Stressor Response Modeling Group

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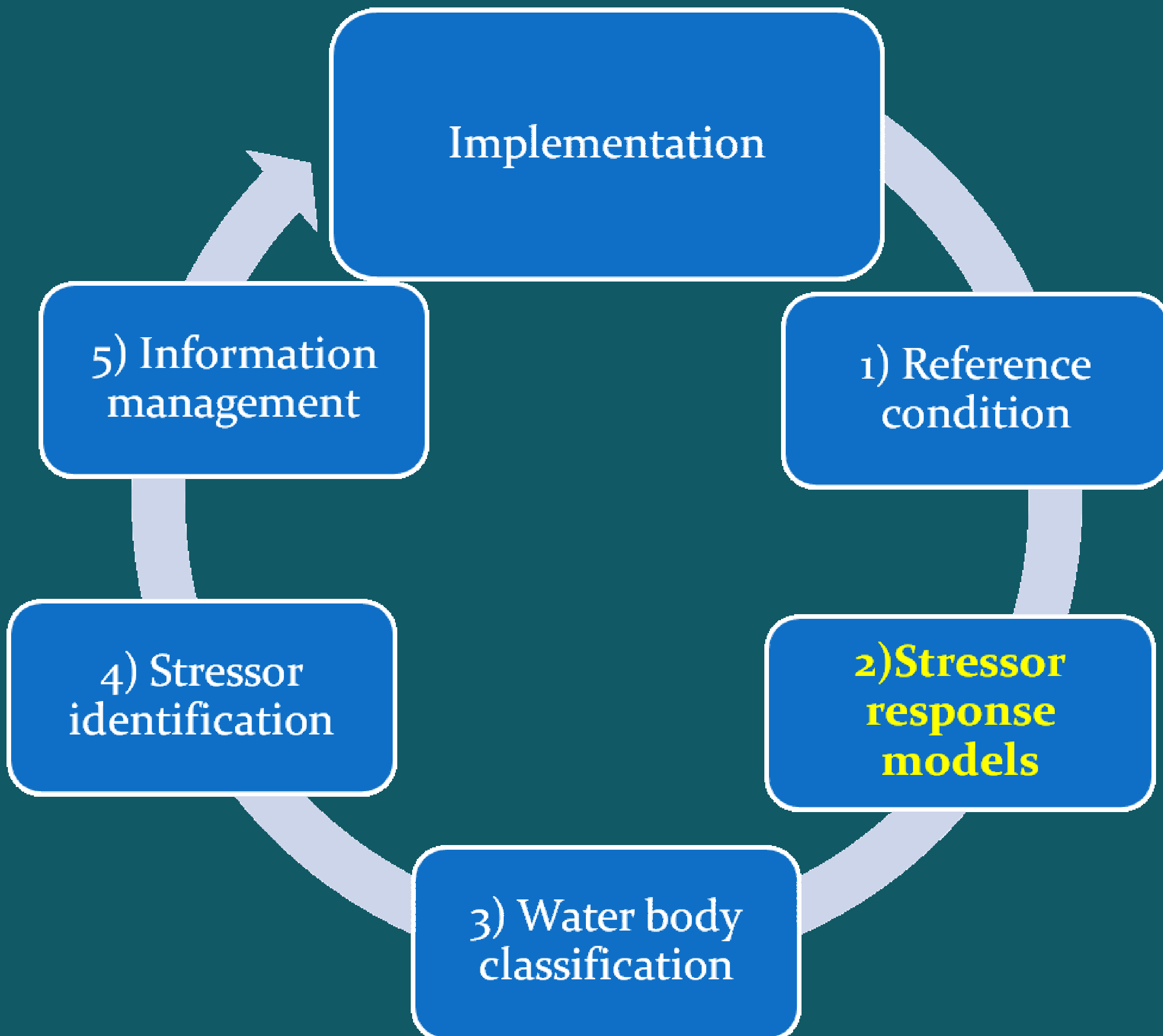
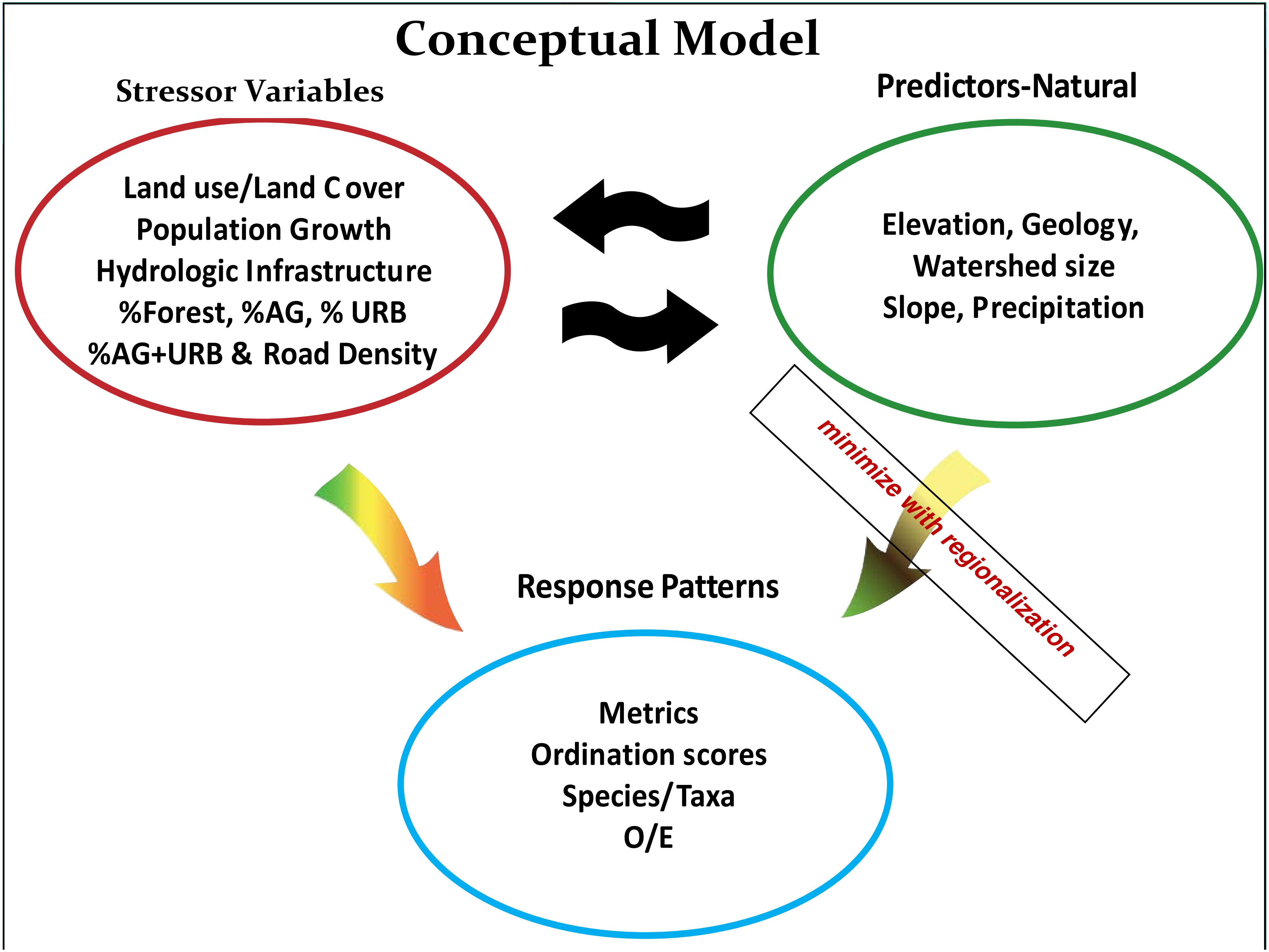
WHY STRESSOR RESPONSE MODELS?

