Monitoring of Riparian and Aquatic Habitat in the Olympic Experimental State Forest: First Results and Research Opportunities

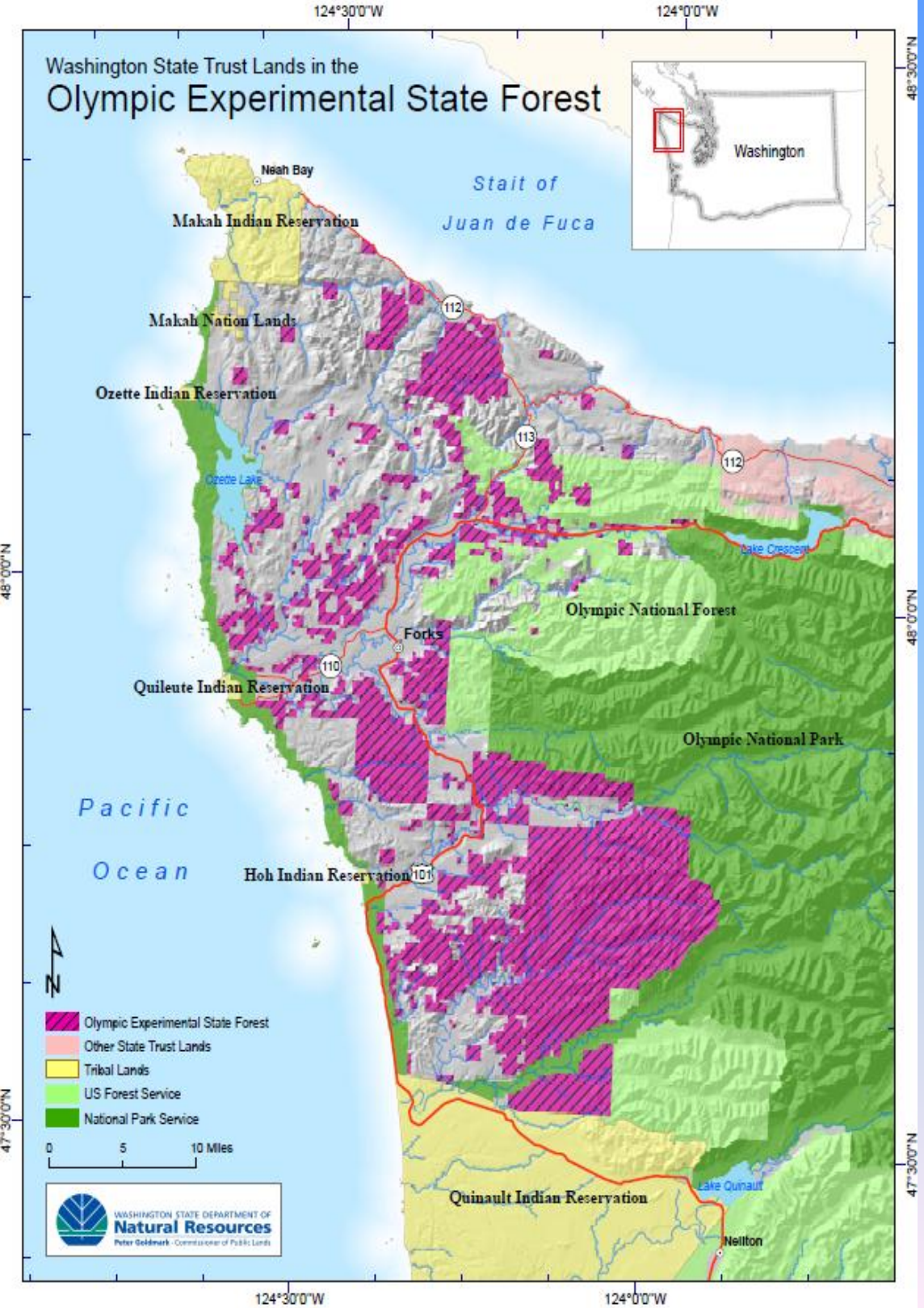
Teodora Minkova, WA Department of Natural Resources

Presentation at the Stream Talk Seminar, OSU

March 17, 2014

Presentation Outline

- Description of the Olympic Experimental State Forest (OESF)
- Context for the riparian monitoring project
- Project goal and objectives
- Monitoring indicators
- First results
- Research opportunities



