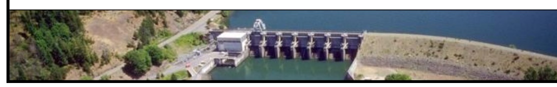
WFA8433-Natural Resource & Conservation Decision Making

Class 1

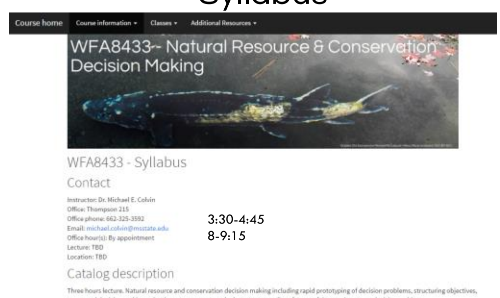
Introduction to decision making & PrOACT



Class website

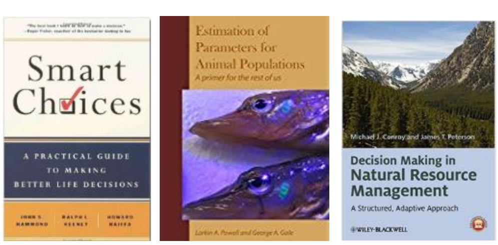
https://mcolvin.github.io/WFA8433-Natural-Resource-Decision-Making

Syllabus



3:30-4:45
8-9:15

Textbooks….



7.95 17.50 103.74

Class website

- https://mcolvin.github.io/WFA8433-Natural-Resource-Decision-Making/

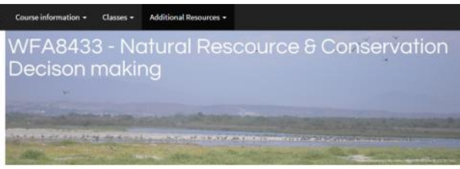
Class website

- Transparent
- Versioning
- Reproducible
- Collaborative
- Documentation
- Stakeholders

About the class

- Analysis is important!
- Link statistics to management actions!
- Freely available

Course home · Course information · Classes · Additional Resources



WFA8433 - R tutorials and resources

A great course on R for Fish and Wildlife Grads put together by folks at Oregon State University. It is 20 or so pages on relevant bits of R and other useful information (e.g., databases) geared toward new R users.

- R for Fish and Wildlife Grad

Here are some nice YouTube video tutorials about using R from the folks at Google.

- R 1.1 - Initial Setup and Navigation
- R 1.2 - Calculations and Variables
- R 1.3 - Create and Work With Vectors
- R 1.4 - Character and Boolean Vectors
- R 1.5 - Vector Arithmetic
- R 1.6 - Building and Subsetting Matrices
- R 1.7 - Section 1 Review and Help Files
- R 2.1 - Loading Data and Working With Data Frames
- R 2.2 - Loading Data, Object Summaries, and Dates

npr NOW
NPR 24 Hour Program Stream

all tech considered

20 Years Later, Humans Still No Match For Computers On The Chessboard

Listen · 7:17 Queue Download Transcript

October 24, 2016 · 5:36 PM ET
Heard on All Things Considered

ROBERT SIEGEL

Kasparov's confidence proved unjustified. In the years since, computers have built on Deep Blue's 1997 breakthrough to the point where the battle between humans and machines is not even close. Even chess grandmasters like author and columnist Andrew Soltis know this to be true.

"Right now, there's just no competition," Soltis says. "The computers are just much too good."

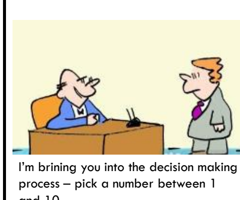
And as it turns out, some players prefer to stay away from computers as opponents, he says.

> Murray Campbell of IBM was part of the Deep Blue project. As he says, chess computers *do* play differently. They make moves that sometimes make no sense to their human opponents.
>
> "Computers don't have any sense of aesthetics or patterns that are standard the way people learn how to play chess," Campbell says. "They play what they think is the objectively best move in any position, even if it looks absurd, and they can play any move no matter how ugly it is."

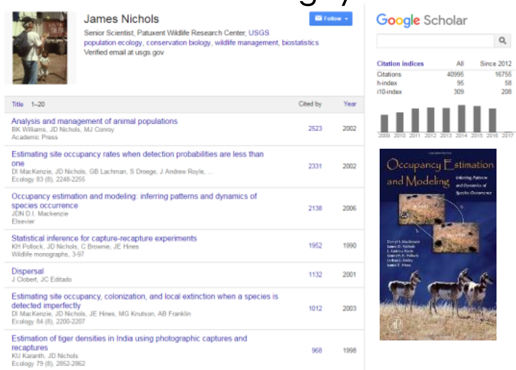
Human chess players bring preconceptions to the board; computers are unbound by habit.

And, unlike people, computers love to retreat, Soltis says.

Decision makers & managers, scientists, & stakeholders oh my…



A smart guy


James Nichols
Senior Scientist, Patuxent Wildlife Research Center, USGS
population ecology, conservation biology, wildlife management, biostatistics
Verified email at usgs.gov

Title 1–20	Cited by	Year
Analysis and management of animal populations BK Williams, JD Nichols, MJ Conroy Academic Press	2523	2002
Estimating site occupancy rates when detection probabilities are less than one DI MacKenzie, JD Nichols, GB Lachman, S Droege, J Andrew Royle, ... Ecology 83 (8), 2248-2255	2331	2002
Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence JDN D I. Mackenzie Elsevier	2138	2006
Statistical inference for capture-recapture experiments KH Pollock, JD Nichols, C Brownie, JE Hines Wildlife monographs, 3-97	1952	1990
Dispersal J Clobert, JC Estado	1132	2001
Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly DI MacKenzie, JD Nichols, JE Hines, MG Knutson, AB Franklin Ecology 84 (8), 2200-2207	1012	2003
Estimation of tiger densities in India using photographic captures and recaptures KU Karanth, JD Nichols Ecology 79 (8), 2852-2862	968	1998

An interview with Jim Nichols


INNGE International Network of Next-Generation Ecologists

Integrating science into conservation decision-making: an interview with Jim Nichols

Hari: In your talk at SCCS-Bengaluru, you said that the way in which scientists usually engage with park managers and conservation decision-makers is inefficient. Why do you think so?

Jim Nichols: I guess the first thing I should say is that inefficiency is not a horrible crime. It is just that, in the conservation world today, our dollars and efforts are so limited. If we can do better within our limited means, why not do so?