- Reference condition isn't a fair standard for all sites
  - Some sites will never be stressor free
- There are quantifiable changes in biological condition with increasing stressors
  - Natural vs. anthropogenic stressors
- Goal is to identify the most accurate model(s)
  - A tool to set biological expectations for nonreference sites

Where does our group/component fit in the technical elements?

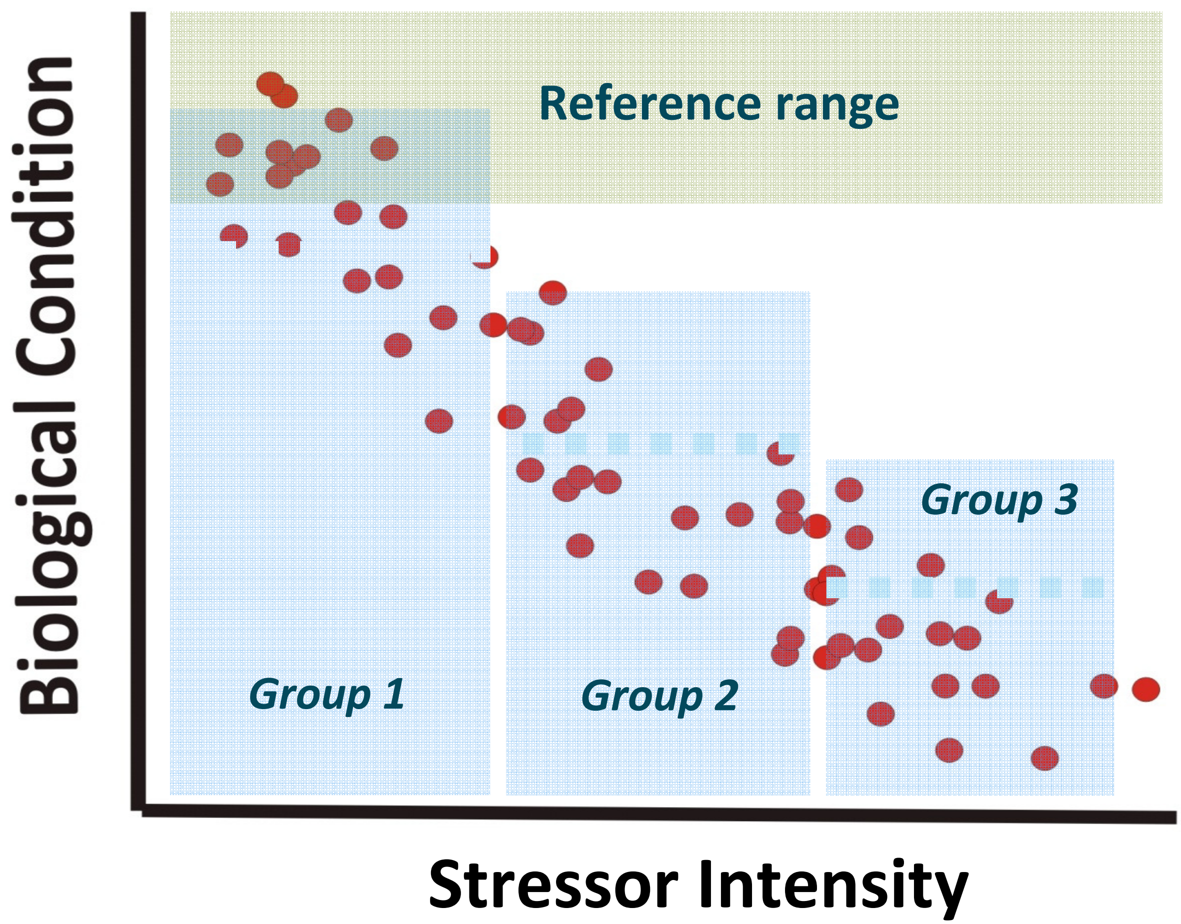




Conceptual Model
Stressor Variables
Predictors-Natural
Land use/Land Cover
Population Growth
Hydrologic Infrastructure
%Forest, %AG, % URB
%AG+URB & Road Density
Elevation, Geology,
Watershed size
Slope, Precipitation
minimize with regionalization
Response Patterns
Metrics
Ordination scores
Species/Taxa
O/E

