ECOLOGICAL CHARACTERIZATION OF A RIPARIAN CORRIDOR

ALONG THE RIO CONCHOS, MEXICO

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ABSTRACT—Restoration of riparian areas is an important step towards improving water flow and water quality of the Rio Conchos in northern Mexico. To provide background data for restoration decisions we characterized the ecological integrity of a 40 km long riparian corridor along the middle Rio Conchos. The characterization consisted of determining dominant species of trees and shrubs, structure, and riparian habitat quality using standard transect sampling and a riparian habitat quality index (QBR index) along the corridor. Our data indicate that while native willow (*Salix babilonica*) and mesquite (*Prosopis grandulosa*) are the dominant trees in the riparian zone, habitat degradation is occurring, and that the major sources of negative impacts to riparian habitat are, in order, overgrazing, sewage input, and gravel extraction to river channel. Invasive saltcedar *(Tamarisk ramosissima)* populate nearby agricultural lands and irrigation canals but have not yet invaded the riparian areas of the middle Rio Conchos.

RESUMEN—La protección de áreas ribereñas es un paso importante para el mejoramiento del gasto y calidad del agua del río Conchos, este río localizado en el norte de México. En este estudio, y con el objetivo de obtener datos base para planes de restauración, caracterizamos la

integridad ecológica de un segmento de 40 Km. de zona ribereña del medio río Conchos. Esta caracterización consistió en la identificación de especies dominantes de árboles y arbustos , estructura, y calidad de hábitat utilizando métodos estándar así como un índice de calidad de hábitat ribereño (QBR). Los resultados indican que a pesar de ser los árboles dominantes especies nativas de sauce (*Salix babilonica*) y mesquite (*Prosopis grandulosa*) , la zona ribereña presenta signos de degradación de hábitat especialmente por sobrepastoreo, descarga de aguas negras, y extracción de grava del lecho del río, en orden de mayor a menor impacto. El árbol invasor cedro de sal (*Tamarix ramosissima*) se puede observar a lo largo de canales de irrigación y áreas de cultivo cercanas pero no se encontró ninguno de estos árboles en el área muestreada del río Conchos.

Vegetation vitality is essential for ecosystem function and structure of riparian habitats (Naiman and Decamps, 1997). Although numerous studies on riparian habitat have been reported for the parts of the Rio Grande basin located within the U.S., few have been reported for the parts of the basin extending into Mexico. In the U.S., basins are threatened by various human disturbances such as groundwater decline (Stromberg *et al*., 1996), urban growth (EPA, 2004), and invasive species (Weeks *et al.*, 1987; Howe and Knopf, 1991; Lujan, 2004).

The Rio Conchos is a major river in northern Mexico, its middle and lower portions flowing through the Chihuahuan Desert into the Rio Grande at the Mexico-U.S. border. Very little is known about the riparian vegetation along the river. However, reduction of water quality, diversion of surface water, overgrazing, groundwater depletion, and introduction of non-native species in the past few decades have most likely impacted the Rio Conchos' riparian habitat (CONABIO, 2000). For example, it is estimated that half of the native species of fishes within the basin are threatened with extinction (Hubbs, 1990), and aquatic species in general are being negatively affected by human activity (Edwards *et al.*, 2001).

The Rio Conchos basin lacks both an inventory of species and a management plan to protect those that are threatened. Towards that end we carried out vegetation analyses along a 40 km riparian corridor to assess current species dominance, vegetation cover, and leaf area index (LAI). Our results are a first step towards documenting the quality of the riparian habitat and the extent of saltcedar (Tamarisk) invasion.

Site Description—A 40-km segment of the middle Rio Conchos was selected for this study. This segment is bound by the town of Julimes and the community of El Potrero, at about 175 and 213 km from the river's confluence with the Rio Grande respectively, and shown in Fig. 1. This segment was selected because it is far from large urban centers and therefore affected less by direct human disturbances. At each of the two river locations, Julimes (JL) and El Potrero (EP) sites (coordinates 28°25'15" N, 105° 26' 30" W and 28° 47' 09" N, 105° 28' 57" W), we selected three sampling sites at approximately 200 meters apart and at locations that appeared to us typical of the larger riparian communities.

Sampling and Methods of Analysis— In order to generally describe the vegetation in the area, the relative density, frequency and coverage for each tree and shrub encountered was determined at each of six sites using two conventional methods; the line intercept method first described by Canfield (1941) and the nearest neighbor method first described by Cottam and Curtis (1956). We also included a relatively new method to assess riparian habitat quality based on simple observations, known as the QBR index (Munné *et al*., 2002). This index was developed for Mediterranean stream catchments to provide a rapid but standard assessment of riparian habitat quality. According to Munné *et al*. (2002), the QRB index is expected to work in characterizing semi-arid riparian habitat. However, the QRB index has not been applied to riparian habitats in an arid region, and our conventional sampling serves as a reference to assess its applicability.

