On-Time Public Comment List

Alaska Board of Fisheries Work Session | Anchorage, October 20-21, 2021

Statewide

<u>ACR 2</u>

Alaska Fisheries Development Foundation PC001

Alaska Shellfish Growers Association PC002

Andy Craig PC003

Ben Van Alen PC004

Ginny Eckert PC005

Hartney Bay Kelp Company PC006

John Whissel PC007

Lara Kreyling PC008

Melissa Good PC009

Michael Mahoney PC010

NOAA Fisheries PC011

Prince William Sound Science Center PC012

Bristol Bay

<u>ACR5</u>

Randolph Alvarez PC013

Alaska Peninsula

<u>ACR 6</u>

Chignik Bay Tribal Council..PC14

Chignik Lagoon Native Corporation..PC15

City of Chignik..PC16

Ivanof Bay Tribe..PC17

Native Village of Perryville..PC18

ACR 6 and 7

Upper Cook Inlet

ACR 10

On-Time Public Comment List

Other

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

RE: Support ACR #2 – Allow importation of live oysters from the Pacific Coast of North America for research purposes (5 AAC 41.070)

October 6, 2021

Dear Alaska Board of Fisheries (BOF) Members,

I am writing on behalf of the Alaska Fisheries Development Foundation (AFDF) to support the Agenda Change Request (ACR) #2, submitted by the Alaska Department of Fish and Game (ADFG), which will allow importation of live oysters from the Pacific Coast of North America for research purposes (5 AAC 41.070).

Formed in 1978, AFDF is dedicated to identifying opportunities common to the Alaska seafood industry and developing efficient, sustainable outcomes that provide benefits to the economy, environment and communities. In 2014, AFDF spearheaded the ***Alaska Mariculture Initiative*** with the intention of accelerating the development of mariculture (growing seaweed or shellfish in Alaska). As a result, Governor Walker created the ***Alaska Mariculture Task Force*** (MTF) by Administrative Order #280 and #297. I served on the MTF from 2016-2021. In 2018, the MTF completed the ***Alaska Mariculture Development Plan* (Plan)**, followed by a more refined ***Five-Year Action Plan*** with a goal of growing a $100 million per year mariculture industry in 20 years. The MTF produced a ***Final Report to Governor Dunleavy*** prior to its sunset date on June 30, 2021. ***The MTF has previously supported the change that ACR #2 will accomplish and requested ADFG to consider submitting it to the BOF (see page 13).***

In the strategic plan to develop mariculture, dozens of research priorities were outlined as necessary actions to support growth of the mariculture industry, including oyster research. NOAA Fisheries and other researchers are interested in conducting oyster research, however, the current regulations (5 AAC 41.070) prohibit importation of live oysters for research purposes, although live oysters can be imported for commercial grow-out. It seems to be a simple regulatory oversight which can be corrected by ACR #2.

AFDF appreciates ADFG's actions to improve regulations which would allow oyster research in Alaska and support ACR #2 for these purposes.

Sincerely,

Julie Decker, Executive Director, AFDF
Cc: Sam Rabung, Director, Commercial Fisheries, ADFG

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

AFDF
Alaska Fisheries Development Foundation, Inc.

Alaska Shellfish Growers Association

PO Box 1758

Homer, AK 99603 907-401-1372
info@alaskashellfish.org
www.alaskashellfish.org

October 6, 2021

Board of Fisheries, Boards Support Section
Alaska Department of Fish and Game
PO Box 115526
Juneau, Alaska 99801

RE: Support for ACR#2 – Allow importation of live oysters from the Pacific Coast of North America for research purposes (5 AAC 41.070)

Dear Alaska Board of Fish Members,

The Alaska Shellfish Growers Association (ASGA) supports this change to regulation (ACR #2). We see no downside to this change, only potential positives for our industry. UAS/UAF and NOAA, and possibly others, would be able to perform valuable research on oysters and oyster propagation in their lab facilities.

Thank you for approving this change.

Sincerely,

Eric Wyatt, President
Alaska Shellfish Growers Association

Submitted
dy Craig
Submitted O
10/6/2021 1:40:19 PM
ffiliatio

Pho e
[redacted]
Email
[redacted]
ddress
707 Railroad Avenue
Cordova, Alaska 99574

Please approve CR2 to allow for taki g up t e issue of import, transport, a d possession of oysters for researc purposes, w ic is currentl illegal. O sters are commerciall farmed i laska but it is difficult to develop best practices w en oysters can ot be grow for researc purposes. Our growi g mariculture i dustr eeds t is ousekeepi g measure approved.

Submitted
e a Ale
Submitted O
10/5/2021 5:35:28 AM
Affiliatio

Pho e
[redacted]
Email
[redacted]
Address
3860 Caroline Street
Juneau, Alaska 99801

I recommend that the oard of Fisheries take o action on development of regulations to expand mariculture i Alaska. The oard has ot been provided i formation on the ecological impacts that i troduci g plants or shellfish will have on the mari e environment. The 169 page "Fi al Report to Gover or Du leav " (Produced by the Alaska Mariculture Task Force, May 2021) makes o mention of the factors that limit plant and animal abu dances. The report suggests, like past Comprehensive Salmon (enhancement) Plan reports suggest, that biotic abu dance is limited by recruits when space and food is always the limiti g factor. The report is silent on the fact that there is ot a huge open iche i Alaskan waters just waiti g to ourish ou g plants and shellfish to marketable sizes. These iches are already filled with atural/wild flora and fau a competi g and cooperati g for their opportu it to grow and survive to reproduce. For maricultured biota to survive, atural/wild biota must die. The environment's carr i g capacit is sustai ed by the rec cli g of utrients from dead and decayi g biota. Deaths sustai life ot births. When tons of maricultured plants and shellfish are harvested their tons of mari e-derived utrients are effectivel removed from the utrient c cle. This puts mariculture efforts i violation of the "sustai ed ield pri cipal" for atural/wild resources that is mandated i Article Ill of Alaska's Constitution. We should ever tr to do somethi g i ature, different from ature, and thi k it will be better than ature.

Submitted
i Eckert
Submitted O
10/5/2021 6:20:54 PM
Affili tio
U iversit of Alask

Pho e
[redacted]
Em il
[redacted]
Address
17101 Pt. Len Loop Rd.
Ju eau, Alask 99801

I am submitti g comments i support of Agenda Ch ge Request (ACR #2) to allow importation of oysters for research purposes. This ch ge is eeded to allow oysters to be imported, tr sported, or possessed for aquaculture purposes, i cludi g research, u der terms of permit issued by the department.

The current regulation has hampered oyster research d the shellfish i dustr i the state, This regulation would allow U iversit of Alask d other researchers statewide to conduct laborator d field research ctivities with o sters.

Research has been critical to growth of the shellfish i dustr i other states. For example i Washi gton state, research has helped to grow vibr t i dustr of about 250 shellfish companies that support 3,000 jobs d contribute hu dreds of millions of dollars to the econom . This one small regulator ch ge will help Alaska's shellfish i dustr , currentl valued arou d one million dollars, to get onto level pl i g field. rowi g shellfish like oysters is sustai able, s fe, d c support Alask commu ities d local economies. Research is eeded to support growth i Alaska's shellfish i dustr d to achieve the goal set by the Alask over or's Mariculture Task Force to grow $100 million i dustr i 20 ears. Their fi al report (M 2021) outli es research eeds d priorities that c onl be achieved with this ch ge i regulation.

Submitted
rtne Kelp Compan
Submitted On
10/6/2021 3:53:11 PM
ffili tion

Please pprove CR2 to llow for taking up the issue of import, transport, nd possession of o sters for research purposes, which is currentl illegal. O sters re commerciall f rmed in lask but it is difficult to develop best pr ctices when o sters cannot be grown for research purposes. Our growing mariculture industr needs this housekeeping measure approved.

Submitted
hn Whissel
Submitted On
10/6/2021 12:01:34 PM
Affili ti n
N tive Village of E ak

Please pprove AC2 t all w for t king up the issue f import, transport, and possessi n f sters f r research purposes, which is currentl illegal. O sters re c mmerciall f rmed in Alask but it is difficult t devel p best pr ctices when sters cann t be gr wn f r research purposes. Our growing mariculture industr needs this h usekeeping measure approved.

Submitted
r Kre ling
Submitted On
10/6/2021 3:48:24 PM
A fili tion

Please pprove ACR2 to llow or taking up the issue o import, transport, nd possession o o sters or research purposes, which is currentl illegal. O sters re commerciall rmed in Alask but it is di icult to develop best pr ctices when o sters cannot be grown or research purposes. Our growing mariculture industr needs this housekeeping measure approved.

Submitted
e issa Good
Submitted On
10/6/2021 7:48:16 A
Affi iation

Phone
[redacted]
Emai
[redacted]
Address
118 Trident Way
Kodiak, A aska 99615

I am submitting t is comment in support of Agenda C ange Request 2 (ACR 2) to al ow for ive oysters to be imported, transported, and possessed from t e Pacific Coast of Nort America to A aska for t e purpose of conducting researc . (5 AAC 41.070).

Current regu ation al ows for t e importation of ive oysters for commercial purposes, but not for conducting researc . T is regu ation as been identified by t e maricu ture industr in A aska, inc uding t e governor's Maricu ture Task Force and the industr ed A aska S e fis Growers Association, and by A aska Sea Grant as a barrier to t e growt of t e s el fis farming industr and to developing an A aska specific oyster broodstock. Aquatic farming of s el fis and seaweeds as been s own to be a safe and sustainable way to support coastal economies and ocal communities. Researc faci ities in A aska are ready to conduct work t at as been identified as essential by t e industr , et are unable to do so egal .

A aska Sea Grant (ASG) is one of 34 Sea Grant programs nationwide in t e United States eadquartered at t e Universit of A aska Fairbanks to serve statewide. Our work supports ealt coastal resources, strong economies, and vibrant communities. We do t is t rough researc , education, and outreac via arine Advisor agents w o ive and work in coastal communities across A aska. Agents work wit marine arvesters and growers to establis met ods to arvest, preserve, process, market, and package A aska's marine resources. Wit t e sunset of t e Governor's aricu ture Task Force, ASG was identified to administer t e new -formed aricu ture Researc and Training Center (RTC). RTC wi focus on bui ding partners ips and everaging resources to faci itate and coordinate training, researc and dissemination of information across disciplines, inc uding biology, engineering, economics, marketing and food sciences. It wi provide statewide access to on ine resources and information. We feel t at wit out t e passing of t is regu ation, researc ers wi be great ampered in assisting t e growt of t e industr and of ac ieving t e goal of bui ding a $100 mi ion dol ar maricu ture industr by 2038.

Submitted
i hael Mahone
Submitted On
10/6/2021 3:51:34 P
Affiliation

Please approve ACR2 to allow for taking up the i ue of import, tran port, and pos e ion of o ter for re ear h purposes, whi h i urrentl illegal. O ter are ommer iall farmed in Alaska but it i diffi ult to develop best pra ti es when o ter annot be grown for re ear h purposes. Our growing mari ulture indu tr needs thi hou ekeeping measure approved.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

October 5, 2021

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

Re: ACR 2 Allow importation of live oysters from the Pacific Coast of North America for research purposes (5 AAC 41.070).

Dear Alaska Board of Fisheries Members:

We are submitting this letter in strong support of a regulatory change brought forward by the Alaska Department of Fish and Game in response to needs voiced by NOAA Fisheries and the Alaska aquaculture industry that would allow for the importation of live oysters for research purposes into Alaska. We thank ADF&G for leading this proposal and look forward to opportunities to work together to advance the Alaska aquaculture industry in the future.

One of the key missions of the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) Alaska aquaculture program is to respond to industry research needs to ensure the growth of an ecologically sustainable and economically robust shellfish and seaweed aquaculture industry in Alaska. The Alaska Shellfish Growers Association and Mariculture Task Force have highlighted oyster research needs to advance the nascent industry. In order to meet industry needs, and accomplish our mission, NOAA Fisheries researchers must be able to hold live oysters in the Auke Bay Laboratories (Ted Stevens Marine Research Institute and Little Port Walter Research Station) and Kodiak Laboratory.

In its current form, the Alaska Administrative Code Number 5 AAC: 41.070. Prohibitions on importation and release of live fish does not allow for research on live oysters. This is a detriment to Alaska because it hinders research and development work vital to industry growth. The change in regulatory language proposed by ADF&G would allow for the transport and holding of live oysters in research facilities along with other aquaculture purposes. Therefore, we strongly encourage the Board to adopt this regulatory change.

NOAA Fisheries has the infrastructure, personnel, funding, and industry collaborations to immediately implement research on oyster husbandry, thermal tolerance, strain selection, genetic diversity, disease susceptibility, and other pressing research questions.

We strongly support this regulatory change so NOAA Fisheries researchers can get to work improving oyster aquaculture in Alaska.

Please direct any questions regarding this letter to Mariculture and Macroalgae Lead Research Biologist - Jordan Hollarsmith jordan.hollarsmith@noaa.gov, or Alaska Regional Aquaculture Coordinator - Alicia Bishop alicia.bishop@noaa.gov.

Sincerely,

for Robert D Mecum

James W. Balsiger Ph.D.
Administrator Alaska Region

cc: Sam Rabung - samuel.rabung@alaska.gov
Garold Pryor - garold.pryor@alaska.gov

October 6, 2021

Dear Alaska Board of Fisheries (BOF) Members,

I am writing on behalf of the Prince William Sound Science Center (PWSSC) to support the Agenda Change Request (ACR) #2, submitted by the Alaska Department of Fish and Game (ADFG), which will allow importation of live oysters from the Pacific Coast of North America for research purposes (5 AAC 41.070).

Formed in 1989, PWSSC works to advance community resilience and the understanding and sustainable use of ecosystems. We are aware of the priorities defined by the Alaska Mariculture Development Plan. We have also recently been part of a large, integrated mariculture research proposal comprised of team members from the University of Alaska Fairbanks, Alaska Sea Grant, the Alaska Fisheries Development Foundation, the Native Village of Eyak, the National Oceanic and Atmospheric Administration Alaska Fishery Science Center, and the Alaska Department of Fish and Game. That proposal team wrestled with the challenge of how to best implement critical oyster research in Alaska in light of the prohibition of using live oysters for research purposes.

PWSSC has designed our new facilities to incorporate a running seawater system (including treated effluent), which we are currently raising funds to construct. Our location in Cordova, part of the fastest growing mariculture region in the state by number of permit applications, makes us a potentially interested future party as it pertains to conducting research using oysters. However, to do so would necessitate a regulatory change, which can be made via the adoption of ACR #2.

Thank you for seriously considering how to allow oyster research in Alaska,

Katrina Hoffman
President & CEO
Prince William Sound Science Center
khoffman@pwssc.org

Comment to B O F FOR A C R 5
WORK SESSION October 20-21, 2021

Regulation 5 AAC 06.364 NAKNEK - KVICHAK District commercial set AND DRIFT sockeye Salmon Fisheries Management AND ALLOCATION PLAN.

This has been a developing problem over the last few years, some years the set net allocation was in the 30 percentage. In 2021 the NAKNEK was not a above average Return. So the setnet Allocation in the Kvichak Reached 47% because of a strong Kvichak Return.

By not sticking to the management plan A Lot more early Kvichak bound sockeye are being harvested, Resulting in the Kvichak escapement extremely slow starting. Till the middle of the season when the peak shows up.

Harvesting to many early Kvichak sockeye Results in subsistence catches in ILIAMNA lake, Especially six mile Lake AND Lake CLARK being poor, till the Run picks up usually mid July.

Taking to many early Kvichak Sockeye AFFECTS the Newhalen River - Lake Clark complex, as stated in the report by

Kathleen A. Jensen AND Ole A. Mathisen

MIGRATORY STRUCTURE OF THE KVICHAK RIVER SOCKEYE SALMON (ONCORHYNCHUS NERKA) ESCAPEMENT 1983

The report states that A Lot of the Early migrants are destined for Newhalen River AND Lake Clark.

By harvesting to many Kvichak sockeye early in the season not only AFFECTS the subsistence catches but it also affects the sport Fishery AND when both gear groups are able to commercial fish the Kvichak district.

Last summer I was calling ADFG in the King Salmon OFFICE to Keep up on the Kvichak run. During the middle of the season (July) when the escapement was building Rapidly. The NAKNEK Kvichak manager was hesitant to open the Kvichak district to the DRIFT Fleet, stating he needed a Little more escapement

IF the N/K manager had managed according to the management plan the drift Fleet would have been fishing in the Kvichak District At Least 1 day earlier, most Likely 2 days earlier.

This would have kept the Allocation Percentages close to what was intended.

By not managing to the Allocation plan, AND HAVING the Kvichak set net Fleet fish As much as the setnetters AND DRIFTERS IN the NAKNEK Section, of the NAKNEK/KVICHAK DISTRICT Really got the Allocation out of WACK AND took A Lot Longer for the DRIFT Fleet to get into the KVICHAK Section.

Back before ALLOCATION, whenever the setnetters AND DRIFTERS fished in the NAKNEK SECTION only, the ADFG only Let the Setnett fleet fish about once every other day. Untill both gear groups fished in the Kvichak Section.

By fishing in the Kvichak section to much early in the season also AFFECTS having both gear groups to fish the NAKNEK SPECIAL HARVEST AREA. untill the Kvichak catches up on its escapement.

Randolph Alvarez

RANDOLPH ALVAREZ
P O Box 4012
Igiugig, AK 99613

Migratory Structure of the Kvichak River Sockeye Salmon (*Oncorhynchus nerka*) Escapement, 1983

Kathleen A. Jensen[1] and Ole A. Mathisen

School of Fisheries and Science, University of Alaska, Juneau, AK 99801, USA

Abstract

JENSEN, K. A., AND O. A. MATHISEN. 1987. Migratory structure of the Kvichak River sockeye salmon (*Oncorhynchus nerka*) escapement, 1983, p. 101–109. *In* H. D. Smith, L. Margolis, and C. C. Wood [ed.] Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Can. Spec. Publ. Fish. Aquat. Sci. 96.

Sockeye salmon (*Oncorhynchus nerka*) in the 1983 Kvichak River spawning escapement were tagged during seven sequential periods. Recovery surveys were conducted on all known spawning grounds in the watershed to determine the migratory structure of various escapement components. The period of peak spawning varies among habitats and occurs from early August to mid-October. Recoveries from every tagging period were made in every geographic area, on every type of spawning bed, and from each temporal (early, middle, and late) spawning component. The Newhalen River–Lake Clark complex had a greater proportion of early migrants than did Iliamna Lake. However, neither the estimated mean of migratory time density or its associated variance differed significantly among various escapement components. Recoveries from schooling/spawning fish and from spent fish in three rivers indicated an overlap in the time of migration of the two groups. Live unspawned and spawning fish tagged during the first two tagging periods were mingled with spent and dying fish tagged in period 4 or later. The minimum time span of active spawning of salmon from a given tagging period ranged from 30 to 70 days. Tags from every period were observed on actively spawning fish during a 20-day span. The results showed the potential for genetic mixing between migrants from every portion of the escapement.

Résumé

JENSEN, K. A., AND O. A. MATHISEN. 1987. Migratory structure of the Kvichak River sockeye salmon (*Oncorhynchus nerka*) escapement, 1983, p. 101–109. *In* H. D. Smith, L. Margolis, and C. C. Wood [ed.] Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Can. Spec. Publ. Fish. Aquat. Sci. 96.

Chignik Bay Tribal Council

P.O Box 50

Chignik, Alaska 99564

Phone (907) 749-4018 email cbaytc@aol.com

On behalf of the Chignik Bay Tribal Council, I submit this comment supporting ACR 6.

I urge the Board to accept ACR 6 so that it can consider out of cycle modifications to 5 AAC 09.365 and 5 AAC 09.366. There are conservation and sustained yield concerns with the early- and late-run sockeye salmon stocks returning to Chignik Lake and Black Lake. These concerns are demonstrated by the failure of the early run to meet its minimum escapement goal every year since 2018, and the failure of the late run to meet its minimum escapement goal for 2 of the last 4 years since 2018.

The failure of these runs has had devastating economic and cultural losses for the tribes, residents, and businesses in Area L who depend on the commercial and subsistence harvest of sockeye salmon. But, despite the obvious severity of this situation, absent Board action, the Alaska Department of Fish and Game cannot and will not change its implementation of these regulations.

The Board has the ability to help change an economically and biologically untenable situation. But, unless and until the Board acts, the commercial and subsistence fisheries in Area L will remain closed or severely limited, individuals and businesses within Area L will continue to bear the entire burden of conservation for these sockeye runs, and the present sustained yield crisis will only grow more severe. I support ACR 6 and urge the Board to do the same.

Respectfully Submitted,

Roderick E. Carlson

Roderick Carlson/ President

CHIGNIK LAGOON
NATIVE CORPORATION

Alaska Board of Fisheries,

On behalf of the Chignik Lagoon Native Corporation, I submit this comment supporting ACR 6.

I urge the Board to accept ACR 6 so that it can consider out of cycle modifications to 5 AAC 09.365 and 5 AAC 09.366. There are conservation and sustained yield concerns with the early- and late-run sockeye salmon stocks returning to Chignik Lake and Black Lake. These concerns are demonstrated by the failure of the early run to meet its minimum escapement goal every year since 2018, and the failure of the late run to meet its minimum escapement goal for 2 of the last 4 years since 2018.

The failure of these runs has had devastating economic and cultural losses for the tribes, residents, and businesses in Area L who depend on the commercial and subsistence harvest of sockeye salmon. But, despite the obvious severity of this situation, absent Board action, the Alaska Department of Fish and Game cannot and will not change its implementation of these regulations.

The Board has the ability to help change an economically and biologically untenable situation. But, unless and until the Board acts, the commercial and subsistence fisheries in Area L will remain closed or severely limited, individuals and businesses within Area L will continue to bear the entire burden of conservation for these sockeye runs, and the present sustained yield crisis will only grow more severe. I support ACR 6 and urge the Board to do the same.

The habitat and the economy of the Chignik Area is of extreme concern to our corporation and we entertain all opportunity to contribute our assistance. We welcome all suggestions on how the corporation can provide more support during these uncertain times.

Sincerely,

Angela Gregorio
Operations Manager
Chignik Lagoon Native Corporation

City of Chignik

PO Box 110
Chignik, AK 99564

Phone (907) 749-2280
Fax (907) 749-2300
cityoffice@chignik.org

On behalf of the City of Chignik, I submit this comment supporting ACR 6.

I urge the Board to accept ACR 6 so that it can consider out of cycle modifications to 5 AAC 09.365 and 5 AAC 09.366. There are conservation and sustained yield concerns with the early- and late-run sockeye salmon stocks returning to Chignik Lake and Black Lake. These concerns are demonstrated by the failure of the early run to meet its minimum escapement goal every year since 2018, and the failure of the late run to meet its minimum escapement goal for 2 of the last 4 years since 2018.

The failure of these runs has had devastating economic and cultural losses for the tribes, residents, and businesses in Area L who depend on the commercial and subsistence harvest of sockeye salmon. But, despite the obvious severity of this situation, absent Board action, the Alaska Department of Fish and Game cannot and will not change its implementation of these regulations.

The Board has the ability to help change an economically and biologically untenable situation. But, unless and until the Board acts, the commercial and subsistence fisheries in Area L will remain closed or severely limited, individuals and businesses within Area L will continue to bear the entire burden of conservation for these sockeye runs, and the present sustained yield crisis will only grow more severe. I support ACR 6 and urge the Board to do the same.

Robert Carpenter, Mayor

Submitted
dgar J. Shan i n
Submitted On
10/6/2021 4:40:06 PM
Affi iation
Ivanof ay Tribe

Phone
[redacted]
m ai
[redacted]
Address
6407 rayton Dr.
Suite 201
Anchorage, A aska 99507

On behalf of the Ivanof ay Tribe, I submit this comment supportin ACR 6.

I ur e the oard to accept ACR 6 so that it can consider out of c c e modifications to 5 AAC 09.365 and 5 AAC 09.366. There are conservation and sustained ield concerns with the ear - and ate-run socke e sa mon stocks returnin to Chi nik Lake and ack Lake. These concerns are demonstrated by the fai ure of the ear run to meet its minimum escapement oal ever ear since 2018, and the fai ure of the ate run to meet its minimum escapement oal for 2 of the ast 4 ears since 2018.

The fai ure of these runs has had devastatin economic and cu tural osses for the tribes, residents, and businesses in Area L who depend on the commercial and subsistence harvest of sockeye salmon. ut, despite the obvious severit of this situation, absent oard action, the A aska Department of Fish and Game cannot and wi not chan e its implementation of these regu ations.

The oard has the abi it to help chan e an economical and biological untenable situation. ut, un ess and unti the oard acts, the commercial and subsistence fisheries in Area L wi remain c osed or severel imited, individuals and businesses within Area L wi continue to bear the entire burden of conservation for these sockeye runs, and the present sustained ield crisis wi on r ow more severe. I support ACR 6 and ur e the Board to do the same.

Sincerel ,

dgar J. Shan in

Counci President

Ivanof a Tribe

Native Village of Perryville
101 1st Avenue
P.O. Box 89
Perryville, AK 99648

Phone: (907) 853-2203 / (907) 853-4030
Fax: (907) 853-2230
nativevillageofperryville@outlook.com
perryvilleadmin@bbna.com

Alaska Department of Fish and Game
Alaska Board of Fisheries
PO Box 115526
1255 W. 8th Street
Juneau, AK 99811-5526
Phone (907) 267-2354
dfg.bof.comments@alaska.gov

October 5, 2021

To whom it may concern;

On behalf of the Native Village of Perryville, I submit this comment supporting ACR 6.

I urge the Board to accept ACR 6 so that it can consider out of cycle modifications to 5 AAC 09.365 and 5 AAC 09.366. There are conservation and sustained yield concerns with the early- and late-run sockeye salmon stocks returning to Chignik Lake and Black Lake. These concerns are demonstrated by the failure of the early run to meet its minimum escapement goal every year since 2018, and the failure of the late run to meet its minimum escapement goal for 2 of the last 4 years since 2018.

The failure of these runs has had devastating economic and cultural losses for the tribes, residents, and businesses in Area L who depend on the commercial and subsistence harvest of sockeye salmon. But, despite the obvious severity of this situation, absent Board action, the Alaska Department of Fish and Game cannot and will not change its implementation of these regulations.

The Board has the ability to help change an economically and biologically untenable situation. But, unless and until the Board acts, the commercial and subsistence fisheries in Area L will remain closed or severely limited, individuals and businesses within Area L will continue to bear the entire burden of conservation for these sockeye runs, and the present sustained yield crisis will only grow more severe. I support ACR 6 and urge the Board to do the same.

Sincerely,

Gerald Kosbruk,
Council President

AKUTAN • COLD BAY • NELSON LAGOON
ALEUTIANS EAST
BOROUGH
FALSE PASS • KING COVE • SAND POINT

October 4, 2021

Alaska Board of Fisheries
Chair Märit Carlson-Van Dort
Via email dfg.bof.comments@alaska.gov

RE Aleutians East Borough Opposed to Agenda Change Requests 6 and 7

The Aleutians East Borough (AEB) encompasses the communities of Akutan, False Pass, Nelson Lagoon, Cold Bay, King Cove and Sand Point, and the fishing areas outlined in *5 AAC 09.365 South Unimak and Shumagin Islands June Salmon Management Plan*. Our local fishermen, processors and communities would be directly negatively impacted by Agenda Change Requests (ACRs) 6 & 7 submitted by Chignik residents, that would further restrict salmon fishing in our region. The AEB urges the Board of Fisheries to reject these ACRs.

The AEB Natural Resources Department (NRD) has examined ACRs 6 & 7, and after analysis, we find that these ACRs *do not* meet the standards as outlined in *5 AAC 39.999 Policy for Changing the Board of Fisheries Agenda*. To accept an ACR, the regulation states: "The board will accept an agenda change request only - for a fishery conservation purpose or reason; to correct an error in a regulation; or to correct an effect on a fishery that was unforeseen when a regulation was adopted."

Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled by August 17th.

Early Run Escapement Objective July 30)	2021 Early Run Escapement Actual	Late Run Escapement Objective (Aug 19)	2021 Late Run Escapement Actual	Total Escapement Objective Thru Aug)	2021 Total Run Escapement Actual Thru 8/17)
350,000 – 450,000	264,615	190,000 – 350,000	321,154	560,000 - 830,000	585,769

Chignik escapement has remained relatively consistent since 2018 and total Chignik escapement in 2021 increased compared to the previous 3-year average. **There is no conservation purpose that would justify considering ACRs 6 & 7 as out of cycle proposals**.

The Board of Fisheries opens the *5 AAC 09.365 South Unimak and Shumagin Islands June Salmon Management Plan* during every regular meeting cycle, including the 2016 and 2019 meetings. The Board amended the above management plan in February 2016 establishing the Dolgoi Island Area and setting a sockeye harvest cap in the area. In February 2019 the Board closed the Dolgoi Area to seine vessels for all of June. Also in 2019, the Board realigned the set gillnet, drift gillnet and seine gear fishing schedules in June, resulting in 73% increased hours of closed ‘windows’ in June with no fishing nets in the water in the South Alaska Peninsula area. Fishermen in the Chignik Management Area CMA) have harvested salmon commercially in 3 of the past 4 years. But the Southeast District Mainland SEDM) has remained closed to salmon fishing for the past 4 years, based on that management plan. **There have been no unforeseen effects of these or other regional fishing regulations to justify accepting ACRs 6 & 7.** South Alaska Peninsula fishermen do share in the burden of conservation for Chignik-bound salmon, which has been clearly demonstrated through a long history of restrictions both in-season and within management plans.

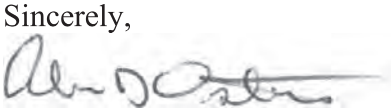
The Board of Fisheries should consider all submitted South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle. In the interim, the Alaska Department of Fish and Game ADFG has in-season emergency management authority and has used that authority appropriately as needed. In 2018 the Board found that an emergency existed in Chignik, which only further confirmed action that had *already* been taken by the Department: closures of both the Dolgoi and Southeast District Mainland areas, through August 8th 2018 unless Chignik Lake interim escapement goals were met. ADFG has clearly demonstrated their ability to manage these fisheries in an effective and timely manner using the tools available to them.

Furthermore, there is no precedent for accepting these ACRs. Since 2017, two ACRs have been submitted from the Chignik area using the same rationale and ACR criteria – **both of which failed without support from the Department and the Board**. Proposals for the South Alaska Peninsula and Chignik should be addressed through the regular process where stakeholders submit proposals to be considered at the regular Board meeting in February 2023. The AEB urges the Board of Fisheries not to accept ACRs 6 or 7 that would further restrict salmon fishing in South Alaska Peninsula Areas to address salmon escapement concerns in Chignik. These ACRs *do not* meet the Board’s standards for accepting ACRs.

The AEB Natural Resources Department is tasked with the study, investigation, and monitoring of fish, wildlife and other natural resources within the Borough, and providing assistance and guidance to other agencies to promote the protection, development, management, and renewal of these natural resources. We are committed to the sustainability of our ocean resources and fisheries. Please feel free to reach out to myself, NRD Director Ernie Weiss, or Assistant Director Charlotte Levy with any questions or concerns you may have.

Thank you for the opportunity to comment.

Sincerely,



Alvin D. Osterback, Mayor
aosterback@aeboro.org

Cc: Ernie Weiss, AEB Natural Resources Director eweiss@aeboro.org
Charlotte Levy, AEB Natural Resources Assistant Director clevy@aeboro.org

Alfredo About Eid
F/V Alaskan Frontier
P.O Box 26
Chignik Lagoon, Alaska 99565

Alaska Board of Fisheries
P.O. Box 115526
Juneau, Alaska 99811-5526

September 30, 2021

Subject: ACR 6 and ACR 7

Dear Board of Fisheries Members:

I recommend that the Alaska Board of Fisheries take affirmative action on ARC 6 and ACR 7.

Chignik's two sockeye salmon runs are extremely weak and escapement goals are not being met on the early run and in only two of the last four seasons on the late stock. As a consequence, there has not been any June or July sockeye fishing in the Chignik Management Area (L) since 2017. The late Chignik run has supported low level harvests in 2019 and 2021 but nothing in 2020 and 2021.

The inability of not meeting Chignik sockeye salmon escapement goals has consequences, none favorable to the perpetuation and sustainability of the Chignik runs.

I foresee further collapse of the Chignik sockeye fishery without Board intervention on the Area M South Peninsula fishery and a decree from the F G Commissioner that the Department will apply the best science possible in assigning stock composition instead of holding to the false assumption inseason that run abundance and timing is annually static or consistent between Chignik's two sockeye runs. This is not meant to take away from the subject of a needed regulatory change in the Area M fishery for Chignik sockeye conservation, but rather to notice the Board that the Department's management of Chignik sockeye salmon needs to be brought up to today's scientific standards.

Both ARC 6 and ACR 7 speak to the need to address the Area M fishery impact on Chignik sockeye salmon. From the Department's genetic study (WASSIP) the Dolgoi Islands and the Shumagin Islands fisheries are harvest areas on east traveling Chignik sockeye from mid June through July. Currently neither area is constrained by a stock conservation provisions. In accordance, there is scant justification for keeping the entire Chignik Management Area closed due to a Chignik sockeye escapement issue **if** the South Peninsula eastern waters remain open through June and July without regard to the number of Chignik sockeye salmon taken.

To move more east-traveling Chignik sockeye salmon into Area L from the eastern waters of the South Alaska Peninsula, I recommend that, at minimum, the Board substantially reduce fishing time in the Shumagins and Dolgoi area in June and July. Absent of such, the Chignik early run may well end up as a **stock of concern** should the 2022 run not meet minimum escapement.

Thank you for considering my input as a Chignik commercial and subsistence fisherman and a full-time Chignik Lagoon resident.

Sincerely,

Alfredo About Eid

Submitted
vin newman
Submitted On
10/6/2021 10:51:06 PM
ffi iation
King cove resident fisher

I m asking the board to say vote no to acr 6 and a r 7 the don't meet the riteria of onservation set by the department thank ou vin Newman .

Comments of Area M Seiners Association to Agenda Change Requests 6 and 7
October 6, 2021

The Area M Seiners Association submits these comments on Agenda Change Requests (ACRs) 6 and 7, which were submitted by the Chignik Intertribal Coalition and Don Bumpus, respectively. ACR 6 seeks unspecified changes in the South Unimak and Shumagin Islands June Salmon Management Plan, 5 AAC 09.365 June Management Plan) and the Post-June Management Plan for the South Alaska Peninsula, 5 AAC 09.366 (Post-June Management Plan to restrict harvests of Chignik-bound sockeye. ACR 7 seeks specific reductions in fishing periods in the Shumagin Islands Section and the Dolgoi Islands Area in the June and Post-June Management Plans to reduce interception of Chignik early-run sockeye.

The ACRs ask the Board of Fisheries to consider these out-of-cycle changes to address Chignik sockeye escapement concerns. However, the ACRs do not meet Board policy for agenda change requests. Under 5 AAC 39.999(a)(1), the Board will, in its discretion, change its schedule for consideration of a proposed regulatory change in response to an agenda change request only for a fishery conservation purpose or reason, to correct an error in a regulation, or to correct an effect on a fishery that was unforeseen when a regulation was adopted. The Board will not accept an ACR that is predominantly allocative in nature in the absence of new information found by the Board to be compelling. 5 AAC 39.999(a)(2). These limitations on ACRs reflect "the importance of public participation in developing management regulations" and the Board's recognition that "public reliance on the predictability of the normal board process is a critical element in regulatory changes." 5 AAC 96.625(e).

The Board's policy for management of sustainable salmon fisheries defines a "conservation concern" as a "concern arising from a chronic inability, despite the use of specific management measures, to maintain escapements for a stock above a sustained escapement threshold (SET)." 5

AAC 39.222(f)(6). "[C]hronic inability" is "the continuing or anticipated inability to meet escapement thresholds over a four to five year period, which is approximately the generation time of most salmon species." 5 AAC 39.222(f)(5). A "sustained escapement threshold" or "SET" is "a threshold level of escapement, below which the ability of the salmon stock to sustain itself is jeopardized" and "can be estimated based on lower ranges of historical escapement levels, for which the salmon stock has consistently demonstrated the ability to sustain itself." 5 AAC 39.222(f)(39). "[T]he SET is *lower* than the lower bound of the [biological escapement goal (BEG)] and *lower* than the lower bound of the [sustainable escapement goal (SEG)]." *Id*. emphasis added).

Neither ACR demonstrates that there is a conservation concern that warrants an agenda change request. The Alaska Department of Fish Game's "Review of Salmon Escapement Goals in the Chignik Management Area, 2018"[1] provides the following summary of the escapement goals for Chignik's sockeye runs and the stock's status as of that time:

> Escapement goals for Chignik River sockeye salmon were originally established in 1968, and set at 350,000 to 400,000 fish for the early run and 200,000 to 250,000 fish for the late run (Dahlberg 1968). In 1998, the BOF established a September 1–15 management objective of 25,000 fish, supplemental to the lower bound of the late-run goal, to accommodate subsistence fishers upstream of the Chignik weir. In 2004, the numerical ranges of the goals were left in place, but the goals were reclassified as SEGs because scientifically-defensible estimates of SMSY were not possible. Also in 2004, the BOF established an August management objective of 25,000 fish in addition to the existing September management objective) to further provide subsistence opportunities upstream of the weir. In 2007, the late-run SEG was changed to 200,000 to 400,000 fish, and the two 25,000-fish management objectives were reclassified as inriver run goals (IRRG; Witteveen et al. 2007). Actual timing of adoption of the inriver goal is unclear from other documents as it was initially just a management objective that was expanded over 2 cycles 1989 and 2004), but was adopted as a formal inriver goal in 2007. In 2013 the early-run

[1] K. Schaberg, M. B. Foster and A. St. Saviour, "Review of Salmon Escapement Goals in the Chignik Management Area, 2018" (ADF&G Fishery Manuscript Series No. 19-02) (Feb. 2019) (available at Review of salmon escapement goals in the Chignik Management Area, 2018. (alaska.gov) .

> goal was changed from an SEG to a BEG and the range was increased to 350,000 to 450,000 fish and the IRRG was officially put into regulation Sagalkin et al. 2013). In 2015 no changes were made to the Chignik sockeye salmon escapement goals Schaberg et al. 2015); however, the BOF increased the inriver goal by 25,000 fish in September. The inriver run goals are currently 25,000 fish in August and 50,000 fish in September, for a total of 75,000 fish above lower bound of the late-run SEG.
>
> **Stock Status**
>
> The current Chignik River early-run escapement goal range 350,000 to 450,000) was established in 2013 and classified as a BEG. In the last 10 years, early-run escapements have been within or above (4 times) the goal every year. The late-run escapements have met the current SEG range 200,000 to 400,000), or have been above (1 time) the goal every year since implementation in 2008 Appendix B). The IRRGs have not been met every year due to the time specific requirements, and lack of weir operation throughout the time IRRGs are in effect. The August component has been achieved in 10 of the last 12 years (not in 2011 or 2014) and the September IRRG has not been met since the escapement goal was updated in 2016 and was only achieved in 3 of the 9 years from 2007–2015 when it was from September 1-15.
>
> **2018 Review**
> Escapements in 2015–2017 exceeded or were within the range of the early-run BEG and the late-run SEG (Table 1; Appendices B2–B4). There was no compelling new information since the last review, and the team agreed that no further analysis was necessary in 2018.

Id. at 6-7.

In 2019, the Board reduced the sockeye IRRG from 75,000 to 20,000 fish 10,000 fish in August and 10,000 fish from September 1-30).[2] Including the IRRG, the Chignik late-run SEG is now 220,000 to 400,000 fish, while the early-run BEG remains at 350,000 to 450,000 fish.

[2] R. Renick, Chignik Management Area Salmon Annual Management Report, 2019 at 7 (ADF&G Fishery Management Report No. 20-11 (Nov. 2020 (citing 5 AAC 15.357 b 3 B)) available at Chignik Management Area salmon annual management report, 2019. (alaska.gov)) (hereafter, 2019 Chignik Management Report

Since 2017, early-run escapements have been below the early-run BEG while late-run escapements continued to be within the late-run SEG except in 2020, as shown in the following table:

	Goal	2018[3]	2019[4]	2020[5]	2021 Preliminary, Minimum Estimates Based on Weir Counts)[6]
Early Run	BEG: 350,000-450,000	263,979	345,918	137,213	264,615
Late Run	SEG: 275,000-400,000 in 2018; 220,000-400,000 in 2019-2021	275,718	336,077	193,765	321,154

These data do not establish a conservation concern warranting an agenda change. Although the early run has failed to meet the BEG in the last four years, the ACRs do not show that it has failed to meet the SET, which, as noted, is lower than the lower bound of the SEG. In 2019, early-run escapement was only slightly below the BEG range, and the preliminary estimate for 2021 estimate from the weir count will likely increase based on genetic analyses. With the exception of 2020 *i.e.*, with the exception of a single year), the early-run escapements have been at levels from

[3] D. Wilburn and R. Renick, Chignik Management Area Salmon Annual Management Report, 2018 at 6-7 ADF&G Fishery Management Report No. 18-32) Dec. 2018) (available at Chignik Management Area salmon annual management report, 2018. (alaska.gov)) (hereafter, 2018 Chignik Management Report .

[4] 2019 Chignik Management Report at 8.

[5] Memorandum from N. Sagalkin to R. Renick re 2020 Chignik Salmon Season Summary at 3 available at https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1233998490.pdf .

[6] "Kodiak Management Area and Chignik Salmon Weir Counts Cumulative Escapement through 09-14-2021" available at https://www.adfg.alaska.gov/static/fishing/PDFs/commercial/westwardsalmon/kodiak_weir_escapement.pdf. . Actual early-run escapement based on these weir counts is a minimum that is subject to change pending genetic analysis of samples during peak overlap of the early and late runs. Also, late-run escapement does not include an estimate of fish that escaped after the weir was removed on August 17.

which the stock has demonstrated an ability to sustain itself.[7] The late run has met the SEG in every year except in 2020, and in that year it was only slightly below the lower bound of the SEG. The ACRs do not show that, even in 2020, the late run was below the SET. Under these circumstances, the ACRs do not demonstrate the existence of a conservation concern warranting an agenda change.

Notably, the primary argument advanced in ACR 6 is that the burden of conservation is not being fairly shared because commercial fishermen in the Chignik Management Area (CMA have had limited opportunity to harvest Chignik salmon in the 2018-2021 seasons. *See Board of Fisheries Work Session Oct. 20-21 Agenda Change Requests* (ACRs) pp. 13-14. Similarly, ACR 7 argues that under the current regulations, neither the Shumagin Islands Section nor the Dolgoi Islands Area share any measure of stock conservation on Chignik-bound sockeye and the purpose of the ACR is to provide for "a sharing in the burden of conservation." ACRs p. 17. Thus, the ACRs seek to increase fishing opportunity in one management area by reducing or eliminating a fishery in a different management area. This is an allocation purpose, not a fishery conservation purpose.[8]

Even if the ACRs demonstrated the existence of a conservation problem, they would be insufficient under the Board's ACR Policy because they do not demonstrate that the problem can be addressed by adjusting the June or Post-June Management Plans. The Western Alaska Salmon

---

[7] Early-run escapements were between 181,112 and 334,093 each year between 1944 and 1949. They were equal or less than 265,000 fish as in recent years) in 1925, 1945, 1946, 1947, 1954, 1956, 1958, and 1967. 2018 Chignik Management Report at 29-33.

[8] ACR 6 is expressly allocative in nature as it "ask[s] the Board to undertake a review of existing fishing regulations governing the harvest of Chignik Sockeye Salmon and make regulatory adjustments as appropriate to assure that the appropriate sharing of the burden of conservation is established." ACRs pp. 13-14. ACR 6 acknowledges that "determining the appropriate sharing of the burden of conversation" has "allocative implications" that the ADFG is "concerned" about, and that "only the Board of Fisheries can resolve." ACRs p. 14.

Stock Identification Program (WASSIP) identified total harvests, harvest compositions and harvest rates in the Area M June and Post-June fisheries in 2006, 2007 and 2008, and remains the best available data on harvest rates in the June and Post-June fisheries on Chignik origin fish. The harvest composition identifies the percentage contribution of different runs to the overall harvest in a given area or fishery. The harvest rate identifies the percentage of a total run that is harvested in a given area or fishery. For conservation purposes, the harvest rate is the more important metric; a low harvest rate indicates a low impact on the run, regardless of the percentage contribution of the run to the overall harvest in the fishery.

The WASSIP study found that the harvest rates on Chignik's early run (Black Lake) in the June and Post-June fisheries were low. The following table presents the WASSIP data for the two areas with the June and Post-June fisheries addressed in the ACRs the Shumagin Islands Section and the Dolgoi Island Area):

Harvest Rates on Black Lake Subregional Reporting Group in the June and Post-June Fisheries by Area Strata[9]						
Area Stratum	2006		2007		2008	
	June	Post-June	June	Post-June	June	Post-June
Shumagin Islands	5.4%	1.6%	2.3%	1.4%	3.7%	1.0%
Dolgoi Island	12.6%	1.6%	2.3%	2.4%	1.6%	0.4%

[9] C. Habicht et al., Harvest and Harvest Rates of Sockeye Salmon Stocks in Fisheries of the Western Alaska Salmon Stock Identification Program (WASSIP), 2006-2008 at 731-33 (Appendices F64-F66) (ADF&G, Special Publication No. 12-24 (Nov. 2012)).

In response to the somewhat higher harvest rates in the Dolgoi Island Area, the Board has acted twice to restrict the fishery in that area. First, it imposed a cap on harvests from that area. During the month of June, the harvest of sockeye salmon in the Dolgoi Island Area is monitored through fish ticket information. Once the harvest of sockeye salmon reaches 191,000 fish, the waters of the West Pavlof Bay Section south of Black Point and the waters of the Volcano Bay Section close to commercial salmon fishing for the remainder of the June fishery and remain closed until July 26.

Second, in 2019, following its comprehensive review of the June and Post-June fisheries and the status of the Chignik runs, the Board closed the Dolgoi Area to purse seine gear during June.[10] These actions were specifically intended to reduce harvest rates on Chignik origin sockeye (including the early run) in the Dolgoi Area and the ACRs present no evidence to indicate that they have been unsuccessful in achieving that objective.

Given the otherwise low harvest rates on the early Chignik run in the June and Post-June fisheries, there is no reason to believe they have either contributed to or can ameliorate the low-run sizes in recent years. Notably, ACR 6 acknowledges that regulatory changes further restricting harvest may not be effective solutions, and that "habitat modifications" may be necessary as part of a long-term solution to salmon management challenges in the Chignik Management Area. ACRs p. 14. For example, the elevation of Black Lake has been in continual decline for decades,

---

[10] The Board has taken other actions to reduce harvest of Chignik origin sockeye in the June and Post-June fisheries. For example, it revised the Southeast District Mainland (SEDM) Management Plan (5 AAC 09.360) so that, in years when a harvestable surplus for the early (Black Lake and late (Chignik Lake) runs of Chignik River system sockeye salmon is expected to be less than 600,000 fish, a commercial salmon fishery is not allowed in the East Stepovak, Southwest Steopvak, Balboa Bay and Beaver Bay Sections or in the Northwest Stepovak Section excluding a portion of Orzinski Bay targeting local runs, until the Department projects that 300,000 sockeye salmon have been harvested in the Chignik Area. As a result of this provision, *no* Chignik River sockeye salmon have been harvested in the SEDM fishery for the past four years.

and "habitat degradation has significantly affected production of Chignik sockeye salmon."[11] The significance of these and other environmental issues in the Chignik Management Area is underscored by the fact that the large majority of fish harvested in Area M are bound for areas where stocks are doing exceptionally well. The 2021 inshore Bristol Bay sockeye salmon run was the largest on record (66.1 million fish) and was 60% above the 41.3 million average run for the latest 20-year period 2001–2020).[12] The unique environmental issues in the Chignik Management Area cannot be addressed through further restrictions on the June and Post-June fisheries. Accordingly, the ACRs have not demonstrated a conservation concern warranting an agenda change.

The ACRs also fail to establish an effect on a fishery that was unforeseen when the regulations were adopted. In February 2019, the Board thoroughly reviewed the June and Post-June Management Plans in light of the low returns to Chignik in 2018 and amended those plans accordingly. Since then, the returns to Chignik have remained relatively consistent, with higher returns and harvests in 2019 than 2018, lower returns and harvests in 2020 than 2018, and similar returns (but somewhat higher harvests) in 2021 than 2018.[13] Under these circumstances, the ACRs

---

[11] Ruggerone, G.T. 2003. Rapid natural habitat degradation and consequences for sockeye salmon production in the Chignik Lakes System, Alaska. SAFS-UW-0309. University of Washington, Seattle; https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/4532/0309.pdf?sequence=1&isAllowed=y

[12] ADFG, 2021 Bristol Bay Salmon Season Summary available at https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1337414316.pdf .

[13] As noted above, in 2019 the early-run escapement was 345,918 fish, only slightly below the lower end of the BEG range of 350,000 to 450,000 fish, while the late-run escapement was 336,077 fish, well within the SEG range of 220,000 to 400,000. In addition, the 2019 runs supported harvests of 638,784 sockeye in the Chignik Management Area. In 2021, preliminary escapement estimates based on weir counts place the early-run escapement at 264,615 fish, below the BEG, and the late-run escapement at 321,151, well within the SEG, but it is likely that both numbers will increase based on genetic analyses and an estimate of escapement after removal of the weir. In addition, the 2021 runs supported harvests of 113,128 sockeye in the Chignik Management Area. *See* ADFG, *Chignik Inseason Commercial Harvest Estimates* (Sept. 1, 2021 , https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareachignik.salmonharvestsummary. According to the Department the low harvest was only partly due to the failure of early run: "The late run of Chignik sockeye salmon has exceeded expectations, however few permit holders have remained in the area. It is not appropriate to compare

fail to demonstrate an effect on the CMA sockeye fishery that was unforeseen when the June and Post-June management plans were reviewed and revised in 2019.

Because the ACRs do not meet Board policy for agenda change requests, they should be rejected. Instead, proposals for regulatory changes to the Alaska Peninsula and Chignik fisheries should be submitted by this coming April and considered at the regular Alaska Peninsula/Chignik finfish meeting in February 2023.

Respectfully submitted,

Kiley Thompson, President

Area M Seiners Association

---

sockeye salmon harvest this year to recent averages due to the low participation and lack of harvest opportunity in June and much of July." Inseason Alaska Commercial Salmon Summary, Chignik (available at Inseason Alaska Salmon Summary, Alaska Department of Fish and Game (last updated September 3rd, 2021).

Chairwoman Marrit Carlson-Van Dort, members of the board,

I am in support of ACR 6 and 7. In 2018 it was claimed that Chignik disaster was due to an anomaly. That idea is no longer supported as we have had multiple years of disasters. This was not something that the board nor the department saw at the time and I believe it needs to be addressed immediately as the entire Chignik area is being devastated and cannot wait for our normal cycle. The way of life and the culture in Chignik is all but lost, unless you act now; the damage is already done, please don't continue to treat Chignik like the neighboring areas personal hatchery. ACR 6 and 7, that are in front of you, I believe they will help the Chignik area, but after reading them I have recognized that there is more need for restrictions and corrective action, here are some suggestion to conserve the Chignik stocks and fishery:

- Shut down areas that are predominantly eastbound fish. If the department is unable to do so, shut down the entire South Peninsula until mid range escapement is met in the CMA.

- Create a fishery for seiners and set netters on the Northside, to stop catching of Chignik bound fish.

- Stop fishing time during early part of season, ie return to the traditional later time frames of openings from the 14th through 23rd of June

- Allocate back to the past 5 to 1 ratio, making the line for the split at Thin point or wherever it was previously at. So that more likely Bristol Bay bound fish will be caught closer to 5 to, 1 Chignik bound.

- Create a step down, step up system; allowing The South Pen to return to the current regulated fishery, after allowing passage of declining Chignik stocks and mid range escapements are achieved.

I implore you to address the situation post haste.

Sincerely,
Benjamin Allen

City of False Pass

P.O. Box 50 · False Pass, Alaska 99583-0050
Telephone (907) 548-2319 · Fax (907) 548-2214

October 5, 2021

Alaska Board of Fisheries
Boards Support Section
PO Box 115526
Juneau, AK 99811-5526

Dear Madam Chair Ms. Märit Carlson-Van Dort:

The Board of Fisheries should not accept ACR 6 or 7 that would further restrict salmon fishing in South Alaska Peninsula Areas to address salmon escapement concerns in Chignik. These ACRs ***do not*** meet the Board's criteria for accepting ACRs.

These requests are predominantly allocative in nature and there is no new compelling information since the last Board cycle. Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early on August 17th. Total Chignik escapement in 2021 increased compared to the previous 3-year average. There is no conservation purpose to justify considering an out of cycle proposal.

The Board made significant changes to the South Unimak and Shumagin Islands Management plans to address Chignik concerns at the regular meetings in 2016 and 2019.

- In 2016, the Board established the Dolgoi area and set a 191,000 sockeye cap.
- In 2019, the Board realigned the set, drift and seine June schedules resulting in an increase of 73% more hours of open waters with zero nets fishing in the South Alaska Peninsula region.
- In 2019 the Board closed the Dolgoi area to seine gear in June.

In addition, ADFG exercises in-season emergency management authority as appropriate. There is no error in regulation or unforeseen effect on the fishery. The Board should consider any South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle.

Finally, South Alaska Peninsula fishermen *do* share the burden of conservation. In addition to restrictions in the South Unimak and Shumagin Islands management area, fishing has been closed for the past 4 years in the Southeast District Mainland management area.

These ACRs can and will severely negatively impact the livelihood of our resident fishermen.

We urge the Board of Fisheries to not accept agenda change requests 6 and 7. Thank you for the opportunity to comment.

Sincerely,

Nikki Hoblet
Mayor

October 6, 2021

Alaska Board of FisheriesChair
Märit Carlson-Van Dort
Via email dfg.bof.comments@alaska.gov

The Board of Fisheries should not accept ACR 6 or 7 that would further restrict salmon fishing in South Alaska Peninsula Areas to address salmon escapement concerns in Chignik. These ACRs *do not* meet the Board's criteria for accepting ACRs.

Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early on August 17th. Total Chignik escapement in 2021 increased compared to the previous 3-year average. There is no conservation purpose to justify considering an out of cycle proposal.

The Board made significant changes to the South Unimak and Shumagin Islands Management plans to address Chignik concerns at the regular meetings in 2016 and 2019.

- In 2016, the Board established the Dolgoi area and set a 191,000 sockeye cap.
- In 2019, the Board realigned the set, drift and seine June schedules resulting in an increase of 73% more hours of open waters with zero nets fishing in the South Alaska Peninsula region.
- In 2019 the Board closed the Dolgoi area to seine gear in June.

In addition, ADFG exercises in-season emergency management authority as appropriate. There is no error in regulation or unforeseen effect on the fishery. The Board should consider any South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle.

Finally, South Alaska Peninsula fishermen *do* share the burden of conservation. In addition to restrictions in the South Unimak and Shumagin Islands management area, fishing has been closed for the past 4 years in the Southeast District Mainland management area.

I urge the Board of Fisheries to not accept agenda change requests 6 and 7. Thank you for the opportunity to comment.

Sincerely,

Jim Smith, Mayor

Concerned Area M Fishermen
35717 Walkabout Rd.
Homer, AK 99603

October 6, 2021

Alaska Board of Fisheries
P.O. Box 115526
1255 W. 8th Street
Juneau, AK 99811-5526

Re: CAMF Opposition to ACR #6 and #7

Dear Chair Carlson-Van Dort and Board of Fisheries members,

Concerned Area M Fishermen (CAMF) represents salmon drift permit holders who participate in the June South Unimak/Shumagin Island fishery, as well as in the post-June fishery in the South Unimak area. CAMF represents approximately 110 permit holders and their families. We have members residing in coastal Alaska from Dutch Harbor, King Cove, Sand Point, to the Kenai Peninsula, and also in the Anchorage Mat-Su bowl area.

CAMF opposes the adoption and scheduling of Agenda Change Request (ACR) #6 and # 7 into the 2021/2022 meeting cycle since we do not believe these requests meet any of the three criteria listed in the Board's "Policy for Changing the Board of Fisheries Agenda". The authors of the ACRs do not claim either "an error in regulation" or to "correct an effect on a fishery that was unforeseen when a regulation was adopted" which are two of the three criteria listed.

The authors of both ACRs do claim there is a "fishery conservation purpose or reason" in light of recent poor sockeye returns to the Chignik system. However, it is important to note the Chignik system has yet to be listed as a "Stock of Concern" by the Board of Fisheries, which would seem to CAMF to be a prerequisite for a finding of a "fishery conservation" problem requiring out-of-cycle action. Further, CAMF believes the proposed remedy—restriction of fishing time in the South Peninsula fishery to the perceived benefit of the Chignik fishery—is predominately allocative in nature, and, therefore, these ACRs should instead be submitted as proposals to be considered during the Board's regular regulatory cycle in February 2023.

While the early portion of the Chignik sockeye goal was approximately 100,000 fish below its lower Biological Escapement Goal (BEG) for 2021, the late run goal was near its upper bound of 400,00 fish, and the system-wide goal for sockeye was also achieved. The 2021 run was also substantially stronger than in 2020 as well. The early sockeye run goal is a BEG, which is an estimation that maximum sustained yield (MSY) of the stock is likely between the upper and lower bounds of the goal. While the 2021 escapement is below the bottom end of the BEG, and (may) potentially affect future yield from the stock, being below the lower bound of a MSY goal is not a "sustainability" issue as the ACRs contend, nor does it constitute a "conservation" concern. As noted in the ACRs, the low surplus production in Chignik may have more than one compounding factor. Cures for these problems, and allocative remedies for these problems, should be vetted in the normal Board regulatory process.

For these reasons, CAMF urges the Board to not adopt ACR #6 or 7.

Respectfully,

Steve Brown, President
Concerned Area M Fishermen
35717 Walkabout Rd.
Homer, AK 99603

From: Debi Schmit
To: DFG, BOF Comments (DFG sponsored)
Cc: [redacted]
Subject: Reject ACRs 6&7
Date: Wednesday, October 6, 2021 8:31:05 PM

October 6, 2021

The Alaska Board of Fish should reject the Agenda Change Requests (ACRs) 6 and 7. There isn't a conservation purpose that justifies such an out-of-cycle proposal therefore all South Alaska Peninsula and/or Chignik proposals should be considered during the regular upcoming 2022/2023 cycle.

This year Chignik had a late run and escapement objectives were met. The weir was pulled on August 17, 2021, and Chignik's escapement increased compared to the three years prior.

At its 2016 and 2019 meetings, the Board of Fish made significant changes to the South Unimak and Shumagin Islands Management plans in response to Chignik's concerns. 1) In 2016 the Dolgoi area was established with a 191,000 sockeye cap. 2) In 2019 the set, drift, and seine June schedules were realigned which resulted in nearly a 75% increase of open waters with no nets fishing in the South Alaska Peninsula region. 3) In 2019 the Dolgoi area was closed to seine gear in June.

The South Alaska Peninsula fishermen's very limited fishery shares in the burden of conservation. In addition to restrictions in the South Unimak and Shumagin Islands management area, fishing has been closed for the past 4 years in the Southeast District Mainland management area.

For these reasons, I urge the Board of Fisheries to not accept agenda change requests 6 and 7.

Thank you for the opportunity to comment.

Corey Wilson

King Cove, Alaska

From: Dale Pedersen
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 6 and ACR7
Date: Thursday, September 30, 2021 12:45:40 PM

The Board of fish should not accept ACR 6 and 7 to further restrict commercial salmon fishing in area M.
These two ACRs do not meet the boards criteria for accepting ACRs.
Chignik late run and total escapement were met in 2021 and they pulled the weir early.
Total chignik escapement in 2021 increased compared to the previous 3 year average, there is no conservation purpose to justify considering an out of cycle proposal.
There has been significant changes in area M fisheries during the last two regular meetings in 2016 and 2019.

Also ADFG staff uses in season emergency management to stop us from fishing when needed as they see fit. We don't need any emergency regulations adopted that can't be addressed by emergency management.

Finally we in area M are sharing in the burden of conservation. With the recent restrictions in June and not being able to fish SEDM in at least 4 years we are indeed sharing.
I respectfully ask the Board of Fish to not consider ACRs 6 and 7.
Thanks for letting me comment,
Dale Pedersen
Sent from my iPad

Submitted
dw i n Foster Jr
Submitted On
10/6/2021 3:50:21 PM
Af ili tion

Phone
[redacted]
Em il
[redacted]
Address
box 253
s n d Point , Al s k 99661

M n m e is D i n Foster jr. I m li elong resident of S n d Point n d h v e participated in commerci l s l mon ishing or over 30 ears. I m riting to ou in opposition of the dopt ion n d scheduling of ACR's numbers 6 n d 7 into the 2021/2022 meeting c cle s I dont believe these requests meet the 3 criteri s listed in the oards "Polic or Ch n ging the OF gen da".

*there is no consev t ion purpose to justi n out of c cle propos l . Chignik l t e run n d tot l esc pem ent objectives ere met in 2021.

*ADFG exercises in-season emergenc m n gem ent u thorit s ppr opri t e. They didnt exercise th t in 2021

South Peninsul isherm n do sh r e the burden of conserv t ion, therefore, i urge the board to not c cept ACR's 6 n d 7 th n ks

Ernie Carlson
FV Desperado
PO Box 21
Chignik, AK 99564
(907) 749-4042

Alaska Board of Fisheries
Board Support Section
PO Box 115526
Juneau, AK 99811-5526

27 September 2021

Dear Board of Fisheries,

Subject: Chignik ACR's 6 and 7

As a lifelong Chignik resident and commercial and subsistence fishermen I am deeply concerned on the failure of the two Chignik sockeye runs. In particular, I am alarmed by the repeated shortfall of the early run which has not met ADF&G's targeted escapement of 400,000 or their prescribed minimum escapement goal of 350,000 in each for the last four years. This is unprecedented.

The long-term consequences of back-to-back Chignik escapements failures will expectedly produce below average runs and potentially cause long-term and lasting ecological damage at Black Lake from an in balance between juvenile sockeye numbers and their main competitor species, stickleback.

Since Statehood, Chignik sockeye salmon production has never been so poor to where escapement shortfalls are common place.

IF Chignik is to survive, relief from the Area M interception fisheries on the south side of the Alaska Peninsula must be part of the recovery. From tagging and genetic studies, we have learned that the Shumagin Islands and Dolgoi area fisheries are harvesting Chignik-bound sockeye salmon along with other transient stocks in June and July. These Area M fisheries need to be accountable for the sustainability of the runs that they impact. This includes the two Chignik sockeye runs. If the Bristol Bay stocks were repeatedly falling below their prescribed escapements would the Board of Fisheries address Area M's impact? In that situation I suspect that the Board, and rightly so, would seriously curtail fishing where Bristol Bay sockeye migrate on the south and north sides of the Peninsula. The Board should consider a similar response in those areas where Chignik sockeye are of known abundance.

Respectfully please take affirmative action on ACR 6 and ACR 7.

Thank you.

Sincerely,

Ernie Carlson

Eugene Anderson
F/V Raymar
1413 Ismaillov St.
Kodiak AK. 99615

Alaska Board of Fisheries
P.O. Box 115526
Juneau, Alaska 99811-5526

October 2, 2021

Subject: Chignik Sockeye Salmon Conservation-- ACR 6 and ACR 7

Dear Alaska Board of Fisheries,

Chignik's two sockeye salmon runs are failing. They need to be restored, and this cannot occur with continued under escapements. In the last four years the early run sockeye escapement has not reached the annual minimum goal even with the entire Chignik Management Area closed through July. The late run has done better but only in two of the last four years with the escapement goal being achieved.

The Chignik sockeye-salmon runs are critically important to the communities of Chignik Lagoon, Chignik, Chignik Lake, and Perryville economically and culturally. They have no alternatives. They are holding on by a thread from the persistent sockeye-run failures. These communities and other stakeholders cannot do more. Help from The Board of Fisheries is needed to improve the odds that Chignik's sockeye escapements goals will be reached. Run sustainability and conservation are on the line and asked is that the Board reduce, through regulation, the harvest of migrant Chignik sockeye salmon in the Area M South Peninsula fishery through at least the end of July. Specifically, the Board should consider requiring Area M fishers to stand down in the Shumagins and Dolgoi Area when the Chignik early-run sockeye escapement goal is below the 400,000 management goal set by F&G.

Thank for considering my input.

Sincerely, Eugene Anderson

Eugene Anderson

Frank Kashevarof Jr.
P.O. Box 52
Seldovia, AK 99663
(907) 351-5617

Alaska Board of Fisheries September 26, 2021
P.O. Box 115526
Juneau, Alaska 99811

Subject: ACR 6 and ACR 7---Chignik

Dear Alaska Board of Fisheries,

Chignik's two sockeye salmon have virtually collapsed especially the early run which has not reached minimum escapement for the last four years. That is four successive years of less than 350,000 early run fish through the Chignik River weir annually. Per ADF&G, the inseason targeted goal is 400,000, and as a consequence, ADF&G has not allowed any June or July commercial fishing in the Chignik Management Area since 2017. More of the same is projected for the 2022 season--- a probable escapement shortfall and no fishery.

The Chignik early run needs to be classified as a ***stock of concern*** with the Board taking a proactive role in limiting interception fisheries, namely in the Area M Shumagin Islands and Dolgoi Area fisheries which are recognized harvest areas of Chignik early-run sockeye salmon in June and July.

It is not too late to safeguard Chignik sockeye salmon. Please take action in accordance with ACRs 6 and 7.

Best regards,

Frank Kashevarof Jr.

JACK FOSTER JR/AMY FOSTER
P. O. BOX 254
SAND POINT, ALASKA 99661
PH 907-383-3633

October 6, 2021

Alaska Board of Fisheries
Alaska Department of Fish and Game
Boards Support Section
P. O. Box 115526
Juneau, Alaska 99811-5526
Dfg.bof.commnets@alaska.gov

Subject: Board Agenda Policy Changes on ACR 6 and ACR 7

Dear Members of the Alaska Board of Fisheries:

I am a commercial fisherman, along with my wife and family in Area M. During the summers we are set net fishermen fishing within the Shumagin Islands. With past detrimental regulations put forth upon us especially on the historical South East District Mainland fishery, an area we haven't been able to fish the past four years and the past several decades has curtailed the SEDM fishery to near extinction.

