Alaska Hatchery Research Program:

A comprehensive approach to investigate hatchery/wild interactions

International Year of the Salmon Synthesis Symposium

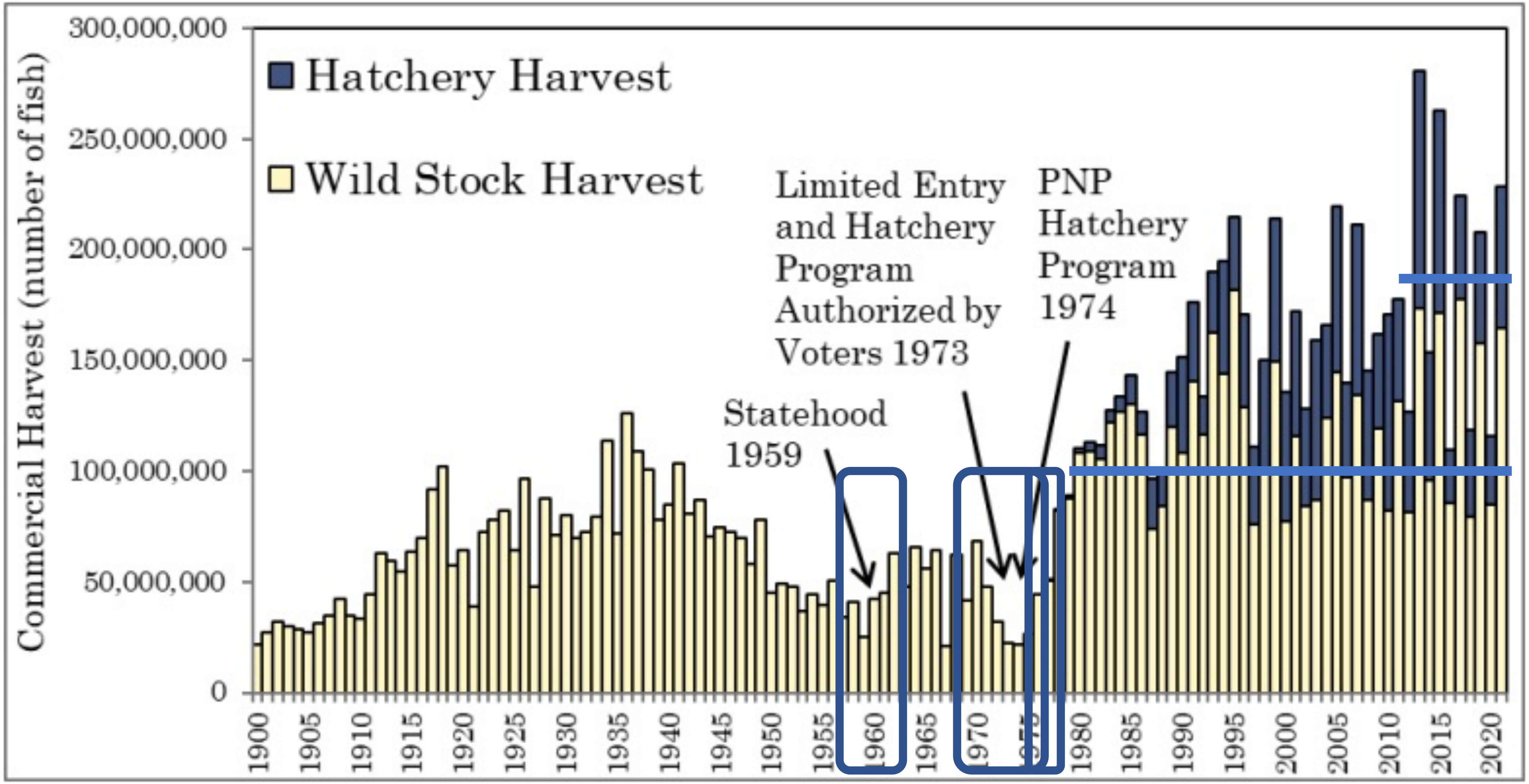
Hatching Plans: The Future of Fisheries Enhancement Programs

Chris Habicht and Bill Templin
Alaska Department of Fish and Game
Division of Commercial Fisheries

