

National Park Service Landscape Dynamics Monitoring: Assessing Seventy Years of Change at Tumacácori National Historical Park

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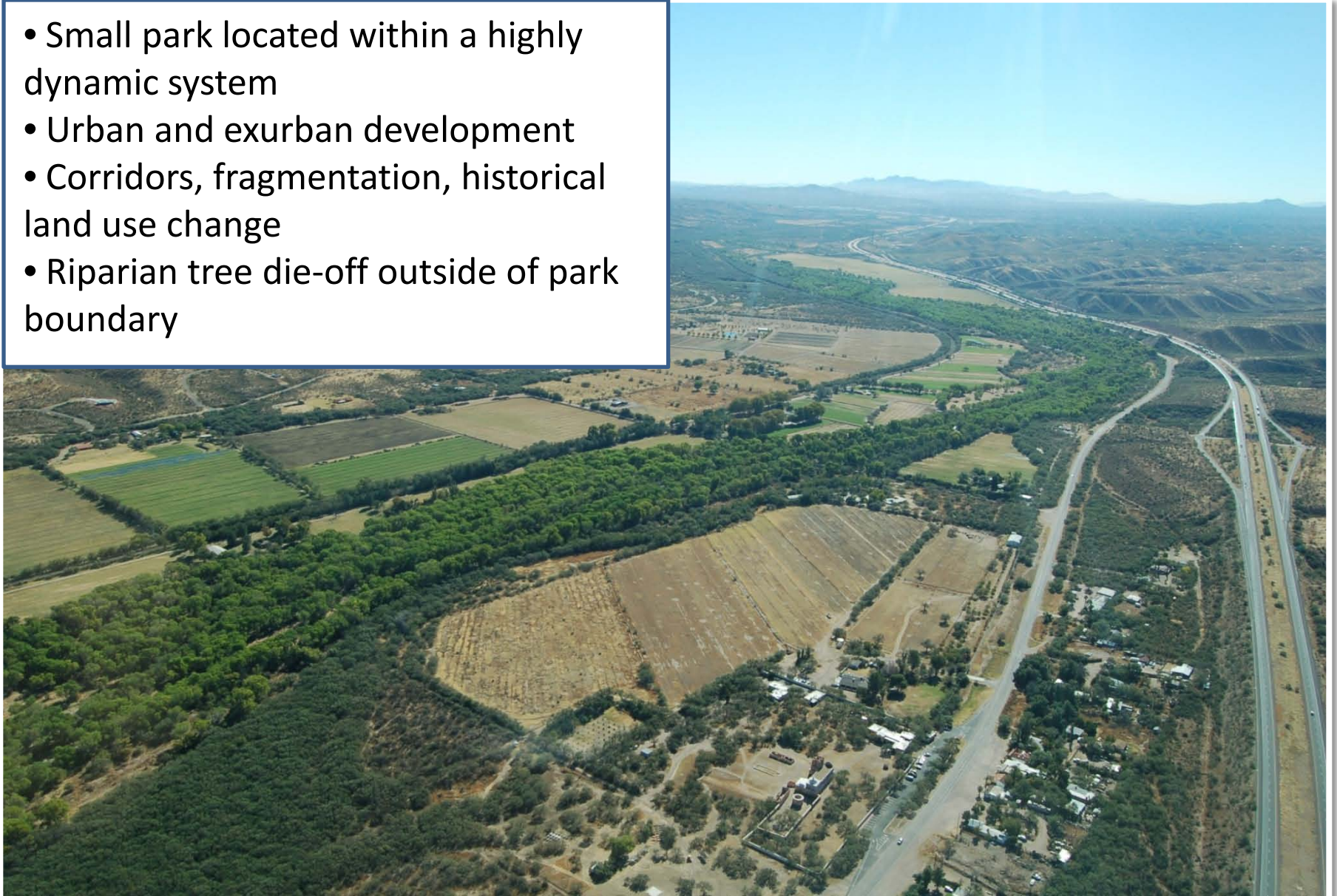
NPS Landscape Dynamics: General Monitoring Approach

- Develop maps describing current land cover in and around Sonoran Desert Network parks
- Determine change in amount and distribution of land cover types
- Link land cover change with land use and census data



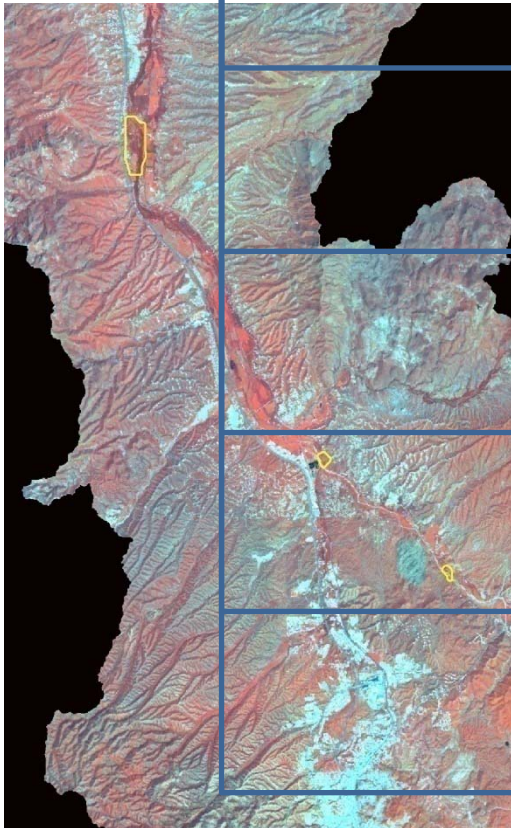
NPS Pilot Study Area: Tumacácori National Historical Park & Surrounding Upper Santa Cruz River Watershed

- Small park located within a highly dynamic system
- Urban and exurban development
- Corridors, fragmentation, historical land use change
- Riparian tree die-off outside of park boundary