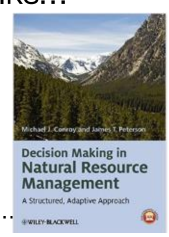
I think the inefficiency comes via a lack of communication and a lack of a central programme within which everyone works. What often happens - or at least what I have seen in my world - is a group of scientists interested in a particular system will get money for studying that particular system, claiming that what they learn will be useful to conservation folks. They will then go out and perform the study, learn something and then give

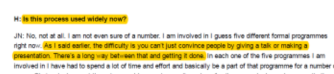
Themes….

- People & Natural Resources
  - Objectives
  - Interdisciplinary
  - Tranparent
  - Repeatable
- <u>Process</u> for making decisions….

Practicing folks…

- Mike Conroy, UGA
- Jim Peterson, UGA, OSU
- Elise Irwin & Connor McGowan, Auburn
- Mike Runge, Larrissa Bailey, Katriona Shea, Sarah Converse, Drew Tyre…
- An incomplete list




H: Is this process used widely now?

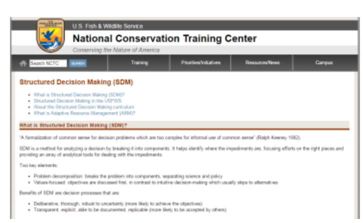
JN: No, not at all. I am not even sure of a number. I am involved in I guess five different formal programmes right now. As I said earlier, the difficulty is you can't just convince people by giving a talk or making a presentation. There's a long way between that and getting it done. In each one of the five programmes I am involved in I have had to spend a lot of time and effort and basically be a part of that programme for a number of

How did I drink the Cool Aid

- Tough to learn from a book….
- Apprenticeship?

How did I drink the Cool Aid

- Tough to learn from a book….

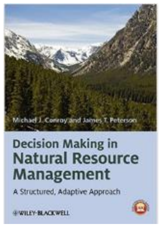

U.S. Fish & Wildlife Service
National Conservation Training Center
Conserving the Nature of America

Structured Decision Making (SDM)

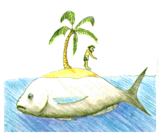
What is Structured Decision Making (SDM)?

How did I drink the Cool Aid

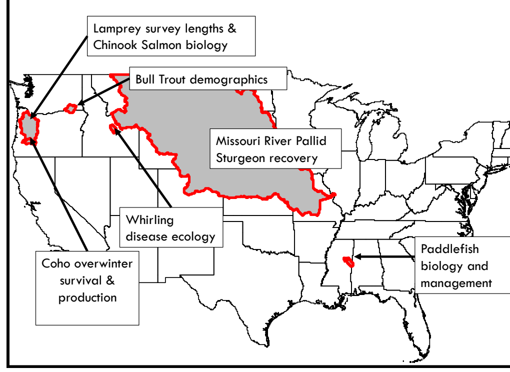
- Tough to learn from a book….



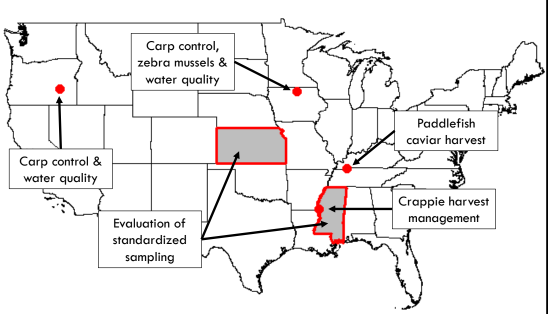
Folks…Stakeholders



Work on streams



Work on lakes and reservoirs

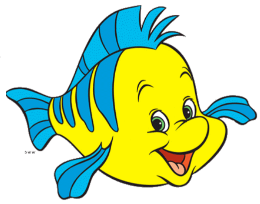


I am a bit fishy

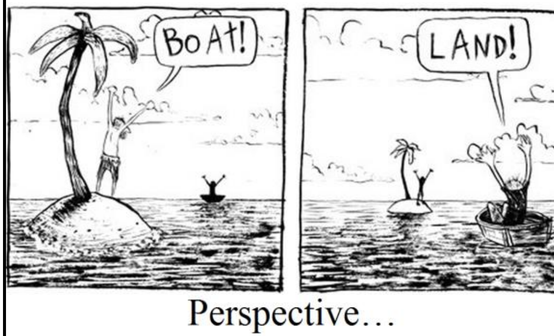
- A decision making process
- Applies to all management problems
- Experiences Research, SDM & ARM

I am a bit fishy

- Experiences Research, SDM & ARM
- Critical for buy in (more later in semester)
- How to think about decision making and your science



Perspective & Buy in



Challenges

1. Communication
2. Stakeholder involvement
3. Data-too little, too much
4. Finite resources
5. No management alternatives

1. Communication

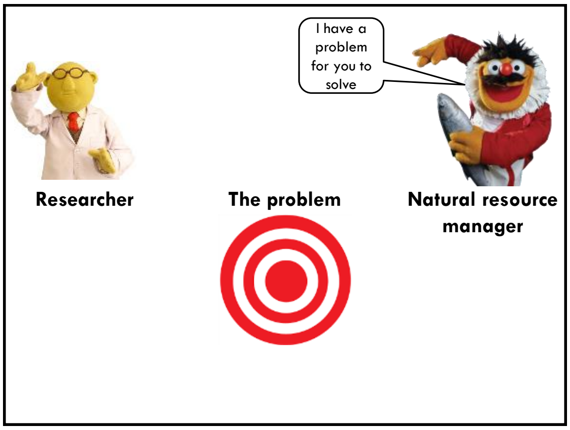
Integrating science into conservation decision-making: an interview with Jim Nichols

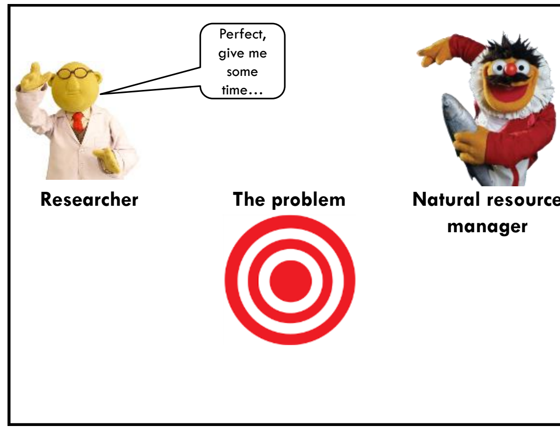
published by harisridhar on Mon, 01/18/2016 - 10:45
Citation for this post: BibTeX | RIS

