

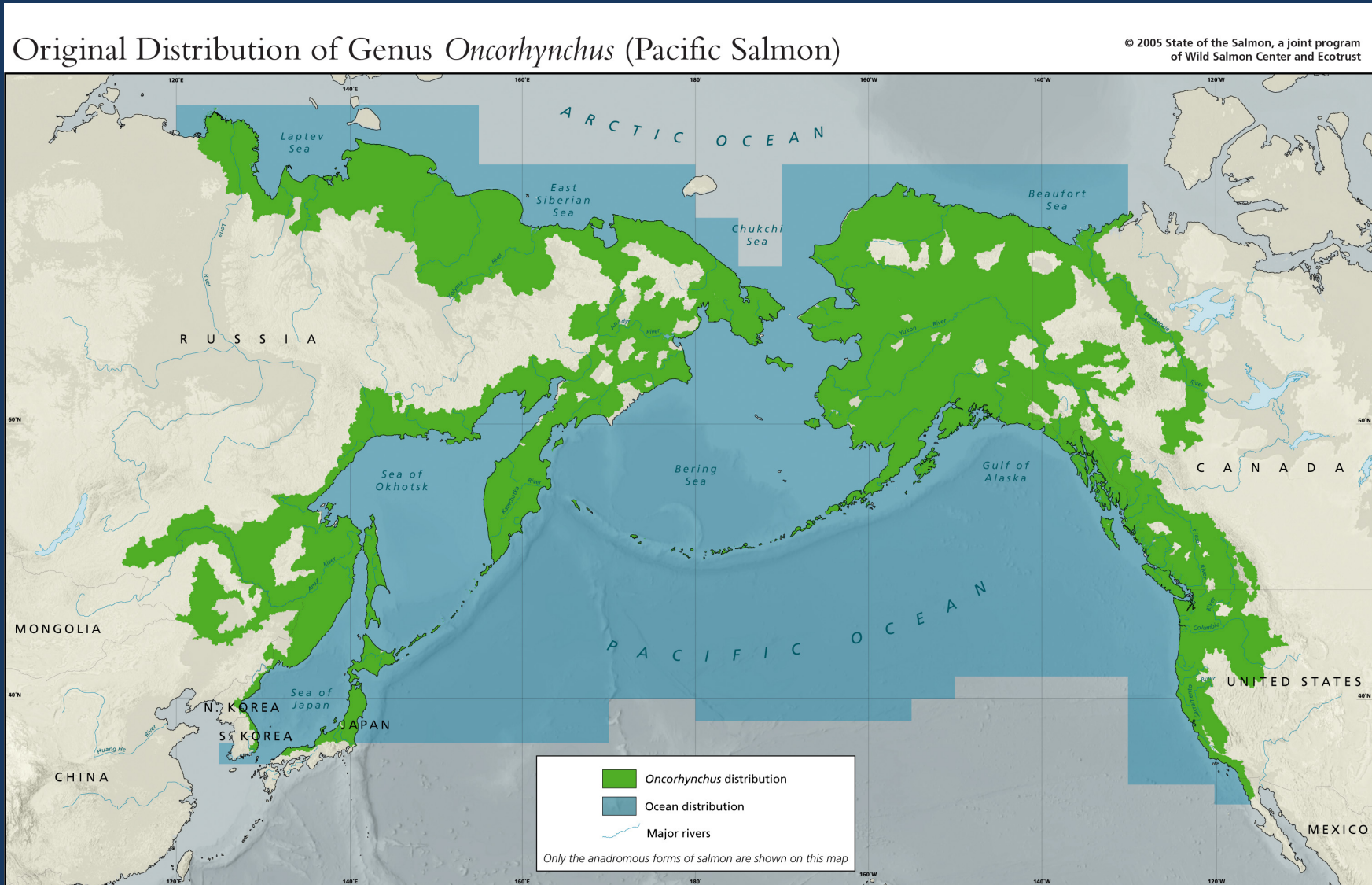
Changes to ocean systems and management goals for Alaska commercial salmon

Adapting to Alaska's Rapidly Changing Climate Workshop

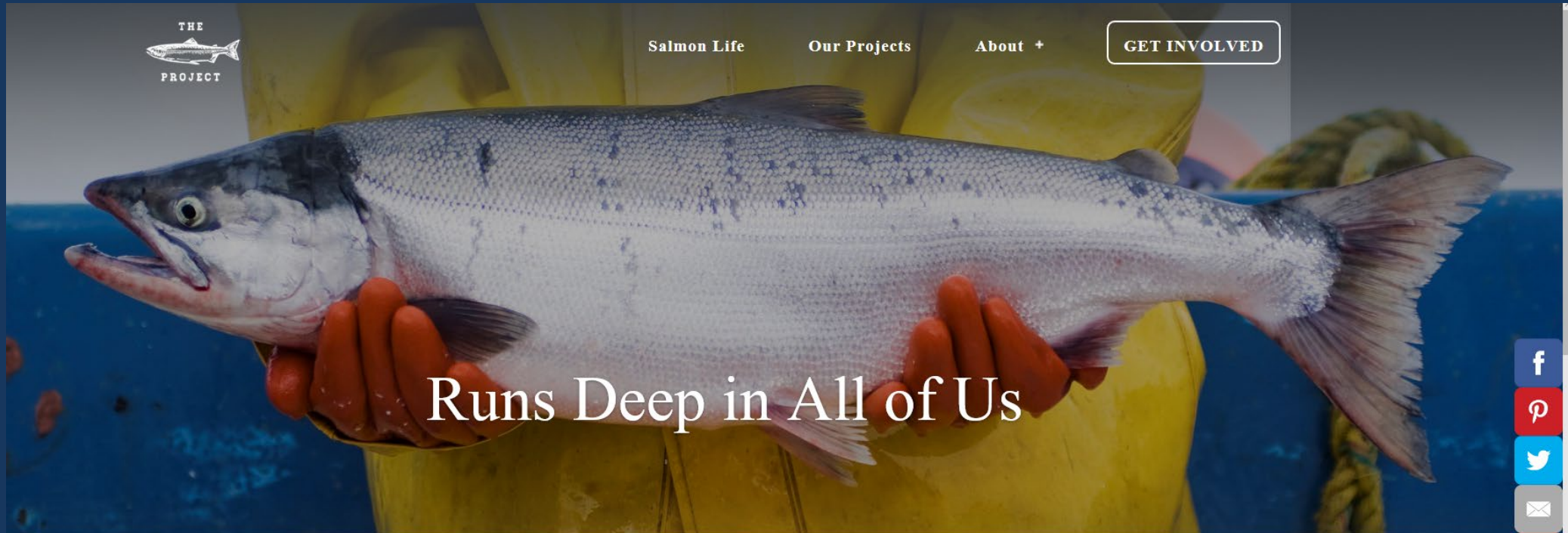


Bill Templin
Chief Fisheries Scientist for Salmon
Division of Commercial Fisheries
Alaska Department of Fish and Game

Alaska at the Heart of the Salmon World



Salmon at the Heart of Alaska



Salmon Life

Our Projects

About +

GET INVOLVED

Runs Deep in All of Us



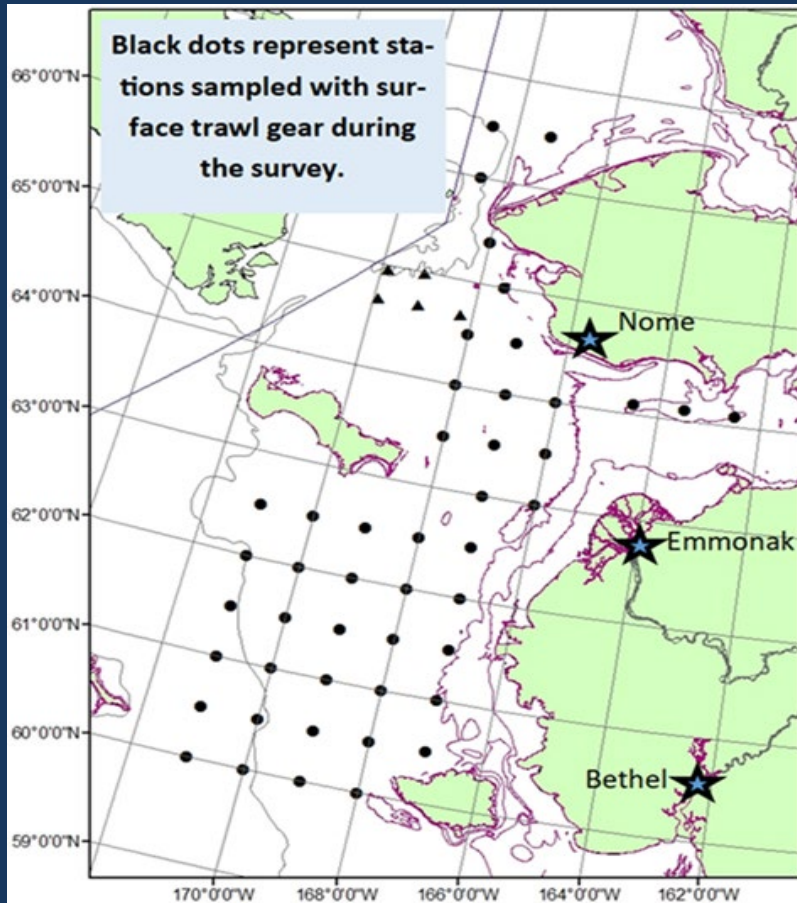
Salmon aren't just another fish in Alaska.
They are our lifeblood.



