On-Time Public Comment List

Alaska Board of Fisheries: Hatchery Committee | Anchorage, March 7, 2020

On-Time Public Comment List

Alaska Board of Fisheries: Hatchery Committee | Anchorage, March 7, 2020

Alaska Board of Fisheries
Alaska Department of Fish & Game
dfg.bof.comments@alaska.gov

RE: Support for Salmon Fishery Enhancement Program

Dear Members of the Board of Fisheries, February 21, 2020

On behalf of the Alaska Fisheries Development Foundation (AFDF), I am writing to you in support of Alaska's salmon fishery enhancement program. AFDF has a unique perspective on this topic, because AFDF is the organization that manages and facilitates the sustainability certification of the Alaska salmon fishery under both the Responsible Fisheries Management (RFM) and the Marine Stewardship Certification (MSC) programs. Both of these programs use third-parties to annually review the management of Alaska's salmon fishery against standards based on internationally accepted principles. ***I am proud to say that the Alaska salmon fishery continues to hold both the RFM and MSC sustainability certifications.***

An important part of Alaska's salmon fishery is the enhancement program which is an example of sustainable economic development that directly benefits fishermen of all user groups, seafood processors, as well as state and local governments, which receive raw fish tax dollars. Statewide, Alaska's salmon hatcheries account for the annual equivalent of 4,700 jobs and $218 million in total labor income, including all direct, indirect, and induced economic impacts. A total of $600 million in annual economic output is connected to Alaska salmon hatchery production. More than 16,000 fishermen, processing employees, and hatchery workers can attribute some portion of their income to Alaska's salmon hatchery production. Thousands of additional support sector workers earn wages connected to Alaska hatchery production.

The Alaska salmon fishery enhancement program also provides economic and ecological stability to our salmon returns, which fluctuate year to year. Thank you for continuing to support Alaskans who rely on salmon fisheries. If you have any questions about the Alaska salmon sustainability certifications, please feel free to contact me.

Sincerely,

Julie Decker, Executive Director, AFDF
Cc: AFDF Board of Directors

Alaska Fisheries Development Foundation, Inc.

Alaska Fisheries Development Foundation
P.O. Box 2223, Wrangell, AK 99929 - Ph: 907-276-7315
www.afdf.org

UNITED SOUTHEAST ALASKA GILLNETTERS

February 20, 2020

Alaska Board of Fisheries
Alaska Department of Fish and Game, Boards Support Section
P.O. Box 115526
Juneau, Alaska 99811-5526

Re: Hatchery Committee

Dear Chairman Morisky and the Alaska Board of Fisheries,

Our member groups wrote to you exactly one year ago today applauding convening the Salmon Hatchery Committee Meeting and Joint Protocol on Salmon Enhancement. We look forward to the second year of the distribution of factual information concerning the enhancement program, and data results from the on-going "Wild and Enhanced Salmon Interaction" study. We'd like to reiterate our previous statements-

- **Alaska's salmon enhancement program is truly unique in the world-**
- **Alaska adheres to a comprehensive salmon plan that was developed over decades and had input from all stakeholders and uses the best science-**
- **RPT's allow for stringent review and are a public and transparent process-**

- **New production is minimal, surgically placed, and incremental allowing for evaluation-**

- **Regional Associations have given financial stability to coastal communities and local fisheries-**

- **Production financially supported by commercial fishermen has had an enormous positive impact on sport fisheries around the state-**

- **Our futures depend on wild stocks, and industry is spending millions of dollars to try to evaluate, unbiasly, the effects of hatchery fish straying into wild systems-**

- **Alaska salmon fisheries, including the hatchery program, continue to be certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC)-**

- **McDowell Group report identifies the economic contribution in 2018 of Alaska's salmon hatcheries to be 4,700 jobs, $218 million in labor income, and $600 million in total economic output-**

Our groups appreciate that the BOF has made it a priority to be personally informed and allow the general public to hear the same detailed information to better separate fact from fiction. This open process at the Board level allows all participants to hear the complete story, not just one line taken out of context that may distort the original intent.

Again, we applaud your effort to disseminate information in this process.

Thank you,

Susan Doherty	*Amy Daugherty*
Executive Director SEAS	Executive Director ATA
Max Worhatch	*Kathy Hansen*
Executive Director USAG	Executive Director SEAFA

Chugach
ALASKA CORPORATION

February 18, 2020

Alaska Department of Fish and Game
Boards Support Section
P.O. Box 115526
Juneau, AK 99811-5526

RE: Salmon Hatcheries Support

To Whom It May Concern,

Chugach Alaska Corporation (Chugach) is an Alaska Native Regional Corporation established pursuant to the Alaska Native Claims Settlement Act of 1971. As an Alaska Native corporation, we serve the interests of the Alaska Native people of the Chugach region and represent more than 2,800 shareholders. The Chugach region includes the communities of Cordova, Seward, Valdez, Whittier, Port Graham, Chenega, Eyak, Nanwalek and Tatitlek and over 5,000 miles of coastline along the southern tip of the Kenai Peninsula, through the Kenai Fjords, Prince William Sound and Gulf of Alaska.

We continue to support salmon hatcheries as spelled out in the attached resolution 18-20 passed by the Chugach Alaska board of directors in 2018.

Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fisherman, seafood processors, as well as state and local governments, which receive raw fish tax dollars. The hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state, particularly in rural coastal communities.
Chugach Alaska Corporation supports Alaska's salmon hatchery programs and the efforts of the Prince William Sound Aquaculture Corporation. We are ready to engage where needed. If you have any questions please feel free to contact me at 907-563-8866.

Sincerely,

Sheri Buretta

Sheri Buretta
Chairman of the Board
Chugach Alaska Corporation

Chugach
ALASKA CORPORATION

CHUGACH ALASKA CORPORATION
BOARD OF DIRECTORS

RESOLUTION 18-20

WHEREAS, the Chugach region includes the communities of Cordova, Seward, Valdez, Whittier, Port Graham, Chenega Bay, Eyak, Nanwalek (English Bay) and Tatitlek and over 5,000 miles of coastline along the southern tip of the Kenai Peninsula, through the Kenai Fjords, Prince William Sound and Gulf of Alaska; and

WHEREAS, Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state; and

WHEREAS, Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments, which receive raw fish tax dollars; and

WHEREAS, Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state and in particular in rural coastal communities.

NOW, THEREFORE, BE IT RESOLVED, that Chugach Alaska Corporation affirms its support for Alaska's salmon hatchery programs.

BE IT FURTHER RESOLVED, that Chugach Alaska Corporation calls on the Alaska Board of Fisheries to work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Dated this 21st day of September, 2018.

Sheri Buretta
Sheri Buretta, Chairman of the Board

ATTEST:

David Totemoff SR.
David Totemoff, Sr., Corporate Secretary

YEA: 8 NAY: Ø ABSTAIN: Ø ABSENT: 1

Cook Inlet Aquaculture Association

40610 Kalifornsky Beach Road
Kenai, Alaska 99611
Phone: 907-283-5761
Fax: 907-283-9433
info@ciaanet.org
www.ciaanet.org

Chairman Reed Morisky
Alaska Board of Fisheries
Boards Support Section
P.O. Box 115526
Juneau, AK 99811-5526

February 21, 2020

via email: dfg.bof.comments@alaska.gov

Re: Hatchery Committee Meeting – March 7, 2020

Chairman Morisky, Members of the Alaska Board of Fisheries,

Cook Inlet Aquaculture Association looks forward to participating in the upcoming March 7th Hatchery Committee meeting. We appreciate the Board's observance of the Joint Board Protocol on Salmon Enhancement as well as the Board's commitment to holding an annual Hatchery committee meeting. This is an important forum to inform and update the board and public regarding hatchery policies and ongoing hatchery related research.

We look forward to presentations on hatchery research and the presentations and discussion regarding Cost Recovery. This subject garnered a lot of attention at the Board's 2019-2020 meeting in Seward. As was discussed in Seward, there are different strategies that each association utilizes to achieve their individual cost recovery goals.

Stakeholders and users within the region make up the Board of Directors for Cook Inlet Aquaculture Association. The Board establishes revenue and cost recovery goals to provide for the achievement of all programs for fisheries enhancement and support programs throughout the Lower Cook Inlet and Outer District.

In addition to our hatchery programs our support programs focus on habitat protection and restoration in addition to field projects throughout the region to provide important data that can be utilized by Alaska Department of Fish and Game to assist with fisheries management decisions.

Cook Inlet Aquaculture Association is dedicated to protecting and providing salmon for all user groups. We recognize the value of both hatchery and naturally produced salmon fisheries.

Thank you for the opportunity to comment.

Respectfully,

Dean Day
Executive Director

COPPER RIVER SEAFOODS
Main Administrative Office
1118 East 5th Avenue · Anchorage, AK 99501
Phone: (907)522-7806 · (888)622-1197 · Fax: (907)274-0348
www.CopperRiverSeafoods.com

Alaska Department of Fish & Game
Board Support Section
P.O. Box 115526
Juneau, AK 99811-5526

Dear Board Members:

Hatchery programs across the state play a huge role in the success of Alaska's salmon fisheries for all user groups. It is because of this important role that Copper River Seafoods supports everything the hatcheries are doing.

The economic value that these hatcheries bring our state is vital to the diversification of revenue needed in a state such as Alaska. Without the stability that the hatcheries offer, the fishery would see additional fluctuations in catch and therefore more fluctuations of the economic wellbeing of the industry. We are all much better off when we can forecast our catch with more accuracy.

There is no scientific evidence that the hatchery fish are competing with wild stocks in any negative way or that straying of hatchery fish is causing a distress to wild stocks. The research being done in these areas needs time to complete their studies so that decisions are made based on science. Please consider this while deliberating on the future of the hatcheries.

Thank you for your consideration,

Martin Weiser
Copper River Seafoods
1118 East 5th Ave
Anchorage, Alaska 99501

CITY OF CORDOVA

February 20, 2020

Alaska Board of Fisheries

RE: Letter Supporting Science-Based Management of Hatcheries for Economic Benefit

Dears Sirs and Madams:

Through recent attendance and monitoring of Board of Fisheries and Departmental meetings, I have observed little dialogue about the legal responsibility of the commissioner and board to economic impacts and fisheries development. Rather than provide an extensive list of the measurable benefits of the hatchery system to our State and communities, I offer a qualitative perspective. Both the Commissioner and Board have responsibilities worth repeating in the context of hatchery management.

Alaska Statutes, Title 16, Sec. 16.05.020. Functions of commissioner.
The commissioner shall…
(2) manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state….; and

Alaska Statutes, Title 16, Sec. 16.05.221. Boards of fisheries and game.
(a) For purposes of the conservation and development of the fishery resources of the state, there is created the Board of Fisheries….

With increasing global pressures on fisheries resources, the hatchery system is complementary to wild stocks from a basic economics perspective. A diversified and supplementary supply satisfies demand from sport, subsistence, personal use, and commercial user groups, and reduces pressures on wild stocks alone. There is ample quantitative data to demonstrate the positive economic impacts of developing underutilized or underdeveloped fisheries. Hatcheries have been developed and are an established and critical socio-economic element. Cordova ranks as the 11th largest seafood port in the US seafood sector, which is in the top five trade imbalances at 94% imported (2018) at $15Billion in no small part due to access to hatchery and wild stocks (which have flourished adjacent to hatcheries).

In discussions with life-long PhD level researchers at science conferences in Cordova, there is much to be learned (in fact it is alarming how little we truly understand) about the complex interactions of ecosystems, climate, predation, human interaction, and feedstocks to salmon production. Cordova supports and encourages the cautious and science-based approach that the Department has exercised to date, and strongly support the retention and production of the hatchery system of Alaska.

Respectfully,

Clay R Koplin

Clay Koplin, Mayor
City of Cordova, Alaska

602 Railroad Avenue P.O. Box 1210 Cordova, Alaska 99574 Telephone (907) 424-6200 Fax (907) 424-6000

CITY OF CORDOVA, ALASKA
RESOLUTION 09-18-24

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CORDOVA, ALASKA, SUPPORTING THE ALASKA SALMON HATCHERY PROGRAM

WHEREAS, the City of Cordova benefits greatly from the State of Alaska Salmon Hatchery Program; and

WHEREAS, Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state; and

WHEREAS, Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments, which receive raw fish tax dollars; and

WHEREAS, Alaska's salmon hatchery program employs strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations; and

WHEREAS, the Alaska Department of Fish and Game regulates hatchery operations, production, and permitting through a transparent public process and multi-stakeholder development of annual management plans; and

WHEREAS, returns of hatchery and wild salmon stocks follow similar survival trends over time and the largest returns of both hatchery and wild salmon stocks have largely occurred since hatchery returns began in about 1980; and

WHEREAS, there are no stocks of concern where most hatchery production occurs, indicating that adequate escapements to wild stock systems are being met in these areas over time; and

WHEREAS, Alaska hatcheries contributed an annual average of nearly 67 million fish to Alaska's commercial fisheries in the past decade; and

WHEREAS, Alaska hatcheries contributed nearly 47 million fish to the commercial fisheries and $162 million in statewide ex-vessel value in 2017; and

WHEREAS, Alaska hatcheries accounted for 57% of the total common property commercial catch and 60% of the total ex-vessel value in the Prince William Sound region in 2017; and

WHEREAS, a draft McDowell Group report on the Economic Impacts of Alaska's Salmon Hatcheries identifies the economic contribution in 2017 of the Prince William Sound hatcheries to be 2,135 jobs, $101 million in labor income, and $307 million in total economic output; and

WHEREAS, Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state and particularly in rural coastal communities; and

WHEREAS, Alaska's salmon hatchery program is non-profit and self-funded through cost recovery and enhancement taxes on the resource and is a model partnership between private and public entities; and

WHEREAS, the State of Alaska has significantly invested in Alaska's salmon hatchery program and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities while maintaining a wild stock escapement priority; and

WHEREAS, Alaska salmon fisheries, including the hatchery program, continue to be certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC);

NOW, THEREFORE BE IT RESOLVED that the City Council of the City of Cordova, Alaska affirms its support for Alaska's salmon hatchery programs; and

BE IT FURTHER RESOLVED that the City Council of the City of Cordova, Alaska supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural salmon stocks, such as the Alaska Hatchery-Wild Salmon Interaction Study which began in 2011 and is scheduled to conclude in 2023; and

BE IT FURTHER RESOLVED that the City Council of the City of Cordova, Alaska calls on the Alaska Board of Fisheries to work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

PASSED AND APPROVED THIS 19th DAY OF SEPTEMBER 2018.

CITY OF CORDOVA CORPORATE SEAL JULY 8, 1909 ALASKA

ATTEST:

Clay R. Koplin, Mayor

ATTEST:
Susan Bourgeois, CMC, City Clerk

Susan Bourgeois, CMC, City Clerk

Cordova District
PO Box 939 | 509 First Street
Cordova, AK 99574 | www.cdfu.org

February 20, 2020

Reed Morisky, Chairman
Glenn Haight, Executive Director
Alaska Board of Fisheries
Alaska Department of Fish and Game, Boards Support Section
P.O. Box 115526
Juneau, AK 99811

RE: Hatchery Committee Meeting Comments

Dear Chairman Morisky and members of the Board of Fisheries,

Cordova District Fishermen United is a non-profit membership organization representing the commercial fishing families who participate in commercial fisheries in Alaska's Area E, which includes Prince William Sound, the Copper River region and the northern-central Gulf. It is our mission to preserve, promote and perpetuate the commercial fishing industry in Area E and to further promote safety at sea, legislation, conservation, management and general welfare for the mutual benefit of all our members.

CDFU has a long history of involvement with and continued support for Alaska's salmon enhancement programs. Our organization has been a longstanding advocate for the economic and social benefits of hatchery production in Alaska. Though the economic benefits should not be minimized, we would like to highlight the contribution that hatchery programs make to our communities beyond any dollar amount. The social fabric of our many communities, both coastal and interior, revolves heavily around salmon, whether through subsistence, sport, personal use, or commercial fishing.

Salmon hatcheries provide opportunity for all, at no expense to the vast majority of harvesters, and are instead self-funded through cost recovery and enhancement taxes paid by the commercial fishing fleet. Alaska's hatchery programs provide opportunities for educational outreach and research. Their support is critical to watershed education and in a number of elementary schools

Cordova District Fishermen United
PO Box 939 | 509 First Street
Cordova, AK 99574 | www.cdfu.org

statewide, providing knowledge, guidance, and financial assistance for salmon tanks in the classroom: educating the next generation of Alaskans on the importance of salmon to our culture and our economy, as well as the basic biological processes throughout the salmon life cycle.

Recently, there has been a great deal of public inquiry regarding Alaska's hatcheries and the science behind them, as well as the process that governs their management. As you are aware, hatchery production is thoroughly vetted through Regional Planning Teams, which include representatives from Alaska Department of Fish and Game and whose meetings are open to the public. These meetings also include scientific reports and presentations from the department on the most current research available.

Members of the Regional Planning Teams have a strong background in the science behind hatchery production and a thorough understanding of local ecology and regional fisheries, as well as a thorough understanding of the local communities engaged in each of these fisheries. Regional Planning Teams operate within the parameters laid out in 5 AAC 40.300-370, and public input is encouraged at all stages of regional comprehensive salmon plan development through this process (5 AAC 40.360). CDFU continues to support this framework for statewide hatchery production planning, as it is an open public process and heavily reliant on input from the scientific community, including representatives from ADFG, USFS, regional aquaculture associations, tribal organizations, as well as members of the public.

Thank you for your time and consideration on this very important issue. We believe it is valuable for the Board of Fisheries to continue to be informed on hatchery production, and we continue to recommend that the Department of Fish and Game regularly provide the Board of Fisheries with reports and updates regarding hatchery production.

Sincerely,

Chelsea Haisman

Chelsea Haisman
Executive Director

Submitted By
Jon Bolling
Submitted On
2/21/2020 4:53:44 PM
Affiliation
City of Craig, Alaska

Phone
907-826-3275
Email
administrator@craigak.com
Address
P.O. Box 725
Craig, Alaska 99921

Dear Hatchery Committee Members:

The City of Craig supports current levels of hatchery production salmon within the State of Alaska.

Alaska's salmon hatchery program has operated for 45 years. The hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments. Alaska's salmon hatchery program employs strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations.

While the City of Craig encourages hatchery operations at current production levels, it also supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural salmon stocks, such as the Alaska Hatchery-Wild Salmon Interaction Study. The study began in 2011 and is scheduled to conclude in 2023.

The Alaska Department of Fish and Game effectively regulates hatchery operations, production, and permitting through a transparent public process and multi-stakeholder development of annual management plans. The effort to manage hatchery production is supported by non-profit associations and is largely self-funded through cost recovery and enhancement taxes on the resource, and is a model partnership between private and public entities.

The City of Craig recognizes that hatcheries accounted for 34% of the total commercial salmon harvest in Alaska in 2018; and 59% of the total ex-vessel value in the Southeast region, 75% of the total ex-vessel value in the Prince William Sound region, 9% of the total ex-vessel value in the Cook Inlet region, and 25% of the total ex-vessel value in the Kodiak region in 2018. The hatchery contributions must be sustained.

The city requests that the Alaska Board of Fisheries work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Thank you for considering the city's comments.

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Gig Decker, and I can be reached at craiggigdecker@gmail.com. I am from Wrangell and commercial fish in Southeast Alaska.

Commercial salmon fishing generates 100% of my personal income, 25-50% of which comes from hatchery salmon. My family, including my adult children, all actively commercial fish for salmon. Hatcheries contribute a significant portion of that income. Hatcheries not only contribute to our personal income, but they provide an important source of food for community members and are sustainably managed.

Respectfully,

Gig Decker

ICICLE

February 21st, 2020

Chairman Reed Morisky
Alaska Board of Fisheries
ATTN: BOF COMMENTS
dfg.bof.comments@alaska.gov

RE: COMMENTS ON AGENDA FOR MARCH 7TH SALMON HATCHERY COMMITTEE MEETING

Chairman Morisky and members of the Alaska Board of Fisheries,

Icicle Seafoods is one of the largest and most diversified seafood companies in North America. Our operations are located throughout the State of Alaska including Southeast, Prince William Sound, Cook Inlet, Kodiak, Dutch Harbor, and Bristol Bay. Our processing facilities and our fishermen depend on regulatory stability and sustainable management of fisheries resources. We appreciate the opportunity to comment on the upcoming salmon hatchery committee meeting. Although an agenda has yet to be posted, we based our comments on the draft agenda posted online at the Upper Cook Inlet meeting.

As has been noted on multiple occasions, Alaska's hatchery program is vital to the success of personal use, sport, and commercial salmon harvesters alike. In addition, a recent McDowell economic report puts the 2018 economic contribution of Alaska's salmon hatcheries at 4,700 jobs, $218 million in labor income, and $600 million in total economic output. Alaska's hatchery programs matter to communities across the state and to the state itself. Icicle and our fishermen support a healthy hatchery program and we believe it is consistent with the Sustainable Salmon Policy.

Recently, salmon hatchery production has been a frequent item on the Board of Fisheries agenda. Given the confusion over the hatchery permitting process and the significant amount of opinion being presented as science by members of the public, we support convening the Salmon Hatcheries Committee and Joint Protocol on salmon enhancement. It would be beneficial to the public to learn more about the existing salmon enhancement public process and review information regarding salmon hatchery production throughout the entire North Pacific in addition to other agenda items. Alaska's hatchery programs have evolved over time, and we look forward to reviewing the most recent science and information made available by ADF&G. We appreciate the Board's continued support of the Alaska Hatchery Research Project, as a means to collect independent data and answer questions on the interaction of wild and hatchery salmon in Alaska. We also look forward to continued discussions regarding the BOF extent of authority and ADF&G's extent of authority related to hatcheries.

We applaud the BOF for returning to a consistent yearly process for dealing with hatchery-related issues and look forward to continuing to participate in a meaningful discussion. Thank you for the opportunity to comment, please reach out if you have any questions.

Sincerely,

Julianne Curry
Public Affairs Manager
Icicle Seafoods, Petersburg
Julianne.Curry@icicleseafoods.com

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Jacob Privat, and I can be reached at jnprivat@gmail.com. I am a commercial fisherman living between Cordova and Seattle.

Hatcheries provide a safety net for coastal communities and seafood industry that my family and business relies on.

The salmon hatchery program was a direct influence on my decision to invest in the Prince William Sound/Copper River drift permit in 2018. My first season ended up being one of the most challenging for the Copper River fleet, but I was able to keep my new business afloat because of the hatchery returns. After working on a tender for a few years and seeing the stability that hatchery fish provided for those in the industry, I made up my mind to invest in an area that provides a science-based approach to sustainability and is economically viable.

My hope is that the Alaska hatchery program strives to be an innovative and positive force for the environment and the industries that work with it.

Respectfully,

Jacob Privat

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Jeff Berger, and I can be reached at jefffberger@gmail.com. I am from Ninilchik and am a public use fisherman.

Hatcheries provide a public resource for the benefit of all users. I earn my living in the processing industry, and these fish provide hundreds of jobs and the resources necessary for our industry to survive. This resource is consumed by the public through commercial harvest, and it feeds the United States and the world.

Respectfully,

Jeff Berger

JEDC Juneau Economic Development Council

JEDC.org
612 West Willoughby Ave. Suite A
Juneau, AK 99801
Phone 907-523-2300
Fax 907-463-3929

February 20, 2020

Board of Fisheries: Hatchery Committee
State of Alaska, Department of Fish and Game

Dear Board of Fisheries,

The Juneau Economic Development Council (JEDC) would like to show its support for the fisheries enhancement program, which has been a major contributor to Southeast Alaska's regional seafood economy. The salmon fishery generates the most ex-vessel value out of all of Alaska's fisheries and hatchery operations account for anywhere from 15% to 28% of that value. The existence of hatcheries has provided some economic resiliency in the industry when cyclical natural stocks are at their lows. This is important to those Alaskans who rely on this industry for the majority or all their earned income and keeps them from having to find supplemental income.

These hatcheries are also important to non-commercial uses such as sportfishing and subsistence. Being able to harvest salmon for these purposes is part of what makes Alaska a great place to live and visit. Currently, hatchery fish account for 17%, 13%, and 8% of Coho, Sockeye, and Chinook sport-caught harvests across the state respectively. For residents, having supplemental salmon stocks from hatcheries such as DIPAC provides easier and more equitable access to a traditional and healthy resource. Within the visitor industry, supplemental stocks are important to the success and sustainability of the charter fishing industry. Fishing in Alaska is a dream for many travelers and is an important opportunity that draws visitors. A decrease in the success rate in charter fishing could have a negative impact on the growing visitor industry.

JEDC affirms its support for Alaskan hatcheries, dialogue between stakeholders, and additional research on the effects hatchery raised stocks have on natural stocks. It is vital, for legal, economic, and ethical reasons, that our wild stocks continue to be managed in a sustainable and economically fair fashion.

Sincerely,

Brian Holst
Executive Director
Juneau Economic Development Council

Kachemak Bay Conservation Society
3734 Ben Walters Ln, Homer, AK 99603
907 235.8214
kbayconservation@gmail.com

Alaska Department of Fish and Game
Board of Fisheries, Hatchery Committee
P.O. Box 115526
Juneau, AK 99811-5526
dfg.bof.comments@alaska.gov

Re: Hatchery Committee Meeting March 7, 2020

Alaska Board of Fisheries, Hatchery Committee:

Alaskans are counting on the Board of Fish Hatchery Committee to do your part for resilient salmon and fisheries. We ask that you to have the department show what scientific research justifies the scale of hatchery releases they permit. We ask that you to have the department show what scientific research justifies the large stray rates they are allowing near hatcheries?. We ask you to take a hard look at how Alaska salmon management in practice lines up with our statutes, particularly the Sustainable Salmon Policy and the Genetic Policy. We ask you to look at all the research that shows just how narrow and weak hatchery genetics are in comparison to wild genetics, for example:

> "After looking at over 50 estimates of reproductive success from 6 case studies on 4 species of salmon, researchers found that even hatcheries using local or predominantly wild-origin parents produced fish with only half the reproductive success, on average, of their wild counterparts when both types of fish return to spawn in the wild environment…One important finding of this study is how consistent the results were across different systems. There has been a tendency to view each study's results in isolation, but when you combine them all together the pattern of reduced reproductive success across all the studies is pretty clear. [1]

We ask you to consider the impact of large-scale straying of these very weak genetics into wild systems. We ask you to take a close look at the hundreds of peer-reviewed papers that indicate that straying of hatchery fish into wild streams is a serious threat to wild salmon and to the ultimately to the viability of our fisheries. We ask you to look at all the hundreds of peer-

[1] "Surviving the wilderness: hatchery fish and fitness." July 2014, https://www.nwfsc.noaa.gov/news/features/hatchery_fish/

Kachemak Bay Conservation Society
3734 Ben Walters Ln, Homer, AK 99603
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reviewed papers that indicate that 1.8 billion hatchery fry released in Alaska impact their prey and species with whom they compete, such as wild salmon, squid, herring, and crab, as well as the user groups who fish those species.

1) Please form a Hatchery Science Advisory Group made up of ocean ecologists and biologists with published, peer-reviewed work on straying, competition, predation and trophic-level impacts. Please refer to the attached literature review for a list of hundreds of such experts. Please also refer to the Hatchery Reform Project and their Independent Scientific Review Group in the Pacific Northwest as a strong model as well as to the B.C. Wild Salmon Advisory Council. We cannot simply ignore the mountain of data that indicates that the hatchery program is jeopardizing our salmon fisheries. The board has to do the politically difficult thing for the benefit of all Alaskans, especially Alaskan fishers.

Consider the 10 primary take-aways from the Pacific Northwest Hatchery Reform Project Scientific Review Group[2] and ask how are we different? How do you know that?

1. Hatcheries generally have failed to meet their objectives.
2. Hatcheries have imparted adverse effects on natural populations.
3. Managers have failed to evaluate hatchery programs.
4. Rationale justifying hatchery production was based on untested assumptions.
5. Hatchery supplementation should be linked with habitat improvements.
6. Genetic considerations have to be included in hatchery programs.
7. More research and experimental approaches are required.
8. Stock transfers and introductions of non-native species should be discontinued.
9. Artificial production should have a new role in fisheries management.
10. Hatcheries should be used as temporary refuges rather than for long-term production.

Kachemak Bay Conservation Society hosted an event in January 2020 that we would like to put forward as a model for a solutions-oriented work group for the Hatchery Committee. We hosted a panel discussion on hatchery impacts to wild fish that included voices from aquaculture, commercial fishing, ADF&G, as well as independent Alaska researchers who study the impacts of hatcheries on wild populations. The discussion can be viewed here. We believe that this collection of viewpoints— including at a minimum several experts who study hatchery impacts to wild fish—would be a good way to generate ideas to resolve some of the tough issues around fishery sustainability, and we urge the board to form such a work group.

[2] Brannon et al. 1999, Independent Scientific Review Group

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2) The Department of Fish and Game has presented no published, peer-reviewed science to support the release sizes they authorize. This is a discredit to the department; it fundamentally weakens the viability of our fisheries, and Alaskans deserve better.

The precautionary principle articulated in the Sustainable Salmon Policy requires that the department show that their policies are not harming wild salmon populations and other populations in the common property that these releases eat, especially herring, crab, shrimp and squid. Sadly, ADF&G's presentation to the Board in 2019 simply stated that the *one study* they are willing to use is incomplete. It is unacceptable that the department presented no data to show that their management approach is evidence-based or precautionary.

Please carefully review some basic questions—

- Why it is that while ADF&G's Genetic Policy states that "gene flow from hatchery fish straying and intermingling with wild stocks may have significant detrimental effects on wild stocks. First priority will be given to protection of wild stocks from possible harmful interactions with introduced stocks. Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks" and yet the department says it is unalarmed by straying?
- Why is it that despite findings of very high stray rates in PWS (10%)[3] and SEAK (9%)[4]—with stray rates near hatcheries ranging from 99%-60%— there has been no department action to reduce straying, even into very valuable wild systems such as West Crawfish in Southeast? Examples of such efforts would be reduction in release sizes, ending remote releases, use of stocks with early- or late- run-timed fish.
- What stray rates does the department think are are acceptable?
- What level of genetic degradation does the department think is acceptable?
- What are the scientific justifications for each these positions?
- In what specific ways does each position reflect the precautionary principle?
- What are the annual statistically significant sample sizes needed to prove that we are within the acceptable stray rates and levels of genetic degradation per year?
- What are the total data on straying and genetic impacts have been collected by the department on this system during all the years this hatchery has been operating?
- What does the precautionary principle tell us we should do if we are lacking data?

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[3] "Interactions of Wild and Hatchery Pink Salmon in Prince William Sound Final Report for 2017."

[4] Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska progress report for 2015, *Volume 1* by Knudsen, E., Rand, P., Gorman, K., McMahon, J., Adams, B., O 'Connell, V., & Bernard, D. R. (2016).

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3) The presentation given to the Hatchery Committee by the department in 2019, unceremoniously and with almost no discussion, dismissed the weight of thousands of contemporary, peer-reviewed, and agency papers that show overwhelming evidence that large-scale production of hatchery salmon threaten wild populations through straying, reduction in fitness, competition and predation.[5] This wholesale rejection of thousands of peer-reviewed papers is not scientific. To say, as the Department has done, that these peer-reviewed studies are merely correlative and therefore irrelevant is a bad-faith argument. It is in bad-faith to willfully ignore what the department knows very well, that the entire field of biology is founded largely on correlative research that has high statistical significance. It ignores the fact that correlative and statistically significant research far surpasses any standard set by the precautionary principle. It ignores the substance and breadth of the research entirely. It ignores the fact that nearly every decision made by the department is based on extremely limited, correlative information.

4) By the time the Hatchery Committee meets in March, the Marine Stewardship Council's (MSC) 2019 Performance Review Audit of Alaska Salmon will be available. The MSC sets a globally agreed high bar for best practice in sustainable fishing and includes a requirement for ongoing improvements where these are needed. The Hatchery Committee must carefully review that Audit and the requirements it sets for the fishery.

Note that MSC's internationally recognized standard for sustainable region-wide straying of hatchery fish into wild streams is **less than 5%**. Note also that British Columbia was forced to forgo the certification, citing issues with the impacts of hatchery releases to wild salmon. The price of fish from British Columbia is now significantly lower and their markets are significantly smaller. It is imperative that Alaska keep its MSC certification, and the Board must have a presentation from the Department on what it is doing to meet the sustainability standards set by MSC.

5) A broad body of scientific work indicates that Alaska's annual production of 1.8 billion hatchery salmon may significantly impact a range of species, including wild salmon, crab, shrimp, herring and squid. As such, Regional Planning Teams (RPTs) write Comprehensive Salmon Plans that guide enhancement efforts that affect many user groups; however, the current statute does not allow these groups on the RPTs.

[5] Please refer to the attached literature review, which is an indication of the breadth and depth of the peer-reviewed papers available to support these theses. Please also refer to the attached Pacific Northwest Hatchery Reform Review Group's Report To Congress and the attached "B.C. Wild Salmon Advisory Council Recommendations for a Made-in-B.C. Wild Salmon Strategy" —while not all of it is applicable to Alaska, a great deal of it is highly pertinent.

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We support alteration of 5AAC 40.310 so that RPTs are required to include members from wild salmon fisheries, commercial, sport and subsistence user groups of other impacted fisheries, as well as at least independent ocean ecologist or fishery biologist who studies the impacts of hatchery production on wild populations.

According to AS 16.05.251, the Board may adopt such regulations that are consistent with 5 AAC 39.220, Policy for the management of mixed stock salmon fisheries.

6) The Genetic Policy is one of the foundations of Alaska's salmon management; sadly, while we have good rules on the books, we are not following them. This policy states that "drainage's *[sic]* should be established as wild stock sanctuaries on a regional and species basis. These sanctuaries will be areas in which no enhancement activity is permitted…" This has not occurred and the board must see that these sanctuaries are established in all regions.

The following general recommendations were made in ADFG Special Publication No. 18-12 "Salmon Hatcheries in Alaska – A Review of the Implementation of Plans, Permits, and Policies Designed to Provide Protection for Wild Stocks:"

a) Clarify the *Genetic Policy* and technical terms, specifically addressing the following: a. Add region(s) that encompass Alaska Peninsula areas. b. Define significant and unique stocks. c. Define remote release sites. d. Revisit the criteria designed to ensure adequate stock diversity among hatcheries. e. Provide clearer guidance for protection of donor stocks. f. Assist with criteria for wild sanctuary designation.
b) Improve communication of policies, plans, and processes to regulatory bodies and stakeholders.
c) Support basic research to better understand homing and the effects of straying. MSC should make sure that ADF&G does what their staff recommends here.

We urge the Board to ensure that these goals are met. These criteria should long ago have been satisfied to protect our wild salmon.

Thank you for your careful consideration of these vital issues. We trust that you will act in the interest of all Alaskans, now and in the future.

Sincerely,

Roberta Highland

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Effects of Hatchery-Origin Pink Salmon On Ecosystems and Other Pacific Salmon:

An Annotated Bibliography

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July 2018

Agler, B.A., G.T. Ruggerone, L.I. Wilson, and F.J. Mueter. 2013. Historical growth of Bristol Bay Agler, B.A., G.T. Ruggerone, L.I. Wilson, and F.J. Mueter. 2013. Historical growth of Bristol Bay and Yukon River, Alaska chum salmon (*Oncorhynchus keta*) in relation to climate and inter-and intraspecific competition. Deep-Sea Res II 94, 165-177.

This study of Bristol Bay and Yukon River adult chum salmon scales from 1965 through 2006 showed that increased growth was associated with higher regional ocean temperatures but slower growth associated with wind mixing and ice cover. Lower third-year growth was associated with high abundance of Asian chum and warmer sea surface temperatures (SST) in the Gulf of Alaska. High abundances of Russian pink salmon was also associated with lower third-year growth but the effects were smaller than those shown for high abundance of Asian chum and warmer GOA SST.

Amoroso, R. O., M. D. Tillotson, and R. Hilborn. 2017. Measuring the net biological impact of fisheries enhancement: Pink Salmon hatcheries can increase yield, but with apparent costs to wild populations. Canadian Journal of Fisheries and Aquatic Sciences 74:1233–1242.

This research estimated the net effect of the largest hatchery program in North America, the Prince William Sound pink salmon. Using other Alaska regions as reference sites (Kodiak, SE Alaska, and southern Alaska Peninsula), the authors used catch data from before establishment of hatchery programs (1960-1976) and after (1988-2011). The reference sites all had smaller programs than PWS (with no southern Alaska Peninsula pink hatchery program). Post late1970s climate regime shift, all regions had higher catches, with PWS having the greatest increase. Changes in wild salmon abundance were estimated for each region. Hatchery releases did not appear to decrease year-to-year variability in catches. No net positive effects (that is, taking into account the cost of the hatchery programs and reduced wild abundance) from the hatchery programs were detected for in Kodiak or SEAK. In PWS, the net effect was an increase in catch by 28%, lower than that estimated by other studies. This does not take into account other negative effects (e.g., other ecosystem effects, smaller size of returning fish), so any increases in hatchery programs should be done with a full accounting of risks and benefits.

Armstrong, J.L., Myers, K.W., Beauchamp, D.A., Davis, N.D., Walker, R.V., Boldt, J.L., Piccolo, J.J., Haldorson, L.J. and J.H. Moss. 2008. Interannual and spatial feeding patterns of hatchery and wild juvenile pink salmon in the Gulf of Alaska in years of low and high survival. Transactions of the American Fisheries Society, 137(5), pp.1299-1316.

This research compared hatchery and wild pinks in PWS and the northern coastal Gulf of Alaska (CGOA) with regard to their summer diets and feeding patterns (e.g., prey composition) in 1999-2004 (encompassing both high- and low-survival years). Hatchery and wild pink salmon had similar diets both during their residence in PWS and after they initially migrate to the CGOA. This lack in difference means that PWS hatchery pink can compete with wild fish for the available prey. Also, it appears that faster-growing fish can migrate from PWS earlier in summer and take advantage of better feeding opportunities in the CGOA.

Atcheson, M. E., K. W. Myers, N. D. Davis, and N. J. Mantua. 2012. (abs) Potential trophodynamic and environmental drivers of steelhead (*Oncorhynchus mykiss*) productivity in the North Pacific Ocean. Fisheries Oceanography 21:321–335.

“Information on prey availability, diets, and trophic levels of fish predators and their prey provides a link between physical and biological changes in the ecosystem and subsequent productivity (growth and survival) of fish populations. In this study two long- term data sets on summer diets of steelhead (*Oncorhynchus mykiss*) in international waters of the central North Pacific Ocean (CNP; 1991–2009) and Gulf of Alaska (GOA; 1993–2002) were evaluated to identify potential drivers of steelhead productivity in the North Pacific. Stable isotopes of steelhead muscle tissue were assessed to corroborate the results of stomach content analysis. We found the composition of steelhead diets varied by ocean age group, region, and year. In both the GOA and CNP, gonatid squid (*Berryteuthis anonychus*) were the most influential component of steelhead diets, leading to higher prey energy densities and stomach fullness. Stomach contents during an exceptionally warm year in the GOA and CNP (1997) were characterized by high diversity of prey with low energy density, few squid, and a large amount of potentially toxic debris (e.g., plastic). Indicators of good diets (high proportions of squid and high prey energy density) were negatively correlated with abundance of wild populations of eastern Kamchatka pink salmon (*O. gorbuscha*) in the CNP. In conclusion, interannual variations in climate, abundance of squid, and density- dependent interactions with highly- abundant stocks of pink salmon were identified as potential key drivers of steelhead productivity in these ecosystems. Additional research in genetic stock identification is needed to link these potential drivers of productivity to individual populations.”

Azumaya, T., and Y. Ishida. 2000. Density interactions between Pink Salmon (*Oncorhynchus gorbuscha*) and Chum Salmon (*O. keta*) and their possible effects on distribution and growth in the North Pacific Ocean and Bering Sea. North Pacific Anadromous Fish Commission Bulletin 2:165–174.

Data from Japanese salmon research vessels from 1972-1998 were analyzed to evaluate the long-term spatial and temporal distribution of chum and pink salmon. Chum salmon distribution varied out-of-phase with the odd-even differences in pink salmon abundance (pinks having higher abundance in odd years). Chum salmon growth was not directly affected by pink salmon abundance but was affected by chum salmon abundance (higher abundance = slower growth), indicating that intra-species competition was more important than inter-species competition. Dietary (stomach content) research would shed more light onto the importance of inter-specific competition.

Batten, S. D., G. T. Ruggerone, and I. Ortiz. In press. Pink Salmon induce a trophic cascade in plankton populations in the southern Bering Sea and around the Aleutian Islands. Fisheries Oceanography. DOI: 10.1111/fog.12276.

This study examined time series (2000-2014) of phytoplankton and copepod abundances around the Aleutian Islands and the southern Bering Sea and compared those numbers with pink salmon abundances, which were eight times higher in odd years than in even (2000-2012). In 2013 (odd year), the abundance was 73% lower than previous odd years and the next year, pink abundance was relatively high (although lower than the average odd year abundance). There are opposing biennial patterns in abundances of large phytoplankters and copepods relative to pink salmon abundances: in odd years, pink salmon abundance and large diatom abundance is high, while copepod (prey of pink salmon and grazer of diatoms) abundance is low. These associations were stronger than comparisons to “stanzas”, the 4-6 year cycle of warm or cold temperatures found in the Bering Sea.

Beamish, R. J., R.M. Sweeting, T.D. Beacham, K.L. Lange, and C.M. Neville. 2010. A late ocean entry life history strategy improves the marine survival of Chinook salmon in the Strait of Georgia. NPAFC Doc. 1282. 14 pp. (Available at www.npafc.org).

One aggregated population of Georgia Strait Chinook salmon (South Thompson drainage of the Fraser River) has increased in recent years while most other Georgia Strait Chinook populations have declined. The South Thompson Chinook juveniles are not abundant in Georgia Strait in July but are by September, and by November are moving to sea, probably through the Strait of Juan de Fuca. Harrison River sockeye salmon are also a “late-entry” juvenile and doing better than others. It is theorized that high populations of pink and chum salmon present in Georgia Strait at the same time as earlier-entry populations of Chinook and sockeye are the reason why these populations of Chinook and sockeye are not doing as well as late-entry populations. Focused research is needed.

Brenner, R. E., S. D. Moffitt, and W. S. Grant. 2012. Straying of hatchery salmon in Prince William Sound, Alaska. Environmental Biology of Fishes 94:179–195.

The authors (all ADFG employees) sampled streams in PWS to determine stray rates using data gathered in two time periods, 1997-1999 and 2008-2010. Percentages of hatchery pink salmon in spawning areas varied from 0 to 98%. Most (77%) of spawning locations had pink salmon from three or more hatcheries, and the escapement at 51% of locations consisted of more than 10% hatchery pink salmon during at least one year surveyed. Application of an exponential decay model indicates that many streams would have over 10% hatchery pinks, even if distant from a hatchery. Besides the implication of genetic effects on wild populations, the authors express concern that estimates of wild escapement may be inflated by the assumption that all fish seen in weirs or in aerial surveys are assumed to be wild.

Debertin, D. J., J. R. Irvine, C. A. Holt, G. Oka, and M. Trudel. 2017. Marine growth patterns of southern British Columbia Chum Salmon explained by interactions between density-dependent competition and changing climate. Canadian Journal of Fisheries and Aquatic Sciences 74:1077–1087.

The authors report the results of a study of 39 years of scale growth measurements of chum salmon from Big Qualicum River (BC) in regard to climate variation and competition with other

North American salmon (chum, sockeye, and pink). When the North Pacific Gyre Oscillation was positive, growth increased (attributed to higher primary production). Growth at all ages was negative when the combined biomass of NA salmon was high. Competition effects increased when the NPGO was more positive and the Pacific Decadal Oscillation was more negative. The authors recommend the use of biomass estimates over abundance estimates to take into account inter-species variations and the observed trend of smaller returning salmon. The authors believe this study is the first to use a longitudinal model to examine growth versus the interactions of climate and density dependent competition. If their results are typical of wild salmon populations, reductions in hatchery releases should be considered.

Grant, W.S., 2012. Understanding the adaptive consequences of hatchery-wild interactions in Alaska salmon. Environmental Biology of Fishes, 94(1), pp.325-342.

This is a review of hatchery-wild interactions with an emphasis on genetic effects to wild populations. While the author acknowledges that some may argue that studies conducted elsewhere may not be applicable to Alaskan salmon populations for a variety of reasons, the near-universal result that introgression between hatchery fish and wild fish leads to reduced fitness in wild populations is a fact that must be considered when evaluating hatchery programs. The adaptive potential of wild populations must be preserved as a buffer against climate change and diseases.

Gritsenko A.V. and E.N. Kharenko. 2015 (abs). Relation between biological parameters of Pacific salmons of the genus Oncorhynchus and their population dynamics off the northeastern Kamchatka Peninsula. J Ichthyol 55:430–441.

“Results are provided of a 7-year study of biological parameters in females of three Pacific salmons of the genus *Oncorhynchus* (pink salmon *O. gorbuscha*, chum salmon *O. keta*, and sockeye salmon *O. nerka*) in the Olyutorsky and Karaginsky gulfs, Bering Sea. Abundance of the pink salmon is identified as the main determining factor of the interannual dynamics of maturity index in female Pacific salmon in coastal waters. Maturity index rises at high levels of abundance as a result of differently directed changes in two parameters: decreasing body weight and increasing ovary weight. In female chum salmon, maturity index depends on the age structure of the population and body weight dynamics of different age groups, factors influenced by high abundance of some pink salmon generations, and does not depend on the abundance of spawning chum salmon. The revealed association between pink salmon and sockeye salmon in dynamics of their biological parameters may result from the similarity of their diets; during the last year of fattening in the sea, the sockeye salmon is affected by the pink salmon, the most abundant of the three species. The interannual variation of biological parameters in pink salmon and chum salmon is more pronounced in Olyutorsky Gulf than in Karaginsky Gulf.”

Heard, W.R., 2012. Overview of salmon stock enhancement in southeast Alaska and compatibility with maintenance of hatchery and wild stocks. Environmental Biology of Fishes, 94(1), 273-283. PC022 5 of 24

This review of the hatchery programs of SEAK, as well as some relevant studies of wild-hatchery interactions, acknowledges that some interactions between hatchery salmon and of wild salmon are unavoidable, but concludes that "obvious adverse impacts from the current levels of hatchery releases and population trends in Alaska's wild salmon populations are not readily evident." The author believes that SEAK hatchery chum programs have been successful in increasing numbers for fisheries, but says that additional increases (which have been requested) should be limited to "gradual incremental steps" given concern over straying in some streams, until better information is generated on the possible impacts of hatchery programs on wild populations.

Hilborn, R. and D. Eggers. 2000. A review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska. Transactions of the American Fisheries Society 129:333-350.

Wertheimer, A. C., W. W. Smoker, T. L. Joyce, and W. R. Heard. 2001. Comment: A review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska. Transactions of the American Fisheries Society 130:712–720.

Hilborn, R. and D. Eggers, 2001. A review of the hatchery programs for pink salmon in Prince William Sound and Kodiak Island, Alaska: Response to Comment. Transactions of the American Fisheries Society 130:720–724.

Hilborn and Eggers used ADF&G catch data from four Alaska regions. The initial paper concluded that while the PWS hatchery program was successful in producing fish to be harvested, the overall increase in harvest wasn't necessarily due to the PWS pink salmon hatchery programs, because other AK regions (with no, or geographically separated hatchery programs) experienced an increase in wild pink production. In fact, increases in pink salmon harvest in PWS occurred before large-scale hatchery programs there. Therefore, the hatchery-produced pink salmon replaced rather than augmented the wild fish. A decline in wild production in PWS was attributed to lower wild escapements and hatchery releases (the authors claim no evidence has been produced to show that the Exxon Valdez oil spill was detrimental to longterm pink salmon production).

Wertheimer et al. (2001) commented that Hilborn and Eggers vastly over-estimated wild pink production and therefore underestimated the proportion of the PWS pink harvest that could be attributed to hatchery production. They also used a longer time-series of catch data, along with other approaches to the data. Hilborn and Eggers (2001), in a response, stand by their conclusions and point out that in this case a longer time-series is not appropriate (positive changes in pink salmon habitat after the 1964 earthquake). They maintain that an increase in PWS pink production was evident before large-scale hatchery releases took place, and that hatchery releases replaced rather than augmented wild production.

Holt, C.A., Rutherford, M.B, and R.M. Peterman. 2008 (abs). International cooperation among nation-states of the North Pacific Ocean on the problem of competition among salmon for a common pool of prey resources. Marine Policy 32, 607–617.

"A common-pool problem in the North Pacific Ocean that remains largely ignored in international policy is competition for prey resources among salmon populations (*Oncorhynchus* spp.) from different countries. Hatcheries release large abundances of juvenile salmon into the North Pacific and the resulting decrease in mean body size of adult wild and hatchery salmon may lead to reductions in benefits. We examine incentives and disincentives for cooperation among nation-states on this issue. We recommend that either a new international organization be created or that amendments be made to the mandate and powers of an existing organization. The resulting organization could encourage collective action to reduce competition among salmon from different nations by using side-payments to change the incentive structure, by establishing a multi-national scientific assessment team to create a common frame of reference for the problem, and by implementing policy prescriptions."

Irvine, J. R., and M. Fukuwaka. 2011. Pacific salmon abundance trends and climate change. ICES Journal of Marine Science 68:1122–1130.

This study compared abundance of five species of salmon (represented by commercial catch data) in both Asia and North America with five climate regimes (1925-1946, 1946-1976, 19771988, 1989-1998, and 1999-2009). Higher catches in the western north Pacific are attributed to hatchery programs (both releases and better hatchery technology resulting in healthier fry). The results confirm earlier studies indicating regime "shifts" in 1947, 1977, and 1989. Higher catches of pink and chum since 1990 in all regions have occurred and can be attributed to hatchery releases in only the northwestern Pacific region because only Russia has significantly increased hatchery releases.

Jeffrey, K. M., I. M. Coté, J. R. Irvine, and J. D. Reynolds. 2016. Changes in body size of Canadian Pacific salmon over six decades. Canadian Journal of Fisheries and Aquatic Sciences 74:191–201.

Commercial catch data for five salmonid species from 1951-2012 were analyzed along with climatic variables (four Pacific Ocean indices), latitude of catch, and total salmonid biomass to determine if size of caught fish has changed, and if so, what variables are associated with the changes. Catch data from the least-selective method were used to minimize any size-selective gear bias. Analyses from the earlier part of the catch dataset agree with the results of previous research. The results from this study indicate changes in body size over time from oceanic changes as well as density-dependent effects. Pink salmon size declined initially but has changed relatively little over the last 20 years. Body size of Chinook, chum, and coho was most influenced by the total biomass of sockeye, chum, and pink salmon in the Gulf of Alaska. Inclusion of Asian chum salmon did not improve model performance. Pink salmon size was reduced as total biomass increased, with odd-years (higher abundances of pinks) showing a more pronounced effect. Chinook and coho body size increased with total salmon biomass,possibly reflecting better overall environmental conditions, given the lack of overlap in diet preferences between Chinook and coho vs. the other three species.

Jenkins, E.S., Trudel, M., Dower, J.F., El-Sabaawi, R.W. and A. Mazumder. 2013. Density-dependent trophic interactions between juvenile pink (*Oncorhynchus gorbuscha*) and chum salmon (*O. keta*) in coastal marine ecosystems of British Columbia and Southeast Alaska. North Pacific Anadromous Fish Commission Technical Report 9:136-138.

This study employed stable isotopes to determine the degree of dietary overlap between juvenile chum and juvenile pink salmon (the southern end of SEAK to the northern end of Vancouver Island), and how that is affected by temperature, abundance (juvenile salmon), and prey availability. Juveniles were collected 2000-1 and 2004-5. The niches of pink and chum overlapped more when abundance was high and prey availability was low. The size difference between the species was not significantly correlated with overlap. It appears that when competition was greater (fewer prey items) both species became less selective and therefore they overlapped more. Hatchery releases resulting in greater numbers of juveniles may thus increase competition.

Kaev, A. M. 2012 (abs). Wild and hatchery reproduction of Pink and Chum salmon and their catches in the Sakhalin-Kuril region, Russia. Environmental Biology of Fishes 94:207–218.

“In the Sakhalin-Kuril region hatchery culture of pink and chum salmon is of great importance compared to other regions of the Russian Far East. During the last 30 years the number of hatcheries increased two-fold, and significant advances were made in hatchery technologies. As a result, chum salmon capture in regions where hatcheries operate (southwestern and eastern Sakhalin coasts, and Iturup Island) was 9 times as high during 2006–2010 than during 1986–1990, whereas wild chum salmon harvest markedly declined. Recent dynamics in pink salmon catch appear to track trends in natural spawning in monitored index rivers, suggesting natural-origin pink salmon play a dominant role in supporting the commercial fishery. It remains uncertain as to whether hatcheries have substantially supplemented commercial catch of pink salmon in this region, and I recommend continued research (including implementing mass marking and recovery programs) before decisions are made regarding increasing pink salmon hatchery production. Location of hatcheries in spawning river basins poses problems for structuring a management system that treats hatchery and wild populations separately. Debate continues regarding the existence and importance of density-dependent processes operating in the ocean environment and the role hatcheries play in these processes. Loss of critical spawning habitat for chum salmon in the Sakhalin-Kuril region has lead to significant declines in their abundance. I conclude by recommending increases in releases of hatchery chum salmon numbers in the region to help recover depressed wild populations and provide greater commercial fishing benefits in the region.”

Kaev, A. M., and J. R. Irvine. 2016. Population dynamics of Pink Salmon in the Sakhalin-Kuril region, Russia. North Pacific Anadromous Fish Commission Bulletin 6:297–305. PC022 8 of 24 I the central Bering Sea. Mar Ecol Prog Ser 478:211–221.

Run size (catch plus escapement) data and numbers of hatchery and wild fry were estimated for eight areas around Sakhalin Island and the southern Kuril islands over the 1975-2015 period. Marine survival was also indexed by dividing run size by the number of fry for each area. Odd-year runs are greater than even-year runs, with the difference increasing over time. The recent increase in pink salmon catch does not appear to be the result of hatchery releases (greater numbers of fry) but instead is the result of environmental conditions in early life stages. Increasing size of adults is attributed to conditions in the common area where pinks (from a number of investigated areas) mingle later in life.

Kaga T., Sato S., Azumaya T., Davis N.D., and M-a. Fukuwaka. 2013. (abs) Lipid content of chum salmon Oncorhynchus keta affected by pink salmon *O. gorbuscha* abundance in the central Bering Sea. Mar Ecol Prog Ser 478:211–221.

“To assess effects of intra- and inter-specific interactions on chum salmon in the central Bering Sea, chum salmon lipid content was analyzed as a proxy for body condition. We measured the lipid contents of 466 immature individuals collected during summer from 2002 to 2007. Individual variation in log-transformed lipid content was tested using multiple regression analysis with biological and environmental variables. A regression model that included chum salmon fork length and pink salmon CPUE (number of fish caught per 1500 m of gillnet) was the most effective in describing variation in lipid content. Path analysis showed that the negative effect of pink salmon CPUE was stronger than the effect of chum salmon CPUE on chum salmon lipid content. Stomach content analysis of 283 chum salmon indicated non-crustacean zooplankton (appendicularian, chaetognath, cnidarian, ctenophore, polychaete, and pteropod) was higher under conditions of high pink salmon CPUE. Increased consumption of non-crustacean zooplankton containing a low lipid level could lower the lipid content of chum salmon. Thus, chum salmon lipid content could be affected directly by their shift in prey items and indirectly by interspecific competition with pink salmon.”

Malick, M.J. and S.P. Cox. 2016. Regional-scale declines in productivity of pink and chum salmon stocks in western North America. PloS one, 11(1), p.e0146009.

Historical population data from 99 wild chum and pink stocks in WA, BC, and AK were assessed, and trends in productivity noted. While productivity of some pink stocks in Alaska declined over time, others increased. The authors believe that the productivity of pink and chum stocks in western North America is driven by common processes “operating at the regional or multi-regional spatial scales.” The effects are not constant but can change over time. While some environmental factors operating at the regional scale (and thus, are potential drivers of productivity) were identified, they were not investigated. “Mechanisms that operate over these spatial scales may include freshwater or marine processes such as disease or pathogens, changes in stream flow and stream temperature, competition with abundant hatchery salmon, or shifts in oceanographic condition such as the timing of the spring phytoplankton bloom or sea surface temperature.” They found that most chum and some pink salmon stocks declined, in contrast to Stachura et al. (2014) and other reports. PC022 9 of 24

Malick, M.J. 2017. Multi-scale environmental forcing of Pacific salmon population dynamics. PhD thesis, Simon Fraser University, School of Resource and Environmental Management, Burnaby, BC. http://summit.sfu.ca/system/files/iritems1/17425/etd10171_MMalick.pdf

This researcher considered variable environmental factors (e.g., phytoplankton phenology, horizontal and vertical transport patterns) and their influence on salmon productivity (*see* Malick and Cox 2016). The thesis also contains a section on policy analysis where the author outlines the problems that arise from management of migratory anadromous fish species, e.g., multiple national and sub-national polities, the fact that management decisions of one entity can impact the resources of another, and incomplete use of real-time data to make management decisions.