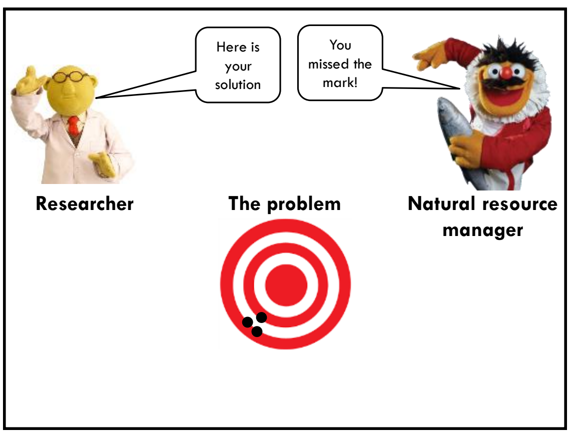
James D. Nichols has been a wildlife biologist with the US Geological Survey for more than 40 years and a long-

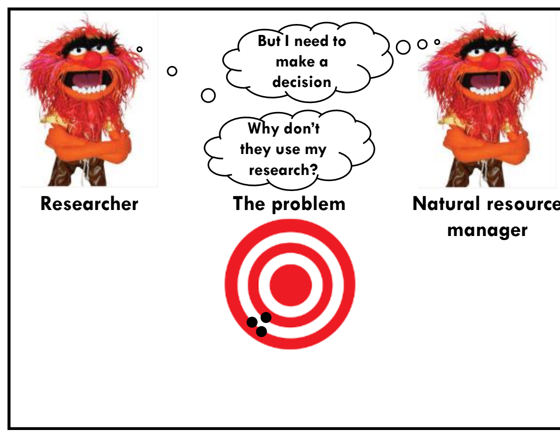
"I think the inefficiency comes via a lack of communication and a lack of a central program within which everyone works." J. Nichols

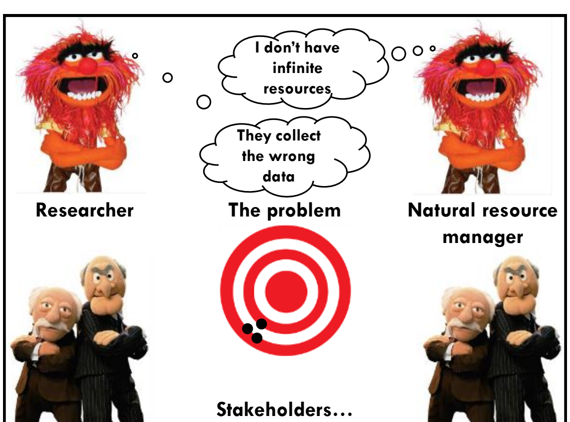
I think the inefficiency comes via a lack of communication and a lack of a central programme within which everyone works. What often happens - or at least what I have seen in my world - is a group of scientists interested in a particular system will get money for studying that particular system, claiming that what they learn will be useful to conservation folks. They will then go out and perform the study, learn something and then give that information to the manager or conservation guy who is actually on the ground doing things. I don't claim that what is learnt is never useful, but very frequently it doesn't hit the mark. In other words, what scientists learn is


I have a problem for you to solve
Researcher
The problem
Natural resource manager


Perfect, give me some time…
Researcher
The problem
Natural resource manager


Here is your solution
You missed the mark!
Researcher
The problem
Natural resource manager


But I need to make a decision
Why don't they use my research?
Researcher
The problem
Natural resource manager


I don't have infinite resources
They collect the wrong data
Researcher
The problem
Natural resource manager
Stakeholders…


2. Stakeholder involvement
Clear Lake Enhancement And Restoration Project
Making Clear Lake Clear Again!
The Nature Conservancy
BASS
Magnolia Crappie Club
Defenders of Wildlife
Golden Gate Fishermens Assoc
GGFA
TROUT UNLIMITED

Stakeholders Increasingly Interested & Judicious


IN THE UNITED STATES COURT
OF FEDERAL CLAIMS

Ideker Farms, Inc.; Lynn and Elaine Binder, Todd and April Binder, and Tyler and Valerie Binder; Richard Binder, Dustin Binder, and Darwin Binder dba Midwest Grain Co.; Eddie Drewes, Robert W. Drewes Recoverable Trust, Rita K. Drewes Recoverable Trust and David Drewes, individually and dba Drewes Farms, Inc.; Patrick Newlon dba Newlon Farms, Inc.; David Newlon
Plaintiffs,

v.

UNITED STATES OF AMERICA,
Defendant.

Case No.: ________

COMPLAIN
NATURE OF THE

1. Plaintiffs bring their claims for a takin
just compensation, by means of a significant and delib
Engineers ("the Corps" or "Corps") from its decade

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MONTANA
GREAT FALLS DIVISION

DEFENDERS OF WILDLIFE; and NATURAL RESOURCES DEFENSE COUNCIL,
Plaintiffs,

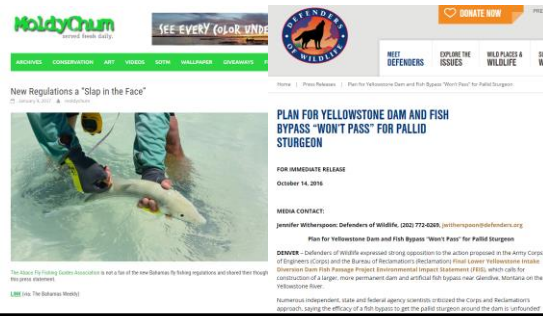
v.

UNITED STATES ARMY CORPS OF ENGINEERS; UNITED STATES BUREAU OF RECLAMATION; and UNITED STATES FISH AND WILDLIFE SERVICE,
Defendants.

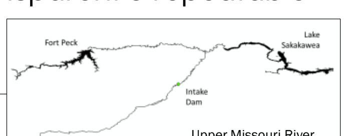
Case No.

COMPLAINT FOR DECLARATORY AND INJUNCTIVE RELIEF

Stakeholder visibility



Managers need to make decisions that are transparent & repeatable



BOZEMAN DAILY
CHRONICLE

Groups sue to save endangered pallid sturgeon

By By LAURA LUNDQUIST Chronicle Staff Writer

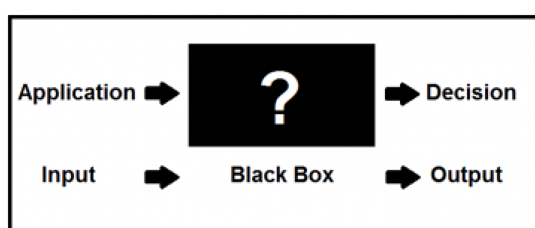
Posted: Monday, February 2, 2015 9:50 am

Environmental groups are suing federal agencies after Bozeman researchers provided additional evidence that Missouri River dams continue to endanger the pallid sturgeon.

On Monday, the Defenders of Wildlife and the Natural Resources Defense Council sued the U.S. Army Corps of Engineers, the Bureau of Reclamation and the Fish and Wildlife Service in a Great Falls federal district court for operating dams on the Yellowstone and Missouri rivers in such a way that endangers the pallid sturgeon.

