

DRAFT

Issues of Non-native Species in Public Reserves

Sonoran Desert Conservation Plan

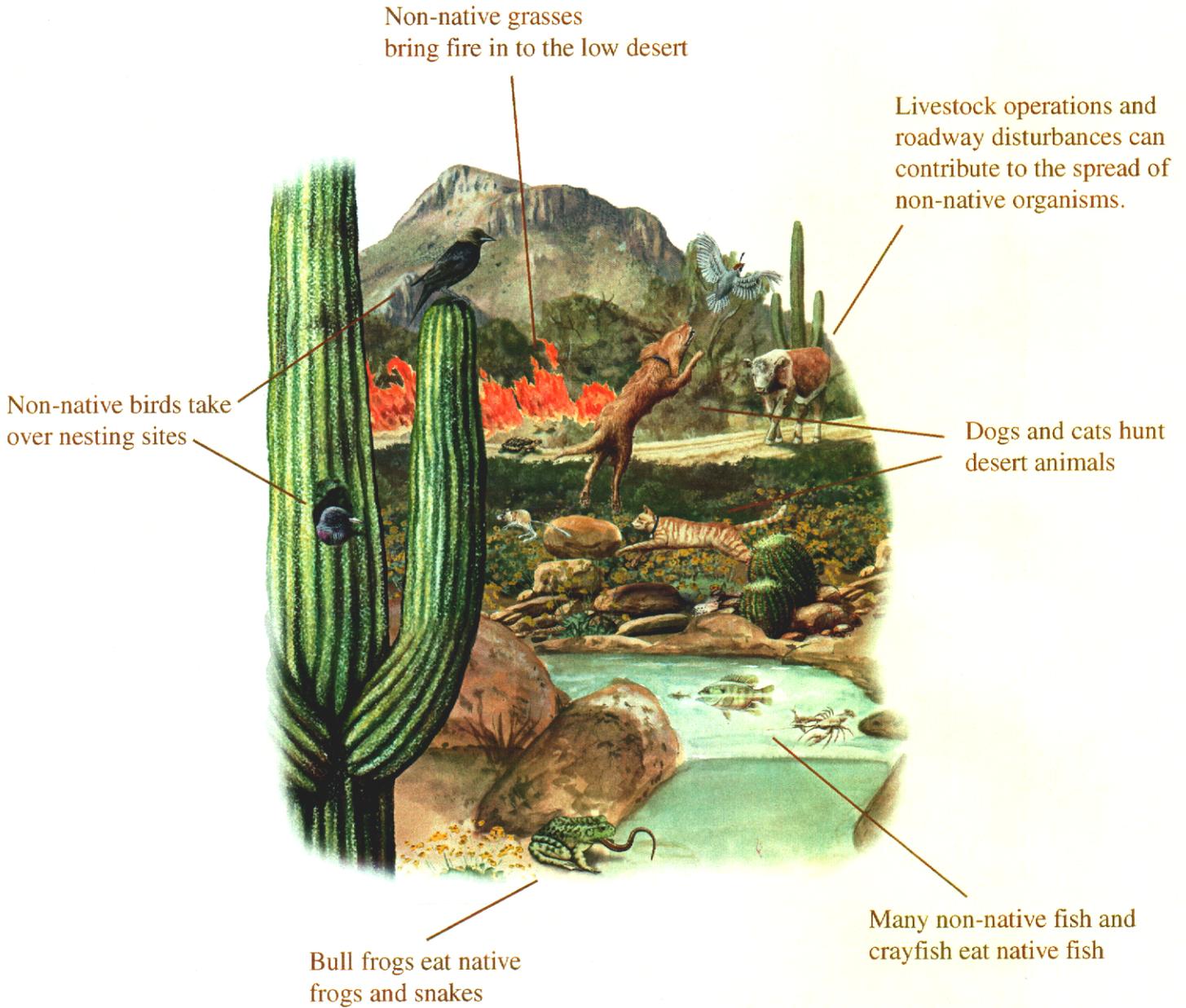
June 2000



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DRAFT

Sonoran Desert Conservation Plan



Issues of non-native species in public reserves



MEMORANDUM

Date: July 7, 2000

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator 

Re: **Issues of Non-Indigenous Species in Public Reserves, Pima County, Arizona**

Overview

In the publication from the Arizona-Sonora Desert Museum called *Buffelgrass, Bullfrogs and other Bioinvaders of the Sonoran Desert*, Dr. Gary Paul Nabhan states: "Few people understand the severity of the current impact of exotic [species] upon natives in the U.S./Mexico borderlands. ... It is likely that at least one of 600 species of non-native plants and animals can be found within a few steps of where we stand. They are welcoming us to the Planet of Weeds." The attached study entitled *Issues of Non-Indigenous Species in Public Reserves* is the first of a series of investigations on the impact of non-native species. County staff reviewed the management plans and discussed the management practices for non-native species with employees of the major reserves in Pima County. The results of this survey and a compendium of federal rules about non-indigenous species are contained in the attached study. An assessment of the biological impacts of non-native species at the system level is being drafted by the consulting team at this time.

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Scope of the Problem - Estimates of Non-Native Species Established in the Sonoran Desert

In describing *The Conservation Dilemma of Non-native Versus Native Fishes*, the preeminent fish biologist Dr. W. L. Minckley provides this perspective:

- "When the Spanish arrived, the pristine Sonoran Desert region had little surface water and relatively few fishes, with at most only 36 species within Arizona's present borders. ... Far more water is impounded today in reservoirs and the number of species has soared! About 80 species, more than 50 from elsewhere, now swim in Arizona waters. Of the original 36, only 6 species persist throughout much of their natural ranges. One is extinct, 12 are endangered, 7 threatened, and 10 are of special concern. Although 8 of the threatened or endangered species survive in adjacent states, they have vanished from Arizona." [ASDM, *Buffelgrass, Bullfrogs & Other Bioinvaders* at 11.]
- "Since all native fishes tested so far do well in artificial waters without exotics, many indict non-native fish species as today's greatest deterrent to conserving our native species. Along with exotic fishes, other aliens including plants, crayfish, clams, snails, and bullfrogs, are proving just as dangerous." [ASDM, *Buffelgrass ...* at 12.]

By taxonomic group, the number of non-indigenous species established in the Sonoran Desert system runs on the order of more than 50 fishes, more than 230 plants, and more than 170 invertebrates, in addition to significant numbers of reptiles, amphibians, birds and mammals. [ASDM, *Buffelgrass ...* at 5.]

"Least Wanted", from *Buffelgrass, Bullfrogs & Other Bioinvaders* by Desert Museum

Non-native species that show up on the list of "least wanted" published in the Desert Museum document, or as problematic non-indigenous species cited by others, include at a minimum:

- Tamarisk; Sahara or Asian Mustard; and Filaree
- Bullfrogs, Crayfish; Green Sunfish; Western Mosquitofish; Red Shiner
- Non-native grasses: Buffelgrass; Johnson Grass; Red Brome; Fountain Grass; and Mediterranean Grass.

Conclusion

The attached study introduces the scale of the problem of managing for non-natives, and the particular species that have come to the attention of the land managers of existing reserves. Since the issue is not widely understood and the regulatory schemes are fragmented, some predict that within five or six human generations non-indigenous species might so out compete native species that "the list of species that constitute 'everything' will be small." [ASDM, *Buffelgrass ...* at 2, quoting David Quammen.] In light of such considerations, the Sonoran Desert Conservation Plan biological assessment is examining both native and non-native species management issues.



Issues of Non-Indigenous Species in Public Reserves in Pima County, Arizona
Prepared by Neva Connolly

I. Background

Invasion by non-indigenous species is one of the most important issues surrounding natural resource management and conservation biology today (Meffe 1999). One of the most devastating effects of non-indigenous species is the ability to decrease biological diversity in an ecosystem. They can compete with native species for space and resources. Non-indigenous species, away from their native environment, often lack effective predators. This allows non-indigenous species to have a competitive edge against native species. Non-indigenous species may also prey on natives. The ecosystem level consequences of non-indigenous species may lead to a world-wide merging of flora and fauna, with few distinct ecoregions (Vitousek 1997).