Today, I am submitting comments on ACR 6 and ACR 7. Both these ACR's do not set forth the criteria for policy for changes to the board's agenda. Currently, there is no new evidence of information provided with escapement levels in the Chignik area in regards to escapement due to the fact that escapements have been relatively consistent the past four years with improvements in 2021. In the past, Board actions were addressed; in 2019 for conservation on the Chignik run which in turn hurt us as fishermen in our area. I do not see a need for action to address ACR 6 and ACR 7 at this time by taking action for the same concerns that have been managed by the department through in season Emergency Order's since 2017. Also, I do not see any unforeseen effects that have been previously addressed by the Board of Fish.

Is there an issue with the Chignik run, yes! Is it due to the environmental or production issues in the river System? By consistently pointing fingers and blaming our area is unwise by altering a management area in Area M that has severely eliminated and impacted one area of the South Alaska Peninsula, the South East District Mainland area negatively affecting the livelihood of myself, my family, my communities and locally established fishermen in Area M and by taking more areas of fishing away from us isn't the correct answer to the situation at hand.

Looking at the current numbers, the 2021 CMA total season sockeye escapement in Chignik is above the three year average stock of concern. Even with changes that have been implemented in 2016 and 2019 changes that has negatively impacted myself and others as salmon fishermen by implementing consideration and changes of our fishermen's efforts to try to improve the Chignik runs.

We do share the burden of conservation; we have been displaced from an area of fishing the South East District Mainland. There is no new information brought forward to justify Policy changes to ACR 6 and ACR 7, proposals which are out of cycle, proposals which should be brought up during its Regular Board Cycle in April of 2022 and the regular meeting in February of 2023. ADFG has in season emergency management authority and has used it when appropriate.

I am asking the Board of Fisheries to not accept ACR 6 and ACR 7.

Sincerely,
Jack and Amy Foster
Jack and Amy Foster Jr

Submitted
mie Wurtz
Submitted On
10/6/2021 8:33:15 PM
Affi i tion
Sa mon Seiner

Phone
[redacted]
Em i
[redacted]
Address
1368 Chuckanut Dr
el ingham, Washington 98229

To oard of Fisheries on ACR 6&7

M dream since m first summer seining in ask when I w s sixteen ears o d w s to eventu bu boat and be able to c pt ain m own vessel, fishing for sustain bl caught wi d s mon. Ever thing about it from the ong hours and and exhausting work to the excitment of big set and the glow of fi ing our boat kept me hooked on this ifest e. I continued to work on s mon boats through highschool and col ege eventu finding m self working summers and winters (for Cod, Pol ock, and Crab) out of Sand Point and King Cove in Area M. Six ears ago I w s able to begin operating seiner but sti did not have the mone to buy m own, It has t ken me 16 e rs to s ve up for m dream but I fin got it this ast Febu r and bought m first boat to fish in the Area M s mon season.

Ever summer I participate in this fisher I am thankfu to have resource that is m n ged so di igent by the state of A ask and provides opertunities for oung fishermen to bui d their own businesses and raise fami ies doing what they ove. I do not take for granted the right to fish s mon here and I cannot think of an one of the other c pt ains I fish round who does. I witness f eet of fishermen who care about their fisher , respect the m n agment and wholeheartedl want to see the s mon runs remain strong and health for decades if not centuries to come.

I respectfu opose the Agenda Change Requests #6 and #7 submitted by the Chignik Intertrib Co ition nd Don umpus.

The propos s are not based solidl in research and do not show true and scientific approach to solving their chignik sockeye escapement concerns. It appears that the true nature of these propos s is to imit fishing time to Are M fishermen with the hope th t the diminished commerci harvest in Chignik wi improve.

The ctu research and dat show that the intention of, and actu harvest of Sockeye by area M fishermen in une and u s mon fisheries re risto bound socke e sa mon. During the WASSIP Stud the dat overwhelmingl showed harvest of Chignik's ack Lake sockeye were extrem ow in the Shumagin and Dolgoi Is ands and most non exist nt in the Unim k District.

Dr m tic reducing fishing time of ristol targeted sockeye s mon fishermen in Area M wi have significant impacts on the Area M seine f eet, their communities, processors, fishermen and fami ies and worst of wi not so ve the issues current t concern of the Chignik fishermen.

The ACR's #6&7 are h i m r attempt at imiting opertunit of Sand Point, King Cove, and F se Pass fishermen to continue to have health and responsible fisher with the sm est hope that they c n acrue more fishing time in their own district.

Th nk ou for spending the time to read m comments. I hope to continue pursuing m ive hood with m fami and crewmembers in the Area M s mon fisher for m n decades to come.

mie Wurtz

F/V PARAGON

September 29, 2021

Jason D. Alexander
213 Airport Road
P.O. Box 69
Chignik, AK 99564

Alaska Board of Fisheries
P.O. Box 115526
Juneau, Alaska 99811-5526

Subject: ACR 6 and ACR 7

Dear Alaska Board of Fisheries:

As a 40 plus year Chignik commercial fisherman, who has experienced fluctuations in Chignik sockeye runs from mediocre to high, never have I seen such a connua tion of progressive runs failures as currently occurring. To me, it is obvious that Chignik's early and late runs are in serious trouble especially the early run which has repeatedly failed to reach minimum escapement (350K) or even close to the level (400k) set by the Department for a commercial fishery for the last four years.

There are probably multiple factors driving the Chignik poor sockeye runs beginning in 2018 and not just one villain. There are management changes needed and that includes addressing the interception of migrant Chignik sockeye salmon in the eastern waters of Area M on the South Peninsula (SP).

The Shumagins and the Dolgoi area of Area M are well known Chignik-sockeye migration corridors. The gillnet and purse seine fisheries in these areas need to be reduced to permit more Chignik-bound sockeye to pass. A solution would be to prosecute the SP June and post-June fisheries more so in the Unimak District's western reach and on the north side of the Peninsula. This would provide Area M ample harvest opportunity on the Bristol Bay runs while minimizing the interception of Chignik and other east-traveling sockeye salmon.

I believe it is grossly unfair that the Chignik Management Area, in its enr ety, is closed when one or more of the Chignik sockeye runs are not meeting escapement requirements, and yet as permi ed under current regulaon, fishing on east-traveling sockeye salmon is allowed through June and July in the Shumagins and Dolgoi areas. Chignik along with Area M fishermen need to do their part in providing escapement into the Chignik River system. Neither area should singly carry the conservation burden.

lease t ake action to protect the Chignik sockeye runs for escapement and sustainable production—it is well justified.

Thank you

Respecbully,

Jason Alexander

Submitted
Ju ian Manos
Submitted On
10/6/2021 8:38:06 PM
Affi iation

Phone
[redacted]
Emai
[redacted]
Address
Rams Creek Loop
KING COVE, A aska 9612

I agree with the A aska Department of Fish and Game staff comments that both ACR's 6 and 7 do not meet the oards own criteria to accept ACR's. Since these ACR's fai to meet an of the three guidelines for accepting an ACR it seems unreasonable to hear such a proposal out of c c e and without a proper public dialogue from the user groups it wou d affect. This was m tenth ear owning and running a seiner out of King Cove and our 2023 planned upcoming meeting wi be m fourth time attending. Though I am on thirt two, I have been involved with this process since 2013 and have come to recognize the importance of these schedu ed meetings. However, without meeting the ACR requirements I don't see how using such means as an ACR to circumvent the proper avenue for presenting proposals (i.e. at our regu ar schedu ed meeting) wi do an thing but undermine the publics trust in the oard of Fisheries process.

Submitted
Ki e Thompson
Submitted On
10/6/2021 3:41:16 PM
Af i iation

Phone
[redacted]
Emai
[redacted]
Address
P.O. Box 116
Sand Point, A aska 99661

M name is i ey Thompson. I am a 30 ear resident of Sand Point. I have commercial ished or 25 ears, with 10 of those ears as captain of a seine boat. I am writing to oppose the adoption of ACR's 6&7 into the 2021/2022 meeting c c e. I do not believe these requests meet the criteria isted in the oards "Polic or Changing the oard of Fish Agenda". THere is no conservation purpose to justi an out of c c e proposal. Chignik ate run and total escapement objectives were met in 2021. The board made signi icant changes to the South Unimak and Shumagin Is ands Management plans to address Chignik concerns in both 2016 and 2019. ADF&G exercises in season management authorit as appropriate. They did not exercise that right in 2021. South Peninsu a ishermen do share the burden of conservation. With that said, I urge the oard not to accept ACR's 6&7.

Lake and Peninsula Borough
P.O. Box 495
King Salmon, Alaska 99613

Telephone: (907) 246-3421
Fax: (907) 246-6602

September 22, 2021

Glenn Haight
Executive Director, Board of Fisheries
PO Box 115526
Juneau, AK 99811-5526
glenn.haight@alaska.gov

Subject: Support for ACR's 6 & 7

Dear Mr. Haight,

The Lake and Peninsula Borough appreciates the opportunity to express support for ACR 6 and 7 at this meeting. The Borough spans three distinct areas of southwestern Alaska: the Lake Iliamna Area, the Upper Peninsula Area, and the Chignik Area. The primary economy of the five Chignik Area communities – Chignik Bay, Chignik Lake, Chignik Lagoon, Perryville, and Ivanof Bay – is the commercial sockeye salmon fishery in the Chignik Management Area. Since 2018, this fishery, the foundation of economy and culture in these communities, has become one of the fastest declining salmon stocks in Alaska.

For four consecutive salmon seasons the early run of Chignik sockeye salmon has failed to attain minimum escapement goals. Apart from small harvests of the late-run sockeye in 2019 and 2021, there has been no targeted commercial harvest of early- or late-run sockeye in the Chignik Management Area in the last four years. This ongoing crisis carries significant consequences for the survival of Chignik communities.
Significant numbers of Chignik bound sockeye are harvested under the June and post-June Management Plans of the Area M salmon fishery[1] and only the Board of Fisheries can establish the appropriate sharing of the responsibility of conservation of Chignik bound stocks under these plans.

The Borough continues to support Chignik's residents and communities throughout these crises. The Borough is increasingly concerned for the health of Chignik's sockeye stocks and the absence of meaningful proactive measures to protect these stocks. Failure to consider protective measures

[1] ADF&G Special Publication 12-22, Appendix D, page 187

in advance of another abysmal salmon season threatens the survival of the region's economy, schools, and culture, and ignores the mandate of sustainable yield.

The next in-cycle Board of Fisheries meeting that can squarely address the dire issues facing Chignik communities is scheduled for February 2023. We strongly request the Board of Fisheries to look favorably on ACR's 6 7 submitted by Borough residents and organizations. We strongly encourage the Board to schedule this issue to be addressed during the current Board of Fisheries cycle. Our concern is that these communities will likely not be able to eke out another year without the Board's leadership and time-sensitive attention to this pressing management issue.

Sincerely,

Glen R. Alsworth, Sr.
Mayor

Norine Jones
111 Airport Road
Chignik, Alaska 99564

Alaska Board of Fisheries
P.O. Box 115526
Juneau, Alaska 99811-5526

September 29, 2021

Re: Chignik's ACR 6 and ACR 7

Dear Members of the Alaska Board of Fisheries:

My family has commercially salmon fished in Chignik for better than 50 years. We have always been able to make a living sockeye salmon fishing but not so nowadays. It is nothing like we have ever experienced. The last four years (2018-21) have produced disastrous results. Only in two of the last four has there been a late-run sockeye fishery, and there has been absolutely no early-run fishery, zero. Making matters worse, Chignik sockeye escapements have been consistently less than the minimum goal in each of the last four years on the early run and in two of the last four on the late run. A grim picture it paints!

Urgent action to help restore the Chignik's sockeye salmon runs is needed from the Board of Fisheries. An initial step would be to reduce the interception of Chignik-bound sockeye salmon in the known harvest areas on the south side of the Alaska Peninsula, namely in the Shumagins and Dolgoi Islands waters. Keeping the Chignik Management Area closed for escapement is not enough. It's simply not right that Area M SP fishermen are allowed to exploit non-local sockeye salmon without any conservation responsibility. This needs to stop. Area M fishermen should be held accountable and when a migrant stock is weak on escapement they need to stand-down the same as required in terminal stock fisheries.

I ask that the Board to ensure the sustainability of the two Chignik sockeye salmon runs not only for the people of Chignik but for the State as a whole. We cannot let status quo in the South Peninsula fishery persist. Fine tune the fishery by putting the effort to the west, beyond the Shumagins and Dolgoi area.

Thank you

I am, Ms. Norine Jones

PSPA
PACIFIC SEAFOOD
PROCESSORS ASSOCIATION

September 30, 2021

Alaska Board of Fisheries
Marit Carlson-Van Dort, Chair
Via email dfg.bof.comments@alaska.gov

RE: Public comment on ACRs 6 & 7

Chair Carlson-Van Dort and Board Members:

Thank you for the opportunity to comment on two agenda change requests (ACRs) before the Alaska Board of Fisheries (Board) during the October 2021 work session. ACR 6 requests the Board review existing regulations and further restrict harvesters of Chignik bound sockeye and ACR 7 requests to further reduce the June and post-June fishing periods for Shumagin Islands and Dolgoi Islands Area. **These ACRs do not meet the Board's criteria for taking proposals out of cycle and as a result, PSPA opposes both ACRs and urges the Board to deny them.**

Pacific Seafood Processors Association (PSPA) is a nonprofit seafood trade association representing eight seafood processing businesses and their investment in coastal Alaska, including several shorebased processors in King Cove, Sand Point, False Pass, and Port Moller that serve Area M salmon fleets, as well as Chignik. These salmon fisheries are essential to and directly benefit harvesters, processors, support businesses, and communities in the region. In the Alaska Peninsula, the Area M salmon fishery primarily supports local families from the fishing villages of False Pass, Nelson Lagoon, King Cove, and Sand Point.

PSPA does not support these two ACRs that aim to further restrict Area M salmon fisheries. While it is important for the Chignik sockeye run to be sustained into the future, there is no new rationale provided to meet the Board's criteria to justify an out of cycle proposal. The situation in Chignik is not unexpected, as the 2021 total season sockeye escapement is just slightly below the previous 5-year average and increased compared to the 3-year average. Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early on August 17. There is no error in regulations to correct or an unforeseen effect from a previous regulation. This is not to say the Board has not been responsive in recent years, evidenced by action in 2016 and 2019 to restrict peninsula fisheries to try to improve Chignik runs:

- 2016: Proposal 186 (RC192) established the Dolgoi area and a 191,000 sockeye cap
- 2019, the Board realigned the set, drift, and seine June schedules resulting in increased closed 'windows' in the South Peninsula
- 2019: the Board closed the Dolgoi area to seining in June

We also note that fishing has not been allowed in the Southeastern District Mainland for the past four years. ADFG retains in-season management authority to further restrict these fisheries and has a record of using that authority when needed. Please do not accept ACRs 6 and 7 and instead consider any South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle. Thank you for the opportunity to comment.

Sincerely,

Chris Barrows, President
Pacific Seafood Processors Association

Sept. 30/21

Draft comment to Board of Fish for the Work Session October 20-21 2021 (comment due October 6)

Paul (Butch) Gundersen Chair of the Nelson Lagoon Advisory committee, This statant of support of this letter is from me personally not from the committee, we were unable to pull a meeting together at this time for various reasons. I am in strong support of this letter as written.

The Board of Fisheries should not accept ACR 6 or 7 that would further restrict salmon fishing in South Alaska Peninsula Areas to address salmon escapement concerns in Chignik. These ACRs *do not* meet the Board's criteria for accepting ACRs.

Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early on August 17th. Total Chignik escapement in 2021 increased compared to the previous 3-year average. There is no conservation purpose to justify considering an out of cycle proposal.

The Board made significant changes to the South Unimak and Shumagin Islands Management plans to address Chignik concerns at the regular meetings in 2016 and 2019.

- In 2016, the Board established the Dolgoi area and set a 191,000 sockeye cap.
- In 2019, the Board realigned the set, drift and seine June schedules resulting in an increase of 73% more hours of open waters with zero nets fishing in the South Alaska Peninsula region.
- In 2019 the Board closed the Dolgoi area to seine gear in June.

In addition, ADFG exercises in-season emergency management authority as appropriate. There is no error in regulation or unforeseen effect on the fishery. The Board should consider any South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle.

Finally, South Alaska Peninsula fishermen *do* share the burden of conservation. In addition to restrictions in the South Unimak and Shumagin Islands management area, fishing has been closed for the past 4 years in the Southeast District Mainland management area.

I urge the Board of Fisheries to not accept agenda change requests 6 and 7. Thank you for the opportunity to comment.

Regards

Paul Gundersen

Paul Johnson
776 Chignik Road
Chignik, Alaska 99564

Alaska Board of Fisheries
P.O. Box 115526
Juneau, Alaska 99811-5526

September 28, 2021

Dear Alaska Board of Fisheries Members:

Re: Chignik ACR 6 and ACR 7

Chignik needs the Board to reduce the interception of sockeye salmon in the eastern waters of Area M, on the South Alaska Peninsula, to better ensure that the Chignik early run does not continue to have an escapement deficit. The two areas in particular where an adjustment is needed are the Dolgoi area and the Shumagins from mid June through July.

Chignik has had four consecutive seasons with Area L commercial fishermen having to totally stand-down in June and July because of insufficient early-run sockeye salmon escapement. We understand the reasoning for being closed but keeping the Shumagins and Dolgoi to target sockeye salmon when there are Chignik-bound sockeye is unfair. Area M should be required to participate in the sharing of conservation. Terminal-stock fisherman should not singularly be required to carry the full burden of meeting escapement requirements.

I understand that Area M on the South Alaska Peninsula has a long history of harvesting migrant, non local, sockeye salmon in June and July and that most of the harvest is on sockeye salmon headed to Bristol Bay. That is fine when it does not unjustly impair other runs.

Due to Chignik escapement issues, I recommend that Area M take Bristol Bay-bound sockeye more so in the Unimak District west of the Dolgoi Islands and be required to reduce their fishing impact on traveling sockeye headed east through the Shumagins and Dolgoi islands. Such would be the right thing to do in face of the persistent and critical shortage of Chignik sockeye salmon.

In closing, I ask you to support ACR #6 and #7.

Most sincerely,

Paul Johnson

Pauloff Harbor Tribe

P.O. Box 97
Sand Point, Alaska 99661

Phone: (907) 383-6075
Fax: (907) 383-6094

October 6, 2021

Chairperson Märit Carlson-Van Dort. Alaska Board of Fisheries

Board Support. P.O. Box 115526

Juneau. AK, 99811-5526

Emailed via pdf attachment to dfg.bof.comments@alaska.gov

Re: Requesting the Board of Fisheries Reject Agenda Change Request (ACR) 6 & 7

Dear Chairperson Märit Carlson-Van Dort,

We urge the Alaska Board of Fisheries to reject ACRs 6 & 7 at your October 20-21, 2021 Work Session. These ACRs does not meet Board criteria found in 5 AAC 39.999, for approving an Agenda Change Request.

Sincerely,

Arlene Gundersen
Tribal Administrator

Submitted
Pete Ham e
Submitted On
10/6/2021 1:35:11 M
Affiliation

I ould like to state m opposition to ACR6 & ACR7, egarding changes to the Alaska eninsula salmon fishe schedule. These ACR's don't meet the c ite ia for a change outside of the normal oard of Fish schedule, and as such, shouldn't be allowed to move fo ard. Changes to allocation ma be submitted du ing the no mal OF schedule, but since these ACR's a e allocative, the don't qualif under the cu ent process.

PETERPAN
SEAFOOD CO., LLC

September 30, 2021

Alaska Board of Fisheries
Marit Carlson-Van Dort, Chair
Via email dfg.bof.comments@alaska.gov

RE: ACR 6 and ACR 7

Chair Carlson-Van Dort and Board Members;

Thank you for the opportunity to comment on two agenda change requests (ACRs) before the Alaska Board of Fisheries (Board) during the October 2021 work session.

Earlier this year Peter Pan Seafoods was acquired by a US-based ownership group that includes a significant Alaska partner. With our successful acquisition of Peter Pan, a storied Alaska seafood brand, we now have a new and much more significant platform to expand and deepen our value-added strategy and refine it as a "Made in Alaska" strategy; keeping jobs and money in Alaska's coastal communities.

ACR 6 requests the Board review existing regulations and further restrict harvesters of Chignik bound sockeye and **ACR 7** requests to further reduce the June and post-June fishing periods for Shumagin Islands and Dolgoi Islands Area. These ACRs do not meet the Board's criteria for taking proposals out of cycle; therefore, we oppose both ACRs and urge the Board to dismiss them.

Our plants in King Cove and Port Moller serve Area M salmon fleets, as well as Chignik. These salmon fisheries are essential to and directly benefit harvesters, processors, support businesses, and communities throughout the region.These salmon fisheries support local families from the fishing villages of False Pass, Nelson Lagoon, King Cove, and Sand Point.

There is a long, comprehensive history of Board of Fish/Alaska Department of Fish and Game analyses of the Area M salmon fisheries. We do not believe that the petitioners have provided any new information that would justify an out of cycle proposal. There is no error in regulations to correct or an unforeseen effect from a previous regulations.

In 2021 the total Chignok season sockeye escapement was just slightly below the previous 5-year average and increased compared to the 3-year average. Additionally, the Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early.

Please dismiss ACR 6 and ACR 7, and encourage the petitioners to introduce their proposals in cycle, in accordance with Board of Fish policy and regulation.

Sincerely,

Jon Hickman

Jon Hickman
Executive Vice President

Silver Bay SEAFOODS
208 Lake St. Suite 2E Sitka, Alaska 99835
Phone: 907.209.3037 abby.fredrick@silverbayseafoods.com

October 6, 2021

Alaska Board of Fisheries
Boards Support Section
PO Box 115526
Juneau, AK 99811
Submitted via email: dfg.bof.comments@alaska.gov

RE: Comments on Agenda Change Request 6 and 7

Dear Alaska Board of Fisheries Members:

Silver Bay Seafoods is opposed to Agenda Change Requests (ACRs) 6 and 7 currently under consideration by the Alaska Board of Fisheries (board) at its October 20-21 work session.

Silver Bay Seafoods is a fisherman-owned, Alaska seafood processing company. We operate six processing facilities in coastal Alaska communities. Our False Pass operation supports purse seine and drift gillnet fishermen who participate in the Area M salmon fisheries.

ACRs 6 and 7 both aim to modify regulations in the *South Unimak and Shumagin Island June Salmon Management Plan* and *Post-June Salmon Management Plan for the South Alaska Peninsula*. ACR 6 is vague and does not propose any specific regulatory changes for the board to consider or for Alaska stakeholders to sufficiently provide input. ACR 7 requests significant reductions in fishing opportunity in these areas. Both requests essentially seek to re-allocate fish between areas out-of-cycle and could have devastating impacts to fishermen, communities, businesses, and Alaskans who are heavily reliant on Area M fisheries.

We agree with the assessment published by the Alaska Department of Fish and Game confirming proposals 6 and 7 do not meet the criteria for an ACR as outlined in the *Policy for Changing a Board Agenda* defined in 5 AAC 39.999(a)(1). Deviation from this policy would disenfranchise stakeholders who depend on a consistent process and predictable regulatory cycle. Proposals can be submitted to the board in April 2022 and considered during the regular meeting for this region where a comprehensive public process can occur.

Thank you for the opportunity to comment.

Respectfully,

Abby Fredrick
Director of Communications

From: Stanley Mack
To: DFG, BOF Comments (DFG sponsored)
Subject: Draft comment to Board of Fish for the Work Session.pdf
Date: Monday, October 4, 2021 2:59:52 PM
Attachments: Draft comment to Board of Fish for the Work Session.pdf

I`m a commercial fisherman /own and operate my fishing vessel,born and raised in KING COVE.and fished in the alaska peninsula(and still fishing)for 75 years.I submit this reason to request that these ACR`s be denied..Thank you very much..STANLEY MACK

Sent from my iPad

Draft comment to Board of Fish for the Work Session October 20-21 2021 (comment due October 6)

The Board of Fisheries should not accept ACR 6 or 7 that would further restrict salmon fishing in South Alaska Peninsula Areas to address salmon escapement concerns in Chignik. These ACRs *do not* meet the Board's criteria for accepting ACRs.

Chignik late-run and total escapement objectives were met in 2021 and the weir was pulled early on August 17th. Total Chignik escapement in 2021 increased compared to the previous 3-year average. There is no conservation purpose to justify considering an out of cycle proposal.

The Board made significant changes to the South Unimak and Shumagin Islands Management plans to address Chignik concerns at the regular meetings in 2016 and 2019.

- In 2016, the Board established the Dolgoi area and set a 191,000 sockeye cap.
- In 2019, the Board realigned the set, drift and seine June schedules resulting in an increase of 73% more hours of open waters with zero nets fishing in the South Alaska Peninsula region.
- In 2019 the Board closed the Dolgoi area to seine gear in June.

In addition, ADFG exercises in-season emergency management authority as appropriate. There is no error in regulation or unforeseen effect on the fishery. The Board should consider any South Alaska Peninsula and/or Chignik proposals during the regular upcoming 2022/2023 cycle.

Finally, South Alaska Peninsula fishermen *do* share the burden of conservation. In addition to restrictions in the South Unimak and Shumagin Islands management area, fishing has been closed for the past 4 years in the Southeast District Mainland management area.

I urge the Board of Fisheries to not accept agenda change requests 6 and 7. Thank you for the opportunity to comment.

--Stanley Mack

Submitted
im th Michael Murph
Submitted On
9/23/2021 1:00:16 PM
ffiliati n

the State f laska ar d f FIsheries;

Pending appr v al are CR 6 and 7, both pertaining t the intercepti n f Chignik (as well as s cke e fr m t her areas) S c ke e in the S uth laska Peninsula.

Per the W SSIP genetic study, which has virtuall been ign red since it was released t the public as far as regulati n changes which were intended t give the Chignik s c ke e fisher fair access t the salm n fishing res u rce it virtuall , s l el relies n f r as far as an ec n m ic driver in the regi n . he W SSIP stud was c n ducted when there were fewer boats, less eff rt inv lved in the S u th laska Peninsula salm n fisher , l gi call , m re salm n must be intercepted n w than when that stud was c n ducted.

What has transpired beginning in 2018 is that Chignik gets NO CCESS t the nce hist rical salm n res u rce. Minimum escapement goals have n t been met f r June r Jul v er the span f 4 ears.

side n t e, in 2018, the S u th laska Peninsual salm n managers did n t even curtail c m mercial salm n harvest t ensure the Orzinski Lake c u ld meet its meager minimum escapement goal.

I ffer a c m m n sense c mparis n between 2 ears f salm n fishing in the S u th laska Peninsula, in 2020 the s c ke e harvest in the S uth laska Peninsula was less than it normall is.

nd at the same time, in 2020 the rist l a salm n fisher had et an t her rec r d harvest.

C mm n sense w uld lead s meone t think that the rec rd rist l ay s cke e run simpl did n t swing int the waters f the S u th laska Peninsula, and that ther socke e st cks made up the maj rit f the s c ke e harvested there.

2021 saw et an t her rec r d rist l a s c ke e run, and in c r ellati n , the S uth laska Peninsula salm n fisher saw it's s cke e harvest c n icided with the large size f the rist l a salm n runs. h s e rist l ay fish appeared t have transited the waters f the S uth laska Peninsula.

rist l ay runs can aff rd t be intercepted, whereas we wh rel n the s cke e runs returning t Chignik can n t.

h e fact that ur scheduled board meeting was pushed f r ward all the wa int 2023 n l adds insult t the financial injur were living with being denied access t u r nce hist rical salm n res u rce.

h ank Y u,

i m th Murph

Submitted
om Man s
Submitted On
10/6/2021 3:10:07 PM
Affiliati n
Kin C ve fisherman

Ph ne
[redacted]
Email
[redacted]
Address
PO box 749
Girdwood , Alaska 99587

I agree with the Alaska Department of Fish andGame staff comments that ACRs 6 and 7 do not meet the oard’s own criteria t accept ACRs, and should not be accepted. ACRs are an important safeguard in the ard process, which is now three ears apart for this area, and shoud be used t facilitate clear solutions in a timel manner not t encourage acrimonious allocative issues t be heard on a earl basis. he oard Process and the issues it considers are important for the vitalit of m business and I appreciate the time ou spend t address them is limited . In the case of ACRs 6 &7 I do not feel their intent is solvin what is an important and complicated problem.

RIDENT SEAFOODS CORPORATION

03 Shilshole Ave. NW, Seattle, WA 98107-4000
(206) 783-3818 • Fax: (206) 782-7195

October 6, 2021

Alaska Board of Fisheries
Marit Carlson-Van Dort, Chair
Via email dfg.bof.comments@alaska.gov

RE: Public comment on ACRs 6 & 7

Chair Carlson-Van Dort and Board Members:

Thank you for the opportunity to comment on two agenda change requests (ACRs) before the Alaska Board of Fisheries' (Board) October 2021 work session. Trident Seafoods is a family-owned company, with shoreside processing and fleet support facilities in twelve Alaskan communities, including Sand Point, False Pass, and Chignik. We serve over a thousand independent harvesters, annually employee several thousand workers (including several hundred Alaska residents, like myself), and invest significantly in Alaska each year.

Trident is commenting on **ACR 6**, which seeks to restrict harvest of Chignik bound sockeye; and **ACR 7**, which requests further reductions to the fishing periods in the Shumagin Islands and Dolgoi Islands Area. **We ask the Board to deny both ACRs, as they do not meet the Board's ACR criteria.**

Specifically, there is no conservation purpose behind either ACR: Late-run and total escarpments were achieved in 2021. 2021 total season sockeye escarpment is near the five-year average and actually increased relative to the three-year average. Neither run is listed as a "stock of concern." There is also no error in regulation or unforeseen effect from previous management actions, as all of the most recent Board actions related to Chignik sockeye have sought to increase returns to the Chignik management area, while restricting effort elsewhere. Most recently, in 2019, the Board increased closed areas for all gear types in the South Peninsula June fishery and closed the Dolgoi area to seining in June. These restrictions had significant impact on harvesters, processors, and communities in Area M, and have not yet been in place for a full sockeye life cycle, which seems necessary for the Board to evaluate their efficacy.

More broadly, we recognize that ACRs serve as a necessary and important tool for the Board to address conservation issues, errors in regulations, or any unforeseen effects of management actions. However, we ask that the Board consider the destabilizing impact that the routine adoption of ACRs can have on all fishery stakeholders and request that you use this tool judiciously and not for issues that are better addressed during the normal Board cycle.

Thank you for the opportunity to comment.

Shannon Carroll

Assoc. Director of Public Policy
Trident Seafoods

Submitted
oy Denkinger
Submitted On
10/6/2021 6:34:02 PM
Affi iation

Phone
[redacted]
Emai
[redacted]
Address
2221 HPR
Sitka, A aska 99835

A aska oard of Fisheries Members:

I am an A aska esident and ife ong comme cia fishe men. I fish in the South A aska Peninsu a o A ea M sa mon fishe ies with a pu se seine commercial fishing permit. oday, I am w iting in opposition to ACR 6 and ACR 7.

oth of these equests seek significant al ocation actions outside of the normal egu ator c c e, but neither meets the equi ements for an agenda change. ADF&G comments also confi med that these two ACRs are not 1) for a fisher conservation pu pose or eason; 2) cor ect an er or in a egu ation; or 3) cor ect an unforeseen er or in egu ation. A ocative proposals shou d be submitted to the oard in Apri 2022 and then they wi be discussed when ever one impacted by these changes wou d be expecting to participate and comment and when other proposals are discussed.

hank ou for considering m comments.

- oy Denkinger

UNGA TRIBAL COUNCIL
P.O. Box 508
Sand Point, Alaska 99661

(907) 383-2415 / 5553 Facsimile
ungatribe@arctic.net

October 6, 2021

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

Subject: Policy for Changing Board Agenda for ACR 6 and 7

Dear Members of the Alaska Board of Fisheries:

The Unga Tribal Council (Native Village of Unga), a federally recognized Aleut Tribe is submitting comments in regards to the following ACR's 6 and 7 being brought before the Board of Fish during its Work Session October 20-21, 2021. WE are asking the Board of Fish to not accept ACR 6 and 7 that would restrict salmon fishing in the South Alaska Peninsula Areas to address salmon escapement concerns in Chignik, for the following reasons, they do not meet the criteria for accepting ACR's.

The Chignik late run and total escapement objectives were met in 2021 and the total Chignik escapement increased compared to the previous 3 year average period. With escapement goals met there is no conservation purposes to justify considering an out of cycle proposal on ACR 6 and 7.

During the regular Board of Fish meetings in 2016 and 2019 the board made significant changes to the South Unimak and Shumagin Islands Management plans to address Chignik concerns. The following actions transpired during those years; in 2016, the board established the Dolgoi area and set a 191,000 sockeye cap. In 2019, the board realigned the set net, drift and seine fishery's June schedules resulting in an increaser of 73% more hours of open waters with zero nets fishing in the South Alaska Peninsula area. In 2019 the Board closed the Dolgoi area to seine gear in June.

With the above listed changes made ADFG also exercised in season emergency management authority as appropriate in Area M. There is no error in regulations or unforeseen effect on the fishery. Proposals on ACR 6 and 7 coming forth to the board should be considered at the South Alaska Peninsula and/or Chignik meetings during the Regular upcoming board cycle.

In addition to the restrictions set forth in the Shumagin Islands and South Unimak management area, most notably the historical local fishery in the South East District Mainland area has been closed the past four years. The South Alaska Peninsula fishermen do share the burden of conservation.

We urge the Board of Fisheries to reject the agenda change in regards to the requests on ACR 6 and 7 and to focus its efforts on reviewing the concerns of our fishery during its regularly scheduled meeting through the normal public process.

Qagaasakuq! Thank you for your time and leadership.

Sincerely,

John Foster /al

John Foster
President

From: B L
To: DFG, BOF Comments (DFG sponsored)
Subject: Chignik salmon run
Date: Friday, October 1, 2021 8:26:25 AM

I am a permit holder and fisherman for 32 years in the Chignik area.I have had to go to another area to fish due to the failed returns of the fishery.The June fishery in the Shumigan Islands must be shut down in order for the early run to survive.The escapement for the first run has not been achieved.If the board of fish ignores this the run will no longer exist.The harvest capability's in area M over the years has increased dramatically.This is blatant miss management for the financial gains of area M.Having [redacted] the X commissioner lobby for area M is not good.There is reckless disregard for the future of our fishery.Stop the greed.

Get Outlook for iOS

Submitted
ennie Grunert
Submitted O
10/4/2021 3:39:52 PM
Affiliati
Chignik Lagoon Resident

Ph e
[redacted]
Email
[redacted]
Address
P.O. x 8
Chignik Lagoon, Alaska 99565

Hi oard of Fish- The Chignik River 1st ru salm have failed t meet mi imum escapement ru 4 ears i a row. The 'wait and see' attitutude of ADF&G eeds t take acti or Alaska will lose another viable fish ru . ADF&G's missi t protect. mai tai , and improve the fish... is ot what the recent acti s of the biologists and board has sh w . All wi g i tercept fisheries t co ti ue t commercial fish a ru that is weak and the verge of dyi g, shows that ou do t have the best i terest i our atural resources. The board eeds t work with the biologist and take acti before it is t late. You eed t protect our resources and ou eed t do it ow.

Tha k u,

ennie Grunert

Chignik Lagoon Resident

Submitted
elvin R.Larsen
Submitted On
10/6/2021 8:57:14 P
Affi iation
F/v Temptation

Phone
[redacted]
Emai
[redacted]
Address
P.O. o x 216
Sand Point, A aska 99661

There is no criteria to bring up area Area fisheries at this work session. Chignik's escapement has been met for their second run & was above the ten ear average. Area has been micro-managed by the Chignik escapement plan- for over fort ears Stepovak has been shut down & ast board c c e the Dolgoi area was also shut down to the seiners ... 80 mi es of coastline. A so during the ast board c c e, Cape Igvak & Kodiak were shut down, showing itt e, if no change to chignik's escapement.The WASSIP study shows area has ver itt e harvest impact on Chignik , and already shares the burden of conservation with our current management plan.

Thank ou,

e vin Larsen

Area seiner

From: Raechel Allen
Sent: Sunday, July 11, 2021 11:39 AM
To: Mitchell, McKenzie (DFG)
Subject: Lower escapements S Pen/Chignik

Board member McKenzie Mitchell,

Thank you for taking the time to speak on the phone while you were in Chignik. We spoke of the importance of escapement goals being achieved in the late 60's and 70's and how that was an important factor in rebuilding the salmon runs then. I had mentioned that it seemed escapements were lowering gradually. When escapements are lower it is easier to achieve goals while maintaining active fisheries (both terminal and intercept). I have included instances where escapements both overall and during time periods have lowered.

This leads me to have greater concern for interception fisheries of Chignik stocks. It also concerns me that as fishing increased in the Shumagins and other points of interception (both earlier and more often), the Chignik escapement may (I believe) have been shifted later and even managed at times on lower ends of escapement. Both these occurrences combined would be exacerbating the escapement issue in Chignik.

In providing protection for Chignik's sockeye salmon, I hope the Board of Fish will consider closing statistical areas that naturally encourage catch on east bound sockeye such as Areas spoken of in the following ADFG excerpt should be considered:
"It is speculated that large numbers of Chignik sockeye may be intercepted during July in portions of the Shumagin Islands Section. These locations do not have a documented history of substantial fishing effort until recently. The locations in question are:
(1) The west side of Unga Island located between Bay Point and Archedin Point.
(2) The portion of the Shumagin Islands Section located southof 55" N. lat. (which includes Mountain Point on Nagai Island).
- 1- The above locations (and other locations in the Outer Shumagins where it is suspected that large numbers of Chignik destined sockeye are being taken) will be closed to commercial salmon fishing if substantial numbers of sockeye are being caught and the Department determines that the late Chignik run is below escapement needs." 1990 Alaska Peninsula General Management Plan pg. 1-2

Also, a return to the pre 2001 GHL ratios of catch in the S Pen (approx. 80% Unimak fishery 20% Shumagin fishery) should be implemented.

Thank you for your consideration. Post script are various changes in escapements.
Raechel Allen

Post script:

<u>SOUTH PENINSULA ESCAPEMENTS</u>
Thin Point escapement in the South Peninsula was 20k-30k in 1997 and presently is 14k-28k.
Thin Point Lake Weir -Thin Point Lake weir is located at the outlet of Thin Point Lake, 55° 02' N. latitude, 162° 38' W. longitude and is about 150 feet in length and varies from 6 inches to 8 feet in depth. The weir has been operated annually since 1994 by two ADF&G employees from mid-July through late August. The point escapement goal is 25,000 salmon and the range is 20,000 to 30,000 salmon. (Regional Information Report No. 4K98-40 pg.3)
Coho escapement goal in Thin Point Lake of 3000-6000 was eliminated at the 2013 Board Meeting

<u>Orzinski</u> (Orzenoi)

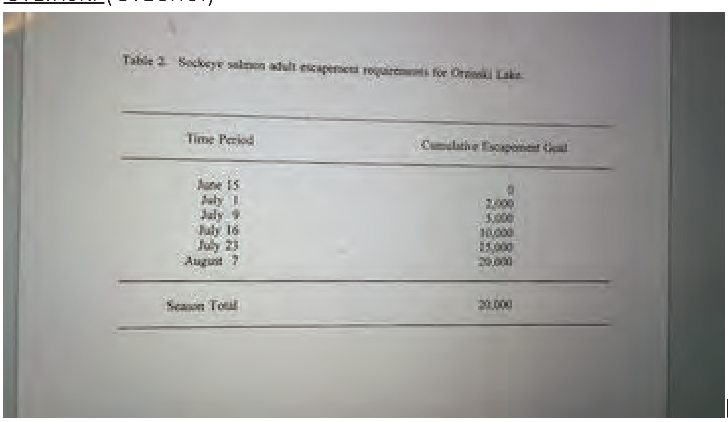
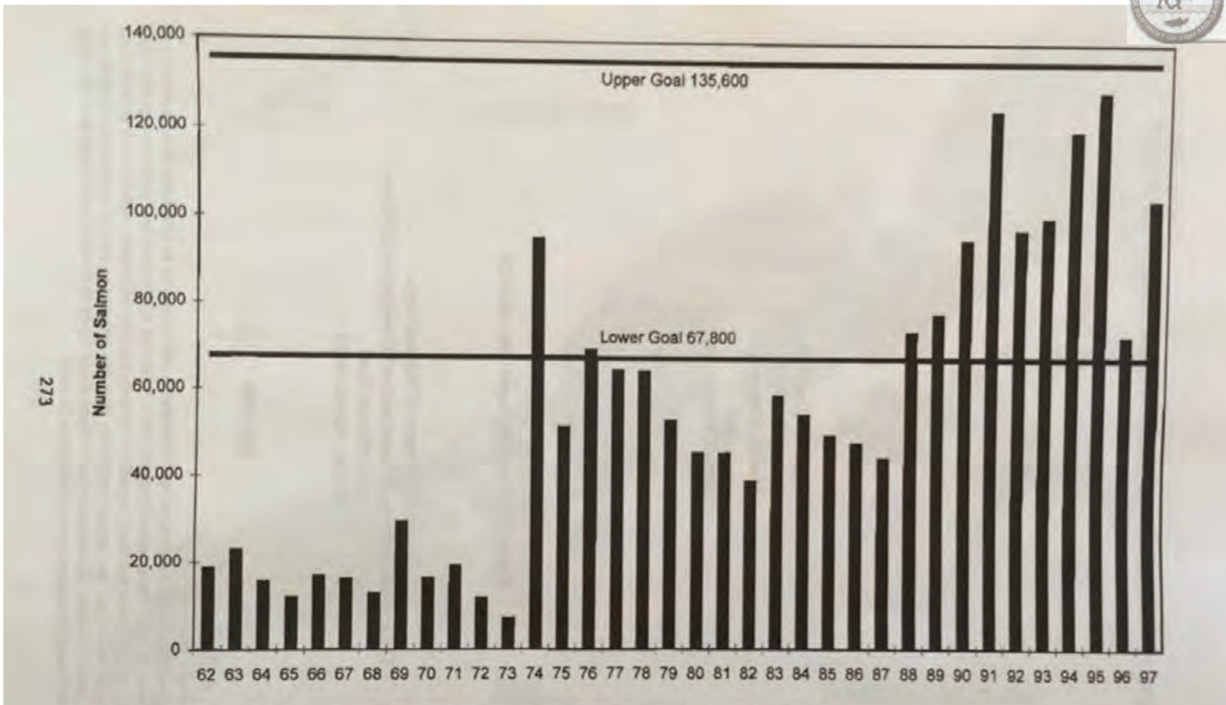


Table 2. Sockeye salmon adult escapement requirements for Orzinski Lake.

Time Period	Cumulative Escapement Goal
June 15	0
July 1	2,000
July 9	5,000
July 16	10,000
July 23	15,000
August 7	20,000
Season Total	20,000

Regional Information Report No. 4K94-14 (April 1994), p.7
Orzinski became 15k-20k escapement

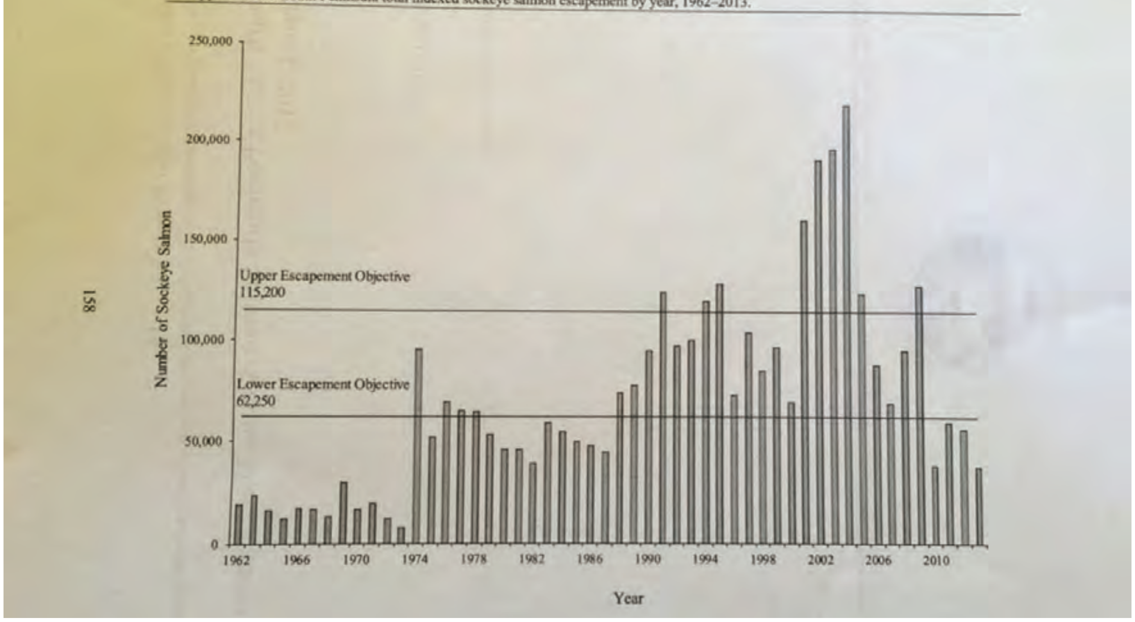
<u>Middle Lagoon (Morchovoi)</u>
Escapement was 16,000 – 32,000 sockeye (Regional Information Report No. 4K98-29, p.14)
But isn't listed with a set escapement goal recently.



Appendix F.8. South Peninsula total indexed sockeye salmon escapement by year, 1962-97.

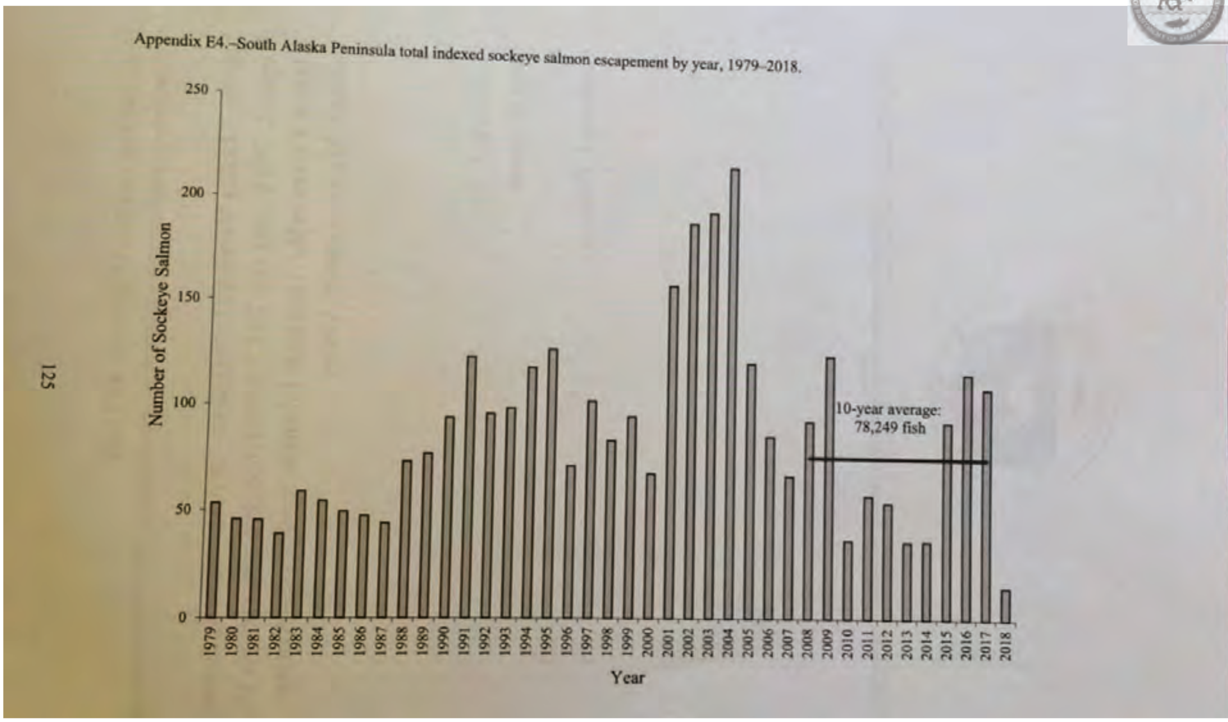
The escapement goal range was 67,800-135,000 (Regional Information Report No. 4K98-29, p.14)

Appendix E4.–South Peninsula total indexed sockeye salmon escapement by year, 1962–2013.



Lower escapement objective was 62,250 sockeye in the 2013 AMR

In the 2019 Peninsula Season Summary it cites a management objective of 48,200-86,400.



CHIGNIK ESCAPEMENT

from1987 ADFG Annual Report

"The Chignik Management Area closed to commercial salmon fishing at 6:00 P.M. 18 June and remained closed until 8:00 P.M. 20 June in order to bring the sockeye escapement back within the escapement schedule. A cumulative escapement of 200,000 sockeye through the weir by 20 June is desired. At 10:OO A.M. on 20 June this was achieved so another opening was announced for 8:00 P.M. on 20 June. The fishery remained open until 6:00 P.M. 23 June when a closure was again necessary to ensure that the early run escapement goal of 400,000 sockeye would be achieved by the end of June."

SP Escapement

Peninsula Management Area and Chignik Salmon Weir Counts Cumulative Escapement through 06-20-2021

Species	Count For 06-20-2021	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Chignik River:											
Sockeye	9,402	61,398	22,457	61,144	33,377	188,333	147,811	193,578	149,222	170,124	221,530
Pink	0	1	0	0	0	0	0	0	0	0	0
Nelson River:											
Sockeye	0	2	10	511	359	2,508	1,186	10,648	28,240	62,177	640
Bear River:											
Sockeye	5,923	23,990	2,733	7,640	6,352	28,185	16,863	18,087	36,660	29,326	12,223
Ilnik River:											
Sockeye	2,451	26,998	2,840	41,555	6,716	46,521	24,616	9,733	12,333	3,810	2,703
Orzinski River:											
Sockeye	0	32	16	4	0	20	25	110	14	416	88
Sandy River:											
Sockeye	786	2,758	599	373	884	902	8,293	6,967	3,306	3,349	237
McLees:											
Sockeye	95	777	350	-	-	167	4,967	5,053	2,210	5,171	-

2012 was the last year 200k escapement was met by 6/20

*I am unaware when the last year 400k was escaped by 6/30 *

10/6/2021

Chairwoman Marit Carlson-Van Dort and board members,

I am a Chignik permit holder and have spent my life enjoying Chignik, it's beauty, it's bounty, and it's culture. All of these hinge on it's fisheries, salmon being predominant. An ACR is rightly being asked of you at this time. For years the people of Chignik testified that the fishery was becoming evermore precarious, opening earlier on less escapement, and having more lengthy closures post June to achieve 2nd run escapement when it would fall behind and having traditional areas closed more frequently to help augment weak escapements. What used to be managed for, 400k sockeye escaped by June 30th, was subsequently managed to target the lower bounds of the early run escapement since 2002. The lower escapements numbers, which also adjusted temporally, helped keep the Chignik fishery open but masked the effects from changes happening in and from intercept fisheries. Eventually, the temporal shift in escapement, as well as aiming for lower bounds of escapement, combined with changes in interception fishing (shifting catch east to the Shumagin fishery by eliminating the GHL in 2001 as one example) have collectively negatively impacted the Chignik fishery and stocks.

In 2018, both Chignik sockeye runs failed and as well the Chinook run (only 825 of the minimum escapement), and for all intensive purposes, with no fishery being prosecuted. The Department of Fish and Game suggested it was an anomaly, perhaps related to the "blob" and that we could take comfort in that they were looking at the situation daily.

In 2019, the Chignik River early-run sockeye salmon run did not develop as forecasted and no directed sockeye salmon commercial fishing periods were scheduled from early June through mid-July. The first run was slightly below minimum objectives.

In 2020 we again experienced exceptionally low escapement for both first and second runs, and as well, the Chinook count did not meet escapement goals. Again, there was no fishery.

This summer, 2021, the first run was well below escapement, the second run was abysmal with only 113k sockeye harvest total, and the Chinook count was also below minimum escapement.

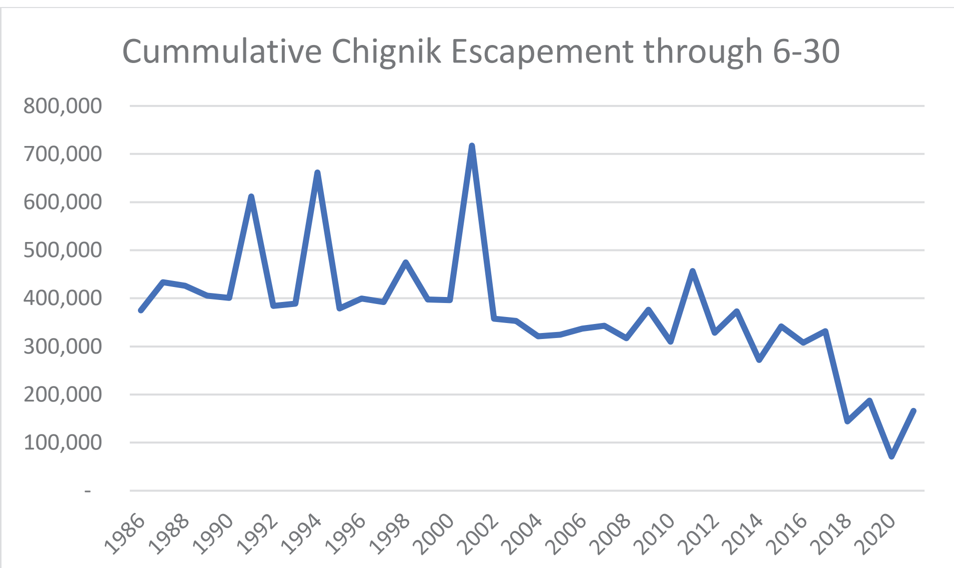
After the last four years of disastrous returns of the salmon, the consequences endured by fisherman and communities of Chignik, and having had little action to protect the Chignik sockeye in well-known migratory pathways along the South Peninsula, I encourage you to take decisive action to return as many spawners to the Chignik river as possible to meet escapement. ACR 6 and 7 are beneficial to that end although I would encourage even more protective measures if they are available to implement, perhaps closing statistical areas that are more prone to catch eastbound sockeye in the South Peninsula.

Between, the Black Lake run, the Chignik Lake run and the Chinook there are at least 3 age classes that are troubled in 2018 and 2000 and low in the other 2 years. These each return to different locations within the Chignik watershed. The likeliness of Black Lake (1.3 age class), Chignik Lake (2.3 age class), and Chignik River (chinook) all being affected in multiple years would favor ocean mortality over spawning habitat as the culprit. Over fishing is a contributor to ocean/nearshore mortality that can be addressed readily. Since the Chignik fishery is not contributing to the under-escapement issue, the conservation must reach farther to ensure the sustainable or biological escapement goals.

An understanding of the South Peninsula's effectiveness at catching Chignik sockeye should be noted and can be observed in 2006, where 688,969 of the 1,850,000 total sockeye caught in the South Peninsula fishery were identified as Chignik River watershed stocks as per the WASSIP study. During 2006 the CMA sockeye harvest was just 902,709. How and where the salmon touch into the South Peninsula may vary from year to year but it is clear from genetic sampling that Chignik sockeye can be a large component of the South Peninsula harvest.

A composite of effects have devastated Chignik salmon, as well as the Chignik fishery and communities relying on it. However, if proactive measures aren't swiftly implemented, please recognize the historical Chignik fishery and, that the people and way of life dependent on it are suffering greatly. If neighboring areas can continue to pursue cape fisheries on mixed stocks of sockeye, primarily bound for other areas, please adjust the Chignik Management Plan to allow a similar cape fishery. If necessary efforts aren't made to protect the Chignik salmon for a sustainable fishery, then please create a cape fishery to sustain the people and communities of Chignik.

I include the graph below as it reflects the changes in first-run escapement. These changes masked some of the negative impacts from interception and do not appear to have helped salmon production either. The shift to managing for the low end of first run escapement (Black Lake) in 2002 and beyond ("The ADF&G first adopted this practice in 2002 to relieve grazing pressure on zooplankton in Chignik Lake to improve juvenile sockeye salmon production." 2006 Chignik AMR, pg. 4) can readily be seen below.



I appreciate all your consideration and wisdom given to this matter. Thank you also for your time.

Sincerely,

Raechel Allen
PO Box 84
Chignik, AK 99564

From: Alan Crookston
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10 , Cook Inlet
Date: Monday, October 4, 2021 5:00:10 PM

Dear BOF Members,

I have 15 fished commercially on the east side of Cook Inlet my entire life, I am 41 years old. My children are fourth generation setnetters.

For the past 10 years the ESSN has born the brunt of the King Salmon conservation efforts in this area, and the restrictions are not equal. Year after year we sit on the beach not allowed to fish, while all other fisheries can fish.

I urge you to support ACR 10.

When the King numbers are low we should not be entirely closed to fishing. When we fish close to shore we simply do not catch many kings - much lower than the drift catch ratio.

Fishing us close to shore would also provide you- the decision makers - with important and relevant data related to the king salmon issue in UCI. ACR 10 will allow us to prevent over-escapement, save our fishery, while protecting the king salmon.

Please vote for ACR 10, and thank you for considering this important matter. Please feel free to contact me anytime if you have any questions about this issue. My fish site is open to all of you any time to help you do you work more effectively.

Respectfully,

Alan Crookston
801-309-4458

Sent from my iPhone

Submitted
manda Roberts
Submitted On
10/6/2021 9:00:12 PM
ffili tion

M n me is m nd Roberts nd I m 3rd generation Upper Cook Inlet fisherman. I am r ising m children s 4th generation Eastside setnetters. M whole life I have watched m grandfather, f ther, nd brothers fight for fisher that is losing so much ear after ear. With all the king closures, I m afr id there will not be fisher for m children and gr ndchildren.

Our fisher is full alloc ted. The llocation to the E stside setnetters commerci l fisher h s been realloc ted to other user groups, resulting in forgone harvest and extreme economic loss to the fisherm n , local coast l communities, nd the st te of lask . I support CR 10 because it gives E stside setnetters small percentage of their llocation of socke e during times of low king abundance. We c n't be the ONLY user group to sit on the beach ever summer. I look forw rd to working with l sk o rd of Fish members to find the solution on how we can keep our 100- ear-old fisher live.

From: Ralph Masterson
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Wednesday, October 6, 2021 5:33:46 PM

To whom it may concern,

I have been a set net fisherman most of my adult life. The last decade has seen multiple years of runs of high sockeye abundance and low king abundance. In these years, we are told to sit and watch while the Kenai River is grossly over escaped, reducing future returns for all user groups. It has been statistically shown that nets within 600' of mean high tide catch an insignificant number of king salmon. Please vote in favor of ACR 10, which would allow allow fishermen to participate, to some extent, in the fishery, in years of high sockeye abundance.

Thanks for your time,

Andrew Milauskas

From: Angel Haines
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR #10
Date: Sunday, October 3, 2021 3:40:55 PM

I'd like to submit my support for ACR #10 for statistical area 244-42

Submitted
gela Cramer
Submitted O
10/6/2021 5:49:48 PM
filiatio

Hello laska oard o Fish Members,

I am i support o CR 10. I have been a set etter i Cook I let on North K- each or 11 ears. It is time that we look or solutio s o how to ma age the surplus socke e i the Kasilof and Kenai Rivers while mi imizi g our chi ook harvest. CR 10 is a per ect tool or DF&G to have i their toolbox to help ma age this complex mixed stock isher .
Please support CR 10 so that we ca have a ull discussion about optio s i March.

Thank ou or our time,

gela Cramer

From: Anne Gatling
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Wednesday, October 6, 2021 5:50:57 PM

Dear Board of Fish Members,

I would like you to consider voting in favor of ACR 10 at your upcoming meeting. This proposal represents an equitable way for some continued fishing on years where there is low king abundance. As it's been demonstrated, there is a statistically insignificant number of kings harvested in the 600' fishery. This seems like a fair way for some fisherman across all beaches to continue to harvest the over abundance of sockeye.

This would help to alleviate the over abundance of sockeyes that keeps occurring year after year in the Kenai River. Resources stretched thin in the Kenai River by the large numbers of sockeyes year after year could lead to a weakened stock.

I appreciate any consideration you could give for a positive vote for ACR 10.

Sincerely,

Anne Pfitzner Gatling

From: Bel Ramirez
To: DFG, BOF Comments (DFG sponsored)
Date: Tuesday, October 5, 2021 6:21:42 PM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,

Belen Ramirez

Submitted
i n n d Lis G br iel
Submitted On
10/6/2021 10:07:47 PM
Affili ti n
Fishe m n

Ph ne
[redacted]
Em il
[redacted]
Address
2305 W t ergate W
Ken i , Al s k 99611

Support of

Dear Al s k d of Fisheries d Members,

We supp t ACR 10 submitted b T vis Eve .

We h v e fished ou Upper C ok Inlet setnets f the past 35 ears. As owners of the number one n d number tw sh e fisher leases issued by the Department of N t u l Resou ces in C ok Inlet, n d legac setnet site, we e in full support of offering limited opportunit t fish within 600 feet of the mean high tide in the E s tside Setnet fisher when the commerci l n d sport fisher e in pai ed est ictions n d est icted in the Late- un Ken i River King S l mon pl n .

Ou f m il h s s t f m n ears on the beach f the conserv t ion of King s l mon. In 2012, 2014, 2018, 2019, 2020 n d 2021 ou fisher w s shut down in the heart of ou season with n opportunit t h vest plentiful sockeye. E c h of those ears the sockeye goals in the Ken i n d K s ilof ivers were either met exceeded.

The EG f the K s ilof River h s been exceeded 9 of the l s t 10 ears. In the l s t 3 ears, the Ken i River in- iver goal h s been exceeded by 500,000 t 1.2 million sockeye.

With the inc eased sockeye goals, the new l ge king goals n d pai ed est ictions, the E s tside setnets will el fish th oughout the season in ***any*** ear. The board could not h v e known these impacts when the egul t ions were dopt ed.

The lost opportunit t h vest sockeye each ear is n economic dis s te , n d c n not be overst t ed, f ou f m ilies, c s t l c mmunities, supp t infr structu e nd p cess s.

At time when the Govern has st t ed th t we need t squeeze ever doll th t we c n out of the econom , it seems cont when $60 t $80 million of economic stimulus w s left on the t bl e bec u se of f egone h vest.

In ecent ears, the concept of the 600 ft fisher w s dopt ed by the board f fisheries n d w s used on limited beaches with positive dat th t sh ws king savings while h vesting socke e when it w s used.

In 2020, in n eff t t include **all** Upper Subdist ict beaches with some h vest opportunit , the new 600 ft fisher w s dopt ed int egul t ion but w s not utilized by the Department.

F the fi st time, in the summer of 2021 the 600 ft fisher f l l beaches w s used on Jul 20th. The h vest esults on th t day were encou gi ng with the prelimin dat showing biologic l l insignific n t king h vest compared t signific n t sockeye h vest of 36,668 sockeye **The board could not have known the king to sockeye harvest of the 600 ft fishery when the regulation was adopted as this was the first time the limited fishery was utili ed and new data was collected.**

In 2021 the drift fisher fished l most ever day int August in n eff t t stop the flow of Sockeye int the Ken i n d K s ilof ivers. F om Jul 20th t August 24th **2, 7, 806** socke e salm n p ssed the counte s in the Ken i Rive . S cke e we e still esc pi ng over 12,000 fish day when the counters were emoved. They could not stop the fl od of fish int the Kenai nd K sil f ive s.

We e s king this board t **re-visit the paired complete closure of the Eastside Setnet fishery in upper cook inlet when large king salmon are projected to be below the goal**. **The board could not have known the impacts of the regulation without the data that was collected in the summer of 2021. The harvest of King salmon was minimal while the sockeye harvest was 36, fish.**

This option is n m z ing compromise t protect king s l mon n d still l l w some h vest f the excess h vest ble st cks f socke e. E s tside setnetters e doing thei part tow ds protecting king s l m n, but we need the opportunit t h vest sockeye if ou sm l l businesses nd hist ic f mil w f life is g ing t su vive.

Please support ACR 10 n d move it t the full board meeting in M ch f full discussion by l l st k eholders. The continued hist ic eastside setnet fisher n d t di tion l f m il lifest le e w th the c nvers t ion.

From: BRIAN SCOW
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Tuesday, October 5, 2021 3:28:57 PM

My name is Brian Scow and I fully support ACR 10! I fish i. The Lower Salamatof Beach

Sent from my iPhone

From: Chris Every
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR-10
Date: Sunday, October 3, 2021 12:54:31 PM

Alaska Board Of Fish Members

I support ACR-10, that will be in front of you during October 20th and 21st, at the 2021 work session.

I setnet in the North K-Beach stat area 244-32.

I hope we can work together and support ACR-10.

Chris Every
cpevery58@hotmail.com
1-907-394-0720

Submitted
ris Ever
Submitted On
10/6/2021 11:17:16 AM
Affiliati n

Ph ne
[redacted]
Email
[redacted]
Address
37033 Minke Drive
Kenai, Alaska 99611

ACR-10

Members of t e Alaska oard f Fis eries, I am writing t is in response t staff comments provided on A R 10.

Does t e agenda c ange request address an effect of a regulation on a fis er t at was unforeseen w en t at regulation was adopted? Yes, I believe t at it does.

T e data fr m t e use f t e 600' fis er ver t e last f ur ears as prove that it is a ver effective t l.

1. T all w t e passage f r King Salm n t t e river during times f low abundance

2. T arvest socke e

3. Genetic studies, ave als produced data (t at was n t available) t support t e use f t e 600' fis er .

4. T e econ mic l ss t t e c mmunity is in t e milli ns b all wing this v lume f s cke e to the spawning grounds, w ic will als diminish returns in t e future, causing future econ mic l ss. T ese l sses are ard t determine, but we all ave t agree l sses ave occurred in t e past, present and future.