The environmental groups are asking the judge to rule that the agencies violated the Endangered Species Act and order them to make immediate changes on two Montana dams — the Fort Peck and Intake Diversion dams — to save the upper Missouri population of pallid sturgeon.

Black box management

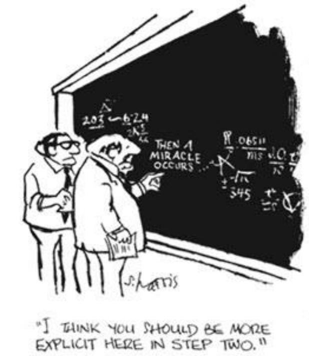


Managers have a model, even if they don't realize it

Mental models

- Increase habitat & population will increase
- Increase harvest & population will compensate

Unstated assumptions

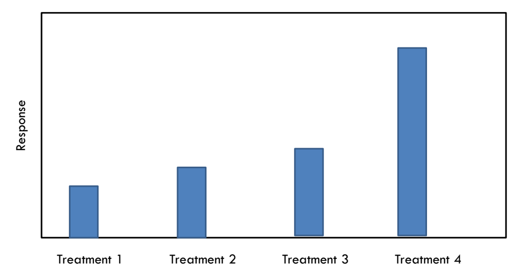


3. Data limitations

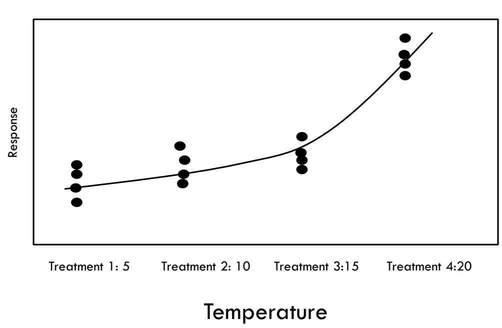
Fisheries biologist never complain about collecting too much data—Dr. Joe Bonneau

- What do we do with the data?
- Is it collected to meet <u>objectives</u>?
- How is it incorporated into management?

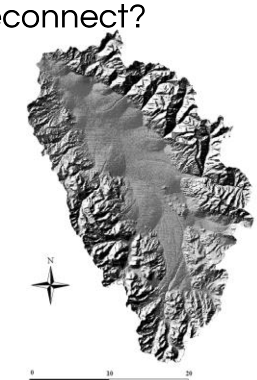
Effects versus prediction



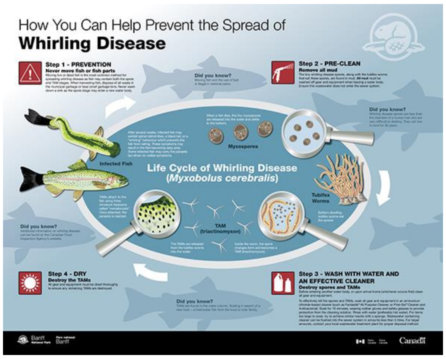
Effects versus prediction



What to reconnect?

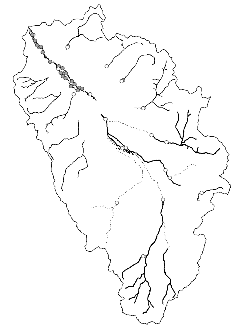


Whirling disease



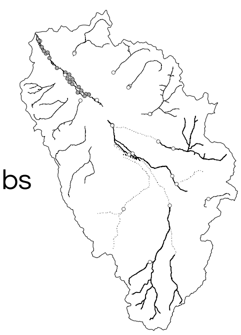
Many times data are not collected in a way that can be used to make a decision

"sites were statistically different"



Monitoring & Current System State

- Data represents "System state"
- Infected or not
- Objective: Minimize risk in tribs
- Cost



Estimating system state

- Monitoring
- State dependent decisions
  - Decision depends on whether downstream is infected (binary)
  - Decision depends on how infected downstream reaches are (continuous)

Formalize learning from data collected & monitoring?

Make smarter decisions…

4. Finite resources

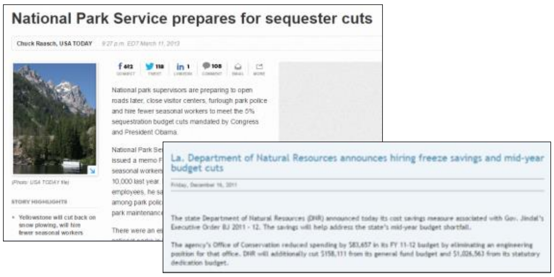
How do we prioritize monitoring?

How do we prioritize research?

If something has to be cut what should it be?

Will it impact decision making & management?

Managers need to do more with less & prioritize monitoring & research in a way that contributes to management decisions



National Park Service prepares for sequester cuts

Chuck Raasch, USA TODAY 9:27 p.m. EDT March 11, 2013

National park supervisors are preparing to open roads later, close visitor centers, furlough park police and hire fewer seasonal workers to meet the 5% sequestration budget cuts mandated by Congress and President Obama.

(Photo: USA TODAY file)

STORY HIGHLIGHTS

- Yellowstone will cut back on snow plowing, will hire fewer seasonal workers

La. Department of Natural Resources announces hiring freeze savings and mid-year budget cuts

Friday, December 16, 2011

The state Department of Natural Resources (DNR) announced today its cost savings measure associated with Gov. Jindal's Executive Order BJ 2011 - 12. The savings will help address the state's mid-year budget shortfall.

The agency's Office of Conservation reduced spending by $83,657 in its FY 11-12 budget by eliminating an engineering position for that office. DNR will additionally cut $158,111 from its general fund budget and $1,026,563 from its statutory dedication budget.

Managers need to figure out how to best allocate finite resources

July 21 - 25, 2008 Structured Decision Making Workshop

Optimal Budget Allocation for American Shad Conservation

A Case Study from the Structured Decision Making Workshop
July 21-25, 2008
National Conservation Training Center, Shepherdstown, WV, USA

11 Million allocated to Pallid Sturgeon research… How to allocate it?

5. Consider management alternatives

Court orders agencies to consider fewer hatchery fish for the Elwha

By Cassandra Profita
EARTHFIX

PORTLAND — A judge has ordered federal agencies to reconsider the number of planned hatchery fish releases into the Elwha River on Washington's Olympic Peninsula.

As crews finish the largest dam removal in history on the Elwha, managers are working to restore fish runs above the dam sites. Their plan includes releasing more than 7 million hatchery salmon and steelhead into the river.

That plan has been controver-

KATIE CAMPBELL | EARTHFIX

In this 2011 photo, Lower Elwha Hatchery Manager Larry Ward feeds the steelhead and coho that are raised in a hatchery for introduction to the Elwha.

