



Developing a High-Resolution Binational
Vegetation Map of the Santa Cruz River
Riparian Corridor and Surrounding Watershed
Cynthia Wallace USGS-WGSC

Development of a multi-temporal (1979-
2009) land cover data set for the Santa Cruz
Watershed
Miguel Villarreal UA Research Associate

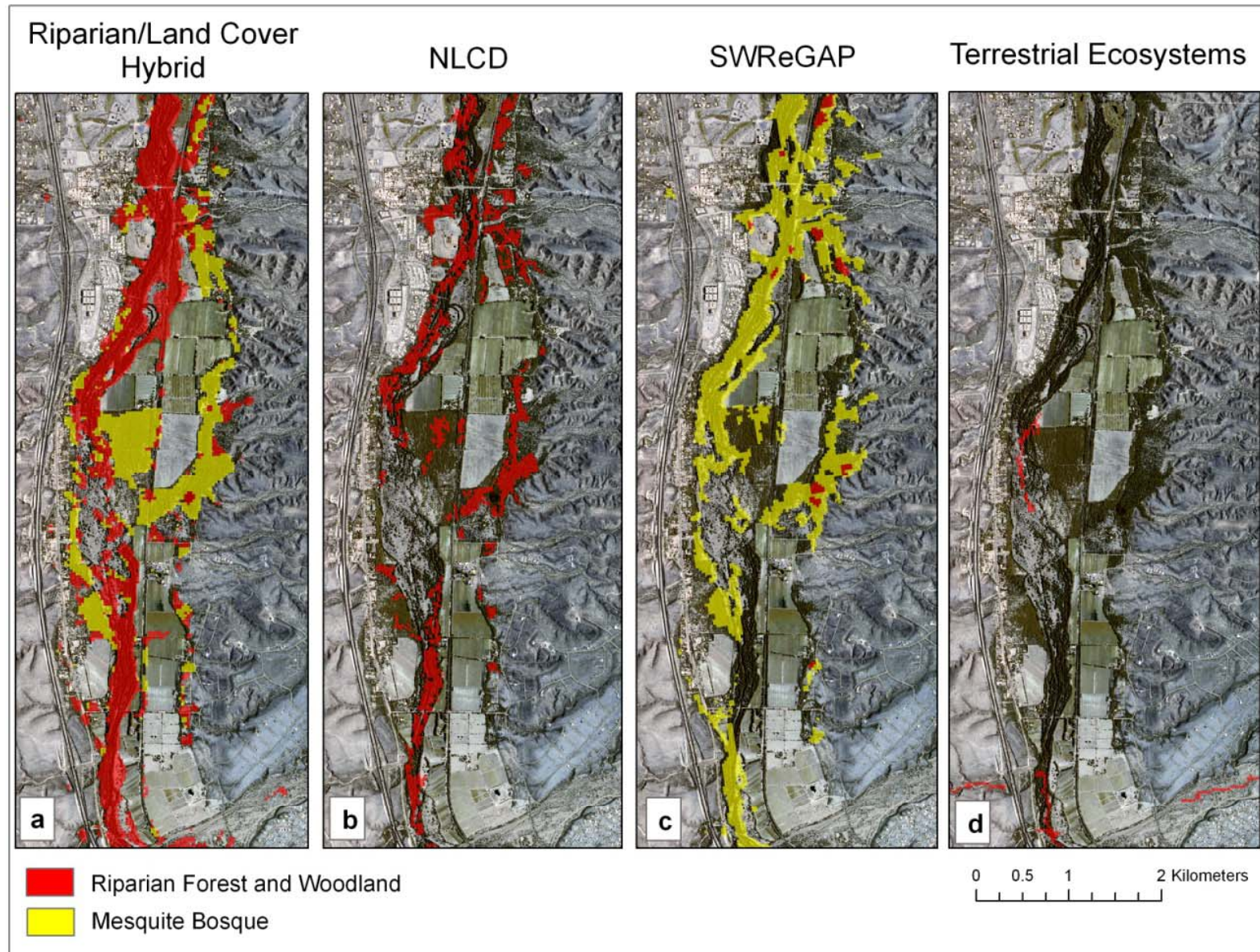


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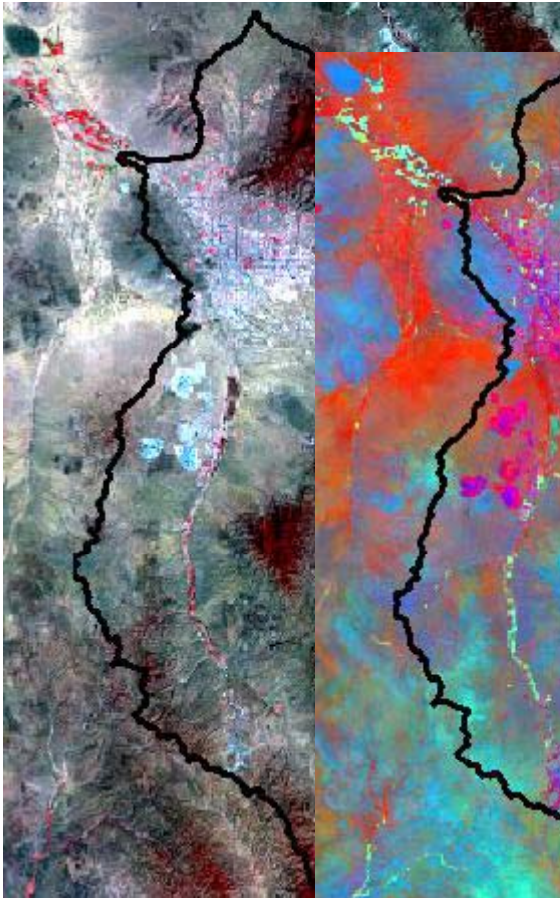
Development of a multi-temporal (1979-
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Miguel Villarreal UA Post-Doc

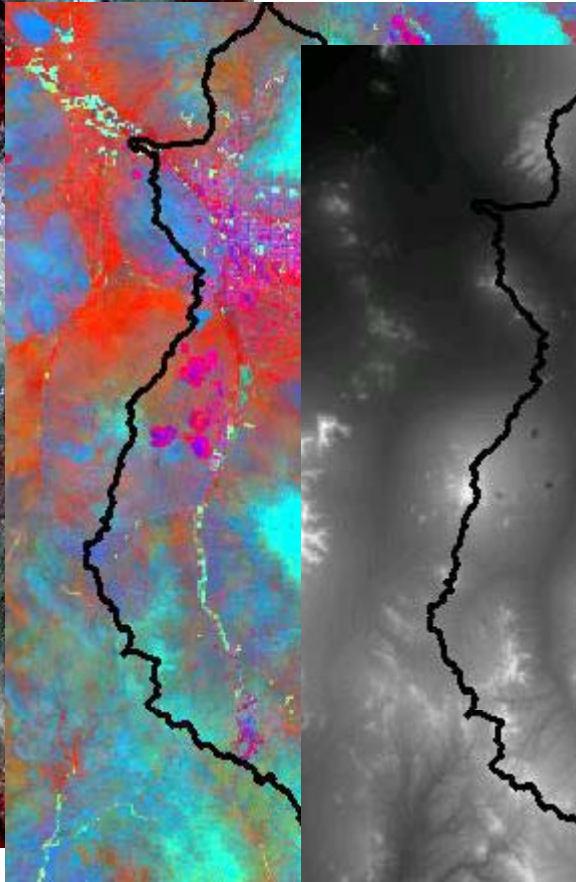


Comparison of mapped riparian classes. The Riparian/Land Cover hybrid Villarreal developed for NPS has a map accuracy of 83-95% for individual riparian classes.