270,000 ac forested lands

Steep erodible terrain

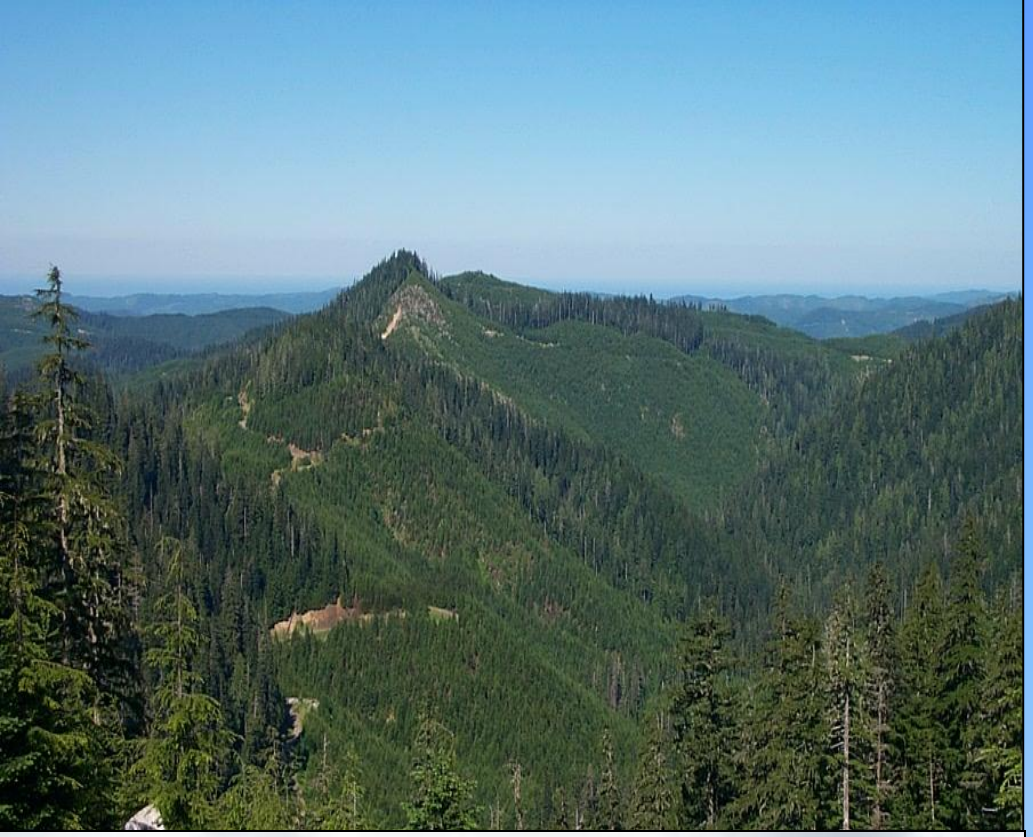
Ave. precipitation of 140"/year

Dense stream network

Temperate rain forest

Sitka Spruce and Western Hemlock vegetation zones

Some of the healthiest salmon populations in WA



Working forest - current harvest level of 576 mmbf / decade

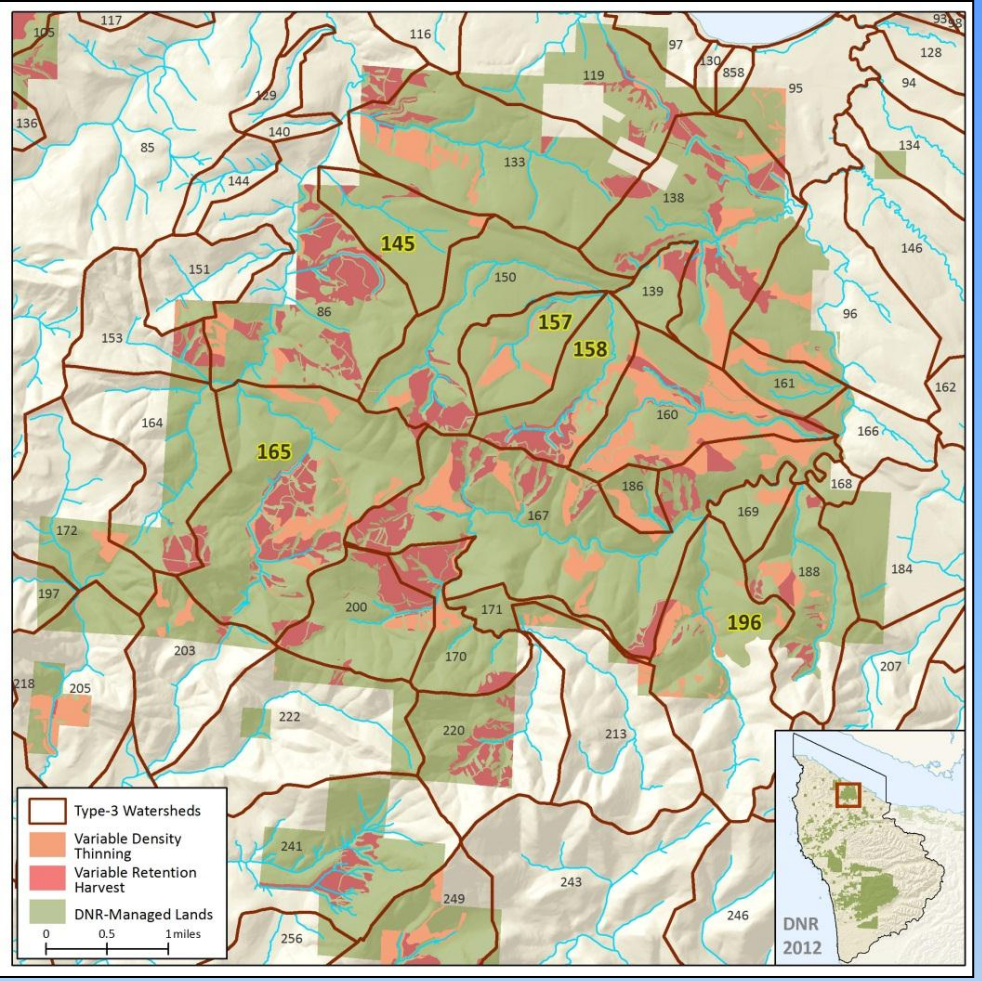
Habitat Conservation Plan signed in 1997

- Northern spotted owl
- Marbled murrelet
- Salmonids

Integrated forest management:

- limited fixed reserves for spotted owl conservation
- variable-width riparian buffers

A place for experimentation



Proposed harvest schedule

Clallam block, 1st decade, landscape alternative

OESF Forest Land Plan was developed to guide forest management

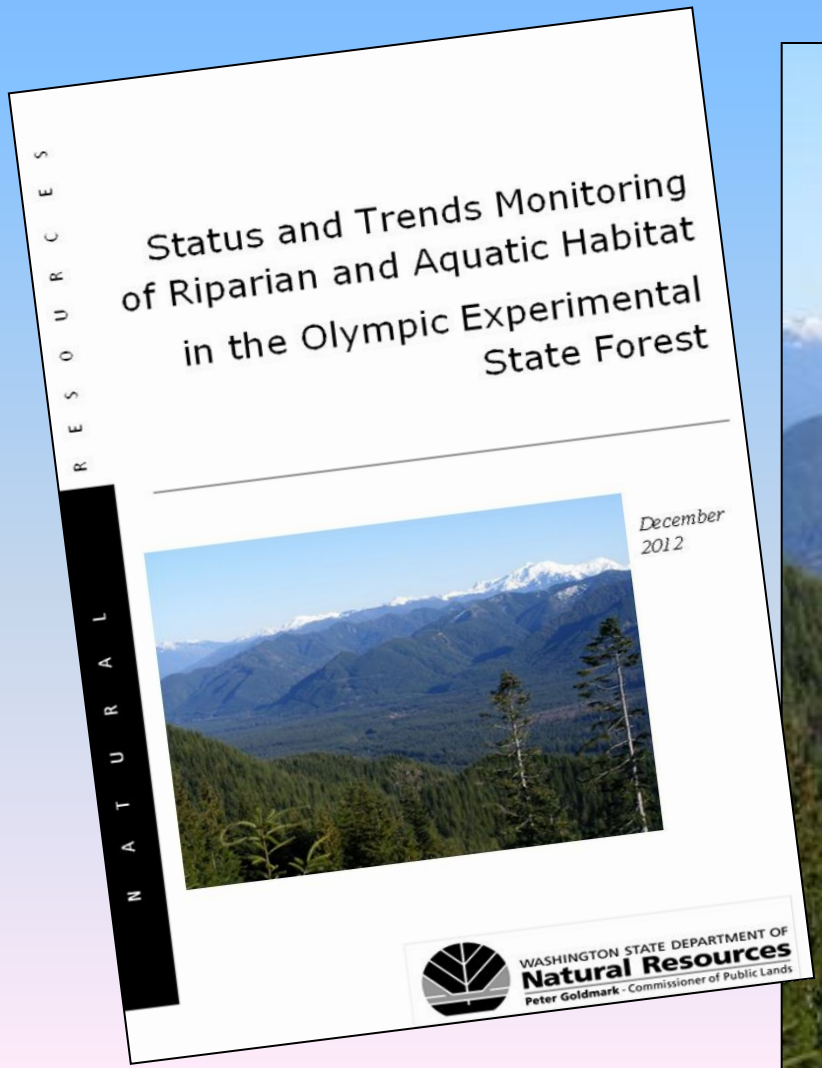
Environmental Impact Analysis (EIS) showed improved aquatic and riparian conditions

Uncertainties identified during the analyses:

- Resource inventory (streams, forest)
- Ecological relationships
- Management effects
- Effects of natural disturbances

Monitoring Goal

To characterize the recovery of riparian and aquatic habitat across the OESF as the forest land plan is implemented.



Objectives of the Study Plan

1. Document the status and trends in riparian and aquatic conditions.

2. Test presumed relationships between riparian, upland, and in-stream conditions.

3. Test the assumptions about habitat recovery and evaluate the EIS projections of riparian habitat conditions over time.

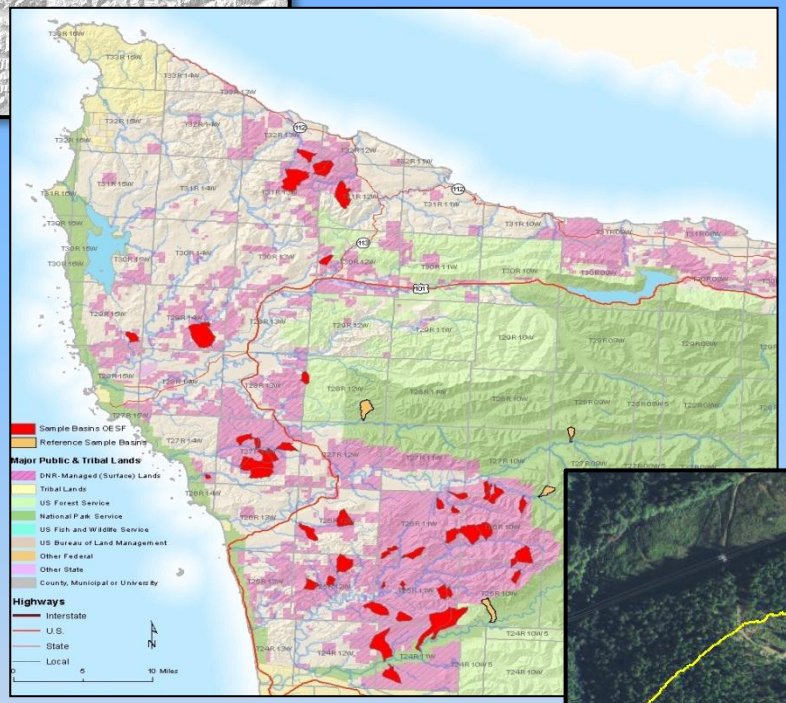
4. Supply information for HCP implementation, effectiveness, and validation monitoring.

