



Invasive Non-native Plant Inventory for Tumacácori National Historical Park

Sarah Studd, Sonoran Desert Network

Mark Zepp, Sonoran Institute

PROJECT SUMMARY



PATRICK J. ALEXANDER @ USDA-NRCS PLANTS DATABASE

Poison hemlock (*Conium maculatum*).

Background

Invasive exotic plants represent one of the most significant threats to natural resources in U.S. national parks today. In the national parks, exotic plants are those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Exotic plants are a concern because they are able to reproduce prolifically, rapidly colonize new areas, displace native species, and alter ecosystem processes across multiple scales. This project had two goals: (1) to map the spatial location, abundance, and distribution of 74 invasive plant species on the Arizona Wildlands Invasive Plant Working Group species list, plus 5 additional species of interest/concern to Tumacácori National Historical Park (NHP) staff; and (2) to rank the recorded species based on significance of impact, ability to become a pest, and difficulty of control using the Alien Plants Ranking System (APRS) (APRSIT 2001; AZ-WIPWG 2005).

Tumacácori NHP is located in the upper Santa Cruz River Valley of southern Arizona. The park comprises three units, each housing abandoned ruins of Spanish colonial missions. San José de Tumacácori and Los Santos Ángeles de Guevavi, established in 1691, are the two oldest missions in Arizona. The third unit, San Cayetano de Calabazas, was established in 1756. The park is approximately 146 ha (360 acres). Tumacácori, with 131.5 ha (325 acres), is the largest unit; Calabazas is 11 ha (28 acres) and Guevavi 2.83 ha (7 acres). The Calabazas and Guevavi units are located 15 km and 23 km SSE of Tumacácori, respectively.

The Tumacácori unit was recently expanded with the acquisition of more than 121 ha of land adjacent to the mission site. The Santa Cruz River runs through the length of the expansion lands and supports a rich riparian habitat of cottonwoods and willows. The Juan Bautista de Anza National Historic Trail winds through the Tumacácori unit, with access from several locations.

Methods

An invasive non-native plant inventory was conducted at Tumacácori NHP during January and February 2006. The survey was a cooperative effort between the National Park Service's Sonoran Desert Network and the Sonoran Institute. Roaming surveys were performed with the intent of comprehensively covering the entirety of all three mission-site units. To conduct these surveys, a field crew walked throughout the park in a systematic way, utilizing handheld mapping units with GIS layers showing current spatial position and the areas already surveyed and mapped. All non-native species encountered were mapped either as a point or polygon feature; points were used for single individuals or patches less than 5 m across, and polygons used for infestations larger than 5 m across. Supplemental circular-plot surveys were also performed, in which vegetation abundance and diversity were measured by way of ocular estimates of percent cover, by species, within three 1-m² quadrats. These surveys were done in order to assess any observer bias, as well as accuracy, in the roaming surveys.

Area affected was calculated as a measure of plant distribution calculated directly from mapped polygon boundaries; this measure does not reflect the intensity of invasion. For example, a 1.5-ha polygon estimated at 25–50% cover would represent 1.5 ha affected.

Area infested was calculated as a measure of the actual land area infested by each target species. Infested area was calculated using polygon data by multiplying the cover-class midpoint by the polygon's area. For example, a 1.5-ha polygon estimated at 25–50% cover would represent 0.5625 ha ($1.5 \times 0.375 = 0.5625$) infested. In both calculations, points were estimated to represent 0.5 m².

Results

Species detected

Of the 79 target species, 14 were observed during roaming surveys at Tumacácori NHP units in 2006 (Table 1). All of these species had been previously recorded at these units. Of these 14 species, only 5 were recorded at the Calabazas and Guevavi units (these two sites were affected by the same suite of five species; see Tables 3 and 4). Of the 14 non-native species mapped, 5 are members of the grass family (*Poaceae*).

Total area affected and infested

Affected-area value varied substantially by species, with several species being widespread throughout the unit (Tables 2–4). Amaranth was mapped across 76% of the unit, Bermuda grass over 72%, Russian thistle over 61%, tamarisk across 42%, and Lehmann lovegrass and poison hemlock at 36 and

Table 1. Non-native invasive species observed during roaming surveys, Tumacacori National Historical Park.