Data Attributes

Landsat TM



Multispectral

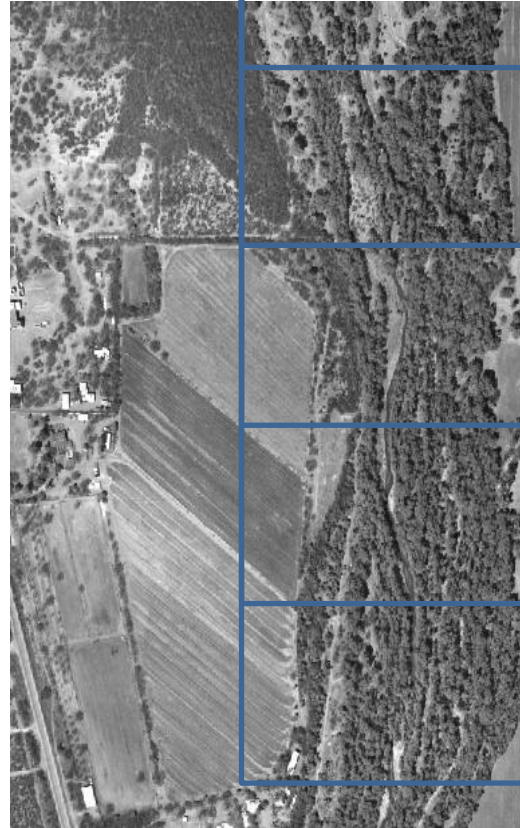
Moderate
Spatial
Resolution

Large
geographic
extent

Classification

-1980s-Present
16 day
coverage

Aerial
Photography



Color/B&W

High Spatial
Resolution

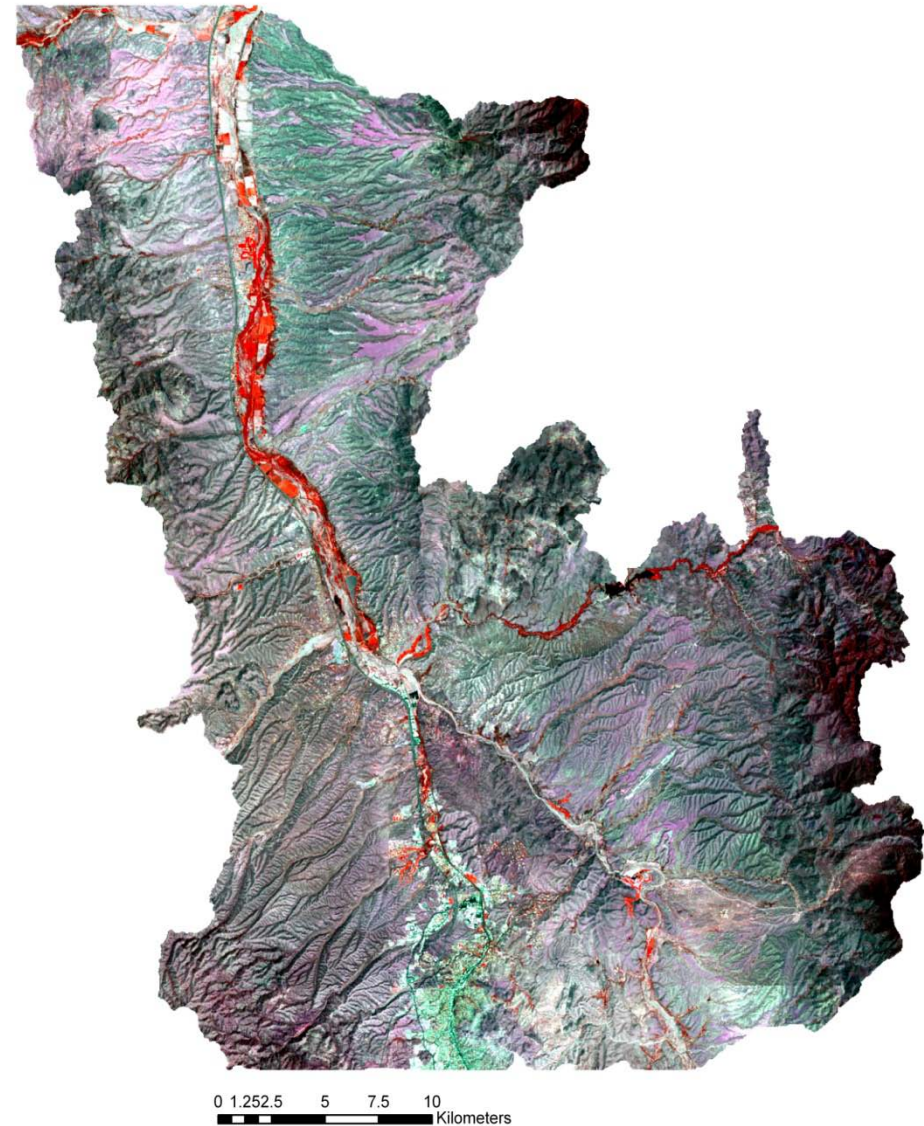
Small
geographic
extent

Mapping

-1930s-Present
- Variable
coverage

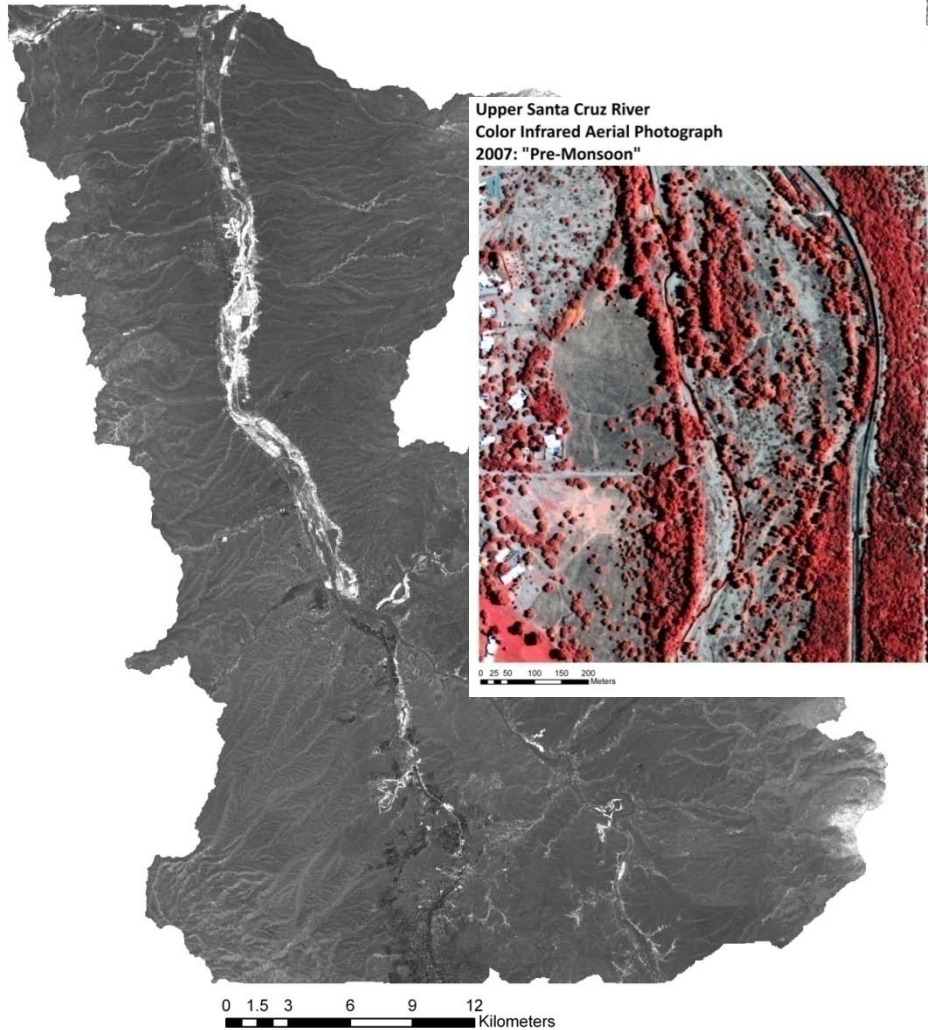
Land Cover Classification Approach

- Landsat Thematic Mapper (TM)
- Image Preprocessing
- Variable extraction: vegetation indices and spectral transformations
- Classification and Regression Tree Model (CART)
- Accuracy Assessment

