

Changes in the Pinacate Reserve Ecosystems: Invasion of Non-Native Plants

Denise Z. Avila-Jiménez

Centro de Datos para la Conservación (CDC), Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES), Hermosillo, Sonora, Mexico

Abstract—Over the years, humans have modified the Sonoran Desert by introducing invasive plants that prosper in disturbed and non-disturbed habitats. These invaders modify the dynamics and structure of populations and the composition of communities, which in turn can result in radical changes in wildlife habitat. The natural landscape of the Sonoran Desert is characterized by extensive valleys with parallel and discontinuous arrangements of narrow ranges (Shreve and Wiggins, 1964). Within this ecosystem is the heart of the Sonoran Desert called the Pinacate Reserve (Reserva de la Biosfera El Pinacate y Gran Desierto de Altar). The Pinacate Reserve registers 97 invasive plant species, of which 18 are altering the natural ecosystems.

In 2002 the Sonora Conservation Data Center (CDC) started a project to identify and map invasive species in Sonora and implemented a pilot program in the Pinacate Reserve. This project found a total of 97 invasive species in the Reserve, 18 of which represent the greatest threat to the natural habitat of the area (table 1). Salt cedar (*Tamarix ramosissima*), buffelgrass (*Pennisetum ciliaris*), and Sahara mustard (*Brassica tournefortii*) have been considered the primary concerns for the Reserve area (CDC, 2002). The CDC analysis also identified sites with the greatest proportion of invasive species within the Pinacate Reserve in order to establish Management Areas for Invasive Species (MAIS). One of these sites that represents a very clear example of significant changes to the natural system is in the Río Sonoyta, located just south of the U.S.-Mexico border and adjacent to Organ Pipe Cactus National Monument. This location in the Río Sonoyta is the site of an abundant invasion of salt cedar that has eliminated native plants such as cottonwood (*Populus fremontii*), willow (*Salix gooddingii*), and mesquite (*Prosopis velutina*). The river is also habitat for endemic species like desert pupfish (*Cyprinodon eremus*), Sonoyta mud turtle (*Kinosternon sonoriensis longifemorale*), and longfin dace (*Agosia chrysogaster*).

Another example of important changes in the ecosystem involves the recent widening of the Mexican highways 2 and 8 that mark the northern and southern limits of the Reserve, respectively. These construction activities resulted in environmental impacts that were difficult to avoid (Búrquez and Castillo, 1993) and that later gave place to the establishment of invasive species like Sahara mustard (*Brassica tournefortii*) and buffelgrass (*Pennisetum ciliaris*), which compete with native species (CDC, 2002). Observations and surveys along the main dirt road that connects the Reserve's biological station with highway 2 have detected Sahara mustard at moderate levels. However, this exotic species has begun to invade adjacent areas as well. A very dense stand of Sahara mustard is located on the west side of the Ladrilleros hills, east of Sierra Suvuk, on the southeastern corner of the Reserve (CDC, 2004). In

this area, the Reserve personnel, students, and social workers have made some first attempts to control the Sahara mustard by mechanical and manual efforts. The results have not yet been impressive since it is a task that will require a long-term commitment.

Exotic plants invade both the low parts of the Reserve and the core zone known as Sierra Pinacate, where there are records of some invasive species already established, like red brome (*Bromus rubens*), filaree (*Erodium cicutarium*), Lehmann lovegrass (*Eragrostis lehmanniana*), and barley (*Hordeum murinum*). These species could present a risk for displacing natives like *Senecio pinacatensis*, which is endemic to the high parts of the Sierra Pinacate.

For the purpose of eradicating invasive species to support the conservation of natural landscapes, we designated a MAIS within the Pinacate Reserve. The management area allows us to unify efforts in the development of programs targeting noxious species. These programs include prevention, inventory, monitoring, mapping, and methods of integration for managing invasive plants, as well as public participation. The ultimate goal of the MAIS is to facilitate cooperation between Reserve administrators and local landowners in order to solve the shared problem of invasive species within a common area. An objective is to prevent the reproduction and dispersal of the invasive species within the management area (Bureau of Land Management et al., 2000).

Within the management area, we identified zones where the infestation of invasive species is most evident. These zones are found within areas of high-priority conservation for the Reserve. Such subdivisions of the MAIS will facilitate the implementation of an Invasive Species Management Plan that will both diminish the presence of these undesirable species and avoid their dispersal (Paredes, 2003). Through mapping and inventories we will have the basic tools to implement the specific actions in the management areas, since these techniques will help us identify and delimit the exact locations of areas with populations of invasive or noxious species (Paredes, 2003).

Table 1—Invasive plants of interest in the Pinacate Reserve.

