

# Landscape pattern, stream network structure, and fish distribution in headwater catchments

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# *Oncorhynchus clarki clarki* Coastal Cutthroat Trout



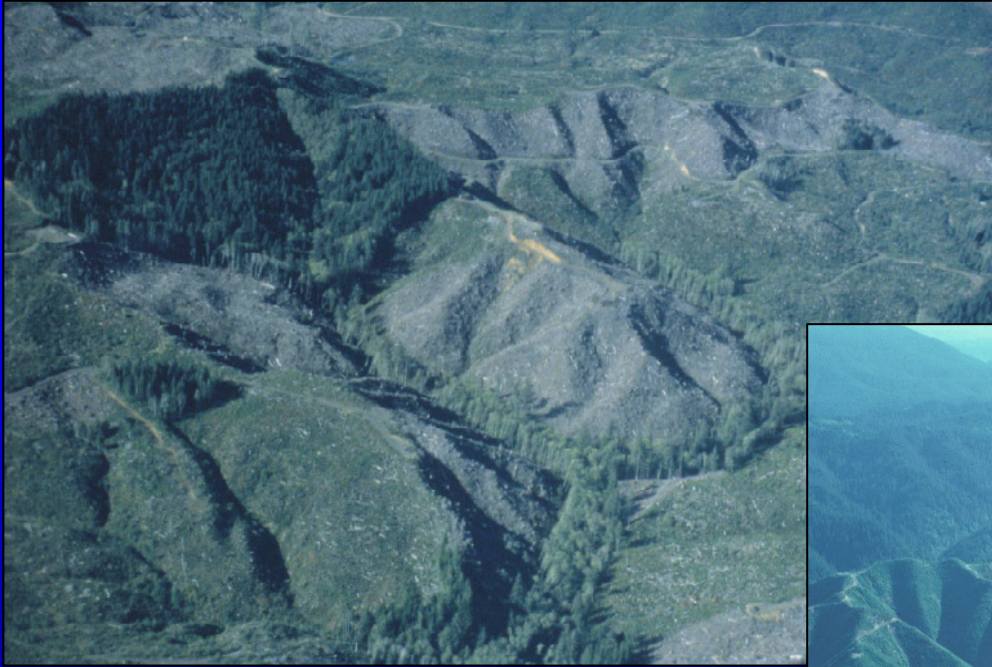
C.A.T. 01-00

*O. clarki*, 210mm, F.L.  
CAMP CREEK COASTAL CUTTHROAT

*Amelia Abby Thomas*



# Landscape ecology of coastal cutthroat trout



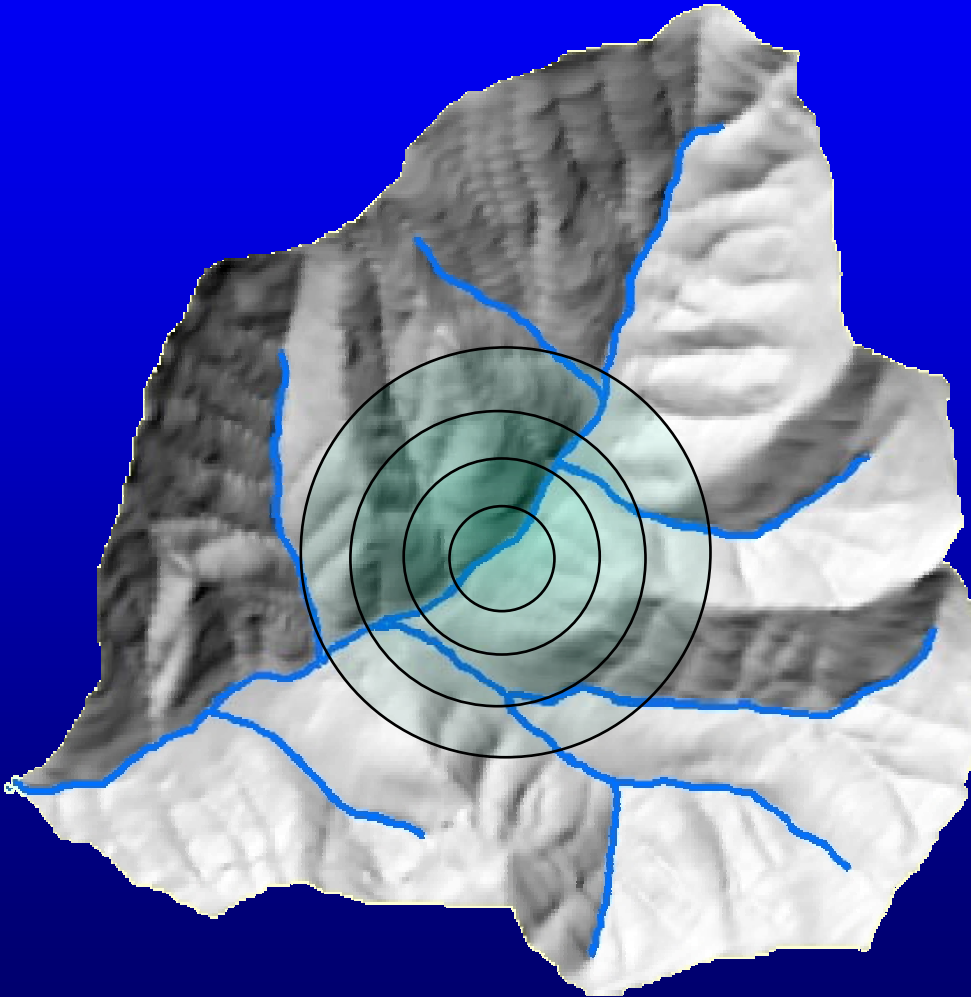
Timber harvest

Natural and anthropogenic disturbance



Climate, geology, and topography

# Spatial scale

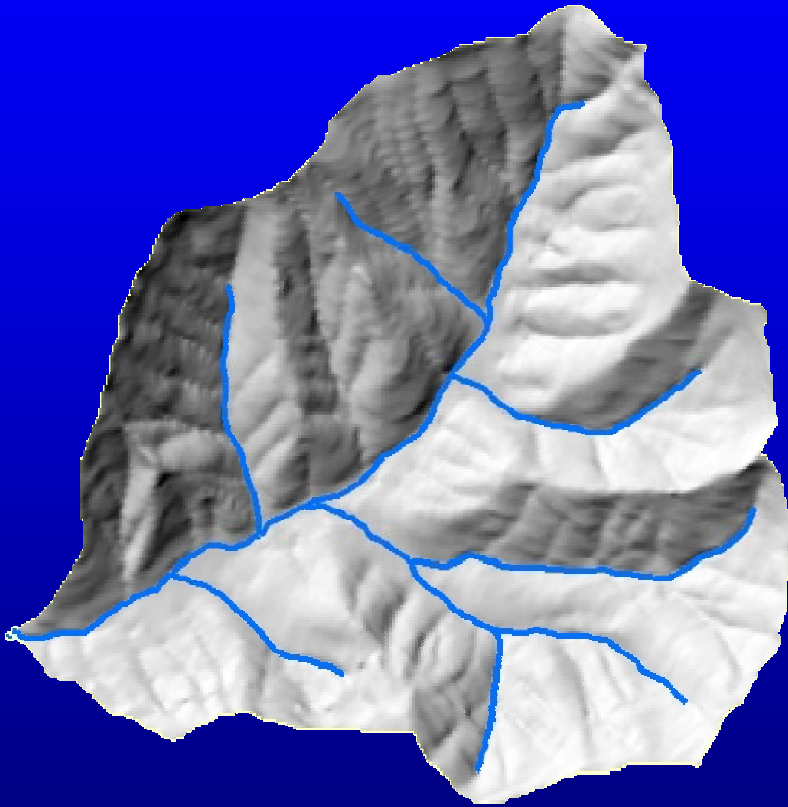


