Department Framework for Interpretation of Results

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Alaska Department of Fish and Game Gene Conservation Lab

Alaska Board of Fisheries, Hatchery Committee Meeting

March 8, 2019

Tab 5

AHRP identified three questions that would help inform policy and that were attainable

1) What is the genetic structure of pink and chum in PWS and SEAK?
2) What is the extent and annual variability of straying?
3) What is the impact on fitness (productivity) of natural pink and chum stocks?

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

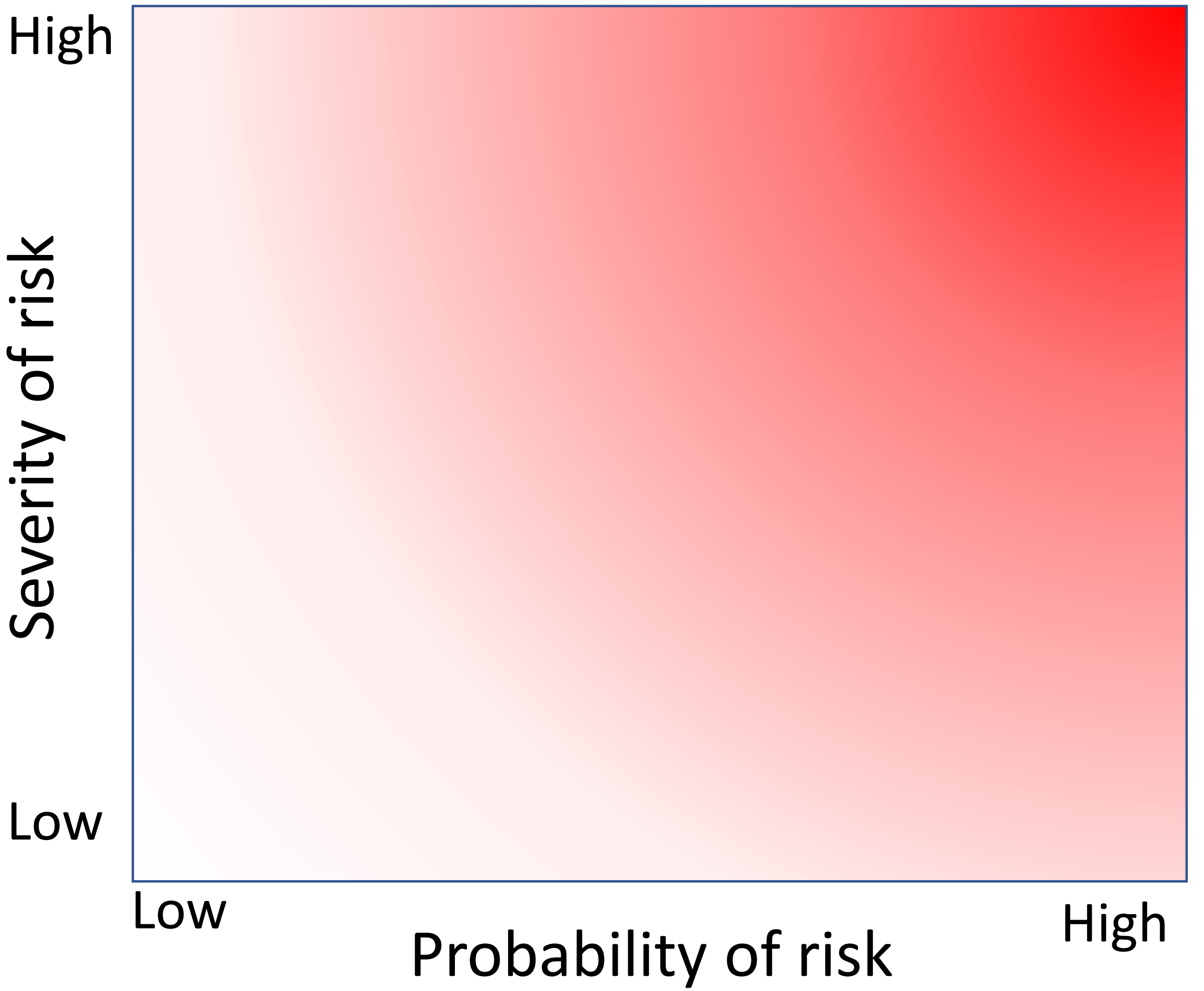
Some questions that I’ve been asked that are not addressed by AHRP

- What are the competition and predation effects of hatchery fish?
  - Within and across species
  - Within marine and freshwater habitats
- Do hatchery fish reduce genetic resilience of wild populations?
- If changes in productivity are observed, what mechanisms could be driving these differences?
- How will findings affect policy?
- How do these hatchery fish in wild systems affect assessment of escapement?