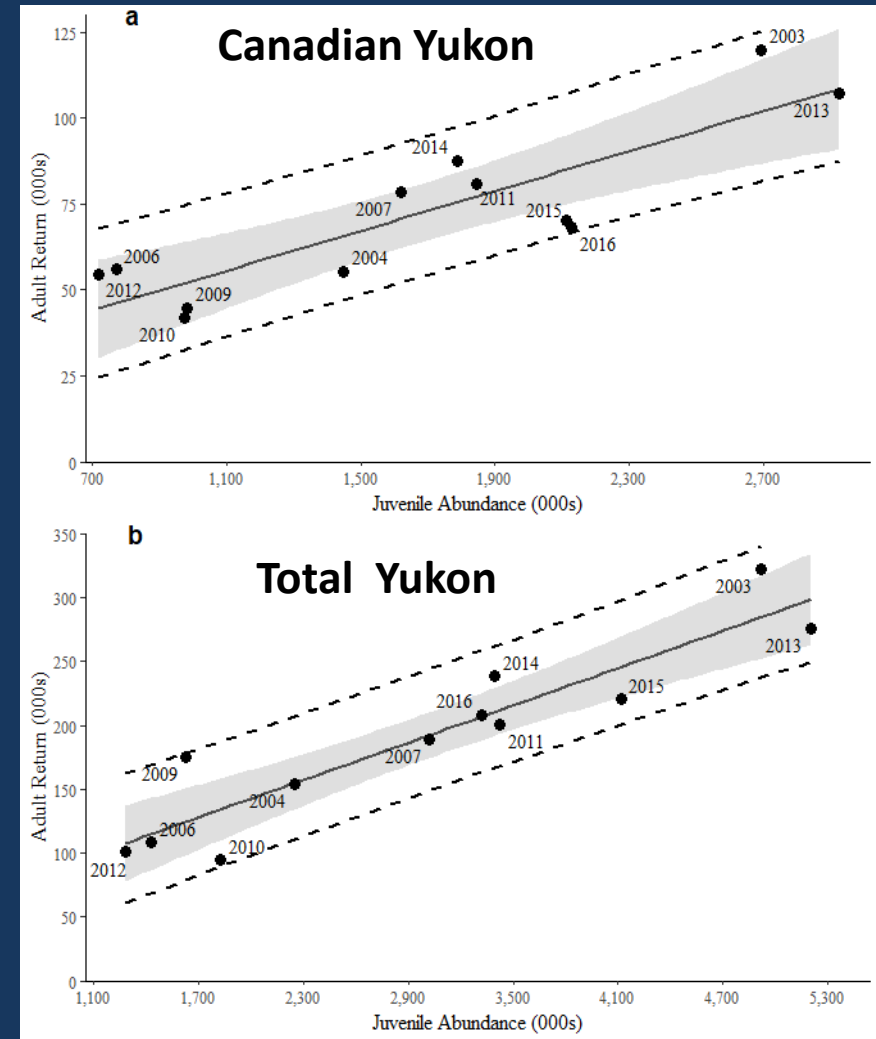
The Salmon Project gives voice to Alaskans' deep relationships with salmon
to ensure that Alaskans' lives will always be salmon lives.

Salmon Returns Largely Set by Early Ocean Survival

Northern Bering Sea surface trawl and ecosystem survey



Juvenile abundance in the survey can forecast the return.



Salmon are Affected by Changes in the Ocean

www.nature.com/scientificreports

SCIENTIFIC
REPORTS

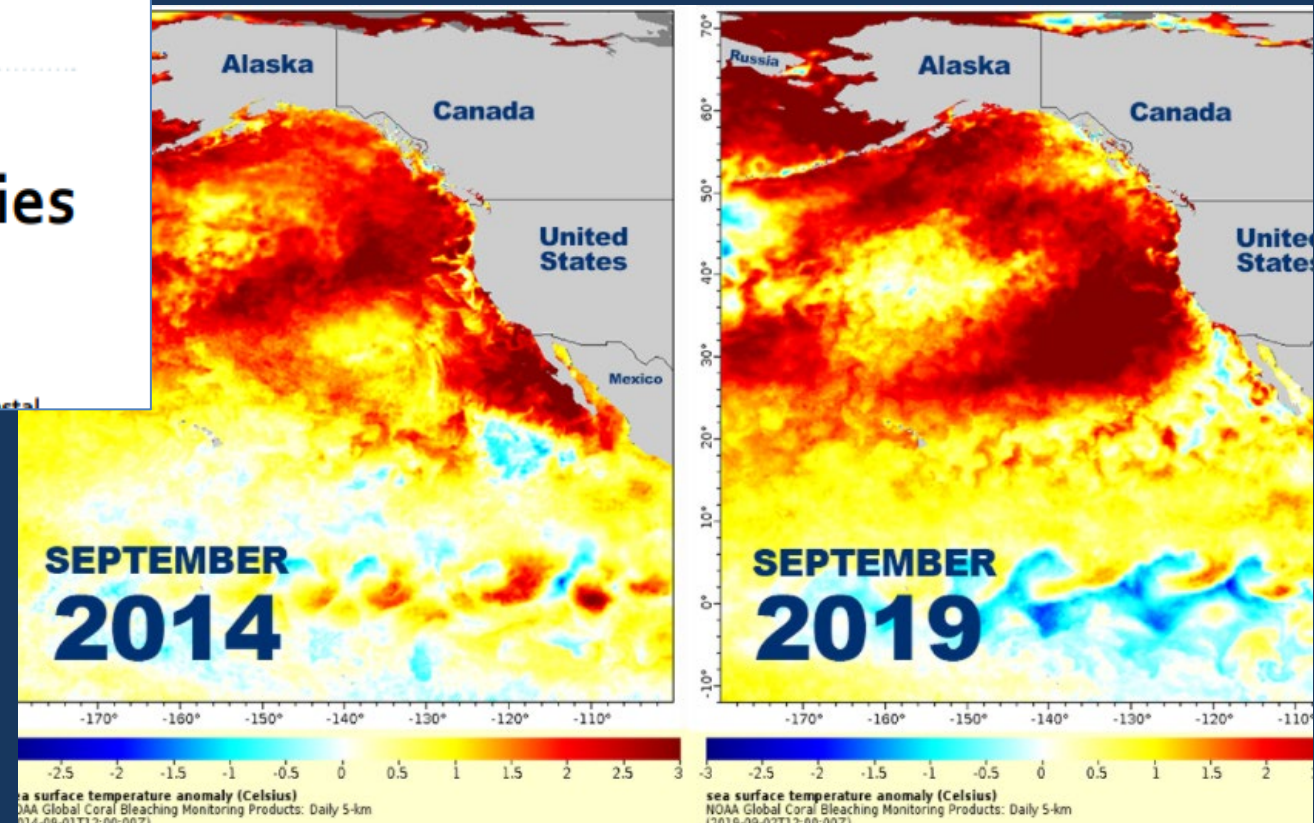
nature research

OPEN

Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific

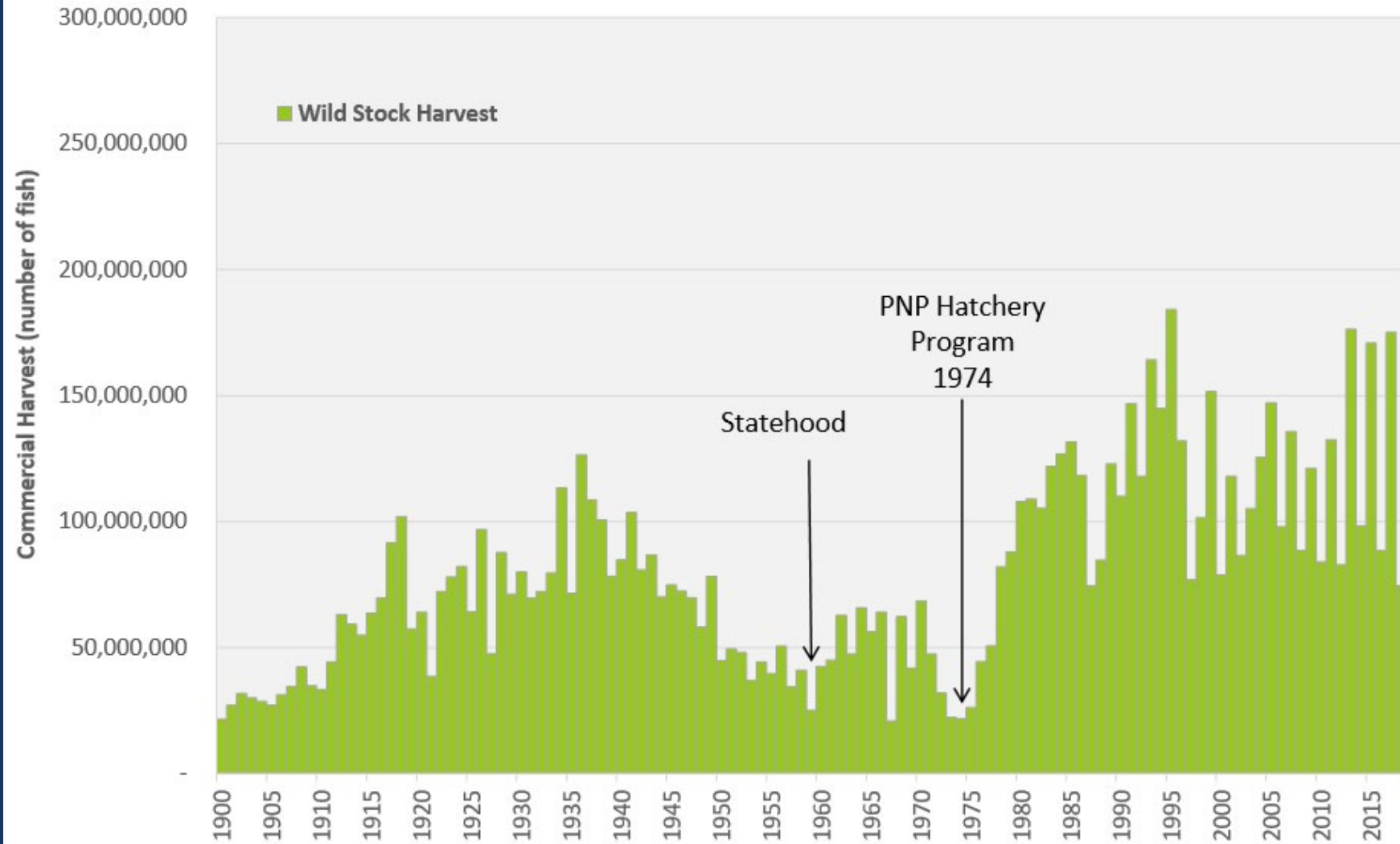
William W. L. Cheung^{1*} & Thomas L. Frölicher^{2,3}

Marine heatwaves (MHWs) have occurred in all ocean basins with severe negative impacts on coastal

