Effects of landscape pattern on the distribution of coastal cutthroat trout in headwater catchments of western Oregon

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U.S. Department of the Interior
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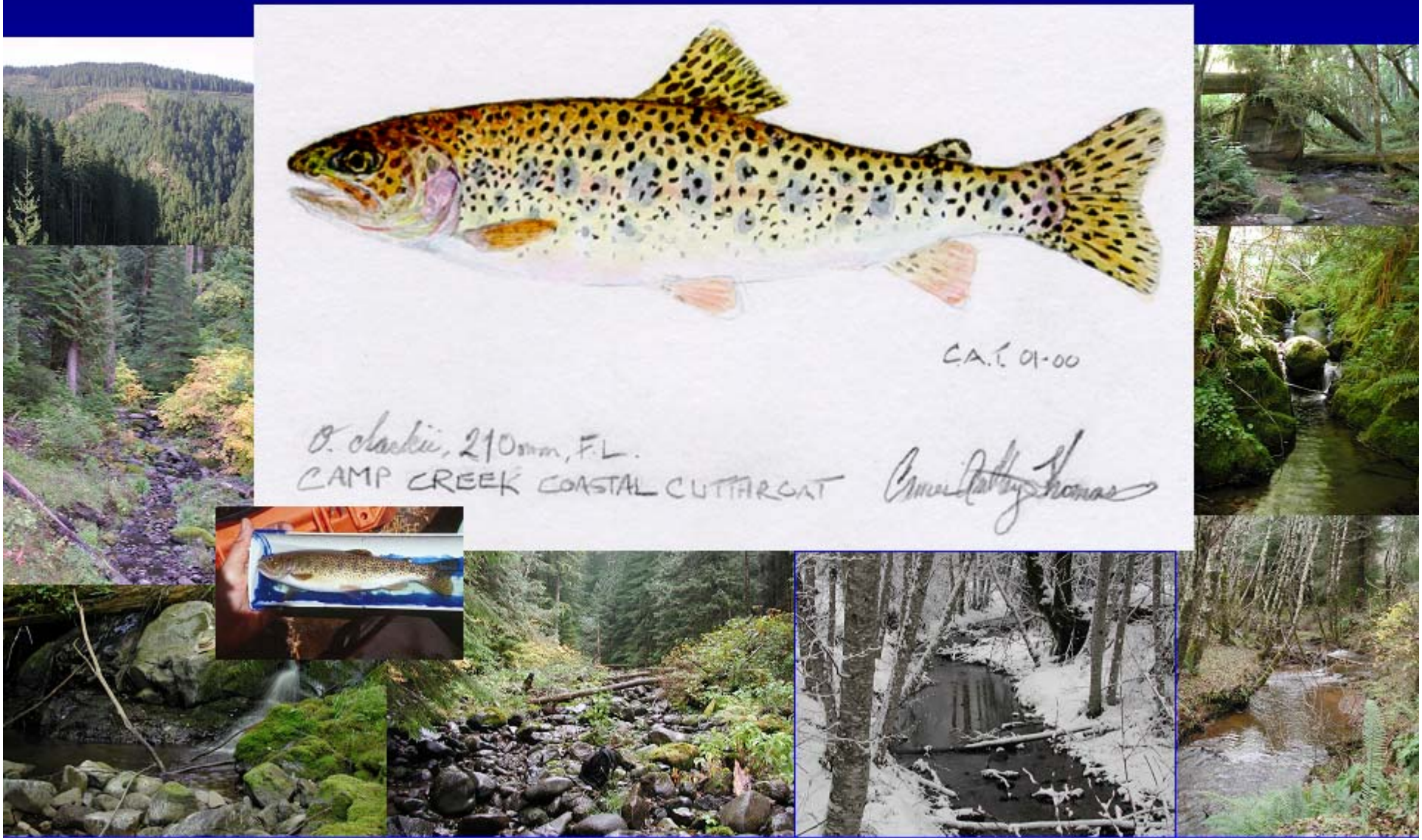
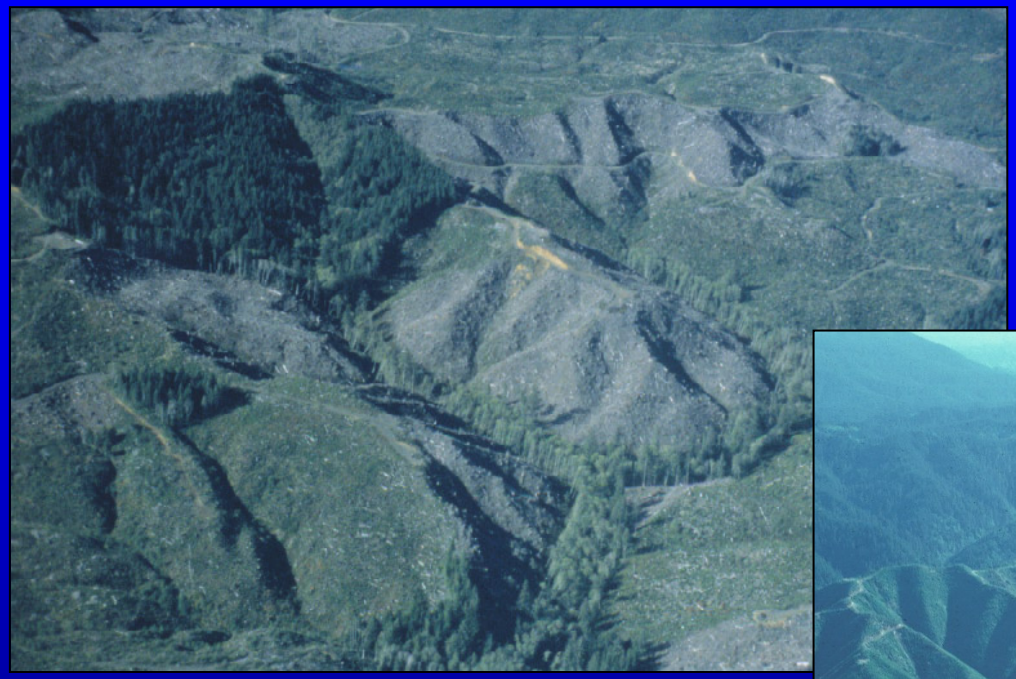
Oncorhynchus clarki clarki
Coastal Cutthroat Trout



