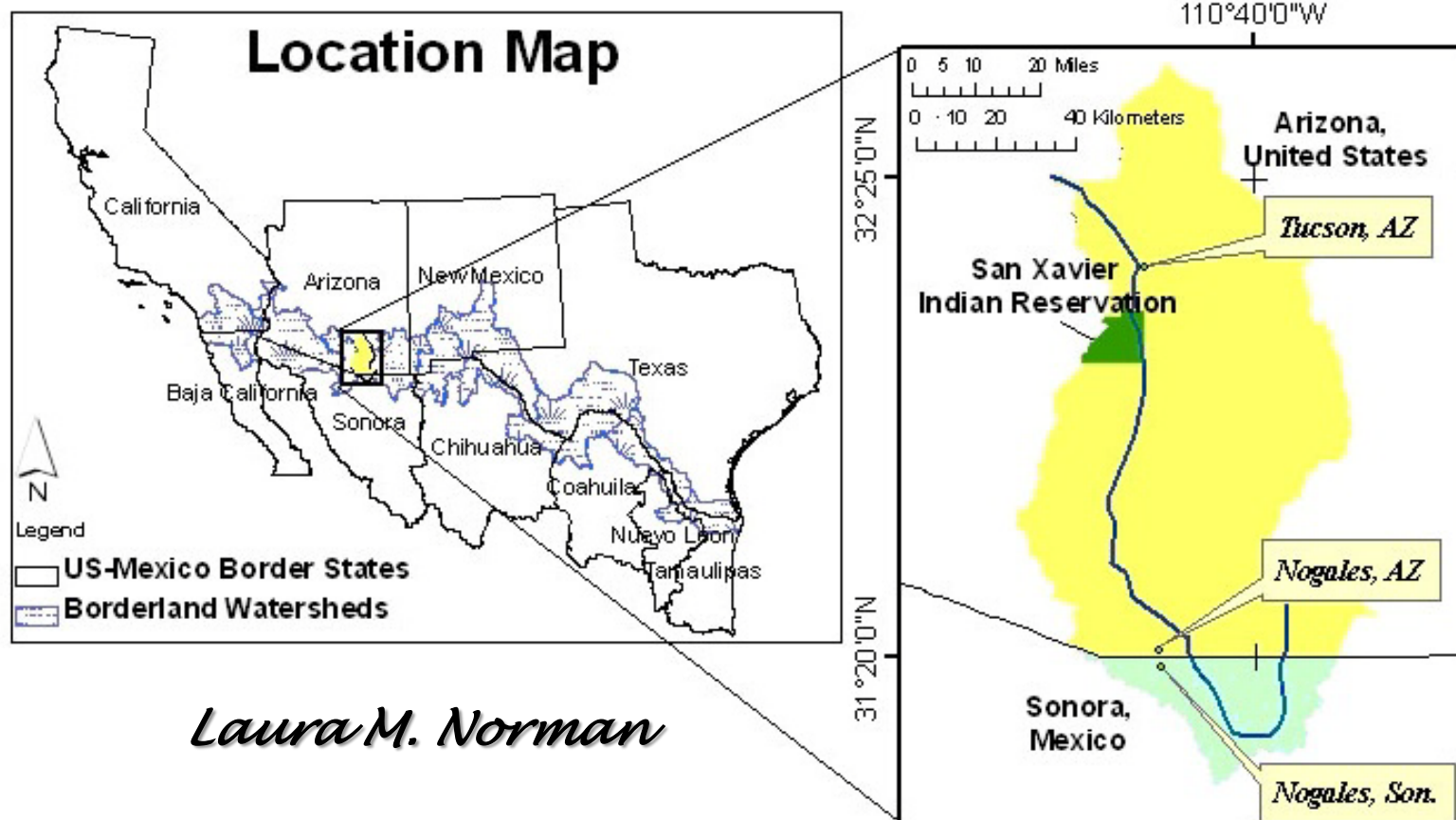
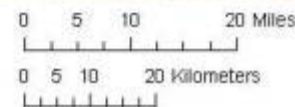
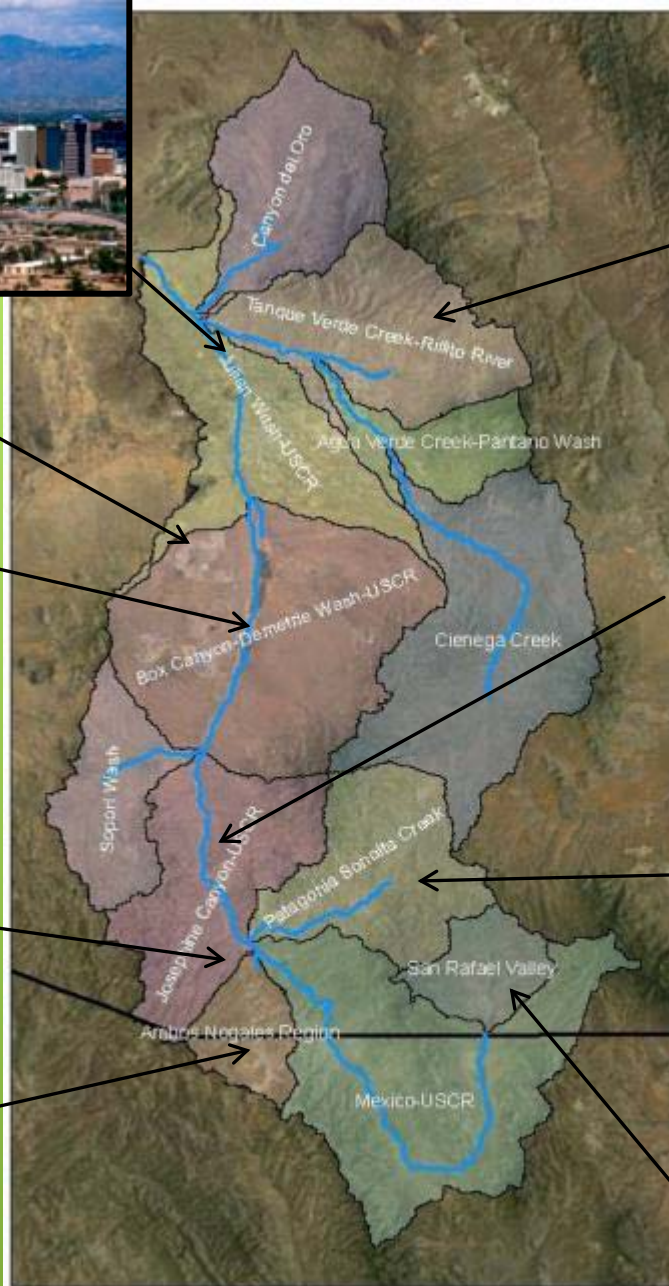


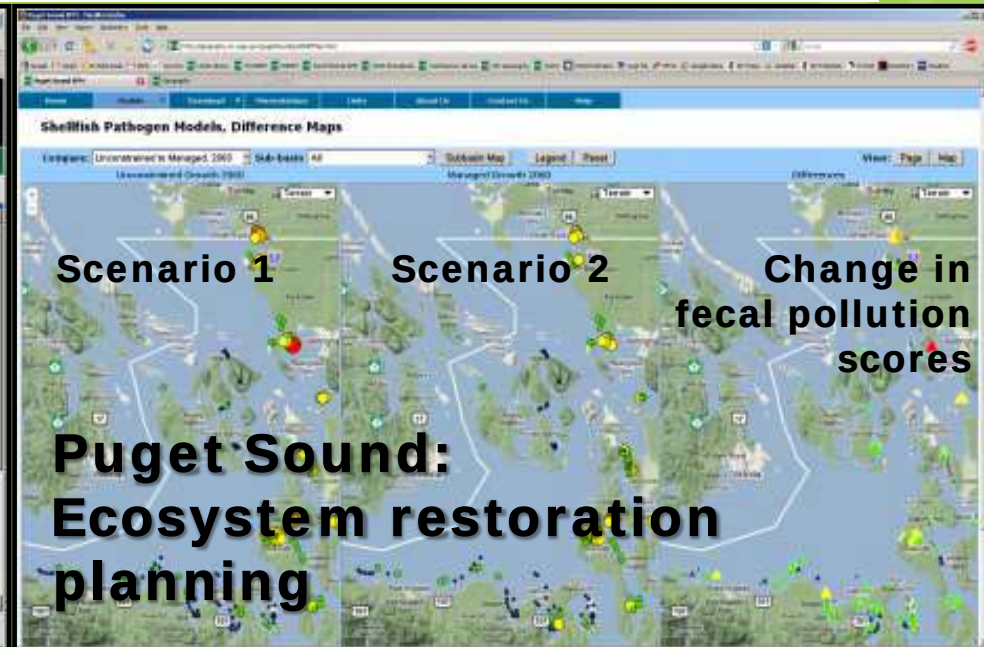
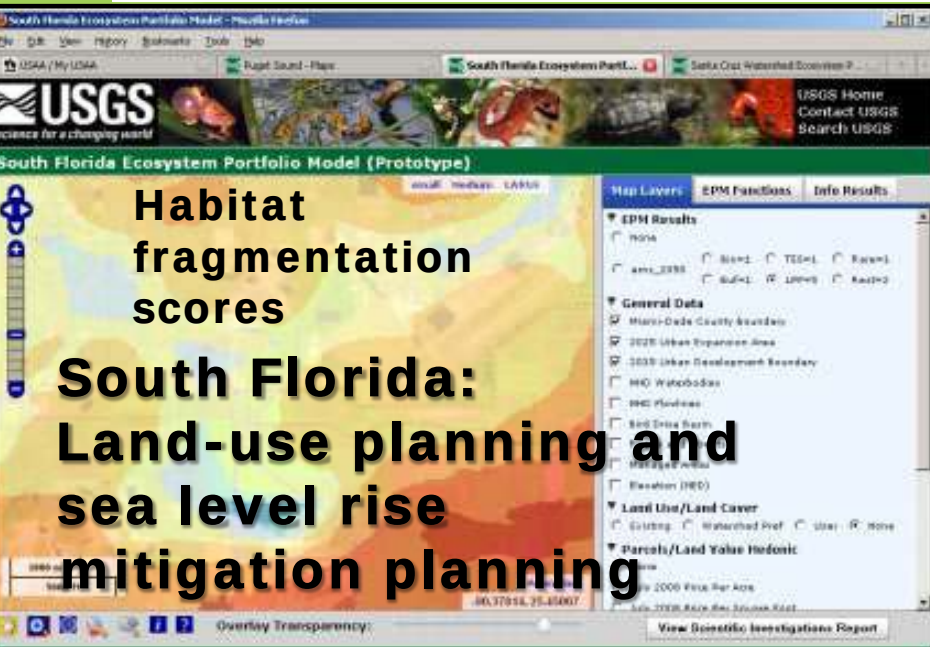
# The Santa Cruz Watershed Ecosystem Portfolio Model (SCWEPM); Progress and Future





# Ecosystem Portfolio Model

- Web-delivered natural resources planning decision support
- Integrates land use change-sensitive models and metrics for tracking ecological, economic, and community quality-of-life endpoints
- Values modeled outcomes using attribute utility, as well as economic land valuation
- Is spatially-explicit and multi-scale



Labiosa, William B., Bernknopf, Richard, Hearn, Paul, Hogan, Dianna, Strong, David, Pearlstine, Leonard, Mathie, Amy M., Wein, Anne M., Gillen, Kevin, and Wachter, Susan, 2009, **The South Florida Ecosystem Portfolio Model; a map-based multicriteria ecological, economic, and community land-use planning tool**: U.S. Geological Survey Scientific Investigations Report 2009-5181, 41 p. <http://pubs.usgs.gov/sir/2009/5181/>