Scientific name	Common name
<i>Ailanthus altissima</i>	tree of heaven
<i>Amaranthus palmeri</i>	Palmer's amaranth
<i>Arundo donax</i>	giant reed
<i>Conium maculatum</i>	poison hemlock
<i>Cynodon dactylon</i>	Bermuda grass
<i>Eragrostis cilianensis</i>	stink grass
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass
<i>Malva parviflora</i>	cheese weed
<i>Marrubium vulgare</i>	horehound
<i>Salsola tragus</i>	Russian thistle
<i>Sisymbrium irio</i>	London rocket
<i>Sonchus</i> spp.	sowthistles
<i>Sorghum halepense</i>	Johnson grass
<i>Tamarix chinensis</i>	tamarisk

34%, respectively. All other species were mapped to be affecting 1–10% of the unit.

Levels of area infested also varied by species, with nine species infesting less than 1% of the total park area, three species infesting 1–4% of the total area, and two species, Bermuda

Table 2. Total area affected and total area infested by target species within Tumacácori NHP's main unit.

Scientific name	Common name	Area affected		Area infested	
		Hectares	Percent of unit	Hectares	Percent of unit
<i>Ailanthus altissima</i>	tree of heaven	T	T	T	T
<i>Amaranthus palmeri</i>	Palmer's amaranth	101.25	76%	18.20	14%
<i>Arundo donax</i>	giant reed	T	T	T	T
<i>Conium maculatum</i>	poison hemlock	45.95	34%	3.83	3%
<i>Cynodon dactylon</i>	Bermuda grass	96.38	72%	30.92	23%
<i>Eragrostis cilianensis</i>	stinkgrass	18.06	13%	0.48	T
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	48.67	36%	0.64	T
<i>Malva parviflora</i>	cheese weed	1.69	1%	T	T
<i>Marrubium vulgare</i>	horehound	13.58	10%	T	T
<i>Salsola tragus</i>	Russian thistle	81.96	61%	5.81	4%
<i>Sisymbrium irio</i>	London rocket	16.14	12%	1.32	T
<i>Sonchus</i> spp.	sowthistle	2.52	2%	T	T
<i>Sorghum halepense</i>	Johnsongrass	13.28	10%	1.26	T
<i>Tamarix chinensis</i>	tamarisk	56.39	42%	2.27	2%

T denotes area <0.1 ha or <0.1%

Table 3. Total area affected and total area infested by target species within the Calabazas unit.

Scientific name	Common name	Area affected		Area infested	
		Hectares	Percent of unit	Hectares	Percent of unit
<i>Amaranthus palmeri</i>	Palmer's amaranth	7.62	86%	0.23	2%
<i>Cynodon dactylon</i>	Bermuda grass	2.39	27%	T	T
<i>Eragrostis cilianensis</i>	stinkgrass	3.24	37%	T	T
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	4.92	55%	0.19	2%
<i>Salsola tragus</i>	Russian thistle	6.52	73%	0.19	2%

T denotes area <0.1 ha or <0.1%

Table 4. Total area affected and total area infested by target species within the Guevavi unit.

Scientific name	Common name	Area affected		Area infested	
		Hectares	Percent of unit	Hectares	Percent of unit
<i>Amaranthus palmeri</i>	Palmer's amaranth	3.48	95%	1.05	37%
<i>Cynodon dactylon</i>	Bermuda grass	0.78	21%	T	T
<i>Eragrostis cilianensis</i>	stinkgrass	1.74	48%	T	1%
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	0.86	24%	T	T
<i>Salsola tragus</i>	Russian thistle	3.07	84%	T	2%

T denotes area <0.1 ha or <0.1%

grass and amaranth, infesting 23% and 14% of the total area, respectively (Tables 2–4).

Discussion

Roaming surveys vs. circular plots

Of the 79 target species, 9 were recorded within the circular plots (Table 5). Stohlgren et al. (2003) suggested randomly locating these plots and comparing the foliar cover of target species within the circular plots to that collected during the roaming surveys. When foliar cover of target species collected via circular plots was plotted against that collected via roaming surveys, the relative abundance of target species was rather consistent between the two methods ($R^2 = 0.62$), indicating that roaming surveys performed well at estimating abundance of target species. Both datasets were transformed using the cube-root transformation.