Outline

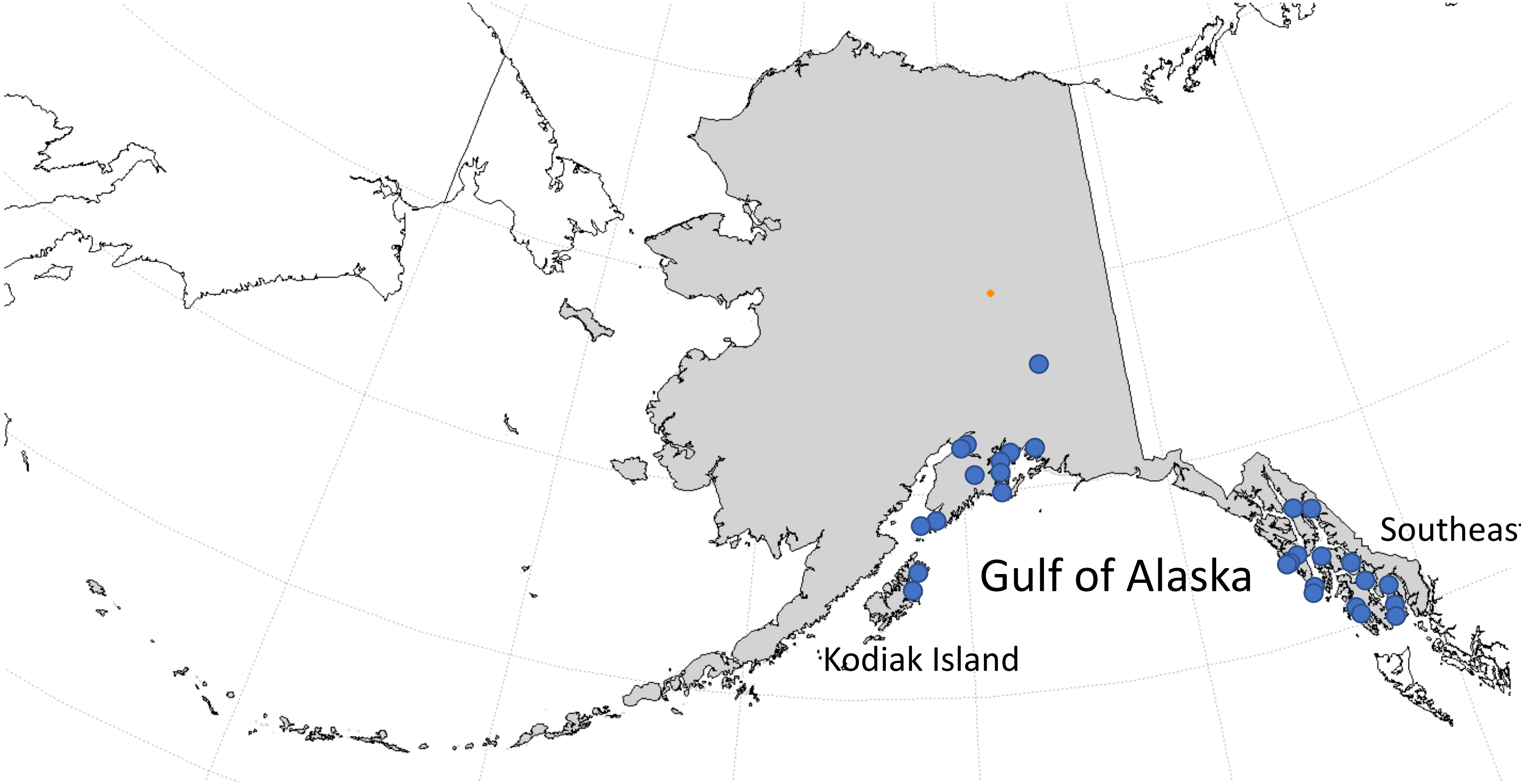
- Background to study
- Components that led to a successful project
  - Assemble experts
  - Ask answerable questions
  - Adapt
  - Communicate
- Science and Policy

Commercial salmon harvest in Alaska, 1900-2021



Wilson, L. 2022. Alaska salmon fisheries enhancement annual report 2021. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 5J22-02, Juneau.