5. Improve understanding of “habitat complexity afforded by natural disturbances”.

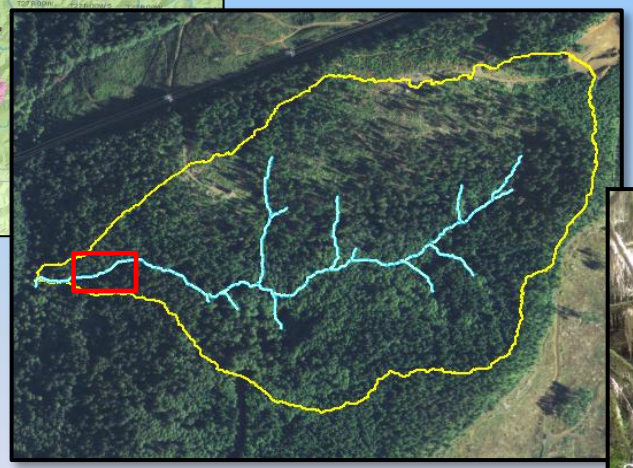
6. Establish critical baseline information for adaptive management.

Spatial Study Design

Target population: 601 basins (size 70 -1760 ac)



Sample: 50 OESF basins + 4 reference basins in the Olympic National Park



Field sampling at the basin's outlet

Sample reach: 100+ m of fish bearing stream and riparian area

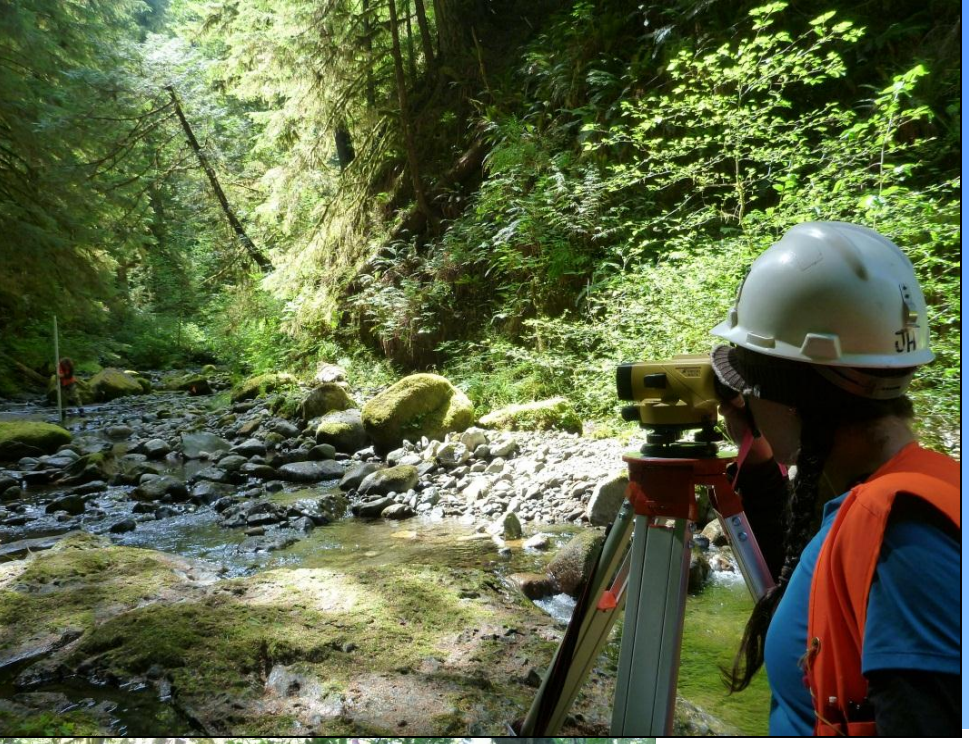
Monitoring indicators

Nine aquatic and riparian indicators sampled at reach level:

1) channel morphology (incl. gradient, confinement, depth, and width)
2) water temperature
3) channel substrate
4) stream discharge
5) in-channel large woody debris
6) habitat units (such as pools)
7) stream shade
8) riparian microclimate
9) riparian forest vegetation

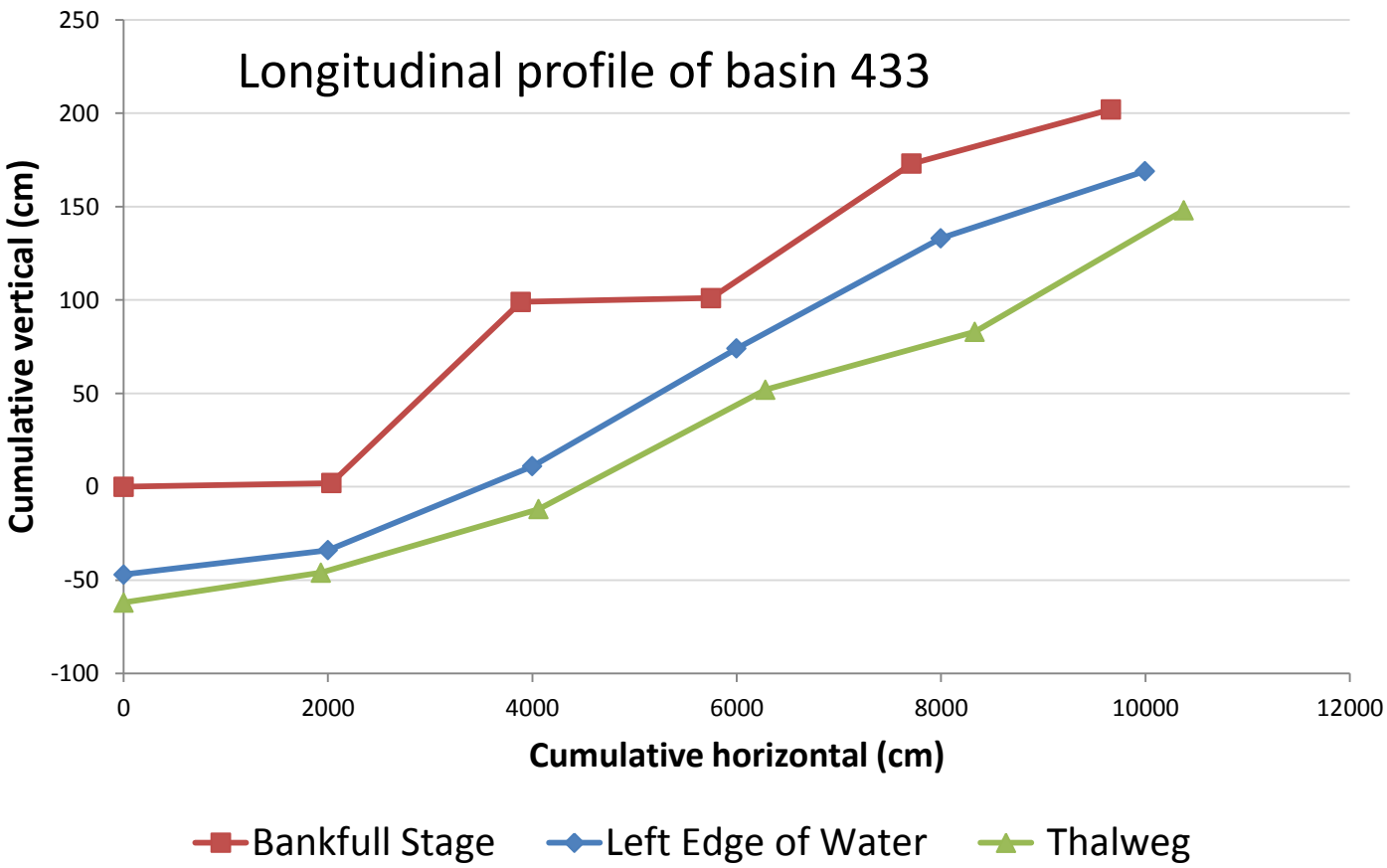
Watershed-level "stressors" were identified for monitoring in the 50 sample basins