Stressor-Response Models to inform Waterbody Classification

Goal is to assign biological expectation to every wadeable, perennial stream



Approach
Stressor-Response Modeling group:

- Develop stressor-response models to support development of biocriteria
- Three step process
  - Data collation
  - Construct preliminary models
  - Refine Models (Calibration/Validation)

Step 1:Data Collation

- Same data compilation effort as for Reference Condition

Step 2: Construct stressor-response models for subareas of California

- Why subareas?
  - California is large
- Stressors and sensitive biological response variables vary across areas
- Initially ~6 areas that roughly correspond to areas regulated by various RWCQBs and EPA Level III ecoregions
  - Southern California
  - California Desert
  - Central Valley
  - Chaparral and Oak woodlands
  - Sierra Nevada the Eastern Cascade Slopes and Foothills
  - North Coast

Step 3: Refine stressor-response models as needed

- Submodels may be needed in large ecologically variable Subregions

Controllable (Manageable/Anthropogenic) Stressor variables?

- Definition:

  -Stressors that are likely to be regulated by CalEPA.

  (i.e. concentrations of nutrient, metals chloride, etc.)

  -Anthropogenic stressors that are not directly remedied by management actions, including population density in the catchment, channel modification for flood control, etc. are typically not considered "controllable".

Can it work?

- The existing tools for assessing California streams
  - Southern California Coastal IBI
  - Eastern Sierra IBI
  - North Coast IBI
  - Central Valley IBI
- O/E three sub-models for the state
- Examples of modeling efforts

  (previous model efforts not focused on manageable stressors variables)

Examples of previous stressor-response modeling

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Comparison of watershed disturbance predictive models for stream benthic macroinvertebrates for three distinct ecoregions in western US

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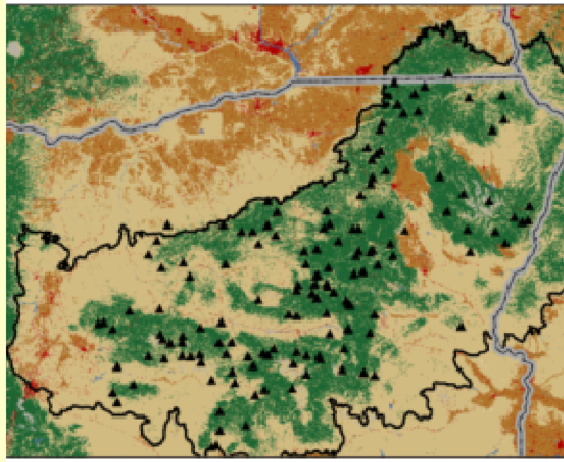
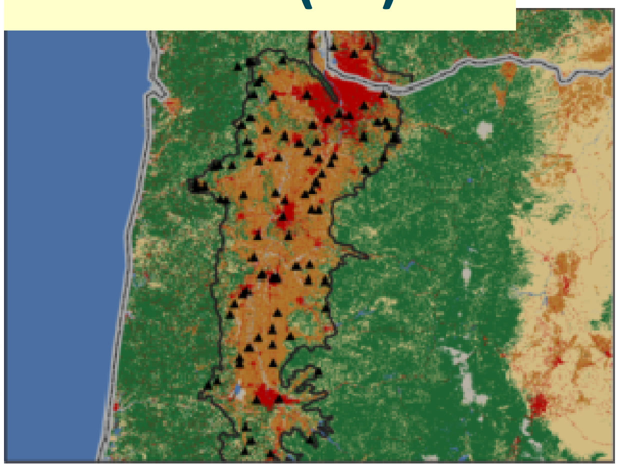
Geographic Regions:

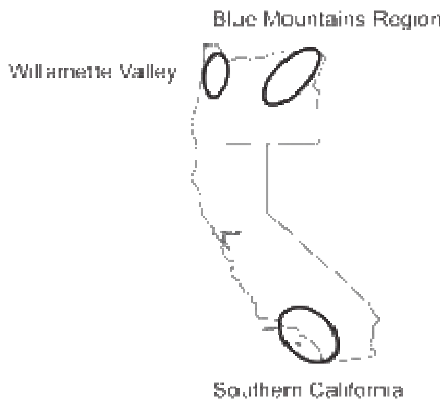
Blue Mnts (147)

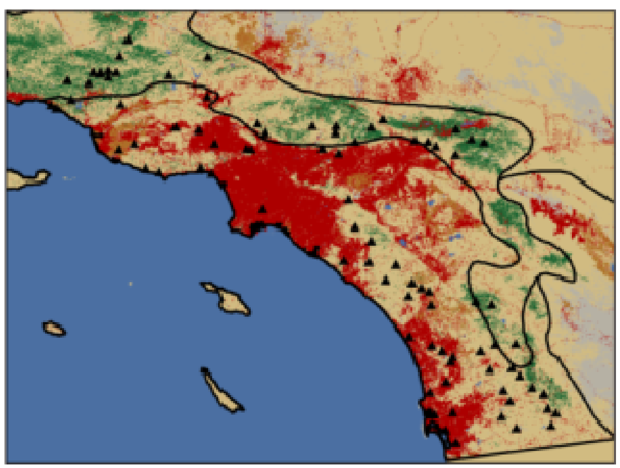
W-Valley (96)

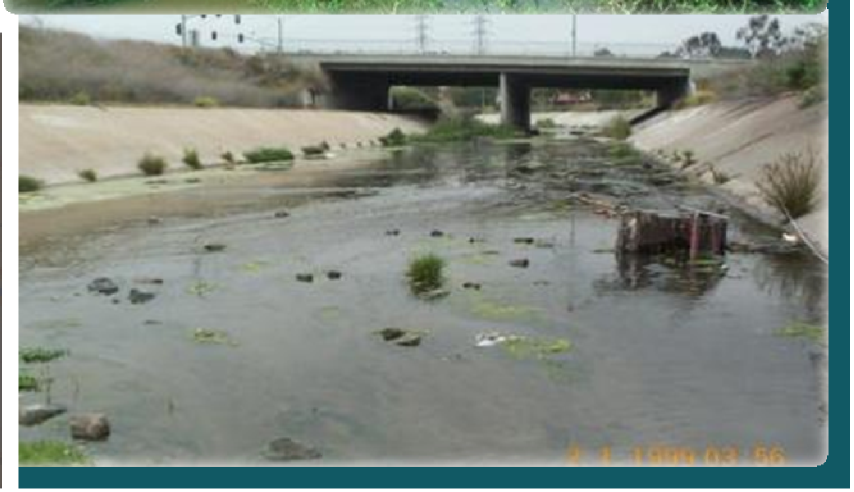
So Cal (57)











Response var.	Regression model	adj-R^2
Southern California		
RICHTOL	**R_Road density, WS Population density**	**0.67**
Taxa richness	WS Shrub (%), WS manmade channels (%), WS Population density	0.52
EPT richness (#)	R Slope, WS Population density	0.58
Blue Mountains		
RICHTOL	**WS_Shrub ,WS_Ag, & WS_MnAnnPrecip**	**0.44**
EPT richness (%)	WS_Shrub , WS_Pasture , & WS_Slope	0.40
Willamette Valley		
RICHTOL	**WS_Ag+Urb, WS_MnAnnPrecip, & Rip_Ag+Urb**	**0.74**
EPT richness (#)	WS_Ag+Urb & WS_MnAnnPrecip	0.71
Non-insect richness (%)	WS_Ag+Urb , WS_MnAnnPrecip , & Rip_Max-Elev	0.71
Plecoptera richness (%)	WS_Ag+Urb & Soil_Mod-Infil	0.68

