Wildlife Connectivity:

We've been telling you for twenty years that we don't have enough time to gather the data

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Ecologists have a great capacity for making simplistic models of self-evident concepts with no emergent properties

Not Rocket Science – Rocket science is just physics, ecology is more complex

Conservation involves self-organizing systems with

- interactions at multiple scales
- Turbulence
- time lags in feed-back
- Chaotic sequences
- Predictable and unpredictable disturbances

CONNECTIVITY is a way of organizing conservation problems

So the first question is: Are there other ways to organize our approach to *situ* conservation of species and ecosystem??

Better said:

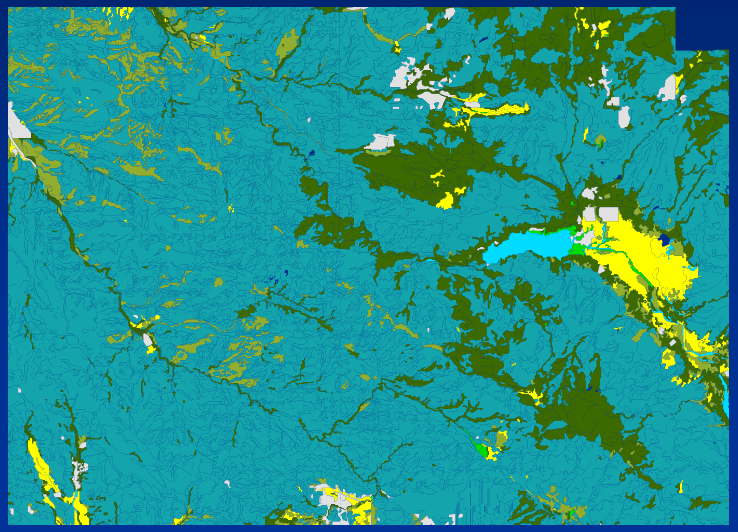
When is CONNECTIVITY the best way to define conservation problem?

Connectivity is one framework for organizing complex conservation problems, but under what circumstances is it the most efficient?

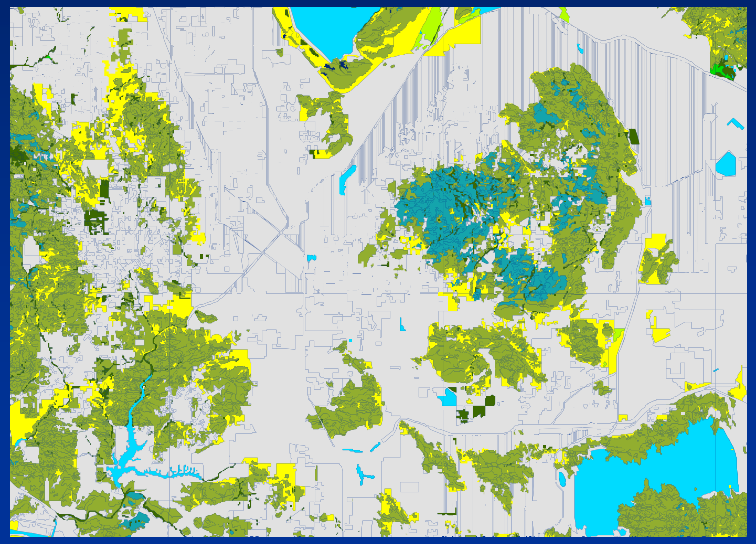
MANAGEMENT STRUCTURE	ORGANIZED BY	BASED ON SCIENCE
CONNECTIVITY	Movement	Genetics, Meta-populations
HABITAT QUALITY	Resources	Suitability
SPECIES DISTRIBUTION	Population	Demography, Dispersion, Dispersal
DEGRADATION	Response	Behavior Population biology

WHERE CONNECTIVITY MATTERS:
TWO EXTREMES OF WILDLIFE LANDSCAPES

INTACT



HABITAT ISLANDS



TWO TYPES OF WILDLIFE LANDSCAPES

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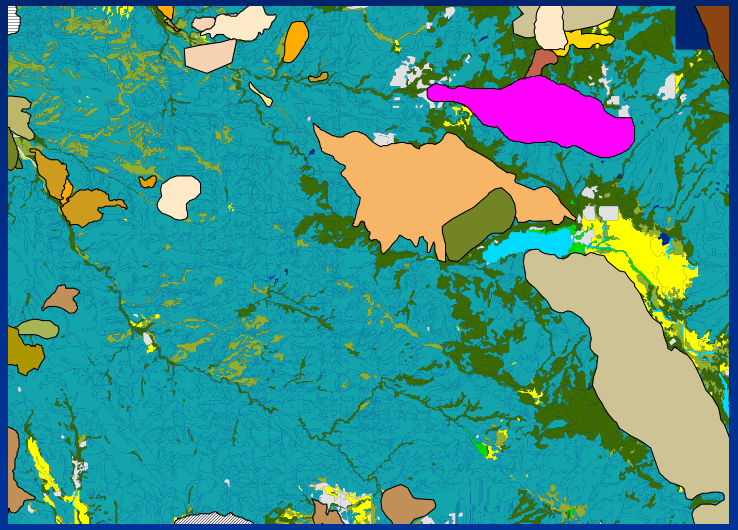
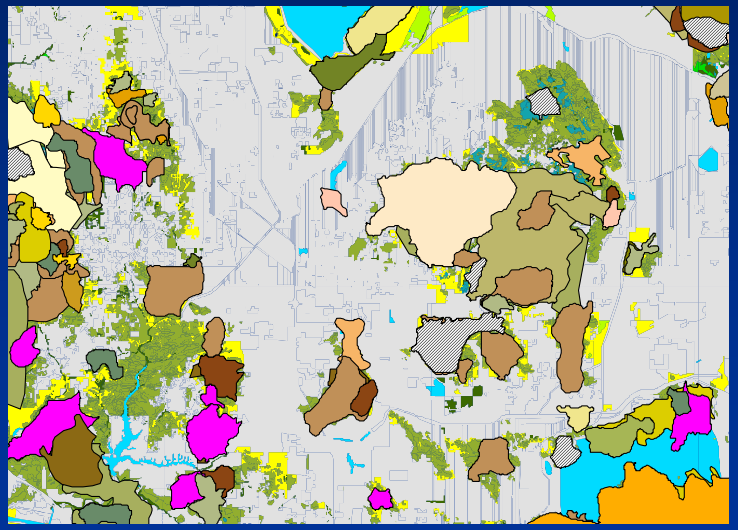