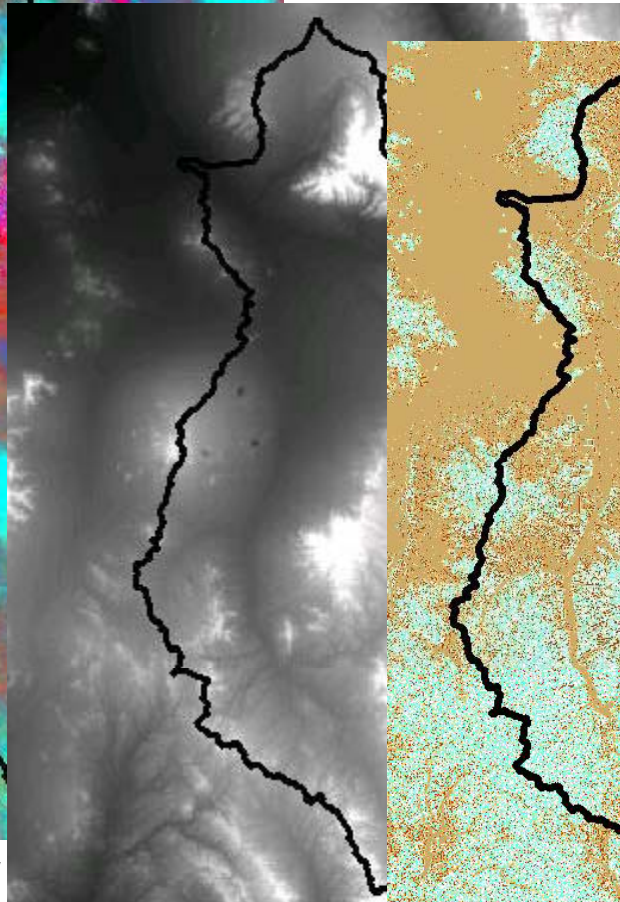
Hybrid Model



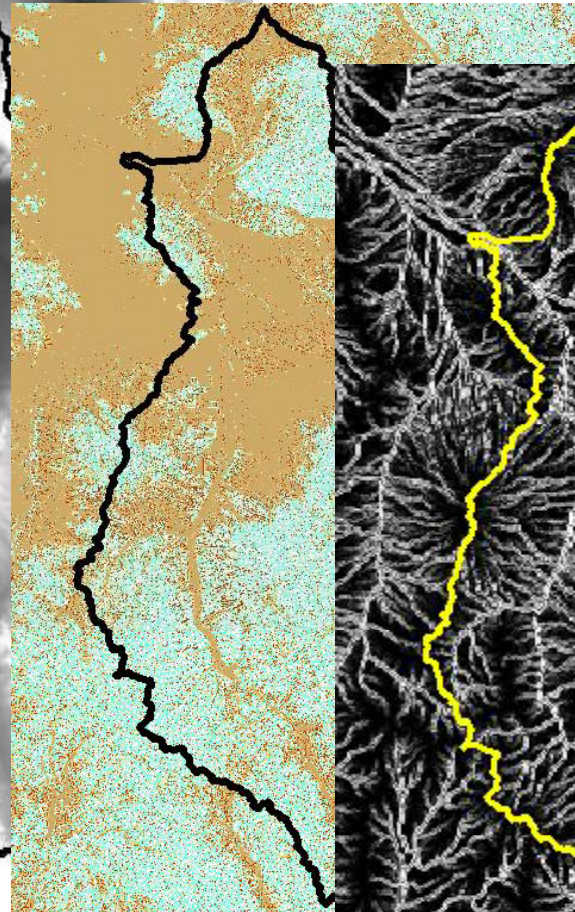
Landsat Spring,
Summer, Fall;
NDVI Texture