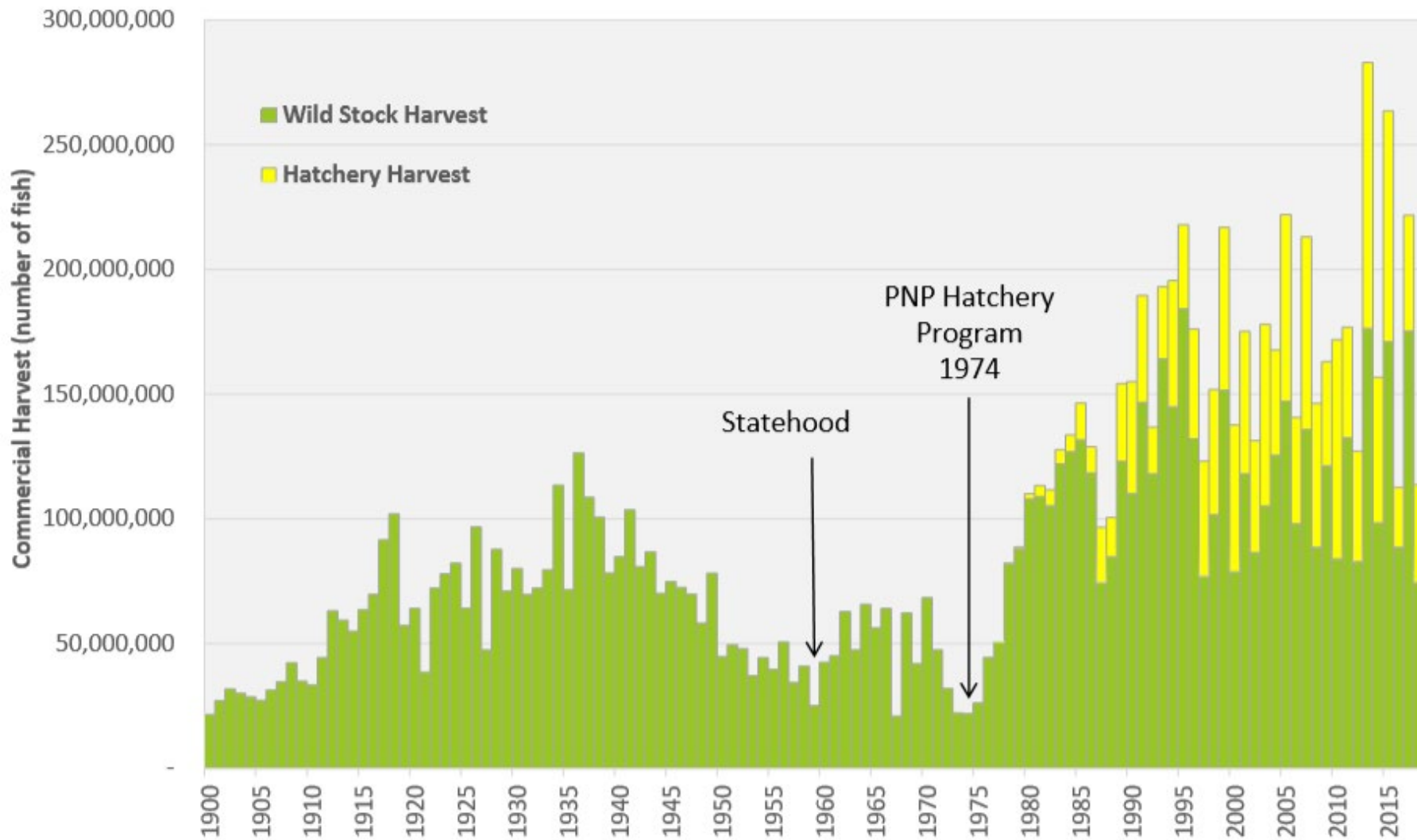


Cheung, W.W.L., Frölicher, T.L. Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific. *Sci Rep* **10**, 6678 (2020). <https://doi.org/10.1038/s41598-020-63650-z>

History Depicted as Salmon Harvest



History Depicted as Harvest + Hatcheries



Constitutional Provisions for Resource Management



Section 1. It is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum benefit of its people.

Section 2. The legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State, including land and waters, for the maximum benefit of its people.

Section 3. Wherever occurring in the natural state, fish, wildlife, and waters are reserved to the people for common use.

Section 4. Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.

Section 15. No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State.

Constitutional Provisions for Resource Management



Article VIII, Sec(4). Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be **utilized, developed, and maintained** on the **sustained yield principle**, subject to preferences among beneficial uses.

It must be recognized that the welfare of people and not fish is the [reason] for a management program, and that if maximum sustained yield has any validity, it is as a means to important human ends rather than as an end in itself.

RA Cooley in *Politics and Conservation: The decline of Alaska salmon*

Alaska Department of Fish and Game

Mission Statement

To **protect**, **maintain**, and **improve** the fish, game, and aquatic plant resources of the state, and **manage** their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the **sustained yield principle**.

Two main responsibilities:

- 1) to the extent possible provide all residents access to salmon for subsistence, economic, cultural and/or recreational uses
- and
- 2) to the extent possible maintain the production of salmon from natural systems for future generations

Board of Fisheries

Ensures public access and local input

By taking on the task of resolving fishery disputes, the Board takes the politically charged issue of allocation away from the fishery managers and politicians...the separation of allocation and conservation is critical for achieving sustainable fisheries in the state.

The Elements of Alaska's Sustainable Fisheries, by Fran Ulmer in *Sustainable Fisheries Management: Pacific Salmon*, E. Knudsen et al Editors, Lewis Publishers, 2000



Board of Fisheries Process

Ensures public access and local input

- Management plans
- Stock of Concern
- Escapement goals
- Research /Data collection
- Analysis
- Expert opinion

- Proposed changes
- Recommendations
- User viewpoint
- Resource needs/desires
- Expert opinion

**Alaska Dept.
Fish and Game**

**Board of
Fisheries**

**Stakeholders
[Public, Fishers,
Industry]**

- Fishing seasons, quotas, bag limits
- Fishing means and methods
- Management plans
- Policies
- Regulations

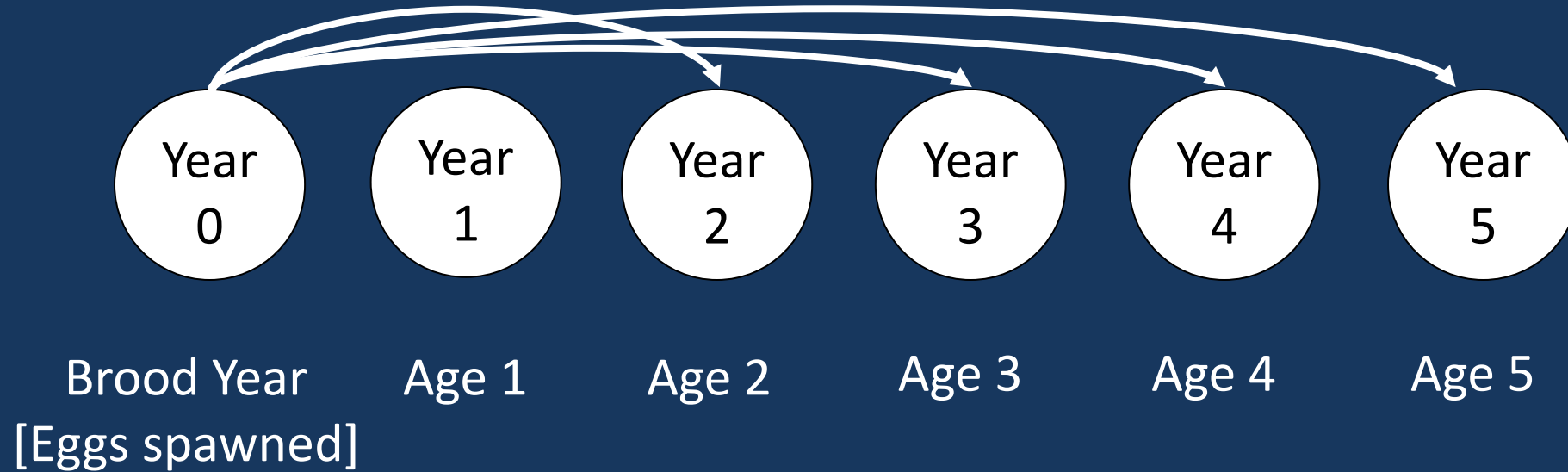
Sustainable Salmon Fisheries Management Policy

Principles

- Protect wild salmon and habitat
- Manage for escapement ranges that sustain production & consider uncertainty in production
- Develop effective management systems
- Precautionary approach to human activities
- Encourage public support and involvement
- Manage conservatively commensurate with uncertainty

Understanding Salmon Age Structure

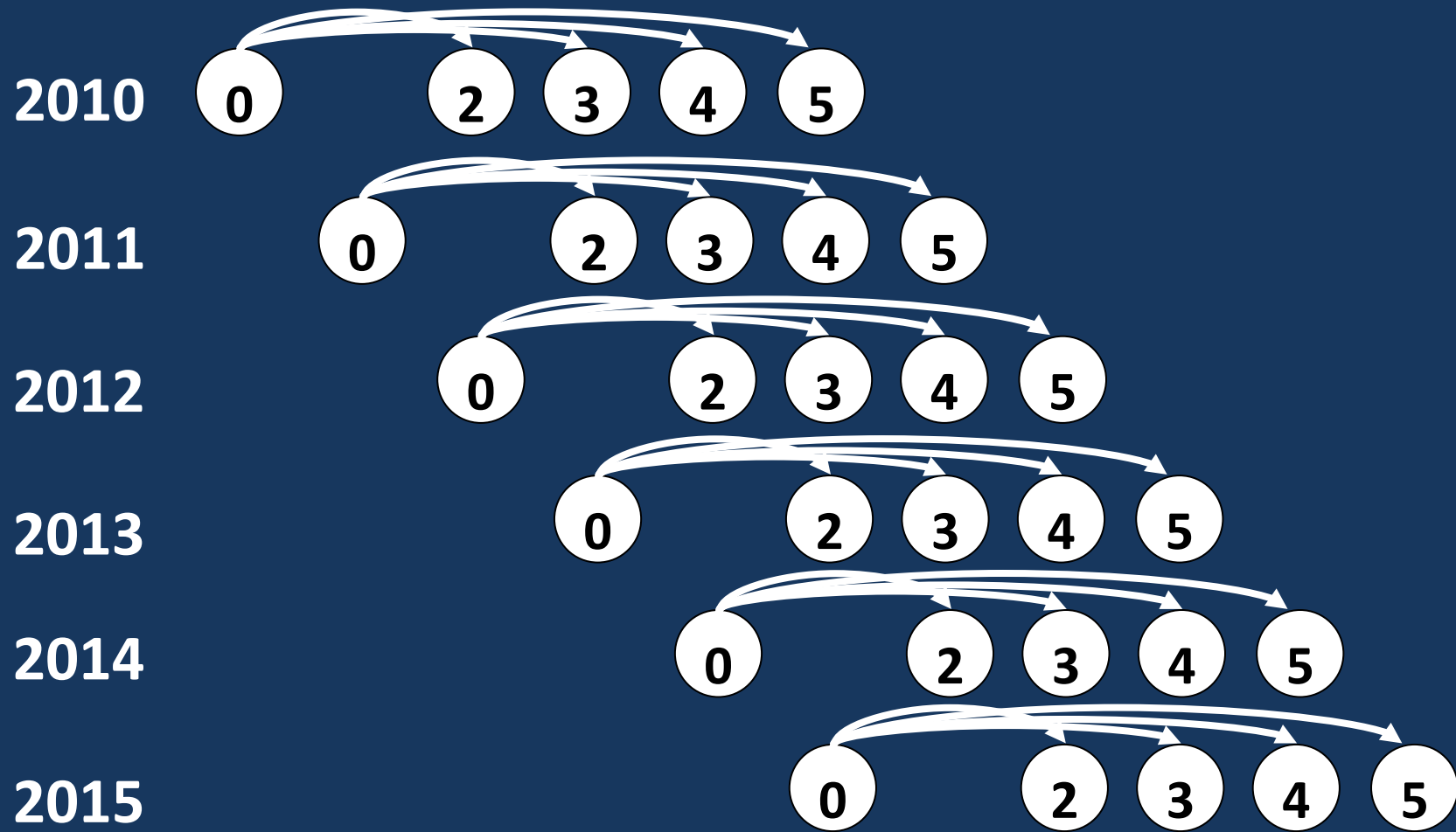
Simple model



Not all salmon species have this age structure.

