

Introduction

- Riparian areas and wetlands in the borderlands between southern Arizona and northern Sonora, Mexico arid region play a disproportionate role in sustaining biological diversity, yet it is estimated that over 90% of the historical wetlands and riparian areas have been lost due to habitat destruction and changing land uses.
- In the borderlands area, gabion and other detention features are being proposed to help restore vegetation and habitats to native conditions. The impact of these features on riparian vegetation has yet to be quantified.



Photo courtesy of City of Nogales, Sonora

Figure 1: Gabions/ Detention Features in Nogales, Sonora (Norman et al. 2010)

- Gabions were installed in Nogales, Sonora (Figure 1), at varying times, some of which are documented in 2011 and 2012 (Table 1).
- We set up a monitoring system to track the visual changes in vegetation around these gabion/rock dams.

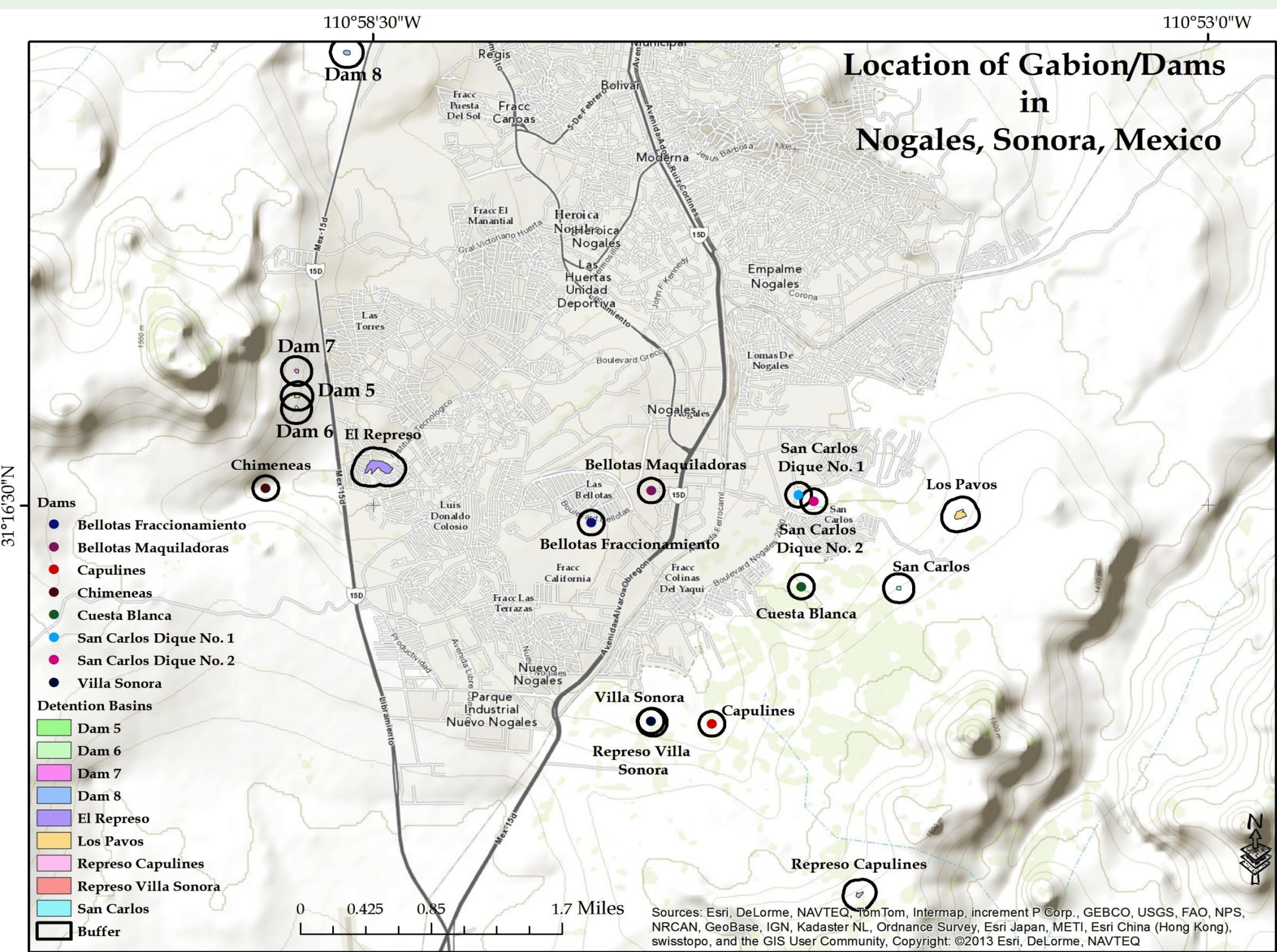


Figure 2: Study area and location of dams/gabions and detention basins in Nogales, Sonora, Mexico

Objectives

- Incorporate use of Aerial photographs, tools, and geospatial application to map changes through time
- Document changes in presence/absence of vegetation cover
- Analyze vegetation changes through time from before and after gabion construction

Methods

- Series of aerial photographs or high-resolution satellite imagery was used to analyze the vegetation changes over time.
- Data were identified from 1994-2012 that depict our study area.
- Identified sixteen dams/gabions/detention basins in Nogales, Sonora, Mexico for our study (Figure 2).
- Data used in this study was acquired in 1994, 2003, 2005, 2006, 2011 and 2012 in Nogales, Sonora, Mexico and accessed via Google Earth.
- Created a 135 m buffer ring around each gabion / dam location, so that riparian vegetation within a uniform area could be captured for each detention feature (Figure 3).
- Riparian vegetation around these gabions was digitized manually using a series of aerial photographs or high-resolution satellite images (Figure 4).
- Polygons of digitized vegetation were compared over time.
- All the aerial photographs were compared with each other to analyze vegetation changes through time from before and after gabion construction.
- Precipitation data from 1990-2012 for Nogales was also analyzed to evaluate its impact on vegetation (Figure 8).
- Visual analysis or manual-interpretation approach was used to detect vegetation changes through time.