II. Non-indigenous, Invasive Species in the Sonoran Desert

The Sonoran Desert has several ecosystems which are negatively affected by non-native species; grasslands, riparian systems, aquatic systems, and desert uplands. It is estimated that several hundred non-native organisms are now present, and in many cases, well established in the Sonoran Desert Region (Arizona-Sonoran Desert Museum, 2000). Many of these non-natives are not invasive, or expected to spread, while other non-natives are causing severe ecosystem-level changes that are or may be irreversible (ASDM, 2000).

Sonoran Desert Uplands

The vegetation characterizing the desertscrub communities of the Sonoran Desert include woody species (such as palo verde, mesquite, ironwood), various types of cacti, and succulents. Many of these plants grow widely spaced, relying on extensive root systems to absorb the infrequent moisture. Native plants growing in these spaces are generally small and do not remain as dry biomass after the growing season. Invasive species threaten the Sonoran desertscrub by crowding out native species and increasing fuel load. Desertscrub communities did not evolve with a fire cycle, and cannot survive burns. Fire occurring in an ecosystem that evolved in its absence can result in a reduction of native species and restructuring of plant and animal interactions, favoring fire-adapted non-indigenous species (ASDM, 2000).

Sonoran Desert Grasslands

Invasive species in the Sonoran Desert Grasslands are linked to human intervention (ASDM, 2000). Throughout the late 1880's and the early 1900's, the desert grasslands suffered livestock overgrazing, human settlement, and agricultural practices. Under grazing pressure, native grasses declined and the frequency and intensity of fire may have also decreased. Increased erosion and the decreased productivity of native grasses provoked land managers to utilize exotic grass species.

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These grasses (prevalent species originated in Africa) were selected for tolerance to drought, forage value, and resistance to overgrazing. The success of these grasses is in part attributable to the disturbed nature of the grassland when the species were first introduced. The exotic grasses seem to thrive in disturbed areas, while native grasses tend to decline in similar conditions (ASDM, 2000). The introduced, invasive grasses (particularly lovegrasses (*Eragrostis sp.*) and buffelgrass (*Pennisetum ciliare*) have the potential to spread uncontrollably, creating monocultural landscapes with low-biodiversity.

Sonoran Desert Aquatic Ecosystems

The river and stream systems of the Sonoran Desert once supported a wide variety of native fish, plants, amphibians, molluscs, and crustaceans. Today, natural water systems have suffered habitat fragmentation and elimination, diminished water quality, and invasion of non-indigenous species. Introduced, invasive organisms have been introduced through stocking programs, interbasin transfers, and unintentional introductions (ASDM, 2000).

Bullfrogs and crayfish, both invaders to Sonoran desert streams, threaten native species by competing for food and feeding on the eggs, young, and adults of native amphibians and fish. Invasive plants and invertebrates can alter the nutrient cycle and water quality, and may facilitate the spread of disease.

The greatest concern of aquatic invaders is the threat of non-native fish on native fish populations. Arizona has 31 native fish species, and over 70 non-indigenous fish species (Meffe, 1999). The Sonoran Desert, characterized by low native fish richness and high endemism, has over 50 exotic fish and has suffered the greatest loss of native fish (ASDM 1999).

Introduced fish may be more aggressive and better suited to disturbed environments than native fish. Non-natives cause native fish declines or extirpations through competition, hybridization, predation, and spread of pathogens (ASDM, 2000). Efforts to control introduced fish once they have become established are expensive, time consuming, and success is often limited.

Sonoran Desert Riparian Ecosystems

Riparian systems in the Sonoran Desert support an estimated 85 percent of the flora and fauna of the desert (Pima County, 1999). Riparian habitats have declined due to livestock use, installation of wells, water diversion, flood control practices, chemical discharge, and other human-caused disturbances. These practices have had consequences for the structure, composition, and distribution of riparian vegetation (ASDM, 2000). These disturbances to the native habitat allows for invasions by non-indigenous species, particularly plant species such as tamarisk, which may permanently alter riparian systems.

III. Modified Land Cover

Reserves typically include areas modified for human activities such as campgrounds, roadways, turfed play areas, corrals, visitor centers, and other disturbed areas. The report, *Determining Species of Concern in Pima County, Arizona*, has targeted roadsides as a habitat for conservation because roads are disturbed areas that foster non-indigenous species. Management against non-indigenous species on roadsides is needed to prevent the spread of non-indigenous species between areas.

IV. Non-native Species in Public Reserves in Pima County

Federal parks and natural areas account for about 3% of total land area in North America. An additional 27% of land is managed by the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, and the Department of Defense (Meffe, 1999). In Pima County, 26.5 % of its land is protected from development in some way (Pima County, 2000). Over half of that land is classified as Natural Preserves, Wilderness Areas, National Parks and Monuments, or National Wildlife Refuges. The remaining land, including U.S. National Forest land, and County-owned Mountain Parks, may serve various purposes, but remain largely undeveloped.

The protected areas in Pima County are increasingly becoming "islands" of natural landscape surrounded by development. The disturbance surrounding the reserves provides non-indigenous species with an opportunity to move into protected areas. All of the protected areas in Pima County, including the more remote reserves of western Pima County suffer, to varying degrees, from non-indigenous species. Each reserve in Pima County manages and controls to varying degrees, from no management at all, to intensive management and eradication efforts (see Table 1).

Cabeza Prieta National Wildlife Refuge

Cabeza Prieta NWR is managed by the U.S. Fish and Wildlife Service. The Refuge covers almost 400,000 acres of the Sonoran Desert ecosystem. The Refuge is near the town of Ajo, the unincorporated town of the Why, and the Tohono O'odam Nation. It is bordered by the Barry M. Goldwater Gunnery Range to the north, the Organ Pipe Cactus National Monument to the east, Yuma County to the west, and Mexico to the south.

Although Cabeza Prieta is in a remote area, non-indigenous plants are present in the reserve (see Appendix A). They are mainly confined to roadsides and other disturbed areas (Bissell, pers. comm., 2000). Control efforts are very limited; hand pulling when exotics are encountered. The Cabeza Prieta Draft Comprehensive Conservation Plan calls for definition, management, and elimination of non-indigenous species by the year 2010.

Management and Control Effort of Exotic Species in Pima County Reserves

Reserve Name	Management Plan	Exotic Species List	Management and Control of Exotic Species
Wilderness Areas	Y	N	
Empire-Cienega Resource Conservation Area	N	N	Attempted bullfrog eradication
Silverbell RCA	Y	N	
Waterman ACEC	Y	N	
BOR Wildlife Corridor	Y	N	
Unreserved Coronado National Forest	Y	N	Scoping report on exotic plant management-preliminary overview of 13 noxious or locally invasive plants.
Santa Catalina Research Natural Area	Y	N	
Butterfly Research Natural Area	Y	N	
Saguaro National Park	Y	Y	Crew and volunteers work on exotic control, surveying and mapping exotics, buffelgrass research
Organ Pipe Cactus National Monument	Y	Y	Buffelgrass control, volunteer efforts
Cabeza Prieta National Wildlife Refuge	Y	Y	
Buenos Aires National Wildlife Refuge	N	N	Yes-Prescribed burning
Barry M. Goldwater Range	N	N	
Santa Rita Experimental Range	N	N	Exotic species planted and encouraged for research and range management
Catalina State Park	Y	Y	Complete floral inventory not yet complete--exotics are included with existing plant list
Colossal Cave Mountain Park	Y	N	Exotics are known and mentioned in Master Plan--complete list is not available
Tucson Mountain Park	N	N	Tucson Mountains are part of an effort by SNP and others to begin a exotic sp. management program
Tortolita Mountain Park	Y	N	
Cienega Creek Natural Preserve	Y	Y	Yes-manual removal of several exotics
Empirita Ranch	N	N	
Bingham Cienega Natural Preserve	Y	N	Yes-tamarisk removal and applied herbicide
Buehman Canyon and deeded land	N	N	

Organ Pipe Cactus National Monument

The Organ Pipe Cactus National Monument (OPCNM) borders Cabeza Prieta NWR. OPCNM is a globally significant Sonoran Desert ecosystem that has been designated a Biosphere Reserve under the International Man and Biosphere program (National Park Service, 1997). The reserve provides habitat for a highly diverse flora and fauna, including threatened, endangered, and sensitive plant and animal species.

