

Monitoring streams and watersheds

Recent advances and persistent challenges

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A stylized, teal-colored silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

Why care about monitoring?

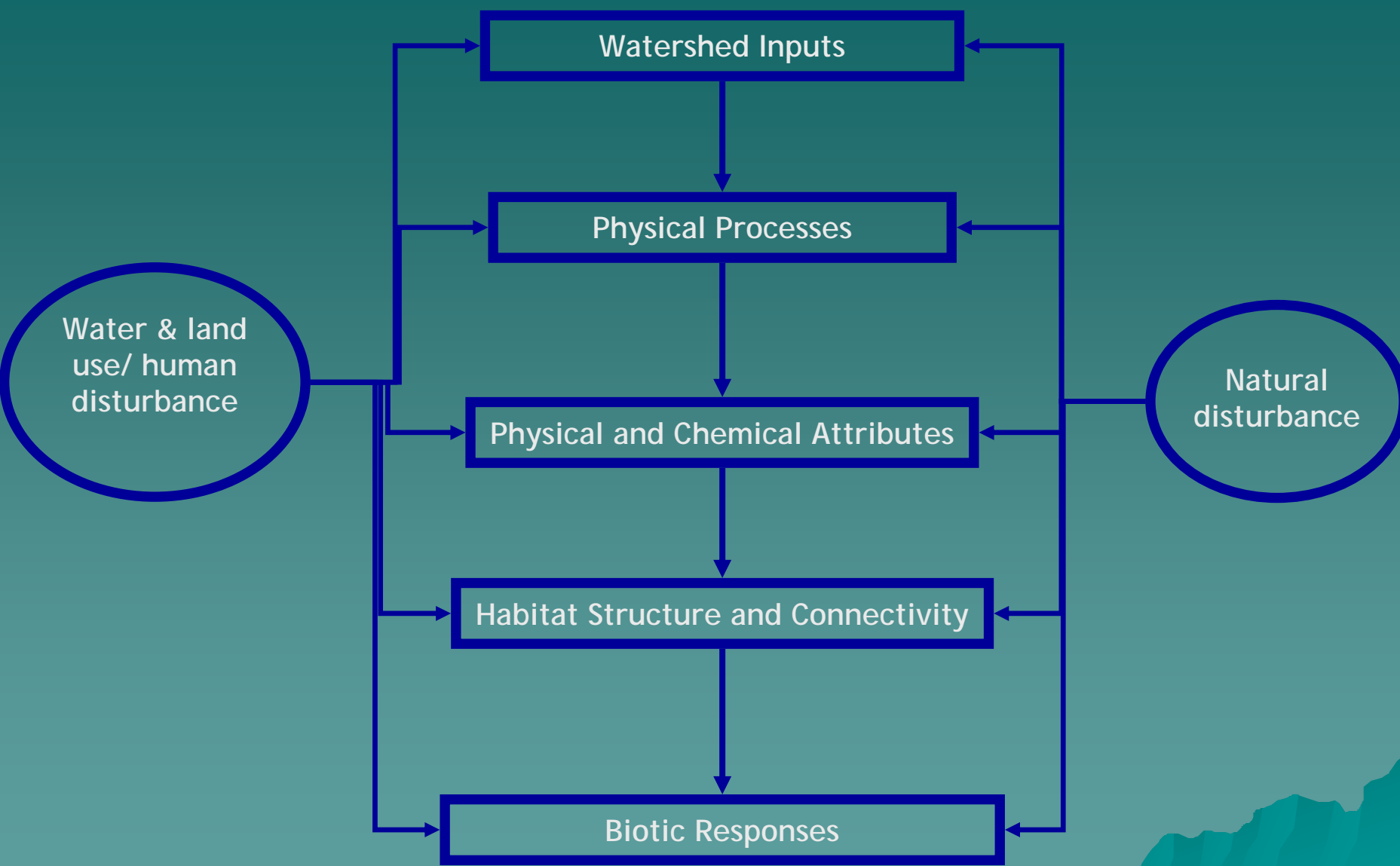
- ◆ Evaluate status and trends
- ◆ Evaluate sources and fate
- ◆ Evaluate performance of BMP's & restoration actions
- ◆ Wise stewardship of scarce resources



