Independent Scientific Advisory Board
for the Northwest Power Planning Council, the National Marine Fisheries Service, and the Columbia River Basin Indian Tribes
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ISAB Presentation:
A Review of Strategies for Recovery of Tributary Habitat

Drs. Pete Bisson and Bob Bilby of the ISAB will present the recently completed ISAB report, "A Review of Strategies for Recovery of Tributary Habitat."

The report examines several topics central to the recovery of tributary habitat:

1. biological objectives related to habitat recovery,
2. strategies for implementing restoration,
3. incentives for implementing restoration,
4. the scientific foundation for habitat recovery; and
5. monitoring and evaluation.

The objective of the review is to answer the question: What concepts and strategies should be incorporated in habitat recovery actions to improve their chances for success?

A copy of the PowerPoint presentation is attached. Hard copies of the full report were sent to Council members on March 31, 2003 and will be available at the meeting. The report can also be accessed on the Council website: www.nwcouncil.org/library/isab/isab2003-2.htm.

A Review of Strategies for Recovering Tributary Habitat

Independent Scientific Advisory Board
April 9, 2003

We examined:

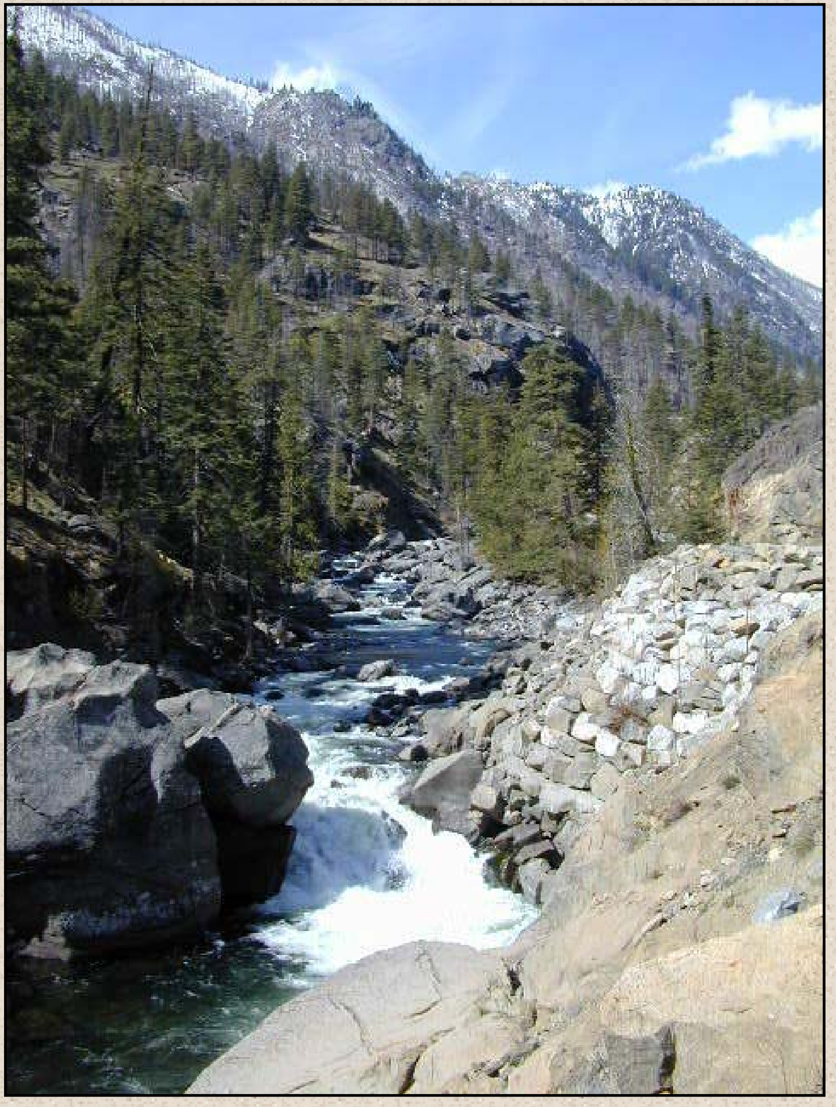
- the biological objectives related to habitat recovery
- the strategies and tools for implementing restoration
- the incentives for implementing restoration
- the scientific foundation for habitat recovery
- monitoring and evaluation

What concepts and strategies should be incorporated in habitat recovery actions to improve their chances for success?