Population dynamics,  
patch size,  
sampling/monitoring,  
habitat conservation.

1:24,000 streams

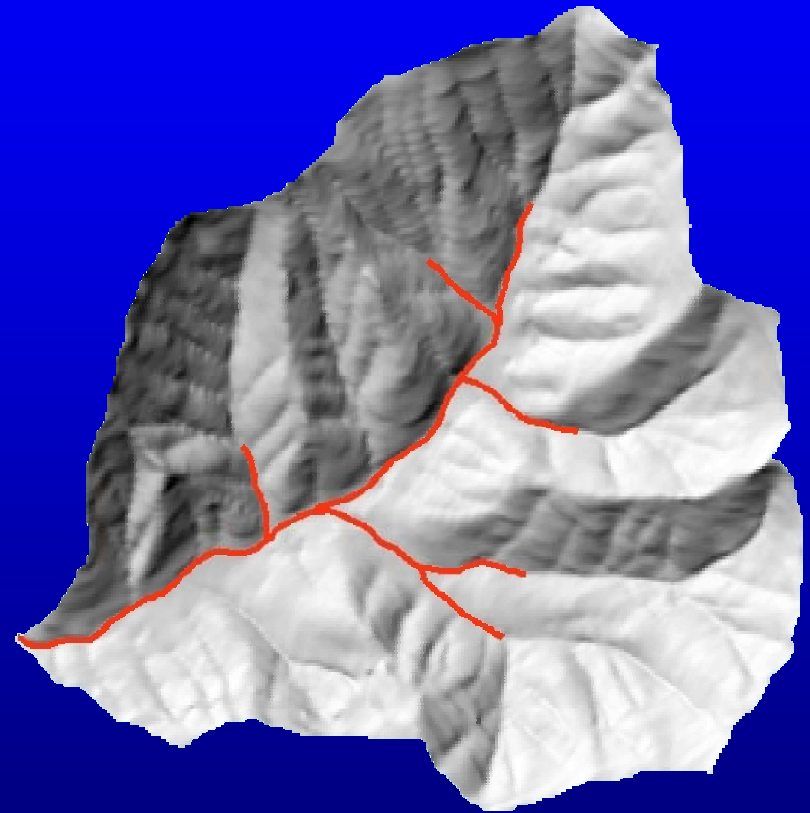
USGS 7.5-min. quad.

# Spatial extent



1:24,000 streams

USGS 7.5-min. quad.

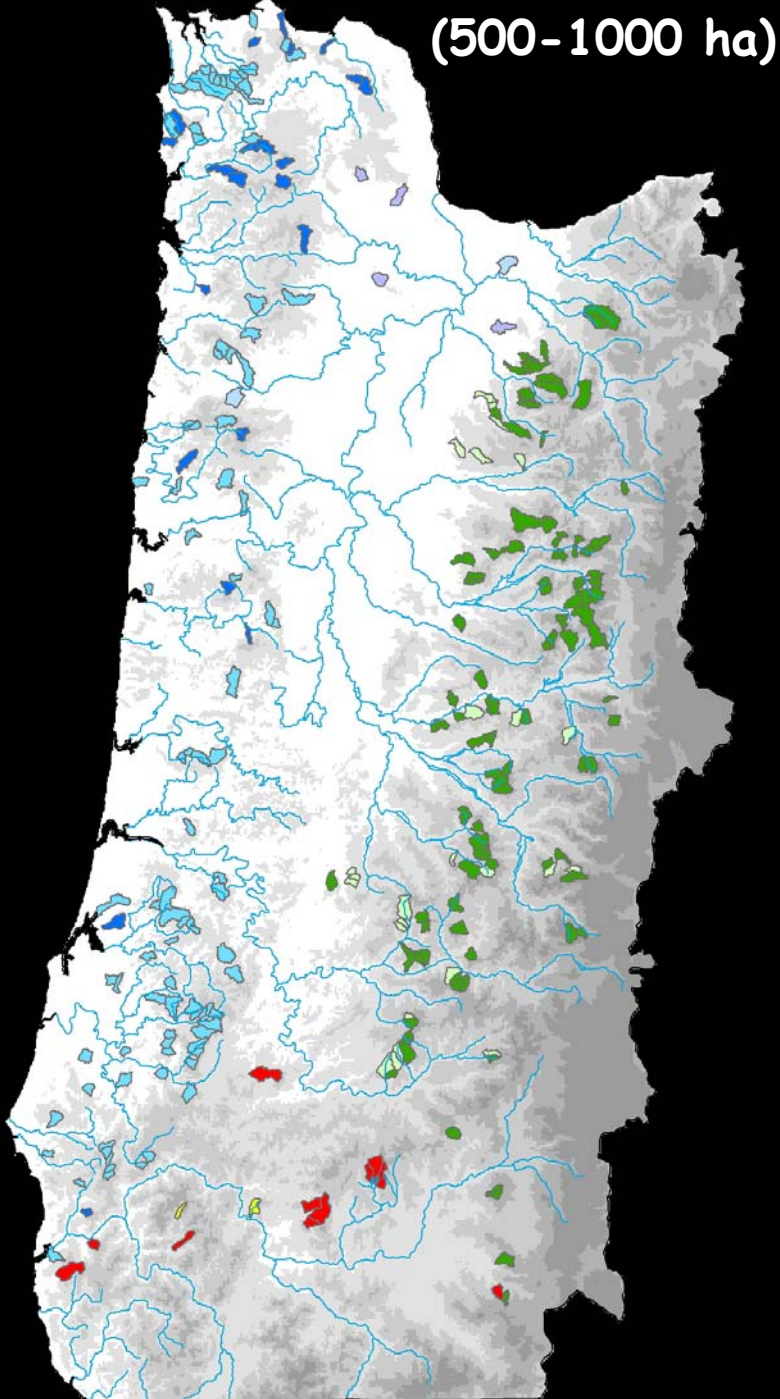


Fish-bearing streams

# Objectives

- Examine variation in the spatial patterns of coastal cutthroat trout distribution.
- Develop explanatory models for predicting cutthroat trout distribution.
- Evaluate potential effects of landscape disturbance on cutthroat trout populations.