Landscape ecology of coastal cutthroat trout



Natural and anthropogenic disturbance

Timber harvest

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

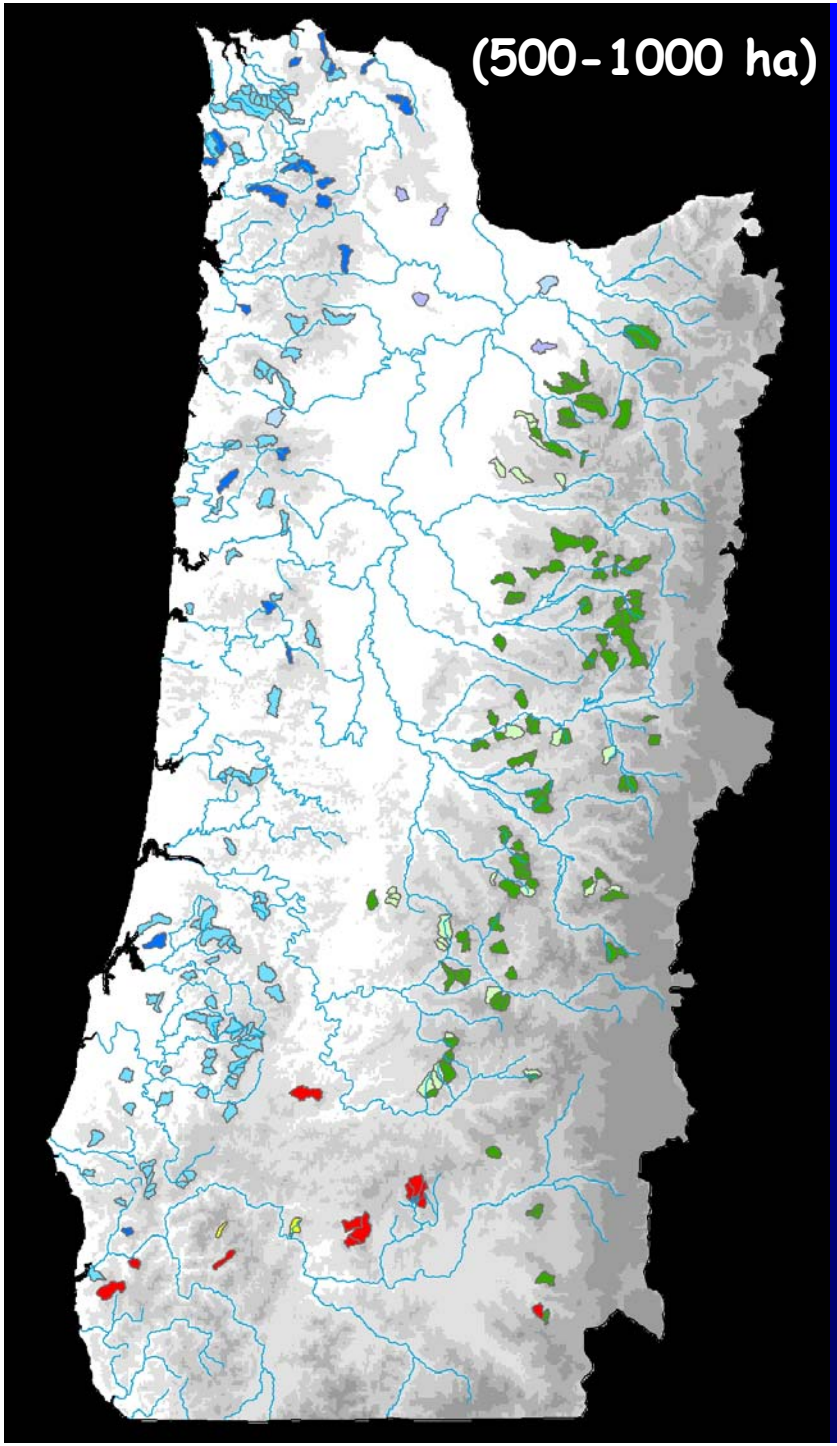
1:24,000 streams

USGS 7.5-min. quad.

Fish-bearing streams

Objectives

- Examine variation in the spatial patterns of coastal cutthroat trout distribution within watersheds in western Oregon.
- Develop explanatory models for predicting cutthroat trout distribution based on landscape characteristics.
- Evaluate potential effects of landscape disturbance on cutthroat trout populations in headwater streams.