# How the EPM works ...

1. Multiple planning scenarios considered
2. Evaluated against multiple criteria scores



**Model-based  
characterization  
of outcomes**

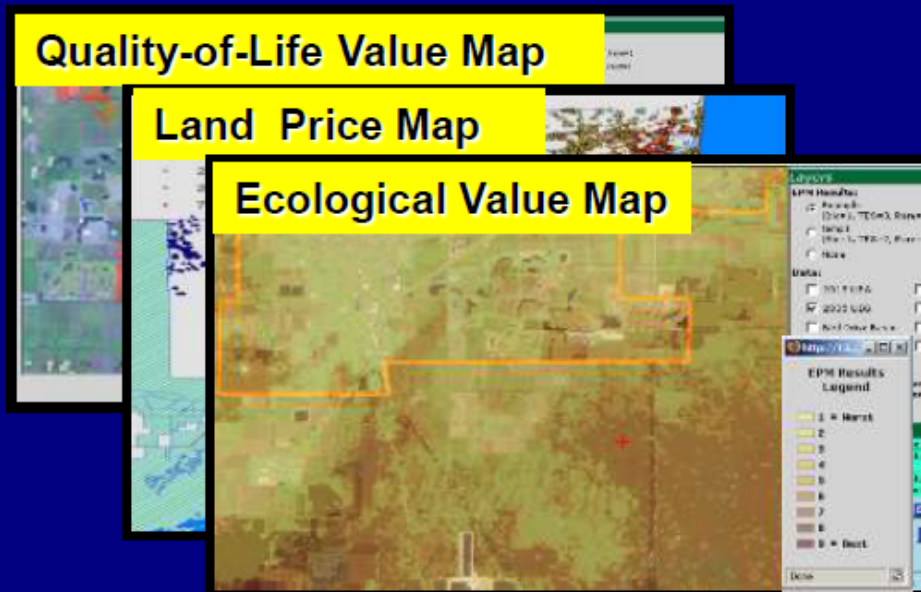
**Ecological  
Value Model**



**Quality-of-Life  
Indicators**



3. Value maps combine user-elicited value judgments and criteria scores



**Multi-attribute  
utility valuation**

**Land Price Model**



**Economic  
model**

# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

LAND-USE

Water resources planning &  
change scenarios

CLIMATE

Ecological or  
Biophysical // Ecological Value

Economic // Market  
Land Price

Social //  
Human  
Well-Being



# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

**LAND-USE**

**CLIMATE**



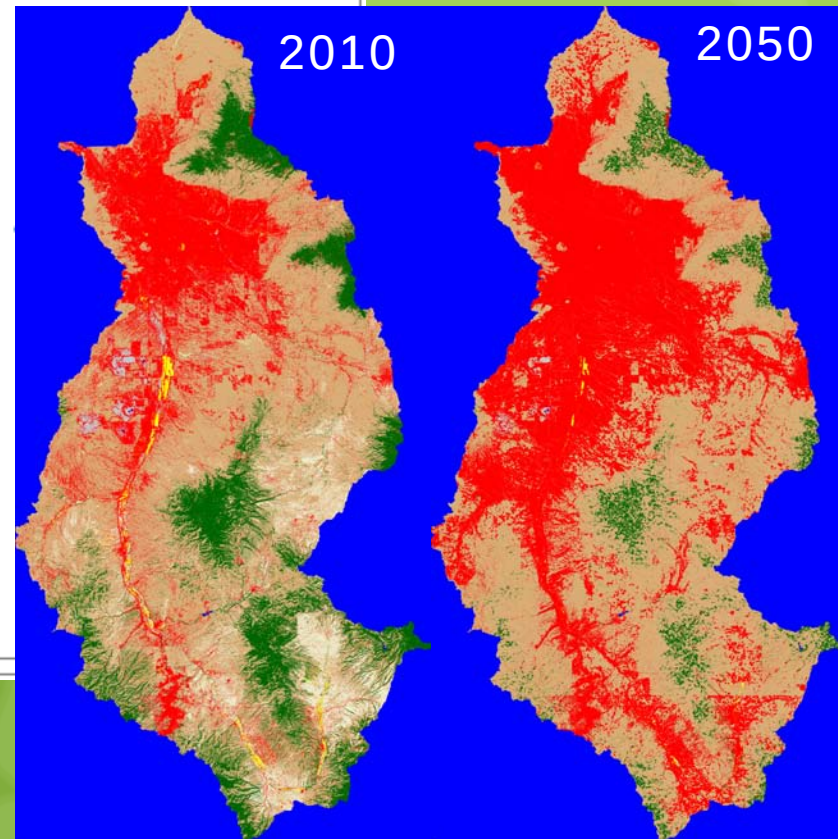
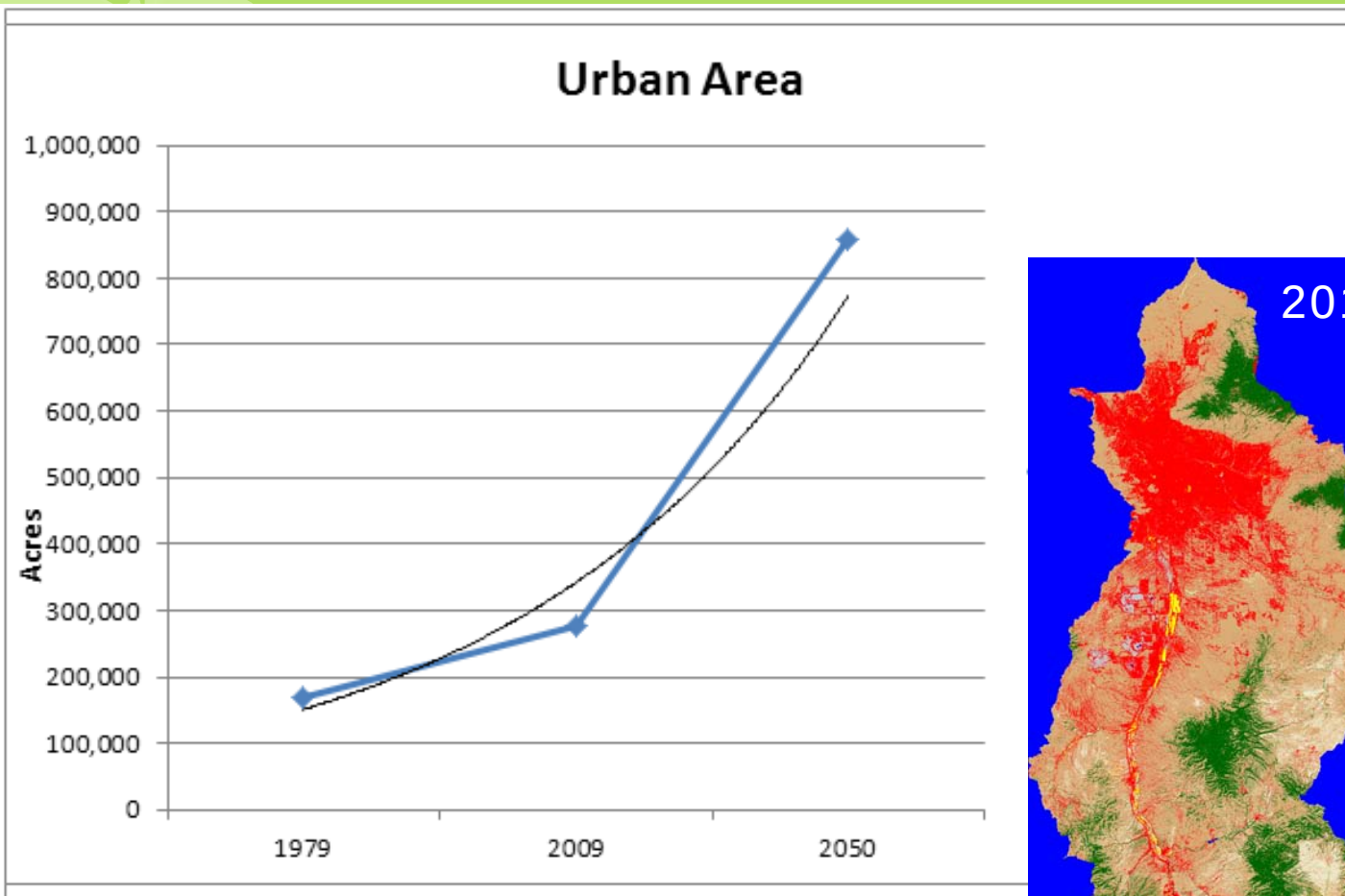
Ecological or  
Biophysical // Ecological Value

Economic // Market  
Land Price

Social //  
Human  
Well-Being

Norman , Laura, Tallent-Halsell, Nita, Labiosa, William, Weber, Matt, McCoy , Amy, Hirschboeck, Katie, Callegary, James, van Riper III, Charles, and Gray, Floyd, 2010, Developing an Ecosystem Services Online Decision Support Tool to Assess the Impacts of Climate Change and Urban Growth in the Santa Cruz Watershed; Where We Live, Work, and Play: Advanced Forum for Sustainability Development.<http://www.mdpi.com/2071-1050/2/7/2044/>

# Current Trend predicts exponential growth rate to the year 2050



# Alternatives...



Current Trends Scenario

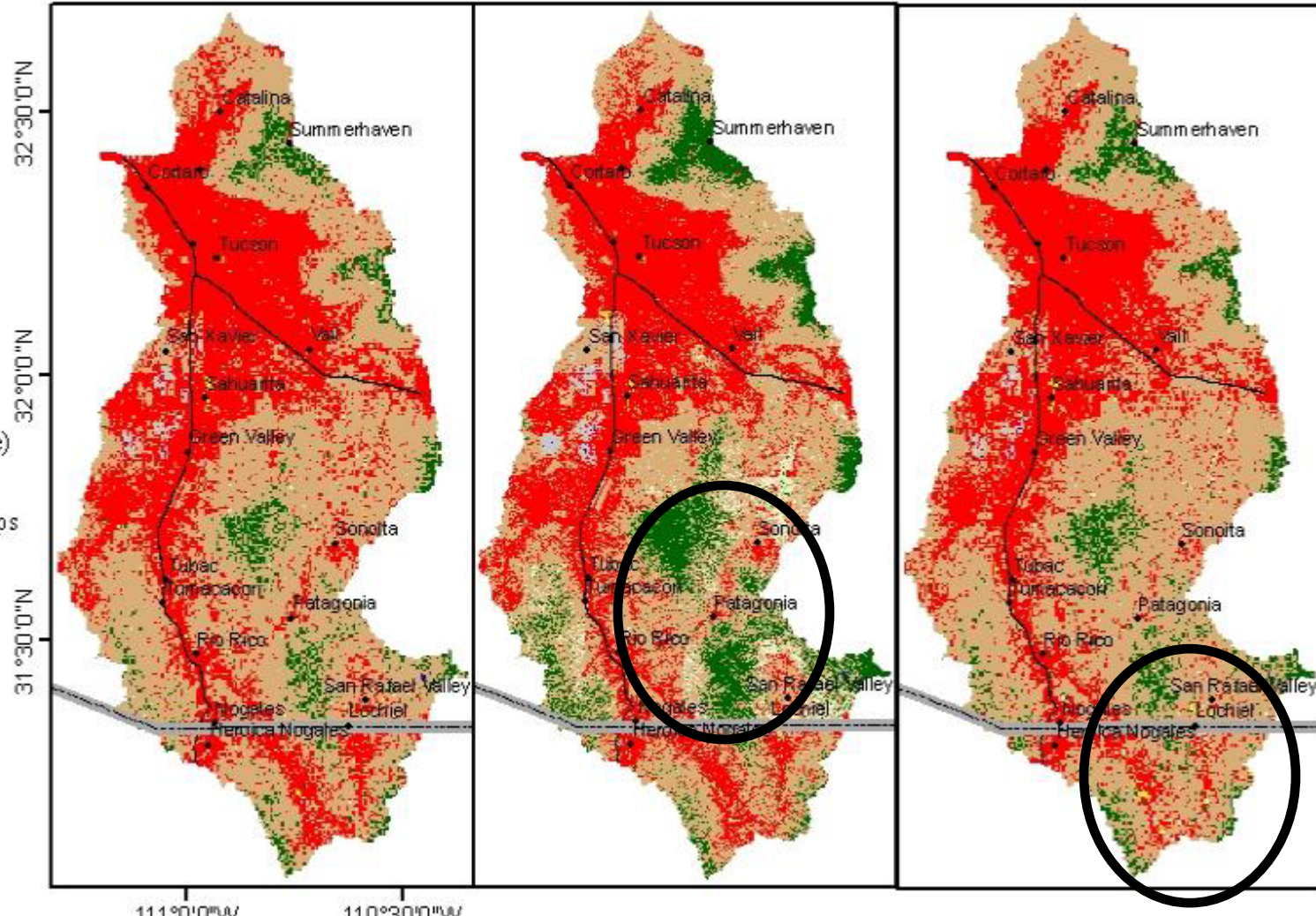
Conservation Scenario

Megalopolis Scenario

## Legend

- Populated Places
- International Boundary
- Highways
- Urban
- Open Water
- Wetlands
- Evergreen Forest
- Deciduous Forest (Mesquite)
- Grassland/Herbaceous
- Pasture Hay/Cultivated Crops
- Urban/Recreational Grasses
- Shrub/Scrub
- Barren Land

0 5 10 20 Miles  
0 5 10 20 Kilometers



Norman, Laura M., Feller, Mark and Villarreal, Miguel L., 2012 In Press, **Developing Spatially Explicit Footprints of Plausible Land-Use Scenarios in the Santa Cruz Watershed, Arizona and Sonora**, accepted for publication Landscape and Urban Planning.

# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

**LAND-USE**

**CLIMATE**



Ecological or  
Biophysical // Ecological Value

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Norman , Laura, Tallent-Halsell, Nita, Labiosa, William, Weber, Matt, McCoy , Amy, Hirschboeck, Katie, Callegary, James, van Riper III, Charles, and Gray, Floyd, 2010, Developing an Ecosystem Services Online Decision Support Tool to Assess the Impacts of Climate Change and Urban Growth in the Santa Cruz Watershed; Where We Live, Work, and Play: Advanced Forum for Sustainability Development.<http://www.mdpi.com/2071-1050/2/7/2044/>

# Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America

Richard Seager,<sup>1\*</sup> Mingfang Ting,<sup>1</sup> Isaac Held,<sup>2,3</sup> Yochanan Kushnir,<sup>1</sup> Jian Lu,<sup>4</sup> Gabriel Vecchi,<sup>2</sup> Hwei-Ping Huang,<sup>1</sup> Nili Harnik,<sup>5</sup> Ants Leetmaa,<sup>2</sup> Ngar-Cheung Lau,<sup>2,3</sup> Jennifer Velez,<sup>1</sup> Naomi Naik<sup>1</sup>

... will affect hydroclimate in the arid regions of southwestern North America. The projected reduction of water resources and the course of regional transition to a more arid climate models that this region of aridity of the recent multiyear drought or the Dust Bowl of the new climatology of the American Southwest within a



Variability associated with El Niño Southern Oscillation (ENSO)—shows that the projected future aridity of the southwestern U.S. will be dramatically amplified during **La Niña** conditions, characterized by **higher temperatures (~0.5°C)** and **lower precipitation (~3 mm / mnt)** than projected trends.

These results have important implications for water managers in the Southwest who must prepare for **more intense winter aridity** associated with future ENSO conditions.

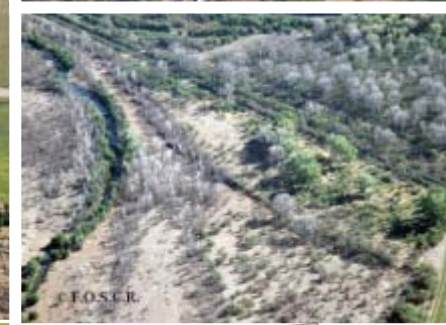
Dominguez, F., J. Cañon, and J. Valdes. 2010. "IPCC-AR4 Climate Simulations for the Southwestern US: The Importance of Future ENSO Projections." *Climatic Change* 99 (3): 499–514.

What happens when there is no water ?...

**BEFORE**



**AFTER(?)**



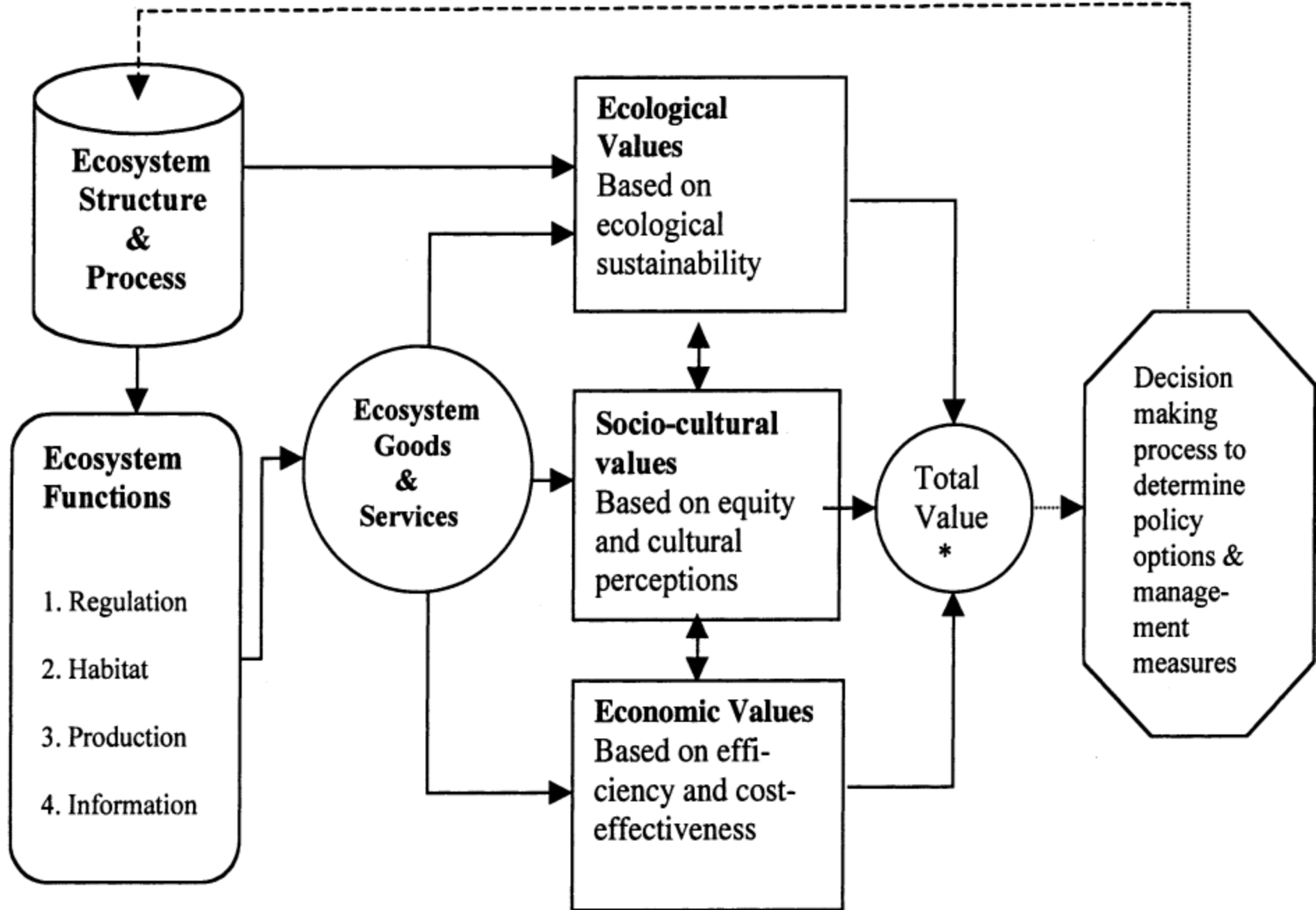
# Ecosystem Services



- Why do we care? → Benefits to people

*Can an ecosystem services assessment facilitate communicating the costs and benefits of different scenarios of environmental health to people across borders?*

- Santa Cruz watershed Ecosystem Portfolio Model (SCWEPM)
- Incorporates socio-economic impacts with the biophysical....



# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

**LAND-USE**

**CLIMATE**

Biophysical  
// Ecological Value

Economic // Market  
Land Price

**Social //  
Human  
Well-Being**

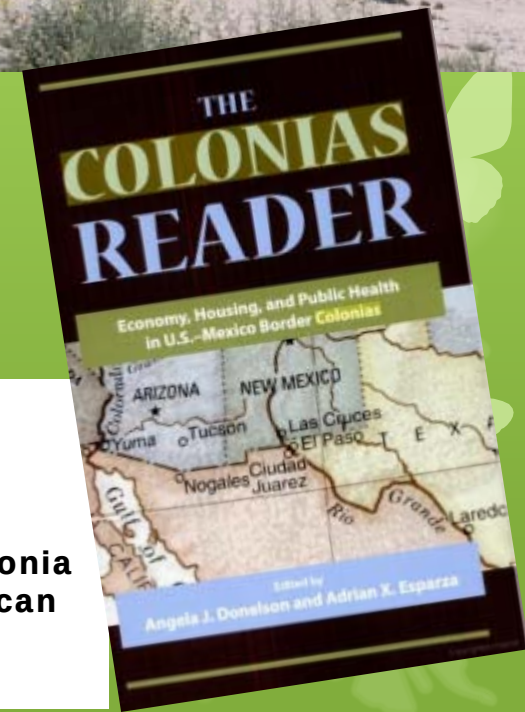


Norman , Laura, Tallent-Halsell, Nita, Labiosa, William, Weber, Matt, McCoy , Amy, Hirschboeck, Katie, Callegary, James, van Riper III, Charles, and Gray, Floyd, 2010, Developing an Ecosystem Services Online Decision Support Tool to Assess the Impacts of Climate Change and Urban Growth in the Santa Cruz Watershed; Where We Live, Work, and Play: Advanced Forum for Sustainability Development.<http://www.mdpi.com/2071-1050/2/7/2044/>

# colonias



- **Colonias** are rural neighborhoods within 150 miles of the border that lack adequate infrastructure or housing, as well as other basic services.
- The *colonias* typically have high poverty rates
- *Colonias* residents have traditionally struggled to gain access to the public services available in those communities...

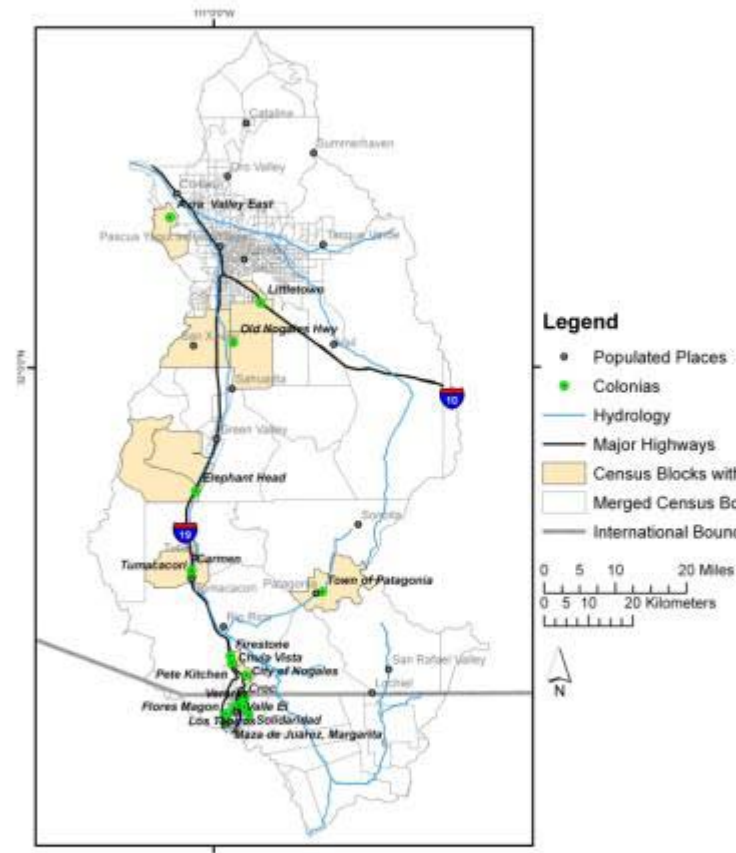
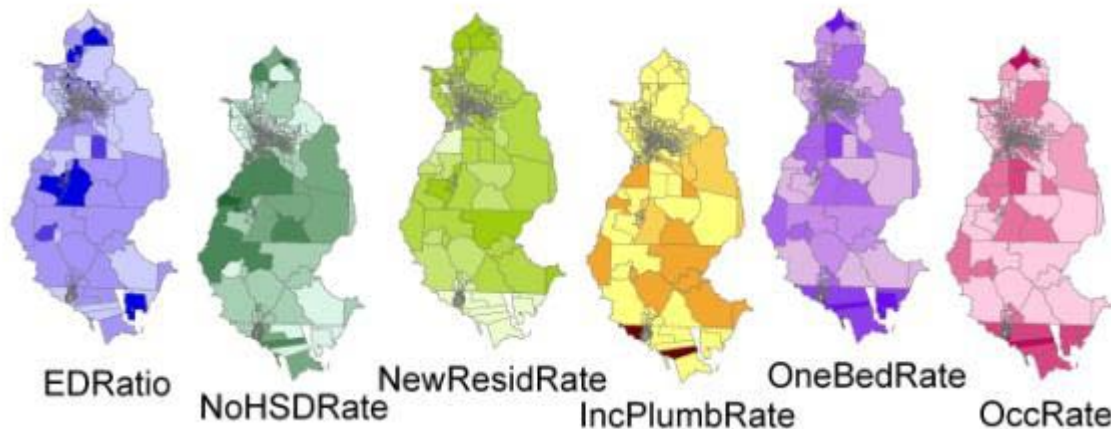


- Norman, Laura, 2010, **Urbanization and Environmental Health in Arizona Colonias; In The Colonias Reader; Economy, Housing, and Public Health in U.S.-Mexico Border Colonias**, ed.s Angela J. Donelson and Adrian X. Esparza, published by University of Arizona Press, Tucson
- Norman, Laura M., Donelson, Angela, Pfeifer, Edwin, and Lam, Alven H., 2006. **Colonia Development and Land Use Change in Ambos Nogales, United States-Mexican Border**: U.S. Geological Survey Open File Report: 2006-1112.  
<http://pubs.usgs.gov/of/2006/1112>

