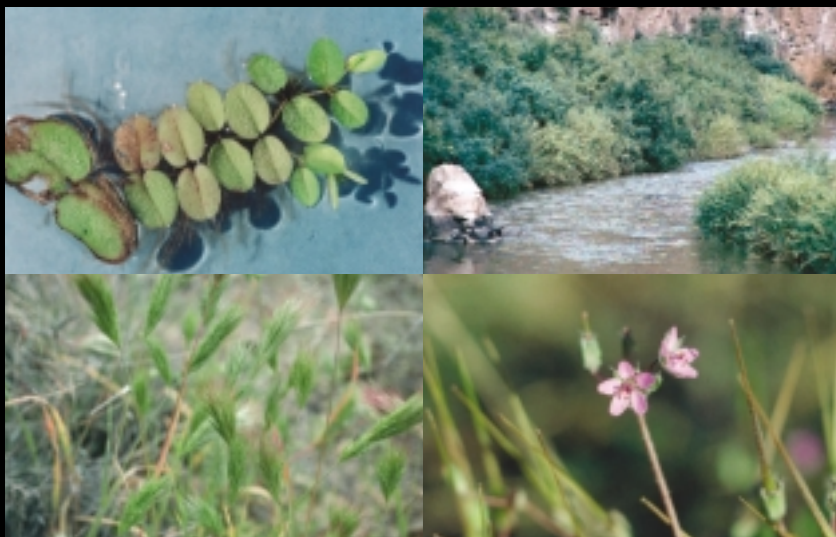


# INVASIVE plants of the Sonoran Desert



*A Field Guide*

# Invasive Plants of the Sonoran Desert

by Nina Chambers, Sonoran Institute  
and Trica Oshant Hawkins, Environmental Education Exchange



This publication was made possible through a grant from the National Fish and Wildlife Foundation and funding from the U.S. Fish and Wildlife Service. Funding was also provided by the Ford Foundation, National Park Service-Mexico Affairs Office, Department of Defense Legacy Program, David and Lucile Packard Foundation, Fear Not Foundation, and other partners. This publication is meant for non-commercial educational and research purposes only.

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Cover photographs, clockwise from top left: Ed Northam, Barbara Tellman, Ed Northam, Tom Van Devender

Book design: Terry Moody

## Acknowledgements

We express our sincere gratitude to the many people and organizations that contributed to this field guide.

### **Thank you to our reviewers**

David Bertlesen, Arizona Native Plant Society  
Patrick Boles, Arizona State Land Department  
Alberto Búrquez Montijo, Instituto de Ecología, UNAM  
Phillip Cooley, Bureau of Land Management  
Richard Felger, Drylands Institute  
John Hall, The Nature Conservancy  
Curt McCasland, U.S. Fish and Wildlife Service  
Bruce Munda, Natural Resource Conservation Service  
Ed Northam, Arizona Department of Agriculture  
Dan Robinett, Natural Resources Conservation Service  
Barbara Tellman, Arizona Native Plant Society  
Tom Van Devender, Arizona-Sonora Desert Museum

### **Thank you to our partners**

Arizona Native Plant Society  
Arizona-Sonora Desert Museum  
Desert Southwest Cooperative Ecosystem Studies Unit  
Drylands Institute  
Environmental Education Exchange  
Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora  
International Sonoran Desert Alliance  
Instituto de Ecología, Universidad Nacional Autónoma de México  
National Fish and Wildlife Foundation  
National Park Service  
Society for Ecological Restoration  
Sonoran Desert Invasive Species Council  
Sonoran Institute  
Southwest Vegetation Management Association  
The Nature Conservancy  
U.S.D.A., Animal and Plant Health Inspection Service  
U.S. Fish and Wildlife Service

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## Save the Desert, Prevent a Weed

A weed is an unwanted plant, and people have lived with and combated unwanted plants since the dawn of agriculture, or perhaps even earlier. Like all creatures, especially big and numerous ones, people make changes in their ecosystems. Many weedy plants and pests do exceptionally well in places altered by humans and, therefore, continue co-evolving with us. Go to empty lots, backyards and front yards, or agricultural fields, and as more people invade the desert, the plants you see there tend to be at the pain or pleasure of past and current people.