Biological Objectives

Tributary performance standards are referenced in the All-H Report and mean the specific habitat states that would achieve biological recovery in an area of interest. These standards become the *de facto* biological objectives for tributary habitat.

Traditional Approach:

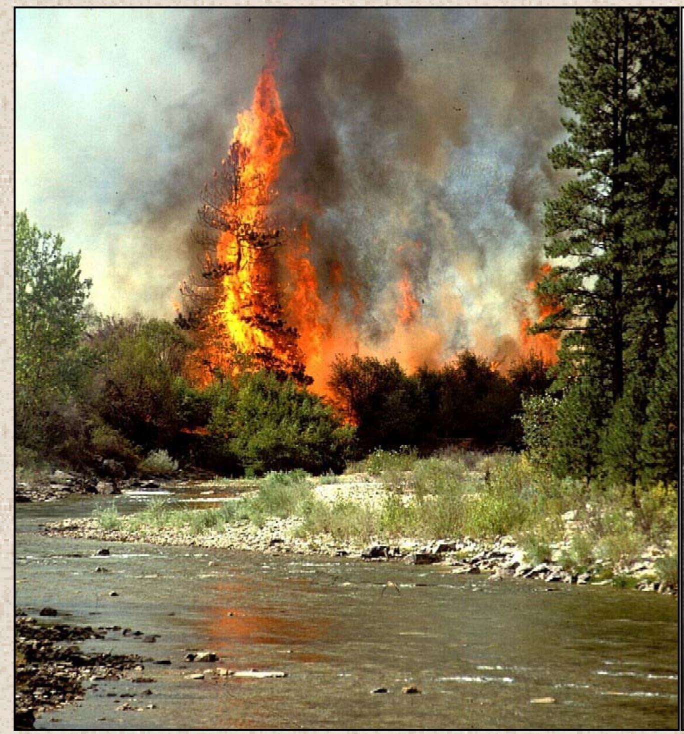
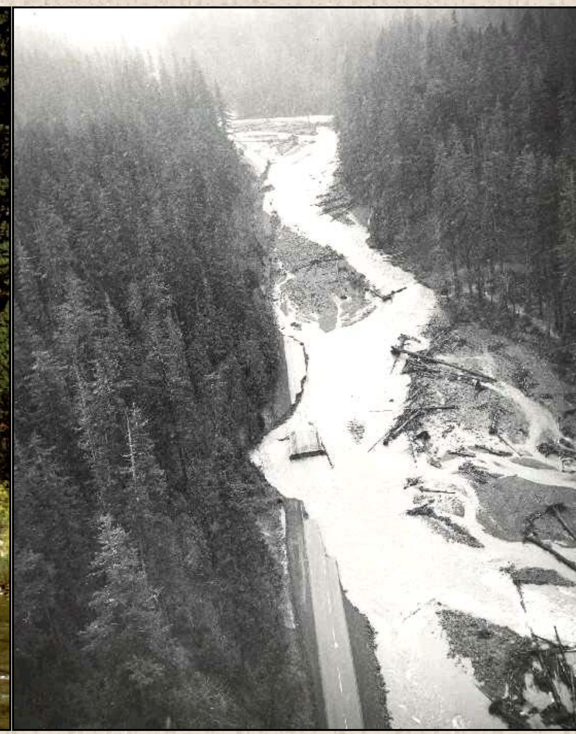