Locations of Anadromous Pacific Salmon Hatcheries in Alaska



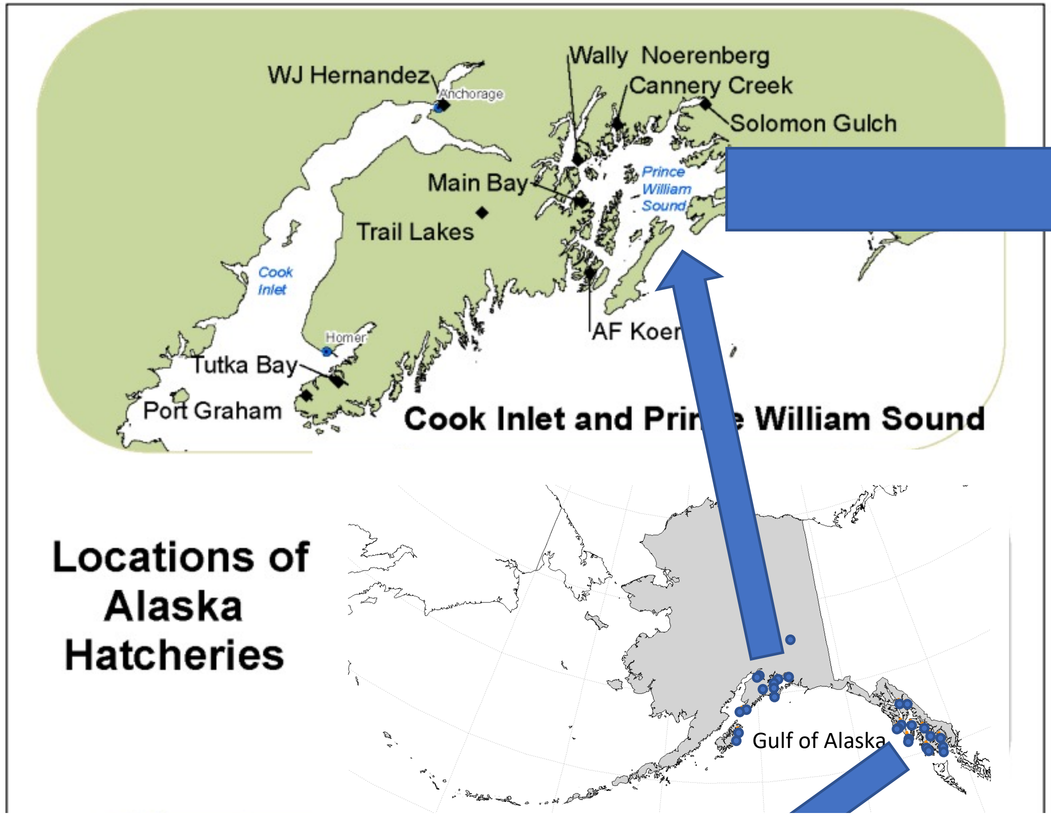
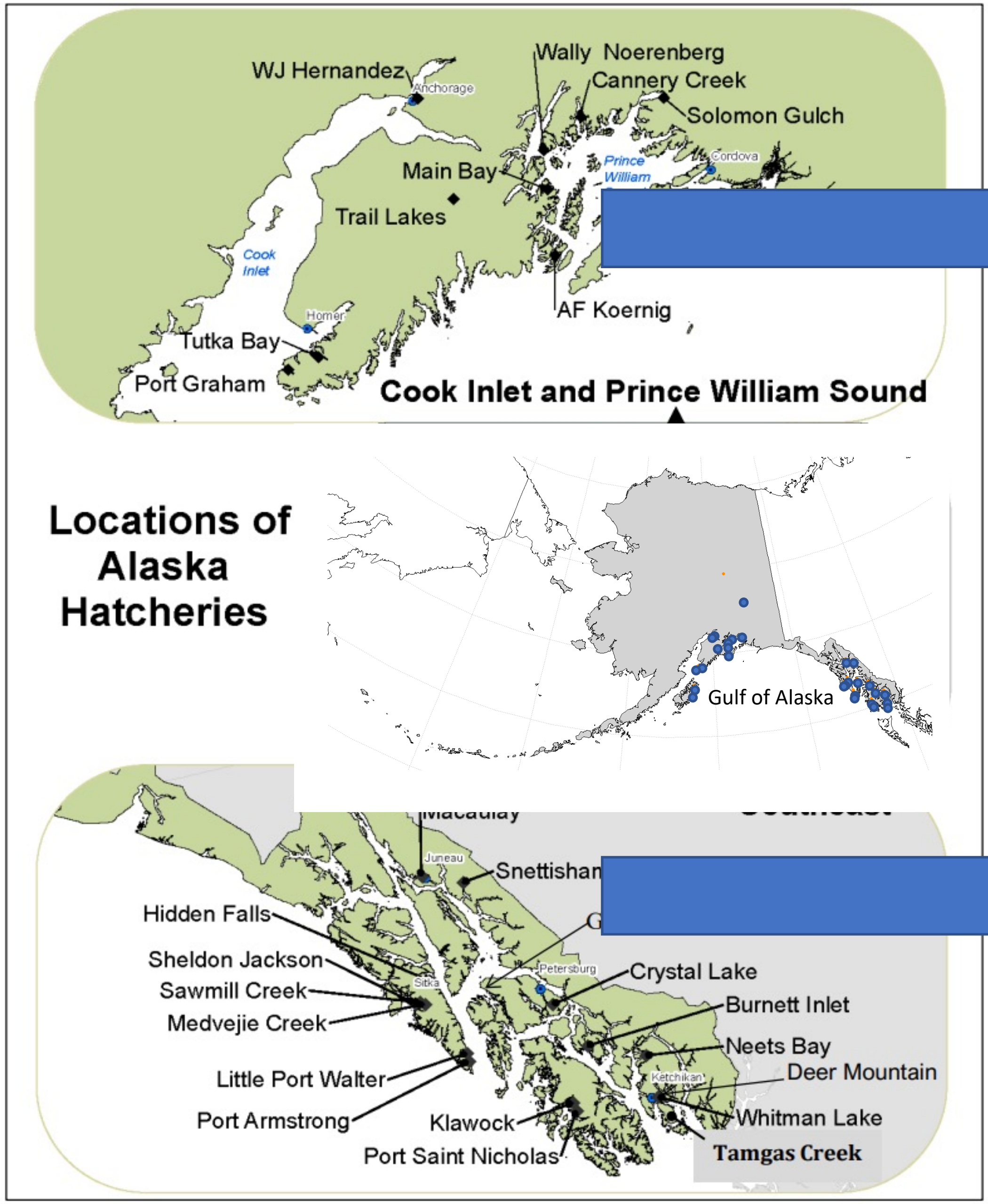


Figure 4.–Salmon hatcheries currently operating in Alaska.

Wilson, L. 2022. Alaska salmon fisheries enhancement annual report 2021. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 5J22-02, Juneau.



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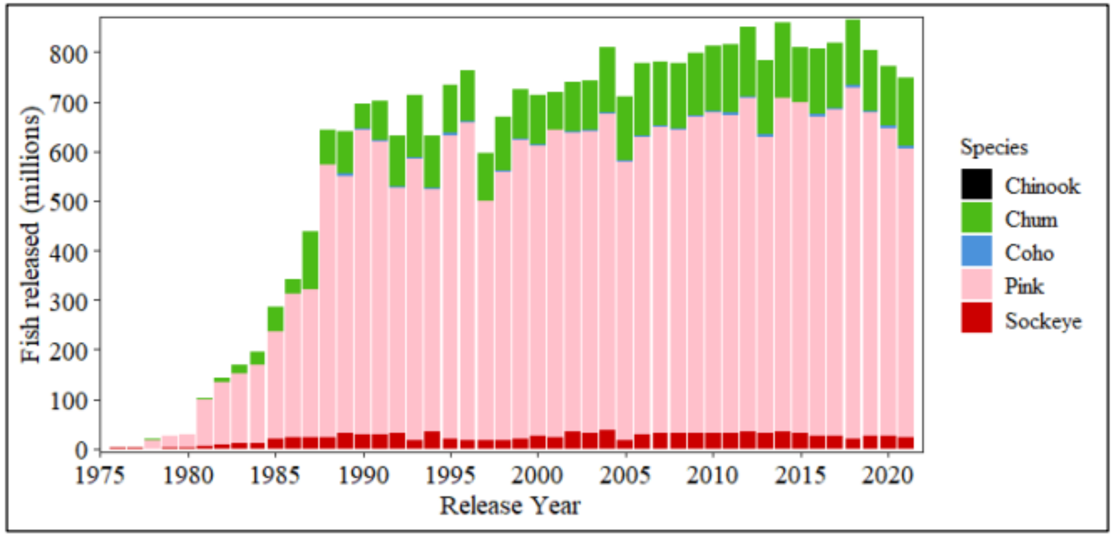


Figure 16.–Total salmon released for Prince William Sound Alaska hatchery programs, 1975–2021.