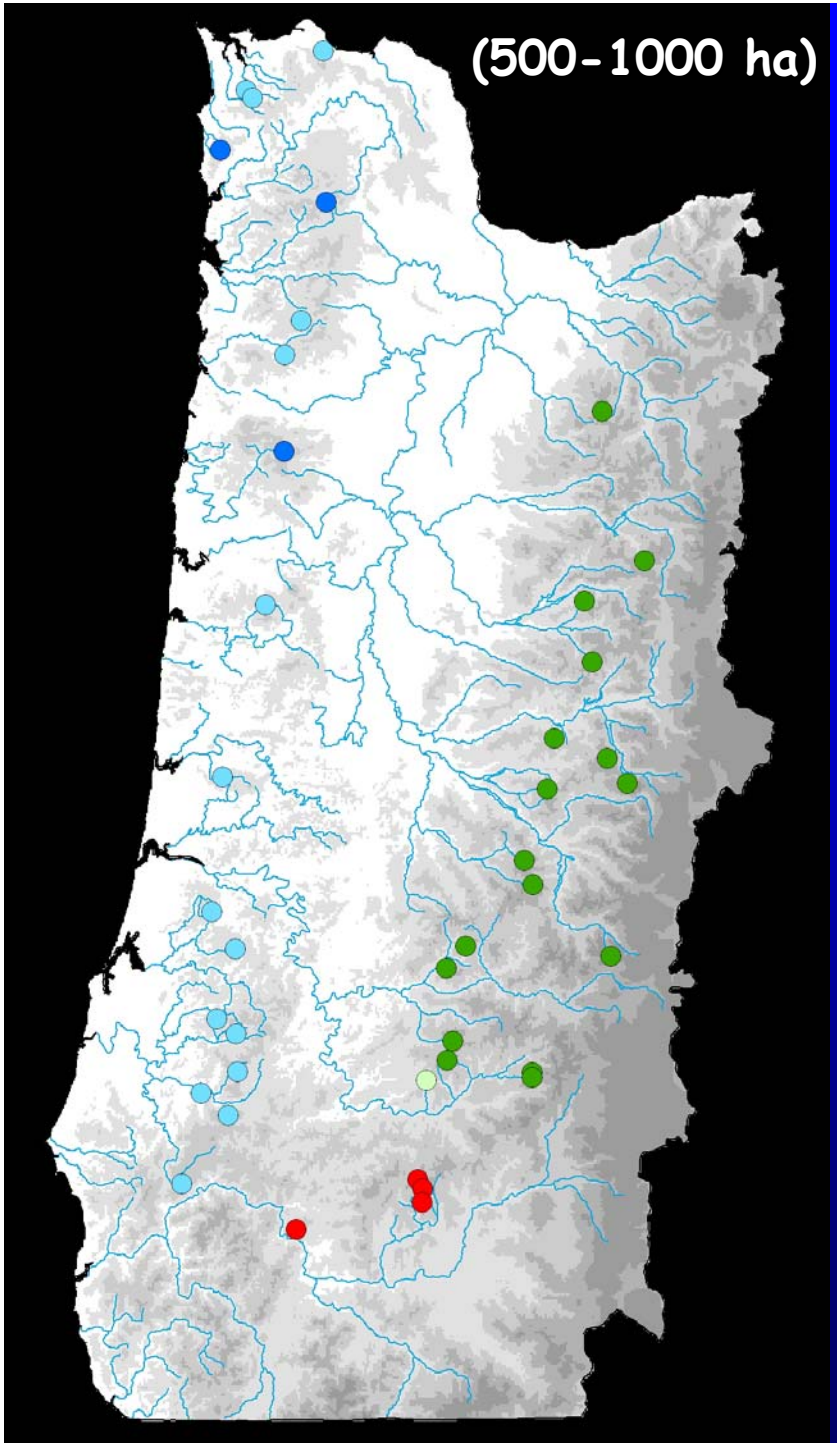


Site selection

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

Ecoregion	Rock type: Hard	Rock type: Soft
Coast Range		
Cascades		
Klamath		

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



Site selection

Randomly selected populations (n = 40)

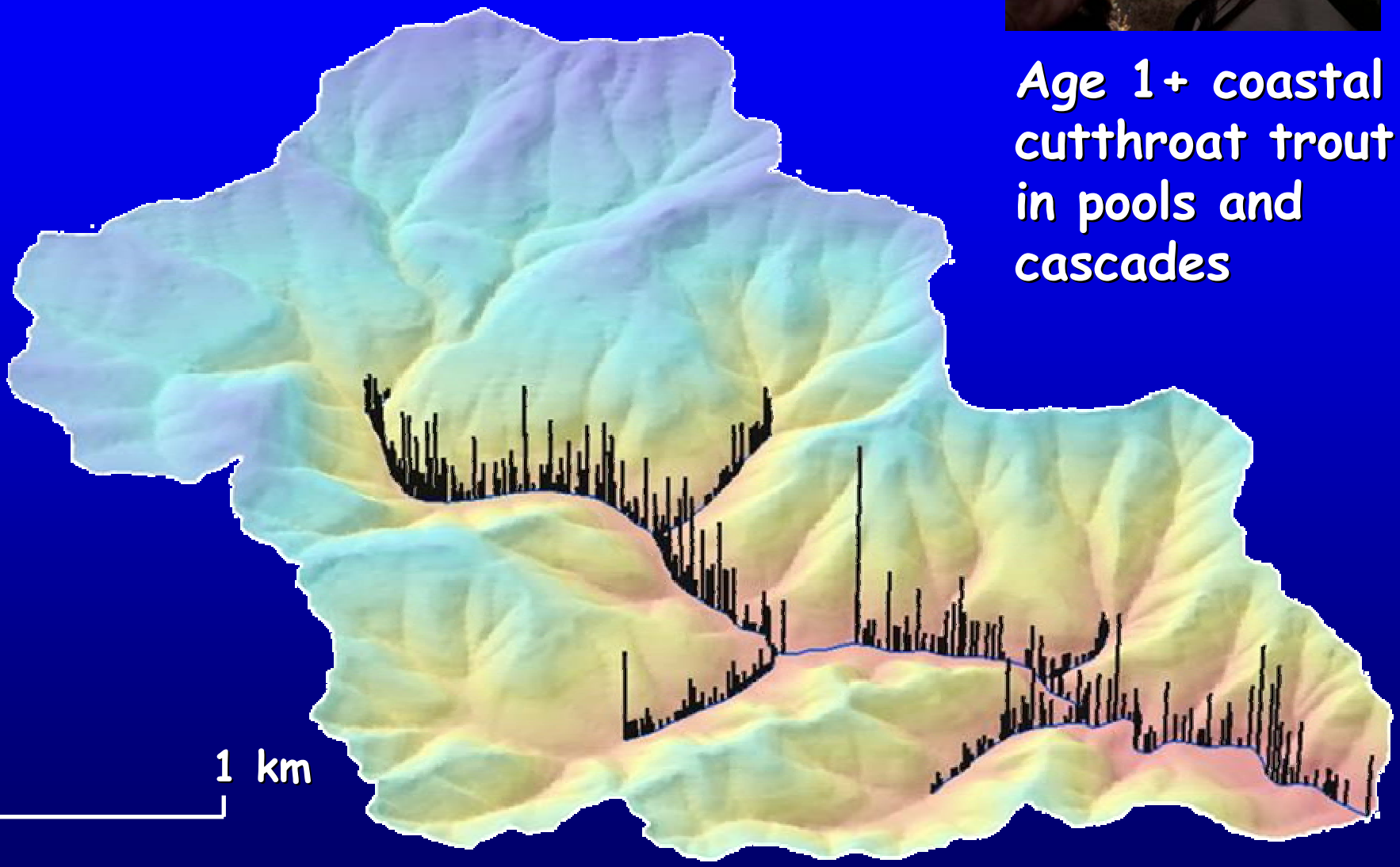
Ecoregion	Rock type: Hard	Rock type: Soft
Coast Range		
Cascades		
Klamath		

