From the molecular interactions to population risk to ecosystem services, a risk assessment adaptive management approach for the Salish Sea

Wayne G. Landis[1], John D. Stark[2], Katherine E. von Stackelberg[3], Chelsea J. Mitchell[2], Valerie R. Chu[1] Lindsay K. Wallis[1], Christopher Trinies[1], and April J. Markiewicz[1]

1-Western Washington University
2-Washington State University Extension Puyallup
3-Harvard University

This is has been a quantitative session describing toxicological effects at a variety of scales

1. Chu-chinook, pesticides, environment and four watersheds

2. Spromberg-Pacific herring and localized oil spills

3. Mitchell-chinook, pesticides, environment and patch dynamics

4. Bard-recolonization of intertidal community and restoration

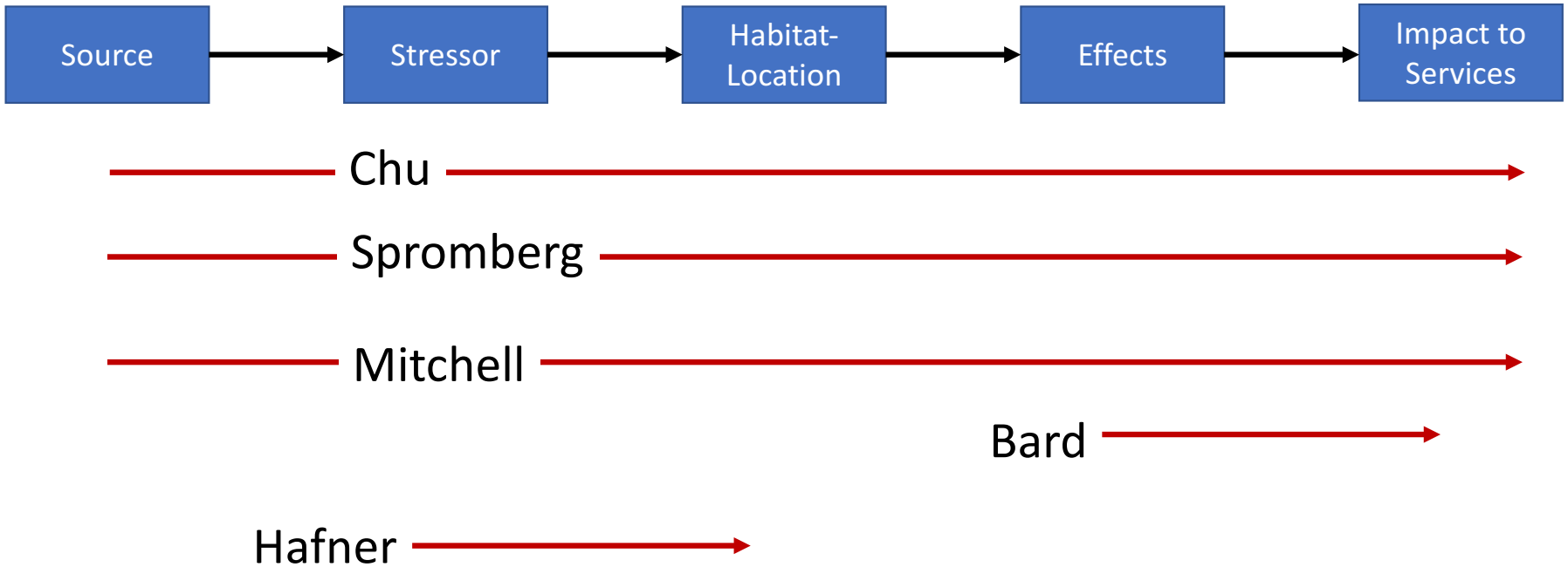
5. Hafner-Multivariate analysis and background concentrations

The Question..

How can the varied types of information be incorporated into an adaptive management process for decision making?

It can be incorporated by using risk as the metric and imbedding it into a multifaceted quantitative adaptive management framework.

The steps today-Describing Causality



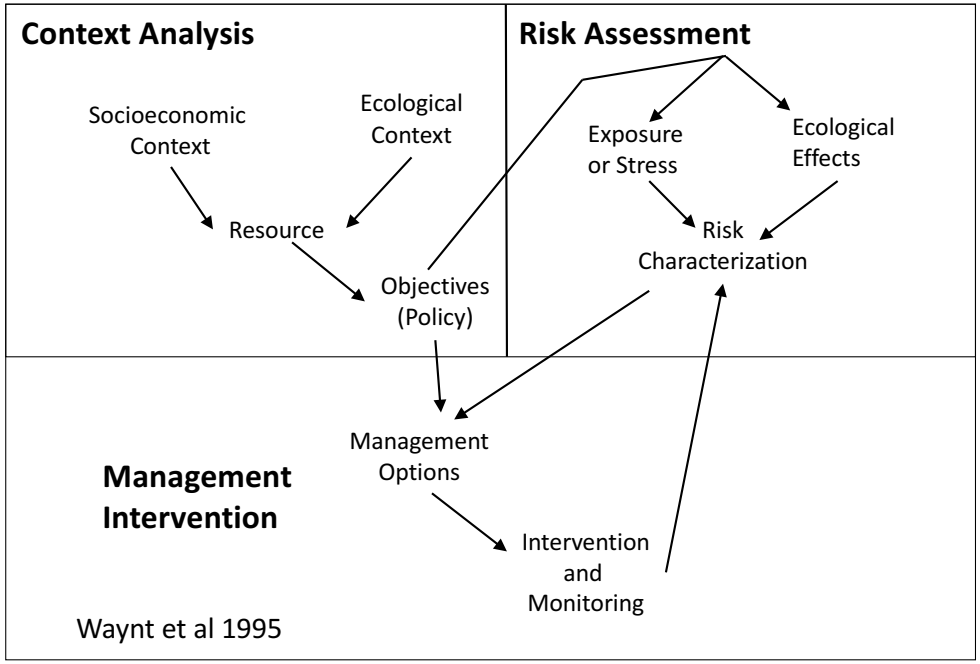
Adaptive management and the science of decisions