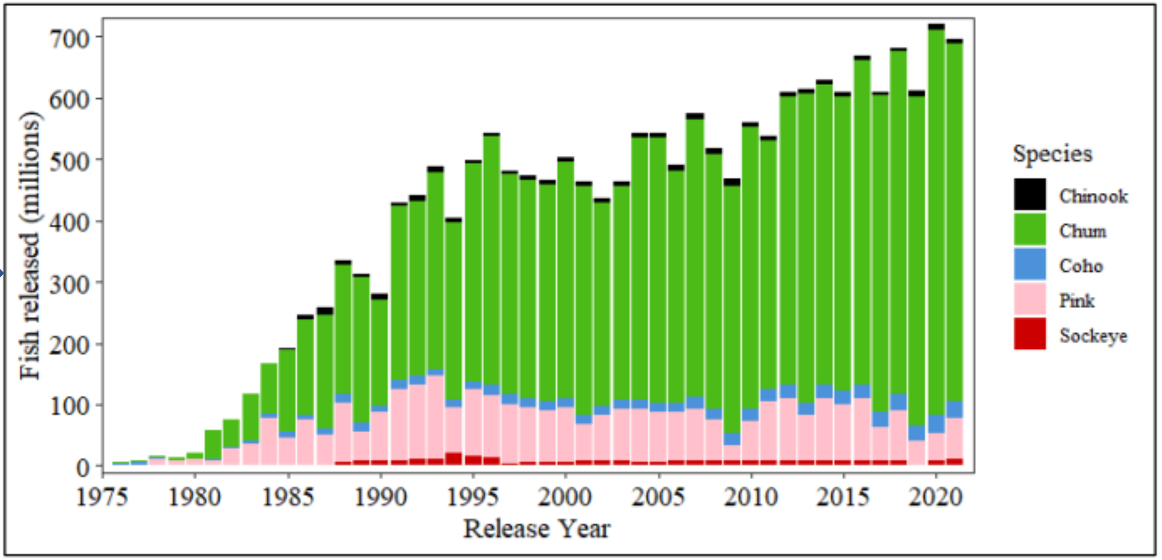


Figure 13.–Total salmon released for Southeast Alaska hatchery programs, 1975–2021.

Wilson, L. 2022. Alaska salmon fisheries enhancement annual report 2021. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 5J22-02, Juneau.

Published Hatchery/Natural Fitness Studies

Steelhead

Differential reproductive success of sympatric, naturally spawning hatchery and wild steelhead trout (*Oncorhynchus mykiss*) through the adult stage

Jennifer E. McLean, Paul Bentzen, and Thomas P. Quinn

MOLECULAR ECOLOGY
Molecular Ecology (2011) 20, 1860–1869

Reduced reproductive success of hatchery coho salmon in the wild: insights into most likely mechanisms

VÉRONIQUE THÉRIAULT,* GREGORY R. MOYER,*[1] LAURA S. JACKSON,† MICHAEL S. BLOUIN‡ and MICHAEL A. BANKS*

Genetic Effects of Captive Breeding Cause a Rapid, Cumulative Fitness Decline in the Wild

Hitoshi Araki,* Becky Cooper, Michael S. Blouin

Molecular Ecology (2007) 16, 953–966

Effective population size of steelhead trout: influence of variance in reproductive success, hatchery programs, and genetic compensation between life-history forms

HITOSHI ARAKI,* ROBIN S. WAPLES,† WILLIAM R. ARDREN,*‡ BECKY COOPER* and MICHAEL S. BLOUIN*

biology letters
Conservation biology
Biol. Lett. (2009) 5, 621–624
Published online 10 June 2009

Carry-over effect of captive breeding reduces reproductive fitness of wild-born descendants in the wild

Hitoshi Araki*,†, Becky Cooper and Michael S. Blouin

Transactions of the American Fisheries Society
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/utaf20

Diminished Reproductive Success of Steelhead from a Hatchery Supplementation Program (Little Sheep Creek, Imnaha Basin, Oregon)

Ewann A. Berntson[a], Richard W. Carmichael[b], Michael W. Flesher[b], Eric J. Ward[c] & Paul Moran[c]

Genetic adaptation to captivity can occur in a single generation

Mark R. Christie[a,1], Melanie L. Marine[a], Rod A. French[b], and Michael S. Blouin[a]

PNAS

Chinook

North American Journal of Fisheries Management 28:1472–1485, 2008
[Article]

Use of Parentage Analysis to Determine Reproductive Success of Hatchery-Origin Spring Chinook Salmon Outplanted into Shitike Creek, Oregon

JASON BAUMSTEIGER[1]
U.S. Fish and Wildlife Service, 1440 Abernathy Creek Road, Longview, Washington 98632, USA
DAVID M. HAND* AND DOUGLAS E. OLSON
U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, 1211 Southeast Cardinal Court, Suite 100, Vancouver, Washington 98683, USA
ROBERT SPATEHOLTS[2] AND GEOFF FITZGERALD[3]
Confederated Tribes of the Warm Springs Reservation of Oregon, Department of Natural Resources, Warm Springs, Oregon 97761, USA
WILLIAM R. ARDREN[4]
U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview, Washington 98632, USA

