Modeling the Effects of Agricultural Conservation Practices on Water Quality in the Pacific Northwest Basin

Presenter: R. Srinivasan, Professor, Texas A&M

C. Santhi and CEAP National Assessment Team
Texas A&M University System, Temple, Texas

Presentation Overview

- **CEAP National Assessment**
  - CEAP/SWAT/APEX Modeling Approach

- **Pacific Northwest Basin – Calibration and Validation**

- **Determine the Major Sources of Sediment and Nutrients delivered to local streams in the PNWB**

- **Determine the Off-site Benefits of Agricultural Conservation Practice Scenarios on Water Quality in the Pacific Northwest Basin**

CEAP/SWAT/APEX National Modeling System

Watershed Configuration Details (Subbasins/Rivers/Routing/Reservoirs)

Weather (Precipitation, Temperature and others)

Dry and Wet Atmospheric Nitrogen Deposition

SWAT Watershed Model (Calibrated)

APEX Farm Scale Model (Calibrated)

Point Sources: Flow, TSS and nutrient loadings from Municipal and Industrial Plants

Uncultivated Land: Flow, sediment, nutrient and pesticide loadings from HRUs

Cultivated Cropland &CRP: Edge of field flow, sediment, nutrient & pesticide loadings from subareas with practices

Effects on Edge of Field Water Quality

INTEGRATE APEX OUTPUT

Instream Processes: Routing through reach, ponds, reservoirs to 8-digit watershed outlet & through main river reaches to basin outlet

SCENARIOS

1. Current Conservation Baseline: SWAT simulation using APEX output with current conservation practices
2. No Practice: SWAT simulation using APEX output without conservation practices
3. Additional Treatment Need: SWAT simulation using APEX output with ENMC and ENMA
4. Background: SWAT simulation with APEX output with background grass-tree mix condition

Conservation Scenarios

1. Current Conservation Baseline: APEX inputs with current conservation practices from CEAP survey
2. No Practice: APEX inputs without conservation practices
3. Additional Treatment Need: APEX inputs with different combinations of practices & practice acres (ENMC and ENMA)
4. Background: APEX inputs with grass-tree mix condition on cropland

RESULTS

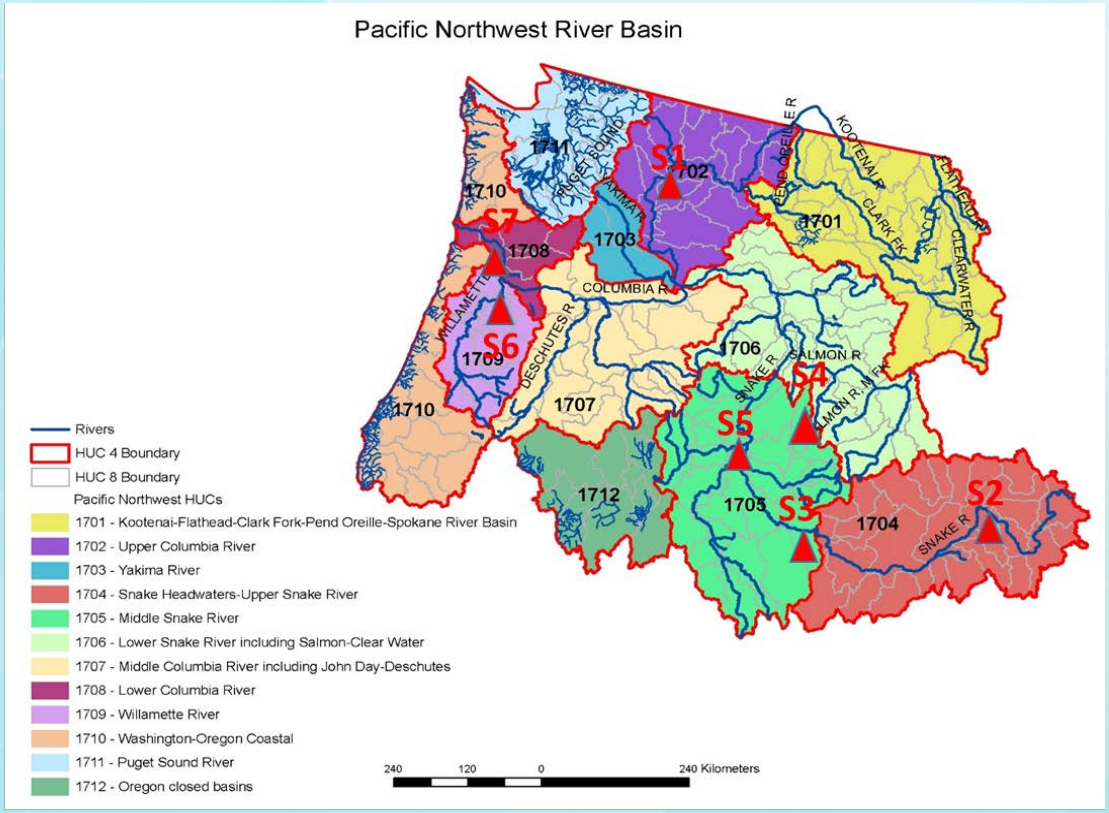
Effects on Local/Instream Waters

1. Reductions in sediment, nutrients and pesticide yields and loads at 8-digit watersheds due to current conservation practices and additional treatment practices on cropland
2. Reductions in instream loads at river points due to current conservation and additional treatment scenarios