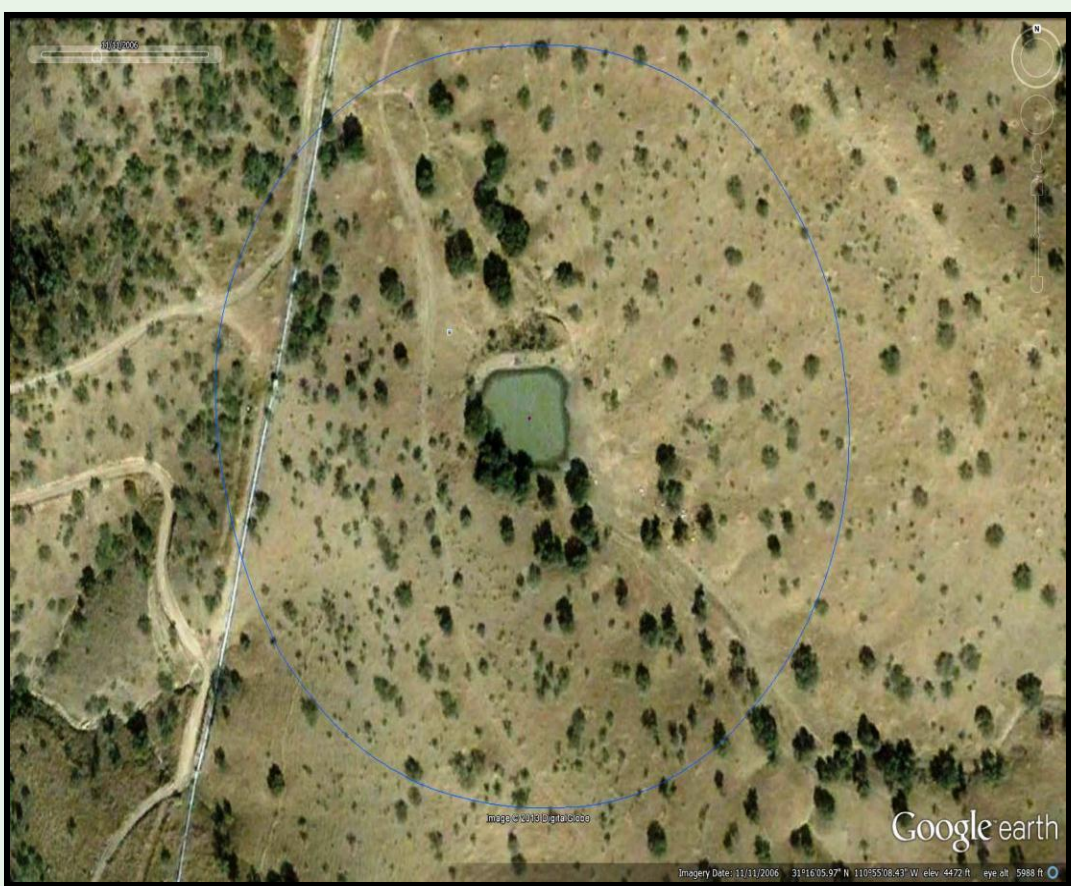


Figure 3. Aerial Photograph depicting vegetation in San Carlos on 2.29.2003 (135 m buffer ring shown in blue color)