## Socio-Environmental Vulnerability Index Formula Adjusted for the Santa Cruz Watershed

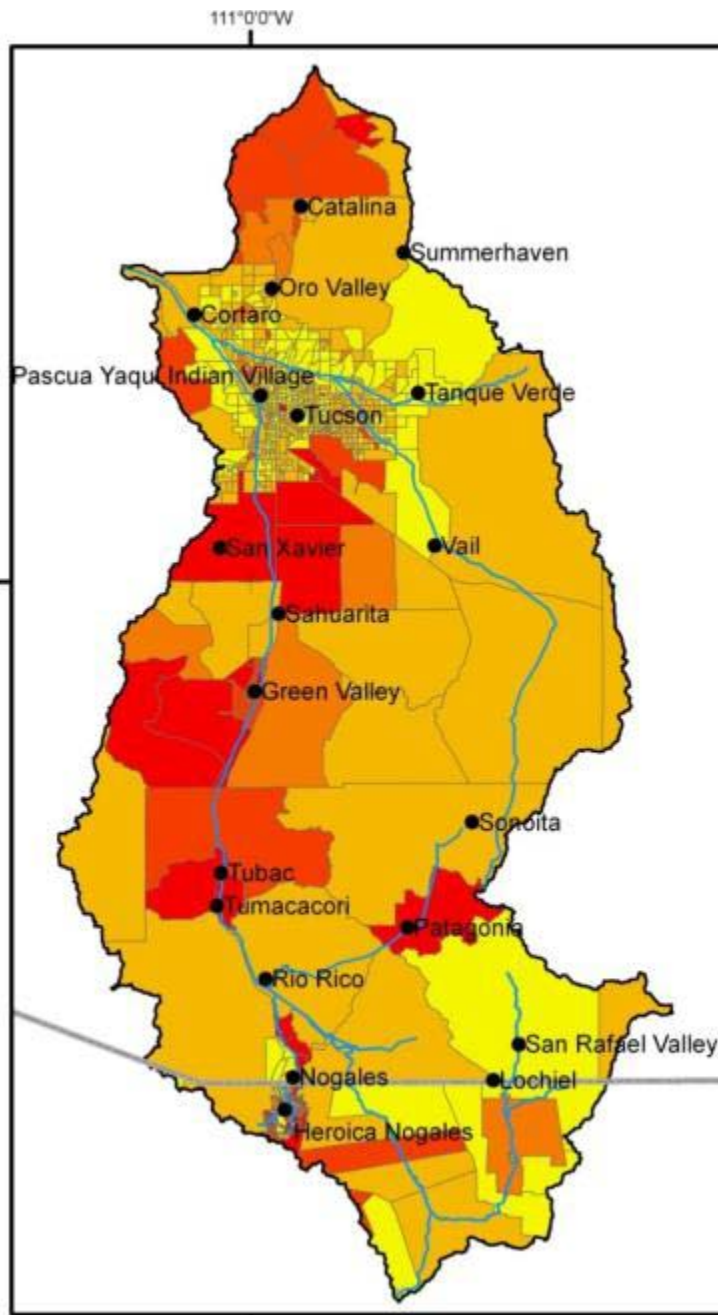
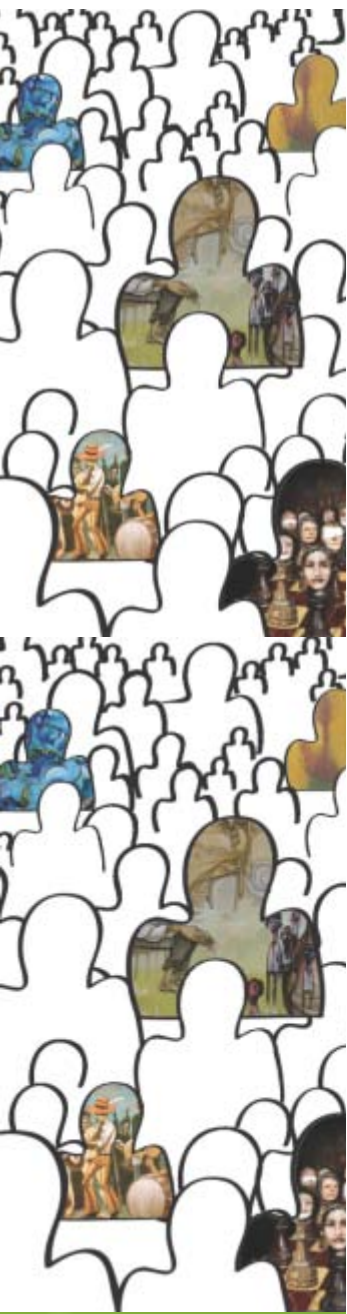
$$\text{SEVI} = (\text{EDRatio} + \text{NoHSDRate} + \text{NewResidRate} + \text{IncPlumbRate} + \text{OneBedRate} + \text{OccRate} + \text{ColoniaRate})/7$$

## Modified Socio-Environmental Vulnerability Index (SEVI)



Integrated Mexican Basic Geo-Statistical Areas (AGEBs by their Spanish acronym) with U.S. Census Block groups for the Santa Cruz Watershed, describing population, education, access to urban services, and household assets.

# Socio-Environmental Vulnerability



**Yellow is  
low**

## Legend

- Populated Places
- Hydrology
- International Boundary
- Santa Cruz Watershed

## Modified-SEVI

- 0.00 - 0.14
- 0.15 - 0.19
- 0.20 - 0.21
- 0.22 - 0.26
- 0.27 - 0.40

0 4 8 16 Miles

0 4 8 16 Kilometers



# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

LAND-USE

CLIMATE



**Biophysical  
// Ecological Value**

Economic // Market  
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Norman , Laura, Tallent-Halsell, Nita, Labiosa, William, Weber, Matt, McCoy , Amy, Hirschboeck, Katie, Callegary, James, van Riper III, Charles, and Gray, Floyd, 2010, Developing an Ecosystem Services Online Decision Support Tool to Assess the Impacts of Climate Change and Urban Growth in the Santa Cruz Watershed; Where We Live, Work, and Play: Advanced Forum for Sustainability Development.<http://www.mdpi.com/2071-1050/2/7/2044/>

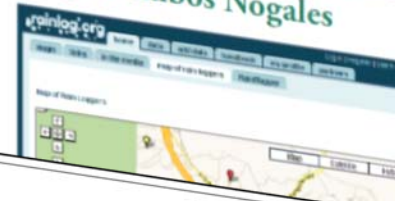


~ Flooding and erosion are two main issues confronting people in the borderlands that impact human livelihoods, health, and sometimes mortality...

## Flash-Flood Forecasting at Ambos Nogales

BY LAURA M. NORMAN

Scientists and experts from academia and public and private agencies from the United States and Mexico are expanding a model designed to evaluate the watershed of Nogales, AZ, and Nogales, Sonora.



## Journal of Flood Risk Management

Flood hazard awareness and hydrologic modelling at Ambos Nogales, United States-Mexico border

L.M. Norman<sup>1</sup>, H. Hu<sup>2</sup>, L. Levick<sup>3</sup>, I. Shea Burns<sup>3</sup>, D. Phillip Guertin<sup>4</sup>, F. Lara-Valencia<sup>5</sup>, D. Semmens<sup>6</sup>

Article first published online: 24 MAR 2010  
DOI: 10.1111/j.1753-318X.2010.01066.x



## A Coupled Model Approach to Reduce Nonpoint-Source Pollution Resulting from Predicted Urban Growth: A Case Study in the Ambos Nogales Watershed

Journal  
Urban Geography  
Publisher  
Bellwether Publishing, Ltd.  
ISSN  
0272-3638 (Print)  
Subject  
Social Science, Sociology, Geography, Planning and Urban Development, Gender Studies and Cultural Studies  
Issue  
Volume 29, Number 5 / July 1-August 15, 2008  
Category  
Article  
Pages  
496-516  
DOI  
10.2747/J0272-3638.29.5.496  
Online Date  
Tuesday, June 17, 2008



## Nogales Flood Detention Study

By Laura M. Norman, Lanie Levick, D. Philip Guertin, James Callagary, Jesus Guadarrama, Claudia Zulma Gil Anaya, Andrea Prichard, Floyd Gray, Edgar Casto, Edgar Tepezano, Hans Hu, Prescott Vandervort, Saul Rodriguez, Jose Nunez, D. Alwood, Gilberto Paltico Olvera Granillo, and Francisco Octavio Garduño Galtés

