Arundo donax, Giant Reed, a new invasive plant and severe threat to the integrity of Cuatrociénega's aquatic ecosystems

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Introduction:

Arundo donax, or giant reed, is a highly invasive riparian grass native to the Old World. The United States Environmental Protection Agency classifies *Arundo donax* as one of the top three invasive plant species of highest concern in riparian habitats (E.P.A. 2001). In general, non-native species are considered one of the most important threats to wetland/riparian ecosystems and it is estimated that non-native species costs the world millions to billions of dollars annually (Pimentel et al. 2000).

Arundo donax has been established downstream of the Cuatrociénegas valley for many years. One localized, but well-established stand has been growing behind the Visitor Center in the middle of the valley for probably the past 8-10 years. For many years the Visitor Center stand was most likely mistaken for the possibly native and smaller *Phragmites*, which has become more common throughout the valley in recent decades. Since *Arundo* propagates only asexually by fragmentation and dispersal of stem and rhizome propagules, and the one known stand seemed unlikely to spread via those mechanisms, it did not seem to present a great threat to Cuatrociénegas aquatic ecosystems.

However, our discoveries over the past two years of widely distributed *Arundo* stands scattered over a large part of the valley indicates this species poses a major threat to the Cuatrociénegas valley. *Arundo* is now well established at least throughout a large area of the middle and lower Río Mesquites, along a short reach of the Canal de Don Julio, and a dense stand exists along the lower Saca Salada Canal.

The ecological and economic impacts of establishment of this plant in Cuatrociénegas is potentially tremendous. *Arundo donax* stands are one of the planet's most productive communities, with only one linear meter of this plant along a waterway transpiring up to 2000 L of water per day as it grows up to 3 to 7 inches per day to reach heights of 10 m in stands of > 20 tons/ha of above-ground mass. Such massive water loss would dry large areas of the valley and dramatically change nutrient cycling in the aquatic/riparian ecosystem (Bell 1997). *Arundo* stands are almost invariably monospecific and would replace the diverse marshes now providing habitat to the diverse native Cuatrociénegas fauna and flora (Picture 4). The incredibly high stem density of *Arundo* stands makes them virtually impenetrable (Picture 1). When *Arundo* stands dominate an aquatic ecosystem, they interrupt waterways, constraining them to narrow deep, fast-flowing channels. In Cuatrociénegas, the dense overhanging stands would kill stromatolites by shading and alteration of their hydraulic environment.

Arundo has been a major problem throughout the state of California. In areas where *Arundo* is well established, it has replaced native vegetation and has most likely impacted endangered species (Bell 1997). Additionally, *Arundo* has caused a severe fire hazard throughout California due to its flammable nature; even when the plant is green (Frandsen 1994, cited in Boose and Holt 1999). Major control efforts in California have been thwarted by the clonal propagation of *Arundo*. *Arundo* removal has usually been attempted by cutting and applying an herbicide to the cut stumps. However, due to the extensive below-ground biomass, the potential for regrowth is great. Additionally, it appears that transporting cut stands can promote propogation and distribution by scattering small viable pieces during handling. Cut stems as short as 2 cm. can sprout into new stands (Picture 5). Furthermore, when rhizome fragments are removed from the parent plant they can survive short periods of water-logging and sprout into new stands up to 132 days after separation from water depths up to 25 cm (Boose and Holt 1999).

Methodology:

Following our alarmingly increasing frequency of more or less anectodal observations of new stands of *Arundo* over the past two years, we took time this summer to more carefully explore parts of the valley that appeared most likely affected.

In late May of 2004, the first author mapped portions of the Río Mesquites between the Visitor Center and the lower Saca Salada Canal using a Trimble GeoExplorer 3 GPS unit. Initially, the river was mapped by floating on rafts, but after rafting became impractical, the remaining sections were mapped by walking along the shoreline in areas accessible on foot.

In July of 2004, Dean Hendrickson and Suzanne McGaugh mapped a remote portion of the Río Mesquites using kayaks and the same Trimble GeoExplorer 3 GPS unit. We named this largely inaccessible area of the Río Mesquites "The Maze" or "El Laberinto" due to the complexity of traversing it (Picture 6). In "El Laberinto" the main channel of the Río Mesquites repeatedly splits and in parts goes underground as it enters expansive and very dense *Typha* sp. stands. As the river passes, this area's flows appear to coalesce and follow a more-or-less well-defined channel to the point where it is diverted into the Saca Salada Canal.