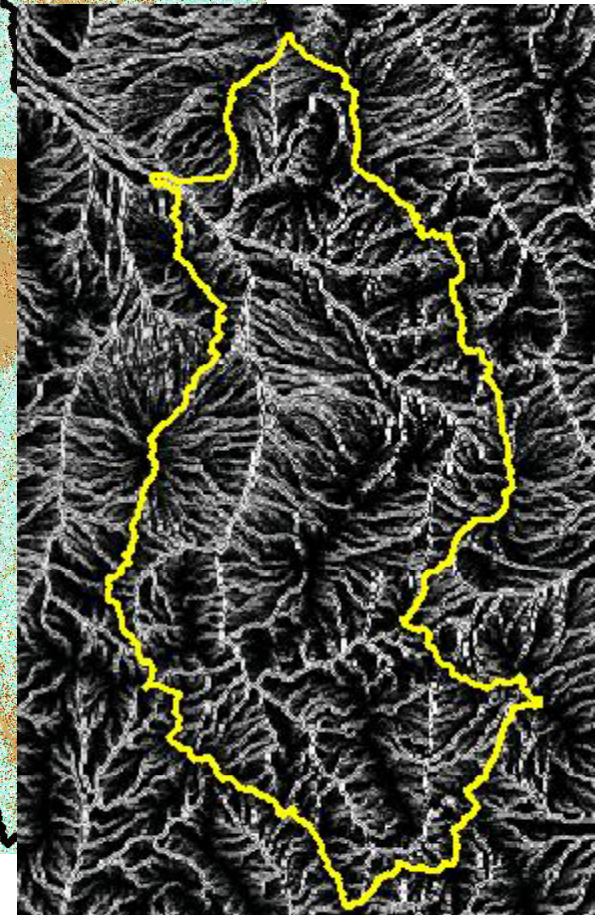
Tasseled Cap BGW



DEM, Aspect, Slope

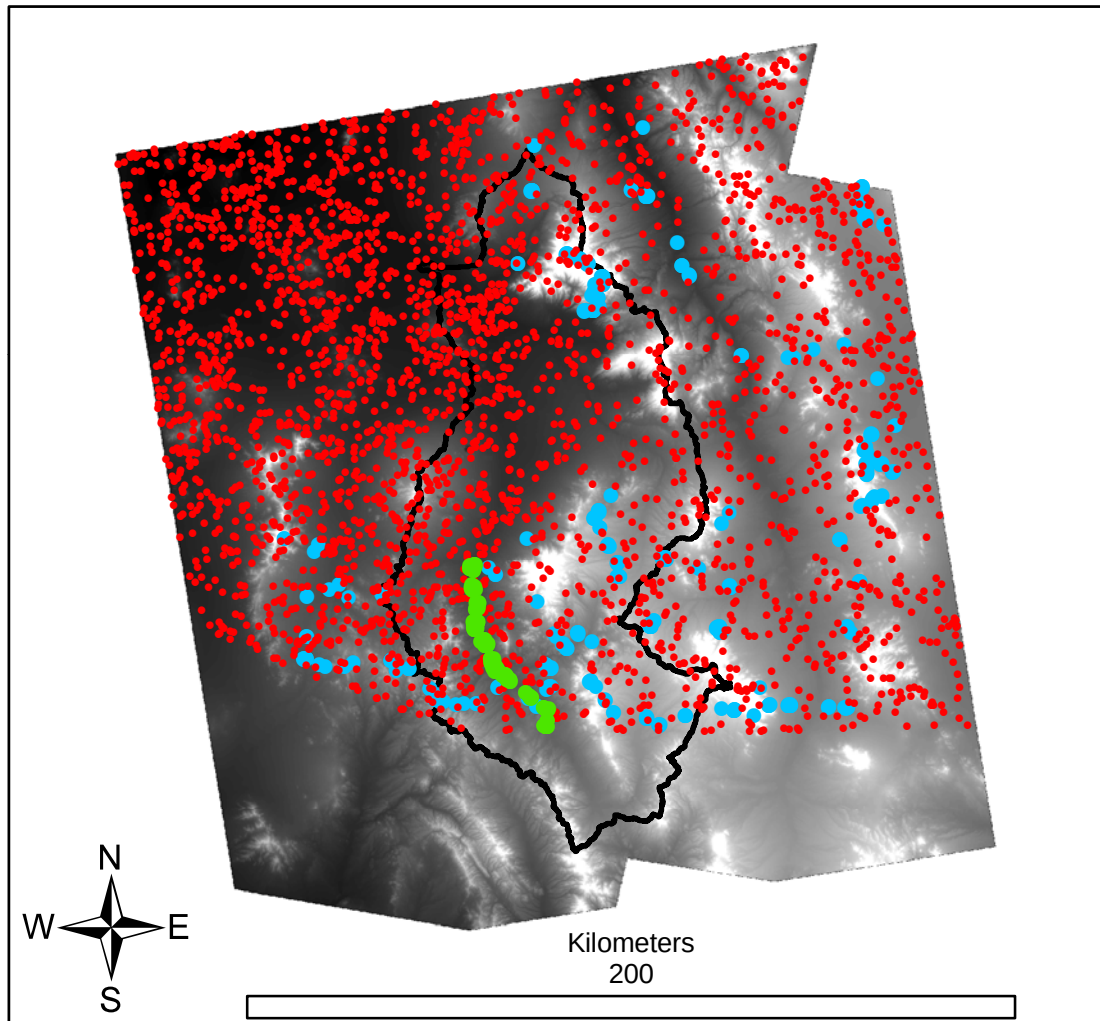


Landform



Flow Accumulation and Derivative

Hybrid Model



Training Data

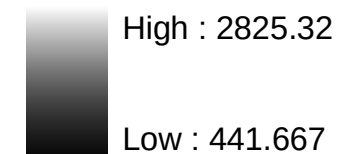
Explanation

Training Data Source

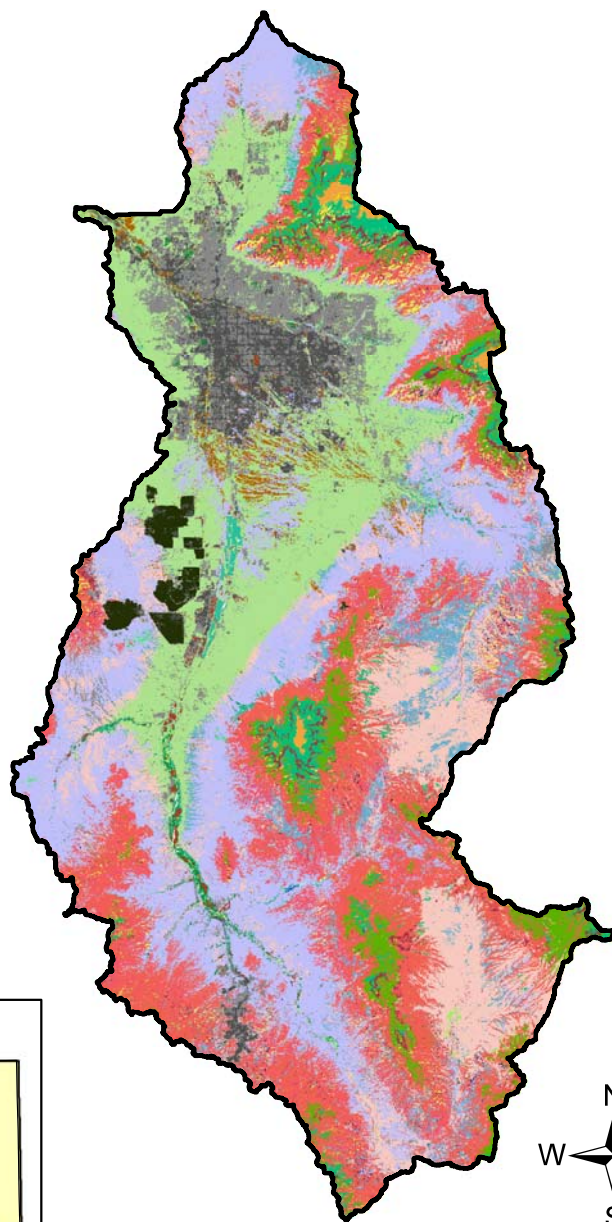
- NM-GAP team
- SWReGAP core areas
- Santa Cruz riparian map (Villarreal)