Now put the work into a Incorporating risk assessment into and framework for solving problems and making decisions.

Adaptive management as a next step

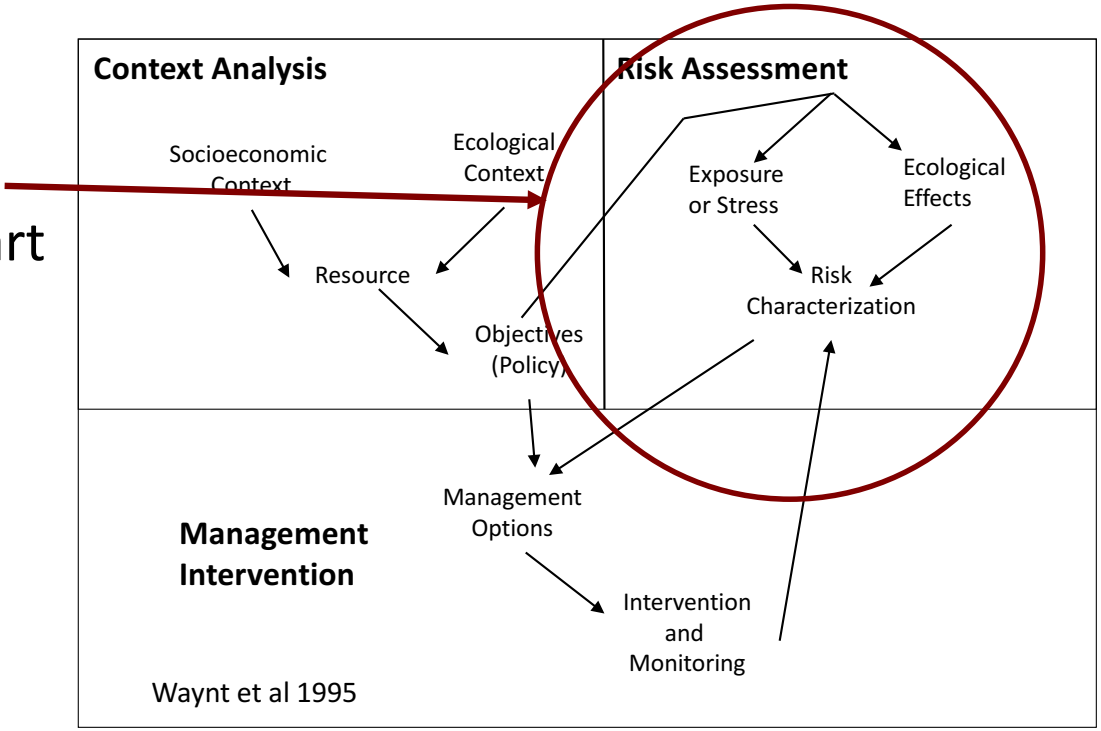
Waynt et al (1995) proposed including risk assessment into an adaptive management cycle

Long-time ago but understood that the systems were non-equilibrium and dynamic.



