WF4133-Fisheries Science

Class 24 Climate change & fisheries

Housekeeping

- 1st drafts have been returned
  - Learning objective: technical writing is bland, don't overthink it…
- Presentations will be Monday 4/24
  - 5 groups @ ~15 minutes per group = 1.25 hrs
- Final draft due May 4th 11 am.

Housekeeping

- Final Exam Wednesday May 3rd 8-11 am

MWF, MW, M, W, F CLASSES

If Class Meets		Exam Will Be		
8:00 am	MWF	Thu	May 4	8:00 am to 11:00 am
9:00 am	MWF	Wed	May 3	8:00 am to 11:00 am
10:00 am	MWF	Tue	May 2	8:00 am to 11:00 am
11:00 am	MWF	Thu	May 4	12:00 pm to 3:00 pm
12:00 pm	MWF	Fri	Apr 28	12:00 pm to 3:00 pm
12:30 pm	MW	Fri	Apr 28	12:00 pm to 3:00 pm
1:00 pm	MWF	Mon	May 1	12:00 pm to 3:00 pm
2:00 pm	F	Thu	May 4	3:00 pm to 6:00 pm
2:00 pm	W	Thu	May 4	3:00 pm to 6:00 pm

http://www.registrar.msstate.edu/students/schedules/exam-schedule/s/?year[value][year]=2017&semester=spring

Homework (20 points)

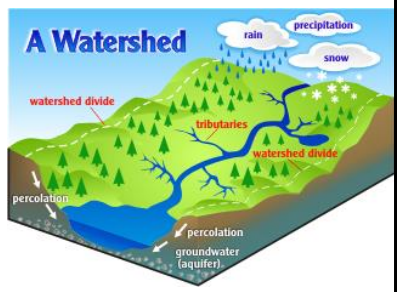
- Provide 1 multiple choice question you believe is a good candidate for a final exam question
- Provide 1 question, that is not multiple choice, you believe is a good candidate for a final exam
- Provide 1 question or topic you would like to see reviewed prior to the final exam. (Optional)
- http://goo.gl/forms/OppPJlMzOc
- For full credit your responses are due by 5pm 4/24/2016.

CLIMATE CHANGE & FISHERIES

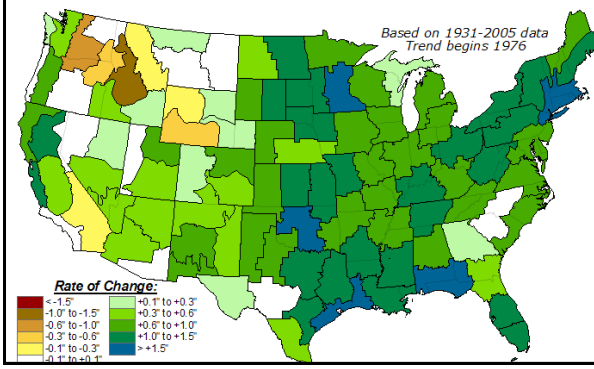
Something we are wrestling with

Climate change & water

- Amount
- Temperature



Precipitation trends



Amount

- Frequency of droughts
- Duration of droughts
- Changes/variability in precipitation
- Changes in snowpack

Amount

Amount

2014 versus 2017

Politics and Social Issues

« View the Politics and Social Issues Index

« View Other Columns

California Fisheries in Crisis:
impact of drought and illegal marijuana grows

Upcoming forum focuses on historic drought and marijuana grows and their devastating impact to California watersheds - Hearing set for July 1 in Sacramento

Senator Mike McGuire (D-North Coast), chairman of the Joint Committee on Fisheries and Aquaculture, announced today that a hearing on the impacts of the drought and marijuana grows on fisheries will be held **Wednesday, July 1 at the State Capitol in Sacramento**.