Factors influencing the relative fitness of hatchery and wild spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Wenatchee River, Washington, USA

Kevin S. Williamson, Andrew R. Murdoch, Todd N. Pearsons, Eric J. Ward, and Michael J. Ford

MOLECULAR ECOLOGY
Molecular Ecology (2012) 21, 5236–5250

Supportive breeding boosts natural population abundance with minimal negative impacts on fitness of a wild population of Chinook salmon

MAUREEN A. HESS,* CRAIG D. RABE,† JASON L. VOGEL,‡ JEFF J. STEPHENSON,* DOUG D. NELSON† and SHAWN R. NARUM*

Evolutionary Applications
ORIGINAL ARTICLE

Reproductive success of captively bred and naturally spawned Chinook salmon colonizing newly accessible habitat

Joseph H. Anderson,[1,2,3] Paul L. Faulds,[2] William I. Atlas[1,4] and Thomas P. Quinn[1]

Coho

Changes in run timing and natural smolt production in a naturally spawning coho salmon (*Oncorhynchus kisutch*) population after 60 years of intensive hatchery supplementation

Michael J. Ford, Howard Fuss, Brant Boelts, Eric LaHood, Jeffrey Hard, and Jason Miller

MOLECULAR ECOLOGY
Molecular Ecology (2011) 20, 1860–1869

Reduced reproductive success of hatchery coho salmon in the wild: insights into most likely mechanisms

VÉRONIQUE THÉRIAULT,* GREGORY R. MOYER,*[1] LAURA S. JACKSON,† MICHAEL S. BLOUIN‡ and MICHAEL A. BANKS*

Chum

Reproductive behavior and relative reproductive success of natural- and hatchery-origin Hood Canal summer chum salmon (*Oncorhynchus keta*)

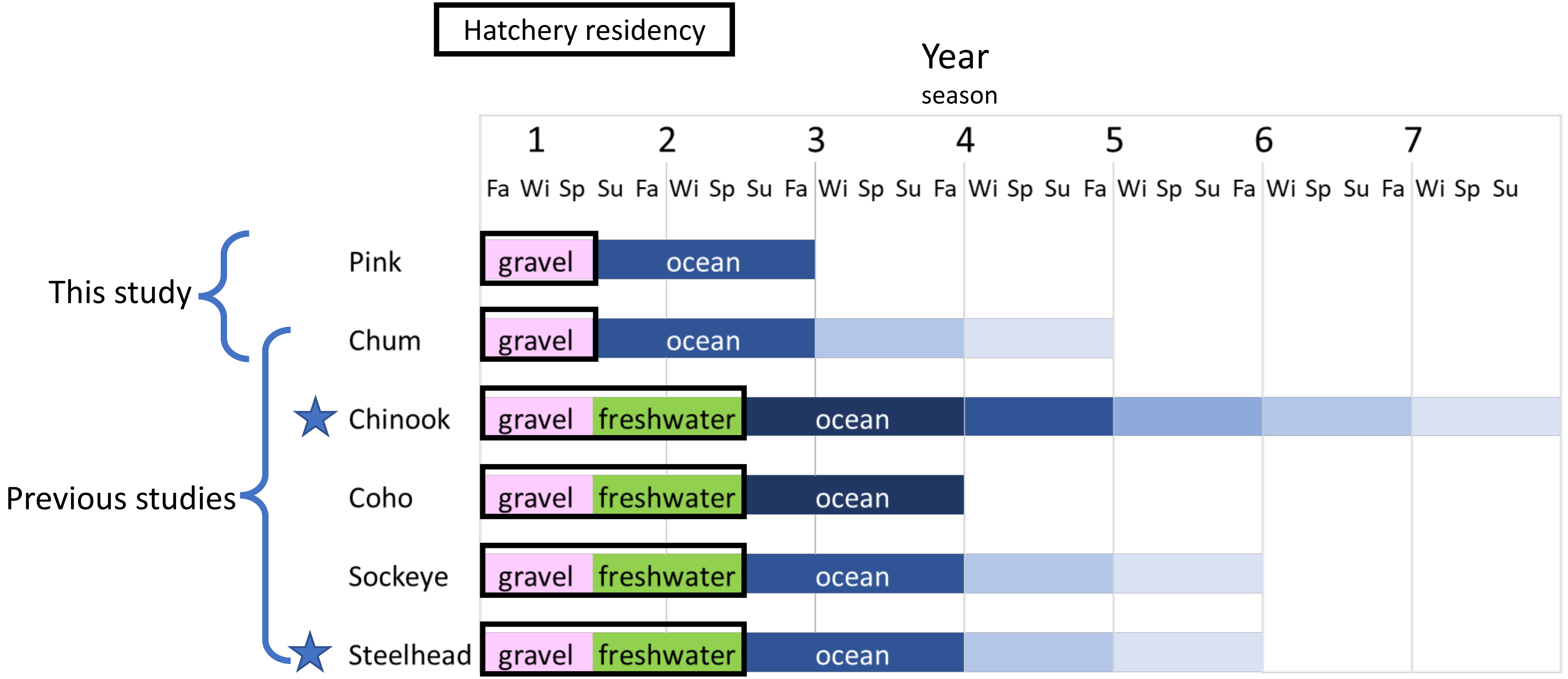
Barry A. Berejikian, Donald M. Van Doornik, Julie A. Scheurer, and Richard Bush