Summary:

- We were able to develop models for each of three regions
- The strength of our models were similar to those previous generated by Van Sickle et al 2004
- We identified important landscape affecting macroinvertebrate community patterns
- We noted some commonalities within ecoregional models of the most important landscape variables

Modeling Biological Stream Condition in Highly Urbanized Southern California

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Manuscript Will Be Submitted to Ecological Indicators

Background

- Evolved from the previous USGS effort to model stream condition (individual metrics)

Objectives of SoCal Model

- Develop a simple, predictive model of SoCal-IBI at unsampled sites using land use, land cover and hydrologic infrastructure.
- Such a model could be used to:
  - Prioritize sites for sampling
  - Identify potential reference sites
  - Identify potentially impacted sites

Southern CA IBI Modeling effort

- Develop MLR model of IBI scores (Ode et al 2005)
- Larger data set within the SoCal Chaparral Ecoregion

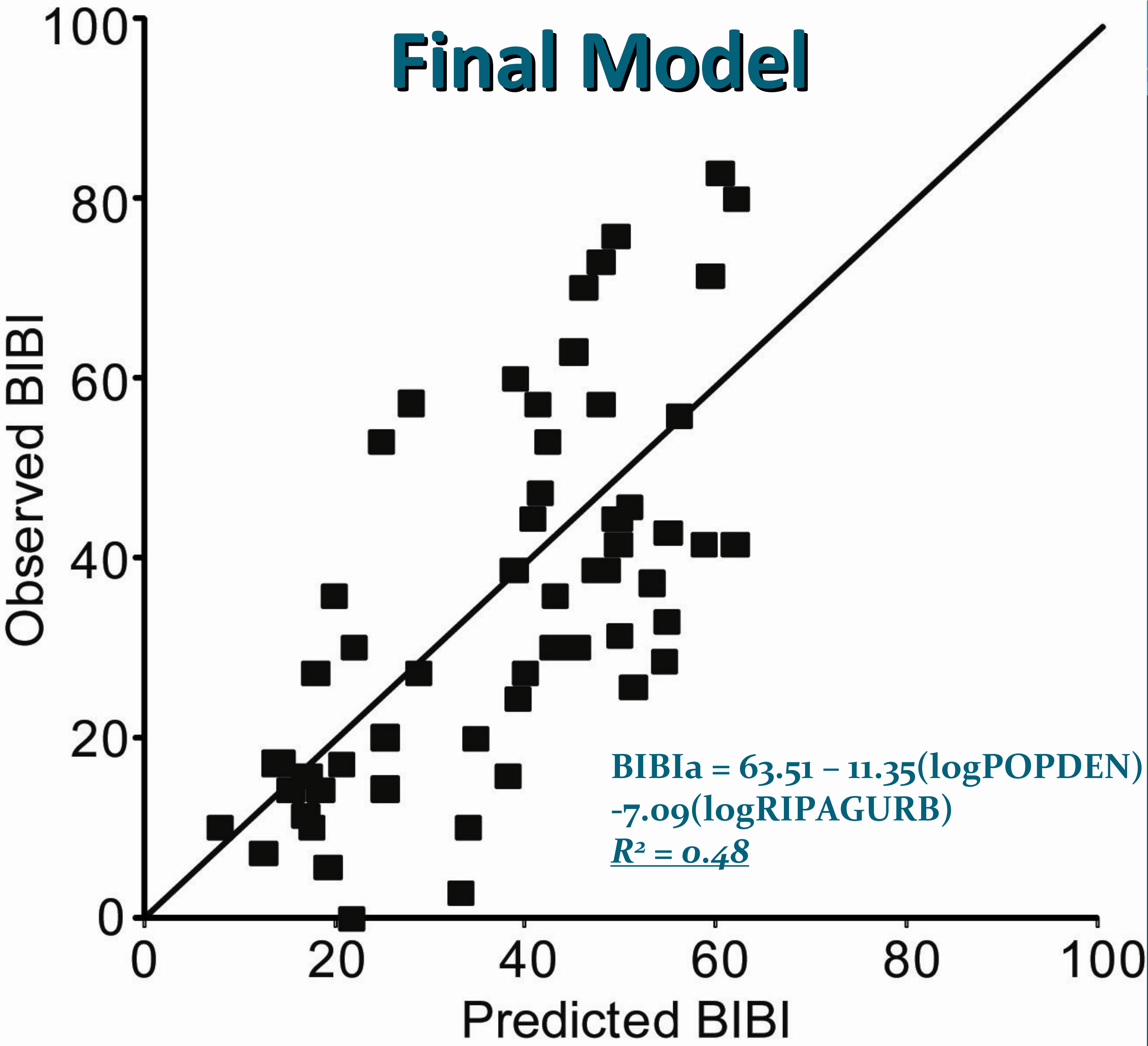
Southern California development sites (n=100)