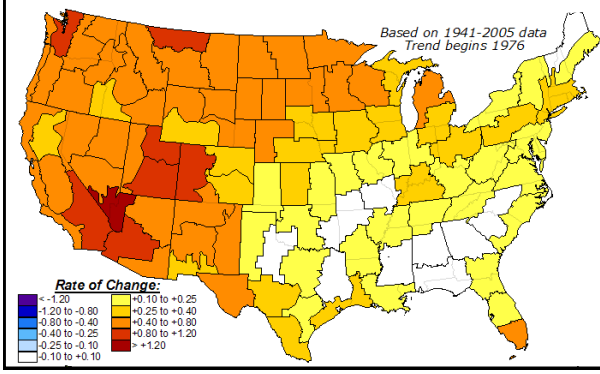
"In our fourth year of this historic drought, we have to find ways to protect our fisheries from the impacts of the driest years on record, and the devestating impacts of rogue marijuana grows. The combination of the drought and rogue grows have resulted in unprecedented fish kills, have put endangered species on the brink in many

California Drought Has Wild Salmon Competing With Almonds For Water

ALASTAIR BLAND

A young Chinook salmon, called a smolt, near Vallejo, Calif., on April 24, 2014. North Coast tribes and environmentalists fear that the smolts and Chinooks may not survive this year's low river flows and warm water.

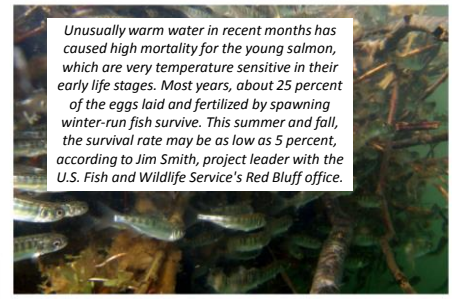
Temperature trends



Big Trouble Looms For California Salmon — And For Fishermen

NOVEMBER 06, 2015 1:28 PM ET

ALASTAIR BLAND



Unusually warm water in recent months has caused high mortality for the young salmon, which are very temperature sensitive in their early life stages. Most years, about 25 percent of the eggs laid and fertilized by spawning winter-run fish survive. This summer and fall, the survival rate may be as low as 5 percent, according to Jim Smith, project leader with the U.S. Fish and Wildlife Service's Red Bluff office.

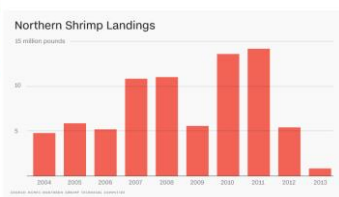
Juvenile Chinook salmon swim in the American River in California. The state's salmon fishery, which revolves around fall-run Chinook, has been estimated to be worth $1.4 billion, with the fish finding their way into markets and restaurants.

No shrimp today: Maine's waters are

Why is the Gulf of Maine warming?

Scientists aren't certain, but Appelman and other experts suspect climate change is playing a role.

The world's oceans in general are warming, partly because the atmosphere is getting hotter and oceans absorb that heat. But there's something particularly fishy going on in the Gulf. It's warming faster than most other places on earth.



Maine's fishing industry has been declining for years due to factors like overfishing and increased regulation, but there's another culprit eating away at profits: Maine's ocean waters are warming – and it's killing northern shrimp.

Goethel, Gamage and other fishermen used to look forward to shrimping as a way to augment their income in the cold New England winters.

"Now, I see a lot of those same people, they've got 4-wheel trucks and they're trying to plow snow to take in some kind of income," Goethel says.

Regulators measure the size of Maine's Northern Shrimp.

Regulators at the Atlantic States Marine Fisheries Commission banned commercial shrimping in 2014. The goal was to give northern shrimp a chance to repopulate. While the ban has helped, regulators are still worried about the species' survival.

"You get stronger survival rates with cooler temperatures," explains Max Appelman, the commission's fishery coordinator.