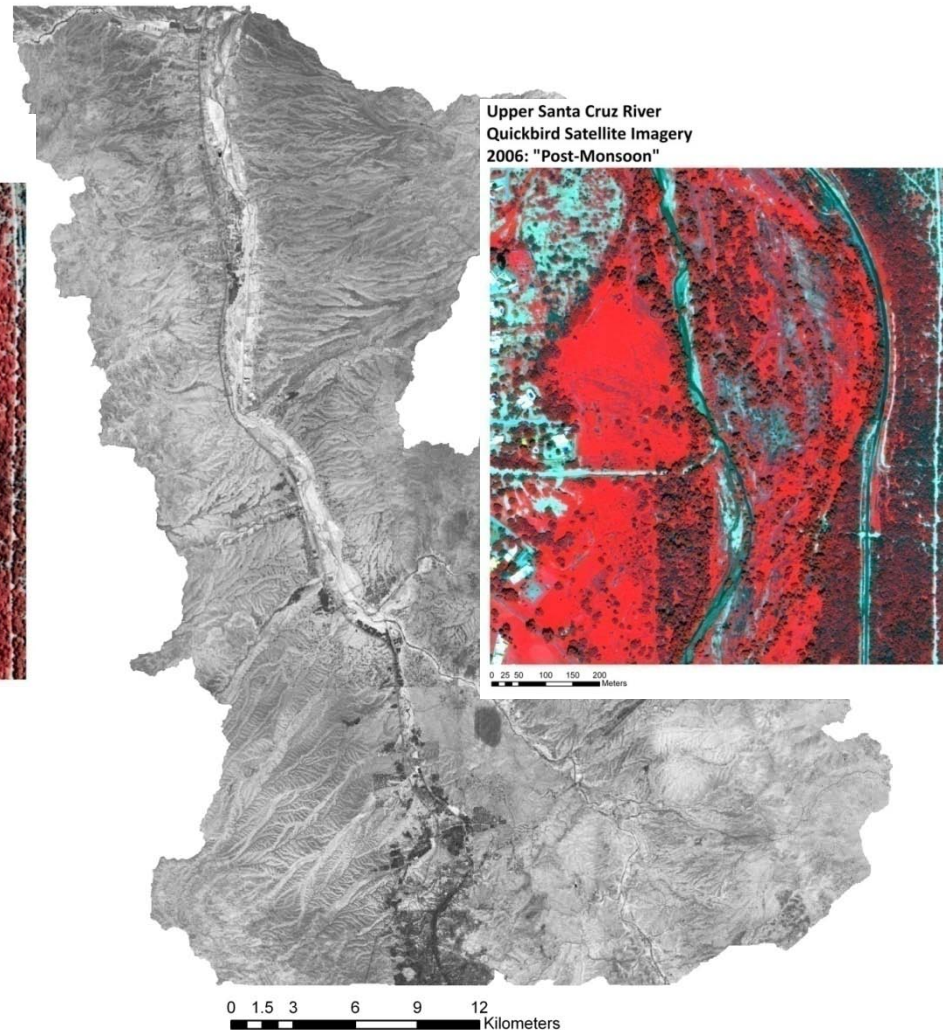


Multi-date TM Imagery: Phenological Considerations

Upper Santa Cruz River Watershed
2006 Pre-Monsoon NDVI

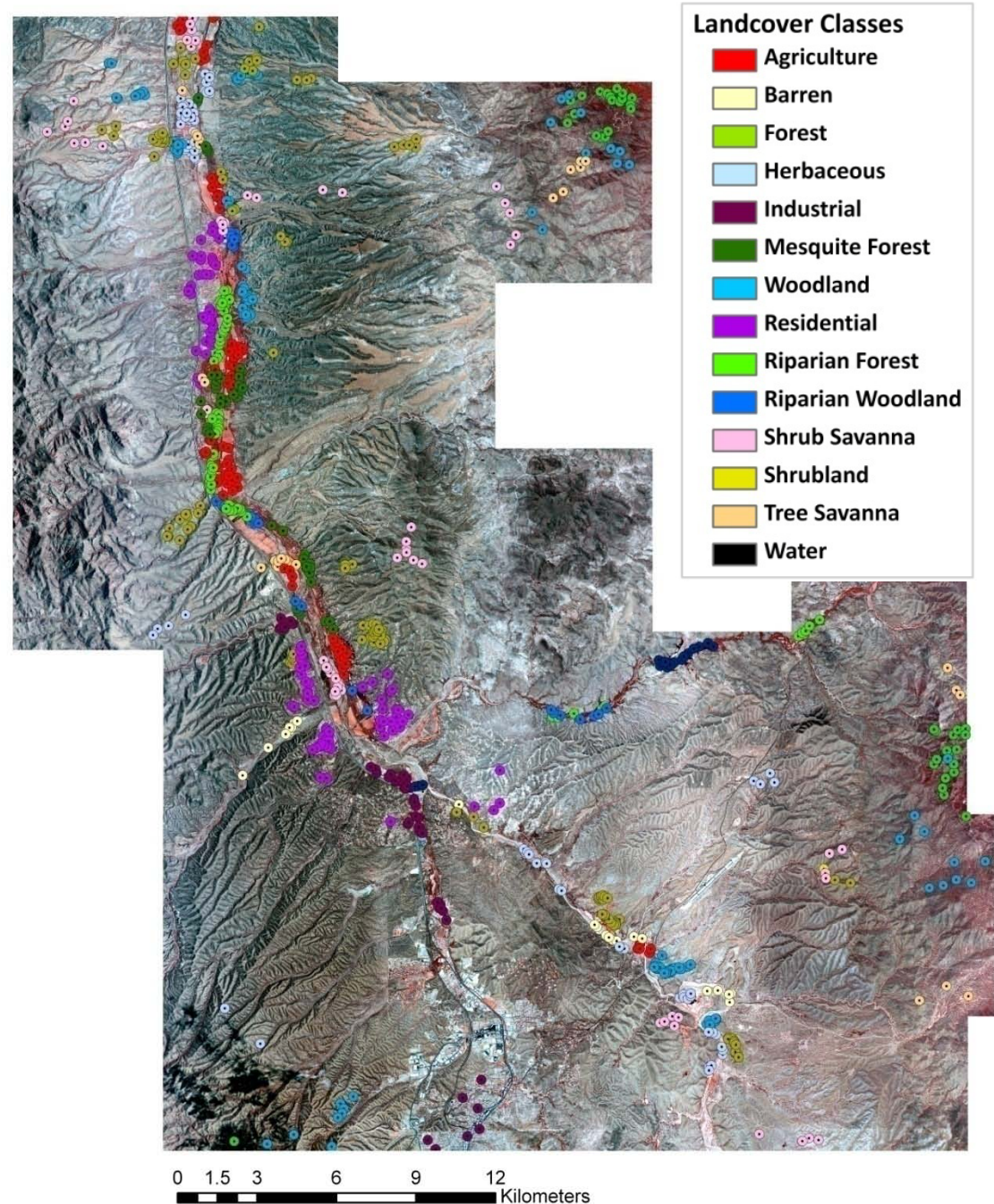


Upper Santa Cruz River Watershed
2006 Post-Monsoon NDVI



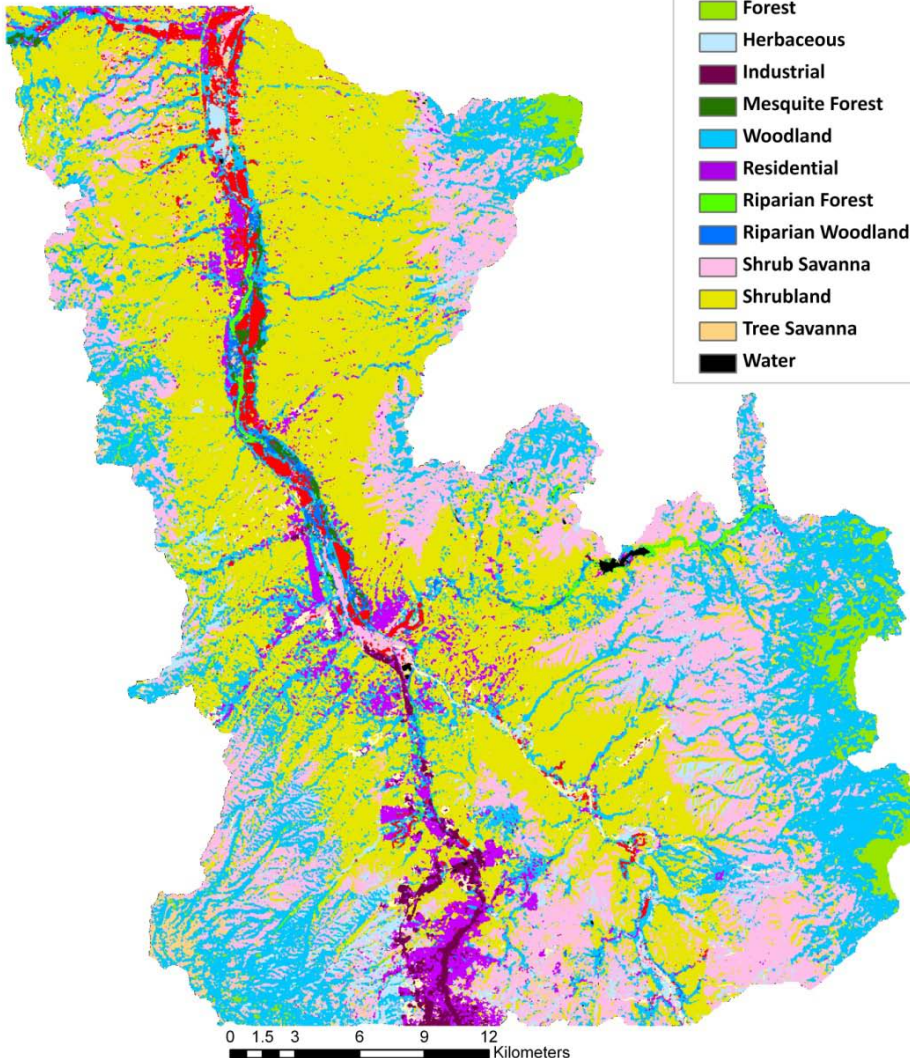
Developing a CART Classification

- Develop classification scheme
 - 14 classes
 - Physiognomic
 - Land use
- Acquire and/or create spatial data layers (attributes)
- Collect training points
- Develop CART model
- Apply model to spatial data