(500-1000 ha)



# Site selection

Isolated headwater  
populations of  
coastal cutthroat trout  
( $N = 269$ )

## Rock type

### Ecoregion

Hard

Soft

Coast Range



Cascades

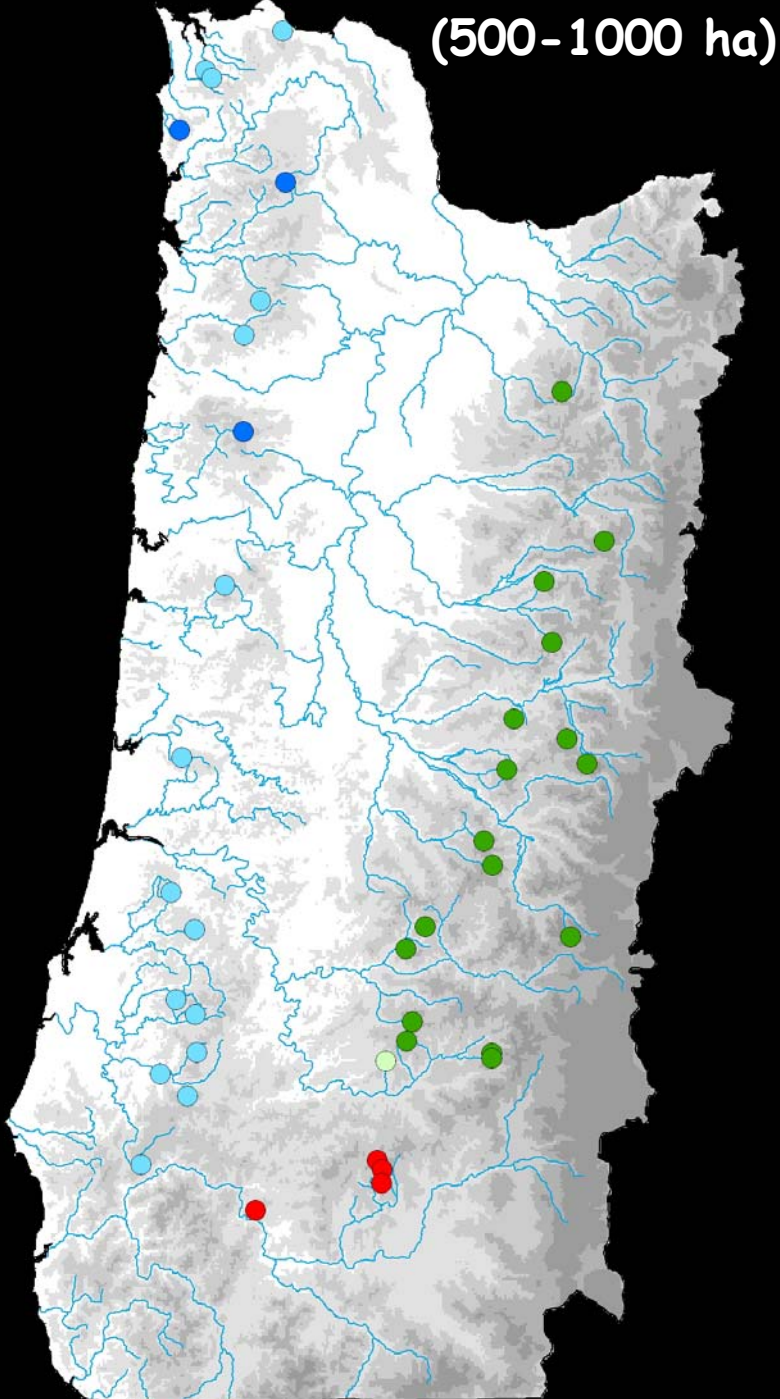


Klamath



(Gresswell et al. 2004. *GIS/Spatial  
Analyses in Fishery and Aquatic Sciences*)

(500-1000 ha)



# Site selection

Randomly selected  
populations  
( $n = 40$ )

## Rock type

### Ecoregion

Coast Range

Cascades

Klamath

Hard

Soft



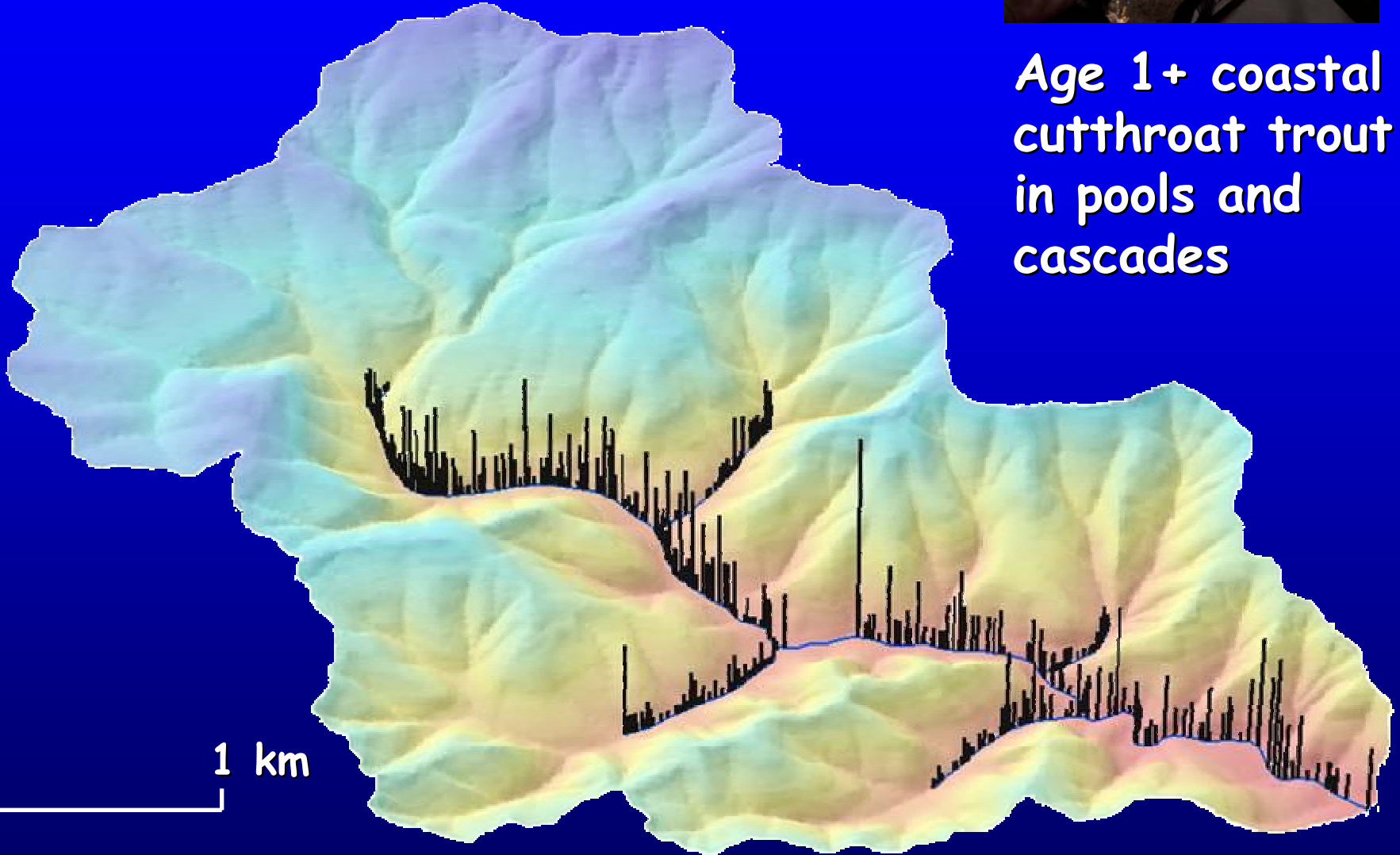
(Gresswell et al. 2004. *GIS/Spatial Analyses in Fishery and Aquatic Sciences*)