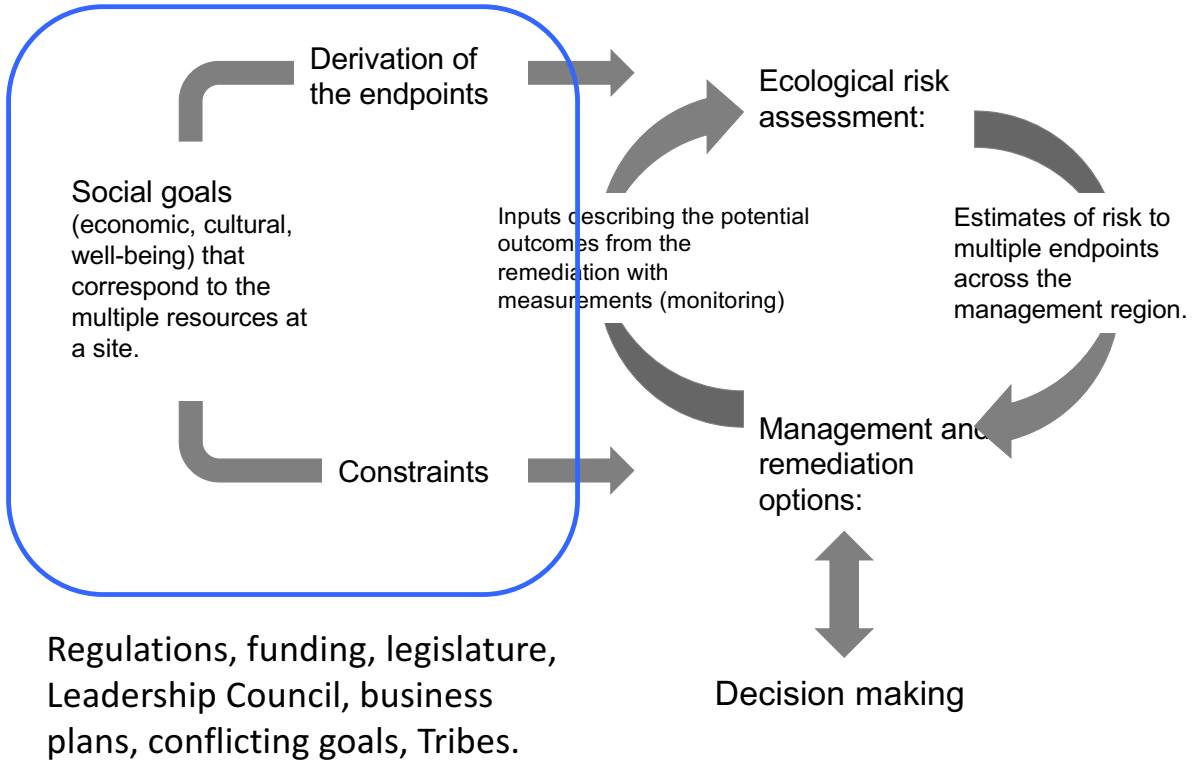
Waynt et al proposed including risk assessment into an adaptive management cycle

Ecological risk assessment is part of the adaptive management process.

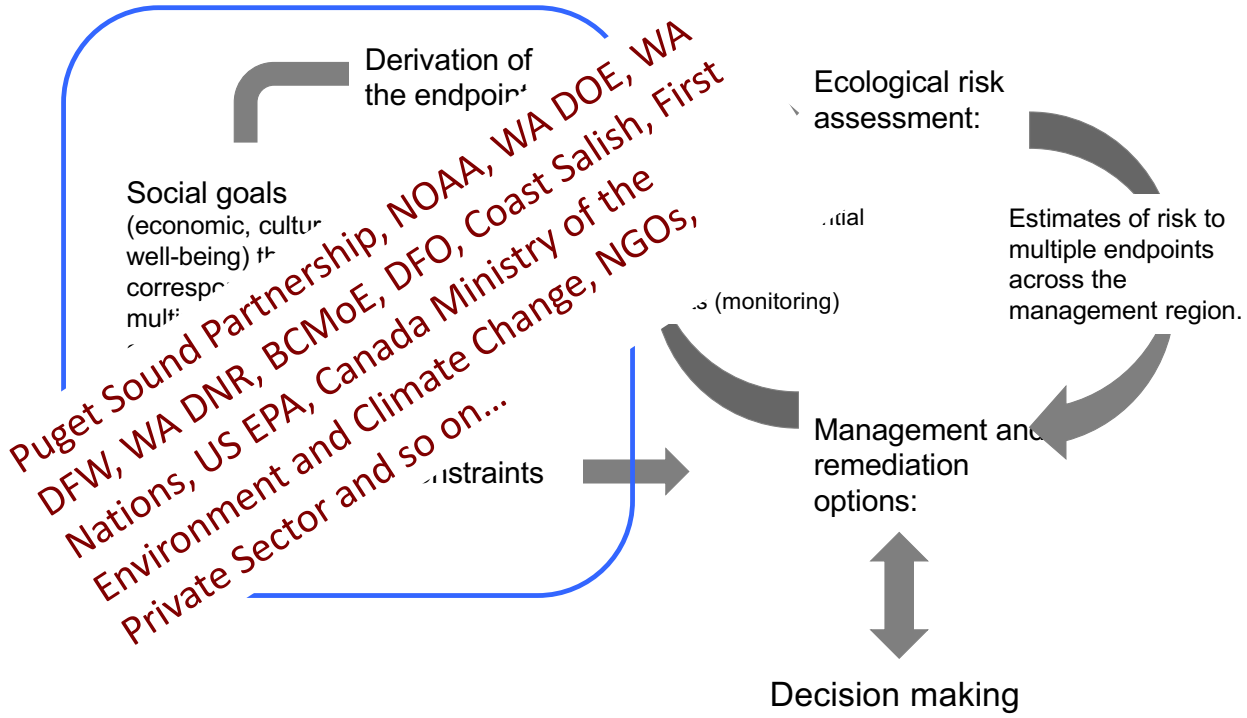


Two interconnected parts……

Landis WG, Markiewicz AJ, Ayre KK, Johns AF, Harris MJ, Stinson JM, Summers HM. 2017. A general risk-based adaptive management scheme incorporating the Bayesian network Relative Risk Model with the South River, Virginia, as case study. *Integr Environ Assess Manag*. 13:115-126



Goals and Constraints are essential to set the stage for the evaluation and decision making.