Southern California validation sites (n=59)

Explanatory Variables Considered
Final Selections for Modeling

Variable	Development	Validation
Watershed Factors		
Elevation (m)	99 (3-1503)	141 (1-1292)
Population density (persons/km^2)	27 (0-4643)	14 (1-4480)
Urban (%)	8 (0-99)	7 (0-98)
Agriculture (%)	0 (0-45)	<1 (0-45)
Agriculture + urban (%)	9 (0-99)	11 (0-98)
Forest (%)	9 (0-93)	9 (0-84)
Shrubland (%)	38 (<1-93)	36 (1-100)
Road density (km/km^2)	2 (0-12)	2 (0-12)
Man-made channel density (km/km^2)	0.01 (0-0.61)	0.01 (0-0.35)
Mean annual precipitation (cm)	65 (31-159)	69 (34-155)

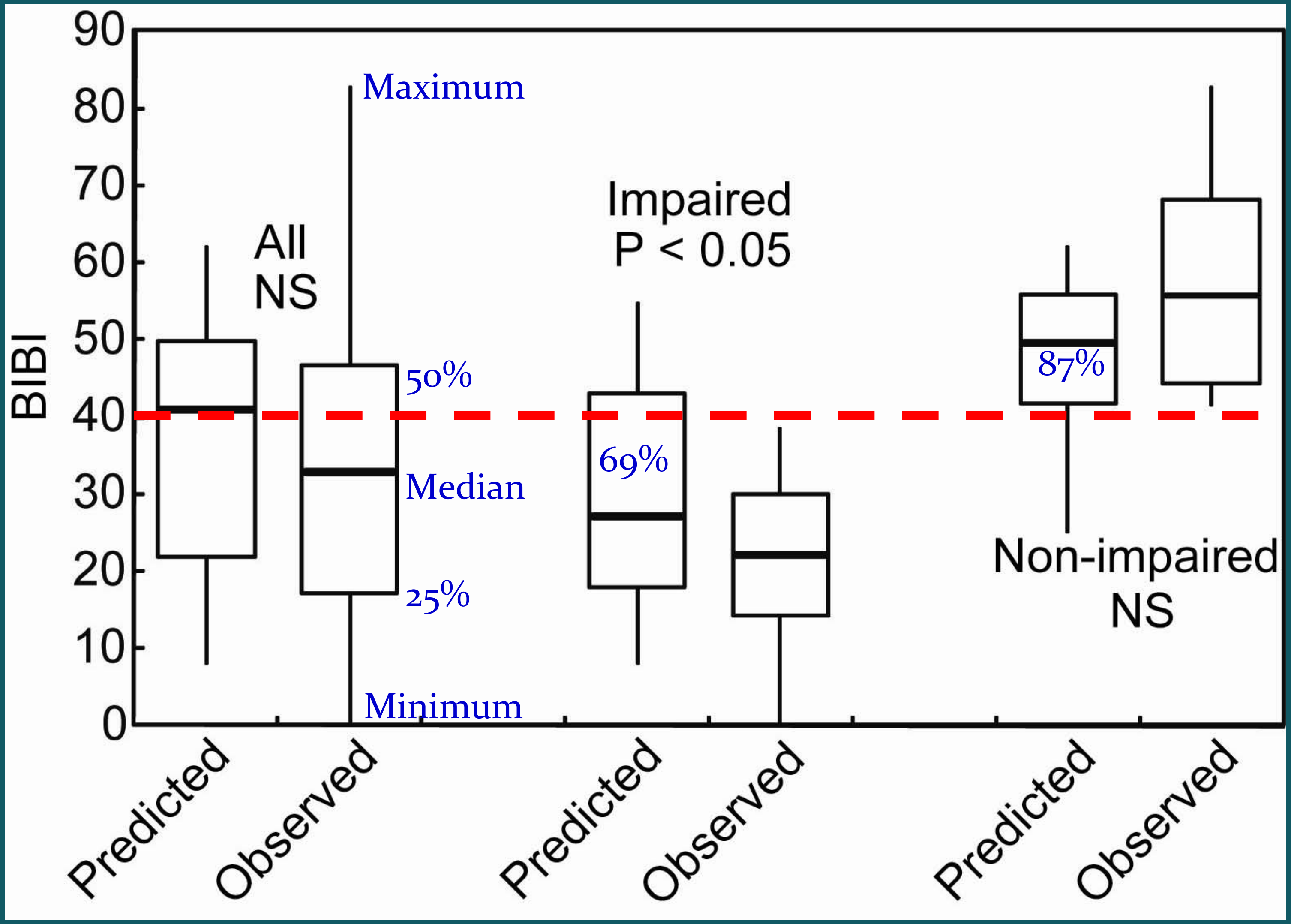
Final Model



BIBIa = 63.51 – 11.35(logPOPDEN) -7.09(logRIPAGURB)

$R^2 = 0.48$

Model Accuracy



Validation sites (N = 59)

Would Other Modeling Methods Work Better?

- Classification and Regression Trees (CART)
  - R^2=43%
- Boosted Regression Trees
  - R^2=47%
  - MLR was R^2=48%
- Not much difference in model outcomes
  - Likely a data limitation

Responses of Individual Metrics
B-IBI provides better response

Metric	PopDen	RAgUrb	R^2
Coleoptera taxa (#)	-0.42	NS	0.25
EPT taxa (#)	-0.46	NS	0.37
Predator taxa (#)	-0.32	NS	0.16
Collector individuals (%)	NS	0.36	0.14
Intolerant individuals (%)	-0.26	-0.27	0.21
Noninsect taxa (%)	0.60	NS	0.40
Tolerant taxa (%)	0.49	NS	0.23

Improving the Model

- Probably difficult without site visit
  - Remote sensing (cost?)
  - More complex GIS analyses (probably not)
- Assess reasons for misclassifications
  - If mostly due to one factor may be able to correct (unlikely)
- *For biocriteria*
  - Include site specific data (i.e. habitat and water quality measurements)

Initial Objectives Met?

- Identify potential reference sites? YES
  - Prioritize for conservation assessment
- Identify potentially impacted sites? YES
  - Prioritize for restoration assessment
- Prioritize sites for sampling? YES
  - Stratify new sampling according to specific needs

Next Steps/benchmarks

- Proofed data delivered to USGS
  - Oct/Nov 2010
- Preliminary data analysis/screening
  - Nov/ Dec 2010
- Develop Preliminary Models internally
  - Mar/Apr 2011
- Refine Models
  - Mar-Apr 2012
- Present Final Models for review
  - May 2012
- Submit publication(s) for review
  - Jul-Aug 2012