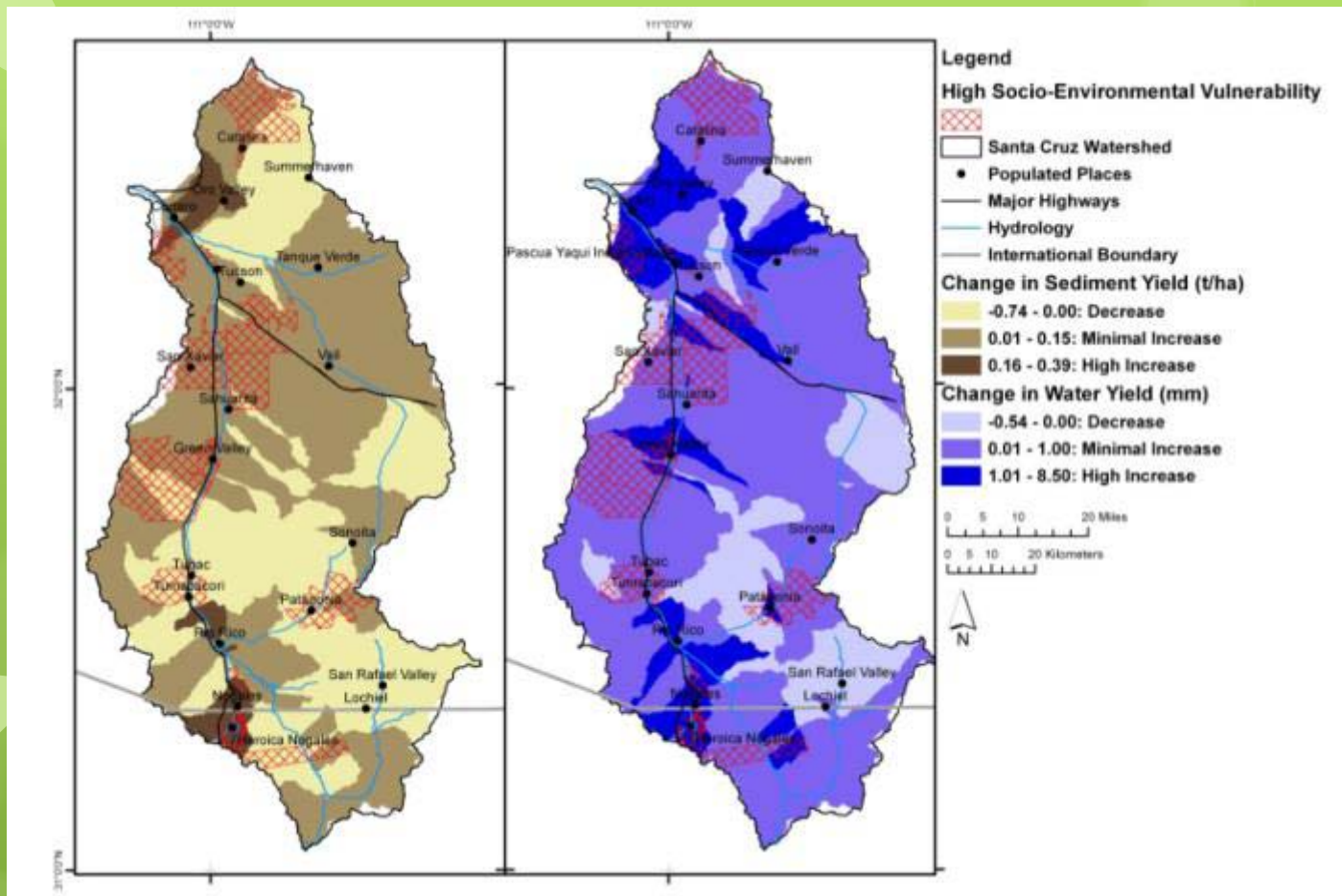
Open-File Report 2010-1262

U.S. Department of the Interior  
U.S. Geological Survey



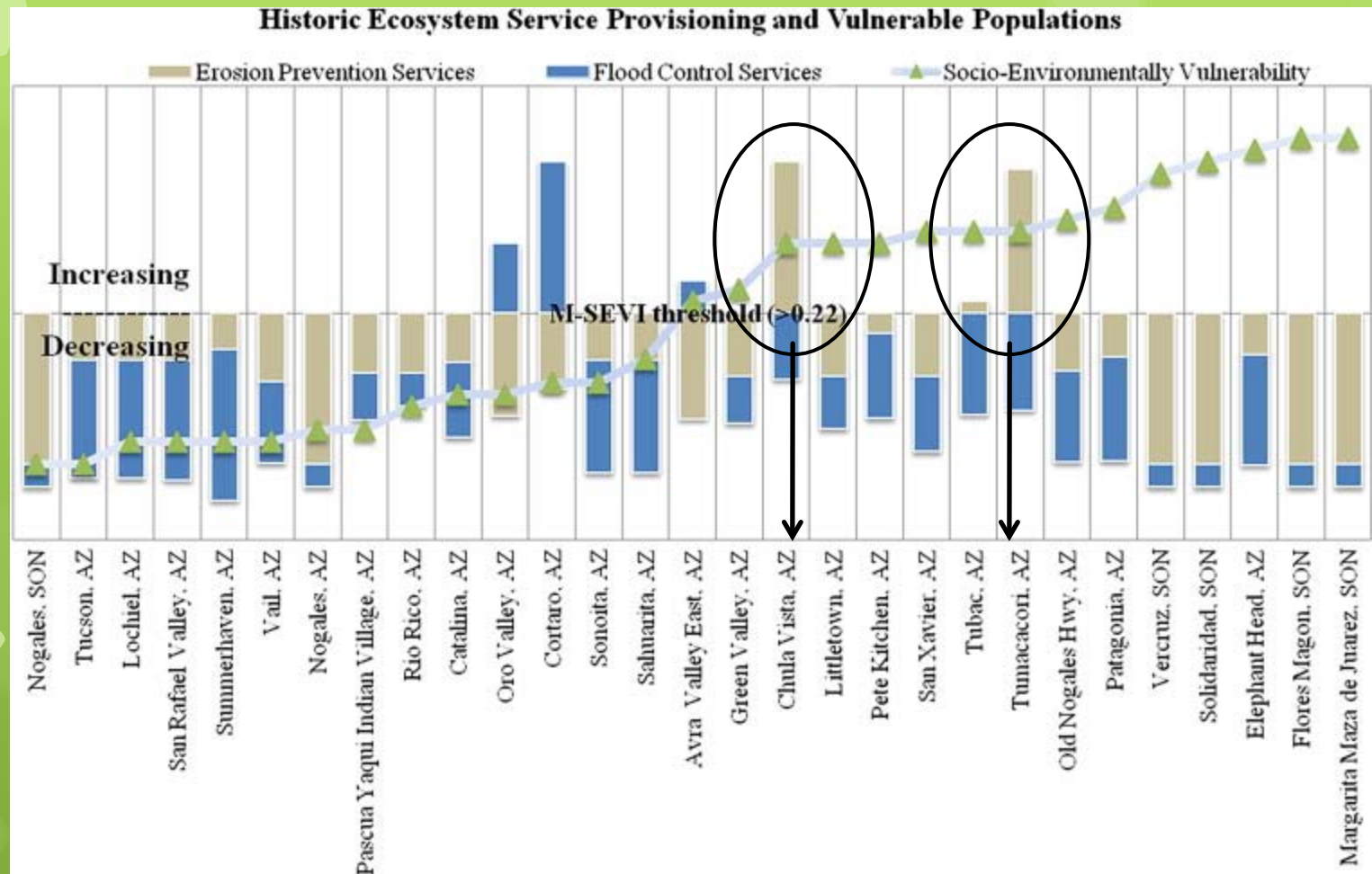
# Soil and Water Assessment Tool (SWAT)

Regulating services, such as flood- and erosion-control can help protect communities from extreme climate events such as rainstorms and droughts ...

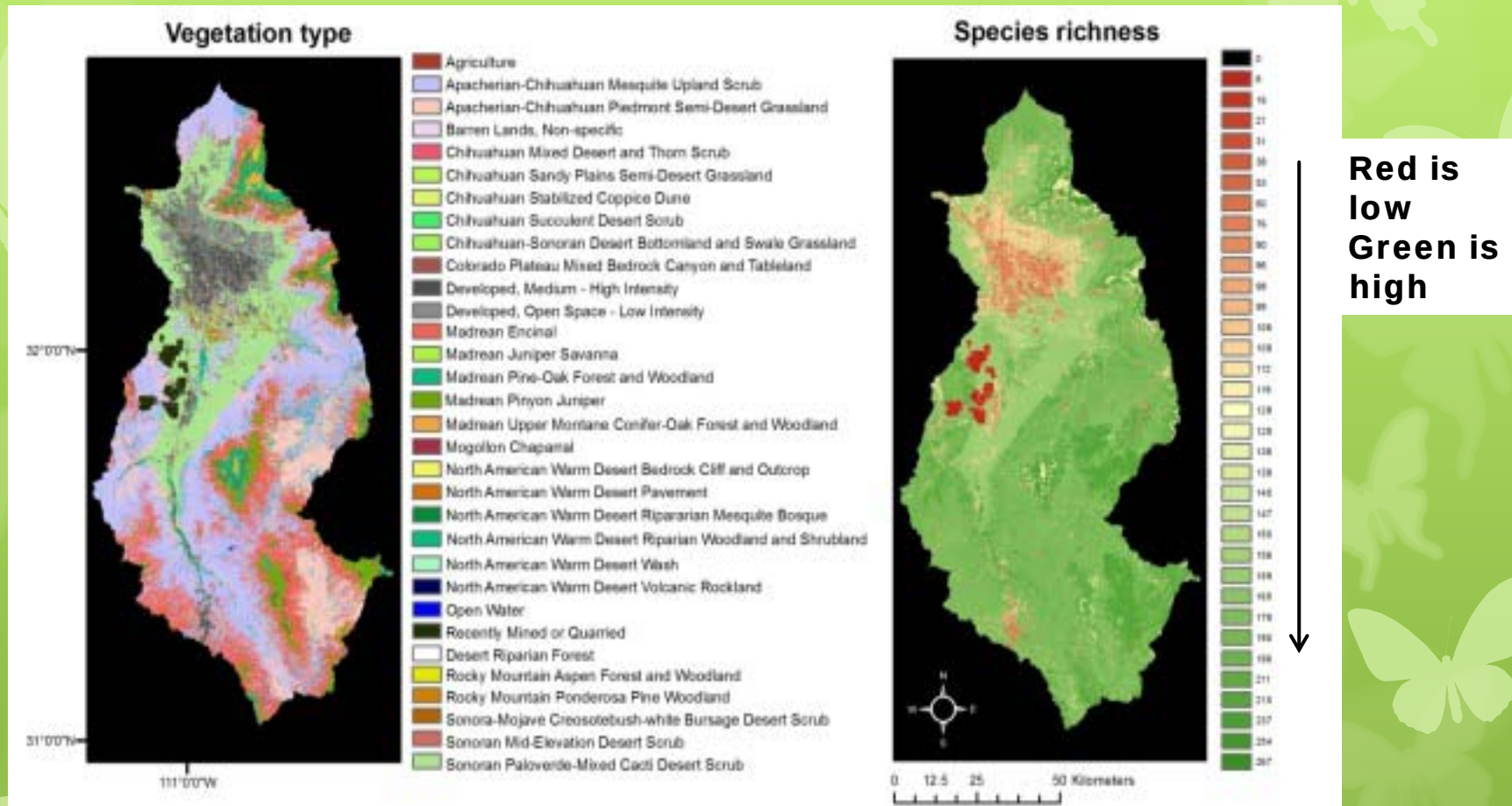


Norman, Laura M., Miguel L. Villarreal, Francisco Lara-Valencia, Yongping Yuan, Wenming Nie, Sylvia Wilson, Gladys Amaya, and Rachel Sleeter. 2012. "Mapping Socio-environmentally Vulnerable Populations Access and Exposure to Ecosystem Services at the U.S.-Mexico Borderlands." *Applied Geography* 34, no. 0 (May): 413–424. [doi:10.1016/j.apgeog.2012.01.006]

# Bar graph portraying the changing provision of ecosystem services in relationship to the socio-environmental vulnerability of populations.



We quantified and mapped terrestrial vertebrate species richness using Wildlife Habitat Relation models and a high res. binational vegetation map.

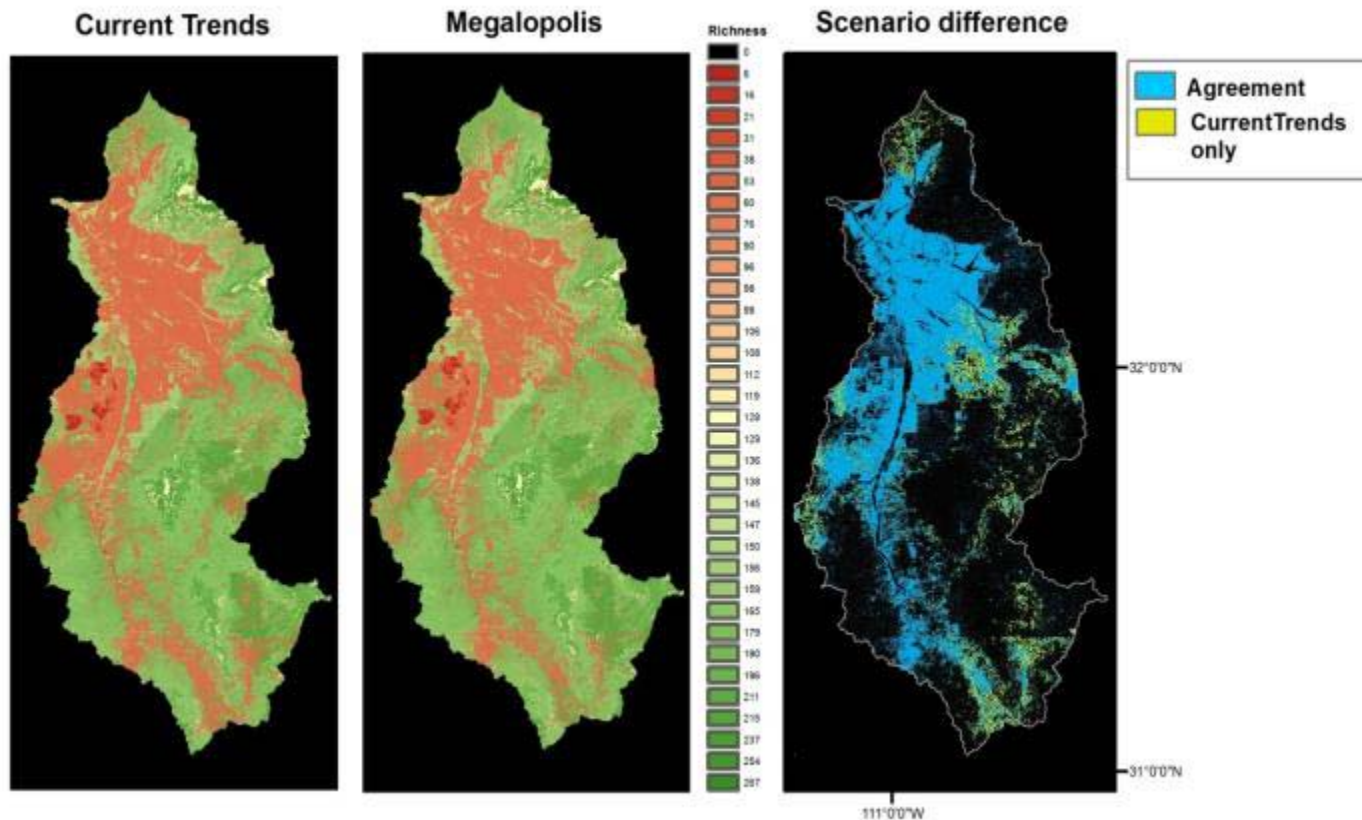


**Biodiversity hotspots occur in the riparian corridors and the grasslands.**

- Wallace, Cynthia S.A., Miguel L. Villarreal, and Laura M. Norman. 2011. "**Development of a High-Resolution Binational Vegetation Map of the Santa Cruz River Riparian Corridor and Surrounding Watershed, Southern Arizona and Northern Sonora, Mexico.**" U.S. Geological Survey Open-File Report 2011-1143: 22. <http://pubs.usgs.gov/of/2011/1143/>
- Villarreal, Miguel L., Norman, Laura M., Boykin, Kenneth G., and Wallace, Cynthia S.A. 2012 In Review, **Biodiversity losses and conservation trade-offs: assessing future growth scenarios for a North American transnational trade corridor**, submitted to International Journal of Biodiversity Science, Ecosystem

# URBAN GROWTH SCENARIOS impact BIODIVERSITY

Current Trends: 45% of existing riparian woodland, & 34% of semi-desert grasslands  
\*\*\* *approximately ½ the species predicted to live in these habitats*  
Megalopolis: 44% riparian woodland & 24% semi-desert grassland ...(reduces loss)



Villarreal, M.L., Norman, L.M., and W.B. Labiosa. 2012 In Review, "Assessing the vulnerability of human and biological communities to changing ecosystem services using a GIS-based multi-criteria decision support tool: The Santa Cruz Watershed Ecosystem Portfolio Model", 6th International Congress on Environmental Modelling and Software - iEMSs 2012, Managing Resources of a Limited Planet: Pathways and Visions under Uncertainty, Leipzig Germany, 1-5 July.

