

Vascular Plants and Vertebrate Inventories in Sonoran Desert National Parks

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Abstract—Biological inventories are important for natural resource management and interpretation, and can form a foundation for long-term monitoring programs. We inventoried vascular plants and vertebrates in nine National Parks in southern Arizona and western New Mexico from 2000 to 2004 using repeatable designs, commonly accepted methods, and standardized protocols. At Tumacácori National Historical Park alone, we recorded 378 species of plants and 213 species of vertebrates, including a total of 273 species that were previously undocumented in the park. Data collected in all nine parks will be used in developing monitoring plans for National Parks in the Madrean Archipelago, and for the Sonoran Desert ecoregional monitoring effort.

Introduction

Species inventories can provide a baseline for monitoring biological resources and a foundation for species checklists. Preventing species loss is a fundamental goal of many land-management agencies (NPS 2000), yet losses do occur (e.g., Drost and Fellers 1996; Newmark 1995). Managers often lack species inventories that could be used to identify potential losses and indicate the need for further research or management action to prevent further loss (NPS 1992). In recognition of a general lack of natural resource information, the National Park Service initiated the Vital Signs Inventory and Monitoring Program to increase scientific research in National Parks and detect long-term changes in biological or physical resources (NPS 1992). Knowledge of which species are present, particularly sensitive species and where they occur, is critical for making management decisions such as locating new facilities and developing fire management plans.

We inventoried vascular plants and vertebrates in nine National Parks in Arizona and western New Mexico from 2000 to 2004 (table 1). Our objectives were to: (1) compile historical data; (2) complete field surveys using standardized methods and repeatable study designs to document at least 90% of plant and vertebrate species present; (3) provide park managers with products that are useful for interpretation and management; and (4) provide data to inform National Park Service and regional monitoring initiatives.

In this paper we describe sampling designs, field methods, and results from Tumacácori National Historical Park (NHP), the first park for which we have completed inventories. Tumacácori NHP is representative of several small National Parks in the Madrean Archipelago region that were created to protect cultural resources but which also possess significant natural resources that had not been inventoried.

Methods

Sampling Design

We search for species using both quantitative, plot-based surveys (e.g., trapping grids for nocturnal rodents) and a form of unbounded, visual and auditory encounter surveys (Crump and Scott 1994: 84). Plot-based surveys are repeatable and allowed us to estimate relative abundance or density of all species we detected. We used a combination of random and non-random spatial sampling designs for plot-based surveys. Our visual and auditory encounter surveys were not plot-based and allowed field crews to search areas that they thought, based on their experience, would add species to our list. We recorded UTM coordinates for all survey plots and for all animals that we observed.

Field Methods

Primary field methods that we used at Tumacácori NHP are listed below; see Powell et al. (2004) for a detailed description:

- Plants: modular plots, random walking surveys/incidental sightings
- Fish: electrofishing, dip netting
- Amphibians and reptiles: time-area constrained search, drift-fence pitfall arrays, unbounded surveys
- Birds: variable-circular plots (point counts), taped-playback, line transects
- Mammals: Sherman live traps set in grids, pitfall traps, infrared-triggered cameras

Assessing Inventory Completeness

We used a variety of methods to assess our goal of 90% species detection, including comparison of our results to sources

Table 1—Summary of vascular plant and vertebrate inventories in National Park Service Units in Arizona (AZ) and New Mexico (NM), 2000-2004.

Park	Taxon group						
	State	Plants	Fish	Amphibians	Reptiles	Birds	Mammals
Casa Grande National Monument	AZ	X		X	X	X	X
Chiricahua National Monument	AZ	X		X	X	X	X
Fort Bowie National Historic Site	AZ	X				X	X
Gila Cliff Dwellings National Monument	NM	X		X	X	X	X
Saguaro National Park	AZ	X		X	X	X	X
Tonto National Monument	AZ	X		X	X	X	X
Tumacácori National Historical Park	AZ	X	X	X	X	X	X
Tuzigoot National Monument	AZ	X	X	X	X	X	X

that would predict species presence at the park. These sources included published and unpublished reports, range maps, and additional expert opinions. We also plotted results of our surveys as species-accumulation curves; asymptotic curves can indicate whether most species present have been detected (Hayek and Buzas 1997: 314-316).