(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



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

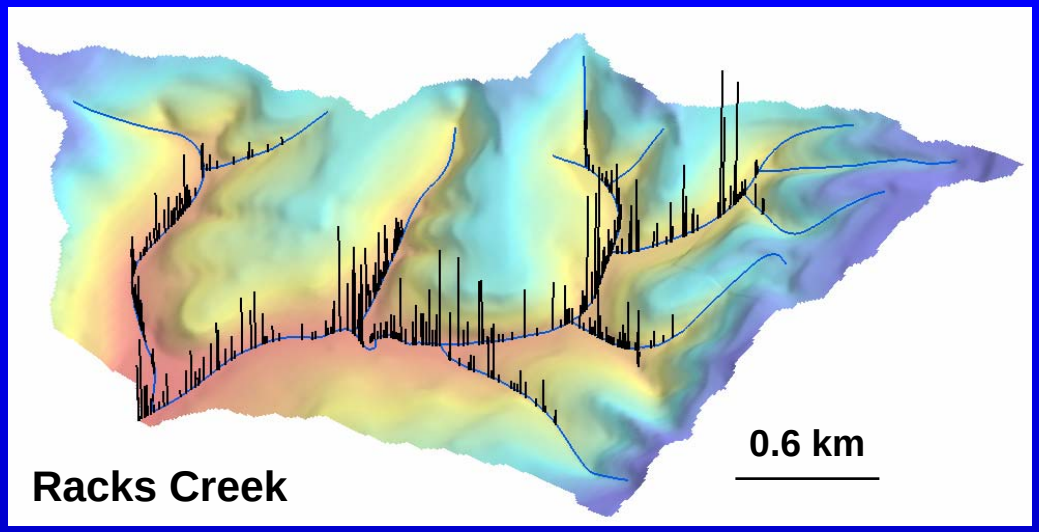
Spatial scale

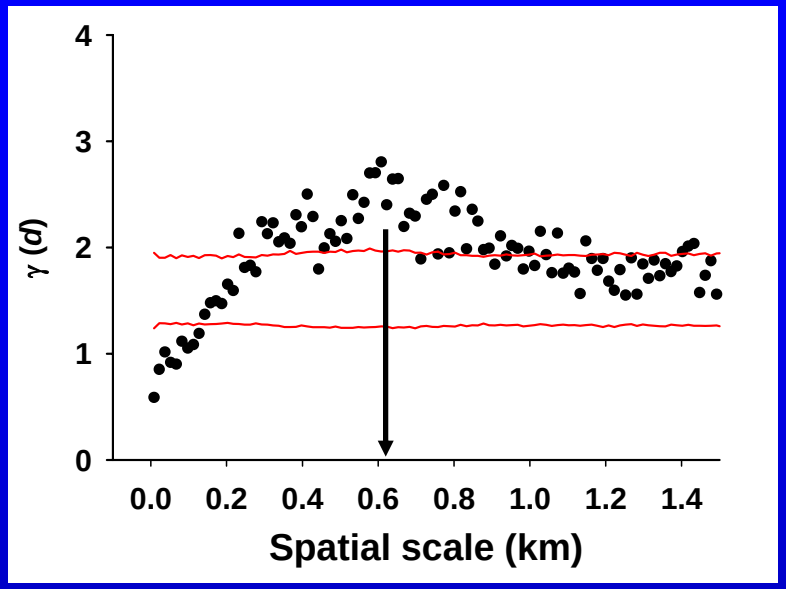
Population dynamics, patch size, sampling/monitoring, habitat conservation.