Climate & us

El Nino shaping up nicely

12 hours ago

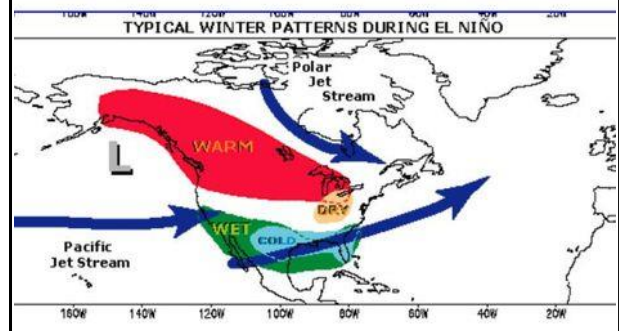
The numerical models continue to point to a strong El Nino event bringing the promise of heavy winter rains. About two month ago, I had some concerns that it may not bring abundant rainfall, a lot of these apprehensions have gone away, and here's why.

Last year, I and many others predicted abundant rainfall. Obviously, my prediction didn't come to pass — in large part because of decreasing seawater temperatures in the Nino 3.4 region (an area in the east-central equatorial Pacific) during the vital months of winter.

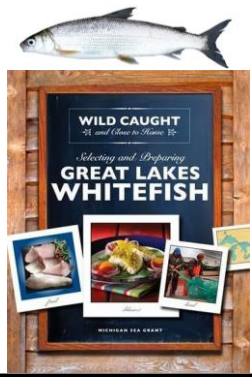
But this year, it's different — with each month's oceanographic observations and predictions, it is becoming more likely that seawater temperatures will peak during December, January and February, usually our wettest months.

Another worry was the "blob" of abnormally warm seawater off the Pacific Northwest and what has been dubbed the Ridiculously Resilient Ridge of high pressure there. But that area of high pressure has weakened considerably. Consequently, the blob is just about gone.

Many climatologists thought the southern branch of the polar jet stream that traditionally brings winter storms to our area would be driven north by the blob, keeping storms to the north of the Central Coast.



Lake Whitefish



Lake Whitefish

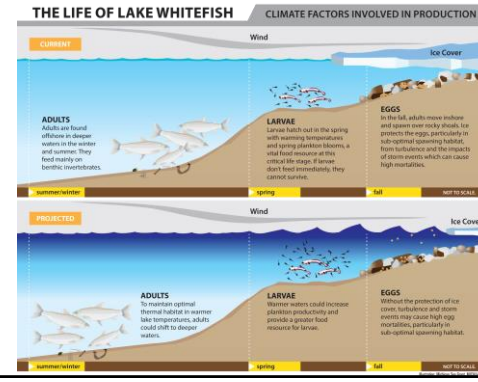
- Spawn in fall
- Hatch in spring

"Research has observed positive relationship between recruitment and spring temperatures and ice cover and a negative relationship between recruitment and fall temperatures and fall wind speed."

The other foot

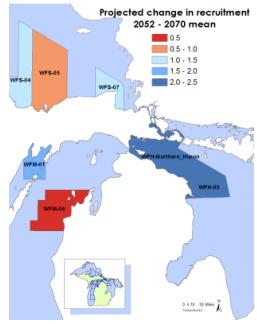
"However, warmer fall temperatures, more wind, and less ice cover may inhibit egg survival and, consequently, Lake Whitefish production."

Climate drives recruitment?

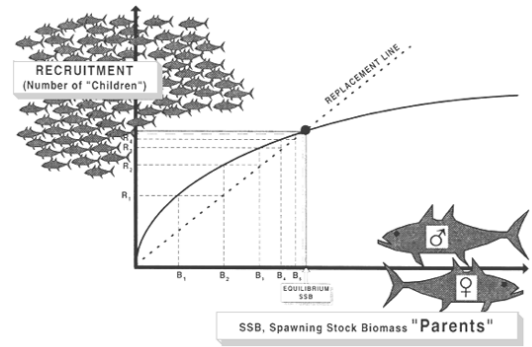


Results

"Potential for increased Lake Whitefish recruitment in the Great Lakes with climate change and some shift in the distribution of the fishery."