5. T e current regulations inder t e departments management f t e five salmon species effectivel . (T is as been said by t e department people).

S t is 600' fis er is a fantastic tool t at s ould be embraced.

ris Ever

From: Chris McConnell
To: DFG, BOF Comments (DFG sponsored)
Subject: Set Netters - Kenai
Date: Monday, October 4, 2021 12:40:02 PM

Dear Board of Fish Members,

I would like you to consider voting in favor of ACR 10 at your upcoming meeting. The great tradition of fishing along the Kenai beaches benefits the state in terms of the economy and richness of our state's fishing culture. This proposal represents an equitable way for some continued fishing on years where there is low king abundance. As it’s been demonstrated, there is a statistically insignificant number of kings harvested in the 600’ fishery. This seems like a fair way for some fisherman across all beaches to continue to harvest the over abundance of sockeye.

Sincerely,
Chris McConnell
2412 Forest Park Drive
Anchorage, AK 99517

Submitted
ristian Marinos
Submitted On
10/6/2021 9:37:50 PM
ffiliation
Employee of Scow fis ing (setnetting) on lower Salamatof beac

Phone
[redacted]
Email
[redacted]
ddress
2845 E Sunset Drive
Eagle Mountain, Utah 84005

I want to offer m full support of R 10 as a solution to better regulate t e Kenai and Kasilof river sockeye salmon population, and to elp setnetters in t e upper subdistrict of t e entral District stay in business. M famil as fis ed on t e lower Salamatof eac for over a decade. However, we will not be able to continue running our business if t e current regulations remain in place, and we continue to be s ut down being left wit little to negative financial gains. Please consider t is necessar c ange for businesses and salmon regulations alike!

Thank ou,
ristian Marinos

From: Dane Markham
To: DFG, BOF Comments (DFG sponsored)
Subject: In Support of ACR 10
Date: Tuesday, October 5, 2021 9:41:54 AM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,

Dane Markham
permit # 273387

DATE: October 4, 2021

TO: Alaska Board of Fish
FAX#907-46--6094

FROM: Daniel Wichers -North K-Beach

RE: ARC 10 approval

Hello,

I am a permit holder and have been fishing on my family's setnet sites for over twenty years with the exception of joining the military for six years. I wanted to let you know that I am in support of ARC 10. This will allow east side setnetters a chance for some opportunity to harvest excess red salmon on low king salmon runs.

Thank you for your consideration in passing ARC 10.

Sincerely,
Daniel Wichers
Daniel Wichers

From: NorggroN
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 10:06:40 PM

Hello,

This is David Rorrison, a setnetter in the upper subdistrict and I would like to voice my support for ACR 10. A Lot of hard work has gone into it and I think it is a good idea.

DATE: October 4, 2021

TO: Alaska Board of Fish
FAX#907-46--6094

FROM: David Wichers – North K-Beach
PO Box 1728
Kenai, AK 99611

RE: ARC 10 approval

Hello,
I am reaching out to you to let you know that I am in full support of ACR 10. I have been an eastside set netter for 35 years, and have seen many changes in our fishery. We felt the effects last summer on our fishery and believe that ACR 10 is a good step in helping to correct an unforeseen consequence.

Thank you,
David Wichers
David Wichers

Submitted
e i n Ever
Submitted On
10/6/2021 10:52:00 PM
Affiliation

ello, m name is evin E er . I am a 4th generation commercial fisherman in Cook Inlet. I full support ACR 10. I have watched m great-grandfather, grandfather and now m father fight to keep our fisher iable. It is time to look at all solutions and approaches to har est socke e surpluses while being conser ati e with har est on Kenai Ri er chinook salmon. The 600ft tool is an excellent wa to stop the o er escapement we have seen in the past several ears in the Kenai and Kasilof Ri ers.

Please take an honest look at ACR 10, man families rel on our decisions. Thank ou for our time.

e i n Ever

From: Elizabeth Marinos
To: DFG, BOF Comments (DFG sponsored)
Subject: In support of ACR10
Date: Wednesday, October 6, 2021 9:12:18 PM

I want to add my full support to enact ACR10 as proposed to allow for a limited 600ft fishery when we are not projecting to meet the King OEG. My family fishes on the lower Salamatof beach. This is a very necessary change that needs to be made both to allow setnetters along this beach to maintain our livelihood, as well as to maintain proper escapement goals and a balanced ecosystem for sockeye salmon. I urge you to vote for this proposal to be enacted. As businesses we will not survive if we continue to be shut down year after year.

Thank you so much for your consideration,
Elizabeth Marinos

Submitted
ic N ce
Submitted On
10/4/2021 9:03:57 PM
Affi iation

Dear oard of Fish Members,

I am a comme cia fishe man on Sa amantof each. I wou d ike ou to conside voting in favor of ACR 10 at ou upcoming meeting. This proposal epresents an equitable way fo some continued fishing on ears whe e there is ow king abundance. As its been demonst ated, there is a statistical insignificant number of kings ha vested in the 600' fisher . This seems ike a fai way fo some fishe man ac oss a beaches to continue to ha vest the over abundance of sockeye.

Sincerel ,
ic N ce

Submitted
ith lv
Submitted On
10/6/2021 8:28:00 PM
Affili tion

I m riting today to support ACR 10. I have been an E stside setnetter through m teen ge ears and into adulthood. King s lmon in Alask are definetl in times of lo abundance. The Ken i River king s lmon is no exception. It is time for all of us to come together to find additional tools to h rvest surplus socke e hile minimizing chinook harvest. The dat from the 600ft fisher h s proven to be ver effective to do just th t.

I ppreci te our time nd effort to tr to find solution to complex m tter.

Th nk ou

Submitted
r L Hollier
Submitted On
10/5/2021 4:58:01 PM
A fili tion
sel

Members of Al s k oard o Fish,

Ia m writing in support o ACR 10.

St comments on ACR 10 st t ed there w s NO conserv t ion purpose or reason to support this ACR.

Exceeding in-river goals in the Ken i River b double the top end of the in-river goal n d going over the top end E of the K s ilof River ,340,000, by l most 200,000 cert i nl ppear s like conserv t ion issue to me.

I thought t the 2020 meeting o the OF when the K silo goals were lowered, th t ADF& st t ed th t 500,000 to the K s ilof might not repl c e its sel .

In the Ken i River the don't know wh t th t number is where the number of sp w ners bring back less th n 1:1 return. Seems ridiculous to tr to ind th t number.

St when it irst w nted to go to ig King goal, i thought the minimum number w s 11,500.

Th t number w s turned into 13,500 SE n d 15,000 OE . Wh does the commerci l isher h v e to put 15,000 in the Ken i River ter AUgust 1, when the river is shut down to sport h r vest?

Lets not orget bou t the closure to the Dri t isher in the EEZ. Another un oreseen regul tion.

Please pass ACR 10, n d then h v e r n k discussion in M rch.

Th nk ou

r L Hollier

Ken i Ak.

Submitted
vin
Submitted On
10/6/2021 4:19:02 PM
Affili tion

Phone
[redacted]
Em il
[redacted]
Address
11620 NE 150th Place
Kirkland , Washington 98034

M name is avin Hudkins and I am 4th generation commercial fisherman on S l m atof each. I am 18 ears old and have spent ever summer of m life fishing the same plot of land where m randfather settle in the mid 1920's. I m also UCI permit holder.

I am writing today in support of ACR 10 and ask th t ou please take into consideration what this ACR states. This ACR does fit the criteri as we have new information in 600 foot fisher that was put into the plan in 2020 and used in 2021. While we onl have one day of data, the 600 foot fisher was ver effective in harvesting sockeye and conserving king salmon, 39,000 sockeye to 11 kings.

I m asking the oard to please re address the impacts of full closure, giving ADF& the tool in the tool box to use the 600 foot fisher in all of UCI when kings are in low abundance. The impacts on our fisher with full closure has been detremental to not onl our fishing families, but the Kenai River as well.

Thank ou for our time.

vin Hudkins

Submitted
eorge N ce
Submitted On
10/5/2021 4:13:54 PM
Affi iati n

Ph ne
[redacted]
Emai
[redacted]
Address
PO ox 401 Kenai, Ak. 99611
Kenai, A aska 99611

Having fished n the Salamatof beach for 41 ears we have seen our fishing time dr p over the ears, m hope is that ou wou d consider the ACR10 proposal t al ow fishing time during times of sockeye abundance. Thank u

Submitted
eg Johnson
Submitted On
10/6/2021 3:51:49 P
Affiliation
Upper Subdist ict setnette /CI

In Regards to ACR 10 . I believe additional tools or approaches are necessa to both utilize potential sockeye su pluses in both Kenai and Kasilof ive s while maintaining a precautionar approach du ing low abundance in king salmon etu ns. If passed and moved to statewide meeting ACR 10 will se ve as good platfo m to fu the the discussion on how to utilize su plus socke e du ing low king salmon abundance . The concepts laid out in this ACR a e precautionar and deserve a full discussion . Should this ACR be passed I look fo wa d to participateing in the discussion this spring. Thank ou eg Johnson

From: jake markham
To: DFG, BOF Comments (DFG sponsored)
Date: Tuesday, October 5, 2021 6:19:46 PM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,

Jake Markham

From: Jan Kornstad
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Monday, September 27, 2021 5:37:25 PM

Please add ACR 10 to your October meeting agenda. If we have to wait for the next Board cycle for this issue to be addressed it is doubtful that those of us who fish on Upper Salamatof Beach will be able to survive the economic consequences of these drastic restrictions and closures.
Vern and Jan Kornstad

Sent from my iPhone

From: Jessica Nyce
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 1:54:09 PM

Dear Board of Fish Members,

As a lifelong setnetter, I would like you to consider voting in favor of ACR 10 at your upcoming meeting. This proposal represents an equitable way for some continued fishing for sockeye on years where there is low king abundance. As it's been demonstrated, there is a statistically insignificant number of kings harvested in the 600' fishery. This seems like a fair way for some fisherman across all beaches to continue to harvest the overabundance of sockeye.

Sincerely,
Jessica Nyce

From: Jessie Banas
To: DFG, BOF Comments (DFG sponsored)
Subject: Setnetting on Cook Inlet
Date: Tuesday, October 5, 2021 6:30:17 AM

Dear Board of Fish Members,

I would like you to consider voting in favor of ACR 10 at your upcoming meeting. This proposal represents an equitable way for some continued fishing on years where there is low king abundance. As it's been demonstrated, there is a statistically insignificant number of kings harvested in the 600' fishery. This seems like a fair way for some fisherman across all beaches to continue to harvest the over abundance of sockeye.
As a constituent who grew up in Kenai and return to visit family monthly, I believe commercial fishing plays a vital role in maintaining robust Kenai Peninsula communities. I hope you vote to support commercial fishing.
Sincerely,

Jessie Banas
907.399.3027
Sent from my iPhone

DATE: October 4, 2021

TO: Alaska Board of Fish
FAX#907-46--6094

FROM: JoAnn Wichers —North K-Beach
PO Box 1728
Kenai, AK 99611

RE: ARC 10 approval

Hello,
I am reaching out to you to let you know that I am in full support of ACR 10. My family and I have been setnet fishing in Cook Inlet for over 30 years and been greatly affected by all of the changes to our fishery over the years. We are in support of ACR 10 because we feel that it adds another tool that our fish and game department can use to help harvest surplus red salmon when the king salmon run has low returns. It will allow some opportunity for Cook Inlet setnetters.

Thank you,
JoAnn Wichers
JoAnn Wichers

Submitted
en Coleman
Submitted O
10/6/2021 2:32:25 PM
Affiliatio
Ea tside Setnetter

Pho e
[redacted]
Email
[redacted]
Addres
35565 aranof Street
enai, Alaska 99611

M ame i en Coleman a life long Alaskan and a resident of enai. I'm al o a 50 ear East ide Set etter who fi hes on Upper alifon k each, tati tical area 244-32.

I'm writi g i upport of ACR 10. A I'm ure the oard k ow , the Late Ru i g Salmon escapement was ub par thi last eason and has been for the last few eason . The result of low escapement and changes to the RLRKSMP duri g the la t oard c cle re ulted i earl complete clo ure to the ESSN for the fourth ear ru i g. Such clo ures cau e evere fi ancial damage to the fi her who rel on ockeye catch. I deed we, as a fi her , have petitioned the State to declare economic di aster for 2018,2020 and likel 2021.

The Department taff have commented that there i o con ervation, purpose or reason to upport and ACR. I believe a con ervation and purpose exi t . For man con ecutive ear the ockeye escapement goal has been exceeded on both of the enai and asilof River . 2021 escapement i to the asilof was exceeded by 60% ove the EG and the enai River was exceeded by over 100%! Of cour e the monetar damage i i the 10' of million over the last 4 ear .

What are the i -river con equences of conti ui g over escapement? Can the Department qualif /quantif their on upport? Seem that by managi g the weak tock(ki g almon) i the man er we do we're i the proce of weake i g the socke e stock due to over escapement, i deed the retur per paw ed conti ues to trend dow .

ACR 10 offer a template to fi d a way to harvest ockeyes i a low i g Salmon ituatio . ESSN fi her over the ear have been in ovative in our que t to co tinue harve ting ocke e while minimizing ki g i cidental catch. Please pas ACR 10 and let' have a eriou di cu ion about how we can accompli h both conti ued harvest of ocke e a d protectio of i g Salmo .....rea o able people can fi d reasonable olution. The i ue at hand can ot wait u til the 2024 Cook I let meeti g!

Respectfull Submitted, en Coleman

From: Levi Boyd Johnson
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 7:37:52 PM

To Whom it may concern,

My name is Levi Johnson and I manage the fish site located just south of Ted Crookston. This fish site has been in my family for 60 years, my grandfather Boyd Campbell took ownership from Ken Carlsen over 20 years ago and all of his grandsons have had the opportunity to manage it. I am the youngest grandson, and would hate to see it close its doors under my management. This being said, if something does not change soon I will not be able to continue managing the site.

This site has provided me the income needed to put myself through school in pursuit of an engineering degree. I owe everything I have to the Kenai River ecosystem, and hate to see it abused in the way that it has been over the last 10 years in name of large Kenai River Kings. Witnessing the over-escapement that has been allowed to happen has been painful.

For these reasons, I would like to state my support for ACR 10, and ask you for yours. We are asking to work with you to better conserve the Kenai River ecosystem, to keep it producing for generations to come. Please allow us to do this.

Best regards,
Levi Johnson

Submitted
r Anderson
Submitted On
10/6/2021 12:52:53 P
Affili tion

Dear Al s oard of Fish embers,

I h v e been setnetter in Cook Inlet for over 25 ears. I full support ACR 10.

Over the past sever l ears E stside setnetters h v e shouldered the m j orit of the burden when it comes to ing conserv tion. We h v e s t on the beach for ing conserv tion in 2012, 2014, 2018, 2019, 2020, n d 2021 while the soc e e goals in the K s ilof n d Ken i River h ve been met or exceeded each of these ears.

The K s ilof River EG for soc e e of 140,000-320,000 h s been exceeded 9 out of the l s t 10 ears. In the l s t 3 ears the Ken i River In-River Goal h s been exceeded by 500,000- 1.2 million soc e e. The loss of h r vest bl e surplus ear f ter ear is dev s t ting the E stside Setnet fisher . There re no l tern t ive h r vest bl e stoc s v i l bl e to the users in this rea.

The 600ft tool is not new to our fisher . It w s created in 2017 for the K silof nd North K- each sections to h rvest K s ilof bound soc e e while minimizing the h rvest of Ken i River Late Run Chinook. This tool h s been ver successful with its limited use over the past 4 ears.

At the 2020 Upper Cook Inlet OF meeting NEW 600ft fisher w s est blished (In Ken i River Late Run King Pl n) th t included the entire Upper Subdistrict. During the 2021 season, this NEW 600ft fisher w s used for the first nd onl time on 7/20/21 n d provided new dat . The new dat from the 600ft fisher indic tes de minimis Late Run Ken i Chinook h r vest (36,668 soc e e n d 11 l r ge l te run chinoo).

This does meet the ACR criteri to correct n effect on fisher th t w s unforeseen. Along with the new inform t ion bou t the EEZ s st t ed in ACR 10. When the NEW 600ft fisher w s created t the 2020 UCI OF meeting, there w s no dat of the h rvest potenti l of the entire Upper Subdistrict limited to 600 feet v i l bl e to oard embers to s sist them in m ing decisions nd tr de- offs regarding the complic t ed m n gem ent of mixed-stoc fisheries n d the competing goals of the Ken i n d K s ilof River S stems.

We r e s ing the oard of Fish to re- ddr ess the unforeseen impacts of the complete closure of the E s tside Setnet fisher by giving ADF&G the tool of the 600ft fisher . This tool will reduce both the negative economic impacts while conserving chinook s l mon.

Th n ou for our time,

r Anderson

From: Live
To: DFG, BOF Comments (DFG sponsored)
Subject: Support ACR 10
Date: Tuesday, October 5, 2021 5:36:29 PM

Hello,
I am writing to voice my support of ACR 10. I am watching my families livelihood be taken away because under the current management plan there are practically NO options for setnetters during periods of low king abundance. Setnetters and managers deserve options and this can give them some. Please help.
Warm regards,
Michael Crookston

From: Michael Gatling
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Wednesday, October 6, 2021 4:01:59 PM

Dear Board of Fish Members,

I would like you to consider voting in favor of ACR 10 at your upcoming meeting. This proposal represents an equitable way for some continued fishing on years where there is low king abundance. As it’s been demonstrated, there is a statistically insignificant number of kings harvested in the 600’ fishery. This seems like a fair way for some fisherman across all beaches to continue to harvest the over abundance of sockeye.

Sincerely,

Michael Gatling
ESSN Fisherman for over 30 years

From: Michele Markham
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 9:18:14 AM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,

Michele Markham
Permit # 223791

From: Mike Markham
To: DFG, BOF Comments (DFG sponsored)
Subject: support for ACR 10
Date: Tuesday, October 5, 2021 9:16:56 AM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,

Mike Markham
Permit # 370514

From: BRIAN SCOW
To: DFG, BOF Comments (DFG sponsored)
Subject: Regarding ACR 10
Date: Tuesday, October 5, 2021 3:32:32 PM

My Name is Nancy Scow, I fish Salamatof Beach. I totally support ACR

Sent from my iPhone

From:	Paul Crookston
To:	DFG, BOF Comments (DFG sponsored)
Subject:	Support ACR 10
Date:	Tuesday, October 5, 2021 6:56:53 PM

I am life long set-netter writing to urge your support of ACR 10. My family has fished on lower Salamatof Beach for over 50 years.

Paul J. Crookston
801-719-6465

Submitted
e id ornstad
Submitted On
10/6/2021 9:33:35 PM
A filiation

Phone
[redacted]
Email
[redacted]
Address
46701 Joyce Cir
enai, Alaska 99611

I would like to comment regarding AC 10:

Modify com ci sal on set gi net fishery in th *Kenai Rive La e Run King Salmon Management Plan* (5 AAC 21.359).

While I am not generall in avor of et another restrictive measure to Eastside Setnetters, I would like to support AC 10 given the predicament we ind ourselves in with low king numbers and large over abundance o socke e.

Eastside setnetters, objectivel cannot be a actor in the declining king numbers or 3 reasons: 1) The ishing pressure rom ESSN has onl ever been resticted over the last several decades. (2) ESSN ishing methods have not changed. (3) The number of ESSN has not increased in decades.

It would be ver hard to understand wh the ESSN isher would need to continue to experience an urther mandated complete closures in times of sockeye abundance when: 1) it has not contributed to the decline in kings, (2) it harvests a ver small portion of the king run even on a ull compliment of gear, and (3) the Department already has a near shore isher measure it can, and has used to reduce even urther the already small number of kings harvested in the ESSN.

I am a 3rd generation ESSN o almost 50 ears and I can speak directl to the king catch on our site on Salamotof each. On a ull compliment of twelve 35- athom, 45-mesh gear, we catch between 1-3 kings each opener on average, **near y of which c ught *mo e* than 600' f o ean high w t .** From m perspective, on our beach, AC 10 is a viable tool to use or the specific situation we ind our selves in in Upper Cook Inlet of late with concurrent weak king runs and strong sockeye runs.

For kings, the problem is likel complex, and WHE E it is occurring seems to be a m ster , but it simpl cannot be occuring in the Eastside setnets. The ESSN isher has onl ever reduced its e ort in a non-targeted isher while large kings are speci icall targeted in their spawning beds by hundreds of anglers dail . The ESSN isher largl does not even occur in waters where kings primaril run. Simpl put, most kings are running outside and/or underneath the set nets (even with a ull compliment of gear). There is no data that supports that the ESSN isher has contributed to the decline o kings, but there is plent o data to support that ESSN isher can be used b the Department to help ef ectivel manage an overabundance of sockeye while at the same time conserving kings. Please consider AC 10 or this reason. Thank ou or the time ou all put into these work sessions. It is signi icant.

Submitted
oberta N ce
Submitted On
10/5/2021 4:08:24 PM
Affi iati n

Ph ne
[redacted]
Emai
[redacted]
Address
PO x 401
Kenai, A aska 99611

Dear OF, I am asking ou t please support AC 10. Our fami has been setnet fishing on Salamatoff each for 41 ears and the fisher has dec ined t such an extent that I'm not sure it wi ever recover. Processing plants have dwindled, empl ing crew when they make s itt e money is a chal enge, finacial gearing up for five days f fishing is just s difficult! AC 10 w uld significant he p with planning, crew, supplies, and f d. It's al just s depressing and we rea need ur he p!

From: Romayne Hindman
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10 support
Date: Wednesday, October 6, 2021 11:24:37 PM

As a long time set netter in Cook Inlet, I would like to give my support and ask that the board of fish do the same to ACR 10. I see this as a way in times of low King salmon returns to slow the escapement of Sockeye salmon into the river system and try to manage both stocks for the future.

Respectfully
Romayne Hindman
Cook Inlet Set Netter
Central District, East Forlands Section

Submitted
S h Frost d-Hudkins
Submitted On
10/6/2021 5:02:58 P
Affili tion

Phone
[redacted]
Em il
[redacted]
Address
PO OX 1116
Kenai, Alask 99611

name is S ah F ostad-Hudkins and I am w iting today to support ACR 10. I m 3rd Generation fisherm n following in m G andfather and m Father’s footsteps. Alongside with m husband, ou children and ou grandchildren, we e continuing ou families legac .

We full support ACR 10 as it states and believe that it fits the c iteri as we have new information, it will cor ect an effect on fisher th t was unforeseen and we have new information with the EEZ.

- Utilizing the 600 foot fisher would allow fishermen to h vest excess socke e, ll while conse ving king h vest.
- When the 600ft fisher is used, most nets e dr and on the beach at some point du ing an opener as ou tidal ange in Cook Inlet is the second l gest in the world. While this makes ou h vest time less, when we e in the water, we e ver effective.
- On Jul 20th, fo the fi st time ll ESSN (including Sal m tof e ch) we e given the opportunit to h vest excess sockeye salmon all while educing ou king h vest using the 600 foot fisher . It proved to be ver good day for both. Over 36,000 sockeye were h vested to 11 kings.
- The amount of sockeye entering the Kenai River in August has inc eased since 2003.
- On Jul 31st, 2021, 77,985 entered the iver.
- In August the dipnetters have completed thei season and m n drifters have packed it w for the winter as well.
- On August 24th, the number of sockeye past the counter was 2,441,825. This is 1,241,825 A OVE the upper end of the sockeye goal.
-

It is imperative for the commerci l fishermen to have the opportunit to h vest excess socke e salmon ll while conse ving the king salmon and ACR 10 would give the Department the abilit to do just that.

Thank ou for ou time and ou effort in the States Fisheries.

S h nd Jason Hudkins

From: Sara Martinez
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 8:31:07 PM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,
Sara

--
Sara Martinez
saraamartinez92@gmail.com
480) 234-5127

Submitted
r h pellegrom
Submitted On
10/6/2021 12:39:32 PM
ffili tion

If weak tock m n gement takes precedence over exceeding board mandated escapement goal , then It' ju t w te of the State' time and money to h ve on r counter , employees, equipment, etc.

I upport CR10

Submitted
S l Anderson
Submitted On
10/6/2021 5:55:52 PM
Affili tion

Phone
[redacted]
Em il
[redacted]
Address
5521 101st St SW
Mukilteo , W s ington 98275

M name is S l Anderson and I m 4t generation comerical fis erman on S l m atof eac . I spend m summers arvesting salmon alongside m parents, m siblings, m usband and now m 3 c ildren. I m ver proud of t e legac t at we carr and wis to s are t t wit m c ildren for ears to come.

I am writing today in suppprt of ACR 10. T e last sever l ears ave s own s ifting of run timing nd more socke e entering the Kenai River in August. In fact, on August 24t t e Kenai River w s at 2,441,825 sockeye past t e counter w ic was 1,241,825 above t e upper end of t e goal. I support ACR 10 as written and believe t at in ears of low abundant king salmon, t is "tool" would allow t e Department to direct t e rvest of excess socke e salmon ll w ile conserving king salmon.

T ank ou for our time and our dedication to our fis eries.

S l Anderson, 4t Generation UCI setnetter

Submitted
Sta i Steffy
Submitted On
10/5/2021 6:19:27 PM
Affili tion

Phone
[redacted]
Em il
[redacted]
Address
21912 55th Ave SE
Woodinville, Washington 98072

I support ACR 10.

-St ci Steff , UCI commer i l fishermen

From: Taylor Markham
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 8:29:26 PM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Thanks,
Taylor

--
Taylor Markham
taylormarkham@gmail.com
480) 241-0841

Submitted
ed rookston
Submitted On
10/6/2021 11:27:31 PM
Affi iation
ommercia Setnetter

Phone
[redacted]
Emai
[redacted]
Address
53509 Veco Ave
Kenai, A aska 99611

Dear oard of Fish Members;

he comments below are submitted in response to the ADF&G Staff omments on A Rs which were recent made public. In particu ar these comments are specific to A R 10 concerning the use of a 600 foot near shore setnet fisher in times of ow king salmon abundance. Implied in m comments is m support for A R 10 and m urgent request that the oard accept A R 10 for advancement and inc usion in an upcoming oard Meeting Agenda for deliberation and action.

Response to Staff omments regarding A R 10:

Heading #1; What this A R seeks to change. his information is accurate and I agree with it.

Heading #2; Present Situation. A so accurate and I agree with it.

Heading #3; Staff Assessement of A R 10

his heading section contains no information whatsoever as to the reasoning for, nor provides an evidence to support the "NO" determinations on al 3 criteria. As commercial fishermen we have appropriatel engaged with man members of the ADF&G staff regarding these matters. We are aware there certain are members of ADF&G staff who have serious concerns about the issues addressed in A R 10. Specifical regarding criteria a) and c).

riterion "a)" asks — Is there a fisher conservation purpose or reason? onsidering the enormous repeat and predictable over escapement of sockeye into the Kenai and Kasi of rivers and the already measurable decrease in returning run sizes, and also given the poor production of the Kenai River main stem spawning king salmon, there c ear is a ong term conservation purpose and reason to A R 10. It is to provide a much needed tool and method to area managers to enable them to manage to meet the appropriate escapement goals in a balanced effective manner so as to avoid the ong term conservation concerns for both sockeye and kings caused by the unchecked, repeat, al time record high evels of over escapment.

Criterion "c)" asks — Does the A R address an effect of a regu ation on a fisher that was unforeseen when that regu ation was adopted. Once again, there is no information as to the reasoning for, and no evidence to support, a "No" determination. However, the oard Members wi recal the position presented by the commissioner at this summer's emergenc meeting on the same issue. In short, it was represented to the Board that the "fisher " in question was the ESSN fisher and that the "effect" in question was the mandator c osure of the ESSN as a resu t of a previous adopted regu ation. It is ogical to presume perhaps the same source of inf uence was once again brought to bear in the finding of the "No" determinations in this staff assessement. his representation is mis eading and fai s to comprehend the true scope and purpose of A R 10. he "fisher " addressed by A R 10 is the whole Upper ook In et Salmon Fisher , which inc udes interested communities and industries and individual persons involved in and effected by that fisher . he regu ation it addresses is the regu ation adopted which completel and mandatori c oses the entire ESSN if projected ate run arge king sa mon escapement is ess than 15,000 fish — regardless of al other factors. Now the meat of this question is focused in the consideration of overwhelming evidence of the negative effects of the regu ation (cited previous) on a fisher (the whole Upper ook In et fisher) that were unforeseen when that regu ation was adopted.

hese unforeseen effects inc ude:

• he inabi it for fisheries area biologists and managers to check and harvest unprecedented al time record high over escapements of socke e into the main rivers.

• The combined osses to the fisher , which inc udes al persons, communities and industries that enable a fisher to even exist, of staggering porportions. Using the valuatrion provided by KPEDD of $100 per sockeye the oss in this 2021 season alone on the forfeited 1,443,684 sockeye totals over $144,000,000 in economic oss to the "fisher " (and al those direct and indirect connected to the fisher). Additional , enormous simi ar osses occurred in 2019 and 2020.

• he biological alteration of the sockeye run return timing — shifting to arger and ater run peaks cause by unbalanced harvesting throughout an entire run span.

• he unfair and unjustifiable total exc usion of the setnet fisher from a harvest opportunit , whi e transferring that al ocation to other user groups who are fishing at fu force.

• Other significant factors which have bearing on the dramatic effect of the stated regu ation and its impact on the abi it of fisheries managers to manage in a balanced approach for the mixed stock difficu ties presented by strong sockeye numbers and weak king numbers are: 1) It was unknown and unforeseen to the oard in 2020 that fishing setnets on in near shore waters, c ose to the water ine resu ts in a dramatic reduction of the incidenta king harvest number by setnets. his was c ear demonstrated in the few 600 foot setnet openings in the 2021 season; 2) it was unknown and unforeseen to the oard in 2020 that the current Administration of the State of A aska and the eadership of the Dept. of Fish and Game wou d inexp icabl refuse to cooperate with federal authorities to manage the EEZ waters of U I and force the counci to c ose this arge fishing area to commercia drift gi net fishing. his new, unprecedented and unforeseen action further exacerbates the need for a change to the existing regu ation so as to al ow for some meaningfu method of harvesting socke e whi e great reducing the harvest of king sa mon.

A of these factors and the abundance of evidence c ear demonstrate that A R 10 does in deed address an effect of a regu ation on a fisher that was unforeseen when that regu ation was adopted. he answer to the question asked in criterion "c)" is "Yes."

The fact that the Staff Assessment states "No" to both "a)" and "c)" raises some serious questions for the oard to consider. he message of the Staff Assessment has the unspoken implication that the entire ADF&G staff somehow unanimous agreed that A R 10 does not meet an of the criteria. Yet we know from persona conversations this is not the case. here is no explanation provided as to how the assessment was determined. Was it based on broad cooperative input and a carefu ana sis by senior staff? Was there a vote? If so - what were the resu ts? Who and how man felt the A R does or does not meet the criteria? he question emerges as to whether the assessment determination was made in the same manner as in the wel documented emergenc meeting this past summer, wherein the commissioner issued a finding based his narrow representation that the on effect in question was the c osure the ESSN. He dec ared that was an anticipated event and therefore was not unforeseen and hence no emergenc existed.

he true scope of A R 10 is to address the man serious negative effects caused as a resu t of the c osure of the ESSN, which effects were unforeseen by the oard. Not merel to state that the c osure itse f was an unforeseen event.

Additional the oard is eft to consider wh the highest evel of authorit in the department is not providing eadership and sound problem so ving ski s and actions and a so management ski s to address the problem and to enable a more balanced and effective mangement and uti ization of the vital sa mon resource. Wh is a va id proposed effective solution method not embraced, explored, employed and considered in an open, honest, co aborative and positive manner? How does one exp ain the dismissa and margina ization of the proposed so ution and a so the denia of the ver existence of an enormous problem so obvious to others? Where is the eadership, the stewardship, the responsibi it , and the accountabi it ?

Detai s provided under the heading #4 ADDI IONAL INFORMA ION are accurate and concise. It shou d be helpfu to the oard in understanding some, though certain not a , of the histor behind this current situation. It further explains some of the f aws in the 600 foot fisher as current defined from an application standpoint. It a so summarizes the ooming cha enges and uncertaint associated with the ook In et EEZ c osure. ut one thing is certain, fish unharvested in the EEZ cannot possibl be harvested along the U I beaches if there are no setnetters fishing in the water at a ! In general the additional information section tends to endorse the needs addressed in A R 10.

However, there is an obvious ommission of the a the relevant data obtained b the department which positivel showed the extreme effectiveness of the near shore fisher method. his data has been presented to the oard in other documentation and discussions. Suffice it to sa here that significant numbers of socke e were harvested and the number of kings harvested was a most insignificant — extremel ow numbers were taken. Again, the question arises — wh is this high relevant data not inc uded in the ADDI IONAL INFORMA ION section for the oard to consider? his is et again a prime examp e of how inf uencers in the ADFG are not sincere in their role to educate and advise the OF to assist ou in our duties but rather to present questionable and unjustified information, just ike these assessment eva uations and withho d and hide certain high re evant from ou, just ike the catch data and evidence of the effectiveness of the 600 foot setnet openings. It f ies in the face of good judgement and wise management and defies an sincere intent (b some) to so ve real problems with real so utions.

I acknow edge the col ective judgement of this oard and express appreciation for our sincere intentions to solve real problems with real so utions. Man conversations have indicated a wi ingness to earn the facts and understand the issues and a resolve to take positive action to overcome the serious problems inherent in the current regu ation structure and to do so even out of c c e and amidst the difficu ties caused b the pandemic. hank ou.

Warm regards,

ed rookston, ide haser Fisher , LLC — Kenai Setnetter

From: Thomas Hindman
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Wednesday, October 6, 2021 11:19:17 AM

I would like to show my support for ACR 10. As a long time set netter in Cook Inlet, i believe that the adoption of ACR 10 would help in the reductio of over escapement of Sockeye salmon during King return years.

Thanks

Thomas Hindman

Cook Inlet set netter

Central District, East Forlands

From: Travis Every
To: DFG, BOF Comments (DFG sponsored)
Subject: ACR 10
Date: Wednesday, October 6, 2021 9:08:57 AM

Members of the Alaska Board of Fisheries, I am writing this in response to staff comments provided on ACR 10.

Does the agenda change request address an effect of a regulation on a fishery that was unforeseen when that regulation was adopted? Yes, I believe that it does.

The pending closure of the Cook Inlet EEZ to commercial salmon fishing was not discussed during any BOF meeting when the current Kenai River Late Run King Salmon Management Plan was modified. When the current paired restrictions were adopted into the management plan the UCI drift fleet had access to substantially more fishing area, as well as fishing areas farther south, than they will in 2022 when the EEZ waters of Cook Inlet will be closed to commercial salmon fishing.

2021, and previous years, experienced sockeye salmon runs to both the Kenai and Kasilof rivers that substantially exceeded each rivers sockeye escapement management objectives. According to ADFG fish count website, the Kenai River was to be managed to an In-river goal of 1,000,000 to 1,200,000 sockeye passed the counter in 2021. As of August 24th, the number of Sockeye past the counter was 2,441,825. 1,241,825 above the upper end of the sockeye goal. The Kasilof River is managed to a BEG of 140,000 to 320,000 with an OEG of 140,000 to 370,000. On August 15th the count in the Kasilof River was 521,859. 201,859 above the BEG.

With the ESSN closed, large escapements were achieved in these river systems even though the Drift fleet was fished more aggressively by ADFG in an attempt to slow the entrance of sockeye. UCI set net, and drift fleets are sockeye targeted fisheries.

With the newly introduced restrictions on the UCI drift fleet it is a true statement that , " It is unknown to what extent harvest in the drift gillnet fishery may change because of this decision", but one thing is certain more sockeye will make it into these river systems resulting in even more over escapements, forgone harvest, and economic loss.

ACR 10 is simply seeking some limited opportunity to target sockeye in the ESSN when there is a harvestable surplus, while reducing incidental chinook harvest by utilizing the 600 ft fishery.

Travis Every.

Sent from my iPhone

From: Zachary Markham
To: DFG, BOF Comments (DFG sponsored)
Subject: Support for ACR 10
Date: Tuesday, October 5, 2021 3:03:14 PM

Dear Board Members,

Over the last few years, we have watched our season be closed due to low king abundance. I am in support of ACR 10. Please consider this ACR to help protect Alaska's fisheries and Alaskan Fishermen.

Zach Markham
Permit # R773996

--

Zachary Markham

480-773-1855

Submitted
ristine randt
Submitted On
10/4/2021 7:55:59 PM
Affi iation

Phone
[redacted]
Emai
[redacted]
Address
1412 4th Ave.
Kenai, Alaska 99611

October 03, 2021

oards Support Section

P.O. ox 115526

Juneau, AK 99811-5526

air ar son-VanDort, oard Members,

M Name is hristine randt, and I am a set net fisherman in t e Kasi of Subdistrict, Sout K- eac . We are a 4-generation site t at as been fis ing since t e ate 1960s. We old t e original permits and t ey ave stayed in t e fami .

I am opposed to an c anges at t is time. In 2020 m son submitted A R 5 to t e OF Work Session t at requested c arification by t e OF to give c arity to the ommissioner as to w en to use t e 600 ft. under the fo owing conditions; when t e Kasi of and Kenai River wi meet t e escapement goals and w en t e ower end of t e ate run Kenai King Salmon escapement may not be met. At t at time t e OF members did not support t is to be brought up at t e Statewide Meeting and suggested t at it be submitted as a proposal at t e next Upper ook In et Meeting c c e. ommissioner Laing said e wou d ike to see it used as a tool t e next summer to see ow it works.

I personal do not ave a beac net. We old 4 permits and out of t ose 4 on 2 ave beac nets. I also know t at t ere are a majorit of permit olders in t e Kasi of subdistrict t at do not ave beac nets. T is is a istorical fis er t at as always been managed for t e most part by t e Kasi of River Management plan. T e Kasi of River needs to be managed separatel , and t e tools to do t is are already in place in t e Kasi of River Salmon Management P an 5 AA 21.365.

T e tools are t ere for t e ommissioner and fis er managers to use. We ave continuous over escaped bot t e Kasi of and Kenai Rivers in a ope to make t e King runs return. I believe t at t is management strategy is f awed. Do we real know t e effect t at t ese arge returns into t e Kenai River ave on t e King eggs and redds? How about t e mi ions of pinks t at go up t e middle of t e river and are predators to King Salmon eggs w at effect do t ese ave on t e King redds? How about t e Rainbow Trout and t e Dol Varden? T ese fis are also predators and impact King Salmon and I know t at a biologist 10 ears ago was concerned about t eir arge popu ations.

The ast 3 ears t e arge King escapement in t e Kenai River as been 11,499 to 11,868. I believe t at we s ou d ower t e bottom end of t e arge Kenai River Late Run King escapement to 11,000. Kings are s owing up ater and ater ever season as are t e Kenai River Socke e Sa mon.

Over escaping t e Kasi of and Kenai Rivers is a waste of resources. T e Department as unnecessari real ocated t e sockeye runs to al users except for t e set net f eet. Our opportunit to arvest as been taken even t ough t e reds are plentifu .

I do not want the 600 ft. to turn into the status quo and I be ieve that this is w at wi appen if we do not wait unti an Upper ook In et oard c e appens.

A R's 11, 13 and 14 ave valid questions t at s ou d be answered and addressed at t is OF Work Session.

P ease consider directing ommissioner Laing to stay wit in Socke e goals. I am not suggesting t at we s ou d forget about t e King escapements but t e restrictions placed on set netters are aving ver itt e impact on getting more Kings into t e river and instead we are impacting t e Socke e runs.

T e definition of insanit : Doing t e same t ing over and over and expecting different resu ts.

Respectfu ,

ristine randt

Permit o ders, Brian, Kear and Gar Koski

Submitted
r L Hollier
Submitted On
10/4/2021 1:42:42 PM
Affili tion
Self

Hello OF hair Mrs. arlson-Van Dort and OF Members,

My n me is r L Hollier. I m life long resident of Kenai. I h ve been an ESSN fisherm n since 1971, I fish Kalifonsk each, mostl North Kalifonsk each, statistic l re 244-32. M fish sites are multi-permit famil operation, that fish loc tions from beach nets out to the 1.5 mile boundar .

I would like to submit few comments on proposals that the OF will address at the workshop in October, 2021.

I OPPOSE A R 9, which would seek to m ke changes to the Ken i River Late-Run King Salmon M n agement Pl n (KRLRKSMP). One item in A R 9, seeks to open the Kasilof Section 1/2 mile fisher during times when there are low King S lmon returns to the Kenai River. In the KRLRKSMP there re hourl restictions pl ced on the ESSN fisher 48,36,24 depending on wh t step downs re being t ken in-river. AS ADF& h s st ted in their comments " Additionall , when fishing in the K silof Section within one-h lf mile of shore, the hours used count tow rd the m ximum number of hours th t the entire ESSN fisher m be open". Fishing restricted hours, in the K silof 1/2 mile fisher , th t imp cts the entire ESSN fisher is wrong. I lso believe that the King Salmon harvest would be much higher th n 600 ft fisher . For these two major reasons I oppose A R 9.

I SUPPORT A R 10, which lso seeks to m ke changes in the KRLRKSMP, b fishing limited 600 ft fisher on the ESSN fisher . A R 10, s written is prett straight foreward. I do believe that there re unforseen consequences of some parts of the KRLRKSMP th t went into regul tion in 2020. I think th t n emergenc does exsit. In 2021 the Ken i River exceeded its upper end socke e in-river goal by over 1 Million and its SE by over 200%. In 2020 the OF, on recommendations from ADF& , lowered the E in the Kasilof River b 20,000 on the upper and lower end (140,000-340,000). Yet it 2021 the Kasilof River h d n escapement of over 520,000. I believe A R 10 should pass at this OF Work Shop. At the OF Statewide meeting in March 2022, all user groups and ADF& c n work on possibl m king some changes to A R 10 nd the KRLRKSMP , so grossl exceeding OF m ndated goals might not occur.

I OPPOSE A R 11. This A R asks to eliminate the 29 mesh gear restrictions th t occur in the KRLRKSMP. A 5 inch mesh net that is 45 meshes deep fishes over 18 ft deep t slack tide. The same gear that is 29 meshes deep fishes about 12 ft deep t slack tide. I believe th t fishing 29 mesh deep nets is tool that enables the ESSN fisher to h rvest socke e will reducing King Salmon h rvests, during times of low King Salmon returns.

Th nk ou,

r L Hollier

Ken i, Ak.

From: Mark Ducker
To: DFG, BOF Comments (DFG sponsored)
Subject: Comment and Information regarding ACR 11 and ACR 14
Date: Wednesday, October 6, 2021 11:51:34 PM
Attachments: ADFG response to Kintama report.pdf

Glenn,

First of all, the Department's response to ACR 11 negated the issue and provided nothing that was germane to the ACR in RC 2 by ADFG response. Second, ACR 14 was treated similarly with nothing germane to my ACR being provided to the public or board within RC 2.

The issue was explained in ACR 11. I will attach the Department s response to the Kintama Report since RC 2 negated the germaneness. Also on page 19 of the Kintama report the author misrepresents Kenai late-run king salmon model estimates as 5,098 Kenai River king salmon but were in fact all UCI king salmon harvested (Northern District, Kaligan Island, West side, and Eastside harvest as stipulated by Pat Shields in the memorandum notation).

ACR 14 was specific to yield loss and a management concern; i.e., surplus to escapement harvest foregone and predictable recruitment production losses resulting from chronic high escapement levels as a direct result of provisions found in the Kenai River late-run king salmon management plan and specified within ACR 14. However, RC 2 failed to mention any escapements nor BEG yield analysis for the public or board. I will attach files to address this issue including escapement tables on Kasilof sockeye salmon and Kenai late-run sockeye salmon. In the last 5 years alone 928,962 (nearly 1 million) Kasilof River sockeye salmon - surplus to escapement above the midpoint went into escapement and were foregone. Yield loss on Kenai late-run relative to surplus yield available was 3,349,703 sockeye over the last 5 years. Both sockeye stocks combined represents 4,278,665 sockeye (foregone harvest) - 21,393,325 pounds of commercial fish which represents 43 million dollars in ex-vessel value alone. The recruitment loss can represent an additional 43 million in economic losses.

I will forward escapement tables and CPUE sockeye data tables for the last 5 years which is germane to ACR 11 and ACR 14.

Thanks,

Jeff Beaudoin

COMMENTARY Open Access

Oversimplification of complex harvest modeling issues outlined in Welch *et al.* (2014)

T Mark Willette[1*], Pat Shields[1] and Eric C Volk[2]

Abstract

In their paper, 'Migration behavior of maturing sockeye (*Oncorhynchus nerka*) and Chinook salmon (*O. tshawytscha*) in Cook Inlet, Alaska, and implications for management,' Welch *et al.* (Anim. Biotelem. 2:18, 2014) report data on migratory behavior and relative swimming depths of Chinook and sockeye salmon near the Eastside Setnet (ESSN) fishery, Cook Inlet, Alaska, using acoustically tagged fish and an anchored array of acoustic receivers. Using this information, they provide a model to estimate changes in Chinook and sockeye salmon harvests associated with potential regulatory changes affecting surface gillnet depths in this fishery. We are concerned that the modeling exercise paints an unrealistic picture of how simply changing gillnet dimensions would translate into a viable management approach to preserve or increase sockeye salmon harvests while minimizing catch of Chinook salmon. Much of this fishery occurs in very shallow water, and Cook Inlet tides range about 10 m with tidal current speeds reaching about 9 km hr^{-1}. Model assumptions that gillnets in this dynamic environment were hanging vertically and that gillnets did not reach the bottom are not valid. Gillnets in this fishery billow in strong currents causing the lead lines at the bottom of the nets to rise in the water column, and an unknown but high fraction of all gillnets reach the bottom for some portion of each tide cycle. We believe further information and a more sophisticated analysis is needed to realistically model changes in Chinook and sockeye salmon harvests in relation to gillnet depths, and we are concerned about unintended consequences that may arise from unrealistic solutions based on limited data proposed in the regulatory arena.

Keywords: Chinook salmon, *Oncorhynchus tshawytscha*, Sockeye salmon, *Oncorhynchus nerka*, Acoustic telemetry, Migratory behavior, Swimming depth, Gillnet fishery, Harvest modeling, Fishery management

Background

In their paper, 'Migration behavior of maturing sockeye (*Oncorhynchus nerka*) and Chinook salmon (*O. tshawytscha*) in Cook Inlet, Alaska, and implications for management,' Welch *et al.* [1] provide interesting insights on migratory behavior and relative swimming depths of Chinook and sockeye salmon near the Eastside Setnet (ESSN) fishery, Cook Inlet, Alaska, using acoustically tagged fish and an anchored array of acoustic receivers. Based on data from 11 Chinook and 25 sockeye salmon, a central finding of their paper is that Chinook were deeper swimmers than sockeye salmon in the study area, with median migration depths of 4.8 and 1.8 m, respectively. Conceptually, these differences in water column distributions offer a means to selectively avoid the deeper migrating species in set gillnet fisheries by using shallower nets. The authors provide a modeling exercise ([1], Figure nine) which uses this data to predict how changes in gillnet dimensions could preserve desired harvest of migrating sockeye salmon while avoiding deeper swimming Chinook salmon, a species of particular concern returning to the Kenai River. Unfortunately, limited data from very few fish and a number of caveats, some noted by the authors, make their approach unrealistically simple and potentially misleading in the highly contentious regulatory environment of Cook Inlet fisheries.

Main text

The ESSN fishery is conducted in a 90-km section along the eastern shore of Cook Inlet extending from the beach to approximately 2.4 km offshore [2]. The bottom slope is very shallow with extensive mud flats at low

* Correspondence: mark.willette@alaska.gov
[1]Alaska Department of Fish and Game, 43961 Kalifornsky Beach Rd. Suite B, Soldotna, Alaska 99669, USA
Full list of author information is available at the end of the article

tide. South of the Kenai River, water depths at mean lower low water (MLLW) average about 10 m along the offshore boundary of the fishery (http://www.ngdc.noaa.gov). North of the Kenai River, in the Salamatof statistical area, where many Chinook salmon are caught, water depths near the offshore boundary at MLLW average about 15 m. Nets are often fishing in much shallower water towards shore. Spring tides in Cook Inlet range about 10 m and tidal current speeds can reach about 9 km hr^{-1} [3,4]. The tide stage at one end of the district is out of phase with the tide stage at the opposite end of the district by about 60° (http://tidesandcurrents.noaa.gov). The marine array of acoustic receivers used by Welch *et al*. [1] consisted of 16 acoustic receivers located along the offshore boundary of the ESSN fishery (approximately 2.4 km from shore) and 54 acoustic receivers located along transects extending 15 km offshore of the seaward boundary of the ESSN fishery. Thus, migration depth data were generally collected in water much deeper than where the fishery actually occurs.

A fundamental assumption used by Welch *et al*. in calculating the potential harvests of Chinook and sockeye salmon based on swimming depth data is that gillnets hang straight down, with a standard 45 mesh net covering about 5.5 m in depth. While we understand that this assumption was adopted for simplicity, the actual fishing depths of nets in this fishery are undoubtedly far more dynamic. In reality, gillnets in this fishery billow like a sail in strong currents causing the lead lines at the bottom of the nets to rise in the water column. The authors acknowledge that deep nets may rise off the bottom more than shallow nets due to their greater surface area and, thus, resistance in the strong current, potentially reducing some of the assumed difference in net depths. But, there are other variables that can affect the effective fishing depth of gillnets including current speed, which changes during the tide cycle; the weight of the lead line; and the number of fish caught in the net at any given time, which increases drag but also adds weight to the net. Effective fishing depth of individual gillnets changes through a tide cycle, and because tides are out of phase in different parts of the fishing district, effective fishing depths of nets at various locations in the district can be very different at any given time. It is likely that actual harvests of either species would differ substantially from those predicted under the simple scenario advanced in this study.

A second concern is the implicit assumption in the authors' analysis that gillnets would not rest on the sea bottom, allowing fish to swim below the nets. They point out that sport fishers frequently troll for Chinook salmon in very shallow water in this area. Since water depth in much of the ESSN fishery is very shallow, particularly south of the Kenai River, it is clear that a high fraction of all gillnets reach the bottom for some portion of each tide cycle during the fishery. Fishermen may also move their nets through the tide cycle depending upon conditions. Without a better understanding of net locations with respect to the sea floor through a tide cycle, it is very difficult to predict actual harvest changes with altered net depth. In addition, differences in depth distributions of Chinook and sockeye salmon in deep water will not be maintained in shallow water where the bottom forces their distributions to overlap, and shallower nets will not affect harvests of Chinook relative to sockeye salmon when nets reach the sea floor.

In an earlier study focused on how to minimize harvests of Chinook salmon in the ESSN fishery, Bethe and Hansen [5] found that the highest average harvest rate of Chinook salmon (0.41 per net set) occurred in set nets located at intermediate distances from shore where gillnets were likely reaching the bottom at low tide. The average harvest rate of Chinook salmon further inshore (0.23 per net set) and offshore (0.15 per net set) was lower. Bethe and Hansen's [5] data are consistent with the notion that Chinook salmon are most often captured as they migrate inshore and first encounter gillnets that reach the bottom. Reducing the depth of gillnets may simply shift the harvest closer to the beach where nets again reach the bottom. Importantly, this study [5] also found that the vertical distribution of Chinook salmon catches in gill nets was essentially uniform at all distances from shore.

Finally, size distributions of acoustically tracked Chinook salmon and those captured in the ESSN fishery were very different. The smallest acoustically tracked Chinook salmon was about 85 cm in length [6], whereas 82% of Chinook salmon captured in the ESSN fishery were <85 cm (mode 50 cm) in length [7]. Welch *et al*. [6] found that Chinook salmon mean swimming depths were not correlated with length, but this may have been due to the limited sample size and data range. Folkedal *et al*. [8] found that smaller Atlantic salmon swam at shallower depths in commercial sea cages.

Conclusions

In our view, analyses in Welch *et al*. [1] oversimplify problems associated with estimating changes in Chinook and sockeye salmon harvests that may occur with changing gillnet depths, and actual harvest changes would likely differ substantially. We do not take issue with the central findings of the study which document migratory behavior of these species within the study area where the acoustic array was located. Unfortunately, despite best efforts, this study tagged very few Chinook salmon and not all of those were Kenai River origin fish. We do not know how well these fish represent Kenai River Chinook salmon behavior in general or how their migration depths may change as they leave the study area for the river and shallower water. Combined with the complexities of net and fishermen behavior as the fishery is prosecuted, predicting actual harvest impacts to Chinook and sockeye salmon from simple changes in net dimensions is very difficult and uncertain. We are concerned that this harvest modeling exercise paints an unrealistic picture of how simply changing gillnet dimensions would translate into a viable management approach to preserve or increase sockeye salmon harvests while minimizing Chinook salmon harvests.

The complexity of the problem may require simulating gillnet behavior in tidal currents and the migratory behavior of Chinook and sockeye salmon in the ESSN fishery. Modeling gillnet behavior will require information on locations of all gillnets and bottom depth at each net location. The effective fishing depths of gillnets should also be determined over a range of current speeds with nets that are hung with various amounts of web and lead line. Use of time-depth recorders on various parts of the net could be used to refine our understanding of net behavior. These data could be used in conjunction with a tide model to simulate the behavior of gillnets during the course of a fishing season. Simulating Chinook and sockeye salmon migratory behavior will require information on swimming depths of Chinook and sockeye salmon in shallower waters and a thorough understanding of how these fish migrate within the fishery. Developing the level of understanding of these processes necessary to accurately estimate harvest changes will be very costly and challenging. We are committed to providing the best information possible to the Alaska Board of Fisheries as they deliberate regulatory changes. However, we are also acutely aware of unintended consequences that may arise from unrealistic solutions based on limited data proposed in the regulatory arena.

Abbreviations

ESSN: Eastside Setnet; MLLW: Mean lower low water.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

TMW, PS, and ECV co-wrote the manuscript. All authors read and approved the final manuscript.

Authors' information

TMW has been employed by the State of Alaska Department of Fish and Game (ADF&G) for 23 years and currently holds the position of Research Project Leader for the ADF&G, Commercial Fisheries Division in upper Cook Inlet. He has been in this position for the past 14 years.
PS has been employed by the ADF&G for 30 years and currently holds the position of Area Management Biologist for the ADF&G, Commercial Fisheries Division in upper Cook Inlet. He has held this position for the past 4 years and previously held the position of Assistant Area Management Biologist for 10 years.
ECV has been employed by the ADF&G for 10 years and currently holds the position of Chief Fishery Scientist for salmon, Commercial Fisheries Division, Headquarters.

Acknowledgements

The preparation and submission of this manuscript was funded by the State of Alaska.

Author details

[1]Alaska Department of Fish and Game, 43961 Kalifornsky Beach Rd. Suite B, Soldotna, Alaska 99669, USA. [2]Alaska Department of Fish and Game, 333 Raspberry Rd, Anchorage, Alaska 99518, USA.

Received: 3 February 2015 Accepted: 11 March 2015
Published online: 26 March 2015

References

1. Welch DW, Porter AD, Winchell P. Migration behavior of maturing sockeye (*Oncorhynchus nerka*) and Chinook salmon (*O. tshawytscha*) in Cook Inlet, Alaska, and implications for management. Anim Biotelem. 2014;2:18.
2. Shields P, Dupuis A. Upper Cook Inlet commercial fisheries annual management report, 2013. Fishery Management Report 13-49. Anchorage, AK: Alaska Department of Fish and Game; 2013. Available at: http://www.adfg.alaska.gov/FedAidpdfs/FMR13-49.pdf.
3. Muench RD, Schumacher JD, Pearson CA. Circulation in the lower Cook Inlet, Alaska. NOAA Tech Mem. 1981;28:PB82–126418. ERL PMEL.
4. Moore SE, Shelden KEW, Litzky LK, Mahoney BA, Rugh DJ. Beluga, *Delphinapterus leucas*, habitat associations in Cook Inlet. Alaska Mar Fish Rev. 2000;62(3):60–80.
5. Bethe, ML, Hansen, P. Investigations of methods and means to minimize Chinook salmon harvest in the East Side Set Net Fishery of Upper Cook Inlet, 1996. Special Publication 98-3. Anchorage, AK: Alaska Department of Fish and Game; 1998. Available at: http://www.adfg.alaska.gov/FedAidPDFs/sp98-03.pdf.
6. Welch DW, Porter AD, Winchell P. Chinook and sockeye salmon migration patterns in Cook Inlet, 2013. Report to the State of Alaska: Department of Fish and Game, Division of Commercial Fisheries, By Kintama Research Services, Ltd.; 2013.
7. Eskelin, T, Barclay, AW, Antonovich, A Mixed stock analysis and age, sex, and length composition of Chinook salmon in the EastSide Set Gillnet Fishery in upper Cook Inlet, Alaska, 2010-2013. Fishery Data Series 13-63. Anchorage, AK: Alaska Department of Fish and Game; 2013. Available at: http://www.adfg.alaska.gov/FedAidPDFs/FDS13-63.pdf.
8. Folkedal O, Stien LH, Nilsson J, Torgersen T, Fosseidengen JE, Oppedal F. Sea caged Atlantic salmon display size-dependent swimming depth. Aquatic Living Res. 2012;25(2):143.

From: Mark Ducker
To: DFG, BOF Comments (DFG sponsored)
Subject: Fwd: Info request
Date: Wednesday, October 6, 2021 11:52:20 PM
Attachments: image001.png

---------- Forwarded message ---------
From: **Marston, Brian H (DFG)** <brian.marston@alaska.gov>
Date: Tue, Oct 5, 2021 at 4:00 PM
Subject: RE: Info request
To: Mark Ducker <mandsduckerak@gmail.com>

That table contains final counts so I don't want to put that in the table…..but below are preliminary numbers for 2021 and are available on the fish count web site

The preliminary numbers for 2021 are

Kenai 2441825

Kasilof 521855

Fish Creek 22271, weir pulled early on 7/28 but still made goal

Brian Marston

Fishery Biologist

UCI Commercial Fisheries

Alaska Department of Fish and Game

9074207740 cell

9072629368 office

From: Mark Ducker <mandsduckerak@gmail.com>
Sent: Tuesday, October 5, 2021 3:43 PM
To: Marston, Brian H (DFG) <brian.marston@alaska.gov>
Subject: Re: Info request

Thanks - please include 2021 numbers as this year we got jacked by 2/3 loss of gear / less than half hours allowed / and nearly half the time fished in a cup of water.

Jeff

On Tue, Oct 5, 2021 at 3:02 PM Marston, Brian H (DFG) <brian.marston@alaska.gov> wrote:

	Kenai River		Kasilof River		Fish Creek	
	Abundance	Abundance	Abundance	Abundance	Abundance	Abundance
Year	Goal[a]	Estimate [b,c]	Goal	Estimate[b,c]	Goal	Estimate[c]
1978	350,000-500,000	398,900	75,000-150,000	116,600	-	3,555
1979	350,000-500,000	285,020	75,000-150,000	152,179	-	68,739
1980	350,000-500,000	464,038	75,000-150,000	184,260	-	62,828
1981	350,000-500,000	407,639	75,000-150,000	256,625	-	50,479
1982	350,000-500,000	619,831	75,000-150,000	180,239	50,000	28,164
1983	350,000-500,000	630,340	75,000-150,000	210,271	50,000	118,797
1984	350,000-500,000	344,571	75,000-150,000	231,685	50,000	192,352
1985	350,000-500,000	502,820	75,000-150,000	505,049	50,000	68,577
1986	350,000-500,000	501,157	75,000-150,000	275,963	50,000	29,800
1987	400,000-700,000	1,596,871	150,000-250,000	249,250	50,000	91,215
1988	400,000-700,000	1,021,469	150,000-250,000	204,000	50,000	71,603
1989	400,000-700,000	1,599,959	150,000-250,000	158,206	50,000	67,224
1990	400,000-700,000	659,520	150,000-250,000	144,289	50,000	50,000
1991	400,000-700,000	647,597	150,000-250,000	238,269	50,000	50,500
1992	400,000-700,000	994,798	150,000-250,000	184,178	50,000	71,385
1993	400,000-700,000	813,617	150,000-250,000	149,939	50,000	117,619
1994	400,000-700,000	1,003,446	150,000-250,000	205,117	50,000	95,107
1995	450,000-700,000	630,447	150,000-250,000	204,935	50,000	115,000
1996	550,000-800,000	797,847	150,000-250,000	249,944	50,000	63,160
1997	550,000-825,000	1,064,818	150,000-250,000	266,025	50,000	54,656
1998	550,000-850,000	767,558	150,000-250,000	273,213	50,000	22,853
1999	750,000-950,000	803,379	150,000-250,000	312,587	50,000	26,667
2000	600,000-850,000	624,578	150,000-250,000	256,053	50,000	19,533
2001	600,000-850,000	650,036	150,000-250,000	307,570	50,000	43,469
2002	750,000-950,000	957,924	150,000-250,000	226,682	20,000 - 70,000	90,483
2003	750,000-950,000	1,181,309	150,000-250,000	359,633	20,000 - 70,000	92,298
2004	850,000-1,100,000	1,385,981	150,000-250,000	577,581	20,000 - 70,000	22,157
2005	850,000-1,100,000	1,376,452	150,000-250,000	348,012	20,000 - 70,000	14,215
2006	750,000-950,000	1,499,692	150,000-250,000	368,092	20,000 - 70,000	32,566
2007	750,000-950,000	867,572	150,000-250,000	336,866	20,000 - 70,000	27,948
2008	650,000-850,000	614,946	150,000-250,000	301,469	20,000 - 70,000	19,339
2009	650,000-850,000	745,170	150,000-250,000	297,125	20,000 - 70,000	83,477
2010	750,000-950,000	970,662	150,000-250,000	267,013	20,000 - 70,000	126,829
2011	1,100,000-1,350,000	1,599,217	160,000-390,000	245,721	20,000 - 70,000	66,678
2012	1,100,000-1,350,000	1,581,555	160,000-390,000	374,523	20,000 - 70,000	18,813
2013	1,000,000-1,200,000	1,359,893	160,000-390,000	489,654	20,000 - 70,000	18,912
2014	1,000,000-1,200,000	1,520,340	160,000-340,000	439,977	20,000 - 70,000	43,915
2015	1,000,000-1,200,000	1,704,767	160,000-340,000	470,677	20,000 - 70,000	102,296
2016	1,100,000-1,350,000	1,383,692	160,000-340,000	239,981	20,000 - 70,000	46,202
2017	1,000,000-1,300,000	1,308,498	160,000-340,000	358,724	15,000 - 45,000	61,469
2018	900,000-1,100,000	1,035,761	160,000-340,000	394,309	15,000 - 45,000	71,556
2019	1,000,000-1,300,000	1,849,054	160,000-340,000	378,416	15,000 - 45,000	76,031
2020	1,000,000-1,200,000	1,714,565	140,000-320,000	545,654	15,000 - 45,000	64,234

Note : ND = no data; "-" = incomplete count

[a] Inriver goal

[b] From 1978 to 2010, enumeration estimates and goals prior were in BENDIX units; 2011 through 2020 are in DIDSON units.

[c] Enumeration etimates prior to 2020 reflect minor adjustments to the escapement database.

[d] Yetna River SEG replaced with lake goals at Judd, Chelatna, and Larson Lakes.

[e] Escapement estimates via remote camera; an unknown number of salmon escaped into the lake after camera malfunction or removal.

Brian Marston

Fishery Biologist

UCI Commercial Fisheries

Alaska Department of Fish and Game

9074207740 cell

9072629368 office

From: Mark Ducker <mandsduckerak@gmail.com>
Sent: Tuesday, October 5, 2021 2:58 PM
To: Marston, Brian H (DFG) <brian.marston@alaska.gov>
Subject: Info request

Please send the updated escapement table for Kasilof sockeye and Kenai late-run sockeye.

Jeff B.

From: Mark Ducker
To: DFG, BOF Comments (DFG sponsored)
Subject: Fwd: Data request follow-up
Date: Thursday, October 7, 2021 12:01:41 AM
Attachments: 2021 announcements in recordings of ESSN king harvest2.docx
Copy of Copy of Beaudoin_request_CPUE-bhm3.xlsx

---------- Forwarded message ---------
From: **Marston, Brian H (DFG)** <brian.marston@alaska.gov>
Date: Sat, Sep 4, 2021 at 2:18 PM
Subject: Data request follow-up

Jeff attached please find my response to your data requests.

You asked for the sockeye and king harvest by stat area in the ESSN fishery for year 2017-2021, the gear allowed, and the area open (see excel file). As per your request, I also calculated a cpue for those harvests by stat area. Feel free to calculate that differently if you wish…

You also asked for the recorded announcements and the data (I added the data used to the earlier file I had sent) used to calculate those announcements for Kenai stock compositions for the Kenai and Kasilof section harvests of king salmon in 2021 (see word file).

I realize you also asked for calculations of the Kenai large king harvest by each opening and stat area…

As stated in an email to you on 8/31, the department will not be calculating Kenai large stock composition of harvests by stat area as the sample size is not sufficient to provide those estimates.

If you notice or feel there are errors in these files please contact me so we can rectify the situation. I had to go back to each specific EO individually for all 5 years to get the hours and gear allowed and area open…. so there was a lot searching and of transcription involved. The gear allowed per area is often complex. Please let me know if you have questions or concerns about this file, or if you feel I have misunderstood your requests.

Let me know that you received this please, and if it fulfills your current requests. Also please include me in any further data request directly so that these can be fulfilled ASAP.

Brian

Brian Marston

Fishery Biologist

UCI Commercial Fisheries

Alaska Department of Fish and Game

9074207740 cell

9072629368 office

UCI recording announcements of estimated Kenai River king salmon harvested in the 2021 ESSN fishery and date first announced.

All data that went into these recordings was preliminary and the recordings reflect the best estimates of large Kenai River king harvest available at that time. Final analysis of the genetic samples may change these estimates to some degree.