How well are we doing

- ◆ Endangered species listings
- ◆ Muddy waters – 303(d) listings
- ◆ Human health risk exposure from air and water





A simplified view of watershed processes

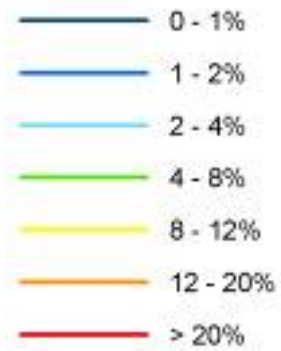
Recent advances

- ◆ Integration of watershed processes into ecological thinking
- ◆ Tech tools and techniques
- ◆ The bugs speak to us
- ◆ Statistical tools for spatial + time



Tonsina River. Copper River Basin, Alaska

Channel Gradient




Aquatic Habitats and Instream Flows

Habitat Criteria
Mapping

Carmen Bypass Reach
Habitat unit 16
Chinook fry rearing guild

Aquatic habitat mapped at flows of:

-  160 cfs
-  205 cfs
-  345 cfs

 Habitat unit boundary

Flow Direction

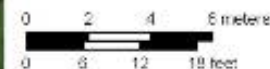
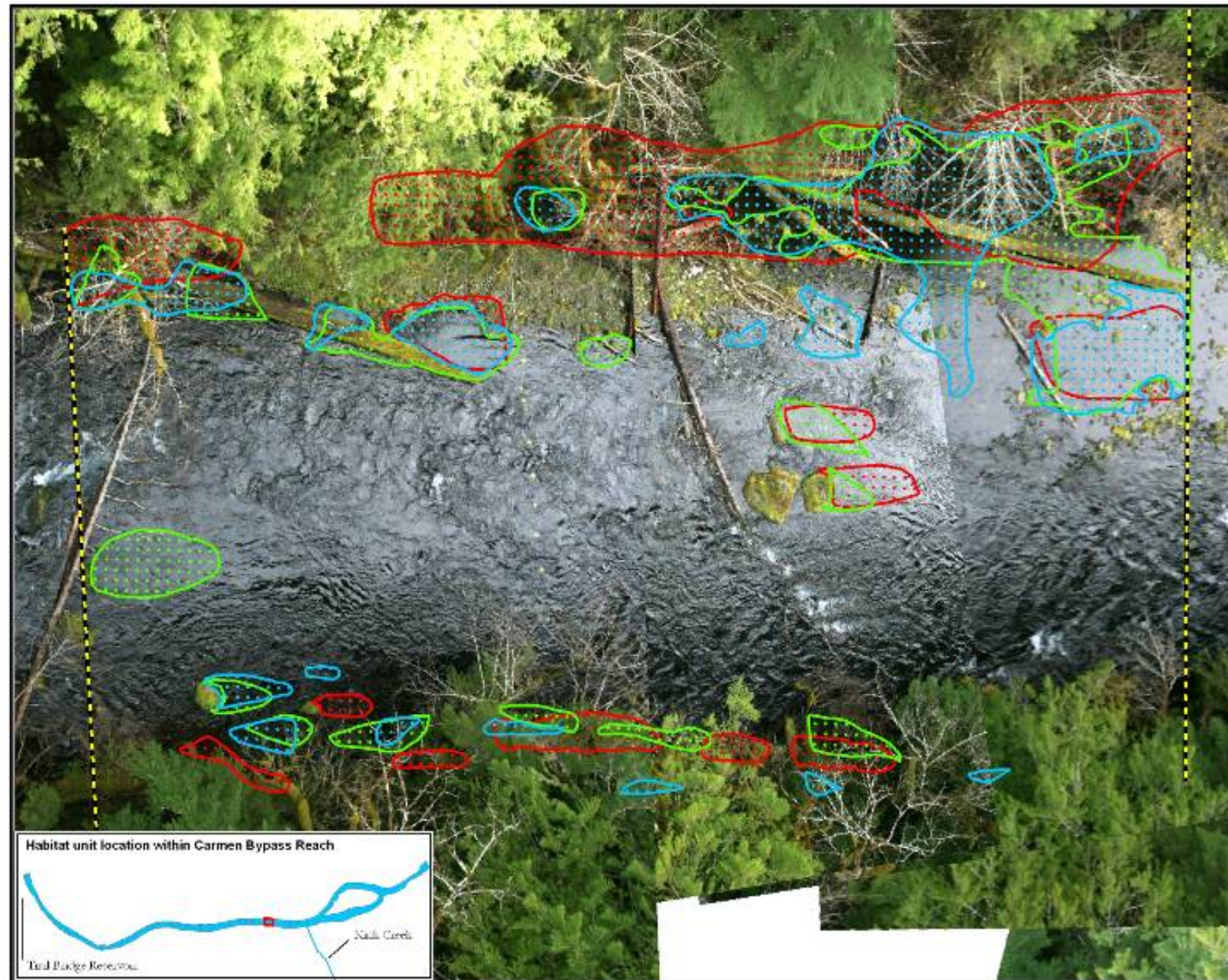