# Single-pass electrofishing surveys

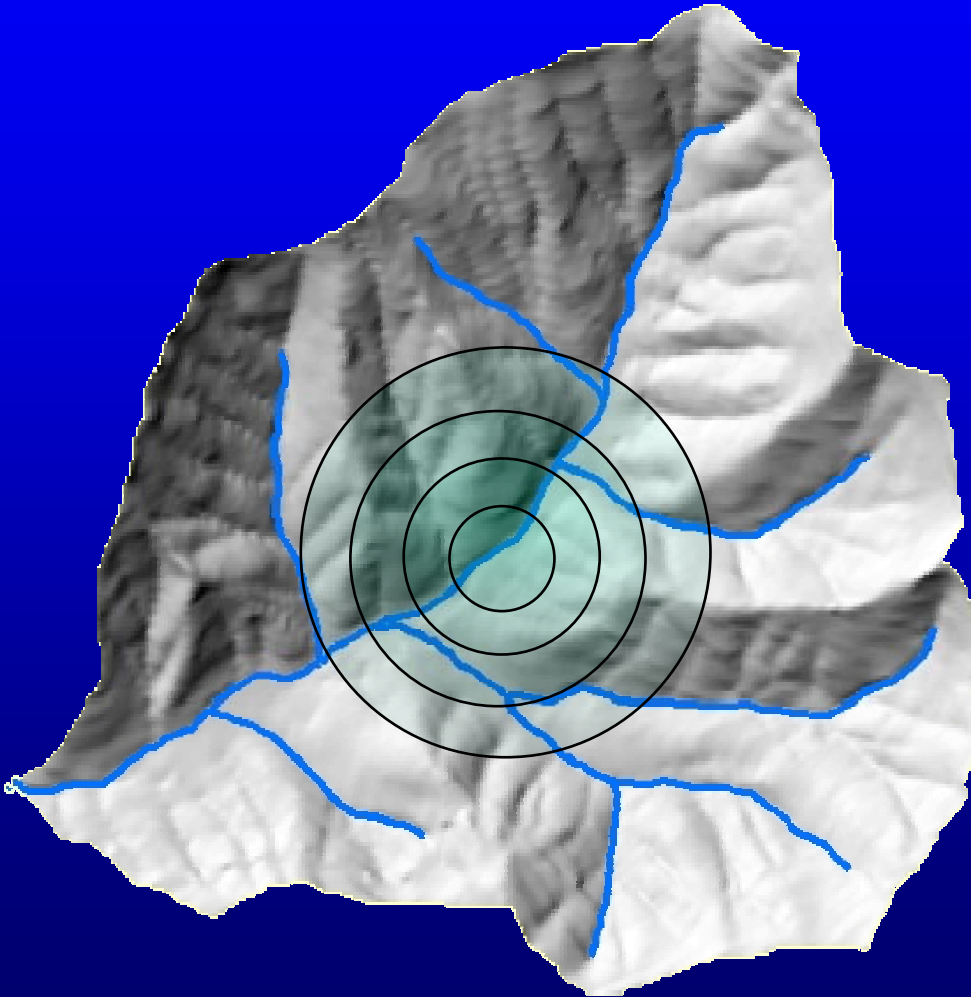
>200 km surveyed in 40 catchments



Age 1+ coastal  
cutthroat trout  
in pools and  
cascades



# Spatial scale

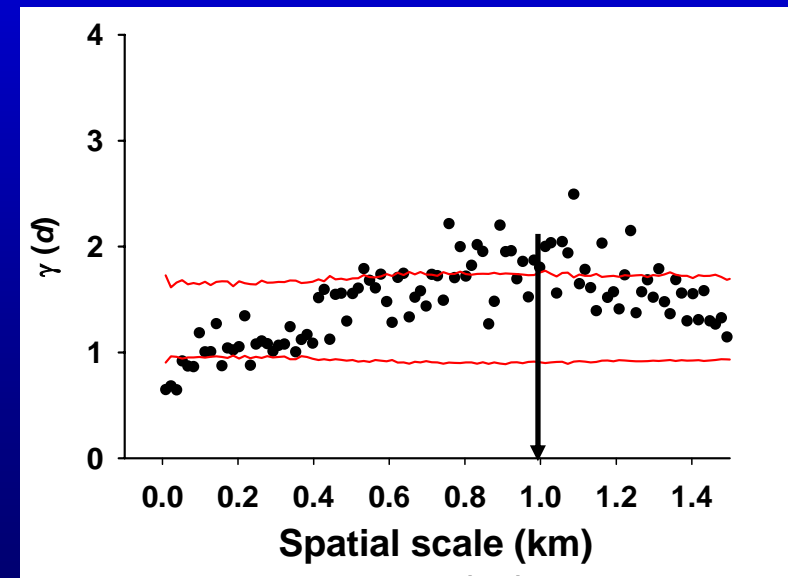
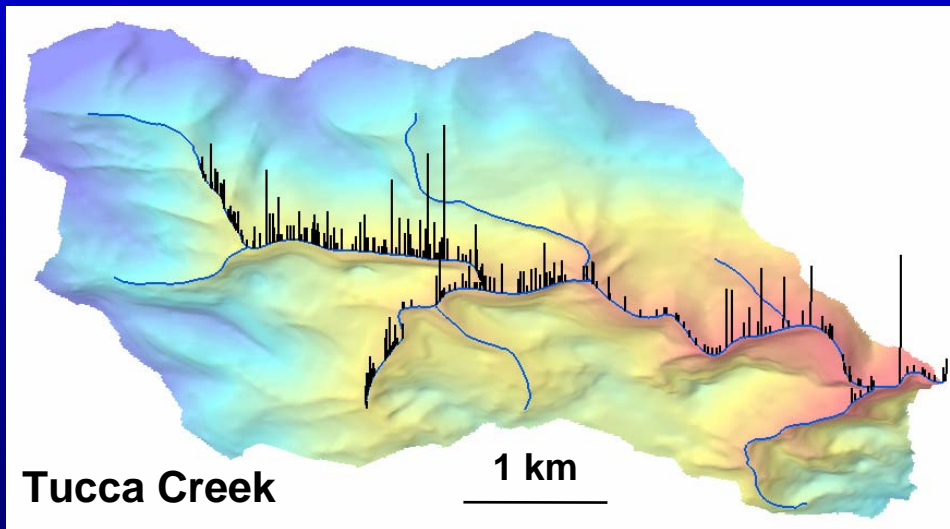