Table 5. Target species occurrences and relative abundances within circular plots.

Species	Circular plot occurrences	Circular plot relative abundance (foliar cover)
<i>Amaranthus palmeri</i>	24	1.6%
<i>Conium maculatum</i>	1	0.02%
<i>Cynodon dactylon</i>	17	13.4%
<i>Eragrostis cilianensis</i>	8	0.24%
<i>Eragrostis lehmanniana</i>	3	0.24%
<i>Marrubium vulgare</i>	2	0.59%
<i>Salsola tragus</i>	5	0.51%
<i>Sisymbrium irio</i>	1	0.16%
<i>Sorghum halepense</i>	3	1.76%

T denotes area <0.1 ha or <0.1%

Alien Plants Ranking System

Most species ranked under the APRS fell into the medium-to-low impact category. On a 100-point scale, plants ranged from 24 to 76 for significance of impact, from 4 to 47 for innate ability to become a pest, and from 21 to 69 for difficulty of control (Table 6). Tamarisk was ranked as having the greatest impact.

Tamarisk was ranked hardest-to-control, with the greatest risk of becoming a major pest. Giant reed could become more of a pest should it spread, but currently should be quite easy to control. Annuals tended to rate scores reflecting relative ease of control and minor pest status.

The less widespread annual species fell mostly within the lesser-impact and easy-to-control categories, with only tamarisk approaching both the very-hard-to-control/serious-impact category.

Conclusions

As a result of this survey, several distinctly infested areas have been identified. In general, the old agricultural areas in the southern portion of Tumacácori NHP still show signs of disturbance and are heavily infested with non-native invasive species. To a lesser extent, areas to the north of the fiesta grounds (also old agricultural fields) also have many invasive plants, but these occur in open areas and the understory of the many trees and shrubs. The riparian corridor has several

invasive species, most notably tamarisk, Bermuda grass, and poison hemlock. Some species mapped were only found sporadically or as individual plants, and do not pose a significant threat. The two smaller units, Calabazas and Guevavi, were both observed to have the same five species. These units are in relatively good shape but management should be considered in some of the worse-affected areas.

Literature Cited

- Alien Plants Ranking System Implementation Team (APR-SIT). 2001. Alien plants ranking system, version 7.1. Flagstaff, AZ: Southwest Exotic Plant Information Clearinghouse. <http://sbsc.wr.usgs.gov/research/projects/swepic/aprs/downloads.asp>. Last accessed January 23, 2008.
- Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG). 2005. List of non-native invasive plants that threaten wildlands in Arizona. <http://sbsc.wr.usgs.gov/research/projects/swepic/SWVMA/sbscmain.asp>. Last accessed January 16, 2008.
- Stohlgren, T. J., T. D. Barnett, and S. S. Simonson. 2003. Beyond North American weed management standards. <http://www.nawma.org/documents/Mapping%20Standards/BEYOND%20NAWMA%20STANDARDS.pdf>. Last accessed January 16, 2008.

Table 6. Ranks of target species for significance of impact, innate ability to become a pest, and difficulty of control.

Scientific name	Common name	Impact	Ability to become a pest	Difficulty of control
<i>Tamarix chinensis</i>	tamarisk	76	47	69
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass	67	38	60
<i>Marrubium vulgare</i>	horehound	48	44	45
<i>Salsola</i> sp.	Russian thistle	43	33	56
<i>Cynodon dactylon</i>	Bermuda grass	30	31	68
<i>Sorghum halepense</i>	Johnsongrass	56	11	44
<i>Sisymbrium irio</i>	London rocket	38	13	55
<i>Arundo donax</i>	giant reed	60	20	25
<i>Ailanthus altissima</i>	tree of heaven	51	9	41
<i>Conium maculatum</i>	poison hemlock	37	22	32
<i>Eragrostis cilianensis</i>	stinkgrass	29	13	44
<i>Sonchus</i> sp.	sowthistles	43	4	37
<i>Amaranthus palmeri</i>	Palmer's amaranth	27	33	21
<i>Malva parviflora</i>	cheeseweed	24	5	28