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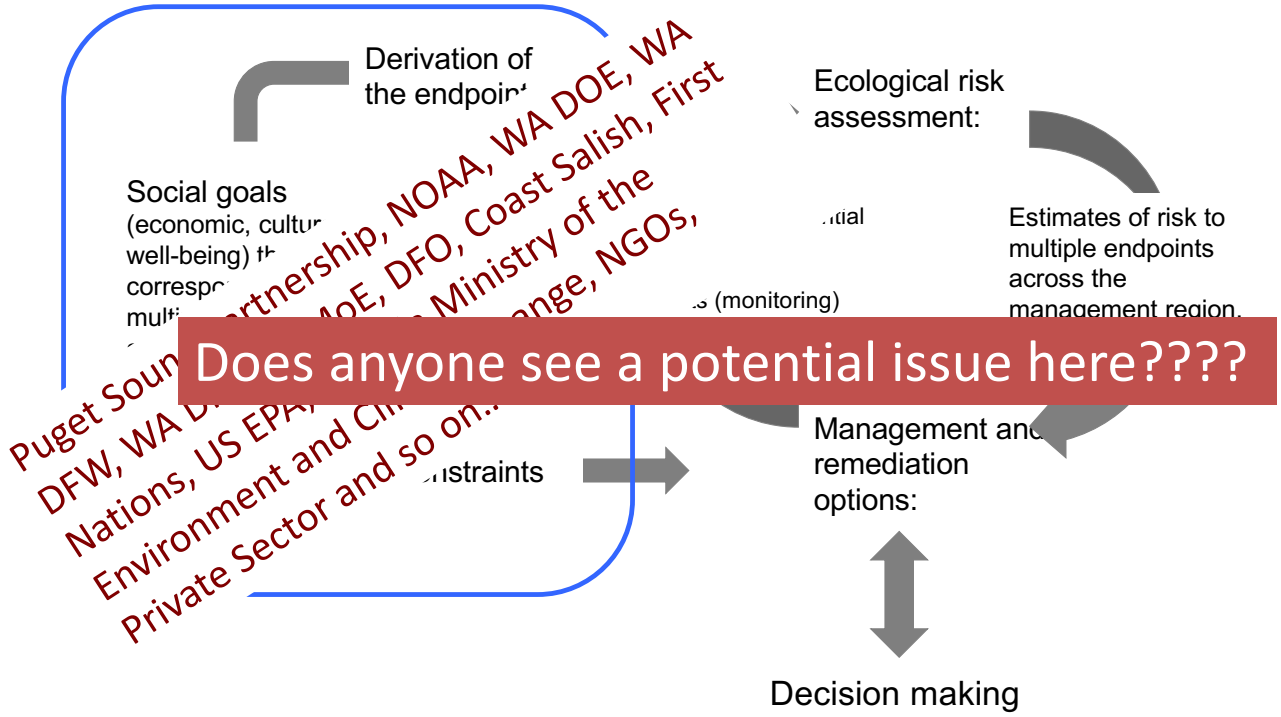
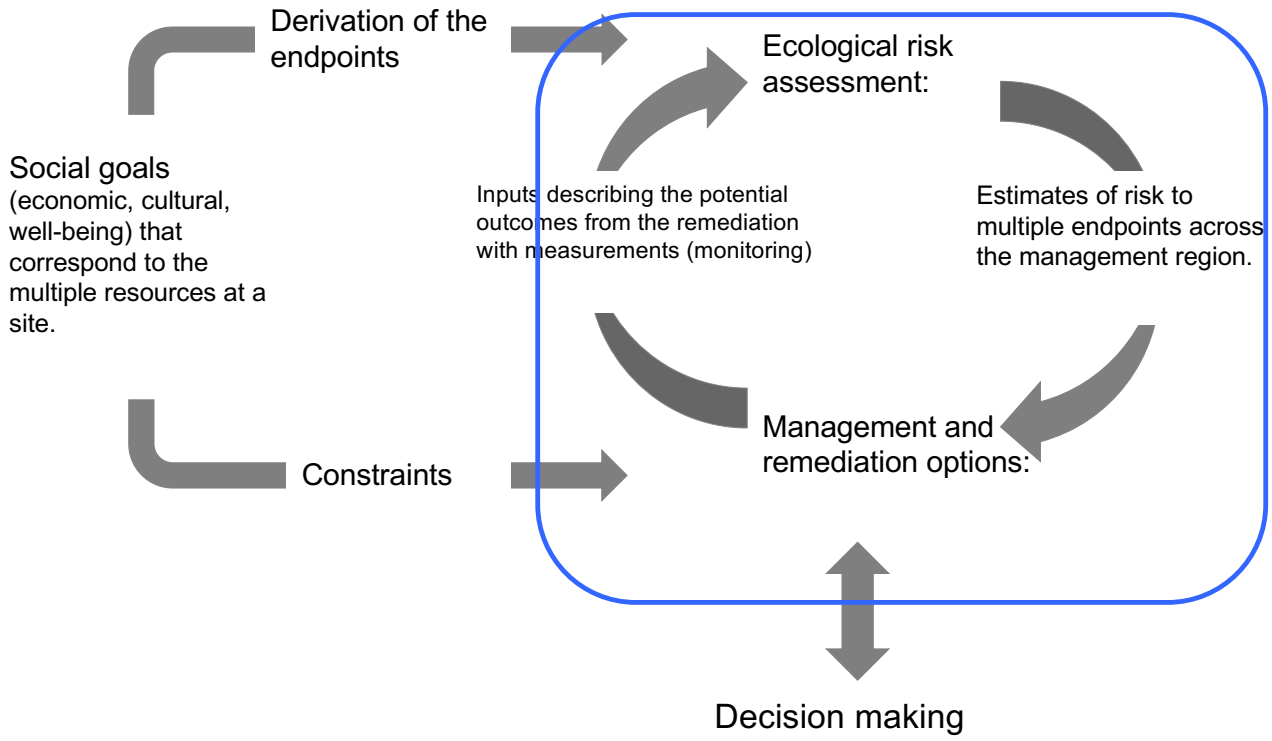
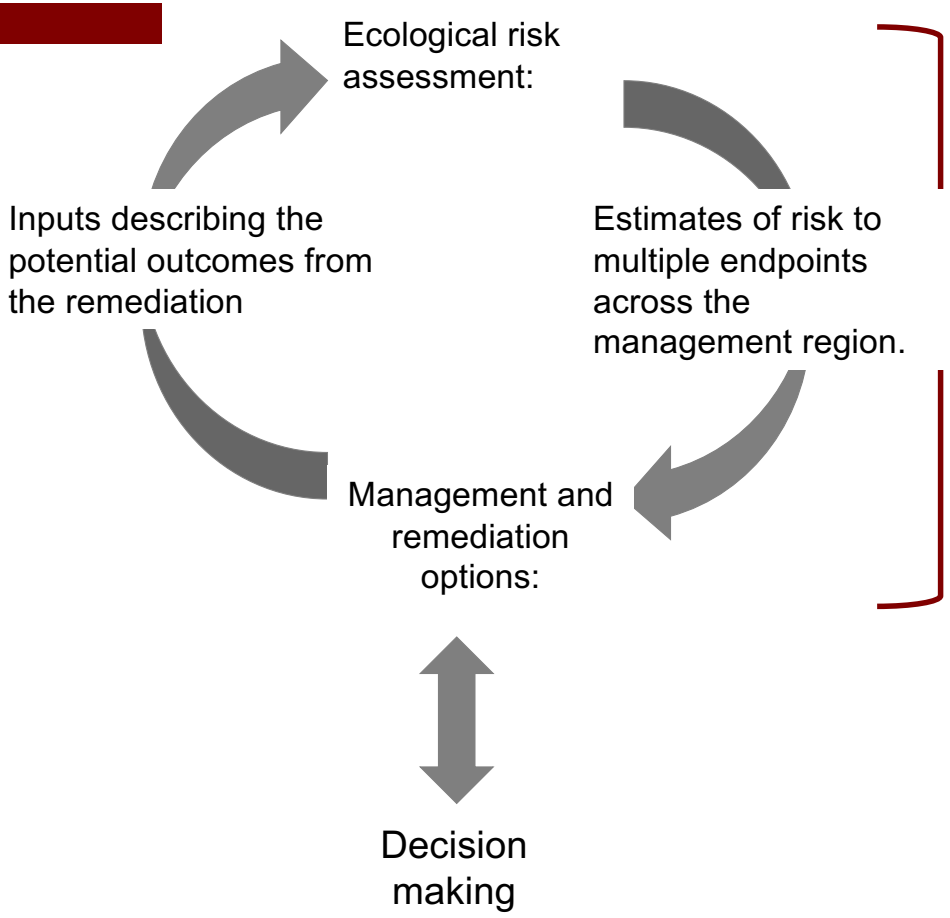