Similar to Cabeza Prieta, OPCNM is relatively isolated from any urban centers, yet non-indigenous species persist, even in undisturbed areas. While non-natives are present in OPCNM, their low numbers indicates the reserve habitat is remarkably healthy (Felger, 1990). An estimated 11.6 percent, or 64 species of plants are potential non-natives to the reserve, though this number is probably too high. Some non-indigenous species may actually be native, a few are present and not reproducing, and a number of them are present in Sonora, but not documented on the reserve (Felger, 1990).

The staff at Organ Pipe have ranked exotic plants (see Appendix B) found on the reserve by guidelines suggested by a National Park Service report titled, "Handbook for Ranking Exotic Plants for Management and Control." Exotic plants are classified according to distribution and abundance, ecological impact, feasibility of control, and urgency based on the amount of attention the species demands (Hiebert and Stubbendieck, 1993).

Buffelgrass, an invasive grass intentionally planted in southern Arizona for livestock forage and soil erosion prevention, had become prevalent at OPCNM during the 1990's. This introduced species is a concern to desert environments due to its ability to reduce biodiversity by out-competing native plants and by fueling fires that are not naturally occurring in desert systems (ASDM, 1999). Based on the list compiled by staff, buffelgrass ranked high in ecological impact, medium to high in feasibility or control, and high in the urgency category (Rutman, no date). Intensive mechanical removal, followed by two years of follow-up seedling removal, has proved successful in minimizing buffelgrass infestations (ASDM, 1999). While buffelgrass is a constant threat to the reserve, OPCNM's vigilance against this species has resulted in an encouraging outcome.

Buenos Aires National Wildlife Refuge

During the last century, the Altar Valley was a Sonoran grassland teeming with a variety of plants and wildlife. The Valley experienced increasing homesteading in the 1860's, with cattle ranching as a primary driving force. Overgrazing left bare ground, which quickly eroded with monsoon rains. The grass disappeared, and the natural fire routine was suppressed. The grassland could no longer support a diverse array of native flora and fauna. Mesquite gained a foothold and replaced grassland species. Lehmann's lovegrass was introduced in the 1970's to stop erosion, a task in which the grass did well. Lehmann's lovegrass replaced native grasses and created a landscape with a low diversity levels.

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The U.S. Fish and Wildlife Service purchased BANWR in 1985, with the primary goal of reestablishing the masked bobwhite. In order to do so, the Sonoran grassland would need to be restored. The park personnel have been working towards that goal using controlled burns to curb mesquite invasion and improve soil for the benefit of native grasses and shrubs. Lehmann's lovegrass is an ongoing problem at the reserve (Gall, pers. comm., 2000). Effective treatment and management for this invasive species has not yet been determined. non-indigenous species that occur in smaller numbers are Johnson grass, Russian thistle, and Boer's lovegrass (see Appendix C for complete list). Johnson grass and Russian thistle occur in areas of disturbed bottomlands (Fonseca, pers. comm., 2000).

Scientists and refuge staff at BANWR have been working on eliminating introduced bullfrogs and tiger salamanders. Control efforts include drying ponds, fencing, and manual removal of the exotic species. Future management and control planning includes additional surveys of wetlands, effectiveness evaluation and removal, restoration or construction of wells near selected ponds, and transplanting Chiricahua leopard frogs to selected ponds to ensure a self-sustaining population (Schwalbe et al., 2000).

U.S. Bureau of Land Management Protected Land

Throughout the west, noxious weeds are spreading on BLM lands at over 2,300 acres per day (BLM, 2000). This is occurring in disturbed and undisturbed areas. Concern for the growing weed infestation occurring on public lands prompted the document, "Partners Against Weeds, An Action Plan for the Bureau of Land Management." The document contains BLM's strategy to prevent and control the spread of weeds on BLM lands through cooperation with local, regional, and national partnerships.

In Pima County, BLM manages the following protected areas: the Empire-Cienega Resource Conservation Area, Baboquivari and Coyote Mountain Wilderness Areas, the Ironwood Forest National Monument and the Waterman Area of Critical Environmental Concern (ACEC). With the recent directive to mitigate weed species, land use decisions on BLM land must consider the effect actions may have on the control or spread of weeds. Actions to control non-indigenous fish and wildlife species have not yet been planned. Efforts to control non-indigenous species on BLM lands in Pima County include bullfrog removal from upper Cienega Creek, and plans to remove tamarisk from the same area (Simms, 2000). Species of concern on BLM lands are Lehmann's lovegrass on Sonoran grasslands, and exotic grass species in the Sonoran Desert uplands.

Saguaro National Park

The U.S. National Park Service is required by law to keep parks as unaltered by human activities as possible. The NPS defines non-native species as "any animal or plant species that occurs in a given location as a result of direct, indirect, deliberate, or accidental actions by humans" (USNPS, 1996). As with the BLM lands, the growing impacts of non-native species to national park lands has prompted the NPS to develop a management policy on exotic species.

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Strategies for controlling non-indigenous species are to prevent invasion, modify NPS policy and guidelines to include non-native plant management issues, educate NPS employees and park users about invasive plant impacts on park resources, inventory and monitor non-native plants, and conduct research and transfer technology (NPS, 1999).

An estimated 7 million acres of NPS land is infested with invasive, non-indigenous species. Saguaro National Park is not exempt (see Appendix D for non-indigenous species list). The SNP staff have been surveying and mapping non-indigenous species in park since 1997. Volunteer groups have been working on eradication of exotic plants since the fall of 1998 (Holden, per.comm., 2000). Plans to control and manage non-indigenous plants include a five-person crew to work on during the summer of 2000, and a buffelgrass research project (herbicide testing) with funding available through 2001-2003.

Tucson Mountain Park

The Tucson Mountain Park encompasses 18,122 acres of the Tucson Mountains. Enclosed in its boundaries are the Arizona-Sonoran Desert Museum and Old Tucson Studios, both tourist attractions which draw large numbers of visitors. The Park is bisected by trails and roadways, disturbances on which non-indigenous plants can gain a foothold. TMP's strategy of minimizing disturbances such as parking and grading is probably a good management tool. Management for non-indigenous species in TMP is in development with the TMP Master Plan. The TMP has limited labor to control non-indigenous species, but the Park has the advantage of neighboring SNP and hosting ASDM on its grounds. Combined efforts to control and manage non-indigenous species in the Tucson Mountains may solve concerns faced by the three separate organizations.

Tortolita Mountain Park

The Tortolita Mountain Park exists as a primitive mountain park. Little comprehensive studies have been done in this park and the extent of non-indigenous species is not known. The Tortolita Mountain Park Background Report states the following policies should be applied for the management of vegetative resources in the park: the introduction of non-indigenous plant species is prohibited; the presence of noxious non-indigenous plant species, such as tamarisk, will be monitored, and if necessary, actively eradicated; and Park areas disturbed for development will be replanted with native plant species (McGann et al., 1996).

Colossal Cave Mountain Park

The Colossal Cave Mountain Park Master Plan-Background Report has little mention of non-indigenous species management. The presence of oleander in Posta Quemoda wash is of concern because this species can be swept to down-stream to Cienega Creek. A list of non-native plants can be found in Appendix E.

Cienega Creek Natural Preserve

Historic uses at the Preserve has resulted in disturbances which can still be observed. Disturbances include the deeply incised stream channel, the presence of non-indigenous plants, and a composition and distribution of plants different than conditions expected without human intervention (McGann et al., 1994). A list of non-indigenous species can be found in Appendix F. Control and management of non-indigenous species at the reserve includes cutting and treating tamarisk with herbicide, hand-picking *Vinca minor*, and fencing cows out (Scalero, pers. comm., 2000). Specimens of Giant Reed and Pampas Grass were found and hand-pulled. Bullfrogs are a new arrival at the reserve (Fonseca, pers. comm., 2000). Their presence may negatively affect leopard frog and Mexican garter snake populations.