1) timber harvest activities
2) road management and use
3) natural disturbances (windthrow, landslides, floods and debris flows)



Stream Elevation Survey

Longitudinal profiles completed for 10 basins



Cross-section Survey

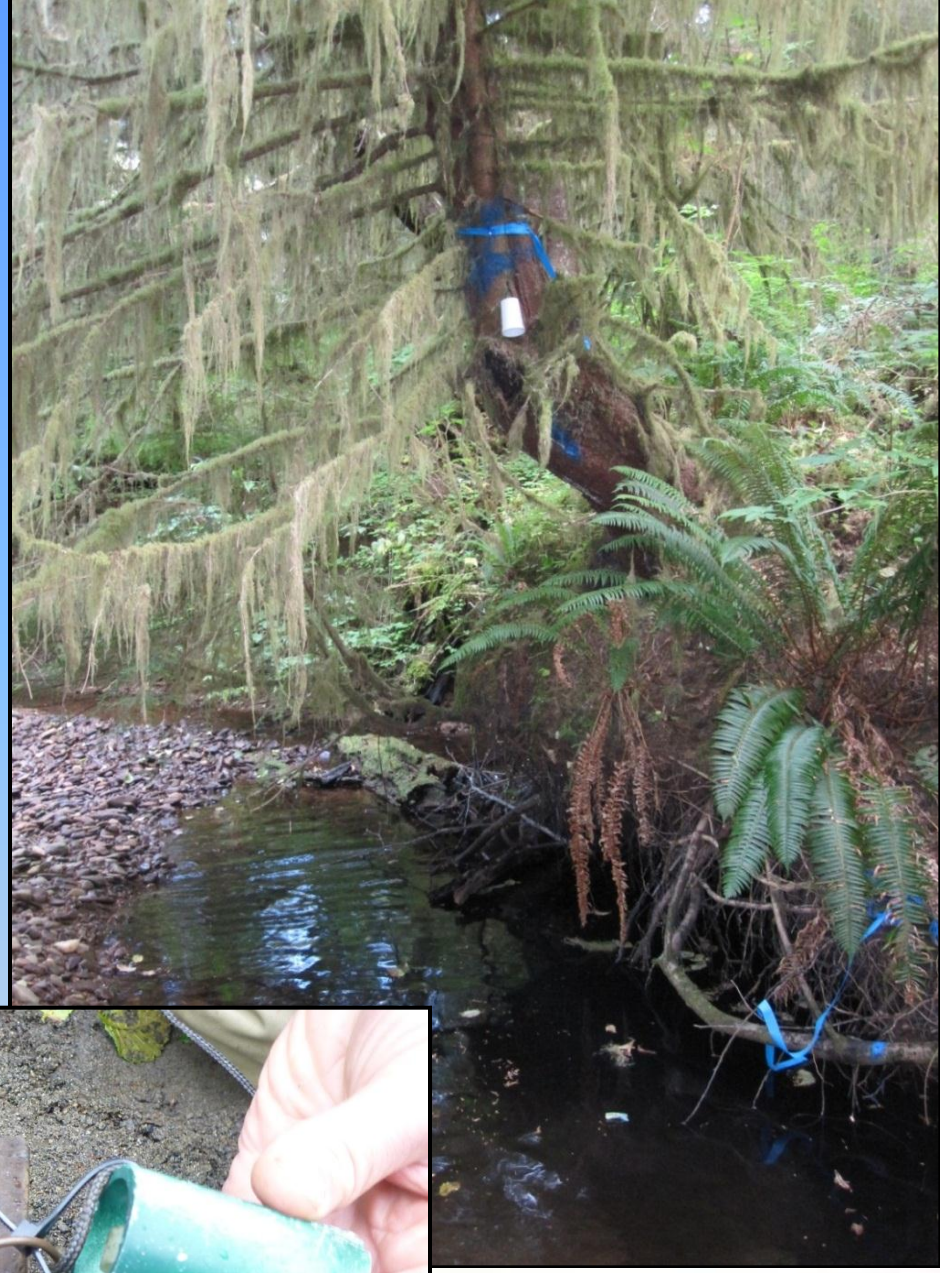
- channel width
- channel depth
- substrate size
- substrate embededness

Cross Section		Channel Substrate					
	station intervals (cm)	Particle #1			Particle #2		
		size (mm)	size class	embed. (%)	size (mm)	size class	embed. (%)
A	0	16	fine gravel	n/a	32	coarse gravel	n/a
A	80	22.6	coarse gravel	n/a	sand	sand	100
A	160	90	cobble	30	90	cobble	5
A	240	32	coarse gravel	n/a	180	cobble	50
A	320	180	cobble	20	90	cobble	15
A	400	8	fine gravel	n/a	90	cobble	40
A	480	16	fine gravel	n/a	32	coarse gravel	n/a
A	560	2	sand&silt	n/a	64	coarse gravel	0
A	640	16	fine gravel	n/a	32	coarse gravel	n/a
A	720	45	coarse gravel	10	64	coarse gravel	15
A	800	64	coarse gravel	n/a	64	coarse gravel	15

