NA
2009	NA	NA	NA	NA	5.4%	11.4%	29.6%	59.8%	NA	NA	NA	NA
2010	9.8%	11.3%	15.7%	23.0%	NA	NA	NA	NA	NA	NA	NA	NA
2011	NA	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%	0.0%	0.0%
2012	7.4%	8.6%	12.4%	18.6%	6.2%	11.4%	27.0%	52.9%	0.0%	0.0%	0.0%	0.0%
2013	NA	NA	NA	NA	NA	NA	NA	NA	10.0%	13.3%	23.4%	40.1%
2014	6.9%	10.1%	19.6%	35.4%	11.1%	13.5%	20.8%	32.9%	0.0%	0.0%	0.0%	0.0%
2015	0.0%	0.0%	0.0%	0.0%	NA	NA	NA	NA	NA	NA	NA	NA
2016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2017	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	7.9%	9.5%	14.4%	22.5%	8.0%	12.2%	24.8%	45.8%	3.8%	4.3%	6.0%	8.8%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-7. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Juneau-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	1,521.2	185.6	336.3	8,038.0	1,964.8	369.8	393.7	2,958.0	725.1	231.0	246.5	1,076.0
2006	603.8	133.3	244.5	5,828.0	1,482.2	263.0	288.4	1,871.0	557.7	252.7	275.9	1,605.0
2007	1,943.6	202.0	237.1	4,821.0	1,673.1	214.7	252.0	2,344.0	401.9	92.7	98.7	1,220.0
2008	2,001.4	225.2	290.8	4,699.0	919.0	98.8	111.1	2,272.0	329.0	42.5	75.5	591.0
2009	1,908.3	236.4	326.4	5,954.0	1,881.7	187.5	227.7	2,581.0	372.9	53.0	86.0	806.0
2010	797.0	107.8	140.2	3,591.0	1,209.2	143.6	159.5	2,499.0	375.4	46.3	49.3	819.0
2011	175.3	45.6	98.7	2,666.0	356.0	43.9	65.8	892.0	570.8	68.8	73.8	1,157.0
2012	291.4	25.6	56.3	1,602.0	826.2	100.1	136.5	1,292.0	824.7	101.9	156.3	1,416.0
2013	1,948.8	245.7	279.5	3,626.0	1,217.0	139.5	179.3	1,783.0	402.0	67.0	90.2	742.0
2014	661.3	70.8	120.4	3,252.0	1,114.4	111.2	166.7	1,621.0	355.3	44.7	57.1	644.0
2015	1,843.2	165.8	226.9	4,382.0	1,578.0	158.0	218.7	3,475.0	271.8	40.6	88.9	664.0
2016	427.2	50.8	108.9	1,858.0	443.3	47.1	70.7	895.0	250.7	43.6	47.6	358.0
2017	501.5	NA	NA	574.0	1,449.5	153.7	198.9	2,006.0	197.5	NA	NA	231.0
2018	231.0	24.0	24.0	432.0	1,217.2	142.2	164.1	1,905.0	275.9	41.0	41.0	359.0
2019	520.9	55.8	62.8	1,121.0	1,226.1	122.6	141.4	1,875.0	14.0	2.0	3.0	418.0
2020	809.8	84.8	145.2	989.0	1,057.8	105.1	120.7	1,609.0	161.1	16.9	28.4	627.0
2021	327.1	32.2	72.2	1,391.0	1,538.8	164.7	281.6	1,788.0	169.5	44.6	64.4	588.0
2022	1,087.4	187.3	247.3	1,638.0	1,333.5	226.3	284.4	2,421.0	33.3	5.0	20.6	637.0
2023	155.6	39.4	47.3	345.0	378.6	79.3	107.1	1,105.0	120.3	36.0	55.9	534.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-8. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Juneau-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	4.2%	6.0%	11.6%	20.8%	13.3%	19.3%	37.3%	67.2%	22.9%	28.0%	43.3%	68.8%
2006	4.2%	5.1%	7.8%	12.3%	15.4%	22.7%	44.4%	80.6%	17.2%	19.3%	25.6%	36.2%
2007	4.9%	8.9%	21.0%	41.0%	10.8%	17.7%	38.4%	73.0%	8.1%	10.9%	19.4%	33.4%
2008	6.2%	10.4%	23.0%	44.0%	4.9%	8.9%	20.9%	41.0%	12.8%	18.2%	34.3%	61.2%
2009	5.5%	8.6%	18.0%	33.6%	8.8%	16.1%	38.0%	74.5%	10.7%	15.1%	28.3%	50.4%
2010	3.9%	6.0%	12.4%	23.1%	6.4%	11.1%	25.3%	49.0%	6.0%	10.5%	23.9%	46.2%
2011	3.7%	4.2%	5.9%	8.6%	7.4%	11.3%	22.9%	42.4%	6.4%	11.2%	25.7%	49.8%
2012	3.5%	5.4%	10.9%	20.1%	10.6%	16.8%	35.5%	66.8%	11.0%	16.7%	33.7%	62.1%
2013	7.7%	12.9%	28.6%	54.7%	10.1%	16.8%	36.9%	70.5%	12.2%	17.2%	32.2%	57.3%
2014	3.7%	5.7%	11.8%	21.9%	10.3%	17.2%	37.8%	72.2%	8.9%	14.2%	30.3%	57.1%
2015	5.2%	9.4%	22.2%	43.5%	6.3%	10.8%	24.5%	47.2%	13.4%	17.3%	28.9%	48.2%
2016	5.9%	8.1%	14.9%	26.1%	7.9%	12.8%	27.6%	52.2%	13.3%	19.7%	39.0%	71.2%
2017	NA	NA	NA	NA	9.9%	17.1%	38.6%	74.5%	NA	NA	NA	NA