Bingham Cienega Natural Preserve

A management goal for the Bingham Natural Preserve is to restore native plant vegetation to abandoned agricultural fields, with the objective of increasing diversity and density of native plants and wildlife (Collazo, 1992). A three year Arizona Department of Water Resources Water Protection Fund Grant has allowed the reintroduction of native plant species (Hill, per. comm). Common non-indigenous species present on the reserve are bermuda grass, sunflowers, Johnson grass, and tamarisk (see Appendix G). Feral pigs and gophers are also present on the reserve. Control of non-indigenous species includes plowing abandoned agricultural fields, applying spot herbicides, and replanting with native grasses and trees. The replanting of natives appears to be a success (Hill, per.comm.).

Coronado National Forest

The Forest Service has recently issued a proposal to implement a management plan for invasive, non-indigenous plants, including the treatment of existing populations (USDA Forest Service, 2000). The purpose of this proposal is to establish a non-indigenous plant management program for the Coronado National Forest. The CNF does not have a problem with noxious weeds, though does suffer from infestation from other non-indigenous plants (see Appendix H). Seven of the twelve Ecosystem Management Areas (EMAs) have invasive weeds, including the Santa Catalina and Santa Rita EMAs (Forest Service, 2000). The desired condition for the Forest is to have existing non-indigenous species eradicated or controlled, with no new infestations occurring. Proposed actions include planning, public education, prevention and early detection, coordination and cooperation, inventory, treatment, mapping, monitoring, and restoration.

Sabino Canyon Creek (Coronado National Forest)

Sabino Canyon has a perennial stream hosting a variety of native and non-indigenous species (see Appendix I for a list of non-indigenous plants). Green sunfish (*Chaenobryttus cyanellus*) is present along with the Gila chub (*Gila intermedia*), and native fish and a candidate for listing under the Endangered Species Act. Gila chub densities are 1/10th less in sections of the stream with green sunfish present (Matter, pers. comm., 2000). In areas without sunfish, Gila chub numbers are higher and have a broader range of sizes.

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The Arizona Game and Fish Department has poisoned and removed sunfish from sections of the stream. Crayfish, a persistent and difficult to control non-native, is also present in the stream. The University of Arizona is studying the effects of crayfish in the creek, as well as effective elimination methods (Matter, pers. comm., 2000).

Catalina State Park

According to Catalina State Park volunteers, non-indigenous plant species are present along roadways, park development and camping grounds (Holland, pers.comm., 2000). While a complete inventory of the park flora has not yet been completed, a non-comprehensive list of non-indigenous grasses is available (see Appendix J) (Hosler, pers. comm., 2000).

V. Federal Agencies Dealing with Non-indigenous Species

In the United States, non-indigenous species have major economic and ecological impacts. A recent study has assessed damages and losses adding up to 138 billion dollars per year (Pimentel 1999). 400 of 958 species listed as threatened and endangered are considered at risk due to competition with and predation by nonindigenous species (Pimentel, 1999).

There are twenty-three federal agencies dealing in some part with non-indigenous species. Each agency varies in its degree of involvement with non-indigenous species. The Animal Plant and Health Inspection Service directs most of its manpower and funds into controlling or detecting non-indigenous species, while the U.S. Coast Guard dedicates only a portion of its attention to non-indigenous species.

Despite all fifty states and every U.S. territories having non-native species (CRS, 1999), there is no federal law that provides coordination among the federal agencies in dealing with non-indigenous species. The current federal framework dealing with non-indigenous species is a patchwork of laws, regulations, policies, and programs (OTA, 1993). With laws that are available, insufficient regulations and appropriations have impeded success (OTA, 1993).

No federal agency (with the exception of U.S. Fish and Wildlife Service and National Park Service) have any specific policy statement for dealing with non-indigenous species (OTA, 1993). The federal laws provide solution to a small fraction of the problem (Meffe, 1999). No single law spans the broad problems of non-indigenous species; the interception, prevention, and control across the many areas they affect, industry, agriculture, habitats (CRS, 1993). Many of the laws only deal with non-indigenous species on a peripheral basis, though on some aspect may limit introduction of non-indigenous species. Research is needed to develop and enforce a comprehensive plan on non-indigenous species (Meffe, 1999).

For the most part, federal agencies have been dealing with non-indigenous species problems as they arise (OTA, 1993). The resulting delay in legislation may result in a growing spread of invasion, as well as increased costs in managing the problem. Keeping non-indigenous species out is easier and less expensive than dealing with an established non-indigenous species (Simberloff, 1996).

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The lack of a inclusive non-indigenous species policy or law linking all federal agencies together leads to loopholes and gaps which allow non-indigenous species to become established. To prevent this problem, a comprehensive national policy needs to be thought out and thoroughly researched. It has been suggested that a designated head agency, with a comprehensive mission and regulatory authority, will be the only way to significantly confront the growing problem of non-indigenous species (Simberloff, 1996).

Areas of Federal Activities (OTA, 1993) Federal activities related to non-indigenous species occur in several areas:

Movement of species into the U.S.

- Involves restricting entry of harmful non-indigenous species by regulation, inspection, and quarantine

Movement of species within the U.S. across state lines

- Involves restricting movement of harmful non-indigenous species by regulation, inspection, and quarantine

Regulating product content or labeling

- Involves restricting entry or interstate movement of harmful non-indigenous species by regulating contamination or mislabeling of non-indigenous species in commerce.

Controlling or eradicating non-indigenous species

Introducing desirable non-indigenous species

Federal land management

- Involves preventing, eradicating, or controlling harmful non-indigenous species on Federal lands and introducing or maintaining desirable non-indigenous species on Federal lands.

Non-indigenous species research

- Addresses prevention, control, and eradication of harmful non-indigenous species and beneficial uses of non-indigenous species

Department of Agriculture

Animal and Plant Health Inspection Service (APHIS)

- Operating 178 U.S. ports of entry, APHIS conducts pre-clearance activities, permit decisions, treatment efforts, detection surveys, and eradication efforts to prevent the introduction of specific foreign pests that would threaten agriculture production and natural ecosystems.
- APHIS works with federal and state agencies as well as non-governmental organization to detect, contain, and eradicate infections of selected foreign pests before they become established and begin to spread.

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- Controlling the spread of nonindigenous pests with naturally high rates of spread is very difficult--APHIS does not attempt eradication, suppression, or containment of such species. The Russian wheat aphid would be an example of a species that is beyond the scope of containment (OTA, 1993).
- Does not deal with species capable of harming ecosystems unless it also poses a threat to agriculture or forestry.

Agricultural Marketing Service

- Works with states in regulating interstate seed shipments.
- Requires accurate seed labeling
- Responsible for implementing the Federal Seed Act

The Foreign Agricultural Service

- Lead agency in USDA foreign activities
- Facilitates overseas activities of APHIS staff--supervises pre-clearance or monitoring foreign pest and pathogen conditions.

Forest Service

- Conducts research programs focused on invasive plant species, forest pests and pathogens.

Agricultural Research Service (ARS)

- Provides scientific and technical support for other USDA agencies.
- ARS conducts research on the prevention, control, or eradication of harmful non-indigenous species

Soil Conservation Service (SCS)

Mission is to protect land against soil erosion

- Advises public and private agencies on grasses, forages, trees and shrubs suitable for erosion control
- Some plants recommended by SCS are not indigenous to U.S. Species native to U.S. may be used and spread beyond their natural range.
- SCS does not control species which they have released and become pests, although SCS is involved in an effort to replace noxious weeds on grazing lands with more palatable ones. In doing this, SCS is considering importing plants from Inner Mongolia (OTA, 1993).