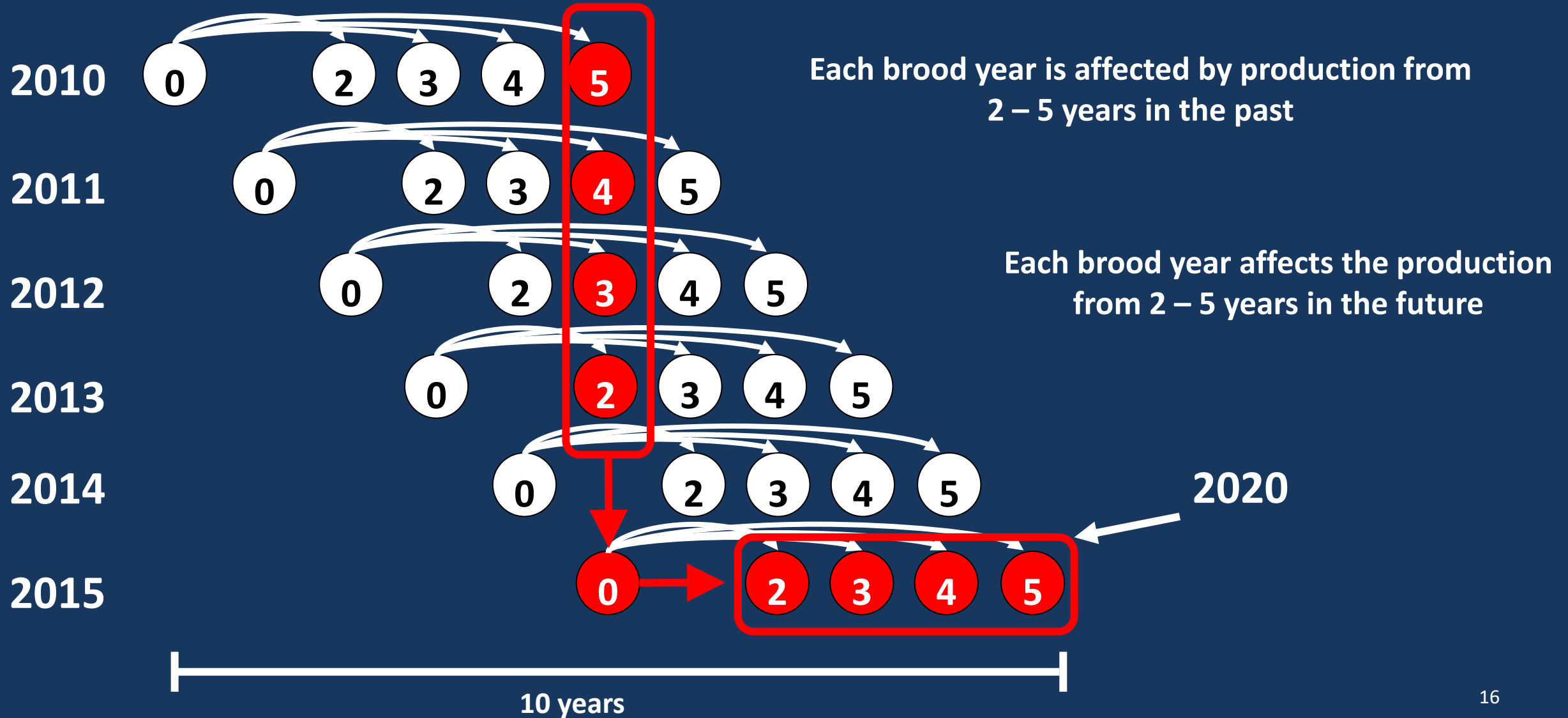
Understanding Salmon Age Structure

Simple model



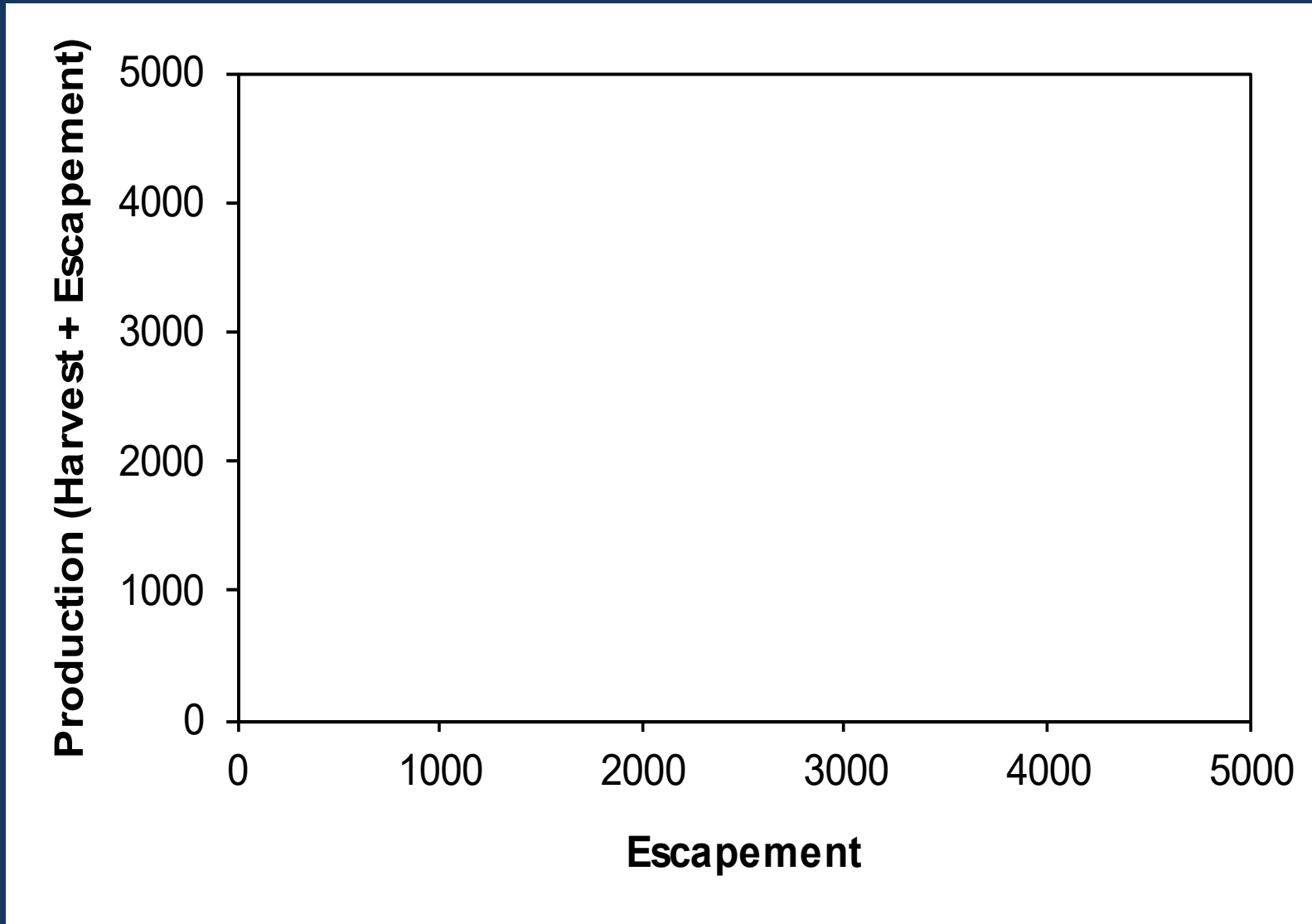
Understanding Salmon Age Structure

Simple model



Theory of Salmon Production

Escapement and the production that comes from it can be plotted on a graph like this...



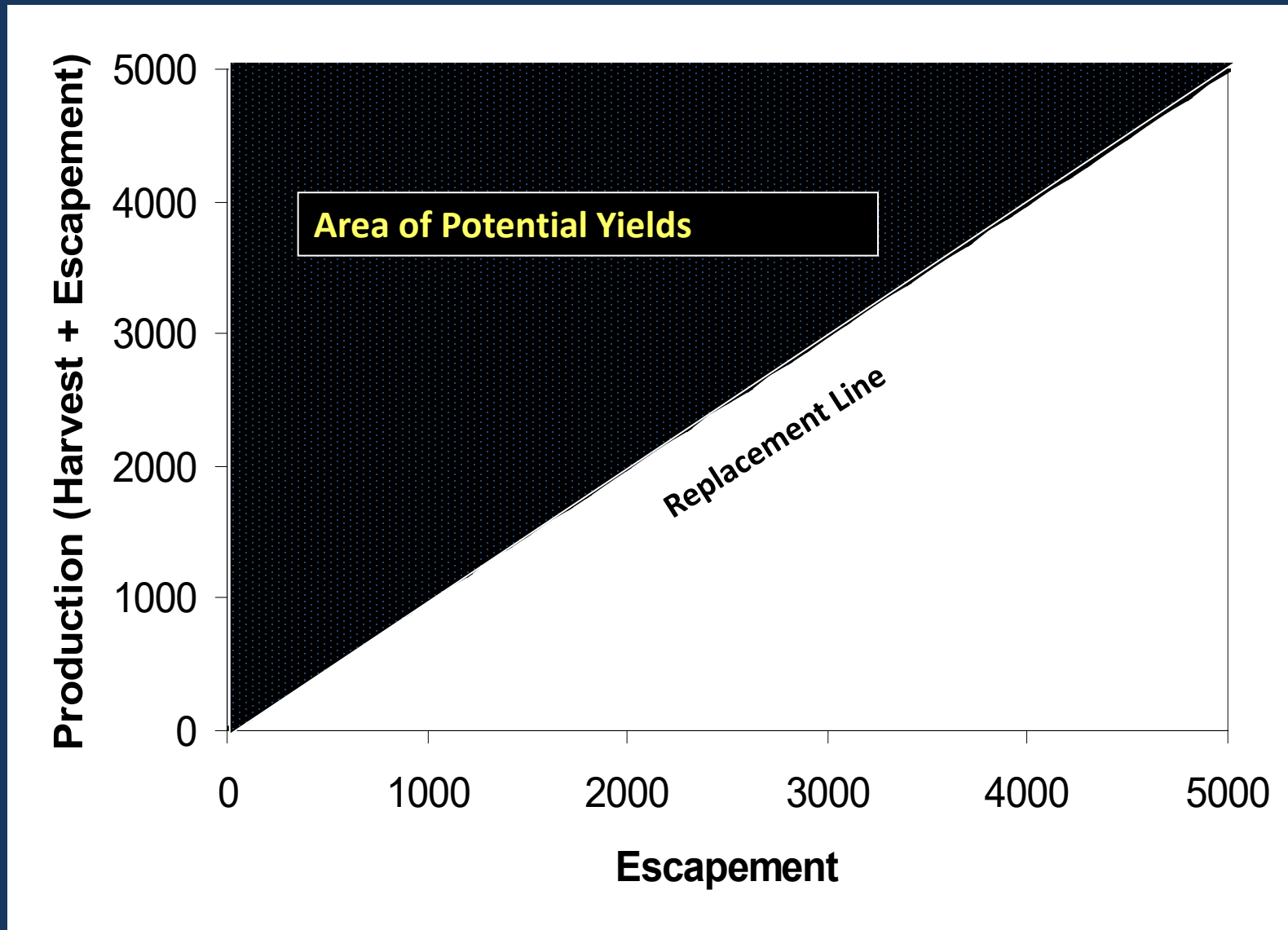
Theory of Salmon Production

...with a **Replacement Line** where escapement = production (i.e. no yields).