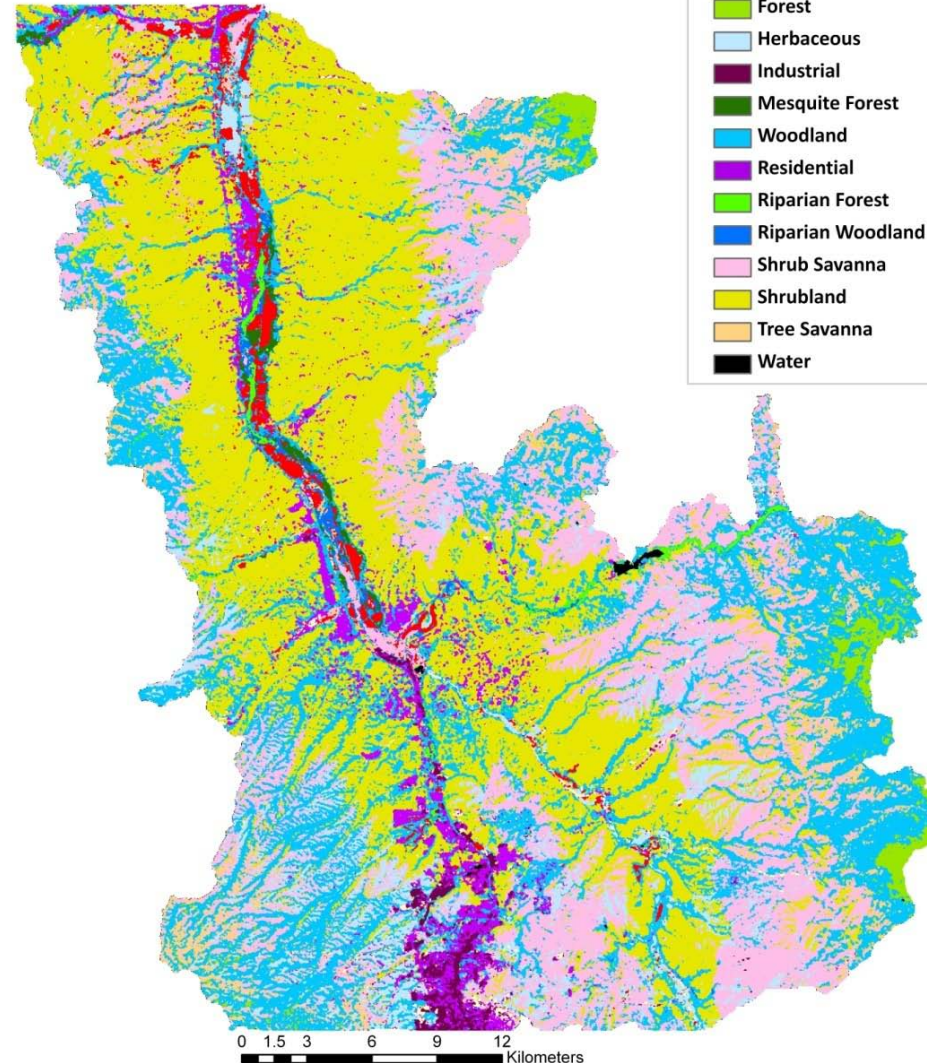


CART Land Cover

Upper Santa Cruz River Watershed
1996 Land Cover Map



Upper Santa Cruz River Watershed
2006 Land Cover Map



Map Accuracy

Overall Accuracy: 2006 (83.8%), 1996 (82.6%),
1987(85.3%)

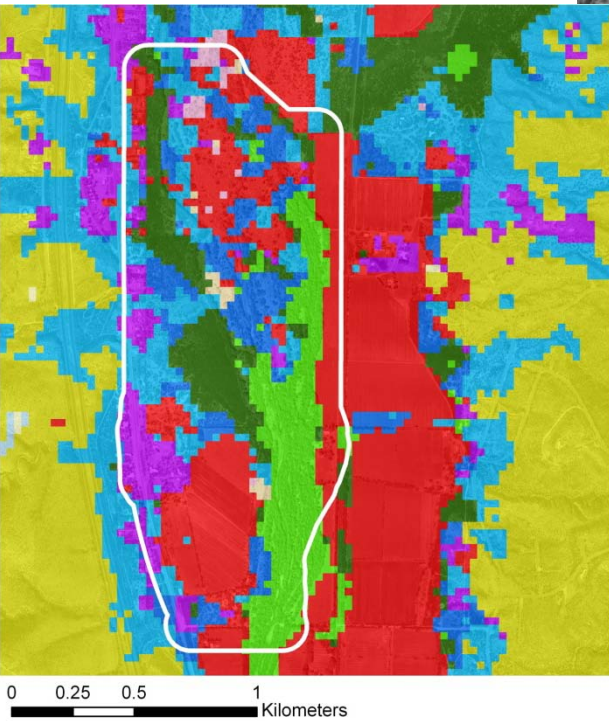
- In cases where CART accuracy is low, the class is typically confused with a functionally similar class type (e.g. residential and industrial, herbaceous and shrub savanna)

Class #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	User's Accuracy
1agriculture	20			3		1	1						2		27	0.74
2barren		13						2							15	0.87
3forest			23				1								24	0.96
4herbaceous	2			22			1				3	1	1		30	0.73
5industrial		1			27			1							29	0.93
6mesquite forest						29								1	30	0.97
7mesquite woodland			1				20	1		2	1	3	1		29	0.69
8residential		4		1	4			19						1	29	0.66
9riparian forest									25	2					27	0.93
10riparian woodland						2				26		1			29	0.90
11shrub savanna				1							25	2	2		30	0.83
12shrubland		3					1				2	23	1		30	0.77
13tree savanna				1			1					4	24		30	0.80
14water														30	30	1.00
Total	22	21	24	28	31	32	25	23	25	30	31	34	31	32	389	
Producer's Accuracy	0.91	0.62	0.96	0.79	0.87	0.91	0.80	0.83	1.00	0.87	0.81	0.68	0.77	0.94		

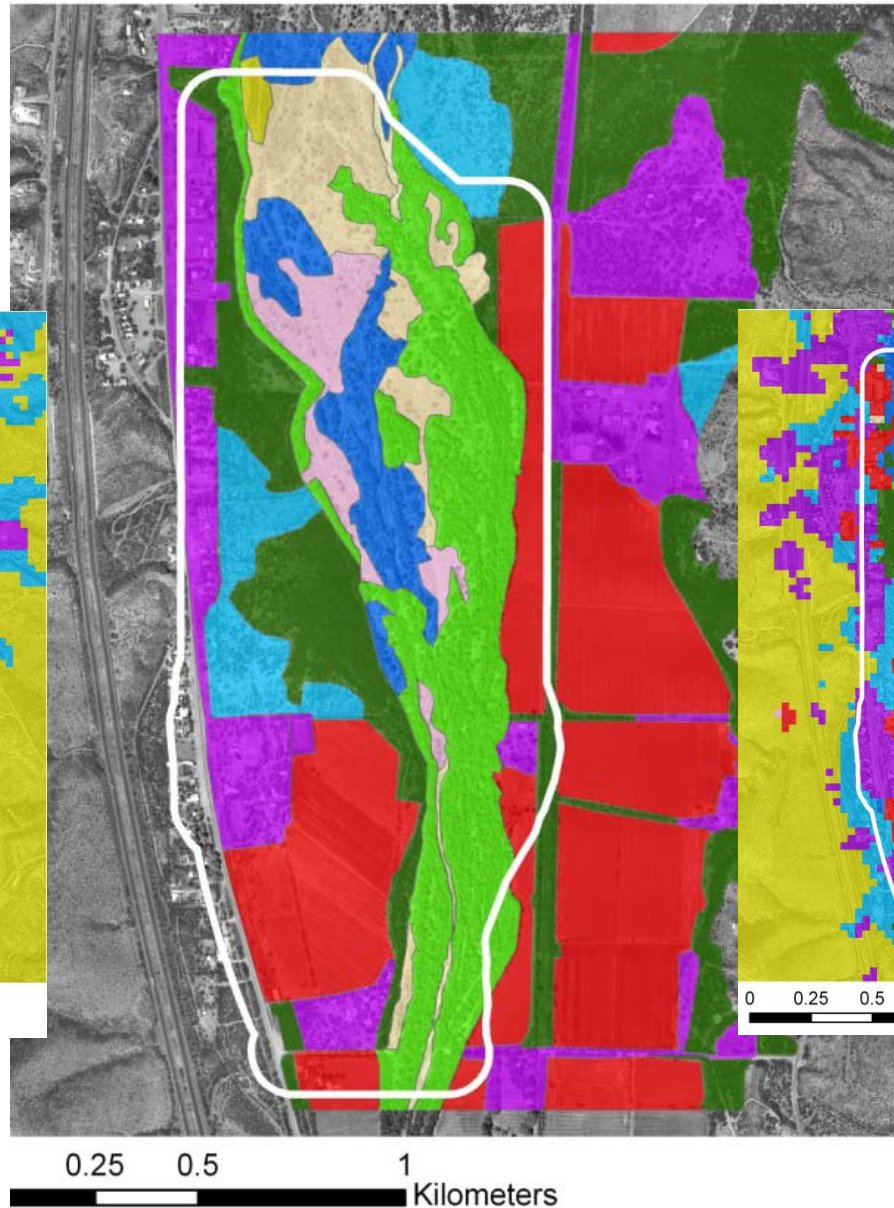
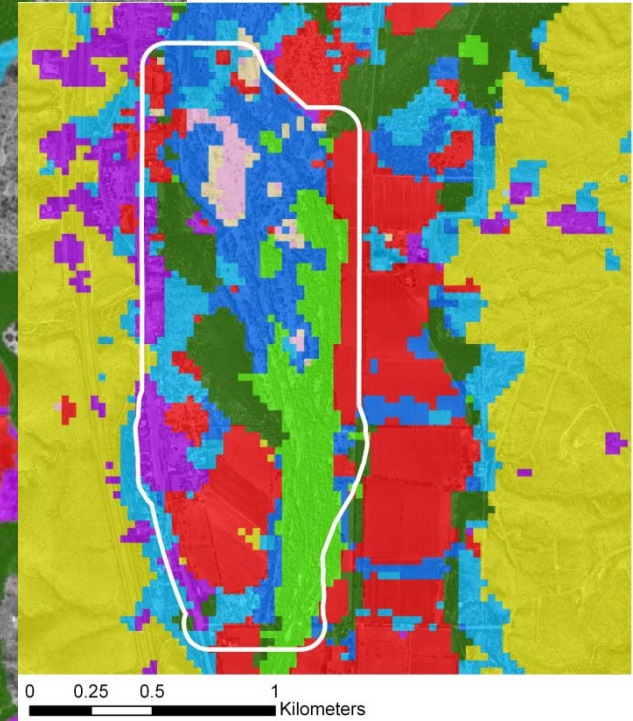
Tumacácori NHP