Agricultural Stabilization and Conservation Service (ASCS)

- Administers Conservation Reserve Program (CRP) created under Food Security Act of 1985, with the objective of reducing water and wind erosion on erodible croplands.
- Farmers enroll eligible lands and then plant soil conserving plants for a ten year contract. In return they get rent and half the money needed for planting.
- In 1990, 58% of CRP lands were planted with non-indigenous species, 42% were planted with indigenous species.
- In 1986-1987, CRP acreage grew by 17 million acres. The grass seed supply was depleted, which resulted in legal importation from abroad of uncertified seed. ASCS has not identified any resulting weed problems, yet conditions provide opportunity for wide-spread distribution of weed species (OTA, 1993).

Cooperative State Research Service (CSRS)

- Funds research on agricultural pest control and aquiculture. CSRS awards grants for research on the management and control of non-indigenous pests.

U.S. Department of the Interior

Fish and Wildlife Service (FWS)

- Focuses efforts on controlling introductions and preventing the spread of non-indigenous species. FWS has an important role in regulating importation of fish and wildlife.
- FWS also promotes activities that involve non-indigenous species, such as fisheries, hunting, and aquiculture.
- FWS co-chairs Aquatic Nuisance Species Task Force.

National Park Service (NPS)

- Works to control or remove exotic species on park lands.
- More than 100 NPS units have identified non-indigenous species as significant resource management threats (CRS, 1999).

Bureau of Land Management (BLM)

- Focuses non-indigenous species efforts primarily on controlling invasive plants (CRS, 1999).
- BLM has implemented a program, Partners Against Weeds, to prevent and control the spread of noxious weeds on public lands (CRS, 1999).
- As of April 9, 1999, BLM's Director had identified invasive weeds as a top priority.

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Geological Survey (USGS)

- The Biological Resources Division focuses on researching factors influencing the invasion by nonindigenous fish and the effects on invasive species on ecosystem processes, native species, and landscape dynamics (CRS, 1999).
- USGS manages the National Nonindigenous Aquatic Nuisance Species Database and several regional databases.

Office of Surface Mining Reclamation and Enforcement (OSM)

OSM allows the use of introduced species in re-vegetating reclamation sites, only if the introduced species are necessary. The introduced species must not include poisonous or toxic species.

Bureau of Indian Affairs (BIA)

- As of 1993, BIA was in its fourth year of a ten-year program for management of noxious weeds, which were estimated to cover 726,000 acres (12%) of BIA land (OTA). The plan's objective is to eliminate 90% of the weed infestation by end of 1999.

Bureau of Reclamation (BOR)

- BOR has built systems in waterways that have dramatically changed the course of the western U.S. rivers. In doing so, non-indigenous species have had a chance to establish themselves in these altered waterways.
- BOR is working with Federal, State, and private agencies to implement control programs to curtail some of the major invasive species along river areas (OTA).

U.S. Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

- NOAA has funded research on identifying pathways of introduction, developing cost-effective prevention methods, developing effective controls that minimize ecological damage, and identifying dispersal mechanisms of established species that might lead to safeguards and protocols to prevent or slow the spread of non-indigenous species (CRS, 1999).
- Has funded much of the outside research on the zebra mussel. Co-chairs on the Aquatic Nuisance Species Task Force.

Department of Defense

- DOD Invasive Species Management Program seeks to prevent the entry of invasive species into the U.S., to control invasive species present on DOD installations, and to restore DOD lands using native plants (CRS, 1999).

- Army Corps of Engineers (COE) conducts the Aquatic Plant Control Program, which is designed to control aquatic weeds (OTA, 1993).
- Member of the Aquatic Nuisance Species Task Force

Environmental Protection Agency (EPA)

- Regulates the entry and distribution of various microorganisms, and conducts research on aquatic nuisance species (OTA, 1993).

U.S. Department of Transportation

Coast Guard (USCG)

- Under Nonindigenous Aquatic Nuisance Prevention and Control Act, USCG is responsible for developing and implementing a ballast water management program to minimize the invasion of non-indigenous species species in ballast water.

Federal Highway Administration

- Focuses primarily on vegetation management, including combating roadside invasive species (CRS).

U.S. Department of Justice-Drug Enforcement Agency

- Restricts importation of certain narcotic nonindigenous plants and fungi.

U.S. Department of Health and Human Services--Public Health Service

- Regulates entry of living organisms that may carry or cause human diseases.

U.S. Department of the Treasury--U.S. Customs Service

- Customs personnel inspect passengers, baggage, and cargo of U.S. ports of entry.
- Has a major role in restricting the entry of harmful non-indigenous species (OTA).

Interagency Efforts

Aquatic Nuisance Species Task Force

- Intergovernmental organization dedicated to implementing the Nonindigenous Aquatic Nuisance Species Control Act by preventing and controlling aquatic nuisance species.
- Co-chaired by FWS and NOAA. Other Federal members include EPA, the Coast Guard, Army COE, USDA, and Department of the State.

Federal Interagency Committee for Management of Noxious and Exotic Weeds

- Provides for technical assistance on private lands, and cooperative work on integrated ecological approaches to management of noxious weeds on federal lands.

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- Composed of various agency representatives from the Departments of Agriculture, Interior, Transportation, Defense, and Energy.
- Accomplishments include a weed fact book, *Invasive Plants: Changing the Landscape of America*, as well as the document *Pulling Together: National Strategy for Invasive Plant Management*. An one hour documentary video on the problem of noxious and exotic weeds is in development for airing in the near future.

VI. Federal Laws and Executive Orders Dealing with Nonindigenous Species

Lacey Act (1900)

- Makes it illegal to import, export, sell, receive, acquire, or purchase fish, wildlife, or plants taken, possessed, transported, or sold in violation of U.S. or tribal law.
- This law may be useful in indirectly regulating non-native species introduction.

Plant Quarantine Act (1912)

- Gives Animal and Plant Health Inspection Service (APHIS) authority to regulate the importation and interstate movement of plants or their parts and any reproductive parts to prevent introduction of plant disease and plant pests.
- APHIS has the authority to quarantine. Quarantine has been successful in keeping witchweed from spreading into the midwestern states, but has not been successful keeping fire ants from spreading (CRS).

National Park Service Organic Act (1916)

- Promotes eradication and control of non-indigenous species and prohibits most introductions in national parks.

The Animal Damage Control Act (1931)

- Gives APHIS authority to operate its Wildlife Services program to control wildlife damage on federal, state, or private land.
- Wildlife Services has cooperated with U.S. Fish and Wildlife Service, and National Park Service to help protect natural resources from loss of life, habitat, or food supply due to activities of other species (CRS, 1999).
- Under authority of the Act, APHIS deals with problems caused by non-native species such as nutria, blackbirds, European starlings, monk parakeets, and brown tree snake.

Federal Seed Act (1939)

- The act prohibits importation and movement of inaccurately labeled seeds, and imposes labeling requirements.

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- The law works with the Federal Noxious Weed Act to regulate the importation of field crop, pasture and forage, or vegetable seed that may contain noxious weed seeds.
- Inconsistencies between the two acts allow undesirable weeds to enter the country. The Federal Seed Act's exclusion of horticultural seeds allows weed seeds to be imported with ornamental crops seeds.

Mexican Border Act (1942)

- Provides authority to the U.S. Department of Agriculture to regulate, inspect and disinfect railroad cars, vehicles, luggage, and other materials from Mexico, including prevention of entry of exotic pests.

Organic Act of 1944

- Authorizes Secretary of Agriculture to detect, eradicate, suppress, control, prevent, or retard the spread of plant pests.

Public Health Act (1944)

- Regulates entry of living organisms that may carry or cause human diseases.

Federal Insecticide, Fungicide and Rodenticide Act (1947)

- Controls movement of nonindigenous microbes into and through the U.S.

Importation of Certain Mollusks (1951)

- Provides inspection and treatment of goods entering the U.S. from areas infested with any terrestrial or freshwater mollusks to control entry of any such organisms.

Federal Plant Pest Act (1957)

- Prohibits agricultural pests (pathogens, noxious weeds, animal and plant pests) from importation and interstate movements.
- APHIS has kept thousands of potentially harmful agricultural pests from becoming established, but has done little to analyze risks to natural habitat such as accepting imports of untreated objects from high risk areas on the assumption of harmlessness. An example of this would be accepting raw wood from Asia that contained the Asian Long-Horned Beetle (CRS, 1993).
- APHIS is a regulator and promotor of agriculture. When weighing risks of a non-indigenous species, trade and economic factors are considered along with biological ones. This may result in slower or even less action than those suffering damage from the pest may expect.