Department is assessing risk

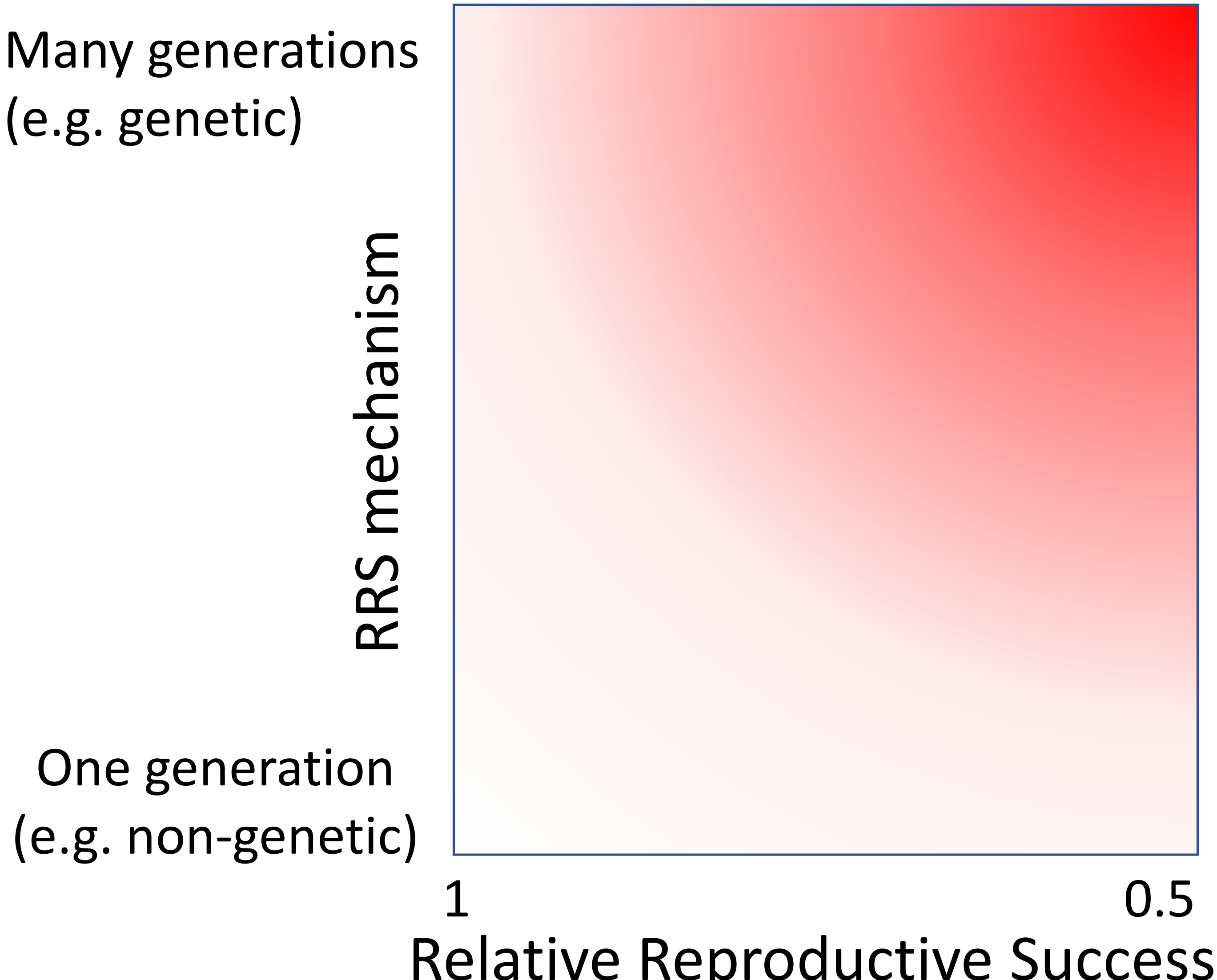
- What we have now:
  - Wild system productivity
  - Hatchery proportions
- What we are working on now:
  - Contemporary population structure – 90% PWS and SEAK
  - Historical population structure – 50% PWS
  - RRS estimates – 7% PWS, 0% SEAK
- Once all AHRG RRS results are complete:
  - RRS interpretation
  - Implications for assessment of escapement
- In the meantime, literature review
  - Genetic resilience of wild populations
  - Competition and predation effects of hatchery fish
    - Within and across species
    - Within marine and freshwater habitats
- Analyses and interpretation will inform policy maker decisions

Conceptual model for assessing risk



Conceptual model for assessing risk

Conceptual model for assessing risk



Assessing mechanisms driving Relative Reproductive Success

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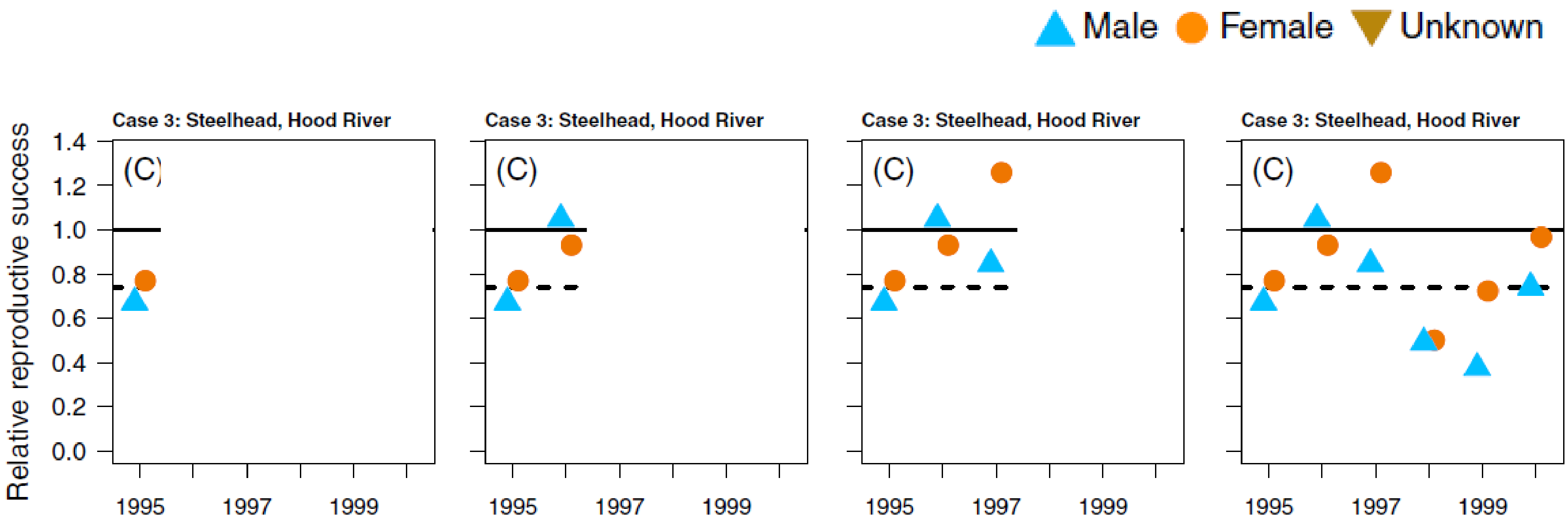
RRS estimates: 7% complete
RRS interpretation: 0% complete