All of the talks in this section can be part of an evidence based adaptive management process.



The Loop-Risk and Adaptive management



Ecological risk assessment ties the loop together.

The Loop-Risk and Adaptive management

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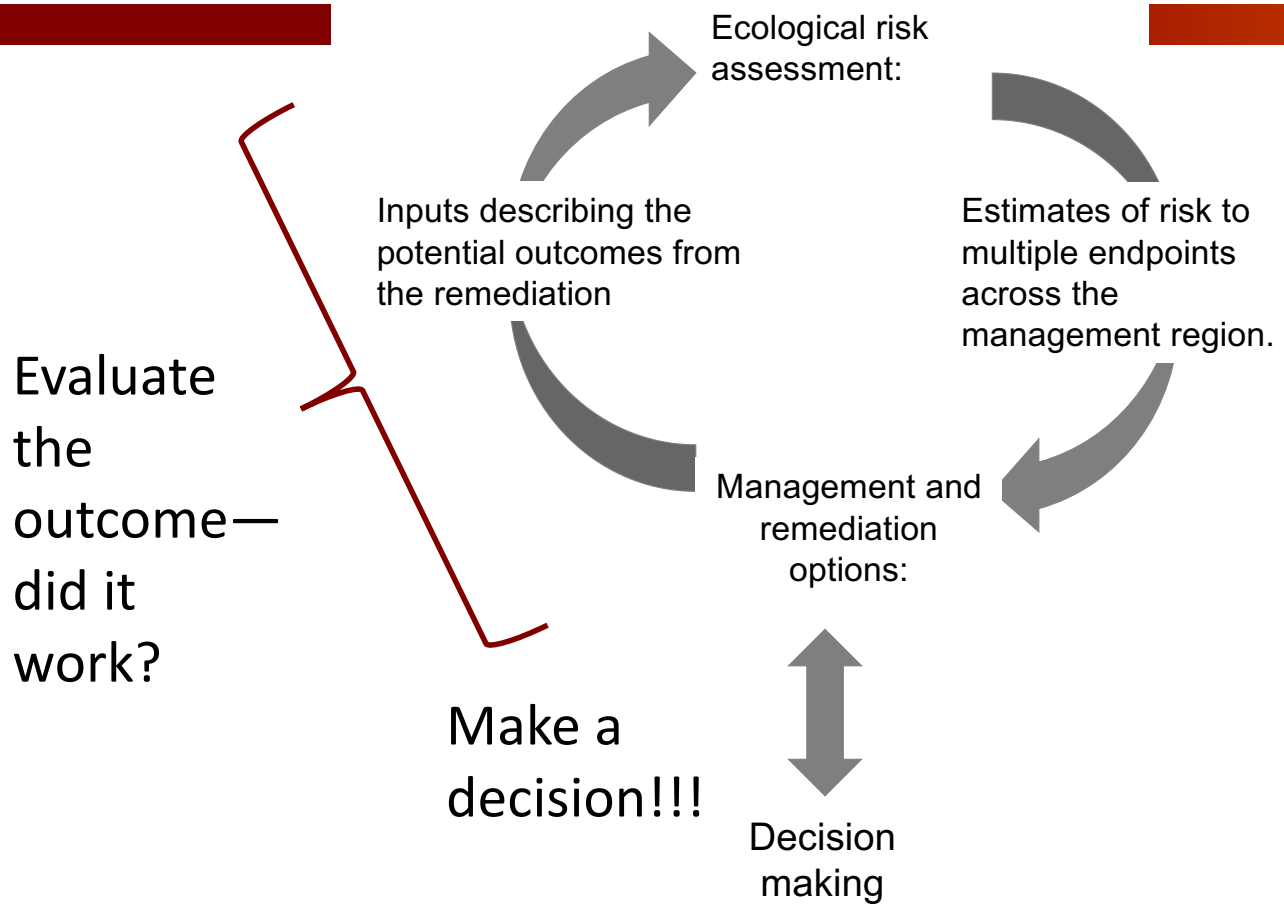