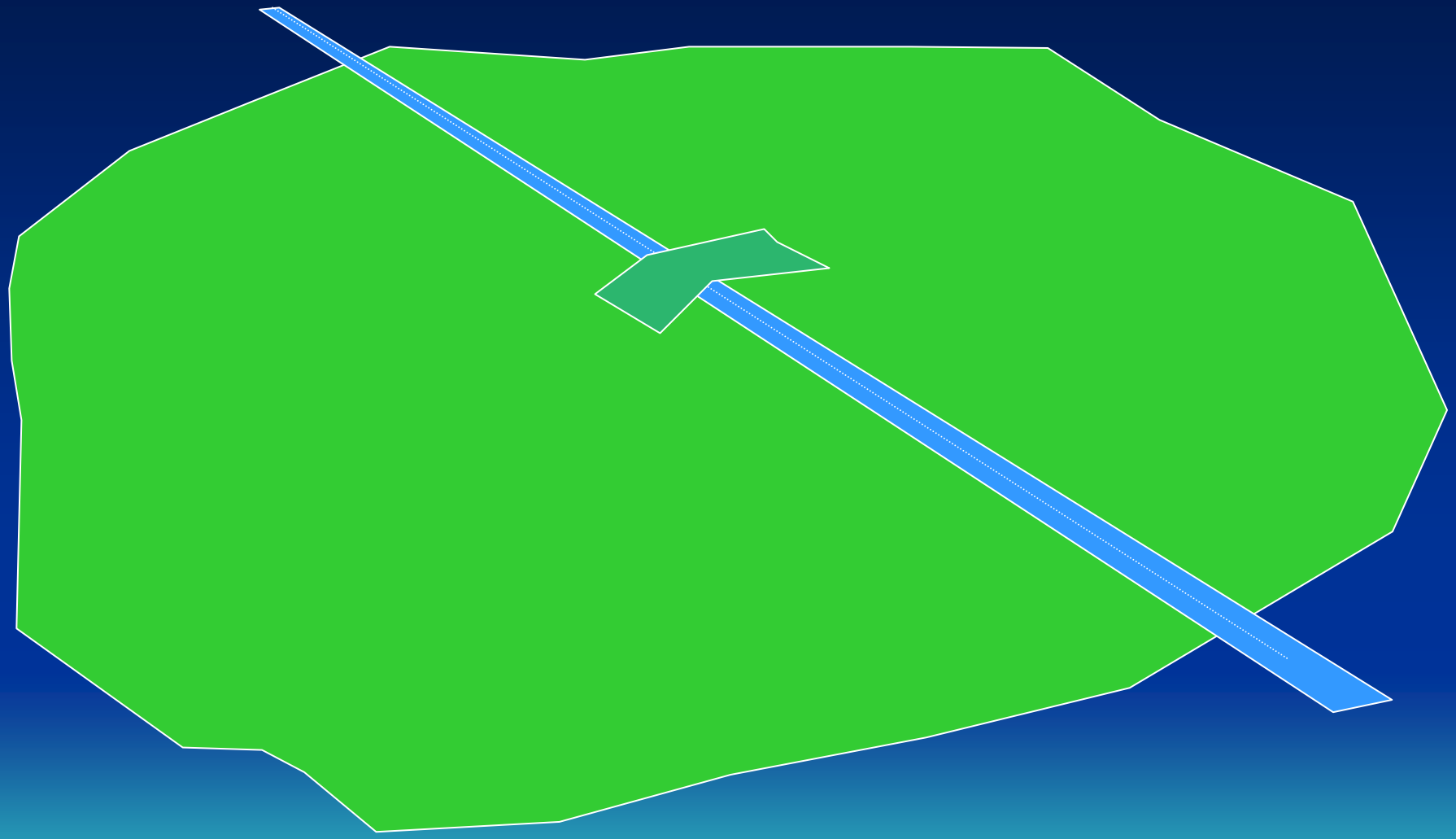
Connectivity isn’t an issue When the landscape insensitive to even large scale perturbations

HABITAT ISLANDS



Connectivity is a primary issue with scale dependent response to extirpation from habitat islands