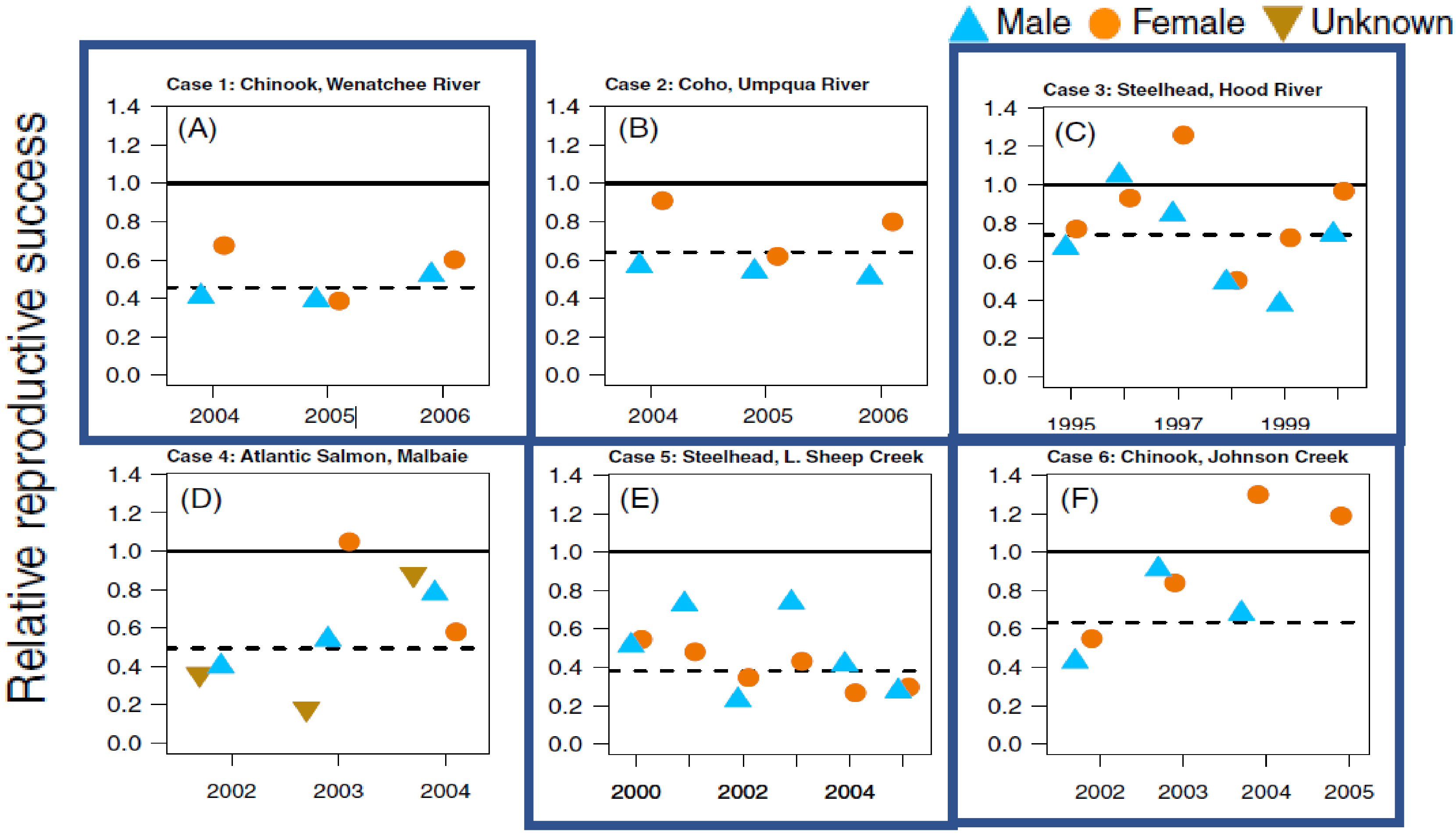
- Inappropriate to interpret beyond:
  - 1 stream (Hogan Bay)
  - 1 generation for even- and odd-years
- Does not represent variation:
  - Across years, within stream
  - Across steams
  - Across generations (grandparents)
  - Across species (chum salmon)

Example of RRS across years within species and location: Steelhead, Hood River



From Christie et al. 2014;
original data Araki et al. 2007

Examples of RRS across years within species and locations



From Christie et al. 2014;
original data various sources

RRS estimates: 7% complete
RRS interpretation: 0% complete

- Inappropriate to interpret beyond:
  - 1 stream (Hogan Bay)
  - 1 generation for even- and odd-years
- Does not represent variation:
  - Across species (chum salmon)
  - Within stream, across years
  - Across steams
  - Across generations (grandparents)
- We do not know what is driving RRS
  - Once we have results, we can investigate mechanisms

Many mechanisms may drive measured RRS: Here are a few

Many generations
(e.g. genetic)

One generation
(e.g. non-genetic)

Relaxation of natural selection

Relaxation of selection: a genetic example

- Hatcheries increase survival – that's the whole point
- Most mortality in the wild is due to unsurvivable events, e.g.:
  - Too much rain – scouring
  - Too little rain – dewatering
  - Too cold – freezing
  - Disturbance
- Some mortality in the wild is caused by genetic issues:
  - Most of these would die in a hatchery anyway
  - Some might survive in a hatchery, e.g.:
    - Lack of disease resistance
    - Inability to avoid predators
    - Tolerance of temperature or oxygen fluctuations
- The conditions in the hatchery do not select out the same fish as the conditions in the wild

Many mechanisms may drive measured RRS: Here are a few

Many generations
(e.g. genetic)

One generation
(e.g. non-genetic)

Relaxation of natural selection

Spawning ground familiarity

Spawning ground familiarity: a non-genetic example

- Homing fish have the potential to find the location where they were incubated
- These incubation locations were suitable (otherwise the fish would not have survived)
- Staying fish (regardless of origin), need to identify a suitable location
- Straying fish that find suitable locations, produce progeny that, if they home, will have the homing fish advantage
- Straying fish that do not find a suitable location, will produce fewer (if any) progeny.
- Therefore, most of this effect is wiped out the next generation

Many mechanisms may drive measured RRS: Here are a few

Many generations (e.g. genetic) ⟷ One generation (e.g. non-genetic)

Relaxation of natural selection

Spawning ground familiarity

Domestication selection

Epigenetics

Genetic drift

Broodstock incompatibility

Sexual selection

Run timing-associated variables

- Fishery prosecution
- Spawning ground competition
- Straying fish delays

Data available to investigate mechanisms driving RRS

- Genetic mechanisms
  - Modeling
  - Grandparent RRS
  - Historical and contemporary genetic structure (PWS)

- Non-genetic mechanisms
  - Timing of spawning
  - Location within stream
  - Fishery prosecution


Questions?