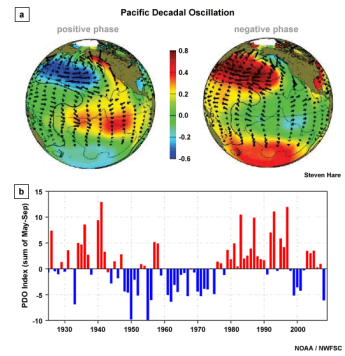
Spawners drive recruitment?



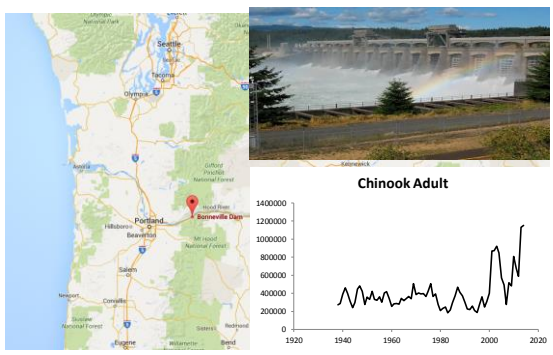
Disentangle climate and fishing?

- Tough to determine
- *"Temperature increased by 2 degrees and survival will decrease 5%"*
- Long time scales…

Pacific decadal oscillation

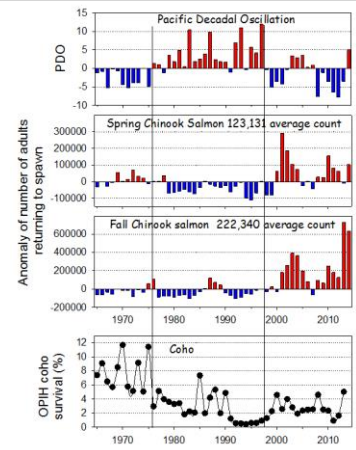


Pacific decadal oscillation



Salmon

- Columbia stocks
- Passing Bonneville Dam



UW TODAY

January 14, 2013

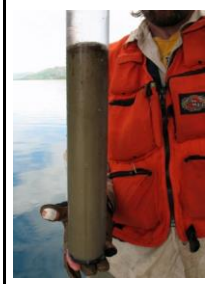
Salmon runs boom, go bust over centuries

Sandra Hines
News and Information

Salmon runs are notoriously variable: strong one year, and weak the next. New research shows that the same may be true from one century to the next.

Scientists in the past 20 years have recognized that salmon stocks vary not only year to year, but also on decades-long time cycles. One example is the 30-year to 80-year booms and busts in salmon runs in Alaska and on the West Coast driven by the climate pattern known as the Pacific Decadal Oscillation.

Now work led by University of Washington researchers reveals those decadal cycles may overlay even more important, centuries-long conditions, or regimes, that influence fish productivity. Cycles lasting up to 200 years were found while examining 500-year records of salmon abundance in Southwest Alaska. Natural variations in the abundance of spawning salmon are as large those due to human harvest.



Researchers gathered sediment cores from lakes in 16 major watersheds in southwestern Alaska. ***Lauren Rogers/U of Washington***

Cycles lasting up to 200 years were found while examining 500-year records of salmon abundance in Southwest Alaska. Natural variations in the abundance of spawning salmon are as large those due to human harvest.

Take home message

Recruitment camps:

1. Climate driven
2. Spawner driven

Need both…

Minimize excessive recruit overfishing so when conditions are good recruitment can happen…

EFFECTS ON FISHERIES

Coolwater species received most attention
Effects on predation and so on unexplored…

Effects on fish and fisheries

1. Closures
2. Movement
3. Disease

Dozens of sturgeon found dead in Columbia River

Originally published July 16, 2015 at 6:56 am | *Updated July 16, 2015 at 12:23 pm*

Sophia Murillo of Kennewick, left, and Frank Carr of Sequim wade into the Columbia River Wednesday to check out an estimated seven-foot long dead sturgeon at the east end of Pasco's Wade Park near Road 39. State fish.. (Bob Brawdy/Tri-City Herald) More

Washington Fish and Wildlife officials have received repeated reports of dead sturgeon this week on the Columbia River, but the exact cause of death remains a mystery.

http://www.seattletimes.com/seattle-news/dozens-of-sturgeon-found-dead-in-columbia-river/

Hoot owl closures

Heat wave spells early trouble for Montana trout

JUNE 24, 2015 BY LAURA LUNDQUIST

River levels are dropping rapidly as summer temperatures continue to climb, and both trends spell trouble for Montana's trout. As Montana Fish, Wildlife & Parks prepares for fishing closures, anglers can do some things to help fish out.