Changes to the daily tally of total kings harvested may have changed the announcements (see the 7/14 and 7/15 announcements). Each announcement was repeated until the tally changed with each proceeding commercial opening.

Formula used

(Total kings)*(2021 pooled proportion large)*(previous years' average Kenai stock)

Calculations and recorded announcements

7/7; As of 7/5, the total season harvest of Kenai River large king salmon in the ESSN fishery was 56 fish, and the total harvest of king salmon of all sizes and stocks was 352.

(Total kings)352*(2021 pooled proportion large).23*(previous years' average Kenai stock).69

7/8; As of July 7, the 2021 total season harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 56 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 356.

(Total kings)356*(2021 pooled proportion large).23*(previous years' average Kenai stock).69

7/11; As of July 9, the 2021 total season harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 91 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 525.

(Total kings)525*(2021 pooled proportion large).25*(previous years' average Kenai stock).69

7/14; As of July 12, the total harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 99 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 718.

(Total kings)718*(2021 pooled proportion large).20*(previous years' average Kenai stock).69

7/15; As of July 12, the total harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 106 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 768.

(Total kings)768*(2021 pooled proportion large).20*(previous years' average Kenai stock).69

7/21; As of July 19, the total harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 168 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 1,160.

(Total kings)1160*(2021 pooled proportion large).21*(previous years' average Kenai stock).69

7/22; As of July 20, the total harvest estimate of Kenai River late run large king salmon in the ESSN fishery was 187 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 1,234.

(Total kings)1234*(2021 pooled proportion large).22*(previous years' average Kenai stock).69

7/26; The total harvest estimate to date of Kenai River late run large king salmon in the ESSN fishery was 187 fish, and the total ESSN harvest of king salmon of all sizes and stocks was 1,234. **This above announcement was repeated until 8/2 in the morning and all announcements of king harvests were discontinued after that time.**

(Total kings)1234*(2021 pooled proportion large).22*(previous years' average Kenai stock).69

All Kings

Shaded rows are preliminary harvest data from inseason assessment

Species Code 410

	Sum of Number Of Animals harvested, Stat Area								Hours	Hours	Hours	Hours	Hours	Hours	Hours	Stat Area CPUE kings per hour							gear allowed	area open
	24421	24422	24425	24431	24432	24441	24442	All ESSN	24421	24422	24425	24431	24432	24441	24442	**24421**	**24422**	**24425**	**24431**	**24432**	**24441**	**24442**		
2017																2017	2017	2017	2017	2017	2017	2017		
06/24	21	20		13				54	13	13		13				1.615385	1.538462		1				all	Kas Full
06/26	26	22		18				66	14	14		14				1.857143	1.571429		1.285714				all	Kas Full
06/28	7	15		9				31	9	9		9				0.777778	1.666667		1				all	Kas Full
06/29	16	13		16				45	12	12		12				1.333333	1.083333		1.333333				all	Kas Full
07/01	16	20		29				65	17	17		17				0.941176	1.176471		1.705882				all	Kas Full
07/03	44	45		27				116	14	14		14				3.142857	3.214286		1.928571				all	Kas Full
07/05	27	21		15				63	9	9		9				3	2.333333		1.666667				all	Kas Full
07/06	56	32		21				109	12	12		12				4.666667	2.666667		1.75				all	Kas Full
07/08	66	64		43				173	17	17		17				3.882353	3.764706		2.529412				all	Kas Full
07/10	106	27		23	39	122	5	322	12	12		12	12	12	12	8.833333	2.25		1.916667	3.25	10.16667	0.416667	all	KKE Full
07/12	51	43		44	42	125	1	306	16	16		16	16	16	16	3.1875	2.6875		2.75	2.625	7.8125	0.0625	all	KKE Full
07/13	99	67		57	65	226	6	520	15	15		15	15	15	15	6.6	4.466667		3.8	4.333333	15.06667	0.4	all	KKE Full
07/15	80	45		53	60	170	3	411	15	15		15	15	15	15	5.333333	3		3.533333	4	11.33333	0.2	all	KKE Full
07/17	73	62		78	61	188	7	469	12	12		12	12	12	12	6.083333	5.166667		6.5	5.083333	15.66667	0.583333	all	KKE Full
07/20	27	64		99	122	172	8	492	12	12		12	12	12	12	2.25	5.333333		8.25	10.16667	14.33333	0.666667	all	KKE Full
07/29	27	35		86	67	341	16	572	14	14		14	14	14	14	1.928571	2.5		6.142857	4.785714	24.35714	1.142857	all	KKE Full
07/31	28	24		65	62	178		357	12	12		12	12	12	12	2.333333	2		5.416667	5.166667	14.83333	0	all	KKE Full
08/03	37	11		43	59	99	1	250	12	12		12	12	12	12	3.083333	0.916667		3.583333	4.916667	8.25	0.083333	all	KKE Full
08/07	6	19		17	22	76	1	141	12	12		12	12	12	12	0.5	1.583333		1.416667	1.833333	6.333333	0.083333	all	KKE Full
08/09	9	13		17	15	54	1	109	15	15		15	15	15	15	0.6	0.866667		1.133333	1	3.6	0.066667	all	KKE Full
08/10	10	15		12	16	26	1	80	12	12		12	12	12	12	0.833333	1.25		1	1.333333	2.166667	0.083333	all	KKE Full
08/14	2	6		4	2	5	1	20	16	16		16	16	16	16	0.125	0.375		0.25	0.125	0.3125	0.0625	all	Kas .5 mile (4), KKE Full (12)
08/15	3			5				8	13	13		13				0.230769	0		0.384615				all	Kas .5 mile
2018																**2018**	**2018**	**2018**	**2018**	**2018**	**2018**	**2018**		
06/25	27	24		8				59	12	12		12				2.25	2		0.666667				all	Kas Full
06/28	31	81		19				131	12	12		12				2.583333	6.75		1.583333				all	Kas Full
06/30	45	70		18				133	14	14		14				3.214286	5		1.285714				all	Kas Full
07/04	74	105		57				236	16	16		16				4.625	6.5625		3.5625				all	Kas Full
07/07	55	39		36				130	8	8		8				6.875	4.875		4.5				all	Kas Full
07/09	36	54		49	51	102	6	298	12	12		12	12	12	12	3	4.5		4.083333	4.25	8.5	0.5	all	KKE Full
07/12	25	62		87	177	110	4	465	12	12		12	12	12	12	2.083333	5.166667		7.25	14.75	9.166667	0.333333	all	KKE Full
07/14	39	63		37				139	12	12		12				3.25	5.25		3.083333				all	Kas .5 mile
07/16							17	17							12							1.416667	all	EF full
07/18	2	19		11				32	7	7		7				0.285714	2.714286		1.571429				all	Kas 600 ft
07/19	38	46		41	5			130	12	12		12	12			3.166667	3.833333		3.416667	0.416667			all	Kas .5 mile, NKB 600
07/21	34	25		24	6			89	12	12		12	12			2.833333	2.083333		2	0.5			all	Kas .5 mile, NKB 600
07/22	10	5		12				27	14	14		14				0.714286	0.357143		0.857143	#DIV/0!			all	Kas 600 ft
07/23	27	26		40	59	196	5	353	12	12		12	12	12	12	2.25	2.166667		3.333333	4.916667	16.33333	0.416667	all	KKE Full
07/26	7	6		7				20	12	12		12				0.583333	0.5		0.583333				all	Kas 600 ft
07/28	10	11		4				25	8	8		8				1.25	1.375		0.5				all	Kas 600 ft
08/08			3					3			12							0.25					all	KRSHA
08/09			7					7			24							0.291667					all	KRSHA
08/10			8					8			24							0.333333					all	KRSHA
08/11			4					4			24							0.166667					all	KRSHA
08/12			6					6			8							0.75					all	KRSHA
2019																**2019**	**2019**	**2019**	**2019**	**2019**	**2019**	**2019**		
06/27	21	19		12				52	12	12		12				1.75	1.583333		1				all	Kas Full
06/29	20	12		12				44	8	8		8				2.5	1.5		1.5				all	Kas Full
07/01	17	19		9				45	12	12		12				1.416667	1.583333		0.75				all	Kas Full
07/04	22	24		28				74	14	14		14				1.571429	1.714286		2				(i)	Kas Full
07/08	39	39		49	26	96	6	255	16	16		16	16	16	16	2.4375	2.4375		3.0625	1.625	6	0.375	(i) except EF	KKE Full
07/11	31	43		37	39	90	8	248	15	15		15	15	15	15	2.066667	2.866667		2.466667	2.6	6	0.533333	(i) except EF	KKE Full
07/13	24	23		41	4			92	12	12		12	12			2	1.916667		3.416667	0.333333			(i)	Kas .5 mile, NKB 600
07/15	26	45		30	39	80	3	223	14	14		14	14	14	14	1.857143	3.214286		2.142857	2.785714	5.714286	0.214286	(i)	KKE Full
07/18	50	53		51	77	170	10	411	15	15		15	15	15	15	3.333333	3.533333		3.4	5.133333	11.33333	0.666667	(i)	KKE Full
07/21	25	26		41	13			105	14	14		14	14			1.785714	1.857143		2.928571	0.928571			(i)	Kas .5 mile, NKB 600
07/22	24	27		27	37	107	13	235	15	15		15	15	15	15	1.6	1.8		1.8	2.466667	7.133333	0.866667	(i)	KKE Full
07/25	19	14		35	26	30	2	126	17	17		17	17	17	17	1.117647	0.823529		2.058824	1.529412	1.764706	0.117647	(i)	KKE Full
07/28	7	9		15	12	53	4	100	16	16		16	16	16	16	0.4375	0.5625		0.9375	0.75	3.3125	0.25	all	KKE Full
07/29	7	9		16	16	43	2	93	16	16		16	16	16	16	0.4375	0.5625		1	1	2.6875	0.125	all	KKE Full
07/31	7	7		14	15	25	2	70	16	16		16	16	16	16	0.4375	0.4375		0.875	0.9375	1.5625	0.125	all	KKE Full
08/01	4	13		17	11	7	4	56	16	16		16	16	16	16	0.25	0.8125		1.0625	0.6875	0.4375	0.25	all	KKE Full
08/02		1		3				4	12	12		12	12			0	0.083333		0.25	0			all	Kas 600 Ken 600
08/03	3	3		4	2		1	13	11	11		11	11	11	11	0.272727	0.272727		0.363636	0.181818	0	0.090909	all	KKE Full
2020																**2020**	**2020**	**2020**	**2020**	**2020**	**2020**	**2020**		
06/23	15	25		7				47	15	15		15				1	1.666667		0.466667				(ii)	Kas Full
06/25	10	17		1				28	12	12		12				0.833333	1.416667		0.083333				(ii)	Kas Full
06/27	7	18		2				27	9	9		9				0.777778	2		0.222222				(ii)	Kas Full
06/30	11	17		9				37	12	12		12				0.916667	1.416667		0.75				(ii)	Kas Full
07/02	16	20		6	1			43	15	15		15	15			1.066667	1.333333		0.4	0.066667			(i) Kas, NKB 4.75	NKB Kas full
07/04	23	23		6				52	9	9		9	9			2.555556	2.555556		0.666667	0			(i) Kas, NKB 4.76	NKB Kas full
07/06	11	27		18	1			57	13	13		13	13			0.846154	2.076923		1.384615	0.076923			(i) Kas, NKB 4.77	NKB Kas full
07/07	5	12		7	1			25	13	13		13	13			0.384615	0.923077		0.538462	0.076923			Kas all, NKB 4.75	Kas 600, NKB 600
07/08	13	25		2				40	8	8		8	8			1.625	3.125		0.25	0			Kas (ii), NKB 4.75	Kas 600, NKB 600
07/09	16	9		2	1	41	2	71	15	15		15	15	15	15	1.066667	0.6		0.133333	0.066667	2.733333	0.133333	KKE (ii)	KKE all
07/13	7	13		9	5	33		67	12	12		12	12	12	12	0.583333	1.083333		0.75	0.416667	2.75	0	KKE (ii)	KKE all
07/15	16	12		11	6	60		105	12	12		12	12	12	12	1.333333	1		0.916667	0.5	5	0	KKE (ii)	KKE all
07/16	5	5		4				14	12	12		12	12			0.416667	0.416667		0.333333	0			all	Kas 600, NKB 600
07/20	9	16		9	13	63	2	112	12	12		12	12	12	12	0.75	1.333333		0.75	1.083333	5.25	0.166667	KKE (ii)	KKE all
07/21	4	5		3				12	8	8		8				0.5	0.625		0.375				all	Kas 600
07/22	14	13		13	15	56	4	115	12	12		12	12	12	12	1.166667	1.083333		1.083333	1.25	4.666667	0.333333	(ii)	KKE all
2021																**2021**	**2021**	**2021**	**2021**	**2021**	**2021**	**2021**		
22-Jun	20	21		8				49	12	12		12				1.666667	1.75		0.666667				(ii)	Kas all
24-Jun	23	9		5				37	15	15		15				1.533333	0.6		0.333333				(ii)	Kas all
26-Jun	22	13		7				42	14	14		14				1.571429	0.928571		0.5				(ii)	Kas all
28-Jun	20	32		20				72	15	15		15				1.333333	2.133333		1.333333				(ii)	Kas all
1-Jul	20	11		19	-			50	15	15		15	15			1.333333	0.733333		1.266667	0			Kas (ii), NKB 4.75	Kas all, NKB 600
3-Jul	15	15		18	1			49	17	17		17	17			0.882353	0.882353		1.058824	0.058824			Kas (ii), NKB 4.76	Kas all, NKB 600
5-Jul	16	12		20	2			50	15	15		15	15			1.066667	0.8		1.333333	0.133333			Kas (ii), NKB 4.77	Kas all, NKB 600
6-Jul	3	1		1	-			5	18	18		18	18			0.166667	0.055556		0.055556	0			Kas (i), NKB 4.75	Kas 600, NKB 600
7-Jul	8	9		8	1			26	15	15		15	15			0.533333	0.6		0.533333	0.066667			Kas (ii), NKB 4.75	Kas all, NKB 600
8-Jul	12	14		15	5	97	4	147	18	18		18	18	18	18	0.666667	0.777778		0.833333	0.277778	5.388889	0.222222	(ii)	all
12-Jul	11	23		24	48	76	3	185	12	12		12	12	12	12	0.916667	1.916667		2	4	6.333333	0.25	(ii)	all
13-Jul	9	10		1	3			23	17	17		17	17			0.529412	0.588235		0.058824	0.176471			(ii)	Kas 600, NKB 600
14-Jul	7	16		4	-			27	17	17		17	17			0.411765	0.941176		0.235294	0			(ii)	Kas 600, NKB 600
15-Jul	15	21		17	38	89	8	188	12	12		12	12	12	12	1.25	1.75		1.416667	3.166667	7.416667	0.666667	(ii)	KKE all
18-Jul			2					2			12							0.166667					all	KRSHA
19-Jul	18	30		38	29	100	8	223	12	12		12	12	12	12	1.5	2.5		3.166667	2.416667	8.333333	0.666667	(ii)	KKE all
20-Jul	8	4		11	4	43	2	72	12	12		12	12	12	12	0.666667	0.333333		0.916667	0.333333	3.583333	0.166667	(ii)	KKE 600

Abreviations

Kas = Kasilof section
KKE - Kenai, Kasilof, and East Foreland sections
KRSHA = Kasilof special harvtes area
NKB = North K Beach stat area
EF = East Forelands section

Sockeye
Species Code 420

Shaded cells are preliminary data from inseason assessment

Stat area	Sum of Number Of Animals harvested, Stat Area 24421	24422	24425	24431	24432	24441	24442	All ESSN	Hours 24421	Hours 24422	Hours 24425	Hours 24431	Hours 24432	Hours 24441	Hours 24442	Stat Area CPUE sockeye per hour 24421	24422	24425	24431	24432	24441	24442	gear allowed	area open
2017																**2017**	**2017**	**2017**	**2017**	**2017**	**2017**	**2017**		
06/24	7,437	2,572		3,040				13,049	13	13		13				572.0769	197.8462		233.8462				all	Kas Full
06/26	9,964	5,799		5,290				21,053	14	14		14				711.7143	414.2143		377.8571				all	Kas Full
06/28	3,250	2,097		2,533				7,880	9	9		9				361.1111	233		281.4444				all	Kas Full
06/29	5,250	2,053		1,738				9,041	12	12		12				437.5	171.0833		144.8333				all	Kas Full
07/01	9,930	3,829		7,282				21,041	17	17		17				584.1176	225.2353		428.3529				all	Kas Full
07/03	12,152	7,121		6,567				25,840	14	14		14				868	508.6429		469.0714				all	Kas Full
07/05	10,434	2,760		2,929				16,123	9	9		9				1159.333	306.6667		325.4444				all	Kas Full
07/06	13,637	4,840		2,865				21,342	12	12		12				1136.417	403.3333		238.75				all	Kas Full
07/08	17,396	10,250		6,184				33,830	17	17		17				1023.294	602.9412		363.7647				all	Kas Full
07/10	22,021	8,395		3,150	3,139	6,165	1,700	44,570	12	12		12	12	12	12	1835.083	699.5833		262.5	261.5833	513.75	141.6667	all	KKE Full
07/12	23,649	8,321		2,973	2,432	4,172	949	42,496	16	16		16	16	16	16	1478.063	520.0625		185.8125	152	260.75	59.3125	all	KKE Full
07/13	20,070	8,658		2,393	2,679	3,991	987	38,778	15	15		15	15	15	15	1338	577.2		159.5333	178.6	266.0667	65.8	all	KKE Full
07/15	24,599	14,298		4,406	4,397	6,947	1,314	55,961	15	15		15	15	15	15	1639.933	953.2		293.7333	293.1333	463.1333	87.6	all	KKE Full
07/17	36,513	16,824		14,643	15,689	39,023	5,944	128,636	12	12		12	12	12	12	3042.75	1402		1220.25	1307.417	3251.917	495.3333	all	KKE Full
07/20	20,662	12,589		8,897	9,590	30,803	5,911	88,452	12	12		12	12	12	12	1721.833	1049.083		741.4167	799.1667	2566.917	492.5833	all	KKE Full
07/29	17,731	13,408		5,018	5,052	24,324	3,599	69,132	14	14		14	14	14	14	1266.5	957.7143		358.4286	360.8571	1737.429	257.0714	all	KKE Full
07/31	9,100	4,977		4,188	5,721	16,151	3,169	43,306	12	12		12	12	12	12	758.3333	414.75		349	476.75	1345.917	264.0833	all	KKE Full
08/03	16,383	8,255		5,731	5,429	8,040	3,756	47,594	12	12		12	12	12	12	1365.25	687.9167		477.5833	452.4167	670	313	all	KKE Full
08/07	5,943	5,884		3,291	4,117	13,813	4,772	37,820	12	12		12	12	12	12	495.25	490.3333		274.25	343.0833	1151.083	397.6667	all	KKE Full
08/09	4,118	3,713		2,303	2,365	3,099	1,178	16,776	15	15		15	15	15	15	274.5333	247.5333		153.5333	157.6667	206.6	78.53333	all	KKE Full
08/10	6,369	6,499		3,253	4,270	5,148	1,792	27,331	12	12		12	12	12	12	530.75	541.5833		271.0833	355.8333	429	149.3333	all	KKE Full
08/14	2,563	2,981		1,223	2,463	6,300	1,728	17,258	16	16		16	16	16	16	160.1875	186.3125		76.4375	153.9375	393.75	108	all	Kas .5 mile (4), KKE Full (12)
08/15	1,852	1,562		1,497				4,911	13	13		13				142.4615	120.1538		115.1538				all	Kas .5 mile
2018																**2018**	**2018**	**2018**	**2018**	**2018**	**2018**	**2018**		
06/25	7,341	2,657		1,568				11,566	12	12		12				611.75	221.4167		130.6667				all	Kas Full
06/28	7,283	3,035		1,464				11,782	12	12		12				606.9167	252.9167		122				all	Kas Full
06/30	5,695	3,375		3,121				12,191	14	14		14				406.7857	241.0714		222.9286				all	Kas Full
07/04	9,652	5,663		4,655				19,970	16	16		16				603.25	353.9375		290.9375				all	Kas Full
07/07	4,391	1,988		2,532				8,911	8	8		8				548.875	248.5		316.5				all	Kas Full
07/09	5,675	2,521		1,819	1,184	2,582	1,056	14,837	12	12		12	12	12	12	472.9167	210.0833		151.5833	98.66667	215.1667	88	all	KKE Full
07/12	10,726	14,737		7,954	6,277	19,376	4,958	64,028	12	12		12	12	12	12	893.8333	1228.083		662.8333	523.0833	1614.667	413.1667	all	KKE Full
07/14	4,504	5,535		2,904				12,943	12	12		12				375.3333	461.25		242				all	Kas .5 mile
07/16							1,939	1,939							12							161.5833	all	EF full
07/18	2,654	5,380		4,394				12,428	7	7		7				379.1429	768.5714		627.7143				all	Kas 600 ft
07/19	6,905	17,663		8,504	6,885			39,957	12	12		12	12			575.4167	1471.917		708.6667	573.75			all	Kas .5 mile, NKB 600
07/21	7,585	4,711		3,037	2,172			17,505	12	12		12	12			632.0833	392.5833		253.0833	181			all	Kas .5 mile, NKB 600
07/22	3,490	1,636		2,588				7,714	14	14		14				249.2857	116.8571		184.8571	#DIV/0!			all	Kas 600 ft
07/23	5,469	2,367		2,240	2,595	15,018	3,713	31,402	12	12		12	12	12	12	455.75	197.25		186.6667	216.25	1251.5	309.4167	all	KKE Full
07/26	2,408	2,153		2,083				6,644	12	12		12				200.6667	179.4167		173.5833				all	Kas 600 ft
07/28	1,718	1,405		1,491				4,614	8	8		8				214.75	175.625		186.375				all	Kas 600 ft
08/08			1,377					1,377			12							114.75					all	KRSHA
08/09			3,855					3,855			24							160.625					all	KRSHA
08/10			2,642					2,642			24							110.0833					all	KRSHA
08/11			1,965					1,965			24							81.875					all	KRSHA
08/12			1,571					1,571			8							196.375					all	KRSHA
2019																**2019**	**2019**	**2019**	**2019**	**2019**	**2019**	**2019**		
06/27	6,811	3,260		1,896				11,967	12	12		12				567.5833	271.6667		158				all	Kas Full
06/29	6,720	3,459		2,012				12,191	8	8		8				840	432.375		251.5				all	Kas Full
07/01	8,904	5,382		3,576				17,862	12	12		12				742	448.5		298				all	Kas Full
07/04	5,519	5,176		4,216				14,911	14	14		14				394.2143	369.7143		301.1429				(i)	Kas Full
07/08	10,107	8,718		5,867	4,128	4,114	2,352	35,286	16	16		16	16	16	16	631.6875	544.875		366.6875	258	257.125	147	(i) except EF	KKE Full
07/11	7,714	6,212		4,668	6,539	14,373	6,334	45,840	15	15		15	15	15	15	514.2667	414.1333		311.2	435.9333	958.2	422.2667	(i) except EF	KKE Full
07/13	5,227	4,507		4,112	3,227			17,073	12	12		12	12			435.5833	375.5833		342.6667	268.9167			(i)	Kas .5 mile, NKB 600
07/15	5,383	6,571		4,708	7,329	12,254	5,043	41,288	14	14		14	14	14	14	384.5	469.3571		336.2857	523.5	875.2857	360.2143	(i)	KKE Full
07/18	5,481	8,011		5,563	8,938	19,751	7,758	55,502	15	15		15	15	15	15	365.4	534.0667		370.8667	595.8667	1316.733	517.2	(i)	KKE Full
07/21	6,349	5,656		5,524	8,076			25,605	14	14		14	14			453.5	404		394.5714	576.8571			(i)	Kas .5 mile, NKB 600
07/22	4,214	4,055		2,418	7,266	34,390	12,084	64,427	15	15		15	15	15	15	280.9333	270.3333		161.2	484.4	2292.667	805.6	(i)	KKE Full
07/25	8,532	8,928		8,699	13,125	47,460	16,731	103,475	17	17		17	17	17	17	501.8824	525.1765		511.7059	772.0588	2791.765	984.1765	(i)	KKE Full
07/28	17,734	17,378		9,289	14,133	22,625	9,872	91,031	16	16		16	16	16	16	1108.375	1086.125		580.5625	883.3125	1414.063	617	all	KKE Full
07/29	13,064	8,774		5,280	12,666	20,067	8,433	68,284	16	16		16	16	16	16	816.5	548.375		330	791.625	1254.188	527.0625	all	KKE Full
07/31	14,234	9,608		5,064	8,746	36,729	18,308	92,689	16	16		16	16	16	16	889.625	600.5		316.5	546.625	2295.563	1144.25	all	KKE Full
08/01	7,165	7,136		2,554	5,551	14,923	13,050	50,379	16	16		16	16	16	16	447.8125	446		159.625	346.9375	932.6875	815.625	all	KKE Full
08/02	2,099	1,052		653	1,331			5,135	12	12		12	12			174.9167	87.66667		54.41667	110.9167			all	Kas 600 Ken 600
08/03	5,747	3,297		1,381	2,163	11,339	7,671	31,598	11	11		11	11	11	11	522.4545	299.7273		125.5455	196.6364	1030.818	697.3636	all	KKE Full
2020																**2020**	**2020**	**2020**	**2020**	**2020**	**2020**	**2020**		
06/23	4,769	3,614		5,257				13,640	15	15		15				317.9333	240.9333		350.4667				(ii)	Kas Full
06/25	6,365	4,528		1,816				12,709	12	12		12				530.4167	377.3333		151.3333				(ii)	Kas Full
06/27	5,193	3,740		2,282				11,215	9	9		9				577	415.5556		253.5556				(ii)	Kas Full
06/30	4,231	3,821		8,288				16,340	12	12		12				352.5833	318.4167		690.6667				(ii)	Kas Full
07/02	8,263	3,967		2,823	1,897			16,950	15	15		15	15			550.8667	264.4667		188.2	126.4667			(i) Kas, NKB 4.75	NKB Kas full
07/04	5,916	3,977		2,280	684			12,857	9	9		9	9			657.3333	441.8889		253.3333	76			(i) Kas, NKB 4.76	NKB Kas full
07/06	8,747	9,939		6,506	2,260			27,452	13	13		13	13			672.8462	764.5385		500.4615	173.8462			(i) Kas, NKB 4.77	NKB Kas full
07/07	3,154	2,416		1,291	1,796			8,657	13	13		13	13			242.6154	185.8462		99.30769	138.1538			Kas all, NKB 4.75	Kas 600, NKB 600
07/08	6,070	2,615		1,144	629			10,458	8	8		8	8			758.75	326.875		143	78.625			Kas (ii), NKB 4.75	Kas 600, NKB 600
07/09	6,145	4,040		1,406	1,479	2,587	889	16,546	15	15		15	15	15	15	409.6667	269.3333		93.73333	98.6	172.4667	59.26667	KKE (ii)	KKE all
07/13	6,966	4,145		3,781	3,032	9,918	3,833	31,675	12	12		12	12	12	12	580.5	345.4167		315.0833	252.6667	826.5	319.4167	KKE (ii)	KKE all
07/15	4,256	3,159		4,201	3,420	7,260	1,577	23,873	12	12		12	12	12	12	354.6667	263.25		350.0833	285	605	131.4167	KKE (ii)	KKE all
07/16	2,583	992		940	2,275			6,790	12	12		12	12			215.25	82.66667		78.33333	189.5833			all	Kas 600, NKB 600
07/20	5,644	2,962		2,994	2,947	24,066	6,840	45,453	12	12		12	12	12	12	470.3333	246.8333		249.5	245.5833	2005.5	570	KKE (ii)	KKE all
07/21	1,601	979		1,382				3,962	8	8		8				200.125	122.375		172.75				all	Kas 600
07/22	2,084	1,727		1,926	2,207	17,788	11,032	36,764	12	12		12	12	12	12	173.6667	143.9167		160.5	183.9167	1482.333	919.3333	(ii)	KKE all
2021																**2021**	**2021**	**2021**	**2021**	**2021**	**2021**	**2021**		
22-Jun	6,632	4,457		5,748				16,837	12	12		12				552.6667	371.4167		479				(ii)	Kas all
24-Jun	8,207	5,888		5,030				19,125	15	15		15				547.1333	392.5333		335.3333				(ii)	Kas all
26-Jun	7,502	4,364		3,831				15,697	14	14		14				535.8571	311.7143		273.6429				(ii)	Kas all
28-Jun	9,688	12,244		10,121				32,053	15	15		15				645.8667	816.2667		674.7333				(ii)	Kas all
1-Jul	7,367	4,987		4,982	2,162			19,498	15	15		15	15			491.1333	332.4667		332.1333	144.1333			Kas (ii), NKB 4.75	Kas all, NKB 600
3-Jul	6,081	5,377		4,999	2,530			18,987	17	17		17	17			357.7059	316.2941		294.0588	148.8235			Kas (ii), NKB 4.76	Kas all, NKB 600
5-Jul	6,473	3,986		4,672	3,110			18,241	15	15		15	15			431.5333	265.7333		311.4667	207.3333			Kas (ii), NKB 4.77	Kas all, NKB 600
6-Jul	4,387	1,165		894	2,243			8,689	18	18		18	18			243.7222	64.72222		49.66667	124.6111			Kas (i), NKB 4.75	Kas 600, NKB 600
7-Jul	3,453	4,260		3,875	2,734			14,322	15	15		15	15			230.2	284		258.3333	182.2667			Kas (ii), NKB 4.75	Kas all, NKB 600
8-Jul	4,558	4,558		2,828	4,181	7,233	3,139	26,497	18	18		18	18	18	18	253.2222	253.2222		157.1111	232.2778	401.8333	174.3889	(ii)	all
12-Jul	2,697	3,638		3,615	4,415	8,361	4,510	27,236	12	12		12	12	12	12	224.75	303.1667		301.25	367.9167	696.75	375.8333	(ii)	all
13-Jul	1,848	1,673		1,550	2,158			7,229	17	17		17	17			108.7059	98.41176		91.17647	126.9412			(ii)	Kas 600, NKB 600
14-Jul	1,511	1,783		1,895	3,329			8,518	17	17		17	17			88.88235	104.8824		111.4706	195.8235			(ii)	Kas 600, NKB 600
15-Jul	3,412	3,367		2,245	3,341	9,370	2,583	24,318	12	12		12	12	12	12	284.3333	280.5833		187.0833	278.4167	780.8333	215.25	(ii)	KKE all
18-Jul			1,465					1,465			12							122.0833					all	KRSHA
19-Jul	3,219	7,621		8,831	16,813	57,285	14,346	108,115	12	12		12	12	12	12	268.25	635.0833		735.9167	1401.083	4773.75	1195.5	(ii)	KKE all
20-Jul	1,906	1,471		1,865	3,460	18,489	9,477	36,668	12	12		12	12	12	12	158.8333	122.5833		155.4167	288.3333	1540.75	789.75	(ii)	KKE 600

Abreviations

Kas = Kasilof section
KKE - Kenai, Kasilof, and East Foreland sections
KRSHA = Kasilof special harvtes area
NKB = North K Beach stat area
EF = East Forelands section

Submitted
seph Pers n
Submitted On
10/6/2021 3:20:19 AM
Affi iati n

ar d f Fish Members

M name is s eph Pers n and I am a third generati n, ife ng East Side Setnetter n the Nini chik each. Whi e ur fisher has suffered tremendous ver the past several seas n s and wi ikel c n tinue t d s under the current management p an, I have severe reservati ns about the s ate f Agenda Change Requests (ACRs) submitted f r u r fisher . First I wh eheartedl agree with the deparment c mments that n ne f them real meet the requirements f an ACR. Whi e the management in ur fisher the past several seas n s has been an utter travest , precisel n n e f it was unexpected r unanticipated based n the acti ns taken b the ar d at the ast in c c e meeting and the managment envir n ment at the state eve that we current have. In ight f that, I am extremel hesitant t have the ar d reappr ac h what am unts t the entiret f the Kenai River Late Run Chin k Management P an utside f the pr cesses and pr cedures aff rded it in an in c c e meeting. There is a reas n the ACR s stem is n t meant f r mere chal enging resu ts fr m the previ us meeting that people are unhappy with, and despite m unhappiness with the current situati n I do n t think it appr pr iate t thr w the entire ar d f Fish pr cess u t the window. Whi e there are s me ACR's in this s ate that I w u d support as an in-c c e pr pos al (particu ar ACR 9), there are a s several (specifical ACRs 8,10) with potential ng term c nsequences that I feel deserve the care and c n siderati n acc rded by an in c c e meeting. This is a c m plex fisher c v ering a ver arge area and man pr pos ed changes that appear t be pure beneficia have gr ss al cative and n g term imp icati ns. That said, if the board feels that the ast tw seas n s f the Upper C k In et East Side Setnet Fisher have n t been managed pt ima , I w u d ve t see support fr m the ar d enc u raging the department t make a m re c ncerted attempt within the restraints f the current management p an t agressive harvest surplus Kenai and Kasi f S c ke e. Whi e I d agree fundamenta with the ACR pr p s ers that the current managment p an is fundamenta f awed, that the Kenai River Late Run Chin k OEG (realistica the highest goal ever placed n the river) is unrealistic and punitive in ight f current realities, and that the st s cke e ppor tunit f the ast few seas n s is unreas n abl damaging both c n servati na and ec n m ical ; I als believe that a significant am u nt f re ief is avai able within the current plan which has been used as restrictive as possible even pri r t significant number f Kenai Chin k being in the district. Furtherm re I d n t believe that there is an thing magica fr m a Chin k c n servati n point f view about a 600 f t fisher , it is merel the m st restrictive pt i n avai able and c nsequent the east effective at al t pes f harvest. It is als extraordinari al cative and has high var ing eve s f effectiveness for different areas f the beach. In s me it is essentia a fu fisher , and t hers it is virtua n fisher at al . Whi e it is true that I pers na w u d have much preferred the pt i n t c n tinue t fish after u 21st f this seas n even in a restricted fashi n, I firm believe that fundamenta changes f this magnitude t a fisher sh u d take p ace within the n r ma pr cess and n t thr ugh an ACR. Thank u for ur c nsiderati n.

seph Pers n

October 5, 2021

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

Re: Board of Fish 2021 Work Session –
Agenda Change Requests 8-14 (Upper Cook Inlet)

Dear Chair Carlson-van Dort and Members of the Board:

The Kenai River Sportfishing Association (KRSA) offers the following comments to the Alaska Board of Fisheries regarding the six Agenda Change Requests addressing Upper Cook Inlet, under consideration at the 2021 Work Session.

KRSA strongly recommends that the Alaska Board of Fisheries reject all six Agenda Change Request asking the Board to take up critical aspects of 5 AAC 21.359. Kenai River Late-Run King Salmon Management Plan. KRSA offers the following rationale for this recommendations:

1. 5 AAC 21.359. Kenai River Late-Run King Salmon Management Plan is one of the cornerstone fishery management plans governing salmon management in commercial, sport and personal use fisheries in the Upper Cook Inlet. Upper Cook Inlet supports the most complex mix stock, mixed species, mixed user group salmon fisheries in the State and is also home to a majority of Alaska's resident population and destination for hundreds of thousands of visitors annually.

   Any change to the Kenai River Late-Run King Salmon Management Plan will unavoidably result in challenges with implementation of the other important management plans in Upper Cook Inlet. KRSA recommends rejecting the six Agenda Change Requests in favor of taking up the issues within the requests when all of Upper Cook Inlet comes up in the regular Board cycle.

2. None of the six Agenda Change Request meet the three criteria identified by the Board as necessary for accepting a request to take up issues out of the regular cycle. The Alaska Department of Fish and Game has submitted a detailed document laying out the reasons that none of the requests meet the three criteria. KRSA agrees with the assessments submitted by the Department.

3. The difficult situation that exists when we are failing to meet minimum escapement objectives for Kenai River Late-Run King Salmon, while at the same time missing opportunity to commercially harvest hundreds of thousands of sockeye salmon, is indeed unfortunate. A careful examination of the 30 plus years of regulatory history (since 5 AAC 21.359 has been codified) makes it abundantly clear that dealing with this situation was not unforeseen by this Board or its predecessors. Step down measures leading to a concurrent closure of all fisheries has always been the basis of this plan.

Kenai River Sportfishing Association
35093 Kenai Spur Highway, Soldotna, AK 99669
Office: 907.262.8588 | Fax: 907.262.8582 | 501 (c) (3) Tax ID 92-0142688

4. Although one could argue that taking up elements of the King Plan out of cycle, through acceptance of an Agenda Change Request, would not result in changes that are predominately allocative, any change would be allocative in some respect. This plan is the result of 30 plus years of regulatory history; any change in this plan must allow for the transparency and public participation created by action taken within the regular cycle.

KRSA appreciates the challenges seen on the Kenai over the past several years, where king salmon have failed to meet minimum escapement goals resulting in closure of opportunity across multiple user groups. We look forward to working with the Board, the Department of Fish and Game, and the public in seeking reasonable conservation and harvest strategies in Upper Cook Inlet within the regular cycle.

Sincerely,

Ben Mohr
Executive Director

Kenai River Sportfishing Association
35093 Kenai Spur Highway, Soldotna, AK 99669
Office: 907.262.8588 | Fax: 907.262.8582 | 501 (c) (3) Tax ID 92-0142688

October 1, 2021

State of Alaska, BOF members

I'm writing this letter in support of both ACR 10 and ACR 8. Both of these ACR's support changes in the Cook Inlet East Side Set Net fishery which has suffered great financial consequences due to unforeseen effects of early fishing closures.

During the 2020 season, the Kenai District set netters only got 5 days of fishing and in 2021, the season was again shut down after only 5 days. This was due to the set net fleet catching 11 kings while harvesting over 35,000 sockeye on what then became our last day of the season. An additional 1.0+ million sockeye then returned upriver, generating next to "zero" income to the borough, local families and businesses. As an example of this, I went red fishing on the Kenai and spent less than $50.00 on two days of fishing, a far cry from what I and my crew would have spent in the community if we had caught more fish on our set net site. I even cancelled a $13,000.00 new outboard motor purchase that I was scheduled to pick up this fall due to lack of funds.

In order to pay summer bills not covered in our 5 days of set netting, I then sold my "back up skiff" to a Bristol Bay set netter. So, the borough loses the tax revenue on my skiff, the local outboard motor dealer loses the associated repairs etc while Bristol Bay gains another asset at Cook Inlet's expense.

In regards to ACR's 10 and 8, I believe that the 29 mesh gear restriction does in fact reduce the number of kings caught by the set net fleet. I do believe that the 29 mesh gear, especially when fished in the 600' fishery, catches even fewer kings. I do believe that the flagged net idea mentioned in ACR 8 might be an additional "step down" tool to be used by the department after use of the 600' fishery.

Please address the negative effect that the current king salmon management plan has on the peninsula economy and enact ACR 10 and give consideration to ACR 8 as a final option to completely closing down the season.

Sincerely,

Lance Alldrin

Cook Inlet Set Netter

East Forelands subdistrict

Alaska Board of Fish Members,

9/30/2021

ACR 10: The 600’/29 mesh fishery is a valuable tool to harvest Cook Inlet sockeye while catching a minimal number of king salmon. This 600’ fishery, though it was made available to the Board in 2020, has rarely been used in the Kenai and East Forelands subsection of the ESSN fishery. During the 2021 season this fishery option was used on the last day of our 5-day fishing season and the king catch was approximately .03% of the days catch (11 kings/36,000 sockeye). It proved to be a viable means in limiting the number of king salmon harvested, however, even with this lower percentage, the ESSN fishery was once again shut down premature. When using gillnets, fishermen alike are unable to target only sockeye, as all salmon species swim in Cook Inlet waters. Therefore, we are trying our best to exclude the king salmon from our harvests by using 29 mesh nets and fishing our gear closer to shore (600’). These alterations to the ESSN fishery appear to be another suitable option to consider using as part of the Late Run Kenai King Salmon management plan. Please support ACR 10.

ACR 8: This ACR addresses an interesting option and that is using flagged nets. A flagged net would catch fewer fish as a fish has to be truly gilled in the net vs trapped in the “bag” due to the pressure of the current. Most kings are not gilled but rather held in the net due to the intense pressure of Cook Inlet tides. I believe flagged nets would catch very few kings while allowing fisherman to catch some sockeye. Perhaps consider ACR 8 as possibly the very last restriction after the 600’ fishery? I’d rather fish flagged nets than no nets at all.

Thank you.

Luke Alldrin

Cook Inlet, East Forelands district

October 5th, 2021

To: Alaska Board of Fisheries

Executive Director Glenn Haight

PO Box 115526

Juneau, AK 99811-5526

Re: Board of Fisheries – Worksession – Agenda Change Requests (ACR's)/ October 20-21, 2021

SOuth K-beach Independent Fishermen's Association (SOKI) is a community organization that aspires to represent the common interests of accessibility to the Alaska Board of Fisheries (BOF). Comprised of Cook Inlet setnet permit holders and others, our purpose is to elevate the concerns of the Kasilof Section of the East Side Set Net (ESSN) fishery. Our primary targeted fishery is the Kasilof River bound sockeye.

SOKI met on 09.23.21 to discuss the upcoming BOF worksession and the ACR's that the have been submitted for board actions.

We would like to submit our comments on individual ACR's;

ACR 8 – There was no support for this concept by any individual present

ACR 9 – There was general support for this action

ACR 10 – There was NO general support for this agenda change as many in the Kasilof section or statistical area within had reservations as to whether this would improve the opportunity for many or more likely it would enhance the opportunity for some within the historically predominant "beachnet" locations of the Kenai section exclusively. Many individual commented that the 600-foot fishery was not utilized by many in the South Kalifornsky Beach, Coho and Ninilchik statistical areas in the latter portions of the season as they produced very limited harvests and because of the bathymetry of their locations. Most commented that it simply was not an effective tool to harvest Kasilof bound sockeye. Others were concerned that this restriction would be implemented from the beginning of the season on and that many fishermen in this section did not have locations in the 600-foot limited area. A few were not supportive of any actions to be considered by this board.

ACR 11 – The group agreed with the individual that no actual credible post analysis of the use of 29 mesh deep gear was debated at the 2020 BOF Upper Cook Inlet (UCI) Regulatory meeting. There were comments from some that a reduction of an estimated 70+ % of gear effectiveness has already been implemented since 2014. This would include the mesh restriction and numbers of nets. Restrictions of area would exacerbate this negative effect further.

ACR 12 – The group accepted this request as a necessary step in modifying the plan in 2020 to give direction to the department through flexible actions dependent on escapements. Managing for escapement goals have been the hallmark of fishery management since statehood and fisheries managers need to maintain sustainable returns. Managing for biological goals should be the baseline for all management plans.

ACR 13 – SOKI submitted this ACR after submitting an Emergency Petition that the board declined to address in season. Recommendations from some of the BOF members comments was that the petitions had merit but that they would be better addressed through the regulatory process.

Conserving and developing the fishery resources is mandated by statute as a requirement for BOF actions. We believe that this agenda change request asks the board to review whether the actions taken in 2020 preserve or conserve large late run Kenai kings as predicted. There is reason to consider other measures that may allow the reduction of these kings while continuing to allow reasonable access to harvesting abundant stocks of sockeye bound for the Kasilof River. Staff comments did not address the specific biological assessment or reason to why this agenda change request is not a conservation or reason. The department gave us a limited historical review of board action or non-actions but did not address any other conservation concerns associated with intersection management plans or objective in their reason to deny this agenda request.

a) Is there a fishery conservation purpose or reason? ABSOLUTELY Yes!

The Commissioner has said that the regulation of closing the ESSN fishery in the king plan restricted him from applying any other step-down measures and suggested that that requirement needed to be taken out of the current language. While it is not clear on how this would be accomplished in the view of the Commissioner, he did express a desire to have other "tools" in the tool bag. We take this to mean that the regulation is contradictory, and the boards intent is not clear on how it may be implemented by fisheries managers. Clearly, the department relies only on 2020 board actions and does not appear to understand the full boards intent or to take into consideration previous board actions.

b) Does the agenda change request correct and error in regulation? Yes

Many BOF members were new to the process in 2020. The Department we feel did not give members a complete review of the consequences of their actions. Estimates were made but many data sets were not included for discussion purposes. The department continues to rely on limited presentations of vital information that board members need to make fair, valid, and reasonable decisions. It is clear that after two years of implementation of the 2020 regulatory changes to the Kenai late run king salmon plan that sockeye escapements into the Kenai and Kasilof Rivers have far exceeded their goals. The disparity of burden sharing is *acutely* painful to the ESSN fishery and the associated processing and commercial fishing support businesses. The board is said to establish the "fisheries policies" for the Sate through its arm as a quasi-judicial body, granted authority to delegate regulations by the legislature.

SOKI simply would ask: <u>Is it the intent of the State of Alaska through the actions of the Alaska Board of Fisheries to decimate a historical and economically functioning commercial fishing industry in Cook Inlet?</u>

c) Does the agenda change request address an effect of a regulation on a fishery that was unforeseen when that regulation was adopted? Most emphatically, YES!

ACR 14 – The group also supported this request as to furthering the justification established in the adoption of an optimal escapement goal (OEG). We do not believe that a clear and though review was submitted to the board members on ramifications of adopting this goal. Information is not available for the board to review if the board requests this information.

We respectfully urge the Alaska Board of Fisheries to consider and accept this supported ACR's and to schedule a hearing at their March Statewide meeting.

Thank you,

Paul A. Shadura II

Spokesperson for: SOKI

P.O. Box 1632

Kenai, AK. 99611-1632

907.283.5098

Ahtna Intertribal Resource Commission

PO Box 613 – Glennallen, Alaska 99588 www.ahtnatribal.org
Phone: 907) 822-4466 Fax: 907) 822-4406 connect@ahtnatribal.org

To the Alaska Board of Fisheries:

We are writing to express strong concern about the stated intention of the Alaska Department of Fish & Game (ADF G) in its Prince William Sound Escapement Goal memo with regard to Copper River king salmon. We feel that the lower bound of the proposed king salmon escapement goal, 21,000 fish, is not adequate to ensure sustainable returns. We urge the Board of Fisheries to look to Prince William Sound proposal 5, which would establish an optimum escapement goal of 24,000 - 40,000 fish, as a preferable, although still inadequate, alternative. We feel that there should be an optimum escapement goal of 35,000 – 50,000 Chinook salmon.

We oppose ADF G's efforts to lower the goal for management purposes. The past two decades have seen unprecedented declines in Copper River Chinook salmon runs. It is difficult to foresee any path to recovery from these declines when ADF G is repeatedly lowering its own goals. The current Chinook escapement goal, 24,000, has already been lowered from the previous one of 28,000.

In addition to the dramatic declines in king salmon run sizes, the sizes of the fish, themselves, are getting markedly smaller as well. This has clear implications for their reproductive potential: smaller fish have fewer eggs and are otherwise less productive. In order to maintain the same level of returns, then, ADF G should be increasing its escapement goal—not decreasing it—in response to these changes in body size.

As a justification for lowering its escapement goals, ADF G has often argued that it must avoid over-escapement, and the associated risks of diminished productivity and returns. This was part of its original rationalization for lowering the escapement goal from 28,000 to 24,000. After the goal was lowered, however, Chinook salmon run sizes continued to decline to historically low levels and under-escapement became commonplace. Lowering the goal again is likely to normalize this pattern of under-escapement by lowering expectations and shifting the management baseline.

Low Chinook runs are already having detrimental impacts on Ahtna tribal citizens and other upriver users who depend on the Copper River for their livelihoods. The 2021 season saw the closure of all state fisheries to Chinook retention. This harms subsistence users who depend on salmon as an important source of food, but it also harms the economic opportunities brought by the upper river sport and personal-use fisheries.

Finally, the problems with Chinook under-escapement and low returns are compounded by a lack of alignment between the escapement goals and the in-river goal. The in-river run goal specified in the management plan is only 17,500 other salmon, which includes both Chinook and coho salmon. This number is inadequate to meet an escapement goal of 21,000—let alone 24,000. The management plan must be revised to reflect appropriate objectives for Copper River Chinook salmon escapement needs.

Along these same lines, the Copper River District Salmon Management Plan (CR District Plan, 5 AAC 24.360) contain different escapement goals that are not consistent with one another. This raises the question of whether ADF G managers in the Copper River district are effectively coordinating with those of the upper Copper River district to work toward system-wide conservation of Chinook salmon.

One obvious reason for this inconsistency is that the department is managing for commercial uses and take, rather than prioritizing subsistence fisheries as required in AS 16.05.258. ADF&G must manage for the conservation and sustainability of the resource.

We appreciate this opportunity to share our concerns and perspectives on ADF G s stated intentions to revise the SEG for Copper River king salmon and the Kenai River Sportfishing Associations Proposal 5 to instead establish an Optimal Escapement Goal as we discuss in more detail below. With increasing salmon conservation concerns and the resulting dire impacts to Alaska tribal communities ancestral tribal uses of salmon across the State of Alaska, it is important for ADF G to live up to its oft-cited claim that it has the most public involvement in fish and wildlife management in the United States.

To such an end, we encourage the Alaska Board of Fisheries and the ADF&G to honor the Policy for statewide salmon escapement goals that requires "...a process that facilitates public review of allocative issues associated with escapement goals" (5 AAC 39.223). In the past and in other regions of Alaska, ADF G has held meetings with the public while reviewing and developing revisions to escapement goals to ensure public involvement in the escapement goal setting process. Throughout this present regulatory cycle, involvement and consultation with the public appears to have been minimal such that we are left with this one opportunity to be involved in this significant decision that directly affects the ability of our federally recognized tribes in fulfilling its self-governance and responsibilities to ensure access to these tribal resources to meeting these needs of their respective tribal citizens. In the absence of any opportunities for public comments or formal tribal consultations at the upcoming Alaska Board of Fisheries Work Session, we are once again limited to sharing our concerns in this letter.

Furthermore, we encourage the Alaska Board of Fisheries and the ADF G to adhere to its own policy as outlined 2002-216-FB, which requires government-to-government consultation with federally-recognized tribes on issues that significantly affect the interests of the Ahtna tribal governments such as reallocating Copper River Chinook salmon from spawning escapement and priority customary and traditional subsistence and ancestral tribal uses of king salmon to the commercial fishery.

In the absence of substantive consultation and communication with the public stakeholders with interests in Copper River salmon management and the sovereign tribal governments of the Copper Basin who have stewarded salmon resources for thousands of years, we submit these written comments that summarize our requests and concerns regarding revisions to the Copper River king salmon escapement goal.

Respectfully,

Karen Linnell
Executive Director

Corporate Headquarters
PO Box 649
Glennallen, Alaska 99588
Office: (907) 822-3476
Fax: (907) 822-3495

Ahtna, Incorporated

Anchorage Office
110 W 38th Avenue, Suite 100
Anchorage, Alaska 99503
Office: (907) 868-8250
Fax: (907) 868-8285

Our Culture Unites Us; Our Land Sustains Us; Our People are Prosperous

October 5, 2021

ADF&G Support Section
ATTN: Board of Fisheries Comments
P.O. Box 115526
Juneau, Alaska 99811-5526

Via email to dfg.bof.comments@alaska.gov

To members of the Alaska Board of Fisheries:

We are writing to express strong concern about the stated intention of the Alaska Department of Fish & Game (ADF&G) in its Prince William Sound Escapement Goal memo with regard to Copper River king salmon. We feel that the lower bound of the proposed king salmon escapement goal, 21,000 fish, is not adequate to ensure sustainable returns. We urge the Board of Fisheries to look to Prince William Sound proposal 5, which would establish an optimum escapement goal of 24,000 - 40,000 fish, as a preferable, although still inadequate, alternative. We feel that there should be an optimum escapement goal of 35,000 – 50,000 Chinook salmon.

We oppose ADF&G's efforts to lower the goal for management purposes. The past two decades have seen unprecedented declines in Copper River Chinook salmon runs. It is difficult to foresee any path to recovery from these declines when ADF&G is repeatedly lowering its own goals. The current Chinook escapement goal, 24,000, has already been lowered from the previous one of 28,000.

In addition to the dramatic declines in king salmon run sizes, the sizes of the fish, themselves, are getting markedly smaller as well. This has clear implications for their reproductive potential: smaller fish have fewer eggs and are otherwise less productive. In order to maintain the same level of returns, ADF&G should be increasing its escapement goal—not decreasing it—in response to these changes in body size.

As a justification for lowering its escapement goals, ADF&G has often argued that it must avoid overescapement, and the associated risks of diminished productivity and returns. This was part of its original rationalization for lowering the escapement goal from 28,000 to 24,000. After the goal was lowered, however, Chinook salmon run sizes continued to decline to historically low levels and underescapement became commonplace. Lowering the goal again is likely to normalize this pattern of underescapement by lowering expectations and shifting the management baseline.

Low Chinook runs are already having detrimental impacts on Ahtna tribal citizens and other upriver users who depend on the Copper River for their livelihoods. The 2021 season saw the closure of all state fisheries to Chinook retention. This harms subsistence users who depend on salmon as an important source of food, but it also harms the economic opportunities brought by the upper river sport and personal-use fisheries.

Finally, the problems with Chinook underescapement and low returns are compounded by a lack of alignment between the escapement goals and the in-river goal. The in-river run goal specified in the management plan is only 17,500 other salmon, which includes both Chinook and coho salmon. This number is inadequate to meet an escapement goal of 21,000—let alone 24,000. The management plan must be revised to reflect appropriate objectives for Copper River Chinook salmon escapement needs.

Along these same lines, the Copper River District Salmon Management Plan (CR District Plan, 5 AAC 24.360) contains different escapement goals that are not consistent with one another. This raises the question of whether ADF&G managers in the Copper River district are effectively coordinating with those of the upper Copper River district to work toward system-wide conservation of Chinook salmon.

One obvious reason for this inconsistency is that ADF&G is managing for commercial uses and take, rather than prioritizing subsistence fisheries as required by AS 16.05.258. ADF&G must manage for the conservation and sustainability of the resource.

We appreciate this opportunity to share our concerns and perspectives on ADF&G's stated intentions to revise the SEG for Copper River king salmon and the Kenai River Sportfishing Associations' Proposal 5 to instead establish an Optimal Escapement Goal as we discuss in more detail below. With increasing salmon conservation concerns and the resulting dire impacts to Alaska tribal communities' ancestral tribal uses of salmon across the State of Alaska, it is important for ADF&G to live up to its oft-cited claim that it has the most public involvement in fish and wildlife management in the United States.

To such an end, we encourage the Alaska Board of Fisheries and the ADF&G to honor the Policy for statewide salmon escapement goals that requires " . . . a process that facilitates public review of allocative issues associated with escapement goals." (5 AAC 39.223). In the past and in other regions of Alaska, ADF&G has held meetings with the public while reviewing and developing revisions to escapement goals to ensure public involvement in the escapement goal setting process. Throughout this present regulatory cycle, involvement and consultation with the public appears to have been minimal such that we are left with this one opportunity to be involved in this significant decision. In the absence of any opportunities for public comments or formal tribal consultations at the upcoming Alaska Board of Fisheries Work Session, we are once again limited to sharing our concerns in this letter.

Furthermore, we encourage the Alaska Board of Fisheries and the ADF&G to adhere to its own policy as outlined 2002-216-FB, which requires government-to-government consultation with federally recognized tribes on issues that significantly affect the interests of the Ahtna tribal governments. The reallocation of Copper River Chinook salmon from spawning escapement and prioritizing customary and traditional subsistence and ancestral tribal uses of king salmon over the commercial fishery are significant to our customary and traditional way of life.

In the absence of substantive consultation and communication with the public stakeholders with interests in Copper River salmon management and the sovereign tribal governments of the Copper Basin who have stewarded salmon resources for thousands of years, we submit these written comments that summarize our requests and concerns regarding revisions to the Copper River king salmon escapement goal.

Respectfully,

Nicholas Jackson, Chair
Customary & Traditional Committee
Ahtna, Incorporated

United States Department of the Interior

NATIONAL PARK SERVICE

Wrangell-St. Elias National Park & Preserve
Mile 106.8 Richardson Hwy. P.O. Box 439
Copper Center, AK 99573-0439
907 822 5234 Fax 907 822 3281
http://www.nps.gov/wrst

NATIONAL PARK SERVICE

IN REPLY REFER TO:

1.A.2

OCT 0 5 2021

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

Dear Members of the Board:

As the delegated in-season manager of Federal subsistence fisheries in the Copper River Drainage, I am writing to offer comments for consideration by the Alaska Board of Fisheries (Board) during its October 20-21, 2021 work session.

On August 20, 2021, I submitted an Agenda Change Request (ACR) for the Board to revise its schedule to include consideration of a proposed regulatory change during its upcoming meeting in Cordova, December 2021. My submission was not accepted as an ACR for Board consideration during the October work session because the subject matter pertained to Copper River salmon escapement goals and thus was considered to be an "in-cycle" subject. Although the ACR was not accepted, I understand that it will be included in the workbook for your October work session and that the Board may consider generating a proposal addressing the issue for the December regulatory meeting. Below, I offer comments in support of such an action.

The regulatory problem that I ask the Board to address is lack of consistency between the king salmon escapement goals in the Copper River District Salmon Management Plan (CR District Plan, 5 AAC 24.360) and the Copper River King Salmon Management Plan (CR King Salmon Plan, 5 AAC 24.361). This inconsistency results in stakeholder uncertainty and concern about how the department is managing the commercial and subsistence fisheries in the Copper River District in coordination with Upper Copper River District fisheries to ensure conservation of Copper River salmon. The CR District Plan specifically directs the department to manage the Copper River District commercial salmon fishery to achieve an inriver goal of salmon, as measured at the sonar counter near Miles Lake. The spawning escapement component of the goal consists of the lower end of the sockeye salmon sustainable escapement goal (360,000 salmon) and ***17,500 other salmon***, which would include king salmon and a relatively small number of coho salmon returning before sonar operations cease in late July. The CR King Salmon Plan specifically directs the department to manage the Copper River commercial and all other fisheries to achieve a sustainable escapement goal of ***24,000 or more king salmon***. The different king salmon escapement goals in these two plans appear to reflect an error in regulation.

To correct this apparent error, the spawning escapement goal of 17,500 other salmon in the CR District Plan should be revised to match *or exceed* (to account for early returning coho in addition to king salmon) the 24,000-king salmon goal of the related CR King Salmon Plan. I ask that the Board generate a regulatory proposal to revise the relevant section of the CR District Plan, 5 AAC 24.360 (b) to read as follows, with revised text **underlined in bold**, and regulatory text to be deleted fully capitalized and enclosed in brackets:

(b) The department shall manage the Copper River District commercial salmon fishery to achieve an inriver goal of salmon, as measured at the sonar counter near Miles Lake, based on the total of the following categories:

Spawning escapement

- lower end of sockeye salmon sustainable escapement goal
- **24,000 king salmon** [17,500 OTHER SALMON]
- **500 other salmon** *(or the department's best estimate for the number of coho included in sonar counts)*

This apparent regulatory error has implications that warrant its resolution through a board-generated proposal during this cycle. From correspondence with department staff, I understand that the CR King Salmon Plan is the primary guidance for king salmon management, and that the department does not consider the king salmon escapement goals in the two plans to be contradictory. But the apparent inconsistency strongly suggests to stakeholders that the total inriver goal of salmon, announced annually, is at least 6,500 too low. The continued apparent inconsistency between the two plans will result in ongoing uncertainty and concern among stakeholders regarding the department's management of Copper River sockeye and king salmon.

This is particularly important given the recent history of king salmon run strength in the Copper River. King salmon escapement in 2020 was the 6th lowest since 2001 and did not meet the escapement goal. It appears that the goal may not have been met again in 2021. If this is the case, it will have been the 4th time in the past 10 years, with the lowest run since 2001 having occurred in 2016 when spawning escapement was estimated to be 12,485 salmon. As an example of inconsistency and potential for confusion among stakeholders, in response to the weak king salmon run during the 2021 season, the department enacted restrictions in several upriver fisheries for the purpose of king salmon conservation; meanwhile the commercial fishery in the Copper River District continued to be managed with routine openings and additional king salmon harvest after upriver restrictions were announced.

Resolving the apparent regulatory inconsistency will clarify for all stakeholders the department's management intent relative to king salmon escapement. This transparency in management intent also may help to address longstanding concerns expressed by local subsistence users in communities nearest the headwaters of the Copper River. Past research and Alaska Native traditional knowledge indicate that sockeye salmon stocks associated with headwater tributaries are among the earliest stocks to enter the river, with run timing similar to king salmon. Since at least 2004 (e.g., Board proposal 53 in 2005) and as recently as 2021, subsistence users in headwater communities have repeatedly urged fisheries managers to allow more early run salmon to escape upstream of the Gulkana River to increase subsistence harvest opportunities. Conservation measures that aim to ensure adequate king salmon escapement have the potential to benefit early migrating sockeye salmon stocks and local subsistence users who depend on these headwater stocks for meeting their subsistence needs.

Sincerely,

Ben Bobowski, Ph.D.
Superintendent

Cordova District Fishermen United
PO Box 939 | 509 First Street | Cordova, AK 99574
phone. (907) 424 3447 | fax. (907) 424 3430
web. www.cdfu.org

October 6, 2021

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

Submitted electronically via: dfg.bof.comments@alaska.gov

Re: CDFU Comments for October Work Session

Dear Members of the Alaska Board of Fisheries,

Cordova District Fishermen United (CDFU) is a 501 (c)5 non-profit membership organization dedicated to advocacy for the commercial fisheries of Alaska's Area E -- Prince William Sound, the Copper River, and the Northern Gulf Coast. Our organization is comprised of Divisions, with each gear-type group represented through their own respective Division: Seine, Gillnet, Groudfish/Shellfish, and Herring. On behalf of the CDFU Gillnet Division, I encourage your review of the following comments:

An ACR addressing the issues in the Main Bay Subdistrict was submitted independently by an Area E fisherman, but after evaluation, the CDFU Gillnet Division would like to voice support for this ACR. Unfortunately, no Prince William Sound ACRs were accepted to the 2021 Work Session Agenda, due to it being a PWS Cycle Year, and in spite of the fact that it has now been 2 fishing seasons since the proposal deadline has passed. At the January 25 Special Meeting, after discussion by members of the Board of Fisheries, Boards Support staff clarified that the ACR process would be available for PWS issues that arose in the upcoming year because although the meetings would be held in 2021, the cycle year should have been 2020 had the Covid-19 pandemic not led to widespread cancellations and postponement of the original meeting schedule.

The issues addressed in the ACR submitted by Mr. Gilman can be primarily identified as conservation issues, as both cost recovery and broodstock at PWSAC hatcheries in Prince William Sound are placed in danger by current management practices. The issue has unfortunately been extremely exacerbated in the 2021 season and led to the submission of an ACR by an Area E fisherman following unprecedented and significant delays in cost recovery and broodstock operations at the hatchery this past season. The ACR seeks to mitigate some of the issues observed by regional residents, fishermen, and those more closely involved with regional hatchery organizations.

It is important for all user groups that the Main Bay Hatchery remain sustainable and economical in

Cordova District Fishermen United
PO Box 939 | 509 First Street | Cordova, AK 99574
phone. (907) 424 3447 | fax. (907) 424 3430
web. www.cdfu.org

perpetuity. Currently, a significant amount of damage and conflict has been observed in the Main Bay Subdistrict and around the barrier seine. Additionally, some users have expressed frustration at the commercial fishermen engaging in hatchery operations, not fully understanding the importance of cost recovery and broodstock to the continuation of Alaska's hatchery programs and the production of sockey salmon in Main Bay. The CDFU Gillnet Division urges the Board of Fish to re-evaluate and accept this ACR to address these growing issues in the Main Bay Subdistrict.

It is vital for all Area E fisheries for Prince William Sound Aquaculture Corporation to operate effectively and efficiently. Conflict, interference, and damage to the barrier seine impact PWSAC's ability to operate, and CDFU Gillnet Division expresses concern that it will lead to increased costs of operation, user conflicts, and quality degradation of sockeye salmon -- impacting the economics of regional fisheries and the hatchery itself.. If this problem is not resolved this Board cycle, CDFU Gillnet Division is concerned about the economic damage to the Area E drift fleet due to lost harvest potential and product degradation when cost recovery is unable to be achieved.

CDFU is in support of the ACR submitted by Mr. Gilman, and urges the Board to consider taking up this issue and adding it to this cycle year. Thank you for your time and consideration, please feel free to reach out to CDFU with any comments, questions, or concerns on the matters addressed above.

Sincerely,

Chelsea Haisman

Chelsea Haisman
Executive Director

From: dave@hookycharters.com
To: DFG, BOF Comments (DFG sponsored)
Subject: King Salmon Conservation
Date: Monday, October 4, 2021 4:25:55 PM

It is time to take drastic measures to save our king salmon! I moved to the Kenai area in the spring of 1976. I ran a commercial drift boat for about fifteen years in the Cook Inlet. I have friends that are set netters. I am a fishing guide on the Kenai River. I have been active in the Board Of Fish process for many years fighting to save our king salmon. We through the Board process put closures in place to protect king salmon up and down the Kenai river. The sport fishing pressure is much less now than it was in the eighties and nineties and still our kings are failing to meet minimum goals. It is time to close all king salmon fishing in Cook Inlet. Yes sport fishing will suffer, but we need to fix the problem now. Back in the seventies and eighties there was a need for set gill netting, but now with the influx in population and the growth of the tourism industry in Alaska we can no longer justify set gill netting. They simply kill too many king salmon. The Cook Inlet drift fleet can be used to catch the excess sockeye and the ones that get past them can be harvested by dip netters from all around the state as well as sprot fishermen. The resource belongs first to the residents of Alaska and individuals who travel to this state to take fish home.

