

Auke Creek Research Station Climate Change Impacts on Anadromous Fish

Thank you to Organizers and Auk Kwaan!!!

 John Joyce and Scott Vulstek • April 13, 2016





What Species Do We Study?

- Pink Salmon
- Chum Salmon
- Sockeye Salmon
- Coho Salmon
- Dolly Varden Char
- Cutthroat Trout
- And a few others, Scuplins, Sticklebacks

 To Understand To Monitor

 To Foster Good Stewardship



What Data Do We Collect?

- Complete Census of migratory fishes 1980 through 2015, other less complete data go further back
- Daily migration data with corresponding age/length by sex
- Multi-species indices of freshwater and marine productivity
- Environmental data
- Data for experimental research
 - Coho indicator
 - Sockeye Fitness H/W
 - Pink Salmon Adaptation

 All operations work to minimize stress on captured fish





How Do We Collect It?





Downstream Weir Operations

 Captures all Water Flow and Downstream Migrants Juvenile Salmon – Pink Chum Sockeye Coho Dolly Varden and Cutthroat Trout

• Daily Counts, Size, Age (Scales), and Genetic Samples taken



Operates 24/7 From Late February thru June

• Small Mesh Panels, Flow Dividers, Fan Traps



Freshwater holding tanks keep fish alive and separate by size, a variety of sizes and species







Adult Weir Installed in June Fish Moving Upstream



Upstream Weir Operations

- Operates 24/7 From Late June thru October
- Larger Grates Block Creek, Single Path Upstream
- Daily Counts, Size, Age (Scales), and Genetic Samples taken



• Upstream Trap Captures all Upstream Migrants Adult Salmon – Pink Chum Sockeye Coho Large sizes of Dolly Varden and Cutthroat Trout



NOAA Research Partners at Auke Creek

- Alaska Department of Fish and Game
- United States Fish and Wildlife Service
- University of Alaska, Southeast
- Juneau Fisheries Center, University of Alaska, Fairbanks
- Arctic Native Science and Engineering Program
- Pacific Salmon Commission
- Douglas Island Pink and Chum
- Over decades, many individuals have helped -- Thank You

Questions I will try to Address

- Are we seeing evidence of climate change in environmental data ?
- How are Auke Lake fish populations reacting to climate change?
- Why is migration timing important?
- How resilient are populations ?
- What are the cautions and concerns?

Changes in Temperature and Flow





1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009	2011



Ъ.

• Flow Patterns, Especially in the Spring, are Changing • Warmer wetter winters, lower elevation snowpack is reduced Snowpack mediated flow increases are earlier

— Avg: 2006-2014 2015

Warm Early Spring Rains Release Most of the Available Snowpack and **Produce Strong Flood Events**

Temperature and Water Flow Spikes are Becoming More Common

Some Serious Concerns About Climate Change Impacts

- Low flow and high temperatures may prevent adult mature fish from being able to migrate, mature, spawn successfully. Low Oxygen, Stress, Disease.
- Do conditions diminish growth or survival in freshwater?
- Do shifts in the timing of salmon migration put juveniles into the ocean at times that are unfavorable for their survival and growth?
- Species that have important ecological connections may not co adapt and population productivity could suffer – eg Dolly Varden and Pink Salmon.
- Downstream migrants may be trapped or migrate in extremely low flows and incur high mortality.
- Is there evidence of impacts on adult size or marine survival?

Spring flows are early and high

Summer and fall flow rely almost completely on rainfall

Лay

Λay

2

....

Λay

30

Conclusions: Genetic change for earlier migration timing in pink salmon, Kovach et al.

Selective forces? 1989 was abnormally warm Early migrating fish adapted to warm water

Coho Adults

Migration Timing Changes

- - predators

 - as a food resource

Migration timing is important for survival

 Juveniles must time the transition to the estuary and ocean when conditions favor growth and survival, food,

• It is under genetic control but is influenced by environmental factors

 Adult salmon timing is important for their survival and also for harvest and other species dependent on salmon

Population Growth Rates are Stable - Kovach et al.

Odd-year pink salmon

λ=1.064 (0.740,1.530)

Sockeye • •

λ=0.971 (0.853,1.106)

Wild and hatchery sockeye salmon adults at Auke Creek. Hatchery fish were produced from lake-stocked fry and age zero smolts at Auke Creek

mumber of adults

Total annual biomass of sockeye salmon smolts leaving Auke Lake and the trend over all years

trends for each group.

20

Average length of age-1 and -2 sockeye salmon smolts leaving Auke Lake with linear

-	-	-			
_	3	5		6	-
0	0	0	0	0	-
0	0	0	0	0	0
	<u> </u>	2	2	2	\sim

Auke Creek Populations are Shifting Migration Patterns in Response to Climate Change

 Almost all juveniles and adults are migrating earlier – Taylor, Kovach et al

 Some shifts represent genetic , evolutionary change – Kovach et al

 Species that are ecologically linked are adjusting similarly – Sargeant et al, Bell et al.

Pink Salmon Fry Production has been Low in Recent Years

Variation in Marine Survival

Adult Coho Mean Length vs. Time 1981-2012 Josh Russell et al.

Summary

Temperature and Flow Patterns are Changing

Migration Timing

- Populations are generally stable

- Juvenile smolt condition is high

Concern over Impacts of Low Flow/High Temp Events at Critical Periods

 Most are migrating earlier, and over a shorter time period So far no evidence of severe mis-match ecologically - Size of coho salmon adults is changing (more from Leon Shaul ADFG) Species ecologically connected seem to be shifting together

Can Populations continue to adapt and maintain productivity?

Thank You All !!! Questions or Comments ???