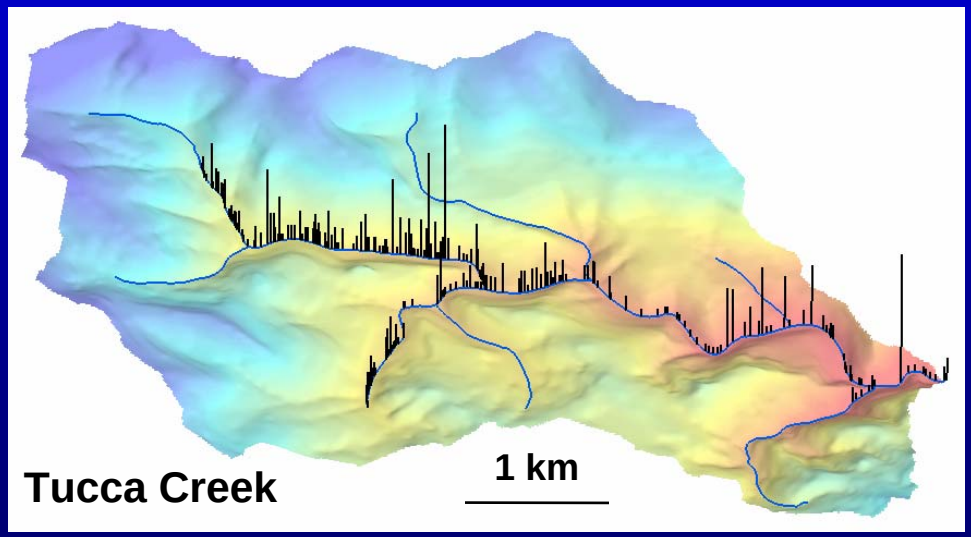
1:24,000 streams

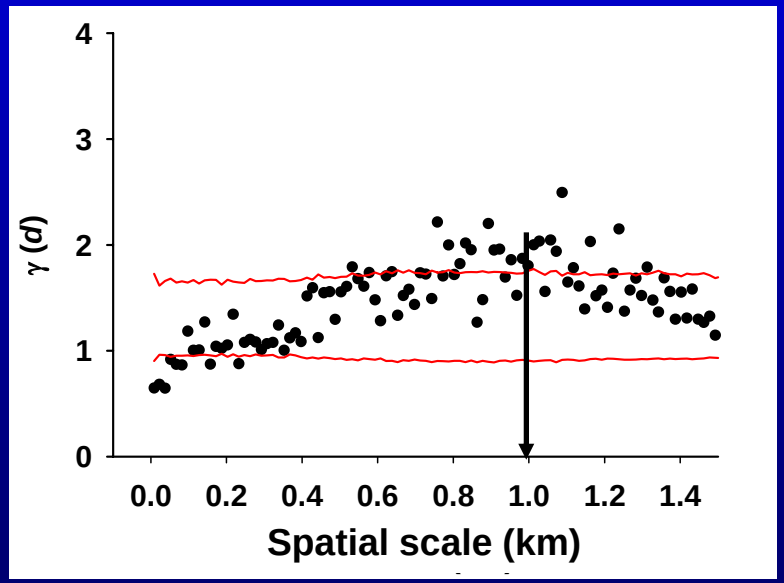
USGS 7.5-min. quad.

Spatial scale of variation of trout counts







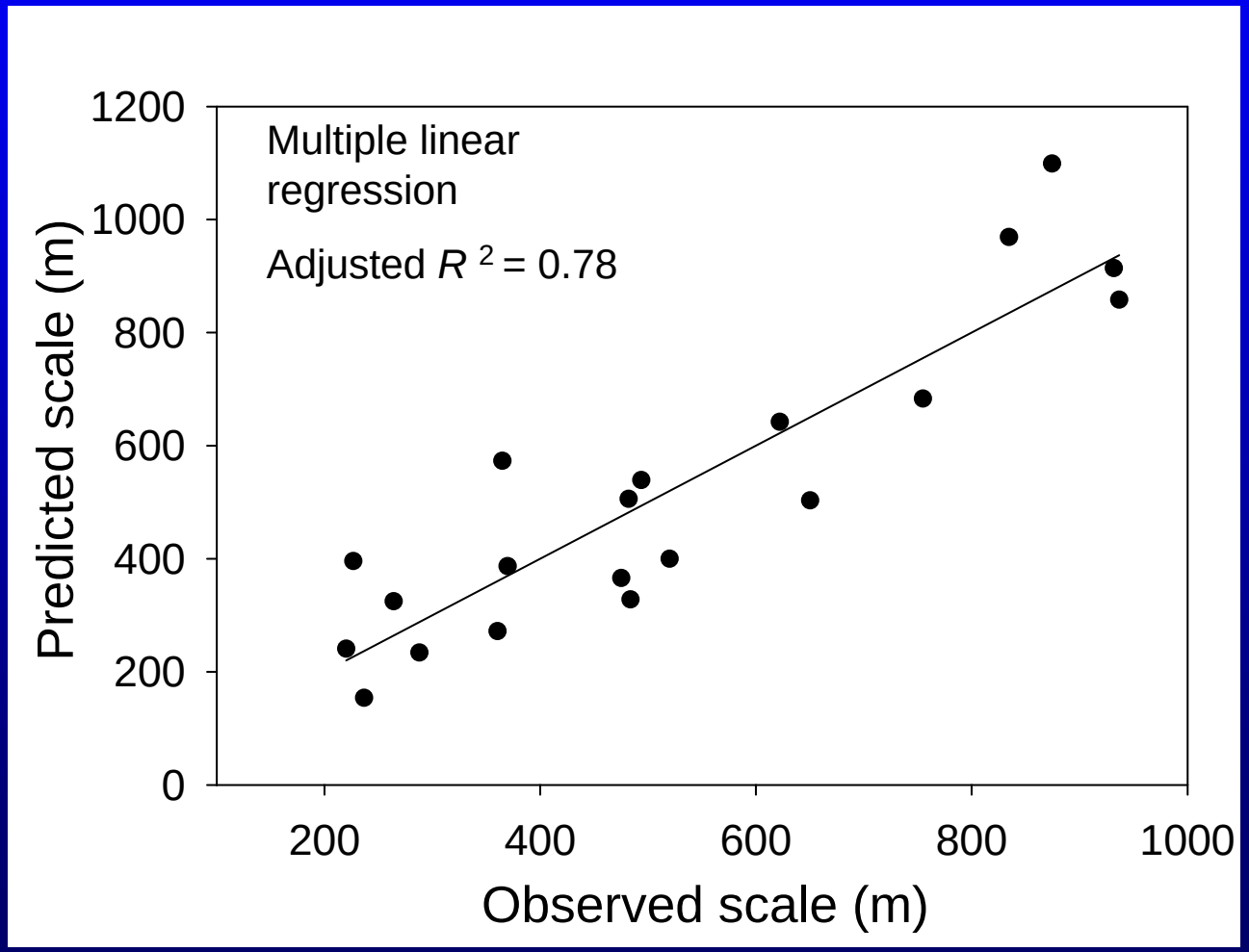


(Ganio, Torgersen, and Gresswell. 2005. *Frontiers in Ecology and the Environment*)