Hatchery/Natural Fitness

Difficulty with Applying Previous Studies

- No studies in Alaska
- Different Context: e.g., compromised habitats
- Non-local and small brood stock population sizes
- Different hatchery objectives (harvest vs mitigation)
- Species with different life histories

Hatchery/Natural Fitness
Different Time in Hatchery Setting

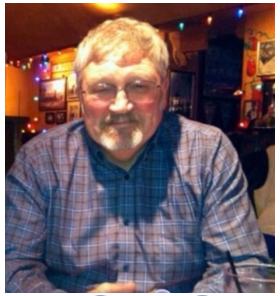


Assemble Experts: Science Panel for the Alaska Hatchery Research Program

Government (state, federal)
Industry (hatcheries, processors)
University

Members since inception

John H. Clark



Past members

Added members

Planning: Funding for the Alaska Hatchery Research Program

THE SEAL OF THE STATE OF ALASKA

CFEC

VFDA

Prince William Sound Aquaculture Corporation
DEVELOPING SUSTAINABLE SALMON FISHERIES FOR ALASKA AND THE WORLD

PACIFIC SALMON COMMISSION

DIPAC

Cook Inlet AQUACULTURE ASSOCIATION

IDAHO • OREGON • ALASKA PACIFIC STATES MARINE FISHERIES COMMISSION WASHINGTON • CALIFORNIA

KODIAK REGIONAL AQUACULTURE ASSOCIATION

NOAA FISHERIES

PSPA PACIFIC SEAFOOD PROCESSORS ASSOCIATION

SSRAA

NSRAA

NORTH PACIFIC RESEARCH BOARD

Anticipated total:
$16.9M

Ask Answerable Questions
The Panel raised three priority questions:

1. What is the genetic stock structure of pink and chum salmon in each region?

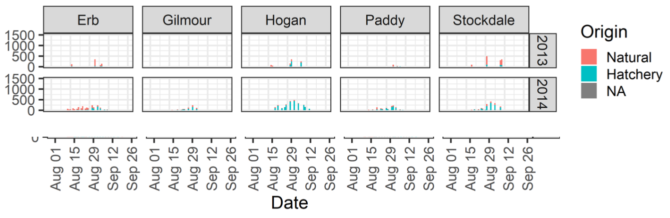
2. What is the extent and annual variability in straying of hatchery pink salmon in Prince William Sound (PWS) and chum salmon in PWS and Southeast Alaska (SEAK)?

3. What is the impact on fitness (productivity) of wild pink and chum salmon stocks due to straying of hatchery pink and chum salmon?

Adapting: Nature did not get the memo, so program adapted

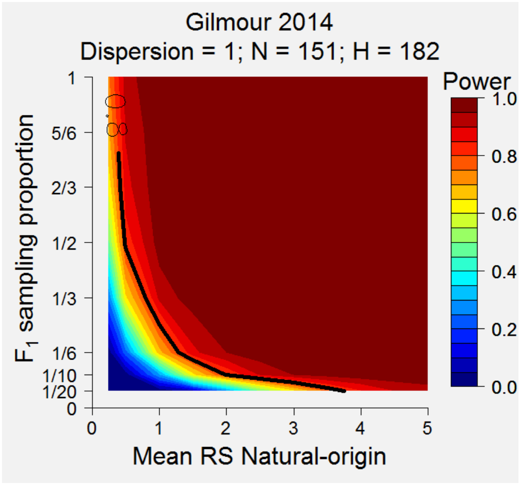
Augmented:

Field data: Lots of variation

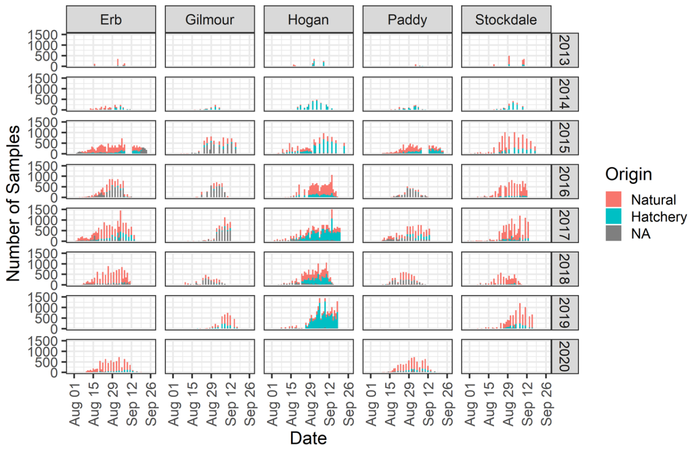


Sample all fish possible

Power analysis: need more samples

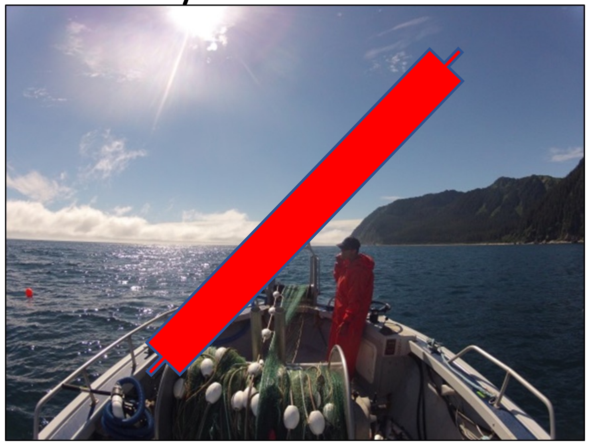


More years: grand parentage



Reduced:

Run reconstruction/ stray assessment



Fitness

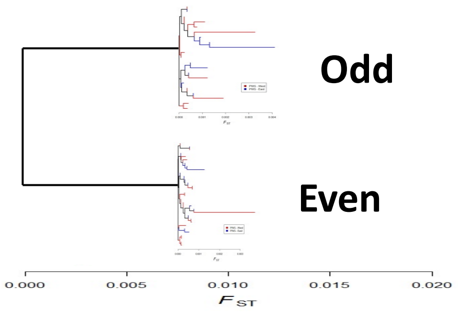
Eliminated alevin sampling

Figure 17. Redd pumping on Stockdale Creek, April, 2014.