Wildlife crossings in mixed conifer forest



Eastern Deciduous Forest, Lowland Tropical Rainforest

BETTER

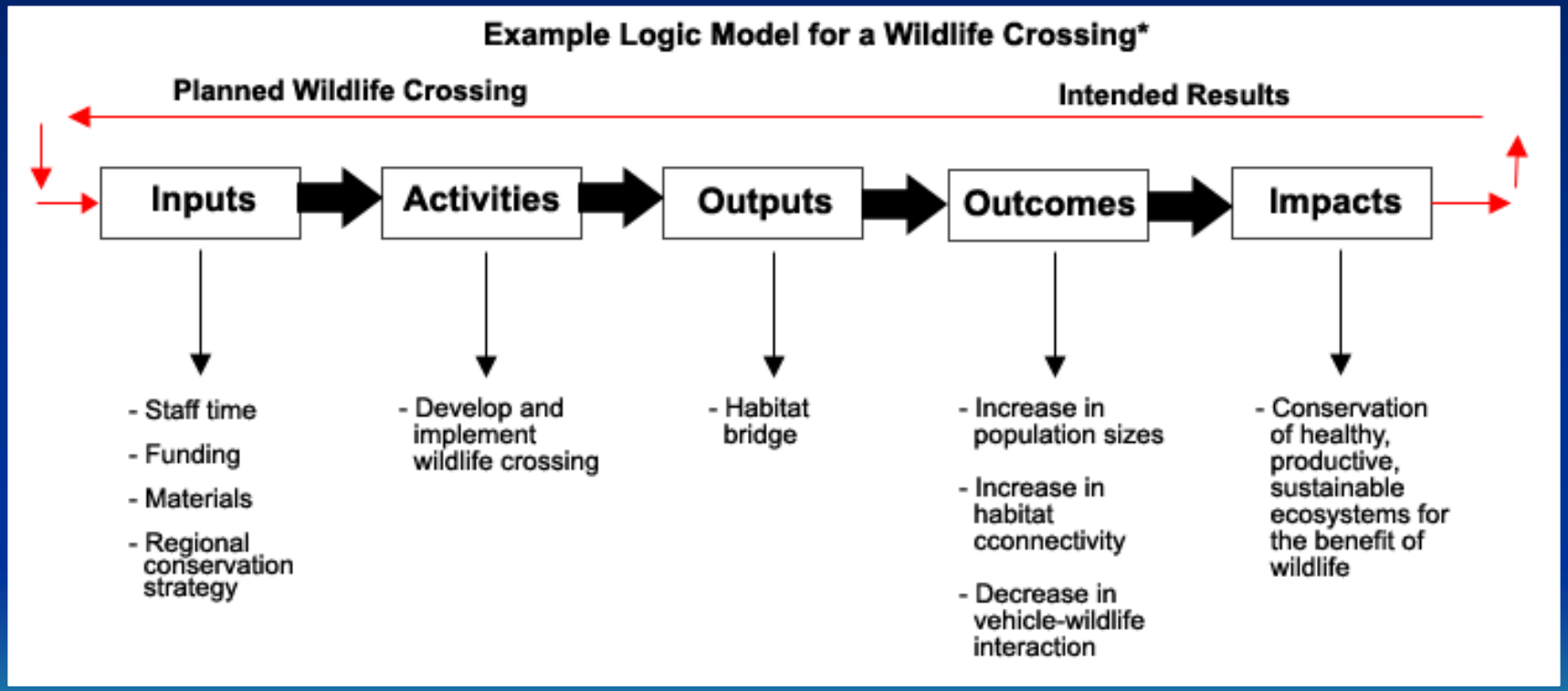
WORSE

Truisms don’t help.

The Principal of Reserve Design	Lessons to my kids
Species well distributed are less susceptible to extinction than are species confined to small portions	Be balanced
Larger blocks, containing larger populations, are better than small blocks	Its better to be rich than poor
Blocks of habitat close together are better than blocks far apart.	It’s good to have friends
Habitat in continuous blocks is better than fragmented habitat	It’s good to stay close to family
Interconnected blocks of habitat are better than isolated blocks.	Communicate with those you love
Populations that fluctuate are more vulnerable than populations that are stable.	Don’t count on a risky job
Disjunct or peripheral populations are likely to be more genetically improvised and vulnerable to extinction, but also more genetically distinct than central populations.	It’s good but dangerous to be different

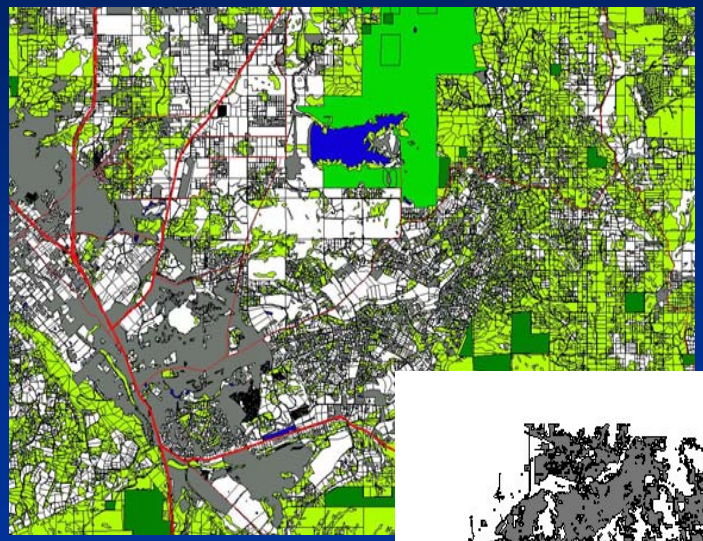
Presumed output and missing inputs in planning wildlife corridors

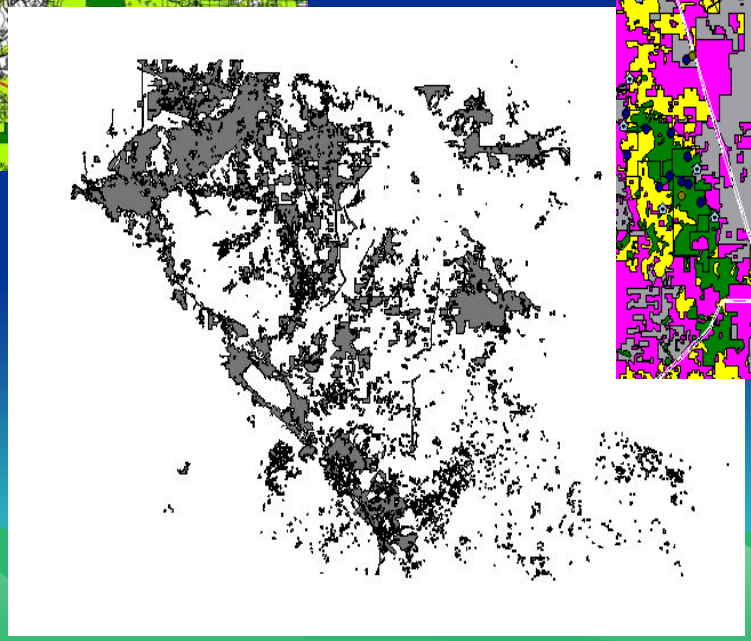
Department of Transportation – Federal Highway Administration
Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects

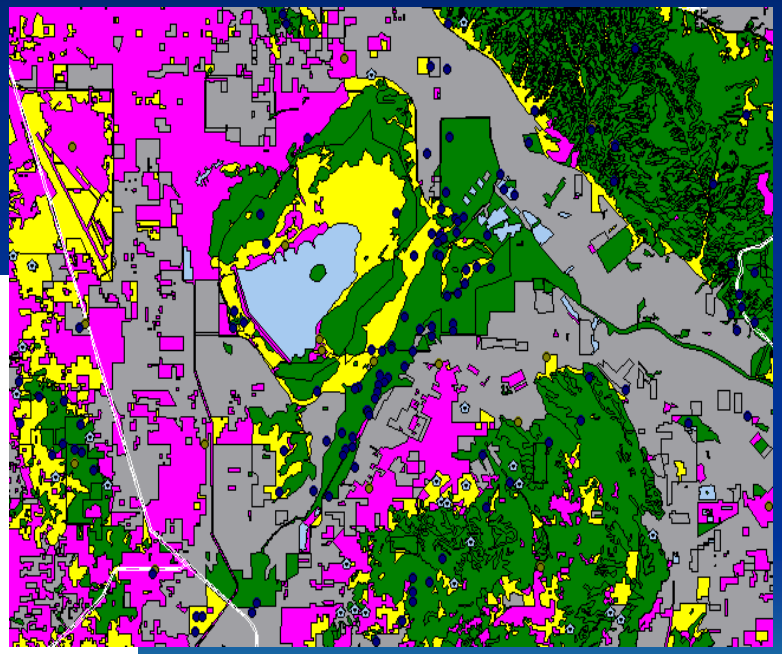


www.environment.fhwa.dot.gov/ecological/eco_5.asp

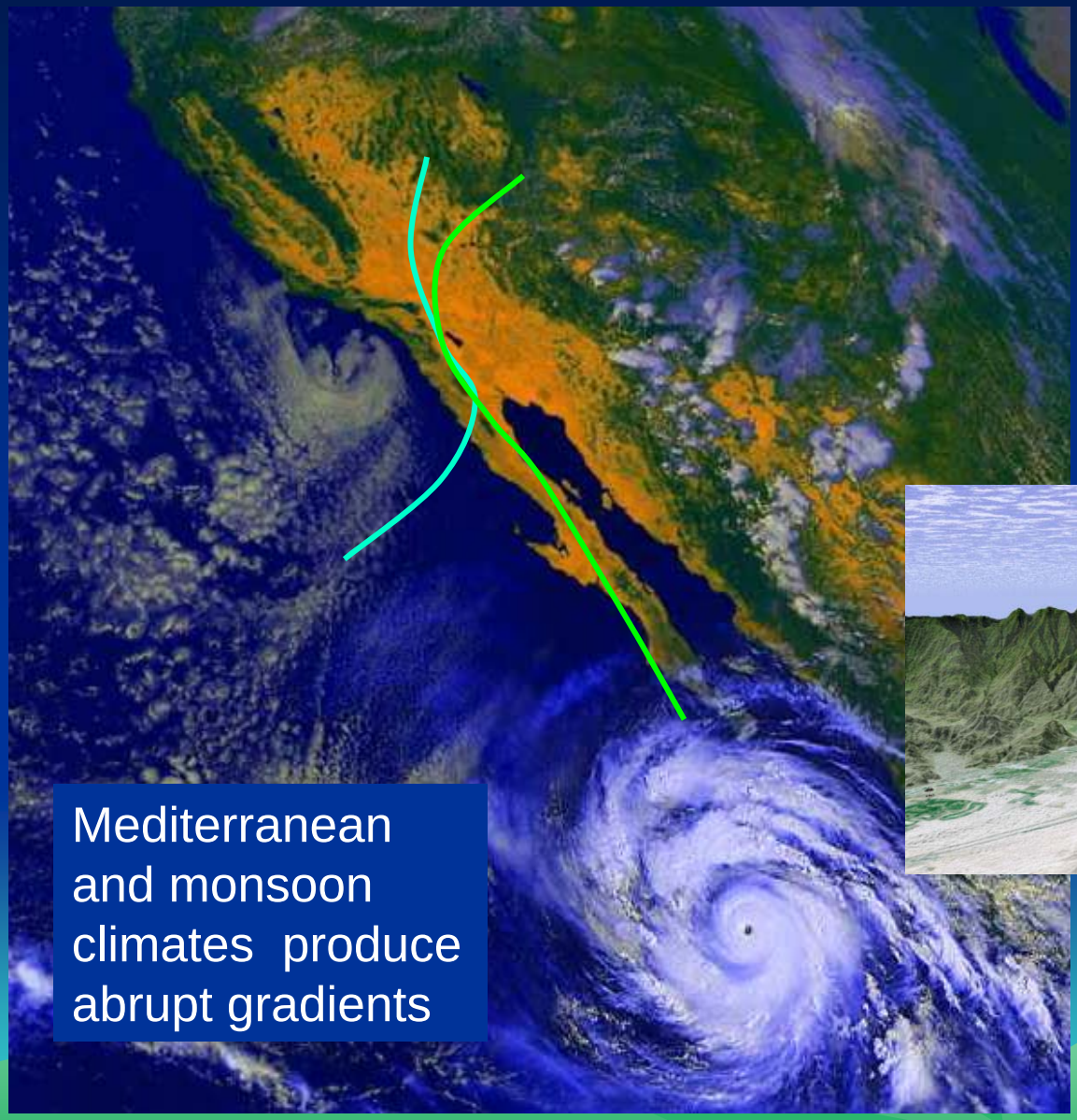
Corridors in complex matrix of human influences





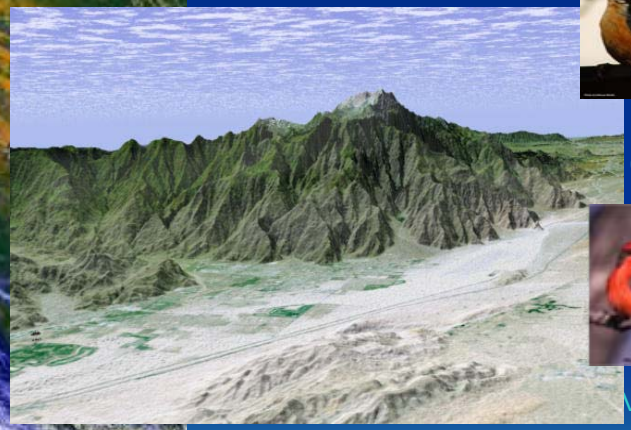


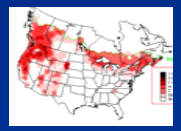
Connectivity in California's heterogeneous landscape



Mediterranean and monsoon climates produce abrupt gradients

Movements of the Pacific and North American tectonic plates create a geological calliope





Red-breasted Nuthatch
(North to Yukon)

Vermillion Flycatcher
(South to Equator)

Southern California is a complex mix of ecosystems and transitions. Eight miles of ecological transition in the San Bernardino Mountains is equivalent to a 1200 miles of transitions in the Midwest.