The author believes that an "international ecosystem synthesis group" could integrate information from various managers and provide "strategic management advice" based on their synthesis of the various information they receive. Because of the complexity of managing Pacific salmon, a multi-faceted approach is warranted.

Manhard, C.V., Joyce, J.E., Smoker, W.W. and A.J. Gharrett. 2017. Ecological factors influencing lifetime productivity of pink salmon (*Oncorhynchus gorbuscha*) in an Alaskan stream. Can. J. Fish. Aquatic Sci. 74(9), 1325-1336.

A study of the pink salmon populations (both even- and odd-years) of a short (323 m) lake-outlet stream indicated that early marine survival was the primary determinant of overall productivity. An overall downward trend in productivity was associated with an observed decline in freshwater spawning habitat quality. A nearby hatchery released large numbers of pink fry 1988-2002 but no difference in marine survival was noted between that time period and afterwards (with no hatchery releases). "[W]hile commercial harvest and hatchery straying do occur, the effects of these processes on adult recruitment are more likely to be stochastic than deterministic."

Morita, K. 2014. Japanese wild salmon research: toward a reconciliation between hatchery and wild salmon management. North Pacific Anadromous Fish Commission Newsletter 35:4–14.

This English-language article summarizes some Japanese-language literature on wild and hatchery salmon management in Japan. The author believes that wild salmon productivity is higher and more important than many people believe. Most large rivers in Japan have hatchery programs, and protecting wild populations is a way to guarantee continued success of the hatchery programs (e.g., genetic reserve, source of broodstock in integrated programs). Integrated hatchery programs are probably the best management option in highly-developed, hatchery-dominated Japanese watersheds.

Morita, K., S. H. Morita, and M. Fukuwaka. 2006. (abs) Population dynamics of Japanese Pink Salmon (*Oncorhynchus gorbuscha*): are recent increases explained by hatchery PC022
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programs or climatic variations? Canadian Journal of Fisheries and Aquatic Sciences 63:55–62.

"Hatchery programs involving the mass release of artificially propagated fishes have been implemented worldwide. However, few studies have assessed whether hatchery programs actually increase the net population growth of the target species after accounting for the effects of density dependence and climatic variation. We examined the combined effects of density dependence, climatic variation, and hatchery release on the population dynamics of Japanese pink salmon (*Oncorhynchus gorbuscha*) from 1969 to 2003. The population trends were more closely linked to climatic factors than to the intensity of the hatchery programs. The estimated contributions of hatchery-released fry to catches during the past decade are small. We concluded that the recent catch increases of Japanese pink salmon could be largely explained by climate change, with increased hatchery releases having little effect."

Moss, J.H., Beauchamp, D.A., Cross, A.D., Myers, K.W., Farley Jr, E.V., Murphy, J.M. and Helle, J.H., 2005. Evidence for size-selective mortality after the first summer of ocean growth by pink salmon. Transactions of the American Fisheries Society 134(5)1313 1322.

Juvenile pink salmon originating from PWS hatcheries were sampled in PWS and the Gulf of Alaska in 2001 to identify the hatchery of origin and determine if larger, faster-growing pink salmon had higher survival rates. Adult pink salmon were also sampled in PWS (at cost-recovery fishing sites) in 2002 for scale analysis to determine if size-selective mortality was occurring after the juvenile sampling (through scale analyses). Both juveniles and adults showed high growth rates in June but lower in July. In July 2001, far fewer juveniles were caught in the Gulf of Alaska than in PWS, although catch rates were similar in August and September, a time when elevated growth rates were also seen. This indicates a bottleneck in growth for PWS pink salmon in July and possible density-dependent effects. The results also indicate that juveniles must attain a critical size in order to survive over the winter and bottlenecks in growth could prevent juveniles from attaining that size.

Myers, K.W., R.V. Walker, N.D. Davis, and J.L. Armstrong. 2004. Diet overlap and potential feeding competition between Yukon River chum salmon and hatchery salmon in the Gulf of Alaska in summer. Final Report to the Yukon River Drainage Fisheries Association. SAFS-UW-0407. School of Aquatic and Fisheries Sciences, University of Washington, Seattle. 63 p.

The overlap in diets and the potential for feeding competition distribution between Yukon River chum salmon and hatchery chum, pink, and sockeye from Asia and Alaska were investigated in summers in the Gulf of Alaska from 1993 through 2003 by examining almost 5000 salmon stomach contents. Inter-specific overlap in salmon diets was low to moderate, however the quality of chum salmon diets was lower than the diets of all sizes of pink salmon and large-sized sockeye salmon. There was a higher potential for competition between Yukon River chum and Alaska hatchery pink salmon in the northeast region of the GOA than in the southeast region. Stomach contents analyses were consistent with previous studies that showed that chum salmon switch their diets to lower-calorie prey when pink salmon abundance is high. The results lead to hypotheses that competition with hatchery salmon in the GOA may reduce the growth of immature Yukon River chum, especially when adverse ocean and climate conditions limit prey abundance, and that the reduction in growth may reduce survival by various mechanisms such as increased predation, decreased lipid storage, and increases in disease and parasites.

Ohnuki, T., K. Morita, H. Tokuda, Y. Oksutaka, and K. Ohkuma. 2015. (abs) Numerical and economic contributions of wild and hatchery Pink Salmon to commercial catches in Japan estimated from mass otolith markings. North American Journal of Fisheries Management 35:598–604.

“Evaluating the contribution of wild and hatchery fish to a fishery is essential to understand economic feasibility as well as the impact of hatchery fish on the ecosystem. However, a precise estimate of this contribution is often difficult to obtain, particularly when hatchery and wild fish are mixed in the catch. In this study, we quantified the contribution of hatchery and wild Pink Salmon *Oncorhynchus gorbuscha* to the mixed- stock commercial fishery in Japan by identifying the ratio of otolith- marked hatchery fish to unmarked and presumably wild fish. The contribution of hatchery fish to the total coastal catch of Pink Salmon in Japan was estimated to be 16.6% and 26.4% in 2011 and 2012, respectively. Thus, the majority of the commercial salmon catch originated from naturally spawned wild fish. Economic yield per release by Japanese hatcheries was 2.2 yen (¥2.2) (≈US$0.022) and ¥1.5 in 2011 and 2012.”

Pearson, W.H., Deriso, R.B., Elston, R.A., Hook, S.E., Parker, K.R. and J.W. Anderson. 2012. Hypotheses concerning the decline and poor recovery of Pacific herring in Prince William Sound, Alaska. Reviews in Fish Biology and Fisheries *22*(1), pp.95-135.

In 1993, the Pacific herring stock of Prince William Sound dramatically declined: the stock was about 20% of the predicted record-breaking biomass. The authors examine a number of studies advancing a number of different hypotheses on the reason(s) for the observed decline, and could find no evidence that any of the following have led to either the decline or the poor recovery of PWS herring: oil exposure from the *Exxon Valdez* oil spill; harvest effects; spawning habitat loss; the spawn-on-kelp fishery; disease. Instead, the authors attribute the decline to poor nutrition that began in the mid-1980s and reached a low in 1993. Disease was a secondary response. The fact that the recovery of PWS Pacific herring has been poor despite fishery restrictions is attributed to oceanic conditions outside of PWS and juvenile pink salmon releases (pink salmon predation on age-0 herring and food competition between pink salmon and age-1 herring). Multi-species or ecosystem-based management, rather than single-species management is recommended.

Peterman, R. M., C. A. Holt, and M. R. Rutherford. 2012. The need for international cooperation to reduce competition among salmon for a common pool of prey resources in the North Pacific Ocean. North Pacific Anadromous Fish Commission Technical Report 8:99–101.

These researchers accept that density-dependent competition is occurring in the north Pacific and is caused by hatchery programs. Increasing hatchery releases may result in a diminishing return on the costs of hatchery programs, but if competition increases sufficiently wild populations will also be affected as well. The situation is that the “common-pool” resource that is the north Pacific is subject to the classic “Tragedy of the Commons”. The North Pacific Anadromous Fish Commission, after amendments to its mandate, is the body best equipped to deal with the situation. The NPAFC should “identify and implement collective actions to prevent further increases in competition among salmon from different nations or even reduce it” as “[a]ction on this problem of multinational grazing of salmon food is long overdue.” Action needs to be taken before a crisis occurs, such as climatic changes that may limit overall salmon productivity, and will likely lead to a knee-jerk call for more (ultimately counter-productive) hatchery releases.

Prince William Sound Science Center studies on hatchery-wild interaction:

Gorman, K., McMahon, J., Rand, P., Knudsen, E., and D.R. Bernard. 2018. Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska. Final report for 2017. Prince William Sound Science Center, Cordova, AK.

Gorman, K., McMahon, J., Rand, P., Knudsen, E., and D.R. Bernard. 2016. Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska. Progress Report for 2016. Prince William Sound Science Center, Cordova, AK.

Knudsen, E., Buckhorn, M., Gorman, K., Rand, P., Roberts, M., Adams, B., O'Connell, V. and D.R. Bernard. 2015. Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska. Final Progress Report for 2014. Prince William Sound Science Center, Cordova, AK; Sitka Sound Science Center, Sitka, AK.

Knudsen, E., Buckhorn, M., Gorman, K., Crowther, D., Froning, K., Roberts, M., Marcello, L., Adams, B., O'Connell, V. and D.R. Bernard. 2015. Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska. Final Progress Report for 2013. Prince William Sound Science Center, Cordova, AK; Sitka Sound Science Center, Sitka, AK.

Knudsen, E., Rand, P., Gorman, K., McMahon, J., Adams, B., O'Connell, V. and D.R. Bernard. 2016. Interactions of wild and hatchery pink salmon and chum salmon in Prince William Sound and Southeast Alaska. Progress Report for 2015. Volume 1. Prince William Sound Science Center, Cordova, AK; Sitka Sound Science Center, Sitka, AK.

Prince William Sound Science Center. 2013. Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska. Annual Report 2012. For Alaska Department of Fish and Game Contract IHP-13-013

These reports were generated as part of a research effort sponsored by ADF&G. The purposes are to: "1) further document the degree to which hatchery pink and chum salmon straying is occurring; 2) assess the range of interannual variability in the straying rates; and, 3) determine the effects of hatchery fish spawning with wild populations on the fitness of wild populations." Ocean sampling was conducted in 2013-2015 in nine locations near the entrances to PWS to determine wild or hatchery origins of pink and chum in PWS (via examination of otoliths). Stream studies were also conducted to determine the proportion of hatchery-origin fish on the spawning grounds and an investigation into the relative survival of the offspring of naturally spawned fish (wild and hatchery-origin). These reports have reported basic data with no advanced statistical or biological analyses. Proportions of hatchery-origin pink salmon on spawning grounds range from zero to over 80% in some PWS streams.

Riddell, B., M. Bradford, R. Carmichael, D. Hankin, R. Peterman, and A. Wertheimer. 2013. Assessment of Status and Factors for Decline of Southern BC Chinook Salmon: Independent Panel's Report. Prepared with the assistance of D.R. Marmorek and A.W. Hall, ESSA Technologies Ltd., Vancouver, B.C. for Fisheries and Oceans Canada (Vancouver. BC) and Fraser River Aboriginal Fisheries Secretariat (Merritt, BC). xxix + 165 pp. + Appendices. Available at www.psc.org/publications/ workshop-reports/southern-bc-chinook-expert-panel-workshop. Accessed June 5, 2018

Evidence presented at a workshop discussing the decline of southern BC chinook did not support the hypothesis that pink salmon abundance had a role in the decline of southern BC Chinook. There was no apparent odd- and even-year pattern in Chinook survival (which would thought to be present if pinks were having an effect), although some recent literature (referenced in this report) indicated that there may be an effect.

Ruggerone, G.T., and J.R. Irvine. 2018. Number and biomass of natural- and hatchery-origin pink, chum, and sockeye salmon in the North Pacific Ocean, 1925-2015. Mar Coast Fish 10:152-168.

Abundance and biomass data are presented for pink, chum, and sockeye for the time period 1925-2015; this is the most comprehensive tally to date. These species are at an all-time high, as the late 1970s regime shift benefited these species. If immature salmon are included, the north Pacific contains 5 x 10^6 metric tons of these species. Pink salmon were the most abundant adult fish of the three (67%) and were 48% of the total biomass (chum 20% and 35%; sockeye 13% and 17%, respectively). Alaska produced 39% of the pink salmon with Japan and Russia producing most of the remainder. Hatcheries accounted for 15% of the pink salmon production (Alaska produced 68% of hatchery pink salmon) although hatchery fish dominated in some regions, such as PWS and SEAK. In the period 1990-2015, hatchery fish composed 40% of the total biomass in the north Pacific, which may be at its carrying capacity. Density-dependent effects are occurring although hatchery-wild interaction effects are difficult to quantify. Management agencies should mark hatchery fish and estimate hatchery- and natural-origin fish in their catch and escapement data to aid focused research efforts.

Ruggerone, G.T., Agler, B.A., Connors, B.M., Farley Jr., E.V., Irvine, J.R., Wilson, L.I. and E.M. Yasumiishi. 2016. Pink and sockeye salmon interactions at sea and their influence on forecast error of Bristol Bay sockeye salmon. North Pacific Anadromous Fish Commission Bulletin 6:349–361. doi:10.23849/npafcb6/349.361 (Available at http://www.npafc.org).

Ruggerone et al. (2010) showed that abundance of sockeye salmon in western and central Alaska tended to be positively correlated with pink salmon abundance, in contrast to more southern regions where sockeye abundance was negatively correlated with pink salmon abundance. Ocean conditions may be an overriding factor, so this research was focused on evaluation of the evidence of competition between Bristol Bay sockeye and pink salmon from Russia and central Alaska. Sockeye scales from 1965 through 2009 were evaluated for growth patterns; abundance of adult pink salmon was available in previously published literature. Growth patterns from all five BB sockeye stocks indicated a strong alternating-year growth pattern, consistent with the hypothesis that sockeye and pinks compete for food on the high seas. Sockeye growth at sea during odd-years was low; other referenced research indicated that pink and sockeye have a high diet overlap. Also, in odd-years sockeye stomach fullness was reduced. Examination of the ADF&G's sockeye salmon abundance forecasts from 19682010 indicated errors in an alternating-year pattern; a tendency for a too-high forecast in even-years, and too low in odd-years, consistent with a hypothesis that competition at sea between sockeye and pink (in the year previous to the sockeye return year) was indeed a factor but was not considered in the forecasts.

Ruggerone, G.T. and B.M. Connors. 2015. Productivity and life history of sockeye salmon in relation to competition with pink and sockeye salmon in the North Pacific Ocean. Can. J. Fish. Aquat. Sci. 72, 818–833.

The Fraser River (BC) sockeye salmon return in 2009 was the lowest in over 60 years, capping a decline that had started in the 1980s. Scientists indicated that declining productivity at sea was responsible rather than factors like spawner abundance or freshwater factors. Pink salmon abundance was identified as a possible factor due to overlapping spatial distribution in the north Pacific and diets. This research uses stock-recruitment dynamics and data from 36 sockeye salmon populations ranging from Washington State north to SEAK (18 were Fraser River drainage populations). Sea-surface temperature (SST) and farmed salmon were also considered as possible confounding factors. Results indicated that 1) during odd-years (high pink abundance), sockeye survival rates and length-at-age of returning sockeye were lower, as well as a higher proportion showing delayed maturation; 2) for all but one population (with a unique "ocean-type" life history) sockeye growth in the second year was negatively correlated with pink salmon abundance and led to lower sockeye productivity; 3) inclusion of environmental factors did not improve performance; and 4) there did not seem to be evidence that returning pink salmon preyed on out-migrating sockeye salmon. The 1970s regime shift saw an actual increase in pink salmon abundance from 200 million to 400 million; a model of pink salmon abundance and Fraser River sockeye returns predicted a reduction in Fraser River sockeye returns of approximately 5.5 million.

Ruggerone, G. T., B. A. Agler, and J. L. Nielsen. 2012. Evidence for competition at sea between Norton Sound chum salmon and Asian hatchery chum salmon. Environmental Biology of Fishes 94:149–163.

An important chum salmon population in Norton Sound, Alaska (Kwiniuk chum) has experienced reduced adult length-at-age, age-at-maturation, productivity, and abundance, corresponding with increased hatchery Asian chum salmon abundance. Analyses of the relevant data indeed show that hatchery Asian chum salmon abundance is negatively correlated with the size and age parameters, productivity, and abundance of the Kwiniuk chum. Inclusion of Asian and western Alaska wild chum salmon abundance did not improve the model. Lower productivity of Kwiniuk chum was correlated with high abundance of wild eastern Kamchatka Island pink salmon during odd-years; the effect was less than that of hatchery chum. This evidence for density-dependent effects points out the need for international cooperation on hatchery releases.

Ruggerone, G.T., Peterman, R.M., Dorner, B. and K.W. Myers. 2010. Magnitude and trends in abundance of hatchery and wild pink, chum, and sockeye salmon in the North Pacific Ocean. Mar Coast Fish 2, 306–328.

Total abundance numbers for both Asia and North America populations of chum, pink, and sockeye salmon were reconstructed from catch and spawner abundance data from 1952–2005. Pink salmon were the most abundant (70%), followed by sockeye (17%) and chum (13%). After the mid-1970s regime shift, pink and sockeye became more abundant while chum numbers decreased. Asian salmon numbers did not increase until the 1990s. Hatchery releases increased during the 1990s and early 2000s, reaching 4.5×10^9 juveniles/yr. Hatcheries were responsible large numbers of adult fish returning: 62% of the chum, 13% of the pink, and 4% of the sockeye in 1990-2005. Combined, wild and hatchery salmon in the same time period averaged 634 million fish, twice as many as during 1952-1975. Better data gathering and management are needed, as well as international cooperation to better manage the common waters, especially in light of possible increases in hatchery releases in the face of evidence of changing climate and density-dependent effects.

Ruggerone, G.T. and J.L. Nielsen. 2004. Evidence for competitive dominance of pink salmon (*Oncorhynchus gorbuscha*) over other salmonids in the North Pacific Ocean. Rev Fish Bio Fish 14, 371–390.

The alternating yearly cycle of pink salmon abundance lends itself to studies of competition with other Pacific salmon. This review article examined studies to date indicating that competition between pink salmon and other salmon is an important process negatively influencing other salmon species because pink salmon are efficient predators of the (common) prey. The authors are not aware of any studies of pink salmon being negatively affected by other Pacific salmon. Their abundance (pink salmon are the most common Pacific salmon), rapid growth, high feeding rates, and early entry combine to make pink salmon a dominant competitor. It also appears that pink salmon have been the dominant competitor in the north Pacific across multiple climate regimes.

Ruggerone, G.T., Zimmermann, M., Myers, K.W., Nielsen, J.L. and D.E. Rogers. 2003. Competition between Asian pink salmon (*Oncorhynchus gorbuscha*) and Alaskan sockeye salmon (*O. nerka*) in the North Pacific Ocean. Fish Oceanogr 12, 209–219.

The researchers hypothesized that competition between Bristol Bay sockeye and Asian pink salmon would be greater in odd-years when pink salmon abundance was generally greater. BB sockeye scale samples from 1955 to the 1990s (from variously aged fish) and fish length (from adult returns in each river system) from 1958-2000 were used to determine growth estimates. Scale growth estimates showed a distinctive alternating-year pattern as growth was typically below average in odd-years and above average in even-years for both ocean age-2 and age-3 sockeye. Lengths of adult BB sockeye were inversely related to Asian pink salmon abundance (of the previous year) for years other than the year of homeward migration. Sockeye survival also was negatively influenced by pink salmon abundance. In the years after the mid-1970's, when pink salmon abundance greatly increased, BB sockeye returns averaged a 22% reduction in the alternating years the when higher pink salmon abundance would exert greater influence. The alternating-years phenomenon is due to Asian, primarily the eastern Kamchatka pink salmon population. In the (smolt) years 1977 to 1997, the researchers estimate 59 million fewer sockeye salmon returned to BB due to the high Asian pink salmon abundance in alternating years.

Saito, T., Hirabayashi, Y., Suzuki, K., Watanabe, K. and H. Saito. 2016. Recent decline of pink salmon (O*ncorhynchus gorbuscha*) abundance in Japan. North Pacific Anadromous Fish Commission Bulletin, 6:279-296.

In-river catch data from twenty-two pink stocks from the coast of the Sea of Okhotsk were analyzed (separated into five regional groups) along with sea surface temperatures (SST). The long-term decline in pink salmon abundance is related to higher coastal SSTs which can cause decreased juvenile survival, preliminary adult mortality, and increased straying. The higher coastal SSTs can also cause a shift in migration timing, although pink salmon hatchery programs have been consciously selecting for earlier migration. No data were available to determine the proportion of wild fish in the escapement.

Schindler, D., C. Krueger, P. Bisson, M. Bradford, B. Clark, J. Conitz, K. Howard, M. Jones, J. Murphy, K. Myers, M. Scheuerell, E. Volk, and J. Winton. 2013. Arctic-Yukon-Kuskokwim Chinook salmon research action plan: Evidence of decline of Chinook salmon populations and recommendations for future research. Prepared for the AYK Sustainable Salmon Initiative (Anchorage, AK). v + 70 pp. Available at www.aykssi.org/ wp-content/uploads/AYK-SSI-ChinookSalmon-Action-Plan-83013.pdf. Accessed June 5, 2018 PC022 17 of 24

The decline in AYK Chinook populations since the 1990s is discussed. All evidence (for and against) various hypotheses is summarized and research recommendations are made. The authors are careful not to be conclusive in their summary, instead stating that the hypotheses are not “statement of facts” but instead represent how the “salmon system” “may work”. One hypothesis, on anthropogenic changes to ocean conditions, includes a discussion of the evidence that hatchery releases of chum, pink, and sockeye are affecting (or not) the survival of AYK Chinook.

Shiomoto, A., Tadokoro, K., Nagasawa, K., and Y. Ishida. 1997. Trophic relations in the subarctic North Pacific ecosystem: possible feeding effect from pink salmon. Marine Ecology Progress Series, 150, 75-85.

Biomass of phytoplankton and macrozooplankton were sampled from 1985 to 1994 in the north Pacific Ocean and year-to-year variations noted. After comparing these data to pink salmon abundance data, the researchers noted that years in which the biomass of macrozooplankton was low corresponded with years when pink salmon were more abundant and phytoplankton biomass was higher. In years when pink salmon were less abundant, macrozooplankton biomass was higher and phytoplankton biomass was lower. Temperatures and surface nutrient concentrations did not show any year-to-year variation, ruling out phytoplankton blooms; also, phytoplankton productivity was higher in even-years than in odd-years. This indicates that the variation in phytoplankton biomass was not regulated by the chemical or physical environment, nor by the productivity of the phytoplankton. Similarly, the macrozooplankton biomass variation did not seem to be influenced by their own productivity. Instead (post-1989), the variations were regulated by predation by pink salmon.

Shaul, L.D. and H.J. Geiger. 2016. Effects of climate and competition for offshore prey on growth, survival, and reproductive potential of coho salmon in Southeast Alaska. North Pacific Anadromous Fish Commission Bulletin 6:329–347. doi:10.23849/npafcb6/329.347. (Available at http://www.npafc.org).

The relationship between Gulf of Alaska and their prey can be described as a "trophic triangle" where both pink and sockeye salmon prey upon minimal armhook squid and also compete with the squid for zooplankton prey. The squid is also the primary prey of coho; this research explored relationships between adult coho weight, environmental conditions, and top-down control on squid by pink and sockeye salmon, using data from 1970-2014 (for some variables, 1990-2014). Most of the variation in the size of coho salmon was equally explained by pink salmon biomass, and a PDO index corresponding with squid emergence and development. The late-marine period may be crucial for coho survival. Pink salmon is a keystone predator that controls the trophic structure of salmon food and directs energy flow in the offshore GOA. Sea ranching of chum salmon may offer an alternative to pinks as a way to lessen effects on higher trophic level species.

Springer, A., van Vliet, G.B., Bool, N., Crowley, M., Fullagar, P., Lea, M.A., Monash, R., Price, C., Vertigan, C., and E.J. Woehler. 2018. Transhemispheric ecosystem disservices of pink salmon in a Pacific Ocean macrosystem, PNAS 2018 115 (22) 5038-5045.

Short-tailed shearwaters make annual 30,000 km, non-stop round-trip migrations from their breeding grounds in southeastern Australia, the Bass Strait, and Tasmania to the north Pacific Ocean and Bering Sea (NP/BS). Other research has noted dietary overlap between pink salmon and shearwaters in the NP/BS and greater numbers of shearwaters (more than an order-ofmagnitude greater) dying in the Pribilof Islands in odd years (high pink salmon abundance) than even years. This research used proxies to estimate shearwater abundance at their breeding grounds and compared those data to pink salmon abundance data (catch plus escapement). There are strong correlations between low bird abundance and high pink abundance in all five examined time intervals. In recent odd-years, there have been increasing numbers of "wrecks": massive bird mortality upon reaching their breeding grounds due to malnutrition during their time in NP/BS (the non-stop migration means that the birds rely on their reserves established in the NP/BS). Greater numbers of birds nest in even years than in odd years. Reduced numbers of shearwaters on the breeding grounds are thought to be responsible for changes in local (breeding ground) ecology, and forced reductions in commercial harvest of shearwaters by Aboriginal residents. These results suggest that pink salmon--and the hatchery releases of pink salmon--are "altering the distribution of wealth stored in this macrosystem."

Springer, A.M. and G.B. van Vliet. 2014. Climate change, pink salmon, and the nexus between bottom-up and top-down control in the subarctic Pacific Ocean and Bering Sea. PNAS

2014 111 (18) E1880-E1888.

Monitoring data from four major seabird colonies (four islands) in the southern Bering Sea and Aleutian Islands were examined and indexed, such as “mean hatch date” and any anomalies noted (e.g., days before [“early”] or after [“late”] the mean). Thirteen of twenty omnivorous species/island samples had later hatch dates in even years, and this result was seen on all four islands. Clutch size was smaller in odd-years than in even-years for one bird species on all three islands where that species is found. Other significant effects were found for some species for parameters such as laying success, hatching success, fledgling success, and productivity, consistent with a hypothesis that in odd-years (high pink abundance) bird reproductive success was reduced. Some species build nests and in all cases where sufficient nests were counted to make comparisons, more nests were built in even-years than in odd-years. Many of these same nesting parameters were negatively correlated with a more specific parameter, the run size of eastern Kamchatka pink salmon. There were no consistent geographic patterns in the strength of the relationships (i.e, no island showed significantly more or fewer significant differences). As might be expected given these results, planktivorous seabirds showed an opposite response (or there was no relationship). The abundance of pink salmon in the northern Pacific and the results here that indicate top-down forcing call for a re-examination of fishing and hatchery practices and an ecosystem-based management.

Stachura, M. M., Mantua N. J., and M.D. Scheuerell. 2014. Oceanographic influences on patterns in North Pacific salmon abundance. Can. J. Fish. Aquatic Sci. 71(2), 226-235.

Authors took the 34 time series of regional salmon (wild North American and Asian, pink, chum, and sockeye) abundance used by Ruggerone et al. (2010) and applied three separate ordination techniques to identify patterns of abundance (as represented by the salmon abundance time-series) vs atmospheric and oceanographic variability (data from 10 environmental indices/datasets previously identified in the literature). Three dominant patterns were identified, accounting for 47% of the variability seen. Asian and North American populations had opposite trends for on pattern, indicating that large-scale climatic events may have different regional effects (e.g., NW Pacific vs. NE Pacific), or that density-dependent relationships become more important during these particular climatic events. Other factors “[f]or example, changes in harvest, hatchery practices, or freshwater habitat may contribute to abundance trends unrelated to climate and ocean variability” but were not investigated.

Sturdevant, M.V., R. Brenner, E.A. Fergusson, J.A. Orsi, and W.R. Heard. 2013. Does predation by returning adult pink salmon regulate pink salmon or herring abundance? North Pacific Anadromous. Fish Commission Technical Report 9: 153–164. (Available at www.npafc.org).

This study investigated predation by returning adult pink salmon on 1) juvenile pink salmon (cannibalism) and 2) Pacific herring in SEAK and PWS through 1) diet comparisons, 2) contrasting adult pinks with more piscivorous but less abundant coho and immature Chinook, and 3) examining climate mechanisms’ influence on predator-prey relationships. In the SEAK straits, herring and salmon were uncommon in adult pink salmon diets, unlike coho salmon diets; Chinook consumed herring but not salmon. In alongshore areas, pinks consumed greater numbers of fish. In PWS alongshore areas, pink diets varied monthly and between years. Pink salmon cannibalism was uncommon in either PWS or SEAK. No evidence was found to support that pink salmon cannibalism was a factor in the alternating-year nature of pink returns, although some results indicate that retuning pinks may locally affect herring in PWS. Environmental factors such as annual temperature variations can affect adult return timing as well as out-migration by juveniles and migration routes, and therefore shift temporal and spatial overlaps of prey and predators.

Sydeman, W.J., Thompson, S.A., Piatt, J.F., Garcia-Reyes, M., Zador, S., Williams, J.C., Romano, M. and H.M. Renner. 2017. Regionalizing indicators for marine ecosystems: Bering Sea - Aleutian Island seabirds, climate, and competitors. Ecological Indicators 78, 458-469.

Marine predators occupying upper-trophic levels, like birds, mammals, and piscivorous fish, are more affected by ocean climate variability than ones in mid-trophic levels. Seabirds are secondary and tertiary consumers and multivariate seabird indicators can be used as indicators of marine ecosystem health. This study used data from 1989 to 2012 on birds' breeding and diet (collected in the Alaska Maritime National Wildlife Refuge), pink salmon abundance, and environmental factors to investigate food webs and developed multivariate indices (principal components or PCs). Besides significant correlations between some PCs representing breeding success with some environmental PCs, there was a strong negative correlation for one breeding PC with pink salmon abundance. This is interpreted as regional kittiwake breeding success is negatively related to pink salmon abundance. Regional murre breeding success is unrelated to pink salmon abundance. The authors recommend keeping bird data separated by genera when developing PCs. Negative and positive relationships between environmental factors and breeding success show the importance of "early season" conditions and how those conditions affect food webs. For kittiwakes, the abundance of pink salmon is another such factor.

Toge, K., R. Yamashita, K. Kazama, M. Fukuwaka, O. Yamamura, and Y. Watanuki. 2011. The relationship between Pink Salmon biomass and the body condition of short-tailed shearwaters in the Bering Sea: can fish compete with seabirds? Proceedings of the Royal Society B: Biological Sciences 278:2584–2590.

From October to March, short-tailed shearwaters (*Puffinus tenuirostris*) breed mainly in Tasmania but spend May to September in the North Pacific Ocean. About 16 million can be found in the Bering Sea in summer, feeding on upper water-column krill, fishes, and small squid; thus they possibly compete with pink salmon for prey. Birds were sampled 2002-2008 for stomach contents and various condition factors, along with pink salmon to estimate pink salmon biomass. Body mass and liver mass were similar among the birds sampled in the central Bering Sea and the birds sampled in the northern Pacific Ocean, suggesting that the birds had in fact recovered their body condition after migration. Bird body mass and bird liver mass were found to be negatively influenced by pink salmon biomass (as represented by pink salmon catch per unit-effort or CPUE). Pink salmon CPUE was higher in odd-years. No significant relationship between stomach contents and pink salmon biomass was found, possibly because of the daytime feeding habits of the birds did not lend itself well to the nighttime sampling of birds.

Ward, E. J., M. Adkison, J. Couture, S. C. Dressel, M. A. Litzow, S. Moffitt, T. Hoem-Neher, J. T. Trochta, and R. Brenner. 2017. Evaluating signals of oil spill impacts, climate, and species interactions in Pacific Herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska. PLoS ONE [online serial] 12(3): e0172898.

Pre- and post-oil spill (the 1989 *Exxon Valdez* oil spill, or EVOS) were used to determine what has driven changes in productivity of Pacific salmon (wild PWS pink, two PWS-lake sockeye populations, as well as Copper River Chinook and Copper River sockeye) and PWS Pacific herring. Five possible drivers were evaluated: 1) intraspecific density dependence; 2) EVOS, 3) changing environmental conditions, 4) interspecific competition, and 5) competition with and predation by adult fish (for salmon)/predation by humpback whales (for herring). Support was found for the first hypothesis for all evaluated fish stocks except wild PWS pink salmon. No support was found that the EVOS event negatively affected long-term productivity. The strongest environmental factor was that freshwater discharge negatively affected herring productivity. Little support was found for effects of juvenile-juvenile competition. A negative relationship was found between adult pink salmon hatchery returns and sockeye salmon productivity but was not shared with herring, Chinook, or PWS wild pink salmon. The lack of support seen in this study for so many of the drivers suggests that other factors may be important and operating on these fish stocks (e.g., disease).

Wertheimer, A. and E.V. Farley Jr. 2012. Do Asian Pink Salmon Affect the Survival of Bristol Bay Sockeye Salmon? North Pacific Anadromous Fish Commission Technical Report No. 8: 102-107.

Ruggerone, G.T., Myers, K.W., Agler, B.A. and J.L. Nielsen. 2012. Evidence for bottom-up effects on pink and chum salmon abundance and the consequences for other salmon species. North Pacific Anadromous Fish Commission Technical Report No. 8: 94-98.

Using the data analyzed by Ruggerone et al. (2003), Wertheimer and Farley conclude there is no evident effect on Asian pink salmon numbers on Bristol Bay sockeye. Using correlation analyses, they found no consistent response in the three BB sockeye stocks with pink numbers (separated into odd-even years). They reject the contentions of Ruggerone et al. (2012) that correlation analyses are not sufficiently robust to detect effects and stand by their conclusion that Asian pinks did not have a detrimental effect on BB sockeye.

Ruggerone et al. stand by the conclusions in Ruggerone et al. (2003) and later manuscripts (linking declines in Bristol Bay sockeye growth and survival to increased Asian pink salmon abundance), thus offering a rebuttal to Wertheimer and Farley (2012). They list a number of reasons why the use of correlation analyses by Wertheimer and Farley (2012) is incorrect, while acknowledging that use of correlation would lead to a conclusion that there is not a significant relationship between Asian pink abundance and BB sockeye survival. Ruggerone et al. also review a number of other papers offered as evidence of density-dependent relationships (while respecting changes in oceanographic conditions).

Wertheimer, A.C., Heard, W.R., Maselko, J.M. and W.W. Smoker. 2004. Relationship of size at return with environmental variation, hatchery production, and productivity of wild pink salmon in Prince William Sound, Alaska: does size matter? Reviews in Fish Biology and Fisheries, 14(3), pp.321-334.

Historically high returns of PWS pink salmon has been accompanied by decreasing body size. This research considered body size at return of PWS pink salmon against ten biophysical factors including hatchery inputs. Body size was also evaluated against wild pink salmon productivity. Two measures of temperature conditions were positively correlated to body size while three measures of pink salmon abundance (hatchery releases, hatchery returns, and overall GOA catch) were negatively correlated with body size. This is evidence that the growth of salmon in the ocean is density dependent and is also affected by environmental factors operating on the basin- and regional-scale. Body size significantly affected wild stock productivity, although marine environmental conditions explained most of the variability. Productivity of PWS pink salmon was affected more by regional environmental indices (e.g., GOA SST) than by basin-scale conditions (e.g., PDO) during their first year in ocean. Overall, density-independent factors affect wild pink salmon productivity more than do than density-dependent ones. While wild stocks may be affected by hatchery programs, the overall net benefit of hatcheries is much greater than the reduction in wild production. Continued evaluation of the efficacy of the hatchery programs is essential to give managers and policy-makers the data they need for informed decision-making.

Wertheimer, A.C., Heard, W.R. and W.W. Smoker. 2004. Effects of hatchery releases and environmental variation on wild-stock productivity: consequences for sea ranching of pink salmon in Prince William Sound, Alaska. Pages 307-326 *in*: K.M. Leber, S. Kitada, H. L. Blankenship, and T. Svasand, eds. *Stock Enhancement and Sea Ranching: Developments, Pitfalls and Opportunities*, Blackwell Publishing, Oxford, UK.

This study is a follow-up to the Wertheimer et al. (2001) comment on the Hilborn and Eggers (2000) study. Wertheimer et al. (2001) believed that the Hilborn and Eggers population model over-estimated wild production and did not consider other factors. Here, the researchers evaluate wild stocks (returns per spawner) against a number of parameters, including hatchery releases. Wild stock data (derived from ADFG harvest data and spawner surveys) from 19601998 were used. Environmental variables included winter air temperature; spring air temperature; spring zooplankton abundance; herring biomass; Gulf of Alaska (GOA) summer sea surface temperature (SST); GOA summer wind stress; Pacific decadal oscillation (PDO); PDO-1 (variable using the annual winter PDO index in pink brood year y -1; evaluates conditions during the adult ocean life-history phase of pinks); GOA pink salmon abundance; marine survival index (MSI); and hatchery releases. Three separate time series were used (1980-1998; 1975-1998; and 1960-1998) because data on all the variables were available only in 1960-1998. For all three time series, indices/variables of environmental conditions better explained variability in wild stock productivity than did hatchery releases. In the 1975-1998 time period, while hatchery releases were significant, MSI explained more variability. The authors believe that the assertions made in Wertheimer et al. (2001) are validated and that wild stocks in PWS have only been marginally negatively affected by hatchery releases, and that the net benefits of pink salmon hatchery programs are substantially greater (an increase in total runs 3x to 6x).

Yasumiishi, E.M., Criddle, K.R., Helle, J.H., Hillgruber, N. and F.J. Mueter. 2016. Effect of population abundance and climate on the growth of 2 populations of chum salmon (*Oncorhynchus keta*) in the eastern North Pacific Ocean. Fishery Bulletin, 114(2).

The seasonal and annual marine growth of chum salmon from an Alaskan creek and a Washington river were compared to abundances of pink and chum salmon and climate indices. Data from the early 1970s through 2004 were used. Pink salmon abundance negatively affected immature growth of chum salmon, except in the case of the first immature year of WA river chum. The exception may be due to the marine distribution of WA river chum; they were not as far west or as far north as the AK creek chum and thus did not overlap with pinks to be affected. Growth of both populations (except mature growth) was positively related to surface sea temperatures after accounting for density-dependent effects.

Zador, S., Hunt Jr., G.L., TenBrink, T., and K. Aydin. 2013. Combined seabird indices show lagged relationships between environmental conditions and breeding activity. Mar Ecol Prog Ser (485), 245-258.

Seventeen data sets related to the reproductive effort of five predacious seabirds were integrated into two indices using principal components analysis and then compared to environmental variables in the eastern Bering Sea. The two principal components (PC1 and PC2) accounted for 65% of the variability. Pink salmon abundance was not one of the environmental variables evaluated, but a “sawtooth” pattern in PC2 values was noted that corresponds to the odd/even year pattern in pink salmon abundance, reflecting lower kittiwake reproductive success in the odd-years (high pink abundance). The authors hypothesize that increased competition for prey between kittiwakes and pink salmon lead to lower kittiwake reproductive success in odd-years.

Zavolokin, A. V., V. V. Kulik, and L. O. Zavarina. 2014. The food supply of the Pacific salmon of the genus *Oncorhynchus* in the Northwestern Pacific Ocean 2: comparative characterization and general state. Russian Journal of Marine Biology 40:199–207.

The intent of the study was to determine how diet, growth, and survival interacted at various levels of salmon abundance and food abundance for salmon species in the northwestern Pacific, based on a hypothesis that salmon consume only a small portion of the prey available to them, even in periods of high salmon abundance. Periods of low food supply were identified for the western Bering Sea, the southern Sea of Okhotsk, and the northwestern Pacific Ocean, and most of these periods coincided with strong shoreward salmon migration. This evidence for a density-dependent effect included a shift in the diet composition and the feeding patterns of salmon. Because there was no reduction in growth or survival of salmon, the effect is thought to be small. The increase in salmon abundance in the 2000s was sufficiently supported by the available food.

B.C. Wild Salmon Advisory Council

Recommendations for a *Made-in-B.C. Wild Salmon Strategy*

Prepared for the Province of British Columbia
February 2019

The members of the Wild Salmon Advisory Council (WSAC) would like to thank the Province of British Columbia for the opportunity to contribute to the development of a made-in-B.C. *Wild Salmon Strategy*. The past seven months of work, including extensive public engagement, has confirmed our belief that the government is taking an important and necessary step by showing leadership on this issue. There is no question that wild salmon are iconic for this province. They link us to our history and hold the promise for our future generations. Wild salmon are woven into the culture, histories and economies of communities throughout B.C. – for the Indigenous peoples of B.C. since time immemorial.

Wild salmon help to support our ecosystems, our Indigenous peoples and the people who depend on them for their lives and livelihoods. However, wild salmon and their habitats are in a seriously weakened state and require intentional energy and investment to secure their future. We have done our best to ensure that our recommendations – including those for immediate action – will contribute to this goal.

The complex task of restoring salmon abundance and optimizing the benefits to British Columbians simply cannot be done without a provincewide effort. The members of the Wild Salmon Advisory Council are encouraged by this journey and hope that, with the help of every British Columbian, wild salmon and the communities that depend upon them will flourish.

Co-Chairs:

Doug Routley, MLA for Nanaimo-North Cowichan, and

Chief Marilyn Slett, Heiltsuk First Nation

Council Members:

Thomas Alexis	Mike Hicks	Martin Paish
Ward Bond	James Lawson	Cailyn Siider
Ian Douglas Bruce	Dawn Machin	Tasha Sutcliffe
Ray Harris	Adam Olsen	Joy Thorkelson

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Introduction

The management of wild salmon in British Columbia is a significant task, complicated by the unpredictability of ecosystems; the jurisdictional authorities of federal, provincial, municipal and Indigenous governments[1]; the interests and needs of ecosystem health, stakeholders and communities; and the challenges, positions and opinions of our collective past.

The 14 individuals who comprise the membership of the Wild Salmon Advisory Council (WSAC) were appointed by the Province of British Columbia through the Office of the Premier in June 2018. They were selected to represent a wide diversity of interests and experiences related to wild salmon in B.C. Their work over the past seven months is to advise the provincial government in support of the development of a made-in-B.C. *Wild Salmon Strategy*.

In fall 2018, the WSAC presented an *Options Paper*[2] to government, which provided initial insights and guidance on protecting wild salmon and maximizing the value of this resource for B.C. The *Options Paper* focused on three key areas as outlined in the WSAC's mandate:

- Restoration and enhancement of wild salmon populations;
- Sustainable fisheries management and stewardship opportunities for communities; and
- New economic development opportunities to assist viable and sustainable community-based fisheries.

The *Options Paper* recognized:

- **First,** that wild salmon are facing a complex set of ever-intensifying pressures from ecosystem changes and from development. Many populations have already been significantly weakened by these pressures. They require strategic and systemic support to secure their survival over the long term. There is urgency in the task at hand.
- **Secondly,** it is imperative that we design ways to return the value of wild salmon and fisheries to the people of British Columbia, particularly to communities adjacent to resources that have always depended on wild salmon and fisheries as a cornerstone of their economies; active fish harvesters who are front-line users and stewards of the resource; and Indigenous peoples whose histories and futures are interwoven with fisheries in so many ways.

The *Options Paper* formed the basis of an engagement process (described on page 10) that included community meetings, online engagement and direct discussions with stakeholder groups and Indigenous fishing organizations.

The recommendations in this report were significantly informed by the input received during this engagement and aim to contribute to reversing the declining trajectory of wild salmon in B.C., and to help stimulate community economies through a focus on (a) increasing wild salmon abundance, (b) protecting and enhancing the benefits that accrue to B.C.'s communities from the wild salmon resource, and (c) ensuring effective mechanisms for community engagement and government action.

The recommendations include a preamble that suggests the overall conditions for success for a made-in-B.C. *Wild Salmon Strategy*. Both immediate actions determined necessary to stem the tide of further population decline, and mid-term actions that require more detailed planning for implementation have been identified and presented.

1 The WSAC accepts the principle that Indigenous Nations have the right to define their governance structures according to their own laws and cultural practices, and have the right to engage with other governments around the issues related to wild salmon using the structures and processes that respect their laws.

2 *https://engage.gov.bc.ca/app/uploads/sites/426/2018/11/Wild-Salmon-Strategy-Options-Paper.pdf*

The framework used to guide the work of the WSAC

1. A Shared Vision for the Future

The members of the Wild Salmon Advisory Council brought different perspectives and interests to the advisory table. This made it both exciting and complex to explore opportunities and challenges with respect to its mandate and subsequent recommendations. Creating a shared vision was an important early step in the WSAC's work.

Council members agree that a made-in-B.C. *Wild Salmon Strategy* will help set the stage for improved marine and freshwater ecosystems in B.C., and for benefits to communities and their economies. To achieve these two objectives the strategy should:

- **Support and enable the return of abundant wild salmon stocks** throughout the province – recognizing their inherent importance for both people and for ecosystem health;
- **Promote economic renewal and reconciliation with B.C.'s Indigenous peoples,** including a recognition of their Section 35 constitutional right as Aboriginal peoples to access fish for food, social and ceremonial purposes, their treaty and court-affirmed rights to access salmon for economic purposes, and their role in fisheries management;
- **Rebuild a formidable, local fishery economy** with sustainable jobs and prosperous businesses across the seafood spectrum, including active fishers – recreational and commercial; seafood processing; and ancillary businesses;
- **Champion community access to, and benefit from, adjacent fisheries resources** to support local employment, food security, and economic development; and
- **Support responsible, sustainable and safe fishing.**

2. A Shared Definition of 'Wild Salmon'

Likewise, addressing the complexities of wild salmon, and enhancement in particular, required the WSAC members to agree to a definition of wild salmon that would guide their work. The WSAC agreed to use the definition of "wild salmon" developed and used in *Canada's Policy for Conservation of Wild Pacific Salmon*[3], as per Figure 1. This policy states that "salmon are considered to be wild if they have spent their entire life cycle in the wild and originate from parents that were also produced by natural spawning and continuously lived in the wild". While this definition has caused some confusion, it was intentionally developed to ensure that salmon had one full generation in the wild to safeguard against potential adverse effects that can result from intensive artificial culture in hatcheries.

Given this definition, the recommendations in this report include the use of enhancement techniques as a tool to support and engender "wild" populations of salmon, while also providing fish for ecosystem health; for Indigenous food, social and ceremonial

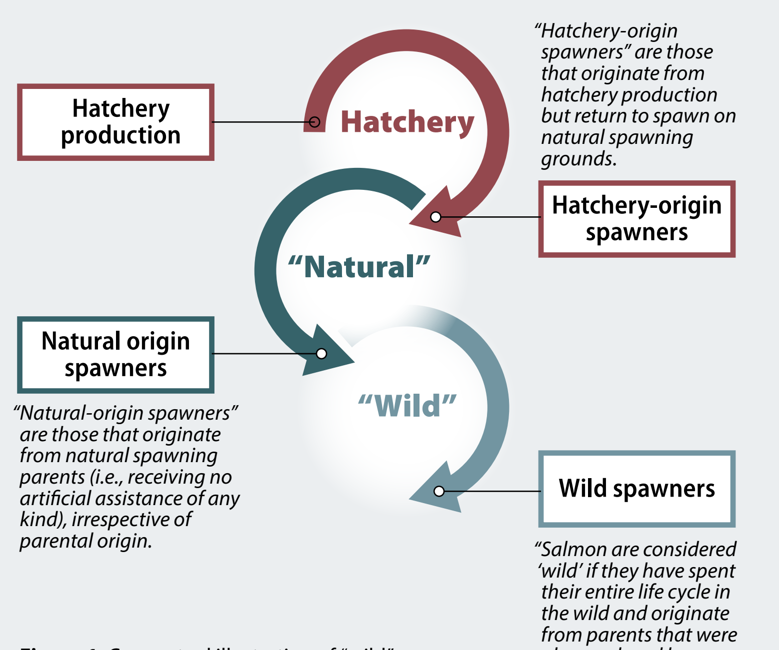

Figure 1. Conceptual illustration of "wild" spawning salmon, as per the definition in *Canada's Wild Salmon Policy* (DFO, 2005), compared with natural-origin spawners and hatchery-origin spawners.

3 *Canada's Policy for Conservation of Wild Pacific Salmon*, 2005, Page 1.

purposes; and for commercial and recreational harvest. Under carefully controlled circumstances, these tools may include, but are not limited to, hatcheries, spawning channels, sea pens, lake fertilization and migration barrier mitigation. In all cases, there is recognition of the need for science-based decision-making and structured monitoring over time to support enhancement efforts.

3. An Acknowledgement of Jurisdiction

The successful management of wild salmon populations in B.C. is complicated by the fact that they travel through multiple jurisdictions during their natural lifecycle. The WSAC has been careful not only to acknowledge these jurisdictions but also to keep jurisdiction top-of-mind in making its recommendations. Looking across the full spectrum of what is possible, the WSAC's summary comment is that "wild salmon need a thoroughly co-ordinated, intentionally designed and very collaborative system in order to flourish."

4. Recognizing the Virtual Circle of Inter-Connectedness

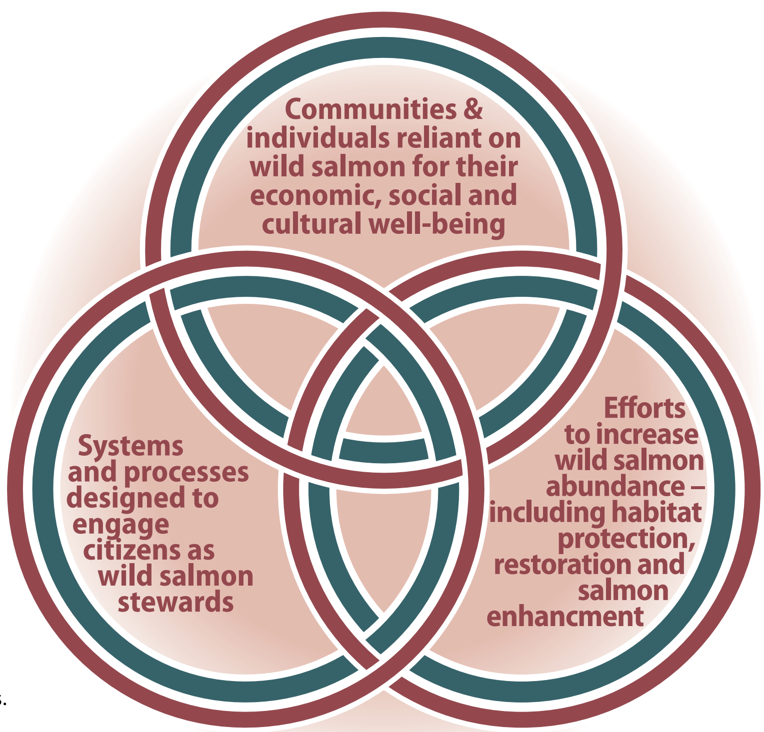

Figure 2. Virtual circle of inter-connectedness.

As illustrated above in Figure 2, WSAC members heartily agree that wild salmon abundance, stewardship and sustainable harvesting practices are connected in a virtuous circle. One without the other two is far less likely to succeed or matter in the longer term. Wild salmon abundance is dependent on people who care about salmon and are prepared to play a role in their survival. Community stewardship engages people to learn and care about wild salmon and creates mechanisms for individuals and communities to participate in resource renewal and sustainable resource management. Communities and resource users – such as commercial and recreational fishers who are contributing jobs and economic opportunity to their communities, understand and have a stake in being resource stewards. Indigenous communities dependent on healthy and abundant stocks for food, social and ceremonial purposes, as well as for economic health, have a constitutionally protected right to participate in fisheries stewardship and management. All parts of this system support and reinforce each other.

Information and insights shaping the WSAC's recommendations

1. The State of Wild Salmon and Steelhead in B.C.

The challenge in describing the state of wild salmon[4] and steelhead is the fact that there are more than 8,000 combinations of species and streams in B.C. that have been affected by over 100 years of development and use. In an effort to manage this complexity, Canada's Policy for the Conservation of Wild Pacific Salmon (2005) has adopted the concept of Conservation Units (CUs) that aggregate these combinations for management purposes. There are currently 432 CU's in B.C., shown in Table 1.

Table 1 Salmon Conservation Units in BC (2018)

Sockeye	Pink	Chum	Coho	Chinook	Steelhead
253	33	39	41	66	Not defined

A *State of the Salmon Report* was commissioned from the Pacific Salmon Foundation (PSF) to establish a baseline for the WSAC's work. Using its Pacific Salmon Explorer tool[5], PSF confirmed that while the true status of wild salmon and steelhead in B.C. is difficult to determine with any degree of certainty, there is no doubt that there are some significant challenges. Available data is highly variable by both species and region and there are significant data gaps in some areas – work is ongoing. There has been a substantial decrease in the numbers of streams surveyed annually for escapement monitoring[6]. The decrease has been greatest for species/stream combinations historically monitored using visual surveys, but some more expensive surveys have also been terminated. These changes mean that any cumulative indices of escapement may not be a consistent annual index.

Below are some of the findings from PSF's *State of the Salmon Report*. PSF confirms that across all regions and all species, the overall abundance of wild salmon and steelhead has declined since the 1950s. Comparing data for the past decade with the time series 1954-2016, wild salmon productivity in the north and central coast (NCC) shows declines of 20% to 45%, and in southern B.C. declines of 43% for sockeye, and 14% for chum have been evidenced, although pinks have increased by ~24% in this region. Chinook salmon throughout B.C. have experienced a widespread decrease in productivity, but these rates are highly variable between years and rivers. There is also increasing concern for changes in the biological characteristics of Chinook salmon, including earlier ages at maturity, smaller size at age and reduced fecundity at maturity. Each of these characteristics contributes to a reduced production and productivity rate[7]. Steelhead trout populations vary from critically poor in the interior Fraser River[8], to recently decreasing stocks in Southern B.C. (non-Fraser) and Central B.C., to stable to positive in Northern B.C.

4 The specific reference to state of salmon as opposed to a status assessment is because the latter requires the existence of abundance targets or biological reference points that do not exist for most BC Pacific salmon.

5 www.salmonexplorer.ca

6 *State of the Salmon Report*, Pacific Salmon Foundation, 2018 (Commissioned by Coastal First Nations in their role as secretariat to the WSAC).

7 Catch and spawning abundance are components of the annual production or abundance of a salmon population. Understanding change over time requires consistent annual reporting of catch and escapement that can then relate the number of parental fish to the number of progeny produced. The number of progeny produced per parent is the productivity of a salmon population. Productivity assessment determines the harvest rate, with the aim of sustaining production levels over time.

8 Endangered and at imminent risk of extinction, COSEWIC 2018.

The vast majority of the estimated 423 steelhead populations in B.C. belong to three major genetic groups. In addition, there are two transition groups that reflect genetic mixing. Steelhead population status in the North Coast, which spans an area over the northern half of the steelhead range within B.C., is informed mainly by the state of Skeena steelhead, which appears to have been stable over the past 20-years, fluctuating near or above biological reference points intended to sustain steelhead production. Steelhead status within the Northern Transition group is informed by Dean and Bella Coola steelhead. Dean steelhead may have undergone a decline to the mid-2000s, while Bella Coola steelhead have clearly declined and remain in a state of relatively low abundance. In Southern B.C., steelhead population status involves three groups (South Coast, South Interior and the Southern Transition). Each is in a state of decline. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has classified the Thompson and Chilcotin populations as Endangered and at imminent risk of extinction. In the South Coast, pinniped predation, extreme climate events and forestry-related stream degradation are contributing to wide spatial scale declines, most dramatic among winter-run populations. Most recently, a decline in Gold River steelhead is particularly noteworthy given its history as a premier B.C. steelhead stream.

Poor marine survival rates appear to be a significant factor across wild salmon declines. Changing ocean conditions due to climate change and other factors, both natural and manmade, will likely continue to hinder recovery efforts in the future. Local habitat conditions, including poorer water quality/quantity and detrimental land uses, are also taking their toll. Fisheries managers have also expressed concern about the potential wildfire impacts in the Interior to wild salmon populations in the Lower Fraser Basin that are currently unknown.

It must also be noted that investment in scientific study and data quality and quantity with respect to wild salmon management has been significantly reduced over the past several years. This fact has contributed to a lack of confidence when reporting the status of salmon in B.C., and fueled hard debates among stakeholders about the reliability of data used to make fisheries management decisions. In the face of this uncertainty, Table 2 offers a summary of the state of wild salmon in B.C.[9] based on the best currently available information.

Table 2 Pacific Salmon on B.C.'s Coast
North and Central Coast
Sockeye: Very abundant. Returns have declined since mid-1990s. (-33%)
Pink: Most abundant species on NCC. Recent years, returns often below long-term averages. (-28%)
Chum: Historically very abundant. Have seen some of the largest declines over 10 years. (-45%)
Chinook: Historically least abundant species. Recent returns well below long-term average. (-26%)
Coho: Abundance has declined over time but maintaining relative consistent numbers. (-21%)
South Coast (SC)
Sockeye: Typically, the most abundant of all species on SC. Dominated by Fraser River runs. Huge variations in run size each season. (-43%)
Pink: 2nd most abundant species on SC. Average abundances above long-term averages. Last 2 runs (since 2013) reduced. (+24%)
Chum: Abundances below long-term average, but similar to the period from 1950s-'70s. (-14%)
Chinook: Data deficient. The subject of a 2018 COSEWIC review – not yet reported. Okanagan Chinook listed endangered, COSEWIC 2017. At present CUs in the SC are rated as: Green (2), Amber (1), Amber/Red (1), Red (10), Data deficient (9) and TBD (7).
Coho: Data deficient. Interior Fraser River coho were assessed as Threatened by COSEWIC, 2016.