A plant's strategies for sending its offspring far and wide can be intricate and marvelous, and immigrations or "invasions" of plants and animals to the Sonoran Desert are nothing new. For example, creosote-bush and hordes of little annual plant species somehow got to North America and the Sonoran Desert from South America during deep pre-historic times, long before the waves of human invasions into the Sonoran Desert. (Some invading plants have seeds that when wet and then dried can stick like cement to an object such as a bird's foot, and others have spines ornamented with tiny grappling hooks. Get out your hand lens and look at the secret structures on weed seeds and parts.) Today we are shocked at the increasing rate of unwanted arrivals and their escalating impact on the native biota. But this is our doing, related to increased human population and habitat destruction, both making new habitats for weedy plants (which tend to be pioneer species), together with accidental or purposeful introductions.

Keep in mind that not all non-natives are bad. In fact only a few are truly invasive and undesirable. Our civilization is based on moving around living things, such as wheat, rice, potatoes, and domestic animals, and along with agricultural crops and garden plants come the inevitable weeds and pests. We cannot know for certain in advance which new non-natives might cause ecologic, economic, and esthetic havoc. We cannot be so isolationist as to stop all imports and newcomers to the region, nor truly halt all globalization. Yet a good understanding of invasive plants can help us make educated choices and at least not perpetrate worst-case scenarios. For example, not long ago red brome (*Bromus rubens*) and *Schismus* were often included in local re-seeding efforts. And for certain, it would be dangerous to purposely introduce different genetic strains of known invasives, such as a more cold-tolerant buffelgrass (*Pennisetum ciliare*).

Sadly, some invasive plants are altering the Sonoran Desert in decidedly undesirable ways. Displacement of native plants and changes in diversity can result in a radically different habitat and food value for wildlife. During years of favorable rains some invasive species, especially red brome and buffelgrass, can become dense enough so that when they

dry, they can carry a fire in late spring and early summer. Sonoran Desert plants such as saguaros and palo verdes and many others are not fire-adapted and do not survive wildfires. Substantial areas of prime Sonoran Desert real estate near Phoenix have lost their saguaro forests due to red brome wildfires.

The percentage or number of non-native species is lowest in the most intact, natural areas of the Sonoran Desert, and highest in the most disturbed, degraded habitats. Of course a single, unusually aggressive, and well-adapted alien species might cause havoc anywhere, but the most pristine places do indeed have floras with the fewest numbers of non-natives. In the mid-20<sup>th</sup> century the greater Sonoran Desert included approximately 146 non-native species, or 5.7 percent of the total flora. Today non-natives make up nearly 10 percent of the Sonoran Desert flora, and the numbers are increasing. In local, disturbed areas, such as urban empty lots, the majority of species are often non-native invasives.

In the 1970s, the Gran Desierto dunes of northwestern Sonora, an area of about 5,000 km<sup>2</sup>, had a flora devoid of non-natives, with the possible exception of annual three-awn grass (*Aristida adscensionis*) and a little annual carpetweed (*Mollugo cerviana*). I say “possible exception” because it is not certain that these plants actually arrived from the Old World by human agency. Certainly they have been in the New World for centuries, at least. By the 1990s, three species, documented to be of Old World origin, had arrived on the yet-pristine dunes: Sahara mustard (*Brassica tournefortii*), Arabian grass (*Schismus arabicus*), and a sow thistle (*Sonchus asper*). The sow thistle is relatively rare on the dunes but the mustard and the grass are now seasonally abundant and undoubtedly have a major impact on the ecosystem. The seed bank in the soil is now too large to eradicate them.

One of the classic starting points to the study of Sonoran Desert invasive plants is Kitty Parker’s report on Arizona weeds, first published in 1958. Dr. Parker, then director of the University of Arizona herbarium, was commissioned to produce a manual on ranch, farm, and garden weeds. As she scoured Tucson and other communities she looked for weedy yards and asked people for permission to pick a few specimens. (Some residents asked her to take all of them.) Three of today’s most pernicious Sonoran Desert invasives are not included in Parker’s classic work: fountain grass (*Pennisetum setaceum*), buffelgrass, and Sahara mustard—indicating their relatively recent arrival.

In considering the history and nature of non-native species, it is instructive to study case histories. Nearly every one has a different story although there are some obvious patterns. For example, some early germinating, fast-growing, winter-spring annuals of Old World origin, such as red brome, Sahara mustard, and *Schismus*, seem “to get a jump on” some of the natives and out-compete them. The first leaves of Sahara

mustard and the leafy stems of *Schismus* often grow close to the ground, forming a local ground cover that apparently prevents growth or germination of the seemingly slower growing or perhaps later-germinating native spring annuals.