Fixed habitat standards

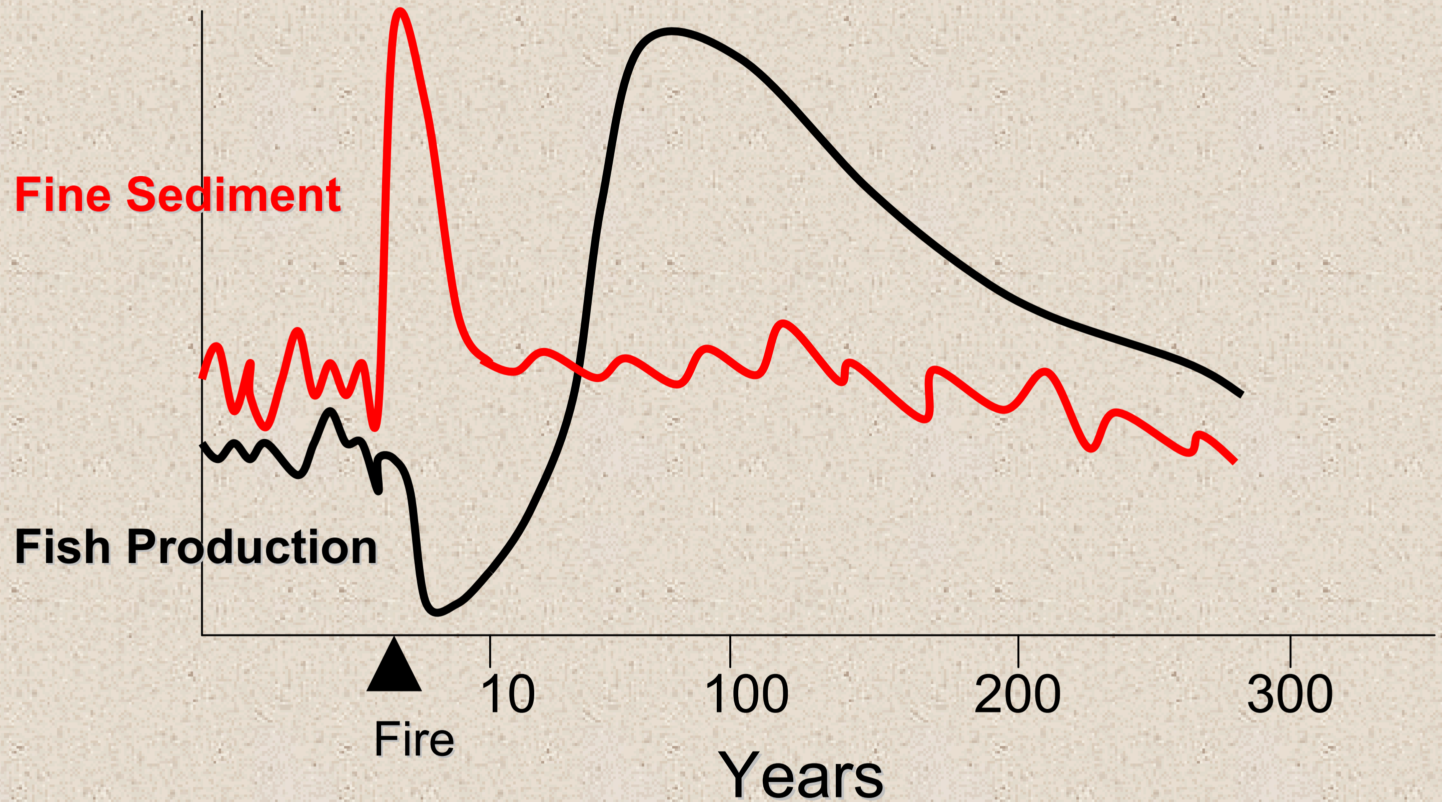
Temperature

Fine sediment concentration

Dissolved oxygen