NRI/Survey/Conservation Practice Details

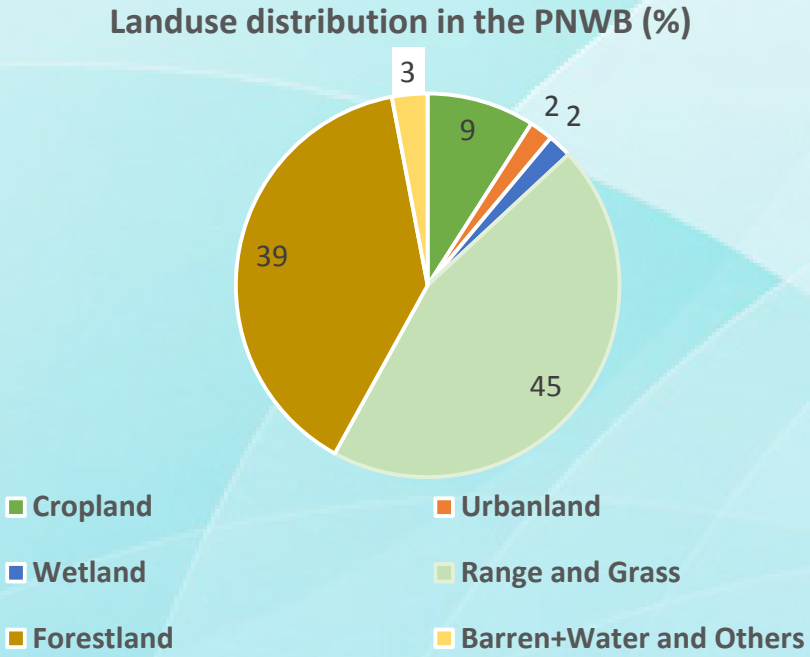
- Structural Practices
- Cultural Management Practices
- Practice Acres
- Farming Activities/Survey Database
- NRI

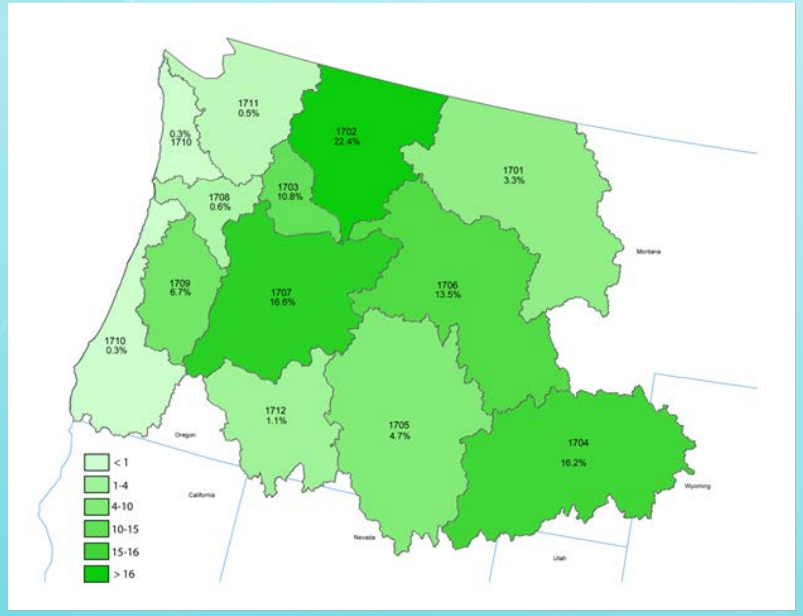
Pacific Northwest Basin with Calibration Gages



Okanogan River at Malottt, WA	S1
Snake River near Heise, ID	S2
Snake River at King Hill, ID	S3
Snake River at Weiser, ID	S4
Willamette River @ Portland, OR	S5
Columbia River at Beaver Army	S6

Pacific Northwest Basin





Drainage Area: 7,18,450 km^2

9% - Cropland Area

Metropolitan Cities: Seattle, Portland, Spokane, Boise, etc

Nutrient enrichment in many freshwater streams: Many streams exceed EPA's nutrient criteria