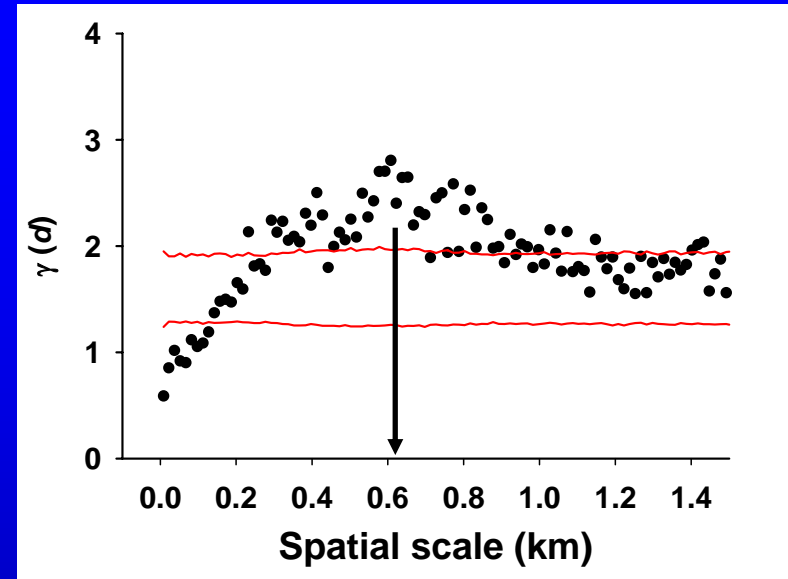
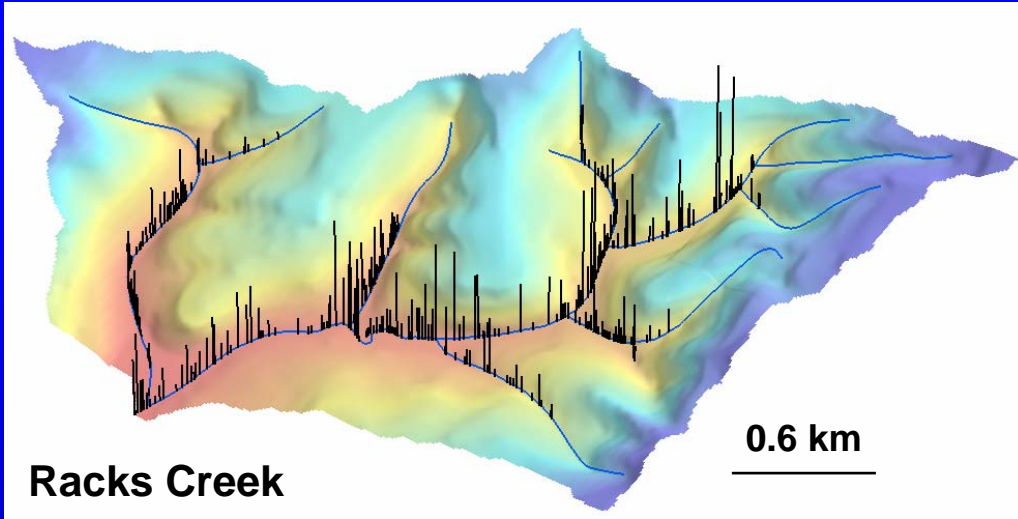


Population dynamics,  
patch size,  
sampling/monitoring,  
habitat conservation.

1:24,000 streams

USGS 7.5-min. quad.

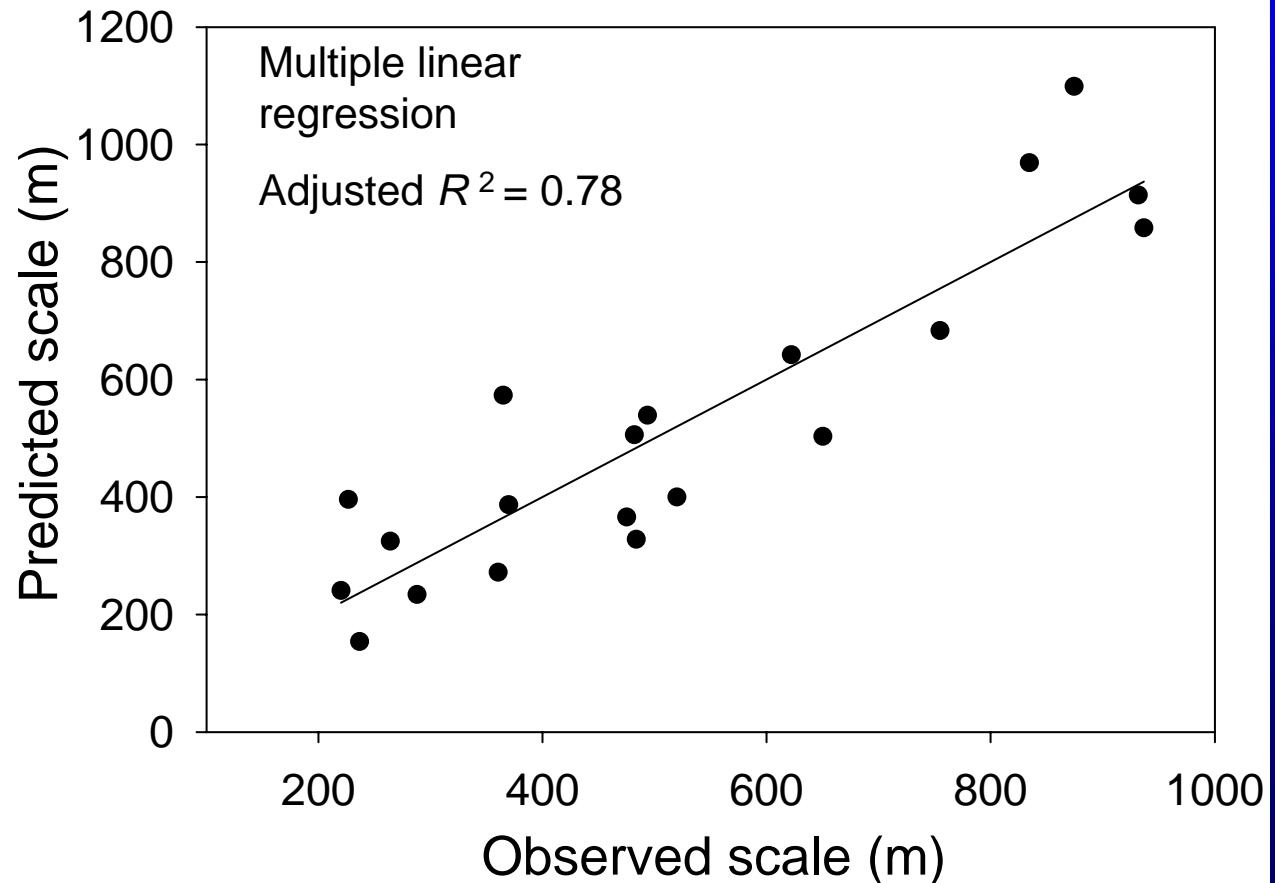
# Spatial scale of variation of trout counts