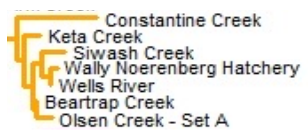
Findings:

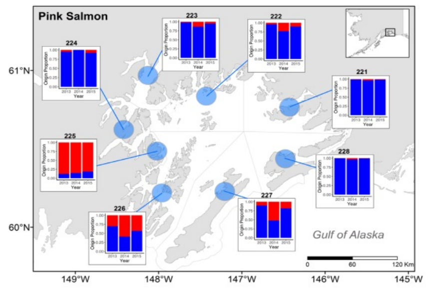
Prince William Sound

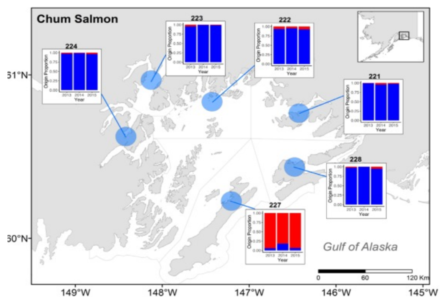
Pink

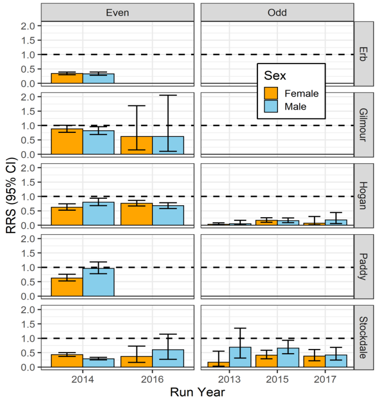


Chum





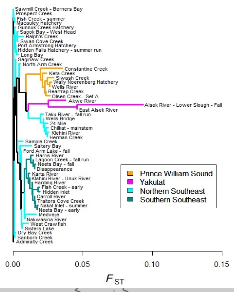


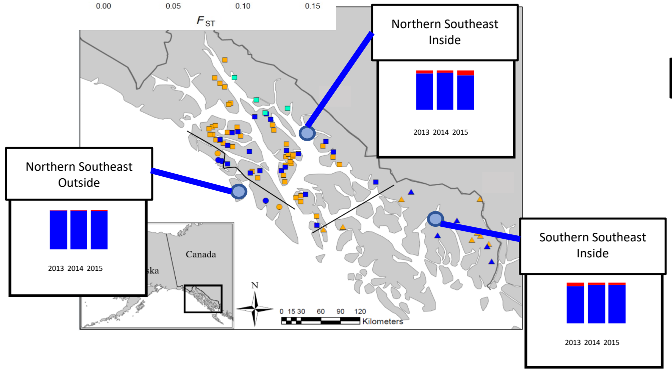


NA

Southeast Alaska

Chum





TBA

Population structure exists:

PWS pink: even < odd;
chum: run timing, geography

SEAK chum: summer/fall, geography

Hatchery fish found in streams:

PWS pink: 5% - 15%;
chum: 3% - 9%

SEAK chum: 2% - 8%

Hatchery fish have lower fitness (productivity)

PWS pink: high variation; 50% RRS average

SEAK chum: TBA

Knudsen, E.E., Rand, P.S., Gorman, K.B., Bernard, D.R. and Templin, W.D., 2021. Hatchery-origin stray rates and total run characteristics for Pink Salmon and Chum Salmon returning to Prince William Sound, Alaska, in 2013–2015. *Marine and Coastal Fisheries*, *13*(1), pp.41-68.
Josephson, R., Wertheimer, A., Gaudet, D., Knudsen, E.E., Adams, B., Bernard, D.R., Heinl, S.C., Piston, A.W. and Templin, W.D., 2021. Proportions of hatchery fish in escapements of summer-run Chum Salmon in Southeast Alaska, 2013–2015. *North American Journal of Fisheries Management*, *41*(3), pp.724-738.
Shedd, K.R., Lescak, E.A., Habicht, C., Knudsen, E.E., Dann, T.H., Hoyt, H.A., Prince, D.J. and Templin, W.D., 2022. Reduced relative fitness in hatchery-origin Pink Salmon in two streams in Prince William Sound, Alaska. *Evolutionary applications*, *15*(3), pp.429-446.