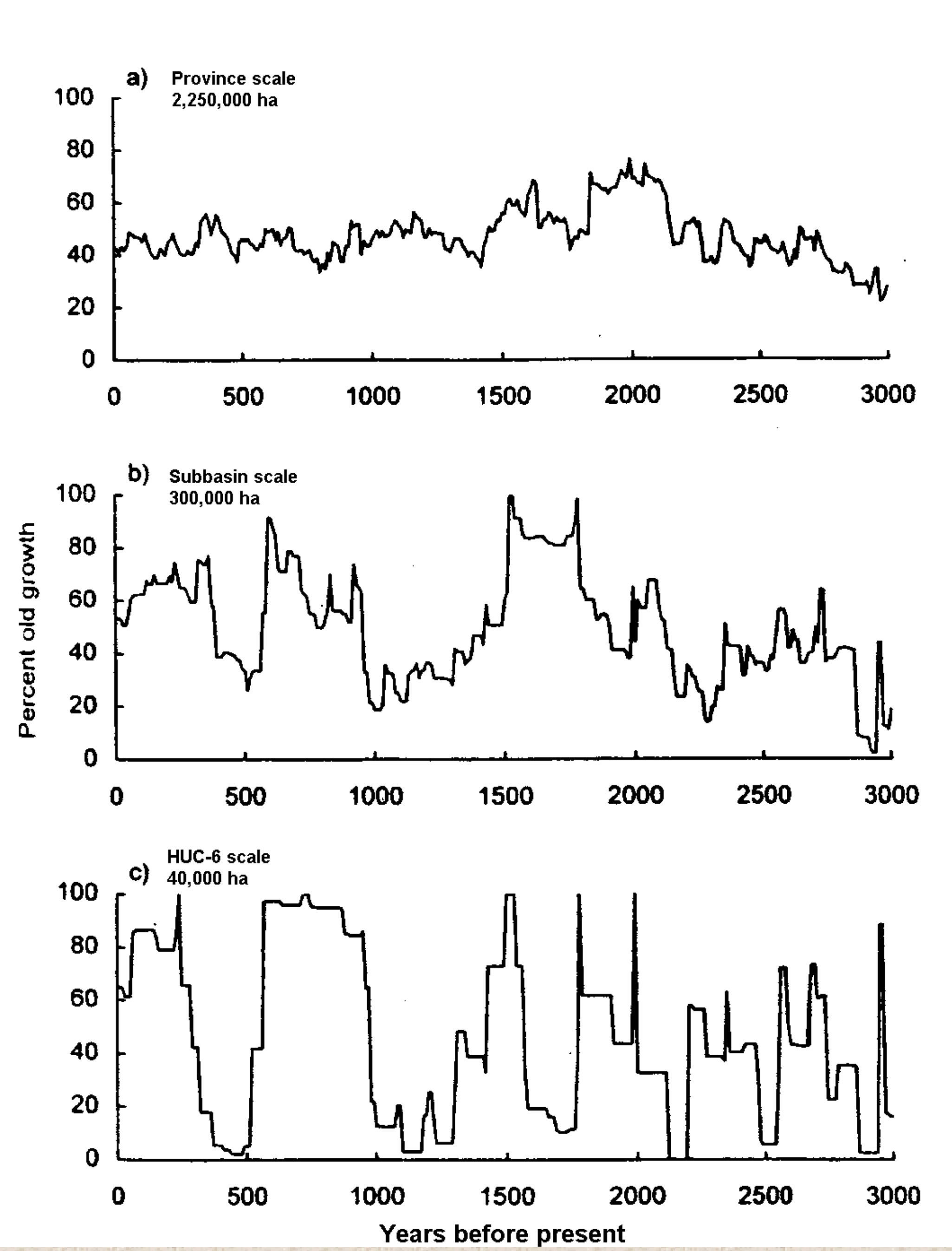

Fixed habitat standards do not easily accommodate the variability created by natural disturbances