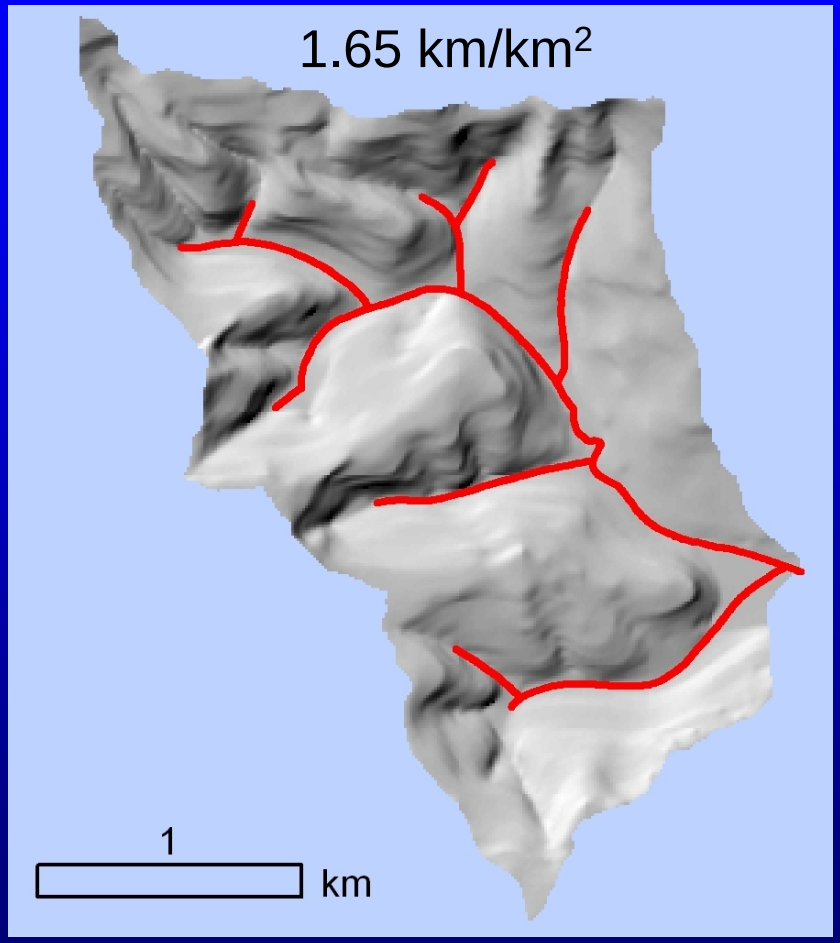
Predicting the spatial scale of variation in CCT distribution

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

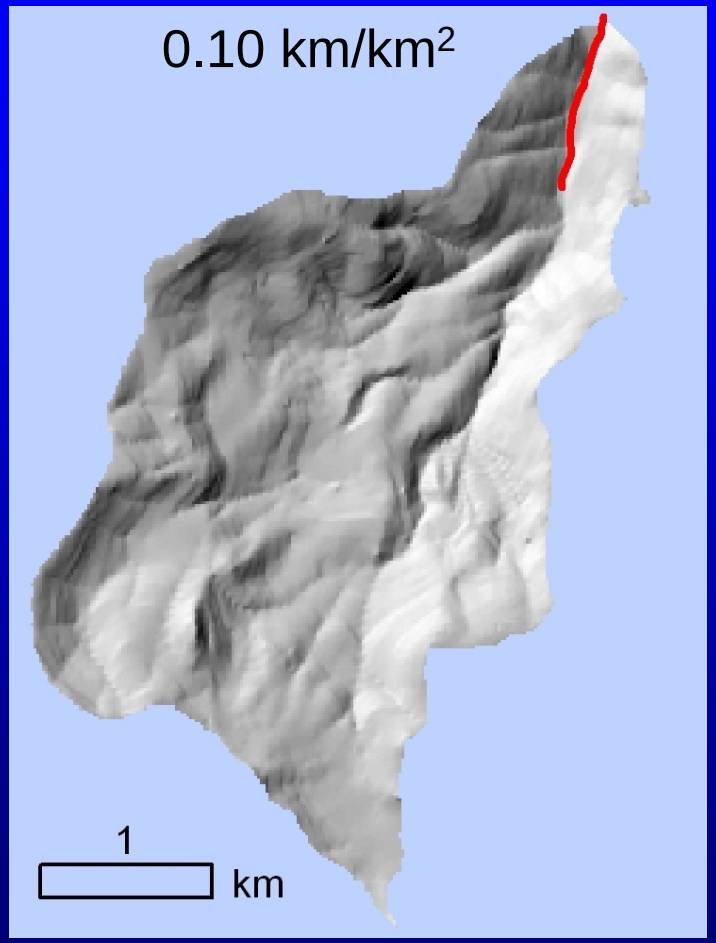
(after accounting for maximum separation distance in basin)