On Being a Wise Consumer of Science

Bill Templin

Alaska Board of Fisheries, Hatchery Committee Meeting
March 8, 2019

The scientific method in theory

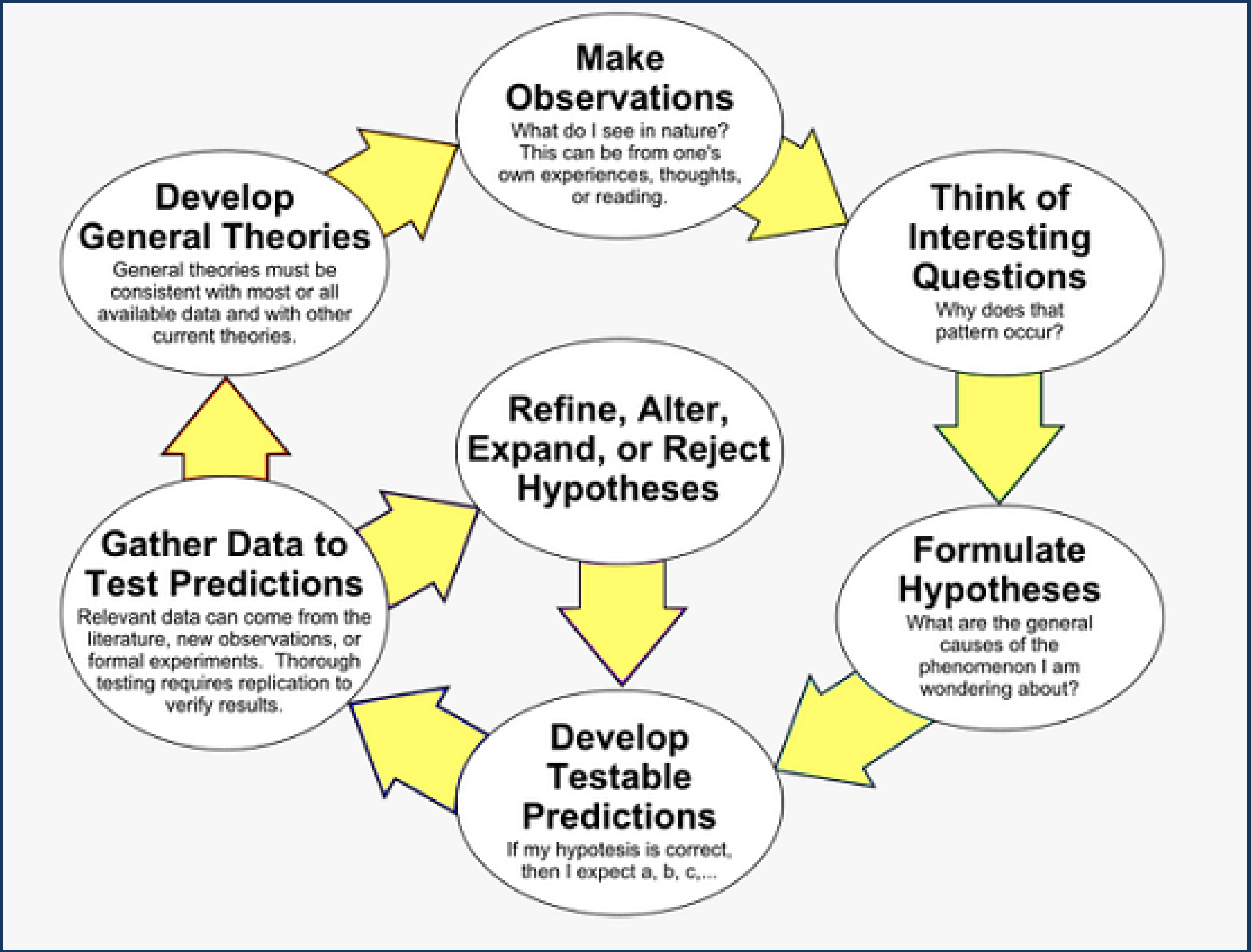


Image from: Chiswick Chap from Wikimedia Commons

The scientific method in practice

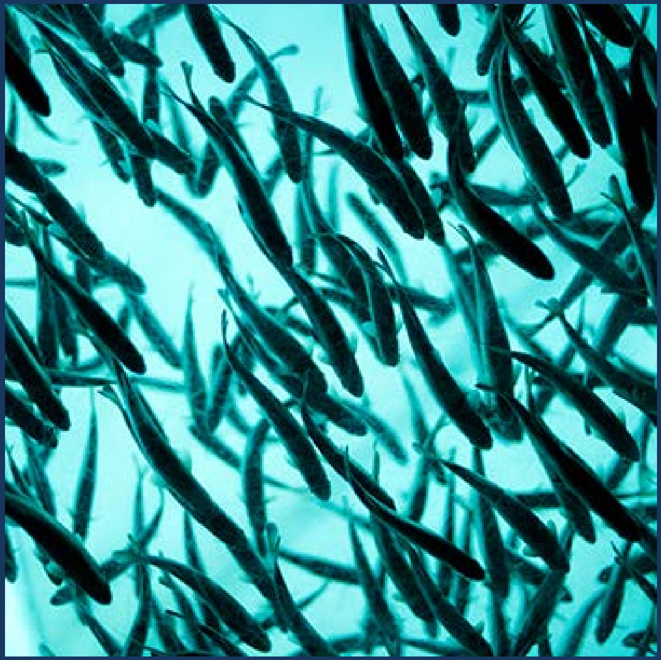
Though usually presented as steps, the scientific method represents a set of principles:

- Careful observations
- Formulating and testing hypothesis that can be <u>falsified</u>
- Refinement of hypotheses
- Skepticism

The scientific method in practice – an example

Critical-Period Hypothesis

- Juvenile salmon entering marine environment
  - Compelling hypothesis
  - Many studies, but mixed result
  - Debate is elevating the science



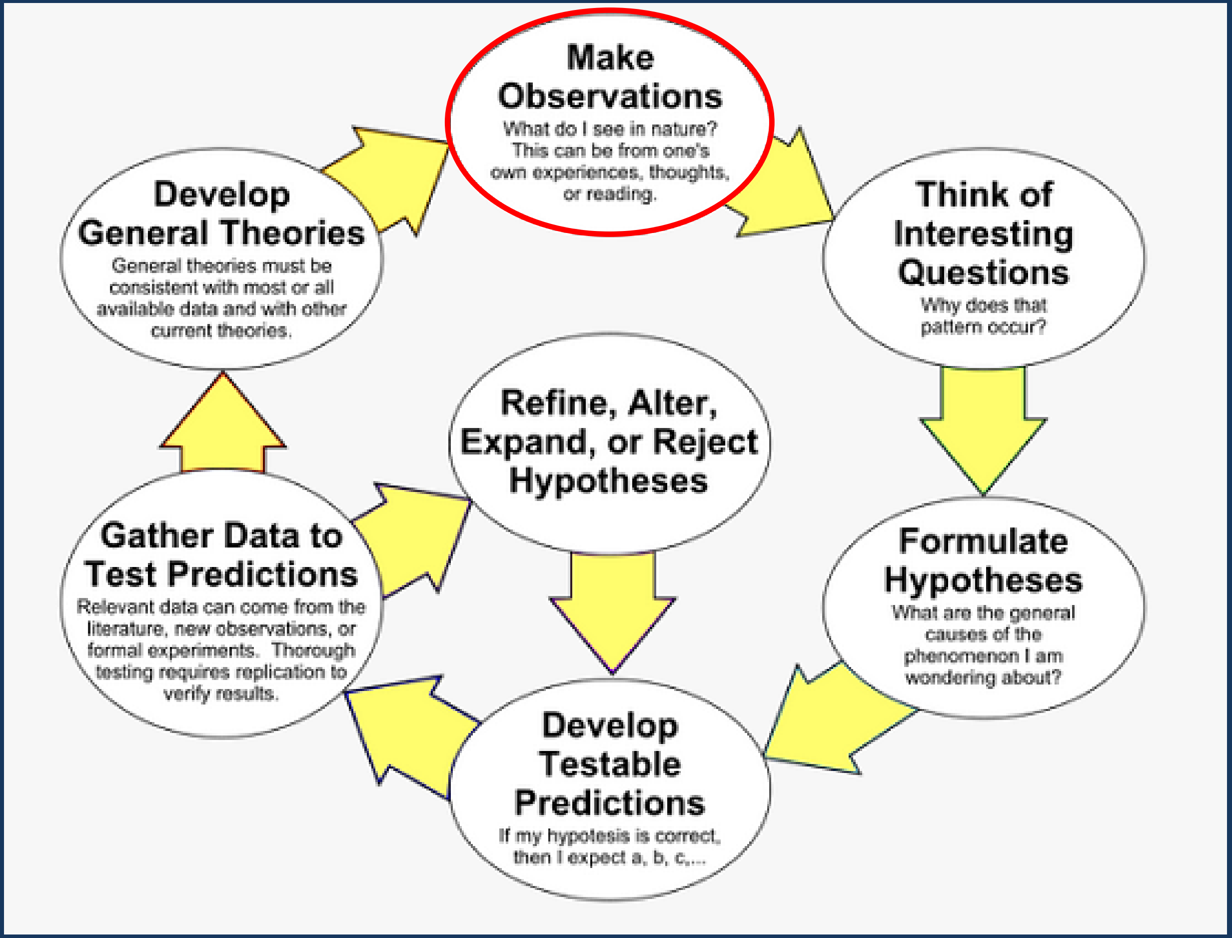
- What are the ramifications of a published journal article that doesn’t complete the scientific process?
  - Not always negative
  - Puts the burden on the reader to understand the limitations of the study

Unprecedented biennial pattern of birth and mortality in an endangered apex predator, the southern resident killer whale, in the eastern North Pacific Ocean

Gregory T. Ruggerone, Alan M. Springer, Leon D. Shaul, and Gus B. van Vliet

Observations:

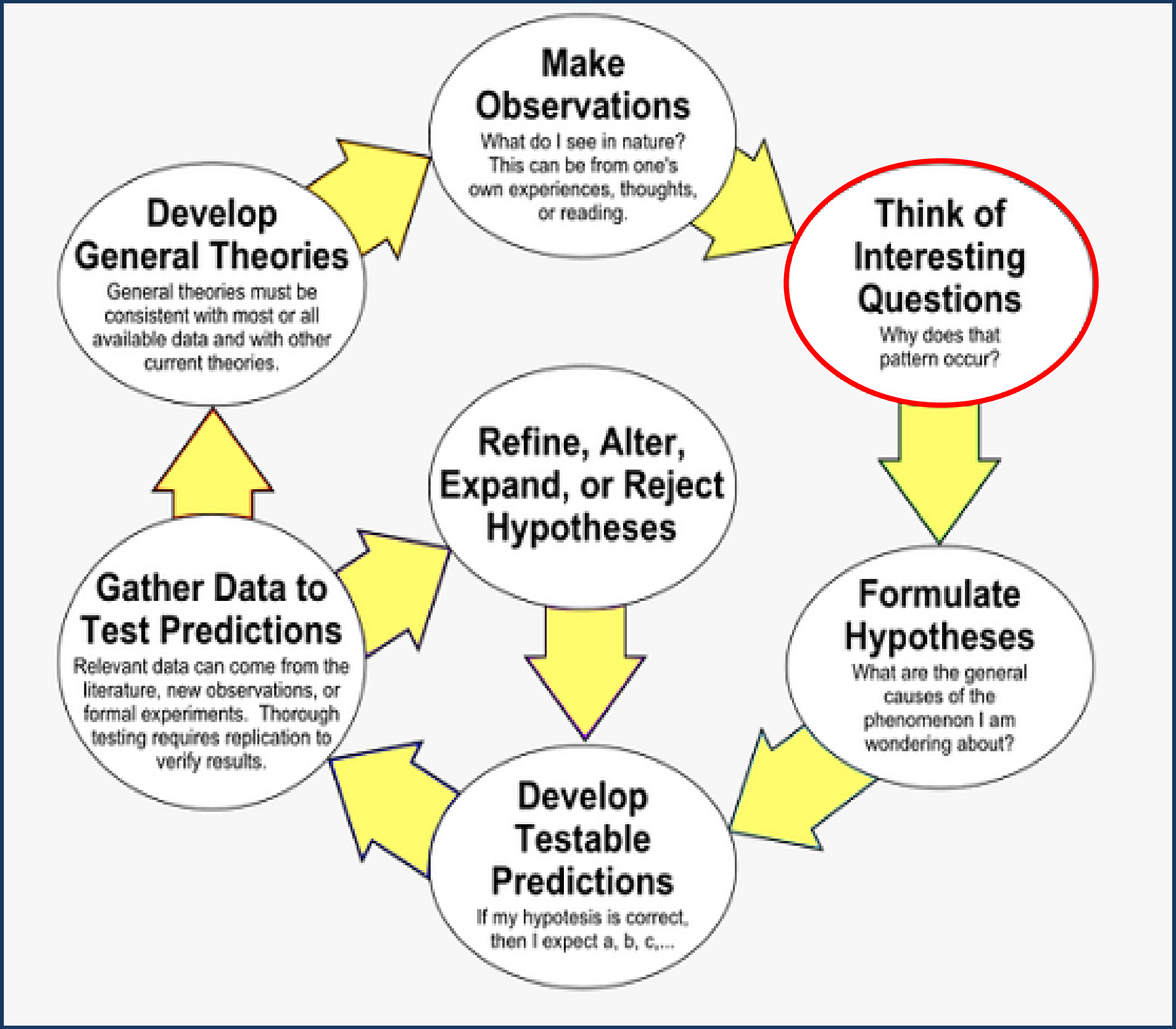
- Southern resident killer whale (SRKW) population declined between 1995-2017
- Biennial pattern present in mortality of SRKWs



Pink salmon and orcas

Interesting question:

- Could pink salmon be responsible for the biennial pattern in SRKW mortality?