By Saturday, high temperatures are predicted to top 100 degrees and stay that way at least through Wednesday for parts of western Montana. That's 20 to 25 degrees above normal for this time of year and the extended heat wave will break records,

Hoot owl

FISHING

Go fishing: Hoot owl restrictions lifted on some western Montana rivers

AUGUST 19, 2015 8:52 PM • BY PERRY BACKUS

Longer nights and cooler water temperatures mean an end to fishing restrictions on three of western Montana's most favored trout rivers.

Montana Fish, Wildlife and Parks lifted "hoot owl" restrictions on the Bitterroot, the entire main stem of the Blackfoot and the Clark Fork, downstream of the Rock Creek confluence Wednesday.

The rivers had been under the restrictions that prohibit fishing from 2 p.m. to midnight since July 3 in an effort to reduce the impact on drought-stressed trout.

FWP's Bitterroot fisheries biologist Chris Clancy said this has been an unusual summer temperature-wise.

"On most years, you could bet money and win that peak water temperatures would appear sometime in the last week of July or first week of August," Clancy said. "This year, the temperatures peaked in late June, early July. It looked really grim for trout back then."

Some timely rains and periodic breaks in the heat made a difference this summer for the Bitterroot River.

"It really didn't turn out all that badly this year," Clancy said.

The state begins to consider instituting "hoot owl" restrictions when water temperatures go over 72 degrees for three consecutive days. Temperatures need to drop below 70 degrees for the same amount of time before the restrictions are withdrawn.

While the upper reaches of the Bitterroot remained cooler due to releases from Painted Rock Reservoir this summer, Clancy said the river downstream of Hamilton started hitting 73 degrees in late June.

In the same time period, water temperatures rose to 76 degrees in the lower reaches of the Bitterroot River near Missoula.

"Trout really don't like 70-degree water all that well," Clancy said.

The preferred water temperature for rainbow and brown trout is around 55 to 65 degrees. Temperatures in the mid 60s are stressful to native bull and westslope cutthroat trout.

Movement

Warmer waters shake up Shore fishing

BY JAMES M. O'NEILL

Malin Pinsky, a marine biologist with Rutgers University, has studied how rising ocean temperatures have affected the commercial and recreational fishing industries off the Jersey Shore.

A dramatic rise in ocean temperature is changing the kinds of fish that swim off New Jersey's coast — a development that has significant ramifications for the state's fishing industry and could even alter restaurant menus.

Species that used to be centered off New Jersey, like shad, have shifted north to New England in search of cooler waters. Fish once centered off Virginia, like black sea bass and summer flounder, now swim in abundance off New Jersey.

"We've been seeing unprecedented warming in the ocean over the past several decades," said Malin Pinsky, a marine biologist at Rutgers University who has studied the changes. "Climate change and the warming of ocean waters is not some abstract global problem. We can see the implications right off our shore in New Jersey."

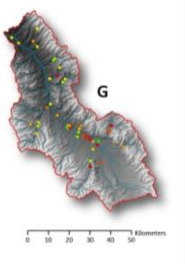
Temperatures had risen one degree every 14 years off New Jersey since the 1970s. In the past decade, warming has accelerated to one degree every 2½ years, Pinsky said.

"Marine fish are very sensitive to a change in temperature — they can only survive in a narrow range, so they are seeking out cooler waters toward the poles and deeper in the ocean," he said. "And deeper generally means farther from shore."