standards

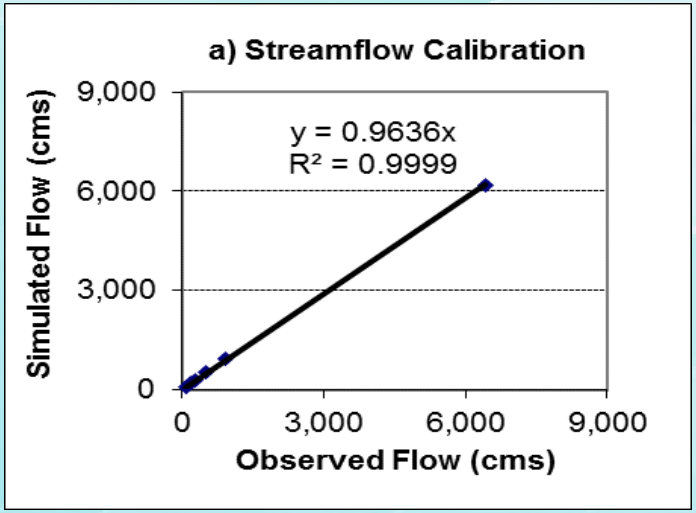
USDA has implemented several

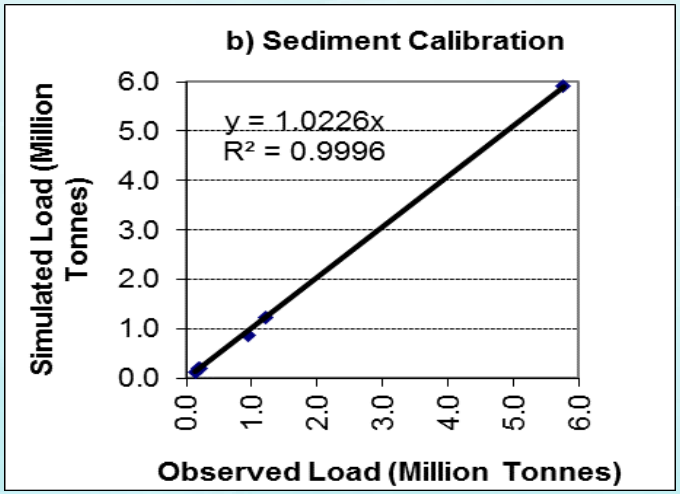
conservation practices

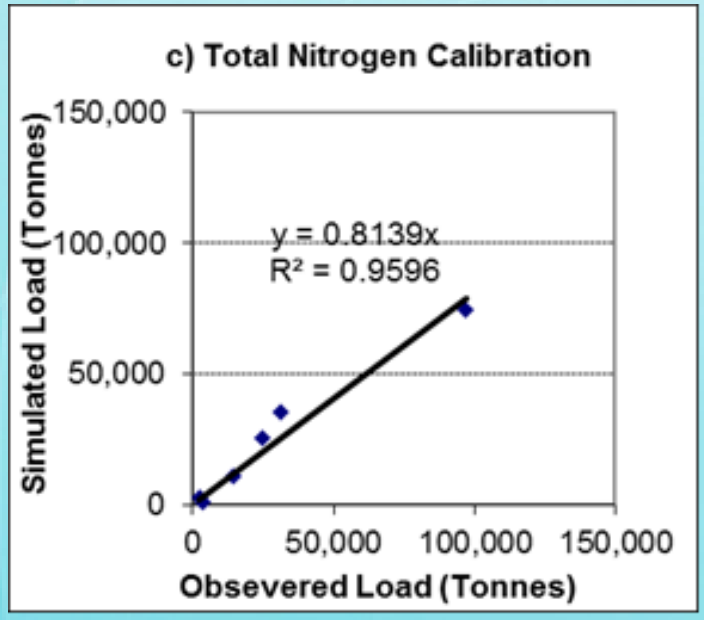
Specific Objectives

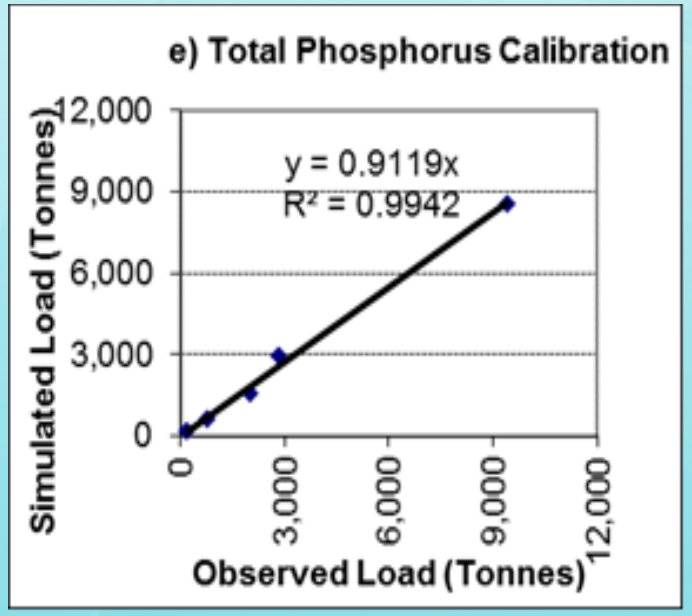
1) Calibrate the Pacific Northwest Basin (PNWB) model for sediment and nutrient loads multiple gauges,
2) Determine the major sources of sediment and nutrients delivered to local waters in the Pacific Northwest Basin, and
3) Evaluate the effects of the current agricultural conservation and future conservation needs on water quality in the Pacific Northwest Basin.