2018	5.6%	10.9%	26.9%	53.5%	8.6%	14.9%	33.7%	65.0%	11.4%	18.7%	40.5%	76.8%
2019	5.6%	10.2%	24.0%	47.1%	7.5%	14.1%	33.7%	66.4%	0.7%	1.0%	2.0%	3.6%
2020	14.7%	22.8%	47.3%	88.0%	7.5%	14.1%	33.8%	66.7%	4.5%	7.1%	14.7%	27.5%
2021	5.2%	7.5%	14.6%	26.4%	15.8%	24.3%	49.9%	92.6%	11.0%	13.3%	20.4%	32.2%
2022	15.1%	21.2%	39.5%	70.0%	11.7%	16.8%	32.1%	57.5%	3.2%	3.7%	5.2%	7.7%
2023	13.7%	17.4%	28.7%	47.4%	9.7%	12.7%	21.7%	36.8%	10.5%	12.2%	17.5%	26.3%
Average	6.6%	10.1%	20.5%	37.9%	9.6%	15.5%	33.3%	62.9%	10.2%	14.1%	25.8%	45.3%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-9. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Ketchikan-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	5,094.3	452.9	554.2	6,549.0	5,085.8	499.1	641.6	9,538.0	129.6	16.3	65.2	1,157.0
2006	2,596.4	267.7	357.2	4,297.0	2,017.7	226.8	317.5	5,345.0	197.3	25.3	141.5	2,006.0
2007	2,262.3	191.5	235.4	3,301.0	2,336.7	225.7	372.5	7,745.0	0.0	0.0	18.3	713.0
2008	2,701.2	298.2	303.5	3,711.0	1,757.1	167.1	222.8	3,208.0	0.0	0.0	0.0	209.0
2009	3,534.3	375.0	611.3	6,113.0	4,440.4	516.2	712.8	9,014.0	377.4	NA	NA	918.0
2010	3,034.7	285.6	373.3	3,928.0	2,266.8	235.2	285.6	5,045.0	113.3	6.6	19.7	289.0
2011	1,234.4	126.2	191.8	3,824.0	2,508.8	270.9	483.8	7,740.0	93.0	8.1	73.3	798.0
2012	571.0	63.2	99.9	1,540.0	1,358.5	119.8	204.4	2,909.0	182.2	17.7	70.7	607.0
2013	1,961.8	172.9	329.8	4,011.0	1,907.6	150.4	543.9	5,115.0	69.4	NA	NA	328.0
2014	1,594.0	126.8	155.4	3,279.0	2,085.3	184.8	670.0	7,765.0	177.8	10.7	85.4	1,323.0
2015	2,081.6	183.6	313.5	5,016.0	2,657.5	224.2	766.2	7,239.0	0.0	NA	NA	1,200.0
2016	1,465.2	107.4	225.2	3,914.0	370.7	27.0	351.6	2,882.0	86.8	5.8	23.2	255.0
2017	1,137.0	140.8	277.0	3,166.0	944.8	111.0	245.4	3,476.0	133.3	13.0	77.8	493.0
2018	308.3	34.2	76.9	1,187.0	524.1	66.2	253.8	4,028.0	229.4	19.5	77.9	672.0
2019	380.2	52.2	103.7	1,636.0	769.1	61.7	198.8	1,934.0	0.0	NA	NA	211.0
2020	332.2	54.7	92.2	697.0	456.4	36.8	183.3	1,883.0	90.4	10.3	29.4	642.0
2021	186.9	43.1	111.9	1,305.0	371.2	53.9	345.9	3,226.0	0.0	0.0	0.0	109.0
2022	538.6	82.4	114.4	1,384.0	853.3	121.3	432.1	3,247.0	21.4	2.9	33.8	282.0
2023	680.8	102.1	160.4	2,240.0	680.4	85.5	401.0	6,225.0	0.0	0.0	112.6	747.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-10. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Ketchikan-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	8.5%	16.3%	40.0%	79.3%	6.7%	12.1%	28.1%	54.8%	5.6%	6.7%	10.0%	15.4%
2006	8.3%	14.3%	32.4%	62.5%	5.9%	9.7%	20.8%	39.4%	7.1%	8.0%	10.9%	15.6%
2007	7.1%	14.1%	35.0%	69.9%	4.8%	7.8%	16.9%	32.1%	2.6%	2.6%	2.6%	2.6%
2008	8.2%	15.4%	37.0%	72.9%	6.9%	12.5%	29.0%	56.5%	0.0%	0.0%	0.0%	0.0%
2009	10.0%	15.7%	33.0%	61.7%	7.9%	12.7%	27.3%	51.4%	NA	NA	NA	NA
2010	9.5%	17.3%	40.6%	79.5%	5.7%	10.1%	23.6%	45.9%	6.8%	10.9%	23.2%	43.7%
2011	5.0%	8.2%	17.9%	34.0%	6.2%	9.5%	19.1%	35.2%	9.2%	10.4%	13.9%	19.8%
2012	6.5%	10.2%	21.1%	39.5%	7.0%	11.8%	26.0%	49.6%	11.7%	14.7%	23.7%	38.8%
2013	8.2%	13.2%	28.0%	52.8%	10.6%	14.5%	25.9%	45.0%	NA	NA	NA	NA
2014	4.7%	9.7%	24.6%	49.5%	8.6%	11.3%	19.5%	33.1%	6.5%	7.9%	12.1%	19.1%
2015	6.2%	10.5%	23.1%	44.1%	10.6%	14.3%	25.5%	44.2%	NA	NA	NA	NA
2016	5.8%	9.6%	21.2%	40.4%	12.2%	13.5%	17.5%	24.1%	9.1%	12.6%	23.2%	40.8%
2017	8.7%	12.2%	22.7%	40.2%	7.1%	9.7%	17.7%	31.0%	15.8%	18.5%	26.6%	40.2%
2018	6.5%	9.0%	16.7%	29.6%	6.3%	7.6%	11.4%	17.7%	11.6%	15.1%	25.5%	42.8%
2019	6.3%	8.6%	15.2%	26.4%	10.3%	14.3%	26.5%	46.9%	NA	NA	NA	NA