In his opinion, the judge wrote that "the court is concerned with the spring coho and steelhead releases," and as the agencies consider options for releasing fewer hatchery fish, those proposed numbers "would be a good starting point for an agreement."

The National Marine Fisheries Service released a statement in response to the decision noting that the judge upheld the overall hatchery plan for the Elwha River.

"Numerous reviews and a broad consensus of scientists

Solutions

All MacGyver needed was a ball point pen and a paper clip

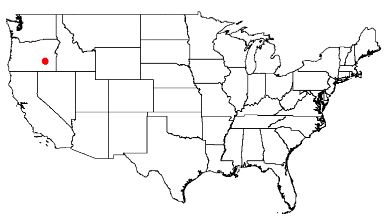
Biologists & ecologists spend time reading biology & ecology books

Biologists & ecologists spend time reading methods & statistics books

We do not read books about decision making & analysis

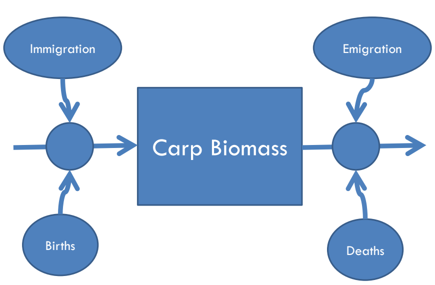
A Central Program

MALHEUR CARP MANAGEMENT

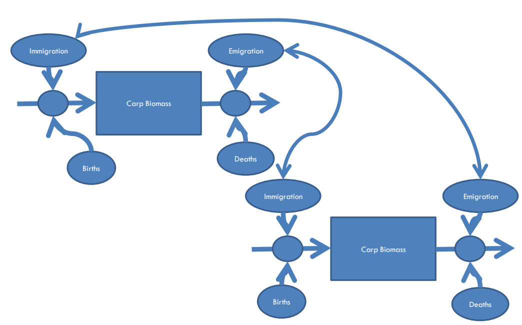


This $8*# is complicated & dynamic!

Conceptualizing population dynamics



Coupling populations

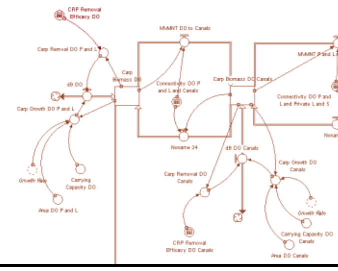


Strategies

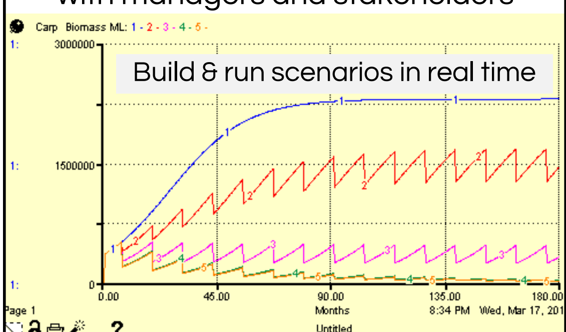
- Reduce connectivity
  - Refuges
  - Movement
- Reduce biomass

To A Simulation Model

- Spatial representation
- Logistic population model
- Allows movement



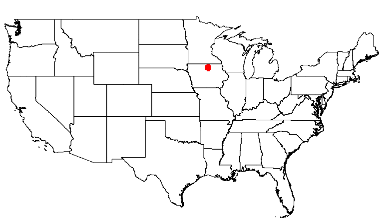
Powerful tool for communicating with managers and stakeholders



Outcomes

- Clear objectives
- Identified alternatives
- Explicit assumptions
- System understanding
- Stakeholder involved in process

CLEAR LAKE ECOSYSTEM MANAGEMENT



Clear Lake is valuable

Visitors spend an average **$43.36 million** annually

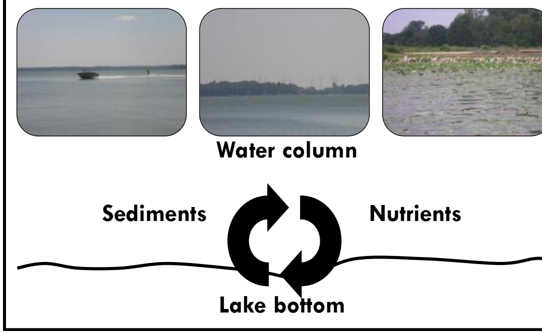
$1-3 million USD recreational fishery

Lake restoration in Iowa

State Legislation HF2782 (2006)

- 1.4 m Secchi disc transparency 50% of the time
- Water quality and public use benefits sustained at least 50 years.

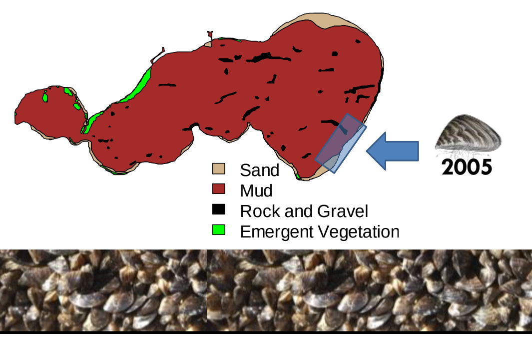
Water quality: internal processes



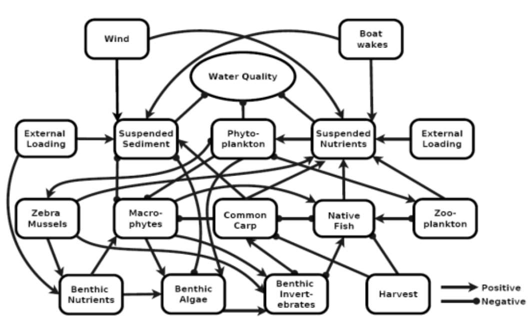
Managing carp biomass

- Pulsed intense removals over a short period
  - Large removals
  - Short duration
  - Spring and fall

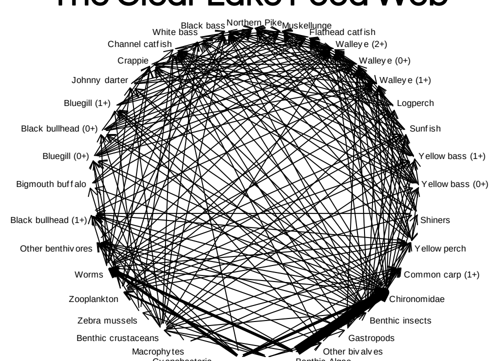
Zebra Mussels



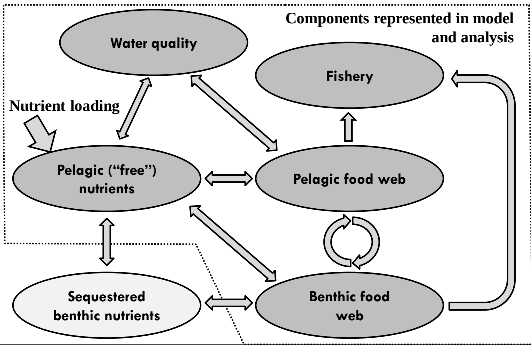
Clear Lake: a complex system



The Clear Lake Food Web



The Clear Lake Ecosystem Model (CLESM)