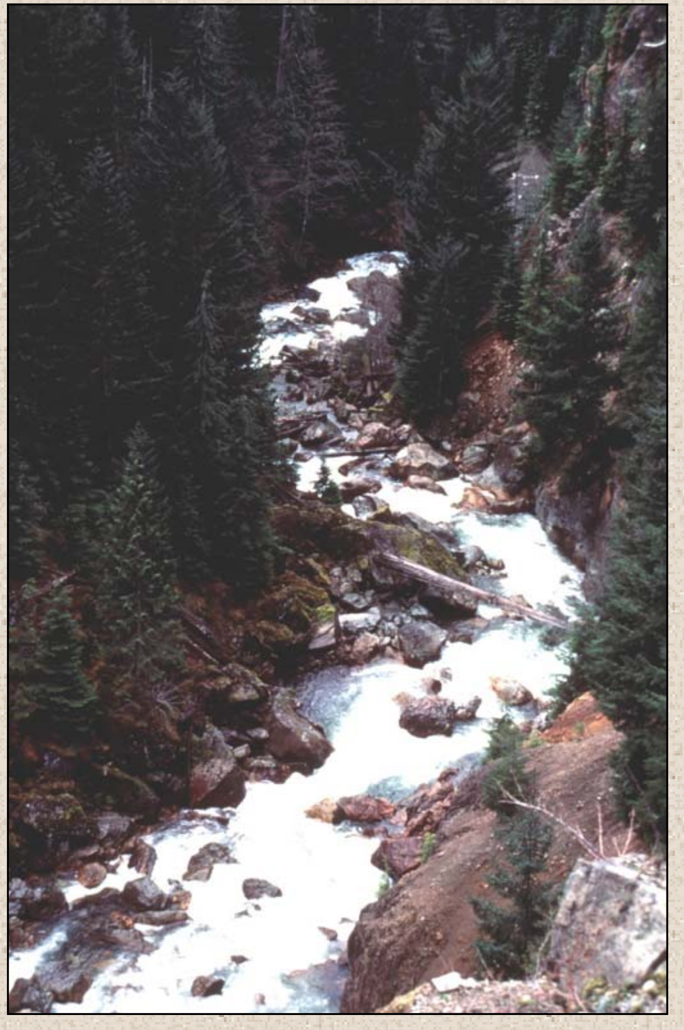

Fine Sediment
Fish Production
10
100
200
300
Fire
Years

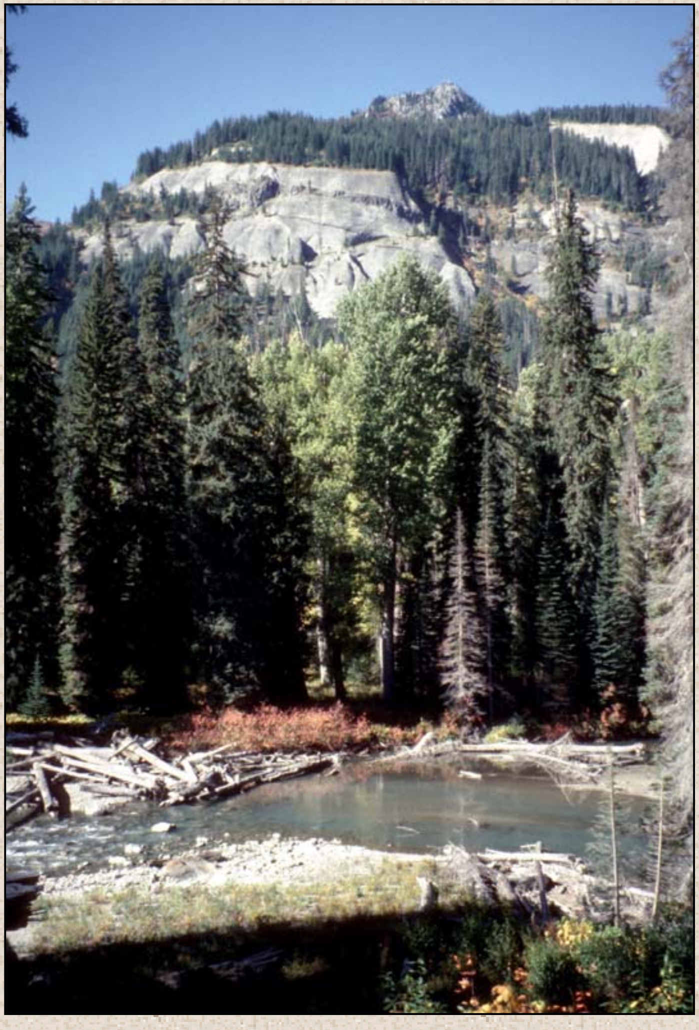
Percentage of old-growth forest in Oregon Coast Range

"Until we can estimate ranges of historical landscape variability more accurately, it will be difficult to substantiate an argument for their use as precise forest management goals"