Many weedy invasives can be easily confused for natives. If you are pulling up a weed, be sure it really is a weed. For example, a native morning glory, *Ipomoea hederacea*, may have rather large, showy flowers, and distinguishing it from certain non-native and potentially invasive garden morning glories requires examination of botanically subtle features. Sometimes horticultural garden selections may require greater soil moisture than the native plants, rendering the escaped garden plant less likely to survive in the wild than its wild relatives. Others, such as fountain grass, can be much easier to identify. This manual is a good way to begin the process of identifying invasive plants and designing and learning strategies for removal, control, prevention, and ecological restoration and protection.

Although there is no single, easy “fix-it” solution to controlling invasive plants, identification and education are among the first steps. Eradication and control is generally most practical in smaller, local areas, and prevention is cheaper than control. Ecological or habitat restoration often will require eradication of invasives, and of course habitat protection in the first place is less expensive than restoration. We are only beginning to learn how to cope with invasive plants, and you can help in the effort.

Richard Felger  
Drylands Institute

## Silent Feet

The words of Aldo Leopold could not frame better the description of invasive species. In *Cheat Takes Over* he warns: "...the spread was often so rapid as to escape recording; one simply woke up one fine spring to find the range dominated by a new weed."

With a few remarkable exceptions, man's perception of some plants and animals as noxious invaders was not recognized until recently. It is true that mankind has been worried about invasive plants since time immemorial, but their interests have always been vested because of concern that the plants would move into agricultural fields, interfering with the cultivation of food plants. Man weeded by hand until new technologies were developed to prevent and control the encroachment on the fields.

Alden Crafts made clear that invasive weeds were a by-product of agricultural practices when he stated, "In the beginning there were no weeds." However, despite his brilliant mind, he missed the point that Leopold made so clearly, that some organisms breach the isolation barriers and establish themselves in a new environment where they can express their full reproductive potential. With silent feet, these plants are usually transported by man and enjoy man-made or man-disturbed environments, but in some instances, the loss of the plants' pathogens, parasites, and herbivores is cause enough for them to spread freely in their new home.

This important field guide is about those plants that, transplanted from their original ranges, displaced the rich flora of the Sonoran Desert through different strategies of life-history. Their success in the invaded habitats causes severe ecological imbalances that are reflected in the loss of biological diversity, ecological productivity, and overall nature services such as erosion control, pollination, and flood control. Non-quantifiable values, such as the aesthetic quality of the landscape, that to many are as important as those fit for appraisal, are also components of this equation.

This field guide has five clearly defined sections. A brief introduction presents the relevance of invasive species. Next is a discussion of weed management, in which preventive measures and control methods are discussed alongside restoration issues. Then there is an extensive section in which each of the selected species, those considered the greatest danger to Sonoran Desert plant communities, are described and illustrated. Finally there is a glossary and a reference section that includes many Internet addresses that offer relevant invasive species information and links.

Grasses represent nearly half of the reviewed species, then five herbs, two shrubs, and a tree complement the terrestrial component of



the most problematic invasive plants of the Sonoran Desert. As water is the most limiting resource in deserts, four aquatic plants that imperil the persistence of adequate water supplies for the rich desert fauna are also included.

Ninety percent of the grasses described in this field guide are African in origin. This dominance highlights the importance of the herbivore-grass interaction in African environments. Grasses are resilient plants that evolved in a harsh, highly disturbed milieu where frequent losses to herbivores and recurrent wildfires were common. The Sonoran Desert cannot be more different. Large grazing herbivores and periodic fires have never been documented for this biome. Large grazers such as cows—another exotic species—cause immediate changes in species composition, ecological structure, and ecosystem dynamics of the desert. Grazing, along with the invasive pastures imported for cattle, invade the desert and start a fire/grass cycle that changes the landscape so dramatically that in many areas there is little hope in returning to the original rich, productive desert. Interestingly enough, this same guide for African environments will list mesquite and Mexican palo verde as major invading plants. Grasses seem to have an advantage here, while woody perennials encroach and choke the rich African savannas.