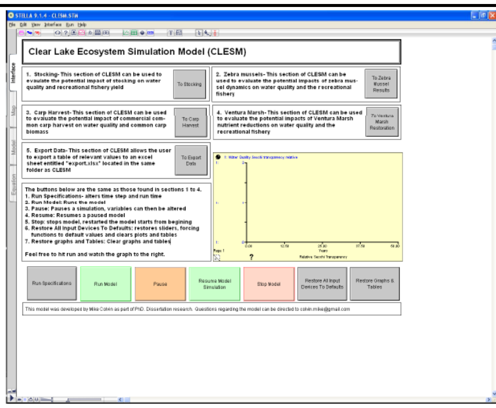


Lots of equations nobody will use… or ever look at

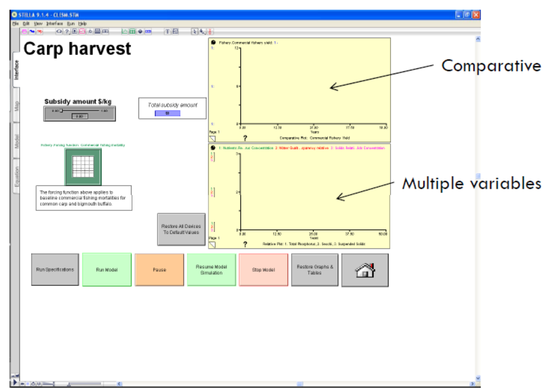
$$
\begin{aligned}
\frac{dBiomass_{juv,i}}{dt} &= Production_{juv,i} + B\ Stocked_{juv,i} \\
&\quad + Migration_{juv,i} + B\ Recruited_{juv,i} \\
&\quad - B\ Graduated_{juv,i} - B\ Predation_{juv,i} \\
&\quad - B\ Other\ mortality_{juv,i} \\
\frac{dN_{juv,i}}{dt} &= N\ Recruited_{ad,i} + N\ Stocked_{juv} - N\ Loss_{juv,i} \\
\frac{dBiomass_{ad,i}}{dt} &= Production_{ad,i} + B\ Migration_{ad,i} + B\ Graduated_{juv,i} \\
&\quad - B\ Recruited_{juv,i} - B\ Harvest_{ad,i} \\
&\quad - B\ Predation_{ad,i} - B\ Other\ mortality_{ad,i} \\
\frac{dN_{ad,i}}{dt} &= N\ Graduated_{juv,i} - N\ Loss_{adult,i}
\end{aligned}
$$

$$
\begin{aligned}
\frac{dBiomass_i}{dt} &= Production_i + Stocking_i + Migration_i \\
&\quad - Harvest_i - Predation_i - Other\ mortality_i
\end{aligned}
$$

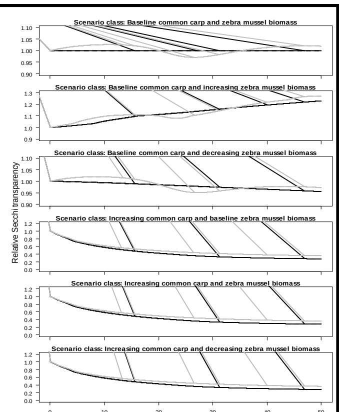
$$
Production_i = \begin{cases} Primary\ production, & i = producer \\ Consumption, & i = consumer \end{cases}
$$



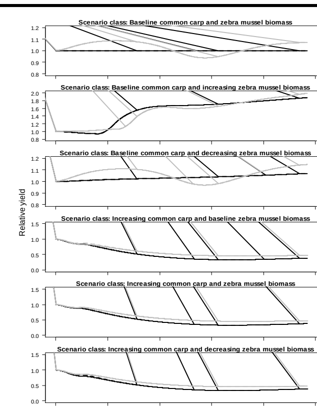
Carp harvest



Water quality



Recreational fishery yield



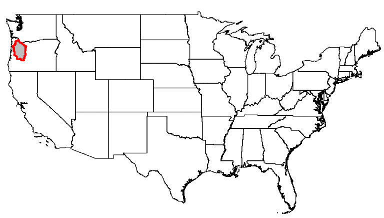
Outcomes

- Finite resources-where to target restoration efforts
- Transparency
- Explicit assumptions
- Communication with stakeholders & managers

Better, but….

- Clear objectives
- Model of dynamics
- Monitoring and system state
- Predict effect of management actions
- NO UNCERTAINTY..

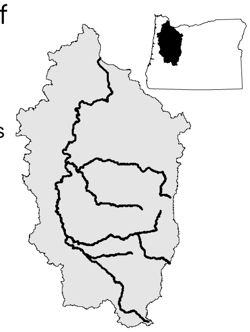
SPRING CHINOOK SALMON RECOVERY



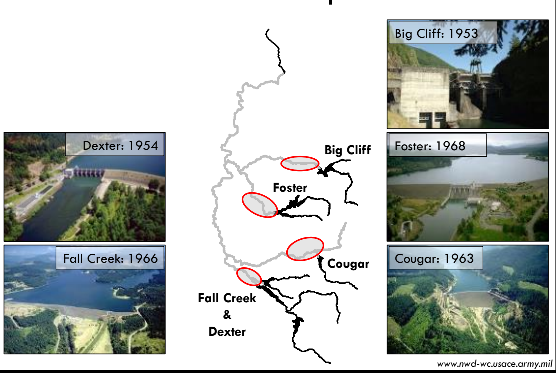
Willamette basin spring Chinook

Anadromous species of conservation need

-Threatened status 1999
- Anthropogenic modifications



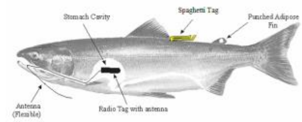
Limited natural reproduction



Just to die before spawning

Lots of money in Chinook Recovery

- Tagging

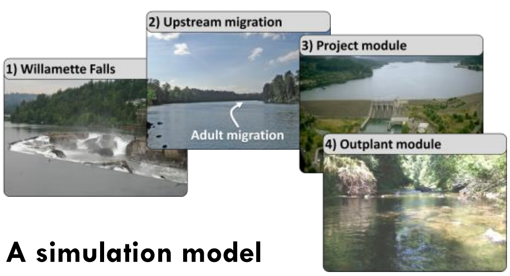


- Transporting
- Monitoring

30+million a year

Data & sources

Run timing at Willamette Falls	Pathogen burdens	Project trap Counts (Foster, Dexter, Cougar Pointe)
Run composition and migration rates	Transport mortalities	Fall Creek trap counts
Holding & outplant	Pathogen free holding	Energetic status and condition
Water quality	Stream flow and temperature	