9 *State of the Salmon Report*, Pacific Salmon Foundation, 2018 (Commissioned by Coastal First Nations in their role as secretariat to the WSAC).

2. Indigenous Peoples and Wild Salmon

Indigenous peoples in British Columbia are inextricably connected to wild salmon. The bonds, for both coastal and upriver Indigenous communities, are deep and significant. Language, ceremony and song connect the people to the land, fish, animals and plants – reminding them that they are related, and that they must respect and honour one another. In the Indigenous world view, the animals and plants are teachers. They sacrifice themselves for people to survive. They connect the people to their lands and to their histories. They are a source of wonder. The value of wild salmon goes far beyond their economic value. They are sustenance for both body and spirit.

For this important reason, a made-in-B.C. *Wild Salmon Strategy* cannot succeed without the active and deliberate engagement of Indigenous governments and fisheries organizations. The issue of wild salmon – both rebuilding abundance and defining enhanced community benefits also has the potential to contribute to reconciliation.

The *Options Paper* outlines the Rights and interests of the Indigenous Peoples in B.C. as affirmed by the constitution of Canada (Section 35), by historic and modern-day treaty agreements, and by numerous court challenges.

Today, B.C.'s landscape and culture includes more than 190 Indigenous communities located adjacent to rivers or in coastal areas with salmon, and fishing interests stand out as a particularly unifying issue. Almost all Indigenous peoples in B.C. have active salmon-bearing streams in their Territories, from the Fraser and Skeena River watersheds to small coho creeks. In some Territories, salmon have been extirpated (e.g., the upper Columbia River) or significantly reduced from their historic abundance (e.g., Okanagan region) through habitat loss, migratory barriers and over-fishing.

Most Indigenous peoples have a common history of their once significant access to fisheries resources being gradually and, in some cases, dramatically reduced. In some cases, the decrease in access has been due to habitat loss. In others, it is the result of natural or human-caused species decline. Much of the loss of Indigenous peoples' access to fisheries resources, however, can be attributed to government policies, regulations and programs that intentionally or indirectly reduced their participation in food/social/ceremonial, commercial and recreational fisheries.

The clear objective today of most, if not all, Indigenous peoples in B.C. is to increase their access to fisheries for both food and economic purposes, and to be involved in the management of these resources. There is a common expectation that increased access to fisheries can again help feed and economically support Indigenous peoples and communities. Increased salmon access can be delivered via three complementary routes:

- Increased salmon abundance;
- A reallocation of salmon; and
- A greater degree of integration into B.C.'s commercial and recreational fisheries.

Currently, Fisheries and Oceans Canada's Salmon Allocation Policy and other DFO policies, regulations and management plans recognize the priority of the food, social and ceremonial right (FSC) after conservation. The challenge for management agencies is to put the FSC priority into effect for Indigenous harvesters and Indigenous peoples' communities that are in many circumstances situated 'upstream', or after, seaward commercial, recreational and where Indigenous fisheries occur.

Today, the B.C. First Nations Fisheries Council (FNFC), organized into 13 regions, works to increase Indigenous peoples' access to fisheries and their involvement in fisheries management and decision-making. Activities of both individual and/or aggregate fisheries programs include: salmon assessment; catch monitoring; hatcheries and low-tech enhancement; habitat restoration; and fisheries management. Most activities take place with the support of federal and provincial management agencies. In many regions, Indigenous groups and communities work with other local salmon interests (environmental, recreational and commercial) and governments through area-specific advisory bodies to raise funds and advise government agencies (including Indigenous) on local stewardship activities and harvesting plans.

3. B.C.'s Fishery Economy – Commercial and Recreational Fishing and Onshore Processing

The WSAC's *Options Paper* includes a detailed description of the state of B.C.'s fisheries economy, which serves to emphasize the critical need for a wild salmon strategy that encompasses real opportunities for the citizens of B.C., and particularly for the communities adjacent to fishery resources, to benefit economically from increased abundance.

B.C.'s recreational fishing sector is recognized as one of the best in the world, attracting visitors to both tidal and non-tidal opportunities. Today, about 300,000 licence holders participate in the tidal recreational fishery each year in B.C., managed by Fisheries and Oceans Canada. Non-tidal recreational fishing is managed by the Province of B.C., and includes a diverse range of fishing experience and settings; from char, pike and walleye angling in the Arctic drainage of the Peace region; to white sturgeon fishing on the Fraser River; from cutthroat and rainbow trout fishing on small Interior lakes; and steelhead angling on world-class rivers systems. Recreational fishing is both an important tourism driver and a part of B.C.'s culture[10].

Since the mid-1990s, ecosystem changes have reduced coho and Chinook populations in the Strait of Georgia and shifted the marine-based recreational fishing effort/opportunities to the west coast of Vancouver Island and the northern coastlines. Inland recreational efforts have been negatively impacted by steelhead and sturgeon declines. Recognizing that the most critical factor for success in the recreational fishing sector is maintaining "'opportunity" and "expectation", catch-and-release regulations, although controversial for some, have been introduced as an important management tool to develop trophy fisheries, minimize impact on non-target species and protect at-risk fish populations.

Securing reliable, diverse and high-quality recreational fishing opportunities today is challenged by many factors, including: climate change and other factors that negatively affect aquatic ecosystems; intensifying Indigenous fishing interests; conservation measures for both fish and fish-dependent species; and transboundary treaties that are shifting annual allowable catch limits for key species.

For a hundred years, the B.C. commercial salmon fishery has been an important contributor to B.C.'s economy, and it has supported community and cultural development for generations, and since time immemorial for Indigenous Peoples. BC wild salmon remain important to local and regional economies and are a defining element of the social and cultural fabric of many coastal and inland communities. Although considerably reduced due to species decline and management decisions, the commercial wild salmon fishery continues to support numerous family-owned fishing businesses, fisheries infrastructure, and ancillary services such as shipbuilding and processing.

Today, the data shows that in B.C.'s wild salmon and seafood sectors, the citizens of B.C. and, most importantly, the communities most reliant on the resource for their economies, are receiving proportionally less economic benefit from fisheries harvests than they were even a decade ago. Shrinking and aging fishing fleets, shuttered processing facilities and increasingly limited employment opportunities are symptomatic of this reality. In spite of the fact that the global demand for seafood is increasing exponentially, that market prices are rising, and that B.C. has some of the finest product in the world, our commercial fishing sector is not demonstrating the benefits for B.C.'s economy or communities that it should.

For B.C. to maintain a vibrant commercial fishing sector, it is critical to address a number of inter-related issues, including: ensuring that the burden of conservation is not unduly borne by the commercial sector; recognizing and supporting the efforts taken by this sector to ensure sustainable stocks; seeking ways to redirect commercial salmon fishing opportunities to adjacent communities and to next-generation fishers through creative licencing policies; and investing in the kinds of innovations that will allow active fishers and adjacent communities to receive increased value from their catch.

10 *BC's Fisheries and Aquaculture Sector Report – 2016 edition* and the 2010 DFO *National Recreational Fishery Survey* note the following statistics for the recreational fishing sector: $1B contributed to the province's economy, accounting for .5% of total real GDP.

There is no simple solution to this challenge. It has been created by deep structural issues that have shifted resource access into fewer hands, forced or allowed business consolidation and vertical integration, allowed offshore ownership of the resource, and enabled more seafood processing to move out of rural communities. The cumulative result of these changes has been to the detriment of fishing and processing jobs in B.C. communities, and particularly in rural areas adjacent to the resource[11]. A multi-year, deliberate plan to correct the current course, using the many tools available to the Province, is required at this juncture. Significantly enhancing the benefits from our fisheries' resources that accrue to the citizens of B.C. is a key intention of the WSAC's recommendations.

Weaving a balance between those who would conserve wild salmon and those who would fish them is challenging. Some argue that too much fishing activity (be it recreational or commercial) is the key cause of wild salmon declines. Others argue that it is exactly the economic, social and cultural benefits that accrue from salmon fishing activities that make people care about protecting them. The WSAC believes that B.C.'s *Wild Salmon Strategy* must be located in a way that acknowledges and honours both perspectives.

11 *Fisheries Seasonality and the Allocation of Labour and Skills, Labour Market Information Study*, Canadian Professional Fish Harvesters, 2018.

Input, feedback and advice received in response to the WSAC's *Options Paper*

1. Engagement Overview

The WSAC's final report and recommendations have been significantly informed by an engagement process with British Columbians. The aim of the engagement was to hear directly from B.C. citizens on the development of a made-in-B.C. *Wild Salmon Strategy*. In particular, the engagement process focused on receiving input on the WSAC's *Wild Salmon Strategy Options Paper*[12], which was presented to government in fall 2018 and provided initial insights and guidance on protecting wild salmon and maximizing the value of this resource for B.C.

During December 2018 and January 2019, community meetings were hosted by WSAC members in seven locations: Campbell River, Port Alberni, Skidegate, Prince Rupert, Richmond, Kamloops and Langford. The meetings were town-hall style and involved a short presentation by the WSAC hosts on the strategy development process and *Options Paper*, followed by attendees providing their feedback to the WSAC hosts and audience. Members of the project team maintained a list of speakers and kept a record of comments provided at each meeting. Concurrent to the community meetings was an online engagement process, which provided the opportunity for input to be submitted through an online feedback form or by email.

These engagement opportunities were communicated in several ways, including on the initiative's engagement webpage, through print and digital advertising, and through direct invitations. During the engagement period, there were 4,842 site visits to the engagement webpage, which included information on the wild salmon strategy development process, the *Options Paper* (and a two-page summary document), the community meeting schedule and access to the online feedback form. Print advertisements in local newspapers and digital advertisements on Facebook (see Table 3) provided details on upcoming meetings, as well as information on the online engagement. Direct invitations to community meetings were sent to MLA offices, Mayors and Councillors, First Nations governments, and local stakeholder groups in advance of each meeting.

12 *https://engage.gov.bc.ca/app/uploads/sites/426/2018/11/Wild-Salmon-Strategy-Options-Paper.pdf*

Table 3

Meeting location/date	Print advertising Total circulation: 162,222	Digital advertising Total reach: 571,432
Campbell River, Dec. 5	Campbell River Mirror Circulation: 16,808	Facebook Ad in Campbell River (Dec. 3-5)
Port Alberni, Dec. 6	Alberni Valley News Circulation: 9,186	Facebook Ad in Port Alberni (Dec. 3 – 6)
Haida Gwaii, Dec. 11	Haida Gwaii Observer Circulation: 848	Facebook Ad in Haida Gwaii/Prince Rupert (Dec. 7 – 11)
Prince Rupert, Dec. 17	Prince Rupert Observer Circulation: 7,406	Facebook Ad in Haida Gwaii/Prince Rupert (Dec. 13 – 17)
Richmond, Dec. 18	Richmond News Circulation: 46,265	Facebook Ad in Richmond/surrounding area (Dec. 15 – 18)
Kamloops, Jan. 8	Kamloops This Week Circulation: 30,691	Facebook Ad in Kamloops (Jan. 4 – 8)
Langford, Jan. 10	Times Colonist Circulation: 51,018	Facebook Ad in Langford/surrounding area (Jan. 6 – 10)

In addition, members of the WSAC held two days of direct meetings with stakeholder organizations in Vancouver. The Wild Salmon Secretariat also co-ordinated direct discussions with Indigenous fisheries organizations.

Overall, the engagement process was guided by the following questions:

- Which opportunities presented in the *Wild Salmon Strategy Options Paper* do you agree or disagree with? What's missing?
- Which issues and opportunities related to wild salmon are the most important to you and your community?
- What should BC's *Wild Salmon Strategy* prioritize?

During the engagement period, 317 comments were received through the online portal and 116 comments were received by email. An estimated 500 people attended community meetings, upwards of 150 speakers addressed Council members. WSAC members met directly with 17 stakeholder organizations, and the Wild Salmon Secretariat co-ordinated direct discussions with eight Indigenous fishing organizations.

Following the engagement period, the project team analyzed all input received for key themes. This information, along with the community and stakeholder meeting summaries, and online submissions upon request, were provided to the WSAC members for consideration during the development of this report and their final recommendations.

2. What the Wild Salmon Advisory Council Heard

Below is a summary of the key themes that emerged from the many valuable comments received during the engagement period.

- **Habitat protection:** Throughout the engagement period it was clear that the protection of existing habitat for wild salmon – from estuaries to headwaters – is a key priority area. It was emphasized that regulation of activities affecting freshwater and nearshore habitats is under provincial jurisdiction and requires additional focus by the Province, in concert with working to support efforts at other levels of government (e.g., municipal). The importance of intrinsic, ecosystem, cultural, food and economic values – from upriver areas to the coast – were emphasized to varying degrees as key reasons to protect salmon habitats and populations. Various threats to existing salmon habitat were noted, including resource extraction, infrastructure that impedes passage, urban development and climate change, among others. Many voiced concerns with a lack of compliance and enforcement related to existing laws and habitat infractions, while others stated that additional regulations are needed to further protect salmon habitats. Examples:
  - Laws/enforcement for forestry, agriculture, mining, and other sectors
  - Riparian Areas Regulation
  - Estuary regulations (near shore habitat management)
  - Environmental impact and cumulative effects assessments
  - Bill C-68 amendments to the federal Fisheries Act
  - Role of municipalities – zoning, storm water management, etc.
  - Infrastructure development and fish friendly criteria
  - 'Heart of the Fraser' – Herrling & Carey Islands
  - Tribal Parks for Salmon
  - Watershed level planning
- **Habitat restoration:** Similar to the above, many noted that restoring salmon habitat is a key priority area. There are many ongoing causes of damage to salmon habitat in B.C. that include, but are not limited to, flood control infrastructure, gravel extraction, logging practices, redundant dams and coastal development. Since restoration can be expensive, and with many systems badly degraded, it will be important to be strategic and co-ordinated, and take a whole watershed approach, when investing in further habitat restoration. There are many organizations already doing this type of work and with knowledge as to where additional work could be prioritized. It was also noted that further activity in this sector could provide employment opportunities. While the Fraser is in high need of restoration and is a significant body of water, so are many smaller rivers and streams throughout the province (including in urban areas), as well as estuaries that provide critical near shore habitat for rearing juvenile fish. Examples:
  - Community-based stewardship activities
  - Pacific Salmon Foundation and other stream keeper and stewardship groups
  - Increasing Salmon Conservation Stamp cost and funds for restoration activities
  - Oceans Protection Plan Coastal Restoration Fund activities
  - Planning and monitoring in the context of climate change
  - Corporate responsibility for habitat restoration
  - Flood control structures and improved fish passage
  - Indigenous peoples' role leading restoration activities in their territories

- **Salmon enhancement:** Different enhancement options, scales and locations received varied response during the engagement. Some noted strong concern about the effects of hatcheries on B.C.'s remaining wild stocks (e.g., reduced genetic fitness, disease, competition for food), and stated that other actions would be more effective at rebuilding wild salmon. Some others suggested that hatcheries should only be used for genetic rescue of critically endangered stocks. Others noted the importance of hatcheries to certain areas, and that there should be support for additional production, in order to help rebuild runs and/or support harvesting opportunities. Adding complexity are the hatchery programs run by other countries around the North Pacific, and related marine survival concerns on the high seas. While some cited the hatchery experiences in the Western United States (e.g., Alaska, Washington) as a positive example for B.C. to learn from, others noted issues with the enhancement approaches in those states. Overall, it was suggested that a thorough evaluation of the benefits and risks of different enhancement options – including but not limited to hatcheries – will be important to the development of B.C.'s *Wild Salmon Strategy*. Examples:
  - Best practices for suite of enhancement tools
  - Hatchery reform – e.g. adipose clip, better monitoring
  - Risk assessments
  - Chinook production and southern resident killer whales
  - Wild Salmon Policy
  - Salmonid Enhancement Program
- **Community stewardship and education:** The engagement period highlighted the many stewardship groups and Indigenous communities already working to help sustain and rebuild wild salmon populations. These initiatives are often lacking the technical support and resources that they need, and improved co-ordination in program delivery would be beneficial. Some noted that grant cycles and programs are restrictive, not helpful to long-term planning and that they take too much time away from organizations that are increasingly volunteer led. The engagement period also highlighted the appetite for and importance of education opportunities related to wild salmon and community stewardship, which is important, not just at the K-12 level, but for adults and in universities as well. It was suggested that programming related to salmon could increasingly focus on freshwater environments and the importance of healthy habitats for wild salmon. Examples:
  - Salmon stewardship and stream keeper groups
  - Salmonids in the Classroom
  - Freshwater Fisheries Society of BC
  - Indigenous role in salmon stewardship and management
- **Pinniped predation:** Several suggested that predation by pinnipeds is a key issue for wild salmon, and that some form of a cull or harvest should be considered. Others noted concerns around this possibility, including that removal of pinnipeds could precipitate cascading ecosystem effects. Examples:
  - Science-based decision-making
  - Consideration of multiple causes of concentrated predation, e.g. log booms in estuaries
  - Focus on specific problem areas/animals
  - Recent U.S. legislation (Washington, Oregon, etc.)
  - U.S. Marine Mammal Protection Act and export considerations

- **Steelhead and cutthroat trout:** Many commented that a targeted focus on Pacific salmon within provincial jurisdiction (steelhead and cutthroat trout) and particularly those populations under threat of extinction, was missing from the *Wild Salmon Strategy Options Paper*. Several suggested that there is an immediate need for the development and implementation of emergency recovery plans for endangered populations. Connections between coastal commercial harvest restrictions and weak stock management meant to protect vulnerable runs were noted, as were other possible stressors and management actions for at-risk steelhead populations. Examples:
  - Recovery and rebuilding plan
  - Selective fishing
  - Emergency stock enhancement
  - Thompson and Chilcotin steelhead
  - COSEWIC listings
  - Connection to Marine Stewardship Council certification in commercial fishery
- **Water for salmon:** Ensuring appropriate water quality and quantity in salmon-bearing rivers and streams was noted as a key area of importance that is under provincial jurisdiction. Many threats to acceptable water quality/quantity for salmon were noted, including toxicity of storm water runoff, wastewater effluent/pollution, mining pollution, sedimentation and increasing frequency of flooding/drought events under climate change, among other issues. Opportunities for improvement that were suggested included working closely with municipalities, building green infrastructure, charging fair prices for water to industrial users and more local control of watershed planning. Examples:
  - B.C. *Water Sustainability Act*
  - Climate change adaptation
  - Green infrastructure
  - Raingardens, bio-swales, bio-detention ponds for filtering runoff
  - Best practices and funding for municipal projects and storm water improvement
  - Highway project infrastructure (dikes, culverts, etc.)
  - Water sustainability plans
  - Micro-plastics pollution in the lower Fraser River
  - Floodwater management and impediments to fish passage
  - Wastewater management
- **Data, research and science:** The need for better information (e.g., stock assessment, escapement, catch data) to influence decision-making, as well as the need for wider access to data, was noted. It was suggested that it is important to look not only at critical salmon habitats, but to overall watershed health as well. Marine survival, particularly amidst changing ocean conditions, was noted as an important area with the need for more data that could influence decision-making. Research into the availability of prey species for salmon (e.g., insects, herring) was also noted as an area where further information, and likely action, will be required in the context of a wild salmon rebuilding initiative. Examples:
  - PSF's Pacific Salmon Explorer
  - Aquatic Health Sciences 'Wet Lab'
  - Stock assessment
  - Traditional ecological knowledge
  - Technical round tables for *Wild Salmon Strategy* implementation
  - International Year of the Salmon research projects to better understand wild salmon issues in the high seas

- **Governance:** Many suggested that it will be important for a provincial *Wild Salmon Strategy* to focus first on areas of provincial jurisdiction, including factors affecting salmon habitat, such as water quality and quantity, water uses, land uses, estuary and near shore environments, parks and protected areas, highways and culverts, exotic and invasive species, dams, and freshwater lakes and rivers, among others. There was also widespread agreement that improved co-ordination within the province, and across multiple levels of government (First Nations, municipal, provincial, federal, international), should be an important focus of the strategy, rather than wasting resources on an unco-ordinated approach, duplication, or reinventing the wheel. The need to collaborate with and engage communities in the development and implementation of the strategy was also noted, as were concerns around the professional reliance model and governance of B.C.'s natural resource sectors. Examples:
  - Learning from previous work – e.g., Pacific Salmon Forum, Cohen Commission, Fisheries Renewal BC
  - Indigenous rights and management – e.g., First Nations Fisheries Council, Wild Salmon Summit
  - Co-ordination with existing/ongoing work – e.g., DFO's Wild Salmon Policy Implementation Plan, International Year of the Salmon, Shuswap Salmon Symposium, Salmon Roundtables, Watershed Councils and planning processes, and others
  - Enhanced provincial participation in important tables/forums
  - Ongoing community involvement throughout B.C. during strategy implementation
- **Monitoring and enforcement:** Monitoring was often described as a key area requiring further effort, and where there are strong opportunities for collaboration. It was noted that resource extraction and other industries require stricter penalties for infringements that degrade salmon habitat, and that regulatory regimes and "boots on the ground" could be enhanced to improve compliance and enforcement. Examples:
  - Indigenous guardianship programs
  - Creek walker programs
  - Conservation officers
  - Higher penalties for violators
- **Salmon values:** The many, and sometimes competing, values of salmon were highlighted throughout the engagement period. These include but are not limited to: salmon's ecological importance, non-consumptive wild salmon utilization, salmon for food/social/ceremonial/cultural purposes, and salmon for livelihoods. It will be important for B.C.'s *Wild Salmon Strategy* to acknowledge the multiple values of salmon throughout the province – including both inland and coastal areas. It was repeatedly mentioned how important it will be to ensure that immediate action is pursued, while ensuring that the next generation cares about wild salmon and their well-being, in order for these values to persist into the future. In addition to salmon fishing, alternative economic opportunities related to wild salmon that were noted include restoration activities and ecotourism. It was generally agreed that adding value to salmon in B.C., and for local communities, is crucial and can take various forms. Examples:
  - Diversification, e.g., restoration economy, ecotourism (salmon spawning, snorkeling, bear viewing)
  - Training, mentorship, education, and youth engagement and opportunities
  - Forward-looking vision
  - B.C. holiday/symbol/license plate to recognize wild salmon importance
  - Importance of values from headwaters to estuaries to sea
  - 'Whole citizen' effort
  - Ecosystem importance, e.g. southern resident killer whales

- **Fishing:** The importance of various forms of salmon fishing, and other fisheries, to communities around the province was highlighted throughout the engagement period. At the same time, the need to focus on stock rebuilding prior to further expansion of salmon fishing opportunities was also noted. It was suggested that further application of selective fishing methods would be worthwhile. Issues with high-use fishing areas were also noted. Many people spoke about current federal and provincial government jurisdictions as they relate to fisheries. Examples:
  - Innovative financing for community fisheries, e.g., license banks, loan board
  - Gear improvements
  - Improved bycatch monitoring
  - Federal Standing Committee on Fisheries and Oceans' study on regulation of West Coast fisheries
  - Ecosystem impacts, e.g., herring fishery
  - Impacts of catch and release
  - Place-based management
- **Fish farms:** Although not in the WSAC's terms of reference, concerns with marine open-pen salmon farming – such as lighting, disease, sea lice, pesticides, and escapes – were repeatedly raised. The need for incentives and innovation related to transitioning to closed containment or land-based systems was often referenced. At the same time, some stated that salmon farms are not the key culprit in wild salmon declines, and that many other issues must be addressed. Overall, it was suggested that there needs to be more ongoing co-ordination between B.C., Canada and Indigenous communities on fish farms and their impacts on wild salmon. Examples:
  - Incentives for innovation and closed containment
  - Limits to salmon farming in Western U.S. (e.g., Washington, Alaska)
  - Broughton Archipelago government-to-government process, outcomes and next steps
  - Land-based aquaculture challenges and success stories
- **Climate change:** Participants in the engagement period reminded that it will be crucial to carefully consider rising water temperatures, changing ocean conditions, salmon survival and other issues related to climate change during the development and management of a provincial *Wild Salmon Strategy*. Ongoing monitoring and traditional knowledge will both be useful in this regard. Examples:
  - Connections to climate initiatives, e.g., Clean BC
  - Drought and flood events and appropriate management
  - Ongoing effects monitoring
  - Species-specific changes
  - Ocean conditions (temperature, acidification)
- **Indigenous Rights and interests:** Indigenous communities/governments/organizations have a constitutional right to participate in salmon management/benefit, a cultural interest in supporting healthy salmon stocks and considerable technical capacity dedicated to the cause. Ensuring they are central to the future of wild salmon in all respects will be critical to success. Along these lines, it was suggested that a more structured and ongoing relationship between Indigenous communities and the provincial government regarding salmon and fisheries issues will be important to the success of a provincial *Wild Salmon Strategy*. At the same time, it will be important to communicate through established processes where possible – rather than reinventing or duplicating processes – in order to avoid siloes or a duplicative approach to engagement. Examples:
  - United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)
  - First Nations Fisheries Council
  - Section 35 Rights, Canadian Constitution
  - Wild Salmon Summit recommendations
  - Draft Principles that Guide the Province of B.C.'s Relationship with Indigenous Peoples
  - Reconciliation
  - Indigenous management and guardianship

The WSAC's recommendations to the Province of B.C.

1. Preamble

As noted earlier in this report, current data suggests that *immediate* intervention is needed to both sustain healthy wild salmon stocks in B.C. and to support the ecological areas and human communities that depend on them. The B.C. government, recognizing the vital importance of abundant wild salmon populations to our environment, culture, and economy appointed the 14-member Wild Salmon Advisory Council (WSAC) in June 2018 to provide advice and guidance to shape a made-in-B.C. *Wild Salmon Strategy*.

Over the past seven months, the WSAC has gathered information through a series of commissioned reports, conducted engagement throughout the province, and held significant internal deliberations. We offer the following recommendations in the belief that they fundamentally support the provincial government's intention on this issue. These recommendations will also be helpful in formulating appropriate and timely actions for both wild salmon and the communities dependent on them for good lives and livelihoods.

Although there is a range of knowledge and interests related to wild salmon amongst WSAC members, our recommendations are premised upon several important shared principles. We heartily agree that a made-in-B.C. *Wild Salmon Strategy* must:

1. Be **action-oriented** with a focus on tangible, achievable, near-term actions that can address the immediate needs of wild salmon and their habitats.
2. Establish **long-term** provincial engagement on this issue, recognizing that impact will require ongoing and significant effort.
3. **Recognize, respect and engage Indigenous governments and communities**, acknowledging their social and cultural relationship to wild salmon, the United Nations Declaration on the Rights of Indigenous Peoples, Section 35 Constitutional Rights, and the numerous court cases[13] that have affirmed their interest to participate in the management and use of the resource.
4. Incorporate intentional and appropriate **collaboration** with all levels of government, including Indigenous governments, working toward a shared vision and co-ordinating resources and capabilities towards its achievement.
5. **Include action on two key fronts** – supporting wild salmon and their habitats through protection, restoration and enhancement initiatives AND ensuring that benefits flow to B.C. residents, particularly those who live adjacent to the resource.
6. Position the provincial government to play three critical roles – as **champion, leader and strategic investor**.

In addition to these six points on which WSAC members agree are the essential conditions for a successful made-in-B.C. *Wild Salmon Strategy*, our recommendations are framed and reinforced by several shared expectations, which were significantly informed by discourse during the engagement period. These expectations include:

- Requiring that actions be supported by best available science, strong technical support, Indigenous and local knowledge, and a public monitoring/reporting framework. This must include a conscious effort to learn from the past. Billions of dollars have been invested in the issue of wild salmon habitat restoration and wild salmon enhancement over the past 20 years. It is necessary that these lessons be brought forward to inform this new endeavor.

13 Court cases include: Delgamuukw, Sparrow, T'silhqot'in, Gladstone, Haines.

- Understanding that strategies often take time to mature and flourish, particularly when they involve complex issues and multiple parties. But in this instance, wild salmon cannot wait for all the stars to align. A successful strategy must therefore include short-term interventions, based on best available evidence and local knowledge, in order to shore-up critical problem areas, demonstrate intent, and engage citizens.
- Accepting that B.C. already has many laws and regulations in its toolbox that could better support wild salmon if they were more consistently applied, monitored and enforced. Doing this requires the intentional development of a new culture inside government where a "wild salmon lens" can inform decision-making and there is a managed requirement that existing tools be applied.
- Acknowledging that the fisheries file inside the provincial government has been dispersed across multiple agencies and programs for the past several years, which has often created confusion and duplication. This has affected the Province's ability to champion both wild salmon issues and economic issues related to the uses of the resource. There are demonstrable advantages to aligning the organization's fisheries capacities, resources and knowledge.
- Recognizing that the locus of action for a made-in-B.C. *Wild Salmon Strategy* must be at the community level. There is considerable, experienced capacity already organized and ready for quick activation throughout B.C., including in Indigenous communities and organizations. Taking advantage of this "infrastructure for action" by supporting community stewardship will allow for a much more efficient launch and ensure that priority issues are identified and addressed.
- Affirming that a made-In-B.C. *Wild Salmon Strategy* must include consideration for both coastal and Interior issues and interests. The Interior regions of the province provide critical spawning habitats for wild salmon, steelhead and other salmonids and are home to multiple communities, cultures and businesses that are reliant on healthy stocks. During the engagement period, WSAC members were reminded that the strategy would be incomplete and inaccurate if it did not keep the needs and issues of Interior communities and environments top-of-mind.
- Ensuring that the made-in-B.C. *Wild Salmon Strategy* addresses all seven species of Pacific salmon in the province. Each is important for different reasons to different jurisdictions.
- Recognizing that the engagement period included many presentations that expressed concern about the risk to wild salmon imposed by B.C.'s finfish aquaculture industry. The WSAC encourages the provincial government to actively implement the recommendations provided to government by the B.C. Ministry of Agriculture's Advisory Council on Finfish Aquaculture[14] with respect to current and future finfish aquaculture facilities on our coast.
- Committing to a strategy that helps ensure B.C.'s wild salmon and other fisheries are structured to achieve maximum benefits for the communities adjacent to them. At this point in history this statement may seem simply aspirational to some, but our recommendations strive to demonstrate how the Province could help to realize a future where fishery resources in B.C. are more immediately tied to local economic opportunities.
- Acknowledging that climate change is a critical factor impacting wild salmon now and any plans made to support them over the coming decades. These impacts are likely to continue to include increased flooding, drought, washout events, wildfire impacts, higher water temperatures and invasive species, among others. This requires that B.C. develop an approach to wild salmon habitat protection, restoration, and enhancement that is flexible and invests in ongoing monitoring for rapid response.

Council members heard loudly and clearly during the engagement period that the current weakened state of wild salmon and steelhead in many parts of B.C. is the cumulative effect of "death by a thousand cuts" inflicted over the past decades. This makes the task of supporting their renewal both complex and critical. B.C. citizens have made it clear to the WSAC that the provincial government's stated intent to take action on wild salmon is crucial because,

14 *https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/fisheries-and-aquaculture/minister-or-agriculture-s-advisory-council-on-finfish-aquaculture/maacfa-2017-docs/minister_of_agricultures_advisory_council_on_finfish_aquaculture_final_report_and_appendices.pdf*

while our futures may not wholly depend on wild salmon, our province will be very much diminished, both in ways we can expect and in ways we cannot yet envision if they are gone.

2. Recommendations

Immediate Actions direct B.C.'s attention toward strategic interventions to stem the tide of further declines in our wild salmon populations and the economies that depend on healthy and abundant stocks. We advise that they be undertaken immediately using best-available science and current knowledge.

Mid-Term Actions recognize that more research, planning, organizing or convening may be required to achieve them but they are critical to include in the strategy and work should commence on them as soon as possible.

GOAL 1: Increase the abundance of wild salmon

Despite billions of dollars of public and private investment over the past 30 years to protect, restore, enhance and manage B.C.'s wild salmon and steelhead resources, both the statistics and the stories indicate that many these populations continue to weaken – some at alarming rates. This raises serious issues for other species that rely on wild salmon, including southern resident killer whales, for the overall health of the ecosystem and for the individuals and communities that rely on wild salmon for their lives and livelihoods. In the face of ongoing pressures from development and changing climate conditions, it is imperative that the Province act quickly to (a) protect salmon habitats not yet disturbed; (b) restore habitats that have been degraded; and (c) prioritize and enhance wild salmon populations where there is a threat of extirpation or well-being at risk. These recommendations direct the government to priority actions that will increase wild salmon abundance in B.C.

Strategy 1.1 Protect salmonid habitats, including water[15], from loss or degradation by actively enforcing existing provincial laws and regulations. Loss of fish habitat has been identified as a leading factor in the decline of Canada's fisheries resources, and salmon in particular[16].

- **Immediately:** Demonstrate the active use and intentional enforcement of existing provincial laws, regulations, policies and programs for the protection of wild salmon spawning and rearing habitats.
- **Immediately:** Provide support to provincial organizations that are working to protect habitats.
- **Mid-Term:** Instruct agencies to use a "wild salmon lens" in relevant provincial land-use decisions related to the use of all Crown lands/watercourses/estuaries (including those leased to industrial uses) so that wild salmon receive greater and more consistent consideration in decision-making. This updated approach should be demonstrated in the government's accountability and reporting frameworks.
- **Mid-Term:** Work closely with municipal and regional governments to ensure their land use decisions are compliant with provincial laws. This could include establishing a regular process of reporting on salmon-related decisions and actions.

15 Water regulations include water quality, quantity, temperature, dams, flood control barriers, water licencing including for agriculture and industry.

16 See, e.g., J.A. Lichatowich, *Salmon Without Rivers: A History of the Pacific Salmon Crisis* (Island Press, 1999); Marvin Rosenau and Mark Angelo, *Conflicts Between Agriculture and Salmon in the Eastern Fraser Valley* (Pacific Fisheries Resource Conservation Council, 2005).

Strategy 1.2 Develop new laws and regulations where existing laws and regulations are shown to be insufficient to adequately protect salmonid habitats, including the assurance of sufficient water quality and quantity to enable successful migration, spawning and rearing of all salmonids.

- **Immediately:** Develop and implement a provincial no-net-loss or habitat compensation policy for any development disturbance of salmonid habitats. Fisheries and Oceans Canada offers one example of this type of policy framework for consideration[17].
- **Immediately:** Pay particular attention to industry and land-use activities including forestry, road construction, mining and agriculture which have been shown to have significant interaction with wild salmon habitats and potentially deleterious impacts. WSAC members received many submissions urging a review of environmental regulations and policies for these activities.
- **Mid-Term:** Review the existing suite of laws/regulations in place to support salmonids, including how these laws/regulations are currently applied, monitored and enforced. This review should include an assessment of how/whether important protection and restoration initiatives are impeded by the current fractured nature of salmon management within the provincial government system. This review could be used to guide the strengthening of existing laws/regulations, the creation of new laws/regulations, and the re-organization of government departments, as needed.
- **Mid-Term:** In consultation with Indigenous governments and other levels of government, develop a long-range and strategic plan to ensure that key salmon habitats are protected in perpetuity[18]. This can be achieved by using tools/mechanisms currently available to the Province (including conservancy legislation, co-management structures, land trusts, land purchases, parks and protected area legislation, marine protected area legislation), or through the introduction of new legislation or regulation. This action can also support the provincial government's reconciliation objectives given its Draft Principles that Guide the Province of B.C.'s relationship with Indigenous peoples[19].

Strategy 1.3 Increase monitoring and enforcement efforts for salmonid habitats across B.C.'s watershed and nearshore environments.

- **Immediately:** Invest to enhance both human and financial capacity related to habitat monitoring, enforcement and infraction prosecution, for habitat disturbances including terrestrial, near shore and freshwater. Working closely with Indigenous governments and community organizations to support these efforts is important. Training and investment in guardianship programs (both existing and new) can help put more boots on the-ground for this effort. The WSAC also recognizes and supports current efforts within government to review and revise its Professional Reliance Model as part of the efforts to ensure laws and regulations are being systematically and accurately enforced.
- **Mid-Term:** Increase transfer funding to bylaw enforcement efforts at the regional and municipal levels. Ensure that this increased funding is accompanied by a publically available accountability and reporting framework.
- **Mid-Term:** Work with all levels of government and stakeholder groups to ensure that the monitoring of all fisheries (particularly counting the number of fish caught) is improved.

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17 *Practitioners Guide to Habitat Compensation*, Fisheries and Oceans Canada, 2002. Compensation is defined in the Habitat Policy as: "The replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of fish production by artificial means in circumstances dictated by social and economic conditions, where mitigation techniques and other measures are inadequate to maintain habitats." This policy includes a hierarchy of compensation options where habitats are in danger of disturbance.

18 WSAC members heard that priority areas, such as the lower Fraser River and key estuarine habitats, should be prioritized for these efforts.

19 *https://news.gov.bc.ca/files/6118_Reconciliation_Ten_Principles_Final_Draft.pdf?platform=hootsuite*

Strategy 1.4 Invest in the restoration of critical salmonid habitats that have been lost or degraded.

- **Immediately:** Focus enabling resources on shovel-ready initiatives that have been identified and prioritized because of their importance to weakened stocks, species at risk and community economies and well-being[20]. Some examples that came to the WSAC's attention during the engagement process include:
    - The Province's Fish Passage Remediation Program, which has a long list of potential projects to remove key fish passage barriers. Although these have been costed and prioritized by the technical working group, resources to complete the recommended work have been limited.
    - The Connected Waters initiative[21], which has a plan on the Lower Fraser to connect waterways impacted by flood control measures. The initiative brings together technical, community and Indigenous partners and would open hundreds of kilometres of watercourses for wild salmon spawning and rearing if resources were available for technical design and engineering work.
    - The Pacific Salmon Foundation has a list of projects throughout the province that it deems could have immediate benefits to key wild salmon runs.
- **Immediately:** Invest the technical and financial resources necessary to support existing initiatives driven by community and Indigenous organizations. Many of these projects are high profile and important to local communities and resource users, and as such could help raise public commitment for the government's objectives and help build community stewardship.
- **Immediate to Mid-Term:** Focus on tools to support the control, prevention and eradication of invasive species in inland lakes and waterways.
- **Immediate to Mid-Term:** Engage with Washington State to learn from its habitat restoration efforts and ensure co-ordinated actions wherever possible for southern resident killer whales and transboundary salmonid migration.
- **Mid-Term:** In collaboration with communities, Indigenous governments, technical experts and stakeholders, establish and implement a long-term strategic restoration plan with clear objectives and a sustainable approach to investment. This plan should clearly identify the habitat-based limiting factors for salmon populations and use these as the foundation for designing the most efficient and cost-effective remedial actions possible. Prioritizing actions that help achieve the Province's vision for restoring healthy stocks in B.C., and supporting stewardship and economic development in communities should inform the development of the habitat restoration strategy. To yield maximum results, it will be necessary to ensure that provincial priorities, activities and expenditures are aligned and co-ordinated with the federal government and Indigenous governments by establishing mechanisms for joint-planning and resource sharing.

20 Establishing the metrics against which the merits of each initiative can be assessed/prioritized will be important to this endeavor. Some considerations include: benefit for COSEWIC-listed species; to commercial and recreational fisheries; to orca recovery; to the FSC food fishery; to existing small business viability; to employment opportunities; to new economic opportunities.

21 *https://www.watershed-watch.org/campaigns/connected-waters/*

Strategy 1.5 Invest in and support salmon enhancement activities that are strategic and science-based.

- **Immediately:** Identify opportunities through the federal Community Economic Development Program (CEDP) and the Public Involvement Program (PIP) to support and invest in salmon enhancement efforts including small-scale hatchery production where these enhancement efforts are being strategically used to rebuild weak or extirpated stocks; for captive brood stock programs; for public engagement/stewardship development; or for short-term interventions to help rebuild stocks for southern resident killer whales. Communities and Indigenous governments should be involved in the design and decision-making process for these opportunities. The strategy could include the redeployment of underutilized capacity. Investment should prioritize the most urgent needs such as Thompson River steelhead.
- **Immediate to Mid-Term:** Pinniped (seal and sea lion) populations have grown considerably stronger over the past several years and are increasingly reported to be predating on wild salmon, particularly in estuaries where log debris provides haul-out habitat. The WSAC recommends engaging with the science and conservation communities to review/confirm current and trends data, and to develop appropriate and timely interventions where pinniped populations or problem animals are threatening wild salmon rebuilding efforts.
- **Mid-Term:** Attach to all enhancement efforts a deliberate and long-term monitoring framework for impact measurement, including the monitoring of climate change impacts over time that may demand course correction.

GOAL 2: Protect and enhance the economic, social and cultural benefits that accrue to B.C. communities from wild salmon and other fisheries, placing emphasis on adjacent communities.

Wild salmon have a critical role to play in healthy ecosystems and communities. The *Wild Salmon Strategy* should aim to embody both the tangible and intangible benefits provided to B.C.'s natural systems and human communities when stocks are healthy and abundant. This requires a remediation strategy that considers: (a) other species, such as orcas, eagles and bears that depend on wild salmon as a key food source; (b) Indigenous peoples and fishing communities that have strong cultural roots linked to wild salmon; and (c) economic relationships to wild salmon, including harvesters, processors, tourism and other businesses. It is concerning that in spite of the fact that the value of wild seafood in the North American marketplace has been steadily increasing over the past two decades, average commercial fishing incomes in B.C. have declined, many recreational and commercial fishing enterprises struggle for viability, and many ancillary businesses that rely on wild salmon and other fisheries have closed. These impacts are most immediately felt at the community level, often in communities that are adjacent to where the fish are caught. The Province, with its jurisdictional authority for labour-force development, communities, food/seafood processing and education/training is in a unique position to ensure that the *Wild Salmon Strategy* is supported by a comprehensive and intentional strategy to maximize the benefits of B.C. fisheries and seafood for the people of B.C. These recommendations aim to ensure that this vision is realized.

Strategy 2.1: Elevate discussions and decisions about using strategic enhancement opportunities to stabilize the commercial and recreational fishing industries in B.C.

- **Immediately:** Invest in a regional salmon development conference to learn from Alaskan representatives and to dialogue with Indigenous governments, fish harvesters, communities, NGO's and scientists about the potential for structuring and operating production hatcheries in association with terminal fisheries to provide economic opportunity to fish harvesters in a manner that does not jeopardize wild salmon stocks. This would require collaboration with the federal government and could eventually involve the development of enabling legislation.

Strategy 2.2: Develop and implement a strategic employment plan to include training, mentoring and job creation that is linked to the activities undertaken through the *Wild Salmon Strategy*. Wherever possible, focus new opportunities in Indigenous, coastal and interior communities dependent on wild salmon and fisheries resources.

- **Mid-Term:** Recognize the potential of the environmental management sector by investing in a co-ordinated approach to skills training, apprenticeships, mentoring, education and job creation that links wild salmon recovery efforts to new economic opportunities. This could include: extending the reach of Indigenous guardianship programs; funding curriculum development for salmon habitat restoration, including field studies; developing hands-on apprenticeship and trades programs, including certification; and designing a jobs bank to encourage jobs/skills matching. As part of this work, which has the potential to create an exciting new employment sector in the province (sometimes called a restoration economy), it will be important for the Province to consider ways to support long-term employment.
- **Mid-Term:** Invest in innovation to support initiatives related to wild salmon recovery. This might include encouraging the development of new technologies for stock assessment, monitoring, habitat assessment, habitat restoration, data collection/storage/sharing, or enhancement.
- **Mid-Term:** Recognizing the increasing crisis in the commercial fisheries labour force, including an aging fleet and the lack of new entrants, research and develop a strategy to rebuild the local labour force for this sector.
- **Mid-Term:** Recognizing that rural communities are at risk of losing much of their labour force capacity as employment in the fish processing sector becomes more urbanized, realizing a strategy to return economic opportunity to rural and Indigenous communities adjacent to the fisheries resource requires investment in labour force development linked to job creation. It also involves strategic investment in local processing facilities to support innovation, skills training and market development.

Strategy 2.3: Enhance local social, cultural and economic benefits from B.C. fisheries for adjacent communities and their active commercial and recreational fishers, including both tidal and freshwater anglers.

- **Immediately:** Establish a comprehensive provincial vision and strategy for B.C. fisheries that acknowledges adjacency principles and reflects the values and objectives of British Columbians. Engage Indigenous governments, recreational and commercial fishers, and coastal and inland fishing communities in developing this vision.
  - For example, the Federal Standing Committee on Fisheries and Oceans is presently studying (Feb 2019) the regulation of West Coast fisheries. B.C. should immediately and directly engage and collaborate with the Standing Committee and present B.C.'s position and commitment to realize improved economic, cultural and social outcomes for B.C. fish harvesters and communities. This could include: policies and regulations similar to those developed in other regions in Canada, and in the federal Bill C68 to protect and enhance community benefits from commercial fisheries.

- B.C.'s position should include similar objectives as in Atlantic Canada's PIIFCAF[22], such as:
  - The importance of maintaining an independent and economically viable fleet;
  - Preventing and, over time, eliminating corporate and foreign control of licenses and quota so that active fishers retain control of their fishing enterprises;
  - Ensuring that the benefits of fishing flow to the active fish harvester and to communities;
  - Over time, landed value retained exclusively by harvesters and not by others.

- **Mid-Term:** Build a regulatory environment that supports democratic representation for active fish harvesters to allow their interests as working fishers, in relation to the fishery are fairly and accurately represented. Other provinces' legislation in this area[23] can provide guidance.
- **Mid-Term:** Consider investing in programs such as communal quota, fish harvester loan boards, and communal licence banks that aim to support the viability of community fishing enterprises and active fish harvesters.

Strategy 2.4: Encourage economic activity adjacent to fishing grounds to benefit coastal and rural fishing communities, Indigenous peoples, shore workers and ancillary businesses. Relevant provincial areas of jurisdiction include labour, fish processing licencing and regulation, community and rural economic development, innovation and governance.

- **Immediate to Mid-Term:** In consultation with impacted communities and workers, build a provincial regulatory environment that supports local processing of adjacent fisheries resources. Policy development could include:
  - Legislation and regulation to support and provide incentives for more fish processing in communities adjacent to the resource, including in the Interior, and to create disincentives for off-shore processing.
  - Tax incentives and innovation awards to encourage research and development into value-added options to increase local processing and to encourage the development of community infrastructure, such as cold storages and offal disposal technology.
  - Processing licenses linked to domestic processing capacity and to adjacency, giving preference to those who invest in the province and the fishery, to encourage the flow of returns to those who invest in on-shore processing capacity.
  - Protection of the B.C. Groundfish Development Quota (GDQ) that provides communities control of 10% of the total groundfish quota of all species, and the alignment of this quota with companies who process groundfish in B.C. communities. This is a mechanism that may also be relevant to other fisheries.

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22 PIIFCAF (policy on Preserving the Independence of the Inshore Fleet in Canada's Atlantic Fisheries). *http://www.dfo-mpo.gc.ca/fm-gp/initiatives/piifcaf-pifpcca/note-bulletin-eng.htm*

23 *https://nslegislature.ca/sites/default/files/legc/statutes/fish%20harvester%20organizations%20support.pdf*

Strategy 2.5: Leverage the weight of existing marketing and branding programs in B.C. and Canada to raise the value and profile of wild salmon and seafood products from B.C.

- **Immediately:** Develop a wild salmon logo to increase interest and awareness. B.C. has already adopted the salmon as a provincial symbol. A logo would complement this decision.
- **Immediately:** Review the terms of reference for the BC Salmon Marketing Council to ensure that this organization is positioned to deliver on the government's *Wild Salmon Strategy.*
- **Mid-Term:** Use existing market development mechanisms supported by the B.C. government including Buy BC, Eat Drink Local, and the BC Food Innovation Network to promote B.C. seafood and to prioritize seafood that trace products back to their points of origin. Consider opportunities and mechanisms to build local and provincial markets for B.C.-caught seafood.

Strategy 2.6: Support fisheries-related eco-tourism opportunities in B.C.

- **Immediately:** Enhance support to existing fishing tourism promotion and marketing initiatives such as Fishing BC[24]. Focus on both fishing and fishery-related marine and inland tourism development opportunities and consider express ways to support Indigenous efforts in this sector of the economy. Support efforts to highlight conservation with respect to wild salmon, particularly during this rebuilding effort. Diversification and community economic development opportunities through new ecotourism opportunities should also be considered.
- **Mid-Term:** Enhance the Fisheries and Aquaculture Sector Report prepared by BC Stats to include a more comprehensive analysis of local economic benefits provided by the recreational fishing sector.

GOAL 3: Develop mechanisms, processes, practices and structures to engage citizens and governments in the effective stewardship and management of B.C.'s wild salmon.

The realization of a comprehensive set of actions to increase the abundance of wild salmon in B.C. and ensure that the value of our fisheries is maximized to benefit B.C.'s economy requires focused capacity inside government, well-developed and intentional relationships with other levels of government, and the support of communities that are the front-line stewards of this resource. These recommendations are aimed at creating the environment for success.

Strategy 3.1: Develop focused and co-ordinated leadership capacity in government to champion and deliver on the wild salmon and economic development recovery efforts.

- **Immediately:** Establish an internal mechanism – an inaugural team or ombudsman to co-ordinate the immediate actions for the *Wild Salmon Strategy*, and to support the development of a lead agency for B.C. fisheries that clearly delineates and supports wild salmon and B.C. fisheries. Wild salmon need a clearly delineated home inside the provincial government structures, especially insofar as urgent action is required on multiple fronts. The current decentralized system creates a fractured voice for wild salmon issues at a time when a singular voice is necessary.
- **Immediately:** Engage Indigenous governments in the development of the *Wild Salmon Strategy* to ensure their interests, capabilities and legal position are represented and well-utilized.

24 *http://fishingbc.com/*

- **Mid-Term:** Establish an external monitoring and reporting mechanism to ensure the actions committed to by government within the *Wild Salmon Strategy* are implemented. This could include reconstituting a group, such as the Wild Salmon Advisory Council for an annual progress review.

Strategy 3.2: Actively engage existing community stewardship groups and Indigenous governments.

- **Immediately:** Support existing organizing and delivery capacity at the community level throughout B.C. to ensure substantive early action on *Wild Salmon Strategy* priorities. Salmon round-tables, local stewardship groups, watershed councils, Indigenous organizations and other organizations are present in communities throughout B.C. and are poised to support the province's wild salmon initiative. Where capacity does not exist or is nascent, invest in bringing stakeholders together to develop delivery capability.
- **Immediately:** Formally recognize the importance of Indigenous organizations and First Nations in the task of rebuilding wild salmon in B.C., along with their constitutionally-protected Right to participate in and benefit from the management of this resource. Include them from the outset in the development of the strategy to ensure their perspectives guide the work ahead.

Conclusion

Creating a made-in-B.C. *Wild Salmon Strategy* at this juncture, when the threats to our wild salmon populations are so complex, requires an urgent and strategic intervention. The Wild Salmon Advisory Council confirmed through its work, including the engagement process, that there ARE solutions and there IS public interest/endorsement for this initiative.

We heard at multiple times, and in many ways, that increasing wild salmon abundance is and should be a provincial government goal. We also heard repeatedly that the citizens of B.C., and particularly adjacent communities, must benefit directly from the public investment that will be required.

The WSAC's recommendations recognize this duality, encourage the Province to take a leadership role on this issue, and offer guidance for both immediate and mid-term actions.

A made-in-B.C. *Wild Salmon Strategy* is long overdue.

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau, AK 99811

Dear Members of the Board of Fisheries:

My name is Karl Wolfe and I can be reached at wildernesswolfe@alaskan.com. I am a public use, sports, and subsistence fisherman in Sitka.

Hatcheries are an integral part of the community that I have called home for over 25 years. In my personal experience hatcheries have benefited myself and my community in the following ways (but not limited to): By offering increased fishing opportunities for all user groups, by offering career related employment and income opportunities for promising fisheries professionals year round, by offering funds to fisheries research, and last (also not but not limited) adding a self-supported non-profit economic boost to the community.

Related to the economic boost to the community; In my personal experience after leaving the fisheries research field to except a job in as a hydro power operator I have seen the direct benefit hatcheries provide the local public utility by increasing electrical demand and thereby revenue by creating processor power demand at time when electrical loads are traditionally light and demand is desired.

Respectfully,

Karl Wolfe

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Keith Edens, and I can be reached at keithedens@yahoo.com. I am from Homer and commercial fish in Prince William Sound.

Hatcheries are extremely important to my family's livelihood! I don't have a second stream of income to run off to. I'm "all in" in commercial fishing. The hatcheries help provide stability over the years to provide enough income for my family. Some years when the wild runs didn't do well I would have been in real bad shape had it not been for the multiple hatcheries production in the sound. If something changes and the hatchery program gets cut I will likely have to sell out and try to find something else to provide for me. Unfortunately that would also mean selling out at a "loss" because boats and permits would most certainly take a huge hit in their value.

Respectfully,

Keith Edens

Office of the Borough Mayor

144 N. Binkley Street, Soldotna, Alaska 99669 • (907) 714-2150 • (907) 714-2377 Fax

Charlie Pierce
Borough Mayor

February 19, 2020

RE: Board of Fisheries Hatchery Committee

Members of the Committee:

As Mayor of the Kenai Peninsula Borough, I support sustainable salmon fisheries and strong hatchery production in Alaska.

Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries by creating employment and economic opportunities not only for the Kenai Peninsula Borough but throughout the entire State. Fisherman, processing employees, and hatchery workers attribute both their time and some portion of their income to Alaska's salmon hatchery production.

The Alaska salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments.

Salmon hatcheries, provide economic and ecological stability to our returns which fluctuate from year to year. It helps support our local economies, and communities we call home. We ask that the Alaska Board of Fisheries work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Thanks for your consideration.

Charlie Pierce
Mayor

CITY OF KETCHIKAN, ALASKA

RESOLUTION NO. 20-2769

A RESOLUTION OF THE COUNCIL OF THE CITY OF KETCHIKAN, ALASKA, SUPPORTING THE ALASKA SALMON HATCHERY PROGRAM; AND ESTABLISHING AN EFFECTIVE DATE

WHEREAS, the City of Ketchikan and surrounding communities of Southeast Alaska benefit greatly from the State of Alaska Salmon Hatchery Program; and

WHEREAS, Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state; and

WHEREAS, Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments, which receive raw fish tax dollars; and

WHEREAS, Alaska's salmon hatchery program employs strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations; and

WHEREAS, the Alaska Department of Fish and Game regulates hatchery operations, production, and permitting through a transparent public process and multi-stakeholder development of annual management plans; and

WHEREAS, returns of hatchery and wild salmon stocks follow similar survival trends over time and the largest returns of both hatchery and wild salmon stocks have largely occurred since hatchery returns began in about 1980; and

WHEREAS, there are no stocks of concern where most hatchery production occurs, indicating that adequate escapements to wild stock systems are being met in these areas over time; and

WHEREAS, Alaska hatcheries contributed an annual average of nearly 67 million fish to Alaska's commercial fisheries in the past decade; and

WHEREAS, Alaska hatcheries accounted for 34% of the total commercial salmon harvest in Alaska in 2018; and 59% of the total ex-vessel value in the Southeast region, 75% of the total ex-vessel value in the Prince William Sound region, 9% of the total ex-vessel value in the Cook Inlet region, and 25% of the total ex-vessel value in the Kodiak region in 2018; and

WHEREAS, a report by the McDowell Group identified the economic contribution in 2018 of Alaska's salmon hatcheries to be 4,700 jobs, $218 million in labor income, and $600 million in total economic output; and

WHEREAS, Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state and in particular in rural coastal communities; and

WHEREAS, Alaska's salmon hatchery program is non-profit and self-funded through cost recovery and enhancement taxes on the resource and is a model partnership between private and public entities; and

WHEREAS, the State of Alaska has significantly invested in Alaska's salmon hatchery program and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities while maintaining a wild stock escapement priority; and

WHEREAS, Alaska salmon fisheries, including the hatchery program, continue to be certified as sustainable by two separate programs, the Alaska Responsible Fisheries Management (RFM) program and the Marine Stewardship Council (MSC).

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Ketchikan, Alaska as follows:

Section 1. The Council of the City of Ketchikan affirms its support for Alaska's salmon hatchery programs.

Section 2. The Council of the City of Ketchikan supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural salmon stocks, such as the Alaska Hatchery-Wild Salmon Interaction Study which began in 2011 and is scheduled to conclude in 2023.

Section 3. The Council of the City of Ketchikan calls on the Alaska Board of Fisheries to work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Section 4. The City of Ketchikan shall transmit a duly certified copy of this resolution to the Alaska Board of Fisheries. This resolution is effective immediately upon passage and approval.

PASSED AND APPROVED by a duly constituted quorum of the City Council for the City of Ketchikan on this 18th day of February, 2020.