Calibration Results at the Gages

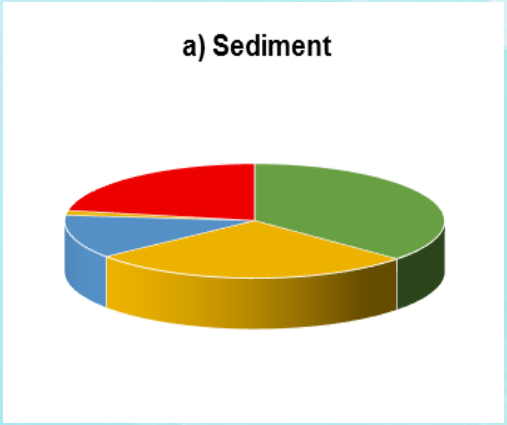


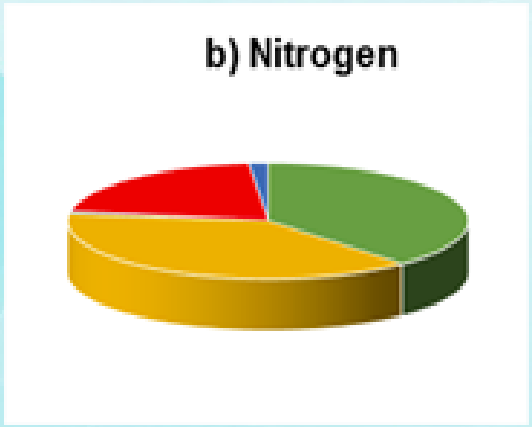


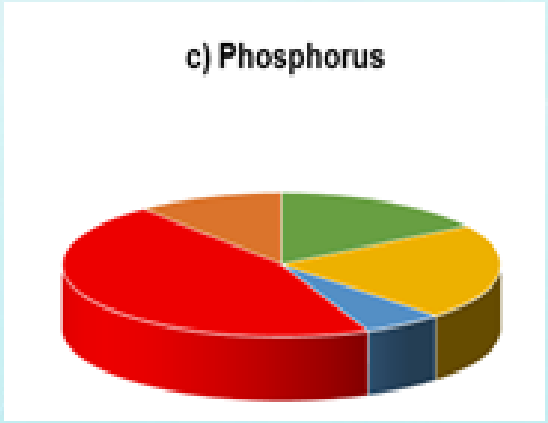


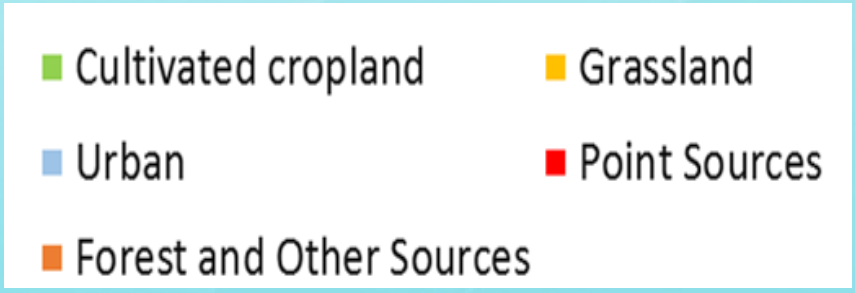


Sources of Sediment and Nutrients









Practices Simulated Within APEX

a) Structural Practices

In-field Practices for erosion control

- Contour Farming
- Strip Cropping
- Contour Buffer Strips
- Terraces
- Grass Terraces
- Tile Drain
- Grade Stabilization Structures
- Grassed Waterways
- Diversion

Edge of Field Practices for buffering

- Filter Strips
- Riparian Forest Buffers
- Riparian Herb. Cover
- Field Borders
- Vegetative Barrier

Wind Erosion Control Practices

- Windbreak / Shelterbelt
- Herbaceous Wind Barrier
- Hedgerow planting
- Cross Wind Practices

b) Cultural/Agronomical Management Practices

Residue, tillage, nutrient, pesticide and irrigation management practices and cover crops