from
Wimberly et al., 2000

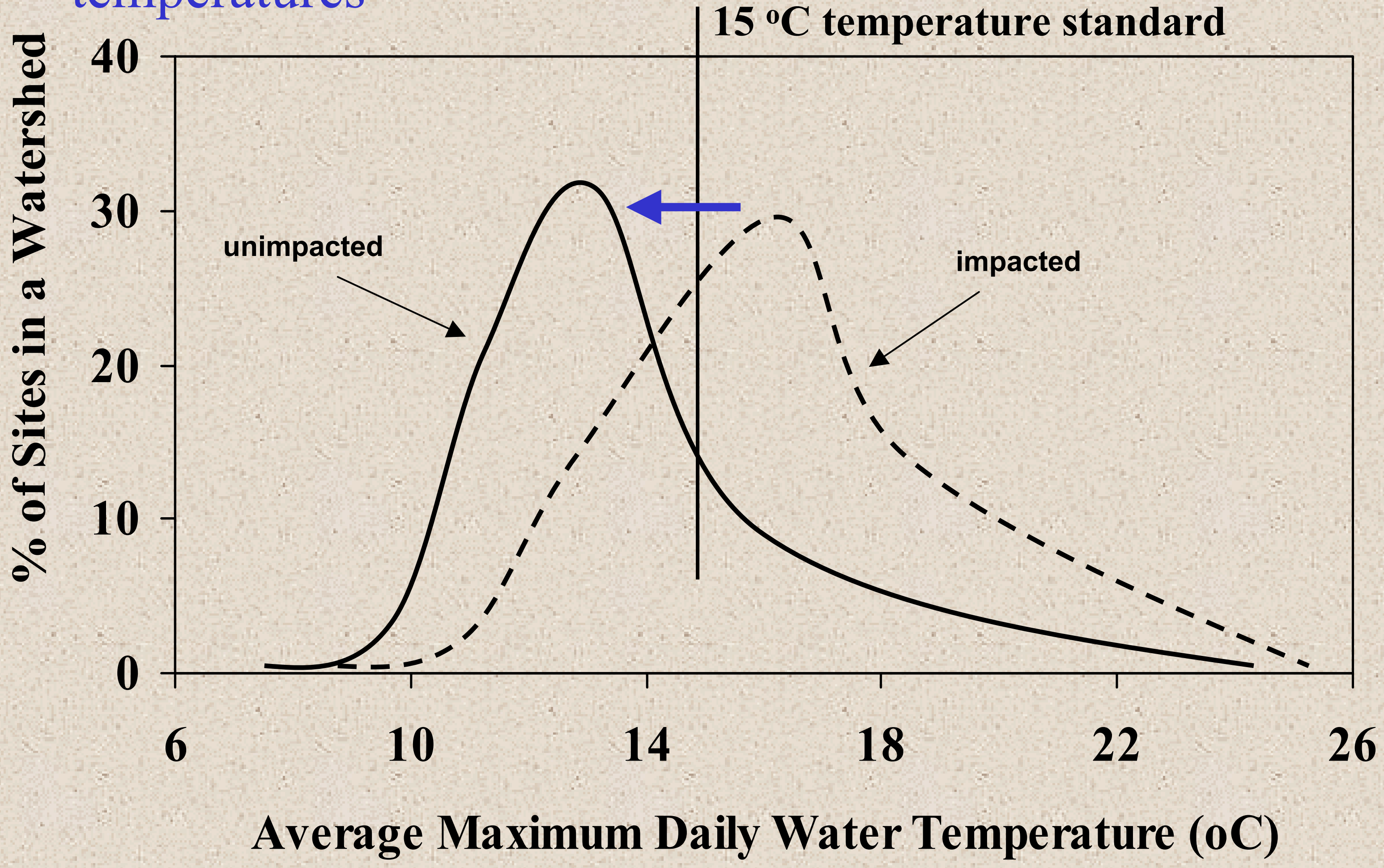




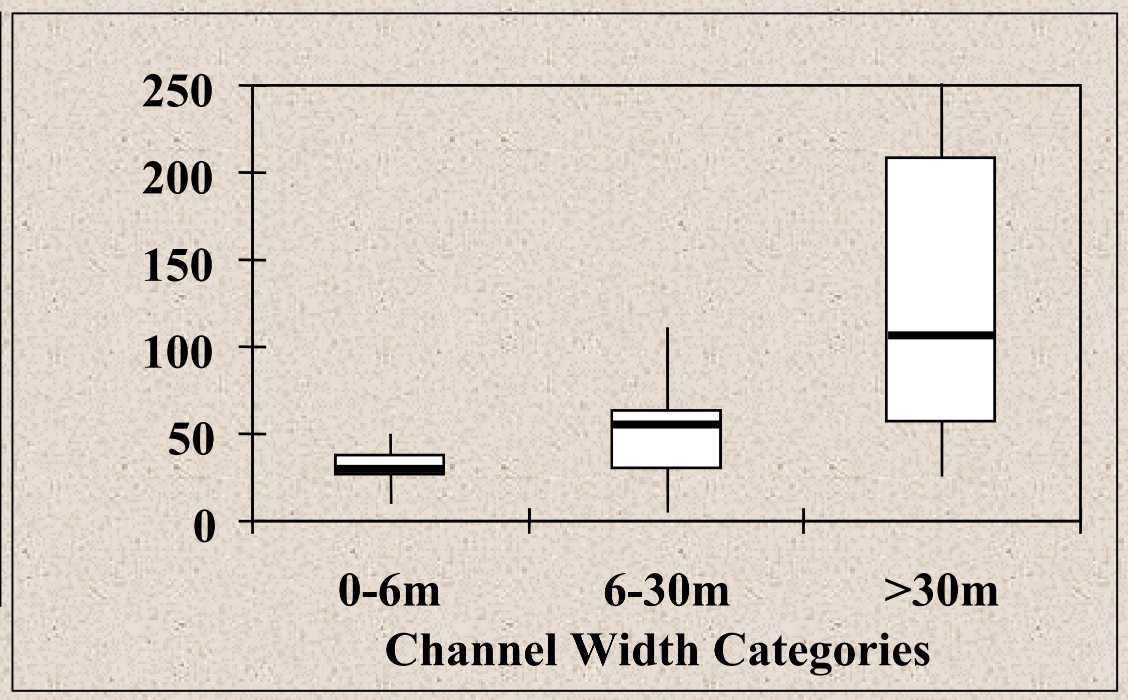


Stream channels are highly variable. Understanding the distribution and range of natural conditions in relatively unaltered watersheds is important for establishing realistic habitat goals and trends.