# Santa Cruz Watershed Ecosystem Portfolio Model "SCWEPM"

LAND-USE

CLIMATE



**Economic // Market  
Land Price**

Biophysical  
// Ecological Value

Social //  
Human  
Well-Being

# Measuring the Impacts of Natural Amenities and the US-Mexico Border, on Housing Value

## Property Value Function

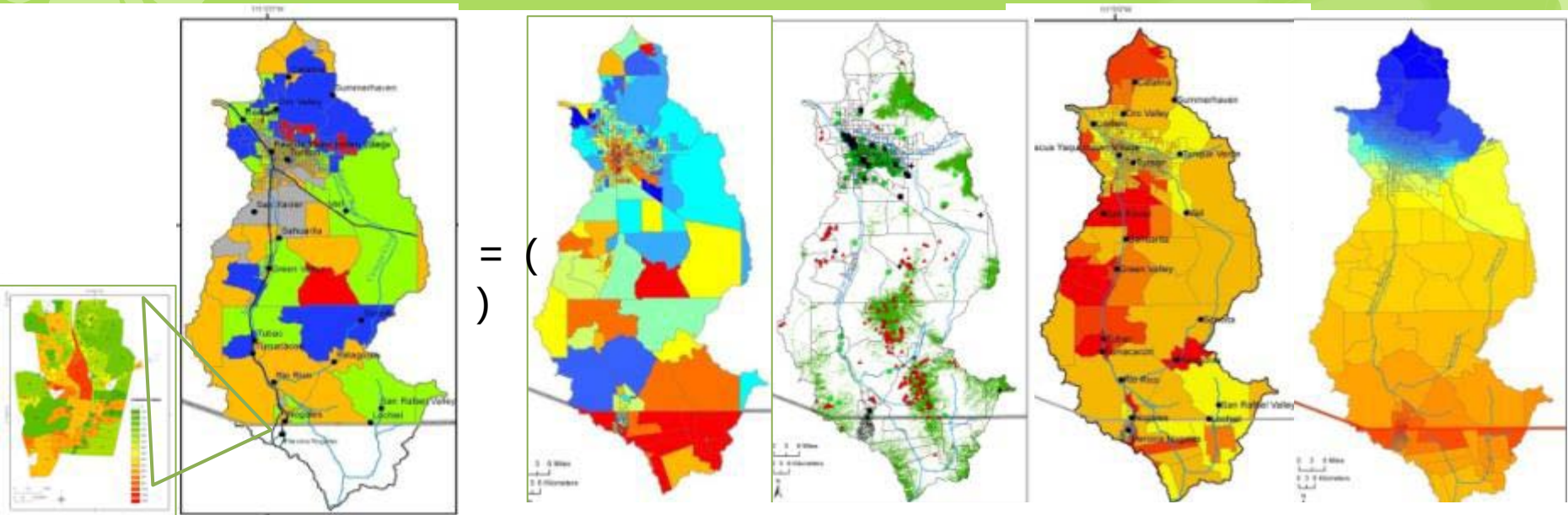
$$V=f(H,E,S,B)$$

Where H = Home structure

E = Environmental amenities

S = Societal factors

B = Proximity to Border



**Value of the house is a function of the home structure, environmental amenities, societal factors and proximity to the border... [V=f(H,E,S,B)]**

Combine census data with GIS data for vegetation and land cover, land administration, measures of species richness and open space, and proximity to amenities and disamenities. ...

# Spatially-Weighted Hedonic Modeling



**US Census block groups having**

- **more vegetation identified as “species-rich”,**
- **having closer access to public lands,** or
- **more undeveloped** and
- **private land**

had higher median home values. \$\$\$\$\$

In contrast, home values in US census block groups

- **closer to the US-Mexico border or**
- **airports / air bases**

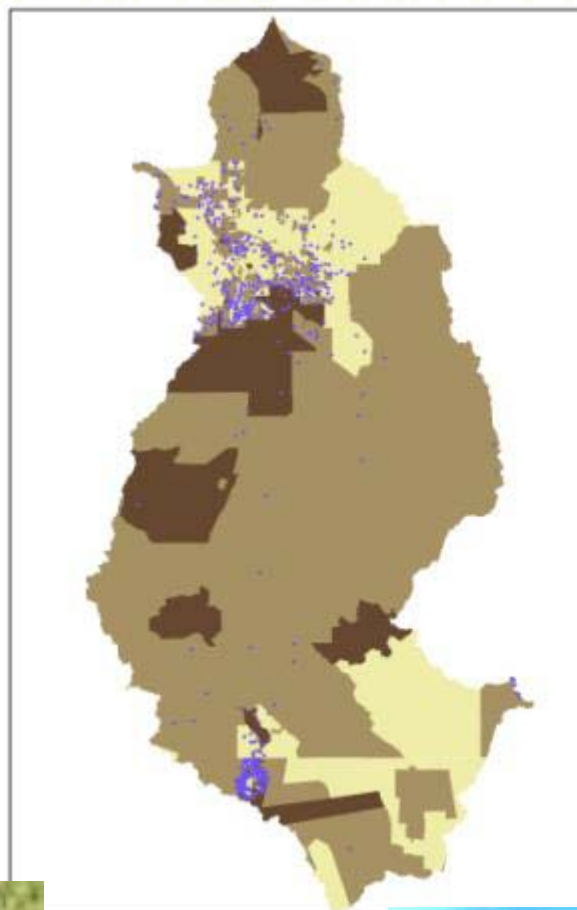
had lower median home values. \$

Future research:

- upload hedonic-pricing model for US-Census to SCWEPM
- expand this effort into Mexico, using AGEBS
- compare future growth scenarios or other management scenarios to discern potential impacts on current market price...

# HEALTH STATISTICS AND DISEASE INCIDENCE FOR CHILDREN 0-19 YEARS OLD LIVING IN THE SANTA CRUZ WATERSHED

- higher low birth weight rates,
- spontaneous fetal death rates,
- infant mortality rates,
- specific birth defect rates,
- infant and 1-14 year old death rates from congenital anomalies/malformations,
- childhood leukemia rates, and
- reportable cases of specific infectious disease caused by waterborne contaminants.



## Legend

Children between the ages of 0-14

1 Dot = 400

P\_0A14\_A

Socio-Environmental Vulnerability Index

low

medium

high

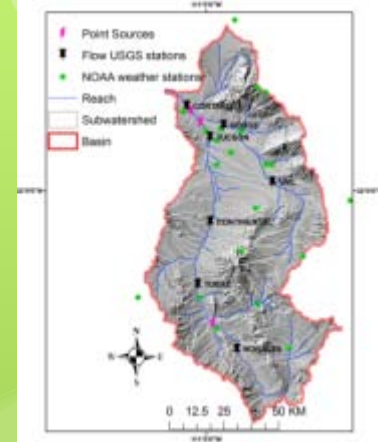


0 4.5 9 18 Miles

0 4.5 9 18 Kilometers



# Contaminants in the Santa Cruz River



- The SWAT model has been calibrated for the Watershed using new Land Use Change Maps
- Future Research
  - SWAT model will be used in combination with field data to identify key sources of contaminants, contributing areas, and transport modes to track their movement to surface waters.
- The SWAT model will then be used to identify critical sub-watersheds where implementing management practices could be most effective to abate pollution.

- Norman, Laura M., Callegary, James, van Riper, Charles, III, and Gray, Floyd, 2010, **The Border Environmental Health Initiative; investigating the transboundary Santa Cruz watershed: U.S. Geological Survey Fact Sheet 2010-3097**, 2 p. [<http://pubs.usgs.gov/fs/2010/3097/>].
- Villarreal, Miguel L., Laura M. Norman, Cynthia S.A. Wallace, and Charles van Riper. 2011, "**A Multitemporal (1979-2009) Land-Use/Land-Cover Dataset of the Binational Santa Cruz Watershed.**" U.S. Geological Survey Open-File Report 2011-1131: 26. <http://pubs.usgs.gov/of/2011/1131/>
- Niraula, Rewati, Norman, Laura M., Meixner, Thomas, and Callegary, James, 2012 In Review, **Multisite calibration of a semi-arid Santa Cruz watershed in Arizona-Mexico Border using SWAT**, submitted to Air, Water and Soil Research.

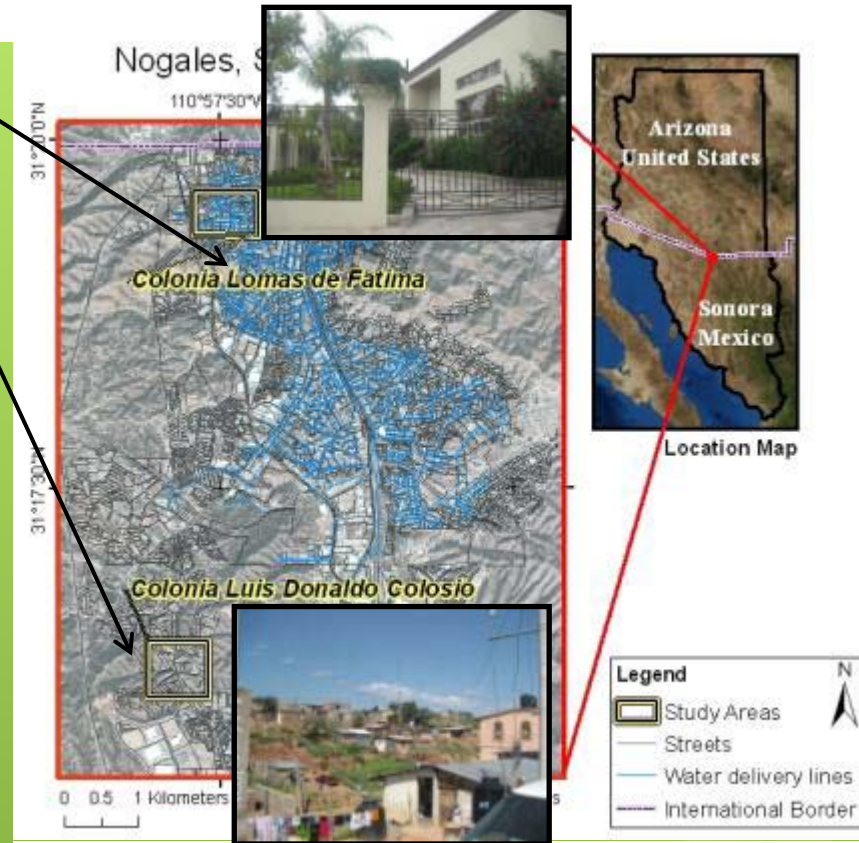
# Water Quality and Health Analysis in Two Different Colonias of Nogales, Sonora, Mexico

**Colonia Lomas de Fatima:** high socio-environmental conditions with municipal piped water  
**Colonia Luis Donald Colosio:** low socio-environmental conditions, served by water trucks (pipas)

\* Water collected from point-of-use) & analyzed for microbial and inorganic water quality parameters known to impact human health: *Escherichia coli* (E. coli), total coliform bacteria, arsenic, lead....

\* A survey was developed and implemented to characterize perceptions of water quality, health impacts, and quality of life.

1. All metal concentrations below the US Environmental Protection Agency's maximum contaminant levels (MCLs).
2. E. coli concentrations exceeded the US EPA's drinking water standard in Colosio but not Fatima.
3. Microbial contamination higher in the summer than winter in both colonias.
4. Survey corroborated reports of gastrointestinal illness in the summer months but not in the winter.



- Norman, Laura M., Caldeira, Felipe, Callegary, James, Gray, Floyd, O' Rourke, Mary Kay, Van Rijn, S., and Meranza, Veronica, 2012 In Press, **Socio-Environmental Health Analysis in Nogales, Sonora, Mexico**, accepted by Water Quality, Exposure and Health (WQEH)
- Caldeira, F., O'Rourke, M. K., & Gil, C. (2011). **Water and Wellness in Two Colonias of Nogales, Sonora, Mexico**. *The International Journal of Health, Wellness and Society*, 1(3), 193–212.