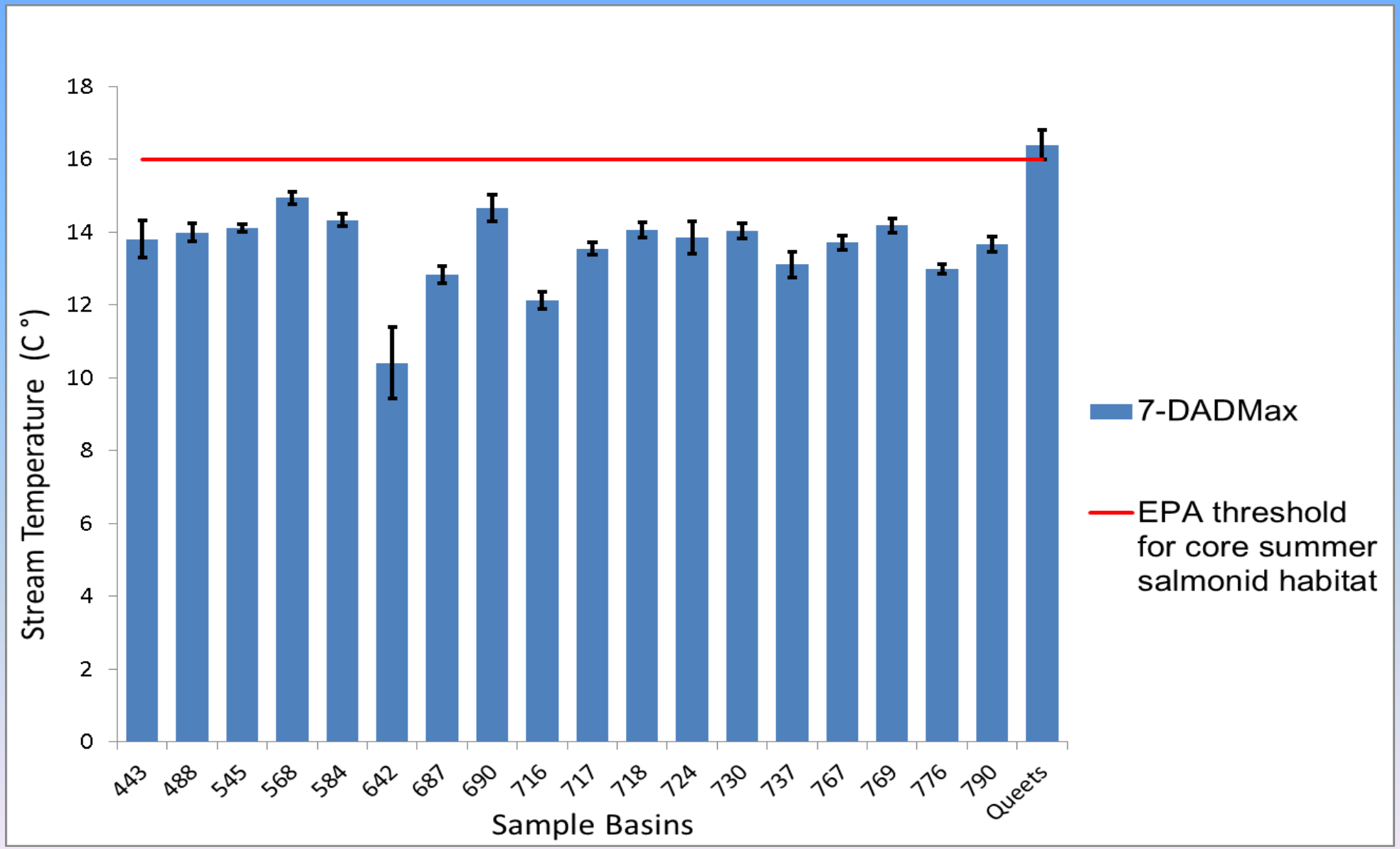
Protocols completed for 10 basins

Stream Temperature

- Continuously recording air and water temperature data loggers
- Installed in all 54 basins
- OESF sites are part of USFS dynamic stream temperature mapping tool



7-day daily average maximum temperature in 18 OESF basins and one reference basin for the period 10/01/2012 - 10/01/2013



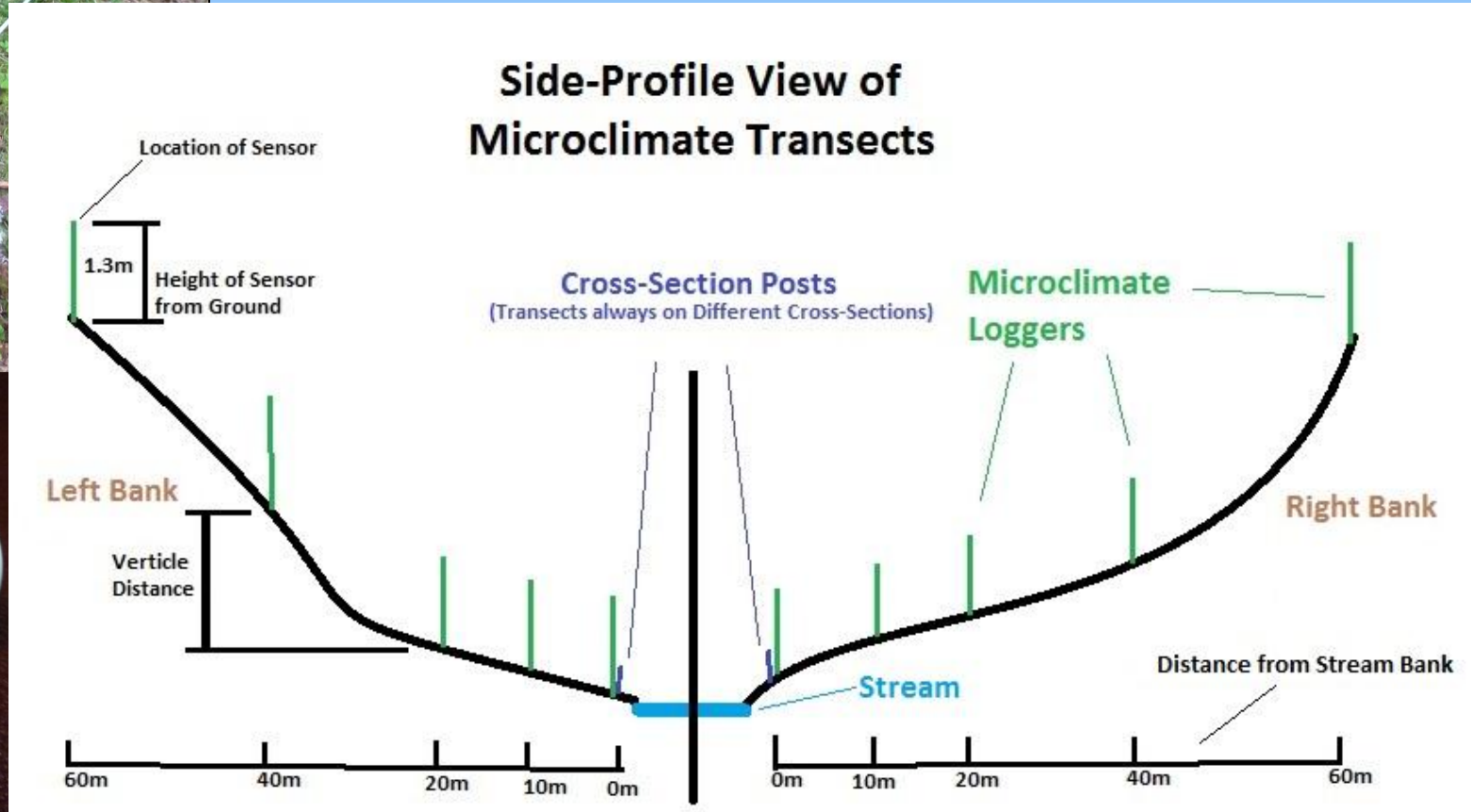
error bars = 1 SD

Stream Shade

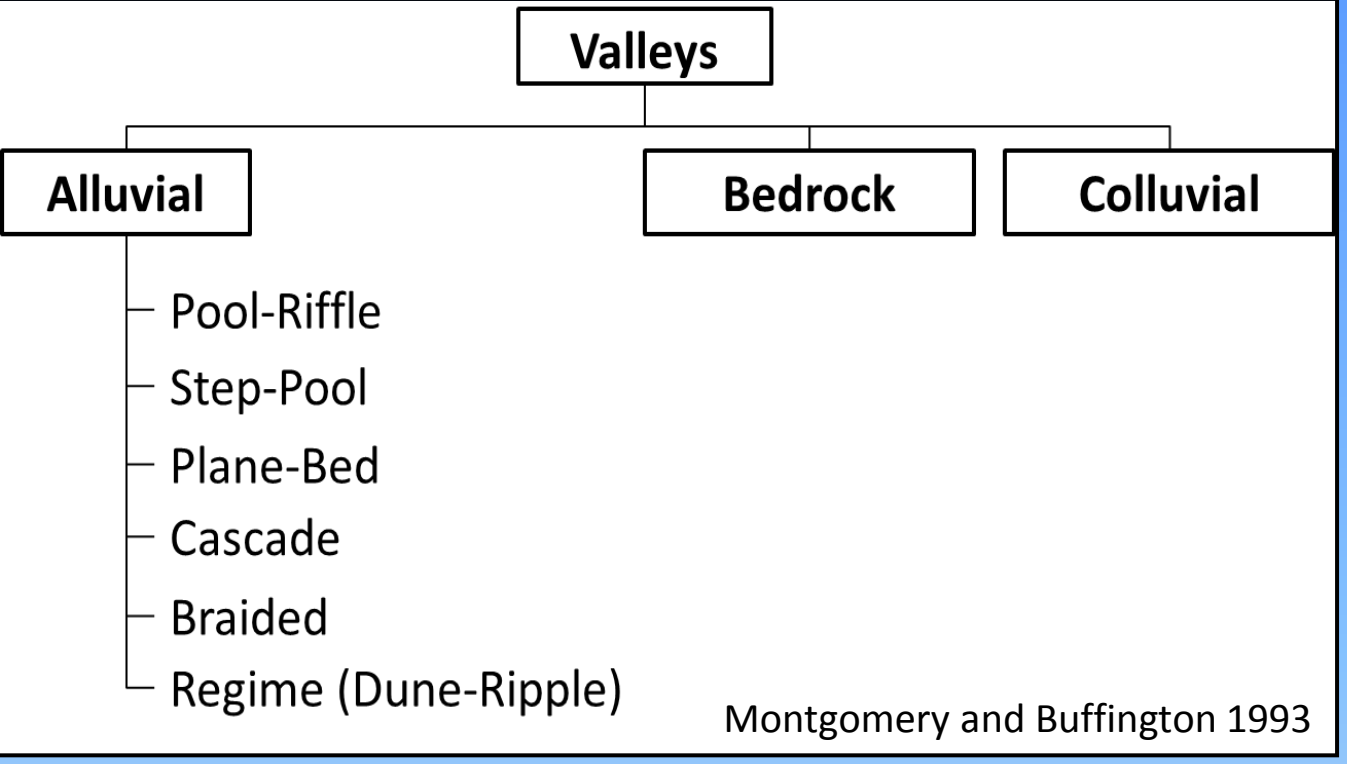
- Sampling through hemispherical photography
- Analyses of images with Hemispher (Schleppi 2011) and Sidelook (Nobis 2005)