2020	13.2%	17.7%	30.9%	53.0%	9.7%	12.2%	19.6%	32.0%	4.6%	6.0%	10.1%	17.1%
2021	8.6%	9.8%	13.5%	19.6%	10.7%	11.8%	15.1%	20.6%	0.0%	0.0%	0.0%	0.0%
2022	8.3%	11.9%	22.9%	41.2%	13.3%	15.8%	23.3%	35.9%	12.0%	12.7%	14.9%	18.5%
2023	7.2%	10.0%	18.6%	33.0%	6.4%	7.5%	10.7%	16.0%	15.1%	15.1%	15.1%	15.1%
Average	7.7%	12.3%	26.0%	48.9%	8.3%	11.5%	21.2%	37.4%	7.8%	9.4%	14.1%	22.0%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-11. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Petersburg and Wrangell-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	355.6	84.4	136.5	6,192.0	15.1	15.0	15.0	302.0	NA	NA	NA	NA
2006	927.4	117.2	198.2	5,839.0	200.4	71.3	107.0	902.0	5.2	5.1	5.1	169.0
2007	567.2	78.0	112.6	4,580.0	466.1	54.8	72.9	702.0	41.0	NA	NA	41.0
2008	286.9	43.9	95.9	3,330.0	57.6	NA	NA	64.0	0.0	NA	NA	10.0
2009	286.3	34.9	50.2	3,042.0	211.8	19.6	19.6	407.0	0.0	NA	NA	58.0
2010	262.8	26.5	49.3	2,568.0	0.0	0.0	0.0	377.0	0.0	0.0	0.0	50.0
2011	367.0	34.7	95.1	2,758.0	344.0	30.4	33.2	344.0	0.0	0.0	1.4	57.0
2012	68.8	7.0	47.5	2,194.0	279.4	26.9	51.1	463.0	0.0	0.0	0.0	57.0
2013	189.2	19.7	88.3	2,727.0	0.0	0.0	12.0	410.0	0.0	0.0	0.0	90.0
2014	810.5	69.5	112.8	2,889.0	131.6	27.4	27.4	349.0	0.0	NA	NA	91.0
2015	963.3	74.0	170.5	3,393.0	362.8	24.9	24.9	407.0	0.0	NA	NA	20.0
2016	523.2	71.4	140.4	3,489.0	155.6	33.9	67.7	757.0	0.0	NA	NA	25.0
2017	790.3	76.2	103.6	1,360.0	345.0	NA	NA	345.0	0.0	NA	NA	10.0
2018	0.0	0.0	0.0	64.0	204.2	53.2	53.2	778.0	384.5	45.1	71.9	652.0
2019	54.9	23.2	52.6	420.0	126.4	13.2	32.3	297.0	0.0	0.0	0.0	178.0
2020	0.0	0.0	11.6	498.0	196.8	26.4	26.4	838.0	0.0	NA	NA	105.0
2021	94.9	18.7	29.8	429.0	54.7	8.6	18.9	590.0	NA	NA	NA	NA
2022	60.3	10.9	32.5	465.0	89.8	27.6	27.6	695.0	0.0	NA	NA	146.0
2023	43.6	9.2	18.4	368.0	107.5	22.8	44.6	904.0	1.0	NA	NA	201.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-12. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Petersburg and Wrangell-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	2.2%	2.7%	4.2%	6.6%	5.0%	5.0%	5.0%	5.0%	NA	NA	NA	NA
2006	3.4%	4.9%	9.6%	17.3%	11.9%	13.5%	18.2%	26.2%	3.0%	3.0%	3.0%	3.1%
2007	2.5%	3.6%	7.2%	13.1%	10.4%	16.9%	36.4%	69.0%	NA	NA	NA	NA
2008	2.9%	3.7%	6.1%	10.2%	NA	NA	NA	NA	NA	NA	NA	NA
2009	1.7%	2.6%	5.3%	9.9%	4.8%	10.1%	25.8%	52.0%	NA	NA	NA	NA
2010	1.9%	2.9%	6.0%	11.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2011	3.4%	4.8%	8.8%	15.5%	9.7%	19.8%	50.2%	100.8%	2.5%	2.5%	2.5%	2.5%
2012	2.2%	2.5%	3.4%	5.0%	11.0%	17.1%	35.3%	65.6%	0.0%	0.0%	0.0%	0.0%
2013	3.2%	3.9%	6.0%	9.5%	2.9%	2.9%	2.9%	2.9%	0.0%	0.0%	0.0%	0.0%
2014	3.9%	6.8%	15.3%	29.6%	7.8%	11.2%	21.1%	37.7%	NA	NA	NA	NA
2015	5.0%	7.9%	16.7%	31.2%	6.1%	15.3%	43.0%	89.1%	NA	NA	NA	NA
2016	4.0%	5.5%	9.8%	17.0%	8.9%	10.7%	16.1%	25.0%	NA	NA	NA	NA
2017	7.6%	13.5%	31.0%	60.1%	NA	NA	NA	NA	NA	NA	NA	NA
2018	0.0%	0.0%	0.0%	0.0%	6.8%	9.0%	15.5%	26.3%	11.0%	16.8%	34.2%	63.1%
2019	12.5%	13.4%	15.9%	20.1%	10.9%	15.1%	27.8%	49.0%	0.0%	0.0%	0.0%	0.0%
2020	2.3%	2.3%	2.3%	2.3%	3.1%	5.4%	12.2%	23.5%	NA	NA	NA	NA
2021	7.0%	8.9%	14.9%	24.7%	3.2%	4.1%	6.7%	11.0%	NA	NA	NA	NA
2022	7.0%	8.2%	11.7%	17.6%	4.0%	5.0%	7.9%	12.9%	NA	NA	NA	NA
2023	5.0%	6.0%	9.2%	14.3%	4.9%	6.0%	9.1%	14.3%	NA	NA	NA	NA
Average	4.1%	5.5%	9.6%	16.6%	6.6%	9.8%	19.6%	35.9%	2.4%	3.2%	5.7%	9.8%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-13. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Wrangell Narrows-area sport fishery by Sport Period, 2005–2023.