We continually logged GPS locations with the Trimble GeoExplorer 3 as we explored and used the same units to digitally map accessible *Arundo* stands, which were also photographed. All of the data was collected in the North American 1927 Geographic Coordinate System and the North American Datum of 1927, differentially corrected, and plotted on the map shown below.

The gaps in sections of the Río Mesquites map shown in this report are due access difficulties in the field. The river was virtually impossible to follow on foot or by raft/kayak in some sections as it either goes underground, turns into a series of marshes or enters the complex "Maze" (Pictures 2 and 3).

Only portions of the Saca Salada Canal were mapped because of a lack of appropriate equipment and the sense that *Arundo* may not be able to colonize in the main parts of the Canal. Casual observation has shown that the *Arundo* in the Cuatrociénegas valley has established in bends in the Río Mesquites, or areas of abundant exposed surface areas, as well as in areas of relatively slow current. However, we also noted that *Arundo* had established in areas of higher velocities, but on top of stromatolites that, as we observed throughout much of the Río Mesquites in 2003, had been exposed during a period of exceptionally low water. The Saca Salada Canal is straight, fast moving, and has high walls vegetated in part by other species, and in general, there is little place for drifting *Arundo* propagules to become lodged and root. Explorations of the middle sections of the Saca Salada Canal confirmed that there was no *Arundo* established, however, a colleague later informed us that a large stand of Arundo is well established in the lower Saca Salada canal.

Discussion:

Given California's experience of intensive and costly control efforts that have been largely unsuccessful, it seems unlikely that this weed can be controlled in Cuatrociénegas without massive investment. We propose, however, that the potentially severe impacts to both humans and the rest of the valley's biota make serious consideration of immediate implementation of a control effort a high priority.

A local example of the extreme impact of this invasive plant can be seen in the canyon alongside the Monclova-Cuatrociénegas highway near Celemania. Since the mid-1960's this primarily mesquite bosque bottomland was transformed first to a *Phragmites* dominated riparian by the 1970's (as documented by Pinkava 1984), and is now dominated by *Arundo*. This canyon is a realistic indicator of what future habitat destruction will occur in the Rio Mequites area if no action is taken to prevent *Arundo* distribution. It is not difficult to imagine the entire Río Mesquites and its associated marshlands looking like this in the near future. This canyon is the type (and only known) locality for the endemic darter, *Etheostoma segrex*, of which only one specimen was found during our 2003 search for it. It seems clear that habitat changes caused by *Arundo* are most likely responsible for this endemic darter's demise and apparent near-extinction. Unfortunately, its sister species, *E. lugoi,* lives in specialized habitats in the Río Mesquites alongside of some of the newly discovered *Arundo* stands.

The *Arundo* stands that were found in this study are still relatively small and manageable. Removal of *Arundo* is expensive and labor intensive; the longer *Arundo* stands exist within the basin, the more difficult and costly it will be to remove. In parts of California, *Arundo* has become so dense and abundant that stands can only be removed mechanically, causing massive ecosystem disturbance and in the long run facilitating *Arundo*'s expansion (Boose and Holt 1999). The uniqueness and sensitivity of the Cuatrociénegas ecosystem and difficulty of access to much of it (e.g. "The Maze") preclude mechanized removal of *Arundo*, however, there is still access to areas where *Arundo* is known to be establishing now, and most stands are relatively small. The risk in not taking aggressive action now may likely be loss of a unique habitat forever.

References:

Bell, G.P. 1997. Plant Invasions: Studies from North America and Europe. Ecology and management of *Arundo donax*, and approaches to riparian habitat restoration in southern California. 103-113. The Netherlands: Backhuys, Leiden.

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E.P.A. Environmental Protection Agency. 2001. Nonindigenous Species- An Emerging Issue for the EPA. Region/ORD Nonindigenous Species Workshop Reports. (1):14.