At each site the width of the riparian plant community perpendicular to the river's channel from its boundary with the transition zone to desert habitat was determined. From the mid-point of the riparian plant community we laid two 25m transect lines that ran parallel to the river to conduct the line intercept determination. Transect lines were divided into 5m segments (0−5m ¨1¨, 5−10m ¨2¨, 10−15m ¨3¨, 15−20m ¨4¨, and 20−25m ¨5¨) and three segments were randomly selected from each 25m transect line.

The abundance and size distribution of major tree species (e.g., *Populus nigra, Salix babilonica, Prosopis glandulosa)* and invasive salt cedar (*Tamarix ramosissima*) were recorded along sub-transects. Trees were tagged and their circumference at breast height (1.5 m above ground) was recorded. Along each transect, the identity, location and intercept length of all understory species were registered. The number of individuals and intercept lengths for each species were summed along each transect. In addition, leaf area index (LAI) was determined using a digital LAI meter (AccuPar LP-80, Decagon Devices, Inc.). LAI values relate to biomass and evapotranspiration (Dahm *et al*., 2002).

The transects for line intercept were also utilized for nearest neighbor sampling, where random points along the transect were used to mark the center of four quadrants. In each quadrant we measured the distance to the closest tree, its circumference at breast height and its height. We followed the calculations described by Bonham (1989).

The QRB index was determined as a third independent determination of riparian habitat quality, where the QBR index was calculated in the field through a two-sided A4 page completed in 10 min (see Munné *et al*., 2002). This is a simple field method where the ecological quality of riparian habitats is assessed based on four categories of a riparian habitat (vegetation cover, cover structure, cover quality, and channel alterations). Scores for each category range from 0 – 100, with the value of 100 assigned to the highest quality (see Munné *et al*., 2002 for example data sheets and scoring).

Results/Discussion—Dominant trees in sampling locations were willow (*Salix babilonica*), cottonwood (*Populus nigra*), palo verde (*Cercidium texanum*), mesquite (*Prosopis grandulosa*), and desert willow (*Chilopsis linearis*), while dominant shrubs were seepwillow (*Baccharis glutinosa*), shorter varieties of mesquite (*Prosopis julifora*), desert hackberry (*Celtis pallida*), and spiny aster (*Chloracantha spinosa)*, as shown in Tables 1 and 2. All three methods gave consistent results in which willow, mesquite and cottonwood are dominant species of trees, while saltcedar were absent in all locations sampled. However, the information obtained by each method was also unique in reporting certain important characteristics of the riparian habitat. For example, the nearest neighbor focuses on trees while the line intercept includes trees, shrubs, and grasses. Unlike saltcedar which was absent from the riparian area, cottonwood, willow and palo verde were observed in the riparian area but did not cross some of the transect lines, for which its value was reported as not present (N.P.) instead of zero in Table 1. The QBR index was able to identify the area most affected by human disturbances. Although the QBR index is less quantitative and more dependent of the observer's skills than the line intercept and nearest neighbor methods, its determination includes aspects relevant to riparian habitat quality, such as geomorphology of the channel and presence of man-made structures, and can be a valuable complement to the conventional methods.

According to the QBR index (see Table 3), riparian habitat at El Potrero (EP) is of higher quality than that of Julimes (JL), which can be attributed to JL being much closer to large urban centers and more intense irrigation practices. It is evident that the river's self-cleaning processes (e.g., settling of particles, aeration, and adsorption of dissolved ions into solid surfaces) are taking effect along the 40 km segment downstream of JL, improving the water quality and hence the riparian habitat conditions. Nevertheless, cattle were present in all sampling locations of both JL and EP, and their outcome to soil erosion, removal of vegetation and presence of animal waste was evident.

The field sampling occurred a few months after the Rio Conchos flooded for the first time in more than 50 years. Saplings of mesquite were observed at the river banks, but young trees were generally absent. With overgrazing and other disturbances we predict that these mesquite saplings will not grow to maturity. This observation coincides to that reported by Howe and Knopf (1991) who observed a decline in younger trees along the Rio Grande.

Although saltcedar were abundant along irrigation ditches and between agricultural parcels nearby, we did not see any of these trees at the sites we sampled in the middle the Rio Conchos. Saltcedar is considered a nuisance in the Rio Grande, Pecos and lower Rio Conchos (Weeks *et al*., 1987) even though *Tamarix* may not displace native vegetation or play a role in changing the hydraulic properties of the river (Everitt, 1988; Dahm *et al*., 2002; Glenn and Nagler, 2005). For instance, Dahm *et al*. (2002) found that evapotranspirarion (ET) of saltcedar varied only slightly compared to cottonwood. Nevertheless, the cottonwood-willow riparian habitat supports the highest wildlife species richness and density in the Colorado River and Rio Grande (Snyder and Miller, 1992). We believe that this is also true for the Rio Conchos.

Although a close monitoring of this invasive tree is important, the protection of the remaining riparian vegetation is undoubtedly a more pressing issue.

Conclusion—Protection of riparian vegetation is crucial to the sustainable management of natural resources in the Rio Conchos basin. The assessment methods utilized in this study (line intercept, nearest neighbor, and QBR index) were adequate to assess the riparian habitat quality of this river. However, for the development of a sustainable management plan and making restoration decisions for the basin, studies at a larger scale are needed to quantify and evaluate riparian habitat.

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