(a) Sport Periods 1-2

Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	1,657.2	165.5	182.1	1,887.0
2006	2,124.2	251.1	251.1	3,013.0
2007	2,939.1	317.4	317.4	4,388.0
2008	1,850.0	205.6	205.6	1,850.0
2009	1,266.6	131.6	150.4	1,654.0
2010	184.0	NA	NA	813.0
2011	0.0	NA	NA	633.0
2012	0.0	NA	NA	735.0
2013	0.0	NA	NA	430.0
2014	0.0	NA	NA	1,789.0
2015	1,206.0	193.0	193.0	1,206.0
2016	2,359.0	393.2	393.2	2,359.0
2017	1,695.0	206.7	206.7	1,695.0
2018	491.8	NA	NA	1,426.0
2019	540.1	NA	NA	1,254.0
2020	NA	NA	NA	NA
2021	1,372.0	182.9	205.8	1,372.0
2022	1,403.1	264.7	291.1	1,480.0
2023	1,294.0	253.2	253.2	1,294.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-14. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Wrangell Narrows-area sport fishery by Sport Period, 2005–2023.

(a) Sport Periods 1-2

Year	Status quo	20%	50%	100%
2005	9.6%	18.4%	44.8%	88.7%
2006	8.3%	15.2%	36.0%	70.5%
2007	7.2%	13.9%	33.8%	67.0%
2008	11.1%	21.0%	50.6%	100.0%
2009	9.1%	16.7%	39.6%	77.7%
2010	NA	NA	NA	NA
2011	NA	NA	NA	NA
2012	NA	NA	NA	NA
2013	NA	NA	NA	NA
2014	NA	NA	NA	NA
2015	16.0%	25.3%	53.3%	100.0%
2016	16.7%	25.9%	53.7%	100.0%
2017	12.2%	22.0%	51.2%	100.0%
2018	NA	NA	NA	NA
2019	NA	NA	NA	NA
2020	NA	NA	NA	NA
2021	15.0%	24.6%	53.5%	101.7%
2022	19.7%	28.2%	53.9%	96.6%
2023	19.6%	28.5%	55.3%	100.0%
Average	13.1%	21.8%	47.8%	91.1%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-15. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Sitka-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	1,583.9	169.6	589.8	13,062.0	563.6	55.5	451.7	9,842.0	188.4	22.1	159.4	3,707.0
2006	667.0	101.5	432.9	13,350.0	688.3	91.0	521.2	13,917.0	59.9	10.2	232.0	7,484.0
2007	2,156.1	213.5	502.1	13,895.0	795.1	83.4	385.7	10,929.0	13.9	13.7	181.3	6,055.0
2008	1,125.8	154.8	429.8	9,934.0	433.7	39.2	242.8	5,115.0	0.0	0.0	9.5	210.0
2009	952.8	102.3	607.5	7,828.0	181.7	14.3	510.5	7,347.0	97.1	12.1	233.6	3,161.0
2010	1,568.5	168.4	882.8	10,400.0	249.3	22.5	961.8	8,446.0	93.9	10.7	540.6	4,653.0
2011	1,680.4	153.0	1,190.6	10,146.0	660.3	55.5	1,678.6	11,767.0	153.8	19.1	794.4	5,964.0
2012	1,087.6	78.6	1,191.8	9,607.0	624.6	34.6	1,622.4	8,812.0	180.5	40.0	730.6	3,386.0
2013	1,974.3	154.8	1,407.6	9,239.0	359.1	24.2	1,487.9	8,151.0	53.9	4.4	482.7	2,468.0
2014	1,053.6	88.0	3,272.6	18,238.0	404.9	33.1	3,700.9	18,747.0	0.0	0.0	689.5	3,733.0
2015	1,881.8	127.0	2,385.4	17,397.0	410.3	26.9	1,394.9	9,532.0	371.3	40.7	522.3	4,910.0
2016	1,713.4	131.1	3,135.0	19,102.0	359.2	29.8	1,872.7	11,305.0	0.0	0.0	657.4	2,968.0
2017	975.6	144.8	1,535.7	10,426.0	367.9	53.8	1,527.3	11,334.0	0.0	0.0	215.4	1,802.0
2018	1,045.9	100.4	402.5	3,357.0	287.8	19.9	418.6	3,132.0	0.0	0.0	295.6	2,411.0
2019	580.2	52.4	430.2	5,288.0	110.7	11.1	351.2	3,811.0	0.0	0.0	201.5	1,828.0
2020	379.4	48.1	326.7	2,741.0	247.0	42.8	1,026.0	6,193.0	126.0	19.3	783.1	3,982.0
2021	1,211.7	181.7	1,783.3	10,253.0	312.4	28.6	1,388.2	7,288.0	0.0	NA	NA	521.0
2022	1,316.6	148.2	1,651.2	8,696.0	961.7	114.1	1,790.6	7,854.0	0.0	0.0	414.1	2,313.0
2023	434.6	61.0	1,658.6	14,295.0	252.8	31.7	1,268.2	12,740.0	0.0	0.0	636.9	4,246.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-16. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Sitka-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	4.5%	5.7%	9.3%	15.3%	4.6%	5.2%	6.9%	9.8%	4.3%	4.8%	6.3%	8.8%