David Goggia
9087-252-3503

From: **Gale K. Vick**
Date: Thu, Jul 15, 2021 at 8:11 PM
Subject: Recent declines in salmon body size impact ecosystems and fisheries
To: Mckenzie Mitchell

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7438488/

Recent declines in salmon body size impact ecosystems and fisheries

Few organismal traits are as profoundly important as body size, given its role in reproductive fitness, physiology, demography, predator–prey dynamics, and value for human use[1]. Yet major selective forces such as climate change and harvest may be causing widespread declines in organismal body size[2–5]. Climate change has been linked to body size declines in many species[2,3], including Soay sheep in Scotland[6], aquatic ectotherms across Europe[7], and migratory North American birds[8]. Harvest is also known to result in smaller body size[5,9], for example, declines in body size and age-at-maturity preceded the collapse of Atlantic cod stocks off the eastern coast of Canada . Understanding the causes of body size declines is daunting given the influence of numerous, potentially interacting factors. Individually or in unison, these underlying factors can influence body size through shifting population age structure, changing growth rates, or a combination thereof. Age truncation can compound the effects of body size on population productivity by increasing demographic variability in response to changing environments11. Body size declines influence species' demography4 and trophic interactions12 and may reduce the sustainable delivery of ecosystem services such as fisheries yield9.

Here, we examine changes in body size for four species of Pacific salmon *Oncorhynchus* spp.), by assembling a 60-year (1957–2018) database of size and age measurements from 12.5 million individually-measured fish. The uniquely large spatial and temporal scale of our dataset enabled us to conduct one of the most comprehensive studies to quantify system-wide body size declines across multiple species and identify potential causal mechanisms, and one of the first studies to quantify ecological and socioeconomic consequences of those observed size declines. Our overarching goals were to understand the magnitude and consistency of size declines across regions and species, evaluate potential causes, and quantify the consequences of these changes for ecosystems and people.

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-020-17726-z OPEN

Recent declines in salmon body size impact ecosystems and fisheries

K. B. Oke[1,2✉], C. J. Cunningham[2,3], P. A. H. Westley[4✉], M. L. Baskett[5], S. M. Carlson[6], J. Clark[7], A. P. Hendry[8], V. A. Karatayev[5], N. W. Kendall[9], J. Kibele[7], H. K. Kindsvater[10], K. M. Kobayashi[1], B. Lewis[11], S. Munch[1,12], J. D. Reynolds[13], G. K. Vick[14] & E. P. Palkovacs[1✉]

Declines in animal body sizes are widely reported and likely impact ecological interactions and ecosystem services. For harvested species subject to multiple stressors, limited understanding of the causes and consequences of size declines impedes prediction, prevention, and mitigation. We highlight widespread declines in Pacific salmon size based on 60 years of measurements from 12.5 million fish across Alaska, the last largely pristine North American salmon-producing region. Declines in salmon size, primarily resulting from shifting age structure, are associated with climate and competition at sea. Compared to salmon maturing before 1990, the reduced size of adult salmon after 2010 has potentially resulted in substantial losses to ecosystems and people; for Chinook salmon we estimated average per-fish reductions in egg production (−16%), nutrient transport (−28%), fisheries value (−21%), and meals for rural people (−26%). Downsizing of organisms is a global concern, and current trends may pose substantial risks for nature and people.

[1] Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, CA 95060, USA. [2] College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Juneau, AK 99801, USA. [3] Fisheries, Aquatic Science & Technology Laboratory, Alaska Pacific University, Anchorage, AK 99508, USA. [4] College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK 99775, USA. [5] Department of Environmental Science and Policy, University of California, Davis, CA 95616, USA. [6] Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720, USA. [7] National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA 93101, USA. [8] Department of Biology and Redpath Museum, McGill University, Montreal, QC H3A 2K6, Canada. [9] Washington Department of Fish and Wildlife, Olympia, WA 98501, USA. [10] Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA. [11] Division of Commercial Fisheries, Alaska Department of Fish and Game, Anchorage, AK 99518, USA. [12] National Marine Fisheries Service, Fisheries Ecology Division, Southwest Fisheries Science Center, Santa Cruz, CA 95060, USA. [13] Earth to Ocean Research Group, Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada. [14] GKV & Sons, Contracting to Tanana Chiefs Conference, Fairbanks, AK 99709, USA. ✉email: kristaoke@gmail.com; pwestley@alaska.edu; epalkova@ucsc.edu

Few organismal traits are as profoundly important as body size, given its role in reproductive fitness, physiology, demography, predator–prey dynamics, and value for human use[1]. Yet major selective forces such as climate change and harvest may be causing widespread declines in organismal body size[2–5]. Climate change has been linked to body size declines in many species[2,3], including Soay sheep in Scotland[6], aquatic ectotherms across Europe[7], and migratory North American birds[8]. Harvest is also known to result in smaller body size[5,9], for example, declines in body size and age-at-maturity preceded the collapse of Atlantic cod stocks off the eastern coast of Canada[10]. Understanding the causes of body size declines is daunting given the influence of numerous, potentially interacting factors. Individually or in unison, these underlying factors can influence body size through shifting population age structure, changing growth rates, or a combination thereof. Age truncation can compound the effects of body size on population productivity by increasing demographic variability in response to changing environments[11]. Body size declines influence species' demography[4] and trophic interactions[12] and may reduce the sustainable delivery of ecosystem services such as fisheries yield[9].

Here, we examine changes in body size for four species of Pacific salmon (*Oncorhynchus* spp.), by assembling a 60-year (1957–2018) database of size and age measurements from 12.5 million individually-measured fish. The uniquely large spatial and temporal scale of our dataset enabled us to conduct one of the most comprehensive studies to quantify system-wide body size declines across multiple species and identify potential causal mechanisms, and one of the first studies to quantify ecological and socioeconomic consequences of those observed size declines. Our overarching goals were to understand the magnitude and consistency of size declines across regions and species, evaluate potential causes, and quantify the consequences of these changes for ecosystems and people.

Pacific salmon are integral ecosystem components and contribute to human well-being, primarily as sources of food security and cultural connection[13,14]. The annual return of salmon to their natal streams provides vital nutrient subsidies that support freshwater, riparian, and terrestrial ecosystems[15]. Alaska is widely considered a stronghold of intact, functioning salmon–people ecosystems, largely free of the factors that have severely depressed salmon abundances elsewhere, such as over-harvest, habitat-loss, net pen aquaculture (prohibited by law in Alaska), dams, and water diversion[16]. However, accumulating evidence from local and indigenous knowledge suggests that adult salmon body sizes are decreasing, including in Alaska where salmon provide critical support for ecosystems and people[17–19], cf. ref. [20].

Serious consequences for ecosystems and people could result from salmon size declines. Smaller salmon transport less marine-derived nutrients and produce fewer offspring[21,22]. Smaller salmon could threaten food security in rural salmon-dependent communities, where diminished access to calorie-rich salmon directly influences well-being and human health[13]. From an economic perspective, smaller salmon translate to lost commercial fisheries profit due to reduced flesh recovery rates (proportionally more skin, viscera, and bones but less muscle), increased processing cost, and lower prices. In some cases, losses due to changing salmon size could be mitigated by increasing conspecific abundances for certain ecosystems services and species. However, the opportunity for mitigation will be limited for species like Chinook salmon that have generally experienced declines in abundance concurrent with size declines[23] or for ecosystem services for which abundance cannot replace size. For example, recreational anglers highly value catching large fish, which influences decisions on fishing trip destinations[24]. In addition, abundant species like sockeye and pink salmon cannot replace many ecosystem services provided by Chinook salmon because Chinook salmon generally have much greater migration distances, fat content, and cultural importance. For salmon in Alaska, the extent to which body size is changing across species and regions, the causes of size changes, and the consequences for nature and people are poorly known.

We synthesize patterns of salmon body size change across the state of Alaska for Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), and sockeye salmon (*O. nerka*). While previous studies have documented changes in size and age in Pacific salmon[17,18,20], our investigation across species, decades, and locations allows a uniquely comprehensive analysis of consistency in trends, causes, and consequences of those changes at an unprecedented spatial and temporal scale. Our analysis is based on six decades of salmon size and age measurements collected by the Alaska Department of Fish and Game from 1014 sampling locations across Alaska's diverse landscapes—from temperate rainforests to Arctic ecosystems.

We show that body size has declined significantly across Pacific salmon species in Alaska, but that the rate of change has not been constant over time. Changing age structure (younger age-at-maturity) consistently explains a greater proportion of overall size changes than do changing growth rates (smaller size-at-age); salmon are getting smaller primarily because they are returning to reproduce at a younger age than they did in the past. Climate change and competition with highly abundant wild and hatchery-produced salmon appear to be widespread drivers of size declines. We found limited evidence for a widespread role of size-selective harvest. The consequences of these changes for ecosystems and people are widespread: size declines are likely causing decreases in key ecological processes and human uses, including per-capita egg production, marine-derived nutrient subsidies, rural food security, and commercial value for harvesters.

Results

Consistency in salmon size declines. In all four salmon species, average body sizes were smaller after 2010 compared to before 1990 (the earliest baseline with sufficient data, Fig. 1). Comparing mean body length pre-1990 to mean body length post-2010, Chinook salmon exhibited the greatest magnitude decline, averaging an 8.0% decline in body length, compared to 3.3% in coho salmon, 2.4% in chum salmon, and 2.1% in sockeye salmon. Within species, the magnitude of declines varied among regions and populations (Fig. 1). For example, Chinook salmon populations in Westward Alaska and Arctic–Yukon–Kuskokwim declined by 10% on average, whereas conspecifics in Southeast Alaska declined by 4%.

General additive models (GAMs) confirmed that average sizes declined through time in each species (nonlinear year effect for each species $p < 0.0001$, $R^2 = 0.453$, 0.621, 0.687, 0.784 for Chinook, sockeye, coho, and chum salmon respectively, Fig. 2a), although the common (among location) pattern in average size across time differed between species. To evaluate whether there was greater support for species-specific nonlinear year effects through time, or a single shared temporal pattern, we fit competing GAMs to mean-variance standardized length observations from each location. Inclusion of species-specific nonlinear year effects explained much more variance ($R^2 = 0.80$) compared to a single shared (i.e., shared among species) nonlinear year effect ($R^2 = 0.04$). This result was confirmed by fitting an additional model that included both the common and species-specific nonlinear year effects, in which species-specific trends were significant ($p < 0.0001$) while the common trend was not ($p = 0.3$). All species are declining in body size but patterns of decline differ among species, thus species-specific trends were analyzed and are discussed separately.

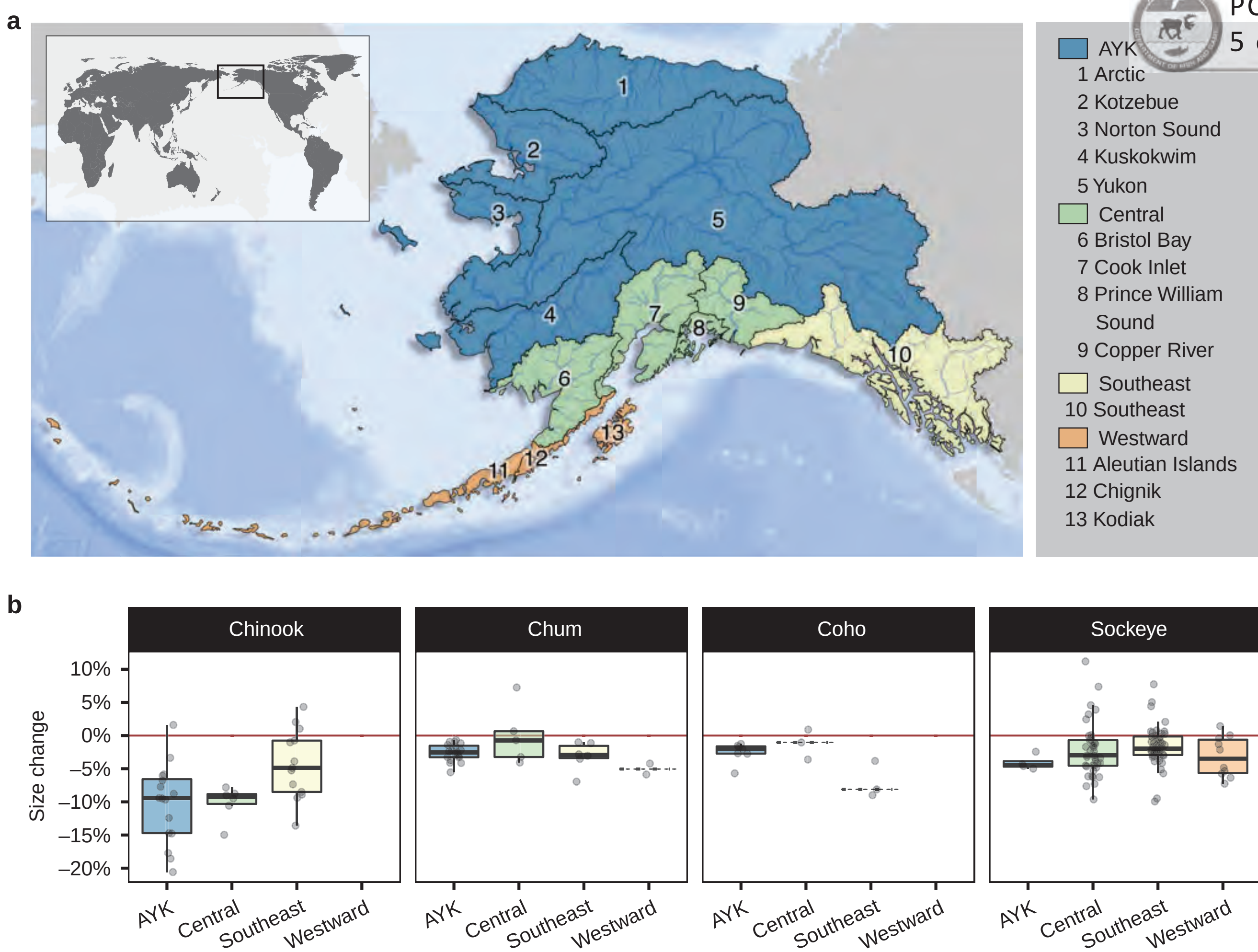


Fig. 1 Across Alaska, average salmon body size has gotten smaller. On average, salmon body size was smaller post-2010 compared with pre-1990 across all areas and species examined. **a** Map of sampling area with regions numbered and colored by Alaska Department of Fish and Game management area. Our analyses included data from all regions shown except Arctic. **b** Boxplots show percent change in mean length between data collected before 1990 and after 2010. Points show change in mean length for individual populations. Red line indicates no change. Center line represents the median, box limits represent the upper and lower quantiles, whiskers represent the 1.5× interquartile range. Only populations for which we had data in both periods were included (100 sockeye, 34 Chinook, 32 chum, and 13 coho salmon populations). If sufficient data were available for three or fewer populations, the box was replaced by a gray dashed line at the median. AYK represents the Arctic–Yukon–Kuskokwim management area. Sample sizes are presented in Supplementary Data 4.

Within each species, size trends were nonlinear (effective degrees of freedom = 3.75 for Chinook, 8.86 for chum, 7.78 for coho, and 8.81 for sockeye salmon; Fig. 2a) and included several periods of increasing and decreasing size. Separate species-specific models (Fig. 2a) revealed similarities among sockeye, chum, and coho salmon, including shared size declines starting in the mid-1980s followed by recovery in the early-1990s. These three species all showed an abrupt decline in body size starting in 2000 and intensifying after 2010. Size declines were more linear in Chinook salmon than in other species, but the rate of decline also accelerated after 2000.

Comparing model fits for GAMs that incorporate regional- and population-level trends revealed that Chinook and coho salmon exhibit high spatial variation in patterns of body size change, best explained by population-specific nonlinear year effects. In contrast, sockeye and chum salmon populations exhibited less spatial variability, which was best explained by regional-level patterns (Supplementary Table S1).

Contributions of declining age versus growth. Across species, shifts in age structure explained 88% of interannual variation in mean size on average (Fig. 3). In general, salmon are currently smaller than in the past because adults are returning to spawn at younger ages (Fig. 2). Changing size-at-age (Supplementary Fig. S1), which might result from decreased growth, explained a greater proportion of size change in coho salmon (20% on average) than in other species (7.4% in Chinook salmon, 7.1% in chum salmon, 5.9% in sockeye salmon), yet across all species and regions the contribution of changing size-at-age to declines in body sizes was less important than that of changing age structure.

Causes of salmon size declines. Both environmental change and increased competition at sea with highly abundant wild and hatchery salmon could result in body size declines through reductions in the availability or quality of food resources[18,20]. Climate warming might also reduce ectotherm body size by increasing metabolic and developmental rates[2]. Finally, all of

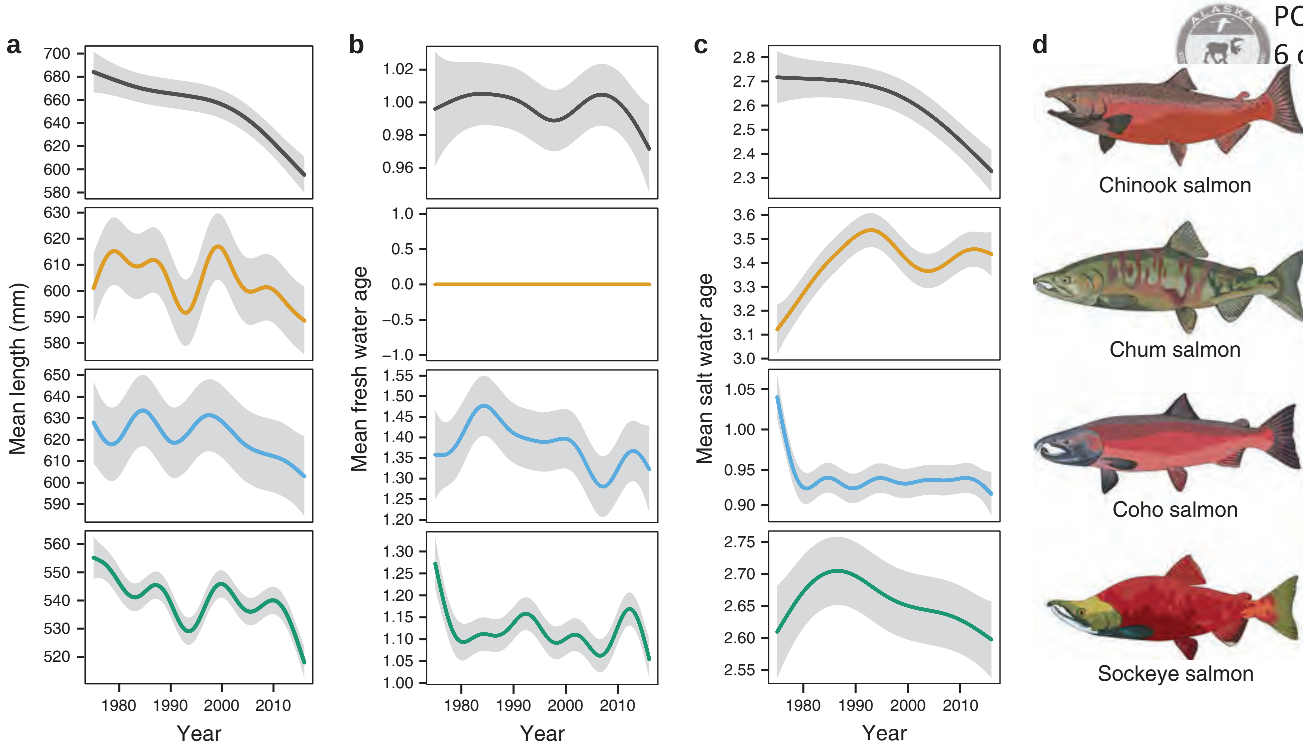


Fig. 2 Body size declines are significant and nonlinear. a Mean fish length has changed in a nonlinear pattern, as demonstrated by the nonlinear year effect from GAMs on mean population length with fixed effects of region and population. **b** Mean freshwater age (in years) has generally declined, except for chum salmon, which leave freshwater shortly after emergence. **c** Mean saltwater age (in years) has also generally declined, except in chum salmon, which increased in saltwater age until around 1990, then decreased. Plots are conditioned on reference populations with the longest time series for each species, but the pattern plotted is the common pattern through time calculated for all populations. Gray areas represent 95% confidence intervals for the nonlinear year effect. **d** Male salmon in spawning coloration. Sample sizes are presented in Supplementary Data 5.

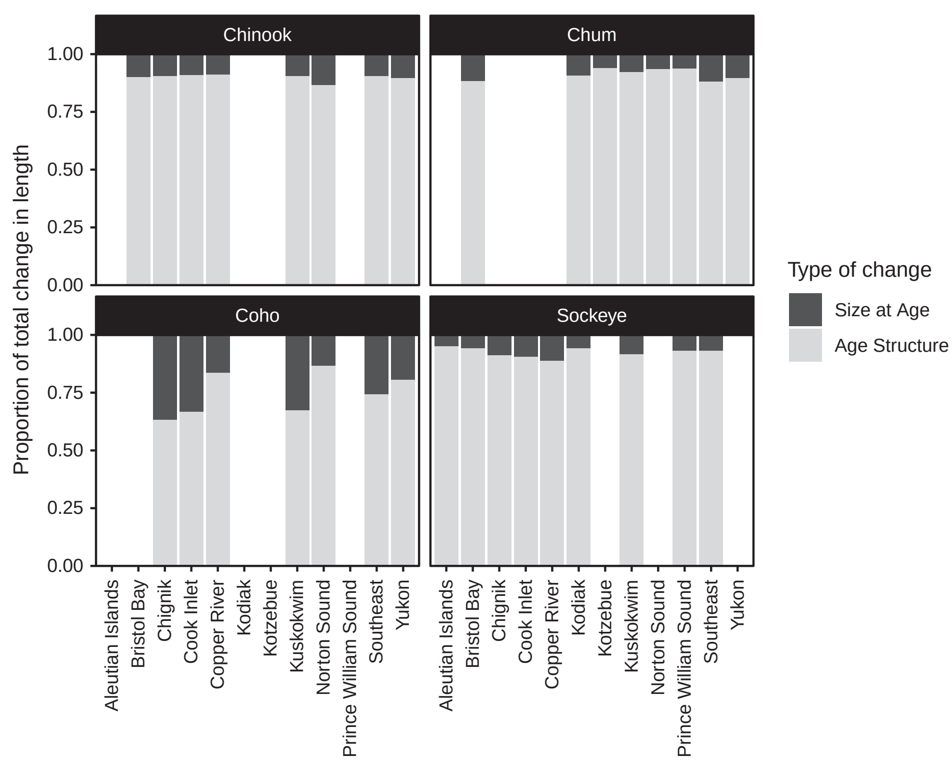


Fig. 3 Body size declines result primarily from shifting age structure. Changes in population mean length are primarily due to changing age composition (gray) and to a much lesser extent changing size-at-age (black). For each population the mean among-year contribution was calculated, then region means calculated from population-level means. Sample sizes are presented in Supplementary Data 6.

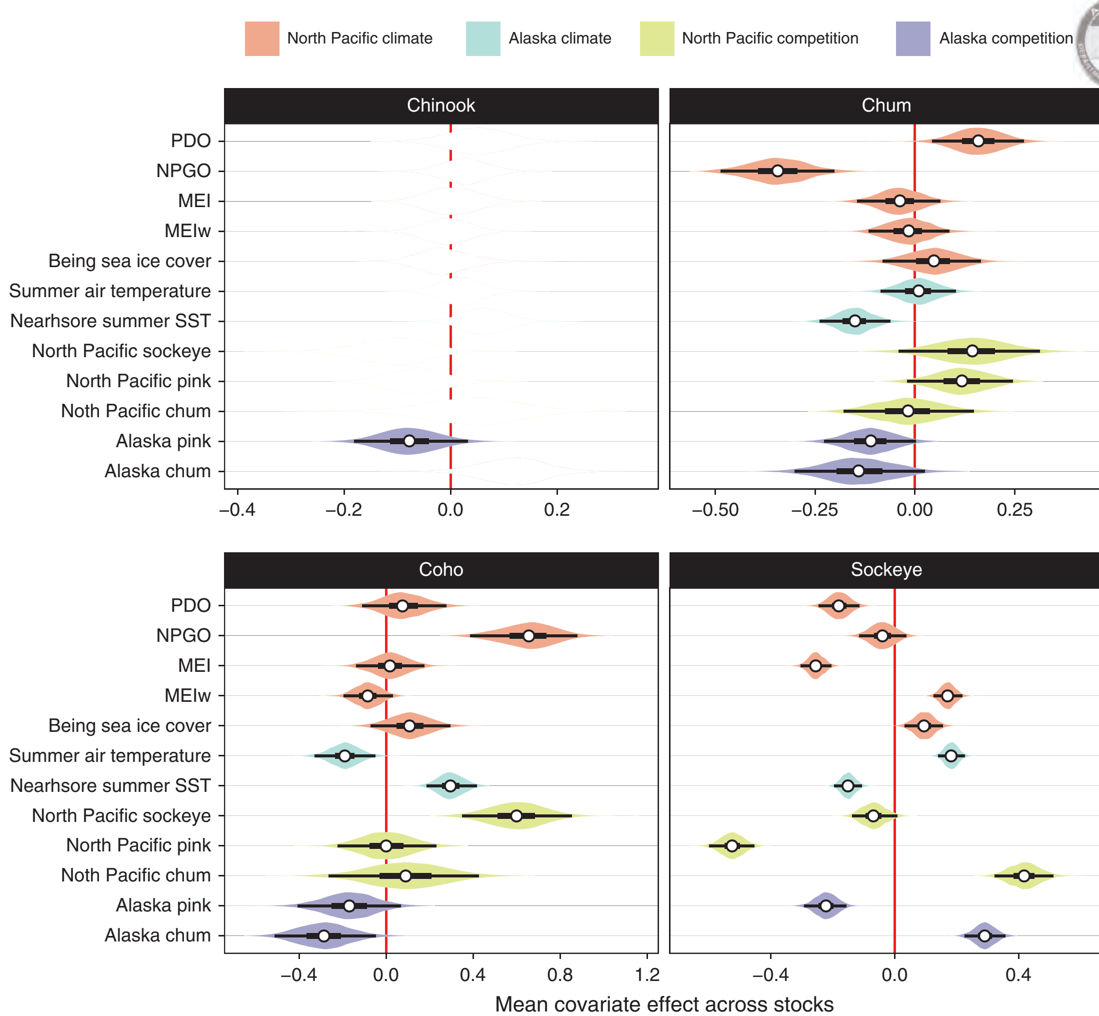


Fig. 4 Climate and competition influence salmon body size. Effects of climate and competition proxies (detailed in Methods, MEIw is winter MEI) on body size varied among species, as estimated by hierarchical Bayesian models describing length-environment relationships. Posterior probability distributions (in color) for estimated species-specific (group) mean effects of climate and competition covariates across locations. Posterior medians, 50% and 95% credible intervals are described by the white point, thick and thin black lines. Negative effects indicate high values of a covariate are correlated with smaller salmon body size on average across locations in Alaska. See Supplementary Fig. S4 for population-specific covariate effect estimates. Sample sizes are presented in Supplementary Data 7.

these environmental factors could result in increased natural mortality in the ocean, leading to reduced average age-at-return to freshwater.

To evaluate the hypothesized effects of climate and competition at sea (Supplementary Figs. S2, S3), we fit hierarchical Bayesian models estimating the association between temporal trends in location-specific salmon size and a range of environmental covariates, while also estimating a nonlinear year effect describing temporal trends in length that were common across populations but not explained by covariates. After accounting for absolute body size differences among populations, our ability to explain changes in body size ranged from a Bayesian[25] R^2 of 0.28 in sockeye salmon, 0.29 in Chinook salmon, 0.35 in chum salmon, to 0.48 in coho salmon.

Multiple factors with small individual effects were associated with body size declines (Fig. 4). Although the relative importance of each metric differed among species (Fig. 4) and populations (Supplementary Fig. S4), at least one climate metric and one competition metric were important for each species. Only Alaskan pink salmon abundance had a negative association with body size across all species, but the negative association was weak in all cases except sockeye salmon. Some factors emerged as particularly important for individual species. For sockeye salmon, North Pacific pink salmon abundance had a particularly strong negative association with body size. For chum salmon, a strong negative association with the North Pacific Gyre Oscillation (NPGO) contrasted with a similarly strong positive association for coho salmon. No single factor was a particularly important predictor of body size in Chinook salmon; instead many factors had moderate contributions to body size change. After controlling for covariate effects, each species-specific model included a common residual trend that showed overall decline in salmon size across time (Supplementary Fig. S6). This result suggests that salmon might be responding to one or more physical or biological drivers that were not included among the environmental covariates explored.

Metabolic effects of temperature on size[26] do not appear to be driving body size changes in Alaska salmon (see Supplementary Methods section "Metabolic effects of temperature on size"). Relationships between salmon body size and temperature did not fit the predictions of the metabolic theory of ecology[26]. Rather, the variable influence of climate drivers suggests that the impact of climate on salmon body size is species-specific and to a lesser extent location-specific

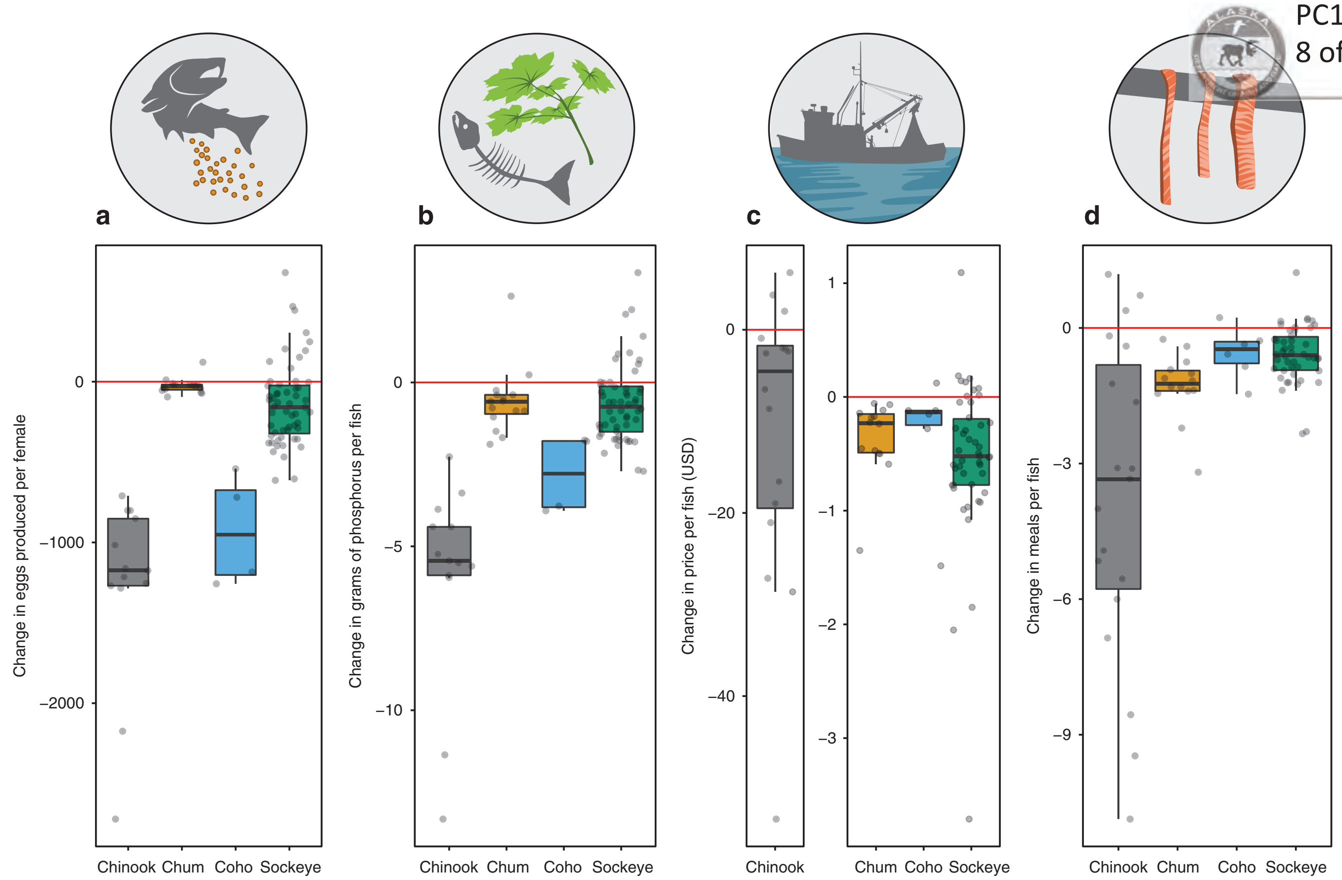


Fig. 5 Size declines could result in negative consequences for ecosystems and people. Salmon body size declines over the past 30 years have negative consequences for **a** fecundity, **b** nutrient transport, **c** commercial fishery value, and **d** rural food security. We estimated the difference in ecosystem services provided by an average salmon before 1990 versus after 2010, by converting change in mass to change in services provided. A meal is the species-specific average reported meal size in grams reported by subsistence users from two villages in nearby Yukon Territory, Canada, see Methods for details. Each gray point represents an estimate for an individual population. The red line represents no change in ecosystems services provided by each fish. Center line represents the median, box limits represent the upper and lower quantiles, whiskers represent the 1.5× interquartile range. Sample sizes are presented in Supplementary Data 4.

(see Supplementary Fig. S4), perhaps occurring through climate-mediated changes in food availability or quality. A similarly variable relationship between temperature and body size across species was recently uncovered in a large-scale analysis of size trends in Australian reef fishes[27].

Due to limited data availability, we investigated the effects of average harvest rate on long-term body length change in a separate analysis on the subset of populations for which we had sufficient harvest information. We expected that if fisheries-induced size structure truncation, or evolution, contributed to size declines, populations subjected to higher rates of size-selective harvest would show greater magnitude declines[28]. We tested this hypothesis using 33 populations (25 sockeye and eight Chinook) with sufficient data to rigorously calculate harvest rate. Counter to expectations, we detected no significant relationship between harvest rate and change in body size among populations (Supplementary Fig. S5, $R^2 = 0.02$, $F_{1,30} = 0.56$, $p = 0.46$).

Consequences of declining body size. To quantify the per-capita change in several ecosystem services resulting from observed declines in body size, we used species-specific length-weight relationships to convert change in length to change in mass (see Methods for details). Next, we converted change in mass to per-capita changes in fecundity, nutrient transport, human nutrition, and commercial value (Fig. 5). The per-capita effects of size declines will be most impactful when accompanied by decreases in abundance, as observed for Chinook salmon, whose abundances[23] and body sizes have both declined in recent years. Our estimates suggest that the dramatic body size declines observed in Chinook salmon translate to equally dramatically reduced per-capita contributions to people and nature, including median reductions in egg production (−15%), commercial value (−25%), meals provided (−26%), and nutrient transport (−26%). Reductions for other species were less dramatic, but still substantial (Fig. 5, Supplementary Data 1–3).

Discussion

We provide comprehensive evidence that four species of Pacific salmon in Alaska are now smaller than they were historically, with the rate of decline having accelerated since the year 2000. Declining body size overwhelmingly results from younger maturation (i.e., age-at-return) rather than reductions in growth (i.e., size-at-age). Although no single factor explained size declines, we revealed that both climate and competition at sea are associated with changes in salmon size across Alaska. This result extends the findings of other recent studies that also show impacts of climate and competition on salmon body size[20] and age-at-maturity[29]. Finally, we show that declines in body size over the past 30 years have likely translated into important ecological and socioeconomic consequences for salmon-dependent ecosystems and peoples in Alaska, especially for the largest of the species, Chinook salmon.

Widespread declines in body size occurred over the past four decades across four salmon species (Fig. 1, Fig. 2a). This finding generalizes previous species- and region-specific analyses[19,30,31]. Size trends were more similar for a given species across regions than for a given region across species (Fig. 1), with Chinook salmon showing the greatest decline in size (−8.0%), followed by coho salmon (−3.3%), chum (−2.4%) and sockeye (−2.1%). In contrast to many previous studies that assume monotonic linear changes in size[18,19], our use of general additive models revealed markedly nonlinear changes, including an apparent recent acceleration of size decline beginning around 2000 that was shared among all four species, and several common periods of high and low average size among sockeye, chum, and coho salmon (Fig. 2a). Identifying the putative drivers of specific periods of time exhibiting shared body size change was beyond our scope, but is likely a fruitful avenue for future research.

Underlying the general body size decline observed across species, a considerable amount of among-region and among-population variation in body size change was observed within species. Body size trends were best explained by models that allowed region-specific (chum and sockeye salmon) or population-specific (Chinook and coho salmon) responses through time, rather than a single response shared among regions and populations (Supplementary Table S1). We interpret this result to reflect the large number of populations sampled from diverse habitats across Alaska, from temperate rainforest ecosystems in Southeast Alaska to subarctic ecosystems in Kotzebue. The idiosyncratic responses of body size to climate indices we observed could be partially explained by differential responses across species, regions, and populations according to site-specific habitat climate filtering, evolutionary histories, and relative location in their species range or climate envelope.

To an unknown extent, other external factors likely also contributed to variation in patterns of size declines among regions and species. For example, the relatively low magnitude body size declines in Southeast Alaska Chinook salmon (Fig. 1) could be explained by an unusual characteristic of the Southeast Alaska troll fishery for Chinook salmon, which catches a high proportion of immature salmon from British Columbia, Washington, Oregon, and California[32]. Reductions in the size and age of Chinook salmon originating from these areas outside of Alaska have not been as extreme as those observed for Alaskan Chinook salmon populations[20,31].

Earlier maturation (age-at-return), rather than slower growth (size-at-age), was primarily responsible for observed size declines across species and regions (Fig. 3). Chinook salmon, which exhibit the greatest life history diversity and thus greatest capacity for change in age-at-maturity, showed the greatest magnitude of decline in both body size and age-at-maturity. This result formalizes and extends findings from previous studies that age truncation appears to play an important role in declining Chinook salmon body size[19,30,31,33]. Compared to Chinook salmon, changes in age-at-maturity were more variable through time in chum and sockeye salmon (Fig. 2), which also showed size declines but of lower magnitude. Both chum and sockeye salmon showed an initial increase in average saltwater age, but this increase has been followed by generally decreasing age-at-maturity, coinciding with the pronounced recent declines in body size.

Although our results provide strong evidence that salmon are becoming smaller because they are returning from the ocean at a younger age, we were unable to distinguish the contributions of changing maturation schedules from increasing marine mortality. Younger age structure could result from numerous scenarios, including plastic responses to positive growth conditions that allow salmon to reach a threshold size earlier[34], evolutionary shifts in maturation schedules[35], increased late-stage mortality[36], compounding risk from overall increased mortality[36], or any combination of the above. Finer-scale information about marine mortality is needed to explore these non-mutually exclusive scenarios. It is also important to recognize that the potential for growth rate to influence age-at-maturity[34] means that, despite the lesser contributions of changing size-at-age, some proportion of the changes in age-at-maturity that contribute to body size declines might ultimately result from changes in growth rate.

Climate and competition at sea clearly influence salmon size. Results for each species indicated a strong effect of at least one climate metric. However, specific metrics varied in their direction and magnitude across species, underscoring the complex effects of climate on body size (Fig. 4). Recent work on salmon productivity has shown that relationships between salmon and climate variables vary through time[37], and the influence of climate on body size could be similarly non-stationary.

Competition metrics also had important but variable effects on salmon body size (Fig. 4; Supplementary Fig. S4). The strongest negative association we detected was between sockeye salmon body size and the North Pacific-wide abundance of pink salmon. This result corroborates previous studies documenting negative influences of Asian pink salmon abundance on Alaskan sockeye salmon, which share similar prey communities and distributions during their final years at sea[38]. Indeed, the only consistently negative effect across all species was that of Alaskan pink salmon abundance (Fig. 4), although this effect was weak in most species. Intriguingly, the shared acceleration of size declines post-2000 occurred during a period of unusually high (though variable) pink salmon abundance in Alaska[39], suggesting high pink salmon abundances could be accelerating or exacerbating size declines. Our results provide further evidence that wild and hatchery-enhanced pink salmon abundance in the North Pacific has reached such high levels that they appear to be exerting an influence on ecosystem structure and function[40].

For each species, we detected an underlying trend shared among populations (i.e., a nonlinear year effect) that was not fully explained by any climate or competition covariates (Supplementary Fig. S6). These shared trends suggest that, within species, populations are responding similarly to other broad-scale factors we did not identify as a priori hypotheses and as a result were not included in our models.

Our results are consistent with previous studies that suggest fisheries are likely not a major driver in broad patterns of salmon size decline[20,29,41], yet might play an important role for some populations[42,43]. Harvest has been implicated in size and age declines for many marine fishes[5,28] and has long been expected to contribute to declining salmon size[17]. We did not detect any overall relationship between harvest rate and size change, but our analysis was necessarily limited to a subset of intensively monitored Chinook and sockeye salmon populations with adequate data. Furthermore, the potential for differences in size selectivity across fisheries and gear types[44] could limit the extent to which these results can be extrapolated to other fisheries.

We lacked sufficient data to investigate several factors that could contribute to size declines, especially in certain species or regions. In Alaska, there is relatively little contribution of hatchery production to the overall abundances of sockeye, coho, and Chinook salmon[29,39], but hatchery selection[45] could contribute to size declines in regions with high hatchery production, such as chum salmon in Prince William Sound and Southeast Alaska. We were unable to rigorously test for an effect of hatchery selection, but populations from hatchery-intensive regions did not appear to show greater magnitude declines in body size compared to populations from other regions (Fig. 1). We also lacked sufficient data on predator abundances to test for effects of size-selective predation, but bioenergetic modeling has shown that size-selective predation from killer whales (*Orcinus orca*)[41] and salmon sharks (*Lamna ditropis*)[46] could be contributing to body size declines in Chinook salmon. The limited diet data available for Alaska resident killer whales[47,48] suggests that they show lower selectivity on Chinook salmon than do killer whales from Washington and British Columbia[49] upon which these models are based[41]. Additional data on hatchery selection, predator abundances, selectivity for salmon, and size-selectivity are needed in Alaska in order to rigorously test these hypotheses.

We estimate that the observed salmon size declines could already be causing substantial reductions in fecundity, nutrient transport, economic value, and food security (Fig. 5). Declines in fecundity can impede population productivity and recovery[50]. Due to these effects on productivity, declines in body size have been used in other systems to predict population declines and collapses[51]. Reduced salmon size also decreases the per-capita transport of marine-derived nutrients into terrestrial ecosystems, with important implications for a wide array of ecological processes including riparian productivity and biodiversity[15]. Salmon are economically important; in 2017, the ex-vessel value (price paid to fishermen) of Bristol Bay salmon fisheries alone was over $214,000,000[52]. Meanwhile, the value of subsistence salmon fisheries for rural and Indigenous communities is profound, with broad implications for food security, well-being, and cultural connectivity[13,14]. Socioeconomic impacts of declining salmon size have long been of concern for Alaskans, especially those whose well-being, food security, and economic livelihoods depend on salmon[14].

We considered per-capita delivery of ecosystem services, but the realized consequences of declining body sizes will also depend on salmon abundances. The consequences of declining size could, to some extent, be balanced by increasing abundances in some species such as sockeye and chum salmon whose abundances have generally increased in recent years throughout the state[39]. In contrast, Chinook salmon abundances have generally declined across Alaska[23], so the socioeconomic impacts of declining Chinook salmon size are already compounded by reduced abundance and resulting regulatory limitations on harvest opportunity. Because Alaska salmon are managed according to a fixed escapement policy under which the number of adult salmon that reach the spawning grounds is held generally constant across years, increases in total abundance tend to result in large harvests but generally do not translate into increased escapement. The relatively stable numbers of salmon on the spawning grounds, even in years of high abundance, will result in limited ability for high abundances to mitigate the per-capita ecological consequences of declining size. How increasing salmon abundance might offset the costs of declining body size for the commercial fishery is a complex topic worthy of further exploration, especially for sockeye and chum salmon.

We also acknowledge that other external factors will impact the consequences of declining body size. For example, the economic costs of declining body size are also influenced by idiosyncrasies of production costs and market fluctuations due to trade policies or the availability of market substitutes like farmed Atlantic salmon[53]. These complexities are extremely difficult to fully address at a state-wide multispecies level, but in-depth species-specific considerations of the potential consequences of size declines that account for abundance are important topics for future investigation.

Our findings contribute to the mounting body of evidence that maintenance of body size, in addition to abundance, is critical for maintaining healthy salmon-people and salmon-ecosystem relationships. Yet, what are the options to slow or even reverse these size declines? While the impacts of size declines are experienced locally, the primary causes appear to be regional and even global. Of the two primary drivers associated with size declines, climate forcing and ocean abundance of salmon and particularly Alaska pink salmon, the latter is within local management control. Across the Pacific Rim, ca. 5 billion hatchery salmon[39] are released into the North Pacific each year where they add to already high abundances of wild pink, chum, and sockeye. While signals of conspecific and interspecific competition are increasingly evident[38,40,54,55], managers currently lack tools to help inform difficult decisions regarding hatchery releases. Tools that quantify the apparent trade-offs between the releases of one species and the impacts of size and productivity on conspecifics and other species are urgently needed.

Our large-scale consideration of salmon body size extends and generalizes previous findings, showing that body size declines are ongoing and more widespread than previously reported. The direct relationship between smaller salmon and economic and social losses has not been estimated previously. Our conservative calculations of the potential per-capita consequences of recent body size declines show the ecological, economic, and social losses could be substantial. We compared current size to a pre-1990 baseline, but this captures only a small window of commercial salmon fisheries in Alaska, which started in the late 1800s. Size declines were observed long before 1990[17], and thus we expect that analyses over longer time series would likely reveal even more dramatic impacts. Despite widespread reporting of body size declines across diverse taxa[2,3], the ecological and socioeconomic consequences of body size declines are underappreciated. Using Pacific salmon in one of the few remaining intact, largely pristine salmon ecosystems on Earth as a test case, we show the consequences for people and ecosystems could be substantial.

Methods

Age-length (AL) datasets. Alaska Department of Fish & Game (ADF&G) monitors the number, body size, sex, and age of Alaska salmon harvested in a variety of fisheries and on their return breeding migration from the ocean to freshwater. Age and body length (AL) data have been collected on mature adults from commercial, subsistence, and sport harvests, escapement (spawning population) projects, and test fisheries since the early 1900's. ADF&G data has historically been archived in regional offices; however, for this project we were able to compile all available data from across the state (Supplementary Figs. S7–S10) into a single dataset, representing over 14 million raw AL samples.

The majority of Alaska salmon fisheries target mature adults during their breeding migration into freshwater. Data from commercial harvests represent the largest proportion (57%) of measurements and are generally collected from marine waters and near river mouths. Although many Alaska salmon fishing districts are designed to operate as terminal fisheries, targeting fish destined for their river of origin, even terminal fisheries can intercept salmon returning to other Alaskan populations, and many other districts are non-terminal. Because most commercial salmon fisheries in Alaska catch a combination of fish from the target stock and intercepted fish returning to other populations, commercial samples often include a mix of fish from different populations within a river drainage and outside the drainage (e.g., Southeast Alaska troll fishery may be >80% non-local fish at times). Commercial samples from some fisheries targeting wild salmon could include a relatively low but unknown proportion of hatchery-origin salmon, which could not be excluded from our analyses without individual-level information on origin (hatchery or wild). Samples from escapement enumeration projects (sampling projects that count the number of mature adults that 'escape' the fishery and return to freshwater) make up the next highest proportion of AL measurements (33%). Escapement projects collect AL data from fish sampled in the freshwater environment, close to or on the spawning grounds, generally at counting towers, weirs, or fences. A variety of other sampling project types (test fishing, subsistence catch, sport catch) make up the remaining portion of these data, with no single project type representing more than 5% of the samples. ADF&G recorded the name of the sampling project, generally as the name of a given river (e.g., Fish Creek) or district (e.g., Togiak District), which we refer to as sampling locations. To ensure as much as possible that methods of data collection were consistent across locations and species, we excluded data collected from projects other than commercial harvest and escapement monitoring from statistical analyses.

Age and length (AL) measurements were collected by ADF&G personnel using standard methods[56]. Briefly, fish length is collected to the nearest millimeter using a measuring tape or a manual or electronic measuring board, depending on project and year. Fish age was most commonly estimated by ADF&G scientists reading growth annuli on scales[57]. For many AL measurements, specimen sex was also recorded, predominantly using external characteristics for sex determination. Sex determination with external characteristics in ocean-phase fish is frequently unreliable[58]. Because most of our data come from commercial harvests that occur in ocean-phase fish prior to the development of obvious external secondary sexual characteristics, we did not analyze the sexes separately. However, other studies examining length at age with reliable sex determination have shown similar trends in size and age for males and females[33,59]. As in Lewis et al.[19], we assume our results reflect similar trends in male and female salmon.

To ensure data were of high quality, a number of quality assurance checks were established, and data failing those checks were excluded from analysis. These checks include ensuring that ages and lengths were within reasonable bounds for each species, that sample dates were reasonable, that data were not duplicated, and that data were all of the same length measurement type (mid-eye to fork of tail). Because mid-eye to fork length was by far the most commonly used length measurement type (85% of samples) within the data, and the vast majority of sample protocols use mid-eye to fork measurements, we assumed that observations where no length measurement type was reported (0.08% of samples) were mid-eye to fork. No other unique length measurement type accounts for more than 2% of samples. We also excluded any samples that measured fewer than ten fish for a given year/location combination. After these extensive checks, we were left with measurements on over 12.5 million individual salmon.

A wide variety of gear types were used to collect samples. The three most common gear types included gillnet, seine, and weir. Sampling methods within projects did not change systematically over time; however, for at least some projects, changes did occur, such as changes in gillnet mesh materials and sizes (for commercial harvest[60]) or sampling location within a watershed (for escapement projects). Some of these methodology changes are sporadically reflected in the data (e.g., mesh size), whereas others are not included and difficult to capture (e.g., weir location changes). Given the inconsistency in data and metadata associated with these fine-scale methodology changes, and the spatial and temporal scale of this dataset, changes in mesh size, gear type, or fine scale location changes (movement of a project within the same river system) were not included in our analyses.

Consistency in salmon size declines. To quantify the spatial and temporal extent of body size change, we estimated the average length of fish for each species in each sampling location and return year (the year when the fish was caught or sampled on its return migration to freshwater), which we interpret as putative biological populations (henceforth referred to as populations). For each population, we averaged these annual means to find the mean body length during a baseline period before 1990 and recent period after 2010. The pre-1990 period included all data collected before 1990, though relatively little data was available before 1980. Comparing data from two discrete time periods avoids potential edge effects that would be introduced in dividing a consecutive time series. Only populations for which we had data in both periods were included (100 sockeye, 34 Chinook, 32 chum, and 13 coho salmon populations). We established a criterion of at least 3 years of data for each population during each time period for inclusion in this analysis. Although somewhat arbitrary, we chose 1990 as the end of the early period to ensure a large number of populations had sufficient data to be included, while still being early enough to provide a meaningful baseline for comparison with current data. Because our goal was to investigate trends experienced by resource users in Alaska, we included data from some stocks that are known to capture salmon that originated from areas other than Alaska. For example, estimates for Chinook salmon from Southeast Alaska are likely influenced by the inclusion of troll-caught Chinook salmon, which are largely composed of salmon originating from British Columbia (B.C.) and the U.S. West Coast. For visualization, the results of this analysis were then scaled up to the level of the fisheries management areas established by ADF&G (Fig. 1).

To quantify and visualize continuous changes in body size across time, we fit general additive models (GAMs) to annual mean population body length for each species. To avoid convergence problems due to small sample sizes, data collected before 1975 were excluded from this analysis. In contrast to previous studies that assumed monotonic linear changes in size[18,19], year was included as a nonlinear smoothed term because preliminary analyses suggested that the rate of length change varied through time. We included data from all populations for which observations from five or more years were available (276 sockeye salmon populations, 202 Chinook salmon populations, 183 chum salmon populations, 142 coho salmon populations). We knew a priori that salmon populations differ in average body size, so to preserve original units (mm) while controlling for variation in absolute body length among populations, we included two fixed factors: population and region. We assigned regions based on terrestrial biomes and the drainage areas of major watershed (shown numbered on Fig. 1, colored by ADF&G management region). Repeating these GAMs on escapement data alone provided equivalent results (Supplementary Fig. S11), which confirms that our results are not due to an artifact of sampling procedures through time.

To visualize changes in age structure and size-at-age, we fit very similar GAMs to age and length-at-age data. As above we included fixed effects for population and region, as well as a nonlinear year effect. Using the same dataset as the previously described GAMs, we used either mean freshwater age, mean saltwater age, or mean length-at-age as the response variable. For length-at-age, we separately fit GAMs for the four most common age classes in each species, except coho salmon, for which sufficient data was available for only three age classes.

To determine the extent to which patterns of body size change are consistent across space within a species, we re-fit these GAMs by replacing the main year effect by either a region-by-year or population-by-year interaction and compared model fit using AIC. These nonlinear interactions allow regions or populations to differ in their patterns of length change through time. These models are more data intensive than the previous GAMs, so we included data from all populations for which our time series consisted of any 20 or more years of data (123 sockeye salmon populations, 37 Chinook salmon populations, 38 chum salmon populations, 14 coho salmon populations).

Contributions of declining age versus growth. To partition the contribution of changes in population age structure versus size-at-age to changes in mean population length, we used the chain rule[61]. We used the discrete time analog of the chain rule

$$\Delta(xy) = y\Delta x + x\Delta y, \quad (1)$$

and assume that change in mean length is a function of changes in population age structure, *p(a)*, and mean length-at-age, *x(a)*. For each species and population, age structure in year *t* was calculated as the proportion of individuals in each age *a*. Mean length in year *t* is given by

$$x_t = \Sigma_a p_t(a) x_t(a), \quad (2)$$

and the year-to-year change in length is given by

$$\Delta x_t = x_{(t+1)} \quad x_t = \Sigma_a p_t(a) x_t(a) + \Delta p_t(a) x_t(a), \quad (3)$$

where

$$p_t(a) = 1/2 \;\; p_{t+1}(a) + p_t(a) \;\; , \quad (4)$$

and

$$\Delta p_t(a) = \;\; p_{t+1}(a) - \;\; p_t(a) \;\; . \quad (5)$$

Solving these formulas year-to-year for each species in each population, we estimated the proportion of change in mean length due to changes in age structure and size-at-age. We included all populations for which we had five or more years of data (though change can only be estimated for consecutive years of data) and averaged the results across populations in each region.

Causes of age and size changes. To identify potential causes of change in salmon body size, we quantified associations with a variety of indices describing physical and biological conditions in Alaska's freshwater and marine salmon habitats. Each candidate explanatory variable was selected based on existing biological hypotheses or inclusion in previous analyses of salmon size or population dynamics.

We considered several ocean climate indicators as potential causes of change in salmon size over time. Pacific Ocean conditions are often quantified using large-scale climate indices such as the Pacific Decadal Oscillation (PDO), El Niño Southern Oscillation (ENSO), and NPGO. These large-scale indices of ocean conditions, as proxies for climate and marine environment, have been shown to affect the survival and productivity of Pacific salmon in the North Pacific Ocean[62,63]. PDO, NPGO[64], and MEI[65,66] indices were all accessed and downloaded online (PDO, http://research.jisao.washington.edu/pdo/; NPGO, http://www.o3d.org/npgo/npgo.php, accessed 2018-02-07; MEI, https://www.esrl.noaa.gov/psd/enso/mei/, accessed 2018-02-08; MEIw, https://www.beringclimate.noaa.gov/, accessed 2018-02-08). In this analysis, winter means of NPGO and MEI were used in addition to an annual mean of MEI. Two ice cover metrics were also used to capture ocean climate conditions. Bering Sea ice cover and retreat were downloaded from https://www.beringclimate.noaa.gov/, originally derived from the National Snow and Ice Data Center data. Bering Sea ice cover index represents the winter anomaly, relative to 1981–2000 mean. Bering Sea ice retreat is an index representing number of days with ice cover after March 15.

Sea surface temperature (SST) was also explored as a potential cause of the changes in salmon size and age. SST has proven to be closely linked to salmon productivity. Mueter et al.[67] found that regional-scale SST predicted survival rates better than large-scale climate indices such as the PDO. They concluded that survival rates were largely driven by environmental conditions at regional spatial scales. SST was extracted from the Extended Reconstructed Sea Surface Temperature (ERSST) version 4[68]. To approximate SST values close to the river mouths which juvenile salmonids are most likely to experience after ocean entry, a double layer of the grid cells tracing the coastline of Alaska were extracted and the mean summer SST was calculated for each region.

Because in situ fluvial temperature measurements are sparse, both spatially and temporally, compared to the coverage of the AL dataset, air temperature was used as a proxy for temperature during the freshwater life stages. Air temperature data were extracted and sorted from remote-sensed satellite observations into multi-monthly regional means by season[69].

Finally, we considered the potential for competition with other salmon to influence salmon size by including the abundances of several highly abundant salmon species as explanatory covariates. Using data compiled by Ruggerone and Irvine[39], we evaluated the abundance of adult pink, chum, and sockeye salmon returning to Asia and North America as a proxy for the abundance of adult salmon of each species in the North Pacific. In addition, we also considered the more localized abundance of pink, chum, and sockeye salmon returning to Alaska, because salmon body size has been shown to vary with salmon abundance in the year of return migration in some species[70] at finer spatial scales. The abundances of coho and Chinook salmon were not included, because they occur at much lower abundance than sockeye, chum, and pink salmon.

We also explored marine mammal abundances as potential predictor variables, but found that the data available precluded rigorous statistical comparison with our time series of salmon size and age structure. For example, the only estimates of orca abundance available for our study area (that from Southeast Alaska and Prince William Sound) show steady, near monotonic increases through our study period[71,72]. Statistically, this leads to insufficient replication and high collinearity with year effects. Although caution is warranted in interpretations of any models for which the assumptions are so obviously violated, we note that preliminary analyses including marine mammal abundance were not dramatically superior in terms of variance explained or model fit. Because of these limitations, we determined that a reliable test of the effect of marine mammal predation was not possible for Alaska.

Ultimately, we only selected covariates with an absolute correlation among covariate time series of less than 0.61. By establishing this threshold for absolute pairwise covariate correlation we sought to include only covariates for which separate associations with salmon size could be identified. The final set of covariates included in our analyses were: (1) ocean climate indicators (PDO, NPGO, MEI, winter MEI (MEIw), and Bering Sea ice cover index); (2) sea surface temperature (SST); (3) air temperature as proxy for freshwater temperature; and (4) ocean salmon abundance (abundance of Alaska sockeye, pink, and chum salmon, and North Pacific wide abundance of sockeye, pink, and chum salmon).

To test hypothesized associations between temporal trends in the average body size (length) of salmon and environmental conditions, we fit a series of Bayesian hierarchical models to data describing size trends across sampling locations for each species. Because the chain rule analysis showed that changes in age structure explained greater interannual body size variation than did changes in size-at-age, we analyzed age-aggregated mean body length. Time series, starting in 1975, of annual mean length by species for each sampling location (l) and environmental covariates were mean-variance (Z) standardized prior to model fitting. Models of the form

$$L_{i,t} = \sum_c(\beta_{l,c} \quad X_{t \quad \delta_{\tau,c}}) + s(t) + \varepsilon_{l,t}, \tag{6}$$

were fit to each salmon species separately using Bayesian methods, where $L_{l,t}$ is the standardized length at each location (l) in each return or observation year (t), $\beta_{l,c}$ are coefficients describing the effect of each covariate (c) on average length at each location, and $X_{t \quad \delta_{\tau,c}}$ is the standardized value of each covariate in each year. The reference year for each covariate is specified relative to the return year, or year in which salmon length compositions are observed (t), by a species and covariate-specific offset δ_c that associates covariate effects with the hypothesized period of interaction in each species' life history (Supplementary Table S2). Location-specific covariate effects are structured hierarchically such that parameters describing the effect of each covariate on observed changes in average length were subject to a normally-distributed prior whose hyperparameters (group-level means and standard deviations for each covariate) were estimated directly from the data:

$$\beta_{l,c} \quad \text{Normal} \; \mu_{\tau_c}, \; {}^{2}_{c} \; , \tag{7}$$

This hierarchical structure permitted us to quantify both the average (group-level) association between length observations at each sampling location (l) and hypothesized covariates (i.e., the hyperparameter μ_c), and the level of among-location variation in these effects (i.e., τ_c^2). Prior distributions for model parameters were generally uninformative, with the exception of the prior on the group-level mean covariate effects (μ_c) which included a mild penalty toward zero,

$$\mu_c \quad \text{Normal}(0, 1). \tag{8}$$

The prior distribution of the group-level (hyper) standard deviation of covariate effects was broad and truncated at zero,

$${}_c \quad \text{Normal}(0, 10)[0, \; , \tag{9}$$

allowing the model to freely estimate the appropriate level of among-location variability in covariate effects.

Observation error was assumed to be normally distributed $\varepsilon_{l,t} \sim Normal(0, \sigma_\varepsilon^2)$, with a common observation error variance ($\sigma_{\varepsilon\tau}^2$) estimated as a free parameter and subject to a broad prior distribution

$$\sigma_{\varepsilon\tau} \quad \text{Normal}(0, 10)[0, \; . \tag{10}$$

Each species-specific model also included a smoothed nonlinear year effect $s(t)$ describing residual trends in length across time that were shared among sampling (observation) locations but were not explained by the covariates. The degree of nonlinearity for the univariate smooth $s(t)$ quantifying the common residual trend in length is controlled by the variance term (σ_s) for the coefficients forming the spline[73], for which a broad zero-truncated prior distribution was defined:

$$\sigma_{\tau} \quad \text{Normal}(0, 10)[0, \; . \tag{11}$$

Hierarchical Bayesian models describing the temporal trend in location-specific salmon length were fit using the brms package[73,74] in R (R Core Team 2018), which generates posterior samples using the No U-Turn Sampler implemented in the Stan software platform[75]. Three independent chains were run for 20,000 iterations with a 50% burn-in and saving every tenth posterior sample, resulting in 3000 posterior samples. Convergence of all chains was diagnosed by ensuring potential scale reduction factors (R) for each parameter were <1.05[76]. The sensitivity of model results to prior choice was evaluated by testing more and less restrictive normally-distributed priors for the hyperparameters describing the group-level average effect of each covariate (standard deviation 1.0 and 0.1); estimated covariate effects were insensitive to prior choice.

The influence of harvest on body size was considered separately from that of climate and competition. Reviews of fisheries-induced evolution have shown that populations subject to higher harvest rates show greater magnitude trait change[28], thus we expected that if fisheries-induced evolution contributes to size change, populations subjected on average to higher harvest rates should show greater magnitude negative size change. To test this hypothesis, we estimated harvest rate as a continuous variable for all populations with sufficient data.

Harvest rate was back-calculated from brood tables, which are datasets curated by ADF&G for management purposes that include the number of offspring from each brood year (year of birth) that return in each of the subsequent years (return year). Brood tables are only available for the most intensively managed salmon stocks. We were able to link brood table data to populations included in our AL datasets for 25 sockeye salmon populations and three Chinook salmon populations. Harvest rates were found from the literature for an additional five Chinook salmon populations[77–79]. To calculate the total harvest in each population and year, we subtracted escapement estimates from the overall estimate of returns (i.e., total run size, or both fish that escaped and were harvested). Harvest rate was calculated as the harvest divided by the estimated run size in each year, then averaged across the time series for each population to obtain the average harvest rate experienced by each salmon population. Averaging across the time series was deemed appropriate, because previous studies from the few Alaska salmon fisheries with sufficient data to consider harvest rate through time have shown that harvest rate is interannually variable but relatively stable through time[33,60]. Estimates from before 1990 or after 2010 (for sockeye) or 2008 (for Chinook) were excluded due to incomplete data availability. Each population for which both a brood table and AL data were available had a long time series of AL data (at least 30 years), so body size change was calculated by fitting a linear model of body length by year and extracting the slope. We regressed change in body size (slope coefficient of length-year regression) against population-specific harvest rate averaged through time (1990–2012), with a fixed effect for species. A harvest rate by species interaction was included but removed because it was not significant. P values were obtained from an ANOVA with type II sum of squares.

Consequences of declining body size. To estimate the potential consequences of salmon body size declines, we calculated the change in ecosystem services that would be expected given the observed change in body length for several important social, economic, and ecological roles filled by salmon in Alaska. For each species and population, we calculated percent change in body size (body length, ΔL) from pre-1990 to post-2010 using the same methods as described for Fig. 1. Specifically, we calculated absolute change in body size as:

$$\Delta L = \text{Mean length}_{\text{post} \quad 2010} \quad \text{Mean length}_{\text{pre} \quad 1990}, \tag{12}$$

and percent change in body size as:

$$\text{Percent size change} = \frac{\text{Mean length}_{\text{post} \quad 2010} \quad \text{Mean length}_{\text{pre} \quad 1990}}{\text{Mean length}_{\text{pre} \quad 1990}}. \tag{13}$$

However, the magnitude of many of the ecosystem services we investigated vary with salmon body mass, rather than directly with body length. To predict salmon weight (W) based on body length (L), we fit a standard length–weight relationship of the form $W = a(L)^b$. Weight data were not available for most regions, so we estimated the a and b parameters for each species by fitting the logarithmic linearized version of this equation to high-quality datasets collected in Alaska for each species (Supplementary Table S3). Using these species-specific length-weight relationships, for each species and location, we calculated the change in weight between 1990 and 2010 (ΔW) by finding the weight of an average post-2010 salmon and subtracting the weight of an average pre-1990 salmon. Detailed results are presented in Supplementary Data 1–3.

To consider the ecological consequences of salmon body size change, we focused on data collected by "escapement projects". These projects usually sample salmon in-river at a weir or counting tower as they migrate upstream onto spawning grounds. For each location with sufficient data (three or more years in each time window, before 1990 and after 2010), we estimated the ecological consequences of salmon size decline as the change in marine-derived phosphorus transported and the change in the number of eggs produced per fish. To calculate change in phosphorus inputs, we modified previously-developed models for anadromous fish nutrient loading to include only the import of nutrients into fresh waters by spawning adults[80,81]. We used a previously-estimated phosphorus content for spawning adult salmon of 0.38% of wet weight[80,81]. We calculated the difference in phosphorus content using the mean weight before 1990 versus after 2010. We ignored the effect of juvenile export on nutrient loading due to insufficient data and because previous studies have found its effect to be negligible unless adult biomass and escapement are extremely low[81].