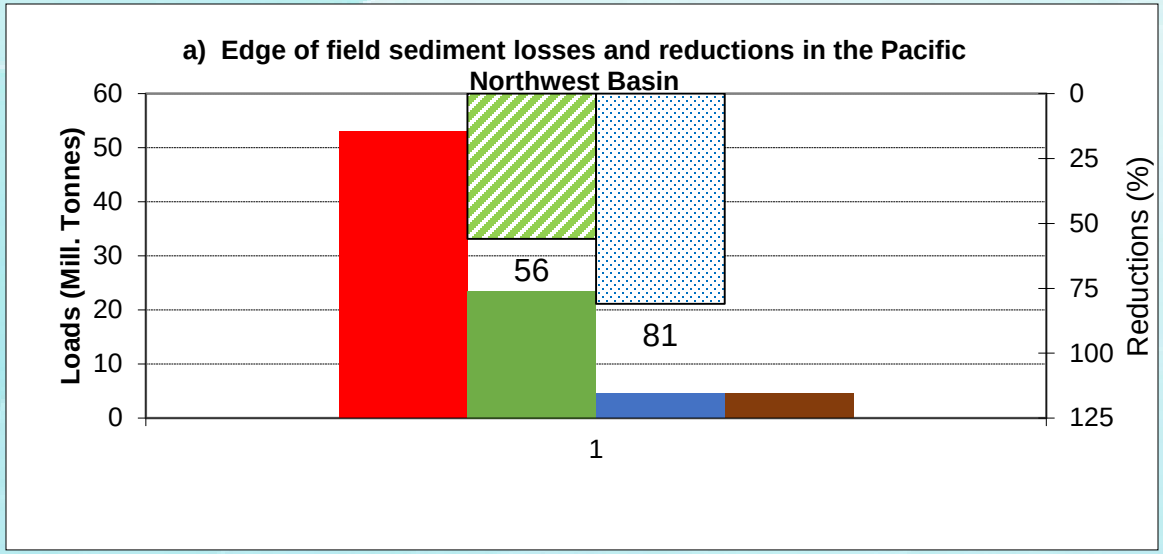
c) Long-term conservation cover

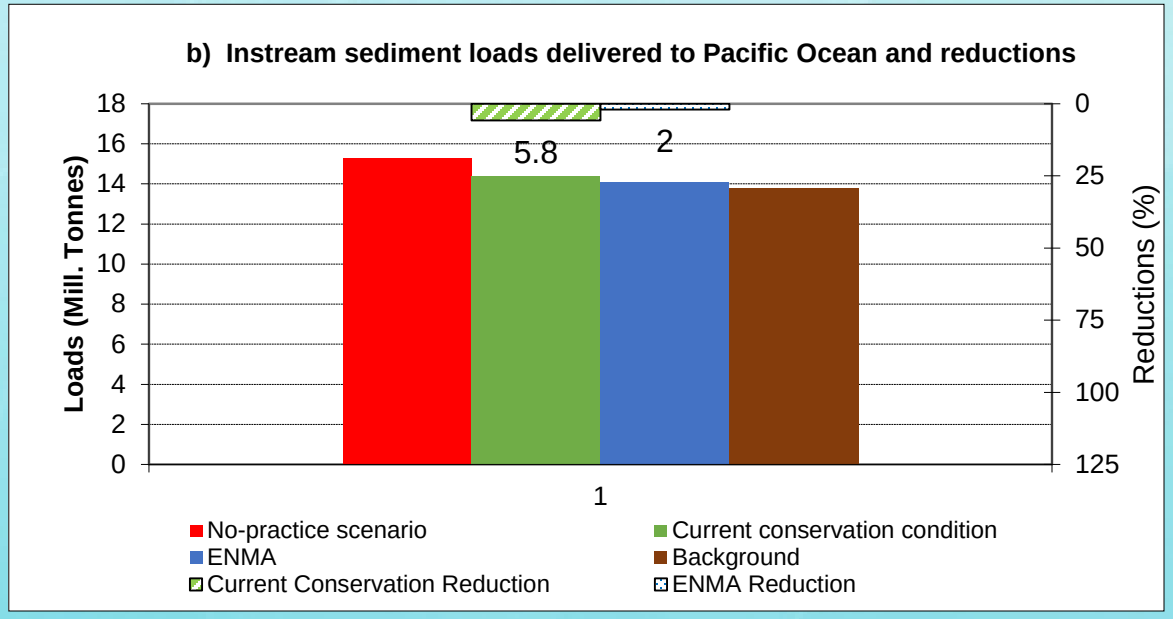
Conservation Practice Scenarios

Scenarios	Practice Details simulated in APEX
No Practice	No conservation practices on cropland
Current Conservation Condition (Baseline 2003-06)	Current conservation practices on cropland
Enhanced Nutrient Management on all under-treated cropland (ENMA)	Nutrient management and structural practices on all under-treated cropland area that have either a high or moderate conservation treatment need
Background	Grass-tree mix grown on cropland. No cultivated land contribution. Includes non-cultivated, and point source contributions and natural background loads from the cropland replaced by grassland

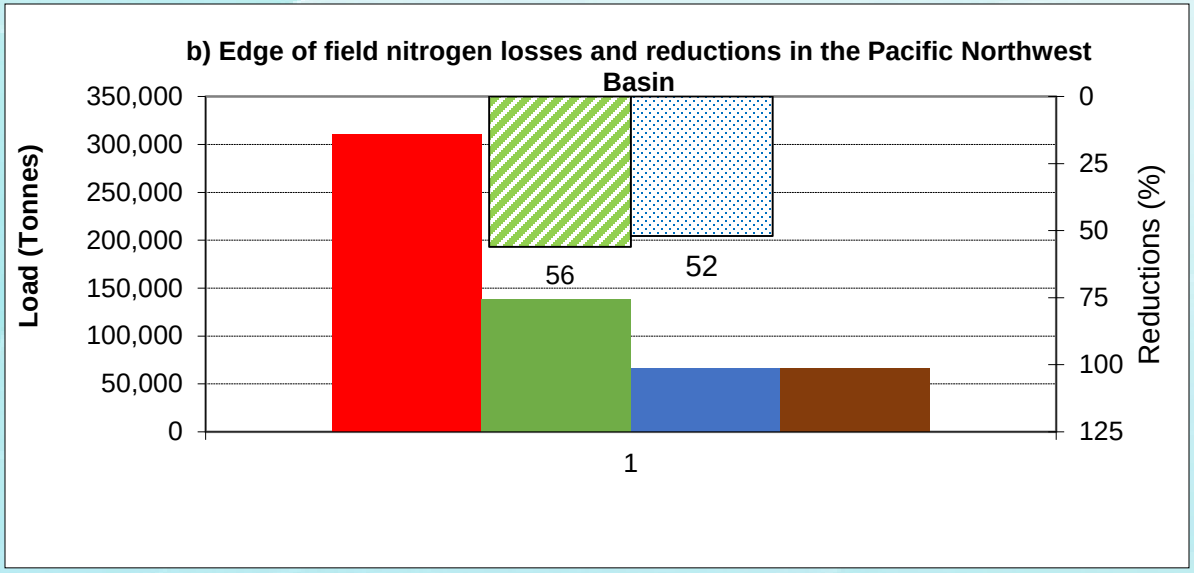
- SWAT simulations made using flow, sediment and nutrient loads generated for each of the above scenario

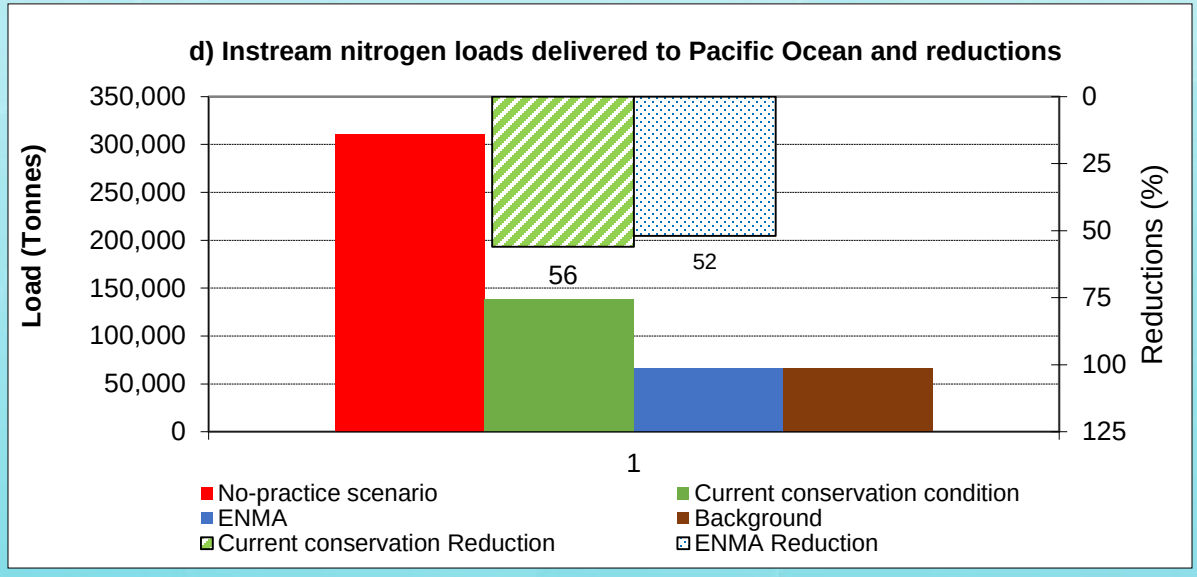
Water Quality Benefits: Conservation Scenarios