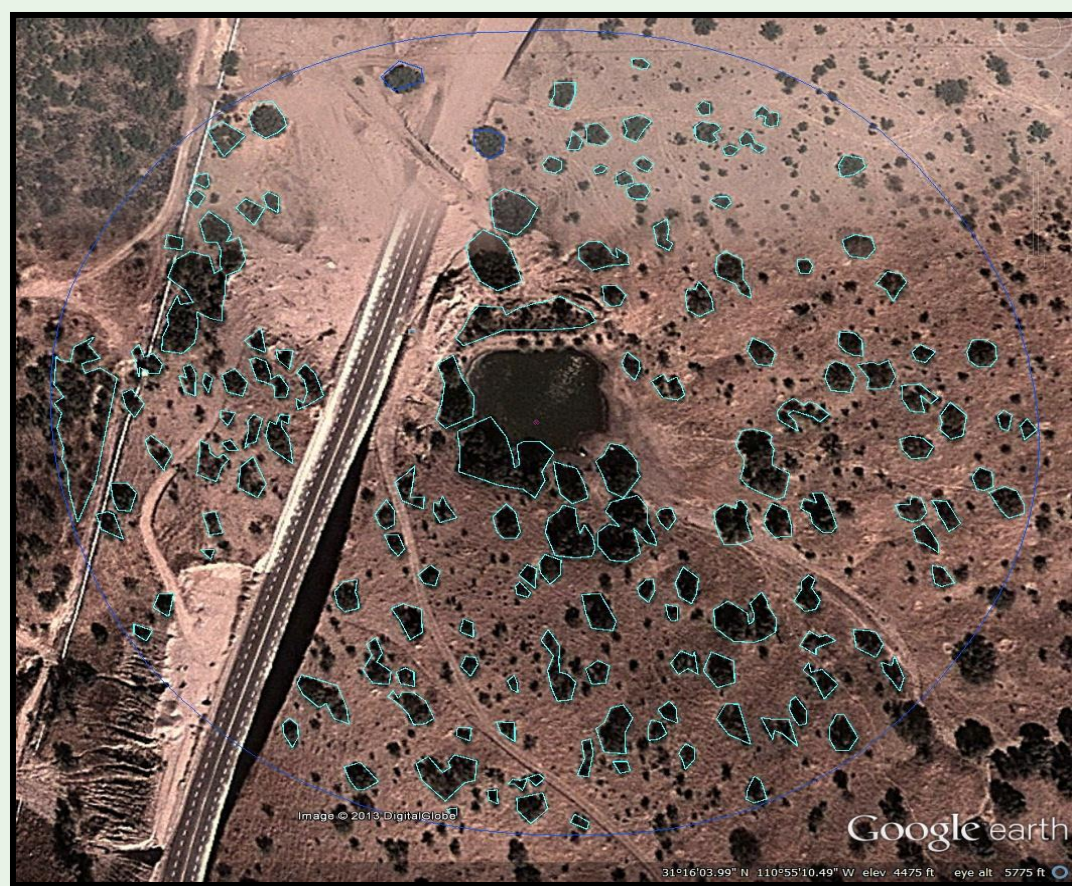


Figure 4. Aerial Photograph of San Carlos depicting vegetation in digitized polygons on 10.23.2012 (135 m buffer ring shown in blue color).



Figure 5. Aerial Photograph depicting vegetation in Capulines on 12.29.2003 (135 m buffer ring shown in blue color).



Figure 6. Aerial Photograph of Capulines depicting vegetation in digitized polygons on 5.12.2011 (135 m buffer ring shown in blue color).