In *The Land Ethic*, Leopold remarks: “The ordinary citizen assumes that science knows what makes the community clock tick; the scientist is equally sure that he does not. He knows that the biotic mechanism is so complex that workings may never be fully understood.” We know, however, that the replacement of Sonoran Desert plants by buffelgrass means a large loss of species, so large that 90 of every 100 species disappear in dense buffelgrass stands. The disappearance of these species also has a great cost in ecosystem dynamics. Sonoran Desert plants never developed fire resistance in their evolutionary history. With the invasion of buffelgrass in central Sonora or Sahara mustard in the Pinacate region, fire becomes king. It evaporates nitrogen and carbon. The rich cryptobiotic crust that stabilizes soils and replenishes nitrogen also vanishes along with tons of organic matter held in trunks, shoots, twigs, and roots of woody perennials and cacti that cannot compete with the newcomers. It may seem that we cannot even dream of restoring the desert to its former glory after invasion has occurred, however, we should try. We should increase the sense of pride of our emblematic plants, not lose hope, and join arms—scientists, managers, the general public, politicians—to bring back some of these lost services, some of our long-gone plants and animals.

Few lay people recognize the plight that invasive species pose to the integrity of the desert. In the fight against invasive plants, this field guide fills a void by allowing people the chance to recognize invasive species and join the efforts of managers and scientists. For those interested in the restoration and management of natural areas, for those concerned

with land transformation and biological invasions, this field guide will prove invaluable in the identification of invasive plants.

Alberto Búrquez Montijo  
Instituto de Ecología  
Universidad Nacional Autónoma de México

## Introduction

This field guide is intended to assist land managers, homeowners, ranchers, educators, students, and others identify non-native, invasive plant species found in the Sonoran Desert and the associated desert riparian areas. These plants are termed ***invasive*** because they have weedy traits that allow them to efficiently invade, persist, and sometimes dominate native plant communities. ***Invaders*** are especially effective at capturing space and resources in disturbed sites. ***Non-native*** (or ***exotic***) means that these plants did not originate here in the Sonoran Desert. The stories of how they got here are varied and interesting, but ultimately they have become a very serious problem.

Plants selected for inclusion in this guide have been identified by scientists and land managers as serious threats to Sonoran Desert landscapes. These plants tend to reproduce and spread rapidly, which helps them successfully compete with native species for space, water, and nutrients. Many of these plants are known to increase the frequency and intensity of wildfires across the landscape. Their value to wildlife (as food and shelter) is usually less than native plant species, and they decrease overall habitat quality and diversity by crowding out native plants to the point of creating ***monospecific*** stands of their own species. Perhaps the most alarming impact of these plants is their ability to alter the desert ecosystem. In areas where they become abundant, natural ecosystems shift from a diverse cactus-shrub landscape (such as saguaro and palo verde) to grassland.

Invasive plants are a problem throughout all Sonoran Desert landscapes, including agricultural areas, wildlands, and roadsides, and they threaten any disturbed land. Many users of this guide will encounter invasive plants in their own neighborhoods: vacant lots, local school yards, city parks, or their own backyards. Although invasive plants in these urban areas may not be extensive or seem to pose detrimental ecological effects, these invaders should be taken seriously and properly addressed. Small infestations lead to larger problems, such as fire hazards, and are unsightly. Perhaps more than anything, however, they can lead to further spread of the species, which becomes costly when large-scale removal is necessary.

The purposes of this guide include helping land managers and homeowners identify key invasive plants and identifying ways to manage or control individual species. Each plant entry includes information about identification, origin and spread, preferred habitat, environmental impacts, and management and control strategies. Additional contacts, resources, and references are listed at the end of this guide, and readers are urged to conduct further investigation or contact a resource professional before taking any action plan for controlling invasive plants.

## Weed Management

Once a problem is identified, managers and homeowners alike should carefully assess the situation before employing a management strategy. Prevention, control, and restoration are important components to consider. Prevention may simply be identifying an area free from invasive plants and carefully protecting that area to keep it weed-free. Control options include physical, biological, and chemical methods. Often, a combination of techniques works best. Applying multiple control methods requires careful timing and is called *integrated management*. Before you begin any kind of weed management, we recommend you are absolutely sure of the identification of the plants and consult other sources of information.

A sound weed management plan assesses the problem with the following questions:

*How extensive is the problem?*

*What are the nearby plant associations?*

*What is the area's proximity to water?*

*What control methods are known for the invading species?*

*What resources are available (tools, labor, funding)?*

### Prevention

Perhaps the best strategy for weed management is to avoid the problem in the first place. Specific actions that discourage invasion and spread of weedy plants include keeping natural areas as undisturbed as possible. Any disturbance to the native soil (such as off-road riding and grazing) in essence cultivates the ground and creates openings that promote germination and establishment of invasive plants. Another prevention strategy is maintaining plant cover.