Robert Sivertsen, Mayor

ATTEST:

Kim Stanker
City Clerk

KODIAK REGIONAL AQUACULTURE ASSOCIATION

KODIAK REGIONAL AQUACULTURE ASS
104 Center Aven
Kodiak, AK 99615

Phone: 907-486-6555
Fax: 907-486-4105
www.kraa.org

Chairman Reed Morisky
Alaska Board of Fisheries
Boards Support Section
P.O. Box 115526
Juneau, AK 99811-5526

February 20, 2020

RE: **March 7 Hatchery Committee Meeting**

Dear Chairman Morisky and Board Members:

Kodiak Regional Aquaculture Association appreciates the Board's observance of the Joint Board Protocol on Salmon Enhancement and well as the Board's commitment to holding an annual Hatchery Committee meeting. We look forward to participating in the upcoming March 7th meeting. We are especially looking forward to hearing and seeing updated reports on hatchery related research as well as the presentations and discussions to take place on Cost Recovery. Along with the Board, KRAA is looking forward to ADF&G's reports on their utilization of the Precautionary Approach and adherence to the Sustainable Salmon Fisheries Policy (SSFP) in review, implementation, and regulation of the hatchery programs.

Community Importance

Kodiak Regional Aquaculture Association is an important contributor to the Kodiak Region's economy and community fabric. Our two hatcheries produce all five species of salmon and provide, on average, over 4 million fish to the common property commercial fishery annually. In addition, our cooperative Chinook, Coho and Rainbow Trout stocking programs provide more than a quarter of a million juvenile fish to lakes and streams on the Kodiak Road System for sport fishermen each year. Finally, we have stocking and imprinting programs in several rural communities that provide subsistence fish for local villages. KRAA employs 20 full-time, year-round staff members and up to 25 seasonal workers in the community and, to the extent practicable, purchases goods and services locally. In summary, KRAA provides salmon for all regional user groups and contributes several million dollars to the local economy on an annual basis.

Alaska Hatchery Research Project

This year's Draft Hatchery Committee Meeting Agenda identifies the primary topic during the open forum as discussion of whether research on hatcheries in Alaska is independent. Discussion and concern over the independence of this research has been of primary importance to hatchery operators throughout the life of this project. Great care was taken in the design and implementation of this project to insure that the outcomes would be neither biased for nor *against* hatchery production. The selection of the Science Panel to include a diverse group of reviewers and participants as well as the use of third party contractors to collect, summarize, and analyze data were critical elements in assuring the independence of this research. Participation of representatives from the Aquaculture Associations was necessary to assure that the research and contractors had accurate information and understanding in relation to the hatchery programs. Achieving proper and neutral balance and devising a robust research program related to hatchery production was the priority of all members of that group. The funding mechanisms for the Alaska Hatchery Research Project (AHRP) have always been transparent.

The Science Panel has created a rigorous and comprehensive research project. To my recall, this was a difficult undertaking given the standing body of research on hatchery production. The bulk of hatchery-related research tends to reflect the assumption that there are inherent problems with hatchery production and has mainly been focused on species other than pink and chum salmon. It appears, from articles and public statements, that many of the critics of the independence of AHRP belong to the camp that assumes hatcheries create "problems" and thus any project, no matter how carefully constructed, that is funded by hatchery operators and members of the commercial fishing industry is biased. The alternative, of course, is NO research project. In the current financial climate, how will an ambitious, unbiased, multi-generational hatchery research project in Alaska get funding if not from Hatchery Operators and the Industry? Indeed, with a $20 million dollar price tag it was difficult to believe that a project that spanned multiple generations of salmon and addressed the questions head-on could ever be mounted. KRAA is confident that any independent, objective review of the project's findings will affirm scientific integrity.

Cost Recovery

During the Board's 2019-20 meeting cycle a number of proposals generated discussion regarding aquaculture associations' cost recovery practices. KRAA's cost recovery approach differs from other regions. In fact, no two aquaculture associations handle cost recovery the same way. Each association has developed cost recovery strategies to address regional needs, local management plans and fishery management, organizational structure, and so on. It's important to note that aquaculture associations have a variety of resource users and stakeholders on their boards, and it is typically the Boards that set revenue and Cost Recovery goals for the associations. Cost recovery strategies often reach beyond the needs of the commercial fishery and address other stakeholder needs --- subsistence, recreational, personal use and community.

Here in Kodiak, the Kodiak Regional Aquaculture Association Board of Directors identified a separate account for money obtained through cost recovery at Kitoi Bay Hatchery. Use of the "Kitoi Account" is limited to hatchery-related expenses. KRAA's other operational and development expenses are paid from the Association's annual 2% Salmon Enhancement Tax revenue based on the ex-vessel value of salmon caught by Kodiak area commercial salmon fishermen, cooperative projects, grants, and cost recovery on non-Kitoi Bay projects. KRAA's Board policy was developed to inhibit the organization, in low revenue years, from increasing hatchery "cost recovery" to pay for non-hatchery projects and administration. In addition, KRAA's cost recovery has been a little more aggressive in years of higher hatchery returns so that in years of lower hatchery returns, as the 2020 season is projected to be, the Association can reduce or even eliminate cost recovery at the hatchery.

KRAA's view of aquaculture association cost recovery is that the stakeholders impacted by cost recovery policies are the best decision makers regarding cost recovery protocols and practices. Should users be unhappy with a particular cost recovery plan, they can approach the aquaculture association board, decide to run for the board and/or communicate with association members regarding their views. Often, practices of the Board have been modified as a result of stakeholder input. As a result, KRAA believes the Alaska Board of Fisheries should not act as the third-party arbitrator of inner-area differences of opinion regarding aquaculture association cost recovery policies. We believe the stakeholders that are experiencing foregone revenue or harvest opportunity should have the ability to work out within the region how cost recovery activity should be conducted.

Along with program reviews for cost and benefit to the region by aquaculture boards, periodic review of programs by ADF&G staff from both Pathology and the Private Non-Profit (PNP) Hatchery division are instrumental in identifying where programs lack merit, require better practices, or should be eliminated. Each year, the Regional Planning Teams also undergo review of Annual Management Plans for each facility. This includes cost recovery plans and can include discussion of strategy. It represents an added opportunity for ADF&G, the aquaculture associations, and the public to review projects, practices and contributions to the region. Regional Planning Teams allow for consideration of the programs of an association as a whole. This allows stakeholders to gain an understanding of the strategy behind a variety of cost recovery decisions that may focus a majority of harvest effort on a single project while freeing other projects from those pressures. Staff recommendations, board review, stakeholder input and planning team assessments all provide for extensive consideration of cost recovery strategies for each facility or association and further assure that a given association is meeting its goals and obligations to all of the salmon resource users in their region.

Sustainable Salmon Fisheries Policy and the Regional Planning Team Process
As hatchery operators, we rely on the expertise provided by the Department to assure that decisions related to our programs are thoroughly vetted. The State of Alaska requires ADF&G to provide for the protection of wild stocks and to adhere to the Sustainable Salmon Fisheries Policy (SSFP) in their review and regulatory capacity for the hatchery programs. This is the function of the permitting process and the Regional Planning Teams (RPT). Every permit request generated by an aquaculture association undergoes rigorous review by Department biologists for compliance with policy and regulation. Department staff recommendations are brought forward at the level of the RPT so that body can make a recommendation to the ADF&G Commissioner regarding whether there is sound science and reason to approve or deny a permit request. The Department's review and public process through the RPT assures that projects are recommended for permitting only if they meet the bar set by the SSFP and precautionary approach.

Regional Planning Teams remain an effective tool for making hatchery-related decisions and provide a forum for the public to comment on hatchery projects and plans. As we mentioned last year, KRAA believes our current process can be augmented to create greater public awareness and engagement. Although the meetings in each region are currently noticed publicly, we can do better. ADF&G as well as regional aquaculture associations and interested stakeholders should all engage to make the RPT meetings an open and important event. Meeting agendas as well as meeting results should be publicly advertised. Public engagement with the RPT process may depend on the issues at hand but public notice and public information about what the RPT's do should be a constant – without regard to whether or not there are "hot" issues.

In closing, KRAA appreciates the Board's use of the Joint Protocol on Salmon Enhancement and the Board's annual convening of the Hatchery Committee. Aquaculture Associations and the hatcheries they manage are important to our region and our communities. The Alaska Hatchery Research Project is an ambitious project undertaken with great effort to develop unbiased scientific assessments and to provide transparency related to the funding and participation of aquaculture associations and industry.

On the topic of Cost Recovery policies, each association employs a unique strategy to fund their operations that may vary from year-to-year depending on operational goals and fishery expectations. Those decisions should be left to the individual Aquaculture Associations, and stakeholder issues or concerns should be addressed in-region. Finally, the Regional Planning Team public process, Departmental review, and the Commissioner's authority in approval or denial of a permit demonstrate the use of the Precautionary Approach in management and permitting of enhancement projects within the state in accordance with the State's constitutional priorities.

Tina Fairbanks
Executive Director

Koniag

3800 Centerpoint Drive
Suite 502
Anchorage, AK 99503

February 13, 2020

Reed Morisky, Chair
Alaska Board of Fisheries Hatchery Committee
PO Box 115526
Juneau, AK 99811-5526

Dear Chairman Morisky:

Koniag is a regional Alaska Native Corporation formed under the terms of the Alaska Native Claims Settlement Act of 1971. Koniag has approximately 4,100 Alutiiq Shareholders. Our region encompasses the Kodiak Archipelago in the Gulf of Alaska and a portion of the Alaska Peninsula. The communities in our region have traditionally been dependent on fisheries resources for subsistence and commercial purposes for centuries. Koniag has long advocated on issues affecting the viability and sustainability of the villages in our region. As part of this effort, Koniag supports sustainable salmon fisheries and strong hatchery production in Alaska.

Koniag supports the Joint Protocol on Salmon Enhancement signed by the Alaska Board of Fisheries and Alaska Department of Fish & Game in 2002 and its intent to provide a public forum for discussion on hatcheries and we thank you for convening the Salmon Hatcheries Committee to accomplish this purpose.

Salmon fishermen, processors and communities of Kodiak Island benefit greatly from the State of Alaska salmon hatchery program. Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state. Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments, which receive fishery business fish tax revenue.

Alaska's salmon hatchery program employs strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations. The Alaska Department of Fish and Game regulates hatchery operations, production, and permitting through a transparent public process and multi-stakeholder development of annual management plans. Returns of hatchery and wild salmon stocks follow similar survival trends over time and the largest returns of both hatchery and wild salmon stocks have largely occurred since hatchery returns began in about 1980. There are no stocks of concern where most hatchery production occurs, indicating that adequate escapements to wild stock systems are being met in these areas over time.

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Alaska hatcheries contributed an annual average of nearly 67 million fish to Alaska's commercial fisheries in the past decade and account for 22% of the total common property commercial catch. In 2018, approximately 3.2 million or 53% of the 6 million pink salmon harvested in the Kodiak management area were produced by the Kodiak Regional Aquaculture Association (KRAA). The preliminary ex-vessel value of the Kodiak hatchery pink salmon in 2018 is estimated to be approximately $4.7 million. KRAA production results in over 3 million dollars annually in ex-vessel value on average, contributing significant economic benefits to local user groups, municipalities, and businesses. The economic contributions of KRAA to the Kodiak management area resulted in 43 jobs, $1.8 million in labor income, and almost $1 million in total economic output in 2017.

Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries by creating employment and economic opportunities throughout the state and in particular in rural coastal communities. Alaska's salmon hatchery program is non-profit and self-funded through cost recovery and enhancement taxes on the resource and is a model partnership between private and public entities. The State of Alaska has significant investment in Alaska's salmon hatchery program and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities while maintaining a wild stock escapement priority. Alaska salmon fisheries, including the hatchery program, continue to be certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC).

Koniag affirms its support for Alaska's salmon hatchery programs and also supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural salmon stocks. Koniag requests the Alaska Board of Fisheries continue to work with the Alaska Department of Fish and Game, the hatchery community and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Sincerely,
KONIAG,

Shauna Hegna
President

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Max Klingenstein, and I can be reached at studywhiz100@yahoo.com. I am a public use and sports fisherman from Anchorage.

I get the majority of my salmon by snagging hatchery fish in Seward. It's a tradition I hope to pass down to my kids.

The hatchery supplying sockeye salmon in Seward/ Resurrection River allows me to fill my freezers without having to resort to dipnetting the Kenai River, which ultimately leaves more wild salmon available to spawn. I spend a lot of time and money in Seward over the month of June, supporting their economy in the process.

Respectfully,

Max Klingenstein

Nancy Hillstrand
Box 674
Homer, Alaska 99603

Feb 21, 2020

Hatchery Committee Joint Protocol on Salmon Enhancement

> *"The precautionary approach shall be interpreted to mean being cautious when information is uncertain, unreliable or inadequate and that the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."* [1]

1. PROBLEM:

ADFG's knowledgeable wild fisheries biologists are prohibited to openly and honestly engage, with the Board of Fisheries.

This blockage of information weakens the knowledge base for an effective statewide perspective on hatchery issues giving the board limited and stifled Information based on the narrow perspective of ideology rather than the best available comprehensive science ADFG has and can offer if allowed to contribute.

SOLUTION:

Invite others as per the last paragraph of the Joint Protocol on Salmon Enhancement.

> *"As appropriate, the board and department may agree to invite other state and federal agencies, professional societies, scientists, or industry spokespersons to attend and to contribute information on particular topics, or sponsor other discussions, such as marketing or intrastate effects."*[2]

An honest balance and debate of up to date comprehensive information "*when information is uncertain, unreliable or inadequate…"*[3] **Request peer reviewed best available science** to determine where all information is coming from pertaining to:

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[1] **FAO *Code of Conduct for Responsible Fisheries*. Rome: FAO.1995**
FAO *Technical Consultation on the Precautionary approach to capture fisheries*. Rome, FAO. 1996.
Rio Declaration on Environment and Development, 1992
The UN Fish Stocks Agreement, United Nations conference on straddling fish stocks and highly migratory fish stocks, Sixth session, New York, 24 July-4 August, 1995
[2] **Joint Protocol on Salmon Enhancement(Protocol)**
[3] **Precautionary approach (see footnote 1)**

"production trends, management issues, updates on hatchery planning efforts, wild and hatchery stock interactions, biological considerations, and research"[4]

2. PROBLEM:

Regulation 5 AAC 40.850 Notice of Permit Alteration Request are amendments to original hatchery permits issued by the commissioner that does not reflect intent of statute AS 16.10.440(b) for the BOF to amend permits by regulation. RPTs meet in remote expensive areas, the public is not aware of what an RPT is so these meetings are generally closed to the public process and dominated by industry only. Personal experience in RPT process has shown that public comment has no bearing.

Authorities: The commissioner of the Department of Fish and Game has exclusive authority to issue permits for the construction and operation of salmon hatcheries. The Board of Fisheries has clear authority to regulate access to returning hatchery salmon and to amend, by regulation, the terms of the hatchery permit relating to the source and number of salmon eggs. The Board of Fisheries authorities also include the harvest of fish by hatchery operators and the specific locations designated by the department for harvest (see AS 16.10.440 (b) and Department of Law memorandum to the board dated November 6, 1997).[5]

SOLUTION*: Since no regulatory action is allowed. Please request from the department, that (e) be added to 5 AAC 40.850 Notice of Permit Alteration Requests*

(e) Final recommendations on these reviewed PAR terms, will be submitted to the Board of Fisheries who may amend these terms by regulation to be incorporated into the original hatchery permit issued by the commissioner.

WHY Support insertion of (e)?

1. It resolves 5 AAC 40.850 which is left with no action except a review and consideration by the commissioner.
2. It still allows the RPT process to battle out the details for industry to have a venue to explain its position to promote recommendation.
3. The BOF minimizes the bully factor.
4. It still allows the commissioner to review and consider recommendation in light of past evaluation of hatchery performance and compliance to pass on knowledge to the BOF for final action where it may amend.
5. It removes conflict of interest of the heavily dominated Regional Planning Teams by industry that have a tendency to intimidate the ADFG voting staff into compromise at a fast track RPT meeting.

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[4] **Joint Protocol on Salmon Enhancement (Protocol issues listed)**
[5] **Joint Protocol on Salmon Enhancement (Authorities)**

6. It removes conflict of interest by a PNP coordinator as a voting member on RPT's that are much too close to industry to make an unbiased decision, can sway the vote from ADFG considerations and who is often the delegated personnel that signs these PAR's for the commissioner with biased oversight.
7. It creates an added level of independent oversight and separation as was the legislative statutory intent. (unless aquaculture takes over the BOF)
8. It engages the lost authority of BOF as mandated in the very heart of the Hatchery Statutes AS 16.10.440(b).
9. It creates a better level of consideration and oversight lost when FRED Divisions 150 employees that had no harvest constituency were removed. This created an obscure unknown section under the commercial fisheries Division with a harvest constituency.
10. It give more access and input for the broad range of the ADFG especially genetics and pathology who do not have access to remote RPT meetings except by quick calls to make decisions on the fly.
11. Gives more quality time to deliberate wild fish impacts of remote releases increased production, predators drawn in, straying and other adverse interaction of altered terms of the original hatchery permits.
12. Places amendments into a regulatory form creating the need to carefully choose changes made instead of experimenting at whim with the public trust without knowledge.
13. It allows opportunity, now not available, for an accessible public process as is available in original issuance of a hatchery permits with distinct public hearings.
14. It gives utilities a forum to understand and make public input of repercussions of water and electricity infrastructure drawdown from hatcheries especially during drought.
15. It creates a statewide perspective in a process on the record to alert other affected regions of changes within originally issued hatchery permits
16. It gives opportunity on a statewide perspective for other regions wild fisheries to address market concerns affecting their prices.
17. It gives a forum for local knowledge input of nursery areas for crab shrimp and other shellfish and miscellaneous shellfish species compromised by remote release sites at whim.

3. PROBLEM:

The PNP coordinator is intimately connected with hatcheries so reviews and signs off on hatchery permits, BMP's AMP's and PARs yet this position is ill fitted to be one of the three voting seats on all Regional Planning Teams. This

creates an imbalance between the ADFG seats with conflict of interest. Having a PNP coordinator so close to industry, skews the comprehensive view intended by the legislature to create Comprehensive salmon Plans CSP which is the main job of the RPT's.[6]

Natural rehabilitation of self-sustaining production of salmon through comprehensive means is getting lost in hatchery bandaids jeopardizing natural population.

<u>SOLUTION:</u> 5 AAC 40.310. Regional planning team composition

(a) Each regional planning team consists of six members. Three are department personnel appointed by the commissioner, and three are appointed by the board of directors of the appropriate regional aquaculture association, qualified under AS 16.10.380 .

(b) The commissioner will, in his or her discretion, request the involvement of representatives of federal and state agencies to assist a regional planning team if their contribution will aid in the development of the regional comprehensive plan.

The PNP Coordinator may become an ex officio member on the RPT to avoid serious conflict of interest and at the discretion of the commissioner, a geneticist, ecologist and habitat specialists could be chosen to create and update Comprehensive Salmon Plans that protect the public trust resources of the state of Alaska. Without FRED Division that had no harvest constituency, the RPTs will need to carefully update CSP's to be comprehensive without morphing into what is unwittingly happening now…hatchery plans.

4. <u>PROBLEM:</u>

PNP's have a serious duty to be accountable for the privilege of operating state hatcheries. In exchange for this privilege to use wild pastures for free, the legislature delegated responsibility of <u>two statutory mandates</u> for private hatchery operators to perform to ensure no adverse effects to the public trust resources:

"The program <u>shall be</u> operated:

1. ***without adversely affecting natural stocks of fish in the state***
2. ***under a policy of management which allows reasonable segregation of returning hatchery reared salmon from naturally occurring stocks."[7]***

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[6] **AS 16.10.375**

[7] **1974 PNP Hatchery Act**

Denial and lobbying using cost recovery money is counterproductive and are part of the problem not the solution to uphold the public trust doctrine.

SOLUTION: It would be great if PNP's would come to the table and understand the concern pertaining to the problems involved. There is more involved than just a concept of ***Substantial public benefits*** as this is only part of the equation and needs to be quantified. Most important for the majority of Alaskans, is the component of "***would not jeopardize natural stocks,*** a condition of hatchery operation.

Hatchery operations must be adjusted until adverse effects and integration of hatchery strays masking wild ceases. All business plans need to correct problems caused in society. A hatchery spill like an oil spill requires attention without delay.

Money from cost recovery and assessment being spent on lobbing and PR is not listed as an expense so may not be legal. This tactic does not even begin to address the concern so many have for adverse hatchery/ wild interaction.

5. **PROBLEM:**

The Hatchery Act clearly differentiates "hatchery reared" from "naturally occurring" populations. **ADFG continues to make statements contrary to this distinction**. This is misleading, contrary to law, while jeopardizing the sustained yield principle and the public trust for current and future generations.. Thousands of scientific papers attest to this distinction.

SOLUTION: to find where the confusion is coming from ADFG must ask for citations to any statements that attempt to mislead the board and public that there is no difference between hatchery or wild fish or no distinction between straying of hatchery and dispersal of wild. Ideologies and guesswork answers without some backing in peer reviewed science is not productive and wastes the Board time. Place a gong, buzzer or light switch in the back of the BOF meeting room for when inaccurate statements or answers are given to the board without basis.

6. **PROBLEM:**

The State of Alaska is lacking the legislative mandated **hatchery / wild policy of management** on reasonable segregation. The massive integration continues unabated from hatchery stray rates exceeding 70% inter-regionally and regionally homogenizing wild anadromous waters of the state. WHY?

This is not reasonable segregation.

SOLUTION: *Create a* policy of management which allows reasonable segregation of returning hatchery reared salmon from naturally occurring stocks."[8] Create a straying proportion trigger percentage where hatchery production or remote release sites are mandated be fine-tuned until this integration ceases especially with climate fluctuations increasing problems.

7 . PROBLEM:

Escapement Goals for wild fish priority are admitted by ADFG to be unreliable from massive straying proportions without taking action. Hatchery strays are masking wild populations giving a faulty sense of wild abundance.

"Large-scale straying of the enhanced chum salmon also has negative implications on wild stock management. All fish counted in streams are assumed to be wild stock fish.

The presence of a high proportion of stray hatchery fish in streams artificially inflates wild stock escapement estimates. Inflated wild stock escapement numbers may mislead management into believing that the escapement goals have been met.

The department then opens districts to harvest wild stock fish assumed to be excess to escapement goals. However, the escapement goal may not have been met because of the large number of hatchery strays in the aerial survey escapement estimates. Additionally there are significant genetic concerns associated with hatchery strays interbreeding with wild stocks." [9]

"Escapement to most wild stock index streams included hatchery marked fish" [10]

SOLUTION:

Continually djusting Escapement Goals is not the solution. This only continues to mask declines in the wild fish escapements until the damage may become irreversible to wild populations. Hatchery operations must step up to the plate and become responsible business people and **adjust production and remote releases.** This is how business works and hatcheries are no different.

"In many anadromous salmonid producing regions around the world strays from large donor hatchery populations are a significant threat to recipient wild populations."[11]

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[8] **1974 PNP Hatchery Act**
[9] **ADFG Special Publication No. 09-10** ***Internal Review PWS Aquaculture Corporation***
[10] Otis and Hollowell presentation to BOF 2019
[11] Keefer Caudill (2014) Homing and Straying by Anadromous salmonids: A Review of mechanisms and rates

“Most recipient-based estimates have substantiated concerns that wild populations are vulnerable to swamping by abundant hatchery and farm-raised strays”

“The long, slow decline of wild native coho salmon was overshadowed by the short-term success of hatcheries that were managed as mass production facilities…”[12]

“Hatcheries…have inadvertently impacted naturally spawning stocks.”[13]

“We do caution against transferring the results gleaned here from hatchery-produced salmon to wild populations as multiple lines of evidence suggest that hatchery fish are likely to stray at different rates than wild fish.[14]

“stray hatchery-produced fish that breed with wild fish of a different lineage may compromise conservation objectives and confound escapement estimates by masking a lack of local natural production.”[15]

“Chinook salmon reared in hatcheries replace rather than supplement naturally occurring Chinook when they are introduced…leading to a loss of genetic diversity and local adaptive fitness leading to reduced survival in the estuary”[16]

Wild (N) and hatchery (H) salmon is clearly differentiated in statute[17], regulation[18] Policy[19] and in the scientific literature”

ADDITIONAL PROBLEMS:

1. concealment of straying in the second largest index stream in Northern SE as in the case of Crawfish NE Arm near Sitka
2. Concealment of an ADFG science report that questions straying research protocol of AHRG raising questions
3. No action on massive inter-regional hatchery straying from PWS Hatchery pinks suffocating LCI significant and sanctuary populations 250 miles away in a separate region.

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[12] Bottom et all (2009) Reconnecting social and ecological resilience in salmon ecosystems
[13] Carlson and Satterthwaite 2011 Weakened portfolio effect in a collapsed salmon population complex. Canadian Journal of Fisheries and Aquatic Sciences 68:1579-1589
[14] Quinn 1993, Dittman and Quinn 1996, Keefer and Caudill 2014
[15] Naish, K. A., J. E. Taylor III, P. S. Levin, T. P. Quinn, J. R. Winton, D. Huppert, and R. Hilborn. 2008 An evaluation of the effects of conservation and fishery enhancement hatcheries on wild populations of salmon. Advances in Marine Biology 53:61-194
[16] Unwin and Glovia (1997) Changes in life history parameters in naturally spawning population of Chinook salmon associated with releases of hatchery reared fish.
[17] Hatchery Act ; AS 16.10.400-470; AS 05
[18] 5 AAC 40; 5 AAC 41;5 AAC 39.222;5 AAC 39.223
[19] Genetics Policy; Sustainable Salmon Policy; Mixed stock Fisheries Policy

4. Remote Release Sites documented in Comprehensive Salmon Plans to cause straying but continue unabated blanketing wild salmon systems homogenizing portfolio populations.
5. No consideration of drought situations increasing straying
6. Exceeding permitted stocking levels;
7. Substandard broodstock to egg take survival rate;
8. Withholding data required in permits;
9. Conducting cost recovery harvest outside Special Harvest Areas (SHA) without emergency order authority; and,
10. Refusing to fund required monitoring.
11. Cost recovery shortfalls;
12. Large-scale straying and refusal to participate in straying evaluation or solution;
13. Roe-stripping associated with excessive broodstock collections;
14. Inadequate reporting of roe sales;
15. Chum salmon *O. keta* otolith marking program failures;
16. Erratic management recommendations;
17. Lack of good faith negotiations;
18. Cooperative agreement problems;
19. Failure to report hatchery production/operational problems;
20. Lack of individual accountability among corporate officers and Board of Directors (Board) members;
21. Unwieldy and unbalanced Board structure; and,
22. ADF&G failure to enforce compliance with permits, Annual Management (AMP) and Basic Management Plans (BMP).1

HATCHERY SALMON ARE DIFFERENT FROM AND HAVE IMPACTS ON WILD SALMON: OUOTES FROM THE SCIENTIFIC LITERATURE

ANALYSIS OF SALMON AND STEELHEAD SUPPLEMENTATION: EMPHASIS ON UNPUBLISHED REPORTS AND PRESENT PROGRAMS: -Examples of success at rebuilding self-sustaining anadromous fish runs with hatchery fish are scarce. We reviewed 316 projects in the unpublished and ongoing work. Only 25 were successful for supplementing natural existing runs, although many were successful at returning adult fish.

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Adverse impacts to wild stocks have been shown or postulated for about ever hatchery fish introduction where the intent was to rebuild runs.

Allendorf et al. 1994: "We are not aware of a single empirical example in which (hatchery) supplementation has been successfully used as a temporary strategy to permanently increase abundance of naturally spawning populations of Pacific salmon."

Altukhov et al 1991: "Artificial reproduction, commercial fisheries, and transfers result in the impairment of gene diversity in salmon populations, and so cause their biological degradation."

Araki et al. 2007: "We show that genetic effects of domestication reduce subsequent reproductive capabilities by ~40% per captive-reared generation when fish are moved to natural environments. These results suggest that even a few generations of domestication may have negative effects on natural reproduction in the wild and that the repeated use of captive-reared parents to supplement wild populations should be carefully reconsidered."

Araki et al. 2008: "Captive breeding is used to supplement populations of many species that are declining in the wild. The suitability of and long-term species survival from such programs remain largely untested, however. We measured lifetime reproductive success of the first two generations of steelhead trout that were reared in captivity and bred in the wild after they were released. By reconstructing a three-generation pedigree with microsatellite markers, we show that genetic effects of domestication reduce subsequent reproductive capabilities by ~40% per captive-reared generation when fish are moved to natural environments. These results suggest that even a few generations of domestication may have negative effects on natural reproduction in the wild and that the repeated use of captive-reared parents to supplement wild populations should be carefully reconsidered."

"Our review indicates that salmonids appear to be very susceptible to fitness loss while in captivity. The degree of fitness loss appears to be mitigated to some extent by using local, wild fish for broodstock, but we found little evidence to suggest that it can be avoided altogether. The general finding of low relative fitness of hatchery fish combined with studies that have found broad scale negative associations between the presence of hatchery fish and wild population performance, should give fisheries managers pause as they consider whether to include hatchery production in their conservation toolbox."

"Accumulating data indicate that hatchery fish have lower fitness in natural environments than wild fish. This fitness decline can occur very quickly, sometimes following only one or two generations of captive rearing."

Araki, Hitoshi, Becky Cooper, and Michael S. Blouin. 2009. Carry-over effect of captive breeding reduces reproductive fitness of wild-born descendants in the wild. Biological Letters 5: (5) 621-624.

"Supplementation of wild populations with captive-bred organisms is a common practice for conservation of threatened wild populations. Yet it is largely unknown whether such programmes actually help population size recovery. While a negative genetic effect of captive breeding that decreases fitness of *captive-bred* organisms has been detected, there is no direct evidence for a carry-over effect of captive breeding in their *wild-born* descendants, which would drag down the fitness of the wild population in subsequent generations. In this study, we use genetic parentage assignments to reconstruct a pedigree and estimate reproductive fitness of the wild-born descendants of captive-bred parents in a supplemented population of steelhead trout (*Oncorhynchus mykiss*).

"The estimated fitness varied among years, but overall relative reproductive fitness was only 37 per cent in wild-born fish from two captive-bred parents and 87 per cent in those from one captive-bred and one wild parent (relative to those from two wild parents). Our results suggest a significant carry-over effect of captive breeding, which has negative influence on the size of the wild population in the generation after supplementation. In this population, the population fitness could have been 8 per cent higher if there was no carry-over effect during the study period.

"The F2 individuals compared in the study were all born in the same river, presumably experienced the same environment, and spawned in the river in the same year. Thus, genetic differentiation during captive breeding in the previous generation is most likely responsible for the reduced fitness of wild-born fish from hatchery parents. A strong genetic effect of captive breeding is consistent with the results of previous studies (Araki et al. 2007, 2008). However, this study also suggests a carry-over effect of the captive breeding, which reduces the reproductive fitness of wild-born descendants in the wild and the population fitness of subsequent generations."

Araki and Schmid 2010: "We summarized 266 peer-reviewed papers that were published in the last 50 years, which describe empirical case studies on ecology and genetics of hatchery stocks and their effects on stock enhancement. Specifically, we asked whether hatchery stock and wild stock differed in fitness and the level of genetic variation, and whether stocking affected population abundance. Seventy studies contained comparisons between hatchery and wild stocks, out of which 23 studies showed significantly negative effects of hatchery rearing on the fitness of stocked fish, and 28 studies showed reduced genetic variation in hatchery populations. None of these studies suggested a positive genetic effect on the fitness of hatchery-reared individuals after release.

"The answer to the question whether hatchery stocking is helpful or harmful to wild stock depends on the goal of the hatcheries, species and the cases. A major limitation in our knowledge is the link between the performance of hatchery fish in the wild and their influence on the stocked populations. Parentage analyses based on genetic methods seem useful to investigate this link. Until we find a way to mitigate the negative genetic impacts on wild stock, however, hatchery stocking should not be assumed as an effective remedy for stock enhancement."

Bachman 1984: "Hatchery brown trout fed less, moved more, and expended more energy than wild brown trout in streams."

Bacon, et al. 2015 Atlantic Salmon conservation stocking at the Girnock Burn was designed to reduce the overwinter mortality associated with poor in-redd survival (Malcolm et al. 2004, 2005) and the within-cohort competition associated with patchy spawning habitat (Webb et al. 2001b; Einum et al. 2008). The procedures were implemented under low stock sizes when spawner numbers were thought to be inadequate to maximize freshwater production. Under these conditions, the beneficial effects of stocking were expected to be large. However, this study found no beneficial effect of artificial incubation and stocking over and above natural processes.

Bams 1970: "Hatchery pink salmon migrated to the ocean one to two weeks earlier than wild pinks."

Beamish 2008 "An analysis of the results of a 10-year study of the population ecology of juvenile hatchery and wild coho salmon. A decline in the percentage of hatchery coho salmon was related to declines in hatchery fish abundance and marine survival; Oscillations in hatchery coho salmon percentage and abundance were related to oscillations in abundance of juvenile pink salmon *O. gorbuscha*. Wild coho salmon responded to conditions in the marine ecosystem differently than hatchery coho salmon, as relationships among growth, survival, and abundance were apparent for wild coho salmon earlier in the year than for hatchery fish.

Beamish, 2010. Competitive Interactions between Pink Salmon and other juvenile Pacific salmon in the Strait of Georgia.

“In July, juvenile sockeye salmon were consistently smaller and had a higher percentage of empty stomachs in years of large pink salmon abundance.

“Other species of Pacific salmon also had higher percentages of empty stomachs in some years when pink salmon were abundant.”

“There was a consistent response between juvenile pink salmon and the dominant line of juvenile sockeye salmon that was present…”

“The large abundances of juvenile pink salmon and their interactions with other juvenile Pacific salmon…indicates that the management of Pacific salmon returning …needs to extend beyond the stewardship of escapements and into the consequences of interactions among juveniles within the… ecosystem.”

Beamish, 2011 It is no exaggeration to suggest that a book could be written, and should be written, about the changes in Pacific salmon from the early 1970s to the present.

“Over this time there has been a collapse of the recreational and commercial fishery of coho and chinook salmon. This collapse occurred despite the establishment of the Salmon Enhancement Program that was supposed to double the catch by about 2000 (Fisheries and Environment Canada 1978).”

Surprisingly, it appears that there was a large increase in the number of juvenile Pacific salmon that entered… over this period of collapse (Beamish et al. 2006, Figure 2),

Adult pink salmon return to spawn…virtually only in odd-numbered years resulting in the population receiving the name “odd-year pinks.” However, the juveniles enter … in even-numbered years and it is in the even-numbered years when these juveniles interact with other species in the…ecosystem.”

“The returns of pink salmon have generally increased over the same period that chinook and coho salmon decreased (Figure 8).”

“A simple explanation is that … pink salmon that enter the ocean earlier than coho and chinook salmon are finding more of their preferred food and growing faster. “

”… the explanation for the increasing abundances of pink salmon may be a combination of increased fry production and more favourable ocean conditions.”

Berejikian and Ford 2004: “All of the studies we found for Scenarios 1 (nonlocal, domesticated hatchery stocks) and 4 (captive and farmed stocks) found evidence of highly reduced relative fitness for nonlocal, domesticated hatchery stocks, captive broodstocks, and farmed populations. We therefore conclude that it is reasonable to assume that steelhead, coho, and Atlantic salmon stocks in these categories will have low (<30%) lifetime relative fitness in the wild compared to native, natural populations.”

Berntson et al. 2011. “Hatchery supplementation programs are designed to enhance natural production and maintain the fitness of the target population, however, the relative reproductive success (RRS) of hatchery-origin fish was 30–60% that of their natural-origin counterparts. There is acute interest in evaluating the reproductive performance of hatchery fish that are allowed to spawn in the wild.

"Despite the higher reproductive success for natural individuals, hatchery fish outnumbered natural ones by more than five to one, yielding an overall hatchery contribution to our offspring sample that was nearly twice that of natural fish… yet it is equally clear that hatchery-reared fish left fewer offspring per individual than their natural counterparts."

Bingham et al 2014: "We examined whether a supplementation program for steelhead *Oncorhynchus mykiss* in southwestern Washington could produce hatchery fish that contained genetic characteristics of the endemic population from which it was derived and simultaneously meet a production goal. Hatchery fish were produced for three consecutive years by using broodstock comprised of endemic juveniles that were caught in the wild and raised to maturity, and then the program transitioned to an integrated broodstock comprised of wild and hatchery adults that returned to spawn.

"Importantly, some auxiliary conservation-based husbandry protocols were attempted (i.e., pairwise mating between males and females) but not always completed due to insufficient broodstock and conflict between production and conservation goals.

"The hatchery met production goals in 6 of 9 years, but wild-type genetic integrity of hatchery fish was degraded every year.

"Specifically, we analyzed 10 microsatellites and observed a 60% reduction in the effective number of breeders in the hatchery.

Hatchery fish consequently displayed reduced genetic diversity and large temporal genetic divergence compared with wild counterparts. To ensure the benefit of conservation-based husbandry, spawning protocols should be based on scientific theory and be practical within the physical and biological constraints of the system. Finally, if conservation issues are considered to be the most important issue for hatchery propagation, then production goals may need to be forfeited.

"The goal of this study was to evaluate whether broodstock management at the AFTC hatchery maintained wild-type genetic characteristics in hatchery fish used to supplement the steelhead population in Abernathy Creek.

Blouin 2003: "Non-local domesticated hatchery summer-run steelhead achieved 17-54% the lifetime fitness of natural native fish."

Blouin 2009: "If anyone ever had any doubts about the genetic differences between hatchery and wild fish, the data are now pretty clear. The effect is so strong that it carries over into the first wild-born generation. Even if fish are born in the wild and survive to reproduce, those adults that had hatchery parents still produce substantially fewer surviving offspring than those with wild parents. That's pretty remarkable."

Blouin 2009: "The implication is that hatchery salmonids – many of which do survive to reproduce in the wild– could be gradually reducing the fitness of the wild populations with which they interbreed. Those hatchery fish provide one more hurdle to overcome in the goal of sustaining wild runs, along with problems caused by dams, loss or degradation of habitat, pollution, overfishing and other causes. Aside from weakening the wild gene pool, the release of captive-bred fish also raises the risk of introducing diseases and increasing competition for limited resources."

Blouin 2009: "There is about a 40% loss in reproductive fitness for each generation spent in a hatchery."

Blouin 2012: Rapid Adaptation to Captivity in Steelhead. We previously demonstrated that first and second generation hatchery steelhead from the Hood River have lower fitness in the wild than do wild fish, and that the difference between first and second generation fish is genetically based. Furthermore, wild-born fish have lower fitness if their parents were first-generation hatchery fish. The mechanism for these fitness declines has remained elusive, but hypotheses include: environmental effects of captive rearing, inbreeding among close relatives, relaxed natural selection, and unintentional domestication selection (adaptation to captivity). We used a multigenerational pedigree analysis to demonstrate that domestication selection can explain the precipitous decline in fitness observed in hatchery steelhead released into the Hood River, Oregon. After returning from the ocean, wild-born and first-generation hatchery fish were used as broodstock in the hatchery. First-generation hatchery fish had higher reproductive success (measured as the number of returning adult offspring) when spawned in captivity than did wild fish spawned under identical conditions, which is a clear demonstration of adaptation to captivity. We also documented a tradeoff among the wild-born broodstock: those with the greatest fitness in a captive environment produced offspring that performed the worst in the wild. These results demonstrate that a single generation in captivity can result in a substantial response to selection on traits that are beneficial in captivity but maladaptive in the wild. Circumstantial evidence points to crowding in the hatchery as a potential selective mechanism.

Bottom et all (2009) "The long, slow decline of wild native coho salmon was overshadowed by the short-term success of hatcheries that were managed as mass production facilities"

Bowles 2008: "Hatchery programs are not a substitute for, or an alternative to, achieving a viable wild population according to NOAA Fisheries' Hatchery Policy. Instead, any hatchery programs have to support natural production."

"The threats to wild populations caused by **stray hatchery fish** are well documented in the scientific literature. Among the impacts are substantial genetic risks that affect the fitness, productivity and genetic diversity of wild populations. Genetic risks increase substantially when the proportion of the adult population that is hatchery fish **increases over 5%** (Lynch and O'Hely 2001, Ford 2002)."

"Hatchery programs also pose ecological risks to wild populations that can further decrease abundance and productivity (reviewed by Kostow 2008). The level of risk is related to both the proportion of the fish in a basin that are hatchery fish and to the source of the hatchery fish. Ecological risks due to the presence of hatchery adults (including adults of a different species) have been demonstrated when the proportion that is hatchery fish is over 10% (Kostow and Zhou 2006).

"In comparison to these risk levels, the proportion of adults in the Deschutes that are out-of-basin hatchery steelhead has been as high as 73%, while the proportion in the lower John Day has been as high as 30% (note that additional out-of-basin stray hatchery Chinook are also present in these basins and also may contribute to the ecological risks). Threats to productivity and genetic diversity are particularly critical when the hatchery fish originate from a substantial distance away from the natal basin of the wild population (Reisenbichler 1988, Waples 1995). This increased threat applies to the Deschutes and John Day populations since the stray hatchery fish are from a different DPS, primarily the Snake River DPS."

"The recovery plan for Oregon populations in the Mid-Columbia Steelhead DPS found that out-of-basin hatchery strays are a primary threat to Deschutes River and John Day River steelhead populations (Carmichael et al. 2008). According to the recovery plan, the Mid-Columbia Expert Panel found, regarding these strays, that 'The principal concern relates to a continuing detrimental impact of stray hatchery fish in natural spawning areas on the genetic traits and productivity of naturally produced steelhead'(Carmichael et al. 2007, section 8.1.2)."

"Origin of broodstock will not alleviate ecological hatchery risks (Kostow and Zhou 2006), and by itself it may not be enough to substantially reduce genetic risks."

"While it is reasonable to expect that a substantial decrease in hatchery fraction would contribute to recovery, the proposed hatchery actions for most of the populations are just a change in broodstock. A population that is supported by a hatchery program is not "trending toward recovery" until the hatchery influence can be removed and the wild population is demonstrated to be self-sustaining without it."

Brannon et al. 1999: (Independent Scientific Advisory Board) : "The three recent independent reviews of fish and wildlife recovery efforts in the Columbia River Basin addressed hatcheries. There was consensus among the three panels (National Fish Hatchery Review Panel, National Research Council, Independent

Science Group), which underscores the importance of their contributions in revising the scientific foundation for hatchery policy. The ten general conclusions made by the panels are listed below.

1. Hatcheries generally have failed to meet their objectives
2. Hatcheries have imparted adverse effects on natural populations
3. Managers have failed to evaluate hatchery programs
4. Rationale justifying hatchery production was based on untested assumptions.
5. Hatchery supplementation should be linked with habitat improvements
6. Genetic considerations have to be included in hatchery programs.
7. More research and experimental approaches are required.
8. Stock transfers and introductions of non-native species should be discontinued.
9. Artificial production should have a new role in fisheries management.
10. Hatcheries should be used as temporary refuges rather than for long-term production.

Braun et al. 2015: "While we found that genetic differences among populations and life history diversity are correlated with asynchrony and response diversity, human impacts on salmon populations, including dams (McClure et al. 2008a), hatcheries and fishing (McClure et al. 2008b), continue to erode biological diversity in salmon populations (Waples et al. 2009). For example, the dynamics of populations impacted by dams and hatcheries are becoming increasingly synchronous (Moore et al. 2010, Carlson and Satterthwaite 2011)."

Braun, Douglas C., Jonathan W. Moore , John Candy and Richard E. Bailey. 2015. Population diversity in salmon: linkages among response, genetic and life history diversity. Ecography 38: 001–012, 2015

Brauner 1994: "In freshwater swimming velocity tests, wild coho salmon smolts swam faster than hatchery fish. In seawater hatchery fish performance compared to wild fish was poor. Hatchery fish had more difficulty osmoregulating."

Brenner 2012 "…straying can mask patterns in the productivity of recipient populations"

Briggs 1953: ""It was possible to obtain some indications of the efficiency of artificial propagation through information supplied by state and federal agencies engaged in fish cultural operations in the three Pacific coast states and in New Zealand. For the portion of the life cycle up to the free-swimming fry stage, the survival of individuals was computed, beginning with the eggs which were brought upstream by the mature females. Utilizing the small amount of information available, a crude percentage survival was calculated as follows: Silver salmon, 58.5; king salmon, 65.1, and steelhead trout, 47.8 percent. These percentages may be compared to the survival data for the same three species under natural conditions in Prairie Creek: Silver salmon, 74.3; king salmon, 86.0, and steelhead trout, 64.9 percent. Therefore, there is no doubt that, during the period of study, substantially more young fish were introduced as fry into Prairie Creek via natural propagation than could be supplied through standard hatchery methods utilizing the entire run in the creek.

Buhle et al. 2009: "Our analyses highlight four critical factors influencing the productivity of these populations: (1) negative density-dependent effects of hatchery-origin spawners were ~5 times greater than those of wild spawners; (2) the productivity of wild salmon decreased as releases of hatchery juveniles increased; (3) salmon production was positively related to an index of freshwater habitat quality; and (4) ocean conditions strongly affect productivity at large spatial scales, potentially masking more localized drivers. These results suggest that hatchery programs' unintended negative effects on wild salmon populations, and their role in salmon recovery, should be considered in the context of other ecological drivers."

"We found that wild populations of Oregon coast coho salmon responded to changing hatchery practices during the 1990s. Productivity, expressed as the per capita growth rate in the absence of harvest, improved with reductions in the density of hatchery origin fish spawning in the wild and the numbers of hatchery smolts released into rivers. The strongest negative effects of hatcheries were associated with hatchery-reared adults breeding in the wild, precisely the pathway that might be expected to contribute most to population rebuilding."

Byrne et al. 1992: "Building more hatcheries should cause alarm to biologists concerned with the preservation of native stocks until it is demonstrated that supplementation can be done in a way that does not reduce fitness of the native stock."

"It is unlikely that hatchery propagation, no matter how enlightened, can optimize traits necessary for the long-term survival of steelhead in a natural stream."

Byrne and Copeland 2012: "Given the SAR (smolt to adult survival) rates measured during the study period and plausible over-winter survival rates in the study streams, we predicted that the observed juvenile production would produce few adults and would not result in a self-sustaining population. This conclusion was corroborated by adult return data. We found no evidence that adult outplanting increased wild population levels, i.e., there was no demographic boost in adult spawners. Further, the differences between the two study streams showed that supplementation programs should carefully assess each target stream.

"Even the most well-planned supplementation programs may have unpredictable consequences and should be carefully monitored to avoid negative effects (Naish et al. 2008). Unfortunately, evaluations of *ad hoc* adult outplant programs are seldom done. Decisions to introduce hatchery reared adults for spawning in the wild should be based on the needs of the target population and the ability of the habitat to support additional reproduction and rearing (ISAB 2002)."

Carlson and Satterthwaite 2011 "Hatcheries…have inadvertently impacted naturally spawning stocks."

Caroffino, David C. et al. 2008: "Through genetic monitoring of two year classes, we determined that hatchery adults produced 1.3-6.2 times as many age-2 juveniles per female than naturally spawning fish. Survival of stocked fry of parents born in a hatchery relative to those of parents born in the wild was 70% in paired-stocking comparisons. These results suggest that stocking local-origin fry can increase the short term abundance of depleted populations and that fish with no hatchery history are a better source for supplemental stocking. Additionally, sampling small numbers of adults for broodstock created genetically distinct groups, which could potentially cause long-term genetic change to the population. Genetic monitoring of adults will be essential to determining whether differences observed persist through the life cycle of the stocked fish."

Chilcote et al. 1986: "The success of hatchery fish in producing smolt offspring was only 28% of that for wild fish. We also found that 62% of the naturally produced summer-run smolts were offspring of hatchery spawners. Their dominance occurred because hatchery spawners within the watershed we examined effectively outnumbered wild spawners by at least 4 .5 to 1. We suggest that, under such conditions, the genetic integrity of wild populations may be threatened."

Chilcote 2002: Based upon a multiple regression analysis, recruitment and productivity in 12 naturally reproducing populations of Oregon steelhead were found to be significantly influenced by four variables, one of which was the level of hatchery fish in the spawning population. It appeared that the presence of hatchery fish depressed overall population productivity, reduced the number of recruits, and lowered the fitness of wild fish. This negative effect was insensitive to the type of hatchery fish. Although hatchery fish represented in five of the study populations were from hatchery broodstocks developed from local wild populations and managed in a manner to avoid domestication, the advantages of this strategy were not apparent. The negative effect of hatchery fish on natural production was not trivial. For example, in a mixed population where hatchery fish comprised 30% of the spawning population, the number of recruits produced was 1/3 less than in a population comprised entirely of wild fish. A variety of supplementation simulations, based upon these findings, demonstrated that the recruitment response of natural populations to the addition of naturally spawning hatchery fish was very weak and carried the additional penalty of reducing the genetic fitness of the wild fish. Various genetic and non-genetic explanations for these results were explored, including the consequences of reduced genetic diversity in hatchery populations as a result of having fewer families than would be found for a wild population of similar size. The management implications of these results are that hatchery steelhead, regardless of their broodstock type, are poor substitutes for wild fish in their natural environments. The addition of hatchery spawners to the natural environment does not appear a useful tool for rebuilding depressed populations of wild steelhead. These results support the view that hatchery programs should be managed to minimize the number of hatchery fish that spawn and rear in natural habitats.

Chilcote 2002: "…there will be little benefit to bringing some of the wild fish into the hatchery environment if the resulting hatchery smolts will have ocean survival rates that are 1/10 of those for wild smolts….all indications are that hatchery fish, even from wild broodstocks, are not as successful as wild fish in producing viable offspring under natural conditions…."

Chilcote 2003: "Naturally spawning population comprised of equal numbers of hatchery and wild fish would produce 63% fewer recruits per spawner than one comprised entirely of wild fish. For natural populations, removal rather than addition of hatchery fish may be the most effective strategy to improve productivity and resilience."

Chilcote 2003: "…straying may lead to maladaptive gene flow into recipient populations."

Chilcote 2008**:** **"**At a recent meeting of lower Columbia River Salmon Recovery Stakeholders, the document , *Recovery Strategies to Close the Conservation Gap Methods and Assumptions,* hatchery fish impacts are discussed. It says, "…relative population survival rates (recruits produced per spawner) were found to decrease at a rate equal to or greater than the proportion of hatchery fish in the natural spawning population. In other words, a spawning population with 20% hatchery strays (regardless of the type of hatchery program and whether they are integrated or segregated) had the net survival rate (recruits per spawner) that was 20% less than a population comprised entirely of wild fish (0% hatchery strays). Likewise, a population with 40% hatchery strays had a population survival rate that was 40% lower than a population comprised entirely of wild fish."

Chilcote et al. 2011, 2013: "We found a negative relationship between the reproductive performance in natural populations of steelhead, coho, and Chinook salmon and the proportion of hatchery fish in the spawning population. We used intrinsic productivity as estimated from fitting a variety of recruitment models to abundance data for each population as our indicator of reproductive performance. The magnitude of this negative relationship is such that we predict the recruitment performance for a population comprised entirely of hatchery fish would be 0.128 of that for a population comprised entirely of wild fish. The effect of hatchery fish was the same among all three species. Further, the impact of hatchery fish from 'wild type' hatchery broodstocks was no less adverse than hatchery fish from traditional, domesticated broodstocks. We also found no support for the hypothesis that a population's productivity was affected by the length of exposure to hatchery fish. In most cases, measures that minimize the interactions between wild and hatchery fish will be the best long-term conservation strategy for wild populations."

Christie et al. 2011: "These results demonstrate that a single generation in captivity can result in a substantial response to selection on traits that are beneficial in captivity but severely maladaptive in the wild. We also documented a tradeoff among the wild-born broodstock: Those with the greatest fitness in a captive environment produced offspring that performed the worst in the wild."

Christie et al. 2014: Here, we review recent studies on the reproductive success of such 'early-generation' hatchery fish that spawn in the wild. Combining 51 estimates from six studies on four salmon species, we found that

(i) early-generation hatchery fish averaged only half the reproductive success of their wild-origin counterparts when spawning in the wild,

(ii) the reduction in reproductive success was more severe for males than for females, and

(iii) all species showed reduced fitness due to hatchery rearing. We review commonalities among studies that point to possible mechanisms (e.g., environmental versus genetic effects).

Furthermore, we illustrate that sample sizes typical of these studies result in low statistical power to detect fitness differences unless the differences are substantial. This review demonstrates that reduced fitness of early-generation hatchery fish may be a general phenomenon. Future research should focus on determining the causes of those fitness reductions and whether they lead to long-term reductions in the fitness of wild populations.

<u>Christie et al. 2016:</u> "…we measured differential gene expression in the offspring of wild and first-generation hatchery steelhead trout (Oncorhynchus mykiss) reared in a common environment. Remarkably, we find that there were 723 genes differentially expressed between the two groups of offspring.

We find that there are hundreds of genes that are differentially expressed (DE) between the offspring of wild fish (WxW) and of the offspring of hatchery fish (HxH) reared in a common environment. By using reciprocal crosses, we further show that these differences in gene expression cannot be explained as maternal effects, sampling noise, or false discovery. Thus, our data suggest that the very first stages of domestication are characterized by massive, heritable changes to gene expression. That the DE genes were dominated by pathways in wound repair, immunity and metabolism adds to growing evidence that adaptation to crowded conditions is an important early stage of domestication.
The large extent of divergence that occurs at the gene-expression level, but not at the genomic level, suggests that selection and not genetic drift is responsible for the large differences in expression detected between the offspring of wild and first-generation hatchery fish.

"Taken together, these results suggest that rearing density may play an important role in facilitating genetic adaptation to captivity, and that adjusting to large numbers of conspecifics may be an important first step towards domestication.

"O. mykiss are one of the few fish species considered to have been fully domesticated31. Phenotypic responses to selection routinely occur in this species with less than ten generations of captive breeding. However, this is the first study to demonstrate that the earliest stages of domestication are characterized by large changes in heritable patterns of gene expression. As subsequent generations of domestication accrue, we speculate that the regulatory changes to expression become codified with gradual and more targeted shifts in allele frequencies (for example, selective sweeps). We hypothesize that adaptation to crowded conditions may drive much of this early domestication. Regardless of the mechanism, it is remarkable that a single generation of domestication can translate into heritable differences in expression at hundreds of genes.

<u>de Eyto et al. 2016:</u> "In Burrishoole, the most important determinant of freshwater survival of salmon was the deleterious effect of hatchery fish in the spawning cohort for salmon. While stocking is seen by many as a possible management action to conserve and bolster stocks, evidence continues to mount that where a wild population is present, and habitat is available, stocking is misguided."

<u>Dickson 1982</u>: "Juvenile hatchery fish show a behavioral shift in stream feeding position compared to wild fish. Hatchery fish feed nearer the surface. This may expose them to greater predation."

<u>Ersbak et al. 1983:</u> "Hatchery trout conditions declined after stocking. Hatchery fish were less flexible in switching to available food in the stream."

<u>Fenderson, 1968</u>: "Hatchery fish are more aggressive and dominate wild fish, and hatchery fish have a higher mortality."

Flagg and Nash, 1999: "The reviews conclude that artificial culture environments condition salmonids to respond to food, habitat, conspecifics and predators differently than fish reared in natural environments. It is now recognized that artificial rearing conditions can produce fish distinctly different from wild cohorts in behavior, morphology, and physiology."

Fleming and M.R. Gross 1993: "The divergence of hatchery fish in traits important for reproductive success has raised concerns. This study shows that hatchery coho salmon males are competitively inferior to wild fish, and attained only 62% of the breeding success of wild males. Hatchery females had more difficulty in spawning than wild fish and hatchery fish had only 82% of the breeding success of wild fish. These results indicate hatchery fish may pose an ecological and genetic threat to wild fish."

Fleming et al. 1994: "Results of this study imply that hatchery fish have restricted abilities to rehabilitate wild populations, and may pose ecological and genetic threats to the conservation of wild populations."

Fleming et al. 1997: "Reproductive success defined in the study as the ability to produce viable eyed embryos did not differ between hatchery and natural females. Hatchery males, however, achieved only 51% the estimated relative reproductive success of natural males under conditions of mutual competition. Hatchery males were less able to monopolize access to spawning females and suffered more severe wounding and greater mortality than natural males."

Fleming and Einum 1997: "Our results thus indicate that the farming of Atlantic salmon can generate rapid genetic change in fitness related traits as a result of domestication due to intentional and unintentional selection. As much of this change appears to be an adaptive response to the culture environment, it can be of value for programmes attempting to improve aquaculture production (e.g. Doyle *et al.,* 1991). This change, however, is a threat to wild populations when these fish escape, and compete and breed with wild salmon. The invasion of escaped farmed salmon into rivers not only increases competition for resources, but also results in the infusion of different genetic traits into wild populations. Many of these traits are likely to be maladaptive for the local environment both because of the non-indigenous origins of the farmed salmon (Einum and Fleming, 1997) and because of the changes that have occurred due to culturing. While natural selection may be able to purge wild populations of such maladaptive traits, its actions are severely hindered by the year-after-year introgression of farmed salmon. The net result is almost certainly a decline in population fitness, as the influence of selection from the culture environment overrides that in the wild."

Fleming et al. 2000: "The farm fishes were competitively and reproductively inferior, achieving less than one–third the breeding success of the native fishes. However, evidence of resource competition and competitive displacement existed as the productivity of the native population was depressed by more than 30%. Ultimately, the lifetime reproductive success (adult to adult) of the farm fishes was 16% that of the native salmon. Our results indicate that such annual invasions have the potential for impacting on population productivity, disrupting local adaptations and reducing the genetic diversity of wild salmon populations."