Instream Water Quality Benefits: Conservation Scenarios





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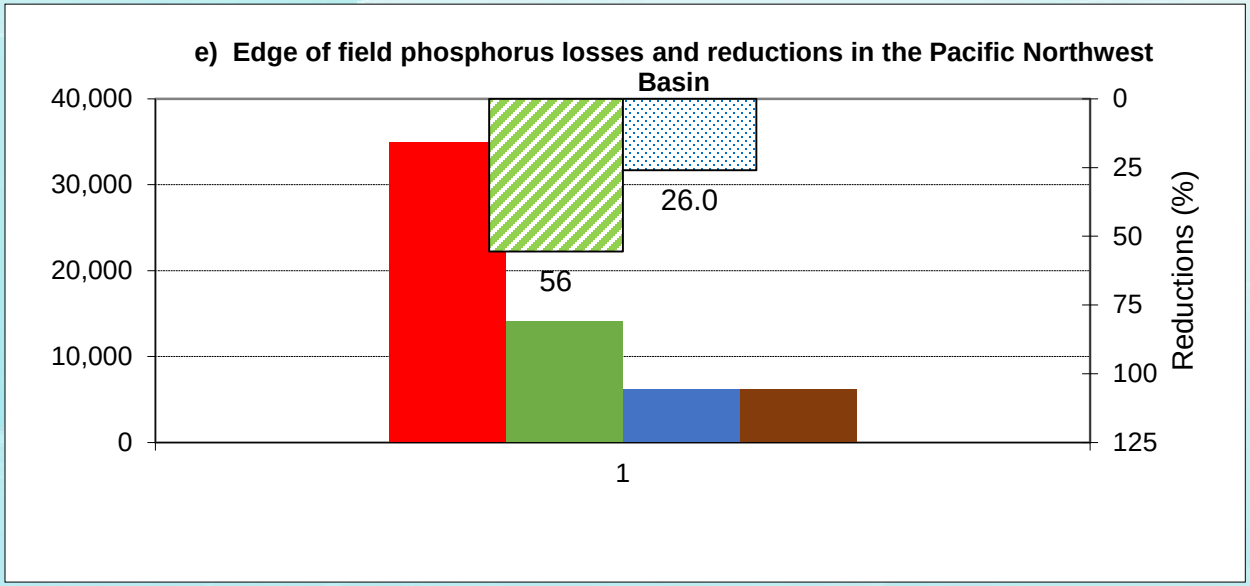