DEM background

Meters



 Santa Cruz Watershed



Kilometers
100

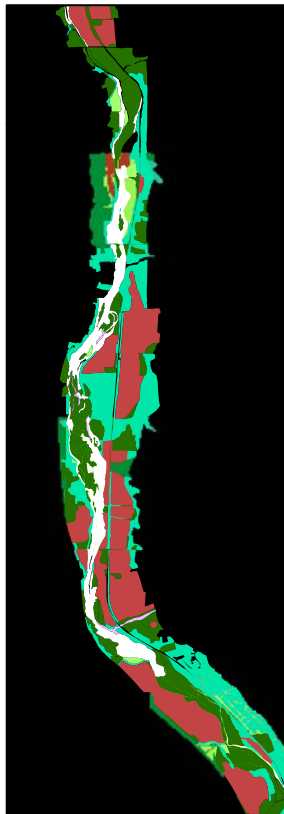


- Agriculture
- Apacherian-Chihuahuan Mesquite Upland Scrub
- Apacherian-Chihuahuan Piedmont Semi-Desert Grassland
- Barren Lands, Non-specific
- Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub
- Chihuahuan Mixed Salt Desert Scrub
- Chihuahuan Sandy Plains Semi-Desert Grassland
- Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub
- Chihuahuan Succulent Desert Scrub
- Chihuahuan-Sonoran Desert Bottomland and Swale Grassland
- Colorado Plateau Mixed Bedrock Canyon and Tableland
- ★ Developed, Medium - High Intensity
- ★ Developed, Open Space - Low Intensity
- Madrean Encinal
- Madrean Juniper Savanna
- Madrean Pine-Oak Forest and Woodland
- Madrean Pinyon-Juniper Woodland
- Madrean Upper Montane Conifer-Oak Forest and Woodland
- Mogollon Chaparral
- North American Arid West Emergent Marsh
- North American Warm Desert Bedrock Cliff and Outcrop
- North American Warm Desert Lower Montane Riparian Woodland and Shrubland
- North American Warm Desert Pavement
- North American Warm Desert Riparian Mesquite Bosque
- North American Warm Desert Riparian Woodland and Shrubland
- North American Warm Desert Volcanic Rockland
- North American Warm Desert Wash
- Open Water
- ★ Recently Mined or Quarried
- Riparian Forest
- Rocky Mountain Aspen Forest and Woodland
- Rocky Mountain Ponderosa Pine Woodland
- Sonora-Mojave Creosotebush-White Bursage Desert Scrub
- Sonoran Mid-Elevation Desert Scrub
- Sonoran Paloverde-Mixed Cacti Desert Scrub

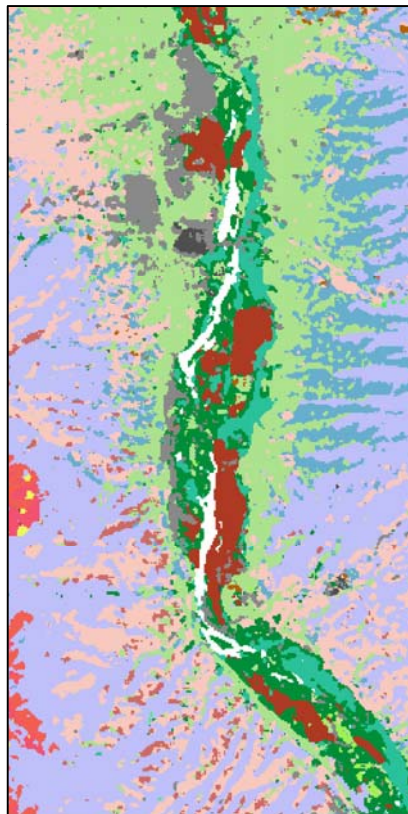


Hybrid Model

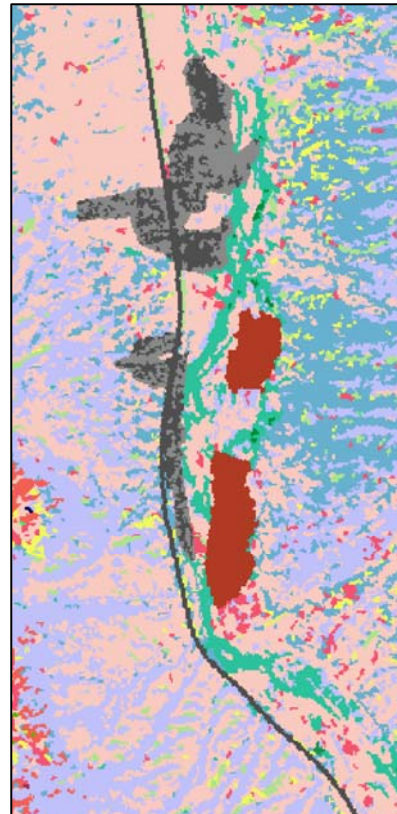
**Santa Cruz
River map
(Villarreal)**



**Santa Cruz
Watershed Map
(this study)**



**SWReGAP
(original)**

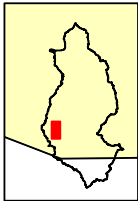


Explanation

- Agriculture ★
- Apacherian-Chihuahuan Mesquite Upland Scrub
- Apacherian-Chihuahuan Piedmont Semi-Desert Grassland
- Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub
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- Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub
- Developed, Medium - High Intensity
- Developed, Open Space - Low Intensity
- Madrean Encinal
- North American Warm Desert Bedrock Cliff and Outcrop
- North American Warm Desert Riparian Mesquite Bosque ★
- North American Warm Desert Riparian Woodland and Shrubland ★
- Riparian Forest ★
- Sonoran Mid-Elevation Desert Scrub
- Sonoran Paloverde-Mixed Cacti Desert Scrub

★ Classes visible in Santa Cruz River Map (on left)