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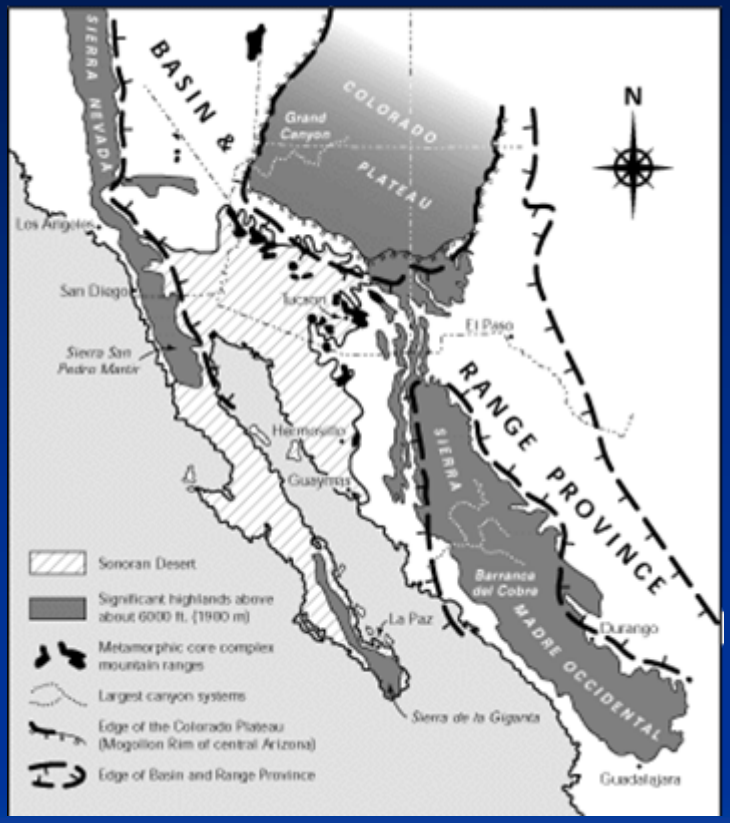
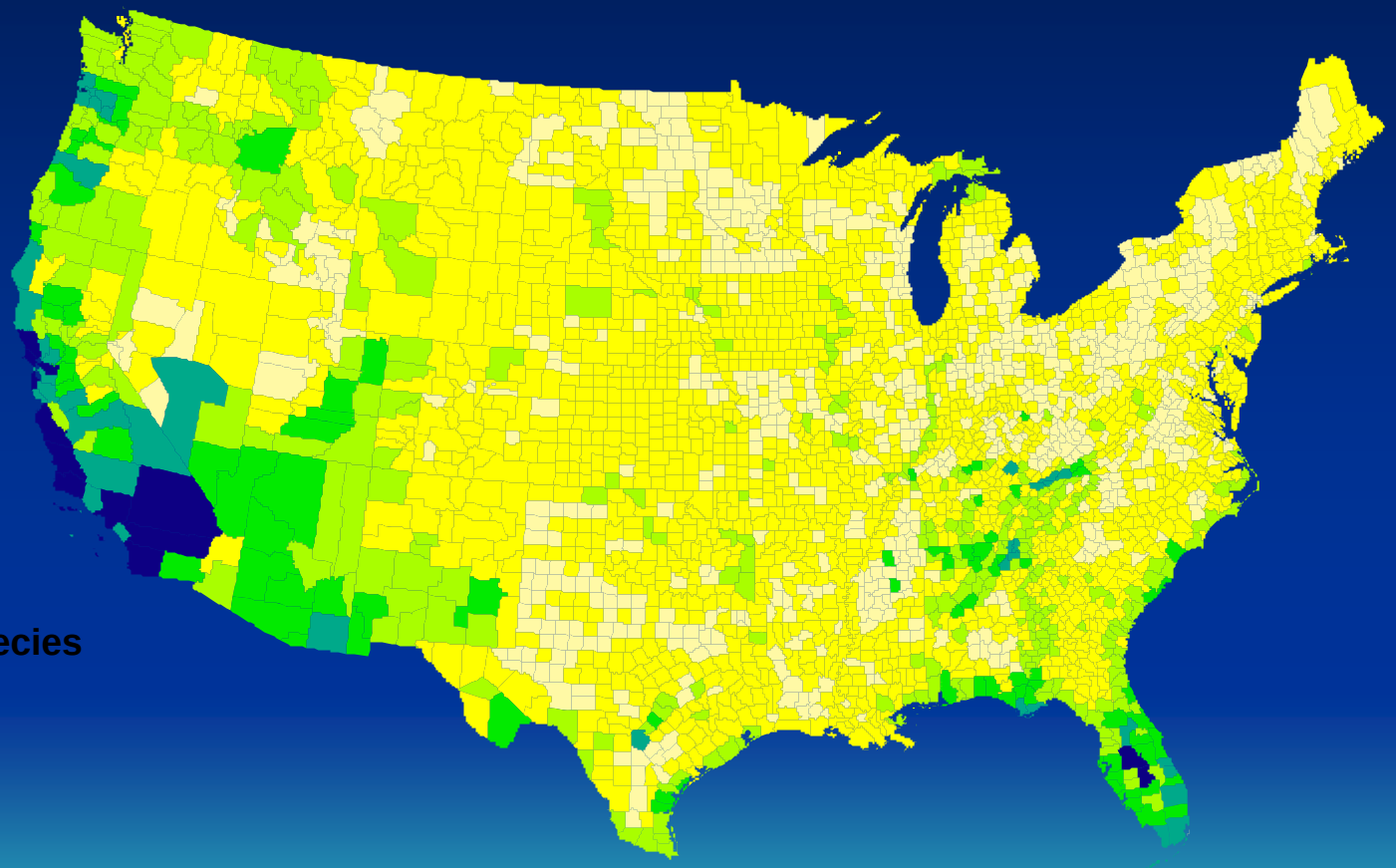


http://images.google.com/imgres?imgurl=http://www.desertmuseum.org/images/seismicity_map2.gif&imgrefurl