Wild Free-Roaming Horses and Burro Act (1971)

- Requires Secretaries of the Interior and Agriculture to manage wild horse and burro herds at population levels that allow preservation and maintenance of ecological balance.

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Federal Noxious Weed Act (1974)

- Authorizes programs to restrict introduction and spread on non-indigenous species noxious weeds.
- Does not focus on weeds that affect native habitat areas. Does not quarantine a weed unless it is on the noxious weed list.

Executive Order 11987 Exotic Organisms (1977)

- Restricts introduction of exotic species into natural ecosystems under federal agency authority.

Cooperative Forestry Assistance Act (1978)

- U.S. Forest Service is responsible for detecting, identifying, surveying, and controlling forest pests.

Nonindigenous Aquatic Nuisance Prevention and Control Act (1990)

- Established a federal program to prevent the introduction of, and to control the spread of, introduced aquatic nuisance species and the brown tree snake.
- Fish and Wildlife Service, the Coast Guard, the Environmental Protection Agency, Army Corps of Engineers, National Oceanic Atmospheric Administration act cooperatively as members of the NANPCA Task Force
- Has been criticized as ineffectual due to the voluntary nature of some of its provisions (CRS, 1999).

Alien Species Prevention and Enforcement Act of 1992

- Makes it illegal to ship certain categories of plants and animals through the mail.
- The law is not specific to the introduction of non-indigenous species, yet it does prohibit plants which fall under Plant Quarantine Act, Federal Plant Pest Act, and plants and animals the fall under the Lacey Act.

Executive Order 13112 on Invasive Species (1998)

- Directs all federal agencies to address invasive species concerns as well as refrain from actions likely to increase invasive species problems.
- Environmental groups have given less attention to the order, despite its potential impacts on biodiversity (CRS, 1999).

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Appendix A
Non-Indigenous Species in Cabeza Prieta National Wildlife Refuge

Seed Plants:

Scientific Names

Common Names

Aizoaceae

Mesembryanthemum nodiflorum

Slender leaf, Iceplant

Asteraceae

Centraurea wrightii

Yellow star thistle

Conyza canadensis var. *galbrata*

Horseweed, Cola de caballo

Conyza coulteri

Laennecia coulter

Lactuca seriola

Prickly lettuce, compass plant

Matricaria matricarioides

Pineapple weed, manzanilla,
false chamomile

Sonchus asper asper

Spiny sow-thistle, chinita

Brassicaceae

Brassica tournefortii

Sahara mustard, wild turnip,
mostaza

Sisymbrium irio

London rocket, pamita

Sisymbrium orientale

Chenopodiaceae

Chenopodium murale

Net-leaf, goosefoot, chual,
cual

Salsola australis

Russian thistle, tumbleweed,
chamizo, volador

Geraniaceae

Erodium cicutarium

Filaree, Stork's bill, Heron bill,
Alfilerillo

Molluginaceae

Glinus radmius

Nyctaginaceae

Boerhavia cocinea

Scarlet spiderling

Portulacaceae

Polygonum argyrocoleon

Silversheath

Tamaricaceae

Tamarix ramosissima

Salt cedar, tamarisk, salado

Zygophyllaceae

Tribulus terrestris

Puncture vine, goathead, torito

Poaceae

Bromus rubens

Red brome, foxtail brome

Cenchrus ciliaris

Pennisetum ciliare

Cenchrus incertus (Cenchrus pauciflorus)

Field sandbur, Huipapori

Chloris virgata

Feather fingergrass, cola de zorra, zacate lagunero

Cynodon dactylon

Bermuda grass, zacate ingles

Echinochloa colunum var. Colunum

Junglegrass, leopard grass,

zacate rayado, zacate pinto

Echinochloa crusgalli var. crusgalli

Barnyard grass, zacate de agua

Hordeum murinum glaucum

Wild barley, cebadilla silvestre

Pennisetum ciliare

Buffelgrass, zacate buffel

Pennisetum setaceum

Fountain grass

Phalaris minor

Little-seed, canary grass

Schismus arabicus

Arabian grass

Schismus barbatus

Mediterranean grass

Sorghum halepense

Johnson grass, zacate Johnson

House sparrow

House starling

Appendix B
Organ Pipe Cactus National Monument Exotic Plant List
By Dr. Richard Felger and Susan Rutman

<u>Scientific Name</u>	<u>Common Name</u>
Poaceae	
<i>Avena fatua</i>	Wild oats
<i>Bromus rubens</i>	Red brome
<i>Bromus tectorum</i>	Downy chess
<i>Ceechrus (Pennisetum) ciliaris</i>	Buffelgrass
<i>Chloris virgata</i>	Feather fingergrass
<i>Cynodon dactylon</i>	Bermuda grass
<i>Echinochloa colonum</i>	Jungle-rice, leopard grass
<i>Dactyloctenium aegyptium</i>	Crowfoot grass
<i>Eragrostis barrelieri</i>	Mediterranean lovegrass
<i>Eragrostis cilianensis</i>	Stinking lovegrass
<i>Eragrostis lehmanniana</i>	Lehmann's lovegrass
<i>Eriochloa acuminata</i> var. <i>Acuminata</i>	
<i>Hordeum murinum</i> ssp. <i>glaucum</i>	Wild barley
<i>Panicum antidotale</i>	Blue panicum
<i>Pennisetum setaceum</i>	Fountain grass
<i>Phalaris caroliniana</i>	
<i>Phalaris minor</i>	Little-seed canary grass
<i>Poa annua</i>	Annual bluegrass
<i>Polypogon monspeliensis</i>	Rabbit grass
<i>Polypogon viridis</i>	
<i>Schismus arabicus</i>	Arabian grass
<i>Schismus barbatus</i>	Mediterranean lovegrass
Aizoaceae	
<i>Mesembryanthemum crystallinum</i>	Ice plant
<i>Mesembryanthemum nodiflorum</i>	Ice plant
Asteraceae	
<i>Carthamus tinctorius</i>	Safflower
<i>Centaurea melitensis</i>	Malta star thistle
<i>Conyza coulteri</i>	
<i>Eclipta prostrata</i>	False daisy
<i>Lactuca serriola</i>	Prickly lettuce
<i>Sonchus asper</i> ssp. <i>asper</i>	Spiny sow-thistle
<i>Sonshus oleraceus</i>	Sow thistle

Brassicaceae

<i>Brassica nigra</i>	Black mustard
<i>Brassica tournefortii</i>	Sahara Mustard
<i>Rorripa nasturtium-aquaticum</i>	Lyre-pod
<i>Sisymbrium irio</i>	London rocket

Cactaceae

<i>Opuntia basilaris</i>	Beavertail cactus
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Chenopodiaceae

<i>Salsola tragus</i>	Russian thistle, tumbleweed
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Euphorbiaceae

<i>Euphorbia prostrata</i>	
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Fabaceae

<i>Medicago polymorpha</i>	Bur clover
<i>Melilotus indicus</i>	Yellow sour-clover

Geraniaceae

<i>Erodium cictarium</i>	Filaree, heron bill
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Linaceae

<i>Linum usitatissimum</i>	Common flax
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Malvaceae

<i>Malva parvifolia</i>	Cheeseweed
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Moraceae

<i>Ficus carica</i>	Fig
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Nyctaginaceae

<i>Boerhavia coccinea</i>	Scarlet spiderling
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Portulacaceae