Methods Continued

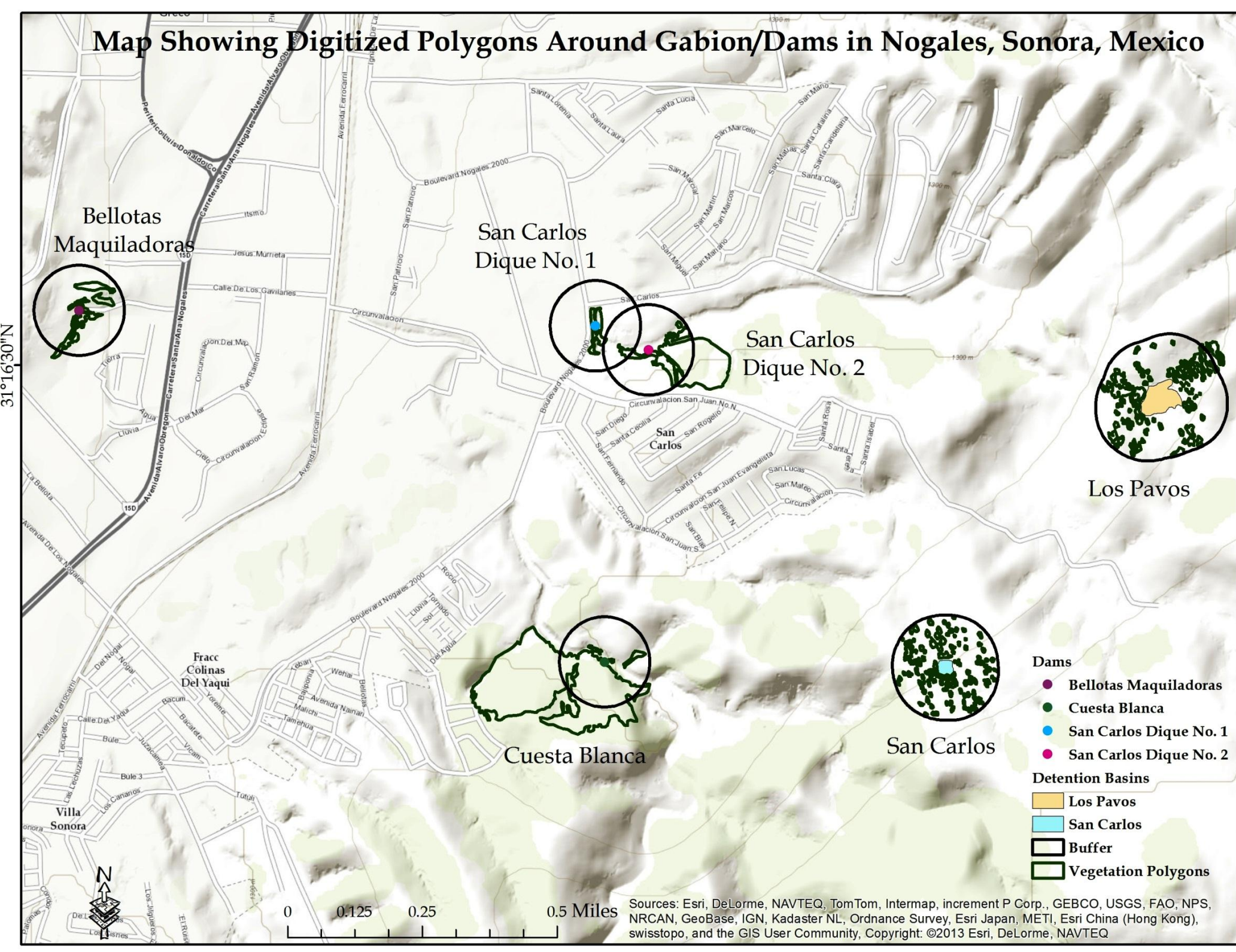


Figure 7: Map showing digitized vegetation polygons around dams/gabions in Nogales, Sonora, Mexico

Table 1. Gabion presence and absence by satellite

ID	Name of Dam/ Gabion	Gabion Installation Period
1	Reproso Capulines	05.12.2011
2	San Carlos	12.29.2003
3	Los Pavos	05.12.2011
4	El Represo	05.12.2011
5	Dam 5	Gabion Structures not visible
6	Dam 6	Gabion Structures not visible
7	Dam 7	Gabion Structures not visible
8	Dam 8	Gabion Structures not visible
9	Villa Sonora & Represo Villa Sonora	05.12.2011
10	Capulines	05.12.2011
11	Cuesta Blanca	05.12.2011
12	San Carlos Dique No. 1	Gabion Structures not visible
13	San Carlos Dique No. 2	Gabion Structures not visible
14	Bellotas Fraccionamiento	Gabion Structures not visible
15	Bellotas Maquiladoras	Gabion Structures not visible
16	Chimeneas	03.16.2010

Results

- We observed the vegetation changes in sixteen detention features in borderlands area.
- Visual examination/interpretation of the different maps during different time- period enabled us to identify general patterns of spatial variability in the amount of vegetation change.
- During 1990 to 2012 there is little recognizable vegetation change related to gabion installation in Nogales watershed.
- Some areas show very little significant vegetation change but most of the other regions had no significant vegetation change trend.

Results Continued

- Results indicated that not much of the study area had experienced a significant vegetation increase and decrease over the study period.
- Results show that vegetation in these areas is being maintained, despite a period of drought; therefore precipitation is not the major cause of the significant increase or decrease in vegetation change over time.
- These results suggested that there was no positive link between the significant vegetation increases or decreases and precipitation and temperature change.