Flick, et al. 1964: "Wild brook trout had higher summer and winter survival than hatchery fish."

Ford, 2002: "Substantial phenotypic changes and fitness reductions can occur even if a large fraction of the captive broodstock is brought in from the wild every generation. This suggests that regularly bringing wild-origin broodstock into captive populations cannot be relied upon to eliminate the effects of inadvertent domestication selection."

Ford 2010: "What is known from peer-reviewed scientific studies on the impact of hatchery salmonids on wild salmonids? Hatchery fish reproductive success is poor; there is a large scale negative correlation between the presence of hatchery fish and wild population performance; hatchery fish reproductive success is lower than for wild fish and this is true for both supplementation and production hatchery programs; there is evidence of both environmental and heritable effects; effects were detected for both release and proportion of hatchery spawners; negative correlations between hatchery influence and wild productivity are widespread; habitat or ocean conditions do not appear to explain the pattern; current science indicates that limiting natural spawning of hatchery fish is generally beneficial to wild populations; there is evidence that reducing hatchery production leads to increased wild production, and cumulative effects of hatchery could be a factor limiting recovery of some ESUs."

Fraser, D.J., A.M. Cook, J.D. Eddington, P. Bentzen, and J.A. Hutchings. 2008. Mixed evidence for reduced local adaptation in wild salmon resulting from interbreeding with escaped farmed salmon: complexities in hybrid fitness. *Evolutionary Applications 1(3): 501-512.*

Interbreeding between artificially-selected and wild organisms can have negative fitness consequences for the latter. In the Northwest Atlantic, farmed Atlantic salmon recurrently escape into the wild and enter rivers where small, declining populations of wild salmon breed. Most farmed salmon in the region derive from an ancestral source population that occupies a nonacidified river (pH 6.0–6.5). Yet many wild populations with which escaped farmed salmon might interbreed inhabit acidified rivers (pH 4.6– 5.2). Using common garden experimentation, and examining two early-life history stages across two generations of interbreeding, we showed that wild salmon populations inhabiting acidified rivers had higher survival at acidified pH than farmed salmon or F_1 farmed-wild hybrids. In contrast, however, there was limited evidence for reduced performance in backcrosses, and F_2 farmed-wild hybrids performed better or equally well to wild salmon. Wild salmon also survived or grew better at nonacidified than acidified pH, and wild and farmed salmon survived equally well at nonacidified pH. Thus, for acid tolerance and the stages examined, we found some evidence both for and against the theory that repeated farmed-wild interbreeding may reduce adaptive genetic variation in the wild and thereby negatively affect the persistence of depleted wild populations.

Habicht 2013: In the face of declining harvests and habitat changes, large salmon hatchery programs were developed in Alaska, British Columbia, and the Pacific Northwest…"

"These hatchery programs currently produce large numbers of fish that may pose ecological and genetic risks to wild populations (Reisenbichler and McIntyre 1977; Campton 1995; Naish et al. 2007; Grant 2012). "

"Recent studies show that hatchery rearing can reduce fitness in the wild (Kostow 2004; Araki et al. 2007, 2008) and that hybridization between hatchery and wild fish can lower the overall fitness of wild populations (Ford 2002)."

"One particular unwanted effect is interbreeding between hatchery-reared and wild fish."

Hilborn 1992: "Pacific salmon hatcheries have failed to deliver expected benefits and they pose the greatest single threat to the long-term maintenance of salmonids."

" Artificial production has negatively impacted wild stocks through many mechanisms, including competition for space and food, predation by hatchery fish on wild stocks, genetic effects, hatchery fish causing premature emigration of wild fish, introduction of disease and parasites, robbing of wild stocks for hatchery brood stock, hatchery structures as barriers to wild fish passage, the timing of the water budget, and stimulation or maintenance of fishing pressure by hatchery production."

" Hatcheries have impacted wild stocks primarily by making society believe that we could have intense fisheries, dams, and habitat loss, and have salmon by building hatcheries. The hatchery system on the Columbia has failed to mitigate or compensate…those hatcheries have not been able to rebuild or help maintain wild stocks."

"The disease resistance of wild fish has been eroded by crosses with hatchery fish (ODFW 1991b). Hatcheries throughout the Columbia have been plagued by disease problems (Goodman 1990), and these diseases have undoubtedly been transmitted to wild fish. For instance, Chapman et al. (1991) suggest that Snake River chinook salmon are heavily infected with bacterial kidney disease (BKD) as a result of large-scale hatchery programs on the Snake."

"Mitigation Myth —that is the belief that you can have
dams, logging, irrigation, grazing, etc., and have fish by using hatcheries."

Hilborn et al. 2000 *Transactions of the American Fisheries Society* 129:333–350, 2000
"The evidence suggests that the hatchery program in Prince William Sound replaced rather than augmented wild production."

"This analysis suggests that agencies considering the use of hatcheries for augmenting salmonids or other marine species should be aware of the high probability that wild stocks may be adversely affected unless the harvesting of the hatchery fish is isolated from the wild stocks and the hatchery and wild fish do not share habitat during their early ocean life."

"The program was conceived in a period of low abundance of wild fish, but by the time large-scale hatchery production came on-line the wild production had increased. Hatchery production increased and wild production then declined. In contrast, abundance of wild stocks in the three other pink-salmon-producing areas of Alaska increased as much and stayed high while wild production in PWS declined."

Hjort and Schreck 1982: "The results of this study also suggest a potential weakness in hatchery supplementation. Selection through hatchery environment and hatchery practices may be changing the overall phenotype of hatchery stocks, as well as the between-year variability of individual genotypes (as we found for transferrin). If these changes result in reduced performance of the donor stocks in other stream systems, practices designed to increase hatchery production must be weighed against the actual benefits to wild production."

Hulett et al. 1994: "Hatchery winter steelhead were about one-half as effective as wild winter-run steelhead in naturally producing smolt offspring. Hatchery winter steelhead were about one sixth as effective as wild winter steelhead in naturally produced adult offspring."

Independent Economic Advisory Board (IEAB) 2002: "Augmentation and mitigation hatcheries, which seek to enhance fish harvests, can be judged by the cost incurred per additional fish harvested. The costs per harvested hatchery fish ranged from $23 for Priest Rapids fall chinook, to $55 per Spring Creek fall chinook, to $453 for Irrigon hatchery summer steelhead, to $1,051 for McCall summer chinook, to $4,800 - $68,031 at the Leavenworth hatchery complex."

Hatchery	**Species Produced**	**Cost of a Salmon that is caught**
Leavenworth	spring chinook	$4,800
Entiat	spring chinook	$68,031 (Highest $891,000)
Winthrop	spring chinook	$23,068
Priest Rapids	fall chinook	$12.00 (Highest - $293)

Irrigon	summer steelhead	$453	
Spring Cr.	fall chinook		$237 (range 14.53 - $460)
Clatsop	coho		$124
	Spring chinook		$233
	Fall chinook		$65
Nez Perce	fall and spring chinook		$3,700
McCall	spring chinook		$786 (range $522 to $1,051)

"The benefit of the fishery is $45 to $77 per fish for the commercial fishery and $60 per fish for the sport fishery"

ISAB 2002. "We believe that available empirical evidence demonstrates a potential for deleterious interactions, both demographic and genetic, from allowing hatchery-origin salmon to spawn in the wild. Because it is virtually impossible to 'undo' the genetic changes caused by allowing hatchery and wild salmon to interbreed, the ISAB advocates great care in permitting hatchery-origin adult salmon to spawn in the wild."

ISRP 2011: ". The BACI analysis found that productivity in the Imnaha River had decreased relative to all nine unsupplemented sites. The ISRP concludes that a conservation benefit in terms of NOR abundance is unlikely from supplementation. Based on the analysis of productivity loss in the Imnaha River, the ISRP concludes that costs to population fitness are likely.

"Hatchery-origin adults spawning in the stream produced parr at slightly higher rates than natural-origin fish (1.03:1), produced smolts at an equal rate (1:1), but produced adults at a lower rate (0.77:1)."

"The supplementation projects as they are currently conducted with high proportions of hatchery fish in the hatchery broodstock and on the natural spawning grounds are likely compromising the long-term viability of the populations."

"Over the long-term, however, hatchery-dominated programs that are implemented to reduce extinction risk will result in genetic changes owing to domestication selection and drift that are likely to offset any demographic benefit."

Johnson et al. 2013: "Our findings of genetic introgression suggest that temporospatial overlap can occur between naturally spawning summer and winter steelhead in UWR subbasins, and that assortative mating and current management have not entirely prevented hybridization between native and introduced *O. mykiss* stocks. Interbreeding with hatchery summer steelhead could lower the fitness of native UWR winter steelhead, as hatchery-reared Skamania stock summer steelhead have low fitness in the wild (Chilcote et al. 1986; Kostow et al. 2003; Leider et al. 1990)."

Jonsson et al. 1993: "Differences were evident for hatchery Atlantic salmon relative to wild salmon, with common genetic backgrounds, in breeding success after a single generation in the hatchery. Hatchery females averaged about 80% the breeding success of wild females. Hatchery males had significantly reduced breeding success, averaging about 65% of the success of wild males."

Jonsson and Jonsson 2002: "During the past 150 years, (hatchery) enhancement and supplementation have become essential parts of salmonid management. Interaction is likely to have a negative effect on the viability of wild populations."

Jones and Cornwall 2018: "…ODFW discontinued a coho salmon hatchery program… to support recovery of a wild Coho Salmon population… (1) adult abundance increased and (2) spawning time expanded and moved closer to the historic timing. "The results indicate that hatchery closure can be an effective strategy to promote wild population recovery."

Keefer Caudill (2014) Homing and Straying by Anadromous salmonids: A Review of mechanisms and rates "In many anadromous salmonid producing regions around the world strays from large donor hatchery populations are a significant threat to recipient wild populations."

"Most recipient-based estimates have substantiated concerns that wild populations are vulnerable to swamping by abundant hatchery and farm-raised strays"

Kliess 2004: "Salmonid management based largely on hatchery production, with no overt and large-scale ecosystem-level recovery program, is doomed to failure. Not only does it fail to address the real causes of salmonid decline, but it may actually exacerbate the problem and accelerate the extinction process."

Knudsen et al. 2006. "Perhaps the most important conclusion of our study is that even a hatchery program designed to minimize differences between hatchery and wild fish did not produce fish that were identical to wild fish."

Knudsen et al. 2008: "Consequently, in this project, on a per capita basis hatchery-origin females are a minimum of 6-7% less fit than wild fish owing to lower fecundity. This demonstrates that hatcheries do not produce fish that are identical to wild fish."

Kostow 2003 : "Our data support a conclusion that hatchery summer steelhead adults and their offspring contribute to wild steelhead population declines through competition for spawning and rearing habitats. We conclude that even though naturally spawning hatchery steelhead may experience poor reproductive success, they and their juvenile progeny may be abundant enough to occupy substantial portions of spawning and rearing habitat to the detriment of wild fish populations. Therefore, the large numbers of introduced summer steelhead would have competed heavily with wild winter steelhead for habitat resources, and this may have contributed to their decline. In the Clackamas basin, smolt offspring of hatchery fish appear to have wasted the production from natural habitat because very few return as adults." (emphasis added)

Kostow 2004: "In conclusion, this study demonstrated large average phenotype and survival differences between hatchery-produced and naturally produced fish from the same parent gene pool. These results indicate that a different selection regime was affecting each of the groups. The processes indicated by these results can be expected to lead to eventual genetic divergence between the new hatchery stock and its wild source population, thus limiting the usefulness of the stock for conservation purposes to only the first few generations."

Kostow 2011 "Hatchery programs for Pacific Salmon and Steelhead cause ecological risks to wild fish populations when the presence of hatchery fish detrimentally affects how wild fish interact with others of their own species, with their environment, or with other species."

"Some of the most commonly observed risks are direct predation of wild fish by hatchery fish; (Parker 1971); Hargreaves and Le Brasseur 1986; Hawkins and Tipping 1999); Dudiak per comm., competition between hatchery and wild fish, (Nickleson et al. 1986; Nielsen 1994), attraction of other predator species, particularly when hatchery fish are concentrated in time and space, Collins et al. 1995: Nickelson 2003), density dependant effects triggered by large numbers of hatchery fish in fresh water and marine environments (Emlen et al 1990; Kostow and Zhou 2006; Buhle et al. 2009), and disease transmission (Johnsen and Jensen 1986; Bartholomew and Reno 2002; Krkosek et al. 2005).

Kostow and Zhou 2006: "In the Clackamas River basin, the summer steelhead hatchery adults had poor reproductive success; fewer smolts were produced per parent than in the wild population, and almost no offspring of hatchery fish survived to adulthood (Kostow et al. 2003). The hatchery program was meant to provide a sport fishery, and the production of adult offspring was not intended. If successful hatchery reproduction had occurred, at least the offspring could have contributed to fisheries. Instead, the hatchery fish wasted basin capacity by occupying habitat and depressing wild production while producing nothing useful themselves. It is not unusual for hatchery adults to have poor reproductive success when they spawn naturally (other examples are provided by Reisenbichler and Rubin 1999, Kostow 2004, and McLean et al. 2004). The combined effect of poor hatchery fish fitness and depressed wild fish production due to competition with the hatchery fish poses a double jeopardy that could quickly erode natural production in any system."

Leider, et. al., 1990: "The mean percentage of offspring from naturally spawning hatchery steelhead decreased at successive life history stages, compared to wild steelhead, from a potential of 85-87% at the egg stage to 42% at the adult stage. Reproductive success of naturally spawning hatchery steelhead compared to wild steelhead decreases from 75-78% at the subyearling stage to 10.8-12.9% at the adult stage."

Levings, et al., 1986: "Hatchery chinook used the estuary a shorter period of time than wild chinook. The greatest overlap between hatchery and wild chinook in the estuary is in the transition zone where greater competition could occur."

Lynch and O'Hely 2001: "Our results suggest that the apparent short-term demographic advantages of a supplementation program can be quite deceiving. Unless the selective pressures of the captive environment are closely managed to resemble those in the wild, long-term supplementation programs are expected to result in genetic transformation that can eventually lead to natural population no longer capable of sustaining themselves."

Marchetti and Nevitt. 2003: "Our work may suggest a mechanistic basis for the observed vulnerability of hatchery fish to predation and their general low survival upon release into the wild. The brains of hatchery raised rainbow trout are smaller in 7 out of 8 critical neuroanatomical measures than those of their wild reared counterparts. Our results are the first to highlight the effects of hatchery rearing on changes in brain development in fishes."

Mason, et al., 1997: "Hatchery x wild and wild x wild crosses had higher survival in the natural stream compared to hatchery x hatchery crosses."

McClure et al. 2008: "Continued interbreeding with hatchery-origin fish of lower fitness can lower the fitness of the wild population. Generally, large, long-term hatchery programs that dominate production of a population is a high risk factor for certain viability criteria and can lead to increased risk for the population. The populations meeting 'high viability' criteria will necessarily be large and spatially complex. In order to meet these criteria (spatial structure and diversity) there should be little or no introgression between hatchery fish and the wild component of the population. Populations supported by hatchery supplementation for more than three generations do not in most cases meet ICTRT viability criteria at the population level."

"Artificial propagation does not contribute to increased natural productivity needed for viability, and appears in most cases, to erode productivity of wild populations."

McLean et al. 2004: "Hatchery steelhead spawning in the wild had markedly lower reproductive success than native wild steelhead. Wild females that spawned in 1996 produced 9 times as many adult offspring per capita as did hatchery females that spawned in the wild. Wild females that spawned in 1997 produced 42 times as many adult offspring as hatchery females. The wild steelhead population more than met replacement requirements (approximately 3.7 – 6.7 adult offspring were produced per female), but the hatchery steelhead were far below replacement (<0.5 adults per female)."

McMichael et al. 1997: "Our results indicate that residual hatchery steelhead reduced the growth of wild resident rainbow trout during summer under controlled conditions. We infer that when hatchery steelhead become residuals, thus increasing local densities of salmonids for extended periods, the growth of sympatric wild rainbow trout growth is likely to decrease. A reduction in size, due to slower growth during the summer, could decrease overwinter survival (Hunt 1969; Toneys and Coble 1979, 1980; Oliver and Holeton 1979), resulting in decreased population size (Cunjak et al. 1987).

McMichael et al. 1999: "Hatchery steelhead behaviorally dominated wild O. mykiss in most situations. Hatchery steelhead were generally larger and behaved more aggressively and violently than wild fish, which may have contributed to their dominant status.

"Our study confirmed that releases of conventionally reared hatchery steelhead can pose ecological risks to preexisting wild populations.

"Acknowledging that releases of hatchery salmonids may affect preexisting wild salmonid populations is an important step toward protection and recovery of imperiled populations of wild anadromous salmonids. Thorough evaluation of current hatchery programs and implementation of rigorous monitoring programs should be required in watersheds where depressed stocks of wild salmonids occur, even though these precautions will not ensure that wild stocks are protected or restored (Waples 1999)."

Meffe 1992: "Countless salmon stocks have declined precipitously over the last century as a result of overfishing and widespread habitat destruction. A central feature of recovery efforts has been to build many hatcheries to produce large quantities of fish to restock streams. This approach addresses the symptoms but not the causes of the declines."

Miller, R. B. 1953: "Hatchery cutthroat trout had lower survival compared to wild fish due to absence of natural selection at early life stages."

Miller, W. H. et al. 1990: "Over 300 (hatchery) supplementation projects were reviewed and the authors found: 1) examples of success at rebuilding self-sustaining anadromous fish runs with hatchery fish are scarce (22 out of 316 projects reviewed), 2) success was primarily from providing fish for harvest, and 3) adverse impacts to wild stocks have been shown or postulated for every type of hatchery fish introduction to rebuild runs."

Miller L. M. 2004: "We have documented an early life survival advantage by naturalized populations of anadromous rainbow trout *Oncorhynchus mykiss* over a more recently introduced hatchery population and outbreeding depression resulting from interbreeding between the two strains. Averaging over years and streams, survival relative to naturalized offspring was 0.59 for hybrids with naturalized females, 0.37 for the reciprocal hybrids, and 0.21 for hatchery offspring. Our results indicate that naturalized rainbow trout are better adapted to the conditions of Minnesota's tributaries to Lake Superior so that they outperform the hatchery-propagated strain in the same manner that many native populations of salmonids outperform hatchery or transplanted fish. Continued stocking of the hatchery fish may conflict with a management goal of sustaining the naturalized populations.

Miller L. M. et al. 2014: "Reduced reproductive success of hatchery fish spawning in the natural environment will reduce the ability of stocking programs to enhance wild populations. . The reproductive success of hatchery females was significantly lower than that of wild females (approximately 60%) in all three study years; however, the reproductive success of hatchery males was only significantly lower in one year. Continued reliance on hatchery supplementation may hinder achievement of the long-term goal of a fishery supported largely by naturally reproducing populations."

Mobrand et al. 2005: "We concluded that hatcheries must operate in new modes with increased scientific oversight and that they cannot meet their goals without healthy habitats and self-sustaining naturally-spawning populations."

Moore et al. 2010: For a group of spatially distinct populations, synchrony in population dynamics can increase risk of simultaneous and global extinction. In contrast asynchronous population dynamics decrease extinction risk and may increase sustainability of long-term production from groups of populations. Pacific salmon exhibit fine-scale population structure and local adaptation to their natal habitats which likely contributes to asynchrony in population dynamics… artificial propagation programs may increase dispersal among populations, eliminating locally adapted life history variation. We document increased demographic synchrony among Chinook salmon populations within the Snake River region over the last 40 years, concurrent with increased intensity of human impacts…synchronization of Snake River salmon has compromised its performance. Management of spatially structured species can benefit from explicit consideration of population diversity.

"There was not only an increase in synchronization, but there was also a decrease in population productivity, further reducing portfolio (number of locally adapted stocks) performance.

"Chinook salmon populations within the Snake River Evolutionarily Significant Unit have become more synchronized; over 75% of the populations increased in synchrony over the last four decades.

"…hatchery releases, which increased substantially during the study period are associated with increased straying and decreased population structure. In addition, dams homogenize habitats and flow regimes, leading to the loss of habitat variability that maintains salmonid population diversity.

"Regardless of the underlying mechanisms, the observed increase in population synchrony has major conservation implications. First, the theory predicts that increased synchrony will increase extinction risk for the entire meta-population, which has already been identified as having a substantial risk of extinction.

"Improve salmon and steelhead management by 1) "Include population diversity as a goal for recovery; 2) Preserve the diverse habitats and natural processes that maintain response diversity. Preserving variable landscapes and the physical processes that maintain habitat variation will help maintain the different environmental conditions supporting adaptation and response diversity of phenotypic traits such as timing of migration and spawning; 3) Adjust artificial propagation programs to manage for response diversity. Reducing artificially inflated straying rates, using locally derived brood stock, and ensuring that hatchery-origin spawners are not overly represented on spawning grounds; 4) Manage harvest…to avoid depleting low productivity populations; 5) Monitoring should not just focus on currently productive populations but also include lower productivity populations."

Moran and Waples 2007: "…we show some compelling differences in reproductive success of hatchery and wild fish. Naturally spawning hatchery fish are less than half as productive as wild fish."

Mullan, "Mean hatchery spring chinook smolt to adult survival ranged from 0.16 to 0.55%, 1976-1988 compared to wild spring chinook survival rate of from 1.6 to 8.1%. Naturally produced smolts were about 10 – 80 times as viable as hatchery smolts."

Naish et al. 2008: "If one concern has been identified, it is that many hatchery programmes continue to be operated with few objectives, and with a poor understanding of the magnitude and importance of the impacts of genetic effects of hatchery releases and the role of this information in informing remedial actions."

"A rapidly growing body of literature points towards detrimental behavioural interactions between hatchery and wild fish. More is known about these interactions in freshwater rearing habitats than in estuarine and marine environments. There is also, however, a paucity of information on whether risk avoidance measures are effective at reducing competition and predation and, as far as we know, little attention is directed towards carrying capacity when the size of release is considered."

"stray hatchery-produced fish that breed with wild fish of a different lineage may compromise conservation objectives and confound escapement estimates by masking a lack of local natural production."

"Introduction of pollutants or stressors that alter disease ecology A final method by which hatcheries could increase disease risk to wild stocks is by altering the ecology of a watershed. Naturally, this would be most likely for large hatcheries on small watersheds (Tervet, 1981). Effects could range from changes in stream temperature by large inputs of hatchery water, or phosphorous or organic matter that can increase algal growth or lower dissolved oxygen levels. Such stressors could be expected to affect the host–pathogen relationship for endemic diseases among wild fish."

"hatchery fish may remain susceptible and could become infected with certain endemic pathogens following release. If large numbers of such fish suffer a significant disease outbreak while co-habiting with wild stocks they could generate sufficient infection pressure to produce an added risk to the unexposed portion of the wild stock; Such fish, infected later than their wild cohort, could also serve as carriers during in-river or ocean migration to infect portions of the wild stocks in areas where the disease is not endemic or at times at which it does not normally occur."

Naylor et al. 2005: "Interbreeding between wild and farmed fish can result in mixing gene pools if the hybrids can reproduce, and eventually can lead to a wild population composed entirely of individuals descended from hatchery fish. In a Norwegian study (Fleming et al. 2000), 55% of hatchery salmon in the experimental spawning population contributed 19% of the genes to adult fish in one generation later. Continued one-way gene flow at this rate would halve the genetic difference between hatchery and wild salmon every 3.3 generations and lead to rapid genetic homogenization."

Naylor et al. 2005: "In McGinnity and colleagues' (2003) recent farm release study in Ireland, the lifetime success of hybrids was only 27% to 89% as high as that of their wild cousins, and 70% of the embryos in the second generation died. These results provide strong evidence of how interbreeding might drive vulnerable salmon populations to extinction."

Naylor et al. 2005: "Aggressive farm and hybrid fish can also result in shifts of wild counterparts to poorer habitats, increasing mortality. The productivity of the native juvenile salmon population was depressed by more than 30% in the presence of farm and hybrid juveniles."

Naylor et al. 2005: "An earlier review (Hindar et al. 1991) of the genetic effects following releases of nonnative salmonids reached two broad conclusions. First, the genetic effects of intentionally or accidentally released salmonids on natural populations are often unpredictable and may vary from no detectable effects to complete introgression or displacement. Second, when genetic effects on performance traits (e.g. survival in fresh water and seawater) have been detected, they appear always to be negative in comparison with the traits of unaffected native populations."

Nickelson 1986: "Hatchery coho juveniles are more abundant after stocking in streams but the result is fewer adult returns and fewer juvenile coho salmon in the next generation than in streams that were not stocked."

Nickelson 2003: "Hatchery programs designed for harvest augmentation should be removed from basins with habitat that has high potential to produce wild salmonids. To aid recovery of depressed wild salmon, the operation of hatcheries must be changed to reduce interactions of hatchery smolts with wild smolts. A program that reduces harvest, restores habitat, and reduces hatchery effects is necessary."

NMFS 2010: "Hatchery production has been reduced to a small fraction of the natural-origin production. Nickelson (2003) found that reduced hatchery production led directly to higher survival of naturally produced fish, and Buhle et al. (2009) found that the reduction in hatchery releases of Oregon coast coho salmon in the mid1990's resulted in increased natural coho salmon abundance."

ODFW 2010: "Chilcote and Goodson examined data sets on population abundance for 121 populations of coho, steelhead, and Chinook in Oregon, Washington, and Idaho. They found that population productivity was inversely related to the average proportion of hatchery fish in the naturally-spawning population, consistent with the findings of Buhle et al. (2009). The magnitude of this effect was substantial. For example, a population comprised entirely of hatchery fish would have one tenth the intrinsic productivity of one comprised entirely of wild fish. There was no indication that the significance or strength of this relationship was different among the three species examined (chinook, coho and steelhead). In addition, there was no indication that the type of broodstock (integrated with the local natural-origin population versus segregated) affected the significance or intensity of the response." (Section 2: Updating the Scientific Information in the 2008 FCRPS BiOp May 20, 2010, Page 118 and Lower Columbia River Salmon Recovery Plan 9-2010 ODFW)

ODFW 2010a: "For example, the reduction in productivity between a population comprised entirely of wild fish and one comprised of equal numbers of hatchery and wild fish is 66 percent for steelhead, 76 percent for coho, and 43 percent for Chinook."

ODFW 2010b: "Hatchery programs have the potential to benefit or harm salmonid population viability by affecting abundance, productivity, distribution, and/or diversity. Hatchery related risks to salmon population viability include genetic changes that reduce fitness of wild fish, increase risk of disease outbreaks, and/or alter life history traits, and ecological effects—such as increased competition for food and space or amplified predation—that reduce population productivity and abundance. Hatcheries can also impose environmental changes by creating migration barriers that reduce a population's spatial structure by limiting access to historical habitat."

ODFW 2011: The study was able to determine that the F1 generation of coho released as unfed fry or as smolts both had a run time of 51 days compared to 73 days for wild-born fish. Coho released as smolts exceeded natural recruitment with a return rate of 3.1 to 3.5 per female compared to 1.3 to 1.4 per female for natural recruitment. Unfed fry varied with a recruitment rate of 1.0 and 2.0 per female. With the F2 generation, reproductive success (RS) was analyzed. The study found that compared to wild coho, the average reproductive success of progeny from the unfed fry releases which produced returning F2 coho was 38% lower for males and 16% lower for females. F2 coho from the smolts had even lower average reproductive success being 47% and 25% lower respectively than wild coho. Hatchery jacks however had a RS more equal to wild coho. The mechanism for the difference is still unknown. However since both unfed fry and smolts have reduced RS, artificial mating and early life-stages in the hatchery likely had some impact on later reproductive success.

Ó Maoiléidigh 2008**:** **"**We conclude that extensive stocking programmes undertaken in Ireland over the last thirteen years have made little real contribution to the productivity of Irish rivers or to the goals of restoring self-sustaining salmon runs. Furthermore, evidence from recent experiments suggesting that artificial introductions are likely to depress rather than enhance the productivity of natural populations, including feral or quasi-wild populations that have been established by successful hatchery programmes, suggests that more caution and planning is required before hatchery reared progeny are released into the wild .

Paquet et al. 2011: "Hatcheries are by their very nature a compromise – a balancing of benefits and risks to the target populations, other populations, and the natural and human environment they affect."

Perry, et al. 1993: "Idaho has been trying to unravel the secrets of hatchery and wild salmon interactions in nature. Since hatchery salmon do not survive as well as wild salmon, it is important to fix this problem. It is possible that a hatchery supplementation program may inadvertently replace the target natural population with one having lower survival and reproductive potential."

Reisenbichler, et al. 1977: His research shows that hatchery x hatchery crosses of steelhead fry survival was lower than for wild x wild crosses and wild x hatchery crosses in streams. Likewise he found that hatchery x hatchery crosses survived better in the hatchery environment. The hatchery fish were derived from local wild steelhead and had changed in performance in two generations of hatchery rearing. Conclusion: differences in survival suggested that the short-term effect of hatchery adults spawning in the wild is the production of fewer smolts and ultimately, fewer returning adults than are produced from the same number of wild steelhead spawners.

Reisenbichler 1986: "Most (hatchery fish) outplanting programs have been unsuccessful. Rigorous planning, evaluation, and investigation are required to increase the likelihood of success and the ability to promptly discern failure."

Reisenbichler 1992: "Because anadromous salmonids home to their natal streams to spawn, managers can expect the fish in different streams to be from genetically distinct stocks. We recommend that steelhead from different coastal drainages be considered and managed as distinct stocks."

Reisenbichler 1994: "Gene flow from hatchery fish also is deleterious because hatchery populations genetically adapt to the unnatural conditions of the hatchery environment at the expense of adaptedness for living in natural streams. This domestication is significant even in the first generation of hatchery rearing."

Reisenbichler 1996: "Available data suggest progressively declining fitness for natural rearing with increasing generations in the hatchery. The reduction in survival from egg to adult may be about 25% after one generation in the hatchery and 85% after six generations. Reduction in survival from yearling to adult may be about 15% after one generation in the hatchery and 67% after many generations."

Reisenbichler and Rubin 1999: "When the published studies and three studies in progress are considered collectively… they provide strong evidence that the fitness for natural spawning and rearing can be rapidly and substantially reduced by artificial propagation. This issue takes on great importance in the Pacific Northwest where supplementation of wild salmon populations with hatchery fish has been identified as an important tool for restoring these populations. Recognition of negative aspects may lead to restricted use of supplementation, and better conservation, better evaluation, and greater benefits when supplementation is used.

"Apparently domestic selection is often intense. The fitness of stream type chinook (spring chinook) salmon was diminished after four generations of culture, despite continuous gene flow from the wild population (on average, wild fish comprised 38% of the hatchery broodstock). The fitness of steelhead was diminished after only two generations in the hatchery (Reisenbichler and McIntyre, 1977). Presumably substantial change occurs in the first generation."

"These conclusions imply that supplementation (wherein wild fish interbreed with hatchery fish of reduced fitness) will reduce the productivity of naturally spawning populations, and often may compromise conservation objectives."

"Relative survival of hatchery steelhead continued to decline with age of the cohort, at least until after emigration as smolts. This decline suggests that the fitness of the next generation would be low even before interbreeding with more hatchery fish, and that continuous supplementation should progressively diminish the productivity of the naturally spawning population."

"The typical population proposed for supplementation is presumably one of low productivity which is substantially below carrying capacity. Continued supplementation of such a population may reduce its productivity so that the population even becomes dependent on supplementation and cannot replace itself otherwise."

Reisenbichler et al. 2004: "Genetic theory and data suggest that sea ranching (hatchery production) of anadromous salmonids (*Onchorhynchus spp.* and *Salmo spp.*) results in domestication (increased fitness in the hatchery program) accompanied by a loss of fitness for natural production. We tested for genetic differences in growth, survival, and downstream migration of hatchery and wild steelhead (*O.mykiss*) reared together in a hatchery. We found little or no difference in survival during hatchery rearing but substantial differences in growth and subsequent downstream migration. Intense natural selection after release from the hatchery favored fish that had performed well (e.g. grew fast) in the hatchery. This selection in the natural environment genetically changes (domesticates) the population because at least some of the performance traits are heritable. Domestication should improve the economic efficiency for producing adult hatchery fish but compromise conservation of wild populations when hatchery fish interbreed with wild fish."

RIST 2009: "Most information available indicates that artificially-propagated fish do have ecological impacts on wild salmonid populations under most conditions (e.g. a 50% reduction in productivity for steelhead in an Oregon population). To the degree that the trait distributions seen in wild salmon populations are adaptations to their environments, selection imposed by the hatchery environment could result in reduced fitness of hatchery fish in the wild."

Sergeant, 2017 "While preserving thermally suitable stream habitat for cold-water taxa facing climate change has become a land management priority, managers should also consider that some protected watersheds may still be at risk of increasingly frequent hypoxia due to human impacts such as water diversion and **artificially abundant salmon populations caused by hatchery straying."**

Scheuerell et al. 2015: Using 43 years of monitoring data, we asked whether 11–23 years of supplementation have increased the density of naturally produced adults (i.e., fish that were born in the wild, not reared in a hatchery) in 12 supplemented populations, and if so, by how much. We found that, on average, supplementation has increased adult density among the 12 supplemented populations by only 3.3%.

In the US Pacific Northwest, salmon hatcheries release about 400 million juveniles per year at a cost of roughly $40 million USD (Naish et al. 2008). Many of these fish are produced to meet tribal, commercial, or recreational harvest demands, or to mitigate for habitat loss.

Massive efforts are underway worldwide to conserve at risk species, and societies would like to know what they are getting for their investment.

Schenekar, Tamara and Steven Weiss 2017: Captive bred individuals are often released into natural environments to supplement resident populations. Captive bred salmonid fishes often exhibit lower survival rates than their wild brethren and stocking measures may have a negative influence on the overall fitness of natural populations. Stocked fish often stem from a different evolutionary lineage than the resident population and thus may be maladapted for life in the wild, but this phenomenon has also been linked to genetic changes that occur in captivity. In addition to overall loss of genetic diversity via captive breeding, adaptation to captivity has become a major concern. Altered selection pressure in captivity may favour alleles at adaptive loci like the Major Histocompatibility Complex (MHC) that are maladaptive in natural environments.

Our results support that stocking measures in autochthonous [native] populations should be avoided, especially with nonnative fish. If stocking measures are inevitable in natural habitats, ideally, locally established brood-stocks with local genetic material should be used. Adaptation to captivity should be minimized, e.g. by the continuous supplementation of new "natural" genetic material in order to keep the genetic composition of the captive population as close to its source population as possible. Nonetheless, genetic or epigenetic changes can begin in the first generation of captivity (Christie et al. 2016) and thus it appears to be extremely difficult or impossible to use hatchery operations in any capacity without risking deleterious effects to the wild population.

Schroder, et al. 2008: "Pedigree assignments based on microsatellite DNA, however, showed that the eggs deposited by wild females survived to the fry stage at a 5.6% higher rate than those spawned by hatchery females. Subtle differences between hatchery and wild females in redd abandonment, egg burial, and redd location choice may have been responsible for the difference observed. Other studies that have examined the effects of a single generation of hatchery culture on upper Yakima River chinook salmon have disclosed similar low-level effects on adult and juvenile traits. The cumulative effect of such differences will need to be considered when hatcheries are used to restore depressed populations of chinook salmon."

Seamons et al. 2012. "We tested the efficacy of the strategy of segregation by divergent life history in a steelhead trout, Oncorhynchus mykiss, system, where hatchery fish were selected to spawn months earlier than the indigenous wild population. The proportion of wild ancestry smolts and adults declined by 10–20% over the three generations since the hatchery program began. Up to 80% of the naturally produced steelhead in any given year were hatchery/wild hybrids.

"…proportions of hybrid smolts and adults were higher in years when the number of naturally spawning hatchery-produced adults was higher. Divergent life history failed to prevent interbreeding when physical isolation was ineffective, an inadequacy that is likely to prevail…"

"Controlling the behavior or breeding biology of captively reared animals released into the wild is one of the most significant issues for managers tasked with minimizing risks associated with captive rearing.

"Hatchery steelhead are intercepted and harvested downstream of the Forks Creek Hatchery, but harvest rates are clearly not sufficient to prevent large numbers of hatchery-produced fish from reaching spawning grounds. Indeed, the number of hatchery produced adults returning to the Forks Creek Hatchery equaled or exceeded the total number of wild fish estimated to be spawning in the entire Willapa River during the most recent three return years.

"Hatchery rearing may have negative fitness consequences even when the stocks are locally derived (Araki et al. 2007b, 2009). Nonlocal populations, like the hatchery broodstock used at Forks Creek, often have lower reproductive success than native wild populations because of a lack of local adaptation (Kostow et al. 2003; reviewed in Berejikian and Ford 2004; Araki et al. 2007a, 2008; Chilcote et al. 2011; Fraser et al. 2011). Interbreeding between hatchery and wild stocks could have long-term fitness consequences.

"One obvious solution is to reduce or cease production and release of steelhead from the hatchery; however, this option may be unpopular and difficult to implement. Physical segregation may be augmented by improving weirs. However, weirs or dams are costly and they affect the habitat to some extent. Flooding and debris compromise most weirs, allowing fish to bypass them. Even if barriers were completely effective at preventing upstream migration, the hatchery-produced fish might spawn elsewhere in the basin.

"Segregation by life history was thought to complement physical segregation, but our study shows that it failed to prevent genetic interactions between hatchery and wild steelhead populations. Thus, managers should also consider other options for minimizing interactions between wild and cultured animals."

Shrimpton, et al., 1994: "Juvenile hatchery coho showed a reduced tolerance to salt water compared to wild coho."

Slaney, et al., 1993: "Hatchery adult steelhead strayed more than wild steelhead."

Sosiak, et al., 1979: "As juveniles, hatchery fish had less stomach fullness and fed on fewer taxa than wild fish. This was determined after hatchery fish were in streams from one to three months."

Steward et al. 1990: Authors reviewed 606 hatchery supplementation studies and found that few directly assessed the effects on natural stocks. Genetic and ecological effects and changes in productivity of the native stocks that can result remain largely unmeasured. However, the general failure of supplementation to achieve management objectives is evident from the continued decline of wild stocks.

Swain, et al. 1991: Hatchery coho salmon diverged from the wild fish in fin size and body dimensions. These were considered adaptations to the hatchery environment.

Taylor, 1986: "Hatchery coho salmon diverged in body structure and variation from that of the wild coho."

Vincent 1987: Hatchery stocking ended in a Montana stream and wild trout more than doubled (160%) and the wild trout biomass increased by 10 times.

Theriault et al. 2011: "Supplementation of wild salmonids with captive-bred fish is a common practice for both commercial and conservation purposes. However, evidence for lower fitness of captive reared fish relative to wild fish has accumulated in recent years, diminishing the apparent effectiveness of supplementation as a management tool. To date, the mechanism(s) responsible for these fitness declines remain unknown. In this study, we showed with molecular parentage analysis that hatchery coho salmon (Oncorhynchus kisutch) had lower reproductive success than wild fish once they reproduced in the wild. This effect was more pronounced in males than in same-aged females. Hatchery spawned fish that were released as unfed fry (age 0), as well as hatchery fish raised for one year in the hatchery (released as smolts, age 1), both experienced lower lifetime reproductive success (RS) than wild fish.

Unwin and Glovia (1997) "Chinook salmon reared in hatcheries replace rather than supplement naturally occurring Chinook when they are introduced…leading to a loss of genetic diversity and local adaptive fitness leading to reduced survival in the estuary

Waples and Do 1994: Genetic interactions between hatchery and wild salmonids will increase as hatchery supplementation becomes a more dominate form of hatchery management.

Waples 1994: Hatchery captive brood stocks may shift genetic structure in natural populations.

Webster 1931: "To those of us interested in fisheries work, artificial propagation is never and should never be considered as replacing natural reproduction."

Williamson et al. 2010: Wenatchee River hatchery and wild spring chinook – "Hatchery-origin fish produced about half the juvenile progeny per parent when spawning naturally then did natural-origin fish. Hatchery fish tended to be younger and return to lower areas of the watershed than wild fish, which explained some of their lower fitness.

Wohlfarth 1986: Stocking with hatchery stocks cannot replace wild productivity because hatchery fish are selected for adaptation to the hatchery environment and do not perform well in the natural environment.

Wood, et al., 1960: Hatchery coho salmon 14 months after release into a stream did not reach the body composition of the wild salmon in time for downstream migration and had lower ocean survival.

Young, K. A. 2013: The debate over Atlantic salmon, Salmo salar L., stocking in Britain centres on the trade-off between enhancing rod fisheries and harming wild populations. This article informs the debate by quantifying the relationship between stocking and angler catch statistics for 62 rivers over 15 years. After controlling for environmental factors affecting adult abundance, the 42 rivers with stocking had non-significantly lower mean catch statistics than the 20 rivers without stocking. This difference increased with the age of stocked fish. Among stocked rivers, weak relationships between mean stocking effort and catch statistics also became more negative with the age of stocked fish. For stocked rivers, there was no evidence for a generally positive relationship between annual stocking efforts and catch statistics. Those rivers for which stocking appeared to improve annual rod catches tended to have lower than expected mean rod catches. The results suggest the damage inflicted on wild salmon populations by stocking is not balanced by detectable benefits to rod fisheries.

Zaporozhets: 2011. We document evidence of life history trait divergence between wild and hatchery salmon in Kamchatka region of the Russian Federation. Specifically, we document cases where hatchery salmon return at younger ages and smaller sizes and exhibit lower life history diversity compared to their wild counterparts. We feel a broader, ecosystem level approach to managing salmon hatcheries is warranted, as proposed by Lichatowich (1999) and Williams et al. (2003), to help ensure that hatchery fish are raised in conditions that more closely match those in the natural environment and hatchery risks are contained by adopting precautionary management approaches to help conserve wild salmon populations.

We stress the importance of preservation of wild salmon populations, and we encourage further studies to more fully understand the consequences of interactions between wild and hatchery salmon.

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* Provide quotes in text
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** Citation is a sworn statement in a legal document

NATIVE VILLAGE OF Port Lions
Traditional Tribal Council
P.O. Box 69, Port Lions, Alaska 99550
PORTLIONSTRIBE.NET

February 21, 2020

Alaska Department of Fish and Game
P.O. Box 115526
Juneau, AK 99811-5526

Dear Chairman Morisky and Members of the Board of Fisheries,

I am submitting this letter in support of Alaska's salmon hatcheries. The Native Village of Port Lions relies each year on healthy, sustainable and predictable salmon runs. Whether its commercial fishermen harvesting salmon, Alaskans and young biologists working in the hatcheries or processors, or inhabitants from the Native Village of Port Lions-- as they have done for generations -- subsistence and sport fishing, salmon touches every way of life here. This is why our salmon hatcheries are so important; they sustain our livelihoods, culture, and community. Salmon hatchery production in Alaska supports local economies and promotes long term sustainable harvests for all user groups by relieving pressure from wild runs during seasons of low wild abundance.

Kodiak Regional Aquaculture Association (KRAA) provides economic and ecological stability to our salmon returns, which fluctuate year to year. Over a six-year period, commercial fishermen harvested an annual average of 222 million pounds of hatchery-produced salmon worth $120 million in ex-vessel value. Regionally, Kodiak accounts for $7 million annually of the $69 million earned by fishermen in ex-vessel value each year. Additionally, Alaska's salmon hatcheries account for the annual equivalent of 4,700 jobs and $218 million in total labor income, including all direct, indirect, and induced economic impacts. A total of $600 million in annual economic output is connected to Alaska salmon hatchery production.

Thank you for working for healthy runs and communities. Without our hatchery program, Alaskans would have neither. Thank you for the important work you are doing at the Board of Fisheries. I ask that the Board of Fish continue to consider the interests of all users and regions of Alaska and support sustainable hatchery production and responsible, thoughtful resource management.

Sincerely,

Nancy Nelson
President

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Nicholas Crump, and I can be reached at nicholaswcrump@gmail.com. I am a commercial fisherman from Valdez.

Hatcheries in Prince William Sound allowed my father to catch enough salmon to support our family when I was a child. Now that I'm a fisherman too, I'm relying on them to be there in the future for my career as well.

Hatcheries stimulate the economy for commercial fishers, charter captains, retail outfitters, hotels, bed and breakfasts, gas stations, grocery stores, and many others. They're very important to the state of Alaska and should be celebrated and protected.

Respectfully,

Nicholas Crump

NORTHERN SOUTHEAST REGIONAL AQUACULTURE ASSOCIATION, INC.

(907) 747-6850 1308 Sawmill Creek Road Sitka, Alaska 99835
FAX (907) 747-1470
EMAIL steve_reifenstuhl@nsraa.org

February 20, 2020

Board of Fisheries

March 7, 2020
Statewide Meeting Anchorage, Alaska

Re: Hatchery Committee Joint Protocol on Salmon Enhancement #2002-FB-215

Dear Chairman Morisky and Board of Fish Members:

Northern Southeast Regional Aquaculture Association (NSRAA) appreciates this opportunity to comment on the Board's adherence to the 'Joint Protocol' and continuation of the BOF Hatchery Committee's review of the State of Alaska's salmon enhancement program. The Board has requested information on several topic areas: management, SSFP precautionary approach, salmon enhancement research & its independence or lack thereof, and board authority vs ADF&G authority regarding the state's hatchery program. We will address each of these topic in brief here and more fully at the Hatchery Committee open forum on March 7th in Anchorage.

Two of the topic areas the board is requesting regarding current and future straying research will be presented at the Hatchery Wild Investigation on March 6th in Anchorage, the day prior to the BOF Hatchery Committee. The science panel members who developed the hypotheses and study design will be in attendance. There is no better venue than this one to learn about Alaska hatchery-wild interactions from the scientists who are conducting, analyzing, and reporting on the findings. The most relevant research on hatchery pink salmon straying in Alaska will be presented, with important opportunities to speak with the researchers and science panel members.

Precautionary Approach to Salmon Enhancement

This is a pertinent topic for the board to delve into. A good start is *Precautionary Management of Alaska Salmon Fisheries Enhancement* by Gaudet D., et.al. The full paper is attached. Here is an excerpt from the introduction:

> "The ADF&G worked with a broad consortium of expertise from other regulatory agencies, the University of Alaska, and fisherman's associations to formulate guidelines and policies for the hatchery programs in the initial years (mid-1970s–1980s). At the time that ADF&G was developing and implementing these standards the United Nations (UN) was developing principles with respect to precautionary reference points and a precautionary approach (United Nations 1995, Article 6 and Annex 2). The UN explicitly singled out reference points, monitoring and development of alternative management as a part of the approach. Later, the UN's Food and Agriculture Organization (FAO) defined the precautionary approach as **"A set of agreed cost effective measures and actions, including future courses of action, which ensures**

prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong (Garcia undated).” In considering this approach, the FAO concluded that: **“although the precautionary approach to fisheries may require cessation of fishing activities that have potentially serious adverse impacts, it does not imply that no fishing can take place until all potential impacts have been assessed and found to be negligible”.** While developing and implementing the policies and regulations for salmon enhancement in Alaska (McGee 2004), ADF&G used common-sense principles similar to those later defined by the UN. In terms of biological reference points, achieving escapement goals is the primary objective for sustainable salmon management in Alaska.”

Board Authority vs ADF&G Commission Authority

Sec. 16.10.440 Regulations relating to released fish (b) “The BOF may…………amend ….the terms of the permit relating to the source and number of salmon eggs….”

This clause was adopted in 1979 when the hatchery program was in its infancy. The intent of the clause was to regulate wild brood **source** number of **eggs** from that source. The implication of taking eggs from a wild source aligns with the board’s authority to regulate escapement and allocation of returning salmon. The Ashburn and Mason paper put it this way:

> “When this statute was enacted in 1979, the legislative’s reference to ‘the source and number of salmon eggs’ almost certainly referred to the collection of wild salmon eggs, before the hatcheries’ cost recovery operations had been fully established. Back in 1979, collection of salmon eggs from wild stocks involved the harvest of wild salmon still swimming out in the ocean. In those early days, egg take had a potential to affect the Board’s allocative decisions. By contrast, hatchery egg take today is conducted entirely from returning hatchery broodstock, captured in terminal harvest areas, not out in the Sound, with little or no allocative implications.”

In addition, Sec. 16.10.455 allows for cost recovery fisheries in Special Harvest Areas (SHA/THA) where the returning fish become the property of the permitted hatchery operator, who can then provide access to a processor/harvester in the SHA via a contractual agreement for the royalty rights to harvest hatchery salmon.

Independence of Hatchery Wild Investigation (HWI)

The Alaska Hatchery Research Project (AHRP) was formed in 2011 and consists of eleven scientists from diverse backgrounds and agencies. The panel developed the hypotheses to be tested through an arduous process.http://www.adfg.alaska.gov/static/fishing/PDFs/hatcheries/research/2018.12.19_hwi_sp_roster.pdf These dedicated individuals embrace scientific integrity and hold up Alaska’s wild salmon as iconic, like most Alaskans. It seems funding of the research by the ‘salmon industry’ is the concern heard most often. Certainly, it would be nice if a philanthropic foundation provided the $20 million in funding, but if that were the paradigm required, none of the current research from 2012-2020 would have been conducted. In fact, it was the enhancement organizations themselves that requested the research project to ADF&G in 2010 and 2011 and helped obtain funding.

Salmon Enhancement Research – current, needed research, data gaps
The BOF may benefit from an annual summary from the North Pacific Anadromous Fish Commission. This international group consisting of Canada, U.S., Korea, Russia, and Japan considers and reviews research and management of salmon across their geographic range of the North Pacific Ocean, and provides a more enlightened context for understanding salmon hatchery programs.
https://npafc.org/newsletter/

Thank you for this opportunity to comment. I look forward to the discussion at the hatchery forum. Please consider attending the HWI science meeting on March 6th..

Respectfully,

Steve Reifenstuhl
General Manager, Northern Southeast Regional Aquaculture Assoc.

Precautionary Management of Alaska Salmon Fisheries Enhancement

Prepared For:

Alaska Fisheries Development Foundation

by
David Gaudet (DG Fisheries Service), Ronald Josephson (Alaska Department Fish and Game), and Alex Wertheimer (Fishheads Technical Services)

Data Sources:
ADF&G Fisheries Monitoring Permitting and Development Reports and Staff
ADF&G Commercial Fisheries Prince William Sound Management Reports and Staff
ADF&G Commercial Fisheries Southeast Alaska Management Reports

Preface

The Alaska commercial salmon fishery has been certified as sustainable by the Marine Stewardship Council and the Alaska Responsible Fisheries Management programs. Both of these programs seek to assess a fishery against principles adopted by the United Nations Food and Agriculture Organization (FAO). A major tenet of the FAO principles is the use of Precautionary Management. This paper examines the use of the precautionary principle in the management of the enhanced salmon fisheries in Alaska. The intent is to demonstrate that precautionary principles have been incorporated into statutes, regulations and policies of the Alaska Department of Fish and Game with respect to the management of the enhancement program and the associated fisheries. It also examines harvest and escapement data to look for any obvious adverse effects from the salmon enhancement program.

Authors

David Gaudet is a retired Alaska Department of Fish and Game (ADF&G) Fisheries Biologist. During his career with ADF&G, he supervised a statewide sonar population assessment program, was the Management Biologist for the Commercial Troll fishery and a Special Assistant to the Commissioner for the Pacific Salmon Commission. Following retirement he continued to work in assessment of commercial fisheries as well as participate as a permit holder in commercial salmon fisheries.

Ron Josephson is a retired ADF&G Fisheries Biologist. He began his career with the department in 1976 at Big Lake Hatchery as a technician, he later served there as an Assistant Hatchery Manager before moving to Southeast where he spent time as the Snettisham Hatchery Biologist and an Area Biologist for FRED Division. He was director of the Mark Tag and Age Lab in Juneau from 1988 to 2009 when he moved to Headquarters to oversee the state's hatchery and mariculture permitting section. He served on a number of Pacific Salmon Commission technical committees including Data Sharing, Transboundary Rivers, and Selective Fishery. He was also the chair of the Salmon Marking Working Group of the North Pacific Anadromous Fish Commission. He has served as coordinator for the Alaska Hatchery Research Program since its inception in 2010.

Alex Wertheimer is a retired National Marine Fisheries Service Fisheries Biologist. He has carried out research in Alaska on salmon enhancement technology and strategies, hatchery and wild salmon interactions, bycatch mortality of Pacific salmon, the impact of the Exxon Valdez oil spill on salmon in Prince William Sound, and the nearshore and pelagic marine ecology of Pacific salmon. He was a member of the science team that wrote the Alaska Genetic Policy, the National Oceanic and Atmospheric Administration (NOAA) Biological Review Team assessing status of Chinook salmon in the Pacific northwest, and the Chinook Technical Committee of the Pacific Salmon Commission. Upon retirement in 2009 he received the NOAA Distinguished Career Award. Since retirement, he has continued to consult on scientific studies and reviews, including forecasting of Pacific salmon, quantification of by-catch mortality, and the Pacific Salmon Recovery Plan. He currently serves on the Pacific Salmon Commission's Standing Committee on Scientific Cooperation and on the Science Panel overseeing the Alaska Hatchery Research Program.

Introduction

Prior to statehood in 1959, when fisheries were managed from outside the territory of Alaska, there was a pronounced decline in the harvests of salmon. Harvest in Alaska averaged 90 million fish in the 1930's, but fell to 25 million fish in 1959 (Figure 1, from Vercessi 2015). Gaining local control of the management of Alaska's fisheries was a major impetus for pursuing statehood. The fisheries were important enough that the Alaska constitution mandates fish be harvested sustainably: (Article 8, section 4) "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the state shall be utilized, developed and maintained on the sustained yield principle, subject to preferences among beneficial uses." After statehood, salmon harvests increased in the 1960's (except for 1967), averaging 50 million fish annually, but the early 1970's saw an extended period of low salmon harvests throughout the state; in 1973 and 1974, statewide harvest was 22 million fish. The decline in harvest and abundance was particularly acute for Prince William Sound (PWS) pink salmon, where many stocks were severely impacted by the 1964 earthquake. Access to some spawning grounds in PWS was completely eliminated by tectonic uplift, while other habitat became available for colonization (Roys 1971). Harvests of pink salmon in PWS had averaged nearly 8 million fish annually in the 1940's, but were less than half that in the 1960's, and were less than 1 million in 1972 and 1974. In response to the statewide decrease, Alaska designed an enhancement program to increase salmon harvest, while maintaining the sustainability of wild salmon. Implementing language from the Alaska Legislature stated "The program shall be operated without adversely affecting natural stocks of fish in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks."

Salmon enhancement projects were not limited to stocking fish. In some instances streams channels were altered to provide fish passage so salmon could access additional spawning habitat. Other projects such as lake fertilization were initiated to increase the production of juvenile salmon. However, the largest numbers of fish from enhancement programs have resulted from hatchery production (Stopha 2016). Unlike fish farms, the hatcheries do not grow fish to adulthood, rather, they act as a nursery, fertilizing and incubating eggs, and imprinting and releasing the resulting progeny. The females of each of the five salmon species in Alaska produce thousands of eggs, of which few survive to return as adult fish to spawn. The majority of the natural mortality occurs in freshwater during the egg to juvenile life stages. Under hatchery conditions, the developing embryos are protected from the vagaries of natural environmental conditions such as low stream flows, freezing, and gravel scouring from floods. For pink salmon, egg to juvenile survival under hatchery conditions is often 90% or greater, while in natural streams in Southeast Alaska (SEAK) survival over this period averages 4-9% (Heard 1991; Stopha 2016).

Today, statewide harvests of salmon have increased remarkably since the early 1970s (Figure 1). Catches now consistently exceed 100 million fish annually, and in 2013 reached an all-time record 273 million fish. Approximately 35% of the total common property catch is from enhancement operations, primarily pink and chum salmon (Vercessi 2015; Stopha 2016).

A Precautionary Approach to Enhancing Fisheries

The Alaska Department of Fish and Game (ADF&G) recognized the need to minimize the effects enhancement can have on wild stocks by adopting standards with respect to hatchery location, genetics, disease, culture techniques, monitoring, data collection and management. The ADF&G worked with a broad consortium of expertise from other regulatory agencies, the University of Alaska, and fisherman's associations to formulate guidelines and policies for the hatchery programs in the initial years (mid-1970s–1980s). At the time that ADF&G was developing and implementing these standards the United Nations (UN) was developing principles with respect to precautionary reference points and a precautionary approach (United Nations 1995, Article 6 and Annex 2). The UN explicitly singled out reference points, monitoring and development of alternative management as a part of the approach. Later, the UN's Food and Agriculture Organization (FAO) defined the precautionary approach as **"A set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong (Garcia undated)."** In considering this approach, the FAO concluded that: **"although the precautionary approach to fisheries may require cessation of fishing activities that have potentially serious adverse impacts, it does not imply that no fishing can take place until all potential impacts have been assessed and found to be negligible".** While developing and implementing the policies and regulations for salmon enhancement in Alaska (McGee 2004), ADF&G used common-sense principles similar to those later defined by the UN. In terms of biological reference points, achieving escapement goals is the primary objective for sustainable salmon management in Alaska.