Theory of Salmon Production

There is a potential for yields only when production is greater than escapement



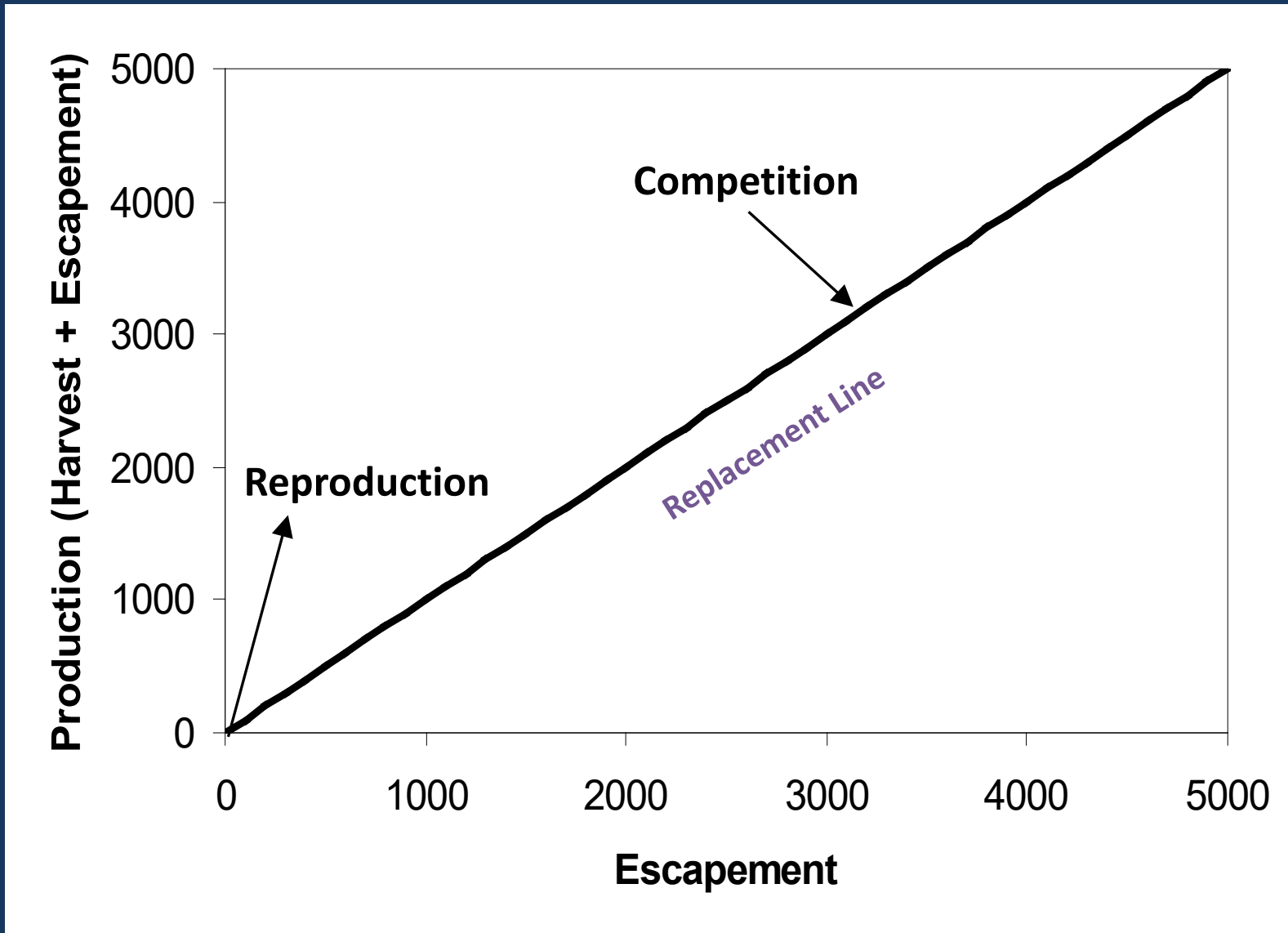
Theory of Salmon Production

Potential yields are the result of the **reproductive capacity** of salmon, but...



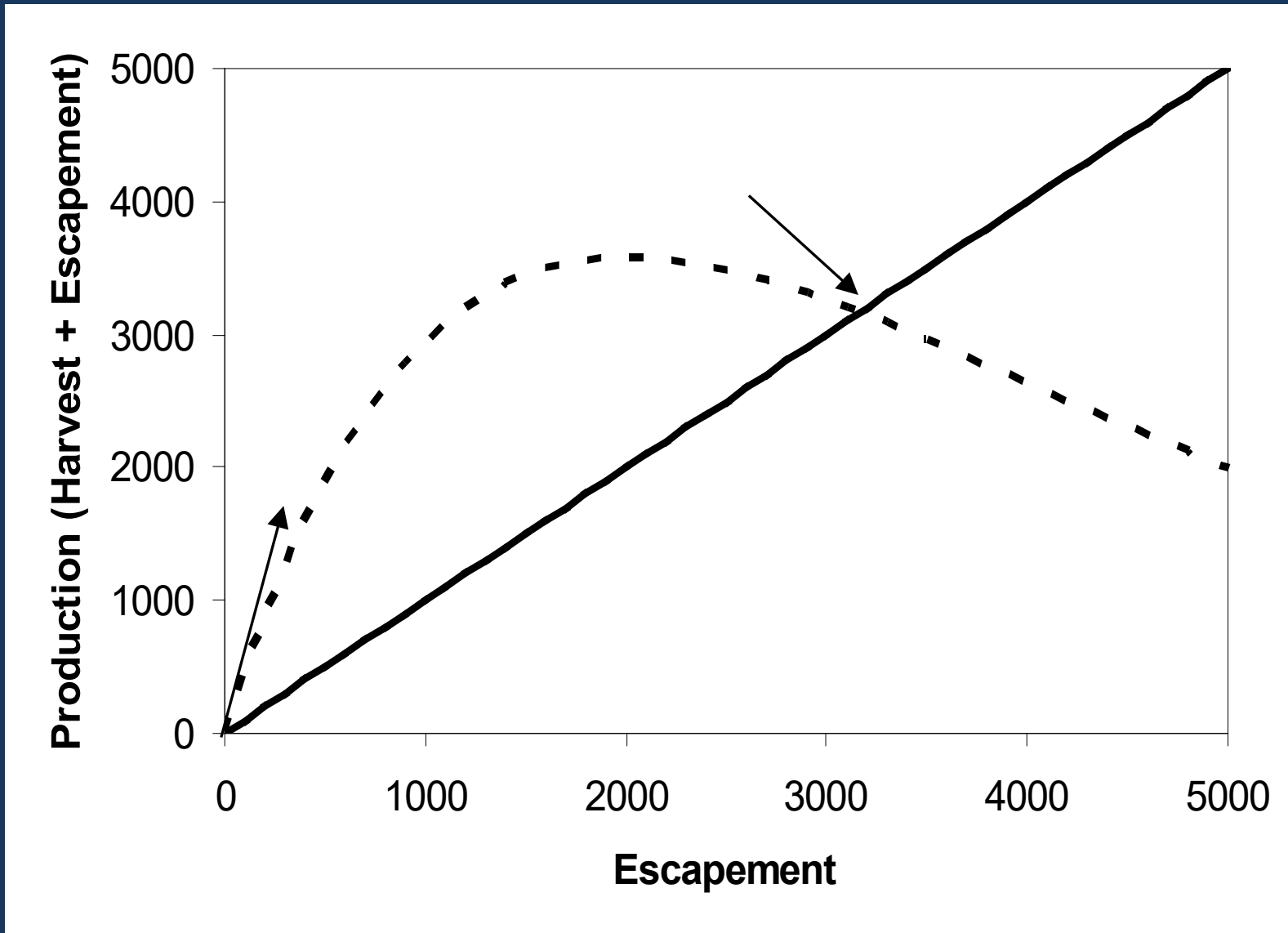
Theory of Salmon Production

...as escapements are increased, competition increases, which limits potential yields.