Microclimate

- Continuously recording loggers measuring air temperature and humidity
- Installed in 10 basins

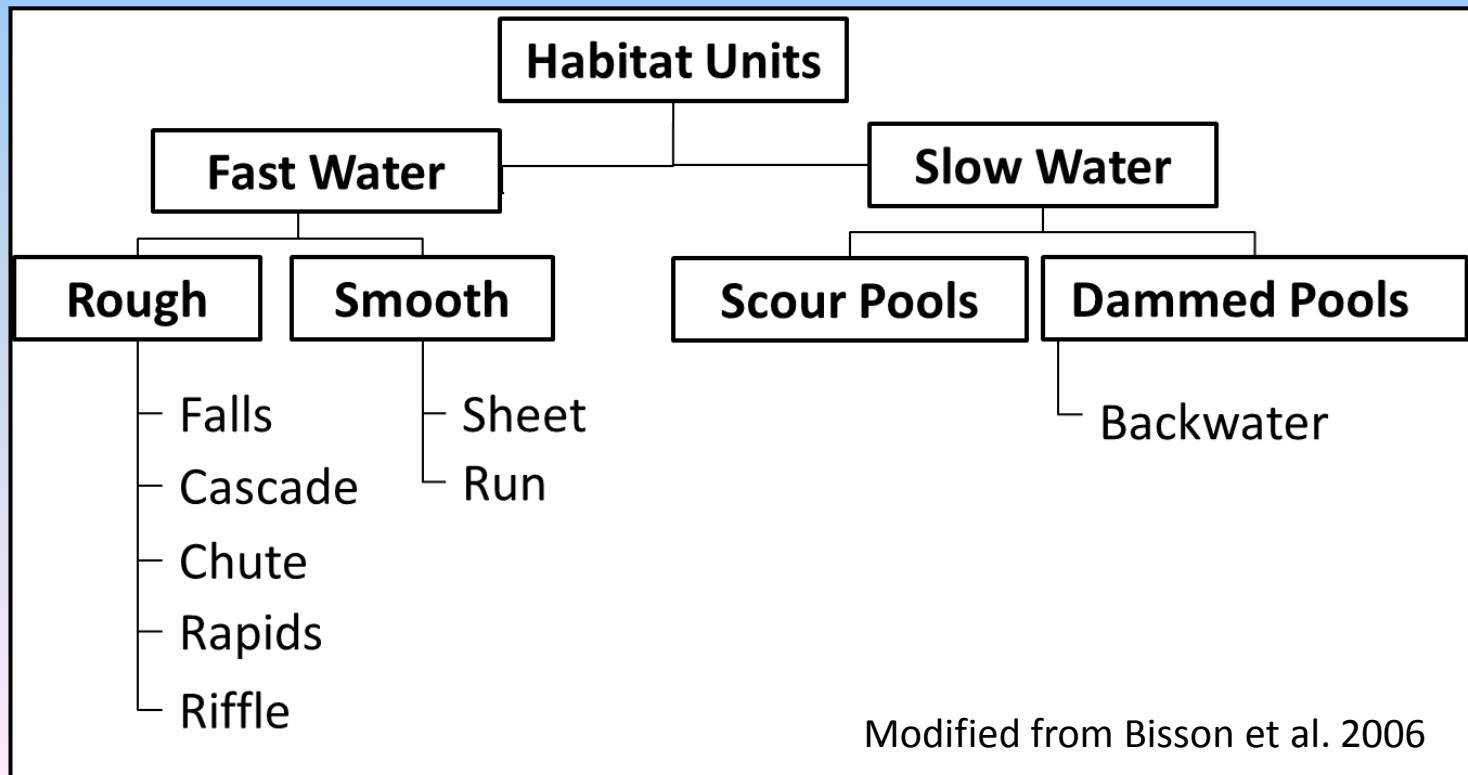


Classification of Channel Types and Habitat Units



Montgomery and Buffington 1993

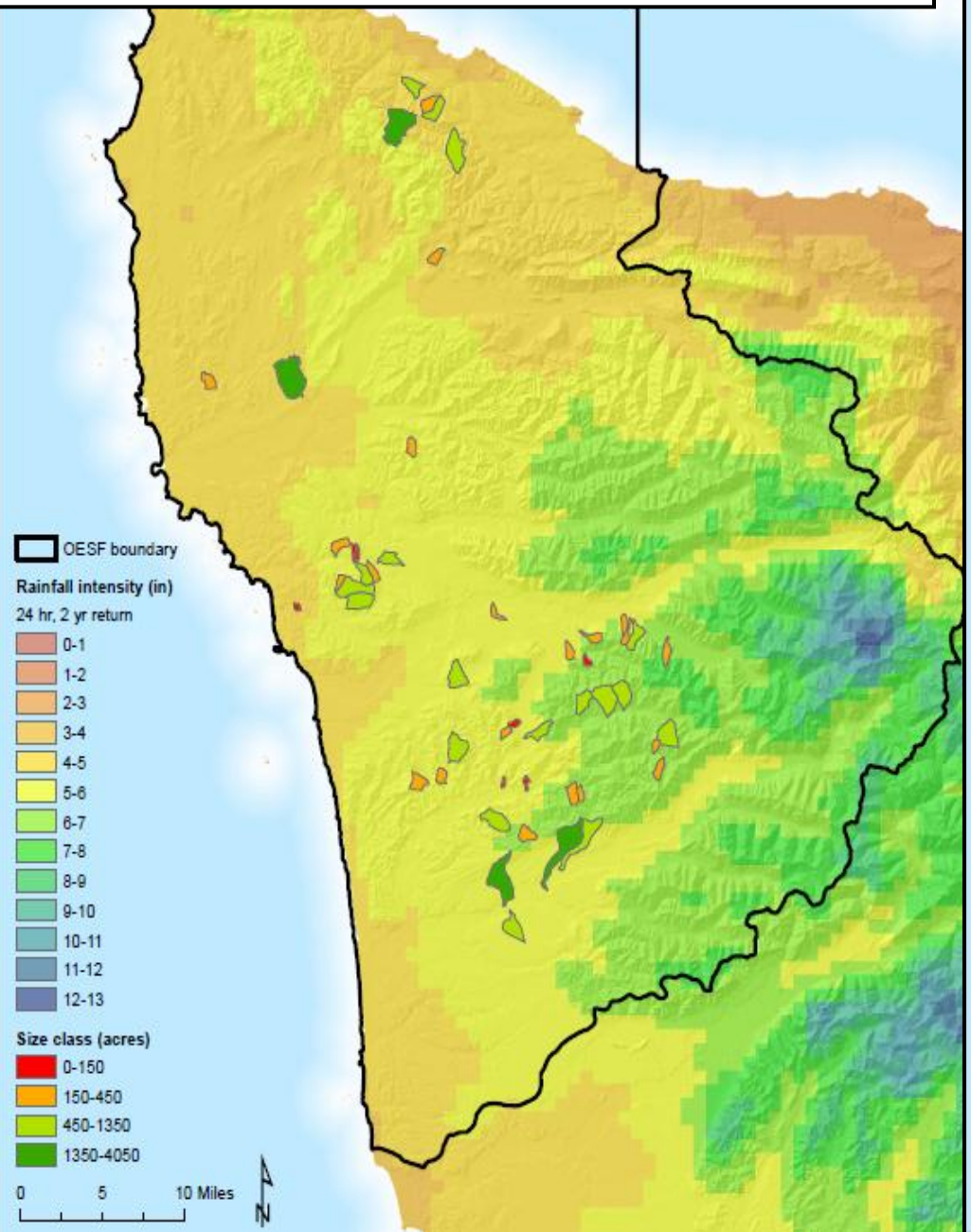
Habitat unit's measurements completed in 10 basins