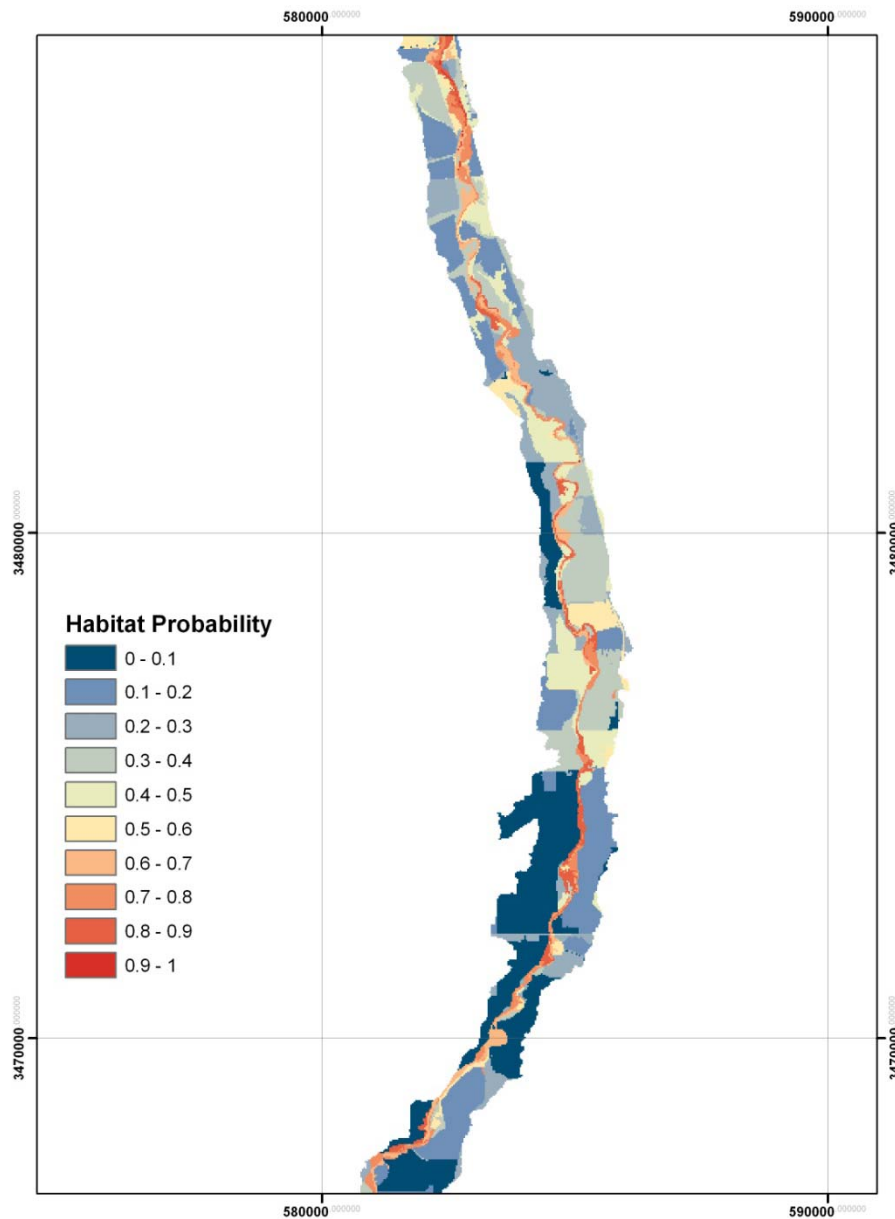
Location



5

Kilometers

Habitat Modeling: YBCU at San Pedro



Detailed vegetation maps are an important input to the type of habitat modeling shown here for the San Pedro. The probability map was developed using Maxent and including vegetation, landuse, patch statistics and topographic derivatives.





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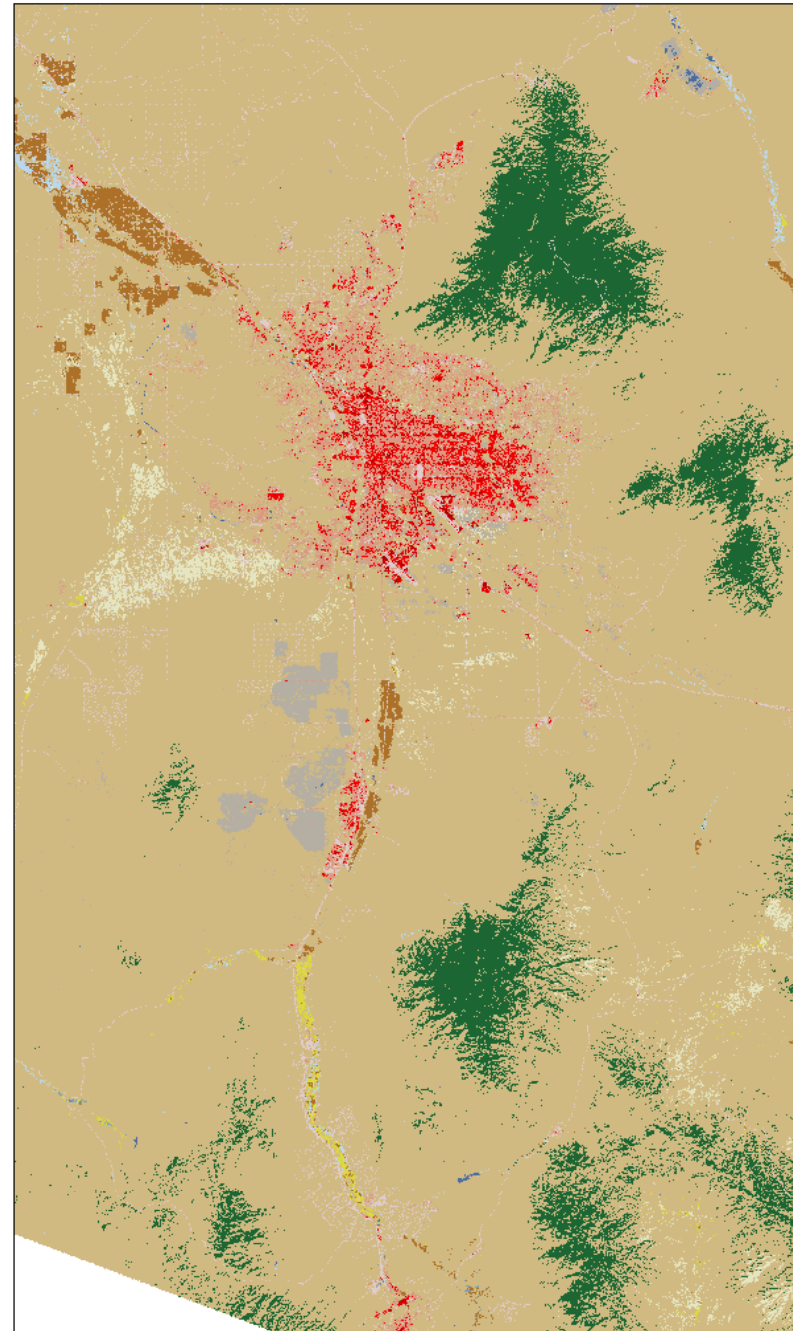
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NLCD 2001 Land Cover Classification Legend