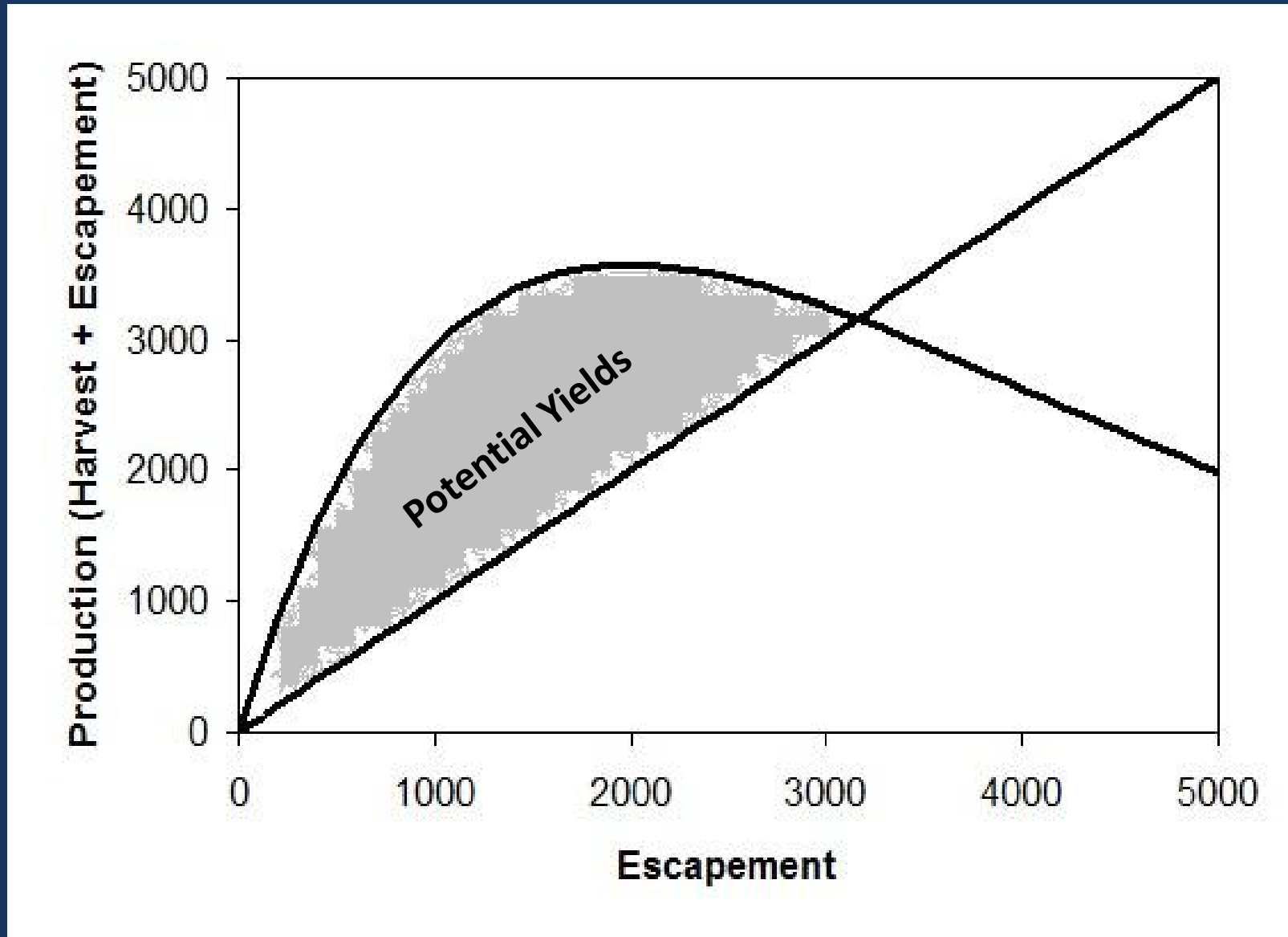
Theory of Salmon Production

We can model the interaction of reproductive potential and competition using historical data.



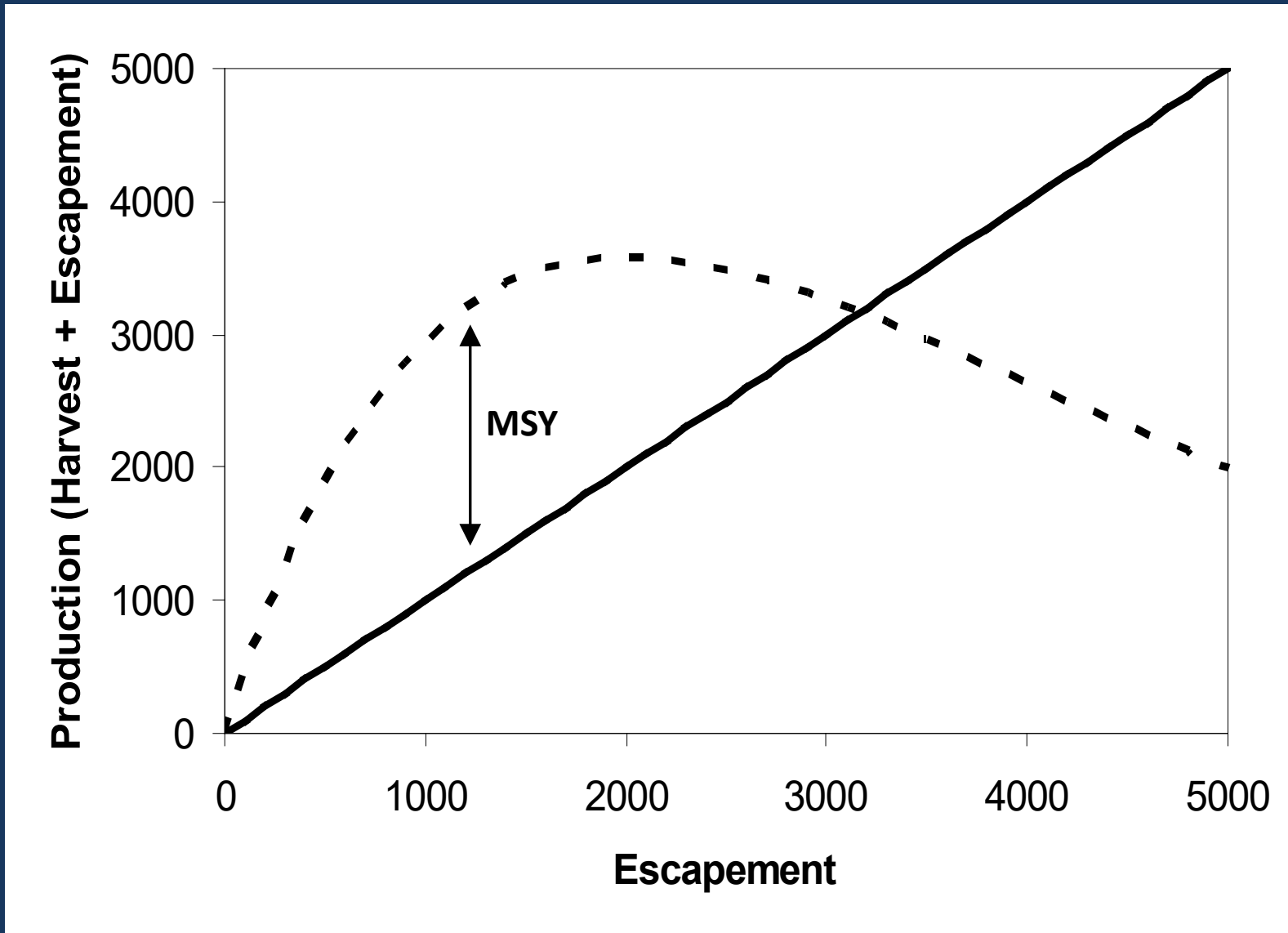
Theory of Salmon Production

The model helps to define potential yields we can expect from different escapements.



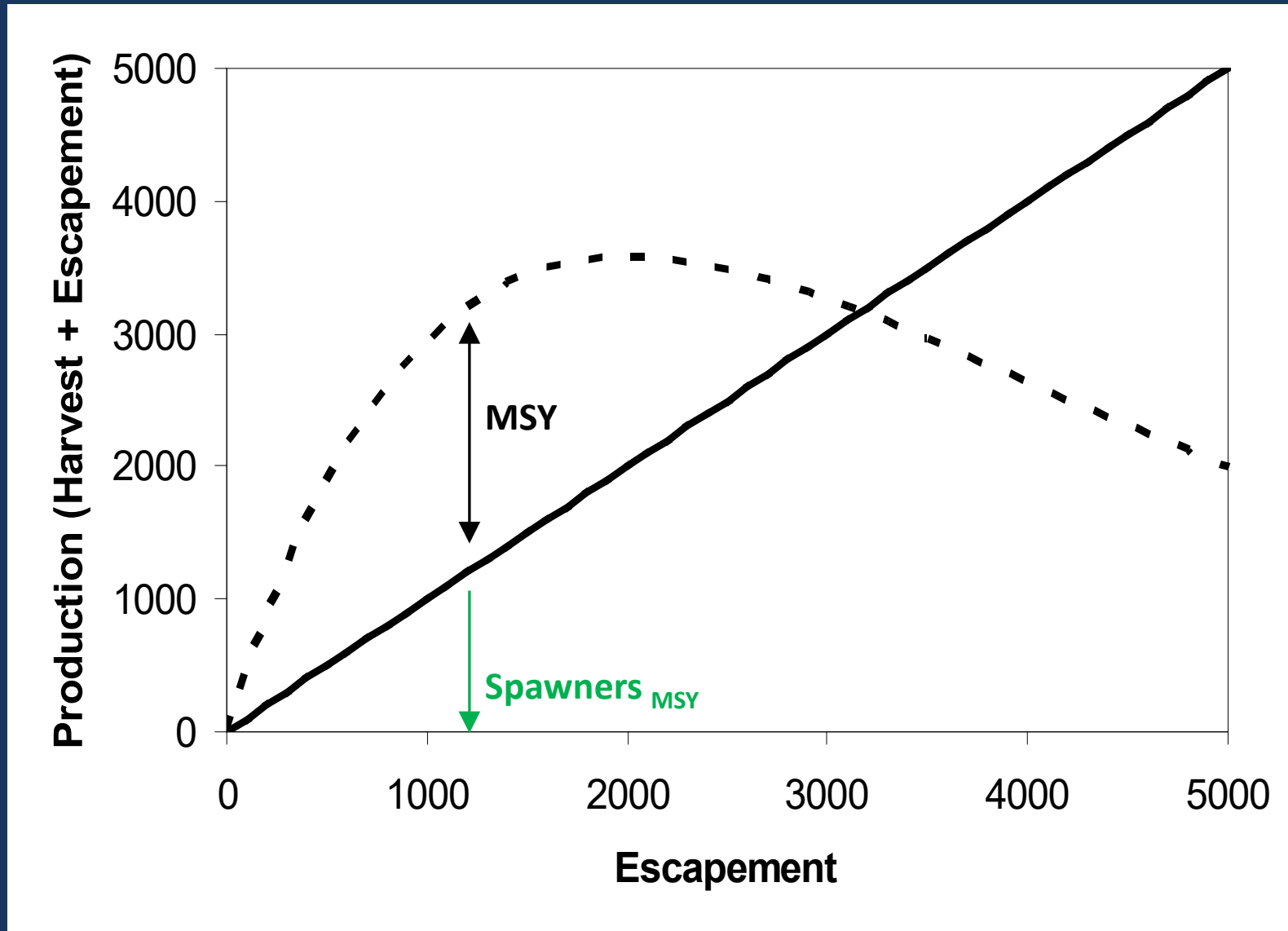
Theory of Salmon Production

MSY is the **maximum sustainable yield** based on the model...