Family	Scientific Name	Synonyms	Common Name	Distribution/ Characteristic
AIZOACEAE	<i>Mesembryanthemum crystallinum</i>	<i>Cryophytum crystallinum</i>	Cristal IcePlants, hielitos	Wildland invasive
AIZOACEAE	<i>Mesembryanthemum nodiflorum</i>		Slender-leaf iceplant, Hielitos	Wildland invasive
ASTERACEAE	<i>Centaurea melitensis</i> L.		Malta starthistle	Sonoyta farm fields and impacted sites (roadsides); wildland invasive
BRASSICACEAE	<i>Brassica tournefortii</i>		Sahara mustard, Mostaza	Widespread wildland weed; density greatest on sandy soils
CYPERACEAE	<i>Cyperus esculentus</i> var <i>esculentus</i>		Yellow nutgrass, yellow nut sedge, Coquillo amarillo, cebollin, coquille.	Temporary or permanent wet habitats; invasive
GERANIACEAE	<i>Erodium cicutarium</i>	<i>Geranium cicutarium</i>	Filaree, storksbill Alfilerillo	Widespread and natural- ized in disturbed and undisturbed wildlands
MOLLUGINACEAE	<i>Mollugo cerviana</i>	<i>Pharnaceum cerviana</i>	Thread-stem carpetweed, indian chickweed	Common in wildlands
POACEAE	<i>Bromus rubens</i>	<i>B. madritensis</i> ssp. <i>rubens</i>	Red brome, Bromo rojo	Invasive in disturbed & undisturbed habitats; limited by low rainfall
POACEAE	<i>Cynodon dactylon</i>		Bermuda grass , Zacate bermuda, zacate ingles.	Invasive in wetland habitats, common along roadsides and major arroyos
POACEAE	<i>Panicum antidotale</i>		Blue panic grass	Wildland invasive
POACEAE	<i>Pennisetum ciliare</i>	<i>Cenchrus ciliare</i>	Zacate buffel	Wildland invasive
POACEAE	<i>Pennisetum setaceum</i>			Wildland invasive
POACEAE	<i>Polypogon monspeliensis</i>			Wetlands
POACEAE	<i>Schismus arabicus</i>	<i>S. barbatus</i> ssp. <i>arabicus</i>	Zacate árabe	Widespread & abundant
POACEAE	<i>Schismus barbatus</i>	<i>Festuca barbata</i>	Zacate común del mediterráneo	Widespread & abundant
POACEAE	<i>Sorghum halepense</i>	<i>Holcus halepensis</i>	Zacate Johnson	Irrigation ditches and roadsides; potential invasive in wetlands
TAMARIACEAE	<i>Tamarix ramosissima</i>		Pino salado, salado	Riparian systems, wetlands and ditches; invasive
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i>		Torito, toboso	Farm fields and occasional along roads; not in wildlands

Invasive species control in Mexico is new, and it is just as new in Sonora where such species of plants are still used in some regions for cattle forage. Thus, we are in the first stages of the programs to implement controls for invasive plant species with the support and collaboration of American organizations and agencies with more experience in the control of undesirable species.

During this initial phase, we participated in international meetings, conferences, and workshops with the objective of determining preliminary status of invasive plants in the Pinacate biosphere reserve and surrounding areas. These gatherings helped identify priority actions for control and management through advice from expert organizations that have stated their interest in supporting this type of project in

the Reserve (Paredes 2002). Sister reserves of the Pinacate and Organ Pipe Cactus National Monument conducted a workshop in March of 2002 that identified needs of both external participants (municipal officials, landowners, and interested groups) and personnel from the parks. This workshop included presentation by researchers with experience in this topic, visits to the areas with problem invasive plants in the Pinacate Reserve, and the forming of teams to discuss the basic aspects of control and management of these species.

In closing, we would like to acknowledge and state our special gratitude to the Arizona Department of Transportation and the Sonoran Desert Invasive Species Council. We appreciate the help of all the agencies and organizations who have assisted us.

References

- Bureau of Land Management (U.S. Department of Interior), USDA Forest Service, and National Park Service. 2000. Guidelines for Coordinated Management of Noxious Weeds: Development of Weed Management Areas. 228 p.
- Búrquez Montijo, Alberto y Castillo Sánchez, Carlos. 1993 in: Programa de Manejo “Reserva de la Biosfera El Pinacate y Gran Desierto de Altar Municipio de Puerto Peñasco, Gral. Plutarco Elías Calles y San Luis Río Colorado, Sonora, México.” Gobierno Estatal.
- Centro de Datos para la Conservación (CDC). 2002. Datos de Campo.
- Centro de Datos para la Conservación (CDC). 2004. Datos de Campo.
- Chambers, Nina; Trica O. Hawkins. Invasive Plants of the Sonoran Desert. A Field Guide. Sonoran Institute. Tucson, AZ.
- Felger, Richard S. 1980. Vegetation and Flora of the Gran Desierto, Sonora, Mexico. Desert Plants 2: 87-114.
- Felger, Richard S. 2000. Flora of the Gran Desierto and Río Colorado of Northwestern Mexico. The University of Arizona Press, Tucson. 673 p.
- Paredes Aguilar, Rafaela. 2002. Estatus de las Plantas Invasivas en la Reserva de la Biosfera El Pinacate y Gran Desierto de Altar. Informe Final. Centro de Datos para la Conservación (CDC)-IMADES. Septiembre. 5 p.
- Paredes Aguilar, Rafaela. 2003. Area de Manejo de Invasivas (WMA) “El Pinacate.” Informe Final. Centro de Datos para la Conservación (CDC)-IMADES. Noviembre. 8 p.
- Shreve, Forest; Wiggins, I. L. 1964. Flora and Vegetation of the Sonoran Desert, 2 vols. Stanford University Press, Stanford, CA.