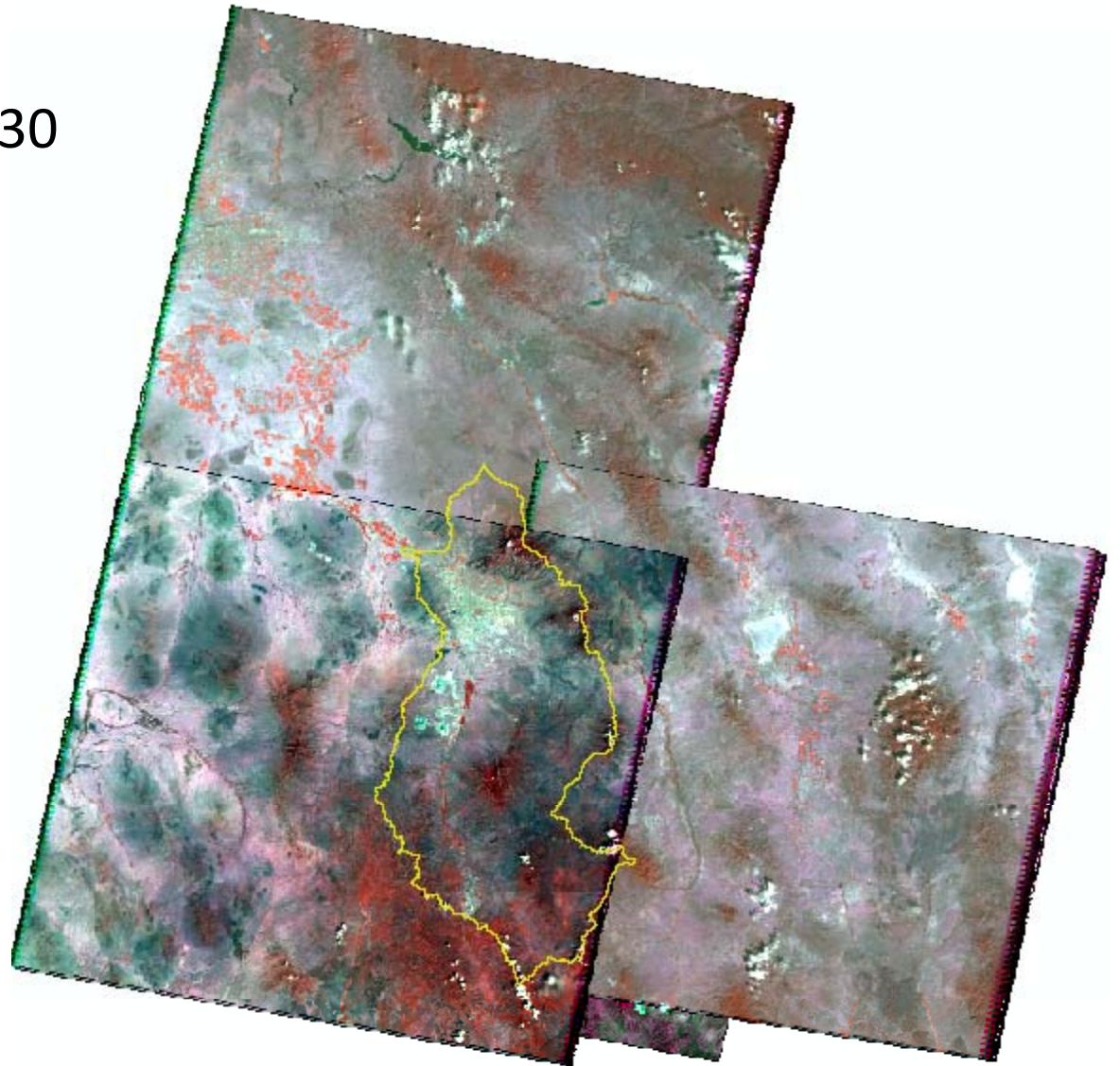
	11 Open Water
	12 Perennial Ice/Snow
	21 Developed, Open Space
	22 Developed, Low Intensity
	23 Developed, Medium Intensity
	24 Developed, High Intensity
	31 Barren Land
	41 Deciduous Forest
	42 Evergreen Forest
	43 Mixed Forest
	51 Dwarf Scrub*
	52 Shrub/ Scrub
	71 Grassland/ Herbaceous
	72 Sedge/ Herbaceous *
	74 Moss *
	81 Pasture Hay
	82 Cultivated Crops
	90 Woody Wetlands
	95 Emergent Herbaceous Wetlands

* Alaska Only

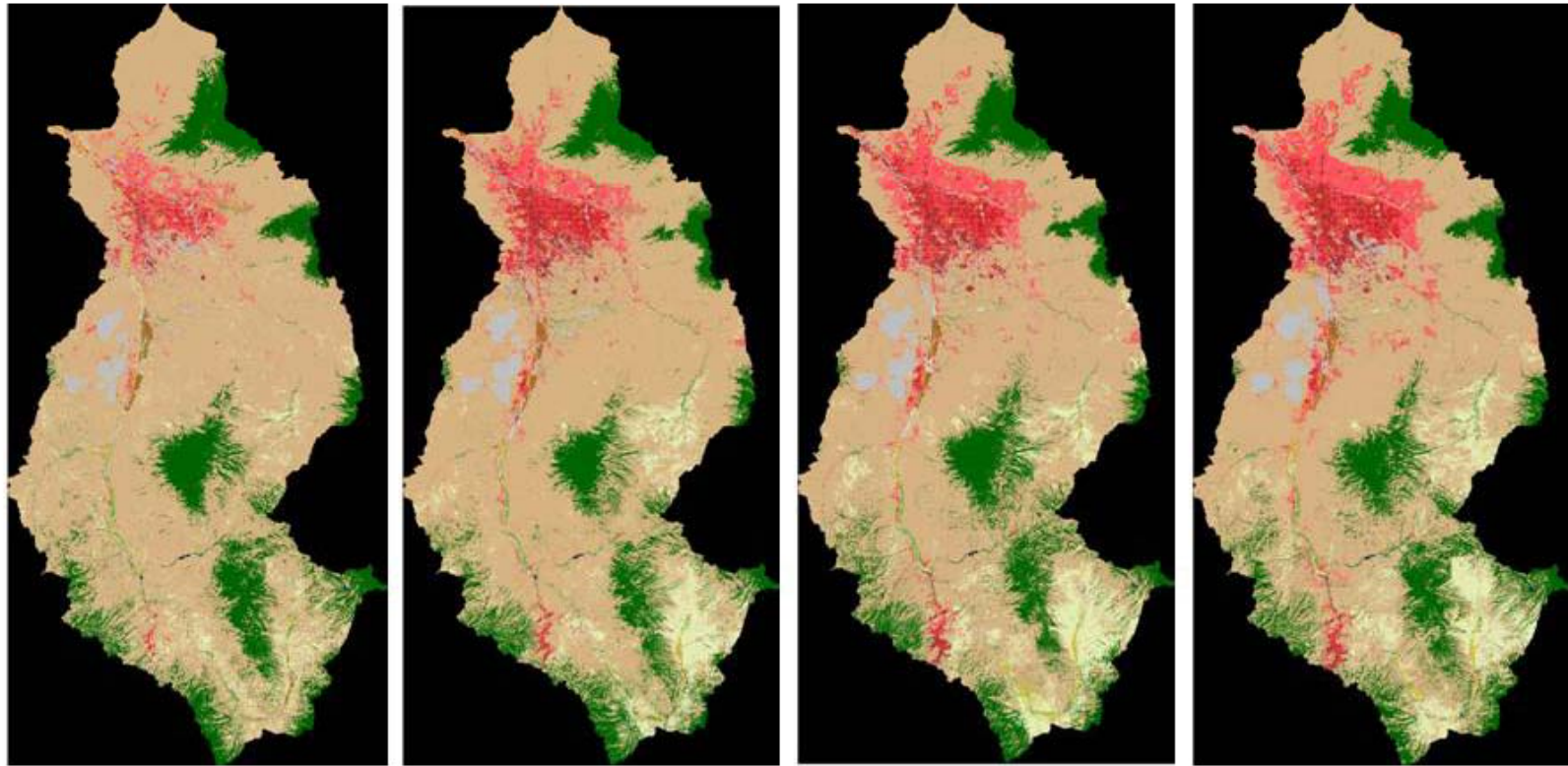


General Approach

- Landsat TM and MSS
 - Moderate resolution (30 and 60m)
 - Multispectral
 - Multi-date
 - Historical series
- Image Preprocessing
- Variable extraction: vegetation indices and spectral transformations
- CART
- Accuracy Assessment



Santa Cruz Watershed Land Use/Land Cover 1979 - 2009



- 11. Open Water
- 21. Developed, Open Space
- 22. Developed, Low Intensity
- 23. Developed, Medium Intensity
- 24. Developed, High Intensity