2006 Vegetation Map

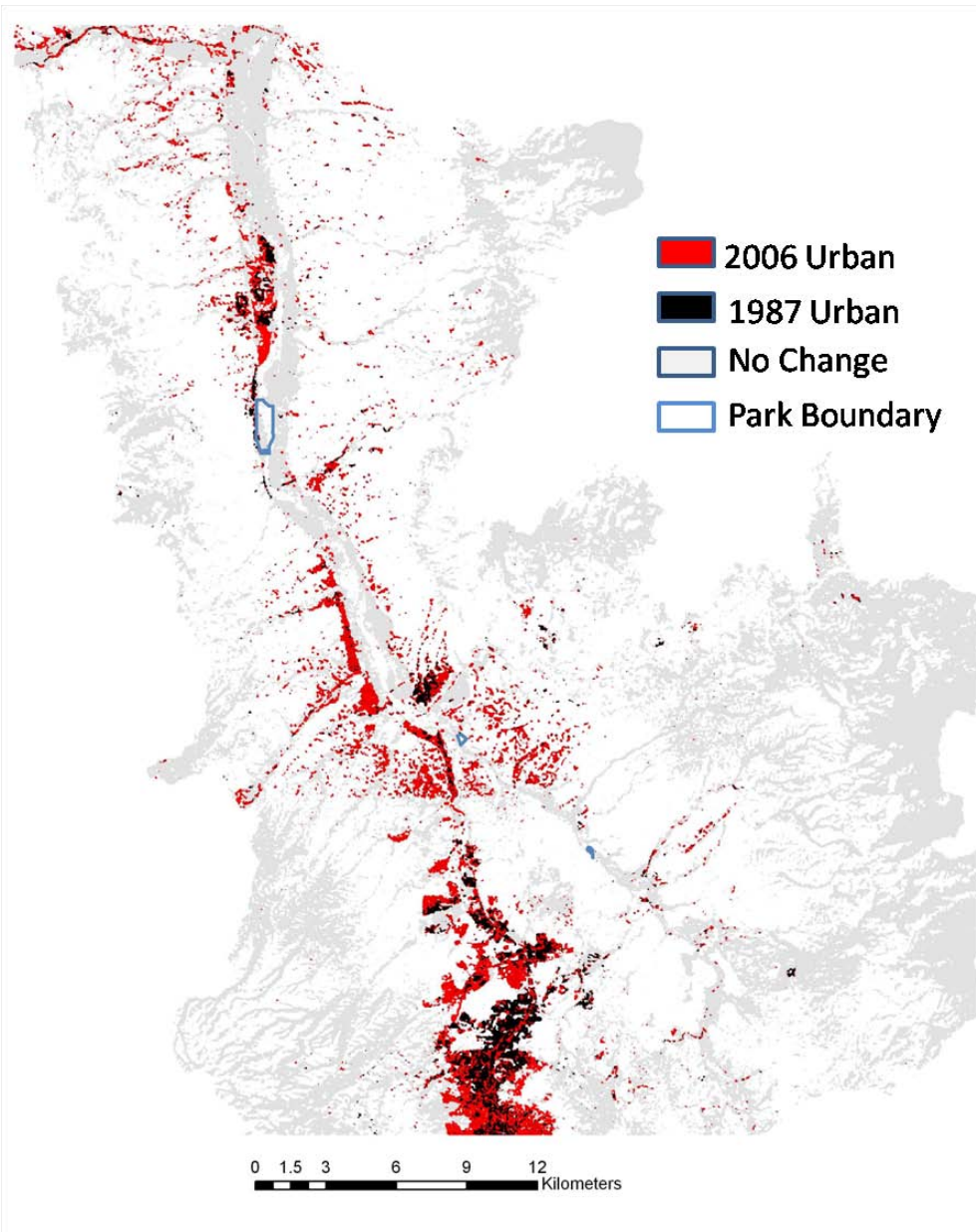
2004 CART
Classification



2006 CART
Classification

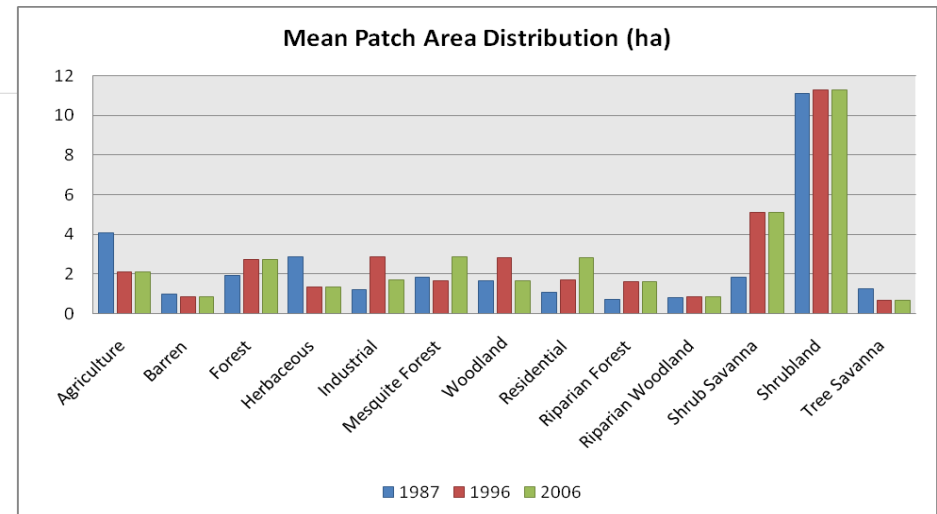
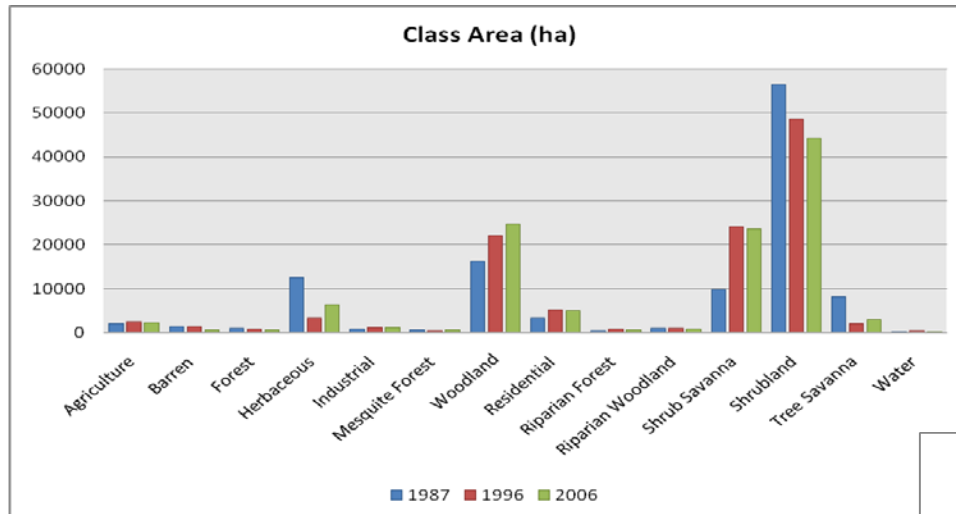


Monitoring Landscape Dynamics



Landscape Dynamics Monitoring Products:

Changes in land cover types over time (decade interval) can be analyzed using fragmentation metrics (i.e. Mean Patch Area Distribution)