Photo: <http://www.fishbase.org>

Revised September 20, 2005



Habitat polygons delineated using LEAP.

Are we there yet?

- ◆ Significant coordination efforts between governments:
 - ◆ - standardize sampling design
 - ◆ - database and archival practices
 - ◆ - comparability of field methods
 - ◆ - comparison of results
 - ◆ - evaluation techniques & design

Persistent challenges:

- ◆ Applying “idealized” expectations to all streams
- ◆ Lack of understanding of how to work with altered processes in urban streams
- ◆ Large investments in “fixing” problems, ...
- ◆ Little investment in monitoring outcomes

Brief History of EMAP

- ◆ 1988: initial charge from EPA Science Advisory Board
- ◆ 1991: Environmental Monitoring and Assessment Program: “ecological status/trends; emerging problems”
- ◆ Geographic coverage—hexagonal grids
- ◆ Previous success with National Acid Precipitation Assessment Program

- ◆ EMAP hexagonal grid design got many regional agencies on board
- ◆ Needed specialization has occurred:
 - ◆ Aquatic Resource Monitoring
 - ◆ Regional EMAPs

www.epa.gov/emap/

- ◆ Hexagonal grids fine for certain landscapes (forests, arable land), not others
- ◆ Need to recognize streams as networks resulted in GRTS design

Sampling--Why Do We Care?

- ◆ Good estimates
- ◆ Reasonable standard error
- ◆ Generalization of results
- ◆ Reasonable cost





Guidance on Choosing a Sampling Design for Environmental Data Collection

for Use in Developing a Quality
Assurance Project Plan

EPA QA/G-5S

Quality

Multi-panel Sampling Design

THE OREGON PLAN *for* *Salmon and* *Watersheds*



Sampling Design and Statistical Analysis
Methods for the Integrated Biological and
Physical Monitoring of Oregon Streams