Map of Federally-listed Endangered Species by County

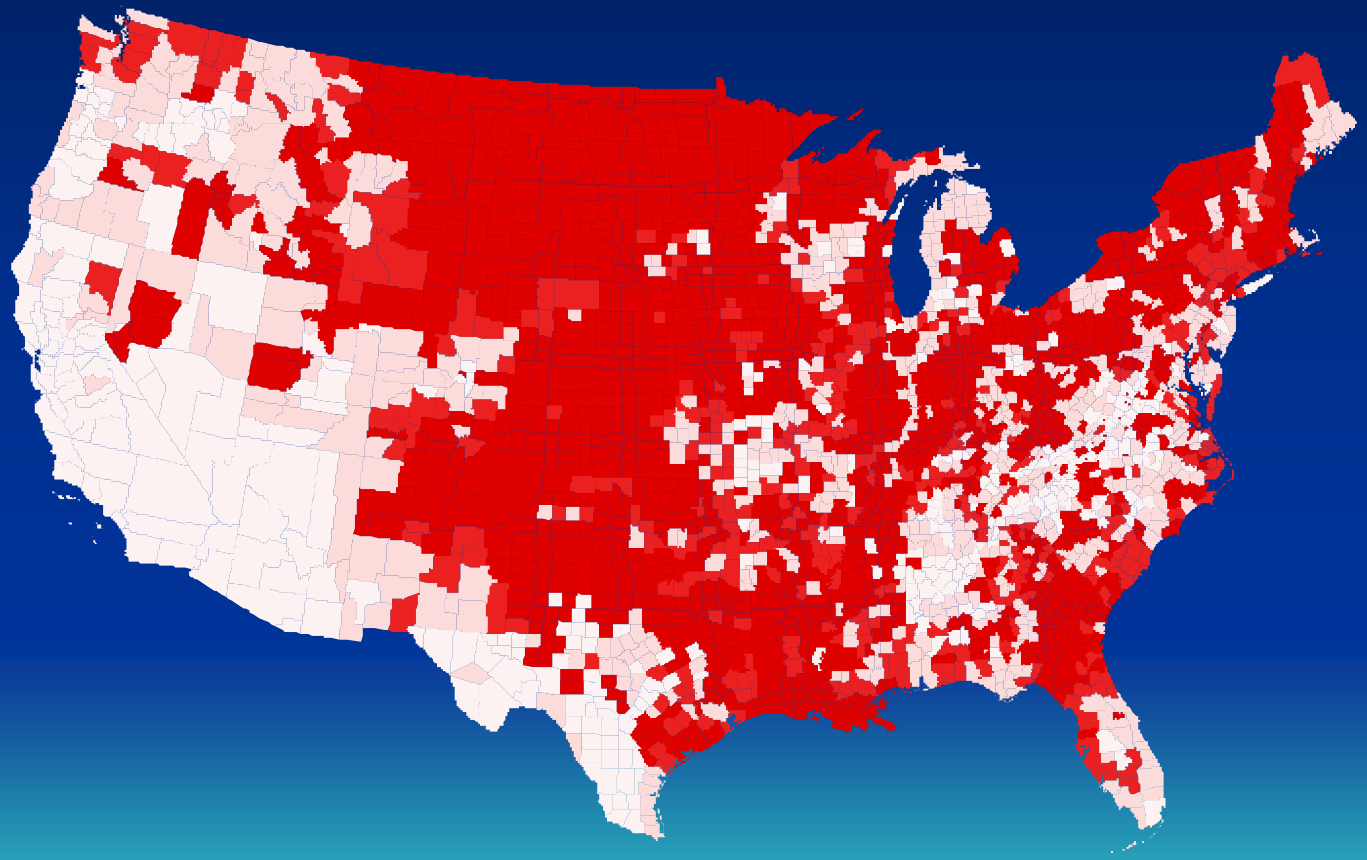


Number of Endangered Species

- 0 or 1
- 2 to 5
- 6 to 10
- 10 to 15
- 16 to 25
- >25

Geographic impact of the ESA

About 75% of counties in the United States have relatively little interaction with endangered species – either because they have no listed species or because their listed species have broad distributions (Bald Eagles, Indiana Bats, Interior Least Terns, or Piping Plover).



Percent of listed species
In county that are widely
distributed (>50 counties)
in the United States

- 75 to 100%
- 50 to 75%
- 25 to 50%
- 0 to 25%

Most Endangered Species are found in <10 counties

	NUMBER OF SPECIES	Counties Present	Counties Dominant
NARROW_RANGE ENDEMICS	**1104** (89.4%)	**938** (30%)	**73**
SUB-REGIONAL (State) **DECLINING**	**8** (0.6%)	**746** (24%)	**107**
REGIONAL (multi-state) **DECLINING**	**49** (4.0%)	**835** (27%)	**67**
WIDESPREAD (National) **DECLINING**	**27** (2.2%)	**2645** (84%)	**1835**
SALMONIDS	**32** (2.6%)	**1017** (33%)	**86**
PELAGIC SPECIES	**15** (1.2%)	**100** (3%)	**3**

The Distribution Patterns of Endangered Species in the US[1]