Vegetation Map

GIS-based vegetation delineation

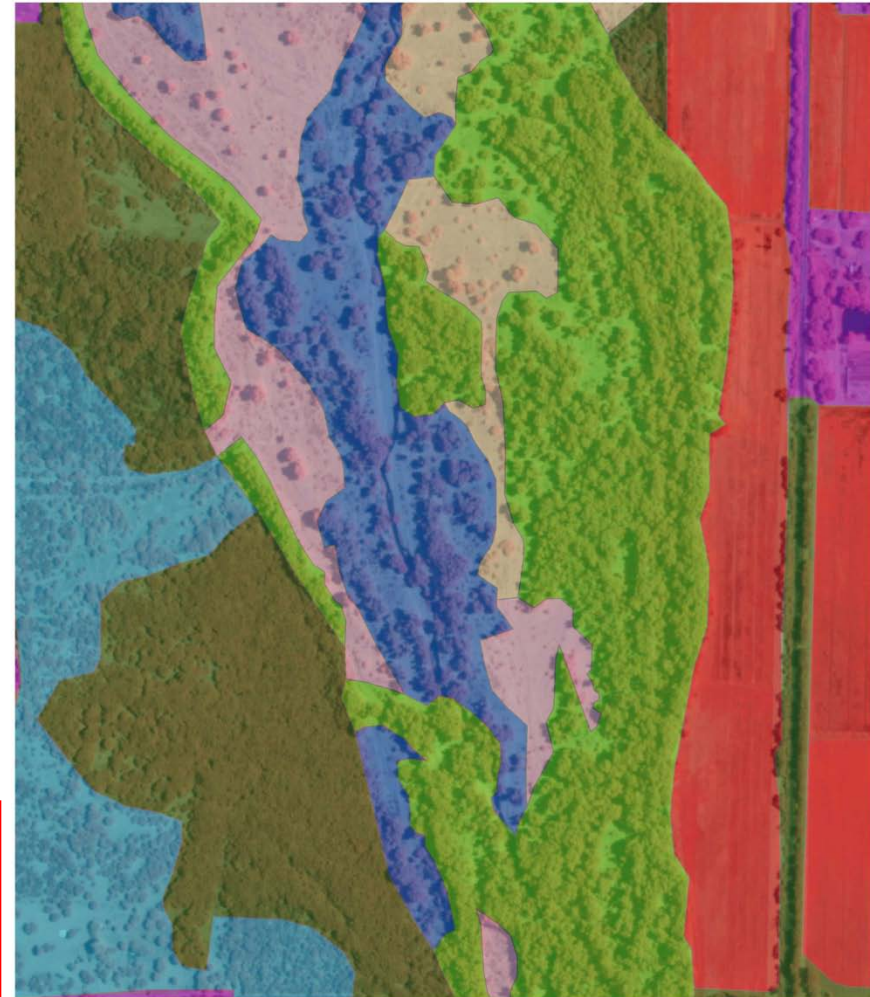
- Coarse lifeform mapping

Field Component:

- Compile and rank species data
- Develop NVC Alliance
- Modify polygon boundary
- Attribute polygon

~ 50 km of linear river mapped

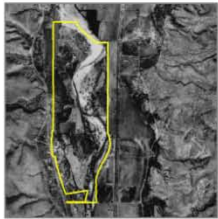
Formation
Accuracy:
Kappa = 94.1%



Historical Vegetation Mapping

Tumacácori

1936



1956



1975



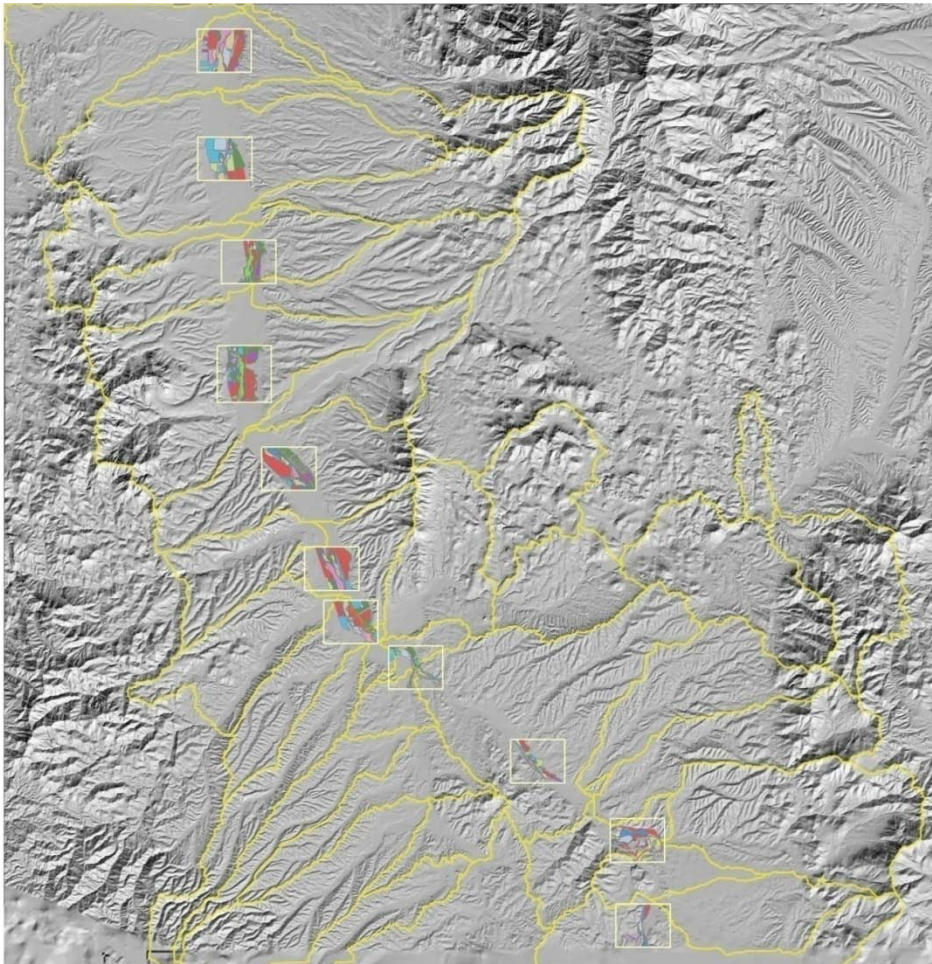
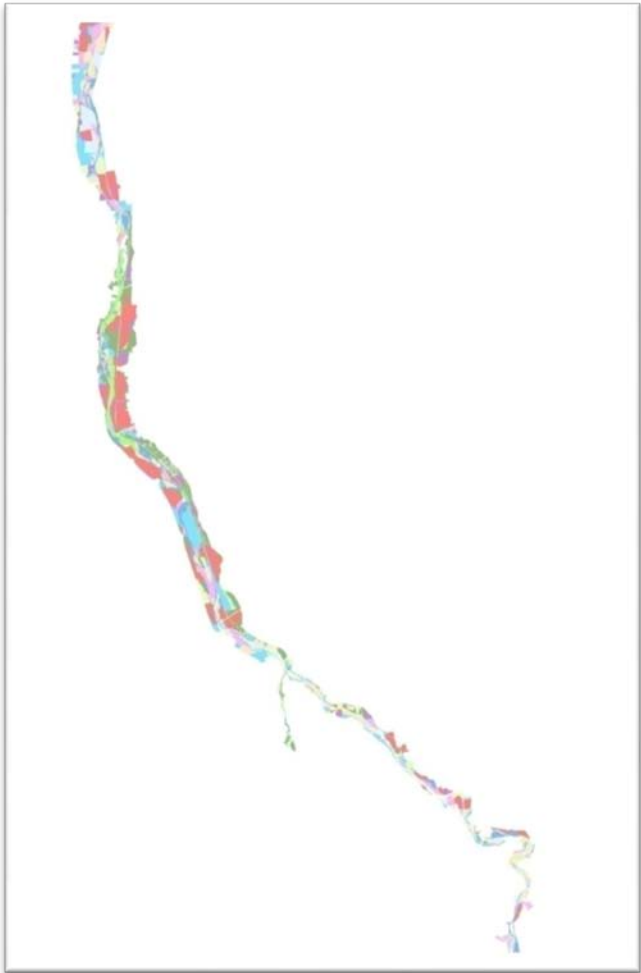
1984