Spatial extent of coastal cutthroat trout distribution



Racks Cr. – Coast Range



Nevergo Cr. – Cascades

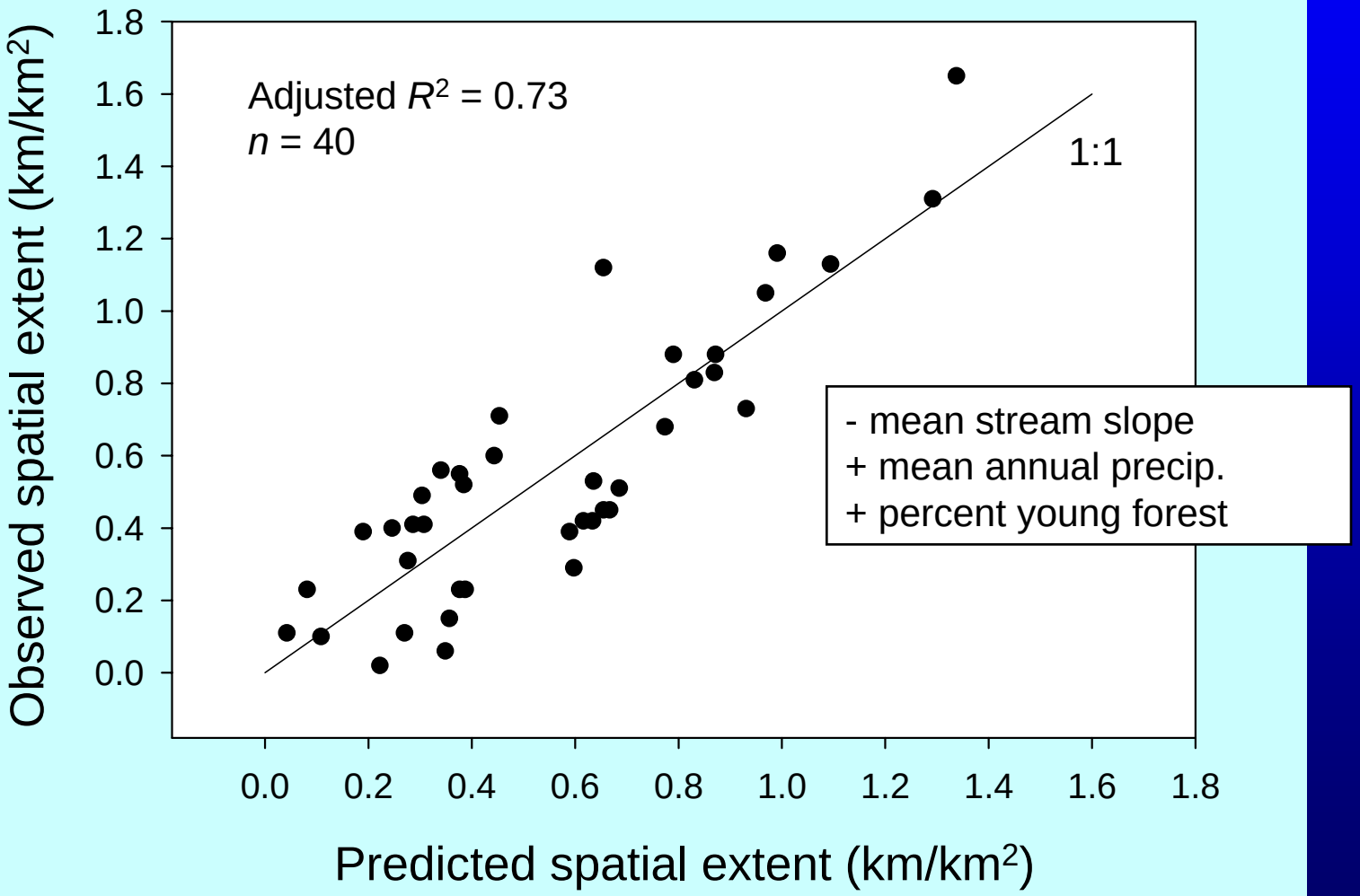
Predictor variables in multiple linear regression models

- 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^2)
- Shape factor (basin length^2 / basin area)
- Percent resistant rock (basin area)
- Ecoregion; geology (categorical)

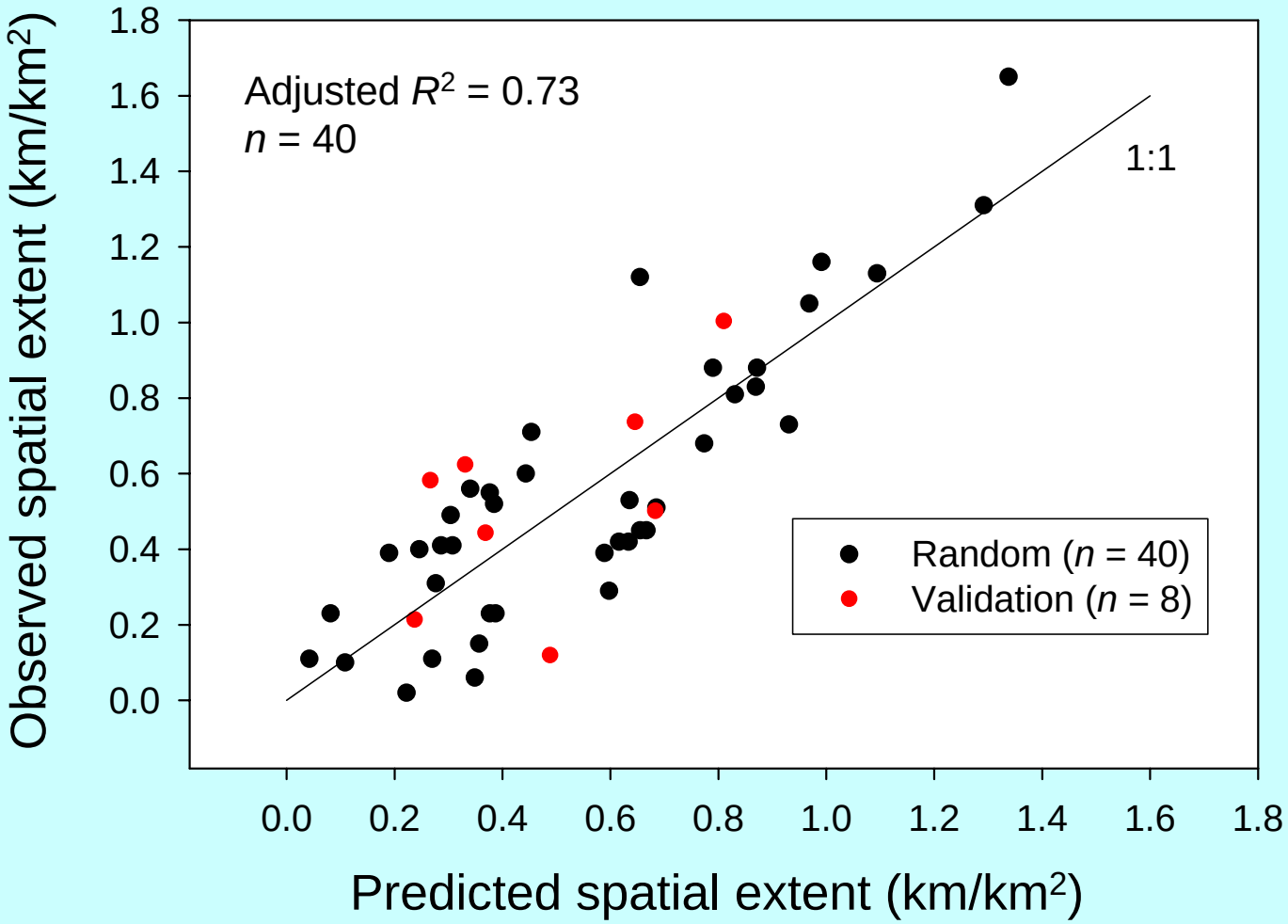
Model selection with Akaike's Information Criterion (AIC)