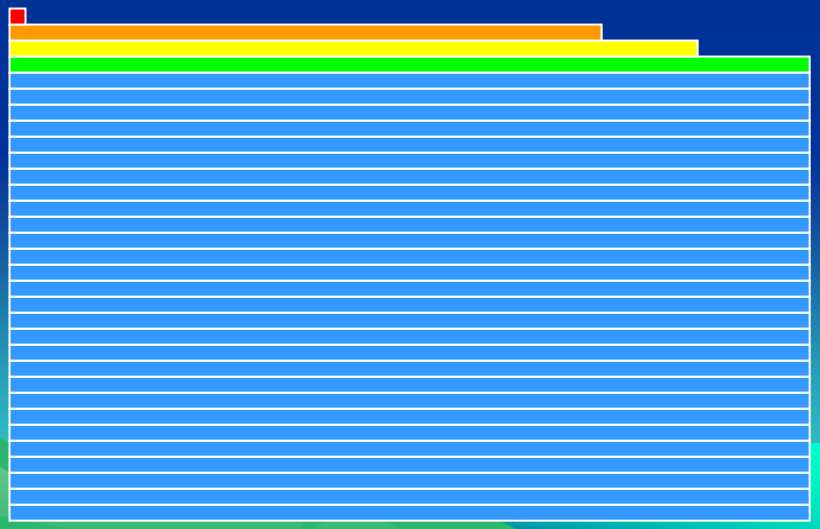
Group	Narrow-range Endemics	Sub-regional (state)	Regional	National
Crustaceans	**100.0**			
Arachnids	**100.0**			
Conifers and Cycads	**100.0**			
Lichens	**100.0**			
Amphibians	**93.5**		**6.5**	
Flowering Plants	**91.8**	**3.2**	**4.4**	**0.6**
Snails	**91.1**	**8.9**		
Insects	**88.0**	**2.2**	**7.6**	**2.2**
Ferns and Allies	**82.6**	**4.3**	**4.3**	**8.7**
Fishes	**62.4**	**17.4**	**18.1**	**2.0**
Mammals	**58.7**	**8.7**	**13.5**	**19.2**
Birds	**50.5**	**10.3**	**21.6**	**17.5**
Reptiles	**43.6**	**17.9**	**20.5**	**17.9**
Clams	**43.3**	**22.1**	**28.8**	**5.8**

[1]Excluding species in US protectorates

Many of the earth's rarest species do not inhabit rainforests, coral reefs, or oceanic islands.

- They are scattered across otherwise unremarkable habitats in arid and semi-arid landscapes
- Small, species-poor, disjunct patches
- Can not be maintained by single large reserve
- Makes their conservation complex

Tropical Rainforest ecosystems



Mediterranean ecosystems
(California scrub/woodlands / forblands)

What if we use wildlife response to human influences with connectivity:

The species under management

Human alteration of landscapes

Species responses to human influences

The connectivity necessary to achieve a management goal

Persistence *in situ* has three components in southern California

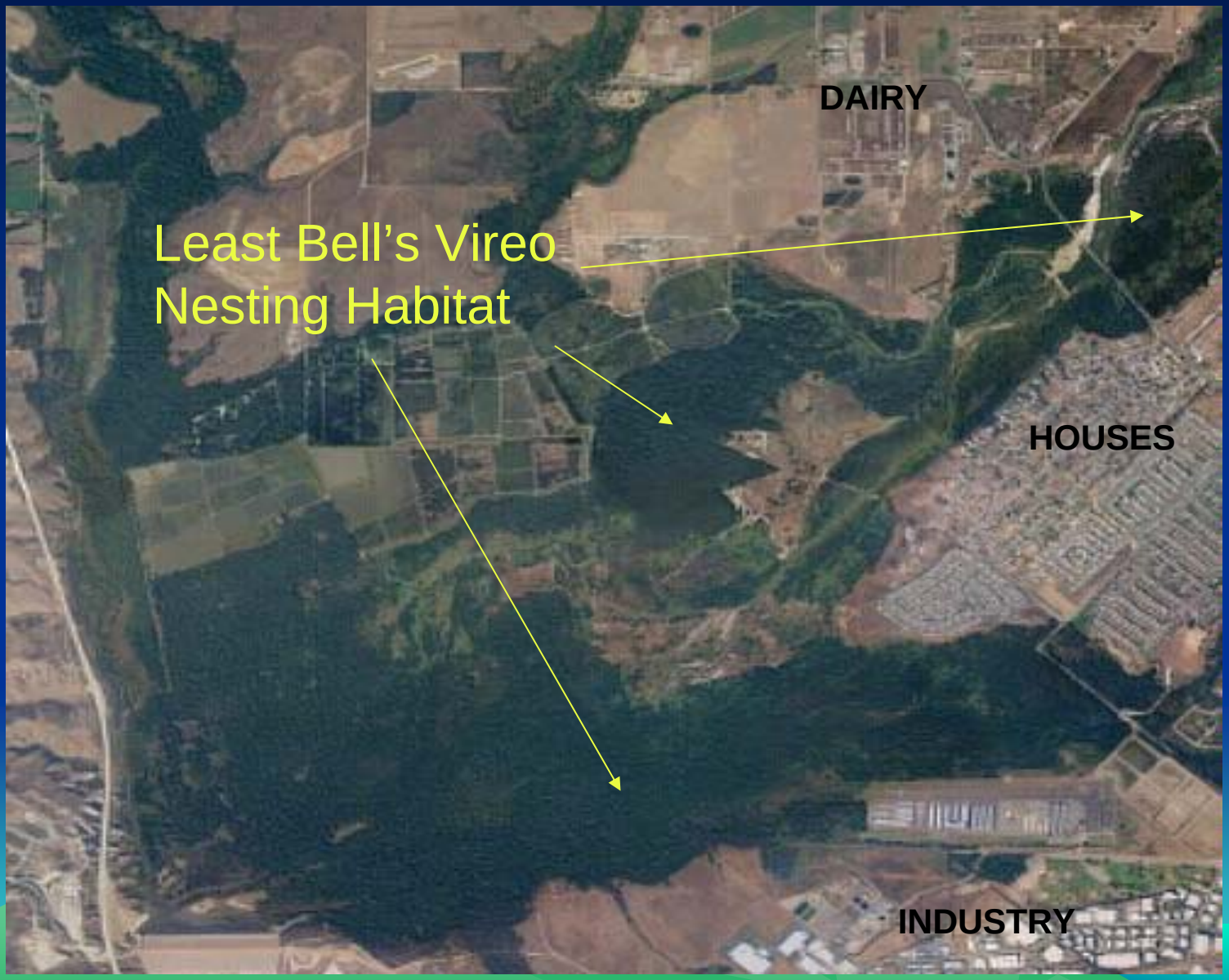
Threats to wildlife
Wildlife responses
Management Actions