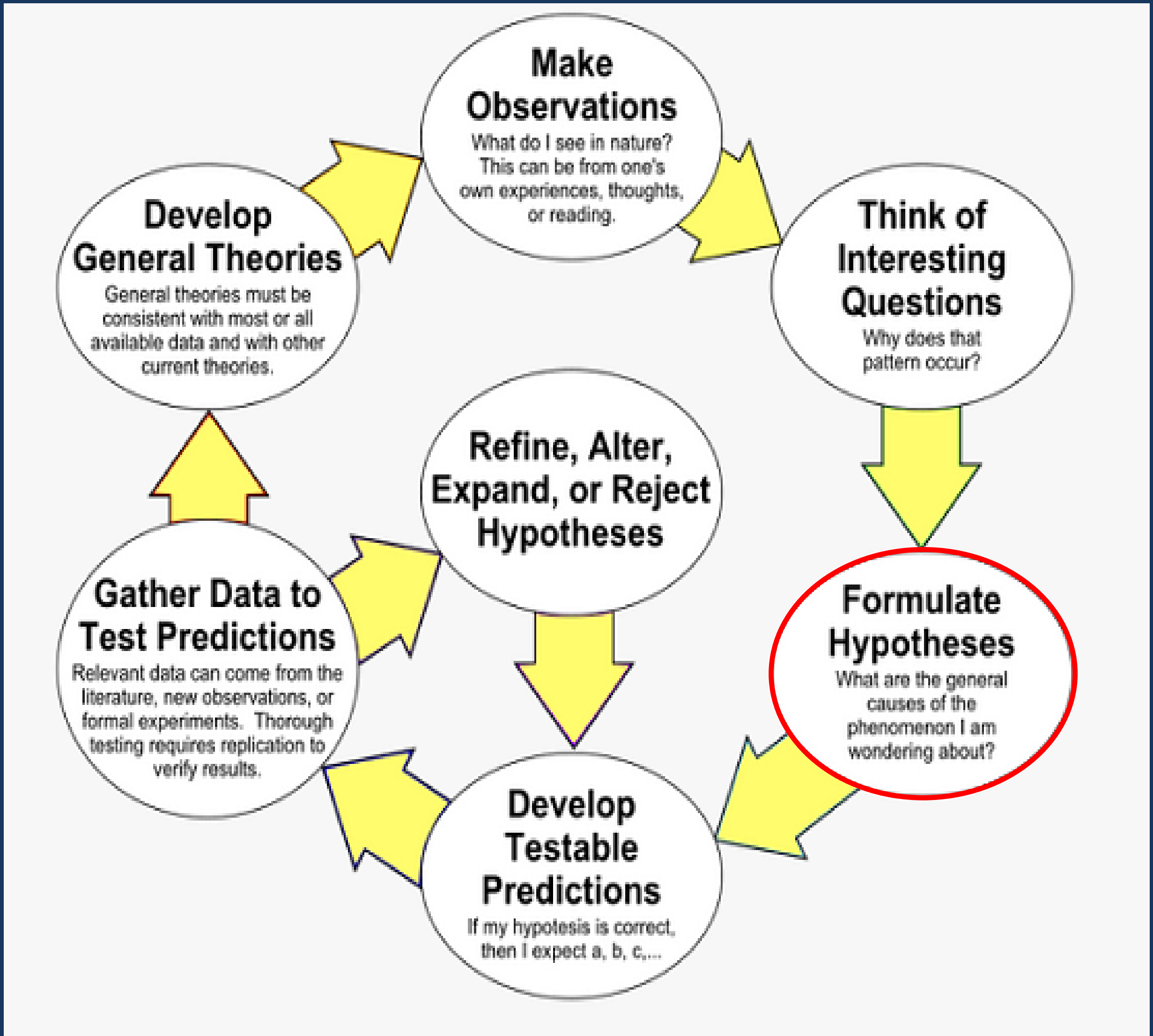
Pink salmon and orcas

Hypotheses:

- Highly abundant odd-year pink salmon interfere with the ability of whales to feed on co-migrating Chinook salmon in the Salish Sea

OR

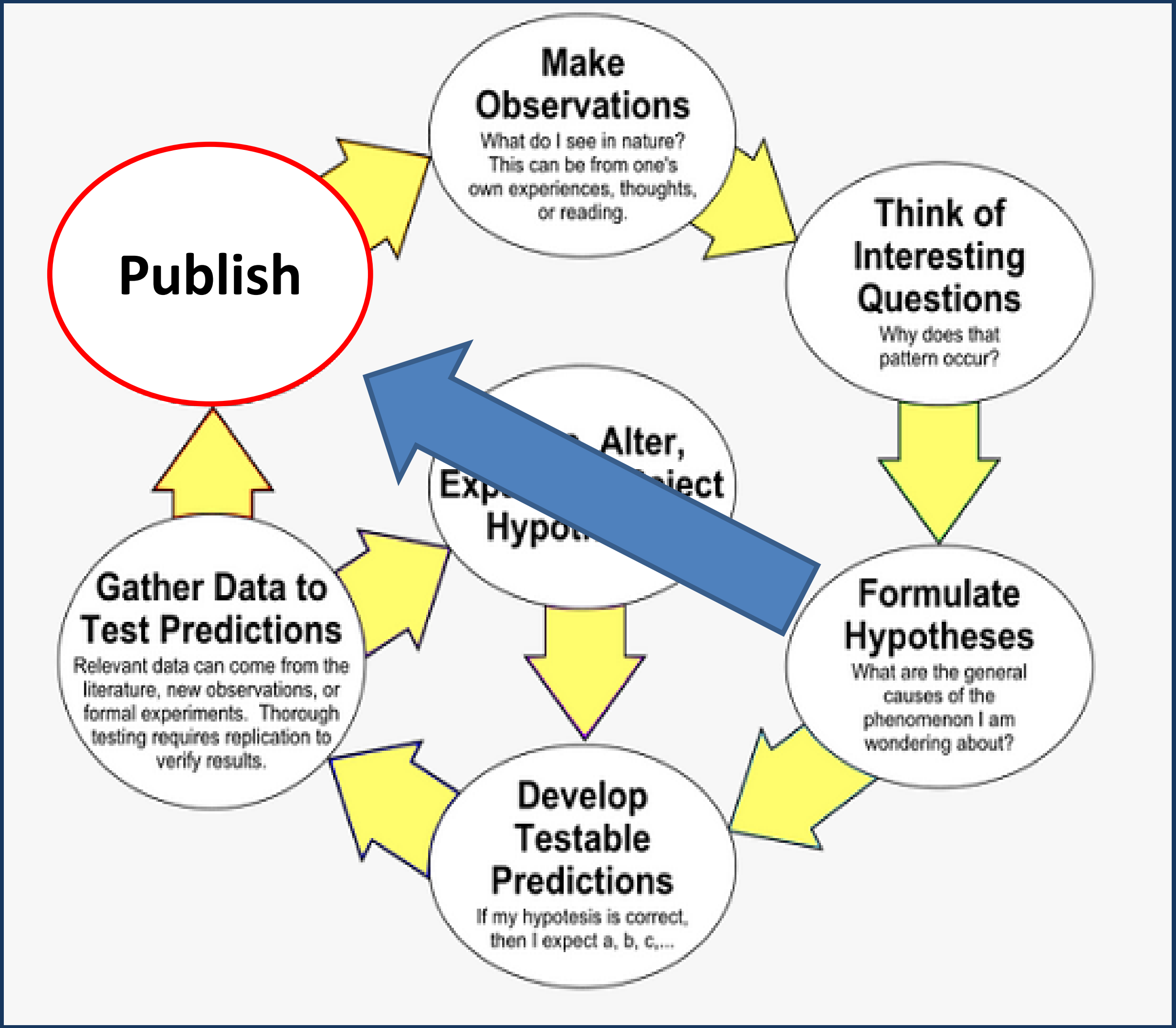
- Pink salmon enhance the ability of the whales to feed resulting in lower mortality in odd years when pink salmon are highly abundant



Pink salmon and orcas

General theory:

- Pink salmon are the only possible explanation for the biennial pattern in mortality



Pink salmon and orcas

"We recognize the need for additional analyses and rationale to explain this pattern but we wish to facilitate rapid communication of these unique findings because a greater understanding of SRKW demography enhances the likelihood for advancing their recovery." (page 292)

RICHMOND NEWS ≡ MENU

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Scientists find 'odd' pattern in killer whale birth, death rates

Fisheries scientists suspect odd-even year fluctuations may have something to do with pink salmon

Nelson Bennett / Business in Vancouver
JANUARY 21, 2019 11:46 AM

Study says things like ship noise and contaminants don't explain why Southern Resident Killer Whale birth and death rates would fluctuate on odd-even year cycles. | Photo Joan Lopez.