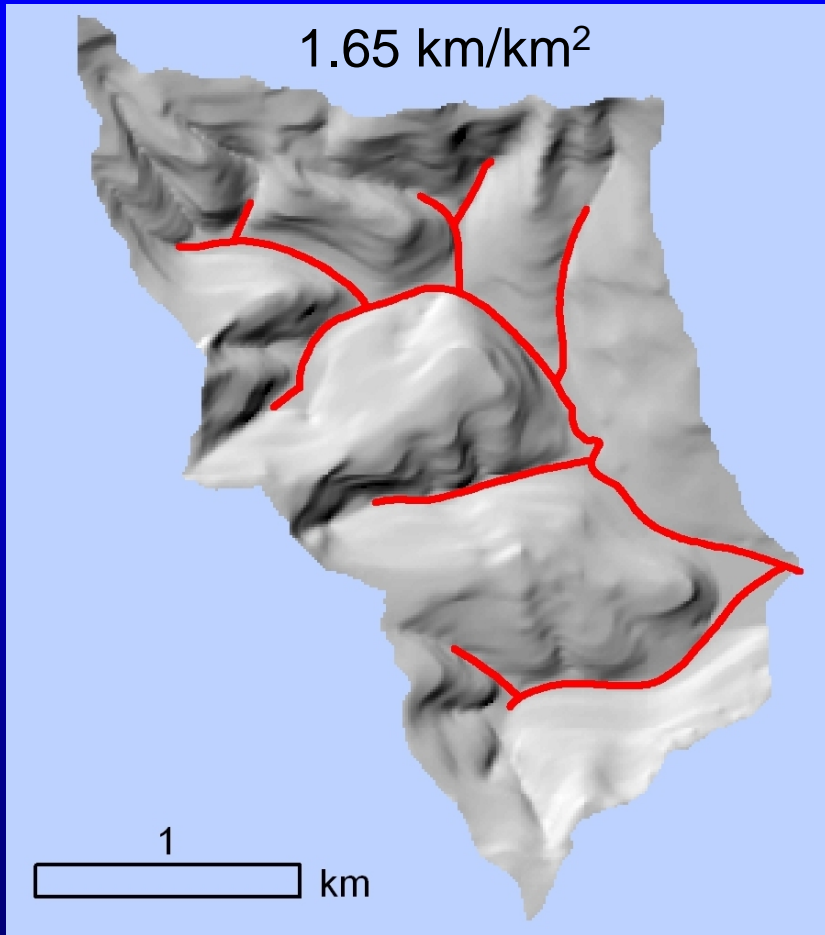
(Ganio, Torgersen, and Gresswell. 2005. *Frontiers in Ecology and the Environment*)

# Predicting the spatial scale of variation in CCT distribution

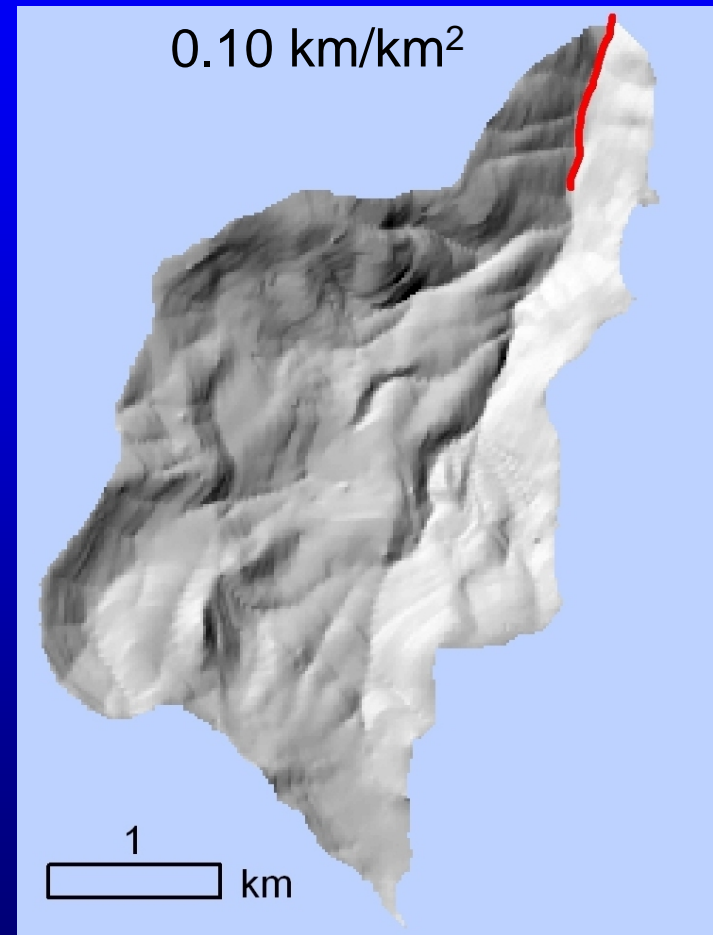
- Weak rock (+)
- Hard rock (-)
- Mean distance between tributaries (+)