1996

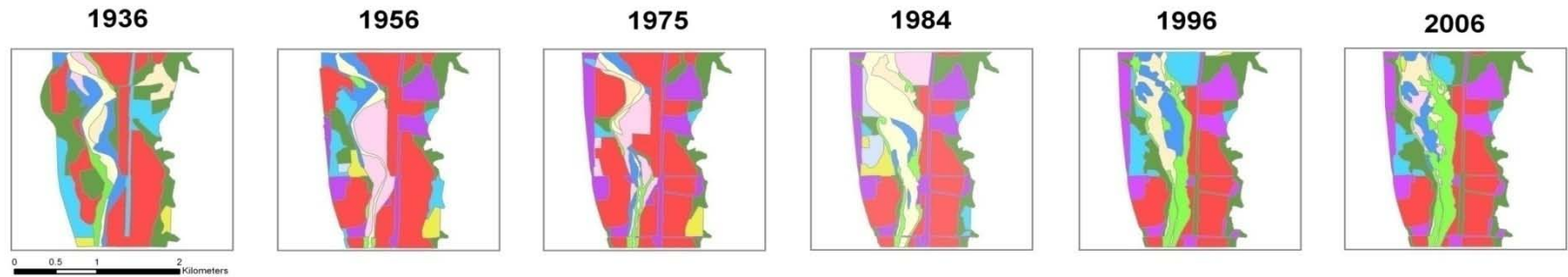


2006

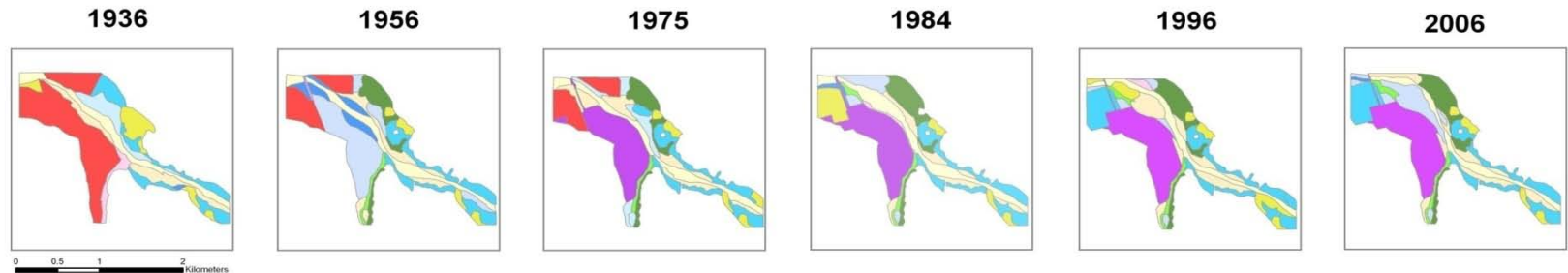


Historical Vegetation Change 1936-2006

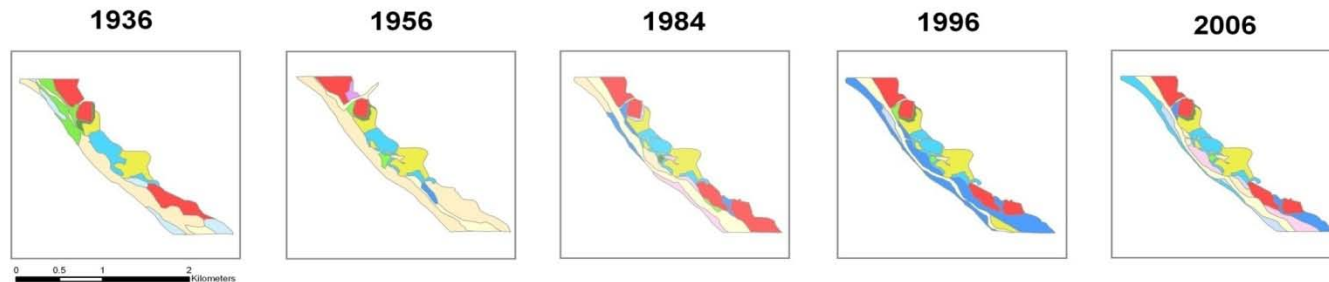
Tumacácori



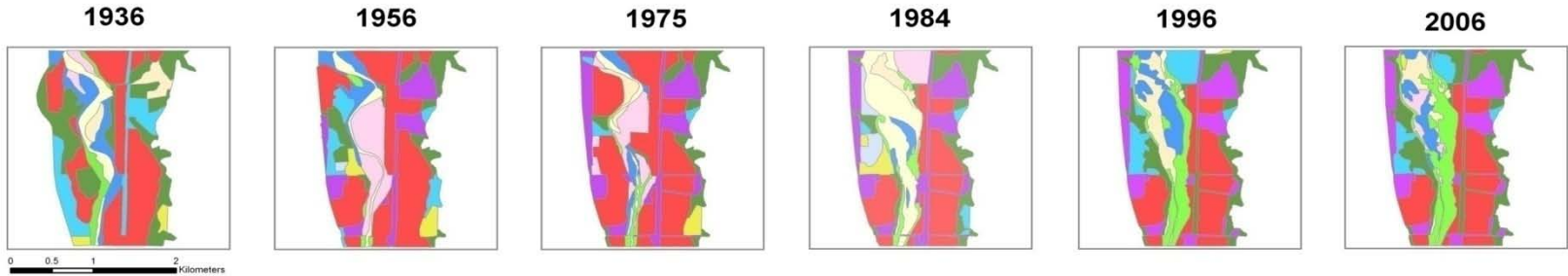
Calabazas



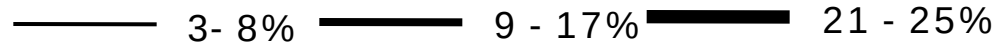
Guevavi



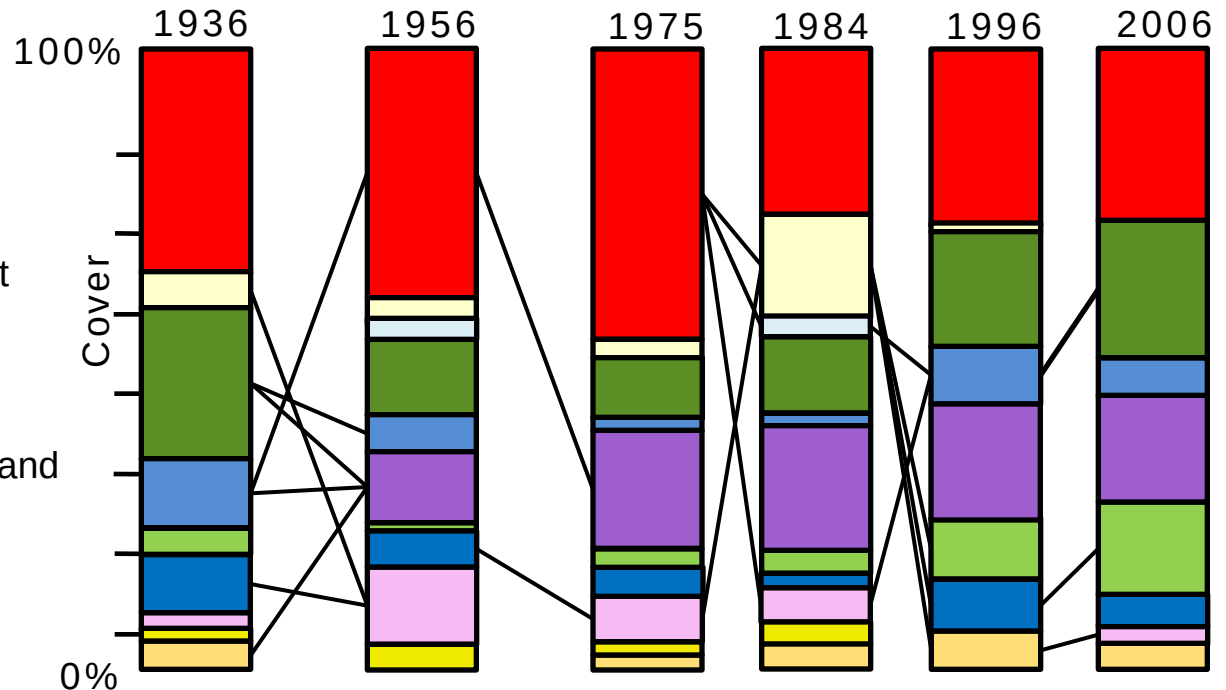
Tumacácori



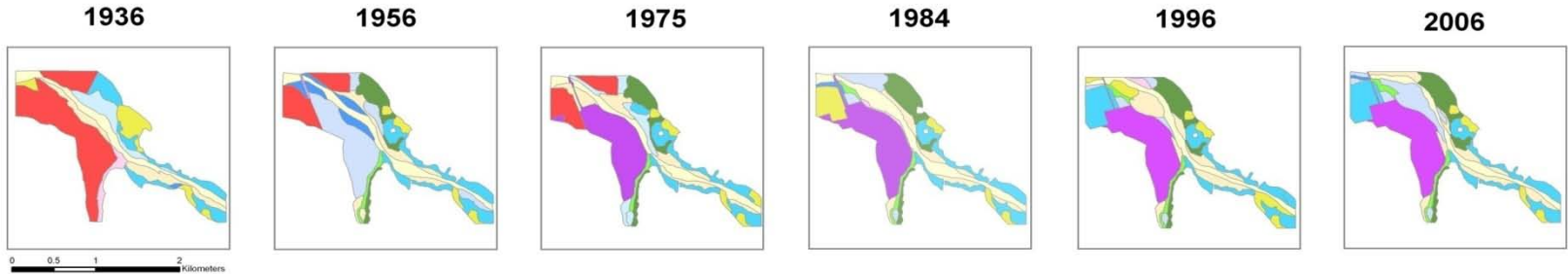
Percent Change in Landscape