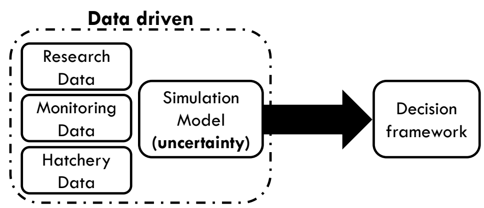


A simulation model to assimilate all the information

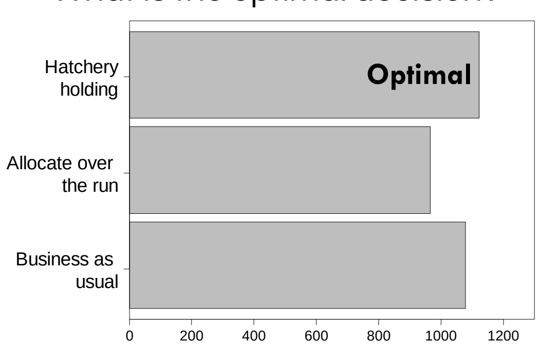
A decision framework

Structured decision making approach

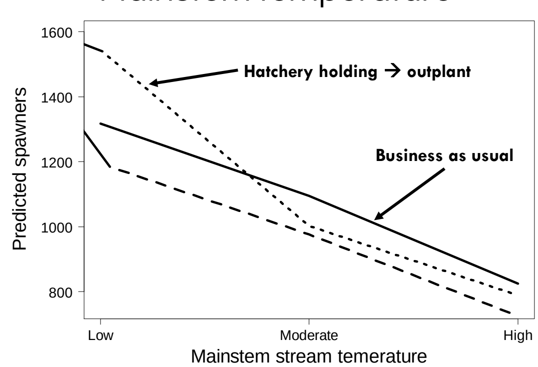
1. **Simulation model**
2. **Decision model**



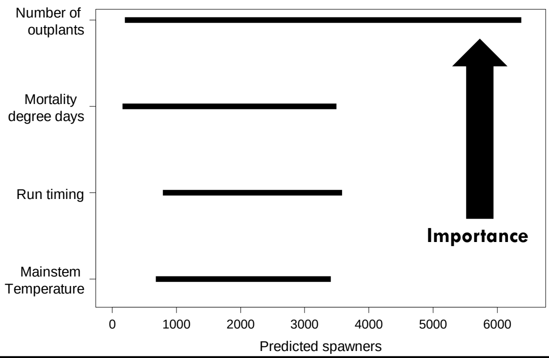
What is the optimal decision?



Mainstem temperature



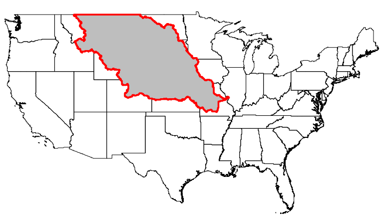
Informing research and monitoring



Outcomes

- Finite resources-where to target restoration & monitoring
- Transparency
- Explicit assumptions
- Communication with stakeholders and managers
- Using monitoring to learn

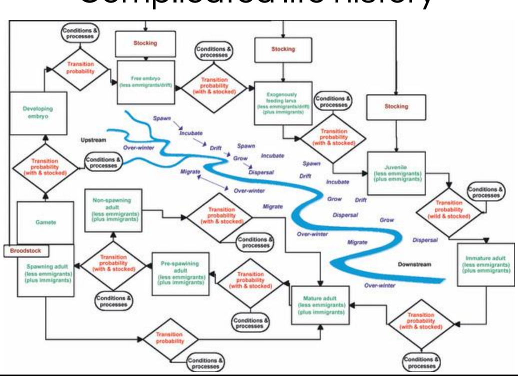
PALLID STURGEON RECOVERY



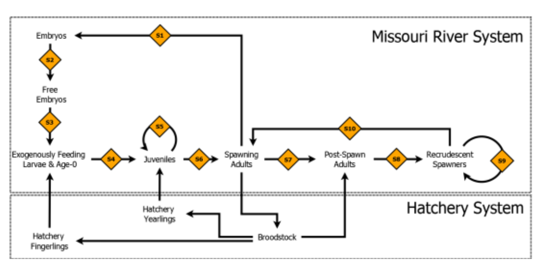
Ongoing over several decades

- 53+ Million annually recovery
- Active stakeholder group-MRRIC
- Multi attribute decisions
  - Human considerations
  - Recovery
  - Terns & Plovers
- 700 million over 10 years

Complicated life history



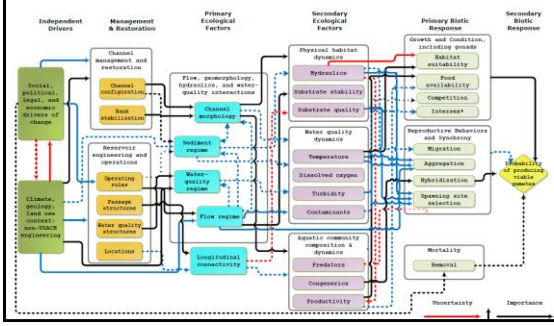
Stage based model



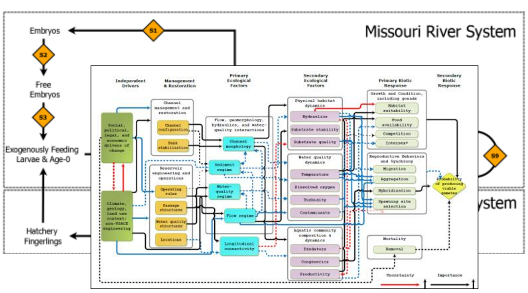
Collaborative model

- Build on existing work-stage based matrix type
- Collaborative
- Flexible
- Fits within Effects Analysis