# Public Values

## Upper Santa Cruz



Photo: Sky Island Alliance



Photo: Sonoran Institute

## Middle Santa Cruz



Photo: Tucson Audubon



Near Camino Del Cerro



## Public Values for the Santa Cruz River

- Natural resource variation along river axis
- Socio-demographic variation along river axis

Data from Census 2000

| Location          | Persons | Median Age | HH Size | Median HH Income |
|-------------------|---------|------------|---------|------------------|
| Rio Rico NE       | 3,164   | 32.2       | 3.12    | 51.0             |
| Rio Rico NW       | 2,882   | 24.1       | 3.68    | 31.1             |
| Rio Rico SE       | 1,590   | 27.1       | 3.83    | 32.4             |
| Rio Rico SW       | 2,777   | 27.8       | 3.83    | 36.5             |
| Tubac             | 949     | 58.5       | 1.97    | 39.4             |
| Tumacacori-Carmen | 569     | 41.2       | 2.55    | 35.9             |
| Amado             | 275     | 36.8       | 2.64    | 20.4             |
| Tucson            | 486,699 | 32.1       | 2.42    | 31.0             |

Matt Weber, Ph.D.,

Economist,

US EPA, Corvallis, OR

Weber, Matt, Ringold, Paul, Thurston, Hale, Norman, Laura, Tallent-Halsell, Nita and Labiosa, William, 2010, **Using Focus Groups to Understand Ecosystem Services of an Impacted Southwestern River** [abs.]: ACES, A Conference on Ecosystem Services, Dec., 2010, Phoenix, AZ.

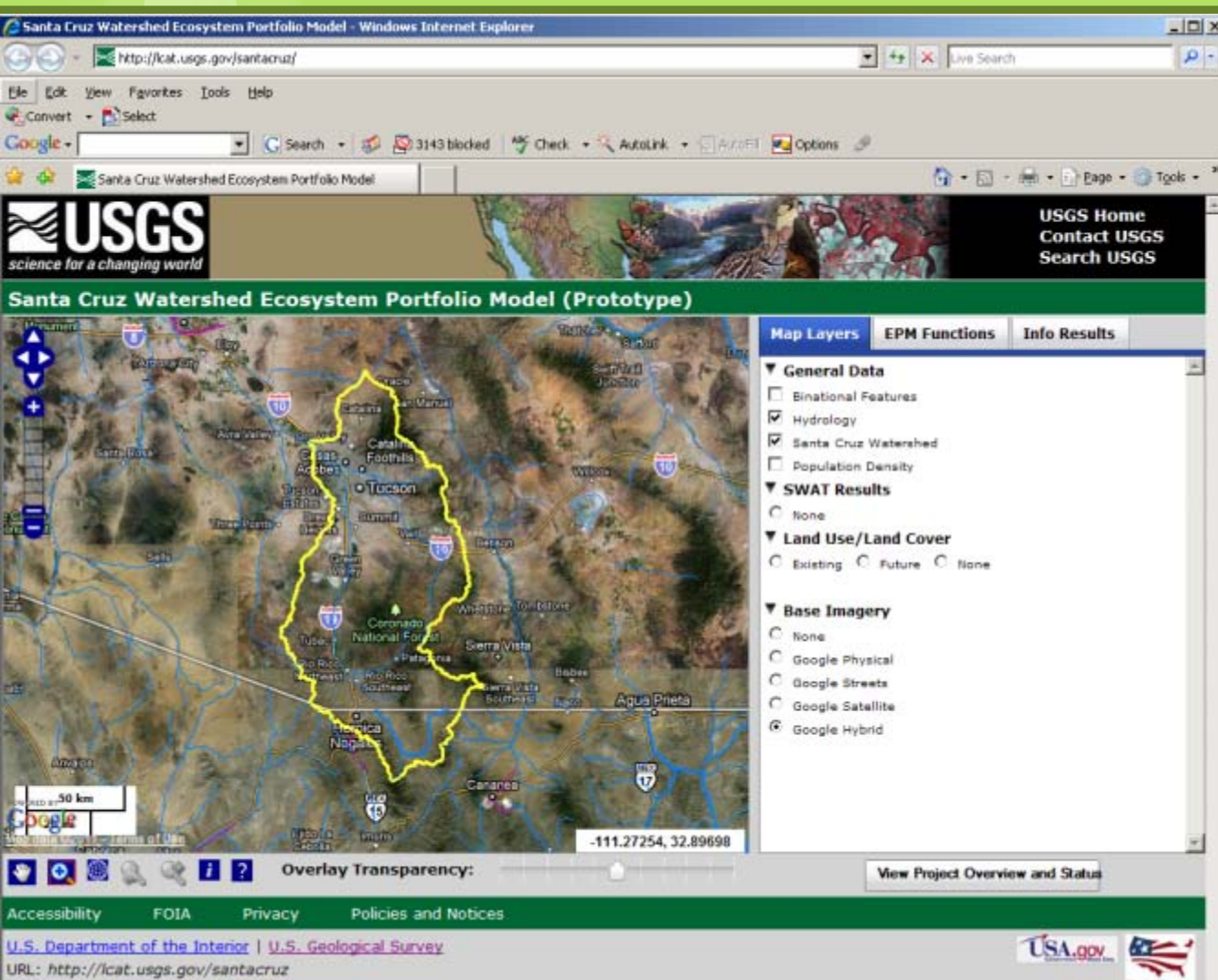
# SCWEPM → Impacts of Global Change

- Using futuristic maps / climate scenarios as new input, rerun calibrated
  1. hydrologic model,
  2. habitat model, and
  3. hedonic model.
- What are the associated costs and benefits of different management regimes?

**○ *Which ecosystem service is taking the hardest hits?***

**○ *Are vulnerable populations being protected or exploited?***

# Online Decision Support System



- Ecosystem Services
- Prototype Online
- Streaming live data from the BEHI and Google Earth websites
- SWAT runs live through interface

# Provide unbiased data and tools online to allow for *more-informed* decisions

User has the option to include (or not) each of the criterion mapped out for each sub-model.

Here is the ecological submodel criterion, but we also can weight the economic and human well-being submodels...

I.E. → Do we care about TES for this decision or not? If so, is it more important than species richness?

The screenshot shows a web browser window titled "EPM Criteria - Mozilla Firefox" with the URL <http://cat.usgs.gov/sflorida/epmparms.html>. The page is titled "EPM Criteria" and contains several input fields and checkboxes for configuring an EPM run.

**Name of Run:** [Text Input Field] **Overwrite Existing EPM Run:** ☐

**Description:** [Text Input Field]

**Land Cover:** [Dropdown Menu] (Currently set to FLUCCS 2004)

**Weight the relative importance of each ecological criterion:**

|                                         |       |                    |         |                      |       |         |        |     |       |
|-----------------------------------------|-------|--------------------|---------|----------------------|-------|---------|--------|-----|-------|
| Biodiversity Potential:                 | [1.0] | p:                 | [100.0] |                      |       |         |        |     |       |
| Threatened, Endangered & Focal Species: | [1.0] | Pref p:            | [3.0]   | Wt:                  | [2.0] | Suit p: | [5.0]  | Wt: | [1.0] |
| Rare & Unique Habitats:                 | [1.0] | p:                 | [1.302] |                      |       |         |        |     |       |
| Waterway Quality Buffer Potential:      | [1.0] | TN Wt:             | [1.0]   | TP Wt:               | [1.0] | SS Wt:  | [1.0]  |     |       |
| Landscape Patterns & Fragmentation:     | [1.0] | CA p:              | [53.06] | Wt:                  | [1.0] | CORE p: | [50.0] | Wt: | [1.0] |
|                                         |       | Cohesion Wt:       | [1.0]   | Habitat Neighbor Wt: | [1.0] |         |        |     |       |
|                                         |       | Biodiversity Wt:   | [1.0]   | Nat. Wt:             | [4.0] | Decay:  | [1.0]  |     |       |
| Restoration Potential:                  | [1.0] | TES Wt:            | [1.0]   | Water Wt:            | [4.0] | Decay:  | [1.0]  |     |       |
|                                         |       | PnRkld/Hammock Wt: | [2.0]   | Well Wt:             | [4.0] |         |        |     |       |

**Buttons:** [Run EPM] [Cancel]

**Status Bar:** Done

# Community Recognition

WR Geography · Windows Internet Explorer

http://geography.wr.usgs.gov/science/ecoservices/SCWatershedSp.html

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## Servicios de los Ecosistemas Análisis del Cambio Climático y el crecimiento urbano en el Alto de Santa Cruz de cuencas hidrográficas, la cuenca de Santa Cruz de Ecosistemas cartera modelo (SCWEPM)

### INTRODUCCIÓN

La administración y propiedad de la Cuenca del Santa Cruz (SCW) está dividida en cuatro naciones gobernantes: la Nación Tohono O'odham, la tribu Pascua Yaqui, México y los Estados Unidos (fig. 1). El manejo del uso de la tierra tiene un impacto en los procesos naturales y define la disposición de la tierra. El modelo de portafolio de los Ecosistemas (EPM), es una herramienta de apoyo a la decisión, y está siendo desarrollado para imitar los servicios de los ecosistemas y los escenarios alternativos sobre la base de predicciones de desarrollo urbano y cambio climático. El EPM es una herramienta de evaluación basada en un mapa multi-criterio que las partes interesadas pueden utilizar para compensaciones entre la valoración de las cuencas hidrográficas y los atributos de los ecosistemas a escalas múltiples para uso dentro de un proceso de decisión participativa.

Tenemos la intención de aplicar dicho mecanismo en el SCW para apoyar la equidad del medio ambiente mediante el fomento de la participación entre los residentes. La intención de esta investigación es evaluar los problemas de servicio de los ecosistemas de la cuenca internacional, pero sin perder el foco en las necesidades de los interesados. El SCWEPM utilizará un

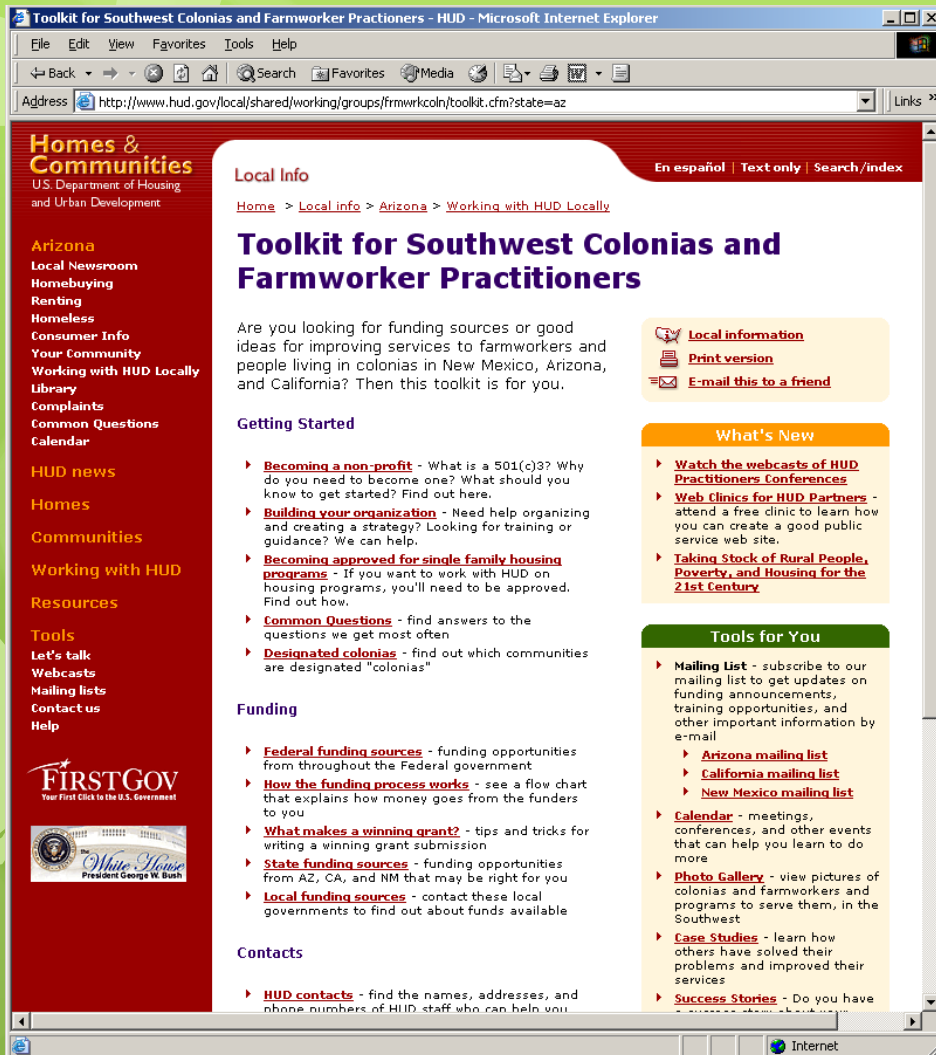


SCWEPM

Local intranet 100%

- Meeting attendance
- Regular e-mail correspondence
- Dataset creation (colonias, infrastructure and resources)
- Translation to Spanish!