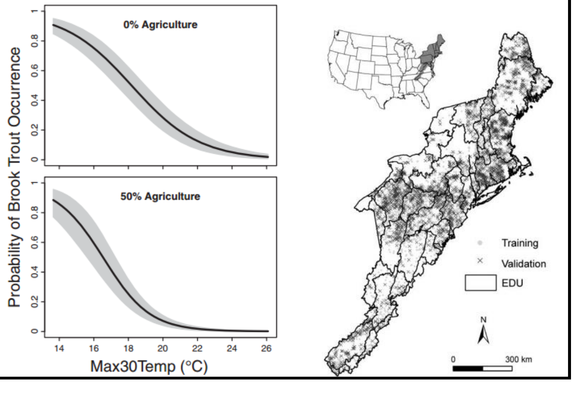
Malin Pinsky, a marine biologist with Rutgers University, has studied how rising ocean temperatures have affected the commercial and recreational fishing industries off the Jersey Shore.

Within stream networks

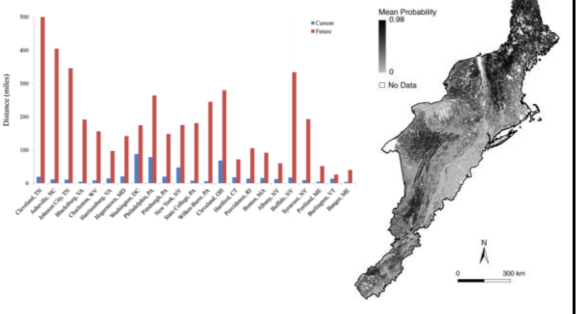
- Move towards cooler water, if available…



Brook trout



Effect on fisherman



Transport thermal barriers

Truckin': Salmon Take A Long, Strange Trip To The Pacific Ocean

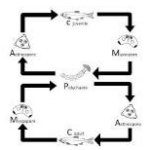
MARCH 26, 2014 3:21 AM ET

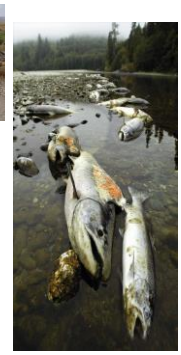
RICHARD GONZALES

Listen to the Story

Pacific Or Bust: Fingerling Chinook salmon are dumped into a holding pen Tuesday as they are transferred from a truck

Disease

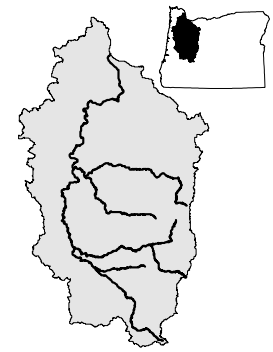




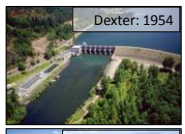
Willamette basin spring Chinook

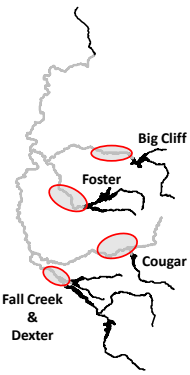
Anadromous species of conservation need

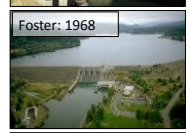
-Threatened status 1999
- Anthropogenic modifications