"Distribution of natural conditions" performance standard aims to achieve a more natural distribution of temperatures



Pieces of large wood per 100m of stream channel in Cascade Mountain streams



Fox, 2001

Restoration effectiveness may be tracked by examining the rate of change in the distribution of conditions in streams toward the desired natural range

Fixed habitat standards vs. range and distribution of natural conditions

Fixed standards

- Conceptually simple
- Ecologically unrealistic
- May be biologically unproductive

Range of natural conditions

- Complex
- Allows for watershed dynamics
- Acknowledges processes that create and maintain productivity
- Replaces fixed habitat targets with natural distribution and rates of change

Can habitat targets be related to fish abundance or diversity?

Life History Stage	Habitat
Spawning and egg incubation	Gravel bedded riffles and pool tailouts in proximity of cover suitable for adult spawners (e.g., deep pools, undercut banks, debris jams)
Early fry rearing	Low velocity with cover in close proximity to food source typically associated with shallow, channel margin habitat with cover from wood and overhanging vegetation
Summer rearing	Pool habitat with cover in close proximity to food source typically associated with low gradient channels, pool/riffle morphology, streams in flood plain valley type
Winter rearing	Low velocity refuge with cover typically associated with off-channel habitat on floodplains including low gradient tributaries, secondary channels and ponds

Responses can be evaluated at the reach level and related to application of a single restoration action

But, ultimate effectiveness depends on performance throughout entire freshwater life cycle. Performance must be evaluated at a scale sufficiently large to enable complete freshwater rearing.

Limiting factors and restoration decisions

Emphasis of limiting factor analysis should be on whether ecosystem processes are functionally impaired, as opposed to whether an environmental assessment reveals potentially dangerous conditions for a species of interest *at the reach scale*.

Ecosystem Processes

• erosion	• large wood recruitment
• flow regime	• storage and routing of sediment and organic material
• aquatic and riparian interactions	

Wood additions

Fencing and planting riparian zones

Most limiting factor analyses and restoration projects have been directed at reach-specific habitat problems

At this scale, demonstrating restoration effectiveness for enhancing fish populations is usually impossible

Implementation Strategies

With sufficient data on habitat condition and sensitivities to human actions and fish populations, numerous analytical methods can be used to develop habitat recovery plans. However, the data necessary to parameterize these models are rarely available.

Several predictive approaches have been developed to use incomplete data to relate tributary habitat to aquatic community condition or the abundance of target species:

- Expert opinions
- Expert systems
- Empirical models

Expert opinions

- Most common approach
- Can be highly subjective
- Underlying assumptions often unsubstantiated or not made explicit
- Prediction power unknown

Expert systems (e.g., ICBEMP-BBN, EDT)

- Objective method for combining multiple scientific opinions
- Clearly visible assumptions, *if* the process is properly documented
- Parameterizing models reveals important data gaps
- Limitations of model outputs must be acknowledged when interpreting results
- Predictive power unknown

Empirical modeling (e.g., SWAM; CART)

- Relates abundance or occurrence of species of interest to habitat attributes at a given location
- Associations between populations and habitat characteristics used to predict abundance for locations where only habitat information is available
- Informative when relatively complete data are available
- Enhanced by new statistical approaches and improvement in remote sensing and spatial mapping technologies
- Provide indication of predictive power; low for most methods

ISAB Recommendation

Use more than one analytical method (ideally, expert and empirical). Policy makers can gauge the degree of scientific uncertainty by comparing the output from two or more analytical tools, understanding the assumptions made by each of them, and knowing the areas of agreement and disagreement.

If multiple analytical techniques based on different assumptions and methods all point to the same locations and habitat conditions as being important factors limiting fish production, considerably more confidence can be placed in these conclusions.

Implementation Incentives

The successful implementation of tributary habitat improvements rests in large part on the incentives facing those with decision authority over tributary resources. In the case of publicly owned resources – either state or federal – mechanisms exist through various legislation, administrative rules and consultation procedures to motivate and coordinate restoration actions.

Examples:

- Environmental policy instruments (e.g., TMDLs)
- Federal agriculture-environmental incentive-based programs (e.g., Farm Act incentives such as the Conservation Reserve Program, Wildlife Habitat Incentives Program)
- Other federal programs (e.g., Challenge Cost-Share Programs)
- State programs for environmental improvements (e.g., OWEB)

> Growth in voluntary compliance with incentive-based programs in agriculture indicates that they are popular with agricultural producers. In areas of rapid population growth and urbanization, similar incentive-based programs are needed to encourage nonagricultural participation in tributary habitat restoration.