2006	3.2%	3.7%	5.1%	7.5%	3.7%	4.2%	5.7%	8.0%	3.1%	3.2%	3.4%	3.8%
2007	3.6%	5.2%	9.8%	17.6%	3.5%	4.3%	6.4%	10.0%	3.0%	3.0%	3.0%	3.0%
2008	4.3%	5.4%	8.7%	14.1%	4.7%	5.6%	8.2%	12.5%	4.5%	4.5%	4.5%	4.5%
2009	7.8%	9.0%	12.6%	18.6%	6.9%	7.2%	8.0%	9.2%	7.4%	7.7%	8.6%	10.1%
2010	8.5%	10.0%	14.5%	22.0%	11.4%	11.7%	12.6%	14.1%	11.6%	11.8%	12.4%	13.4%
2011	11.7%	13.4%	18.4%	26.8%	14.3%	14.8%	16.5%	19.4%	13.3%	13.6%	14.3%	15.6%
2012	12.4%	13.6%	17.1%	22.9%	18.4%	19.2%	21.4%	25.1%	21.6%	22.0%	23.4%	25.7%
2013	15.2%	17.4%	24.0%	34.9%	18.3%	18.7%	20.1%	22.4%	19.6%	19.8%	20.4%	21.6%
2014	17.9%	18.5%	20.3%	23.2%	19.7%	20.0%	20.6%	21.7%	18.5%	18.5%	18.5%	18.5%
2015	13.7%	14.8%	18.2%	23.8%	14.6%	15.1%	16.4%	18.7%	10.6%	11.4%	13.6%	17.4%
2016	16.4%	17.3%	20.1%	24.7%	16.6%	16.9%	17.9%	19.5%	22.1%	22.1%	22.1%	22.1%
2017	14.7%	15.6%	18.3%	22.7%	13.5%	13.8%	14.7%	16.2%	12.0%	12.0%	12.0%	12.0%
2018	12.0%	15.1%	24.5%	40.2%	13.4%	14.3%	17.2%	21.9%	12.3%	12.3%	12.3%	12.3%
2019	8.1%	9.2%	12.6%	18.1%	9.2%	9.5%	10.4%	11.8%	11.0%	11.0%	11.0%	11.0%
2020	11.9%	13.3%	17.3%	24.0%	16.6%	16.9%	18.0%	19.9%	19.7%	20.0%	20.9%	22.3%
2021	17.4%	18.5%	21.9%	27.4%	19.0%	19.5%	20.8%	22.9%	NA	NA	NA	NA
2022	19.0%	20.5%	25.0%	32.4%	22.8%	24.0%	27.6%	33.6%	17.9%	17.9%	17.9%	17.9%
2023	11.6%	11.9%	12.8%	14.2%	10.0%	10.1%	10.7%	11.7%	15.0%	15.0%	15.0%	15.0%
Average	11.3%	12.5%	16.3%	22.7%	12.7%	13.2%	14.7%	17.3%	12.6%	12.8%	13.3%	14.2%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-17. Estimated contribution of SEAK hatchery-origin Chinook salmon ($\widehat{H}_S$), contribution of marked SEAK hatchery-origin Chinook salmon ($\widehat{M}_S$), contribution of marked Chinook salmon ($\widehat{M}$), and harvest ($\widehat{H}$) in the Yakutat-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$	$\widehat{H}_S$	$\widehat{M}_S$	$\widehat{M}$	$\widehat{H}$
2005	0.0	0.0	19.1	379.0	0.0	0.0	1.9	159.0	0.0	0.0	0.0	8.0
2006	0.0	0.0	6.9	329.0	0.0	0.0	14.0	145.0	57.0	NA	NA	57.0
2007	7.0	4.8	9.6	446.0	0.0	0.0	10.7	147.0	0.0	0.0	0.0	18.0
2008	2.9	2.8	19.1	458.0	0.0	0.0	7.0	152.0	0.0	NA	NA	2.0
2009	9.1	3.8	64.6	555.0	0.0	0.0	61.3	301.0	0.0	NA	NA	24.0
2010	145.6	13.7	34.2	424.0	0.0	NA	NA	135.0	0.0	0.0	0.0	31.0
2011	0.0	0.0	27.7	277.0	0.0	0.0	8.5	83.0	0.0	NA	NA	14.0
2012	0.0	0.0	29.0	218.0	0.0	NA	NA	70.0	0.0	0.0	0.0	4.0
2013	0.0	0.0	68.5	411.0	0.0	0.0	9.5	98.0	0.0	0.0	0.0	8.0
2014	29.1	9.7	43.6	644.0	0.0	0.0	70.4	365.0	0.0	0.0	0.0	16.0
2015	0.0	0.0	53.0	615.0	0.0	0.0	4.7	217.0	0.0	0.0	8.3	87.0
2016	0.0	0.0	106.2	818.0	0.0	0.0	0.0	81.0	0.0	0.0	0.0	41.0
2017	74.5	11.8	48.7	472.0	0.0	0.0	8.1	122.0	0.0	NA	NA	38.0
2018	0.0	0.0	19.7	200.0	0.0	NA	NA	203.0	0.0	0.0	3.4	47.0
2019	0.0	0.0	63.8	720.0	0.0	0.0	11.0	185.0	0.0	0.0	0.0	31.0
2020	50.0	NA	NA	204.0	0.0	NA	NA	543.0	0.0	NA	NA	84.0
2021	0.0	NA	NA	542.0	0.0	NA	NA	131.0	0.0	NA	NA	5.0
2022	27.0	NA	NA	1,054.0	0.0	NA	NA	518.0	0.0	NA	NA	175.0
2023	0.0	0.0	30.7	579.0	0.0	0.0	25.1	254.0	0.0	0.0	10.6	107.0

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

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Table E2-18. Estimated (10%; status quo) and modeled (20%, 50%, and 100% SEAK marking scenarios) mark fractions in the Yakutat-area sport fishery by Sport Period, 2005–2023.