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SOMETHING TO THINK ABOUT, PERHAPS

"Ships are expendable; the whales are not." – Paul Watson

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Chamber Music Festival Founders Set for Musicians-in-Residence Community Concerts →

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Pink salmon and orcas

Manuscript section

	Abstract/ Key words	Intro	Methods	Results	Discussion	Conclusions
Pink	2	0	0	0	16	3
Chinook	2	2	0	0	11	2
Salmon	4	2	0	0	34	5
Whale	6	4	12	13	5	0
SRKW	0	4	8	2	20	8

Concluding thoughts

- Researcher's responsibility to communicate research clearly and effectively
- Readers need to evaluate the strength of the evidence presented and conclusions drawn
  - e.g., Is chocolate good or bad for you?
- The peer review process is not perfect
  - Review of manuscripts is voluntary
  - Reviewers evaluate the science not the "splash"-factor
  - Publication of paper does not imply full acceptance of all reviewers and that all of their concerns were addressed
  - Some journals have incentives to publish papers that boost their profile

Enhancement Related Research: Ideas & Recommendations

Bill Templin

Alaska Board of Fisheries, Hatchery Committee Meeting
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Enhancement Research Categories

- Monitoring
- Straying
- Genetic stock structure/fitness
- Competitive Interactions/Carrying capacity
- Research Tools

Monitoring

Robust programs needed for:

- Harvests
  - estimate hatchery fraction in the catch
- Spawning grounds
  - assess presence of hatchery fish in the escapement

* In addition to on-going AHRP

Straying

- Understanding stray rates of wild stocks
- Investigating the potential to reduce stray rates via hatchery practices
- Effect of remote release sites on stray rates
- Effect of different harvest and fish management strategies that may minimize straying impacts
- Effects of straying on escapement goal management
- Use AHRP results, once completed, to guide next steps

Genetic Stock Structure/ Fitness

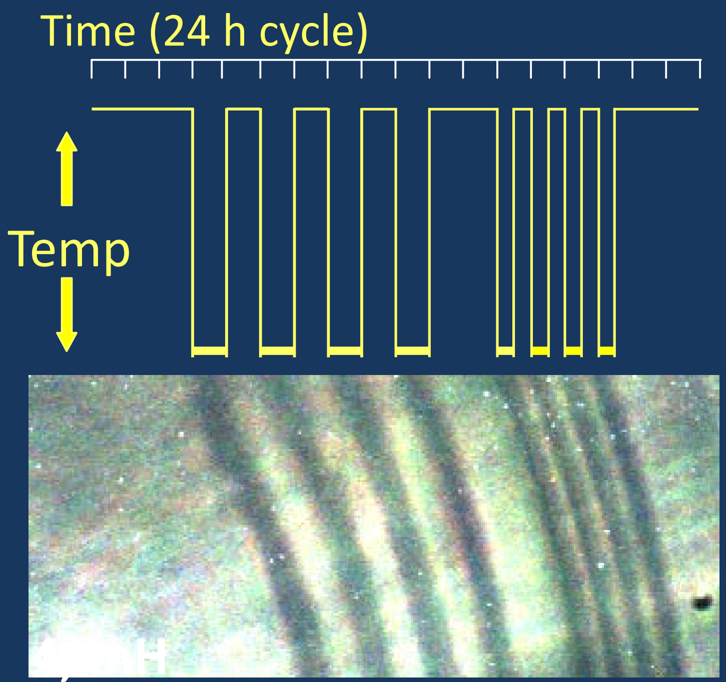
- Baseline genetic studies for areas that may have hatchery salmon programs in the near future
- Effect of hatcheries on population structure and genetic diversity
- Effect of hatcheries on relative reproductive success and productivity

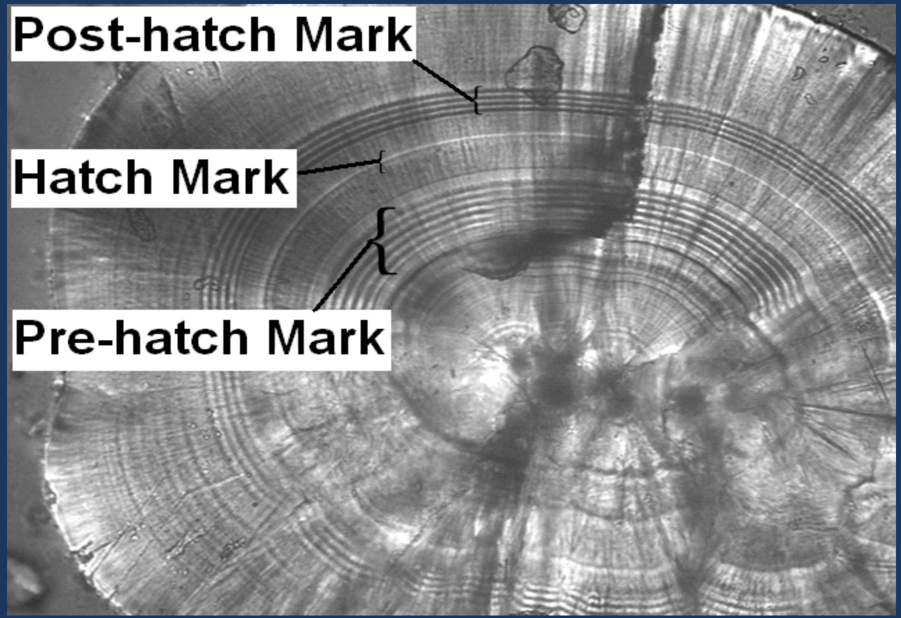
Competitive Interactions/ Carrying Capacity

- Collaborate on international research on carrying capacity
- Do out-migrating hatchery fish diminish the local prey base enough to impact local wild salmon stocks?
- Do hatchery produced salmon adversely affect the abundance of other wild species?

Research Tools

- Research alternative fish marking strategies





Summary/ Next Steps

- Many avenues of potential research
- Need to evaluate and prioritize
- Develop research plans and secure funding
- Seek collaborations and partnerships