Additionally, land managers should consider establishing a monitoring program to detect new invasions or the spread of existing invasions. Homeowners can keep a similar vigil in their neighborhoods and communities. Simply being aware of what naturally occurs in your neighborhood can alert you to changes in the plant community. Be aware of invasive plants being sold at nurseries and take care not to plant species that are invasive. Being able to identify invasive weeds is obviously important in the prevention of their spread!

## Control Methods

After careful assessment of the problem, land managers or homeowners should implement a control strategy and follow-up maintenance plan. Methods of control are briefly described below; additionally, each species discussion offers recommendations for management and control.

**Physical controls** include a variety of manual and mechanical techniques to remove plants and can involve a combination of the following:

- *manual removal* of the plant by hand or with hand tools (shovels, hoes, and specialty tools) is an important strategy, but it must include the complete removal of seeds, roots, and rhizomes to be effective. This method may need to be repeated over a number of years to be successful.
- *mechanical removal* of the plant with machinery such as a back hoe or a tractor equipped with a plow or disk can be effective in some cases, but for certain perennials can spread rhizomes.
- *controlled burns* are not recommended or should be undertaken with extreme caution. Sonoran Desert plants are not adapted to fires, while many invasive plants are fire tolerant. In fact, burning can promote germination and re-growth of many desert invaders. For invasive plants whose seeds germinate in response to fire, repeated controlled burns can be used to “flush” the seed bank, provided enough plant litter fuel is available for several burns during a growing season.
- *flooding or draining* can kill some plants by providing too much or not enough water, though this method is not practical at a landscape level.
- *deep mulching* will prevent seedlings of some species from getting enough light to grow.
- *solarization* involves covering the ground with black plastic or nursery cloth to bake the ground and the seeds and seedlings under the cloth, making them non-viable. However, this is an expensive and difficult method to use on large areas.

**Biological control** uses living organisms to control unwanted plant growth. These include predators (such as insects or diseases), grazing animals (such as cow, sheep, or goats), or competition from other plants (such as species that take up space, water, and nutrients).

**Chemical control** uses herbicides to control weedy plants. This can be effective with small, isolated stands or extensive, monospecific stands.

Herbicides are usually most effective when applied during the active growing season of the plant. Care must be taken when using chemicals around water sources (there are strict regulations) and when invasive plants are interspersed with desirable native species. Weather conditions can influence herbicide effectiveness and movement (drift) from the treated area.

## **Restoration**

Perhaps one of the most important questions the land manager or homeowner must ask when considering any weed management program is: *“What do we want instead of this weed?”* Once the invasive plant has been removed, something must be installed in its place or further invasion is almost certain. Planting and maintaining a healthy population of native vegetation is effective in reducing re-invasions. Re-establishing native species is encouraged; they are adapted to the Sonoran Desert climate, are generally low-water users, and native wildlife are adapted to them. However, it takes vigilance to continue to control invasive plants while the natives become established. In urban settings (such as gardens, schoolyards, and parks), however, managers or homeowners may desire other non-native (non-invasive) landscape plants. *It is important to note that not all non-natives are invasive.* Our lives are indeed enhanced by the diversity of plants that we can grow here in the Sonoran Desert. Of all the many plants we cultivate and enjoy, only a small percentage escape our yards and invade the landscape. Become aware of which ornamentals are invasive and avoid planting them.