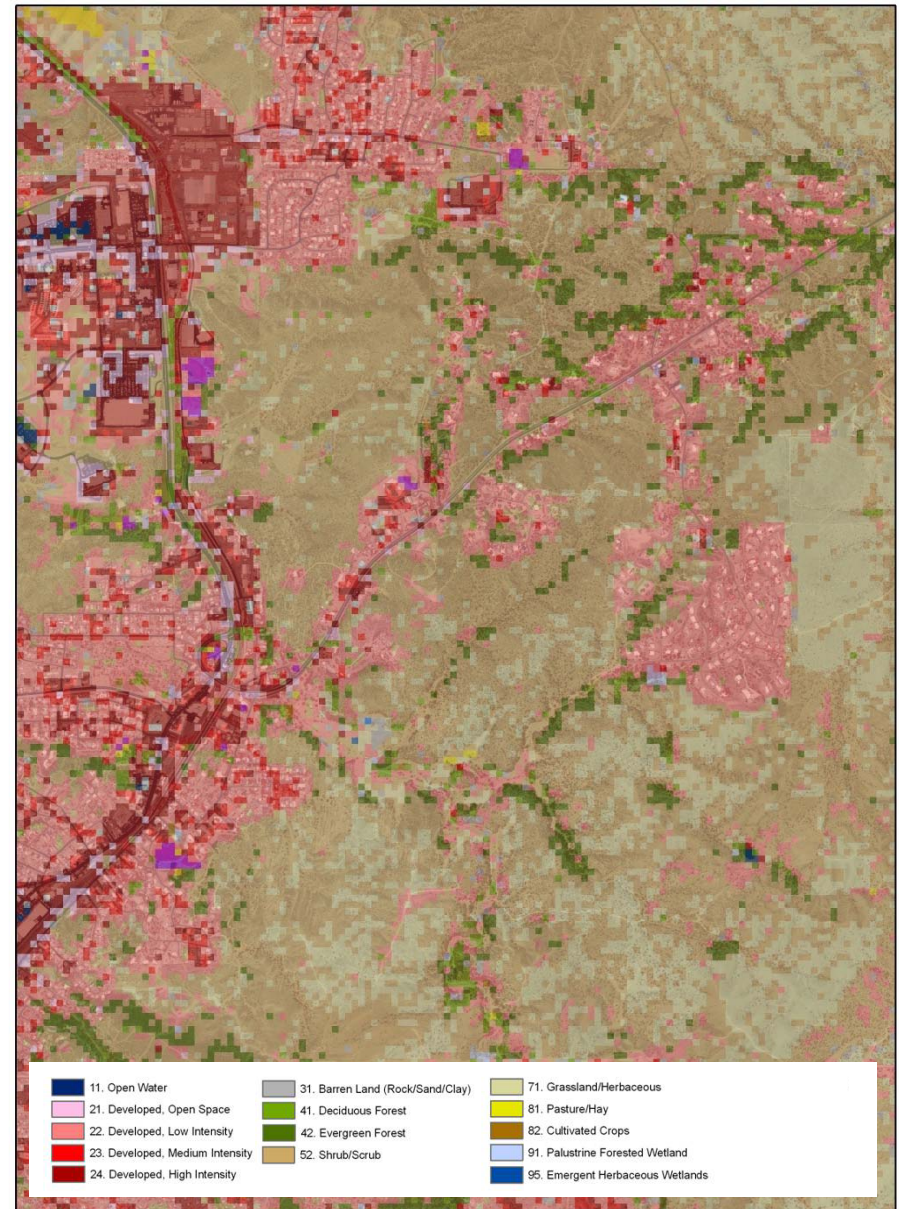
- 31. Barren Land (Rock/Sand/Clay)
- 41. Deciduous Forest
- 42. Evergreen Forest
- 52. Shrub/Scrub

- 71. Grassland/Herbaceous
- 81. Pasture/Hay
- 82. Cultivated Crops
- 91. Palustrine Forested Wetland
- 95. Emergent Herbaceous Wetlands