The purpose of this paper is to review the establishment of Alaska's hatchery program and the precautionary approaches built into it, and to specifically examine the results of the large scale pink and chum salmon hatchery production in PWS and SEAK areas for indications of adverse impacts to wild salmon stocks. These areas were selected because they represent the highest levels of hatchery production relative to wild production in Alaska.

Early Hatcheries and the Creation of FRED

The first hatcheries in Alaska were built in 1891 on the Karluk River system on Kodiak Island and on Katlaku Creek in SEAK for the production of sockeye salmon (Roppel 1982). By the early 1900s, about a dozen more hatcheries were built, some by the U.S. Bureau of Fisheries, again primarily for sockeye salmon. A lack of knowledge of salmon life history and poor hatchery practices resulted in little adult production and eventually, closure of the hatcheries by the 1930s. Salmon followed a slow steady decline until statehood in 1959 after which there was a modest recovery only to be followed by the record low catch in 1967 and consistent low harvests in the early 1970s (Figure 1). In response to these unprecedented low catches, the Alaska State Legislature (Legislature) created the Division of Fisheries Rehabilitation, Enhancement and Development (FRED) in ADF&G (Heard 2012). Because the low runs were not a consequence of habitat destruction (the vast majority of salmon habitat in Alaska is still in pristine condition), the focus was to enhance the catches, not replace them. This is in marked contrast to many hatchery programs in the Pacific Northwest, which had been developed to mitigate impacts of salmon habitat loss from dams, logging, urbanization, and other anthropogenic factors. The responsibilities of FRED were detailed by the Legislature in AS 16.05.092. These included among other responsibilities: (1) develop a comprehensive, coordinated state plan for the orderly rehabilitation, enhancement and development of the state's fisheries; (2) encourage investment by private enterprise in the technological development and economic utilization of the fisheries resources; and (3) encourage, sponsor, and conduct research on the basic problems inhibiting the sound development of hatcheries. In short, the intent was to include the best scientific practices of hatcheries in other areas into Alaska's program while avoiding the pitfalls and mistakes others may have made. The overarching goal of the program was to provide fishery enhancement while minimizing adverse impacts on wild stock production (McGee 2004).

By the time FRED was established, there were salmon hatcheries located at Kitoi Bay, Little Port Walter, Fire Lake, Fort Richardson, and Crystal Lake (Heard 2012). These facilities were operated by ADF&G, except for Little Port Walter, which was operated by the National Marine Fisheries Service (NMFS).

Most, but not all, of the initial FRED facilities were located away from significant wild stocks. Exceptions included hatcheries at Sikusuilaq Springs on the Noatak River, East Creek on Nunavaugaluk Lake, Big Lake on Meadow Creek, Crooked Creek, Gulkana River, Klawock River, and Russell Creek. As the fishery enhancement program evolved, criteria for location of hatcheries and release sites were developed to minimize interactions with adjacent wild stocks. Of the facilities listed in this paragraph, hatcheries on all except the Gulkana and Klawock Rivers have closed

Some of the pre-FRED facilities remain: Kitoi Bay, Little Port Walter, and Crystal Creek. Some early FRED facilities built on systems with relatively small populations also remain, including Cannery Creek, Klawock River, and Tutka Bay Lagoon.

The Alaska Legislature also wanted to ensure participation of the private sector in the enhancement effort. Thus, the Legislature passed the Private Non Profit (PNP) Hatchery Act. The act provided for private groups and associations to build and operate hatcheries as well as other types of enhancement. It also provided for the formation of Regional Aquaculture Associations (RAAs) to function as nonprofit corporations, similar to the local fisheries cooperatives in Japan. By 1990, there were 45 hatcheries operating in Alaska, including 18 operated by the State of Alaska (Vercessi 2015). This number has declined to 29 hatcheries statewide, as ineffective hatcheries were closed down (Stopha 2016). Most of the State hatcheries were contracted for operation by the RAAs or adjacent PNPs. Of the 29 hatcheries now in operation, 25 are operated by PNPs; 2 sport fish hatcheries are operated by ADFG; 1 small research facility at Little Port Walter is operated by NMFS; and 1 hatchery on the Metlakatla Indian Reservation operated by the Metlakatla Indian Community (Stopha 2016).

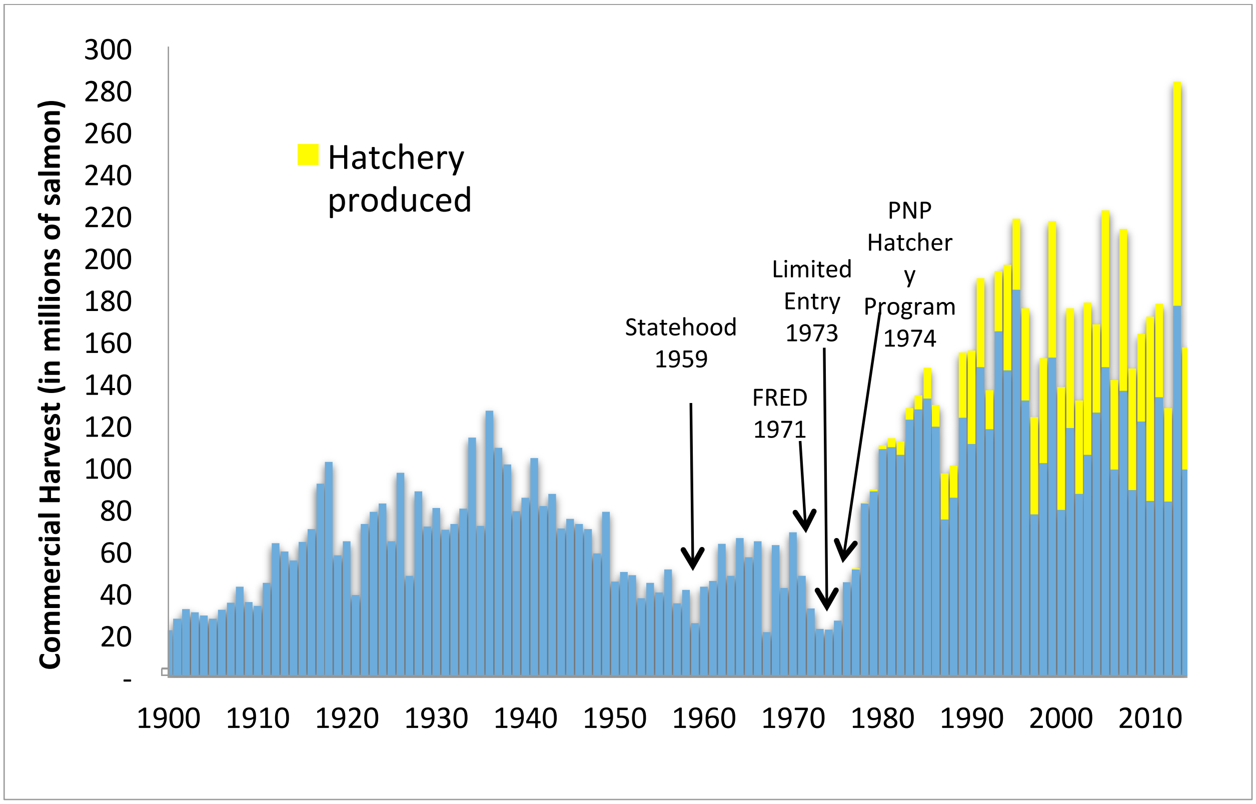

Figure 1. Alaska commercial salmon harvests in millions of fish, 1900-2014 (Vercessi 2015).

Developing and Implementing Salmon Enhancement in Alaska

Alaska had the luxury of being able to review the practices and results of existing enhancement or hatchery programs. Many of the existing Pacific salmon hatcheries in North America at the time were mitigation facilities, operated to replace salmon populations reduced or extirpated through habitat degradation. Most of these facilities were operated by either the northwest states or the Federal Government (US and Canada). Many people that would eventually become involved with the Alaska program had worked in some of these facilities.

Following the establishment of FRED, a system of policies and practices was developed for managing enhancement in Alaska. A key component for implementing the hatchery management policies are the Regional Planning Teams (RPT), which serve as an advisory group to the Commissioner of ADF&G (AS 16.10.375). The RPTs are comprised of six voting members, including three from ADF&G (2 regional and 1 headquarters staff) and three from the appropriate RAA (5 AAC 40.310). In addition, the RPTs invite input from management and research biologists, scientists from universities and federal agencies, commercial and recreational fishery groups, and local community representatives. RPTs develop and maintain regional comprehensive salmon plans. The plans may contain best practices with respect to achieving such goals as low stray rates (ADF&G 2004). The locations of hatcheries are given prime consideration in the planning process. Criteria include degree of isolation from wild stocks, capacity for terminal harvest, anadromous or other fish in the watersource, as well as concordance with regional allocation goals (McGee 2004; Stopha 2016).

Finally, the Alaska Board of Fisheries (BOF) sets policies that reflect the hatchery program's role in sustainable fisheries. These policies include: Policy for the management of mixed stock salmon fisheries (5 AAC 39.220); Policy for the management of sustainable fisheries (5 AAC 39.222); individual management plans for Terminal Harvest areas; and allocation of salmon including hatchery production (e.g., allocation policy for SEAK, 94-148-FB).

Over time, policies and practices were adopted by ADF&G and the hatchery operators to minimize impacts on wild salmon:

- **New Facilities**
  - Careful siting of hatcheries and terminal harvest areas (temporal and spatial segregation from wild stocks to minimize mixed fisheries, while allowing harvest of all the returning salmon to minimize potential breeding with wild stocks).
  - Hatchery production is not approved if there is not high confidence that the resulting salmon will be adequately harvested, thus decreasing the potential for hatchery strays.

- **Release Strategies**
  - All hatchery release strategies are reviewed by ADF&G and are ultimately under the authority of the Commissioner of ADF&G. Both economic and ecological evaluation of the release plan forms part of the decision making process.

- **Genetic Policy and Guidelines**
  - Genetics policy written to guide hatchery program and practices to allow protection of wild stocks by avoiding foreseeable negative effects (ADF&G 1985, Davis, 1989).
  - Introduction of genetic material from distant stocks is prohibited and hatchery broodstock is developed from local area stocks.
  - Random mating is used to avoid artificial reduction in the genetic composition of the hatchery broodstock – i.e. fish are not intentionally selected for phenotypic traits such as run timing, size, shape, color etc..
  - Large numbers of returning fish are used for broodstock. This is especially true for pink and chum salmon hatcheries in PWS and SEAK. Large population sizes allow for a large gene pool and decreases, over time, the likelihood of genetic loss due to inbreeding.

- Collection of broodstock for the hatcheries is stratified over spawn/run timing to maximize the heterogeneity of the gene pool.
- ADF&G gene conservation lab reviews proposed transport of fish and gametes to and from hatcheries.

- **Fish Health Policy and Guidelines**
  - Establishment of statewide policies and guidelines for fish health and disease control that are regularly updated and revised (Meyers 2014).
  - ADF&G pathology review of proposed transport of fish and gametes to and from hatcheries.
  - Hatcheries are subject to biennial pathology inspections to maintain fish health at acceptable levels.

- **Planning and Reporting**
  - Each hatchery is required to complete an annual report containing information on hatchery returns, numbers of eggs taken, and numbers of fry or smolt released, by species and stock, to insure compliance with their approved permits.
  - Salmon enhancement regions have been defined by the Commissioner of ADF&G in accordance with Alaska Salmon Hatchery and Enhancement Statutes (AS16.10.375-470)
  - Each Region is required to produce a Comprehensive Salmon Plan to guide enhancement activities in each region. The plans can be periodically reviewed and updated to meet changing needs and incorporate improved information (Stopha 2016).

- **Harvest**
  - The Policy for Statewide Salmon Escapement Goals (5 AAC 39.223) provides the mechanism for establishing and managing for escapement goals for wild salmon stocks; these escapement goals are the reference points for sustainable wild-stock management.
  - There is a priority for protecting wild stocks in the management of salmon fishery harvest (AS16.05.730) so that harvests in traditional common property fisheries are based on the abundance of wild stocks consistent with the Policy for Statewide Salmon Escapement Goals.
  - In-season indicators of stock abundance are used to determine allowable fishery effort to achieve escapement goals. There are no pre-determined harvest targets.
  - Special Harvest Areas are designated to harvest returning hatchery fish.
  - Marks are be used to determine the amount of hatchery fish in the harvest.
  - Hatchery operators may be required to “mop-up” fish not caught in directed fisheries in Special Harvest Areas in order to minimize straying of hatchery-produced fish.

- **Habitat**
  - Salmon enhancement in Alaska is to supplement wild production, not to mitigate loss of habitat from anthropogenic activities.
  - There is vigorous regulatory and statutory protection to maintain wild salmon habitat.
  - Most salmon habitat in Alaska is intact; there have been few salmon watersheds impacted by damming for hydroelectric production or other purposes.
  - Anadromous Fish Act (AS 16.05.871) gives special protection to water bodies (lakes and streams) utilized by salmon.
  - ADF&G Habitat Division regulates and permits acceptable activities, including hatchery activities specified in the Anadromous Fish Act.

- **Marking of Hatchery Fish**
  - All state-regulated hatcheries in SEAK and PWS thermally mark all releases of pink and chum salmon to allow identification of hatchery salmon.
  - Other species of salmon released from SEAK and PWS hatcheries are also otolith marked or represented by coded-wire tags (in somes cases, both types of marks are used on releases of Chinook and coho salmon.).
  - Mass otolith marking can be used for in-season fisheries management and estimation of hatchery contributions to common property fisheries. Otolith marking also allows determination of the presence of hatchery fish in the spawning escapements of wild stocks.

- **Transportation of Hatchery Fish**
  - Fish Transport Permits (FTPs) are required to transport eggs or fish for hatchery operations. FTPs are reviewed by local ADF&G area management and research biologists, geneticists from the State Gene Conservation Laboratory, and pathologists from the State Fish and Shellfish Pathology Laboratory. Final approval is by the Commissioner or his/her designee.
  - FTPs are approved for specified time periods, and must be reconsidered at the end of the time period for continuation.

- **Sustainability and Precautionary Approach**
  - Sustainability as an objective of conservation policy is enshrined in the Alaska Constitution.
  - Sustainability and a precautionary approach for salmon management have been placed into policy by the BOF (5 AAC 39.222).

Regulation of Private Nonprofit Hatcheries in Alaska

There is a codified plan for oversight and regulation of the Private Nonprofit hatcheries in Alaska (Figure 2). The plan gives ADF&G complete authority over the program.

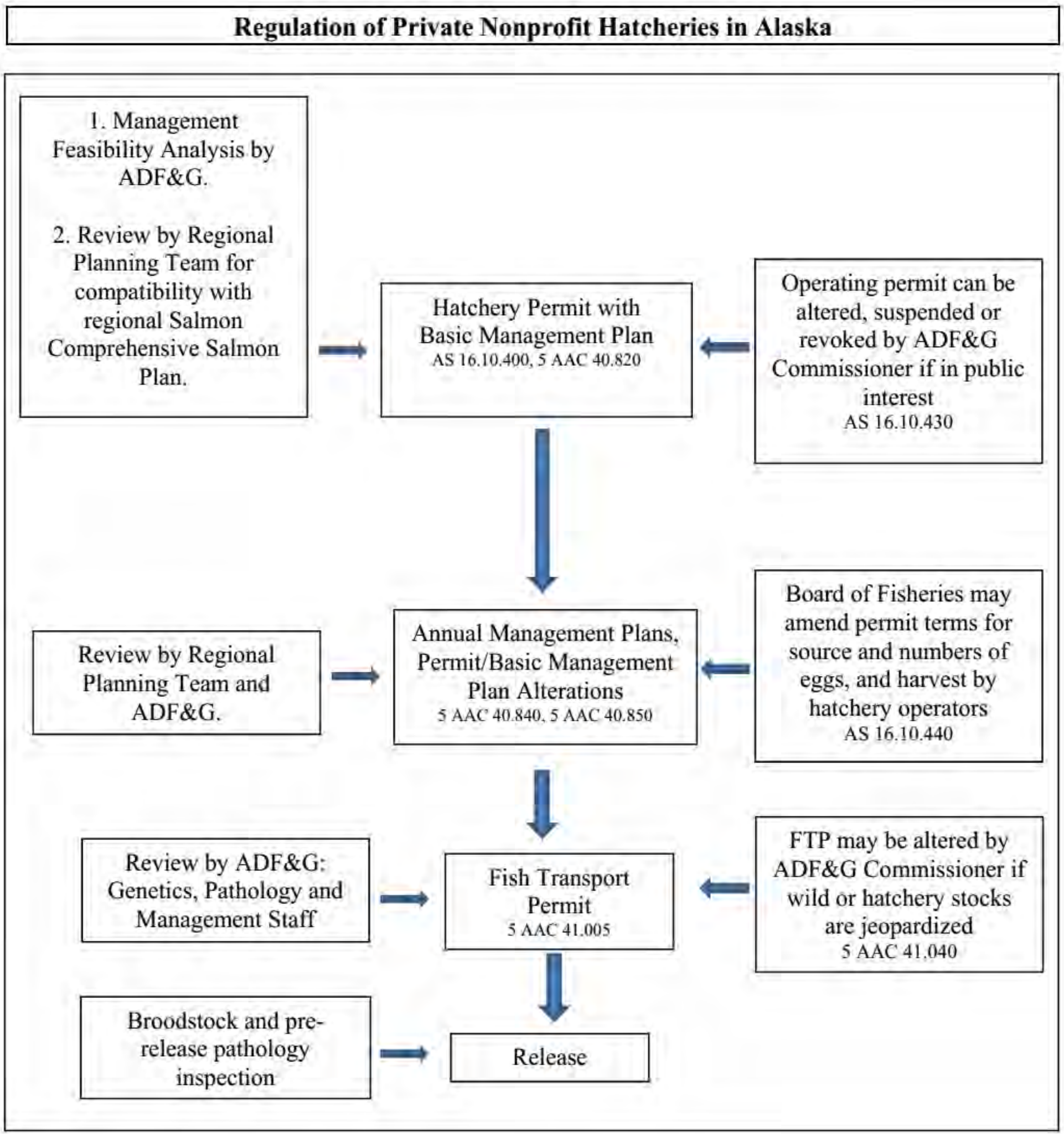

Figure 2. Flowchart demonstrating the regulation of Private Nonprofit hatcheries by ADF&G (McGee 2004).

Review of the Hatchery Operators and Programs

In 2011, ADF&G began a systematic review of all of the licensed hatcheries for conformance with State of Alaska policies (http://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesOtherInfo.reports). Through 2014, the four PWS and nine of the twelve SEAK hatcheries have been reviewed (Stopha 2013a-d; Stopha 2014a,b,c and Stopha 2015 a-f).
Twenty-two policy items ranging from identification of broodstocks to use of the precautionary approach to hatchery practices were identified. The performance at each

hatchery, with respect to the policy item, was evaluated. The reviews found that practices were in conformance with only minor inconsistencies (e.g., Stopha 2015 a-f).

Permit Alteration Requests (PARs)

An important tool that ADF&G has to manage the hatcheries is the Permit Alteration Request (PAR). In order to request a changed to a Hatchery Permit, a PAR is prepared by the permit holder and submitted to ADF&G. The process is initiated by a hatchery operator and must be used to change the hatchery's permitted capacity, broodstock source, or approved release sites. PARs are reviewed by RPTs, ADF&G staff, and the public and are approved or denied by the Commissioner.

Recent review of hatcheries provided a listing of PARs by hatchery (e.g., Stopha 2015 a-f). Some PARs are never formally submitted; they are retracted by the applicant after conceptual review and discussions with ADF&G. Each PAR is extensively vetted prior to approval or denial.

Precautionary Approach in Management

The policies and practices implemented by ADF&G constitute a precautionary approach to meeting the mandates of sustained yield and conservation of salmon resources under the Alaska constitution and the legislation enabling the enhancement programs. This approach is consistent with the FAO Precautionary Approach. It incorporates management of the fisheries and oversight of the hatcheries to provide for optimum and sustained production of both wild and hatchery stocks. Area and regional fishery managers monitor indicators of abundance, escapements of wild stocks, and wild/hatchery composition of the catch in order to ensure that wild stock escapement goals are attained.

In addition to in-season and annual management and regulatory activity, ADF&G supports research activities to inform management policies. Currently ADF&G is implementing the Alaska Hatchery Research Program (AHRP; ADF&G 2015). It is a large scale hatchery/wild interaction study examining genetic structure and straying rates of pink and chum salmon in PWS and chum salmon in SEAK, and relative fitness of hatchery strays and wild spawners for pink salmon in PWS and chum salmon in SEAK (ADF&G 2015). The project is a collaborative effort, funded by the State of Alaska, salmon processors, and fishermen through hatchery operators. A Science Panel with broad expertise in salmon management, enhancement, and hatchery/wild interactions designed the research plan and provides oversight and guidance to the research. The field work is being carried out by the Prince William Sound Science Center (PWSSC) and Sitka Sound Science Center (SSSC) under contract from the State of Alaska. The ADF&G Gene Conservation in Anchorage and otolith mark recovery laboratories in PWS and SEAK are providing the genetic and otolith analyses.

Large Scale Hatchery Enhancement: Case Histories

Pink and Chum Salmon Hatchery Programs in PWS and SEAK

Pink and chum salmon are the species most utilized for large-scale hatchery production in Alaska. In 2014, these species accounted for 93% of the eggs collected in Alaska for enhancement operations and 92% of the estimated returns to the hatchery operations (Vercessi, 2015). Enhanced salmon now make up the large majority of the harvest for PWS pink salmon and SEAK chum salmon.

The selection of pink and chum salmon for large-scale fishery enhancement in Alaska is a result of their short freshwater life-history. The remaining three species of Pacific salmon in Alaska require a much longer time in freshwater. Sockeye and coho salmon typically spend one to two years, and Alaska Chinook salmon one year, as juveniles in freshwater after emerging from the spawning gravel before smolting and emigrating to the sea. In contrast, pink and chum salmon migrate to the sea as fry after emerging from the spawning gravel. The short freshwater residence of pink and chum salmon makes hatchery culture more cost-effective and likely reduces the effects of domestication relative to smolt species such as sockeye, coho and Chinook salmon. On a per fish basis, the amount of freshwater and space required to culture fish to the fry stage is less than required to raise fish from fry for a year to the smolt stage. Pink and chum salmon fry are typically raised in marine net pens for 1–3 months to increase their survival after release. This type of rearing space is less expensive than freshwater raceways for smolt species, and does not require an extensive freshwater supply (Stopha 2016). Per-fish food costs and labor costs are reduced because of the smaller size at release and the shorter culture period.

The pink and chum salmon hatchery programs in PWS and SEAK are the largest enhancement production programs in Alaska (Vercessi 2015; Stopha 2016). FRED built and initially operated some of the pink and chum hatcheries in these regions; however, all of them except the Federal research facility at Little Port Walter and the tribal hatchery at Metlakatla are now operated by PNPs (Table 1).

There are four facilities and two operators that produce pink or chum salmon in PWS. These facilities are currently permitted for a total of 727 million pink and 165 million chum salmon eggs. In 2014, they collected 729 million pink and 144 million chum salmon eggs. The Main Bay facility in PWS, now operated by the Prince William Sound Aquaculture Corporation (PWSAC), raised pink and chum salmon until 1989 and 1987 respectively. Only sockeye salmon are raised there now.

Table 1. The PNPs, facilities, and pink and chum salmon eggs permitted and estimated number collected in 2014 in the PWS and SEAK programs.

Area	PNP	Facility	Pink Salmon		Chum Salmon	
			Permitted	2014	Permitted	2014
PWS	PWSAC[1]	A. F. Koernig	162.00	162.00	34.00	31.00
		Cannery Creek[11]	187.00	187.00		
		W. Norenberg	148.00	148.00	131.00	113.00
	VFDA[2]	Solomon Gulch	230.00	231.65		
	Totals		727.00	728.65	165.00	144.00
SEAK	NSRAA[3]	Hidden Falls[11]			101.00	101.32
		Haines Projects			4.80	3.07
		Medviejie	0.30	0.30	77.00	76.97
		Sawmill Creek			30.00	15.04
	AKI[4]	Port Armstrong	105.00	92.21	30.00	24.77
	DIPAC[5]	Macaulay			125.00	123.16
	SSSC[6]	Sheldon Jackson	3.00	3.30	12.00	12.06
	KNFC[7]	Gunnuk Creek	20.00		65.00	20.00[8]
	SSRAA[9]	Burnett Inlet			37.00	23.50
		Neets Bay			102.70	97.99
		Whitman Lake			44.30	42.00
	POWHA[10]	Port St. Nicholas			8.00	
	Totals		178.30	95.81	636.80	539.88
Grand Total			905.30	824.46	801.80	683.88

The SEAK program currently includes 11 facilities and six operators; the Gunnuck Creek program is not operating but eggs under the permit are being taken by NSRAA. Total permitted capacity is 178.3 million pink and 636.80 million chum salmon eggs. In 2014, operators took 95.81 million pink and 539.88 million chum salmon eggs. The Snettisham Hatchery raised chum and Chinook salmon when it was operated by FRED from 1980–1996; now operated by DIPAC, it produces sockeye salmon exclusively.

[1] PSWAC Prince William Sound Aquaculture Corporation
[2] VFDA Valdez Fishery Development Association
[3] NSRAA Northern Southeast Regional Aquaculture Association
[4] AKI Armstrong Keta Incorporated
[5] DIPAC Douglas Island Pink and Chum
[6] SSSC Sitka Sound Science Center
[7] Kake Nonprofit Fishery Corporation
[8] In 2014, chum eggs for the Gunnuk Creek permit were collected at Hidden Falls
[9] SSRAA Southern Southeast Aquaculture Association
[10] Prince of Wales Hatchery Association
[11] Facility built by FRED, now operated by PNP

Escapements of Pink and Chum Salmon in Relation to Goals and Enhancement

ADF&G manages wild salmon populations for escapement goals, which are analogous to FAO's precautionary reference points. Escapements are reported as either numbers of fish (obtained with tower, sonar and weir counts) or as an index (aerial or walking surveys). These data sets are then used to develop escapement goals based on the *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (EGP: 5 AAC 39.223). The BOF adopted these policies into regulation during the winter of 2000–2001 to ensure that the state's salmon stocks are conserved, managed, and developed using the sustained yield principle.

Escapements in PWS for pink and chum salmon management units and in SEAK for summer chum salmon management units were compared between time series pre-dating large scale enhancement to time series concurrent with large scale enhancement. The pre-hatchery time series was defined as the period for which escapement data were available for a species/management unit and hatchery production made up <10% of the harvest. Two basic metrics were considered: 1) the frequency which escapements met the current escapement goal (or lower bound of the current escapement goal range); and 2) the average escapements between the hatchery time series. Escapement goals have changed over time as managers have accumulated more information and refined analyses, so the actual management target for specific years in both time periods could differ from the current goal. Variation in escapement is driven by a myriad of factors, including large variations in the environmental conditions in the freshwater and marine habitats utilized by pink and chum salmon, as well as anthropogenic factors such as harvest management and enhancement. However, the current goal represents a metric to assess whether escapements have declined or been maintained relative to both the pre-hatchery period and the current benchmark of adequate escapement. Escapement data were sourced from Moffitt et al. (2014) and Weise et al. (2015).

Prince William Sound Pink Salmon

ADF&G has established sustainable escapement goals for eight geographic districts in PWS (Moffitt et.al. 2014). Achievement of the current escapement goals (established in 2011) was analyzed retrospectively for odd and even years 1965 through 2014 (Table 2). For all districts, the escapement goal was met or exceeded in most years. The average across all districts was 78% and 71% of the years for the odd and even year runs, respectively.

Table 2. Percentage of years (1965-2014) escapements met or exceeded the PWS Pink Salmon escapement goals established in 2011.

	Eastern	Northern	Coghill	Northwestern	Eshamy	Southwestern	Montague	Southeastern	Average
Odd	84%	76%	80%	80%	60%	84%	80%	76%	78%
Even	84%	68%	72%	72%	72%	76%	44%	76%	71%
2011 Escapement Goal Ranges									
Odd	310,000	90,000	60,000	50,000	4,000	70,000	140,000	270,000	
	640,000	180,000	250,000	110,000	11,000	190,000	280,000	620,000	
Even	250,000	140,000	60,000	70,000	3,000	70,000	50,000	150,000	
	580,000	210,000	150,000	140,000	11,000	160,000	140,000	310,000	

The frequency the escapement goal was attained was also evaluated for escapements in the pre-hatchery years (1965–1976) and in years when hatcheries contributed a significant portion of the overall return (1977–2014). Comparing the escapements to the current (2011) goal is simply a constant metric for both time periods, even though most escapements in either time period occurred under different management objectives. Because the lower bound of goals has generally decreased over time, there is a bias in the retrospective analysis to overestimate achieving or exceeding goals in the pre-hatchery period.

For odd-year pink salmon, the frequency of attaining goals was higher in seven of eight districts and overall for PWS during the hatchery time period (Figure 3). During the pre-hatchery period, goals were attained over 50% of the years in only two of eight districts, whereas goals have been attained over 75% of the years in all districts in the hatchery period. The average across all regions was 40% during the pre-hatchery period, and 92% during the hatchery period.

For even-year pink salmon, the frequency of attaining goals was higher in six of eight districts and overall for PWS during the hatchery time period (Figure 4). During the pre-hatchery time period, goals were attained over 50% of the years in three of eight districts, whereas goals have been attained over 75% of the years in the hatchery period for seven of the eight districts. The average across all regions was 58% during the pre-hatchery period, and 80% during the hatchery period.

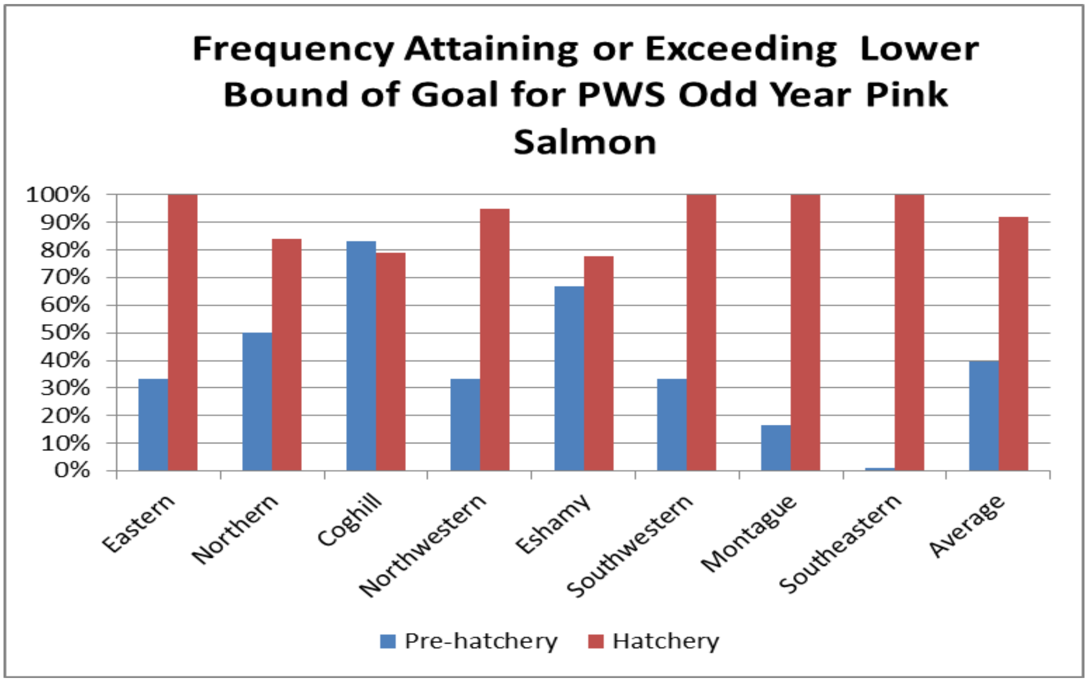

Figure 3. Frequency of attaining or exceeding 2011 escapement goals for odd-year pink salmon returning to Prince William Sound during pre-hatchery (1965–1976) and hatchery (1977–2014) time periods.

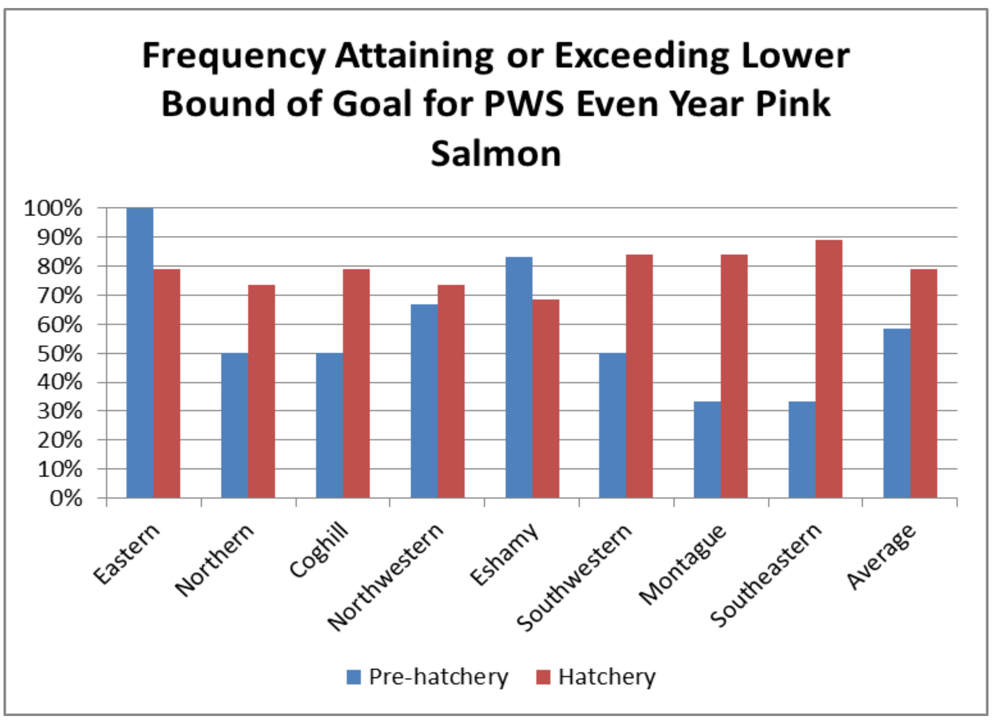

Figure 4. Frequency of attaining or exceeding escapement goals for even-year pink salmon returning to Prince William Sound during pre-hatchery (1965–1976) and hatchery (1977–2014) time periods.

Escapements by district were also generally higher in the hatchery time period compared with the pre-hatchery time period (Figures 5 through 20). For odd year returns, escapements in seven of the eight districts have been 2–3 times higher during the hatchery time period than the pre-hatchery time period. For the one exception, the Coghill District (Figure 7), escapements averaged 201,000 pre-hatchery and 199,000 during the hatchery time period. For the entire PWS, odd-year escapements during the pre-hatchery time period have averaged 971,000; escapements during the hatchery time period have averaged 2,225,000.

The results were similar for even year returns to PWS. Escapements have been higher in the hatchery time period for all of the eight districts, albeit very similar for the Eshamy District (Figure 17). For the entire PWS, even-year escapements during the pre-hatchery time period have averaged 845,000; escapements during the hatchery time period have averaged 997,305.

Escapement estimates include fish of both natural and hatchery origin. The proportion of hatchery strays in the spawning escapements estimated by district for 2013 and 2014 (Knudson et al. 2016) were used to estimate the number of natural-origin fish in the escapements for these respective years. For odd-year pink salmon in 2013, escapements were above the lower-bound of the escapement goal for all districts. The numbers of natural origin spawners were also above the lower bound of the escapement goals in all districts except Eshamy, where hatchery strays comprised most of the escapement (Figures 5-12). The Eshamy District is primarily a sockeye salmon management unit and comprises less than 1% of the pink salmon escapement in PWS.

For even-year pink salmon in 2014, five of the eight districts were above the lower-bound of the respective escapement goal, while the Northern, Northwestern, and Montague Districts were below goal (Figures 13-20). Of the five districts above the lower bound, three (Coghill, Eshamy, and Southwestern) districts would not have been above without the presence of hatchery fish in the escapements. Natural spawners in Coghill were at 95% of the lower bound, and in Southwestern at 79% of the lower bound. In the Eshamy District in 2014, as with the 2013 odd-year return, the escapements were predominately hatchery strays (Figure 17.)

This evaluation of pink salmon escapements in PWS prior and during the hatchery period indicates that returns to the spawning grounds have been greater and more consistent during the hatchery time period. Thus there is no indication of a negative impact of the hatchery program on the number of pink salmon spawning naturally in PWS or on the frequency of attaining escapement goals. These trends can be attributed to increased productivity and good management of wild stocks and, in some cases, supplementation of escapements by hatchery fish.

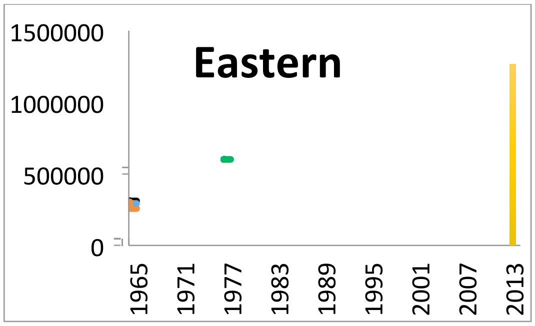

Figure 5. Eastern district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

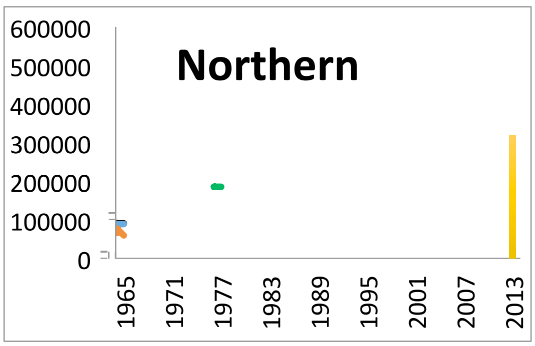

Figure 6. Northern district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

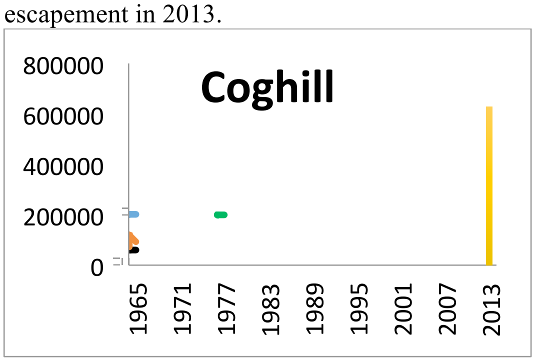

Figure 7. Coghill district odd year pink salmon escapements (orange line) versus the 2011 goal (black line), Blue line is pre-hatchery period average, green is the line hatchery period average, and the yellow bar is natural origin escapement in 2013.

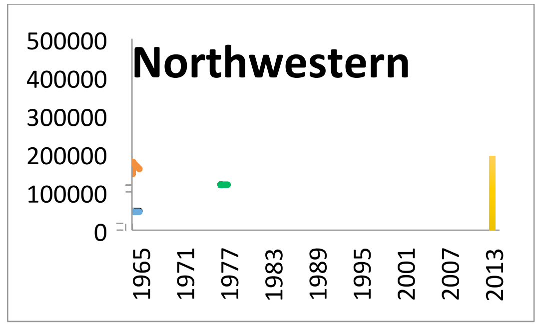

Figure 8. Northwestern district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

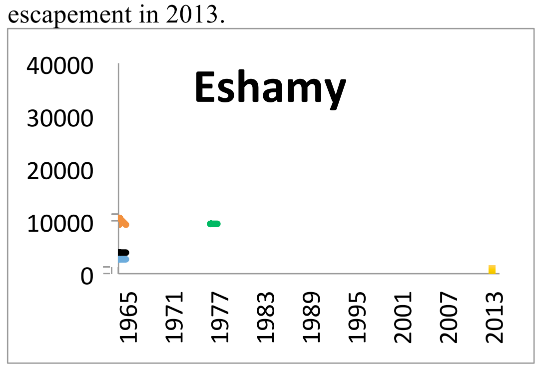

Figure 9. Eshamy district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

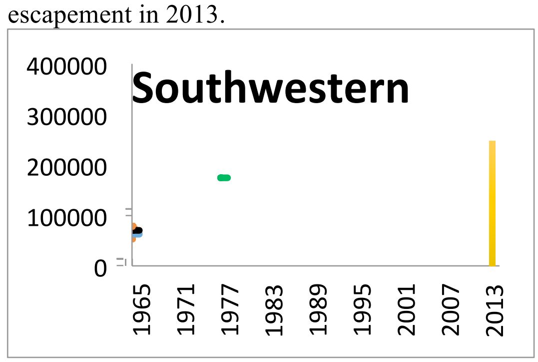

Figure 10. Southwestern district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and yellow bar is natural origin escapement in 2013.

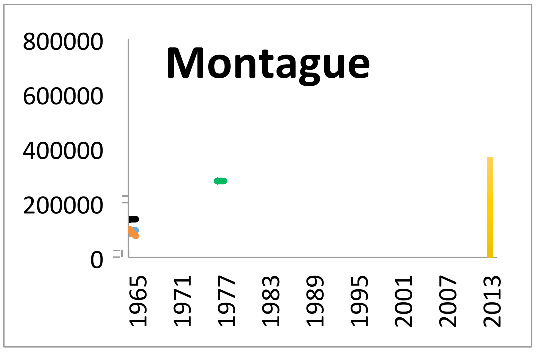

Figure 11. Montague district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

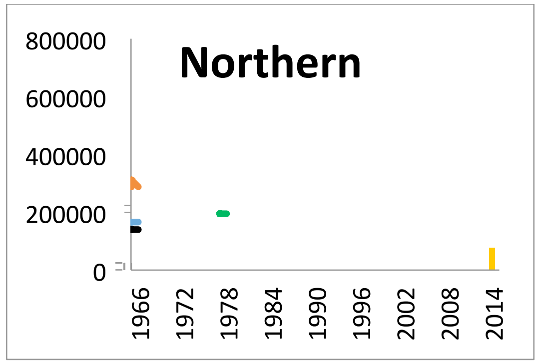

Figure 14. Northern district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

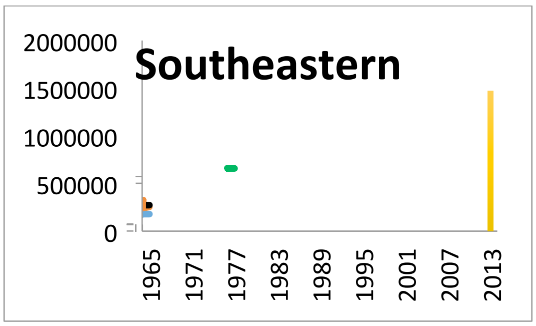

Figure 12. Southeastern district odd year pink salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

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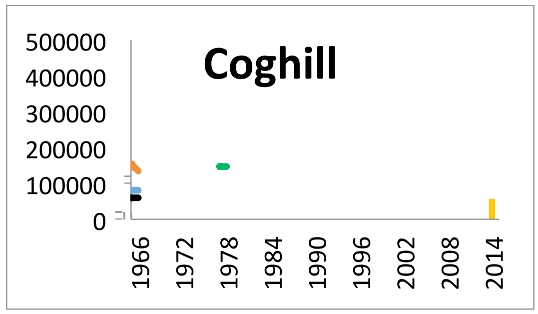

Figure 15. Coghill district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

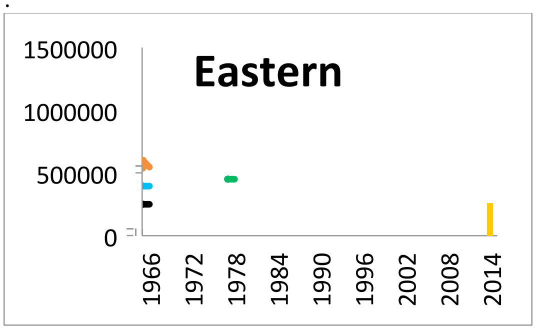

Figure 13. Eastern district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

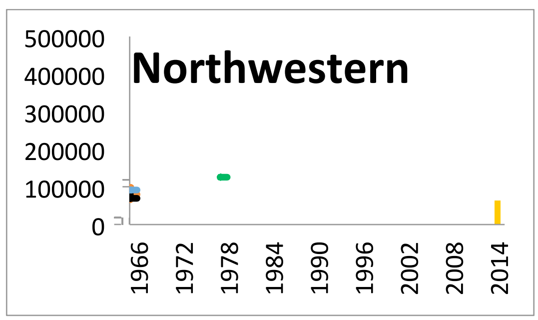

Figure 16. Northwestern district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014

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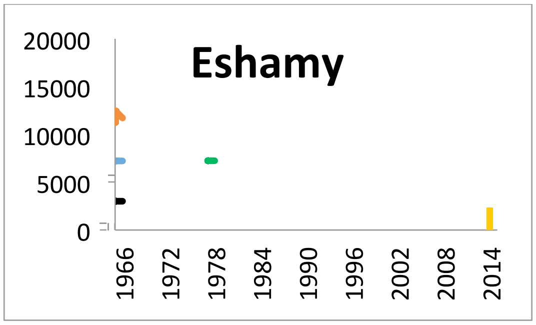

Figure 17. Eshamy even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

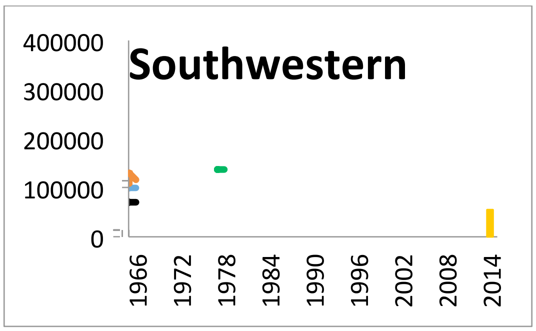

Figure 18. Southwestern district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

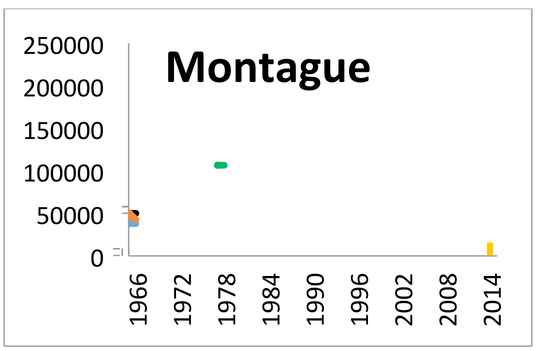

Figure 19. Montague district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

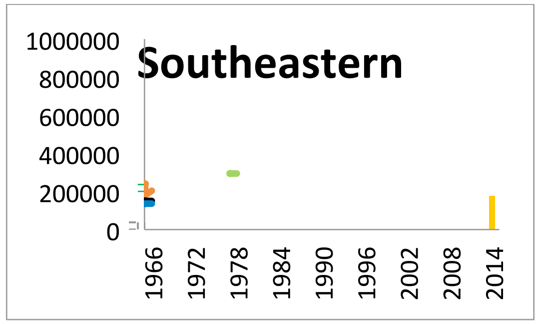

Figure 20. Southeastern district even year pink salmon escapements (orange line) versus the 2011 goal (black line), blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2014.

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Prince William Sound Chum Salmon

Escapements for chum salmon were also examined versus the 2011 escapement goals (Table 3). Over the 51 years 1963-2013, the escapement goal was met or exceeded in most years in all regions. The average across all regions was 74.5%. Escapement goals were achieved most often in the Northern District (82.4%) and the least in the Southeastern District (66.7%).

Table 3. PWS chum salmon 2011 escapement goals and percentage of years 1963-2013 escapements either met or exceeded or were below the goals.

	Eastern	Northern	Coghill	Northwestern	Southeastern	Average
Above	70.6%	82.4%	76.5%	76.5%	66.7%	74.5%
Below	29.4%	17.6%	23.5%	23.5%	33.3%	25.5%
2011 Lower Bound Escapement Goal						
	50,000	20,000	8,000	5,000	8,000	

The frequency the 2011 escapement goal was attained or exceeded was also evaluated for escapements in the pre-hatchery years (1963–1985) and in years when hatcheries contributed a significant portion of the overall return of chum salmon (1985–2013). The frequency of attaining goals was higher in all five chum salmon management districts during the hatchery period in PWS (Figure 21). During the pre-hatchery period, goals in the five districts were attained from 43% to 67% of the years, with two districts less than 50%. In the hatchery period, district goals have been attained over 85% of the years in all districts. The average across all regions was 57% during the pre-hatchery period, and 91% during the hatchery period.

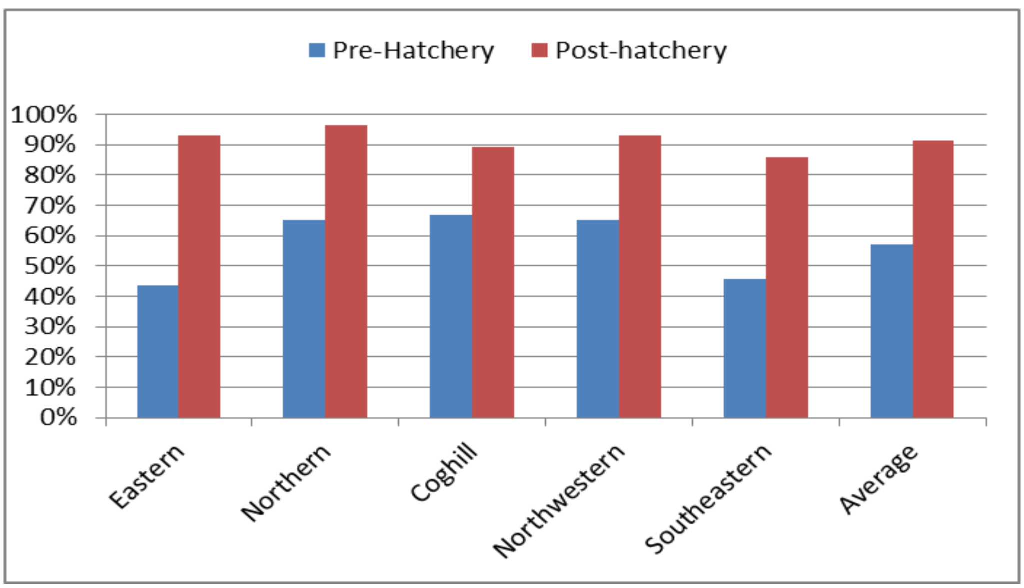

Figure 21. Frequency of attaining or exceeding the 2011 escapement goals by management district for chum salmon returning to Prince William Sound during pre-hatchery (1963–1985) and hatchery (1986–2013) time periods.

Escapements of chum salmon by district were also generally higher in the hatchery time period compared with the pre-hatchery time period (Figures 22–26). In four of the five districts, escapements during the hatchery period have been 50–500% higher than during the pre-hatchery period. In the Coghill district (Figure 23), average escapement was 2% higher in the pre-hatchery period at 21,200 versus 20,800 during the hatchery time period. For the entire PWS, pre-hatchery escapements averaged 144,000 compared to 286,000 during the hatchery time period.

Escapement estimates include fish of both natural and hatchery origin. The straying rates observed by district for 2013 (Knudsen et al. 2016) were used to estimate the number of natural-origin fish in the escapements for 2013. Escapements in 2013 were above the lower bound of the goal for four of the districts, and within 99% of the lower bound for the Northwestern district (Figures 22-26). Natural origin spawners were also above the lower bound for the Eastern, Northern, Coghill, and Southeastern Districts. For the Northwestern District, natural spawners were 95% of the lower bound in 2013.

This evaluation of chum salmon escapements in PWS prior to and during the hatchery period indicates that returns to the spawning grounds have been greater and more consistent during the hatchery time period. Thus there is no indication of a reduction caused by the hatchery program on the number of chum salmon spawning naturally in PWS or on the frequency of attaining management goals. Because the proportion of hatchery strays in the spawning escapements in PWS is generally low (Knudsen et al. 2016), these escapement patterns can be attributed primarily to increased stock productivity during the hatchery time period and good management to ensure wild stock escapements.

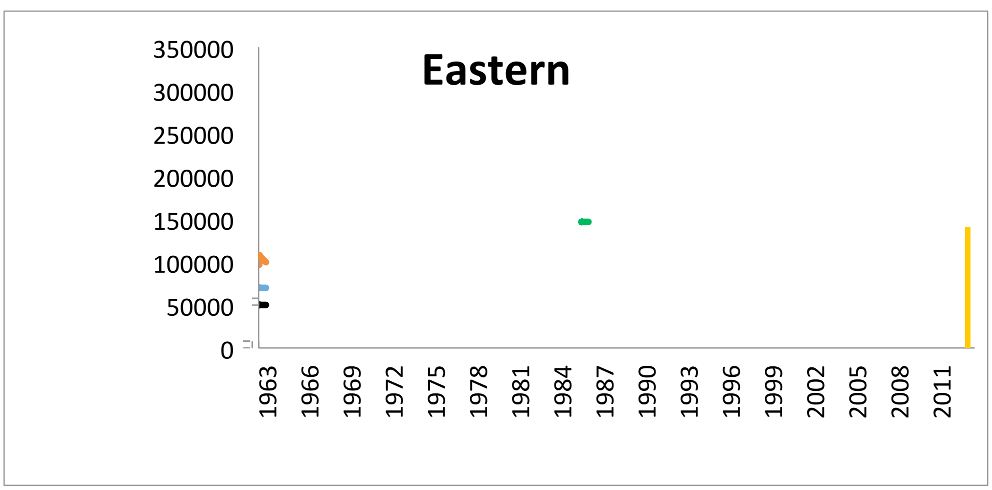

Figure 22. Eastern district chum salmon escapements (orange line) versus the 2011 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

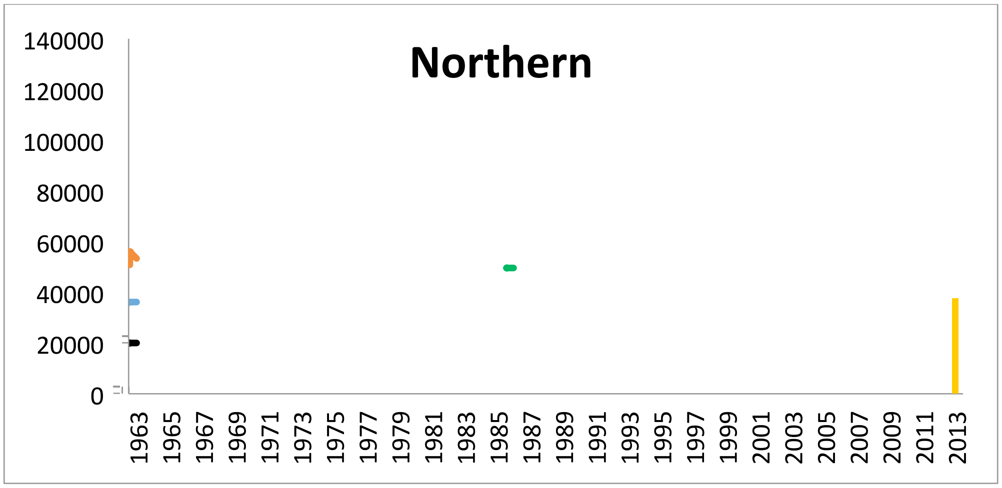

Figure 23. Northern district chum salmon escapements (orange line) versus the 2011 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

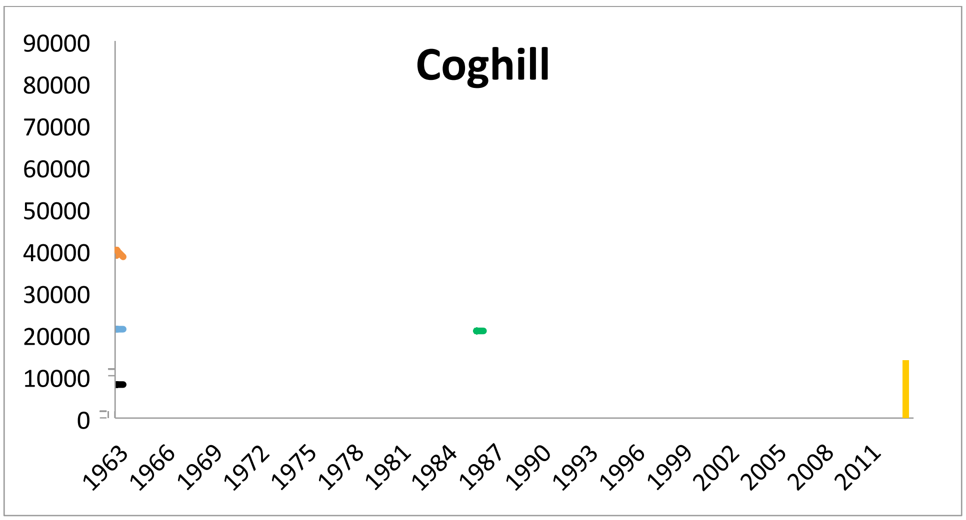

Figure 24. Coghill district chum salmon escapements (orange line) versus the 2011 goal (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

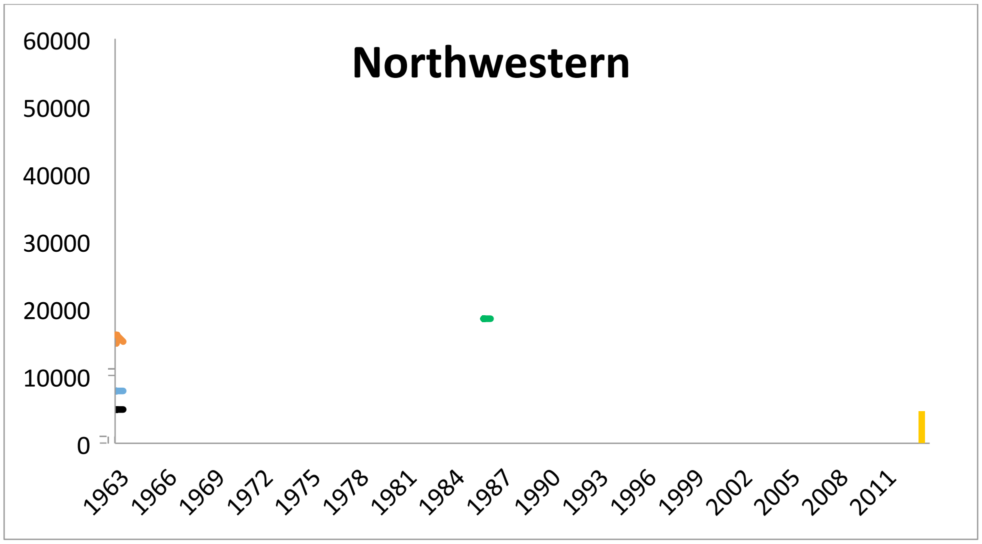

Figure 25. Northwestern district chum salmon escapements (orange line) versus the 2011 goal lower bound (black line). Blue line is pre-hatchery period average, green line is thehatchery period average, and the yellow bar is natural origin escapement in 2013.