Foundation for Recovery

Understanding large-scale spatial and temporal patterns is important in subbasin planning because restoration strategies need to identify the best sites for protection as well as the best candidates for restoration – those sites that have a likelihood of linking together to create highly productive habitat network at some future time.

Common elements of successful subbasin assessments:

- Thorough, systematic inventory of conditions within the drainage system
- Measures of ecosystem processes extending beyond the stream to encompass whole watersheds
- Landscape-scale comparison of life-history needs and habitat status for limiting factor analysis (context for restoration priorities)
- Explicit strategies for habitat recovery, e.g., rebuilding outward from core stronghold areas; reconnecting aquatic, riparian, and floodplain ecosystems

Monitoring and Evaluation

Understanding the effect of habitat conditions on salmon population performance requires replicated observational studies or intensive research level experiments to be conducted at large spatial and long temporal scales.

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit, over a period of time

- Tier 1 trend monitoring of similar projects over time and space provides evidence for general conclusions

ISAB recommendation:

Develop and enhance trend-monitoring procedures based on ground-verified, remotely sensed data from sources such as aerial photography or satellite imagery. Changes in aquatic habitat and land use should be monitored at the largest possible spatial scale.

Tier 2 (statistical) monitoring uses statistical inferences to extrapolate data from sites to larger areas. The inferences require probabilistic selection of sites and repeated sampling over time.

- Evaluation of the effectiveness of habitat improvement projects will require Tier 2 monitoring for some parameters, e.g., the number of redds in a watershed.

ISAB recommendation:

Develop and implement standardized statistical site selection procedures and establish common protocols for cost-effective "on the ground" or remotely sensed data collection of a limited number of indicator variables.

Tier 3 (experimental research) monitoring is often required to establish cause and effect relationships between management actions and population response

- Requires the use of experimental designs incorporating treatments and controls

ISAB recommendation:

Implement Tier 3 at selected locations to establish underlying causes for changes in population and habitat status identified in Tiers 1 and 2 monitoring. An experimental, long-term monitoring program can help identify important or unexplained trends.

Two approaches to Tier 3 monitoring

1. Paired treatment-control watersheds, in which a single type of restoration (e.g., riparian fencing) is applied to a large number of sites and compared to nearby unfenced control sites
2. Intensive watershed monitoring (IWM), in which closely spaced measurements are directed at a few intensively monitored watershed pairs

- IWM approach is easier to implement and more feasible
- Paired treatment-control approach can be applied within the context of IWM; treated and untreated sites can be paired at a multiple spatial scales within the IWM design

Tier 3 (experimental research) monitoring

- Tier 3 monitoring is the most effective method of obtaining the type of data required to increase the predictive power of analytical tools such as EDT
- Identification of candidate watershed pairs can be a useful product of subbasin planning
- The more pairs, the higher the confidence in applying the Tier 3 results to other areas

ISAB recommendation: Tier 3 monitoring is critical to understanding the efficacy of tributary habitat restoration. ISAB recommends the intensive watershed monitoring approach, ideally a network of paired watersheds distributed across the subbasin, where Tier 3 monitoring will be focused.

Relationship Among Monitoring Tiers

Tier 1

- Evaluation of habitat changes using easily-measured data
- Trends in habitat change

Tier 2

- Statistical evaluation of changes in biological or habitat condition
- Attributes that cannot be assessed with remote methods, including fish populations

Refine parameters

Applicability of T3 to other locations

Refine parameters

Tier 3

- Intensive evaluation of system response at the watershed level
- Cause-effect relationships; biological response
- Validate analytical tool assumptions
- Identify most useful parameters for T1 and T2 monitoring

Summary

1. At this point, we don't know the "best way" to determine restoration priorities
2. Habitat performance standards are better defined by the range and distribution of natural conditions than by fixed habitat standards
3. Multiple analytical tools are preferable to relying on a single decision support tool
4. Restoration incentives exist that may not be fully utilized by landowners or acknowledged in subbasin plans

Summary

5. Successful subbasin assessments include a landscape-scale context of ecological health, human development, and fish life cycle needs, coupled with explicit strategies for habitat recovery

6. Monitoring and evaluation should consist of integrated, hierarchical programs that include scientifically designed, long-term experiments and controls