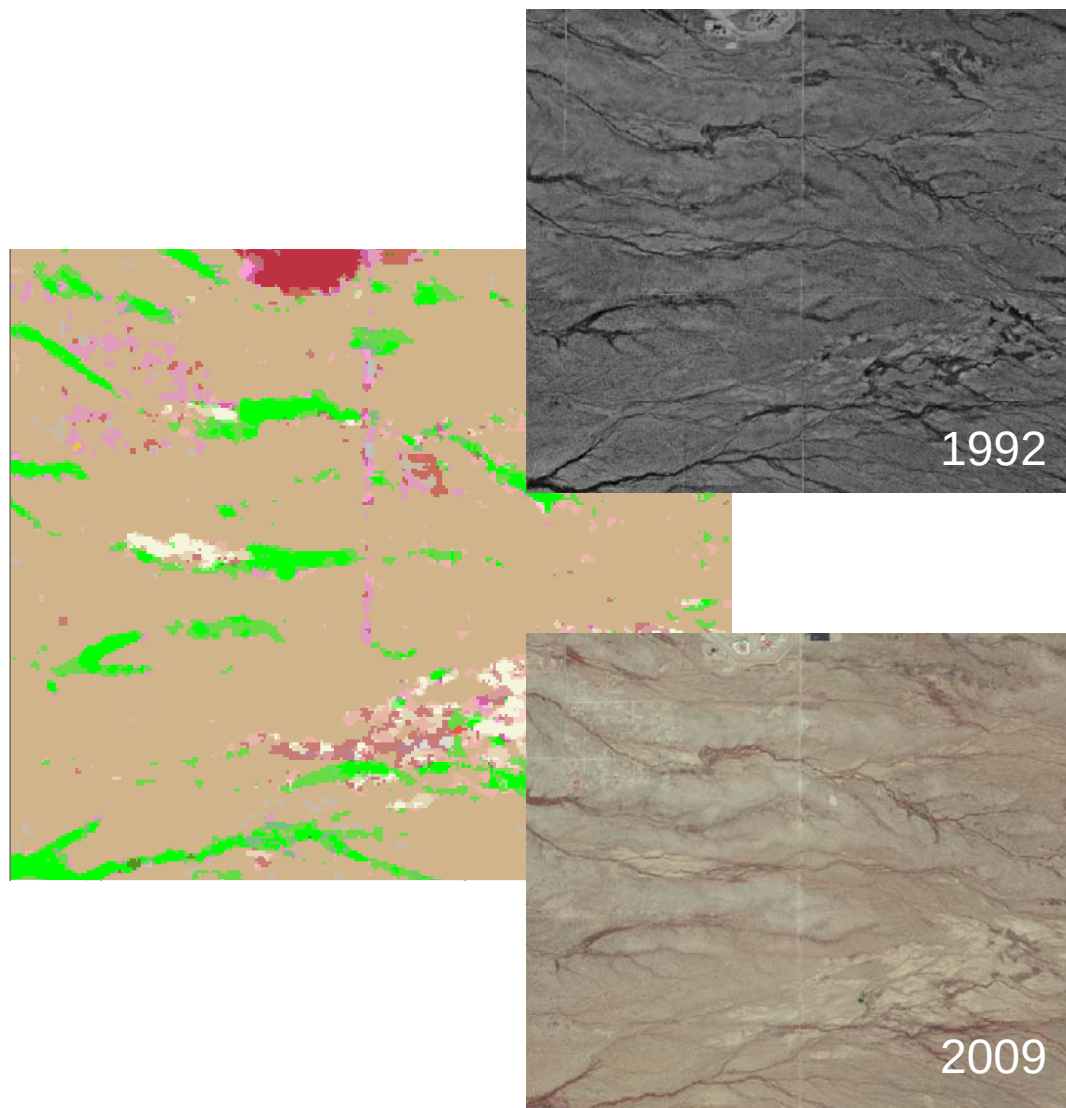
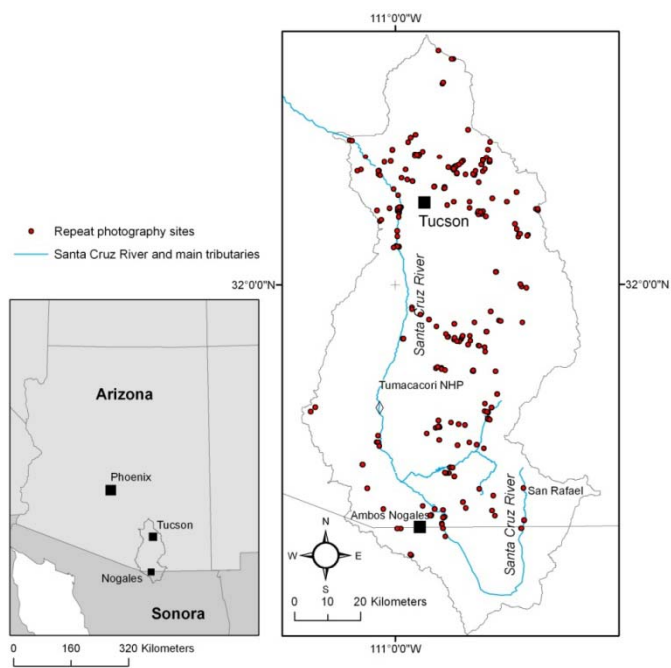
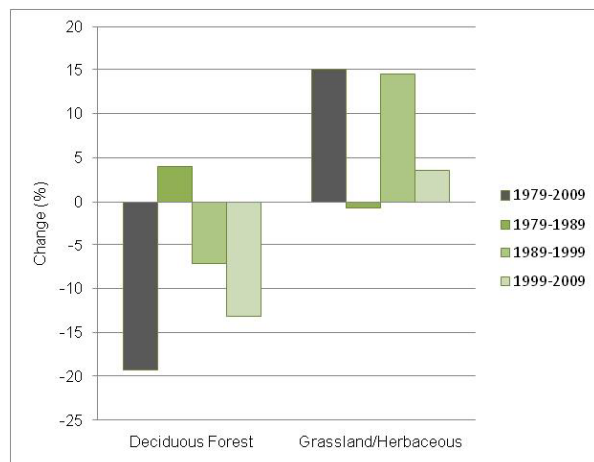
0 12.5 25 50 Kilometers

Map Accuracy

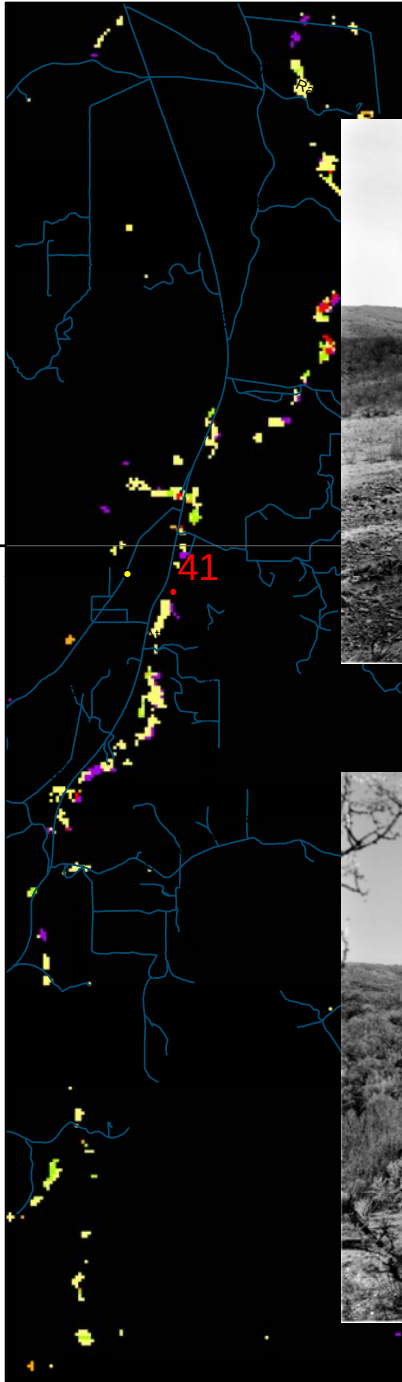
- Accuracy was assessed by determining the land cover type from high-resolution aerial photographs
- The LULC maps of 1979, 1989, 1999, and 2009 are more than 80% accurate:
- 1979 (overall accuracy = 84.72%; kappa = 0.83)
- 1989 (overall accuracy = 84.30%; kappa = 0.83)
- 1999 (overall accuracy = 81.79%; kappa = 0.80)
- 2009 (overall accuracy = 86.50%; kappa = 0.85)



Landscape change trends



Landscape change trends



1915



1962



1994



2011



Our research on SC riparian corridor presented at 1st SCRD meeting is now available:

RIVER RESEARCH AND APPLICATIONS

River Res. Applic. (2011)

Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.1510

THE INFLUENCE OF WASTEWATER SUBSIDY, FLOOD DISTURBANCE AND
NEIGHBOURING LAND USE ON CURRENT AND HISTORICAL PATTERNS OF
RIPARIAN VEGETATION IN A SEMI-ARID WATERSHED

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^c Arid Lands Resource Sciences, University of Arizona, Tucson, Arizona, USA

Forthcoming USGS Open File Reports:

Villarreal, M.L., L. M. Norman, C. S. A. Wallace, and C. van Riper. 2011. A multi-temporal (1979-2009) Land Use/Land Cover data set of the binational Santa Cruz Watershed. U.S. Geological Survey Open-File Report 2011-XXXX, 31 p.

Wallace, C.S.A., Villarreal, M.L., and Norman, L.M., 2011, Developing a high-resolution binational vegetation map of the Santa Cruz River riparian corridor and surrounding watershed: U.S. Geological Survey Open-File Report 2011–XXXX, xx p.