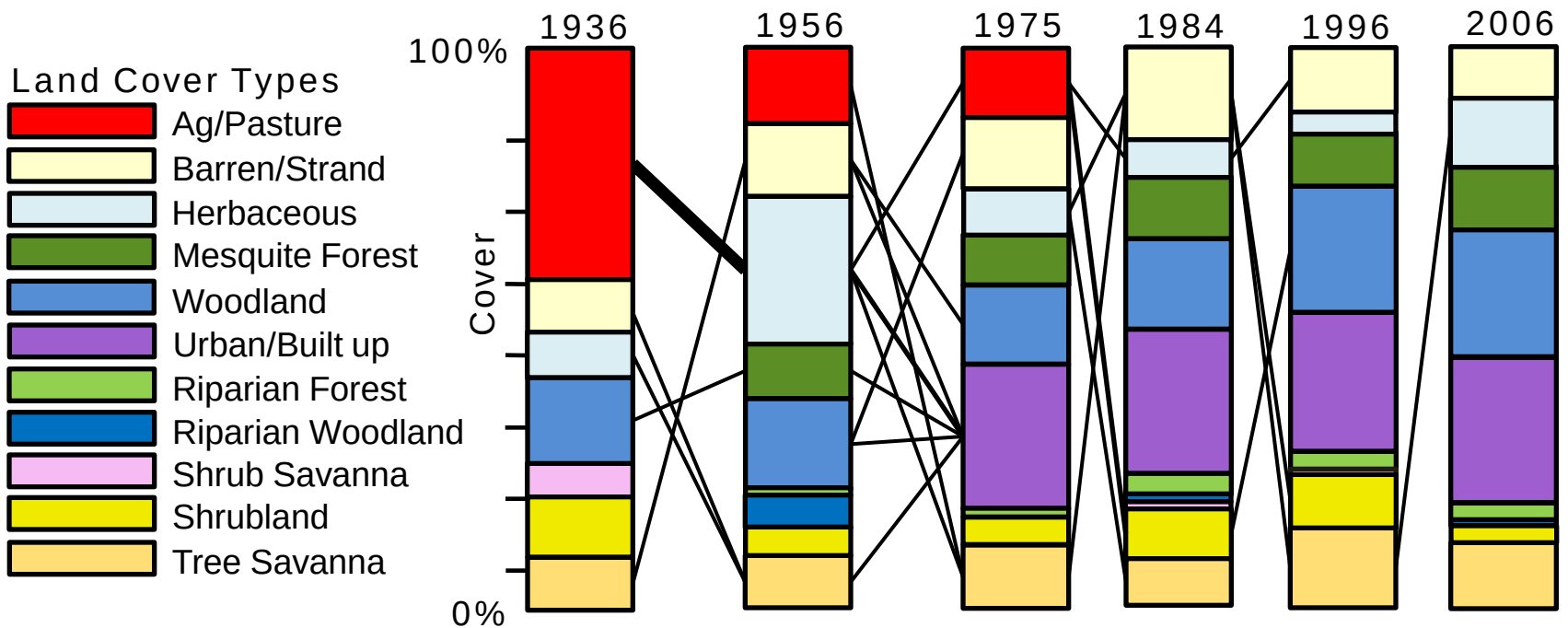
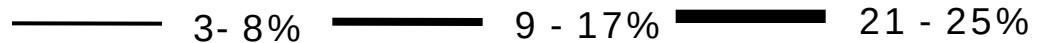
Land Cover Types



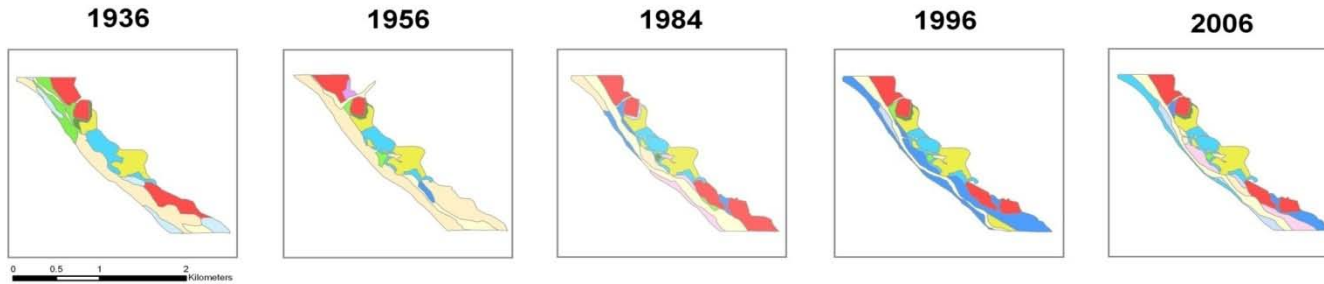
Calabazas



Percent Change in Landscape

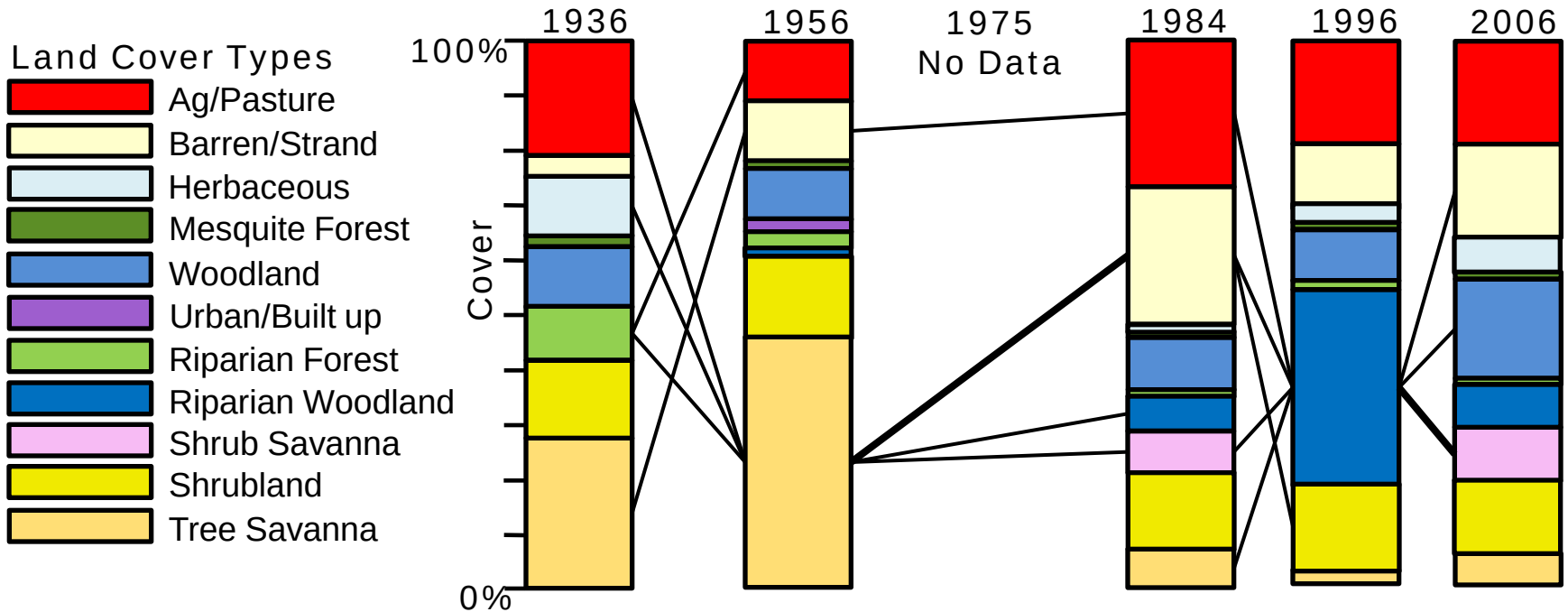


Guevavi



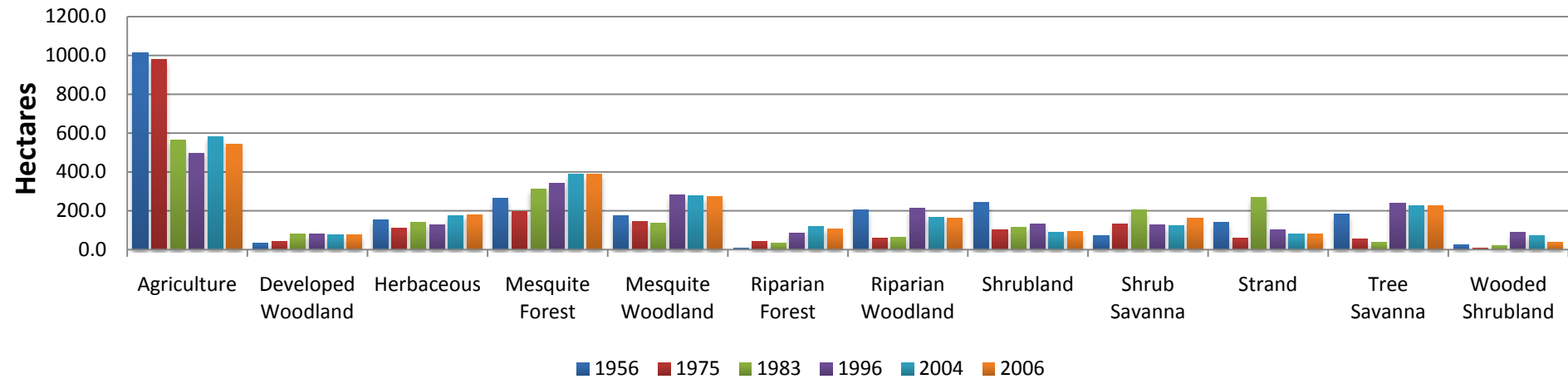
Percent Change in Landscape

———— 3 - 8% ———— 9 - 17% ————— 21 - 25%



Landscape Change

Class Area



Number of Patches