Portulaca oleraceae var oleracea Common purslane

Primulaceae

Anagallis arvensis

Punicaceae

Punicum granatum Pomegranate

Solanaceae

Calibrachoa parviflora Wild petunia
Solanum americanum Black nightshade

Tamaricaceae

Tamarix aphylla Athel tree, salt cedar
Tamarix ramosissima Salt-cedar, tamarisk

Verbenaceae

Lantana camara Lantana

Zygophyllaceae

Tribulus terrestris Puncture vine, goathead

Appendix C
Buenos Aires Non-indigenous Plant List
Compiled by Steve McLaughlin

Scientific Name	Common Name
Dicotyledonae	
Aizoaceae	
<i>Glinus radiatus</i>	
<i>Mollugo verticillata</i>	
Amaranthaceae	
<i>Amaranthus albus</i>	Tumbleweed
Asteraceae	
<i>Conyza canadensis</i>	Conyza
<i>Lactuca serriola</i>	Wild lettuce
<i>Sonchus asper</i>	Spiny sow thistle
Brassicaceae	
<i>Capsella bursa-pastoris</i>	Sheperds purse
<i>Descurainia sophia</i>	Flixweed
<i>Nasturtium officinale</i>	
<i>Sisymbrium irio</i>	London rocket
Chenopodiaceae	
<i>Salsola iberica</i>	Russian thistle
Convolvulaceae	
<i>Convolvulus arvensis</i>	Field bindweed
<i>Ipomoea hederacea</i>	Morning glory
<i>Ipomoea purpurea</i>	Tall morning glory
Fabaceae	
<i>Lotus corniculatus</i>	Birdfoot trefoil
<i>Medicago polymorpha</i>	Bur clover
<i>Melilotus indicus</i>	Alfalfilla

Geraniaceae

Erodium cicutarium

Filaree

Lamiaceae

Lamium amplexicaule

Henbit

Marrubium vulgare

Horehound

Malvaceae

Malva parviflora

Cheese weed

Nymphaeaceae

Nymphaea mexicana

Nymphaea odorata

Plantaginaceae

Plantago major

Common plantain

Polygonaceae

Polygonum aviculare

Knotweed

Polygonum lapathifolium

Rumex crispus

Curly dock

Rubiaceae

Galium aparine

Salicaceae

Salix cf. babylonica

Scrophulariaceae

Veronica anagallis-aquatica

Tamaricaceae

Tamarix ramosissima

Tamarisk

Verbenaceae

Phyla cuneifolia
Zygophyllaceae

Tribulus terrestris

Puncture vine

Monocotyledonae

Poaceae

Avena fatua

Wild oat

Bromus catharticus

Rescue brome

Bromus rubens

Red brome

Bromus marginatus

Brome

Cynodon dactylon

Bermuda grass

Digitaria sanguinalis

Common crabgrass

Echinochloa crusgalli

Barnyard grass

Eragrostis curvula var conferta

Weeping lovegrass

Eragrostis cilianensis

Stinkgrass

Eragrostis echinochloidea

Lovegrass

Eragrostis lehmanniana

Lehmann lovegrass

Hordeum murinum ssp glaucum

Barley

Panicum antidotale

Blue panic

Poa annua

Annual bluegrass

Poa pratensis

Kentucky bluegrass

Polypogon monspeliensis

Rabbitfoot

Schismus barbatus

Mediterranean grass

Sorghum halepense

Johnson grass

Triticum aestivum

MALVACEAE

Malva parviflora

little mallow

POACEAE

Agrostis semiverticillata

water bent

Agrostis stolonifera

creeping bent

Avena fatua

wild oat

Bromus catharticus

rescue brome

Bromus rubens

red brome

Bromus tectorum

cheatgrass

Cortaderia sellowana

pampus grass

Cynodon dactylon

Bermida grass

Digitaria ciliaris

crabgrass

Digitaria sanguinalis

large crabgrass

Echinochloa colona

barnyard grass

Echinochloa colonum

barnyard grass

Eragrostis cilianensis

stinkgrass

Eragrostis curvula

weeping lovegrass

Eragrostis echinchoidea

Lehmann lovegrass

Eragrostis lehmanniana

Gastridium ventricosum

Hordeum leporinum

wild barley

Hordeum murinum

wild barley

Hordeum vulgare

common barley

Pennisetum ciliare

buffelgrass

Pennisetum setaceum

fountain grass

Phalaris caroliniana

Carolina canary grass

Phalaris canariensis

canary grass

Phalaris minor

littleseed canary grass

Phleum pratense

common timothy

Poa annua

annual bluegrass

Poa pratensis

Kentucky bluegrass

Polypogon monspeliensis

rabbitfoot grass

Renchelyretum repens

natal grass

Renchelrytum roseum

Schismus arabicus

Arabian grass

Schismus barbatus

Mediterranean grass

Setaria viridis

green foxtail

POLYGONACEAE

Polygonum aviculare

prostate knotweed

Rumex acetosella

red sorrel

Rumex crispus

curly dock

RUBIACEAE

Galium aparine

goosegrass

Hedyotis crassifolia

SOLANACEAE

Nicotiana glauca

tree tobacco

TAMARICACEAE

Tamarix spp.

tamarisk

ZYGOPHYLLACEAE

Tribulus terrestris

puncturevine

Appendix E
Colossal Cave Mountain Park Non-indigenous Plant List
(Colossal Cave Mountain Park Master Plan Background Report)

Scientific Name	Common Name
Chenopodiaceae	
<i>Salsola australis</i>	Russian thistle
Geraniaceae	
<i>Erodium cicutarium</i>	Filaree, storksbill
Solanaceae	
<i>Nicotiana glauca</i>	Tree tobacco
Tamaricaceae	
<i>Tamarix pentandra</i>	Tamarisk, salt cedar
Poaceae	
<i>Bromus rubens</i>	Red brome
<i>Cynodon dactylon</i>	Bermuda grass
<i>Eragrotis lehmanniana</i>	Lehmann's lovegrass
<i>Pennisetum ciliare</i>	Buffel grass
<i>Sorghum halepense</i>	Johnson grass
<i>Nerium oleander</i>	Oleander
<i>Caesalpinia pulcherrima</i>	Mexican Bird-of-Paradise

Appendix F
Cienega Creek Natural Preserve Non-indigenous Plant List

Scientific Name	Common Name
Asteraceae	
<i>Centaurea melitensis</i>	Malta star thistle
<i>Sonchus oleraceus</i>	Annual sow thistle
Chenopodiaceae	
<i>Salsola tragus</i>	Russian thistle, tumbleweed
Brassicaceae	
<i>Brassica tournefortii</i>	Sahara mustard
<i>Sisymbrium irio</i>	London rocket
Fabaceae	
<i>Melilotus officinalis</i>	Yellow sweetclover
Geraniaceae	
<i>Erodium cicutarium</i>	Filaree
Poaceae	
<i>Avena fatua</i>	Wild oat
<i>Bromus marginatus</i>	Brome
<i>Bromus rubens</i>	Red brome
<i>Cynodon dactylon</i>	Bermuda grass
<i>Eragrostis barrelieri</i>	Mediterranean lovegrass
<i>Eragrostis curvula var conferta</i>	Weeping lovegrass
<i>Eragrostis lehmanniana</i>	Lehmann lovegrass
<i>Panicum antidotale</i>	Blue panic grass
<i>Phalaris minor</i>	Canary grass
<i>Phleum pratense</i>	Common Timothy
<i>Polypogon monspeliensis</i>	Rabbitfoot grass
<i>Schismus arabicus</i>	Arabian grass
<i>Sorghum halepense</i>	Johnson grass
Solanaceae	

Nicotiana glauca
Salanum elaeagnifolium

Tree tobacco
Silverleaf nightshade

Tamaricaceae

Tamarix pentandra

Salt cedar

Appendix G
Bingham-Cienega Natural Preserve Non-indigenous Plant List

Scientific Name	Common Name
Apiaceae	
<i>Berula erecta</i>	Water parsnip
Asteraceae	
<i>Bidens sp.</i>	
<i>Centaurea melatensis</i>	Malta star thistle
<i>Conzya canadensis</i>	Horseweed
<i>Lacutca serriola</i>	Prickly lettuce
<i>Sonchus oleraceus</i>	Annual sow thistle
Brassicaceae	
<i>Brassica nigra</i>	Black mustard
<i>Capsella bursa-pastoris</i>	Shepherds purse
<i>Chorispota tenella</i>	
<i>Descurainia sophia</i>	Flixweed
<i>Sisymbrium irio</i>	London rocket
Chenopodiaceae	
<i>Salsola tragus</i>	Russian thistle
Convolvulaceae	
<i>Convolvulus arvensis</i>	Field bindweed
Fabaceae	
<i>Medicago sativa</i>	Alfalfa
<i>Melilotus albus</i>	White sweet clover
<i>Melilotus indicus</i>	Annual yellow sweet clover
Geraniaceae	
<i>Erodium cicutarium</i>	Filaree
<i>Erodium texanum</i>	Stork's bill
Lamiaceae	