Limited natural reproduction

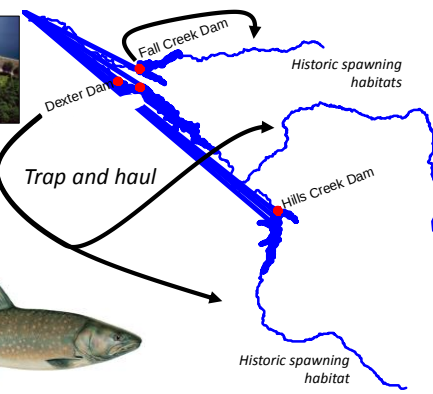




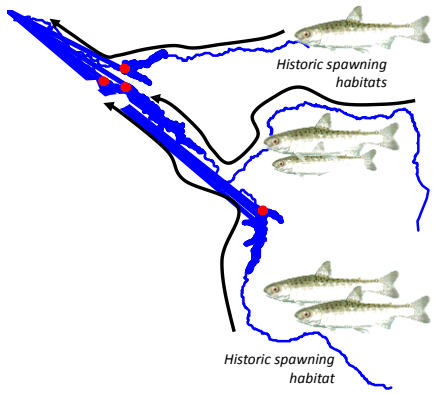


www.nwd-wc.usace.army.mil

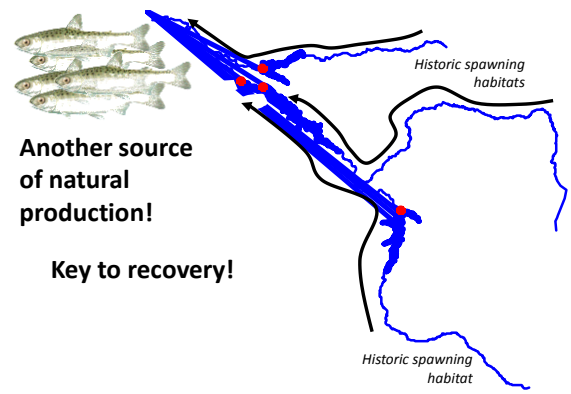
Natural production



Natural production



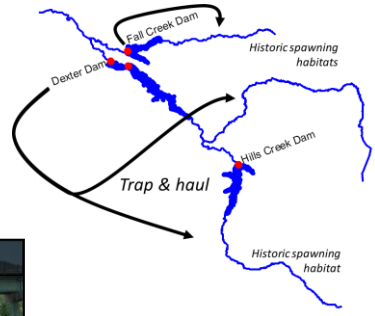
Natural production



Another source of natural production!

Key to recovery!

Reintroduction above dams

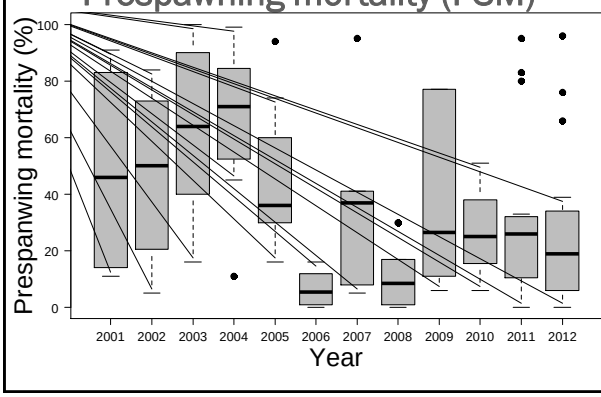


Problem: Prespawn mortality (PSM)

In excess of 90% in some years

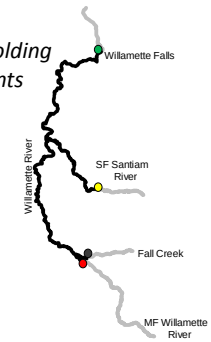
—Temperature

Prespawning mortality (PSM)