	(a) Sport Period 1				(b) Sport Period 2				(c) Sport Period 3			
Year	Status quo	20%	50%	100%	Status quo	20%	50%	100%	Status quo	20%	50%	100%
2005	5.1%	5.1%	5.1%	5.1%	1.2%	1.2%	1.2%	1.2%	0.0%	0.0%	0.0%	0.0%
2006	2.1%	2.1%	2.1%	2.1%	9.7%	9.7%	9.7%	9.7%	NA	NA	NA	NA
2007	2.2%	2.2%	2.4%	2.7%	7.3%	7.3%	7.3%	7.3%	0.0%	0.0%	0.0%	0.0%
2008	4.2%	4.2%	4.2%	4.2%	4.6%	4.6%	4.6%	4.6%	NA	NA	NA	NA
2009	11.6%	11.7%	12.1%	12.6%	20.4%	20.4%	20.4%	20.4%	NA	NA	NA	NA
2010	8.1%	11.5%	21.9%	39.2%	NA	NA	NA	NA	0.0%	0.0%	0.0%	0.0%
2011	10.0%	10.0%	10.0%	10.0%	10.3%	10.3%	10.3%	10.3%	NA	NA	NA	NA
2012	13.3%	13.3%	13.3%	13.3%	NA	NA	NA	NA	0.0%	0.0%	0.0%	0.0%
2013	16.7%	16.7%	16.7%	16.7%	9.7%	9.7%	9.7%	9.7%	0.0%	0.0%	0.0%	0.0%
2014	6.8%	7.1%	8.1%	9.8%	19.3%	19.3%	19.3%	19.3%	0.0%	0.0%	0.0%	0.0%
2015	8.6%	8.6%	8.6%	8.6%	2.2%	2.2%	2.2%	2.2%	9.5%	9.5%	9.5%	9.5%
2016	13.0%	13.0%	13.0%	13.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2017	10.3%	11.8%	16.2%	23.6%	6.7%	6.7%	6.7%	6.7%	NA	NA	NA	NA
2018	9.8%	9.8%	9.8%	9.8%	NA	NA	NA	NA	7.1%	7.1%	7.1%	7.1%
2019	8.9%	8.9%	8.9%	8.9%	6.0%	6.0%	6.0%	6.0%	0.0%	0.0%	0.0%	0.0%
2020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2023	5.3%	5.3%	5.3%	5.3%	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%
Average	8.5%	8.8%	9.8%	11.5%	8.2%	8.2%	8.2%	8.2%	2.4%	2.4%	2.4%	2.4%

Note: Dates associated with Sport Period change from year to year; however, periods 1-3 correspond roughly to January–May, June–July, and August–December, respectively. NA used for all parameters and cells is defined consistently to mean estimation was not possible.

APPENDIX F: SEAK CHINOOK HATCHERY SALMON RELEASE, MARKING, AND TAGGING INFORMATION

Appendix F1.–Total Chinook salmon released by hatchery organizations in SEAK.

Operator	AKI	DIPAC							NMFS
Hatchery	Port Armstrong	Macaulay							Little Port Walter
Release Year & Site	Port Armstrong	Auke Bay	Fish Creek	Gastineau Channel	Lena Cove	Pullen Creek	Thane Net Pens	DIPAC Total	NMFS Total
2014	161,355	70,000	209,700	257,300	90,000			627,000	211,164
2015	252,749	88,800	269,500	218,900	179,900	228,700		985,800	149,503
2016	231,839	88,400	279,400	220,500	179,100		124,100	891,500	30,358
2017		87,000	279,300	219,500	148,900		150,100	884,800	115,628
2018		89,300	233,900	249,400				572,600	160,691
2019		89,600	278,700	248,800	187,500		182,800	987,400	192,767
2020			272,200	1,441,400				1,713,600	
2021									201,926
2022			364,403	443,468	206,536			1,014,407	62,680
2023			249,587	324,540	199,848			773,975	
Total	645,943	513,100	2,436,690	3,623,808	1,191,784	228,700	457,000	8,451,082	1,124,717

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Operator	NSRAA												
Hatchery	Hidden Falls							Medvejie			Sawmill Cr	Sheldon Jackson	All NSRAA
Release Year & Site	Gunnuk Cr & Kasnyku Bay	Gunnuk Cr	Kasnyku Bay	Little Port Walter	Southeast Cove	Bear Cove	Crawfish Inlet	Crawfish Inlet & Halibut Point	Crescent Bay	Halibut Point	Crawfish Inlet	Deep Inlet	NSRAA Total
2014			558,227			1,780,952				377,549			2,716,728
2015			674,433			1,385,629				431,295			2,491,357
2016			588,842			2,320,019	129,250			392,677			3,430,788
2017			556,005			1,935,237	155,854	419,513					3,066,609
2018	232,377		370,292			1,542,778	198,924	208,678		190,639			2,743,688
2019		108,625	433,213			1,842,409	573,250		395,447				3,352,944
2020		179,754	315,266			1,719,553	635,764		388,556				3,238,893
2021		194,231	442,196			1,792,777	795,152		399,607		243,159		3,867,122
2022		186,704			312,054	2,054,932	517,632		354,164		311,123	39,074	3,775,683
2023		154,649		40,313	347,658	2,397,410	160,633		298,223				3,398,886
Total	232,377	823,963	3,938,474	40,313	659,712	18,771,696	3,166,459	628,191	1,835,997	1,392,160	554,282	39,074	32,082,698

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Operator	POWHA		MIC			
Hatchery	Port St Nicholas		Tamgas Creek			All Tamgas Creek
Release Year & Site	Coffman Cove	Port St. Nicholas	Port Chester	Tamgas Cr	Tamgas Harbor	MIC Total
2014	67,808	246,358		9		9
2015	48,796	175,459				
2016	37,695	100,318		355,328		355,328
2017				351,898		351,898
2018				85,789		85,789
2019				198,175		198,175
2020			134,456	136,485		270,941
2021			284,442		288,846	573,288
2022			267,267			267,267
2023					153,061	153,061
Total	154,299	522,135	686,165	1,127,684	441,907	2,255,756

Note: Cell shading denotes no hatchery release during the release year for a given release site.