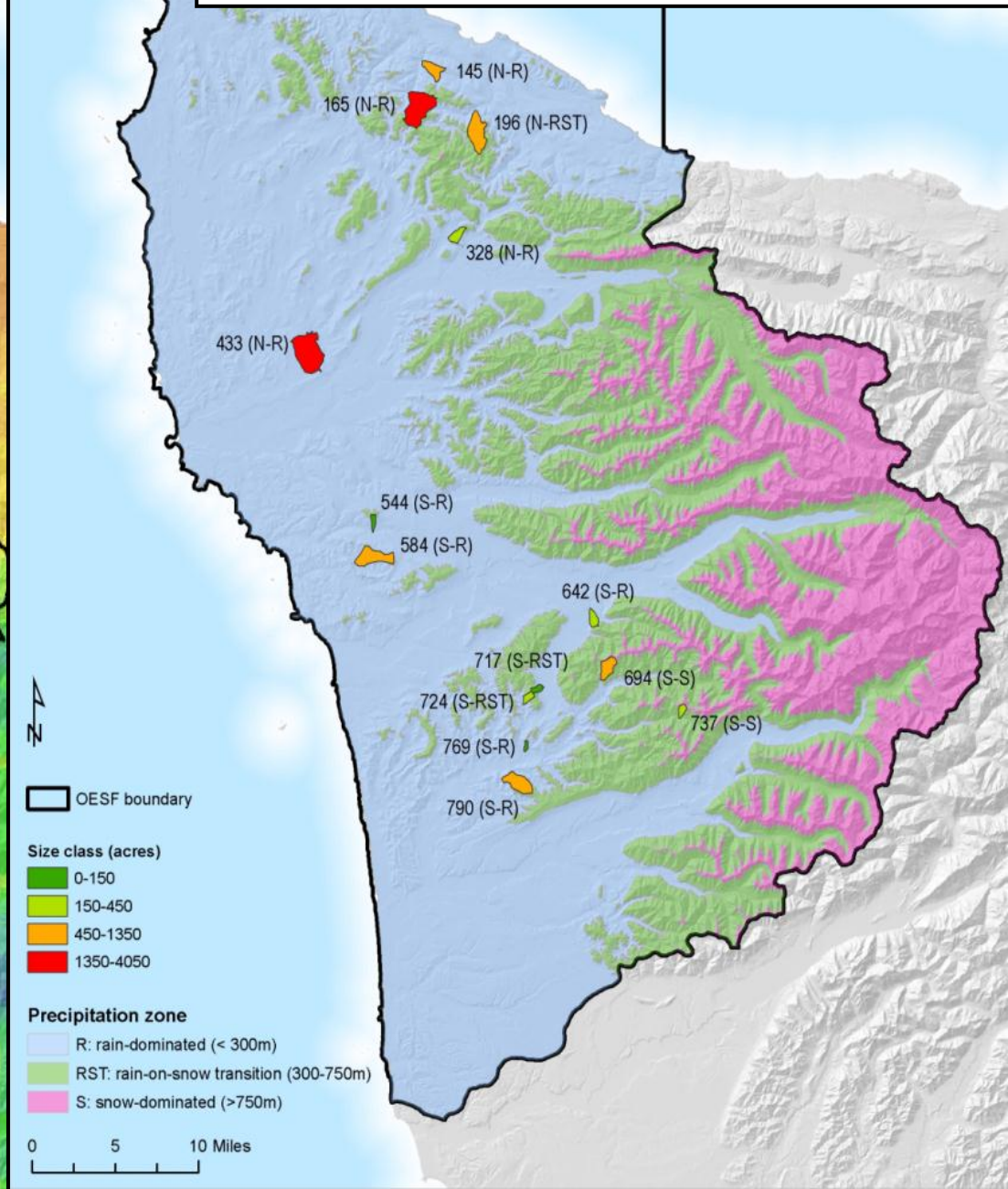
Modified from Bisson et al. 2006

Hydrologic Monitoring

The 50 sample basins categorized by size and rainfall intensity



The 14 sample basins selected for hydrologic monitoring



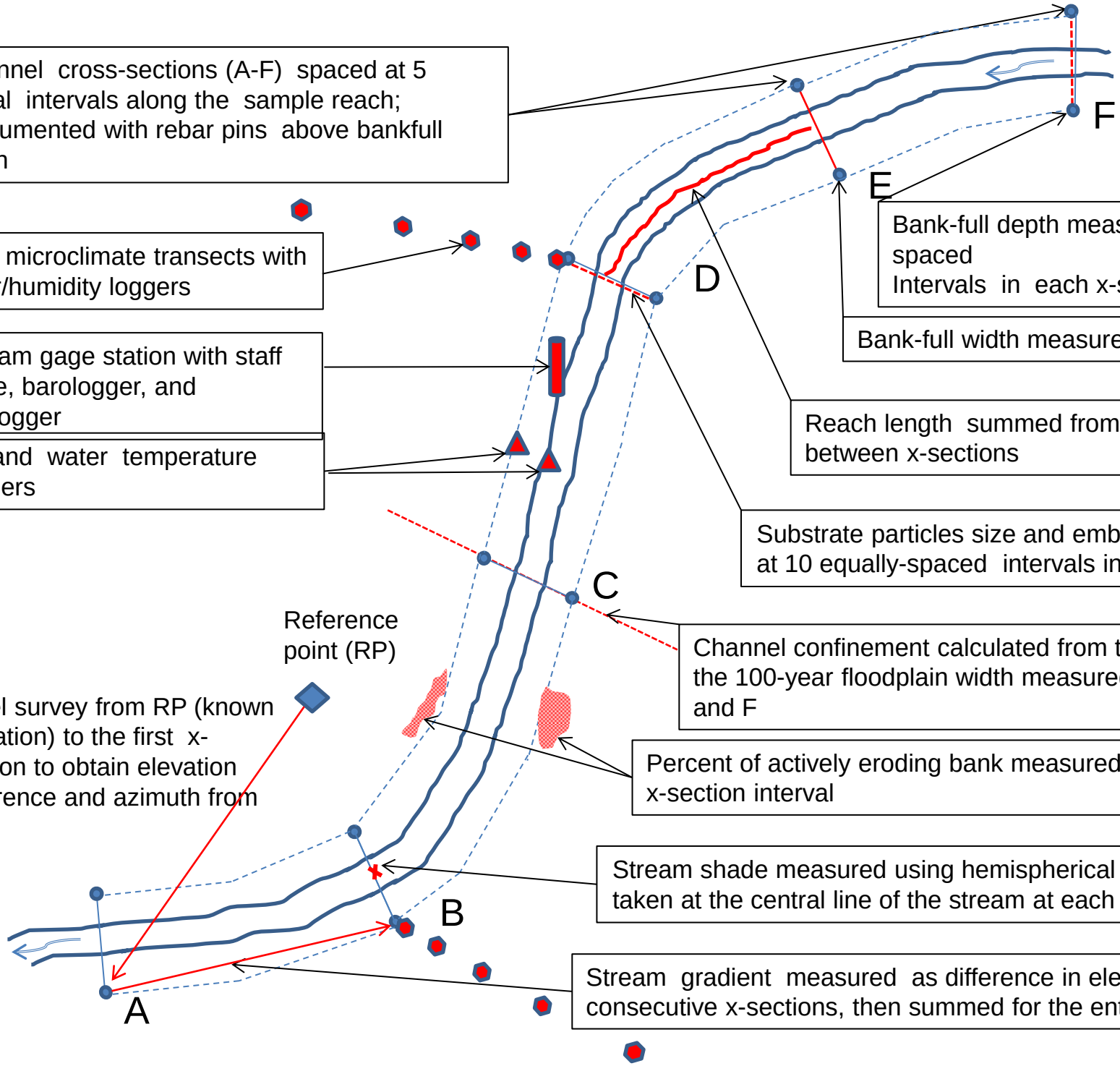
Hydrologic Protocol

1. Selection of sample basins
2. Establishing sampling installations
3. Recording water level data and measuring water discharge
4. Building rating curves
5. Discharge/rating curve record correction over time
6. Analyses of status and trends of stream flow
7. Current metrics of interest: peak flow and summer low flow magnitude

Hydrologic Gage Installations

- Each stream gage site includes:
  - Unvented Solinist pressure transducers (air and water)
  - Staff gage
  - Benchmarks
- Field and office work:
  - Discharge measured 10-12 times first year; 6-8 times following years or as needed to maintain rating curve; following USGS protocol as closely as possible
  - Cross-section surveys
  - Access database and GIS layers including basin characteristics, survey data, and stream gage output

Sample Reach Schematic (≥ 100 m)



Channel cross-sections (A-F) spaced at 5 equal intervals along the sample reach; monumented with rebar pins above bankfull width

Two microclimate transects with 5 air/humidity loggers

Stream gage station with staff gage, barologger, and leveogger

Air and water temperature loggers

Level survey from RP (known elevation) to the first x-section to obtain elevation difference and azimuth from RP

Bank-full depth measured at 10 equally-spaced Intervals in each x-section

Bank-full width measured at each x-section

Reach length summed from the stream lengths between x-sections

Substrate particles size and embededdness measured at 10 equally-spaced intervals in each x-section

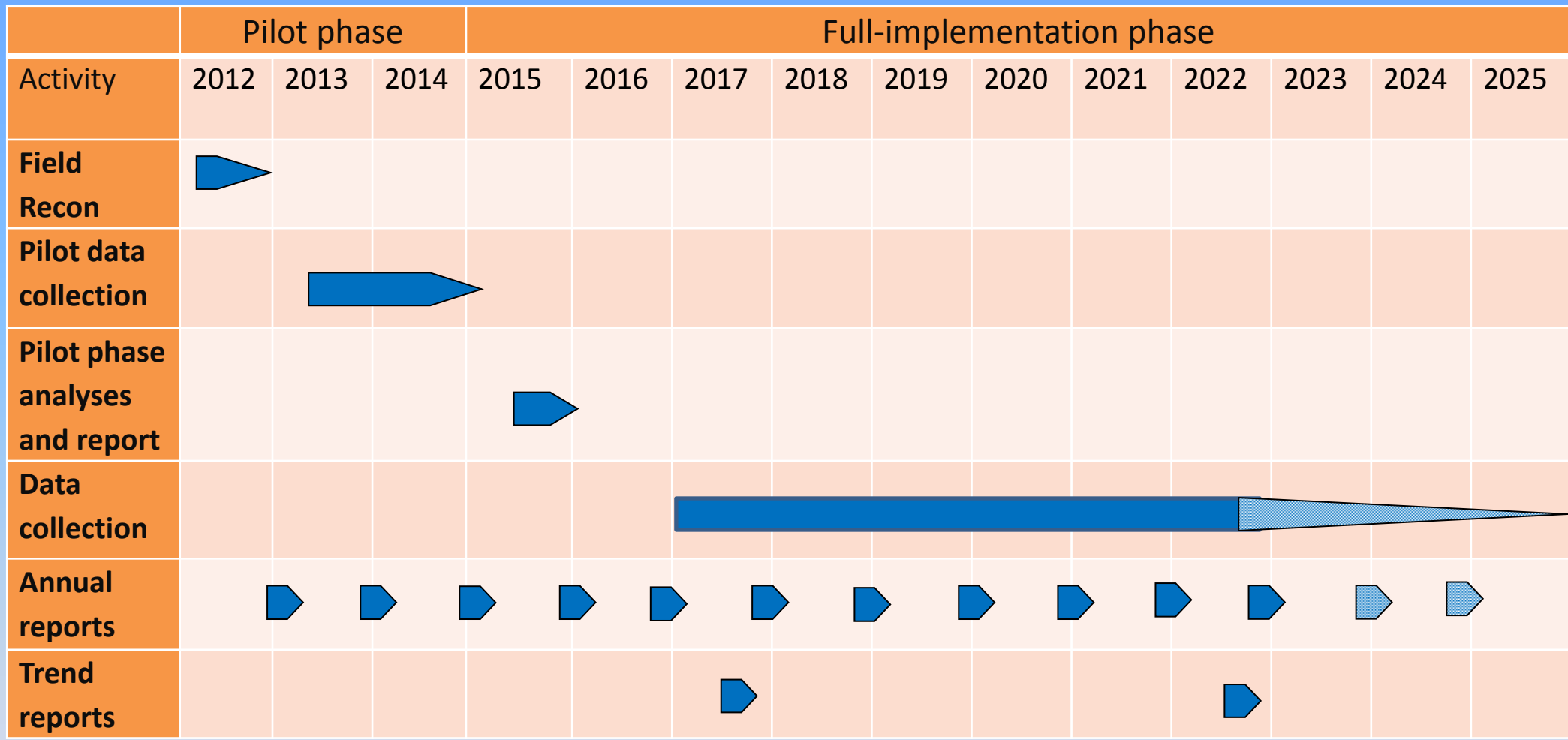
Channel confinement calculated from the bankfull width and the 100-year floodplain width measured at x-sections A, D, and F

Percent of actively eroding bank measured on both banks in each x-section interval

Stream shade measured using hemispherical photos of the canopy taken at the central line of the stream at each x-section