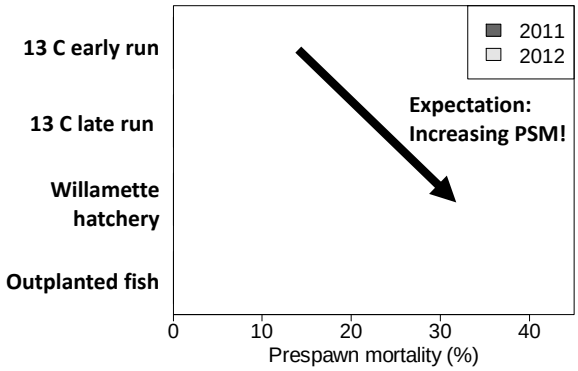


Holding in cool pathogen free water

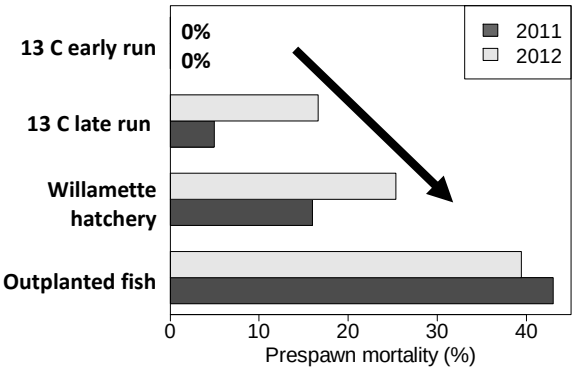
Annual holding experiments at ~ 13C



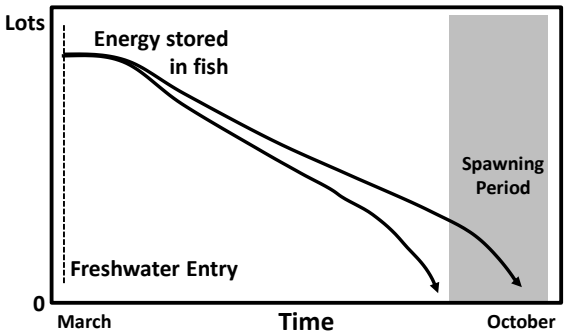
PSM and thermal exposure



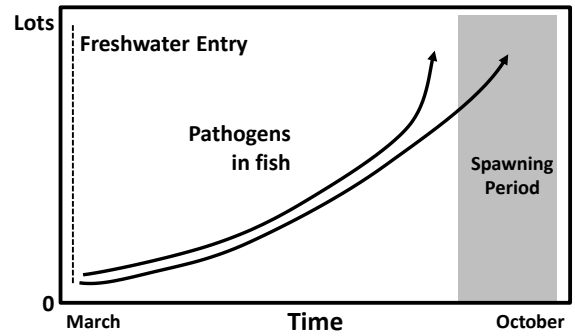
PSM and thermal exposure



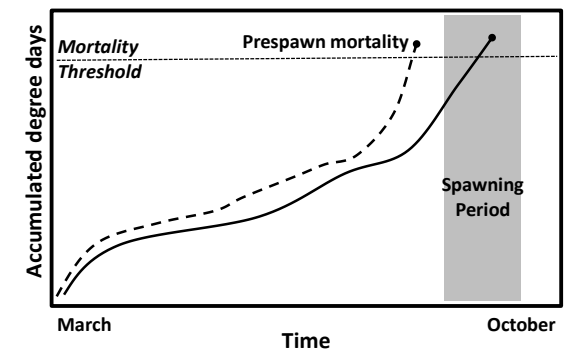
Race against time



Race against time



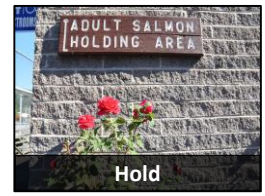
Race against time



Example management alternatives

Hypothesized to reduce PSM

1. Trap → outplant: prioritize brood stock
2. Trap → outplant: proportional allocation
3. Trap, hold @ hatchery →outplant

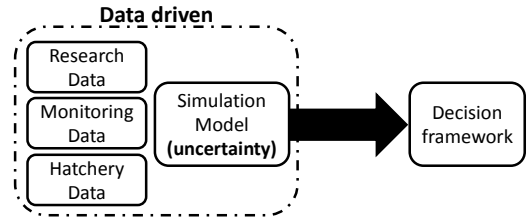


How do we decide?

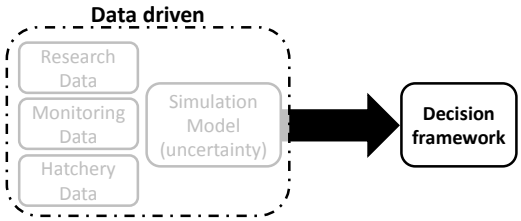
A decision framework

Structured decision making approach

1. **Simulation model**
2. **Decision model**



How do we decide?



What are decision models?

Focus on decision

1. Optimal decision
2. Account for uncertainty
3. Sensitivity of decision
4. Inform Research & Monitoring

An example

What is the optimal decision?