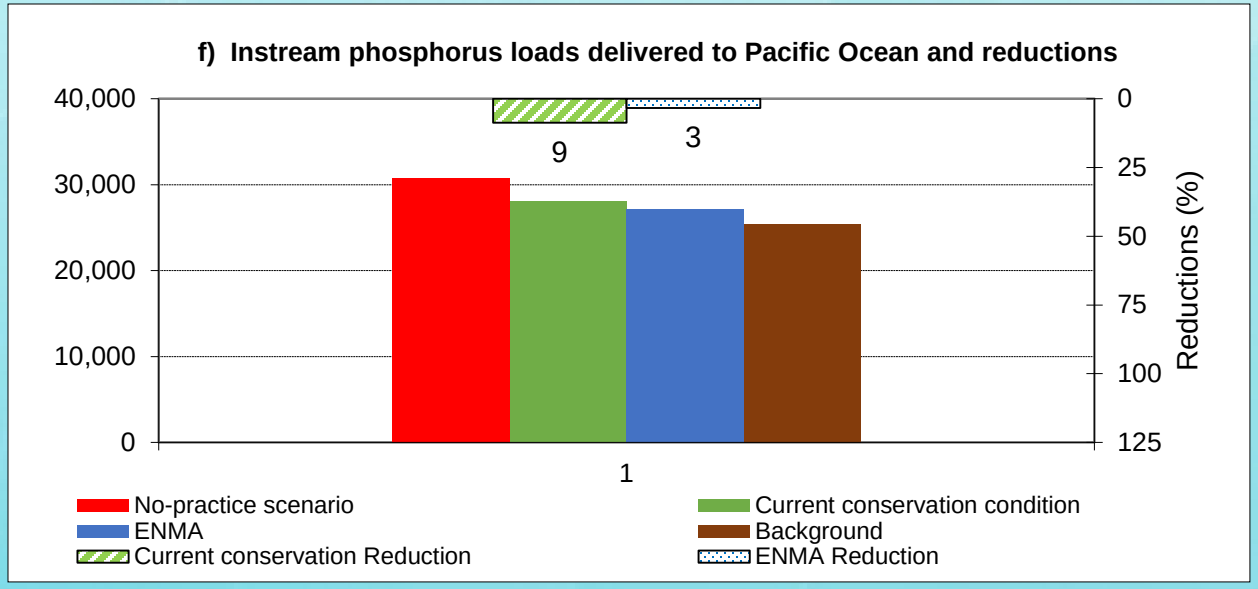

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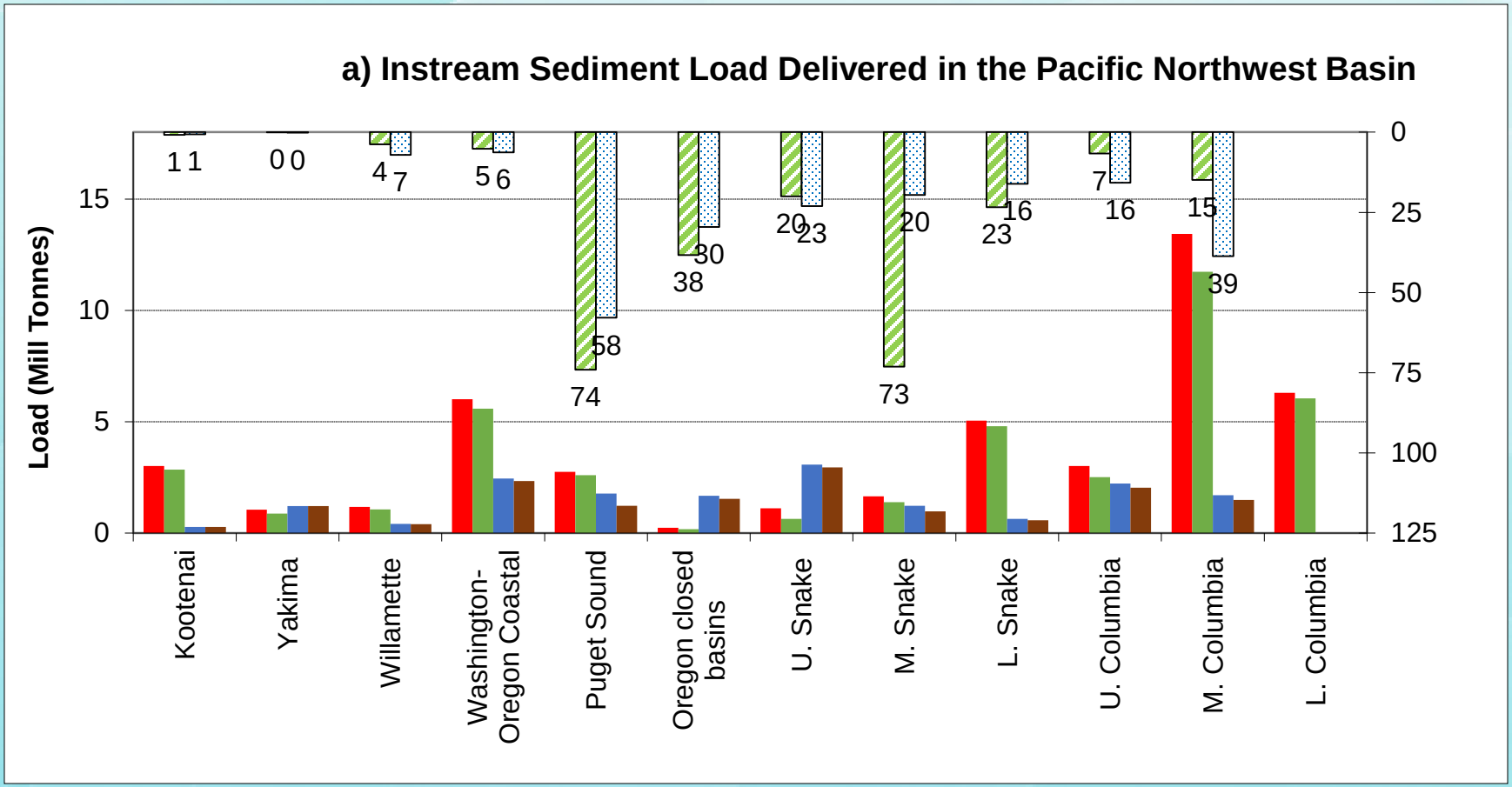
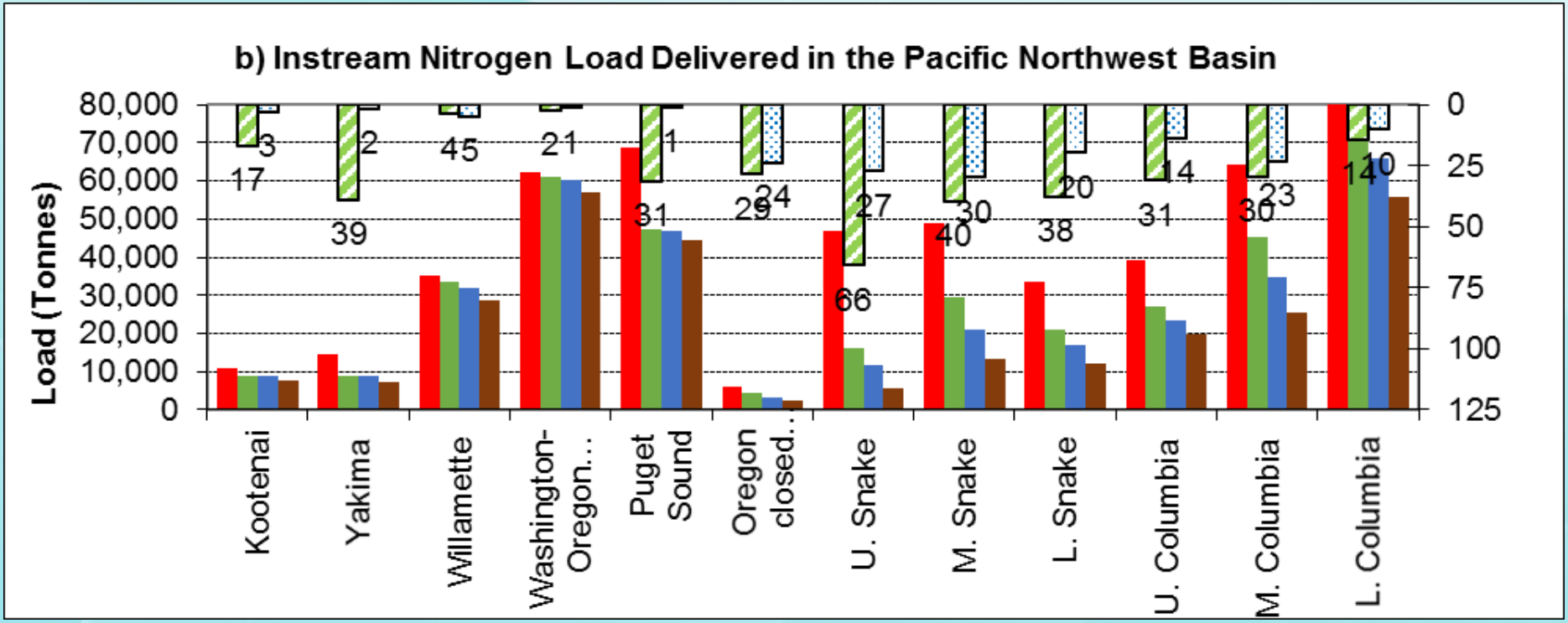
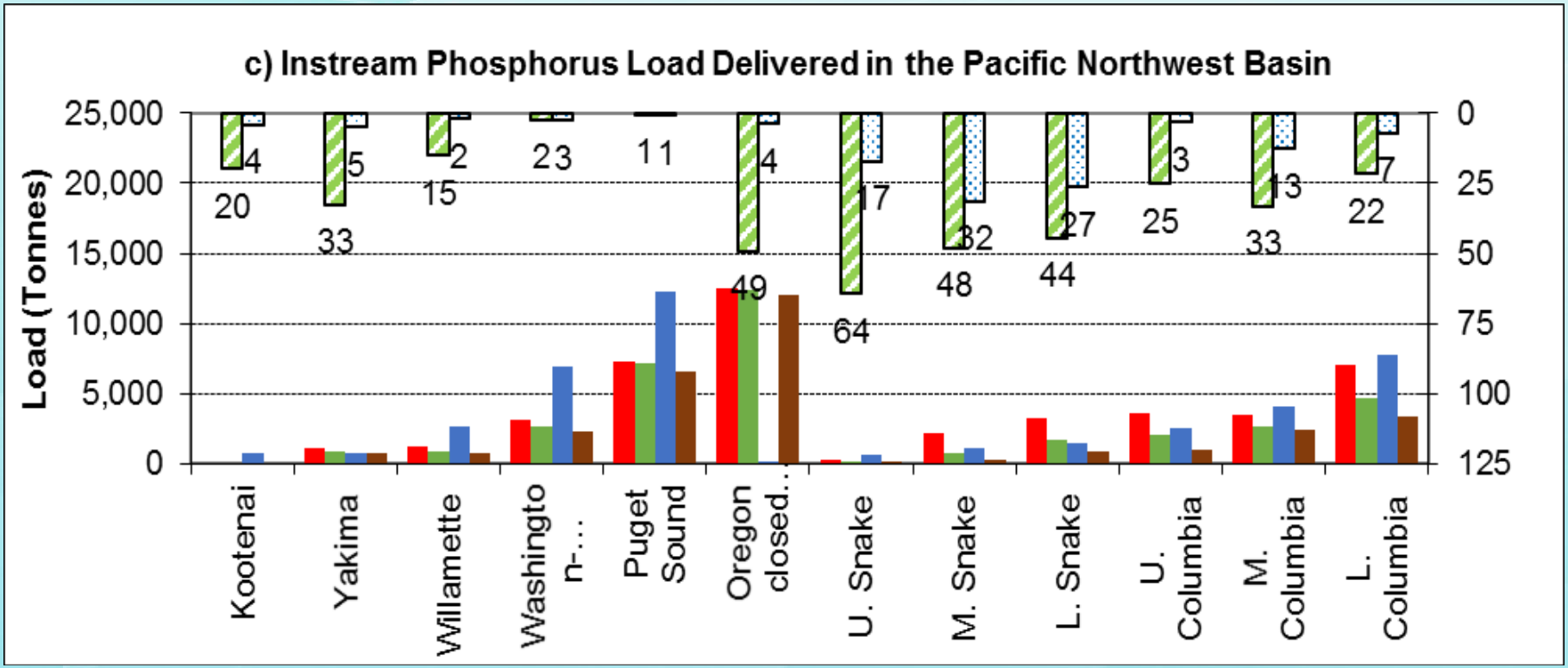


Instream Water Quality Benefits (Spatial): Conservation Scenarios



Instream Water Quality Benefits (Spatial): Conservation Scenarios



Major Findings from Assessment on PNWB

- Conservation practices reduces field level losses of sediment, nutrients and pesticides. Benefits of the practices are better reflected and greater at field level.

- Conservation practices improves water quality of streams and rivers, lakes and other water bodies in the river basin.

- Targeting critical acres improves effectiveness of conservation practices significantly.

- Modeling can aid in all of the above processes.

- Modeling tools available to study other emerging issues on eutrophication, algae blooms, climate change, future conservation programs, and restoration efforts at regional level.


Thank you !!!