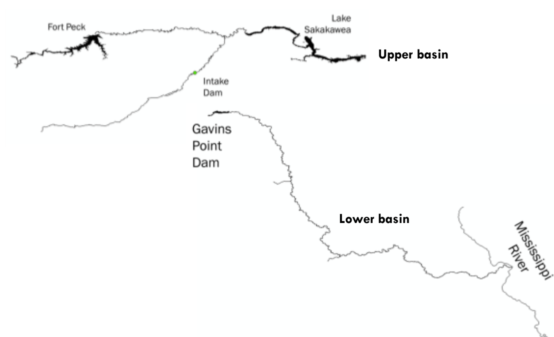
Conceptual Ecological Models



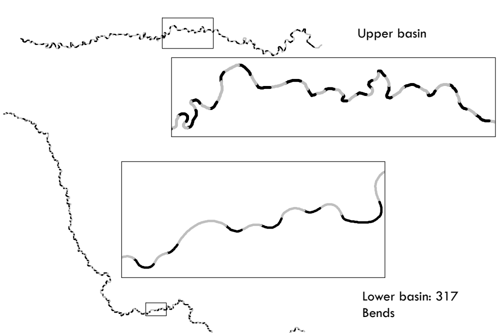
Linking CEMs



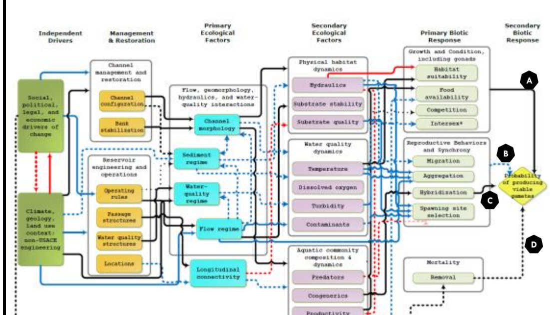
Spatial extent



Spatial grain



Linking management & science



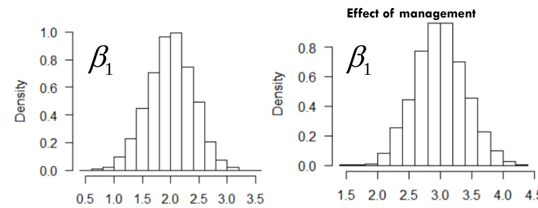
Effects function

$$\text{A)}\quad Y = \beta_0 + \beta_1 \cdot A_1 + \beta_2 \cdot B_2 + \beta_3 \cdot C_3 + \beta_4 \cdot D_4$$

$$\text{B)}\quad \Pr_{viable\,gametes} = exp(Y)/(1+exp(Y))$$

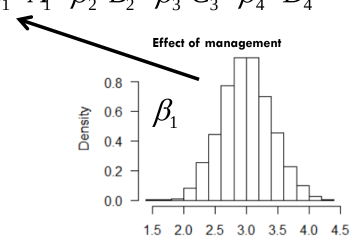
Can estimate parameters by capture-recapture (monitoring), field experiments, or expert elicitation

Linking Information

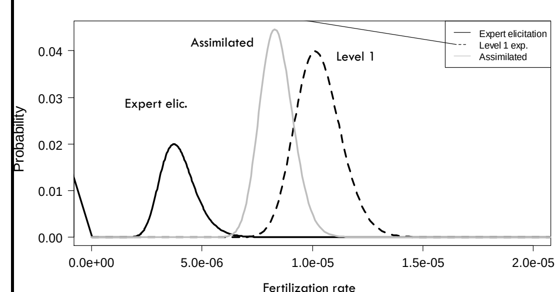


Effects function

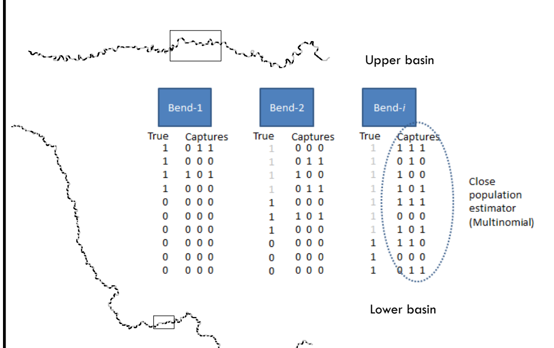
$$\text{A)}\quad Y = \beta_0 + \beta_1 \cdot A_1 + \beta_2 \cdot B_2 + \beta_3 \cdot C_3 + \beta_4 \cdot D_4$$

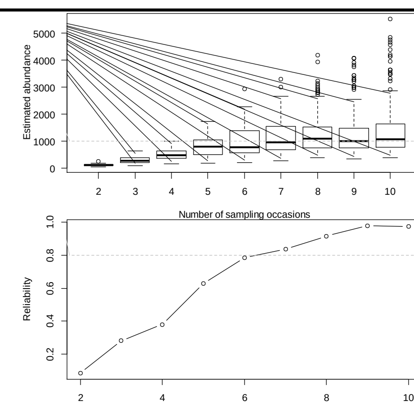


Formalize learning...

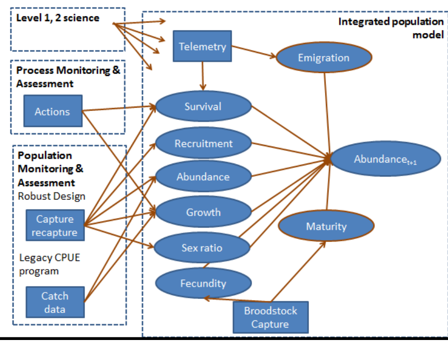


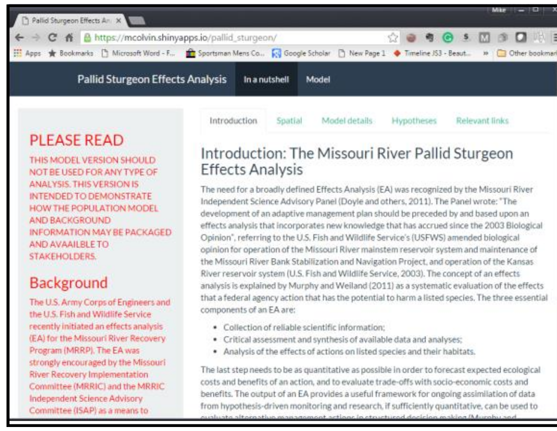
Population monitoring

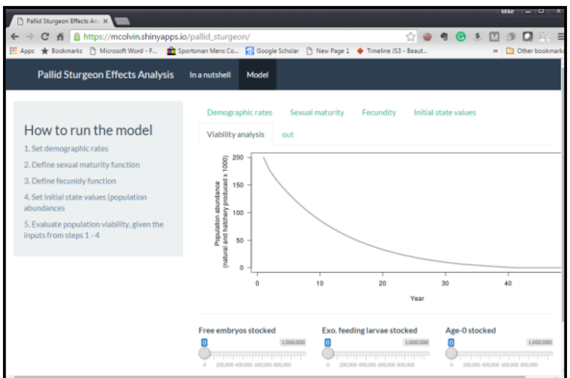




Integrated population model







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A Central Program