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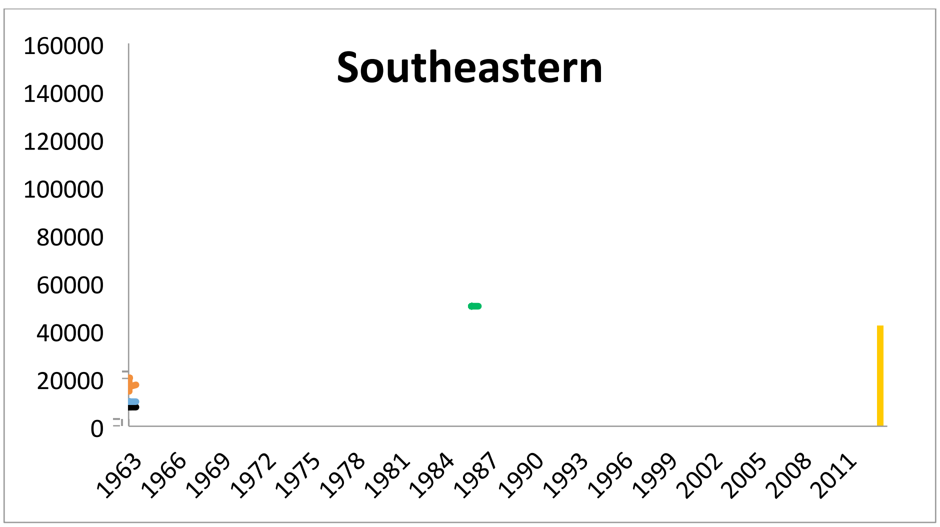

Figure 26. Southeastern district chum salmon escapements (orange line) versus the 2011 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

Southeast Alaska Chum Salmon Escapements

Escapements for summer chum salmon in SEAK were also examined versus the ADF&G escapement goals. The focus was on summer chums as this is the primary run type used in SEAK chum salmon hatchery programs. There are three management subregions of summer chum salmon in SEAK: Southern Southeast Summer Run (SSSR); Northern Southeast Outside Summer Run (NSOSR); and Northern Southeast Inside Summer Run

(NSISR). Current escapement goals were revised for the three management subregions in 2012, and again for the SSSR and NSOSR districts in 2014 (Piston and Heinl 2014). There were 54 years of adjusted index escapement numbers for SSSR and NSISR, and 31 years for NSOSR district. Over the entire time period that index numbers were available, the current escapement goal was achieved or exceeded 76% of the years for SSSR, 78% for NSOSR, and 72% for NSISR (Table 4).

Table 4. Southeast Alaska summer run chum salmon escapements versus current escapement goals.

	Southern Southeast Summer Run	Northern Southeast Outside Summer Run	Northern Southeast Inside Summer Run
Above	75.9%	78.1%	72.2%
Below	24.1%	21.9%	27.8%
Current Escapement Goals			
Goal	62,000	25,000	119,000

The frequency the escapement goal was attained or exceeded was also evaluated for SEAK summer chum salmon escapements in pre-hatchery years and in years when hatcheries contributed a significant portion of the overall return of chum salmon (1985–2013). Pre-hatchery escapement index counts were available for 1960–1983 for the SSSR and NSISR, but only for 1982 and 1983 for NSOSR. The frequency of attaining goals was higher in all summer chum salmon management subregions during the hatchery period in SEAK (Figure 27). During the pre-hatchery period, goals were attained in 50–70% of the years in the three subregions, whereas goals have been attained in 77–90% of the years in the hatchery period.

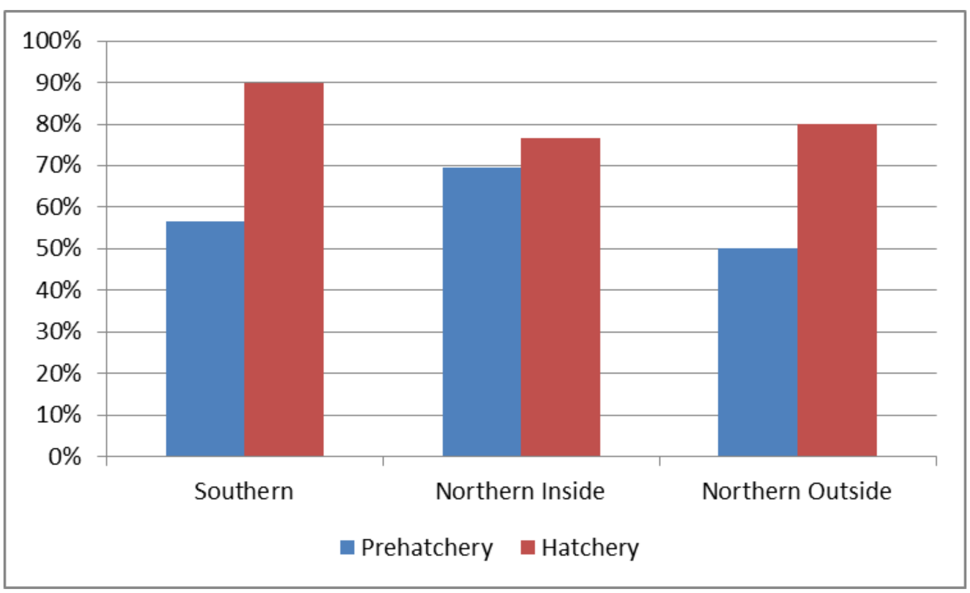

Figure 27. Frequency of attaining or exceeding escapement goals by management subregions for summer chum salmon returning to Southeast Alaska during pre-hatchery

(1960–1983) and hatchery (1984–2013) time periods. (For Northern Outside, pre-hatchery escapement data were available only for 1982–1983).

Average escapements of chum salmon were also higher in the hatchery time period compared with the pre-hatchery time period in the three districts (Figures 28–30). Escapements have averaged 50% higher for the SSSR district, 4% higher in the NSISR, and 220% higher for the NSOSR district, although in the latter case only two escapement observations were available for 1982 and 1983 for the pre-hatchery period.

Escapement estimates include fish of both natural and hatchery origin. The straying rates observed by district for 2013 (Knudsen et al. 2016) were used to estimate the number of natural-origin fish in the escapements for 2013. Escapements in 2013 were above the lower bound of the goal for the SSSR and NSISR, and 92% of the lower bound for the NSOSR (Figures 28-30). Natural origin spawners were also above the lower bound for the SSSR and NSISR. For the NSOSR, natural spawners composed 90% of the lower bound in 2013.

This evaluation of summer chum salmon escapements in SEAK prior and during the hatchery period indicates that returns to the spawning grounds have been greater and more consistent during the hatchery time period. Thus there is no indication of a negative impact of the hatchery program on the number of summer chum salmon spawning naturally in SEAK or on the frequency of attaining management goals. As in PWS, this trend can be attributed primarily to increased productivity and good management of wild stocks. Hatchery strays are present in the escapements in all three subregions, but, as discussed below, the proportion in the escapement does not substantially bias the escapement index counts at the management unit level.

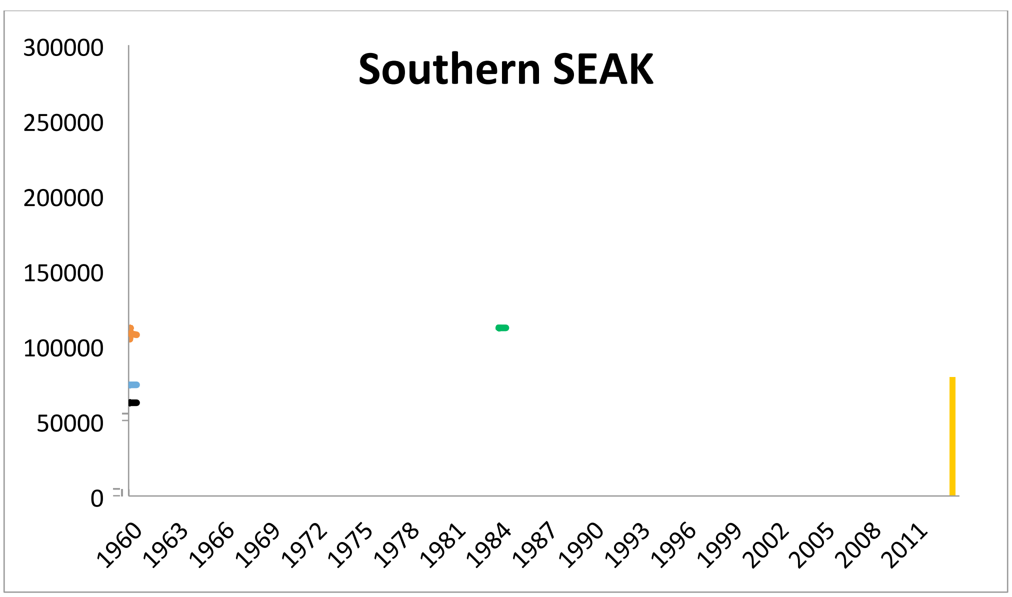

Figure 28. Southern Southeast Summer Run escapements (orange line) versus the 2014 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

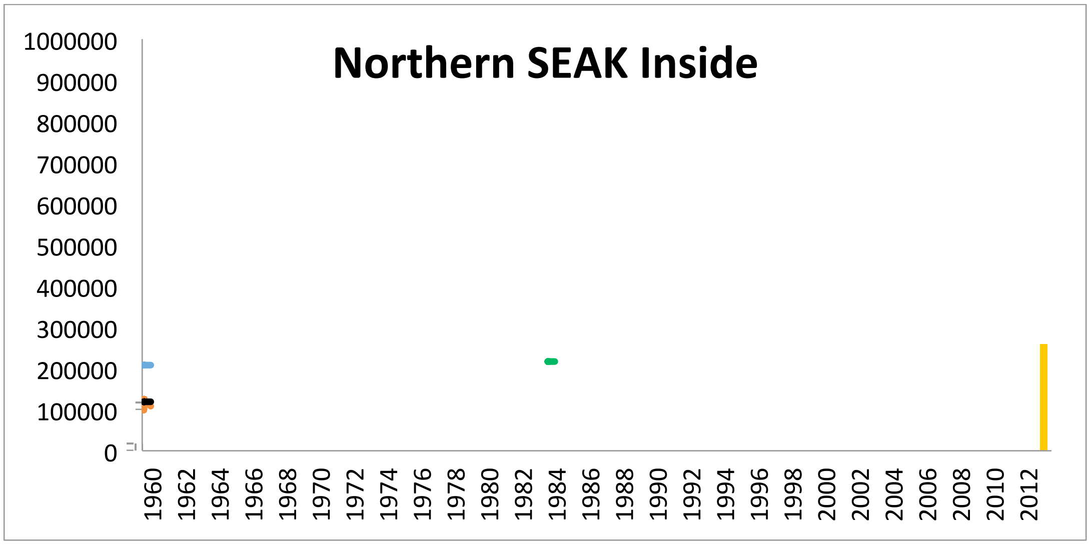

Figure 29. Northern Southeast Inside Summer Run escapements (orange line) versus the 2012 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013..
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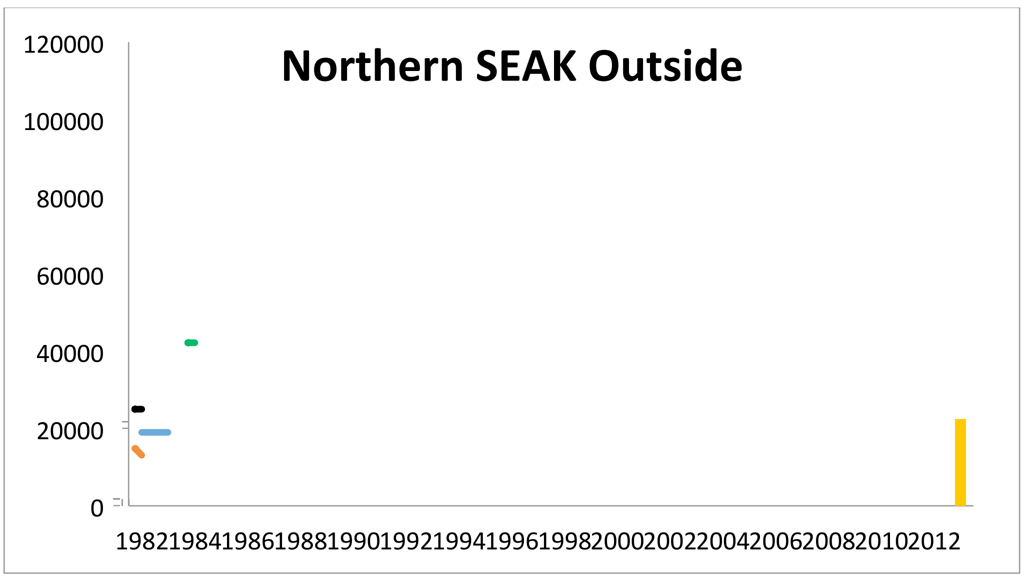

Figure 30. Northern Southeast Outside Summer Run escapements (orange line) versus the 2014 goal lower bound (black line). Blue line is pre-hatchery period average, green line is the hatchery period average, and the yellow bar is natural origin escapement in 2013.

Effects of Hatchery Strays on Management and Escapement Numbers

One concern for hatchery impacts on wild stocks is that hatchery strays into wild systems may comprise the ability of fishery managers to accurately assess the run strength and escapement of the wild component of the run. The number of hatchery strays is often attributed to hatchery practices, and is related to the size of the release, the effectiveness of imprinting at the release site, and the ability of ADF&G and the hatchery to harvest the returning fish. In PWS, management has utilized a process called the Salmon Harvest Task Force (SHTF, Wiese, 2015) and meetings with fishermen inseason to maximize harvest of hatchery fish while maintaining sustainable harvest rates on wild fish. The SHTF is a collection of PWS area processors, gear groups and aquaculture associations that provide formal management recommendations to ADF&G. For its part, ADF&G through its management and research programs, is able to provide timely information on composition of the return. This up to date information, along with an intensive aerial survey program and emergency order authority by local management biologists can result in harvesting a large proportion of the hatchery fish which presumably results in fewer strays. In 2014, managers established large closed areas to ensure wild salmon escapement while harvesting a large proportion of hatchery fish.

A review of this issue for pink salmon in PWS (Anonymous 2011) found that strays are not likely to affect the manager's ability to evaluate wild stock escapement strength during the period prior to August 26. Most directed fishing on pink salmon occurs prior to this date, and hatchery proportions in streams were very low prior to this time in the studies done by Brenner et al. (2012), except in the Eshamy District where high proportions of strays from Wally Norenberg Hatchery (WHN) and Armin F. Koernig (AFK) are likely to bias indices of wild escapement (e.g., Knudsen et al. 2016), and possibly, toward the end of directed fishing in the Southwestern district. Strays from Cannery Creek Hatchery (CCH) or WHN are not likely to have an effect on inseason management in any district except in the Eshamy District. Eshamy streams represent approximately 1% of the escapement index for pink salmon in PWS. Chum salmon in PWS were not included in the review, but given lower magnitude of straying for chum salmon relative to pink salmon (Knudsen et. al. 2015 b, 2016.), it is likely that the proportion of strays is not comprising the relationship of escapement index counts and run strength.

The instance of hatchery strays in wild summer chum salmon streams in SEAK has been estimated by Knudsen et. al., (2015a,b; 2016) and Piston and Heinl (2012 a, b). Both studies found that proportions of hatchery fish were generally highest in streams closest to hatchery release sites, and Piston and Heinl observed proportions of hatchery fish greater than 10% in some streams more than 50 km from the nearest release site. The overall estimated proportion of hatchery fish in the entire NSISR management unit ranged from 6% to 13%. Both studies found the estimated overall proportion of hatchery strays in the NSOSR index was less than 2% annually. Piston and Heinl did not make estimates of the incidence of hatchery fish in SSISR district; Knudsen et. al. (2015 a,b) estimated percentages ranging from 5% to 8% from 2013-2015. Based on this information, hatchery strays are not biasing escapement numbers at the management unit level, and do not compromise the ability of the managers to assess overall wild run strength and index escapement.

Hatchery Impacts on Production of Wild Salmon

Large scale hatchery production of pink and chum salmon in Alaska began in the early 1980s. There have been multiple generations of hatchery fish interacting with wild fish. For pink salmon in PWS, there have now been approximately 18 (odd and even year each) generations of hatchery influence. If interactions between hatchery and wild fish were affecting production, negative trends should be apparent over this time. The on-going AHRP is examining the impact of hatchery strays on fitness using sophisticated genetic techniques and will determine if there are other influences. In the following sections, we examine trends in production of PWS pink salmon and catch of PWS and SEAK chum salmon to elucidate whether there is evidence of reduced wild productivity.

Prince William Sound Pink Salmon

In PWS, it has been argued that hatchery stocks have replaced the productivity of wild stocks of pink salmon, so that there is no net gain realized (Hilborn and Eggers 2000). However, harvest and escapement indexes of wild stocks in PWS and SEAK have been consistent with historical levels during over 30 years of large-scale hatchery production, indicating that the enhanced production has been compatible with sustained wild stock productivity (Wertheimer et al 2001). Wertheimer et al. (2004a) estimated that an annual average production of 24 million hatchery pink salmon was associated with a yield loss of around 1 million (4.2%) wild fish. Most of the variability in wild stock productivity was explained by varying environmental conditions affecting marine survival. The relatively small yield loss attributed to hatchery fish abundance was associated with smaller size of returning adults at high abundance, which results in reduced fecundity (Wertheimer et al. 2004b).

In PWS, ADF&G has developed estimates of total escapement from the escapement indices, which along with estimates of wild stock harvest allows estimation of total wild stock production. The PWS wild pink salmon production for all years shows higher average production during the hatchery time period than in the pre-hatchery time period (Figure 31). For the years 1960–1976, prior to significant hatchery production, wild stock production averaged 6.7 million. During the hatchery time period (1977–2000) analyzed by Hilborn and Eggers (2000) and Wertheimer et al. (2004a), wild stock production averaged 12.0 million (1977–2000). In more recent years, (2001–2013) wild stock production has averaged 11.9 million based on ADF&G catch and escapement data. During these time periods, average hatchery contributions to the commercial harvest (common property and cost recovery) has increased from an average of 13.9 million for 1977–2000 to an average of 39.2 million in recent years (Figure 32.)

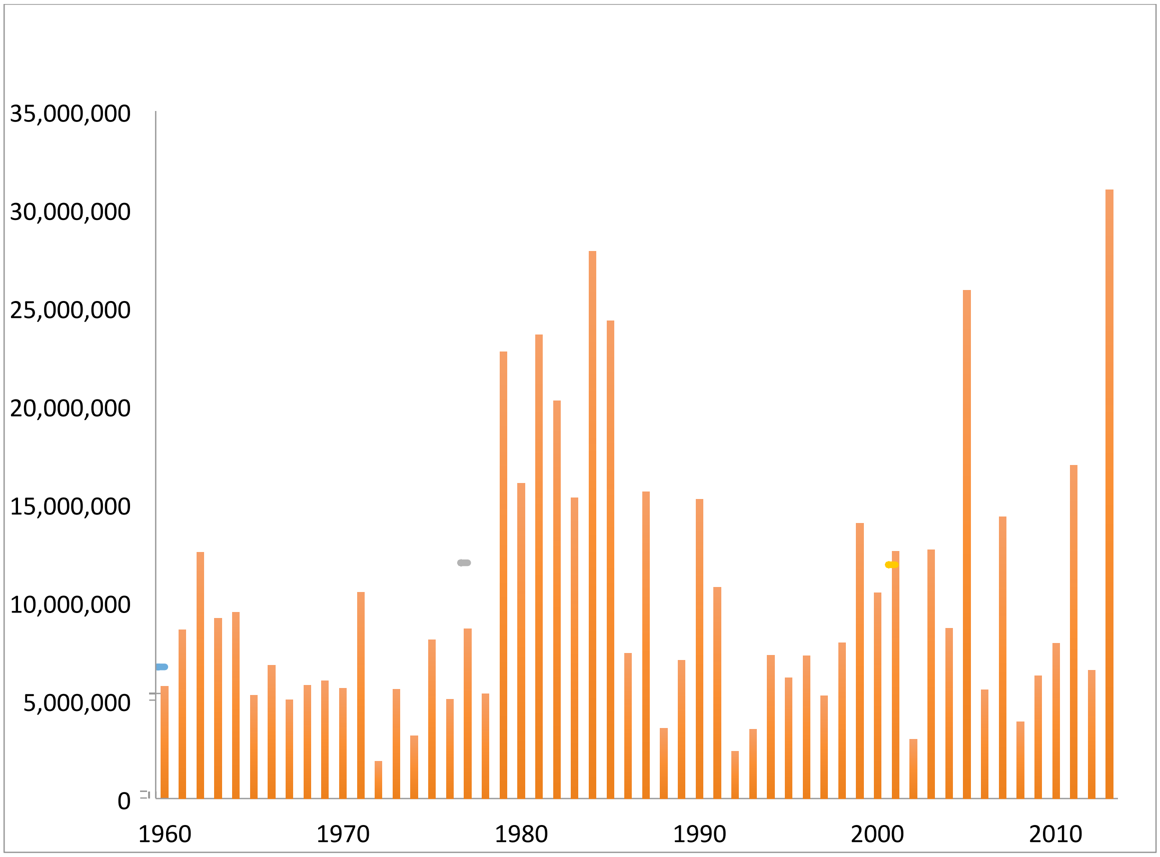

Figure 31. PWS Wild Pink Salmon Production for all years. Lines indicate average production for pre-hatchery years (1960–1976) and two hatchery time periods: 1977–2000 and 2001–2013. Data are personal communication, T. Sheridan, ADF&G).

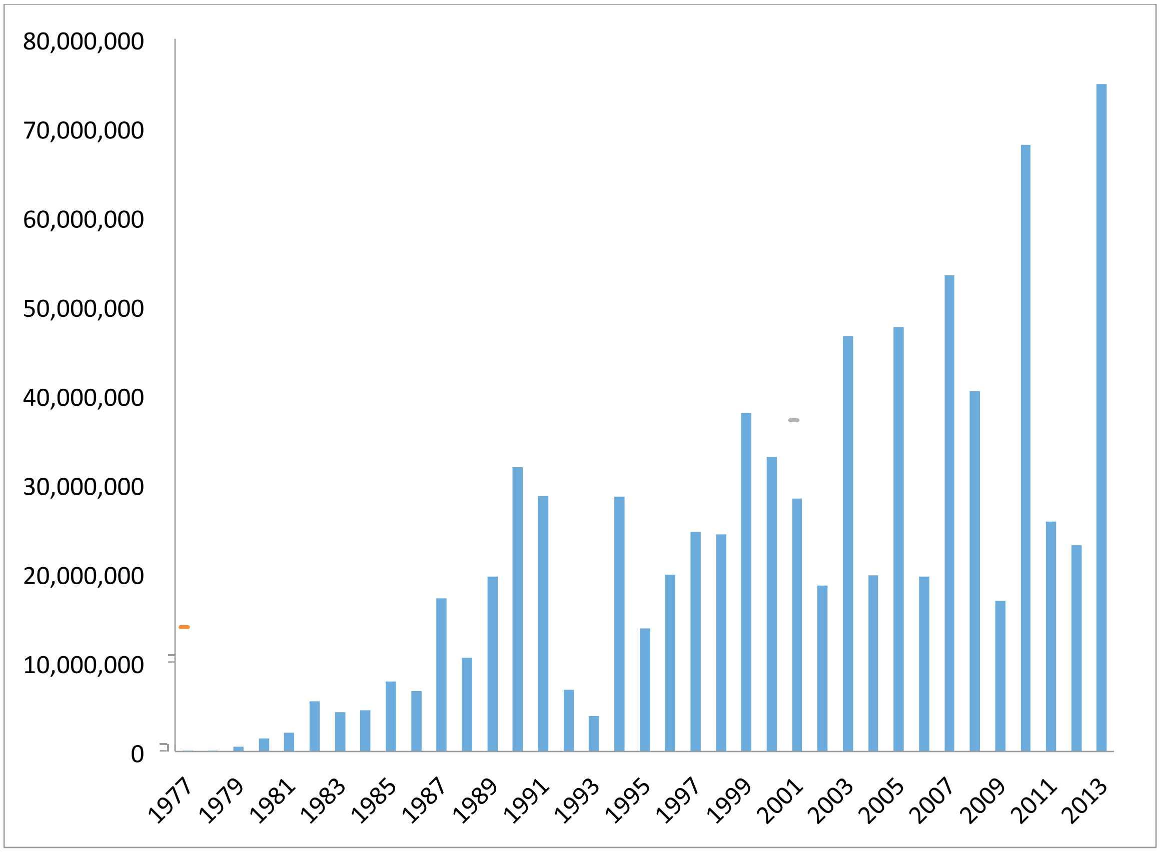

Figure 32. Total commercial harvest (common property and cost recovery) of hatchery pink salmon in PWS, 1977–2013. Lines indicate averages for 1977–2000 and 2001–2013. Data are from ADF&G PWS Area Management Reports..

For both even and odd year runs of pink salmon in PWS, total wild production was higher during the hatchery time period (post 1976) than during the pre-hatchery time period (1960–1976). The difference has been more marked for the odd year run, as the even-year wild run has been weaker than the odd-year wild run in recent years. For the even year run, average wild production during the hatchery time period has been 9.3 million, ~50% higher than the 6.2 million average for the pre-hatchery time period (Figure 33). For the odd-year run, the average wild production during the hatchery time period has been 14.6 million, ~100% higher than the 7.3 million average for the pre-hatchery time period (Figure 34).

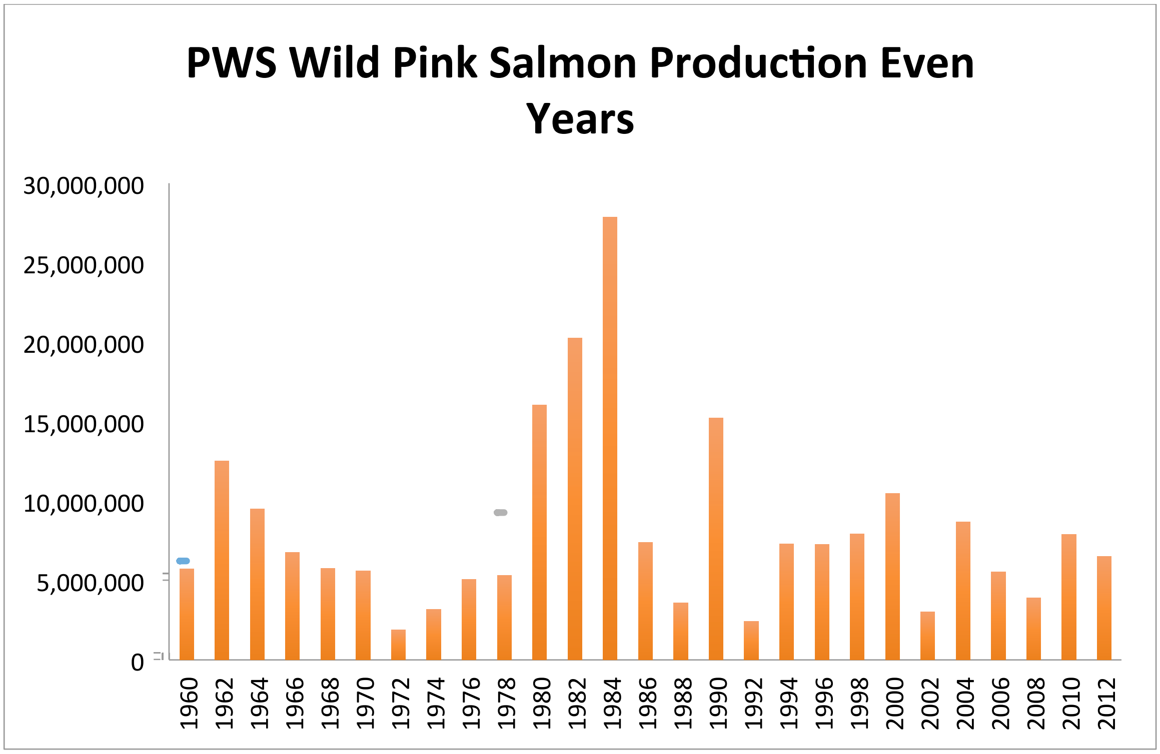

Figure 33. PWS Wild Pink Salmon Production for even years. Lines indicate averages for pre-hatchery (1960–1976) and hatchery (1977–2013) time periods. Data are from personal communication, T. Sheridan, ADF&G).

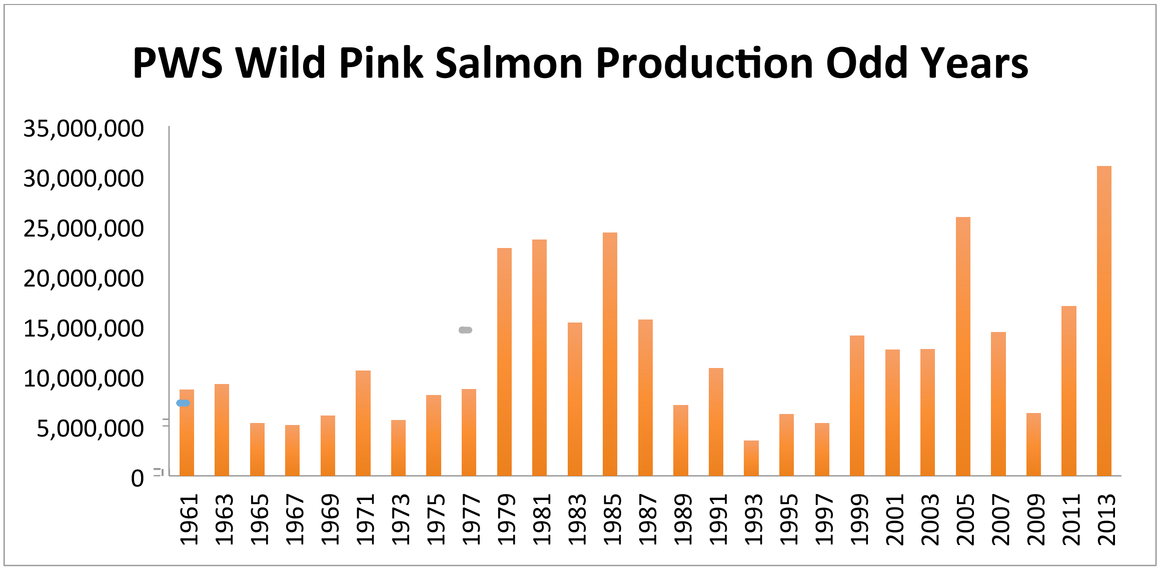

Figure 34. PWS Wild Pink Salmon Production for odd years. Lines indicate averages for pre-hatchery (1960–1976) and hatchery (1977–2013) time periods. .Data are from personal communication, T. Sheridan, ADF&G).

Prince William Sound Chum Salmon

Total commercial harvest (common property and cost recovery) for PWS chum salmon is shown in Figure 35. As hatchery operations have increased, average annual harvest of chum salmon has increased. During the pre-hatchery time period (1965–1985), harvest averaged 577 thousand fish. This increased as hatchery operations ramped up, to an average of 1.6 million fish for 1986–2000 and 3.5 million fish for 2001–2010.

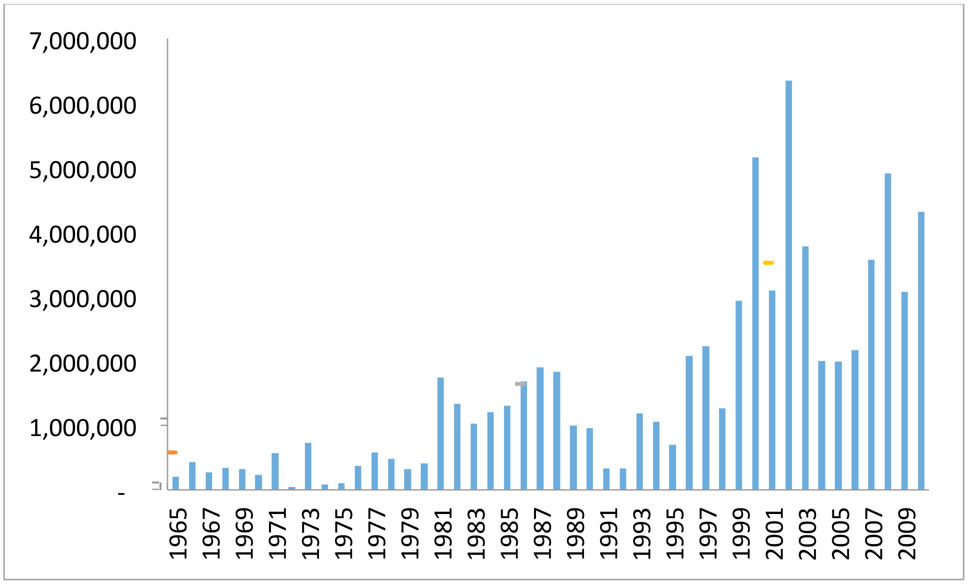

Figure 35. Total commercial harvest (common property and cost recovery) of chum salmon in PWS, 1977–2010. Lines indicate averages for pre-hatchery (1965–1985) and hatchery (1986–2000 and 2001–2010) time periods. Data are from ADF&G PWS Area Management Reports.

Southeast Alaska Summer Chum Salmon

Total commercial harvest (common property and cost recovery) for SEAK chum salmon is shown in Figure 36. Similar to PWS, as hatchery operations for chum salmon have increased, average annual harvest of chum salmon has increased. During the pre-hatchery time period (1960–1983), harvest averaged 1.6 million. This increased as hatchery operations ramped up, to an average of 7.8 million fish for 1986–2000 and 9.9 million fish for 2001–2014.

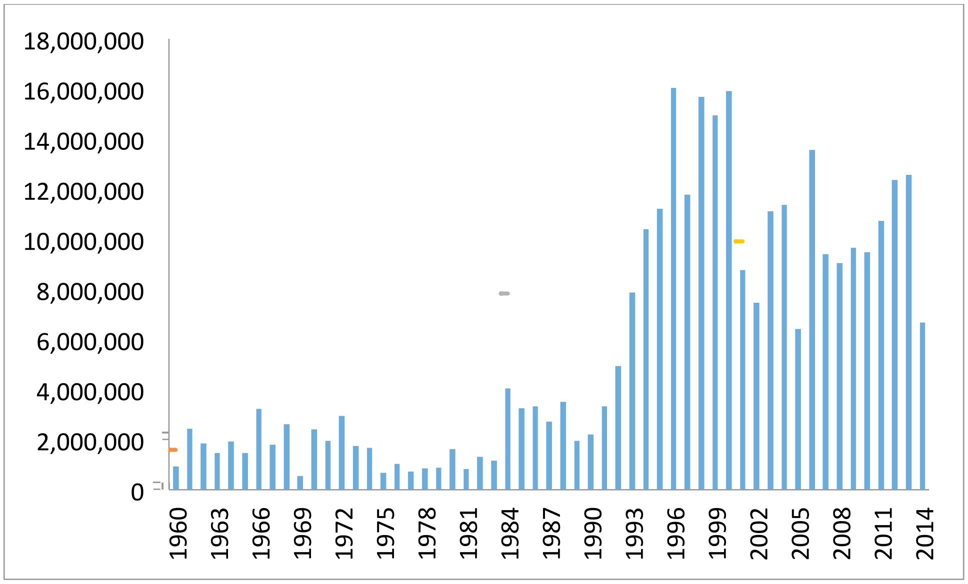

Figure 36. Total commercial harvest (common property and cost recovery) of chum salmon in SEAK, 1960–2014. Lines indicate averages for pre-hatchery (1960–1984) and hatchery (1984–2000 and 2001–2014) time periods. Data are from Piston and Heinl (2014), ADF&G (2016).

Hatchery /Wild Genetic Interactions

While policies and management strategies have been implemented by ADF&G to reduce risk to wild stocks, the scale of the Alaska enhancement program may result in enhanced fish causing genetic impacts to wild populations. The potential for interactions depend on the straying rates into wild spawning grounds and the impact of hybridization between wild and hatchery origin fish on reproductive success (fitness). The AHRP includes an objective to determine the degree (if any) of this impact.

Grant (2012) reviewed many examples of adaptations and effects of hatchery practices and hatchery strays, of the 68 studies listed, only three related directly to pink and chum salmon and none were representative of hatchery practices in Alaska. Brenner et al. (2012) have shown proportion of hatchery strays in the escapements in PWS streams ranging from 0–98% for pink salmon, and for chum salmon from 0–63%. However, selection of streams for sampling for hatchery strays was designed to estimate the proportion of hatchery origin fish in streams relative to distance from specific hatchery sites, and may not be representative of the proportion of hatchery fish in the escapements at the districts or PWS area.

Both direct genomic studies of populations and retrospective studies of productivity of hatchery-influenced populations have demonstrated loss of fitness in steelhead (*O. mykiss*), Chinook, and coho (e.g., Araki et al 2008; Chilcote et al. 2011). These species have long freshwater life histories, which is believed to greatly increase the potential for domestication effects that could affect fitness in the wild. Evidence from pink or chum salmon hatchery programs (in which salmon are artificially cultured only until they are fry) is sparse. Berejekian et al. (2009) found no statistical difference in the reproductive success of hatchery and wild origin chum salmon; the relative success of hatchery-bred males was slightly higher than natural origin males, while the relative success of hatchery-bred females was slightly less than that of natural origin females.

The AHRP currently underway is designed to estimate the proportion of stray hatchery pink and chum salmon in PWS and SEAK wild systems, and the potential level of introgression and fitness of hatchery-wild salmon F1 generation. The fieldwork is being carried out by the PWSSC in PWS, and by the SSSC in SEAK. The straying field work was completed in 2015 and the fitness of hatchery-wild salmon F1 generation study will be completed in 2023 for chum salmon and 2018 for pink salmon.

Jasper et al. (2013) have documented introgression from hatchery chum salmon to wild chum salmon in PWS. Demonstration of introgression at neutral genes does not necessarily imply fitness effects. Although there is risk associated with introgression, some introgression from hatchery stocks into wild stocks has always been expected, because of the recognition that there will be a degree of straying and interaction between hatchery and wild origin fish. Jasper et al. (2013) also found that the genetic stock structure of wild chum stocks in PWS is largely intact.

ADF&G Response to Evidence of Negative Effects of Hatchery Programs

ADF&G has monitored for negative effects of hatchery programs by sampling for hatchery strays in wild stock escapements and tracking wild production. As noted above, ADF&G is co-sponsoring and managing the AHRP quantifying straying rates and evaluating impacts of hatchery strays in PWS and SEAK. If a reduction in fitness of natural stocks is seen, ADF&G (personnel communication J. Regnart, ADF&G (retired)) has identified the following directed actions with which it may respond:

- Reduction in production from hatcheries most likely contributing to the problem;
- Elimination or relocation of remote release sites where higher stray rates may increase introgression;
- Changes to management of brood stock or hatcheries, which may include introduction of additional sources of wild brook stock;
- Specific management actions which seek to further avoid harvest of wild stocks while increasing harvest of hatchery fish.

Discussion

In contrast to the mitigation hatcheries of the Pacific Northwest, which were built to replace wild production that was diminished or even extirpated by widespread habitat degradation and damming of many major salmon-producing rivers, the Alaskan hatchery program was developed to supplement and enhance fisheries that historically depend on wild production (McGee, 2004). The policies and procedures established by ADF&G at the onset of the Alaskan hatchery program were intended to avoid some of the detrimental impacts observed with Pacific Northwest hatchery programs. These policies have been generally successful for over three decades by preventing introductions of exotic stocks of fish and fish pathogens and allowing increased harvest of salmon while managing to minimize the risk to wild stocks. Since implementation of the enhancement program, the salmon harvests in Alaska have increased from the nadir of some 20 million fish statewide in the early 1970's to an average of 179 million in the last ten years, peaking at 272 million fish in 2013. Hatchery production now comprises around 35% of the statewide salmon harvest (Vercessi 2015; Figure 1).

Straying of pink and chum salmon is not just a hatchery phenomenon. Pink salmon are generally recognized as the species of Pacific salmon with the highest straying rates (Quinn 2005). Sharp et al. (1994) found extensive straying of coded-wire tagged wild pink salmon in PWS following the Exxon Valdez oil spills, with rates ranging from 9–54%. In SEAK, Mortensen et al. (2002) estimated local stray rates of thermal marked and coded wire tagged fish at 5–10%, and Thedinga, et. al. (2000) estimated a mean stray rate for wild coded-wire-tagged (CWT) fish at 5.1% (a range of 1.5% – 9.2%). Thedinga et al. (2000) found higher stray rates for fish from a wild population with a high proportion of intertidal spawners relative to a wild population with predominately upstream spawners. This could contribute to the high rates observed in PWS by Sharp et al, (1994), where 35–75% of the pink salmon spawn intertidally. Without straying, colonization of new areas such as Glacier Bay and reclaimed lands (and the new streams) from the 1964 earthquake could not have occurred (Hendry et al. 2003).

Given the importance of straying in the biology of Pacific salmon for maintaining metapopulations and colonizing new habitats (Quinn 2005), ADF&G envisioned that some salmon released from hatcheries would stray. However, it was also thought that the use of locally derived brood stocks, maintenance of high genetic diversity within hatchery broodstocks, and management policies to constrain hatchery strays would minimize detrimental effects of straying of hatchery fish to the sustainability of wild stocks.

Since the mid-1980s, the pink and chum salmon hatchery programs in PWS have stabilized and remained at relatively constant release levels. Both odd and even year pink salmon have had over 20 generations of exposure to hatchery strays. This paper has examined escapements and production of wild fish, and has found no indication of obvious negative effects. For both pink and chum salmon in PWS, escapements are larger during the hatchery time period than in years prior to significant hatchery production of these species in their respective regions. For PWS pink salmon, total wild stock production has consistently averaged higher during the hatchery time period than during the pre-hatchery years for which data are available. This sustained wild production has been synoptic with hatchery production that now contributes over 37 million pink salmon to the annual harvest.

For PWS chum salmon, these increased escapements and catches have occurred concurrent with the finding by Jasper et al. (2013) that introgression has occurred in the population. That study also found that the genetic structure of chum salmon remains. At the same time, total commercial harvest in PWS has increased from an average of 577,000 annually in the pre-hatchery time period, to 3.5 million in recent years.

Escapements for summer chum salmon in SEAK also have been larger and more frequently attained or exceeded current escapement goals in the hatchery time period (1984–2013) than in years prior to significant hatchery production (1960–1983). While wild stock escapements have been sustained, the total commercial harvest has increased over 500% (Figure 35). This is consistent with the review by Heard (2012) concluding that there were no large scale impacts on wild stocks of chums in SEAK.

These results, the explicit hatchery management policies and regulations, the ADF&G management plan for addressing negative effects, and continued research into hatchery/wild interactions demonstrate that ADF&Gs management of the large scale pink and chum hatchery program support sustainable wild stock productivity and is consistent with the current concepts of the precautionary approach. The FAO defines the Precautionary Approach as "A set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong." In considering its approach, they concluded that; "although the precautionary approach to fisheries may require cessation of fishing activities that have potentially serious adverse impacts, it does not imply that no fishing can take place until all potential impacts have been assessed and found to be negligible". The precautionary management policies were developed and adopted by ADF&G prior to the FAO definition of the precautionary approach, but are consistent with the FAO definition.

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Ocean Beauty Seafoods has been in business for over 100 years and operates five large processing plants in Alaska along with seven distribution locations in the lower 48 and reprocessing including two smoke salmon operations in Washington, it's employees, fishers, and the communities they serve benefit greatly from the Alaska Salmon Hatcher programs. The hatchery programs have given sustainable incomes that benefit the processors, fishers as well as state and local government, which receive raw fish tax. In addition, it provides opportunities to subsistence, sport and charter fishermen. The influx of activity during the Salmon fisheries also adds to local communities by giving grocers, marine service industry, along with regional airlines a windfall they would not have if we did not have the hatcheries to shore up the non-hatchery fisheries.

The methodology that the Hatcheries work under is precautionary and transparent, they have worked with strong proven science to protect the wild stock. The Alaska Department of Fish and game has worked closely through permitting processes along with the public and all stakeholders in the salmon industry. Hatchery fish follow the same survival trends of non-hatchery fish and the largest salmon returns have occurred after the start of the hatchery programs. There are no stock of concern in any area of hatchery production. On average the hatcheries add 67 million fish to the commercial fisheries and in the past decade the hatcheries accounted for 34% of the commercial catch. In 2018 hatchery fish accounted for 59% of the total ex-vessel value in Southeast 75% in Prince William Sound, 9% in Cook Inlet and 25% in Kodiak. The McDowell Group reports that in 2018 Alaska Salmon hatcheries contributed 4,700 jobs, $218 million in labor income, and $600 million in economic output. The State of Alaska has invested significantly into the Salmon Hatchery programs and it has returned economic opportunities throughout the state especially in rural coastal communities. It has given greater access to fish for not only the commercial fisheries but also sport and substance fisheries while taking pressure off the wild stock.

Ocean Beauty Seafoods fully supports the Alaska Salmon Hatchery programs. We are a major contributor the Alaska Hatchery Wild Salmon interaction study, a science based non-bios study started in 2011 set to conclude in 2023. Currently all Alaska Salmon including Hatchery Salmon have been certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC). We ask that the Alaska Board of Fish to work with the Alaska Department of Fish and Game, the hatchery community, and industry leaders to further it's understanding and the importance of the Alaska Salmon Hatchery program to all Alaskans.

Mike Forbush

Ocean Beauty Seafoods

Sr. Alaska operations Manager

PSPA
PACIFIC SEAFOOD
PROCESSORS ASSOCIATION

February 21, 2020

Alaska Board of Fisheries
Reed Morisky, Chair
Via email: dfg.bof.comments@alaska.gov

RE: On-time comments for March 7 Hatchery Committee

Chairman Morisky and Board Members:

Thank you for the opportunity to comment in advance of the Alaska Board of Fisheries (Board) Hatchery Committee scheduled for March 7.

PSPA is a nonprofit seafood trade association representing seafood processing businesses and their investment in coastal Alaska, including three shorebased processing plants located in Prince William Sound (Cordova and Valdez), four in southeast Alaska (Wrangell, Petersburg, Ketchikan), and two in Kodiak. Alaska's unique salmon enhancement program is critical to the stability of the fishery-dependent communities in these regions, as well as the livelihoods of thousands of Alaskans. More than 16,000 fishermen, processing employees, and hatchery workers can attribute some portion of their income to Alaska's salmon hatchery production. In addition, on average, more than 270,000 hatchery-origin salmon are harvested annually in sport and related fisheries, and these numbers are considered conservative. Overall, Alaska's salmon hatcheries contribute nearly a quarter of the value of our state's salmon harvests and generate $600 million in economic output, with impacts throughout the economy.

Hatchery pink and chum salmon are crucial for Prince William Sound, Kodiak, and Southeast processors because they provide the volume and stability needed to keep plants operating. Processors and harvesters have made significant long-term investments in processing plants and their fishing businesses, respectively, based on this program and permitting decisions. In addition, tenders, support vessels, support businesses, transportation companies, sportfish businesses, and community governments (through fish taxes) are dependent on the direct and indirect economic activity that the hatchery programs provide.

The State of Alaska established the hatchery program in 1971—at a time when Alaska's salmon returns were at historic lows—to provide for more stable salmon harvests and bolster the economies of coastal communities that would not otherwise have viable economies. Since the beginning, the hatchery program was designed to supplement natural reproduction, not replace it, and to minimize negative interactions with naturally occurring populations of salmon. A testament to this design is that wild pink and chum salmon returns and harvests have greatly improved since the inception of the program. PSPA supports a strong hatchery program and believes it is consistent with the Department and the Board's sustainable salmon policy.

Given the interest in and dependence on the hatchery program and the overwhelming public support for the program conveyed at your last Hatchery Committee meeting, we appreciate the Board continuing to convene the Hatchery Committee and supporting the intent of the Joint Protocol on Salmon Enhancement. This protocol is intended to highlight statewide perspectives on issues associated with hatchery production of salmon and to provide a forum for open discussion of hatchery topics, including updates and preliminary results from the ongoing Alaska Hatchery Research Project.

The Alaska Hatchery Research Project is a long-term study intended to answer some of the most pressing scientific questions on the interaction of wild and hatchery pink and chum salmon in PWS and SEAK. This research, conducted by the Prince William Sound Science Center and Sitka Sound Science Center, is a direct response to the value that hatchery production provides to Alaska and the mandate that hatchery production be compatible with sustainable productivity of wild stocks, and thus was instigated and supported by ADF&G, the university, the fishing industry, and hatchery operators. The research plan and objectives were developed and continue to be monitored by a panel of scientists with broad experience in salmon management and wild and hatchery interactions. The department has provided continuous updates, additional study subjects, and a continuous evaluation of best practices, as was done recently in October 2018 (*Special Publication No. 18-12, Salmon Hatcheries in Alaska – A Review of the Implementation of Plans, Permits, and Policies Designed to Provide Protection for Wild Stocks, ADFG October 2018*). We appreciate the Board's support of the hatchery research project as a means to collect unbiased and critical data that serve to protect and maximize Alaska's salmon resources.

PSPA is committed to sound science through the use of best available data and the expertise of our fishery scientists and managers, and values a strong public process. We appreciate the Board's support for a public process to discuss hatchery issues and research.

Sincerely,

Nicole S. Kimball

Nicole Kimball
PSPA - Anchorage

PETER PAN SEAFOODS, INC.

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February 18, 2020

Alaska Board of Fisheries
Reed Morisky, Chair
Via email dfg.bof.comments@alaska.gov

RE: Hatchery Committee Meeting

Dear Chairmen Morisky and Board Members:

Thank you for the opportunity to comment on Salmon Hatcheries Committee Meeting and Joint Protocol on Salmon Enhancement put forth by the Alaska Board of Fisheries on March 7th. Peter Pan Seafoods, Inc continues to support a transparent and comprehensive mechanism that encourages sustainable salmon fisheries and strong hatchery production in Alaska.

Peter Pan Seafoods is a long-standing processor of Alaska's seafood. We have processing facilities in King Cove, Port Moller, Dillingham and Valdez as well as fisherman support facilities at Sand Point, False Pass and Naknek. We have been processing in Prince William Sound since 1988. Our operations are intricately tied to and supported by the communities in which we reside. The health of these communities and our industry is dependent on sound management that protects the health of Alaska's fishery resource.

Hatcheries in Alaska continue to have remarkable economic impacts directly effecting the harvesting and processing sectors, as well as, local communities. In Valdez alone, over 900 captains and crew support the local the grocery stores, hardware stores, and restaurants in the community. This activity is synonymous for all communities with a total of 4,700 jobs and $600 million in annual economic output that benefit from hatchery production throughout Alaska.[1]

The Alaska Hatchery Research Project is funded in partnership by the State, hatchery organizations and the processing industry. It is a groundbreaking study that provides conclusions to many unanswered questions regarding salmon in Alaska. Utilizing these unbiased and scientific methods to assess our fisheries' stocks provides essential data that serves to protect and maximize both wild and hatchery resources.

Peter Pan Seafoods, Inc thanks you for providing a platform for discussion and encourages you to continue to support the Salmon Hatchery Committee Meeting.

Sincerely,

Mike Simpson
VP. Of Alaska Operations

[1] Economic Impacts of Alaska's Salmon Hatcheries, McDowell Group, 2018.

PSVOA

1900 W Nickerson St., Ste. 320 ■ Seattle, WA 98119 ■ Tel: (206) 283-7733 ■ Fax: (206) 283-7795 ■ www.psvoa.org

February 21, 2020

VIA E-MAIL

Reid Morisky, Chair
Alaska Board of Fisheries
P.O. Box 115826
Juneau, AK 99811

Re: Joint Protocol on Salmon Enhancement & Salmon Hatcheries Committee Meeting

Dear Chair Morisky and Board of Fisheries Members:

The Purse Seine Vessel Owners Association ("PSVOA") respectfully submits the following letter in support of the convening of the Salmon Hatcheries Committee Meeting and Joint Protocol on Salmon Enhancement on March 20, 2020. First and foremost, PSVOA supports sustainable salmon fisheries and strong hatchery production in Alaska. PSVOA further supports the spirit and intent of the Joint Protocol to highlight statewide perspectives on issues associated with hatchery production of salmon, and to provide a forum for open discussion on hatchery topics to improve dialog and transparency between Board of Fisheries (BOF), ADF&G, fisheries stakeholders, and the public.

Contrary to some of the misinformation that has been circulated by the anti-hatchery movement, The Alaska hatchery program provides economic and ecological stability to Alaska salmon returns, which fluctuate from year to year. Salmon hatchery production supports local economies, coastal communities, and all user groups, including the sport fishing sector.

Alaska's salmon hatcheries account for the annual equivalent of 4,700 jobs and $218 million in total labor income. Combining the direct, indirect, and induced economic impacts connected to Alaska salmon hatchery production totals $600 million in annual economic output.

A majority of PSVOA members participate in salmon purse seine fisheries in either Southeast, Prince William Sound (PWS), or Kodiak. According to a October 2018 report by the McDowell Group, over a six-year period, PWS harvests of hatchery salmon generated $69 million in ex-vessel value annually. In Southeast, hatchery salmon accounted for an average annual ex vessel value of $44 million, followed by Kodiak ($7 million).

The benefits of Alaska's salmon hatchery production are not limited to commercial fisheries. On average, approximately10,000 hatchery-origin Chinook, 5,000 chum, 100,000 coho, 19,000 pink, and 138,000 sockeye salmon are harvested annually in sport and related fisheries. As a percentage of statewide sport-caught fish, hatchery-origin salmon accounted for 17 percent of sport coho harvests, 13 percent of sport sockeye harvests, and 8 percent of sport Chinook harvests.

In sum, Alaska hatchery salmon production is major contributor to Alaska's economy, and the lifeblood of many of the Alaska commercial salmon fisheries.

Very truly yours,

/s/ Robert Kehoe

Robert Kehoe, Executive Director
Purse Seine Vessel Owner's Ass'n

Representative Louise Stutes

Alaska State Legislature / District 32

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Kodiak, AK 99615
Phone: 907-486-8872
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Date: February 21, 2020

To: Alaska Board of Fisheries

Re: Support for Alaska's Salmon Hatchery Program

Dear Chairman Morisky and Members of the Board,

I am submitting this letter in strong support of Alaska's salmon hatcheries. As the State Representative for Kodiak, Cordova, Yakutat, and portions of Kachemak Bay, I know how reliant Alaskans are on healthy, sustainable, and predictable salmon runs. Whether you are a subsistence, sport, commercial, or personal use fisherman, or simply an industry worker or eager consumer, salmon touches everyone's life in Alaska.

Alaska's salmon hatchery program was instituted in 1973 to supplement diminishing wild returns statewide. Since that time, it has supported local economies and promoted long term sustainable harvests for all user groups by relieving pressure from wild runs during seasons of low wild abundance. Further, since the program's inception, the average annual harvest of wild salmon has increased from 40 million to 75 million.

From 2012 through 2015, commercial fishermen harvested an annual average of 222 million pounds of hatchery-produced salmon worth $120 million in ex-vessel value. Additionally, Alaska's salmon hatcheries account for the annual equivalent of 4,700 jobs and $218 million in total labor income, including all direct, indirect, and induced economic impacts. A total of $600 million in annual economic output is connected to Alaska salmon hatchery production.

I ask that the Board consider the interests of all users and regions of Alaska and support sustainable hatchery production and responsible, thoughtful resource management.