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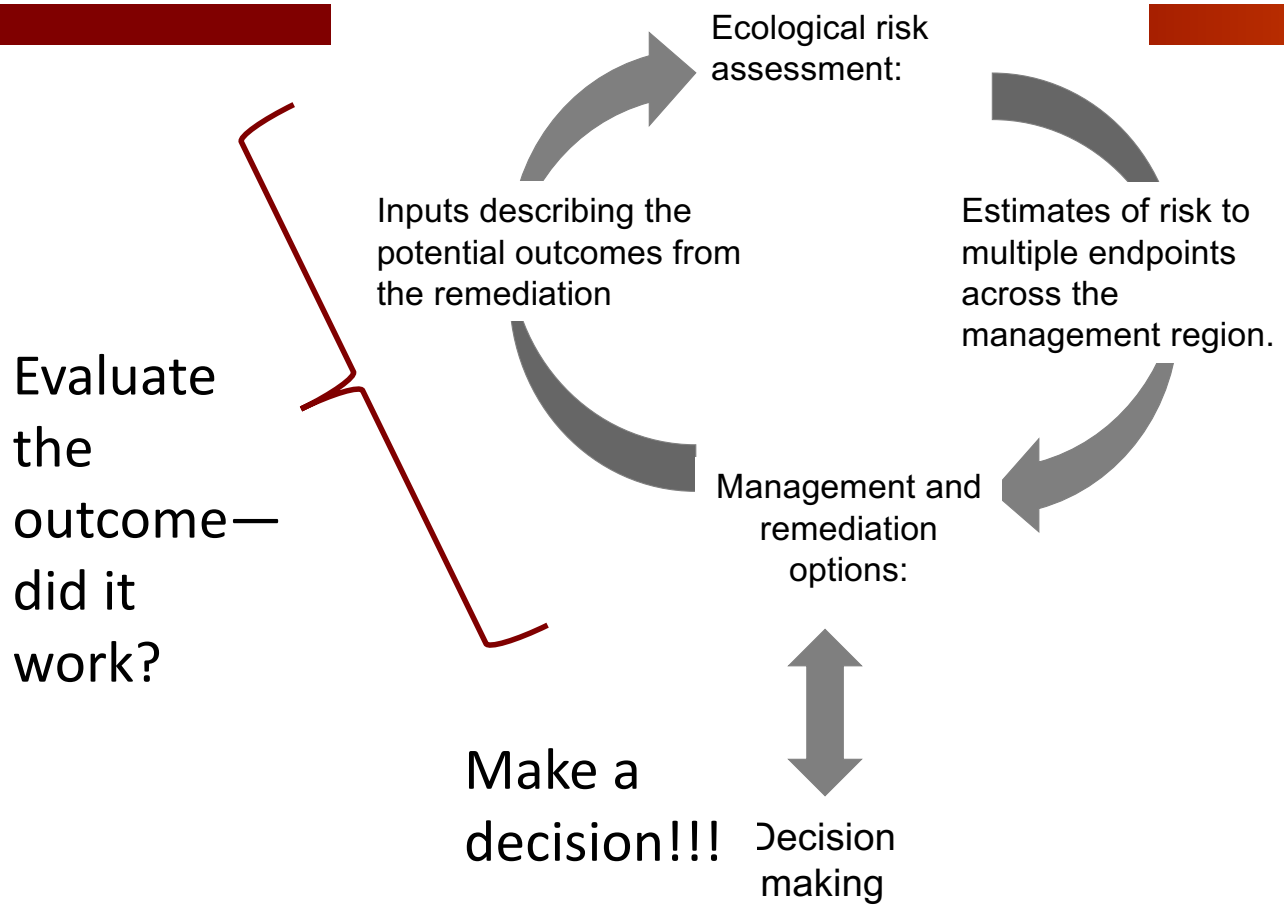