Appendix F2.–Total marked Chinook salmon released by hatchery organizations in SEAK.

Operator	AKI	DIPAC							NMFS
Hatchery	Port Armstrong	Macaulay							Little Port Walter
Release Year & Site	Port Armstrong	Auke Bay	Fish Creek	Gastineau Channel	Lena Cove	Pullen Creek	Thane Net Pens	DIPAC Total	NMFS Total
2014	33,673	10,949	20,534	31,988	11,058			74,529	208,418
2015	74,626	10,090	27,828	29,381	19,266	40,248		126,813	145,536
2016	29,703	9,663	26,886	21,875	29,353		13,433	101,210	29,817
2017		7,557	25,930	19,342	13,554		14,176	80,559	113,875
2018		9,750	22,298	22,529				54,577	159,076
2019		16,079	43,474	42,827	29,051		27,883	159,314	138,150
2020			58,443	286,370				344,813	
2021									160,879
2022			79,238	90,745	45,884			215,867	62,234
2023			249,587	322,575	195,033			767,195	
Total	138,002	64,088	554,218	867,632	343,199	40,248	55,492	1,924,877	1,017,985

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Operator	NSRAA												
Hatchery	Hidden Falls						Medvejie				Sawmill Creek	Sheldon Jackson	All NSRAA
Release Year & Site	Gunnuk Cr & Kasnyku Bay	Gunnuk Cr	Kasnyku Bay	Little Port Walter	Southeast Cove	Bear Cove	Crawfish Inlet	Crawfish Inlet & Halibut Point	Crescent Bay	Halibut Point	Crawfish Inlet	Deep Inlet	NSRAA Total
2014			53,713			97,467				22,496			173,676
2015			57,532			77,104				27,608			162,244
2016			35,958			159,425	24,393			26,735			246,511
2017			46,885			185,679	17,244	52,956					302,764
2018	29,689		56,261			199,894	33,216	28,122		25,913			373,095
2019		34,283	32,277			131,048	77,078		35,279				309,965
2020		34,662	29,139			112,885	65,416		40,229				282,331
2021		34,994	34,904			123,192	67,150		34,190		1,136		295,566
2022		34,300			34,574	184,689	60,244		68,456		16,526	3,066	401,855
2023		35,568		40,313	35,434	183,379	34,813		35,028				364,535
Total	29,689	138,239	346,669	40,313	70,008	1,454,762	379,554	81,078	213,182	102,752	17,662	3,066	2,876,974

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Operator	SSRAA											
Hatchery	Crystal Lake				Deer Mountain	Port St. Nicholas	Whitman Lake					All SSRAA
Release Year & Site	Anita Bay	City Cr	Crystal Cr	Neets Bay	Ketchikan Cr	Port St. Nicholas	Carroll Inlet	Herring Cove	Ketchikan Cr	Neets Bay	Port St. Nicholas	SSRAA Total
2014	49,956	23,794	55,372	43,249				55,322		32,979		260,672
2015	31,097		66,150	31,968				65,108	22,560	10,956		227,839
2016	41,002	19,137	63,594	37,620			42,319	75,932	19,544	22,049		321,197
2017	43,851	22,034	64,419	43,365	20,048	54,884	41,694	54,003		21,288		365,586
2018	42,901	21,822	62,046	19,792		40,869	64,798	64,343	17,599			334,170
2019	75,012	16,434	122,442	62,788		66,466	133,066	113,512	20,005			609,725
2020	46,716	19,777	63,845	32,482	10,941	40,125	78,413	69,949	21,510			383,758
2021	49,097		62,731		21,423	78,390	63,341	59,283	20,728			354,993
2022	464,251	93,240	624,925		20,475	491,140	569,933	706,264	89,570			3,059,798
2023	402,297		651,151		9,777	87,483	625,418	698,458	82,763		99,264	2,656,611
Total	1,246,180	216,238	1,836,675	271,264	82,664	859,357	1,618,982	1,962,174	294,279	87,272	99,264	8,574,349

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Operator	POWHA		MIC			
Hatchery	Port St. Nicholas		Tamgas Creek			All Tamgas Creek
Release Year & Site	Coffman Cove	Port St. Nicholas	Port Chester	Tamgas Cr	Tamgas Harbor	MIC Total
2014	30,956	30,743		9		9
2015	31,450	32,681				
2016	30,150	31,355		5,161		5,161
2017				6,864		6,864
2018				3,898		3,898
2019				15,919		15,919
2020			22,749	25,434		48,183
2021			66,009		58,105	124,114
2022			23,683			23,683
2023					38,757	38,757
Total	92,556	94,779	112,441	57,285	96,862	266,588

Note: Cell shading denotes no hatchery release during the release year for a given release site.

Appendix F3.–Total tagged Chinook salmon released by hatchery organizations in SEAK.