# End -Uses: Acquire “Colonias” funding



## HUD Funding in Arizona

➤ More than 40 colonias projects have been funded in Arizona...

➤ Projects primarily include investments in sewer & water infrastructure, but also items such as housing rehab, installation of roads, street lights, youth centers, and library.

# End Uses- Urban Planning

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- Provide the same datasets and high-technology software to all
- Combine data describing public works, aerial photography, transportation, and housing information for overlay analyses
- Visualize across the Int'l border
- Internet is accessible 24-hours a day
- Anyone with Internet access can utilize
- Promote sustainable development by supplying tools to visualize potential growth

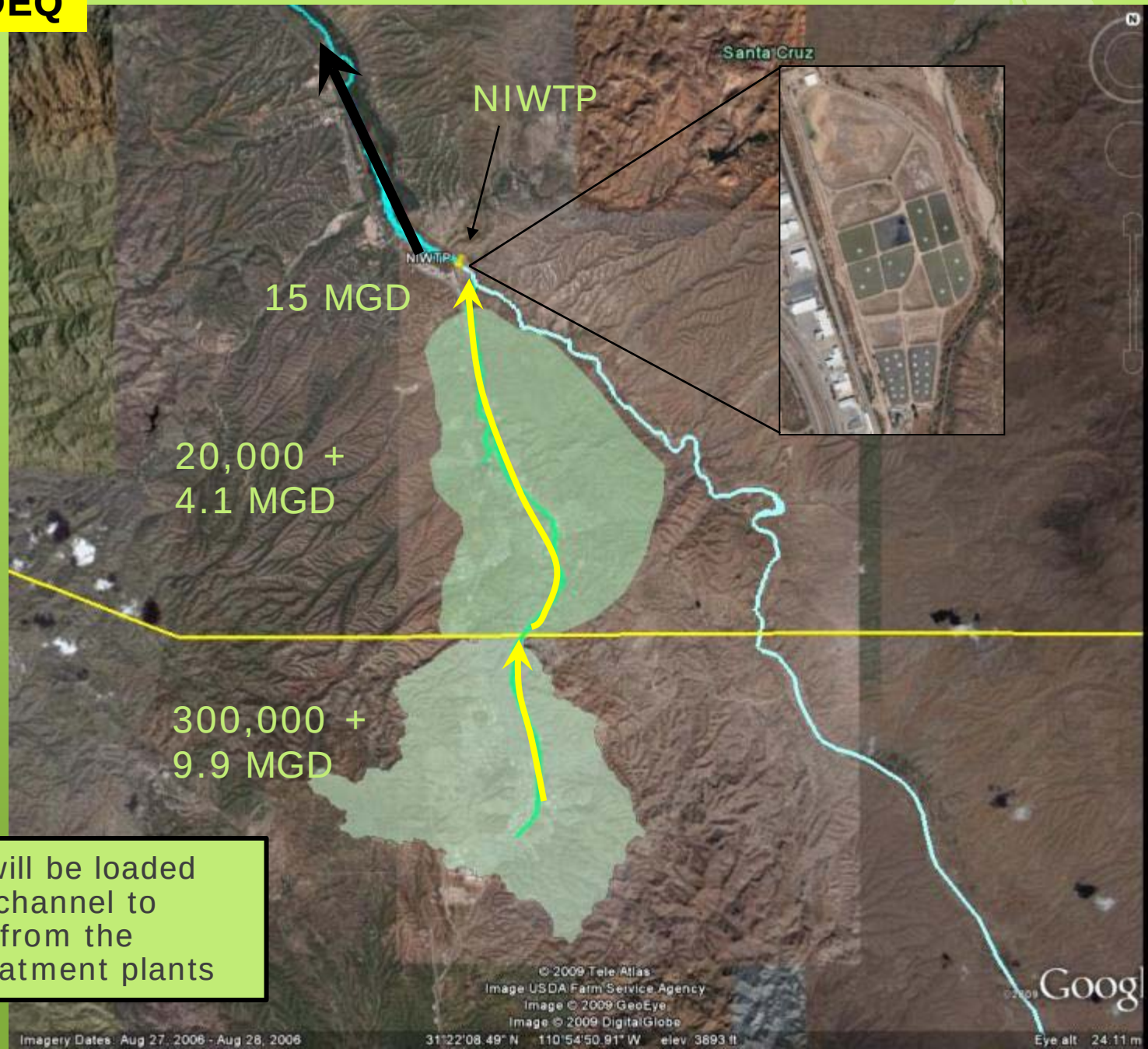
# Binational Water Policy & Decision-making

June 2012: Arizona – Mexico Commission

The AMC's mission is to improve the economic well-being and quality of life for residents through a strong cooperative relationship with Mexico and Latin America through advocacy, trade, networking & information.



# Diagram by Hans Huth; ADEQ

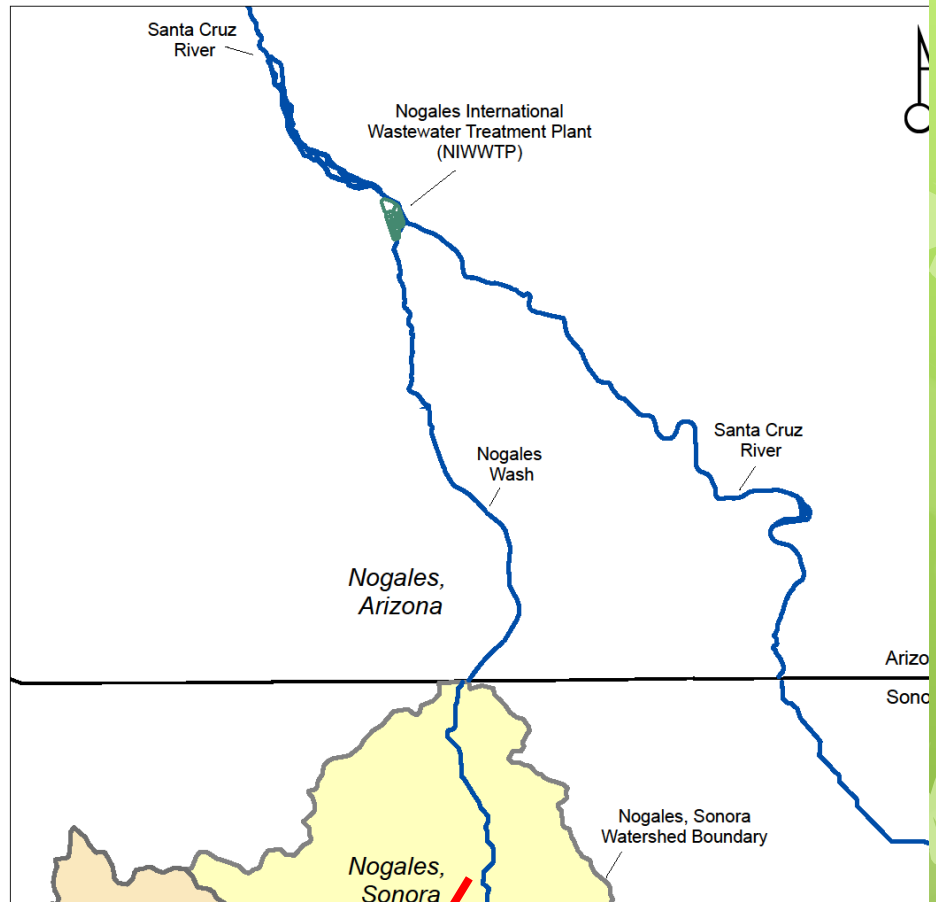


- Point sources will be loaded directly to the channel to simulate input from the wastewater treatment plants

## Inter-basin Transfer

Once we simulate input from the wastewater treatment plants and adjust calibration of the model—we can then predict what might happen in the Santa Cruz Watershed in terms of Ecosystem Services...

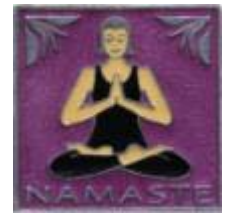
Ambos Nogales Hydrography



# Outreach: “Google Group; SCWEPM Folks”

- Began June 25, 2009, as a group of people working to develop the Ecosystem Portfolio Model as a multidisciplinary platform for the Santa Cruz watershed.
- Over 90 members as of March 20, 2012, including private stakeholders/citizens and representatives from: Arizona Department Emergency and Military Affairs (ADEMA), Arizona Department of Environmental Quality (ADEQ) Arizona Department of Water Resources (ADWR) Arizona Land and Water Trust (ALWT), Arizona State University (ASU), Bureau of Land Management (BLM), City of Nogales-Sonora, Friends of the Santa Cruz River (FOSCR), Global Community, International Boundary and Water Commission (IBWC), Santa Cruz County Flood Control, Sonoran Institute (SI), Sustainable Santa Cruz, The Nature Conservancy (TNC), Tucson Audubon Society (TAS), University of Arizona- Bureau of Applied Research and Anthropology (UA-BARA), University of Arizona-Geography, University of Arizona-Hydrology and Water Resources, US Army Corps of Engineers (USACE), US Department of Agriculture-Agricultural Research Station (USDA-ARS), US Environmental Protection Agency (EPA), US Geological Survey (USGS), and Watershed Management Group (WMG)....

# ACKNOWLEDGEMENTS



This project is funded by:

**USGS Geographic Analysis and Monitoring (GAM) Program;**  
**USGS U.S.-Mexico Border Environmental Health Initiative (BEHI); &**  
**US EPA's Ecosystem Services Research Program (ESRP)**

Agencies and partners:

**USGS** (Bill Labiosa, Miguel Villarreal, James Callegary, David Strong, Mark Feller, Cynthia Wallace, Floyd Gray, Nicholas Paretti, Charles van Riper, Rachel Sleeter, Silvia Wilson, Diana Papoulias, and Jean Parcher);

**US EPA** (Matt Weber, Yongping Yuan, Wenming Nie, and John Lin);

**US NPS, Tumacacori National Historical Park** (Jeremy Moss & Jason Welborn);

**Tohono O'Odham Nation, San Xavier District** (Austin Nunez, & Scott Rogers);

**Arizona State University** (Francisco Lara-Valencia);

**University of Arizona** (George Frisvold, Tom Meixner, Rewati Niraula, Gaurov Arora, Felipe Caldeira, Gladys Amaya, Katie Hirschboeck, Sandy Dall'erba, Laura López-Hoffman, Phil Guertin, Francina Dominguez, Amy McCoy, and Chris Scott);

**New Mexico State University** (Ken Boykin)

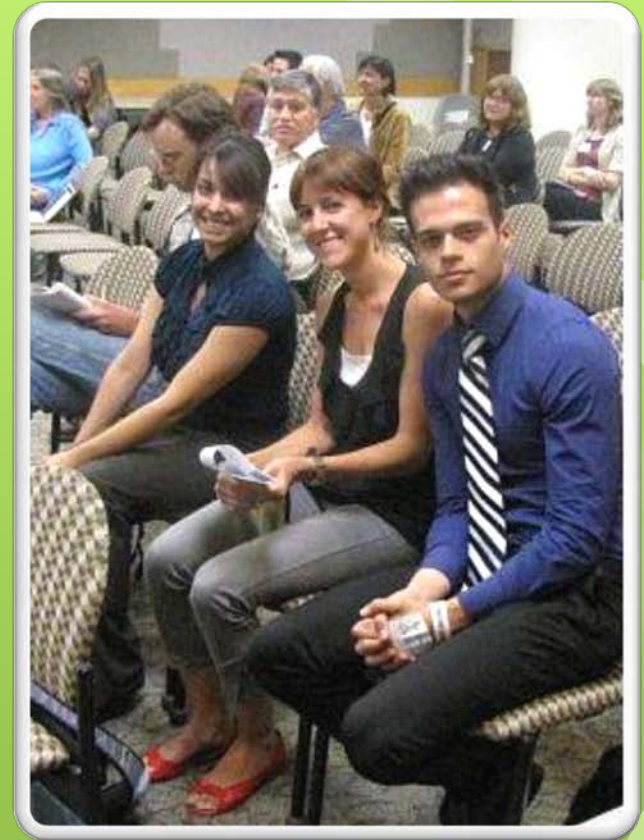
**Arizona Department of Environmental Quality** (Hans Huth and Jose Rodriguez);

**Instituto Municipal de Investigación y Planeación** (Claudia Gil Anaya, Edgar Castellanos, Edgar Tepezano);

**Sonoran Institute** (Emily Brott and Claire Zugmeyer); &

**Friends of the SCR** (Sherry Sass, Jen Parks, Ben Lomeli, and Sofia Grigera). ☺

# Thank you!



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*en Espanol:*

<http://geography.wr.usgs.gov/science/ecoSevicesSCWatershedSp.html>