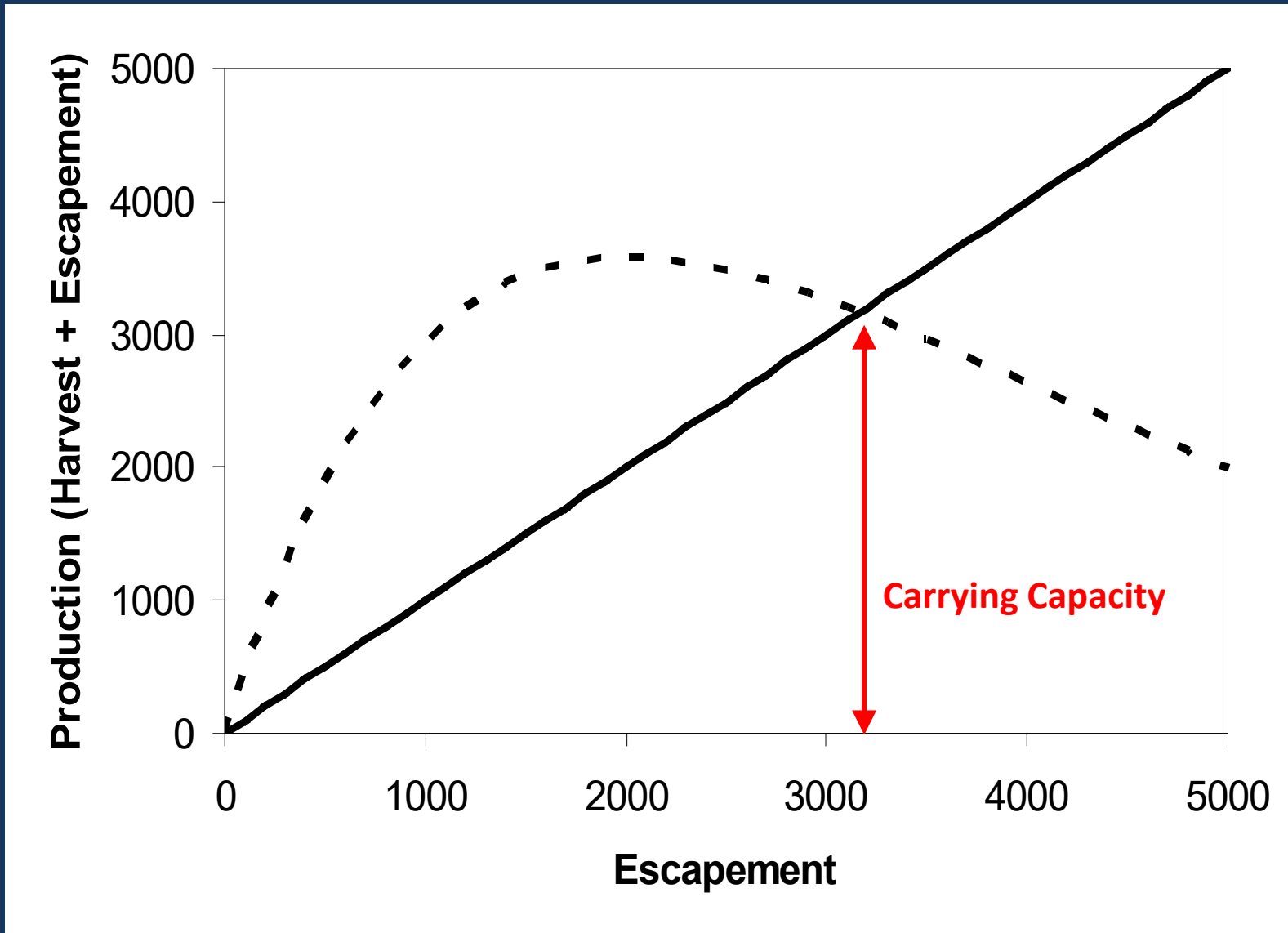
Theory of Salmon Production

...and is associated with the number of spawners that is expected to produce MSY.



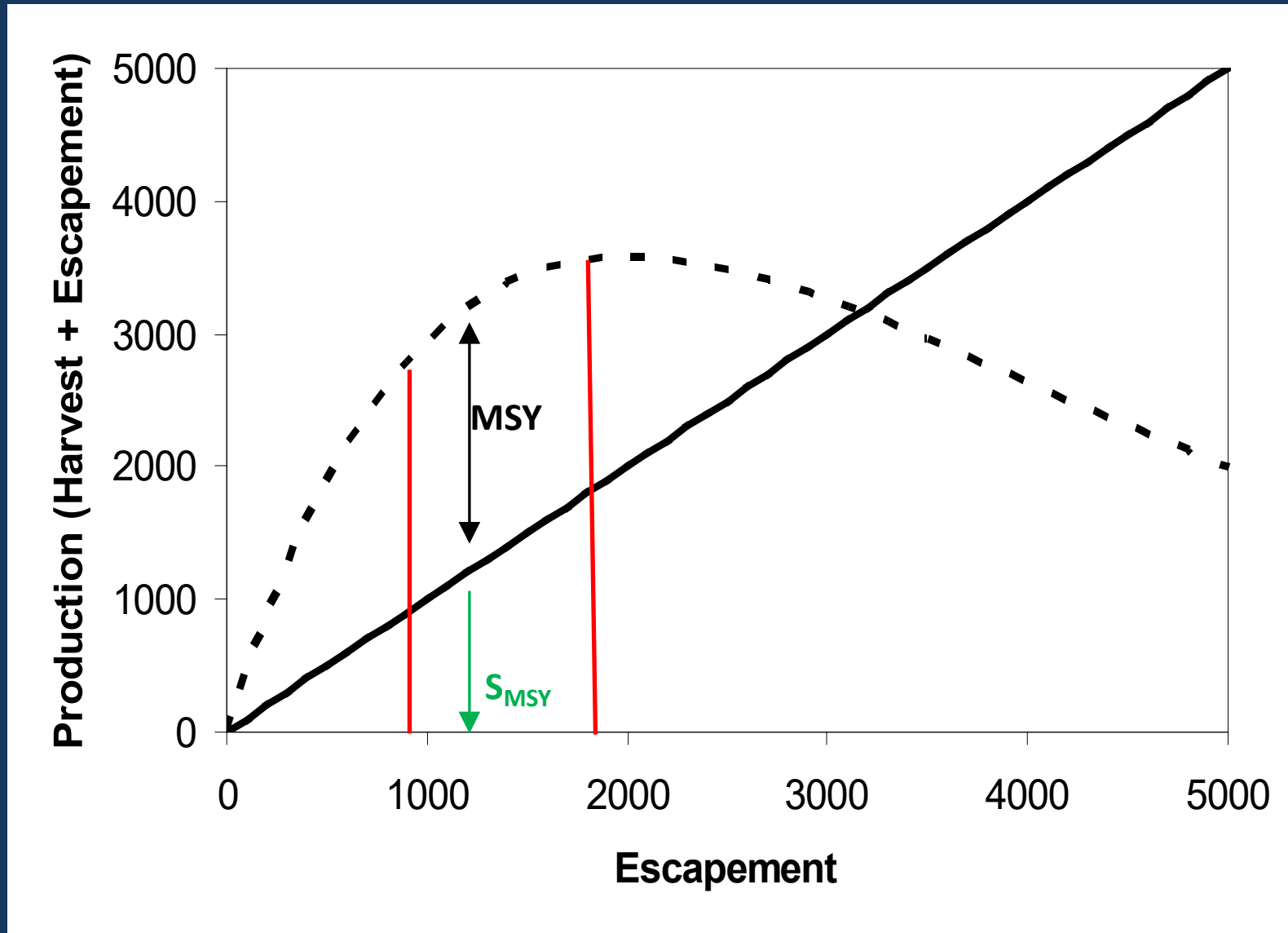
Theory of Salmon Production

Another quantity we can estimate from the model is the carrying capacity.



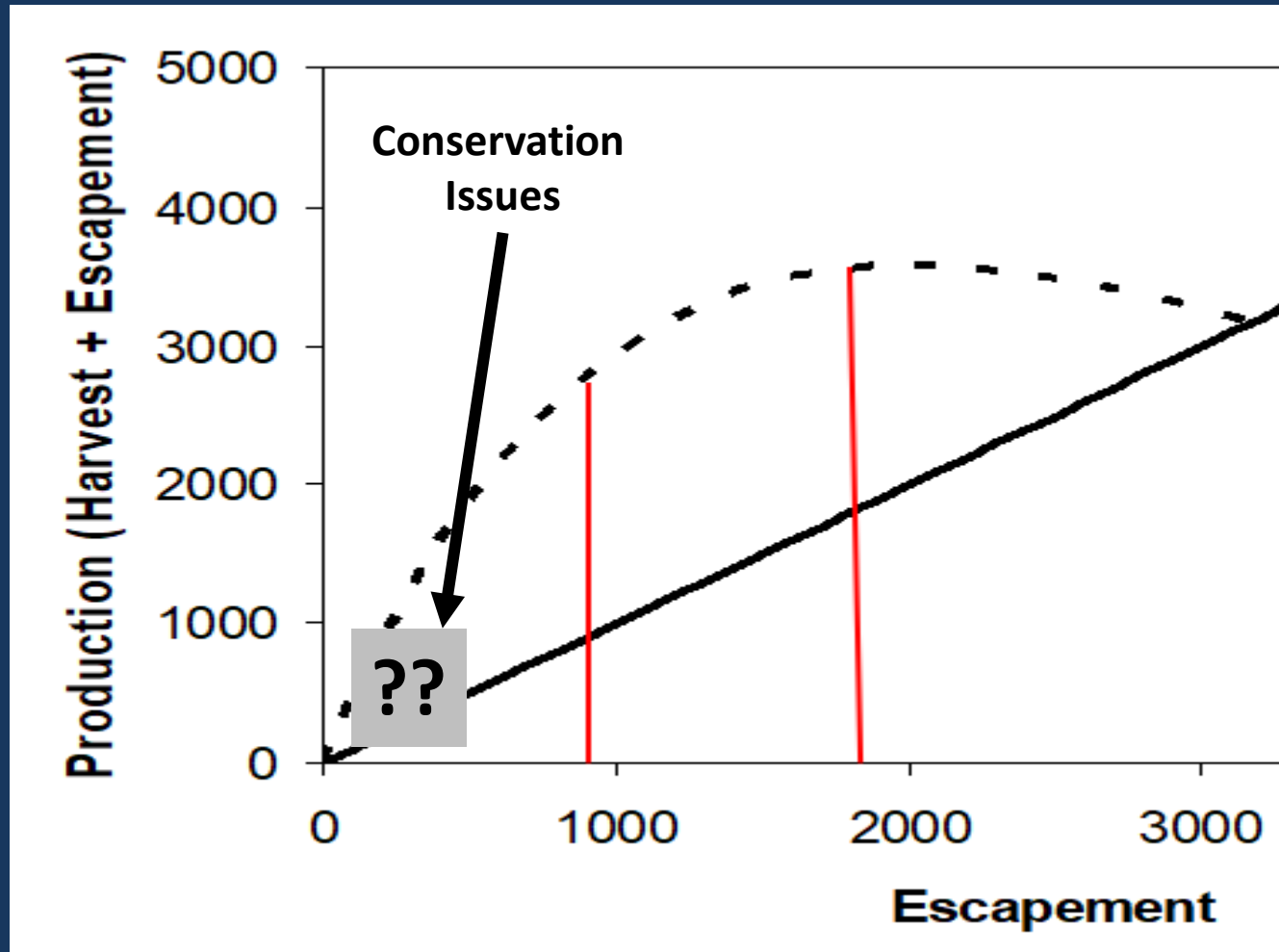
Theory of Salmon Production

A range around the number of spawners that produce MSY is the theoretical basis for an escapement goal.



Theory of Salmon Production

Notice that escapement goals are set for yield, thus they are well above escapement levels that would cause concern for conservation of the stock.