* 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

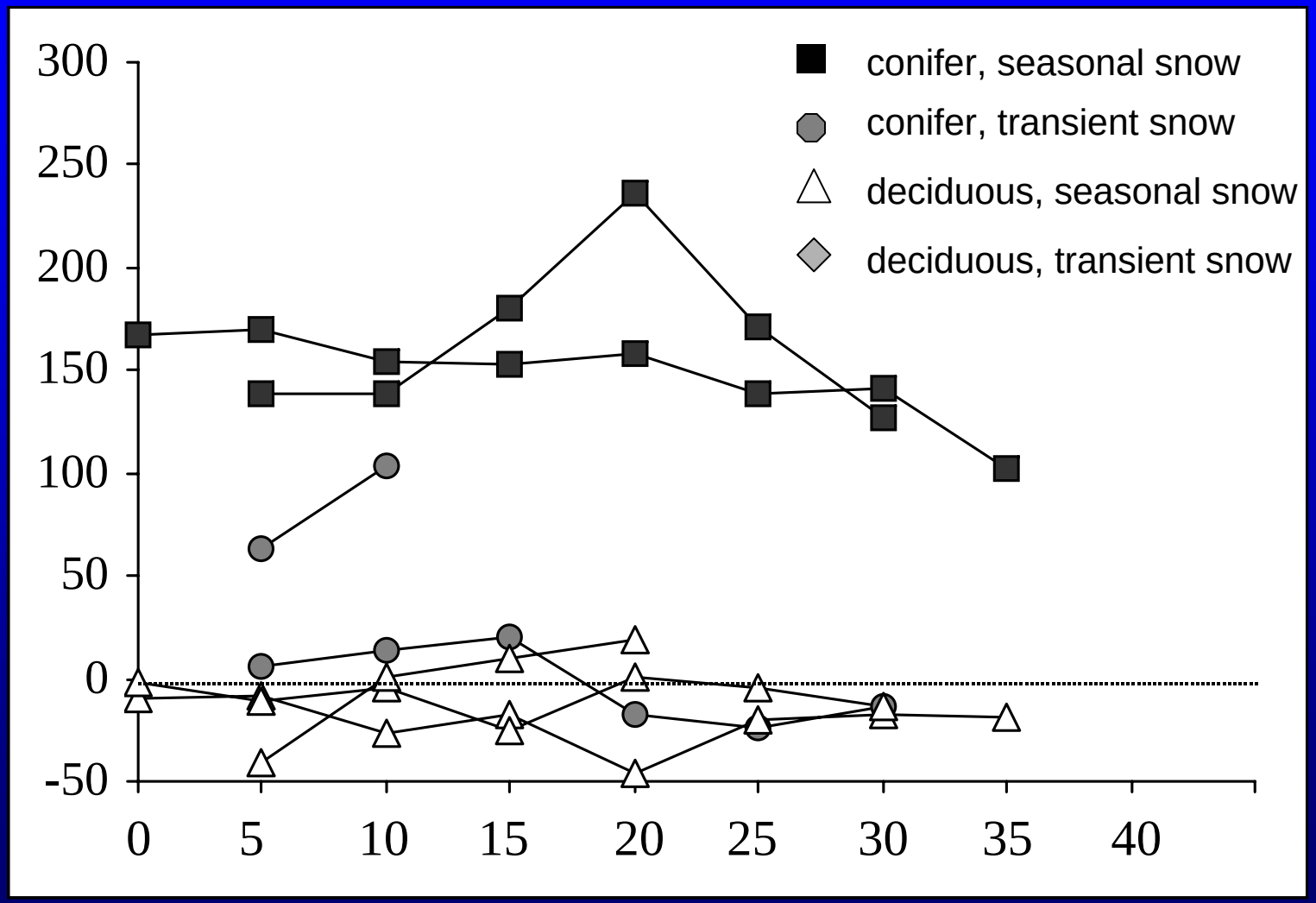


Percent young forest

- Percent young forest predicted spatial extent but was <u>not a good</u> <u>predictor of total numbers</u> (R^2 = 0.32).
- What does this suggest about <u>young forest structure</u> and its relationship with trout distribution?
- What are some <u>potential mechanisms</u> 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

CFER Cooperative Forest Ecosystem Research

USGS science for a changing world

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