Operator	AKI	DIPAC							NMFS
Hatchery	Port Armstrong	Macaulay							Little Port Walter
Release Year & Site	Port Armstrong	Auke Bay	Fish Creek	Gastineau Channel	Lena Cove	Pullen Creek	Thane Net Pens	DIPAC Total	NMFS Total
2014	33,673	10,949	20,534	31,988	11,058			74,529	208,418
2015	74,626	10,090	27,828	29,381	19,266	40,248		126,813	145,535
2016	29,703	9,663	26,886	21,875	29,353		13,433	101,210	27,979
2017		7,557	25,930	19,342	13,554		14,176	80,559	110,756
2018		9,750	22,298	22,529				54,577	159,076
2019		16,079	43,474	42,827	29,051		27,883	159,314	83,379
2020			58,443	286,370				344,813	
2021									159,767
2022			79,238	90,745	45,884			215,867	62,214
2023			53,826	65,799	38,179			157,804	
Total	138,002	64,088	358,457	610,856	186,345	40,248	55,492	1,315486	957,124

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Operator	NSRAA												
Hatchery	Hidden Falls						Medvejie				Sawmill Creek	Sheldon Jackson	ALL NSRAA
Release Year & Site	Gunnuk Cr & Kasnyku Bay	Gunnuk Cr	Kasnyku Bay	Little Port Walter	Southeast Cove	Bear Cove	Crawfish Inlet	Crawfish Inlet & Halibut Point	Crescent Bay	Halibut Point	Crawfish Inlet	Deep Inlet	NSRAA Total
2014			53,713			97,467				22,496			173,676
2015			57,532			77,104				27,608			162,244
2016			35,958			159,425	24,393			26,735			246,511
2017			46,885			185,679	17,244	52,956					302,764
2018	29,689		56,261			199,894	33,216	28,122		25,913			373,095
2019		34,283	32,277			131,048	77,078		35,279				309,965
2020		34,662	29,139			112,885	65,416		40,229				282,331
2021		34,994	34,904			123,192	67,150		34,190		1,136		295,566
2022		34,300			34,574	184,689	60,244		68,456		16,526	3,066	401,855
2023		35,568		40,313	35,434	183,379	34,813		35,028				364,535
Total	29,689	138,239	346,669	40,313	70,008	1,454,762	379,554	81,078	213,182	102,752	17,662	3,066	2,912,296

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Operator	SSRAA											
Hatchery	Crystal Lake				Deer Mountain	Port St. Nicholas	Whitman Lake					ALL SSRAA
Release Year & Site	Anita Bay	City Cr	Crystal Cr	Neets Bay	Ketchikan Cr	Port St. Nicholas	Carroll Inlet	Herring Cove	Ketchikan Cr	Neets Bay	Port St. Nicholas	SSRAA Total
2014	49,956	23,794	55,372	43,249				55,322		32,979		260,672
2015	31,097		66,150	31,968				65,108	22,560	10,956		227,839
2016	41,002	19,137	63,594	37,620			42,319	75,932	19,544	22,049		321,197
2017	43,851	22,034	64,419	43,365	20,048	54,884	41,694	54,003		21,288		365,586
2018	42,901	21,822	62,046	19,792		40,869	64,798	64,343	17,599			334,170
2019	75,012	16,434	122,442	62,788		66,466	133,066	113,512	20,005			609,725
2020	46,716	19,777	63,845	32,482	10,941	40,125	78,413	69,949	21,510			383,758
2021	49,097		62,731		21,423	78,390	63,341	59,283	20,728			354,993
2022	98,748	12,629	130,073		20,475	112,547	126,870	166,211	19,898			687,451
2023	125,870		126,229		9,777	87,483	130,221	145,919	19,503		19,368	664,370
Total	604,250	135,627	816,901	271,264	82,664	480,764	680,722	869,582	161,347	87,272	19,368	4,209,761

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Operator	POWHA		MIC			
Hatchery	Port St. Nicholas		Tamgas Creek			ALL Tamgas Creek
Release Year & Site	Coffman Cove	Port St. Nicholas	Port Chester	Tamgas Cr	Tamgas Harbor	MIC Total
2014	30,956	30,743		9		9
2015	31,450	32,681				
2016	30,150	31,355		5,161		5,161
2017				6,864		6,864
2018				3,898		3,898
2019				15,919		15,919
2020			22,749	25,434		48,183
2021			66,009		58,105	124,114
2022			23,683			23,683
2023					38,757	38,757
Total	92,556	94,779	112,441	57,285	96,862	266,588

Note: Cell shading denotes no hatchery release during the release year for a given release site.

APPENDIX G: ADF&G MSF FEASIBILITY STUDY TEMPLATE

Appendix G1.–A mark-selective fishery feasibility template developed by the ADF&G, DSF for use in MSF planning.

Steps

1. Define the scope of the fishery that will be evaluated.
    a. Location; Dates; Species
    b. Identify goal(s) of the MSF scenarios being evaluated, for example:
        i. Maintain/increase fishing opportunity
        ii. Maintain/increase harvest opportunity
        iii. Protect wild stocks
2. Evaluate relevant fishery management, assessment, and hatchery enhancement programs
    a. Relevant management processes to implement new fishery
        i. Domestic, national, and international
    b. Available assessment tools
        i. Are technical fishery monitoring tools in place at appropriate temporal and geographic resolution to evaluate whether an MSF is meeting its goals and meeting PSC reporting requirements?
        ii. Release mortality study, focused on the specific fishery
    c. Relevant enhancement program characteristics
        i. Characterize relevant enhancement activities and coordinate with hatchery associations
            1. Release amounts, locations, ancestral stock utilized
            2. Marking and tagging rates
3. Engage with community members and fishery stakeholders to understand perspectives on MSFs
    a. Opportunity for information sharing and outreach to educate anglers about MSFs and to solicit questions, comments, and recommendations on MSF scenarios from a broad group of fishery users.
    b. Plan for postseason engagement to evaluate fishery outcomes from community perspective

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4. Evaluate relevant fishery data to inform MSF scenarios
    a. Planning exercise: Were you able to quantitatively or qualitatively demonstrate an MSF would meet your stated goals?
        i. Mark-Fraction analysis- demonstration of plausibility
        ii. Model anticipated MSF impacts (fishery and stock outcomes) to assess whether goals will be met

5. Synthesize results of steps 2–4 to:
    a. Evaluate potential for MSF to achieve its goals
    b. Identify information or capacity gaps to MSF implementation and assessment
    c. Describe impacts: costs/risks, benefits; contrast with non-MSF scenario
    d. Assess who will benefit from the MSF scenario and who will be harmed