# Spatial extent of coastal cutthroat trout distribution



Racks Cr. - Coast Range



Nevergo Cr. - Cascades

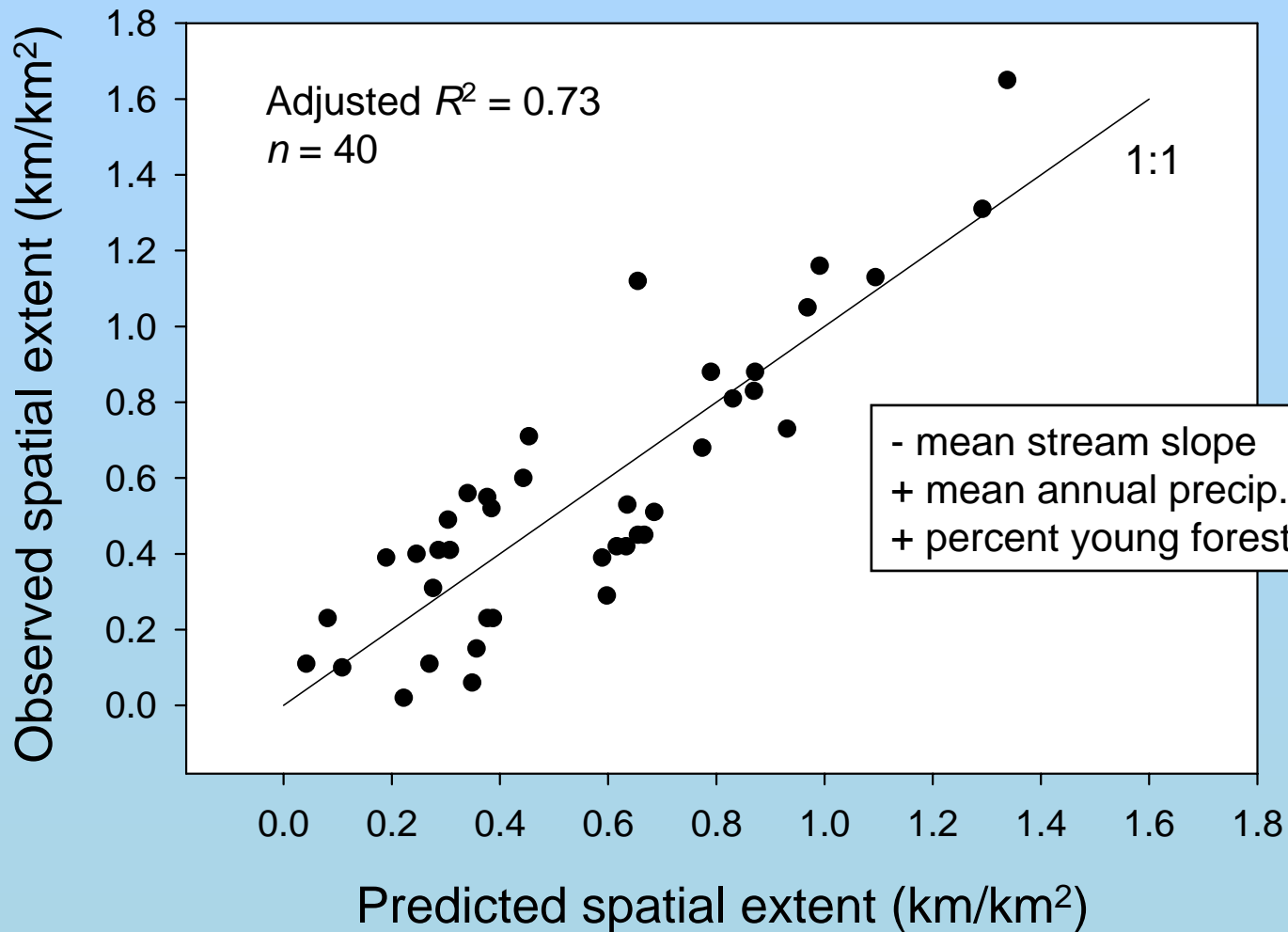
# Predictor variables in multiple linear regression models

- Mean stream slope (10-m DEM)
- Percent young forest (Cohen et al. 2002)
- Mean annual precipitation
- Mean January temperature
- Residual topography (10-m DEM; basin volume / surface area)
- Percent private ownership (basin area)
- Percent old-growth (basin area)
- Road density (km/km<sup>2</sup>)
- Shape factor (basin length<sup>2</sup> / basin area)
- Percent resistant rock (basin area)
- Ecoregion; geology (categorical)

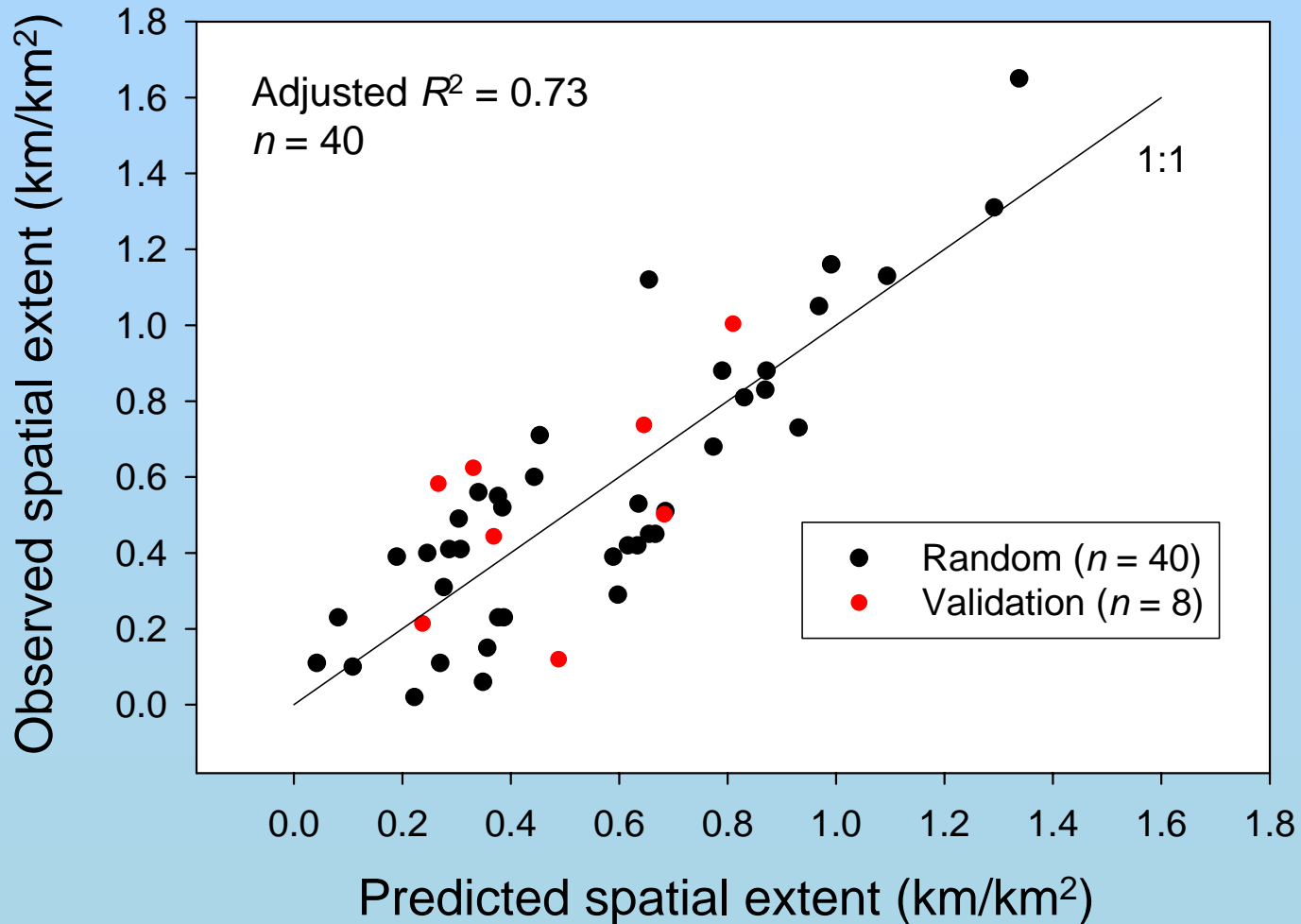
## Model selection with Akaike's Information Criterion (AIC)