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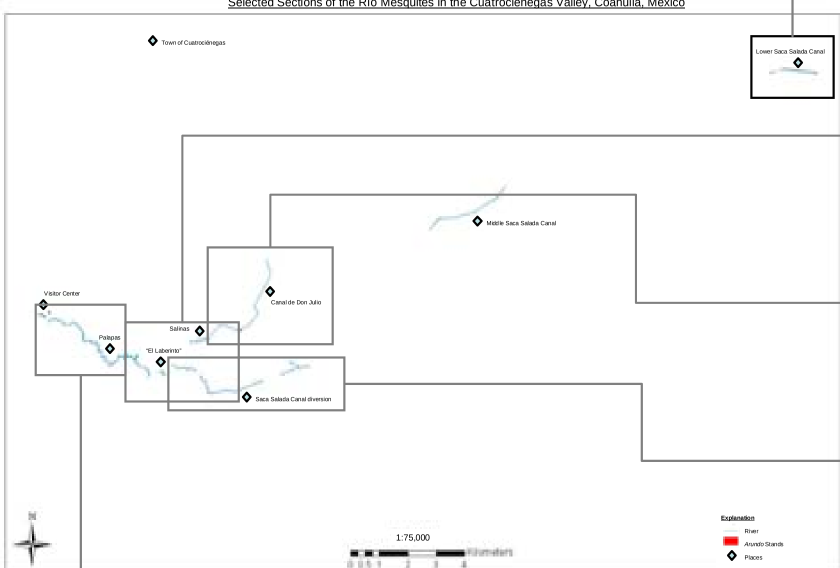
Pimentel D., Lach L., Zuniga R., Morrison D. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50:53–65.

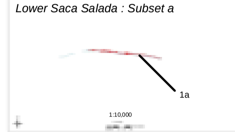
Pinkava D. J. 1984. Vegetation and flora of the bolson of Cuatro Cienegas region, Coahuila, Mexico: IV. Summary, endemism and corrected catalogue. *J.Ariz.Nev.Acad.Sci.* 19(1):23-47.

Results:

Selected Sections of the Río Mesquites in the Cuatrociénegas Valley, Coahuila, Mexico

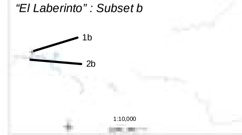


Lower Saca Salada : Subset a



1a: Huge *Arundo* stand. Arundo has taken over this area of the canal and is virtually impenetrable (No Picture)

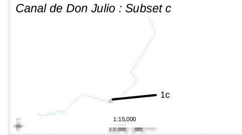
"El Laberinto" : Subset b

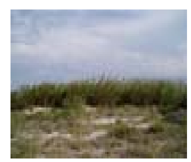


1b: Large, Remote *Arundo* stand

2b: Medium sized, Remote *Arundo* stand (No Picture)

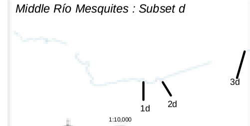
Canal de Don Julio : Subset c

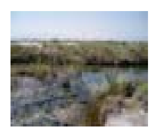




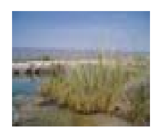
1c: Large *Arundo* stand

Middle Río Mesquites : Subset d

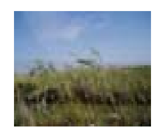




1d: Newly established *Arundo* stand

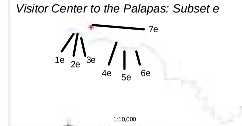


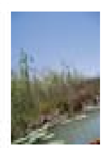
2d: Medium *Arundo* stand



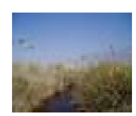
3d: Small *Arundo* stand

Visitor Center to the Palapas: Subset e

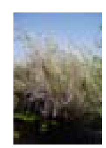




1e: Small *Arundo* stand

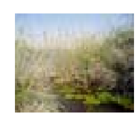


2e: Small *Arundo* stand

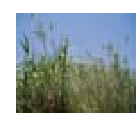


3e: Medium *Arundo* stand

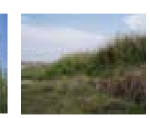
4e: Small *Arundo* stand (No Picture)



5e: Small *Arundo* stand

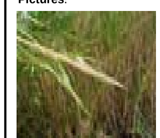


6e: Small *Arundo* stand



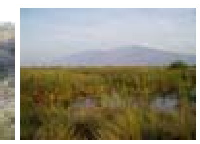
7e: Large *Arundo* stand by Visitor Center

Pictures:



Picture 1: Example of the density of an Arundo stand along the Canal de Don Julio.

Picture 2: The Río Mesquites emerging from an underground channel near Salinas.



Picture 3: The Río Mesquites turning into a marsh near Salinas.

Picture 4: An endangered Terrepene coahuila crawling into the Río Mesquites.

Picture 5: A half meter tall, newly established Arundo donax growing on a stromatolite.

Picture 6: Exploring "El Laberinto" in kayaks.