Time Scales for Salmon Management

Data

- Salmon catch timeseries 120 yrs
- Escapement timeseries 0 – 80 yrs
- Escapement goal timeseries 0 – 60 yrs

Salmon Lifecycle

- Chinook 2 – 7 yrs
- Chum 3 – 7 yrs
- Sockeye 3 – 6 yrs
- Coho 3 yrs
- Pink 2 yrs

Regulatory Cycle

- Board of Fisheries 3 yrs
- Escapement Goal review 3 yrs
- Management Plan change 3 yrs

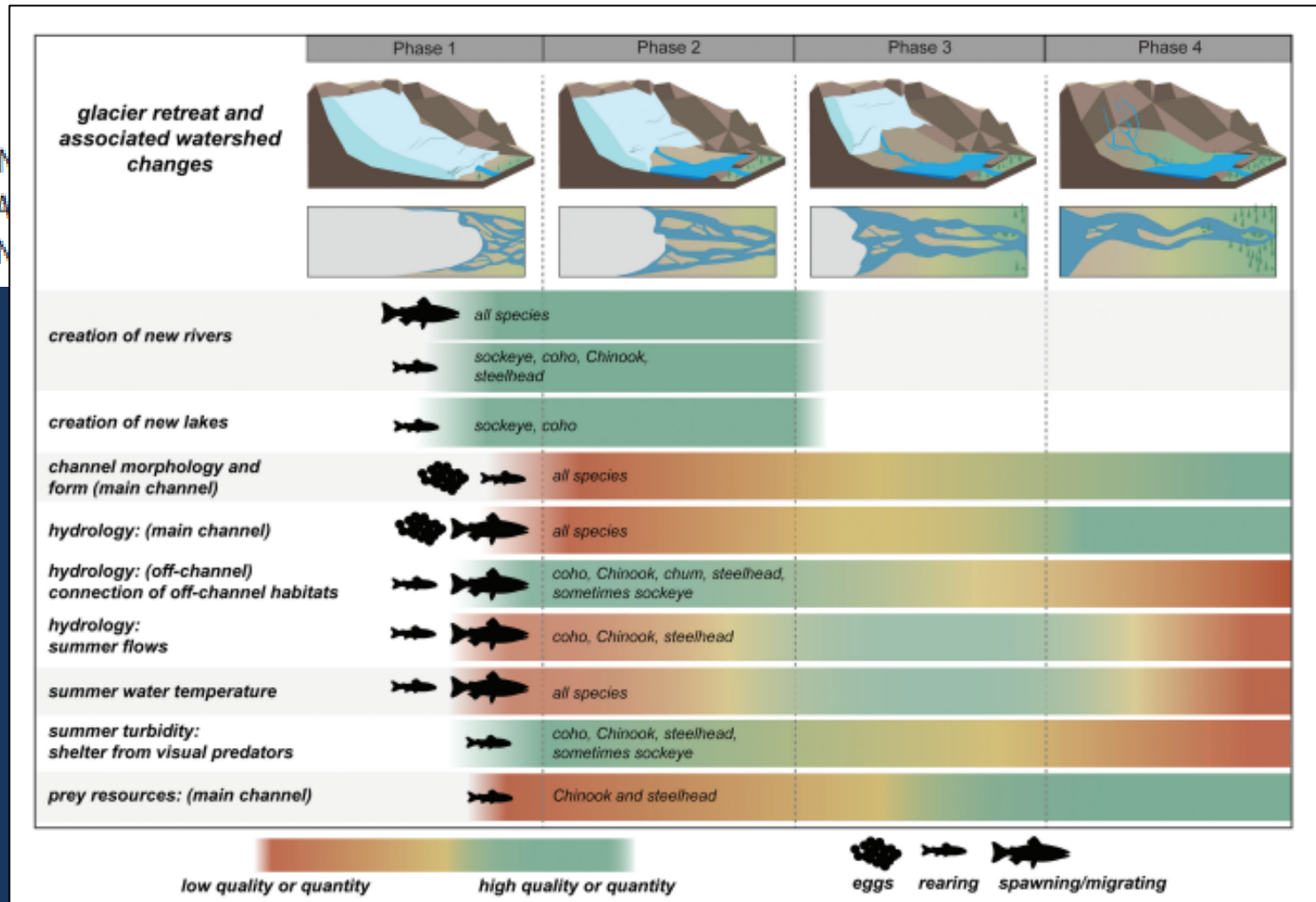
Management of Fishery

- Season length 2 wk to 1 yr
- Inseason action Days

Mixed Effects of Changes in the Environment

Glacier Retreat and Pacific Salmon

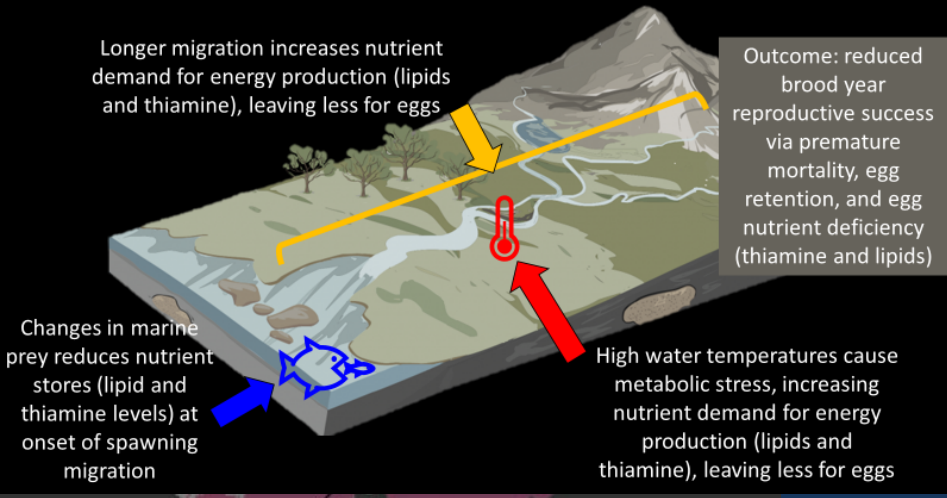
KARA J. PITMAN, JONATHAN
 RICHARD E. BRENNER, ERA
 VALENTINA RADIĆ, GORDON



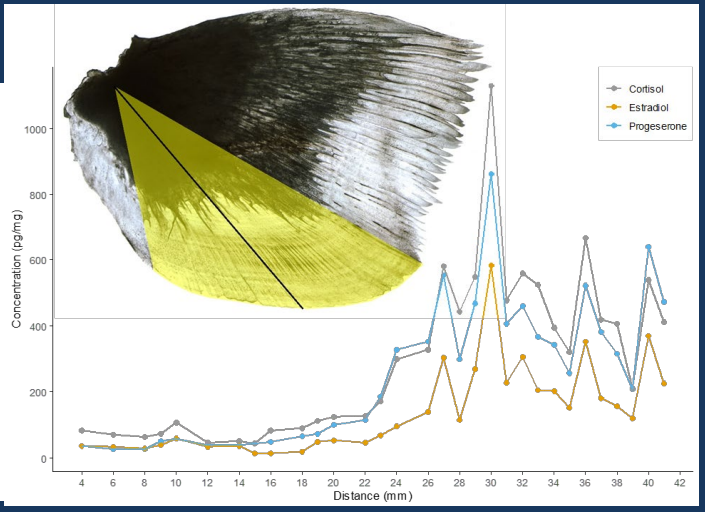
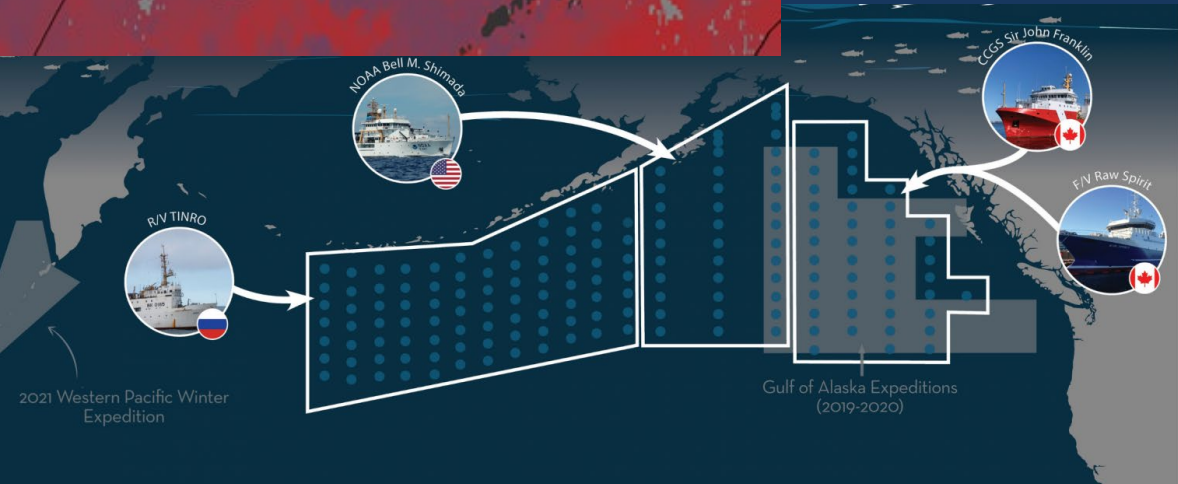
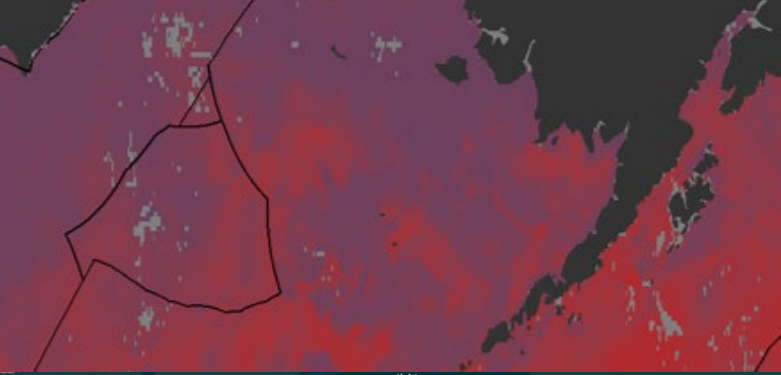
ADF&G Salmon Ocean Ecology Program (SOEP)

- 2022 Pan-Pacific Expedition (International Year of the Salmon – USA, Canada, Japan, Korea, Russia)
- Where have all the Chum salmon gone? An assessment of marine critical periods for Arctic Yukon Kuskokwim chum salmon in a changing environment (NOAA & ADF&G)
- Exploring Linkages Between a Changing Climate and Productivity of Yukon River Chinook Salmon (ADF&G, NOAA, USGS and YRDFA)
- Species distribution models for Chinook salmon in the Bering Sea (ADF&G, UAF, NOAA)
- Determinants of life history in Yukon River chum salmon (ADF&G and Baylor University)

Climate-Mediated Drivers of Productivity in Yukon River Chinook Salmon



Predicted Chinook Abundance based on SST and Chlorophyll from 5 May 2019





Any Questions?