Communicating: Public and professional contexts

Evolutionary Applications

Evolutionary approaches to environmental, biomedical and socio-economic issues

Open Access

ORIGINAL ARTICLE | Open Access

Reduced relative fitness in hatchery-origin Pink Salmon in two streams in Prince William Sound, Alaska

Kyle R. Shedd, Emily A. Lescak, Christopher Habicht, E. Eric Knudsen, Tyler H. Dann, Heather A. Hoyt, Daniel J. Prince, William D. Templin

Alaska Department of Fish and Game

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Hatcheries

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Hatcheries Research

Overview

Overview | Current Research Project | Findings | Meetings

In 1971, the State of Alaska initiated its modern salmon fishery enhancement program in response to severely depressed commercial salmon fisheries. Protection of wild stocks has been foremost since the inception of the program and statutes, regulations, and policies are in place to provide for this

https://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesResearch.main

North American Journal of Fisheries Management

Article | Open Access

Proportions of Hatchery Fish in Escapements of Summer-Run Chum Salmon in Southeast Alaska, 2013–2015

Ronald Josephson, Alex Wertheimer, David Gaudet, E. Eric Knudsen, Benjamin Adams, David R. Bernard, Steven C. Heinl, Andrew W. Piston, William D. Templin

Marine and Coastal Fisheries

Dynamics, Management, and Ecosystem Science

Featured Paper | Open Access

Hatchery-Origin Stray Rates and Total Run Characteristics for Pink Salmon and Chum Salmon Returning to Prince William Sound, Alaska, in 2013–2015

E. Eric Knudsen, Peter S. Rand, Kristen B. Gorman, David R. Bernard, William D. Templin

Application of Science to Policy

The AHRP is providing valuable biological information for understanding the interaction between hatchery and wild pink and chum salmon.

- Scientifically answerable questions
- Appropriate study design

However, more than biology must be considered when making decisions about salmon resources:

1) Biological, 2) Social, 3) Economic, and 4) Cultural

The interface of science and policy is where scientific knowledge is incorporated into belief/value systems to provide a bridge for decision making.

Application of Science to Policy

Proposed Model for Science – Policy Dialogue

Science

Policy or Human Valuation

Questions for Prudential Judgment

1. Does an event occur? — Observe
2. How often and to what extent?
3. Does the event have an effect?

(2–3: Measure/ Experiment)

4. Is the effect harmful? — Compare to standard
5. Would addressing the harm cost more than it would benefit? — Collate/ Evaluate

Application of Science to Policy

Example Application

Science

Policy or Human Valuation

Issue: PWS pink salmon hatchery fish spawning in streams

1. Are hatchery pink salmon spawning in streams in Prince William Sound? **YES**

2. Which streams have spawning hatchery pink salmon and how many are present? **Streams near hatcheries, and 5% – 15%**

3. Does the presence of spawning hatchery pink salmon have an effect on wild pink salmon populations? **Yes, for short-term production; Maybe, for other definitions of "effect"**

4. Is the effect of hatchery-origin pink salmon spawning with wild pink salmon harmful? **Maybe; requires definition of harm and the mechanism**

5. Would the cost to restrain hatchery-origin pink salmon from spawning in streams outweigh the benefit from reducing the interaction? **Maybe; what is the cost relative to the benefit?**

Proposed Path Forward

Need:

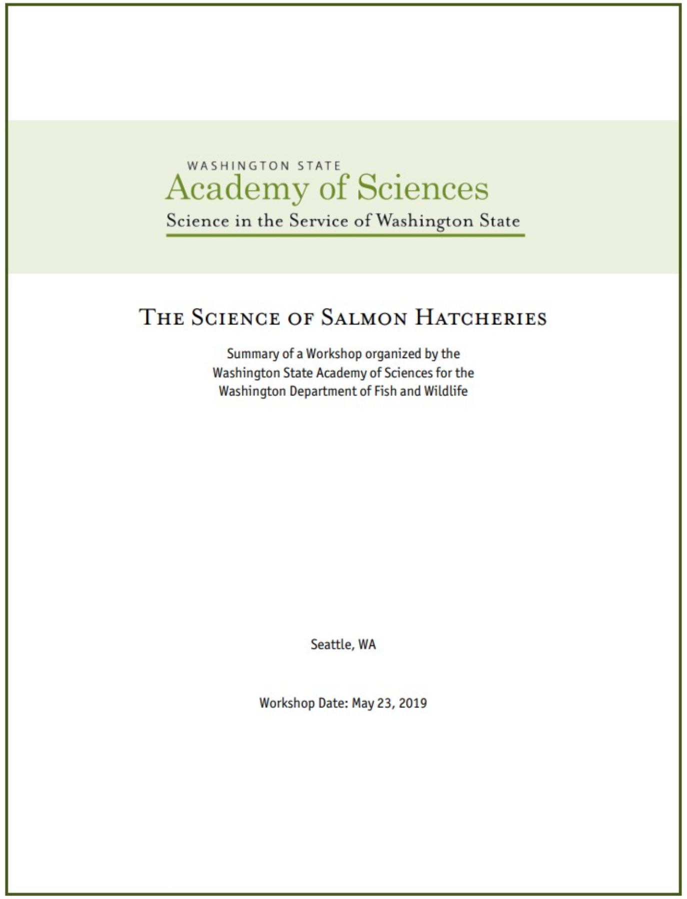
1. More pink salmon fitness results expected in next couple of years
2. Chum salmon fitness results pending
3. Questions 4 & 5 require definitions of **harm**, **cost** and **benefit** and the means to weigh them

Proposal: Convene a working group of agency staff, stakeholders and subject matter experts to:

1. Review current state of knowledge
2. Identify issues, concerns, and data needs
3. Develop framework for risk/benefit assessment
4. Provide ADF&G with recommendations

Implementation Needs:

1. Define scope
2. Identify facilitator group
3. Seek funding


WASHINGTON STATE
Academy of Sciences
Science in the Service of Washington State

THE SCIENCE OF SALMON HATCHERIES

Summary of a Workshop organized by the
Washington State Academy of Sciences for the
Washington Department of Fish and Wildlife

Seattle, WA

Workshop Date: May 23, 2019


Questions?
07.30.2014