Report Number: OPSW-ODFW-2002-07



Multi-panel Sampling Design: Context

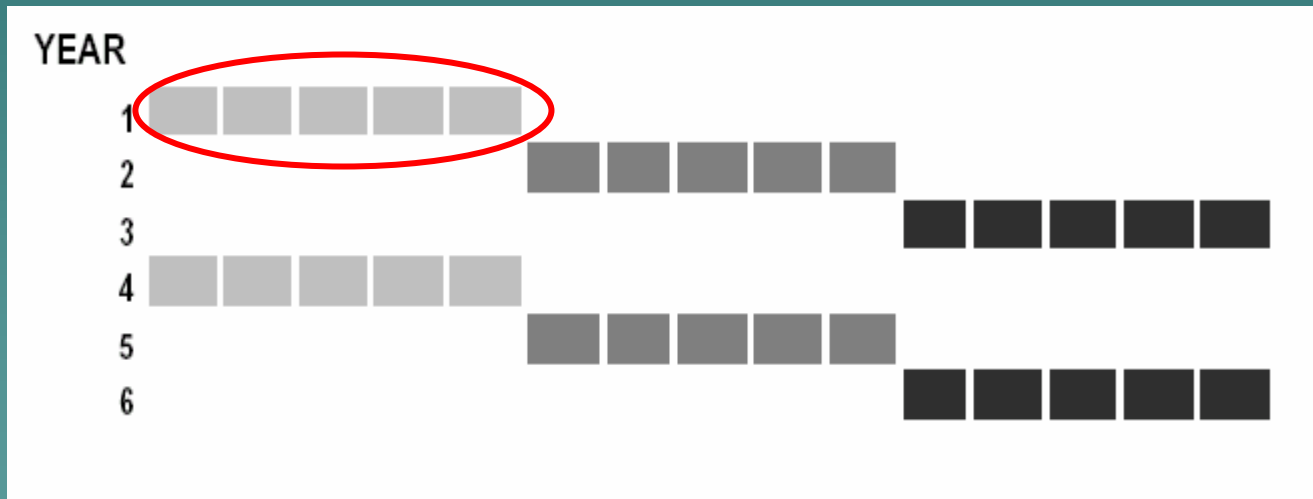
- ◆ Monitoring for both status and trend
 - Status: spatial coverage (sites)
 - Trend: temporal coverage (times)
- ◆ Can accomplish both with this design!

Multi-panel Sampling Design-- What is a panel?

- ◆ Panel = set of sites with a revisit period
- ◆ Panels chosen to reflect spatial patterns

Multi-panel Sampling Design

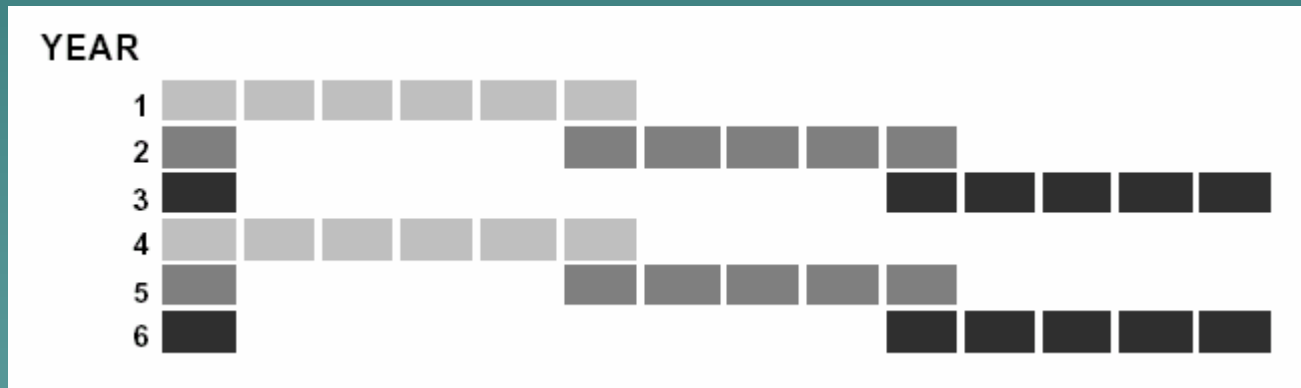
Simplified Rotating Panel Design:



Reproduced from: Firman, J.C. and Jacobs, S.E. 2003. A Survey Design for Integrated Monitoring of Salmonids. Oregon Department of Fish and Wildlife

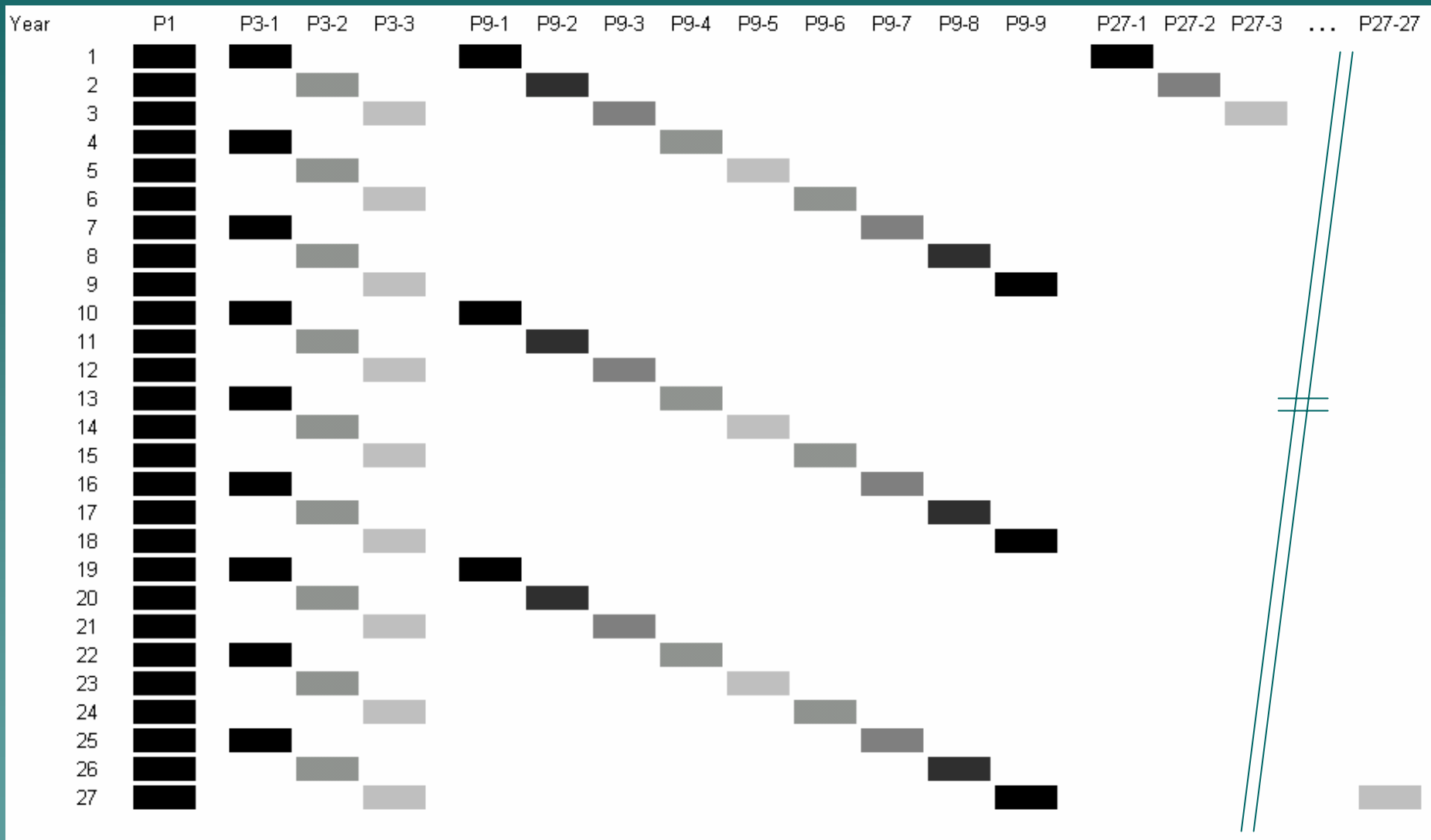
Multi-panel Sampling Design

Slightly More Complicated Panel Design:



Reproduced from: Firman, J.C. and Jacobs, S.E. 2003. A Survey Design for Integrated Monitoring of Salmonids. Oregon Department of Fish and Wildlife

ODFW Integrated Monitoring Design:



Modified from: Firman, J.C. and Jacobs, S.E. 2003. A Survey Design for Integrated Monitoring of Salmonids. Oregon Department of Fish and Wildlife

Multi-panel Sampling Design

Panel designs are usually based on a 3-5 year rotation.

ODFW's design adopted a three-year rotation to coincide with the three-year life cycle for coho salmon.

Multi-panel Sampling Design

In ODFW study a panel consisted of:

- ◆ ~ 79 Habitat Sites
- ◆ ~ 41 Spawning Sites
- ◆ ~ 13 Juvenile Sites

Multi-panel Sampling Design - Summary

- ◆ Useful when both spatial and temporal coverage required
- ◆ Accounts for temporal correlation at a site and spatial correlation among sites
- ◆ Requires all sites be known to define the panels

“Visual Sample Plan” Software

- ◆ Uses site maps and interactive questions to determine # samples, cost, sampling locations
- ◆ User imports a site map
- ◆ Spatial sampling, but not set up for stream networks
- ◆ <http://dgo.pnl.gov/vsp>

Visual Sample Plan (VSP)



The screenshot shows the DQO website interface. On the left is a vertical navigation menu with a black background and white text. The main content area is white and features the DQO logo at the top, followed by the text 'Data Quality Objectives'. Below this is a link for 'Security and Privacy'. The 'Visual Sample Plan (VSP)' section is highlighted, containing a descriptive paragraph, a small map of a red area with blue sampling points, and two bullet points. At the bottom of the VSP section are links for downloading the latest version and beta version, and a link for the VSP description.

DQO Data Quality Objectives

[Security and Privacy](#)

Visual Sample Plan (VSP)

VSP provides statistical solutions to sampling design, world-class mathematical and statistical algorithms, and a user-friendly visual interface, while answering two important questions in sample planning.



VSP

- How many samples are needed?
The algorithms involved in determining the number of samples needed can be quite involved and intimidating to the non-expert. VSP can quickly calculate the number of samples needed for various scenarios at different costs.
- Where should the samples be taken?
Sample placement based on personal judgment is prone to bias. VSP instantly provides random or gridded sampling locations overlaid on a user-input site map.

Download the latest **Visual Sample Plan** version [here](#).

Download the latest **Visual Sample Plan Beta** [here](#). (Version 2.2 Now Available)

[VSP Description](#)

Navigation Menu:

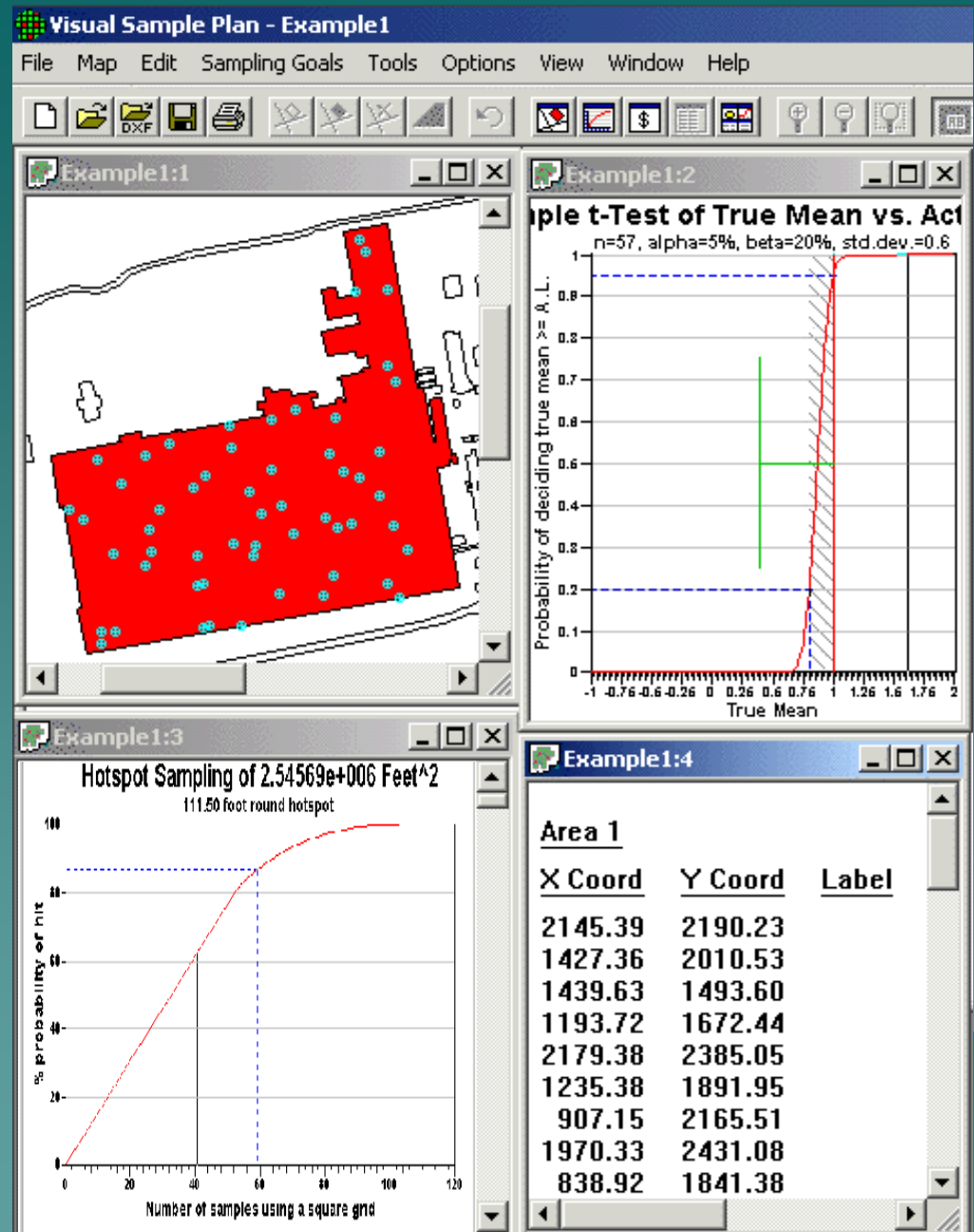
- ▶ [Homepage](#)
- ▶ [Why DQOs?](#)
- ▶ [Case Studies](#)
- ▶ [VSP Software](#)
- ▶ [Other Software](#)
- ▶ [Training](#)
- ▶ [Publications](#)
- ▶ [Hanford DQO](#)
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- ▶ [Search](#)

<http://dgo.pnl.gov/vsp>


Visual Sample Plan (VSP)

Modified from:

<http://dgo.pnl.gov/vsp>



Conclusions & challenges

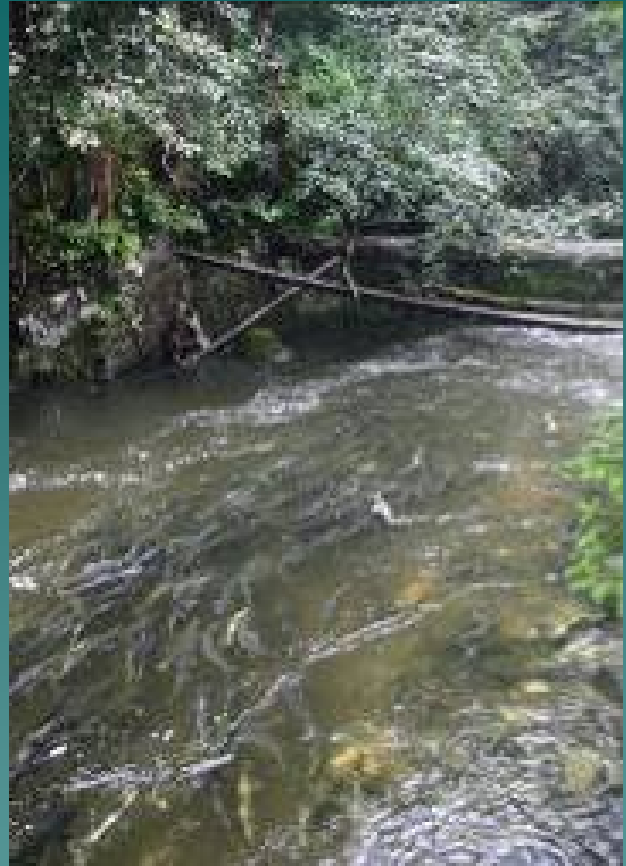
- ◆ Sampling approaches take into account complex and connective nature of stream networks
 - ◆ Computationally complex estimates, but better attention to spatial and temporal correlation
 - ◆ Requires more up front collaboration between biologists and quantitative folks
 - ◆ Adequate \$\$
- 

Web Sites

- ◆ www.epa.gov/quality/qa_docs.html
- ◆ dgo.pnl.gov/vsp
- ◆ oregonstate.edu/dept/statistics/epa_program/docs/

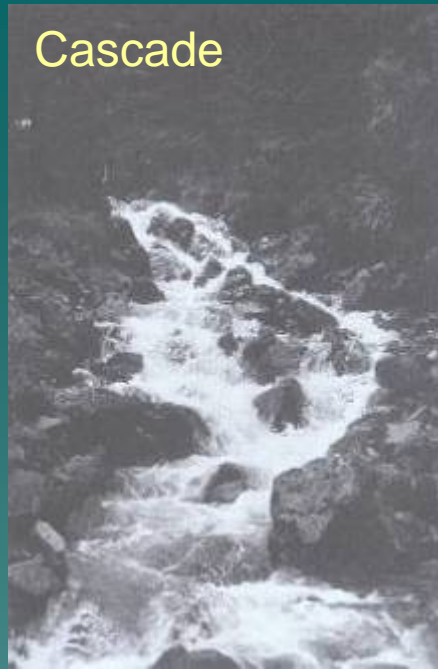
The End



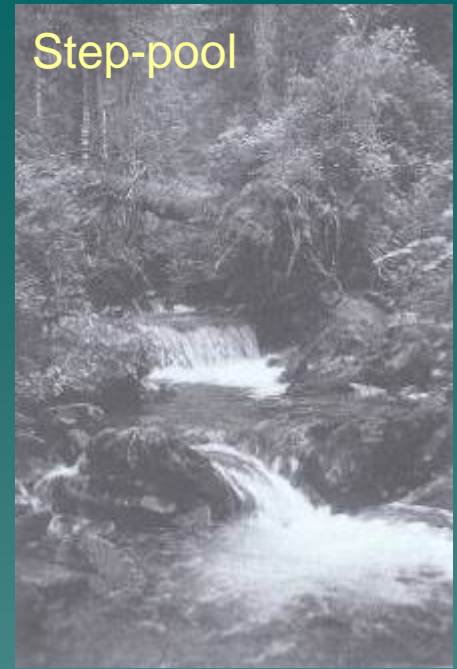


Montgomery & Buffington Stream Channel Classification Scheme

Cascade



Step-pool



Plane bed



Pool/riffle