\* Variables listed in order of ascending AIC for models predicting spatial extent

# Predicting the spatial extent of trout distribution based on landscape variables



# Model validation

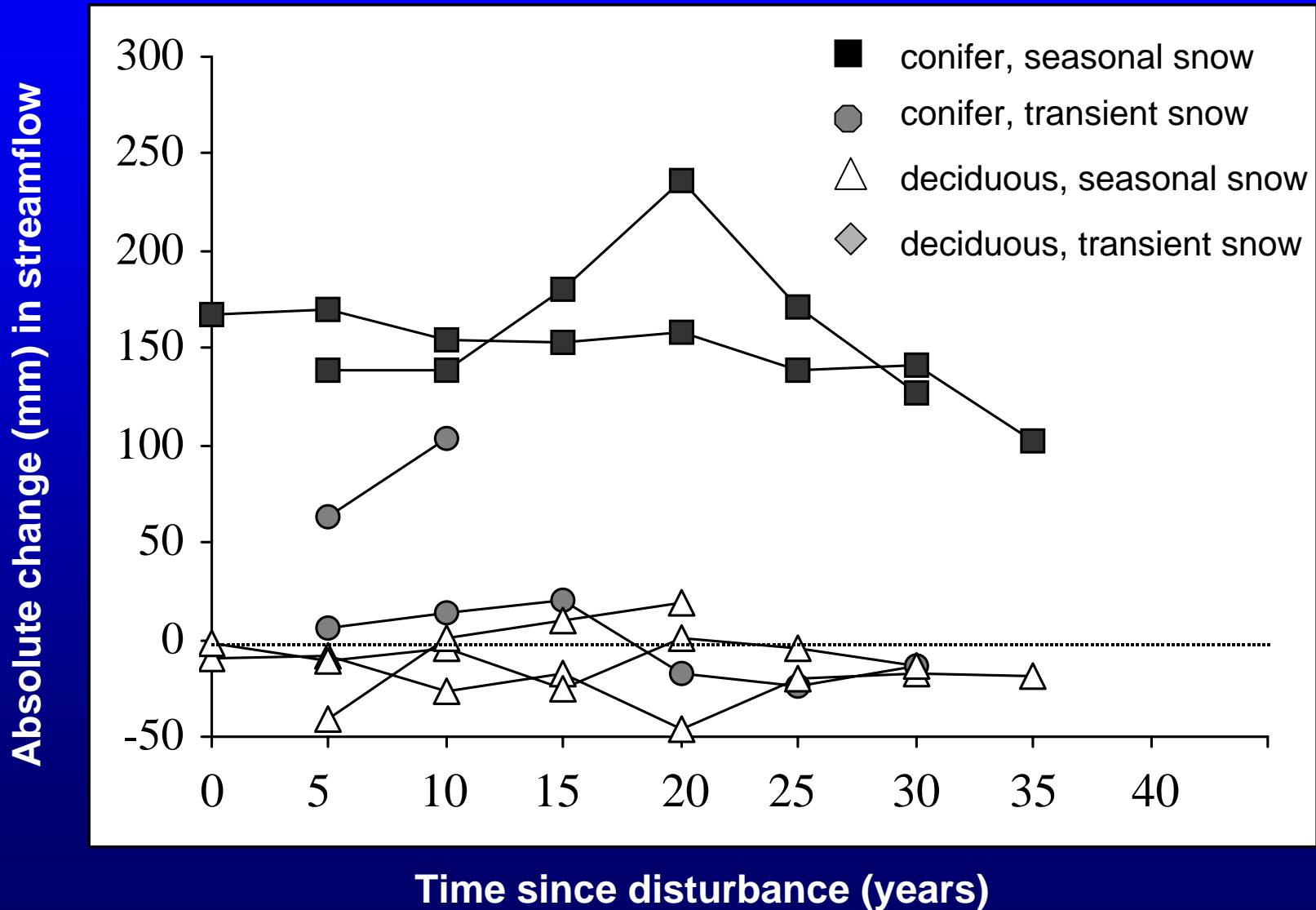


# Percent young forest

- Percent young forest predicted spatial extent but was not a good predictor of total numbers ( $R^2 = 0.32$ ).
- What does this suggest about young forest structure and its relationship with trout distribution?
- What are some potential mechanisms by which timber harvest influences fish distribution?

# Hydrologic response (Jones and Post 2004)

Clearcuts produce persistent spring surpluses



# Alternative hypotheses

- Multiple hypotheses explaining the association between the spatial extent of trout distribution and young forest structure.
- Effects of disturbance on vegetation, geomorphology, and temperature.
- Complex biological responses of trout to changes in cover, productivity, and physical constraints to movement.

# Conclusions

- Links between geology, geomorphology, and fish distribution
- Relationships between fish distribution, hydrology, and cumulative watershed effects?
- Using digital elevation models (DEM) and remote sensing to predict fish distribution at broad scales

# Acknowledgments



**OREGON STATE  
UNIVERSITY**