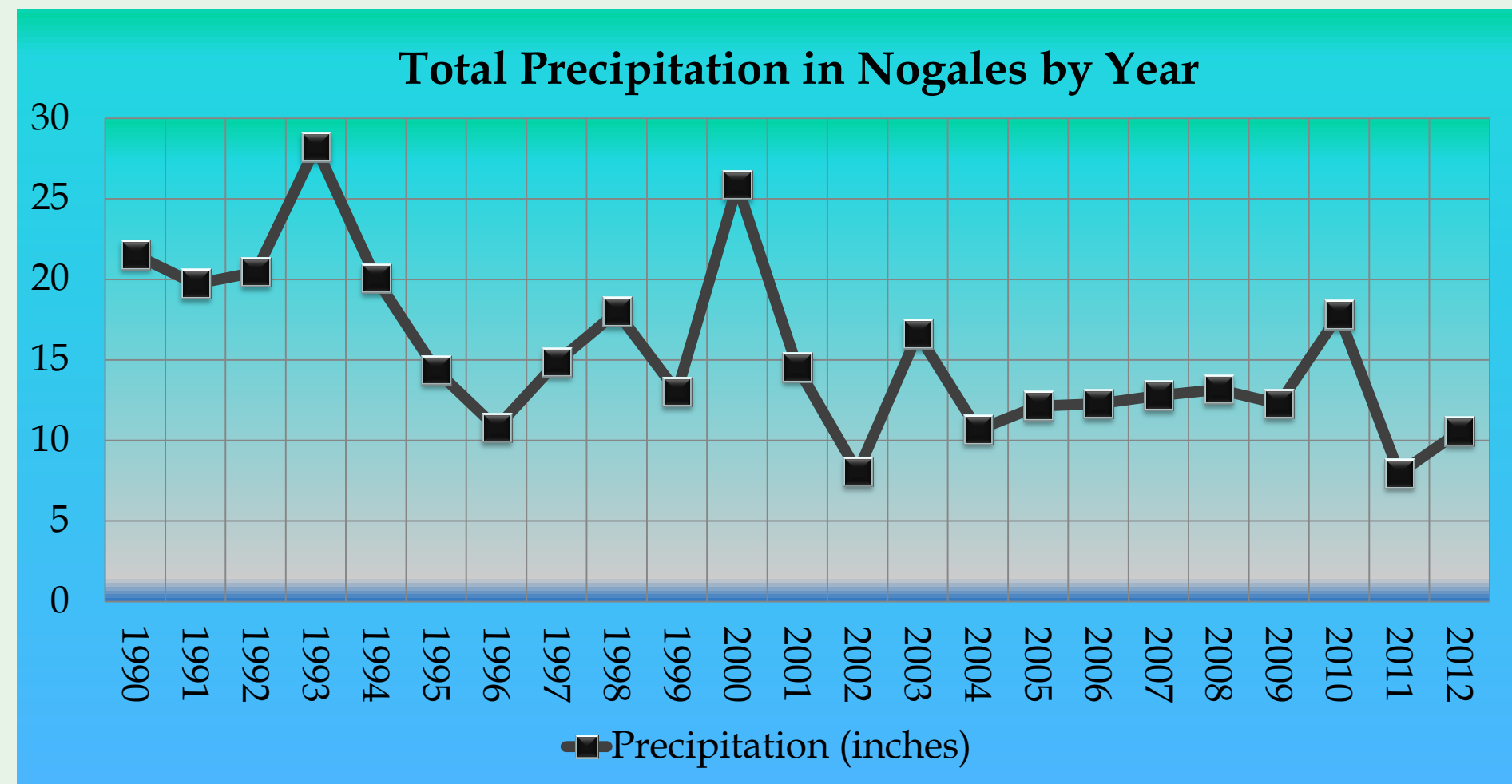


Figure 8: Total Precipitation in Nogales from 1990-2012

Conclusion / Future Research

- During the period from 1990 to 2012, results show that in the Nogales watershed there is little significant vegetation change related to gabion installation.
- There may be couple of factors responsible for this. First, it could be possible that water level in these dams was not good enough to impact the riparian vegetation & second, the urban development in the area could be an impact.
- Our results indicate that even simple methods of visual interpretation of historical aerial photographs may serve as an effective tool for the detection and quantification of long-term, landscape patterns of vegetation dynamics

Future Research Possibilities:

- Get construction dates for each gabion in the study area from the authorities.
- Long-term monitoring to examine impacts of detention features on vegetation.

Acknowledgement of Data

- Imagery courtesy of the Google Earth.
- Temperature data was provided Western Regional Climate Center, Reno, NV <http://www.wrcc.dri.edu/>
- Norman, L.M., Levick, L., Guertin, D.P., Callegary, J., Quintanar Guadarrama, J., Zulema Gil Anaya, C., Prichard, A., Gray, F., Castellanos, E., Tepezano, E., Huth, H., Vandervoet, P., Rodriguez, S., Nunez, J., Atwood, D., Patricio Olivero Granillo, G., and Octavio Gastelum Ceballos, F., 2010, Nogales flood detention study: U.S. Geological Survey Open-File Report 2010-1262, 112 p. [<http://pubs.usgs.gov/of/2010/1262/of2010-1262.pdf>]