Sincerely,

Louise Stutes

Representative Louise Stutes

Representative.Louise.Stutes@akleg.gov

SALMON HATCHERIES
FOR ALASKA

February 20, 2020

Alaska Board of Fisheries
1255 W. 8th Street
P.O. Box 115526
Juneau, AK 99811-5526

Members of the Board of Fisheries:

Please find attached a legal memorandum produced by the firm of Ashburn & Mason P.C. in Anchorage. This memorandum was produced in July 2018 to answer questions pertaining to the Alaska hatchery program and related questions on Board processes and jurisdiction, hatchery production regulation, harvest and permit management, and more. The upcoming March 7 Hatchery Committee Meeting will include presentations from various state departments. We are submitting this memorandum to provide additional background to the Board for consideration in advance to the discussions that will take place on March 7 in Anchorage.

Please don't hesitate to contact any one of us with questions or for additional information.

Sincerely,

Steve Reifenstuhl
General Manager
Northern Southeast Regional Aquaculture Association (NSRAA)
Sitka, Alaska

Tommy Sheridan
General Manager & CEO
Prince William Sound Aquaculture Corporation (PWSAC)
Cordova, Alaska

Dean Day
Executive Director
Cook Inlet Aquaculture Association (CIAA)
Kenai, Alaska

Katie Harms
Executive Director
Douglas Island Pink and Chum, Inc. (DIPAC)
Juneau, Alaska

Mike Wells
Executive Director
Valdez Fisheries Development Association (VFDA)
Valdez, Alaska

Tina Fairbanks
Executive Director
Kodiak Regional Aquaculture Association (KRAA)
Kodiak, Alaska

David Landis
General Manager
Southern Southeast Regional Aquaculture Association (SSRAA)
Ketchikan, Alaska

Bart Watson
General Manager
Armstrong Keta, Inc.
Port Alexander, Alaska

ASHBURN & MASON P.C.

LAWYERS

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DONALD W. MCCLINTOCK III • JEFFREY W. ROBINSON • THOMAS V. WANG
OF COUNSEL JULIAN L. MASON III • A. WILLIAM SAUPE

July 9, 2018

VIA EMAIL: dfg.bof.comments@alaska.gov

Chairman John Jensen
Alaska Board of Fisheries
P.O. Box 115526
Juneau, AK 99811-5526

Re: **Public Comments of Ashburn & Mason, P.C., Counsel for Prince William Sound Aquaculture Corporation In Opposition To May 16, 2018 KRSA et al. Emergency Petition Regarding VDFA Hathcery Production (Comment Due Date July 9, 2018).**

Dear Chairman Jensen and Members of the Board of Fisheries,

Ashburn & Mason, P.C., counsel to Prince William Sound Aquaculture Corporation ("PWSAC"), submits the following opposition and public comments to the above-referenced petition:

INTRODUCTION

Petitioners ask the Board to declare an emergency and reduce the current permitted salmon production at Valdez Fisheries Development Association's ("VFDA") Salmon Gulch Hatchery. The Department of Fish and Game (the "Department") granted VFDA's production permit in 2014, which provided for gradual production increases on a yearly basis. In year three of the permit, Petitioners now ask the Board to declare an

ASHBURN & MASON P.C.

"emergency" and essentially veto this permit without engaging in the notice and comment rulemaking required by statute. The Petition establishes no "emergency," nor does the Board of Fisheries ("Board") have the statutory authority to veto the Department's prior permit decision regarding salmon production.

A permit granted four years ago does not qualify as an "emergency" under any definition of the word, let alone the strict definition governing emergency petitions under Alaska law. By statute, true regulatory emergencies are held to a minimum and rarely found.[1] The reason for this strict standard is that enacting regulations outside of the notice and comment rulemaking procedures mandated by the Administrative Procedure Act is strongly disfavored. Here, establishing an emergency requires "unforeseen" and "unexpected" threats against fish and game resources.[2] VFDA's long-standing permit is neither unforeseen nor unexpected. The fact that Petitioners chose not to engage in the public process leading to the permit grant does not make the permit "unforeseen."

Even if there were an emergency, the Board lacks statutory authority to grant the relief requested by Petitioners. As set forth in detail below, the legislature invested the Department with the legal duty to oversee all aspects of hatchery creation, operation, and

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[1] AS 44.62.270.

[2] 5 AAC 96.625(f).

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production,[3] including but not limited to how many fish hatchery operators are allowed to incubate and release each year. By statute, the Department, not the Board, regulates hatchery activities that directly impact production levels, such as the harvest of eggs from hatchery broodstock.[4] The Board, on the other hand, is tasked with regulating and allocating the harvest of both hatchery and wild salmon among all user groups that the hatcheries were established to serve, including commercial, personal use, sport, subsistence, and hatchery cost recovery.[5] The Department and the Board have respected and abided by this division of labor and authority for over 30 years. To our knowledge, the Board has never before attempted to second guess a decision by the Department to authorize a specific level of egg take in a hatchery permit.

The Petition seeks to disrupt this well-established division of authority by interjecting the Board into the realm of production management. Specifically, the Petition asks the Board to micro-manage egg take levels from hatchery broodstock, which is squarely within the Department's sphere of authority and expertise, and outside the Board's jurisdiction over allocation of harvest levels. The Petition's only ground for this change in the *status quo* is a narrow statutory subsection, AS 16.10.440(b), addressing

[3] AS 16.10.400-.470; 5 ACC 40.005-.990.

[4] AS 16.10.445; 5 AAC 40.300; 5 AAC 40.340; 5ACC 40.840.

[5] *E.g.*, AS 16.05.251.

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the Board's authority to amend hatchery permits regarding the "source and number of salmon eggs." This provision cannot bear the weight Petitioners place on it.

When this statute was enacted in 1979, the legislative's reference to "the source and number of salmon eggs" almost certainly referred to the collection of *wild* salmon eggs, before the hatcheries' cost recovery operations had been fully established. Back in 1979, collection of salmon eggs from wild stocks involved the harvest of wild salmon still swimming out in the ocean. In those early days, egg take had a potential to affect the Board's allocative decisions. By contrast, hatchery egg take today is conducted entirely from returning hatchery broodstock, captured in terminal harvest areas, not out in the Sound, with little or no allocative implications.

Even if the statute could be construed to apply to eggs recovered from returning hatchery broodstock, it is an insufficient legal basis for disrupting the Department's comprehensive regulatory regime, which includes hatchery production planning and detailed permitting requirements. Again, the Board has jurisdiction over harvest levels, and the Department has jurisdiction over all aspects of hatchery production, including egg take levels.[6]

[6] *E.g.*, AS 16.10.445, granting the Department exclusive authority over "the source and number of salmon eggs taken" by hatchery operators.

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The Petition is also premature. The potential effects of hatchery fish straying into wild salmon streams, which is the stated impetus for the Petition, have been closely watched by the Department's biologists over the years. These effects are now the subject of an ongoing, in-depth scientific study. Until the study results are known, it is premature to consider curtailment of hatchery production that has already been permitted by the Department. Further, the Board has already stated its intent to address hatchery issues during its regular fall meeting cycle. These important issues can be addressed at that time where there is full opportunity for public participation and comment.

ABOUT ASHBURN & MASON AND PWSAC

Ashburn and Mason is submitting these comments, which focus on the relevant statutes, regulations, and established administrative practice, as a supplement to the comments submitted directly by the Prince William Sound Aquaculture Corporation ("PWSAC"). Ashburn & Mason has represented PWSAC since its creation in 1974. Our firm worked closely with PWSAC's visionary founders in the legislative process that resulted in the creation of the private nonprofit hatcheries ("PNPs") regional aquaculture associations, now codified at AS 16.10.375, *et. seq.*

PWSAC's founders were commercial fishers and community leaders who were responding to repeated wild salmon run failures, and the resulting economic distress throughout the Prince William Sound region in the early 1970s. Working together, the fishermen, local community representatives, the Department, and key legislators developed an innovative legal framework for the creation and operation of the state's PNPs and regional aquaculture associations.

Over the past 40-plus years, the statewide hatchery system has been a resounding success, and is an integral part of Alaska's world class sustainable fisheries. Alaska's hatcheries have generated tens of millions of dollars of economic benefit every year spread across all user groups, supplementing, but not displacing, the sustained yield of Alaska's wild salmon stocks. In fact, all of PWSACs hatcheries were started with salmon eggs collected originally from local wild stocks. The genetics of all Prince William Sound hatchery fish are therefore traceable back to local streams.

DISCUSSION

I. NO EMERGENCY EXISTS TO JUSTIFY THE PETITION TO RESTRICT VFDA'S PERMITTED EGG TAKE

By statute, true regulatory emergencies, which allow the Board to issue regulation without public notice and comment, are held to a minimum and rarely found.[7] This is because public notice and comment are essential to the fairness and transparency of

[7] AS 44.62.270.

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regulatory rulemaking in Alaska. The explicit state policy against the adoption of emergency regulations is so fundamental to the function of regulatory rule-making that it is codified in the Administrative Procedure Act.[8] The Commissioner's decision to deny the emergency Petition reflects this well-established policy and decades of Alaska law and regulation, and must be respected.

The Petition does not present an emergency. Rather, it challenges a permit granted several years ago. The narrow exception for adoption of emergency regulations is limited to "unforeseen" and "unexpected" threats against fish and game resources.[9] These threats must be so imminent that regulatory intervention cannot wait for the usual notice and comment process under the Administrative Procedure Act.[10] For example, the Board adopted an emergency regulation to reorganize the Chignik fishery in 2005 when the Supreme Court issued a decision invalidating the previous fishery rules just six weeks before the season was slated to open.[11] The Superior Court agreed that the timing of the Supreme Court's decision created a legitimate emergency because no one could

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[8] *Id.*

[9] 5 AAC 96.625(f).

[10] 5 AAC 96.625(f).

[11] As referenced *infra.* at 3-4, the Commissioner currently has standing authority to review petitions for emergency regulation. See, 2015-277-FB. Prior to the adoption of this policy in 2015, the Board retained the authority to review petitions for emergency regulation.

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reasonably rely on when the Supreme Court would issue its decision, or what that decision would be. In addition to the "unexpected" and "unforeseen" nature of the Supreme Court's decision, the timing also created a sense of imminence. With less than six weeks before the fishing season opened, the Board "had to act quickly...because it had to have something in place for the June opening."[12]

Here, the Petition fails to demonstrate how VFDA's long-standing permit, or the current conditions in the Sound, present an unexpected or unforeseen situation threatening the salmon fisheries. No acute biological or environmental event has impacted the Sound or Cook Inlet in recent months, creating an unpredictable threat. Rather, the purported justification for an emergency petition is an alleged trend, observed over the last several *years*. There is no reason why the proposed Board action could not have been presented a year ago or, more to the point, why it could not wait until the next regularly scheduled Board meeting, which will provide a fuller and fairer opportunity for interested parties and members of the public to comment and participate in the process.

In short, the Commissioner properly exercised his authority under AS 16.05.270 and 2015-277-FB to determine that the Petition failed to present an emergency under the

[12] See, *State of Alaska, Alaska Bd. of Fisheries v. Grunert,* 139 P.3d 1226, 1241 (Alaska 2006).

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Administrative Procedure Act. For the reasons explained in the Commissioner's June 14, 2018 letter to Petitioners, emergency action is unwarranted under these circumstances.

II. THE BOARD DOES NOT HAVE VETO AUTHORITY OVER HATCHERY PRODUCTION PERMITS

A. The Commissioner Has Primary Authority Over Hatchery Permitting and All Hatchery Operations

1. History and Purpose of the Hatchery Program

The desire of Alaskans to manage their abundant salmon fisheries was a driving force behind Alaska Statehood.[13] The importance of protecting and developing natural resources such as salmon is embedded in the Alaska Constitution, which directs the legislature to "provide for the utilization, development, and conservation of all natural

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[13] *See, e.g.*, *Pullen v. Ulmer*, 923 P.2d 54, 57 n. 5 (Alaska 1996); Alaska Legislative Affairs Agency, *Alaska's Constitution: A Citizen's Guide* (4th ed. 2002) at http://w3.legis.state.ak.us/docs/pdf/citizens_guide.pdf (Many Alaskans concluded "that the notion of the federal government's superior vigilance as a trustee of the public interest was really a cloak for the institutional interests of bureaucrats and the economic interests of nonresident corporations exploiting those resources (principally Seattle and San Francisco salmon canning companies)."); HOUSE COMM. ON INTERIOR AND INSULAR AFFAIRS, *Act Providing for the Admission of the State of Alaska into the Union of 1957*, H.R. REP. No 85-624 (1958) (The Statehood Act "will enable Alaska to achieve full equality with existing States, not only in a technical juridical sense, but in practical economic terms as well. It does this by making the new State master in fact of most of the natural resources within its boundaries . . . ."); Univ. of Alaska Anchorage, Institute for Social and Economic Research, *Salmon Fish Traps in Alaska* (1999), at 14, at http://www.iser.uaa.alaska.edu/publications/fishrep/fishtrap.pdf ("Alaska political entrepreneurs used the [fish] trap issue to rally the citizens of the territory around the quest for statehood.").

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resources belonging to the State, including land and waters." It also requires the legislature to make decisions that "provide for the maximum benefit of its people."[14] The Alaska Constitution proclaims that "fish, wildlife, and waters are reserved to the people for common use,"[15] and dictates that "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses."[16] Further, the Constitution expressly references the goal of "promot[ing] the efficient development of aquaculture in the State," and protecting Alaska's economy from outside interests:[17]

> No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State. This section does not restrict the power of the State to limit entry into any fishery for purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood ***and to promote the efficient development of aquaculture in the State.***

By the early 1970s, salmon runs were in steep decline throughout Alaska. In Prince William Sound, seining did not open at all in 1972 and 1974 due to dangerously

[14] ALASKA CONST. art. VIII, § 2.

[15] ALASKA CONST. art. VIII, § 3.

[16] ALASKA CONST. art. VIII, § 4.

[17] ALASKA CONST. art. VIII, § 15. The Constitution has since been amended to provide for the limited entry permit system now in place, *See infra* n. 7, but the reference to promoting the "efficient development of aquaculture" remains unchanged.

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low wild stock returns. In response, the State of Alaska resolved to restore the salmon fisheries. A constitutional amendment provided the basis for limited entry legislation for commercial fisheries,[18] and the state hatchery program was initiated through the creation of the Fisheries Rehabilitation & Enhancement Division (FRED).[19]

Under AS 16.05.020, the Commissioner must "manage, protect, maintain, *improve, and extend* the fish, game ... of the state in the interest of the economy and general well-being of the State." The Department is further required to: "develop and continually maintain a comprehensive, coordinated state plan for the orderly present and long-range rehabilitation, *enhancement*, and development of all aspects of the state's fisheries for the perpetual use, benefit, and enjoyment of all citizens" and "through rehabilitation, *enhancement*, and development programs do all things necessary to ensure perpetual *and*

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[18] AS 16.43.400 *et seq.* Alaska's limited entry fishery essentially provides that only permit holders may engage in commercial fishing. The granting of these permits, and the management of the commercial fisheries, are tightly regulated by numerous state agencies including the State Commercial Fisheries Entry Commission (CFEC), the Alaska Department of Fish & Game (ADF&G), and the Board of Fisheries (BOF). *See generally Johns v. CFEC*, 758 P.2d 1256, 1263 (Alaska 1988) ("The Limited Entry Act has two purposes: enabling fishermen to receive adequate remuneration and conserving the fishery.").

[19] AS 16.05.092. As explained more fully below, FRED no longer exists as a distinct division within the Department. However, the operation of most or all of the original hatcheries owned and operated by FRED has been transferred to the regional aquaculture associations, under long-term professional services agreements. PWSAC, for example, currently operates the Cannery Creek, Main Bay, and Gulkana Hatcheries, all of which were constructed and initially operated as FRED hatcheries in the early 1970s.

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increasing production and use of the food resources of state waters and continental shelf areas."[20] Similarly, the Department is required generally to "manage, protect, maintain, *improve, and extend* the fish, game and aquatic plant resources of the state in the interest of the economy and the general well-being of the state."[21] The Department is also generally charged to do everything possible to assist with hatchery operations.[22]

In addition, the legislature created the Fisheries Enhancement Revolving Loan Fund to promote the enhancement of Alaska's fisheries by, among other things, providing long-term, low-interest loans for hatchery planning, construction, and operation.[23] PWSAC has received significant support from this program over the years, particularly for capital investments.

In 1974, the FRED state-owned and managed hatchery program was expanded to include private ownership of salmon hatcheries with the passage of the Private Non-Profit (PNP) Hatchery Act.[24] The Act stated that its purpose was to "authorize the private ownership of salmon hatcheries by qualified non-profit corporations for the purposes of

[20] AS 16.05.092(3) (emphasis added).

[21] AS 16.05.020(2) (emphasis added).

[22] AS 16.10.443.

[23] AS 16.10.500-.560; *see generally* Alaska Division of Investments, "Fisheries Enhancement Revolving Loan Fund Program Overview," April 2007 at http://www.commerce.state.ak.us/investments/pdf/FEover07.pdf.

[24] These provisions are now codified at AS 16.10.375 *et seq.*

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contributing, by artificial means, to the rehabilitation of the State's depleted and depressed salmon fishery." Further, as noted above, a separate fisheries enhancement loan program was created in 1976 to provide state financing for nonprofit hatcheries.[25]

Over time, the State has transferred operation of some of the FRED hatcheries to other entities, including the nonprofit hatcheries operated by the regional aquaculture associations, concluding that it would be more cost-effective for these hatcheries to be operated by the regional associations. The legislature specifically authorized the sub-contracting of state hatcheries in 1988,[26] acknowledging that after 17 years of the State planning, building and operating hatcheries, Alaska sought an even more efficient way of ensuring a healthy, robust, and sustainable salmon fishery.[27]

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[25] AS 16.10.500 *et seq.; see also State Commercial Fisheries Entry Comm'n v. Carlson*, 65 P.3d 851 (Alaska 2003) ("The state operates a revolving loan fund to support investments in developing and operating fish hatcheries and other fish enhancement projects.").

[26] AS 16.10.480.

[27] Alaska's partnership with the nonprofit hatcheries is unique. Almost all states operate hatcheries of some kind (salmon, trout, walleye, catfish, etc.), but no state operates a hatchery program like Alaska's, and no state works with private nonprofit entities to assist the state government in its hatchery programs. By way of example, California has 21 state hatcheries (http://www.dfg.ca.gov/fish/Hatcheries/HatList.asp), Oregon has 33 state hatcheries (http://www.dfw.state.or.us/fish/hatchery/), and Washington has 91 state hatcheries (http://wdfw.wa.gov/hat/facility.htm), and all of these hatcheries are operated by the government.

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Alaska law provides that the hatcheries may only be non-profit.[28] By design, the hatcheries are allowed to recover operating and capital expenses, as well as costs for research and development and expansion of the production system, including wild stock rehabilitation work.[29] The system is designed to provide benefits to the common property resource users. The nonprofit regional aquaculture associations have no stock-holders, owners, or members. Today, five regional aquaculture associations, from Southeast Alaska to Kodiak, including PWSAC, produce hatchery salmon for common property fisheries.

Thus, the Alaska Constitution, combined with numerous statutes, including those creating the Department of Fish and Game,[30] the Limited Entry Act,[31] the Private Non-Profit Hatcheries Act,[32] and the Fisheries Enhancement Revolving Loan Fund,[33] together

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[28] AS 16.10.380.

[29] AS 16.10.455.

[30] AS 16.05.010, *et.seq.*; *see also* 5 AAC 40.100-.990.

[31] AS 16.43.400 *et seq.* Alaska's limited entry fishery essentially provides that only permit holders may engage in commercial fishing. The granting of these permits, and the management of the commercial fisheries, are tightly regulated by numerous state agencies including the State Commercial Fisheries Entry Commission, the Alaska Department of Fish & Game (ADF&G), and the Board of Fisheries (BOF). *See generally Johns v. CFEC*, 758 P.2d 1256, 1263 (Alaska 1988) ("The Limited Entry Act has two purposes: enabling fishermen to receive adequate remuneration and conserving the fishery.").

[32] AS 16.10.375-480.

[33] AS 16.10.500-.560.

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demonstrate a strong and long-standing state policy in Alaska of promoting hatchery development for the purpose of enhancing and ensuring the long-term vitality of Alaska's fisheries.

2. The Department Strictly Regulates All Aspects of Hatchery Creation, Operation, and Production

The Alaska Department of Fish and Game has been charged by the Alaska legislature with final authority over how many fish hatchery operations are allowed to incubate and release each year,[34] and to regulate all other details of hatchery operation.[35]

Pursuant to AS 16.10.375, the Commissioner must designate regions of the state for salmon production and develop a comprehensive salmon plan for each region through teams consisting of Department personnel and nonprofit regional associations of user groups. The Commissioner also has the task of classifying an anadromous fish stream as suitable for enhancement purposes before issuing a permit for a hatchery on that stream. As 16.10.400(f).

Of particular relevance to the issue presently before the Board, AS 16.10.400(g) requires a determination by the Commissioner that a hatchery would result in substantial public benefits and would not jeopardize natural stocks. The statutes also require the

[34] AS 16.10.445; 5 AAC 40.300; 5 AAC 40.340; 5 AAC 40.840.

[35] AS 16.10.400-.470; 5 AAC 40.005-.990.

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Department to conduct public hearings near the proposed hatcheries, and to consider comments offered by the public at the hearings before issuance of a permit.[36]

All state hatcheries are operated pursuant to a permit issued by the Department.[37] Standard permit conditions include: (1) provisions that eggs used for broodstock come from a source approved by the Department;[38] (2) no placement of salmon eggs or resulting fry into waters of the state except as designated in the permit; (3) restrictions on the sale of eggs or resulting fry; (4) no release of salmon before department inspection and approval; (5) destruction of diseased salmon; (6) departmental control over where salmon are harvested by hatchery operators; and (7) hatchery location to prevent commingling with wild stocks. [39]

Further, there is an intricate system of basic and annual hatchery plans that are reviewed annually by the Department and provide for performance reviews, and in

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[36] AS 16.10.410.

[37] AS 16.10.400; 16.40.100-.199; 5 AAC 40.110-.240.

[38] AS 16.10.445. This requirement is related to regulations regarding fish transport permitting. *See* 5 AAC 41.001-.100. These regulations provide that no person may transport, possess, export from the state, or release not the waters of the state any live fish unless that person holds a fish transport permit issued by the Commissioner.

[39] *See generally* McGee, *Salmon Hatcheries in Alaska – Plans, Permits, and Policies Designed to Provide Protection for Wild Stocks,* Published for 2004 American Fisheries Society Symposium, at 327.

appropriate cases, permit alterations.[40] The basic management plans include a complete description of the facility, including the special harvest area, broodstock development schedules, and description of broodstock and hatchery stock management.[41]

Year-to-year hatchery production is regulated through the annual management plans (AMPs) approved and adopted by the Department. For example, each year, PWSAC and the other PNPs across the state work with the Department, which ultimately formulates an AMP for each hatchery. That plan, among other things, determines the number of eggs the hatchery will collect, how the eggs will be collected, the number of fish it will incubate, and how many fish will be released from the hatchery. [42] The AMP also addresses how PNPs will conduct their cost recovery harvest at each hatchery and addresses other specifics of hatchery operation.[43]

3. The Board's Proper Role is to Allocate Harvest, Not to Override the Department's Permitting and Production Decisions

[40] 5 AAC 40.800-990. As noted above, there is also an extensive Regional Comprehensive Planning Program established under AS 16.10.375 and 5 AAC 40.300-.370, with full public participation. This process creates Regional Planning Teams who are charged to "prepare a regional comprehensive salmon plan . . . to rehabilitate natural stocks and supplement natural production . . . ." 5 AAC 40.340.

[41] *See generally* McGee, at 329.

[42] 5 AAC 40.840.

[43] McGee, at 329.

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The Board of Fisheries is established by AS 16.05.221, "for purposes of the conservation and development of the fishery resources of the state."[44] In general terms, the Board's duties complement those performed by the Department. While it has broad statutory authority, the Board has historically focused on allocation of fisheries resources between and among the various user groups and gear types. For example, under AS 16.05.251(a) the Board has the power to set time, area, and methods and means limitations on the taking of fish. Under AS 16.05.251(a)(3), the Board also establishes quotas, bag limits, and harvest levels. To the best of our knowledge, however, the Board has always deferred to the Department's expertise and experience with respect to the detailed management of hatchery permitting and production levels.

B. The Board Cannot Override Annual Hatchery Production Permits Issued by the Department

Petitioners contend that AS 16.10.440(b) grants the Board the authority to upend the Department's carefully constructed regulatory framework governing hatchery

[44] AS 16.05.221.

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production.[45] This interpretation of the statute reads it out of context and is inconsistent with its historical origins. Under Alaska law, this statutory provision must be construed in light of the overall statutory scheme governing Alaska's salmon hatcheries,[46] its legislative history and intent,[47] and over 40 years of consistent administrative interpretation and practice, during which the Board (to our knowledge) has never

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[45] AS 16.10.440 provides: (a) Fish released into the natural waters of the state by a hatchery operated under AS 16.10.400 - 16.10.470 are available to the people for common use and are subject to regulation under applicable law in the same way as fish occurring in their natural state until they return to the specific location designated by the department for harvest by the hatchery operator. (b) The Board of Fisheries may, after the issuance of a permit by the commissioner, amend by regulation adopted in accordance with AS 44.62 (Administrative Procedure Act), the terms of the permit relating to the source and number of salmon eggs, the harvest of fish by hatchery operators, and the specific locations designated by the department for harvest. The Board of Fisheries may not adopt any regulations or take any action regarding the issuance or denial of any permits required in AS 16.10.400 - 16.10.470.

[46] *See, e.g. Monzulla v. Voorhees* Concrete Cutting, 254 P.3d 341, 345 (Alaska 2011), *citing In re Hutchinson's Estate*, 577 P.2d 1074, 1075 (Alaska 1978), where the Supreme Court articulated the doctrine of *in pari materia*: the "established principle of statutory construction that all sections of an act are to be construed together so that all have meaning and no section conflicts with another."

[47] *See, e.g. Native Village of Elim v. State* 990 P.2d 1, 5 (Alaska 1999), *Kochutin v. State,* 739 P.2d 170, 171 (Alaska 1987) *citing Hammond v. Hoffbeck*, 627 P.2d 1052, 1056 & n. 7 (Alaska 1981).

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attempted to use this statute as the basis for usurping the Department's traditional control over hatchery production.[48]

At the time Section 440(b) was enacted in 1979, the hatchery system was in its infancy. Most hatchery egg take was from wild stocks, not returning hatchery fish, which is how egg take is conducted today. The thinking at the time was that salmon eggs harvested from wild stocks were still a "public resource" while the fish were swimming out in the ocean, and the harvest of wild fish for egg take had allocation implications that could potentially fall within the Board's purview. In contrast, today's egg take procedures are conducted almost exclusively from returning hatchery broodstock that are captured in the special harvest areas directly in front of the hatcheries. At that point, the hatchery salmon cease to be a public resource and their capture and the collection of their eggs have very limited allocative implications. Further, as the Commissioner noted in his January 14, 2018 Memorandum to the Board on the subject of the current Petition, "the

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[48] *See e.g. Marathon Oil Co. v. State, Dep't of Nat. Res.*, 254 P.3d 1078, 1082 (Alaska 2011), *Premera Blue Cross v. State, Dep't of Commerce, Cmty. & Econ. Dev., Div. of Ins.*, 171 P.3d 1110, 1119 (Alaska 2007), and *Bullock v. State, Dep't of Cmty. & Reg'l Affairs*, 19 P.3d 1209, 1219 (Alaska 2001), where the Alaska Supreme Court held that agency decisions based on "longstanding, consistent and widely known" interpretations of agency expertise should be given "great weight."

Board's authority over the possession, transport and release of live fish had not been delegated to the department when AS 16.10.440(b) was amended."[49]

Moreover, the legislative history of Section 440(b) indicates that it was never intended to be used by the Board as back door means of overriding the Department's permitting authority or limiting hatchery production. The Resources Committee's letter of intent on HB 359, which included the language in question, states as follows:

> There are three other major changes made by the bill:
>
> (1) Section 2 of the bill amends AS 16.10.440(a)(b). The amendment clarifies the role of the Board of Fisheries. The role of the Board of Fisheries as envisioned by the original legislation was to regulate the *harvest* of salmon returning to the waters of the state. That role extends to regulating those fish which are returning as a result of releases from natural systems and also from hatchery releases. There are provisions in other specific locations for the harvest of salmon by the hatchery operator for sale, and use of the money from that sale, for the specific purposes as stated in AS 16.10.450. The added language clarifies that the Board of Fisheries may adopt regulations relating to the *harvest* of the fish by hatchery operators at the specifically designated locations. The Board of Fisheries in the past year or two has enacted regulations relating to those harvests for several of the private nonprofit hatcheries in the state.[50]

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[49] Memorandum from Sam Cotton, Commissioner, to John Jensen, Chair, dated January 14, 2018, Re: Emergency Petition to the Alaska Board of Fisheries requesting the Board to reverse a department decision to allow a 20 million increase in the number of pink salmon eggs to be harvested by VFDA in 2018.

[50] House Journal, March 15, 1979, pp. 601-602 (emphasis added).

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The exclusive reference to regulation of harvest, and the absence of any mention of production controls, corroborates the conclusion that the legislature never intended to authorize the Board to limit hatchery production.

The Board's traditional function has always been to allocate harvests among competing user groups, not to regulate production of fish. This legislative history, with its emphasis on "harvest," is also consistent with PWSAC's long-held belief (apparently shared by the Department) that Section 440(b) was intended to cover egg take from wild salmon streams, not to apply to egg take from returning hatchery fish.

Further corroboration of this conclusion is found in AS 16.10.445(a), which unambiguously requires the Department, not the Board, to "approve the source and number of salmon eggs taken under AS 16.10.400-16.10.470." Additional evidence that the Department, not the Board, is responsible for regulating hatchery egg take can be found in 5 AAC 41.001, *et. seq.* For example, 5ACC 41.005 prohibits the release of hatchery fish without a permit issued by the Commissioner. Regulation of egg take and release of the resulting salmon fry are obviously two sides of the same coin. The regulatory scheme clearly and consistently assigns exclusive responsibility for regulating those two closely related hatchery activities to the Commissioner.

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Given the legislative history, the 30-plus year pattern of administrative interpretation, the anomalous language in Section 440(b) regarding regulations to "amend…the terms of a permit," and the mandate of Section 445(b), it is quite clear that the Board has little or no role in regulating hatchery production, including but not limited to egg take permit restrictions.

Moreover, regulation of hatchery production by the Board would overlap and almost certainly conflict with the comprehensive and detailed hatchery regulations that are currently in place and operating effectively. As noted above, the Department has a rigorous permitting process for new hatcheries, 5 AAC 40.100-.240. There is an extensive Regional Comprehensive Planning program established under AS 16.10.375 and 5 AAC 40.300-.370, with full public participation. By regulation, the responsibility of the Regional Planning Teams is to "prepare a regional comprehensive salmon plan ... to rehabilitate natural stocks and *supplement* natural production . . ." 5 AAC 40.340 (emphasis added). As mentioned earlier, there is also an intricate system of basic and annual hatchery plans that are reviewed annually by the Department, performance reviews, and, in appropriate cases, permit alterations. 5 AAC 40.800-.900. Production levels are carefully monitored by the Department under these regulations and adjusted if necessary for economic or biological reasons. The Department's statutory authority for this intense level of hatchery regulation is quite clear, and there seems to be little room for the Board to insert itself into a very public process that has been working well for many years.

CONCLUSION

Back in the early 1970s, Prince William Sound experienced recurring wild salmon run failures, which caused serious financial distress throughout the region. In response, the framers of the Constitution and the Alaska Legislature took active and far-sighted steps to first establish a state run hatchery system and, shortly thereafter, the private non-profit and regional hatchery regime that has consistently stabilized the runs and enhanced salmon harvests throughout the state since 1976. Overall, Alaska's hatcheries have been a remarkable success and have helped the state's salmon resources to thrive and expand over the past 40 years, creating millions of dollars of positive economic impact, without any demonstrable harm to wild salmon stocks.

From the very beginning, every aspect of Alaska's hatcheries' creation, operation, and production have been closely supervised and regulated by the Department, with harvest area and allocation decisions made by the Board. This division of responsibility has served Alaska well for many years and there is no good reason to abandon it now.

For these reasons, the Board should deny the Petition.

ASHBURN & MASON P.C.

ASHBURN & MASON, P.C.

Matthew T. Findley

for:

A. William Saupe

Laura C. Dulic

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Senator Gary Stevens

Alaska State Legislature

Kodiak, Alaska 99615
(907) 486-4925
Fax: (907) 486-5264

Reed Morisky, Chair
Alaska Board of Fisheries
C/O Board Support Section
P.O. Box 115526
Juneau, AK 99811

February 20, 2020

Dear Chairman Morisky:

It is my understanding the Board of Fisheries will convene a Hatchery Committee meeting when it meets next month. I am pleased to offer this letter of support for Alaska's salmon hatcheries.

As you may know, Alaska's salmon hatcheries throughout our state have become key components of the state's fisheries, providing about 4,700 jobs annually and $218 million in wages. In Prince William Sound, which includes commercial fisheries within my State Senate district, hatcheries are responsible for more than 2,000 of these jobs, and $100 million in labor income. In my home community of Kodiak, hatcheries account for $7 million in ex-vessel value.

As the Hatchery Committee conducts its work, I encourage members to seek testimony from industry members, who can speak to the value and importance of hatcheries to Alaska's fisheries. I am positive they will find such a dialog beneficial.

Thank you for your consideration of this letter.

Sincerely,

Senator Gary Stevens

Senator.Gary.Stevens@akleg.gov

Silver Bay SEAFOODS
208 Lake St, Suite 2E | Sitka, AK 99835 | Phone: (907) 966-3110
4039 21st Ave W, Suite 201 | Seattle, WA 98199 | Phone: (206) 693-3158

February 21, 2020

Mr. Reed Morisky, Chairman
Alaska Board of Fisheries
Boards Support Section
P.O. Box 115526
Juneau, AK 99811-5526

RE: Silver Bay Seafoods Comments on March 7, 2020, Hatchery Committee

Dear Chaiman Morisky and Board of Fisheries Members:

Thank you for hosting the Board of Fisheries Hatchery Committee. It is a valuable opportunity to engage in dialogue, receive data and scientific updates from the Alaska Department of Fish and Game (ADF&G), and to hear public comment.

Silver Bay Seafoods is a vertically integrated, fishermen-owned seafood processing company with several operations thoroughout Alaska. Silver Bay's operations in southeast Alaska and Prince William Sound in particular benefit greatly from these areas'salmon fishery enhancement programs, as do their communities and residents.

We support Alaska's outstanding hatchery program, which is rooted in strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations. This program has demonstrated over 45 years of sustainable enhanced production to supplement our wild stocks, providing economic opportunity and food security to all users. A McDowell Group report identifies the economic contribution in 2018 of Alaska's salmon hatcheries to be 4,700 jobs, $218 million in labor income, and $600 million in total economic output.

Significant investments have been made in Alaska's salmon hatchery program and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities while maintaining a wild stock escapement priority. In particular, the work of the Alaska Hatchery Research Project continues to provide information (using the most cutting edge scientific techniques in the world!) to show how these enhanced stocks interact with our wild salmon. The team of scientists collaborating on this project are well respected and have broad experience in salmon enhancement, management, and wild and hatchery interactions.

We ask you continue to work with the hatchery community, the Alaska Department of Fish and Game, and industry leaders to further your understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Respectfully,

Abby Fredrick

612 W. Willough[illegible]
P.O. Box 21989, Ju[illegible]
Phone (907) 586-4360
www.seconference.org
Email info@seconference.org
SOUTHEAST ALASKA REGIONAL DEVELOPMENT ORGANIZATION

February 20, 2020

Board of Fisheries: Hatchery Committee
State of Alaska, Department of Fish and Game
Via web-submission

Dear Board of Fisheries:

Southeast Conference is the State of Alaska Regional Development Organization (ARDOR) and the federally recognized Economic Development District for southeast Alaska. We would like to reiterate our support for the fisheries hatcheries program that continues to be a major contributor to the Southeast Alaska regional economy. Over a six-year period, commercial fishermen harvested an average of 222 million pounds of hatchery-produced salmon worth $120 million per year in ex-vessel value.

The hatcheries program has provided economic stability and resiliency in the industry when cyclical natural stocks are at their lows. These hatcheries are also important to non-commercial users such as sportfishing, personal and subsistence use and to the ever-growing visitor industry.

More than 16,000 fishermen, processing employees, and hatchery workers can attribute some portion of their income to Alaska's salmon hatchery production. Thousands of additional support sector workers earn wages connected to Alaska hatchery production.

Please find attached Resolution 19-02 which affirms our support for Alaskan hatcheries and supports the convening of the Salmon Hatcheries Committee Meeting and Joint Protocol on Salmon Enhancement. Thank you for giving this your fullest consideration and support.

On behalf of the Board of Directors and our 230 members,

Robert Venables
Executive Director

SOUTHEAST CONFERENCE

Resolution 19-02

A RESOLUTION IN SUPPORT OF THE ALASKA SALMON HATCHERY PROGRAM UTILIZING UNBIASED AND SCIENTIFIC METHODS TO ASSESS THE INTERACTION OF ALASKA'S SALMON HATCHERY PROGRAM WITH NATURAL SALMON STOCKS

WHEREAS, the communities and businesses of Southeast Alaska benefit greatly from the State of Alaska Salmon Hatchery Program; and

WHEREAS, Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state; and

WHEREAS, Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments, which receive raw fish tax dollars; and

WHEREAS, Alaska's salmon hatchery program employs strong scientific methodology and is built upon precautionary principles and sustainable fisheries policies to protect wild salmon populations; and

WHEREAS, Alaska Department of Fish and Game regulates hatchery operations, production, and permitting through a transparent public process and multi-stakeholder development of annual management plans; and

WHEREAS, returns of hatchery and wild salmon stocks follow similar survival trends over time and the largest returns of both hatchery and wild salmon stocks have largely occurred since hatchery returns began in about 1980; and

WHEREAS, there are no stocks of concern where most hatchery production occurs, indicating that adequate escapements to wild stock systems are being met in these areas over time; and

WHEREAS, Alaska hatcheries contributed an annual average of nearly 67 million fish to Alaska's commercial fisheries in the past decade; and

WHEREAS, Alaska hatcheries accounted for 22% of the total common property commercial catch and 43% of the total ex-vessel value in the Southeast region in 2016; and

WHEREAS, a McDowell Group report identifies the economic contribution in 2017 of the Southern Southeast Regional Aquaculture Association (SSRAA) to be 680 jobs, $32 million in labor income, and $70 million in total economic output; and

WHEREAS, Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state and in particular in rural coastal communities; and

WHEREAS, Alaska's salmon hatchery program is non-profit and self-funded through cost recovery and enhancement taxes on the resource and is a model partnership between private and public entities; and

WHEREAS, the State of Alaska has significantly invested in Alaska's salmon hatchery program and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities while maintaining a wild stock escapement priority; and

WHEREAS, Alaska salmon fisheries, including the hatchery program, continue to be certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC);

THEREFORE BE IT RESOLVED that the Southeast Conference affirms its support for Alaska's salmon hatchery programs; and

FURTHER BE IT RESOLVED that the Southeast Conference supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural salmon stocks, such as the Alaska Hatchery-Wild Salmon Interaction Study which began in 2011 and is scheduled to conclude in 2023; and

FURTHER BE IT RESOLVED that the Southeast Conference calls on the Alaska Board of Fisheries to work with the hatchery community, the Alaska Department of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

ADOPTED BY THE SOUTHEAST CONFERENCE MEMBERSHIP AND BOARD OF DIRECTORS ON September 14th, 2018 AND WILL SUNSET ON September 14, 2019.

Witness:

Dennis Watson – President

Attest:

Robert Venables – Executive Director

SSRAA
Southern SE Regional Aquaculture Association
14 Borch Street, Ketchikan, AK 99901; Phone: 907-225-9605; FAX 907-225-1348

February 21, 2020

Alaska Board of Fisheries
Mr. Reed Morisky, Chair

By Electronic Copy Only: dfg.bof.comments@alaska.gov

Re: Hatchery Committee Meeting, March 7, 2020

Dear Chair Morisky and members of the Board of Fisheries,

The Southern Southeast Regional Aquaculture Association (hereafter "SSRAA") is a regional non-profit salmon hatchery organization formed under state and federal law in 1976. SSRAA, along with the State's other regional hatchery associations and similar private non-profit ("PNP") salmon hatcheries, have a substantial interest in any and all topics that the Hatchery Committee may discuss.

With regard to the authority of the Alaska Board of Fisheries over the production of Alaska hatcheries: There may well be competing opinions as to the exact nature and extent of the powers conferred by the Alaska legislature. This may be troubling to some of you, and I can assure you that it is to the PNPs as well. But to conclude that the Board has hatchery operation or production management authority would upend an orderly system that has been carefully developed over decades. It would also conclude that the legislature was in error when it clearly vested authority to the Department to manage all aspects of hatcheries. There cannot be overlapping hatchery authority by both the Department and the Board.

It may even be tempting for you to see things sometime in the future through the lenses of expediency or of vast importance. The weighing of some decision or another may seem important enough to cause the Board to want to "assist" the Department by deciding an issue one way or the other. This is the proverbial slippery slope. This is where the Board should realize that selectively weilding assumed authority narrowly or on a case-by-case basis will cause both immediate problems and unforeseen circumstances.

The Department has been charged with comprehensive authority and oversight of the Alaska hatchery system, and the RPT process has been further refined to effectively monitor and make recommendations to the Commissioner for issues that fall within their purview. This is the system that was crafted carefully by those capable individuals and groups who labored over this division of effort and authority over 40 years ago. These assurances may not prove satisfying since the process remains out of your hands. But the drafters of this program wanted the hatcheries to provide a long-term stable source of fish. If oversight was through the Board of Fisheries process, it simply might not provide as stable a process as was envisioned by these people. This is the history of how these programs and agencies interact.

And honestly, from a practical perspective, the Board now has more before it annually than it can reasonably accomplish. Fisheries enhancement issues can be very different from the management issues you most often consider. The Department no longer maintains the past level of expertise in fish culture and can be hard-pressed to advise you on the technical aspects of many enhancement activities. The process of modifying the projects to meet the criteria of the gear groups, geneticists, pathologists and managers is often a long-term negotiation at the RPT level involving many modifications along the way. These are not the sorts of things that could be accomplished during a Board of Fisheries meeting. The statewide consideration of the relative market effects or fleet behavior caused by regional hatchery production, five years in the future, could well prove impossible to satisfactorily resolve. Does the Board have the resources to adequately and fairly consider regional enhancement production? Why would the Board want to add this workload when there is another parallel public process designed to accomplish these tasks?

It is possible that the Board could have more interactions with the RPT's so that they can better understand these issues. It is likely that the RPT's would also value interaction with the Board so that they could take Board issues into account. The re-commitment of the Board to follow the Joint Protocol and for the Hatchery Committee to maintain regular meetings are also positive steps.

Thank you for your consideration of these comments.

David Landis
General Manager

Submitted By
Thomas Nelson
Submitted On
2/21/2020 10:12:35 AM
Affiliation

Members of the Board of Fisheries,

I am submitting comments to express my support for the Alaska salmon hatchery program. As a PWS commercial fisherman the hatchery program is very important to the stability of the regions fisheries, commercial, sport, and personal use/subsistence. Many coastal communities rely on the economic benefits brought from the increased opportunity these facilities provide. ADFG has oversight on hatcheries, and should remain the authority on the subject. I would also caution against putting to much stock in studies put forth by anti-hatchery entitites from for profit consulting groups, that have studies designed to reach a specific conclusion and do ot investigate any other probable cause. We need to rely on good science, not politically motivated highly speculative theories.

Thank You Thomas Nelson

February 21, 2020

Alaska Department of Fish & Game
ADF&G, Boards Support Section
PO Box 115526
Juneau AK 99811

Dear Members of the Board of Fish:

My name is Tyee Lohse, and I can be reached at tyeefisheries@hotmail.com. I am a commercial, sports, and subsistence fisherman from Cordova, AK.

Hatcheries are important to me and my family because they keep my community alive. They are a large portion of my own personal income. They make it justifiable for canneries to operate in my community. They take fishing pressure off of wild stocks that are more vulnerable. They leave me with hope of sustainable fisheries for future generations.

I harvest hatchery fish for food and profit. My community relies on hatchery returns to support the processors that have plants here and pump money into my community, and others like it. Hatchery runs provide salmon to support a growing fishing fleet that relies on them for a large percentage of their income. Hatchery salmon feed many rural and urban Alaskans.

Respectfully,

Tyee Lohse

VALDEZ FISHERIES DEVELOPMENT ASSOCIATION, INC.
SOLOMON GULCH HATCHERY

P.O. Box 125 Valdez, AK. 99686 1815 Mineral Creek Loop Road Valdez, AK 99686
(907) 835-4874 Fax (907) 835-4831 Mike.Wells@valdezfisheries.com

February 21, 2020

Alaska Dept. of Fish & Game
Alaska Board of Fisheries
PO Box 115526
1255 W. 8th Street
Juneau, AK 99811-5526 via email: dfg.bof.comments@alaska.gov

RE: Hatchery Committee Meeting – March 7th, 2020

Chairman Morisky, Members of the Alaska Board of Fisheries:

The Valdez Fisheries Development Association Inc. (VFDA), offers these brief comments in response to the Board of Fisheries Hatchery Committee meeting topics adopted at the Upper Cook Inlet meeting on February 17th 2020.

Board Authority Related to Hatcheries

VFDA believes strongly that the board's authority governing hatcheries is limited. This argument is best presented in the July 2018 opinion titled, "*Public Comments of Ashburn & Mason, P.C., Counsel for Prince William Sound Aquaculture Corporation in Opposition To May 1 2018 KRSA et al. Emergency Petition Regarding VDFA Hatchery Production*". A copy of this letter has been submitted as public comment for this meeting on behalf of the hatchery operators.

It is the jurisdiction of the ADFG Commissioner to approve hatchery permitting, relying on a longstanding regulatory structure and science based resource management. The board's authority over sources and numbers of eggs provided in AS 16.10.440(b) is understood to be applicable to the selection and number of natural stock eggs when collected to initiate hatchery programs. This action would be allocative in nature and may require the board's discretion. However, once established the further collection of eggs from returning hatchery stocks becomes a function of corporate escapement and the board allocates the harvest of the returning salmon.

We support this separation of duties between the board and the commissioner, which has worked well in the management and oversight of Alaska's hatcheries for many decades.

Is Hatchery Research Independent?

Over many years, the enhancement community has worked in close partnership with the state of Alaska to conduct research and collect fisheries data for salmon resources and habitat around the state. The Alaska Hatchery Research Project (AHRP) is another great example of the public private partnerships used to share costs to collect, analyze, and document significant scientific research. This has led to a better understanding of Alaska's fisheries and salmon resources through these joint efforts. Criticism of this important relationship is both unwarranted and unfair.

Opponents of Alaska's hatchery programs routinely assert that because this research is funded by hatchery associations or industry it lacks true independence. This argument is used often by those that do not take the time to fully understand the relationship between the parties or the research protocol, and simply assumes the outcome is preordered, flawed, or inherently biased.

The AHRP was founded as a group effort between Alaska's enhancement community, the se[illegible] processing industry, and the Alaska Dept. of Fish and Game to fund and complete a researcl[illegible] significant cost, complexity, and duration. A project that would have likely never been undertaken due to its enormity without co participation by the state and the hatcheries.

The project set goals to answer tough fundamental questions on the potential effects of straying of enhanced salmon to natural populations; questions the enhancement community recognized must be asked and answered to ensure the continued viability of Alaska's natural salmon resources.

Understanding the complex interaction of salmon stocks, through the application of rigorous scientific method, is exactly what a diverse group of fisheries professionals is working to accomplish. To insure the integrity of the study, third party contractors are used to collect field data and genetic material, and provide unbiased documentation of the results. ADFG, with its genetics expertise, accurately assess this data which is then presented periodically to the public in an objective and transparent process.

In addition, fisheries scientists with critical views on hatchery wild interaction have been invited to participate on the eleven member science panel, where opposing positions can be presented. The use of these checks and balances have contributed greatly to the integrity of the research.

Finally, it is expected that once the AHRP is completed, this independent study will be further subjected to scrutiny by the broader scientific community. And, as can be well assured, this body of work will spawn additional research on the topic.

In closing, we commend the BOF for its continued convening of the Joint Protocol on Salmon Enhancement #2002-FB-215. This important forum provides an excellent tool to inform and update the board and the public about hatchery policy, ongoing hatchery related research and current trends, and planning processes for hatchery production. VFDA fully supports continuing this vital informational process.

We look forward to future discussions with the Board of Fisheries and ADFG to improve public understanding of these important fishery enhancement programs.

Sincerely

Mike H. Wells
Executive Director

Alaska Dept. of Fish & Game
Alaska Board of Fisheries
PO Box 115526
1255 W. 8th Street
Juneau, AK 99811-5526
dfg.bof.comments@alaska.gov

February 19, 2020

RE: Support for Alaska's Hatchery Programs

Chairman Morisky, Members of the Alaska Board of Fisheries,

Thank you for the opportunity to provide comment to the Alaska Board of Fisheries Hatchery Committee. The City of Valdez strongly affirms its support for Alaska's salmon hatchery programs and has submitted previous Council Resolutions 18-33 and 18-24 in past support.

Valdez and its residents benefit greatly from the fisheries enhancement efforts of hatcheries in Prince William Sound. Salmon produced by the Valdez Fisheries Development Association Inc., and the Prince William Sound Aquaculture Corporation are harvested by Valdez commercial and sport fishermen, processed in our local seafood plants, and shipped across our docks for the benefit of our local economy. Raw fish tax dollars from hatchery salmon harvests provide much needed revenue to maintain our harbors and port facilities.

The economic benefit to Valdez from fisheries enhancement by hatcheries is significant. Regionally, PWS harvests of hatchery salmon generate $69 million in ex vessel value each year.[1] It is estimated that during the period of 2012-2017, the total economic impact from the Solomon Gulch Hatchery alone was $112 million annually[2]. In addition, a substantial number of jobs created by PWS hatchery production in the fishing, seafood processing, and tourism sectors are located in our community.

Valdez residents and visitors also enjoy the benefits of a robust sport fishery due to fisheries enhancement efforts by hatcheries. Anglers come from all over the United States to experience the great salmon fishing Valdez has to offer and participate in the Valdez Silver Salmon Derby, arguably one of the oldest salmon derbies in Alaska.

P.O. BOX 307 • VALDEZ, ALASKA 99686
TELEPHONE (907) 834-3408 • FAX (907) 835-2992

Alaska's salmon hatchery programs are managed using sound scientific methodology and transparent public processes to address permitting, production, and hatchery operations. These nonprofit hatchery associations are self-funded through efficient cost recovery and enhancement tax methods, reducing the burden on state and local governments. The result is a sustainable and efficient method of supplementing wild salmon harvest, which improves the quality of life and coastal economies in communities like Valdez.

We support the intent of the Joint Protocol on Salmon Enhancement to highlight statewide perspectives to issues associated with hatchery production of salmon and to provide a forum for open discussion on hatchery topics. Thank you for your consideration of these comments.

Sincerely,

Jeremy O'Neil
Mayor
City of Valdez, Alaska

[1] Economic Impacts of Alaska's Salmon Hatcheries, McDowell Group 2018

[2] Economic Impacts of the Valdez Fisheries Development Assoc., Inc., McDowell Group 2018

CITY OF VALDEZ, ALASKA

RESOLUTION NO. 18-33

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, SUPPORTING THE ALASKA SALMON HATCHERY PROGRAM

WHEREAS, the City of Valdez benefits greatly from the State of Alaska Hatchery Program; and

WHEREAS, Alaska's salmon hatchery program has operated for 45 years and supplements wild salmon harvests throughout the state; and

WHEREAS, Alaska's salmon hatchery program is an example of sustainable economic development that directly benefits subsistence fishermen, personal use fishermen, sport fishermen, charter fishermen, commercial fishermen, seafood processors, as well as state and local governments such as Valdez, which receive raw fish tax dollars; and

WHEREAS, Alaska hatcheries accounted for 57% of the total common property commercial catch and 60% of the total ex-vessel value in the Prince William Sound region in 2017; and

WHEREAS, the Prince William Sound Aquaculture Corporation (PWSAC) headquartered in Cordova contributes significantly to the economy of Prince William Sound by providing 1,405 jobs, $68 million in labor income, and $192 million in total economic output in 2017; and

WHEREAS, the Valdez Fisheries Development Association, Inc. (VFDA) headquartered in Valdez contributes significantly to the economy of Prince William Sound by providing 824 jobs, $21.5 million in labor income, and $80.1 million in total economic output between 2008 to 2012; and

WHEREAS, Alaska's salmon hatchery program has proven to be significant and vital to Alaska's seafood and sportfish industries and the state of Alaska by creating employment and economic opportunities throughout the state and in particular in coastal communities such as Valdez ; and

WHEREAS, Alaska's salmon hatchery program is non-profit and self-funded through cost recovery and enhancement taxes on the resource and is a model partnership between private and public entities; and

WHEREAS, the State of Alaska has significantly invested in Alaska's salmon hatchery programs and associated research to provide for stable salmon harvests and to bolster the economies of coastal communities like Valdez, while maintaining a wild stock escapement priority; and

WHEREAS, Alaska salmon fisheries, including those of hatchery origin, continue to be certified as sustainable by two separate programs, Responsible Fisheries Management (RFM) and Marine Stewardship Council (MSC);

WHEREAS, salmon hatchery programs are permitted using a public process, employ strong scientific methodology and are built upon sound and sustainable fisheries policies intended to protect wild salmon populations.

NOW, THEREFORE, BE IT RESOLVED, BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, that

Section 1. The City of Valdez affirms its support for Alaska's Salmon Hatchery Programs including PWSAC and VFDA.

Section 2. The City of Valdez supports unbiased and scientific methods to assess the interaction of Alaska's salmon hatchery programs with natural stocks, such as the Alaska Hatchery/Wild Salmon Interaction Study which began in 2011 and is scheduled to conclude in 2023.

Section 3 The City of Valdez calls on the Alaska Board of Fisheries to work with the hatchery community, the Alaska Dept. of Fish and Game and industry leaders to further its understanding of the importance of the Alaska salmon hatchery program to all Alaskans.

Section 4 The City of Valdez supports the Alaska Dept. of Fish & Game's approval of VFDA's permitted increase of 20 million pink salmon eggs taken in 2018 at the Solomon Gulch Hatchery.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, this 2nd day of October, 2018.

CITY OF VALDEZ, ALASKA

Jeremy O'Neil, Mayor

SEAL OF THE CITY OF VALDEZ, ALASKA INC. 1901

ATTEST:

Sheri L. Pierce, MMC, City Clerk

CITY OF VALDEZ, ALASKA

RESOLUTION NO. 18-24

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, SUPPORTING THE VALDEZ FISHERIES DEVELOPMENT ASSOCIATION INC. SOLOMON GULCH HATCHERY PERMITTED INCREASE OF 20 MILLION PINK SALMON EGGS

WHEREAS, the City of Valdez benefits greatly from Prince William Sound salmon fisheries enhancement programs through hatchery propagation; and

WHEREAS, both sport and commercial fisheries enhancement efforts of the Valdez Fisheries Development Association, provide sustainable direct economic and social benefit to the community of Valdez; and

WHEREAS, this benefit is realized through the creation of local seafood processing jobs, fisheries business tax, increased commerce through the Port of Valdez and seafood industry investment in our community; and

WHEREAS, the enhancement of the sport fishery by VFDA provides significant fishing opportunity for both Pink and Coho salmon creating the largest Pink salmon sport fishery in Alaska; and whose efforts greatly support the annual Valdez Silver Salmon Derby and the Valdez Women's Silver Salmon Derby, a Kids Pink Salmon Derby; and

WHEREAS, this sport fishing activity significantly increases summer tourism by bringing an estimated 15,000 visitors annually to sport fish in Valdez; further benefiting local commerce through the sale of sporting goods, boat rentals, custom processing, lodging and RV camping, fuel, harbor moorage, fishing charters and other purchases estimated to be $6.6 million annually; and

WHEREAS, the sport fish enhancement program provided by VFDA is substantially funded through the sale of cost recovery pink salmon; and

WHEREAS, salmon hatchery programs like VFDA are permitted using a public process, employ strong scientific methodology and are built upon sound and sustainable fisheries policies intended to protect wild salmon populations.

NOW, THEREFORE, BE IT RESOLVED, BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, that

Section 1. The City of Valdez affirms its support for the Valdez Fisheries Development Association's salmon fishery enhancement programs.

Resolution No. 18-24
Page 2

<u>Section 2.</u> The City of Valdez supports the Alaska Dept. of Fish & Game's approval of VFDA's permitted increase of 20 million pink salmon eggs to be taken in 2018 at the Solomon Gulch Hatchery.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, this 3rd day of July, 2018.

CITY OF VALDEZ, ALASKA

Jeremy O'Neil, Mayor

ATTEST:

Sheri L. Pierce, MMC, City Clerk

SEAL OF THE CITY OF VALDEZ, ALASKA INC. 1901