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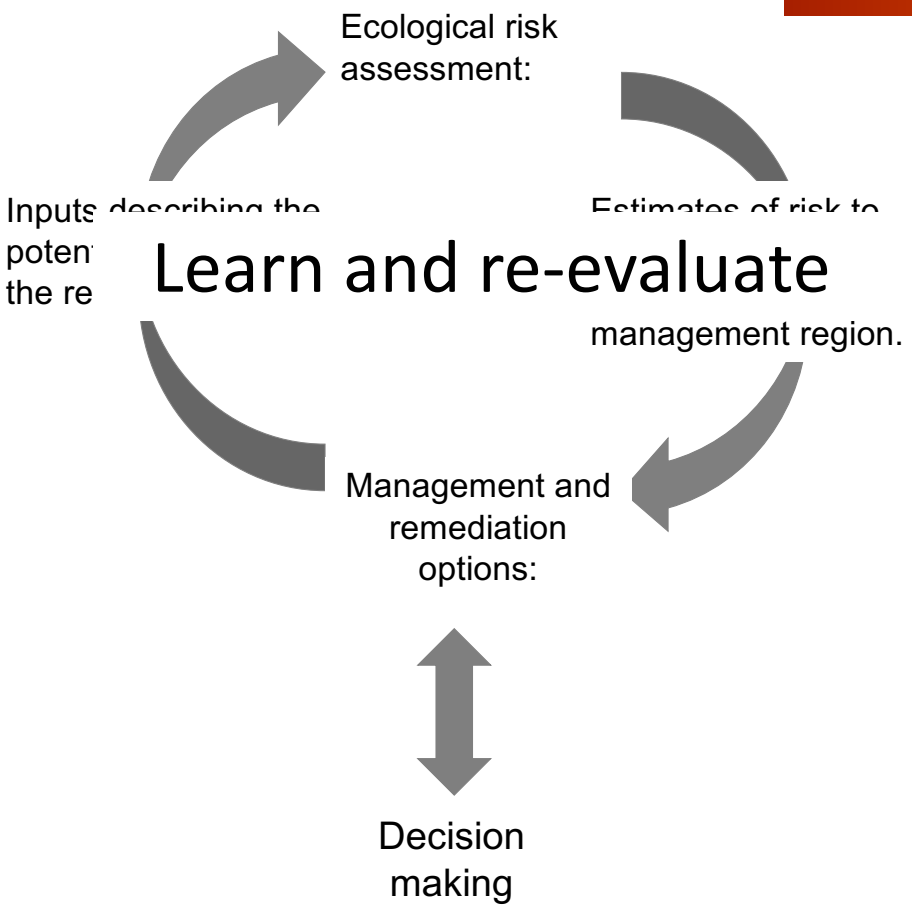
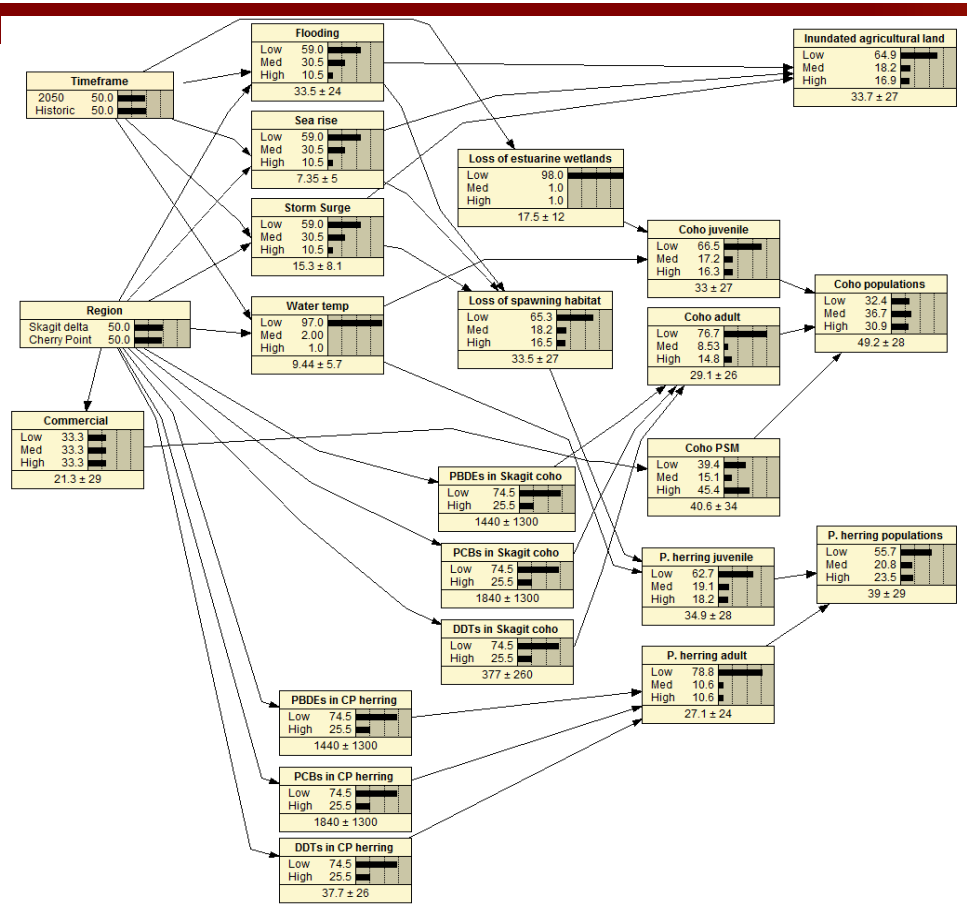