Different goals for different species

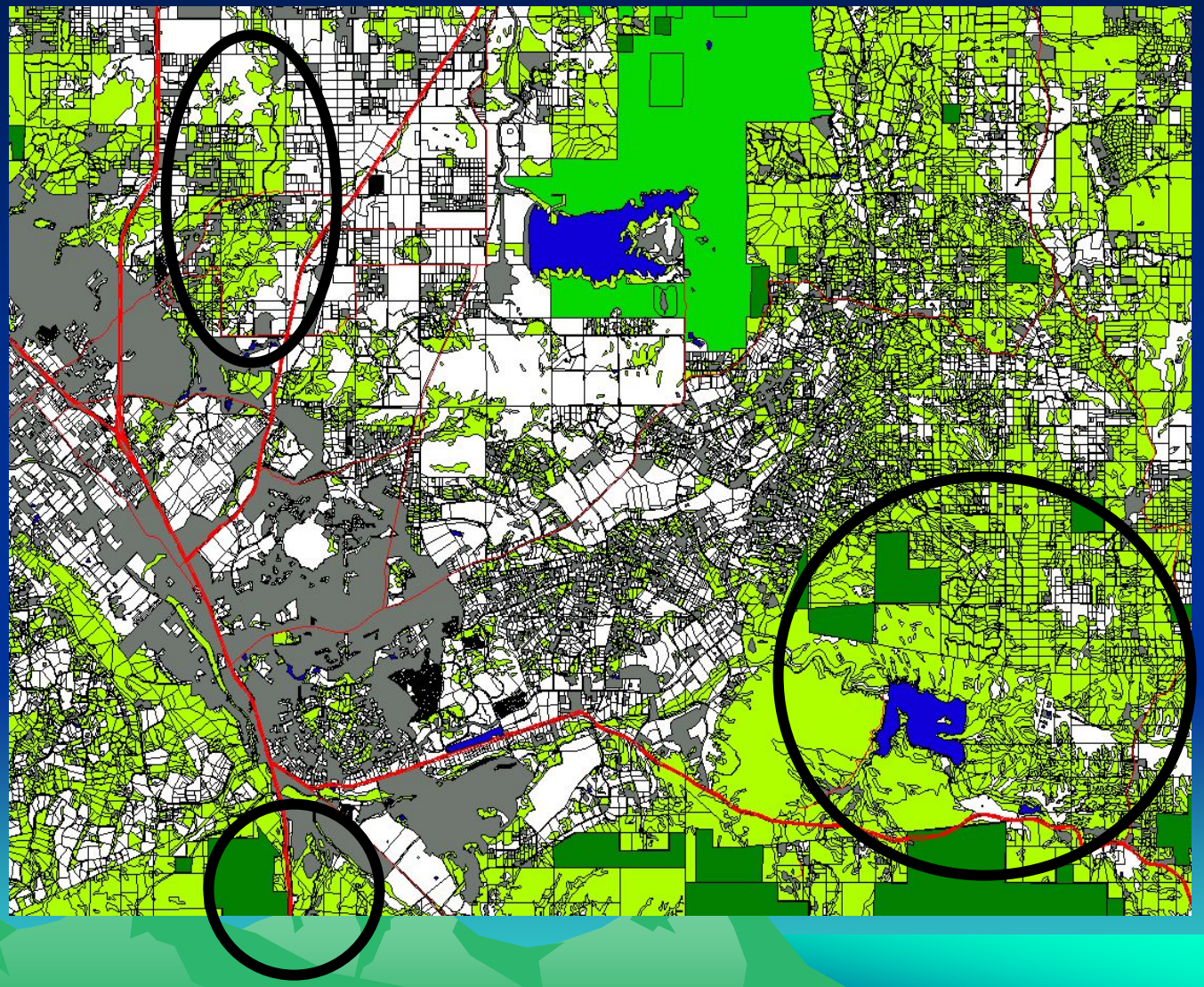
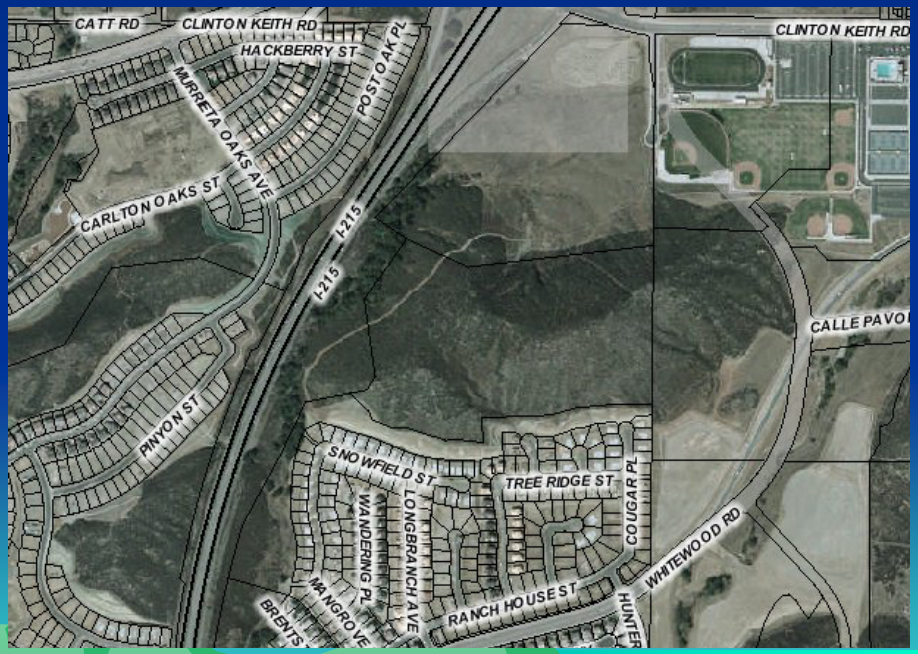
Individual behaviors – Quality and Distribution of Habitat
Social Agonistic Behaviors – Distribution and Quality
Population Structure – Demography, dispersion, dispersal
Population Persistence – Occurrence and Abundance versus Disruptions
Population genetics – Landscape level movements

Conflicts between goals need to be resolved by information

Need for Pragmatism in a complex world: natural versus unnatural habitats



Three Options to spend 40 million dollars: a wildlife bridge, a piece of an Isolated Reserve (400 of 700 acre), or a Large Wildland Reserve (3000 to 5000 acres)



Exceptionally hard edge between wildlife habitat and human habitations