To calculate the change in female fecundity, we used fecundity–length relationships to estimate the fecundity of the average female before 1990 and after 2010 and found the difference. We used published, species-specific fecundity–length relationships estimated for populations within Alaska. Because fecundity data were not available for all regions, we based these relationships on high-quality datasets from representative populations within Alaska (Supplementary Table S4).

To consider the economic consequences of body size change, we focused on data sampled from commercial fisheries. For each location with sufficient data (three or more years in each time window), we asked how much higher per-fish ex-vessel prices would be if fish had not changed in size in the period between 1990 and 2010. That is, using current price-per-pound estimates, we compared the price of two fish: one that weighed the same as an average fish post-2010 and one that weighed the same as the average fish pre-1990. First, we identified the most recently reported ex-vessel prices for each species and region[82]. For each species and region, we then multiplied the weight of the average pre-1990 salmon by its corresponding price-per-pound to calculate the average ex-vessel price for a pre-1990s salmon in today's market. This value was then subtracted from the average ex-vessel value of a post-2010 salmon, calculated in the same way, to estimate the change in ex-vessel per-capita salmon value due to salmon size change.

To consider the social consequences of size change, we focused on data from salmon caught in subsistence fisheries. However, length measurements taken from subsistence projects were rarely available before 1990. For this reason, we also included data from salmon caught in commercial harvest, which are expected to use the most similar gear types (i.e., gillnets) to subsistence harvest. For each location with sufficient subsistence or commercial data (three or more years in each time window), we modeled the social consequences of salmon size decline as the change in nutrient content and total servings or meals per fish. First, we determined the change in edible mass (M) of each fish by scaling according to species-specific values for seafood processing recovery rates[83]. We assumed that subsistence recovery rates are similar to the reported recovery rates for hand-filleted skin-on fillets, which were 55% for Chinook salmon, 60% for chum salmon, 57% for coho salmon, and 53% for sockeye salmon. We expect fillets to be the most commonly used salmon part but acknowledge that subsistence users could use different body parts (including the head and eyes) and that true recovery rates will likely vary among locations and users. We then calculated the nutrient value of the average pre-1990 and post-2010 fish and calculated the change in nutrient value, using species-specific nutritional ratios for protein (g), fat (g), and calories (kcal) per 100 g serving[84]. We used nutritional ratios for raw fish (National Nutrient Database for Standard Reference IDs: 15,078 for Chinook, 15,081 for coho, 15,085 for sockeye, and 15,079 for chum salmon). We also asked how many fewer 100 g servings and how many fewer meals of salmon were available per fish. We assume a standard serving size of 100 g, but note that many individuals will eat more than one serving in a sitting. Because of this uncertainty in serving size, we also included the change in meals by dividing M by the average self-reported estimates of portion sizes of salmon (227 g for Chinook salmon, 165.5 g for chum salmon, 178 g for coho salmon, and 163.5 g for sockeye salmon) from subsistence users in the nearby villages of Old Crow and Teslin, Yukon Territory, Canada[85].

Reporting summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

Our data have been publicly archived on the Knowledge Network for Biocomplexity (KNB): Jeanette Clark, Rich Brenner, and Bert Lewis. 2018. Compiled age, sex, and length data for Alaskan salmon, 1922–2017. Knowledge Network for Biocomplexity. https://doi.org/10.5063/F1707ZTM. Krista B Oke, Curry Cunningham, and Peter Westley. 2020. Collated dataset of covariates that could influence body size of Alaska salmon. Knowledge Network for Biocomplexity. https://doi.org/10.5063/F1N29V9T. In addition, we used publically available data from the following sources: US Department of Agriculture (USDA), Agricultural Research Service Laboratory. USDA National Nutrient Database for Standard Reference, Legacy Version. Available at: http://www.ars.usda.gov/nutrientdata. Alaska Department of Fish and Game. Commercial Salmon Fishery Exvessel Prices by Area and Species (2018). Available at: https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch_exvessel (Accessed: 2018-04-23). Kibele, J. & Jones, L. Historic air temperatures in Alaska for 1901–2015, with spatial subsetting by region. (2017). https://doi.org/10.5063/F1RX997V. Huang, B. et al. Extended Reconstructed Sea Surface Temperature (ERSST), Version 4. Accessed on April 16, 2018 (2015). https://doi.org/10.7289/V5KD1VVF. Di Lorenzo et al., 2008: North Pacific Gyre Oscillation links ocean climate and ecosystem change, GRL. Available at: http://www.o3d.org/npgo/npgo.php (Accessed: 2018-02-08). NOAA, Multivariate ENSO Index. Available at: https://www.esrl.noaa.gov/psd/enso/mei/ (Accessed: 2018-02-08). JISAO, Pacific Decadal Oscillation (PDO). Available at: http://www.research.jisao.washington.edu/pdo/ (Accessed: 2018-02-08). NOAA, Bering Sea Ice Cover Index. Available at: beringclimate.noaa.gov (Accessed: 2018-02-08). NOAA, Winter Multivariate ENSO Index. Available at: https://www.beringclimate.noaa.gov/data/BCresult.php (Accessed: 2018-02-08).

Code availability

Code has been archived publicly and is available at: https://github.com/KristaOke/salmon-size-declines.

Received: 2 December 2019; Accepted: 15 July 2020;
Published online: 19 August 2020

References

1. Peters, R. H. *The Ecological Implications of Body Size*. (Cambridge University Press, 1983).
2. Gardner, J. L., Peters, A., Kearney, M. R., Joseph, L. & Heinsohn, R. Declining body size: a third universal response to warming? *Trends Ecol. Evol.* **26**, 285–291 (2011).
3. Sheridan, J. A. & Bickford, D. Shrinking body size as an ecologial response to climate change. *Nat. Clim. Chang.* **1**, 401–406 (2011).
4. Hsieh, C., Yamauchi, A., Nakazawa, T. & Wang, W. F. Fishing effects on age and spatial structures undermine population stability of fishes. *Aquat. Sci.* **72**, 165–178 (2010).
5. Allendorf, F. W. & Hard, J. J. Human-induced evolution caused by unnatural selection through harvest of wild animals. *Proc. Natl Acad. Sci. USA* **106**, 9987–9994 (2009).
6. Ozgul, A. et al. The dynamics of phenotypic change and the shrinking sheep of St. Kilda. *Science* **325**, 464–468 (2009).
7. Daufresne, M., Lengfellner, K. & Sommer, U. Global warming benefits the small in aquatic ecosystems. *Proc. Natl Acad. Sci. USA* **106**, 12788–12793 (2009).
8. Van Buskirk, J., Mulvihill, R. S. & Leberman, R. C. Declining body sizes in North American birds associated with climate change. *Oikos* **119**, 1047–1055 (2010).
9. Law, R. Fishing, selection, and phenotypic evolution. *ICES J. Mar. Sci.* **57**, 659–668 (2000).
10. Olsen, E. M. et al. Maturation trends indicative of rapid evolution preceded the collapse of northern cod. *Nature* **428**, 932–935 (2004).
11. Planque, B. et al. How does fishing alter marine populations and ecosystems sensitivity to climate? *J. Mar. Syst.* **79**, 403–417 (2010).
12. Audzijonyte, A., Kuparinen, A., Gorton, R. & Fulton, E. A. Ecological consequences of body size decline in harvested fish species: positive feedback loops in trophic interactions amplify human impact. *Biol. Lett.* **9**, 20121103 (2013).
13. Nesbitt, H. K. & Moore, J. W. Species and population diversity in Pacific salmon fisheries underpin indigenous food security. *J. Appl. Ecol.* **53**, 1489–1499 (2016).
14. Moncrieff, C. How People of the Yukon River Value Salmon: a case study in the lower, middle, and upper portions of the Yukon River. (Final report to the North Pacific Research Board project #1413. Yukon River Drainage Fisheries Association. Anchorage, Alaska, 2017).
15. Hocking, M. D. & Reynolds, J. D. Impacts of salmon on riparian plant diversity. *Science* **331**, 1609–1613 (2011).
16. Gustafson, R. G. et al. Pacific salmon extinctions: quantifying lost and remaining diversity. *Conserv. Biol.* **21**, 1009–1020 (2007).
17. Ricker, W. E. Changes in the average size and average age of Pacific salmon. *Can. J. Fish. Aquat. Sci.* **38**, 1636–1656 (1981).
18. Bigler, B. S., Welch, D. W. & Helle, J. H. A review of size trends among North Pacific salmon (*Oncorhynchus* spp.). *Can. J. Fish. Aquat. Sci.* **53**, 455–465 (1996).
19. Lewis, B., Grant, W. S., Brenner, R. E. & Hamazaki, T. Changes in size and age of chinook salmon *Oncorhynchus tshawytscha* returning to Alaska. *PLoS ONE* **10**, e0130184 (2015).
20. Jeffrey, K. M., Côté, I. M., Irvine, J. R. & Reynolds, J. D. Changes in body size of Canadian Pacific salmon over six decades. *Can. J. Fish. Aquat. Sci.* **74**, 191–201 (2016).
21. Steen, R. P. & Quinn, T. P. Egg burial depth by sockeye salmon (*Oncorhynchus nerka*): implications for survival of embryos and natural selection on female body size. *Can. J. Zool.* **77**, 836–841 (1999).
22. Carlson, S. M., Quinn, T. P. & Hendry, A. P. Eco-evolutionary dynamics in Pacific salmon. *Heredity* **106**, 438–447 (2011).
23. Ohlberger, J., Scheuerell, M. D. & Schindler, D. E. Population coherence and environmental impacts across spatial scales: a case study of Chinook salmon. *Ecosphere* **7**, e01333 (2016).

24. Hunt, L. M. Recreational fishing site choice models: insights and future opportunities. *Hum. Dimens. Wildl.* **10**, 153–172 (2005).
25. Gelman, A., Goodrich, B., Gabry, J. & Vehtari, A. R-squared for Bayesian regression models. *Am. Stat.* **73**, 307–309 (2019).
26. Munch, S. B. & Salinas, S. Latitudinal variation in lifespan within species is explained by the metabolic theory of ecology. *Proc. Natl Acad. Sci. USA* **106**, 13860–13864 (2009).
27. Audzijonyte, A. et al. Fish body sizes change with temperature but not all species shrink with warming. *Nat. Ecol. Evol.* **4**, 809–814 (2020).
28. Sharpe, D. M. T. & Hendry, A. P. Life history change in commercially exploited fish stocks: an analysis of trends across studies. *Evol. Appl.* **2**, 260–275 (2009).
29. Cline, T. J., Ohlberger, J. & Schindler, D. E. Effects of warming climate and competition in the ocean for life-histories of Pacific salmon. *Nat. Ecol. Evol.* **3**, 935–942 (2019).
30. McPhee, M. V., Leon, J. M., Wilson, L. I., Siegel, J. E. & Agler, B. A. Changing growth and maturity in western Alaskan Chinook Salmon *Oncorhynchus tshawytscha*, brood years 1975–2005. *North Pac. Anadromous Fish. Comm. Bull.* **6**, 307–327 (2016).
31. Ohlberger, J., Ward, E. J., Schindler, D. E. & Lewis, B. Demographic changes in Chinook salmon across the Northeast Pacific Ocean. *Fish. Fish.* **19**, 533–546 (2018).
32. Shelton, A. O., Satterthwaite, W. H., Ward, E. J., Feist, B. E. & Burke., B. Using hierarchical models to estimate stock-specific and seasonal variation in ocean distribution, survivorship, and aggregate abundance of fall run Chinook salmon. *Can. J. Fish. Aquat. Sci.* **76**, 95–108 (2018).
33. Kendall, N. W. & Quinn, T. P. Length and age trends of Chinook salmon in the Nushagak River, Alaska, related to commercial and recreational fishery selection and exploitation. *Trans. Am. Fish. Soc.* **140**, 611–622 (2011).
34. Thorpe, J. E. Maturation responses of salmonids to changing developmental opportunities. *Mar. Ecol. Prog. Ser.* **335**, 285–288 (2007).
35. Czorlich, Y., Aykanat, T., Erkinaro, J., Orell, P. & Primmer, C. R. Rapid sex-specific evolution of age at maturity is shaped by genetic architecture in Atlantic salmon. *Nat. Ecol. Evol.* **2**, 1800–1807 (2018).
36. Hard, J. J. et al. Evolutionary consequences of fishing and their implications for salmon. *Evol. Appl.* **1**, 388–408 (2008).
37. Litzow, M. A. et al. Non-stationary climate–salmon relationships in the Gulf of Alaska. *Proc. R. Soc. B Biol. Sci.* **285**, 20181855 (2018).
38. Ruggerone, G. T. & Connors, B. M. 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 (2015).
39. Ruggerone, G. T. & Irvine, J. R. Numbers and biomass of natural- and hatchery-origin Pink Salmon, Chum Salmon, and Sockeye Salmon in the North Pacific Ocean, 1925–2015. *Mar. Coast. Fish. Dyn. Manag. Ecosyst. Sci.* **10**, 152–168 (2018).
40. Springer, A. M. & van Vliet, G. B. Climate change, pink salmon, and the nexus between bottom-up and top-down forcing in the subarctic Pacific Ocean and Bering Sea. *Proc. Natl Acad. Sci. USA* **111**, E1880–E1888 (2014).
41. Ohlberger, J., Schindler, D. E., Ward, E. J., Walsworth, T. E. & Essington, T. E. Resurgence of an apex marine predator and the decline in prey body size. *Proc. Natl Acad. Sci. USA* **116**, 26682–26689 (2019).
42. Bromaghin, J. F., Nielson, R. M. & Hard, J. J. A model of Chinook salmon population dynamics incorporating size-selective exploitation and inheritance of polygenic correlated traits. *Nat. Resour. Model.* **24**, 1–47 (2011).
43. Kendall, N. W., Dieckmann, U., Heino, M., Punt, A. E. & Quinn, T. P. Evolution of age and length at maturation of Alaskan salmon under size-selective harvest. *Evol. Appl.* **7**, 313–322 (2014).
44. Kendall, N. W. & Quinn, T. P. Quantifying and comparing size selectivity among Alaskan sockeye salmon fisheries. *Ecol. Appl.* **22**, 804–816 (2012).
45. Grant, W. S. Understanding the adaptive consequences of hatchery-wild interactions in Alaska salmon. *Environ. Biol. Fishes* **94**, 325–342 (2012).
46. Manishin, K. A. Exploring the potential role of late stage predation and Chinook salmon age structure. (University of Alaska Fairbanks, 2018).
47. Saulitis, E. L., Matkin, C. O., Barrett-Lennard, L., Heise, K. & Ellis, G. M. Foraging strategies of sympatric killer whale (*Orcinus orca*) populations in Prince William Sound, Alaska. *Mar. Mammal. Sci.* **16**, 94–109 (2000).
48. Herman, D. P. et al. Feeding ecology of eastern North Pacific killer whales *Orcinus orca* from fatty acid, stable isotope, and organochlorine analyses of blubber biopsies. *Mar. Ecol. Prog. Ser.* **302**, 275–291 (2005).
49. Ford, J. K. B. & Ellis, G. M. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. *Mar. Ecol. Prog. Ser.* **316**, 185–199 (2006).
50. Walsh, M. R., Munch, S. B., Chiba, S. & Conover, D. O. Maladaptive changes in multiple traits caused by fishing: impediments to population recovery. *Ecol. Lett.* **9**, 142–148 (2006).
51. Clements, C. F. & Ozgul, A. Including trait-based early warning signals helps predict population collapse. *Nat. Commun.* **7**, 10984 (2016).
52. Prepared by the McDowell Group for the Bristol Bay Regional Seafood Development Association. *2017 Sockeye Market Analysis*. (2017).
53. Valderrama, D. & Anderson, J. L. Market interactions between aquaculture and common-property fisheries: recent evidence from the Bristol Bay soc salmon fishery in Alaska. *J. Environ. Econ. Manag.* **59**, 115–128 (2010).
54. Springer, A. M. et al. Transhemispheric ecosystem disservices of pink salmon in a Pacific Ocean macrosystem. *Proc. Natl Acad. Sci. USA* **115**, E5038–E5045 (2018).
55. Ruggerone, G. T. & Nielsen, J. L. Evidence for competitive dominance of Pink salmon (*Oncorhynchus gorbuscha*) over other Salmonids in the North Pacific Ocean. *Rev. Fish. Biol. Fish.* **14**, 371–390 (2004).
56. Brenner, R. & Moffitt, S. *Operational Plan: Salmon Age, Sex, Size and Stock of Origin Sampling from Prince William Sound Area Fisheries and Escapements;* Regional Operational Plan CF.2A.2014.02. (Alaska Department of Fish & Game, Anchorage, Alaska, 2014).
57. Tobias, T. M., Waltemyer, D. L. & Tarbox, K. E. *Scale Aging Manual for Upper Cook Inlet Sockeye Salmon;* Regional Information Report No. 2A94-36 (Alaska Department of Fish & Game, Anchorage, Alaska, 1994).
58. Brodersen, A. R., Liller, Z. W. & Truesdale, C. L. *Salmon Age, Sex, and Length Catalog for the Kuskokwim Area, 2012*. (Alaska Department of Fish & Game, Anchorage, Alaska, 2013).
59. Shaul, L. D. & Geiger, H. J. Effects of climate and competition for offshore prey on growth, survival, and reproductive potential of coho salmon in Southeast Alaska. *North Pac. Anadromous Fish. Comm. Bull.* **6**, 329–347 (2016).
60. Kendall, N. W., Hard, J. J. & Quinn, T. P. Quantifying six decades of fishery selection for size and age at maturity in sockeye salmon. *Evol. Appl.* **2**, 523–536 (2009).
61. Hairston, N. G., Ellner, S. P., Geber, M. A., Yoshida, T. & Fox, J. A. Rapid evolution and the convergence of ecological and evolutionary time. *Ecol. Lett.* **8**, 1114–1127 (2005).
62. Mantua, N. J., Hare, S. R., Zhang, Y., Wallace, J. M. & Francis, R. C. A Pacific interdecadal climate oscillation with impacts on salmon production. *Bull. Am. Meteorol. Soc.* **78**, 1069–1079 (1997).
63. Hare, B. S. R., Mantua, N. J. & Francis, R. C. Inverse production regimes: Alaska and west coast Pacific salmon. *Fish. Habitat* **24**, 6–14 (1996).
64. Lorenzo, E. D. I. & Mantua, N. Multi-year persistence of the 2014/2015 North Pacific marine heatwave. *Nat. Clim. Chang.* **6**, 1042–1048 (2016).
65. Wolter, K. & Timlin, M. S. Measuring the strength of ENSO events: how does 1997/98 rank? *Weather* **53**, 315–324 (1998).
66. Wolter, K. & Timlin, M. S. Monitoring ENSO in COADS with a seasonally adjusted principal component index. In *Proc. 17th Climate Diagnostics Workshop* 52–57 (1993).
67. Mueter, F. J., Peterman, R. M. & Pyper, B. J. Opposite effects of ocean temperature on survival rates of 120 stocks of Pacific salmon (*Oncorhynchus* spp.) in northern and southern areas. *Can. J. Fish. Aquat. Sci.* **59**, 456–463 (2002).
68. Huang, B. et al. Extended Reconstructed Sea Surface Temperature (ERSST), Version 4. (2015). https://doi.org/10.7289/V5KD1VVF. Accessed 16 April 2018.
69. Kibele, J. & Jones, L. Historic air temperatures in Alaska for 1901–2015, with spatial subsetting by region. (2017). https://doi.org/10.5063/F1RX997V.
70. Rogers, D. E. & Ruggerone, G. T. Factors affecting marine growth of Bristol Bay sockeye salmon. *Fish. Res.* **18**, 89–103 (1993).
71. Matkin, C. O., Ward Testa, J., Ellis, G. M. & Saulitis, E. L. Life history and population dynamics of southern Alaska resident killer whales (*Orcinus orca*). *Mar. Mammal. Sci.* **30**, 460–479 (2014).
72. Chasco, B. E. et al. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. *Sci. Rep.* **7**, 15439 (2017).
73. Bürkner, P.-C. Advanced Bayesian Multilevel Modeling with the R Package brms. *R J.* **10**, 395–411 (2018).
74. Bürkner, P.-C. brms: an R package for Bayesian multilevel models using Stan. *J. Stat. Softw.* **80**, 1–28 (2017).
75. Carpenter, B. et al. Stan: a probabilistic programming language. *J. Stat. Softw.* **76**, 1–32 (2017).
76. Gelman, A., Carlin, J. B., Stern, H. S. & Rubin, D. B. *Bayesian Data Analysis, 2nd edn*. (Texts in Statistical Science, Chapman & Hall, CRC, Boca Raton, USA, 2004).
77. Mcpherson, S., Clark, J. H., Jones, E., Weller, J. & Ericksen, R. *Stock Status and Escapement Goals for Chinook Salmon Stocks in Southeast Alaska, Special Publication 03-01*. (Alaska Department of Fish and Game, Anchorage, Alaska, 2003).
78. Piston, A. W. & Heinl, S. C. *Chum Salmon Stock Status and Escapement Goals in Southeast Alaska*. (Alaska Department of Fish and Game, Anchorage, Alaska, 2014).
79. Bernard, D. R. & Jones, E. L. III *Optimum escapement goals for Chinook salmon in the transboundary Alsek River*, Fishery Manuscript Series No. 10-02. (Alaska Department of Fish and Game, Anchorage, Alaska, 2010).
80. Moore, J. W. et al. Nutrient fluxes and the recent collapse of coastal California salmon populations. *Can. J. Fish. Aquat. Sci.* **68**, 1161–1170 (2011).

81. Twining, C. W., Palkovacs, E. P., Hasselman, D. J., Friedman, M. A. & Post, D. M. Nutrient loading by anadromous fishes: species-specific contributions and the effects of diversity. *Can. J. Fish. Aquat. Sci.* **74**, 609–619 (2017).
82. Alaska Department of Fish and Game. Commercial Salmon Fishery Exvessel Prices by Area and Species (2018). www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch_exvessel Accessed 23 April 2018.
83. Crapo, C., Paust, B. C. & Babbitt, J. *Recoveries and yields from Pacific fish and shellfish*. (2004).
84. US Department of Agriculture (USDA), Agricultural Research Service Laboratory. USDA National Nutrient Database for Standard Reference, Legacy Version. http://www.ars.usda.gov/nutrientdata.
85. Schuster, R. C., Wein, E. E., Dickson, C. & Chan, H. M. Importance of traditional foods for the food security of two First Nations communities in the Yukon, Canada. *Int. J. Circumpolar Health* **70**, 286–300 (2012).

Acknowledgements

We are extremely grateful to the Alaska Department of Fish & Game and their partners for immense efforts collecting, curating, and sharing the data analyzed in this project, especially R. Brenner for his leadership in championing open and reproducible science. We thank J. Spaeder, J. Ohlberger, and D. Schindler for discussions that improved the manuscript and I. Dutton and F. Davis for leading the State of Alaska Salmon and People (SASAP) Initiative. NCEAS provided computational and data support and supported working group meetings. This project resulted from an NCEAS SASAP working group, funded by the Gordon & Betty Moore Foundation and Nautilus Impact Investing.

Author contributions

E.P.P., N.W.K., and P.A.H.W. conceived of the study; E.P.P. and K.B.O. refined study goals; K.B.O., C.J.C., P.A.H.W., M.L.B., S.M.C., J.S., A.P.H., V.A.K., N.W.K., J.K., H.K.K., K.M.K., B.L., S.M., J.D.R., G.K.V., and E.P.P. guided study design; J.C. lead data collection and QA/QC; K.B.O., C.J.C., S.M., V.A.K., J.K., N.W.K., and K.M.K. analyzed data; K.B.O., C.J.C., E.P.P., J.D.R., B.L., P.A.H.W., K.M.K., and J.C. contributed to writing; K.B.O., C.J.C., J.K., and K.M.K. created figures; K.B.O., C.J.C., P.A.H.W., M.L.B., S.M.C., J.S., A.P.H., V.A.K., N.W.K., J.K., H.K.K., K.M.K., B.L., S.M., J.D.R., G.K.V., and E.P.P. edited the paper.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information is available for this paper at https://doi.org/10.1038/s41467-020-17726-z.

Correspondence and requests for materials should be addressed to K.B.O., P.A.H.W. or E.P.P.

Peer review information *Nature Communications* thanks Eric J. Ward and the other, anonymous, reviewers for their contribution to the peer review of this work.

Reprints and permission information is available at http://www.nature.com/reprints

Gale K. Vick
Fairbanks, Alaska 99709

COMMENTARY TO THE ALASKA BOARD OF FISHERIES
October 6, 2021
Regarding: Area M Test Fishery

My name is Gale Vick. I am a 53 year resident of Alaska, a former drift gillnetter in Prince William Sound, and for 30 years a contractor on fisheries policy. I have been working on Yukon River fisheries issues since 2014 and I am a member of the Fairbanks Advisory Committee.

My first caution is that all species of salmon in Alaska are in obvious trouble, with the exception of Bristol Bay sockeye. You do not need to be a scientist to fully appreciate this. Most of us who have fished all over the state know, for instance, that Chinook salmon abundance and size is dramatically decreasing.[1] Our science supports this and our trajectories suggest that we have not hit bottom yet. While this has been critical mass in the Yukon for many years, we have in the last two years seen record low numbers of chum and coho salmon as well. These numbers mirror other places in part but are much more dramatic in the Yukon.

At the same time, Area M (False Pass) enjoyed record harvests of chum salmon. Because Area M is an intercept fishery for the North Pacific in the Bering Sea, and because there have been past indicators that a sizeable portion of chum salmon could be AYK stocks, it is incumbent upon managers to provide the information through tissue sampling that would give clarity to the origins of all intercepted stocks. Including Chinook.

This is an issue as old as the fishery. The debate is often based on perception because the only reliable figures we have per year are the harvest numbers. But there have been a number of isolated studies, most notably the 2002-2009 WASSIP (Western Alaska Salmon Stock Identification Program) that have given us a window of information. Except for Chinook.

Sometime in the late 1970's, the Alaska Board of Fisheries established a commercial harvest allocation of 8.3% for South Penninsula fisheries of annual Bristol Bay sockeye forecast to Area

[1] I was a co-author on a paper published in *Nature Communications* 2018 on the decline in size of Alaska salmon stocks. This paper was authored by several well-known salmon scientists at Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, College of Fisheries and Ocean Sciences, University of Alaska Juneau, Fisheries, Aquatic Science & Technology Laboratory, Alaska Pacific University, College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Department of Environmental Science and Policy, University of California, Davis, Environmental Science, Policy, and Management, University of California, Berkeley, National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, Department of Biology and Redpath Museum, McGill University, Montreal, Canada, Washington Department of Fish and Wildlife, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, Division of Commercial Fisheries, Alaska Department of Fish and Game, Anchorage, National Marine Fisheries Service, Fisheries Ecology Division, Southwest Fisheries Science Center, Santa Cruz, Earth to Ocean Research Group, Department of Biological Sciences, Simon Fraser University, Burnaby, BC Canada, Tanana Chiefs Conference, Fairbanks.

M fisheries for the month of June. In 1982 there was a major chum crash in the Yukon. Subsequently, an Area M chum cap was instituted. This was based on the sockeye to chum ratio and varied by season. During this time Virgil Umphenor wrote a petition to the BOF on behalf of YRDFA. The Fairbanks Advisory Committee supported. Tanana Chiefs and Kawarek helped with gathering signatures up and down the river. Alaska's Congressional Delegation became involved. The chum cap was subsequently lowered again. But as AYK chum stocks fluctuated, there was general lack of enforcement within Area M harvesting. In 2000, Alaska State Troopers video taped Area M fishermen throwing chum salmon overboard. Virgil, as a member of the BOF, was instrumental in helping to secure staggered openers. Prior to 2001, ADF&G had to do a test fishery to find out the chum to sockeye ratio.

The origins of *harvested* False Pass salmon will invariably change over time, which is why an institutionalized test fishery in the Shumigan Islands and South Unimak is the only way we can have anything close to accuracy.

While the ACR that was submitted on this subject by Virgil Umphenour (Fairbanks Advisory Committee), is not a regulatory issue at this point, we are asking the Alaska Board of Fisheries to consider this issue on record. It will be presented to the Alaska Department of Fish and Game, the Alaska Governor's office and the Alaska Congressional Delegation in the near future.

Thank you.

Cc: Members, Fairbanks Advisory Committee
Serena Fitka, Yukon River Drainage Fisherman's Association
P.J. Simon, Tanana Chiefs Conference
Ben Stevens, Tanana Chiefs Conference

AGENDA CHANGE REQUEST FORM
ALASKA BOARD OF FISHERIES

The Board of Fisheries board) reviews each state managed fishery under its authority once every three years in what is referred to as the board's "three-year cycle". Each year the board takes up regulatory subjects from a consistent set of regions and species, repeating every three years. Regulatory subjects in the current meeting cycle are referred to as "in-cycle" subjects.

The board recognizes there are times when "out-of-cycle" subjects require more immediate attention and created the "agenda change request" ACR) process to allow consideration of these subjects. The board solicits ACRs 60 days prior to its fall work session. Accepted ACRs are scheduled at a subsequent meeting during the current meeting cycle. More on the board's long-term meeting cycle is here.

For the 2021/2022 meeting cycle, the following regulatory regions, species and uses are "in-cycle" including:

- Prince William Sound Finfish and Shellfish species, all uses.
- Southeast and Yakutat Finfish and Shellfish species, all uses.
- All Shellfish in all other regions, all uses.

The deadline for ACRs is August 23, 2021. ACRs received regarding in-cycle subjects will not be accepted as they are effectively proposals that missed the April 2020 deadline.

The board accept requests to change its schedule under certain guidelines set forth in 5 AAC 39.999. The board will accept these agenda change requests (ACRs) only:

1) for a fishery conservation purpose or reason; or
2) to correct an error in regulation; or
3) to correct an effect on a fishery that was unforeseen when a regulation was adopted.

The board will not accept an ACR that is predominantly allocative in nature in the absence of new compelling information, as determined by the board [5 AAC 39.999 (a) (2)].

Please answer all questions to the best of your ability.

1) CITE THE REGULATION THAT WILL BE CHANGED IF THIS ACR IS HEARD. If possible, enter the series of letters and numbers that identify the regulation to be changed. If it will be a new section, enter "5 AAC NEW".

Alaska Administrative Code Number 5 AAC: 39.22

The Policy for the Management of Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222, effective 2000, amended 2001) directs the Alaska Department of Fish and Game (ADF&G) to provide the Alaska Board of Fisheries (Board) with reports on the status of salmon stocks and identify any salmon stock that present a concern.

2) WHAT IS THE PROBLEM YOU WOULD LIKE THE BOARD TO ADDRESS? STATE IN DETAIL THE NATURE OF THE CURRENT PROBLEM. Address only one issue. State the problem clearly and concisely. The board will reject multiple or confusing issues.

The AYK has seen a steadily declining loss of Chinook salmon in both size and run strength over the past 20 years. At the same time, there have been periodic crashes of summer and fall chum salmon in the AYK, with the 2021 season culminating in record losses for the second year in a row. As a result, the Yukon River especially has not had any directed commercial harvest of Chinook since 2008 with lessening subsistence harvest and in 2021, **no** commercial or subsistence harvest of Chinook or summer chum. All recent year salmon escapements have not met requirements for ANS (amounts needed for subsistence.) In addition, 2021 escapement goals have not been made for the Yukon Border passage and escapement goals on the Alaska side of the Yukon have not been met or are unknown in most tributaries. Coho salmon, a traditional late harvest, have, to date, been tracking at the lowest level, possibly on record.

In contrast, Area M *harvested* what may be a record for chum salmon.

The continuing and dramatic declines of Chinook and chum salmon for the AYK have resulted in food security and cultural crises. Concern over the survival of the stocks themselves is paramount. Stakeholders and researchers understand that there are multiple contributing factors to the decline of these stocks but are having a difficult time assessing what factors are potentially under human management vs. environmental factors that are not.

In addition, researchers and stakeholders have become increasingly concerned over impacts of hatchery pink salmon, including straying.

More critical genetic data is needed for the AYK.

Alaska state regulations require the Alaska Department of Fish and Game managers to apply precautionary principles in the conservation of stocks. Three primary tools for this management are stock identification, harvest methodology and harvest restriction.

In previous years, a massive undertaking to identify Western Alaska salmon stocks was facilitated through the Western Alaska Salmon Stock Identification Program WASSIP) which between 2006 and 2009 joined with stakeholders to collect genetic samples for salmon stocks from Chignik Bay to Kotzebue Sound. This added to genetic baseline data and DNA markers within mixed stock analyses (MSA) to identify stock composition of chum and sockeye salmon in relation to salmon passage between Central and Western Alaska. The reporting did not, however, include Chinook salmon. And it ended in 2009.

3) WHAT SOLUTION DO YOU PREFER? Or, if the board adopted your solution, what would the new or amended regulation say?

This ACR requests a Test Fishery for Area M to discern genetic origins of chum, Chinook and pink salmon stocks and to report those findings to the Alaska Board of Fisheries on an annual basis.

Because the 2021 decline of Chinook and chum is so extreme in the AYK, and because there is a potential threat of too many pink salmon, this ACR requests that the Alaska Board of Fisheries BOF) direct the Alaska Department of Fish and Game to report to the BOF on an annual basis the results of genetic compositions these stocks that potentially migrate from Central to Western Alaska and to identify the gaps in data. In addition, to summarize this data in a way that is informational to AYK stakeholders and managers.

There has never been a genetic analysis of Chinook salmon caught in the Area M June fishery. ADF&G considers the Yukon River Chinook stocks as a "Stock of Concern" and it is incumbent on the Department to identify where stocks might be intercepted.

There has not been a genetic analysis of summer and fall chum salmon through the Area M fishery since 2009. And there has never been an assessment of pink hatchery salmon that might be migrating from the Gulf of Alaska.

There has never been a genetic sampling of coho salmon in Area M nor has there been an assessment of pink salmon genetics.

4) STATE IN DETAIL HOW THIS ACR MEETS THE CRITERIA STATED BELOW. If one or more of the three criteria set forth below is not applicable, state that it is not.

a) for a fishery conservation purpose or reason: Identifying AYK stocks that might be part of capture in intercept fisheries will help identify management options for protection of depleted stocks

b) to correct an error in regulation:

c) to correct an effect on a fishery that was unforeseen when a regulation was adopted:

5) WHAT WILL HAPPEN IF THIS PROBLEM IS NOT SOLVED PRIOR TO THE REGULAR CYCLE?

We could have a continued dramatic loss in the AYK of specific year classes of chum and Chinook salmon without knowing percentages of AYK stock that might be intercepted. We just need to know where the Area M June fish are heading to spawn.

We also need to know if Southeast or Central hatchery salmon are migrating) through Area M to the BSAI.

6) STATE WHY YOUR ACR IS NOT PREDOMINANTLY ALLOCATIVE.
There has been no or severely limited commercial fishery in the AYK for chum salmon in the last two years, and there has been no Chinook directed fishery since 2008. And subsistence fisheries have also been extremely curtailed or completely closed. This ACR request is for genetic information.

7) IF THIS REQUEST IS ALLOCATIVE, STATE THE NEW INFORMATION THAT COMPELS THE BOARD TO CONSIDER AN ALLOCATIVE PROPOSAL OUTSIDE OF THE REGULAR CYCLE.

8) STATE YOUR INVOLVEMENT IN THE FISHERY THAT IS THE SUBJECT OF THIS ACR (e.g., commercial fisherman, subsistence user, sport angler, etc.)
I have been a member of what is now the Yukon River Panel longer than any member of either Canada or the United States since 1988.

9) STATE WHETHER THIS ACR HAS BEEN CONSIDERED BEFORE, EITHER AS A PROPOSAL OR AS AN ACR, AND IF SO, DURING WHICH BOARD OF FISHERIES MEETING.

NO… genetics taken for chum salmon back in the 1990s, except for WASSIP 4-year period ending in 2009 and none has been taken for Chinook or pink salmon ever.

Submitted by:
NAME Virgil Umphenour
Individual or Group

878 Lynnwood Way, North Pole, AK 99705
Address **City, State** **Zip**

907-328-8857 907-456-3885 akhunt@ak.net
Home Phone **Work Phone** **Email**

SIGNATURE: Virgil Lee Umphenour **DATE: 8/22/21**

Note: Addresses and telephone numbers will not be published.

Mail, fax, or e-mail this completed form to:
Alaska Board of Fisheries
P.O. Box 115526
Juneau, AK 99811-5526
Fax: 907-465-6094

E-mail: dfg.bof.comments@alaska.gov

Submitted
Ge ald W Foste
Submitted On
10/5/2021 3:20:11 AM
Affiliation

Phone
[redacted]
Email
[redacted]
Address
36238 adford Rd. O ox 1147
Sterling, Alaska 99672

I went halibut fishing out of Homer this summer on a "charter-f ee" Wednesday and there were charter boats (binoculars) anchored in the fi st two spots I usuall stop, so I moved on until we were clear of an other fishe s.

As I eflect on the new "fishing quoto" program f om m point of view it seems like a clever eallocation of halibut f om sport to charter operators who are clearl commercial fishers. Sport fishers are not a cohesive political lobbying group and I suspect thei views were not epresented in whatever process was used.

When I fish halibut in the Juneau area I've seen small st uctu es "plugged" with charters - given the more limited number of fish, this is a problem.

I wanted to voice m displeasu e with this program and although the feds manage the halibut fishe ies, Alaska also pla s an impo tant ole.

From: John/Karen Krieg
To: DFG, BOF Comments (DFG sponsored)
Subject: Agenda change request by Virgil Umphenour
Date: Monday, October 4, 2021 7:47:59 AM

To Alaska Board of Fish,
Please consider the Agenda change request from Virgil Umphenour. While profits may be up for many in the fishing industry, the people along the Yukon have been devastated by the poor runs of resent years. This has been a way of life for thousands of years and they they deserve to have answers for the low runs. Genetic testing may provide some.
Thank you for your time
John Krieg
P.O. Box 56515
North Pole, Alaska 99705

Sent from my iPad

Submitted
hn Renner
Submitted On
10/6/2021 3:38:44 PM
Affi iati n
CRPWS/AC

Ph ne
[redacted]
Emai
[redacted]
Address
P.O. x 756
cordova, A aska 99574

Members of the oard,

On anuar 25th, 2021 OF teleconference concerns were expressed about the validit of the proposals for PWS Copper River due t 2 ears Covid delay. We and other board members questioned how t address the 2 ear COVID delay and address issues that have come up in the meantime. G en Haight stated that the ACR pr cess w u d be avai able t us. Eight ACR's were put in by members f our constituenc al were rejected because we were in c c e. We sti feel that isues have change dramatical on the Copper River and PWS. It has been t ong, we need t either cal for proposals again r open the pr cess up for new input for current issues. P ease feel free t cal me t discuss options at 907-253-7564

Sincerel ,

Chairman Copper River PWS/AC

hn K Renner

From:	Kenneth Jones
To:	DFG, BOF Comments (DFG sponsored)
Subject:	October work session written comments
Date:	Thursday, September 30, 2021 8:48:10 PM

Esteemed board of fish members,

I submitted multiple ACRs this year that were timely before the deadline, which were denied due to being in cycle. However during your spring work session it was said that people should use the ACR process for in cycle topics because the meeting had been delayed due to covid. I would like you to please consider placing my ACR requests as proposals for the December PWS in cycle meeting, this will be the best time to have participants take up these topics that meet multiple ACR criteria, many of which relate to a new fishing technology that did not exist yet when the proposal deadline closed. This fishing technology can curb bycatch and whale depredation and is the future of our fisheries. It would be unfathomably disappointing to many PWS fishers if we had to wait another cycle for these topics to be discussed at an in region meeting.

Thank you for your consideration and I urge you to allow these ACRs for the in cycle PWS meeting.

Kenneth B Jones
Samani Fisheries LLC
Cell : 9073603456
FV Serenity
FV Second Wind

From: Nancy Hillstrand <halibuts@gmail.com>
Sent: Wednesday, July 14, 2021 9:09 PM
Subject: Will different salmon species adapt before the climate votes them off the island?

July 2021 article
Which salmon do we prefer?

Surviv : Salmon Edition

Will different salmon species adapt before the c ate votes the off the is a d?

July 6, 2021 | 4,600 words, about 23 minutes

This article is also available in audio format. Listen now, download, or subscribe to "Hakai Magazine Audio Edition through your favorite podcast app.

On a small, grassy point overlooking the lower Fraser River in southwestern British Columbia, a lone angler reels in his line. He checks his lure and gazes out over the broad ribbon of silty water flowing to the sea. Then he casts again. It's a late August afternoon, and I'm traveling by boat with biologist Dave Scott through the estuary of what is considered one of the world's greatest salmon rivers. But for the moment, there's a stillness stretching over the water: the only disturbance is a trail of wakes our boat leaves behind. As we push downstream, look back at the lone angler perched on the bank. Shoulders slouched, he stands at the water's edge, line cast, waiting. But the river seems in no hurry to reward his patience.

Salmon tend to be few and far between here in the late summer season, but Scott, a salmon biologist with the Raincoast Conservation Foundation in British Columbia, also knows these are hard times on the river. Many of the Fraser's wild salmon populations are in serious trouble, with steadily declining numbers, and Scott and his colleagues have embarked on a new project in the estuary to improve the survival of juvenile salmon. A few days ago, he invited me out on the water to see their progress. Earlier this afternoon, Scott, a lanky, outdoorsy, West-Coast millennial in a black T-shirt and forest-green cargo shorts, welcomed me and a photographer aboard a small motorboat in the historic harbor of Steveston, and the three of us set of .

Perched on the bank of the lower Fraser River, the village o Steveston is now a quiet suburb of Vancouver. But during the early 1900s, canneries crowded the Steveston water ront, where they packed Fraser River salmon into tins that were shipped around the world. The village boomed, and locals took to calling it Salmonopolis. Now times have changed, and ew people call it Salmonopolis anymore. Today, much of the fishing talk in Steveston is about conserving and protecting the Fraser's dwindling salmon stocks.

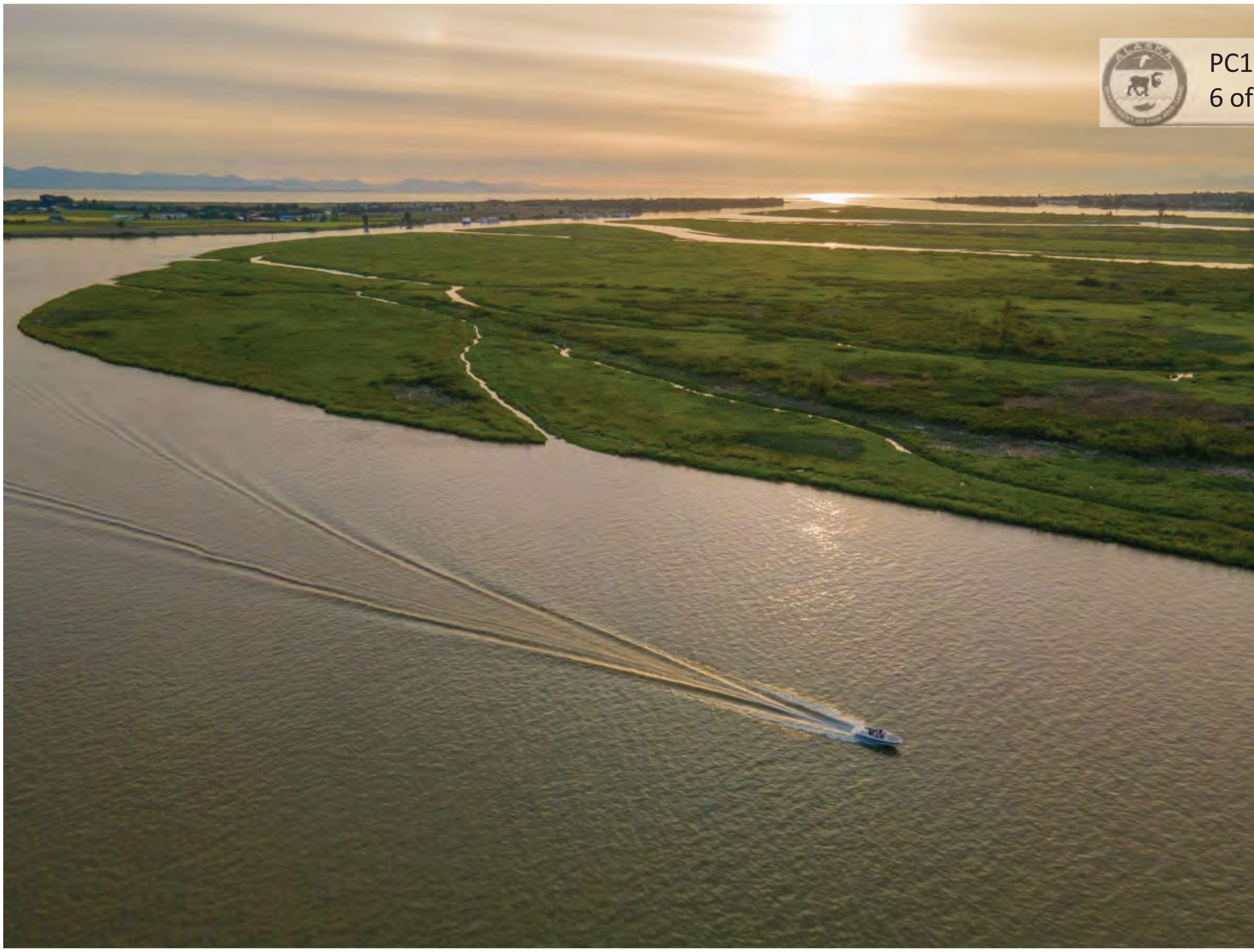
As we cruise downstream, Scott gives me a short primer on the Fraser estuary. Each year, he explains, five species of Pacific salmon travel through the waters of the estuary. They have specific streams they call home, specific times they migrate out to sea, and specific routes to get there. In other words, most salmon are finicky, so habitats that all five species use are of great importance. The Fraser River estuary is just such a place.

Salmon biologist Dave Scott heads out on the Fraser River in British Columbia to check a major new habitat restoration project for Paci ic salmon in the estuary. Photo by Alice Sun

Before the arrival of European settlers, the estuary was a maze of water channels, sandflats, eelgrass beds, and marshlands. It served as a rest area and nursery for vast numbers of migrating juvenile salmon. But those numbers fell as the marshlands were drained for farms and housing developments, and stone jetties blocked water channels to some of the surviving wetlands. So Scott and his colleagues are looking for ways to give young salmon more access to the estuary's remaining wetlands. They're also trying to educate the public about the estuary and its critical importance to dwindling salmon stocks. "We're trying to hit it on all angles," Scott says, his brown hair tousled by the breeze.

But the Fraser isn't the only salmon river in trouble. Scientists are also recording worrying declines in wild salmon stocks in other parts o the Pacific Northwest, too. Land development along reshwater habitats is a common problem in the region, but it's only one of several factors shaping the current picture. Logging, landslides, and climate change also pose serious threats. Rising water temperatures, for example, can impact the intricate food webs that salmon depend upon in both rivers and oceans. And not all salmon species are affected equally, suggesting that genetic diversity within a species also plays an important part in the picture. Remarkably, one of the more genetically diverse and geographically widespread species, chinook salmon, seems to have fared the worst in North America over the past couple of decades.

Given all the changes that salmon populations have seen over the past century, scientists are now looking ahead with a new urgency, bracing for what the future may bring. And many are grappling with several questions. In a future shaped by rapid climate change, which salmon populations will do worse, and which will do better? And how will climate change a fect the geographical distribution of salmon in the future? With this in ormation in hand, researchers hope to develop new ways of protecting today's salmon stocks—and prepare or tomorrow's.



A boat cruises at sunset in the lower Fraser River estuary. The estuary is vital fish habitat: all five species of Paci ic salmon pass through it on their journey to the sea. Photo by Fernando Lessa/Alamy Stock Photo

Much like social scientists, who look at a person's formative years to understand their behavior and predict how they might act in the future, biologists say they are examining the evolutionary history of salmon as part of the research needed to envision the future of these iconic fish. Where, they ask, did Pacific salmon species evolve, and what experiences shaped their evolution and survival? In other words, what informed *their* formative years?

In the past, salmon had millennia to adapt to changes. Now we are forcing them to do so again in a matter of decades.

At the University of Washington in Seattle, ecologist Daniel Schindler has given much thought to the question of how salmon evolved and adapted to their local habitats. Over the past 25 years, Schindler has studied populations of Pacific salmon in many ecosystems in western Alaska, examining how they respond to both climate change and land-use issues. On the day we talk over Zoom, Schindler sports a brushy, graying beard after just returning from a four-month field season in western Alaska. As a principal investigator in the Alaska Salmon Program, the ecologist regularly takes graduate and undergraduate students north to monitor juvenile and adult salmon populations and check on how they are faring there. "That's what keeps me in the business," he says, one corner of his lips turned upward. "But teaching is fun, too."

Schindler is fond of using analogies when he wants to make an important point about salmon. When our conversation turns to the question of how salmon will adapt to freshwater habitats during climate change, he begins by likening the process to a peanut butter and jam sandwich. One slice of bread is the landform—the mountains and river valleys. The other slice is climate. "The lumpy peanut butter is the habitat," Schindler explains, "and the jam is the genetics. Then if you squeeze those two things together, the genetics are responding to the habitat, which is, in its own way, its own living entity."

For salmon, the "living" habitats are landscapes shaped by the dynamic orces o nature—flooding, the movement of ice sheets and glaciers, and landslides. Almost half of the current North American range of Pacific salmon, for example, was blanketed in ice during the Last Glacial Maximum between 26,500 and 19,000 years ago. When the climate finally warmed, the glaciers retreated, carving out U-shaped valleys in the Pacific Northwest, altering water flow and temperature in downstream tributaries, and unlocking new areas for fish to colonize over a period of thousands of years. These momentous events changed the shape of riverscapes, selecting for salmon that could adapt to a dynamic environment. And more was to come. Erosion, land development, and many other factors have continued altering riverscapes over the centuries, creating new conditions or salmon to adapt to. Just where and how a species evolved pro oundly shapes its genetic inheritance.

Among the Pacific salmon species, chinook have the greatest degree of diversity in terms of ecology, life history, and habitats. Often called king salmon by the public, a chinook typically weighs in at around 13 kilograms, though fishers have landed some as large as 50 kilograms, about one-third the weight of a panda bear. And while juvenile chinook dine mainly on insects and crustaceans, the adults feed primarily on other fish.

o ng considered to be the royalty of the salmon world, chinook are in decline across much of the Paci ic Northwest. Today, some scientists worry they could be the canary in a coal mine, sounding the alarm for other salmon species. Photo by Mark Conlin/Alamy Stock Photo

Along the west coast of North America, chinook have adapted to a wide range of environments. They can be found all the way from Northern California to the glacier- ed streams of Alaska. And they have a remarkably varied life history. Some set of or the ocean just a ew months after they hatch; others spend a year or more in their natal streams before venturing to the sea. (These two groups are aptly named ocean-type and stream-type chinook, respectively.) In addition, some chinook can remain at sea for up to six years before migrating home; others stay there just a year.

Schindler likens chinook's diverse populations and habitats to an investor with a varied financial port olio. In the financial world, he says, wise investors don't put all their eggs in one basket. Instead, they place their money in a variety o investments—stocks, bonds, real estate, and the like—and this strategy reduces their risk of losing everything in times of financial turmoil. By keeping a lot of options in the game, it's more likely there will be a winner somewhere, Schindler notes. This is very similar to what chinook salmon have done. The rich diversity of its wild populations and habitats reduces the odds of the entire species being wiped out in the event of a disaster in one region.

With its varied port olio, chinook salmon would look like a good bet for the future. But some statistics cast doubt on this. In 2020, the Committee on the Status of Endangered Wildlife in Canada designated seven chinook populations in southern British Columbia as either endangered or threatened. Much the same is true in the Columbia River watershed in the northwestern United States, where chinook populations may have lost more than one-third of their genetic diversity. More worrying still, the rate of young salmon returning as adults to rivers from California to Alaska over the past half-century has plummeted to one-third of earlier levels.

It's a picture that puzzles many researchers. A myriad of variables impact salmon survival and it takes time and research to untangle them. Land use—from mining to damming and irrigation, for example—has affected chinook stocks in the Pacific Northwest at critical life stages, but it can't be blamed or what's happening in the northern latitudes. Many o Alaska's rivers and streams remain almost untouched by development, and in certain areas, the amount of salmon habitat appears to be growing as melting glaciers produce new rivers and tributaries for salmon to colonize. Yet, wild chinook stocks are struggling in Alaska, far more than other salmon stocks. So what's going on?

Through a viewing glass, a child gazes at a chinook in a fish ladder at the Winchester Dam in Oregon. Much of the decline of the chinook in Canada and the northern United States has been attributed to land development, particularly the damming of rivers. Photo by ZUMA Press, Inc./Alamy Stock Photo

At the University of British Columbia in Vancouver, fisheries scientist Scott inch rubs his chin in puzzlement. That 's "the $64-million question," he says. Currently, studies suggest that much of the problem lies with what chinook stocks are eating in the ocean. The marine diet of some salmon species is changing, but it's not easy to tease out the particulars. Food webs in the ocean are complex, he says. Predator levels change, or prey levels, or the number of fish that compete for the same prey, and these can af ect the entire ecosystem. "It's not as simple as saying the oceans are warmer," inch observ es.

For many ecologists, the fragile state of chinook salmon today is worrisome, given their diverse population stocks and their far-ranging distribution. And there is another puzzling side to this story. Pink salmon tend to be at the other end of the diversity spectrum. Their populations are relatively homogenous. But unlike chinook, pink salmon are an impressive success story.

The pink salmon is the bantam of the Pacific salmon family, with an average weight o two kilograms. Silvery in color as a juvenile, it later develops darker coloration and its flesh eventually turns pink as a result of its marine diet of shrimp and krill, both of which are rich in a reddish-orange pigment. Then, shortly before spawning, the males undergo yet another transformation, developing a large hump of connective and bony tissue near the dorsal fin. This bulge has given rise to a popular name for the species—humpback, often shortened to just humpy.

The pink has a very different life history from the genetically diverse chinook, although the two species evolved in broadly similar latitudes. Pink salmon lay their eggs in coastal habitats, rarely venturing far into the watershed, and the juveniles spend little time in fresh water, heading off to the ocean relatively quickly. Moreover, pink salmon have a ixed, two-year life span. They spawn, migrate, return, and die all within two years, and that often translates into an odd-year–even-year return cycle. Depending on the run, returns can fluctuate widely: odd years will see a flood o returning pinks, even years not so much. Or vice versa. Whether odd or even, however, the year with bumper numbers of pinks has an impact on the ocean ood web. Pinks outcompete other species for food.

Nicknamed humpies due to the appearance of the males before spawning, pink salmon are highly resilient and appear to colonize new habitats with ease. These pinks are migrating through Prince William Sound, Alaska, where glacial retreat has accelerated over the past few decades, exposing new, pristine freshwater habitat. Photo by Chris and Monique Fallows/Minden Pictures

Pinks, however, get relatively little love from foodies in North America, compared with chinook or sockeye. There's a good reason for that. Pinks put much of their energy into growing quickly, whereas chinook and sockeye take more time to grow and store more of their energy as fat. And in the culinary world, the fat content of a salmon translates into taste. Pinks, Schindler says, "just aren't as luscious and juicy and delicious as a nice sockeye or chinook."

Still, pink salmon have a lot going for them. They are accustomed to wandering and they aren't picky about which stream they spawn in. They're adept at colonizing unfamiliar rivers, and they need only a year and a half at sea before returning home to complete their life cycle—traits that make pink salmon reproductive machines.

And it shows. The pink is the most abundant Pacific salmon species. Between 1990 and 2015, more than 400 million pink salmon roamed the North Pacific Ocean and into the Bering Sea annually, far outnumbering chum and sockeye salmon there. But this reproductive success has a serious downside. Pink salmon are now outcompeting other species for ood. In the southern Bering Sea region, or example, pinks are extremely abundant in odd years, and they gobble up vast quantities of the small crustaceans that other salmon species and seabirds need for survival. Some researchers think a similar scenario is taking place in the North Pacific, which could contribute to declining numbers of chum and chinook in the region, as well as the diminishing body size o chinook there: they're just not getting enough to eat. For their size, pinks are stronger swimmers. In addition, they grow more quickly, head to the ocean sooner, and have a higher food consumption rate than their fellow salmon.

For all these reasons, pink salmon may well hold the winning lottery ticket for the future. Certainly, they are the salmon of the present. But their penchant or roaming and colonizing has created a new set o problems in places such as Norway, which is home to native populations of Atlantic salmon.

Just how pink salmon ended up in Norway is a tale that begins in the old Soviet Union. During the 1950s, someone in the Soviet Union came up with the idea of introducing pink salmon to the White Sea, a nearly landlocked finger of the Arctic Ocean along Russia's northwest coast. The idea may have been to boost local commercial fisheries, "but this was back in the Khrushchev days, so exactly why they did what they did—that's difficult to know," says Henrik Hårdensson Berntsen, a salmon researcher with the Norwegian Institute for Nature Research, on a recent Zoom call. A clean-shaven man in a button-down shirt, Berntsen has been trying to piece together exactly what happened.

In 1957, Soviet scientists introduced pink salmon fry from Sakhalin, a Russian island north of Japan, to rivers that drained into the White Sea. The researchers then continued stocking these rivers with pink salmon eggs over the next two decades, and the program led to large catches in the Soviet rivers during most odd years. But the ish ailed to establish breeding populations, probably because they could not adapt to the cold polar waters of the White Sea. So the Soviets eventually switched sources, taking eggs from pink salmon populations in the River Ola, north of Sakhalin. Then in 1999, the stocking project suddenly ended, likely because it was deemed a ailure and due to the politically turbulent time in Russia.

Berntsen thinks fishers continued to catch pink salmon in rivers draining into the White Sea. In addition, some evidence showed that the fish also ranged farther north and west—into the Barents Sea and the North Atlantic. This suggested that pink salmon were breeding in the wild after all. Then, in 2017, something startling happened. Norway saw a huge spike in the number of pinks in its northern rivers. Some researchers estimated that more than 10,000 were in northern Norway, and Berntsen thinks that number is likely an underestimate, since the Norwegian fisheries management agency was taken off guard by the surging numbers and likely failed to record many catches.

Pink salmon return to spawn along a streambed in one of the Shantar Islands of Russia's east coast. During the 1950s, Soviet scientists introduced pink salmon from Sakhalin island, north of Japan, to the White Sea, where they probably began breeding in the wild. Photo by ITAR-TASS News Agency/Alamy ive News

Even more surprising was the appearance of pink salmon on the other side of the Atlantic in 2017—in Newfoundland and Labrador. Some researchers think these fish may be traced back to the Soviet project in the White Sea. Although no one knows how they got all the way to Canada's east coast, it's possible they migrated across the Atlantic Ocean from newly established populations in the United Kingdom and Ireland. Hinch and others think pinks are the weeds of the salmon world. Give them an opportunity to colonize a new area, and they will often take it and excel.

Indeed, they could be doing *too* well in Norway. When the Norwegian government recently studied the possible impact that pink salmon could have on the country's wild and farmed salmon, it listed several major concerns—introduction of pathogens carried by the pinks, growing competition between the pinks and the native Atlantic salmon for food and habitat, and declining water quality in some rivers when large numbers of pink salmon return to spawn, leaving behind their decaying carcasses.

Then, as northern waters warmed over the years, researchers recorded another big spike in pink catches in Norway in 2019. According to Berntsen, this surge could indicate that the fish has now established its two-year life cycle in Norway, a possibility that fits with research findings from other northern regions. Scientists monitoring rivers and streams around the northern Bering Sea between 1995 and 2018, for example, recently found some evidence suggesting that warming freshwater temperatures contribute to higher survival or pink salmon.

But Berntsen cautions against drawing conclusions too quickly. Other factors could be at play, too. Hypothetically, he says, an increase of even 0.2 °C in the sea might be very beneficial for the prey of pink salmon, thereby increasing the food supply. Or a warming ocean could be detrimental to marine predators of pinks, such as whales and sharks. Just as the odd-year abundance of pink salmon in the North Pacific affected an entire ecosystem and the survival of other species, a slight change in conditions in the waters of Norway might tilt the ecosystem there in favor of the pinks.

But while warming temperatures in northern European waters might be helping pink salmon, a changing ocean of Canada's west coast could spell serious trouble for other salmon species.

Tucked in the middle of an unusually quiet and empty orestry building at the University of British Columbia, the water pumps and other equipment in Scott Hinch's lab can be heard from the hallway outside. The fisheries scientist has spent much of his career studying adult salmon migrations, and in a day's time, he will be inducted into the Royal Society of Canada for his research. inch greets me and lets slip that he has to work on his acceptance speech for the ceremony after my visit. Still, he's made time to show me the per ormance tests that he and graduate student Natalie Butler are running in the lab.

Hinch shows me four fiberglass troughs, each filled with water and about 125 young chinook salmon. All the fish are stream-type chinook and all are just under a year old: they were obtained from hatcheries in British Columbia's Shuswap region.

The experiments are designed to test the thermal tolerance of the young fish, and Hinch hopes this work, along with research he's done on other populations and other life stages, will shed light on chinook salmon in a future shaped by climate change. The water in each of the fiberglass troughs is kept at a specific temperature: 15 °C, 18 °C, 20 °C, or 24 °C. The three coolest temperatures reflect the range that chinook salmon have encountered both in historical times and today, while the warmest represents what they might soon experience. For the past two to three weeks, the juvenile fish have been acclimatizing to the water temperature in their respective trough.

Hinch and his team have already completed one experiment, which showed that some young chinook could tolerate waters as warm as 29 °C to 31 °C or a short period o time. Now the researchers are testing something more ecologically relevant—how long the young fish can swim at a specific temperature. To do this, they move ish from the iberglass troughs into swim tunnels kept at a specific temperature between 15 °C and 24 °C, and they observe what happens. The experiment entails a lot of waiting. "Natalie just sits here and watches all day as they fail," Hinch says, laughing. And by "fail," he means the fish stop swimming and go belly-up. When that happens, she moves the struggling fish to a recovery tank.

So far, they've learned that many young fish fail pretty quickly when they're made to swim at a higher temperature—even if they had previously acclimatized to that temperature. " ust because … fish can acclimate, doesn't mean they can ecologically per orm at those temperatures," Hinch says. And outside the lab, in a fast- lowing river or stream, the fish need to be able to per orm.

Juvenile chinook salmon gleam in a tank at the Seattle Aquarium in Washington State. At the University of British Columbia, fisheries scientist Scott Hinch is studying the thermal tolerance of juvenile chinook to see how they may fare in a time of climate change. Photo by Images By T.O.K./Alamy Stock Photo

These results could indicate a troubled future for many stream-type chinook salmon. But they don't mean that all chinook populations face serious peril. With a varied "financial portfolio," chinook salmon have many different options in the game, many different populations, and some of these produce juveniles that migrate to the sea within their first three months of life, thereby reducing their dependence on freshwater habitats. This poses the question: does the future of salmon lie with populations that spend little time in streams and rivers, heading off to the ocean at the first opportunity? That's certainly the strategy of the pink salmon.

Hinch notes that researchers have long considered oceans to be "risky" places for salmon, since marine environments abound in big, hungry predators such as sea lions and sharks. But what was once considered "safe" or "risky" habitat seems to be shifting. In the Pacific Northwest, humans have urbanized, developed, and dammed much of the freshwater habitat that once provided safe havens and nurseries for juvenile salmon. And that may mean that the ocean is looking better.

So might pink salmon, with their brief sojourns in fresh water, have taken a gamble that's paying off? Hinch thinks so. Pink salmon may not be the most consistent species, with their steeply fluctuating numbers shaped by their two-year life cycle, but they *ar* the most productive today.

Moreover, things are also looking bright for them down the line. According to some climate models, the glaciers of western North America will lose 80 percent of their ice over the next 80 years, creating brand-new landscapes and shifting the ranges of many species. In the 1970s, pinks were the first salmon to colonize Glacier Bay in Alaska after the ice retreated from the fjord. Today, climate change is forcing salmon to adapt to dynamic habitats once again, at a pace they've never had to before. And to date, pink salmon have shown they're able to keep up.

But that doesn't mean it's time to throw in the towel on other salmon species. Just ask Dave Scott. In 2016, he and his colleagues at Raincoast began working on ways to help struggling coho and chinook salmon in the Strait of Georgia and the Salish Sea. Scott focused on assisting juvenile salmon in accessing the marshlands of the Fraser estuary before they ventured off to sea. e wants to show me the habitat restoration project that resulted.

As we cruise downstream through the estuary, Scott steers the boat with one hand and points out some of the sights along the way. Some 15 minutes later, we arrive at a spot along the Steveston Jetty, an eight-kilometer-long rock wall that runs parallel to the bank of the Fraser.

Along the Fraser River, Dave Scott points to a newly constructed breach in the eight-kilometer-long Steveston Jetty. The breach serves as an off-ramp, allowing young migrating salmon to exit the Fraser River and reach the marshes in the estuary. Photo by Alice Sun

Constructed roughly a century ago, the jetty acts much like a guardrail on a highway. It guides the flow of ships through the water channel and keeps them from straying into the marshland beyond the riverbank, keeping them on course between the river and the sea. But the construction of the jetty also had an unforeseen consequence. It prevented many young migrating salmon from reaching the maze of marshlands, streams, and mudflats beyond—habitats the fish need in order to rest and adjust to salt water before entering the ocean. In essence, the jetty blocks off some of the access to Sturgeon Bank for the young fish. The Fraser River, Scott says, is "the highway, and we're trying to give them some off-ramps."

To create those "off-ramps," Scott and his colleagues drew up plans to build a few large holes in the jetty, allowing juvenile salmon to swim into the adjacent wetlands. Starting in 2018, a crane was barged to three parts of the jetty. It dug out holes nearly 50 meters wide and stabilized the bottom of each channel with two layers of rock. "We basically rebuilt the jetty here with an opening," Scott says.