Results

We recorded 378 species of plants and 213 species of vertebrates at Tumacácori NHP, including 273 species that were previously undocumented in the park. We recorded a number of notable species including six species that are protected or have conservation status under the Endangered Species Act. Of these six species, Gila topminnow (*Poeciliopsis occidentalis*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and southwestern willow flycatcher (*Empidonax traillii trailli*), and gray hawk (*Asturina nitida maxima*) were recorded on private land adjacent to the park that had been identified as an area for possible park expansion. We also documented the second record in Arizona of muster John Henry (*Tagetes minuta*) listed as a Class A noxious weed in California (California Department of Food and Agriculture 2003). We recorded a total of 76 non-native species, many of which represent management concerns, including one species of amphibian, four species of mammals, three species of birds, and four species of fish (Powell et al. 2004).

Based on historical records, expert opinion, and examination of species-accumulation curves, we believe that we recorded all species of native fish present at Tumacácori NHP; that we likely recorded at least 90% of the plants, amphibians, breeding-season birds, and rodents; but that we recorded less than 90% of winter birds, reptiles, and other mammals (Powell et al. 2004).

Discussion

Inventory data can have immediate conservation application for land managers. Our documentation of Federally-protected species on adjacent land that had been proposed for inclusion in the park, together with the help of private land owners, supported congressional legislation expanding the park area by

almost 700% to include biologically rich riparian areas. Data from the project also are being used to support the nomination of the Santa Cruz River Basin as a National Heritage Site.

Inventory data can be used to create a baseline for monitoring changes in natural resources; monitoring can provide natural resource managers with the information necessary for management decisions and conservation planning (Elzinga et al. 2001). We will use the inventory data from Tumacácori NHP and other parks to inform the Sonoran Desert Ecoregional Monitoring Framework, a multi-agency and multi-national initiative directed at monitoring a wide range of natural and human indicators across the region.

Once our inventories are complete, each park will receive reports (e.g., Powell 2004) detailing methods and results used for all surveys, species lists (species we recorded, historical records and species possibly present but not documented), recommendations for management and additional inventorying, relevant information on non-native species, maps of study sites, and hard copies of all raw data. In reports to larger parks (e.g., Saguaro National Park) we will also provide distribution maps of species of management concern. All parks will also receive databases developed for entering and storing data, protocols for collecting data, and high-quality digital photographs of some species we found in the park. Original data from this effort will be housed at the Sonoran Desert Network Office in Tucson, Arizona.

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References

California Department of Food and Agriculture. 2003 Pest ratings of noxious weed species and noxious weed seed. California Department of Food and Agriculture. http://pi.cdffa.ca.gov/weed-info/wininfo_table-sciname.htm.

- Crump, M. L.; N. J. Scott, Jr. 1994. Visual encounter surveys. In: Heyer, W. R.; M. A. Donnelly; R. W. McDiarmid; L. C. Haye; M. S. Foster, eds. *Measuring and monitoring biological diversity: standard methods for amphibians*. Washington, DC: Smithsonian Institution Press: 84-92.
- Drost, C. A.; G. M. Fellers. 1996. Collapse of a regional frog fauna in the Yosemite area of the California Sierra Nevada, USA. *Conservation Biology* 10(2): 414-425.
- Elzinga, C. L.; D. W. Salzer; J. W. Willoughby; J. Gibbs. 2001. *Monitoring plant and animal populations*. Boston, MA: Blackwell Science.
- Hayek, L. C.; M. A. Buzas. 1997. *Surveying natural populations*. New York: Columbia University Press.
- National Park Service. 2000. *National Park Service management policies*. Washington, DC.
- National Park Service. 1992. NPS-75: *Natural resources inventory and monitoring guidelines*. Washington, DC: U.S. Department of the Interior, National Park Service.
- Newmark, W. D. 1995. Extinction of mammal populations in Western North American National Parks. *Conservation Biology* 9(3): 512-526.
- Powell, B. F.; E. W. Albrecht; W. L. Halvorson; C. A. Schmidt; P. Anning; K. Docherty. 2004. *Vascular plant and vertebrate inventory of Tumacácori National Historical Park, Arizona*. Tech. Rep. 1. Sonoran Desert Inventory and Monitoring Program, Tucson, AZ. (<http://www1.nature.nps.gov/im/units/sodn/reports.htm>).