So we build Bayesian network based risk assessments

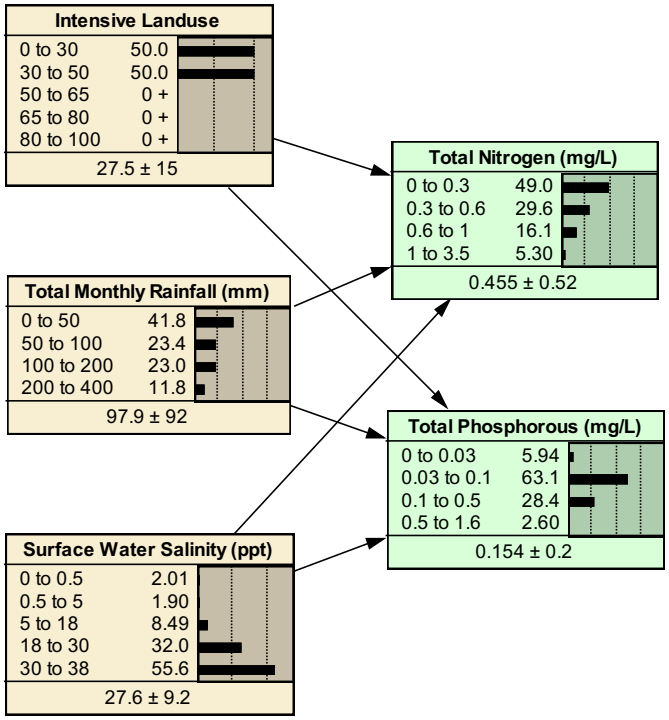


Skagit county and Cherry Point

Coho and Pacific herring

Flooding of Ag Lands

The nodes describe the pathways and strength of the interactions



Learning is expressed in the structure and in the description of relationships in the conditional probability tables

How important is the OP-chlorpyrifos?

Risk is defined in percent probability of not meeting the 500,000 fish management goal.

Scenario	Total Risk	No OP	Change in risk	OP Percent Total Risk	Ecological Percent Total Risk
Skagit-winter	67.3	54.7	12.6	**18.7**	**81.3**
Nooksack-winter	67.3	55.0	12.3	**18.3**	**81.7**
Cedar-winter	64.5	51.3	13.2	**20.5**	**79.5**

There is also the science of decision making

Lots of talk from decision makers and politicians regarding facts or evidence

Not much mention of the use of decision-science to improve the decision making process.

Adaptive management is one such process…….