Stream gradient measured as difference in elevation between two consecutive x-sections, then summed for the entire reach

Project Implementation Schedule



Funding provided by DNR; $250K already invested in the project

Project conducted in cooperation with FS Pacific NW Research Station

Research opportunities within existing project modules

- Relationships between in-stream, riparian, and upland conditions

  Example: riparian forest → shade → stream temperature

- Characterization of habitat complexity afforded by natural disturbances

  Example: natural hydrologic and sedimentation regimes

- Forest management effects on aquatic and riparian habitat

  Example: percent forest cover in a basin → hydrologic regime

Research opportunities: new project modules

- Use of remote sensing data to characterize forested streams

  Example: Developing a Lidar-based model to classify streams based on gradient, confinement and pool-riffle sequence.

- Biological monitoring

  Example: fish, amphibians, and macroinvertebrates

- Relationships between populations and habitat

  Example: coho summer rearing, hydrologic regime, and pools

- Assessment of water quality and sedimentation

- Design of experimental paired-watershed study

Research opportunities: advantages of the OESF as a research site

- An actively managed forest allows field experimentation
- Large land base can accommodate landscape-level studies
- Adjacent Federal lands provide opportunities for reference sites and experimental controls
- Well maintained road system provides easy field access
- Extensive, regularly updated, and non-proprietary datasets are available for spatial analyses
- OESF research and monitoring program conducted knowledge gap analysis and identified priority adaptive management questions
- An example of temperate rain forest ecosystem with extreme rainfall and tree growth rates

Photo: Robert Van Pelt

Acknowledgements

Field crew:

Jessica Hanawalt

Mitchell Vorwerk

Ellis Cropper

Rachel LovellFord

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

PNW

Questions?