<i>Lamium amplexicaule</i>	Henbit
<i>Mentha arvensis</i>	Common mint
<i>Marrubium vulgare</i>	Common horehound

Malvaceae

<i>Malva parviflora</i>	Cheeseweed
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Plantaginaceae

<i>Plantago major</i>	Common plantain
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Poaceae

<i>Avena fatua</i>	Wild oat
<i>Bromus rubens</i>	Red brome
<i>Cynodon dactylon</i>	Bermuda grass
<i>Eragrostis cilianensis</i>	Stink grass
<i>Hordeum murinum sp. glaucum</i>	Annual barley
<i>Hordeum pusillum</i>	Little barley
<i>Polypogon monspeliensis</i>	Rabbitfoot grass
<i>Setaria leucopila</i>	Bristlegrass
<i>Sorghum halapense</i>	Johnson grass

Polygonaceae

<i>Polygonum argyrocoleon</i>	Silversheath knotweed
<i>Polygonum aviculare</i>	Prostrate knotweed
<i>Rumex crispus</i>	Curly dock

Portulacacae

<i>Portulaca oleracea</i>	Common purslane
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Scrophulariaceae

<i>Veronica anagalis-aquatica</i>	Water speedwell
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Simaroubaceae

<i>Ailanthus altissima</i>	Tree of Heaven
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Solanaceae

<i>Datura wrightii</i>	Datura
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Nicotiana glauca
Nicotiana trigonophylla
Solanum elaeagnifolium

Tree tobacco
Desert tobacco
Silverleaf nightshade

Tamaricaceae

Tamarix pentandra

Salt cedar

Appendix H
Coronado National Forest Non-Indigenous Species List

Scientific Name	Common Name
<i>Sisymbrium irio</i>	London rocket
<i>Eragrostis cilianensis</i>	
<i>Erodium cicutarium</i>	redstem filaree
<i>Sonchus oleraceus</i>	spiny sowthistle
<i>Lactuca serriola</i>	prickly lettuce
<i>Tribulus terrestris</i>	puncture vine
<i>Conyza canadensis</i>	
<i>Conyza coulteri</i>	horseweed
<i>Digitaria sanguinalis</i>	crabgrass
<i>Echinochloa colonum</i>	barnyard grass
<i>Sonchus asper</i>	sowthistle, annual
<i>Boerhavia coccinea</i>	scarlet spiderling
<i>Agrostis semiverticillata</i>	bent, water
<i>Eragrostis curvula</i>	stinkgrass
<i>Ipomoea hirsutula</i>	morning glory, woolly
<i>Ipomoea purpurea</i>	morning glory, tall
<i>Malva parviflora</i>	mallow, common
<i>Nictiana trigonophylla</i>	Desert tobacco
<i>Verbesina encelioides</i>	crownbeard
<i>Cyperus esculentus</i>	yellow nutsedge
<i>Euphorbia prostrata</i>	groundfig spurge
<i>Descurainia sophia</i>	tansymustard
<i>Helianthus annuus</i>	sunflower
<i>Morus microphylla</i>	small leaf mulberry
<i>Populus fremontii</i>	Fremont cottonwood
<i>Portulaca oleracea</i>	common purslane
<i>Solanum americanum</i>	black nightshade
<i>Alternanthera pungens</i>	khakiweed
<i>Asparagus officinalis</i>	asparagus
<i>Chenopodium graveolens</i>	nettleleaf goosefoot
<i>Solanum rostratum</i>	buffalobur
<i>Echinochloa colona</i>	barnyard grass
<i>Triticum aestivum</i>	wheat
<i>Ailanthus altissima</i>	Tree of Heaven
<i>Caesalpinia gilliesii</i>	Bird of Paradise
<i>Datura stramonium</i>	Jimson weed
<i>Prunus armeniaca</i>	Apricot
<i>Xanthium saccharatum</i>	cocklebur

Appendix I
Sabino Canyon Non-Indigenous Plant List

<u>Scientific Name</u>	<u>Common Name</u>
Anacardiaceae	
<i>Rhus lancea</i>	African sumac
Asteraceae	
<i>Centaurea melitensis</i>	Malta Star Thistle
<i>Conyza candensis</i>	Horseweed
<i>Euryops multifidus</i>	Euryops
<i>Heterotheca psammophila</i>	Camphor weed, telegraph plant
<i>Matricaria matricarioides</i>	Pineapple weed
<i>Pentzia incana</i>	Pentzia
<i>Sonchus asper</i>	Spiny sow thistle
<i>Sonchus oleraceus</i>	Annual sow thistle
Brassicaceae	
<i>Brassica tournefortii</i>	Sahara mustard
<i>Capsella bursa-pastoris</i>	Sheperds purse
<i>Lepidium virginicum var medium</i>	Peppergrass
<i>Sisymbrium irio</i>	London rocket
Chenopodiaceae	
<i>Salsola iberica</i>	Russian thistle
Fabaceae	
<i>Parkinsonia aculeata</i>	Mexican palo verde
Geraniaceae	
<i>Erodium cicutarium</i>	Filaree
Lamiaceae	
<i>Lamium amplexicaule</i>	Henbit
Malvaceae	

Sida sp. Sida

Oxalidaceae

Oxalis corniculata Creeping wood sorrel

Poaceae

Arundo donax Giant reed
Avena fatua Wild oat
Bromus catharticus Rescue brome
Bromus rubens Red brome
Cenchrus ciliaris Buffelgrass
Chloris virgata Feather fingergrass
Cynodon dactylon Bermuda grass
Digitaria sanguinalis Common crabgrass
Echinochloa colona Junglerice
Echinochloa crusgalli Barnyard rice
Eragrostis cilianensis Stink grass
Eragrostis curvula var conferta Weeping lovegrass
Eragrostis echinocloidea Barnyard lovegrass
Eragrostis lehmanniana Lehmann's lovegrass
Hordeum murinum ssp glaucum Wild barley
Pennisetum setaceum Fountain grass
Phalaris minor Littleseed canary grass
Polypogon monspeliensis Bigelow's bluegrass
Rhynchelytrum repens Natal grass
Schimus barbatus Mediterranean grass
Sorghum halepense Johnson grass
Vulpia microstachya var ciliata Small fescue
Vulpia microstachya var microstachya Small fescue

Portulacaceae

Portulaca oleracea Purslane

Scrophulariaceae

Verbascum thapsus Common mullein

Solanaceae

Solanum elaeagnifolium Silverleaf nightshade

Zygophyllaceae

Trubulus terrestris

Puncture Vine

Appendix J
Catalina State Park Non-indigenous Grass List

Scientific Name	Common Name
<i>Avena barbata</i>	Slender oat
<i>Avena fatua</i>	Wild oat
<i>Bromus rubens</i>	Red brome
<i>Cynodon dactylon</i>	Bermuda grass
<i>Digitaria sanguinalis</i>	Common crabgrass
<i>Eragrostis barrelieri</i>	Mediterranean lovegrass
<i>Eragrostis cilianesis</i>	Stink grass
<i>Eragrostis chloromelas</i>	Boer lovegrass
<i>Eragrostis curvula</i>	Weeping lovegrass
<i>Eragrostis lehmanniana</i>	Lehman's lovegrass
<i>Hordeum glaucum</i>	Wild barley
<i>Hordeum leporinum</i>	Wild barley
<i>Polypogon monspeliensis</i>	Rabbitfoot grass
<i>Rhynchelytrum repens</i>	Natal grass
<i>Schismus barbatus</i>	Mediterranean grass
<i>Pennisetum setaceum</i>	Fountain grass