Scott waves at some of his team members, who are standing in waders on grassy mudflats near the opening, clipboards in hand. They have set up a net in the newly made channel, ready to catch any fish as they travel through this breach. Then they release them. But this August afternoon, as water temperatures reach 19 °C in the estuary, ew young salmon are seeking out the channel. It's too late in the season. Earlier in the spring, however, when the waters were a favorable 7 °C, the team caught as many as 300 juvenile chinook and chum salmon a day, each taking the new of -ramp into neighboring wetlands. "We couldn't believe our eyes as we kept retrieving them," Scott noted in an article on the Raincoast Conservation Foundation website.

For a sampling project, students working with the Raincoast Conservation Foundation maneuver a net across one of the new breaches in the Steveston Jetty. In the spring, the team caught, counted, and released as many as 300 juvenile chinook and chum salmon per day using the breach—a clear measure of success. Photo by Alice Sun

Reducing barriers to wetlands and improving access to vital habitat in the Fraser estuary is only one small part of the work that needs to be done to conserve the Fraser River's famous salmon, however. Much more remains, and it's clear that—much like the salmon—we are on a tight deadline.

If we can't find a way to slow the pace of climate change and give Pacific salmon a chance to adapt to the brave new world of the Anthropocene, then we might all have to get used to the idea o ewer Paci ic salmon species in the world.

From: Nancy Hillstrand
Sent: Thursday, July 15, 2021 1:08 PM
Subject: Profit, Genetic Diversity Loss, and BC's Salmon Collapse

Alaska follows this pattern

https://watershedsentinel.ca/articles/profit-genetic-diversity-loss-and-bcs-salmon-collapse/?mc_cid=e71f8202ec&mc_eid=fa4ff75642

"The reality is that the collapse of west coast salmon lies in the collapse of wild salmon genetics. **Notwithstanding the good intentions** of DFO's "Wild Salmon Policy," the vast majority of BC salmon are now largely hatchery stock, and **little attention is given to the importance of a largely-lost diversity of small populations.** The DFO strategy is intended to maintain the diversity of "the stock" – the fisheries stock (not the "populations") – while continuing to make it available as an economic resource. In other words, the economy continues to be the priority and conservation pays the piper.

What this leads to has been spelled out by H.H. Price in a January 2021 study[3] on the collapse of population and wild genetic diversity in Skeena sockeye. Based on long-term data from 1912 onwards, what is reported is that one population, the Babine population, which consists mainly of hatchery stock, now makes up 91% of returns in the Skeena fishery.

With many smaller populations having been extirpated, abundance has contracted throughout the entire watershed and population diversity has declined by 70%. Life histories needed to respond to changes in ocean conditions have shifted or disappeared. The return of wild salmon is 31% of historic numbers – and as we know from standard fisheries modeling, 30% is the critical limit at which fisheries should be shut down. The actual low genetic diversity of these sockeye makes them extremely vulnerable to climate change impacts."

Received: 26 September 2020 | Accepted: 24 November 2020
OI: 10.1111/1365-2664.13835

Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICL

Portfolio simplification arising from a century of change in salmon population diversity and artificial production

Michael H. H. Price[1] | **Jonathan W. Moore**[1] | **Brendan M. Connors**[1,2] | **Kyle L. Wilson**[1] | **John D. Reynolds**[1]

[1]Earth to Ocean Research Group, Department of Biological Sciences, Simon Fraser University, Burnaby, BC, Canada

[2]Fisheries and Oceans Canada, Institute of Oceans Sciences, Sidney, BC, Canada

Correspondence
Michael H. H. Price
Email: mhprice@sfu.ca

unding information
W Garfield Weston Foundation; Pacific Salmon Foundation; Office of the Wet'suwet'en; Tides Canada; Natural Sciences and Engineering Research Council of Canada

Handling ditor: Andre Punt

Abstract

1. Population and life-history diversity can buffer species from environmental variability and contribute to long-term stability through differing responses to varying conditions akin to the stabilizing effect of asset diversity on financial portfolios. While it is well known that many salmon populations have declined in abundance over the last century, we understand less about how different dimensions of diversity may have shifted. Specifically, how has diminished wild abundance and increased artificial production (i.e. enhancement) changed portfolios of salmon populations, and how might such change influence fisheries and ecosystems?
2. We apply modern genetic tools to century-old sockeye salmon *Oncorhynchus nerka* scales from Canada's Skeena River watershed to (a) reconstruct historical abundance and age-trait data for 1913–1947 to compare with recent information, (b) quantify changes in population and life-history diversity and the role of enhancement in population dynamics, and (c) quantify the risk to fisheries and local ecosystems resulting from observed changes in diversity and enhancement.
3. The total number of wild sockeye returning to the Skeena River during the modern era is 69% lower than during the historical era; all wild populations have declined, several by more than 90%. However, enhancement of a single population has offset declines in wild populations such that aggregate abundances now are similar to historical levels.
4. Population diversity has declined by 70%, and life-history diversity has shifted: populations are migrating from freshwater at an earlier age, and spending more time in the ocean. There also has been a contraction in abundance throughout the watershed, which likely has decreased the spatial extent of salmon provisions to Indigenous fisheries and local ecosystems. Despite the erosion of portfolio strength that this salmon complex hosted a century ago, total returns now are no more variable than they were historically perhaps in part due to the stabilizing effect of artificial production.
5. *Policy implications*. Our study provides a rare example of the extent of erosion of within-species biodiversity over the last century of human influence. Rebuilding a diversity of abundant wild populations—that is, maintaining functioning portfolios—may help ensure that watershed complexes like the Skeena are robust to global change.

KEYWORDS
artificial production, biodiversity loss, conservation genetics, fisheries, historical ecology, population diversity, portfolio effects, salmon abundance

1 | INTRO UCTION

The conservation of common species often is poorly aligned with extinction-focused assessments (Gregory et al., 2005). For example, roughly 95% of the loss in abundance among the world's birds derives from <10% of species, and the vast majority of these are assessed as least concern by the International Union for the Conservation of Nature (Baker et al., 2019). Likewise, the diversity in life-history characteristics and population processes within and among populations is far greater than among species (Hughes et al., 1997), yet global biodiversity assessments typically are species focused (e.g. Maxwell et al., 2016); such emphasis can substantially underestimate the changing state of nature (Luck et al., 2003). Abundance and diversity within populations are important conservation assets independent of global extinction risk (Balmford et al., 2003). Indeed, abundant species and their diverse populations disproportionately influence ecosystems (Gaston et al., 2018).

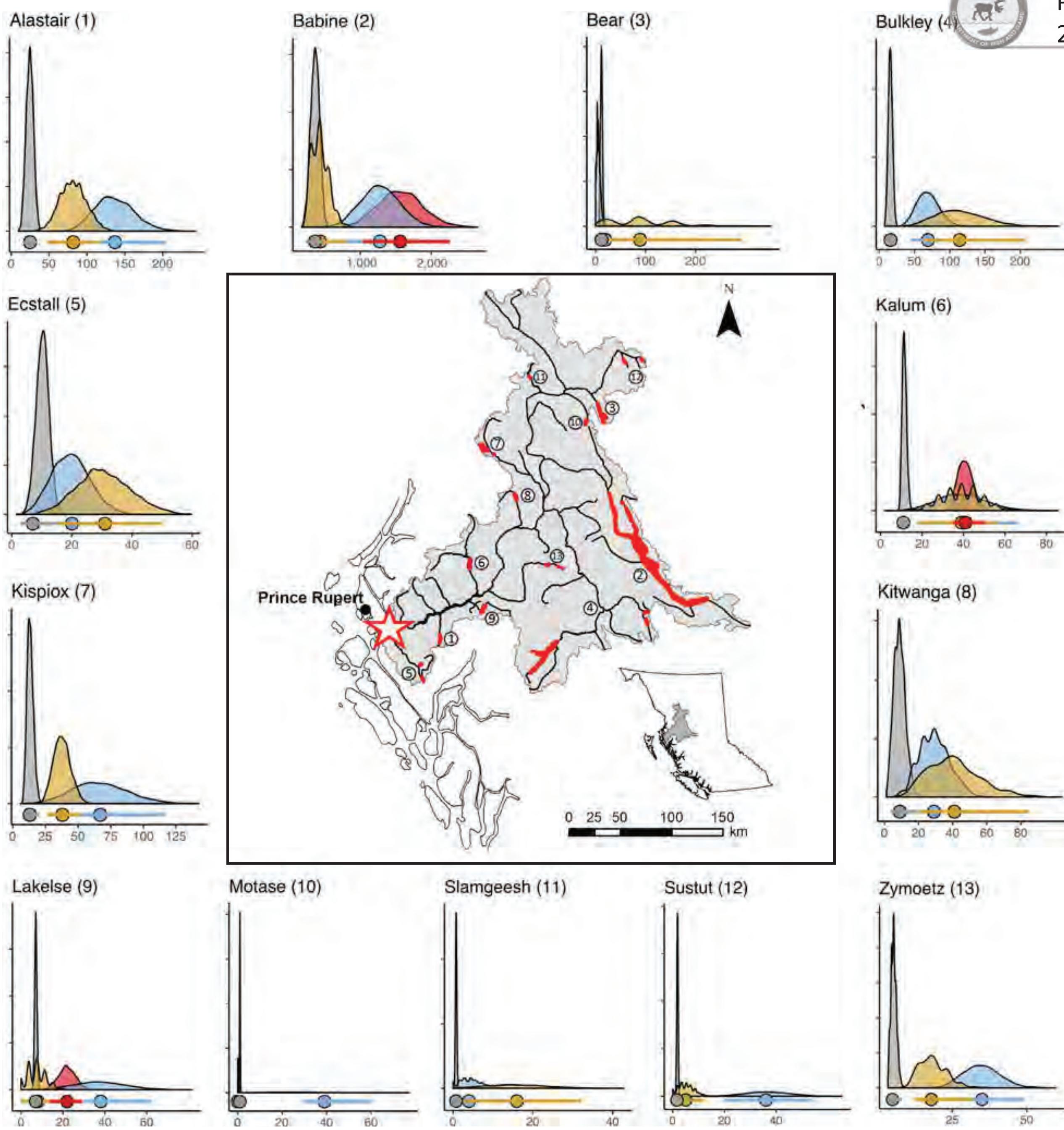
Biodiversity has many dimensions that contribute multiple benefits to humanity (Morris et al., 2014). One key benefit of biodiversity is that it helps stabilize ecosystem processes and functions, thereby bestowing resilience to environmental change. Such stability can arise through portfolio effects, where the aggregation of asynchronous dynamics dampens variability (oak et al., 1998; i gge, 2004). Accordingly, portfolio effects can be stronger in systems with higher (a) richness—the number of species or populations in the system, (b) evenness—the proportional distribution of abundance or mass among the units (e.g. populations) of biodiversity and (c) asynchrony—the different responses of biodiversity to environmental forcing through time (oak et al., 1998). For example, the intact habitat complexes of southwestern Alaska support high levels of population richness and asynchrony in sockeye salmon *Oncorhynchus nerka* that, in turn, stabilize commercial fishery catches (Schindler et al., 2010). There also is a growing appreciation of diversity among individuals, which can contribute to population-level resilience. For example, a diversity of life histories (e.g. different ages-at-maturity) within a population can spread risk across the demographic structure of that population, thereby buffering it from environmental variation over time (Greene et al., 2010; Moore et al., 2014). The spatial distribution of biodiversity can further influence the beneficial extent of that diversity, such as the degree to which consumers can access consistent prey resources across space and time (e.g. eacy et al., 2016; Nesbitt & Moore, 2016). Thus, understanding the potential long-term shifts in the dimensions of biodiversity is a key frontier for conservation science.

Pacific salmon *Oncorhynchus* spp. are common and abundant species with substantial population and life-history diversity (Groot & Margolis, 1991). However, there is a growing appreciation that salmon have been undergoing major shifts in the dimensions of their diversity due to human activities. Most apparent is the decline in abundance and extinction of many populations in southern portions of their range resulting from habitat loss and over-exploitation (Gustafson et al., 2007; Slaney et al., 1996). In response to decreasing abundance, artificial production (i.e. enhancement) programmes—such as hatcheries and spawning channels—have increasingly been initiated. This enhancement may increase abundances for some populations but also can erode local diversity (Naish et al., 2008), homogenize life-history traits (Satterthwaite & Carlson, 2015) and further erode wild salmon abundances through competition in the ocean (Connors et al., 2020) or the subsidization of fisheries (Meffe, 1992). Life histories also are shifting with climate change (Oke et al., 2020). While several studies have documented shifts in dimensions of salmon diversity over the last several decades (e.g. Carlson & Satterthwaite, 2011; Moore et al., 2010), it has remained a challenge to understand potential changes over longer periods, such as the last century of major human impacts.

Here, we study Canada's Skeena River watershed to ask: how has sockeye salmon diversity changed over the last century of enhancement and other human activities (e.g. fishing and habitat alteration) and how might such change affect current fisheries and ecosystems? We use modern genetic tools with century-old fish scales to (a) reconstruct historical abundance and age-trait data for the 1913–1947 time period to compare with contemporary information, (b) quantify changes in population and life-history diversity and the role of enhancement in population dynamics, and (c) quantify the risk to fisheries resulting from observed changes in diversity and enhancement. Our results demonstrate substantial loss in abundance and diversity of wild sockeye populations over the last century. While enhancement has offset declines in wild populations and maintained aggregate abundances—which underpins the Skeena commercial fishery—loss in abundance from wild populations undermines food security and ecosystem provisions throughout much of the watershed.

2 | MAT R IALS AN M THO S

The Skeena watershed is composed of 31 sockeye Conservation Units (CU; Holtby & Ciruna, 2007), which are grouped into 13 population complexes (Price et al., 2019; Figure 1; hereafter referred to as *populations*). Commercial fishing for sockeye began at the mouth of the Skeena River in 1877 (Wood, 2008), and a scale-collection programme began in 1912. We sampled scales from 35 to 50 fish from the collection for each of nine fishing weeks from years 1913, 1916, 1918–1923, 1933, 1935, 1937, 1943, 1945 and 1947 for a total of 5,400 scales. Sampling either began 1 week late or ended 1–2 weeks early in some years (i.e. 1913, 1916, 1918, 1920, 1937, 1943 and 1945) such that scales were unavailable



FIGUR 1 Skeena River watershed and sockeye salmon population abundances. Inset: Skeena River watershed showing locations of each sockeye salmon population complex (numbers 1–13) identified in genetic analyses, with associated nursery lakes (in red), and approximate location of historical scale sample collection and current Skeena Tyee Test Fishery (white-filled red star). Border: estimated population abundance (in thousands) during the 1913–1923 (blue), 1933–1947 (orange) and 2010–2017 (grey) time periods. Red distributions (#2, 6, 9) denote total (wild plus enhanced) abundance during 2010–2017. Circles and horizontal lines are the arithmetic mean and 95% bootstrapped confidence intervals

in some weeks. Because these omissions likely were due to low availability of fish to fisheries, we consider the implications to our analyses negligible. We digitally photographed one scale per fish, and aged each scale by annuli counts (Gilbert, 1913). NA was extracted from scales, genotyped at up to 12 microsatellite loci, and individuals were assigned to population via genetic stock identification (see Appendix S1). All scale samples were from existing collections and therefore exempt from Simon Fraser University's Animal Care Protocol.

We estimated annual historical (1913–1947) numbers (i.e. catch plus spawning fish, which throughout we refer to as *abundance*) of sockeye at the population level in a four-step process (Figure S1; Price et al., 2019), which included three year- and week-specific data inputs: (a) Annual abundance derived from catches (Argue & Shepard, 2005) and exploitation rates (Shepard & Withler, 1958) reconstructed from Skeena cannery and fishery data. (b) Daily counts of sockeye entering the Skeena River from each of 7 years (2011–2017), partitioned into nine fishing weeks equivalent to the historical scale-sampling periods. (c) Weekly proportions of Skeena-origin populations identified in scales. Briefly, with these data, we randomly drew from one of the 7 years of weekly abundance proportions, multiplied these by a given historical year's aggregate abundance, then multiplied these weekly abundances by population proportions, and summed population abundances across weeks. We repeated these steps 50,000 times, and then derived a median abundance estimate for each population for each historical year.

stimates of total abundance during the modern (2004–2017) era are available from PS (2020) and nglish et al. (2018), and detailed in our Supporting Information. Major enhancement projects have occurred since 1970 for three sockeye populations: Babine, Kalum and Lakelse; minor enhancement efforts had occurred for at least two populations (Lakelse and Babine) prior to 1970, with little success (oerster, 1968). To estimate wild-only abundance for the Babine population, we combined annual abundance estimates for the four wild Babine CUs. Annual estimates of wild fish for Kalum were derived from run-reconstructions detailed in the citations above, but with spawning channel contributions removed (Appendix S2). inally, to estimate wild-only abundance for the Lakelse population, we substituted years 2002–2009 (pre-enhancement) for 2010–2017 (post-enhancement) because we could not disaggregate enhanced contributions for the latter years, which greatly increased the abundance of sockeye returning to Lakelse.

We quantified the spatial contraction of population abundance throughout the Skeena watershed, and the potential loss of fish available to in-river fisheries and wildlife. This required estimates of in-river abundance for each population for the two time periods: (a) historical (1913–1947; quantified by subtracting commercial catch from our reconstructed historical abundance estimates) and (b) modern [2004–2017; quantified by adding annual in-river fishery catch (English et al., 2017) to spawning escapement (wild and enhanced fish combined)]. We then compared the change in in-river abundance between time periods for each population (tributary system), and each main-stem section of the Skeena River between populations, by subtracting each population's abundance downstream of each main-stem river section from the total in-river abundance.

We used several sources of age-at-maturity data depending on our question. For example, we used age data from fish (aggregate of populations) caught in commercial fisheries, as reported in annual fisheries reports for the years 1916–1956 (Province of British Columbia, 1957), and from fish caught in the Tyee Test ishery for the years 1973–2016, to estimate changes in life-history diversity and age-at-maturity. We used data from fish (identified to population) collected from commercial fisheries for 1913–1947, and from the Tyee Test Fishery for 2000–2013 to estimate changes in age traits within populations, and to explore the strength of salmon portfolios during various time periods. Because sockeye returning to the Skeena River during 1877–1950 were caught exclusively by linen gill-nets in commercial fisheries, we applied a correction factor to historical age data based on the selectivity of sockeye captured during the modern era by gill-nets in the Tyee Test Fishery to more accurately characterize the historical proportion of ages-at-maturity (Appendix S3). When describing various age-related life-history expressions (i.e. age traits), we use the European designation where the first number denotes the years spent in freshwater, and the second number denotes the years in the ocean (e.g. 1.2 represents 1 year in freshwater and 2 years in the ocean, and 1.*x* represents fish spending 1 year in freshwater and any number of years in the ocean).

We quantified the extent to which diversity among populations in abundance and life history has changed over time (historical versus modern era). Specifically, we calculated Pielou's Evenness, *E*, as a measure of diversity each year:

$$E = H/\ln S \quad (1)$$

where *S* is the number of populations ($n = 13$) or age traits ($n = 4$), and *H* is the Shannon diversity index:

$$H = -\sum_{i-1}^{S} p_i \ln p_i \quad (2)$$

where *p* is the proportional contribution of group *i* such that $\sum_i^S p_i = 1$ (Oksanen et al., 2019). Evenness is bounded between 0 and 1, with 1 being a completely even distribution among populations (*S*). To examine how enhancement of populations post-1970 has affected both population- and age-diversity, we calculated evenness separately using ‘wild-only’ and ‘total’ (enhanced plus wild) abundances; these abundances were applied separately to age-trait proportions to generate annual estimates of each age trait before calculating evenness.

We explored whether the strength of salmon portfolios in the Skeena has changed over time by calculating portfolio effect for each period (1913–1923, 1933–1947, and 2010–2017); here we compared the coefficient of variation (CV; defined as the ratio of the standard deviation to the mean) for the Skeena sockeye complex as a whole (i.e. meta-population CV) to the arithmetic mean CV for individual component population abundances and age traits (i.e. average CV). We chose the 8-year period of 2010–2017 for recent years to be comparable with the eight data-years of 1913–1923; Ecstall and Motase populations were excluded due to lack of recent data.

With these data, we then quantified the individual and combined consequences of (a) portfolio effects, (b) population abundances, and (c) enhancement, on the probability of commercial fishery closures for sockeye returning to the Skeena over the three time periods. Annual commercial fishery openings for Skeena sockeye currently are based on an aggregate abundance target of 1.05 million fish (900,000 spawning escapement plus 150,000 for Indigenous fisheries; DFO, 2003), below which the mixed-stock commercial fishery is closed. We simulated annual pre-fisheries abundances of wild sockeye in each time period by drawing from a log-normal distribution with a bias-corrected mean and standard deviation (i.e. CV, equal either to the meta-population CV or average CV). We repeated this for each time period across 10,000

Monte Carlo trials, and then calculated the proportion of trials where system-wide abundance fell below the aggregate abundance threshold of 1.05 million fish. For the recent period, we simulated wild-only and total (wild plus enhanced fish combined) abundances separately to quantify the degree to which enhancement may influence the probability of commercial fishery closures. Admittedly, our simulation ignores the potential confounding effects of forecast error and changes in exploitation on subsequent population dynamics.

All analyses were performed in R (R Core Team, 2020) using the BOOT, ECOFOLIO, and VEGAN packages.

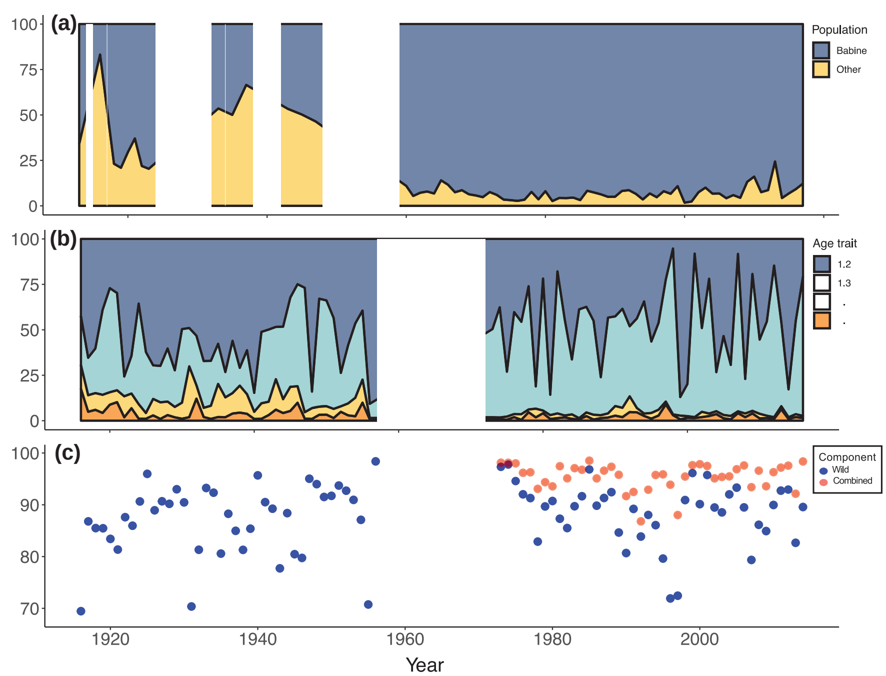
3 | RESULTS

The total number of wild adult sockeye returning to the Skeena River during the modern era is 69% lower than during the historical era of commercial fishing. All wild populations have declined (median = −80%) over the last century, several by more than 90%, and headwater populations (i.e. situated upstream of Babine; #2) have declined the most (average: −93%; igure 1). While most populations had declined in abundance by 1933–1947, five populations had increased, but then declined over the modern era. For example, the Bear population (#3) increased from an average of 22,000 to 89,000 (range: 0–415,000), and Bulkley (#4) from 69,000 to 114,000 (range: 25,000–276,000). Population composition also has shifted between periods such that the Babine population once accounted for 68% of all wild sockeye returning to the Skeena, declined to 48% by 1933–1947, then increased to 75% recently. When enhanced fish are combined with wild fish, Babine now accounts for 91% of all sockeye returning to the Skeena watershed (Figure 2a).

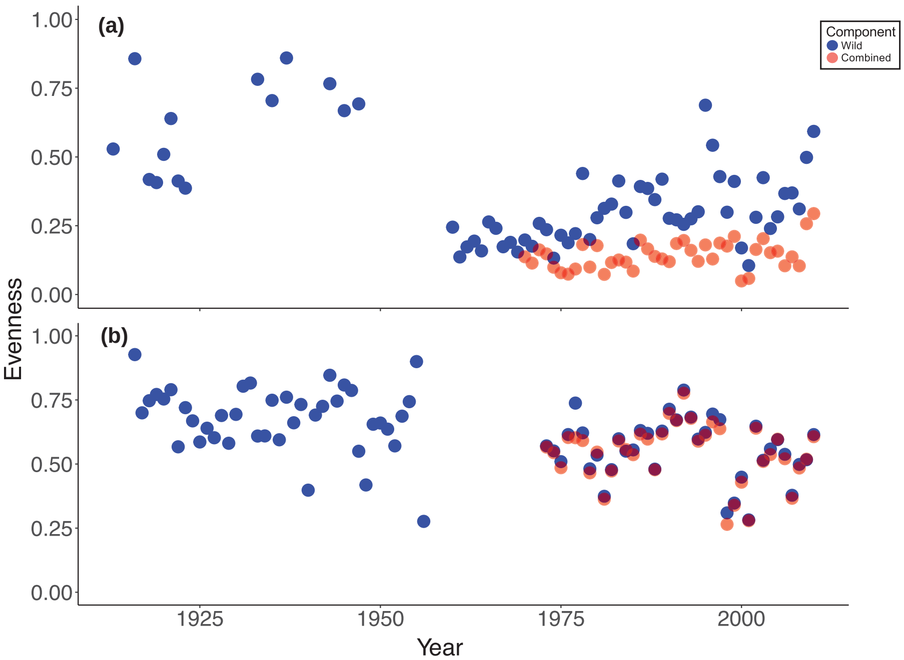
Skeena sockeye currently exhibit the 10 age traits identified in scales collected one century ago, of which 99% are one of four dominant freshwater/ocean ages: 1.2, 1.3, 2.2, or 2.3 (Figure 2b; Appendix S4). Two additional contemporary life histories—fish that reared in freshwater lakes for 3 years and returned to spawn after either 2 (3.2) or 3 (3.3) years in the ocean—were not among those caught in historical fisheries. While the average age (freshwater plus ocean) of populations has not changed, there has been a shift in age composition. For example, the proportion of wild fish with the x.3 (longer residency in the ocean) life history has increased from 37% to 47% (igure 2b). When enhanced fish are included, 51% of sockeye spent 3 years in the ocean, and the proportion of fish in a given year migrating to the ocean after one freshwater year increased from 87% to 96% (Figure 2c).

Individual contributions of wild populations to aggregate abundances have greatly diminished. For example, mean evenness of wild population contributions to overall abundances declined by 35% (from 0.62 to 0.40) between the historical and modern era. When enhanced fish are combined with wild fish, the decline over the last century is even greater (evenness = 0.18 in the recent period, a 70% total decline; Figure 3a). The evenness of age traits declined by 19% (from 0.68 to 0.55) during the period since 1973, and inclusion of enhanced fish only modestly reduced the evenness further (to 0.54; Figure 3b).

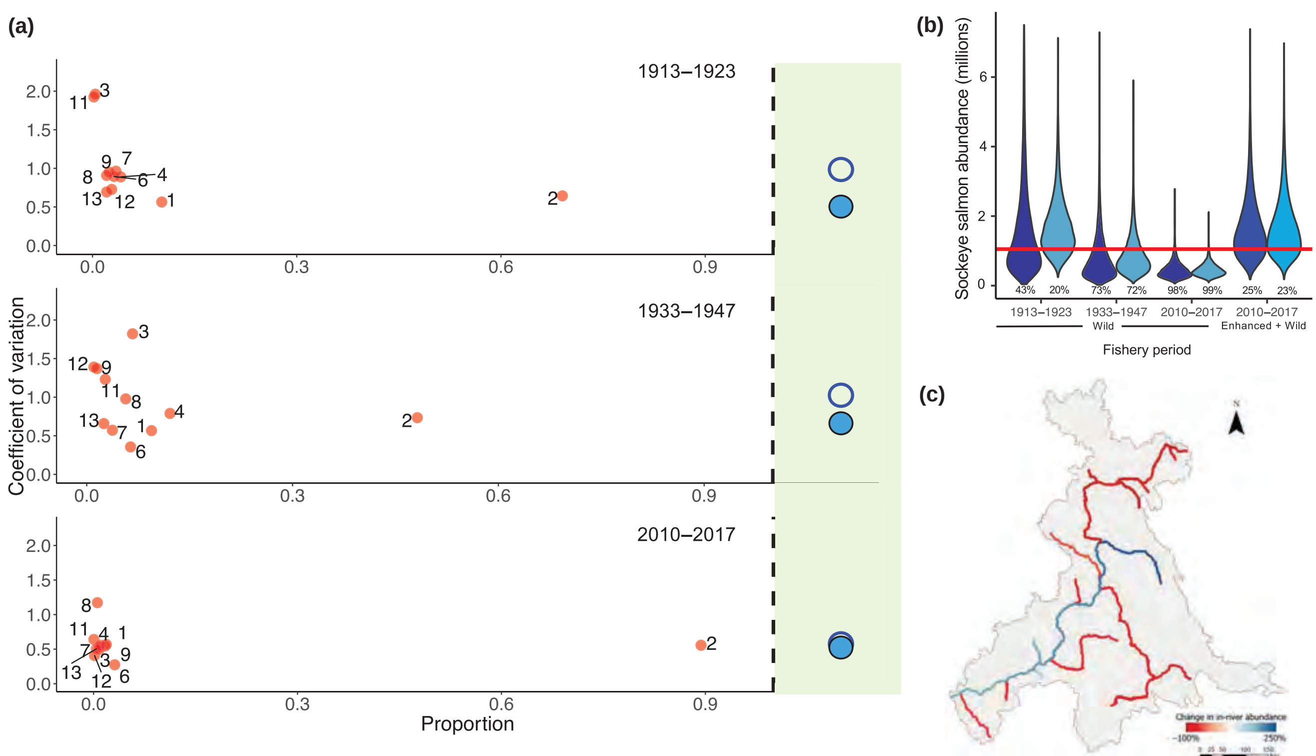
The extent to which the population portfolio dampened interannual variation in abundance has eroded over the last century. For example, portfolio strength during 1913–1923 resulted in aggregate returns that were 2.04 times more stable than if the system had been composed of a single population with homogeneous dynamics (CV reduced from 1.01 to 0.50). For 1933–1947, the comparable value was 1.48 (CV reduced from 0.96 to 0.65). The benefits of population diversity for stabilizing returns have largely disappeared in recent (2010–2017) years (i.e. aggregate returns now are only 1.10 times more stable—CV reduced from 0.57 to 0.52; igure 4a). Had



FIGUR 2 Long-term change in sockeye salmon population and life-history diversity. (a) Percentage of population abundances, where *Other* combines all populations except Babine. (b) Percentage of the four dominant age traits. (c) Percentage of juveniles that emigrated to the ocean after 1 year in freshwater; blue and red circles denote wild fish, and wild and enhanced fish combined, respectively (i.e. for the years since enhancement began, data for each year are shown twice: once for wild fish, and once for wild and enhanced fish combined). Information gaps (white bars) differ in plots a and b because the data are derived from different sources (a: historical scale collection; b: annual government fishery reports)



I GUR 3 Long-term change in sockeye salmon diversity. (a) Evenness in abundance across individual populations. (b) Evenness in age traits across aggregated populations. Blue and red circles denote wild fish, and wild and enhanced fish combined, respectively (i.e. for the years since enhancement began, data for each year are shown twice: once for wild fish, and once for wild and enhanced fish combined)



I GUR 4 Changes in sockeye salmon population diversity and their influence on fisheries and ecosystems. (a) Portfolio effect: each red-filled circle represents the coefficient of variation (CV) of abundance (wild and enhanced combined) across years for each time period as a function of the proportional contribution of each population to total returns; numbers correspond to Figure 1. Shown within green bar is the estimated CV based on the average of the CVs of the different populations (dark-blue circle), and the measured meta-population CV of the entire Skeena sockeye complex (filled light-blue circle). The difference between the estimated and measured CV is a measure of the magnitude of reduction in variation due to the portfolio effect. (b) Simulated abundance and risk of commercial fishery closures for each time period assuming either the average CV (dark blue) or meta-population CV (light blue). Red solid line is the aggregate abundance target of 1.05 million, above which the commercial fishery begins. Values below each distribution are the percentage of simulation trials that were below the abundance target. (c) Change in in-river sockeye abundance (number of fish in the Skeena River and tributaries after marine and lower river commercial fishery removals) between the historical (1913–1947) and modern (2004–2017) eras the Skeena sockeye complex lacked the dampening effects that population diversity provides (i.e. using average versus meta-population CV), commercial fishery closures would have occurred 42% of the time (a 55% increase compared to a diverse system) during the 1913–1923 period, and 74% of the time (3% increase) during 1933–1947 (Figure 4b). While commercial fisheries based on wild fish now would be closed in at least 98% of years because of low abundance, enhanced sockeye production has effectively replaced the loss in wild fish and sustained commercial fisheries.

Finally, the observed changes in abundance are associated with spatial contraction of sockeye abundance throughout the Skeena watershed. Specifically, wild populations have undergone major declines in tributaries (41%–90% loss) and headwater main-stem sections (75%–87% loss; igure 4c). nhancement sustains abundance primarily in one major tributary (Babine) and the main-stem river downstream of Babine.

4 | DISCUSSION

Conserving a diversity of populations and their varied life histories can help buffer ecosystems from environmental change (Schindler et al., 2015). We applied modern genetic tools to century-old fish scales to reveal substantial loss in abundance and biodiversity of wild sockeye populations over the last 100 years for Canada's second largest salmon watershed, the Skeena River. While artificial enhancement has returned aggregate abundances to historical levels, declines in abundance across wild populations have increased the dependency of fisheries on enhanced fish, potentially widening the trade-off between exploitation and conservation of diversity in the watershed (Walters et al., 2008; Wood, 2008). Consequently, the Skeena has lost much of the stabilizing portfolio effects that population diversity had provided a century ago. Furthermore, there has been a spatial contraction in abundance throughout the watershed, which likely decreases the provisioning of salmon to local ecosystems and Indigenous fisheries.

Artificial salmon production has returned abundances to what they were a century ago, but such enhancement may compromise diversity across the watershed. While the abundance of all wild sockeye populations in the Skeena now is substantially lower than during the historical era, some populations—such as Babine—had already declined by the 1940s, which prompted the development of spawning channels by 1970 to rebuild diminished abundance (McDonald & Hume, 1984). nhancement has since increased annual total sockeye returns to 99% of the estimated abundance of one century ago, which has renewed opportunities for commercial marine fisheries and Indigenous fisheries in Babine Lake and the main-stem river downstream. Despite these benefits to fisheries, enhanced production may impact wild Skeena populations in at least four ways: (a) Pathogen transfer from enhanced to wild fish could decrease survival. While there historically have been disease outbreaks at Babine spawning channels (Traxler et al., 1998), improvements may have decreased these risks. (b) Straying of enhanced fish may erode local adaptations in wild populations due to introgression (Naish et al., 2008). Sockeye salmon are known to spawn near their river-of-origin, and different Skeena populations remain genetically distinct (Beacham et al., 2014), yet enhanced fish may stray into wild spawning streams within the Babine system given the close proximity of spawning channels to neighbouring wild streams. (c) Enhanced fish could compete with wild fish (Peterman, 1982). However, there is no evidence that the production of enhanced sockeye has reduced the survival of wild populations (Price & Connors, 2014). (4) Enhanced fish could elevate mortality of wild fish as a result of their incidental capture in mixed-stock fisheries targeting enhanced fish (Meffe, 1992). Increases in aggregate abundance since 1970 are thought to have exacerbated the trade-off between mixed-stock fisheries catch and the protection of wild population diversity in the watershed (Walters et al., 2008; Wood, 2008). All wild populations likely were over-exploited in the decades immediately following spawning channel development due to their co-migration with enhanced sockeye (Walters et al., 2008). However, Canadian aggregate mixed-stock exploitation has declined in recent years [from 46% (1970–2009) to 28% (2010–2017); nglish et al., 2018], and may be sustainable for some wild populations. Thus, the degree to which enhancement now compromises sockeye diversity in the Skeena remains unclear.

Life-history diversity has remained relatively stable since the historical era, though there have been notable shifts in age composition. Sockeye in the Skeena currently display all age traits identified in scales that were collected one century ago, which may indicate the persistence of diverse habitats in the watershed (Waples et al., 2001). Nonetheless, fish are remaining longer in the ocean, with an increase (from 36% to 51%) in the proportion of fish that rear in the ocean for 3 years. Similar increases have been reported for sockeye from the Fraser River and Bristol Bay over the recent period (Cline et al., 2019; Ruggerone & Connors, 2015); increased biomass of salmon in the North Pacific Ocean and shorter residency in freshwater are thought to contribute to these trends. Our data also show that Skeena sockeye now spend less time in freshwater (e.g. decrease from 13% to 4% in the proportion of fish that rear for 2 years). While the reduced duration of freshwater residency across wild populations may be influenced by increasing lake temperatures (as has occurred in Alaska; Cline et al., 2019), enhancement of Babine fish is further increasing the overall prevalence of this life history (Appendix S5). This change in age-structure—where most juveniles now emigrate to the ocean in the same year—increases the risk that an entire cohort will encounter unfavourable conditions (e.g. Moore et al., 2014), and may reduce the resilience of the Skeena sockeye complex to future environmental change.

Portfolio effects have largely eroded in the Skeena over the last century. Had the dynamics of the Skeena sockeye complex a century ago been characterized by the most simplified population portfolio (i.e. a single population), they would have been 2.04 times more temporally variable than was observed. This strength in portfolio is similar to the Bristol Bay sockeye complex, which hosts hundreds of populations from largely undisturbed habitat, and does not have salmon enhancement (Schindler et al., 2010). By 1933–1947, portfolio strength in the Skeena had been reduced by one-third, yet the population complex still was 1.48 times more stable than if it had been composed of a single population. In recent years, the benefits of population diversity have nearly disappeared (i.e. aggregate returns now are only 10% more stable). Degraded portfolio performance is correlated negatively with anthropogenic impact on watersheds across western North America (Griffiths et al., 2014). However, even in a recently collapsed Chinook salmon *Oncorhynchus tshawytscha* system with extensive habitat degradation—where enhancement is thought to have significantly weakened the portfolio (Satterthwaite & Carlson, 2015)—the strength of the population portfolio since the mid-1980s is far greater than it is now for Skeena sockeye (Carlson & Satterthwaite, 2011), although there may be an inherent challenge in comparing across species. While enhancement has simplified the Skeena portfolio by tripling the abundance of sockeye returning to a single population since 2010—removal of enhanced fish from the analyses increased portfolio strength by a factor of five—declines in portfolio strength since the 1913–1923 period also were influenced by increased population synchrony (Appendix S5). Regardless of the mechanism, a notable consequence of the portfolio simplification is that commercial fisheries now depend on a single population that is largely composed of enhanced fish, whereas a diversity of populations sustained fisheries historically.

A simplified population portfolio should lead to an increase in variability of aggregate abundances. However, sockeye returns to the Skeena now are as stable as they were during the historical era despite a weakened portfolio. Such reduced variability may be because the aggregate's variability now is primarily influenced by a single population whose annual production is at least in part stabilized by artificial enhancement. While variability in population abundances also has decreased over the recent period, an inherent challenge in measuring change over long time periods such as ours is the different data collection methods used between eras. We used an admittedly coarse method to quantify population abundance during the historical era compared to higher precision methods of the modern era, which may inflate declines in portfolio strength between periods. However, when we compared the variability of populations between periods using genetic (rather than abundance) data, population variability remained lowest in the modern era (i.e. populations now are more stable than during either of the historical periods; Appendix S5). Indeed, sockeye populations in the Skeena have become more synchronized with one another, all but one (Babine) are at low levels of abundance, and perhaps are responding similarly to a low productivity phase that could be the result of reduced response diversity of these populations. Thus, despite the relative stability of sockeye returns to the Skeena over the recent period, the weakened portfolio may compromise its resilience to larger perturbations in the future.

The erosion of diversity in the Skeena is further expressed in the spatial contraction of salmon abundance throughout the watershed. Wild sockeye abundance has declined in all tributaries and headwater regions since the historical era, which—according to oral accounts—has compromised food security for Indigenous Peoples that rely upon these areas for subsistence fisheries (Cleveland et al., 2006; Gottesfeld & Rabnett, 2008). urthermore, these tributaries are important corridors that provision salmon resources to local ecosystems. Such loss in abundance likely constrains foraging opportunities for wildlife dependent on salmon (Deacy et al., 2016), and lessens the overall delivery of salmon-derived nutrients to ecosystems (Gende et al., 2002), which can affect a large number of species (Walsh et al., 2020).

Our reconstruction of century-old portfolio performance provides a baseline for the recovery of a diminished watershed complex. Modern conservation policies for salmon, such as Canada's Policy for the Conservation of Wild Pacific Salmon, strive to maintain a diversity of populations (DFO, 2005). If the goal of fisheries management is to catch abundant channel-enhanced fish while conserving wild populations, increasing selectivity by moving a larger proportion of the fishery in-river and to terminal locations likely will improve conservation, though it may result in reduced catches (Freshwater et al., 2020). Prioritizing the rebuilding of wild salmon populations could mitigate such trade-offs, help increase fishing opportunities for Indigenous peoples that rely on wild populations and strengthen the sockeye portfolio within this now simplified watershed.

Our study provides a rare example of the extent of erosion of within-species biodiversity over a century of human influence. While the enhancement of salmon supports commercial fisheries, loss in abundance and diversity from wild populations has reduced the provisioning of salmon to local ecosystems and Indigenous fisheries throughout the watershed. What may be underappreciated is the lost stabilizing portfolio effects that this watershed complex hosted a century ago, which ultimately may weaken its resilience to increasingly variable environments. Conserving a diversity of abundant wild populations and their varied life histories—that is, maintaining functioning portfolios—may help ensure that watershed complexes like the Skeena are robust to global change.

ACKNOWL G MEN TS

We acknowledge the impressive efforts of C. Gilbert and W. Clemens for the historical scale collection, and we thank S. McKinnell for rediscovering this treasure, DFO's molecular genetics laboratory for assigning scales to populations, D. Gillespie and DFO's schlerochronology laboratory for aging scales, M. Beere, S. Cox-Rogers, Gitanyow isheries Authority, Gitksan Watershed Authority and Office of the Wet'suwet'en for data, A. Rosenberger and Reynolds laboratory for technical support, and C. Freshwater and two anonymous reviewers for helpful review. This work was supported by the Natural Sciences and Engineering Research Council of Canada, Office of the Wet'suwet'en, Pacific Salmon Foundation, Tides Canada, and W. Garfield Weston Foundation.

AUTHORS' CONTRIBUTIONS

M.H.H.P., J.W.M., B.M.C., K.L.W. and J. .R. conceived the ideas and designed the methodology; M.H.H.P. collected the data; M.H.H.P.

and K.L.W. analysed the data; M.H.H.P. led the project and writing of the manuscript. All authors contributed critically to drafts and gave final approval for publication.

ATA AVAILABILITY STAT MENT

Data available via the Dryad Digital Repository https://doi.org/10.5061/dryad.n5tb2rbts (Price, 2021).

ORCI

Michael H. H. Price https://orcid.org/0000-0002-2909-8836
Kyle L. Wilson https://orcid.org/0000-0002-0870-0509
John D. Reynolds https://orcid.org/0000-0002-0459-0074

REF RENCE S

Argue, A. W., & Shepard, M. P. (2005). Historical commercial catch statistics for Pacific salmon (*Oncorhynchus* spp.) in British Columbia, 1828 to 1950. Canadian Technical Report of Fisheries and Aquatic Sciences 2601. Ottawa.

Baker, D. J., Garnett, S. T., O'Connor, J., Ehmke, G., Clarke, R. H., Woinarski, J. C. Z., & McGeoch, M. A. (2019). Conserving the abundance of nonthreatened species. *Conservation Biology*, *33*, 319–328. https://doi.org/10.1111/cobi.13197

Balmford, A., Green, R. E., & Jenkins, M. (2003). Measuring the changing state of Nature. *Trends in Ecology & Evolution*, *18*, 326–330. https://doi.org/10.1016/S0169-5347(03)00067-3

Beacham, T. D., Cox-Rogers, S., MacConnachie, C., McIntosh, B., & Wallace, C. G. (2014). Population structure and run timing of sockeye salmon in the Skeena River, British Columbia. *North American Journal of Fisheries Management*, *34*, 335–348.

Carlson, S. M., & Satterthwaite, W. H. (2011). Weakened portfolio effect in a collapsed salmon population complex. *Canadian Journal of Fisheries and Aquatic Sciences*, *68*, 1579–1589. https://doi.org/10.1139/f2011-084

Cleveland, M. C., Cox-Rogers, S., & Rabnett, K. (2006). *Kitwanga sockeye recovery plan. A plan to preserve genetic diversity and rebuild an important race of sockeye salmon*. Retrieved from https://salmonwatersheds.ca/library/lib_66/

Cline, T. J., Ohlberger, J., & Schindler, . E. (2019). ffects of warming climate and competition in the ocean for life-histories of Pacific salmon. *Nature Ecology and Evolution*, *3*, 935–942. https://doi.org/10.1038/s41559-019-0901-7

Connors, B., Malick, M. J., Ruggerone, G. T., Rand, P., Adkison, M., Irvine, J. R., Campbell, R., & Gorman, K. (2020). Climate and competition influence sockeye salmon population dynamics across the Northeast Pacific Ocean. *Canadian Journal of Fisheries and Aquatic Sciences*, *77*, 943–949. https://doi.org/10.1139/cjfas-2019-0422

eacy, W., Leacock, W., Armstrong, J. B., & Stanford, J. A. (2016). Kodiak brown bears surf the salmon red wave: Direct evidence from GPS collared individuals. *Ecology*, *97*, 1091–1098. https://doi.org/10.1890/15-1060.1

DFO. (2003). *Skeena River sockeye salmon (update)*. Pacific Region stock status report 2003/047, Prince Rupert, BC. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/342179.pdf

DFO. (2005). *Canada's policy for conservation of wild Pacific salmon*. Fisheries and Oceans Canada. https://www.pac.dfo-mpo.gc.ca/fm-gp/salmon-saumon/wsp-pss/policy-politique/index-eng.html

oak, . ., Bigger, ., Harding, . K., Marvier, M. A., O'Malley, R. ., & Thomson, D. (1998). The statistical inevitability of stability–diversity relationships in community ecology. *The American Naturalist*, *151*, 264–276.

nglish, K. K., Noble, C., & Carr-Harris, C. (2017). *Skeena sockeye in-river run reconstruction analysis model and analysis results for 1982–2017.* Prepared for Pacific Salmon Foundation. Retrieved from https://salmonwatersheds.ca/libraryfiles/lib_452.pdf

nglish, K. K., Peacock, ., Challenger, W., Noble, C., Beveridge, I., Robichaud, D., Beach, K., Hertz, ., & Connors, K. (2018). *North and central coast salmon escapement, catch, run size, and exploitation rate estimates for each salmon Conservation Unit for 1954–2017*. Prepared for Pacific Salmon Foundation. Retrieved from https://salmonwatersheds.ca/libraryfiles/lib_451.pdf

Figge, . (2004). Bio-folio: Applying portfolio theory to biodiversity. *Biodiversity and Conservation*, *13*, 827–849.

Foerster, R. . (1968). The sockeye salmon, *Oncorhynchus nerka*. *Fisheries Research Board of Canada Bulletin*, *162*, 387–399.

reshwater, C., Holt, K. R., Huang, A., & Holt, C. A. (2020). Benefits and limitations of increasing the stock-selectivity of Pacific salmon fisheries. *Fisheries Research*, *226*, 105509.

Gaston, K. J., Cox, D. T. C., Canavelli, S. B., Garcia, D., Hughes, B., Maas, B., Martinez, D., Ogada, ., & Inger, R. (2018). Population abundance and ecosystem service provision: The case of birds. *BioScience*, *68*, 264–272.

Gende, S. M., dwards, R. T., Willson, M. ., & Wipfli, M. S. (2002). Pacific salmon in aquatic and terrestrial systems. *BioScience*, *52*, 917–928.

Gilbert, C. H. (1913). *Age at maturity of the Pacific coast salmon of the genus* Oncorhynchus (Vol. 32, pp. 1–22). Department of Commerce Bulletin of the United States Bureau of Fisheries.

Gottesfeld, A. S., & Rabnett, K. (2008). *Skeena River fish and their habitat*. Ecotrust.

Greene, C. M., Hall, J. E., Guilbault, K. R., & Quinn, T. P. (2010). Improved viability of populations with diverse life-history portfolios. *Biology Letters*, *6*, 382–386. https://doi.org/10.1098/rsbl.2009.0780

Gregory, R. D., van Strien, A., Vorisek, P., Gmelig Meyling, A. W., Noble, . G., Foppen, R. P. B., & Gibbons, . W. (2005). eveloping indicators for European birds. *Philosophical Transactions of the Royal Society B*, *360*, 269–288. https://doi.org/10.1098/rstb.2004.1602

Griffiths, J. R., Schindler, . ., Armstrong, J. B., Scheuerell, M. ., Whited, . C., Clark, R. A., Hilborn, R., Holt, C. A., Lindley, S. T., Stanford, J. A., & Volk, E. C. (2014). Performance of salmon fishery portfolios across western North America. *Journal of Applied Ecology*, *51*, 1554–1563.

Groot, C., & Margolis, L. (1991). *Pacific salmon life histories*. UBC Press.

Gustafson, R. G., Waples, R. S., Myers, J. M., Weitkamp, L. A., Bryant, G. J., Johnson, O. W., & Hard, J. J. (2007). Pacific salmon extinctions: uantifying lost and remaining diversity. *Conservation Biology*, *21*, 1009–1020. https://doi.org/10.1111/j.1523-1739.2007.00693.x

Holtby, L. B., & Ciruna, K. A. (2007). Conservation Units for Pacific salmon under the Wild Salmon Policy. Canadian Science Advisory Secretariat Research ocument 2007/070. Retrieved from http://www.dfo-mpo.gc.ca/Library/334860.pdf

Hughes, J. B., Daily, G. C., & Ehrlich, P. R. (1997). Population diversity: Its extent and extinction. *Science*, *278*, 689–692. https://doi.org/10.1126/science.278.5338.689

Luck, G. W., aily, G. C., & hrlich, P. R. (2003). Population diversity and ecosystem services. *Trends in Ecology & Evolution*, *18*, 331–336. https://doi.org/10.1016/S0169-5347(03)00100-9

Maxwell, S., uller, R. A., Brooks, T. M., & Watson, J. . M. (2016). The ravages of guns, nets, and bulldozers. *Nature*, *536*, 143–145.

Mc onald, J., & Hume, J. M. (1984). Babine Lake sockeye salmon (*Oncorhynchus nerka*) enhancement program: Testing some major assumptions. *Canadian Journal of Fisheries and Aquatic Sciences*, *41*, 70–92.

Meffe, G. K. (1992). Techno-arrogance and halfway technologies: Salmon hatcheries on the Pacific coast of North America. *Conservation Biology*, *6*, 350–354.

Moore, J. W., McClure, M., Rogers, L. A., & Schindler, . . (2010). Synchronization and portfolio performance of threatened salmon. *Conservation Letters*, *3*, 340–348.

Moore, J. W., Yeakel, J. D., Peard, ., Lough, J., & Beere, M. (2014). Life-history diversity and its importance to population stability and persistence of a migratory fish: Steelhead in two large North American rivers. *Journal of Animal Ecology*, *83*, 1035–1046.

Morris, E. K., Caruso, T., Buscot, F., Fischer, M., Hancock, C., Maier, T. S., Meiners, T., Muller, C., Obermaier, ., Prati, . , Socher, S. A., Sonnemann, I., Wäschke, N., Wubet, T., Wurst, S., & Rillig, M. C. (2014). Choosing and using diversity indices: Insights for ecological applications from the German Biodiversity Exploratories. *Ecology and Evolution*, *4*, 3514–3524.

Naish, K. A., Taylor, J. ., Levin, P. S., uinn, T. P., Winton, J. R., Huppert, . , & Hilborn, R. (2008). An evaluation of the effects of conservation and fishery enhancement hatcheries on wild populations of salmon. *Advances in Marine Biology*, *53*, 61–194.

Nesbitt, H. K., & Moore, J. W. (2016). Species and population diversity in Pacific salmon underpin indigenous food security. *Journal of Applied Ecology*, *53*, 1489–1499.

Oke, K. B., Cunningham, C. J., Westley, P. A. H., Baskett, M. L., Carlson, S. M., Clark, J., Hendry, A. P., Karatayev, V. A., Kendall, N. W., Kibele, J., Kindsvater, H. K., Kobayashi, K. M., Lewis, B., Munch, S., Reynolds, J. D., Vick, G. K., & Palkovacs, E. P. (2020). Recent declines in salmon body size impact ecosystems and fisheries. *Nature Communications*, *11*, 4155.

Oksanen, J., Blanchet, G., Friendly, M., Kindt, R., Legendre, P., McGlinn, . , Minchin, P. R., O'Hara, R. B., Simpson, G. L., Solymos, P., Stevens, M. H. H., Szoecs, ., & Wagner, H. (2019). *Vegan: Community ecology package for R*. Retrieved from https://cran.r-project.org/web/packages/vegan/vegan.pdf

Peterman, R. M. (1982). Nonlinear relation between smolts and adults in Babine Lake sockeye salmon (*Oncorhynchus nerka*) and implications for other salmon populations. *Canadian Journal of Fisheries and Aquatic Sciences*, *39*, 904–913.

Price, M. H. H. (2021). Data from: Portfolio simplification arising from a century of change in salmon population diversity and artificial enhancement. *Dryad Digital Repository*, https://doi.org/10.5061/dryad.n5tb2rbts

Price, M. H. H., & Connors, B. M. (2014). Evaluating relationships between wild Skeena River sockeye salmon productivity and the abundance of spawning channel enhanced sockeye smolts. *PLoS ONE*, *9*, e95718. https://doi.org/10.1371/journal.pone.0095718

Price, M. H. H., Connors, B. M., Candy, J. R., McIntosh, B., Beacham, T. . , Moore, J. W., & Reynolds, J. . (2019). Genetics of century-old fish scales reveal population patterns of decline. *Conservation Letters*, *12*(6), e12669. https://doi.org/10.1111/conl.12669

Province of British Columbia. (1957). Report of the Commissioner of isheries for the year ending ecember 31, 1956. Authority of the Legislative Assembly, Victoria.

PSF. (2020). *Salmon watersheds program NCC database outputs 2017*. Retrieved from https://data.salmonwatersheds.ca/data-library/indexpage.aspx?id=67

R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.

Ruggerone, G. T., & Connors, B. M. (2015). Productivity and life history of sockeye salmon in relation to competition with pink and sockeye salmon in the North Pacific Ocean. *Canadian Journal of Fisheries and Aquatic Sciences*, *72*, 818–833. https://doi.org/10.1139/cjfas-2014-0134

Satterthwaite, W. H., & Carlson, S. M. (2015). Weakening portfolio effect strength in a hatchery-supplemented Chinook salmon population complex. *Canadian Journal of Fisheries and Aquatic Sciences*, *72*, 1860–1875. https://doi.org/10.1139/cjfas-2015-0169

Schindler, . ., Armstrong, J. B., & Reed, T. . (2015). The portfolio concept in ecology and evolution. *Frontiers in Ecology and the Environment*, *13*, 257–263. https://doi.org/10.1890/140275

Schindler, D. ., Hilborn, R., Chasco, B., Boatright, C. P., Quinn, T. P., Rogers, L. A., & Webster, M. S. (2010). Population diversity and the portfolio effect in an exploited species. *Nature*, *465*, 609–613. https://doi.org/10.1038/nature09060

Shepard, M. P., & Withler, . C. (1958). Spawning stock size and resultant production for Skeena sockeye. *Journal of the Fisheries Research Board of Canada*, *15*, 1007–1025. https://doi.org/10.1139/f58-055

Slaney, T. L., Hyatt, K. D., Northcote, T. G., & Fielden, R. J. (1996). Status of anadromous salmon and trout in British Columbia and Yukon. *Fisheries*, *21*, 20–35. https://doi.org/10.1577/1548-8446(1996)021<0020:SOASAT>2.0.CO;2

Traxler, G. S., Richard, J., & Mc onald, T. . (1998). *Ichthyophthirius multifiliis* (Ich) epizootics in spawning sockeye salmon in British Columbia, Canada. *Journal of Aquatic Animal Health*, *10*, 143–151.

Walsh, J. C., Pendray, J. ., Godwin, S. C., Artelle, K. A., Kindsvater, H. K., ield, R. . , Harding, J. N., Swain, N. R., & Reynolds, J. . (2020). Relationships between Pacific salmon and aquatic and terrestrial systems: Implications for ecosystem-based management. *Ecology*, *101*, e03060.

Walters, C. J., Lichatowich, J. A., Peterman, R. M., & Reynolds, J. . (2008). Report of the Skeena Independent Science Review Panel. A report to the Canadian Department of Fisheries and Oceans and the British Columbia Ministry of the Environment, Victoria. Retrieved from https://www.psf.ca/document-library/report-skeena-independent-science-review-panel

Waples, R. S., Gustafson, R. G., Weitkamp, L. A., Myers, J. M., Johnson, O. W., Busby, P. J., Hard, J. J., Bryant, G. J., Waknitz, F. W., Neely, K., Teel, . , Grant, W. S., Winans, G. A., Phelps, S., Marshall, A., & Baker, B. M. (2001). Characterizing diversity in salmon from the Pacific Northwest. *Journal of Fish Biology*, *59*, 1–41. https://doi.org/10.1111/j.1095-8649.2001.tb01376.x

Wood, C. C. (2008). Managing biodiversity of Pacific salmon: Lessons from the Skeena River sockeye salmon fishery in British Columbia. *American Fisheries Society Symposium*, *49*, 349–364.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Price MHH, Moore JW, Connors BM, Wilson KL, Reynolds J . Portfolio simplification arising from a century of change in salmon population diversity and artificial production. *J Appl Ecol*. 2021;00:1–10. https://doi.org/10.1111/1365-2664.13835

Portfolio simplification arising from a century of change in salmon population diversity and artificial production

Appendix S1: Genetic identification of populations

Genetic material was extracted from fish scales by DNeasy extractions (Qiagen Inc, Valencia, CA) at Fisheries and Oceans Canada molecular genetics laboratory; samples were genotyped for up to 12 bi- and tetra-nucleotide microsatellites from anonymous regions of the sockeye genome using Polymerase Chain Reaction (PCR). While we employed standard genotyping protocols for the historical samples, we used several additional steps to ensure genotype accuracy. For example, we made adjustments to DNA concentrations depending on DNA quality by including more scales up to 10 per individual fish), used de-multiplex loci to improve amplification on a locus by locus basis, and excluded loci with large base-pair size ranges because of DNA fragmentation. We used the following microsatellite primers to examine nuclear DNA polymorphisms in single PCR reactions: Ots2, Ots3, Ots100, Ots103, Ots107, Ots108, Oki1a, Oki1b, Oki6, Oki10, One8, and Omy77. The properties of these microsatellite markers and their ability to resolve coast wide sockeye stock structure have been reported elsewhere (e.g., Beacham et al. 2004, 2006, 2011). Microsatellites were size fractionated in an Applied Biosystems 3730 capillary DNA sequencer, and genotypes scored by GeneMapper software 3.0 (Applied Biosystems, Foster City, CA) using an internal lane fragment size standard.

We used the Bayesian mixed stock assignment C++ program CBayes (Neaves et al. 2005) using algorithms from the FORTRAN program BAYES Pella & Masuda 2001) to assign historical scales to population. This mixture analysis assigns individuals to putative population of origin by fitting allele frequencies of the unknown individual to the allele frequencies of reference samples collected on the spawning grounds. For each mixed-stock sample, ten 20,000-iteration Monte Carlo Markov chains of estimated stock composition and individual assignments were run, where each chain was initialized with 90% assignment to a randomly selected reference sample. The last 1,000 iterations from each chain were combined with a Gelman-Rubin coefficient < 1.2 (Pella & Masuda 2001) to estimate probability of assignment to baseline population, then combined for each meta-population. Duplicate genotypes, non-sockeye salmon, and those individuals with more than 9 missing loci were removed before the final population assignment.

Appendix S2: Population abundance data

Historical period

Of two primary data sources (i.e., Shepard & Withler 1958, and Argue & Shepard 2005) available for historical catch of sockeye returning to the Skeena River dating back to the early 1900s, we use Argue & Shepard (2005) for several reasons. First, whereas annual sockeye catch records reported in Shepard & Withler (1958) begin in 1908, Argue & Shepard (2005) report numbers of sockeye caught at the onset of commercial fishing in 1877. Second, Argue & Shepard (2005) report numbers of sockeye caught of all ages, whereas Shepard & Withler (1958 report only those sockeye caught of age four and five, which spent one year in freshwater the authors omit sockeye of age six, and those that reared for more than one year in freshwater). Despite these differences, annual estimates of sockeye caught between the two reports are remarkably similar a difference of 11,000 fish on average for years 1913, 1916, and 1918-1923) once corrections for genetically-identified proportions of non-Skeena sockeye are applied to Argue & Shepard (2005) catch data for the Area 4 fishery.

While the historical (1913-1947) catch data was reconstructed from canned-pack data derived from canneries operating on the Skeena River, and much of the fishery occurred in the Skeena River and estuary, some fish that were caught were not of Skeena origin. This was most pronounced during 1933-1947 when the fishery was primarily of motorized vessels that could travel long distances. To correct for this potential overestimation, we applied our annual proportions of Skeena-origin fish quantified from scales to annual abundance estimates. Across the 14 historical years, Skeena sockeye populations accounted for 85% on average of the fish identified from scales.

Our use of scales to reconstruct historical abundance (Figure S1) relied largely on the genetic assignment of those scales to population. While a recent analysis demonstrated high (> 95%) assignment accuracy of Skeena sockeye populations from recently collected tissue (Beacham et al. 2014), lack of baseline data in our study may have manifest into some populations being over-estimated. For example, several historically-known headwater populations e.g., Kluatantan, Kluayaz; see Brett 1952) currently are absent in the genetic baseline. Because geographically-proximate populations share distinctive genetic characteristics, any fish scales) from these unidentifiable populations may have been assigned to the neighbouring populations of Sustut, Motase, or Bear. Similarly, fish from the only known extirpated population in the Skeena (i.e., Seeley Lake , or from others currently unknown but potentially identifiable from our collection (see Iwamoto et al. 2012), may have been mis-assigned - resulting in over-estimates of abundance - or may not have been assigned to a population. However, we believe that any mis-assignments would not largely inflate our historical estimates because populations currently not in the baseline that were assessed in the 1940s were small (i.e., < 1,000 fish; Brett 1952). Furthermore, our estimates for Babine, Bear, Bulkley, Kitwanga, and Lakelse generally agree with previous assessments (Brett 1952; Cleveland et al. 2006), demonstrating the relative robustness of our novel approach, and its importance in shifting baselines back half a century to more accurately assess loss over time.

Our historical abundance estimates were based, in part, on weekly run times of sockeye entering the Skeena River, which were derived from fish caught at the Tyee Test Fishery location marked on Figure 1 of main text; Table S1). Examination of the seven years of recent run-time data that we used shows that the peak migration period for sockeye entering the Skeena was highly variable across years, with an average peak period of week 5 (of 9 weeks), and a range from week 3 to week 7. Analyses over the recent (1949-1999) period suggest that the Babine population (most abundant sockeye population in the Skeena) is tending towards earlier migrations (Hodgson et al. 2006). Price et al. (2019) investigated the robustness of baseline abundance estimates for each population during the 1913-1923 period by shifting the average proportion of fish estimated at the Skeena Tyee Test Fishery one week earlier for each sampling week, for each year (2011-2017) of data. Results showed only minor changes for a sub-set of populations. Thus, our historical abundance estimates – and our resulting diversity analyses - are derived from a range of run-times that likely occurred historically.

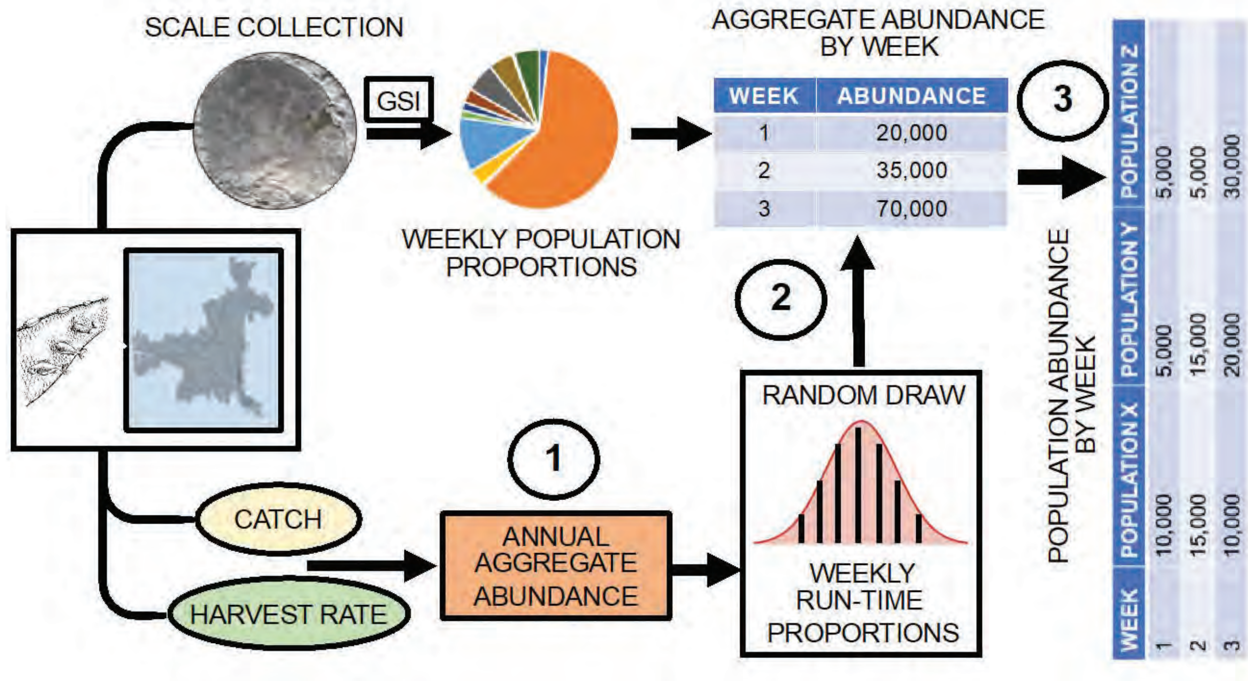


Figure S1. Graphic display of steps used to estimate the annual abundance of each Skeena River sockeye salmon population identified in genetic analyses during the historical (1913-1947 period from fish scales, catch records, catch rate estimates, and aggregate abundance proportions estimated at the Skeena Tyee Test Fishery.

Table S1. Weekly percentage of sockeye salmon entering the Skeena River estimated at the Tyee Test Fishery (location shown on Figure 1 of main text) across seven years of most recent data. These data were used in historical (1913-1947) abundance estimates.

year	week1	week2	week3	week4	week5	week6	week7	week8	week9
2011	1.15	3.32	9.01	12.01	15.52	26.29	20.69	10.08	1.93
2012	1.32	2.62	11.46	28.41	26.82	15.78	11.62	1.00	0.97
2013	1.87	5.43	10.87	18.52	24.30	25.61	10.83	1.91	0.66
2014	1.27	4.50	19.25	18.03	15.52	13.10	10.11	14.82	3.40
2015	1.11	2.94	8.89	11.05	17.16	20.87	20.58	10.38	7.02
2016	4.32	7.10	8.69	9.12	16.77	20.65	19.22	10.53	3.60
2017	0.43	2.27	5.25	10.37	20.30	19.52	24.85	15.13	1.88

Recent period

Recent (2010-2017) estimates of abundance for all sockeye populations are available from PSF 2020) – with methods described in English et al. (2018) - except Sustut, which previously had not been estimated. We calculated annual abundance for Sustut by dividing the number of spawning sockeye counted annually at the Sustut weir (Mark Beere unpublished data) by 1-exploitation rates estimated for a population (Slamgeesh) with similar run-time Cox-Rogers 2012). The Ecstall population complex has not been estimated since 2003; thus, we used the 14 most recent (1990-2003 years to estimate changes in abundance between historical (1913-1947) and modern time periods. Annual estimates of wild fish for Kalum were derived from run-reconstructions detailed in the citations above, but with spawning channel contributions removed. We estimate that 72% of the average total abundance during 2007-2014 was from spawning channel fish because sockeye that spawned at Kalum Lake accounted for 28% of the total annual returns to the population during 1954-1984, with the remaining production attributable to fish that spawned in watershed tributaries. During the years 2007-2014, after a spawning channel had been built (1985) and improved (1994), the total annual abundance contribution of Kalum Lake to the Kalum population has been 98%. Additionally, two populations consist of multiple Conservation Units (CU) that each have their own annual estimates of abundance (PSF 2020). For these populations, we simply summed the annual estimates of each CU within a given population for a combined total estimate of abundance. While infrequent, when one of multiple CUs for a given population complex had missing data in a given year, we inserted the arithmetic mean across recent years for the data-deficient CU into the missing year, and added this value to the abundance estimate of the other CU within the population complex for a combined total estimate of abundance.

As a sensitivity analysis for our main text evaluation of the change in in-river abundance of sockeye - and the potential loss of fish to in-river fisheries and wildlife - we also compared the change in total abundance (assuming zero loss to commercial fisheries; abundance included wild plus enhanced fish) of sockeye returning to tributary streams and the main channel of the Skeena River over the last century. Here, we compared the arithmetic mean abundance of sockeye between the historical (1913-1947) and modern (2004-2017) eras for each population. We quantified abundance for each main-stem section of the Skeena River between populations by dividing the total abundance of sockeye minus each population's abundance downstream of each mainstem river section for the two time-periods. All wild population tributaries, as well as the mainstem channel above Babine, now receive between 58% and 94% less sockeye annually than during the historical era (Figure S2).

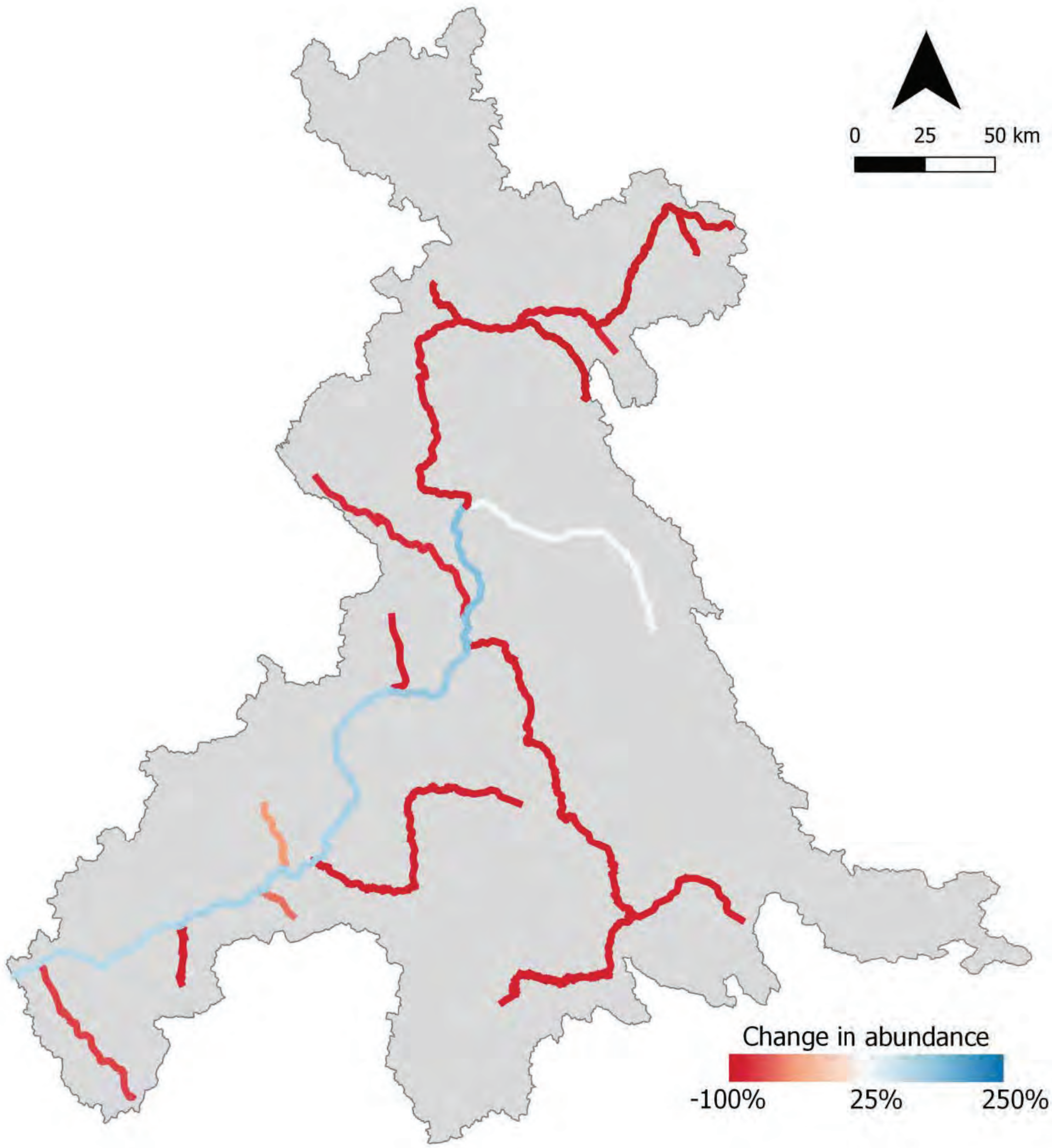


Figure S2. Change in total (wild plus enhanced) abundance (catch plus escapement) of sockeye salmon returning to the Skeena River watershed between historical (1913-1947) and recent (2004-2017) time periods assuming zero loss to commercial marine and lower river fisheries.

Appendix S3: Gill-net selectivity

Sockeye salmon returning to the Skeena River were caught exclusively by linen gill-net in commercial fisheries from 1877 to 1950 (Milne 1955). Migrating sockeye would incidentally swim into the net and become trapped either by being wedged into the mesh opening or becoming tangled in the net. Because nets that targeted sockeye in the historical fishery were uniform in mesh size (5.75"), fish above a particular size likely would have been too large to be wedged, and fish below a particular size would have swum through the net, though both large and small sockeye may have been captured by becoming tangled in the net. Indeed, gill-nets routinely select for larger size-at-maturity (Peterson 1954; Hamley 1975; Gilhousen 1992), and older age-at-maturity to a lesser extent because body-size is more closely correlated with number of ocean years, rather than absolute age). Given such selectivity, we quantified a correction factor based on the selectivity of sockeye captured by gill-nets in the Skeena Tyee Test Fishery to more accurately represent the historical age-distributions. The Skeena Tyee Test Fishery employs a multi-panel net consisting of various nylon mesh sizes (3.5" to 8.0", at 0.5" increments). During 1992 to 1996, data were recorded on the number of sockeye caught in each mesh size, and each captured fish was aged.

We grouped all sockeye caught in all Skeena Tyee Test Fishery mesh size panels (i.e., the Population) into the four dominant (>99%) age-trait categories (i.e., 1.2, 1.3, 2.2, and 2.3); then, we calculated the proportion of fish caught in each category. We repeated this procedure for those fish caught only in the 5.5" mesh size panel (i.e., the Selective Catch , and calculated the difference between Population and Selective Catch for each age-trait category to derive estimates of selectivity. We then multiplied the number of fish caught historically in each age-trait category by the inverse selectivity estimate to generate a corrected estimate of the number of fish in those age-trait categories, and quantified the arithmetic mean age-at-maturity for the aggregate. We followed a similar procedure to derive selectivity estimates for each population for historical mean age-at-maturity for each population. Examination of the Skeena Tyee Test Fishery showed that the mesh size 5.5") most similar to that used in the historical gill-net fishery strongly selected for sockeye that survived three marine years and a combined age of five (i.e., 1.3), and selected against sockeye that survived two marine years and a combined age of four (i.e., 1.2; Figure S3).

We adjusted for the age of sockeye caught in commercial fisheries during our historical period of interest based on the selective action of 5.5" mesh nylon nets for the following reasons: i) 5.75" linen nets were exclusively used to capture sockeye returning to the Skeena River during our period of interest, with a small proportion of sockeye intercepted by 7" linen nets that targeted Chinook (*O. tshawytscha*) salmon early in the fishing season (Milne 1955), ii) a comparative study on the size selectivity of Skeena River sockeye by linen versus nylon gill-nets reported similar size distributions between 5.63" (smaller mesh than historically used) linen and 5.25" (smaller mesh than we used for our analysis) nylon (Todd & Larkin 1971), and iii) Peterson (1954) showed that 5.75" linen nets caught sockeye returning to the Fraser River of average length 61.62 cm (1947) and 59.48 cm (1948), which is comparable to the average length (62.92 cm) of sockeye caught in 5.5" nylon mesh of the Tyee Test Fishery described above. While gill-nets tend to select *for* larger size- and age-at-maturity, we acknowledge that selectivity also can be *against* smaller size- and age-at-maturity in years when body-size is smaller on average than the norm (Todd & Larkin 1971).

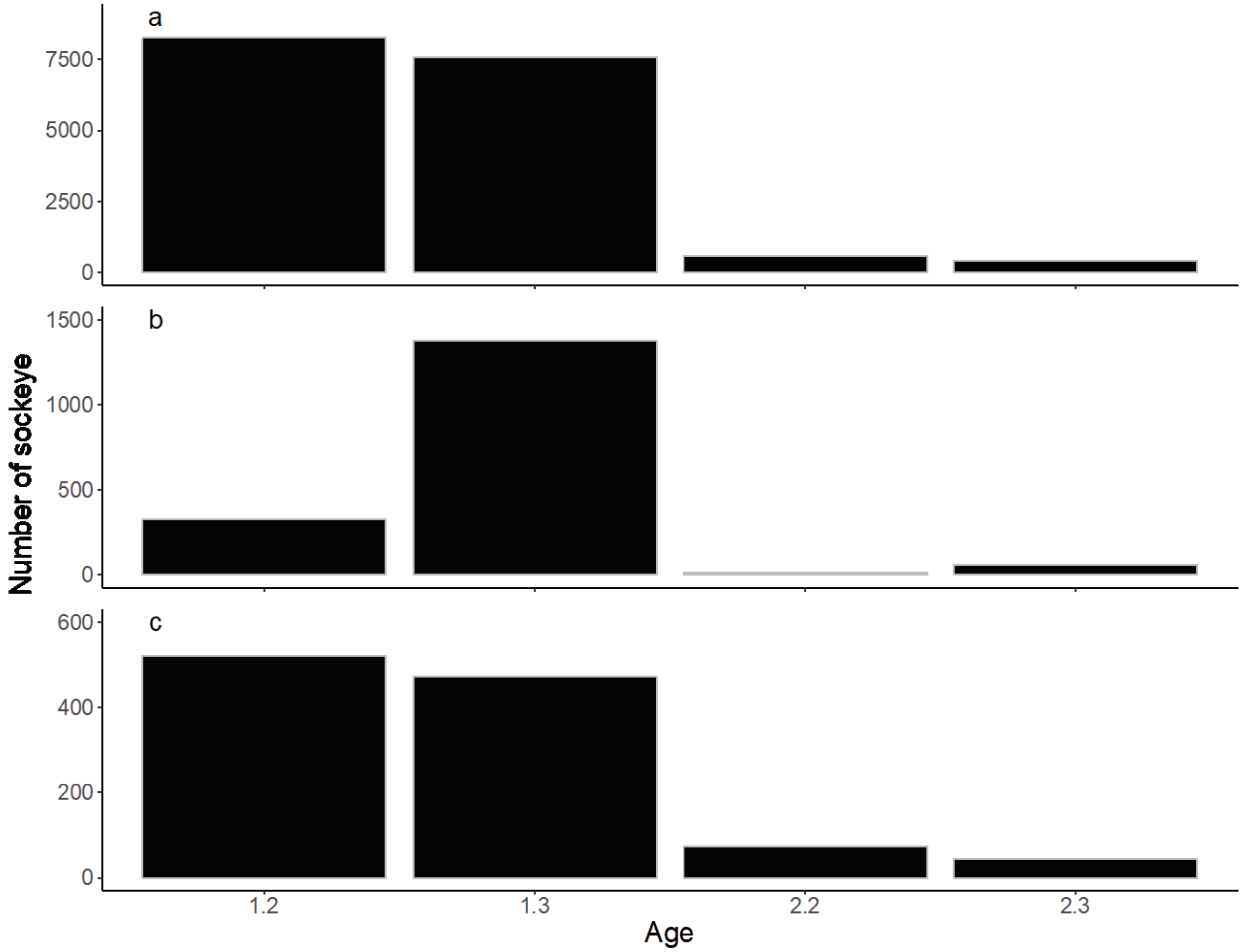


Figure S3. Number and associated age-at-maturity (1.2 = age-4, 1 freshwater + 2 ocean years; 1.3 = age-5, 1 freshwater + 3 ocean years; 2.2 = age-5, 2 freshwater + 2 ocean years; 2.3 = age-6, 2 freshwater + 3 ocean years) of sockeye salmon caught by gill-net on the Skeena River from: a) Tyee Test Fishery (1992-1996) using all mesh sizes, (b) Tyee Test Fishery using only 5.5" nylon mesh, and (c) historical (1913-1923) commercial fishery using 5.75" linen mesh.

We examined the degree to which populations were subject to selection pressure via gill-nets, which could lead to bias in both estimates of absolute historical abundance and the magnitude of change over the last century. The magnitude of change would be biased high in populations that were most vulnerable to capture in the historical gill-net fishery, and biased low in those that had the lowest selectivity. We used catch data from the Skeena Tyee Test Fishery (described above) and body-size of fish caught in the historical fishery (genetically-assigned to population with >90% probability) to derive two selectivity factors: 1) selection *for* (for body-size 600 mm to 650 mm - which is the most frequent size range of fish caught historically - with calculated selectivity pressure index of +0.166), and 2) selection *against* (for body-size 500 mm to 550 mm, with calculated selectivity pressure index of -0.154). We multiplied the number of fish caught in each size category for each population for each historical period (1913-1923 & 1933-1947) by the respective selectivity indices to calculate the number of fish over- and under-selected; we then derived final selectivity scores for each period by calculating the proportion of "selected" fish in the total catch for each population. Populations most vulnerable to gill-net fisheries during 1913-1923 based on the selectivity estimates above include: Babine, Kispiox and Zymoetz (equally), and Alastair, which may have been overestimated in our historical reconstruction by 17%, 13%, and 12%, respectively; Motase and Sustut were the populations least selected for (Table S2). During 1933-1947, Bear, Kalum, and Sustut were most vulnerable to gill-nets (potentially over-estimated by 13%), and Ecstall and Kitwanga were the least vulnerable. These results, based on our bias-correction, suggest that there was considerable variation in the vulnerability of populations to selective gill-net fisheries between periods because of variability in body-size within populations. For example, the body-length of sockeye from the Sustut population averaged 662mm (beyond the most vulnerable size-range) during 1913-1923, yet average fish size declined to 648mm (within the most vulnerable size-range) during 1933-1947.

Table S2. Gill-net fishery selection pressure indices for each Skeena River sockeye salmon population during the 1913-1923 and 1933-1947 time periods, based on fork-length for populations genetically identified in scales with ≥90% assignment probability. Dash represents populations assigned with <90% probability in either time period.

Population	1913-1923	1933-1947
Alastair	0.115	0.057
Babine	0.173	0.079
Bear	-	0.132
Bulkley	0.083	0.062
Ecstall	0.071	0.000
Kalum	0.071	0.125
Kispiox	0.125	0.067
Kitwanga	0.100	0.034
Lakelse	0.107	0.059
Motase	0.000	-
Slamgeesh	-	-
Sustut	0.056	0.125
Zymoetz	0.125	0.100

Appendix S4: Age composition
We extracted aggregate mean age-at-maturity (of the four dominant age traits: 1.2, 1.3, 2.2, 2.3, which comprised >99% of all age traits) data from fish caught in commercial fisheries (n = 77,126) reported annually in historical fisheries reports for the years 1916-1956 (Province of BC 1957), and applied selectivity corrections to the annual data. We used individual age-at-maturity data (of the four dominant age traits) from fish caught in the Skeena Tyee Test Fishery (n = 81,126 scales) for the recent (1973-2016) period. We also examined age-at-maturity and associated age-traits between time-periods at the population level. Here, we used age data for the years 1913-1947 from fish caught in commercial fisheries, and 2000-2017 from fish caught at the Tyee Test Fishery and terminal locations. We included only those scales that were identified to individual populations with a genetic assignment threshold of >90% probability; as a result, Slamgeesh population was not included. We evaluated changes in the diversity of age traits over the last century by comparing the number of unique traits (i.e., 0.3, 1.1, 1.2, etc.) in the historical (1913-1947; n = 5,400 scales) and recent (2000-2013; n 9,337) period, and quantified the change in the proportion of the four dominant age traits between time periods.

We were interested to explore the influence of enhanced production on the shift in age composition over the last century. Because all age data in the recent period include enhanced fish - which constitutes ~70% of all sockeye returning to the Skeena, but are not genetically differentiated from wild fish – we quantified the proportions of age traits for wild-only sockeye in each year by calculating the proportion of wild fish (which included wild Babine) to total abundance (which included enhanced fish) for each year from 1973-2013, and applied these proportions to the 1.2 and 1.3 age-traits. The 2.2 and 2.3 age traits remained unchanged because over 99% of all Babine fish are of the 1.2 and 1.3 age traits.

Skeena sockeye currently display all 10 age-related life-history strategies that were identified in scales one century ago (Figure S4 ; two additional strategies (3.2 and 3.3) not among those of fish caught in historical fisheries are present in recently collected scales. It is highly probable that these "additional" strategies were present among sockeye returning to the Skeena during the historical period, but either were not caught by selective gill-net fisheries, or are present in the Gilbert/Clemens collection of 65,000 fish but were not among the limited number of scales that we analysed (5,400). Mean age-at-maturity for the Skeena sockeye aggregate has increased only slightly from the historical (1916-1956; 4.493 years) to the recent (1973-2016; 4.563 years) period (Figure S5), though some populations have experienced increases or decreases (Figure S6). The proportion of fish with the 1.*x* (one year in freshwater and any number in the ocean) life-history across all populations except Babine increased (from 67% to 87%) on average between historical and modern eras (Table S3). The inclusion of Babine fish further increased the proportion of the 1.*x* life history to 96% in the modern era; however, four of 12 populations did not increase between time-periods. Finally, the evenness of age traits significantly declined (from 0.68 to 0.55; 19%) between historical and modern eras (Figure S7).While different technicians were involved in the aging of scales over the last century, which can introduce interpretation error, any such error would have occurred for either time-period, and likely would not lead to any systemic bias in the age of fish.

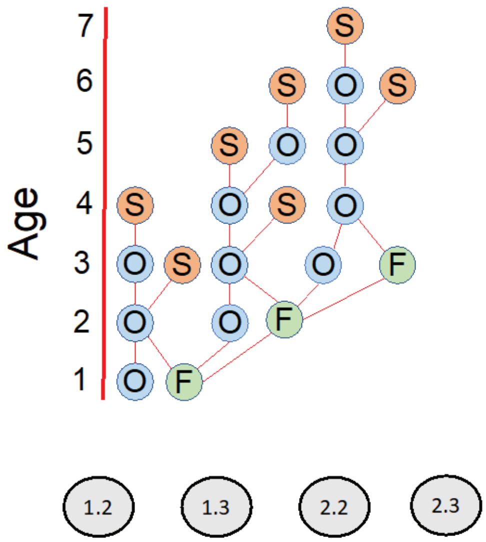


Figure S4. Networks illustrating the life-history strategies for sockeye salmon caught in commercial fisheries at the mouth of the Skeena River during 1913-1947. Each life stage is abbreviated with a letter and colour F = freshwater, O ocean, S returning to freshwater to spawn). The age-at-maturity of the fish is denoted with a number. Also shown are the four dominant age traits 1.2 = age-4, 1 freshwater + 2 ocean years; 1.3 = age-5, 1 freshwater + 3 ocean years; 2.2 = age-5, 2 freshwater + 2 ocean years; 2.3 = age-6, 2 freshwater + 3 ocean years).

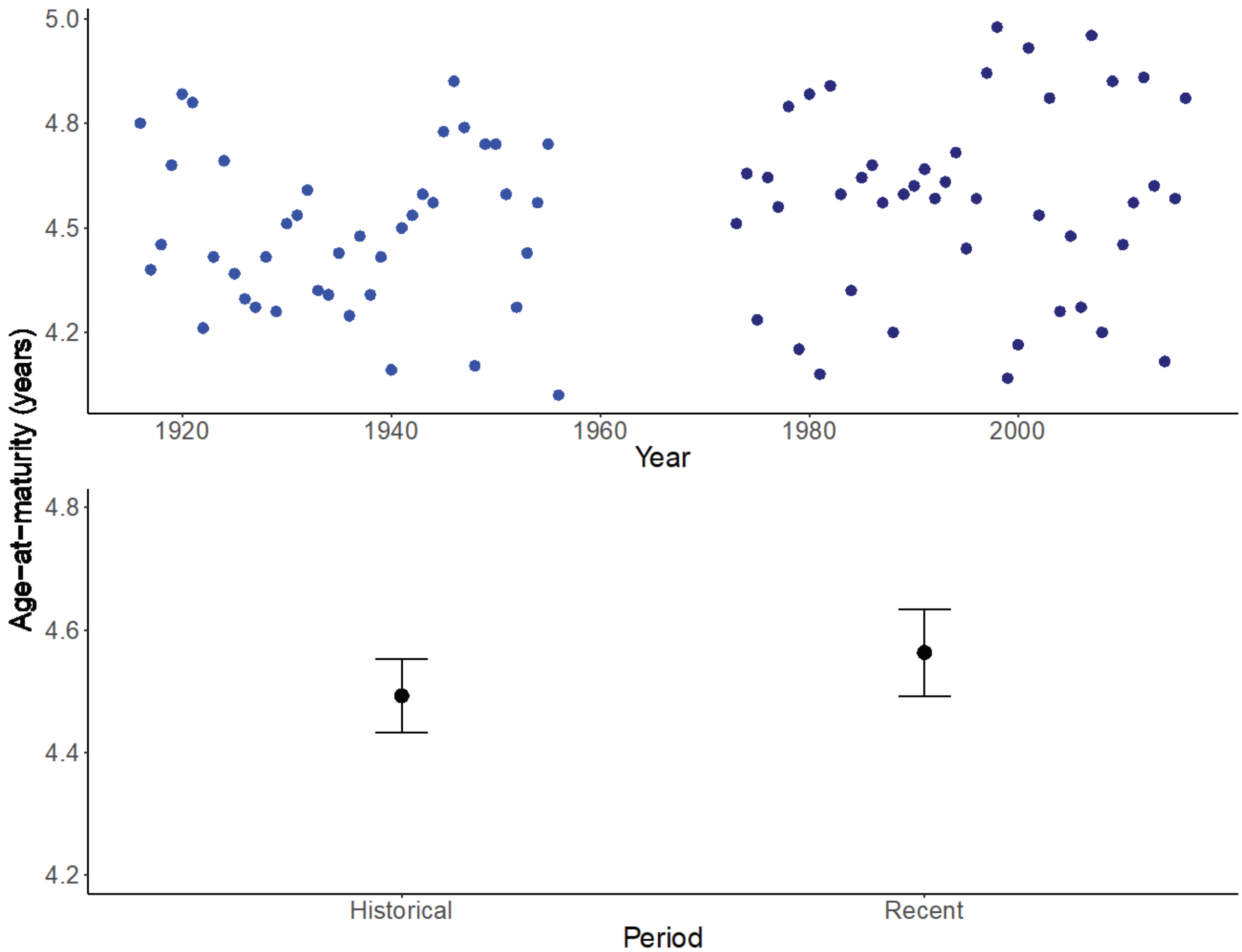


Figure S5. Mean annual aggregate age-at-maturity of sockeye salmon returning to the Skeena River during 1916-2016 (top; light-blue circles are from commercial fishery, dark-blue circles are from Tyee Test Fishery), and mean combined age-at-maturity between time-periods (bottom; Historical is 1916-1956, Recent is 1973-2016).

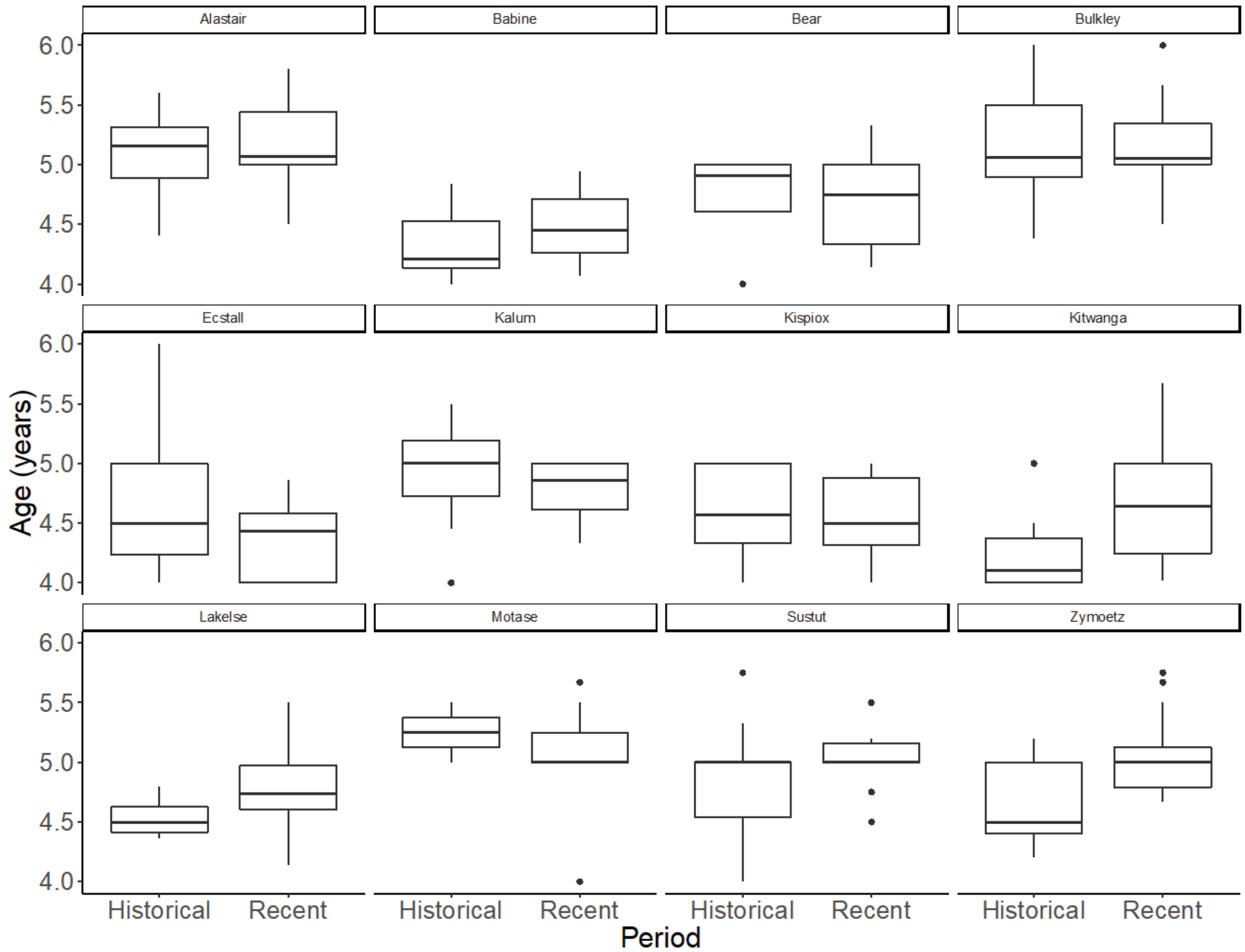


Figure S6. Median (black line) and quartiles (box) for age-at-maturity of each Skeena sockeye salmon population genetically identified with >90% assignment probability between Historical 1913-1947) and Recent 2000-2013) time-periods. Slamgeesh population is not included due to data limitations.

Table S3. Number of scales *n*) analyzed for each Skeena sockeye salmon population during the Historical (1913-1947) and Modern (2000-2017) eras and the respective proportions of the 1.*x* (fish that reared for one-year in freshwater) life history. Only scales assigned to population with >90% probability were included.

Population	Historical *n*	Modern *n*	Historical 1.*x* %	Modern 1.*x* %
Alastair	184	208	39	75
Babine	830	5939	75	97
Bear	44	42	91	93
Bulkley	150	147	35	46
Ecstall	47	33	91	85
Kalum	39	133	85	94
Kispiox	53	192	83	82
Kitwanga	93	882	95	98
Lakelse	43	116	100	96
Motase	3	11	67	73
Slamgeesh	0	533	-	98
Sustut	22	168	77	70
Zymoetz	57	75	83	87

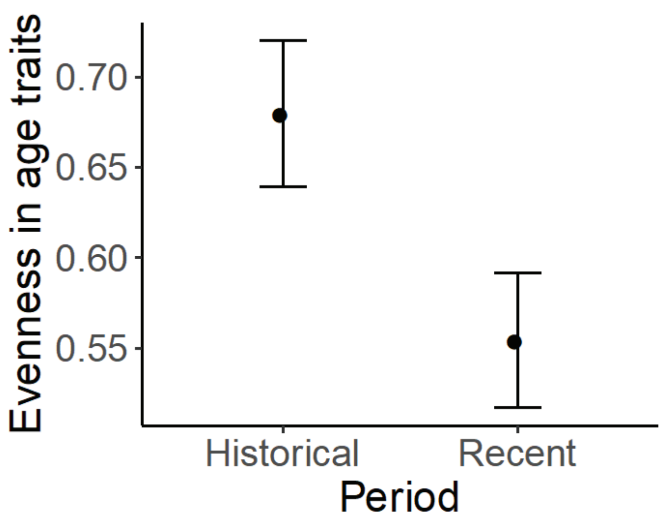


Figure S7. Arithmetic mean (black circle) and 95% confidence intervals black whiskers) for evenness scores across the four dominant Skeena sockeye age traits (1.2, 1.3, 2.2, 2.3) between Historical (1916-1956) and Recent (1973-2016 time periods.

Appendix S5: Portfolio effects

Similar to population abundances, we explored whether the strength of salmon portfolios in the Skeena had changed over the last century by measuring overall portfolio effect (PE) strength based on age traits. Here, we utilized population-specific age data generated from the Gilbert/Clemens scale collection 1913-1923, and 1933-1947) and Skeena Tyee Test Fishery (2006-2013). Age-structure diversity reduced year-to-year variability in abundance by 30%, 20%, and 32% compared to the scenario if populations were of a single age class over the three time-periods (Figure S8). Additionally, we quantified PE strength for population abundances of wild fish (in the absence of enhancement) for the recent (2010-2017) period. While we found that PE strength was reduced in the recent period (1.32 times more stable than had the Skeena consisted of a single wild population) compared to both of the early periods (2.04 during 1913-1923; 1.48 during 1933-1947; Figure S9), PE strength was greater for wild fish abundances than for abundances that included enhanced fish (1.10; Figure 4a of main text).

To estimate uncertainty in our coefficient of variation CV) estimates (and overall population portfolio strength) across individual component population abundances i.e., average CV) for each historical time period (i.e., 1913-1923 and 1933-1947), we calculated 10,000 independent estimates of average CV – each estimate drawing from a single iteration of population- and year-specific historical abundance – and calculated the arithmetic mean average CV and 95% confidence intervals for each time period. Arithmetic mean "average CV" based on 10,000 replicates for the 1913-1923 period was 1.07 (95% confidence interval of 0.97-1.19), and for the 1933-1947 period was 1.00 (95% confidence interval of 0.91-1.10; Figure S10). These results suggest that the strength of the population portfolio may range from 1.96 to 2.23 (1913-1923), and from 1.4 to 1.69 (1933-1947); all of which remain much higher than the recent period strength of 1.1.

We calculated portfolio strength by comparing the temporal CV of metapopulation abundance (the diversified portfolio) with the average-CV of individual population abundances (the single assets). This metric implicitly assumes that the slope z) of a log–log plot of mean temporal abundance and variance (Taylor's power law) equals two. However, analyses of populations with z-scores less than two have been shown to overestimate the stabilizing effect of population diversity for metapopulations (Anderson et al. 2013). We calculated Taylor's power law for Skeena sockeye across the three (1913-1923, 1933-1947, and 2010-2017) time periods to test this assumption. While z-scores were lower than two for both historical time periods (e.g., $z = 1.6$ for 1913-1923, and $z = 1.7$ for 1933-1947), the difference in PE between mean-variance and average-CV based on these values is not statistically significant for salmonids (Anderson et al. 2013).

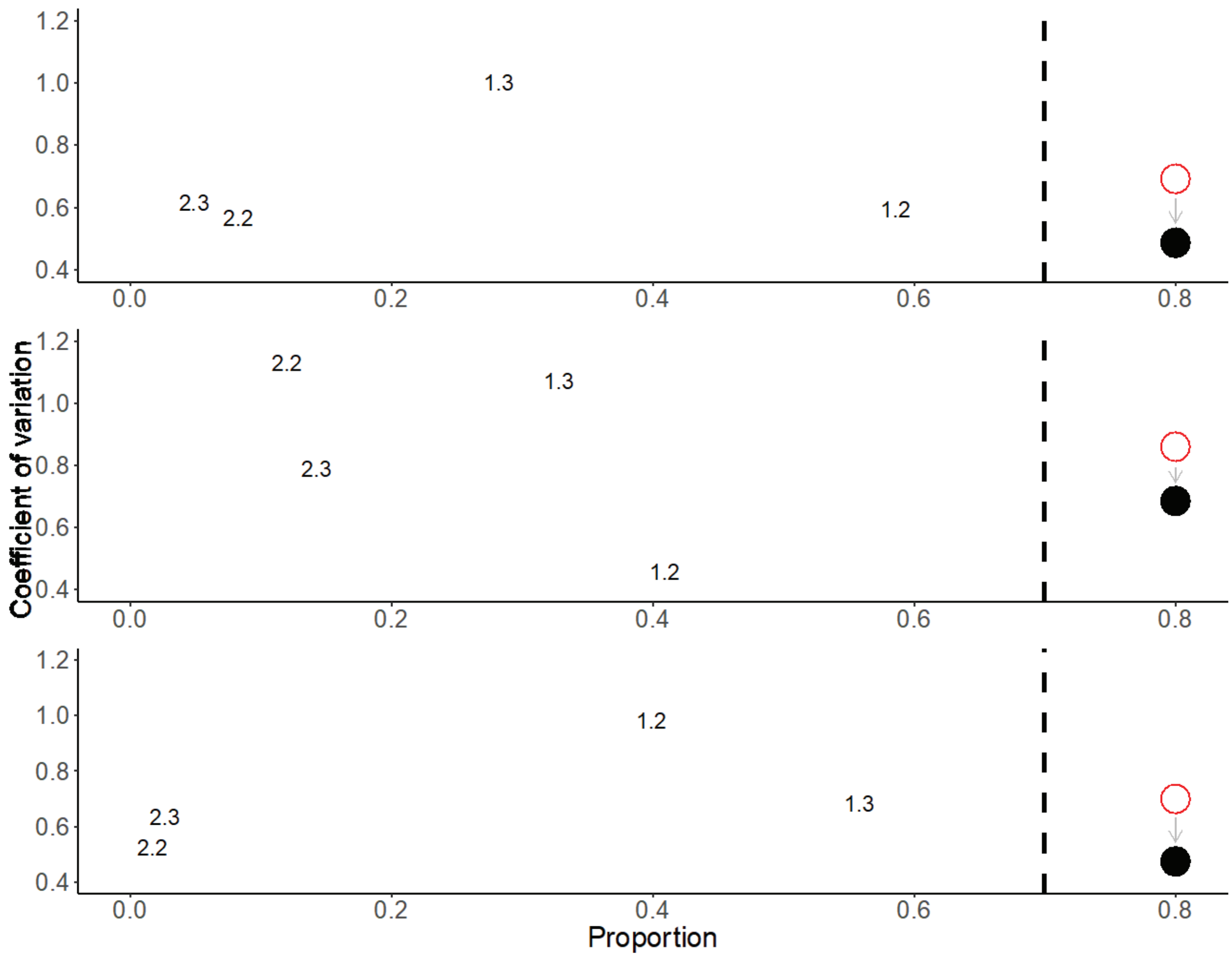


Figure S8. Life-history diversity and stability. Each red-filled circle represents the coefficient of variation (CV) of abundance across years for each time period as a function of the proportion contribution of each life history (1.2 = age-4, 1 freshwater + 2 ocean years; 1.3 = age-5, 1 freshwater + 3 ocean years; 2.2 = age-5, 2 freshwater + 2 ocean years; 2.3 = age-6, 2 freshwater + 3 ocean years). Shown to the right is the estimated CV based on the average of the CVs of the different life histories (red outline while-filled circle), and the measured CV of the entire Skeena sockeye complex (filled black circle). The difference between the estimated and measured CV is a metric of the portfolio effect, the degree to which diversity decreases stability.

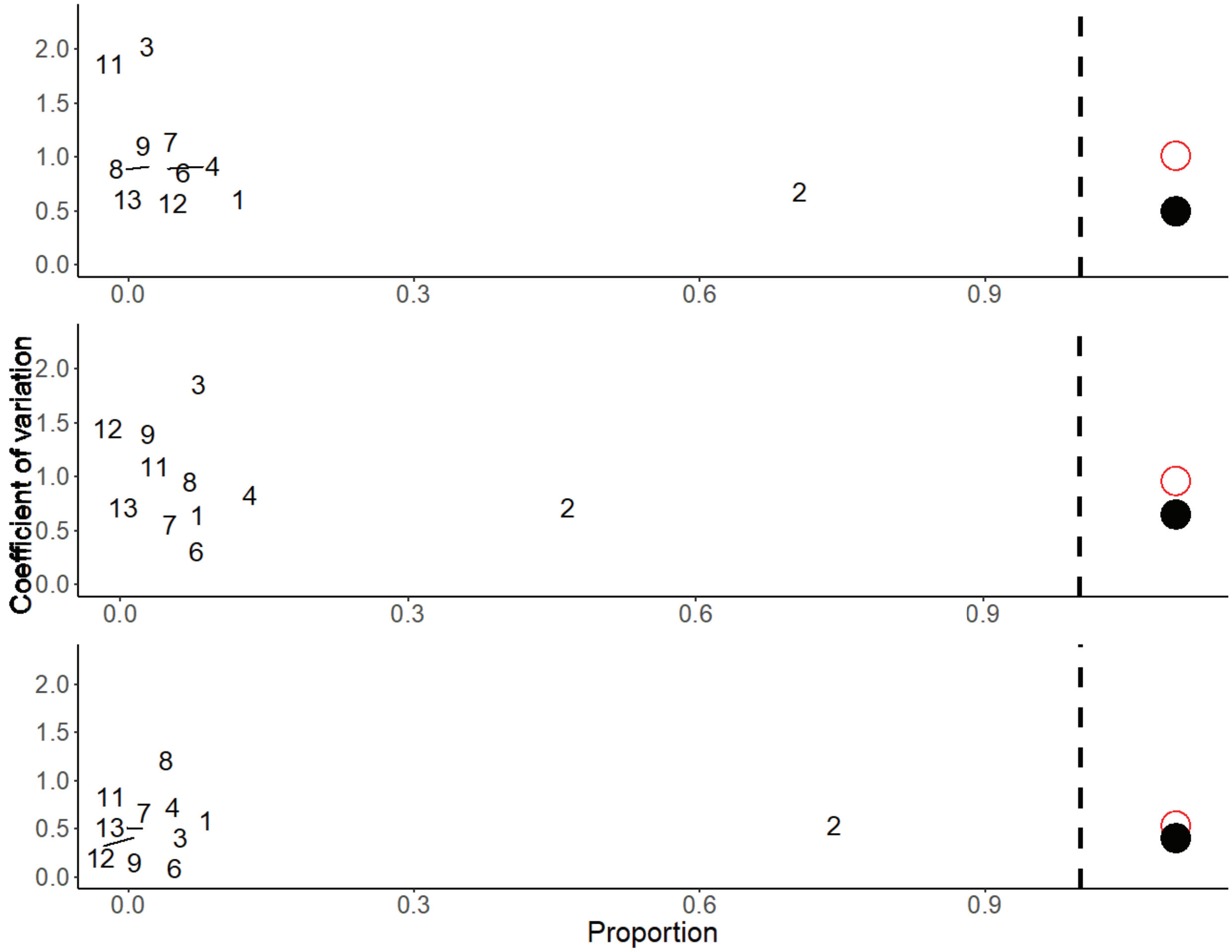


Figure S9. Population diversity and stability of *wild* populations. Each red-filled circle represents the coefficient of variation CV of abundance across years for each time period as a function of the proportion contribution of each wild sockeye population; numbers correspond to Figure 1 of main text. Shown to the right is the estimated CV based on the average of the CVs of the different wild populations (red outline while-filled circle), and the measured CV of the entire wild Skeena sockeye complex (filled black circle). The difference between the estimated and measured CV is a metric of the portfolio effect, the degree to which diversity decreases stability.

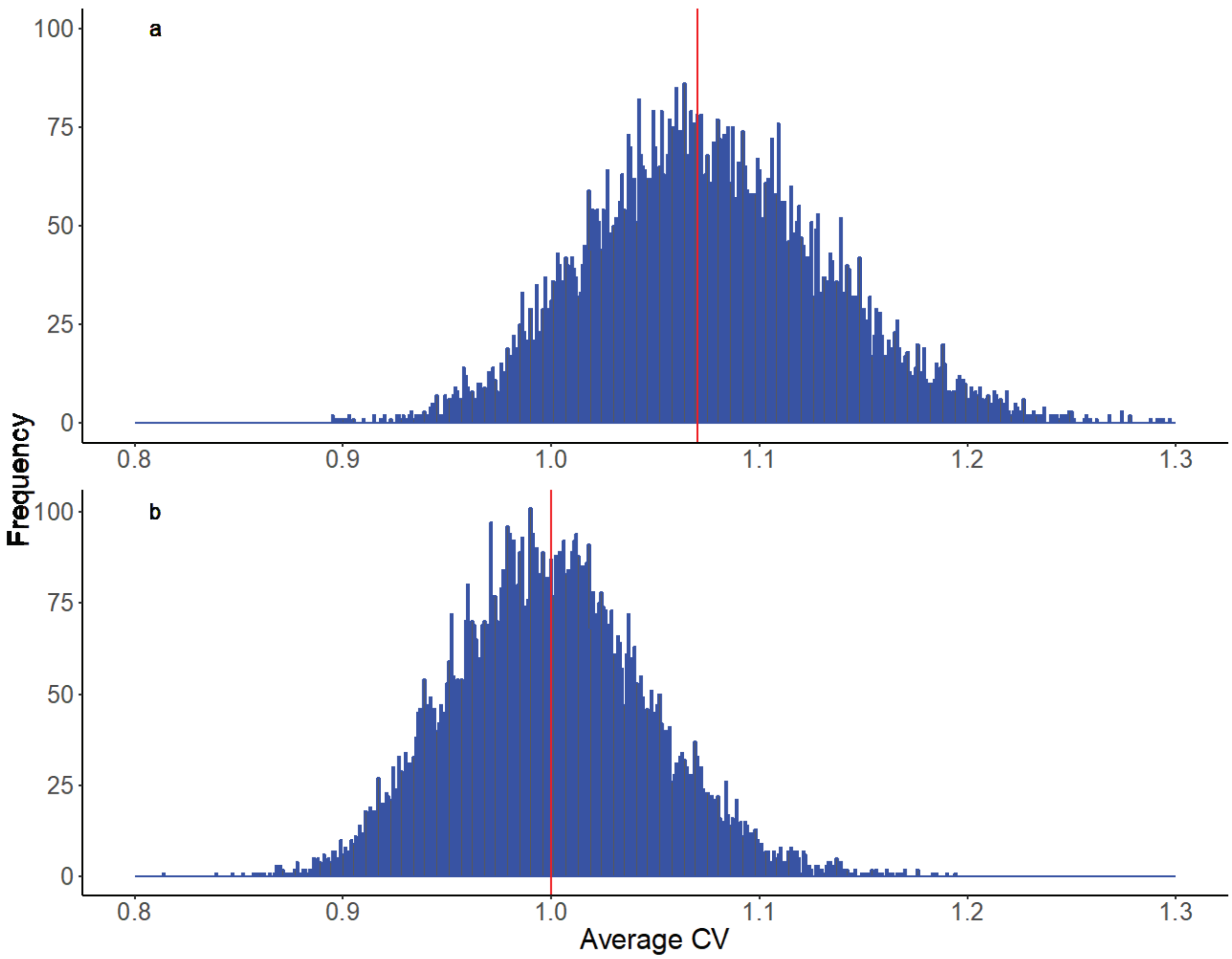


Figure S10. Estimates of coefficient of variation (CV) during a) 1913-1923 and b) 1933-1947 – each of 10,000 estimates were drawing from a single iteration of population- and year-specific historical abundance averaged across Skeena sockeye populations; red vertical line is the arithmetic mean average CV.

We were interested to understand the potential mechanism influencing the erosion in portfolio strength over the last century, and whether enhancement in the recent period had been a primary driver. Here we decomposed aggregate CV into abundance-weighted mean CV across populations and a synchrony index (Thibaut and Connolly 2013; Freshwater et al. 2019). The abundance-weighted mean CV is measured as the mean temporal CV of populations (CV_p weighted by each population's mean abundance (i.e., the sum of the populations' CV scaled by each population's mean abundance):

$$CV_p = \sum_i \frac{\mu_i}{\mu_A}\frac{\sigma_i}{\mu_i}$$

where μ is mean abundance of population i, μ_A is the mean abundance across all populations, and σ is the standard deviation of abundance. Synchrony is defined as the total temporal variance of the populations, divided by the variance of a hypothetical aggregate with the same population variances, but perfect covariance (Loreau & de Mazancourt 2008; Freshwater et al. 2019):

$$\varphi = \frac{\sum_{i,j} p_{i,j}\sigma_i\sigma_j}{(\sum_i \sigma_i^2)}$$

where p represents the correlation between populations i and j.

We report results for the abundance-weighted mean CV for each population (Ecstall and Motase populations were omitted because of insufficient data in the recent period) on Table S4; aggregate abundance-weighted mean CV for each time period was 0.680 (1913-1923), 0.838 (1933-1947), and 0.552 2010-2017). While the Babine population has influenced variability of the Skeena sockeye aggregate over the last 100 years, Babine in the recent time period contributed most (93%; the abundance-weighted mean CV of Babine = 0.511, compared to 0.552 for the aggregate of the variation. Synchrony scores across populations were highest during the 2010-2017 time period (0.903), compared to 1933-1947 (0.769) and 1913-1923 (0.665). Exploring synchrony over the entire contemporary period (1960-2017) time series showed an increasing trend with a noticeable rise in synchrony beginning in the early 2000s (Figure S11).

We observed lower variability among populations in the recent period compared to either of the historical periods, and we wondered whether different methods used for estimating abundance between eras may confound our results. Specifically, might such a difference in variability simply be an artifact of increased precision in the recent estimation of population abundances – or perhaps more likely, higher variability among populations during the historical era because of our coarse abundance reconstruction methods. To test this, we quantified the average CV across populations in each of our three time periods (1913-1923, 1933-1947, and 2009-2016) using annual genetic proportion data, and compared the results to average CV using population abundance data. Genetic data involve less assumptions, and generally are more comparable than abundance data. If the lower variation across populations in the recent period is simply because these populations are less variable recently, the genetic data should reflect this in a lower average CV score compared to the historical periods. Genetic data during the two historical periods were derived from fish caught in commercial fisheries, and during the recent period from fish caught in the Skeena Tyee Test Fishery (reported in our Appendix S1 section above). We found that CV scores averaged across populations in each of our time periods derived from genetic data generally were similar to average CV scores using abundance data. Specifically: 1913-1923 (CV_abundance = 1.0, CV_genetic = 1.1), 1933-1947 (CV_abundance = 1.0, CV_genetic = 0.9), 2009-2016 (CV_abundance = 0.6, CV_genetic = 0.7). This suggests that Skeena sockeye populations indeed have become less variable in the recent period, and likely are experiencing a lower productivity regime given their shared reduction in abundance and high synchrony dynamics reported above.

Table S4. Abundance-weighted mean coefficient of variation (CV) for each time period and Skeena River sockeye population (Ecstall and Motase populations were omitted due to insufficient data during recent period) - including the summed aggregate of populations.

Population	1913-1923	1933-1947	2010-2017
Alastair	0.044	0.052	0.008
Babine	0.473	0.360	0.511
Bear	0.006	0.184	0.003
Bulkley	0.030	0.102	0.005
Kalum	0.020	0.028	0.006
Kispiox	0.037	0.019	0.004
Kitwanga	0.015	0.045	0.006
Lakelse	0.021	0.013	0.007
Slamgeesh	0.005	0.023	0.000
Sustut	0.015	0.010	0.000
Zymoetz	0.013	0.014	0.002
Aggregate total	0.680	0.851	0.553

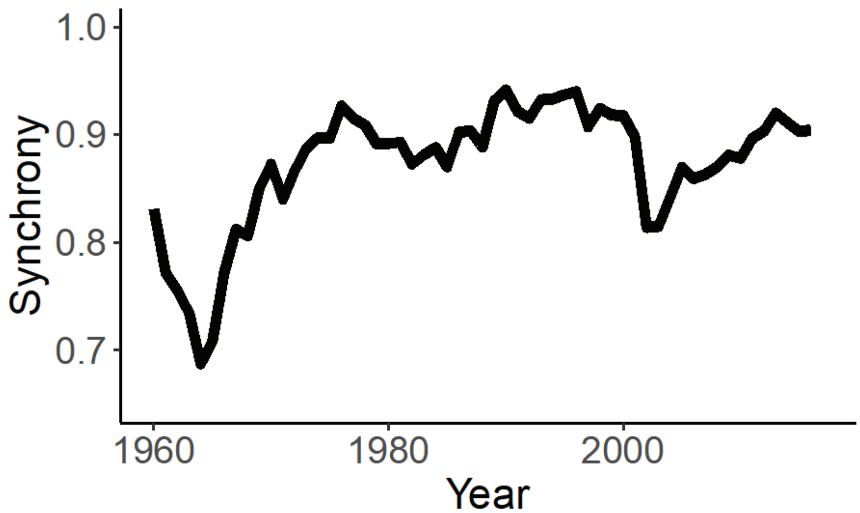


Figure S11. Observed trends in synchrony across Skeena River sockeye populations over the entire contemporary period (1960-2017) time series calculated for 10-year rolling windows.

Supporting Information References

Anderson SC, Cooper AB, Dulvy NK. 2013. Ecological prophets: quantifying metapopulation portfolio effects. Methods in Ecology and Evolution **4**: 971-981.

Argue AW, Shepard MP. 2005. Historical commercial catch statistics for Pacific salmon *Oncorhynchus* spp.) in British Columbia, 1828 to 1950. Canadian Technical Report of Fisheries and Aquatic Sciences 2601, Vancouver.

Beacham TD, Lapointe M, Candy JR, Miller KM, Withler RE. 2004. DNA in action: rapid application of DNA variation to sockeye salmon fisheries management. Conservation Genetics **5**: 411-416.

Beacham TD, McIntosh B, MacConnachie C, Miller KM, Withler RE, Varnavskaya N. 2006. Pacific Rim Population Structure of Sockeye Salmon as Determined from Microsatellite Analysis. Transactions of the American Fisheries Society **135**: 174-187.

Beacham TD, Candy JR, Porszt E, Sato S, Urawa S. 2011. Microsatellite Identification of Canadian Sockeye Salmon Rearing in the Bering Sea. Transactions of the American Fisheries Society **140**: 296-306.

Beacham TD, Cox-Rogers S, MacConnachie C, McIntosh B, Wallace CG. 2014. Population structure and run timing of sockeye salmon in the Skeena River, British Columbia. North American Journal of Fisheries Management **34**: 335-348.

Brett JR. 1952. Skeena River sockeye escapement and distribution. Journal of the Fisheries Research Board of Canada **8**: 453-468.

Cox-Rogers S. 2012. Skeena sockeye sub-stock run-timing and abundance evaluated using Tyee Test Fishery data: 2000-2010. Fisheries and Oceans Canada Memorandum.

Cleveland MC, Cox-Rogers S, Rabnett K. 2006. Kitwanga sockeye salmon recovery plan. A plan to preserve genetic diversity and rebuild an important race of sockeye salmon. Available: https://waves-vagues.dfo-mpo.gc.ca/Library/333631.pdf accessed December 2019).

English KK, Peacock D, Challenger W, Noble C, Beveridge I, Robichaud D, Beach K, Hertz E, Connors K. 2018. North and central coast salmon escapement, catch, run size, and exploitation rate estimates for each salmon Conservation Unit for 1954–2017. Prepared for Pacific Salmon Foundation, Sidney. Available: https://salmonwatersheds.ca/libraryfiles/lib_451.pdf (accessed February 2020).

Freshwater C, Anderson SC, Holt KR, Huang A-M, Holt CA. 2019. Weakened portfolio effects constrain management effectiveness for population aggregates. Ecological Applications **29**: DOI: 10.1002.

Gilhousen P. 1992. Estimation of Fraser River sockeye escapements from commercial harvest data 1892-1944. International Pacific Salmon Fisheries Commission. Bulletin XXVII, Vancouver.

Hamley JM. 1975. Review of gillnet selectivity. Journal of the Fisheries Research Board of Canada **32**: 1943-1969.

Hodgson S, Quinn TP, Hilborn R, Francis RC, Rogers DE. 2006. Marine and freshwater climatic factors affecting interannual variability in the timing of return migration to fresh water of sockeye salmon (Oncorhynchus nerka). Fisheries Oceanography **15**: 1-24.

Iwamoto EM, Myers JM, Gustafson RG. 2012. Resurrecting an extinct evolutionarily significant unit: archived scales, historical DNA and implications for restoration. Molecular Ecology **21**: 1567-1582.

Loreau M, and de Mazancourt C. 2008. Species synchrony and its drivers: neutral and nonneutral community dynamics in fluctuating environments. American Naturalist **172**: E48-E66.

Milne DJ. 1955. The Skeena River salmon fishery, with special reference to sockeye salmon. Journal of the Fisheries Research Board of Canada **12**: 451-485.

Neaves PI, Wallace CG, Candy JR, Beacham TD. 2005. CBayes: computer program for mixed stock analysis of allelic data. Version v4.02. Available: http://www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/mgl-lgm/apps/index-eng.html accessed December 2019).

PSF. 2020. Salmon Watersheds Program NCC Database Outputs 2017. Available: https://data.salmonwatersheds.ca/data-library/indexpage.aspx?id=67 (accessed January 2020).

Pella J, Masuda M. 2001. Bayesian methods for analysis of stock mixtures from genetic characters. Fishery Bulletin **99**: 151-167.

Peterson AE. 1954. The selective action of gillnets Fraser River sockeye salmon. International Pacific Salmon Fisheries Commission. Bulletin V, New Westminster.

Price MHH, Connors BM, Candy JR, McIntosh B, Beacham TD, Moore JW, Reynolds JD. 2019. Genetics of century-old fish scales reveal population patterns of decline. Conservation Letters e12669.

Province of British Columbia. 1957. Report of the Commissioner of Fisheries for the year ending December 31, 1956. Authority of the Legislative Assembly, Victoria.

Shepard MP, Withler FC. 1958. Spawning stock size and resultant production for Skeena sockeye. Journal of the Fisheries Research Board of Canada **15**: 1007-1025.

Thibaut LM, Connolly SR. 2013. Understanding diversity-stability relationships: towards a unified model of portfolio effects. Ecology Letters **16**: 140–150.

Todd IStP, Larkin PA. 1971. Gillnet selectivity on sockeye *Oncorhynchus nerka* and pink salmon (*O. gorbuscha*) of the Skeena River system, British Columbia. Journal of the Fisheries Research Board of Canada **28**: 821-842.

From: Paul Dale
To: DFG, BOF Comments (DFG sponsored)
Subject: Setnet cook inlet 600 foot fishing opportunity during low abundance of Chinooks.
Date: Tuesday, October 5, 2021 4:04:21 PM

Give these setnetters a break, they deserve it and should always have had this consideration! Thanks, Paul Dale, Kenai alaska

Sent from my iPhone

ALL

Board Members:

RECEIVED SUN. OCT 06 2021 BOARDS

My name is Rick Jewell.

Have lived in + out of Alaska For different periods of my life. Been a Natural Resource Worker in Fishing + Loggin all my life. Started setnetting in 1983 on the East Forelands point + on that location For 27 seasons. Am presently Fishing sites just the North Side of Rig-Tenders dock. This year could have been a good Season For setnetters, as the Fish

Were definitely here in numbers. As usual political games came into being. Our last opening, which was extended at the last moment, out too 600' showed a minimal King impact — 11 Kings versus almost 40K Reds. A small trade! That 600' Rule worked + we should have gotten another 1-2-3 days. At least the boats had a good season; with huge Numbers over the counters + we Not Fishing. Our Upper East Forelands

Sub-district doesn't catch hardly any Kings anyway! The pressure in the River on Kings for decades + decades have reduced those runs — do you think maybe the pressure of consistently over-escaping the system has contributed to these smaller runs we see now?? The run of 1987 came from a very small comparatively escapement. You have the tool to manage the sockeye during low King abundance when Reds are plenty.

over →

You are Not within the management plan to be in the business of trying to allowcate to different user groups. When there's an excess of reds we should be allowed to fish them. The 600' Rule does just that!

Thank You;

Sincerely, Rich Powell

S04H59Ø97W

Territorial Sportsmen, Inc.
Post Office Box 32712 • Juneau, Alaska 99803
Telephone: (907) 789-2399 • Fax: (907) 586-6020

September 21, 2021

Alaska Board of Fisheries
c/o Glenn Haight
Executive Director
ADF&G Board Support Section
PO Box 115526
Juneau, AK 99811-5526

Dear Board of Fisheries Members:

The Juneau-based Territorial Sportsmen, Inc. (TSI) respectfully requests that the Southeast Alaska/Yakutat Board of Fisheries meeting scheduled for January, 2022 be postponed until effective safeguards can be developed and implemented to deal with the ongoing COVID-19 pandemic. We believe virtual meetings do not allow for the full spectrum of information sharing and public engagement in the regulatory process, and we further believe it to be highly unlikely that the delta variant of Covid-19 will abate sufficiently by January 2022, thereby creating a health risk to participants.

While virtual meetings have become used for bringing organizations and the public together in the face of the pandemic, we oppose virtual meetings as a venue for the Board of Fisheries process for the following reasons:

1. Southeast Alaska fisheries issues are diverse, complicated, and challenging for board members as well as for members of the participating public. Added to this is the fact that several new board members have come onboard since the last Southeast meeting four years ago. From our experience, personal interactions with board members at scheduled meetings are critically important for members of the public who have interests and insights on issues that they wish to share and have considered in the decision-making process.
2. Board proposals are often amended, sometimes multiple times, before their final adoption. Through Alaska's open board process, the public often helps to formulate and guide final amended regulatory products through interactions with board members at

breaks, by submitting timely Record Copies (RCs), and by participating in impromptu gatherings to develop acceptable and suitable regulatory language. This would all be lost if the upcoming SE Alaska meeting were to be held online, with the risk of promulgating regulations that lack the benefit of broad, critical, and useful input from various and diverse interests.

TSI believes the current fisheries regulations can withstand another season without the need for a board meeting. This belief is based on our knowledge that department staff has Emergency Order (EO) authority to address fisheries conservation issues in a timely manner (as they did in 2021), and with the knowledge that the Commissioner and Board both have Emergency Regulation (ER) authority to handle conservation, allocation, or other emergencies, including stocks of concern, without general board meetings.

As far as other areas of the state are concerned, the fairest way to deal with postponement of the meetings for this cycle is to postpone all areas by one year, effectively creating a one-time 5-year cycle for regulatory board meetings.

When the board takes up Southeast fisheries issues in 2023, it can do so with direct and meaningful in-person input that is critical to sound decision making and the public process.

Thank you for the opportunity to provide input. Please don't hesitate to contact me if you have questions about our request.

Sincerely,

Ryan Beason, President
Territorial Sportsmen Inc.

Submitted
omas Upah
Submitted On
9/5/2021 5:01:40 PM
Af iliation: none

ere comes a time w en t e ealt of t e ecos stems become more urgent t en inancial gain. Commerical is ing of all salmon is continuall decreasing salmon numbers. It is true t at banning all salmon is ing or at least one season maybe longer would devastate an industr and cause di iculties. I Commerical is ing of salmon is allowed to continue t e salmon may not be able to recover. Certainl an people losing income or jobs will most likel recover. In m mind t e c oice is simple but unpopular. anks or listening

Boards Support Section, ADFG
P.O. Box 115526
Juneau, AK 99811-5526

Re: Yukon River Salmon Fishery Issues For Consideration

Chairman Carlson-Van-Dort and Members of the Board of Fisheries:

I am writing on behalf of the Yukon River Drainage Fisheries Association, a non-profit focused on conserving the subsistence and commercial fisheries, and traditional cultures, within the Yukon River system. Our mission is to serve as a voice for the fishing-dependent peoples of the Yukon, and to foster a meaningful dialogue between fishers and fishery managers of the region.

Today, that dialogue is focused on the salmon crisis in the Arctic-Yukon-Kuskokwim. A steady, multi-decade salmon decline on the AYK has been marked with periodic chum and Chinook stock crashes, culminating in a season of record loss in 2021. With zero commercial or subsistence harvest of Chinook or summer chum on the Yukon this year, and many stocks below needed escapement, we are looking for statewide collaboration to examine and address issues impacting the health of these iconic stocks. ***This is a critical matter of well-being in our region, impacting the health of our food systems, livelihoods, family structures, cultural traditions and more.*** While the AYK is not currently in cycle, we would like to call the board's attention to opportunities to discuss and address this crisis in the coming meetings.

Available in the Miscellaneous Section of the board workbook is a proposal submitted by Virgil Umphenour as a non-regulatory ACR. The ACR requests additional genetic scrutiny of chum, Chinook and pink salmon stocks harvested in the Area M salmon fishery. YRDFA strongly supports this request, and asks that the Board schedule a time to take up a meaningful discussion about this and other critical research needs addressing Yukon salmon declines. In particular, as you discuss committee meetings and agendas, please prioritize this issue for the Special Committee on Fisheries Management Research Needs.

Additionally, we ask that Yukon River issues be highlighted in the Committees on habitat and subsistence. Interaction with other fisheries is just one of the important areas to investigate in addressing this crisis, and we believe including it in these and other discussions is an important step.

We intend to work with other stakeholders, managers and state leaders to support public dialogues, project development, funding resources and eventual management responses that will address the Yukon River salmon crisis. Given the critical state of the stock, we ask that the Board support this ongoing process by prioritizing these and other requests addressing Yukon salmon declines. While these requests are non-regulatory, they are a matter of great public and management interest, and the Board process is a critical opportunity to gather public input, and to hold a multi-sector dialogue about the distinct and cumulative challenges facing the Yukon.

In summary, we urge the board to prioritize critical review of the research needs and potential management strategies for addressing Yukon River salmon declines.

The people of the Yukon are eager to partner with all stakeholders and decision makers in solutions to the stock crises we are experiencing on the Yukon. Thank you for prioritizing the discussions that will help us all move toward those solutions, and thank you for considering our comments.

Sincerely,

Victor Lord
Co-Chair - Nenana

William Alstrom
Co-Chair - St. Mary’s