## **Get Involved!**

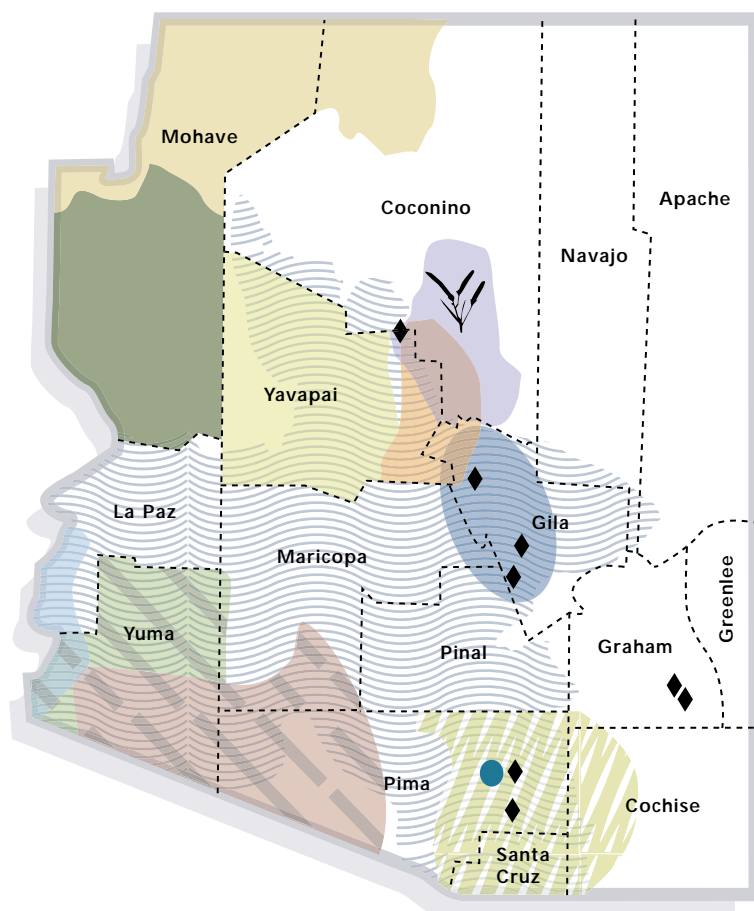
Whether you are a land manager, educator, homeowner, or student, there are things you can do to get involved. First of all, know your weeds! This guide should be very useful in helping you learn how to identify plants that are considered to be invasive in our Sonoran Desert region, and there are additional resources listed so you can learn more. Be aware of your home and community environment, keep an eye on non-native plants, and notice any changes that could indicate a problem. Educate your neighbors about the issue; share your knowledge with them about weed prevention and management. When planting at your home, school, or community, use native or non-invasive plants. Avoid ornamentals that are invasive such as the common fountain grass or Bermuda grass. Volunteer with a land management organization that is involved in a weed management program or participate in a weed management area. Your actions really can make a difference!

## Cooperative Weed Management Areas

Arizona's cooperative weed management areas (CWMAs) are local volunteer organizations that bring together landowners and managers to coordinate efforts and combine expertise to address common invasive plant issues. CWMAs help to enhance and unite individual owners or jurisdictions for the purposes of mapping, planning, monitoring, and conducting other weed management or educational activities.
















Cooperators or members of a CWMA jointly prioritize weed management efforts based on species or common geography in order to prevent the reproduction and spread of weeds into and within the area.

These voluntary partnerships of state, federal, and local governments; private landowners; and other organizations tend to be more effective than any single individual, agency, or organization at addressing weed management issues.



For more information about a CWMA near you, contact Ed Northam, Noxious Weed Program Coordinator, Arizona Department of Agriculture, 1688 West Adams Street, Phoenix, AZ 85007, tel: 602.542.3309, or email: [ed.northam@agric.state.az.us](mailto:ed.northam@agric.state.az.us)

Although weed management areas do not yet exist in Mexico, if you would like more information about invasive plant management in Sonora, contact Rafaela Paredes Aguilar, Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES), Reyes y Aguascalientes (esq.), Colonia San Benito, Hermosillo, Sonora, [paredes@cideson.mx](mailto:paredes@cideson.mx)

	LEGEND
	Aquatic Weed Management Area
	Arizona Strip Weed Management Area
	Borderlands Weed Management Area
	King of Arizona Weed Management Area
	Lower Colorado Giant Salvinia Task Force
	Lower Mohave County Weed Management Area
	San Francisco Peaks Weed Management Area
	Sweet Resinbush/Karoobush Weed Management Areas
	Tonto Basin Weed Management Area
	Sonoran Desert Weedwackers
	Verde Valley Weed Management Area
	West Yavapai Weed Management Area
statewide	Interagency Weed Action Group
	Northern Arizona Weed Council (Flagstaff/Grand Canyon/Verde Valley Region)
	Pima Invasive Species Council
	Sonoran Desert Invasive Species Council
statewide	Southwest Vegetation Management Association





Ed Northam

# Bermuda grass

Poaceae (grass family)

*Cynodon dactylon*

## Origin

*A native to east Africa, Bermuda grass was introduced in North America in the mid-1800s. Now it is a common weed in temperate and subtropical regions throughout the world.*



Ed Northam

Bermuda grass stolon

## Description

- warm-season, **perennial**, **prostrate** or erect grass
- erect flowering stalks each produce a finger-like **inflorescence** which has 4–7 spikes radiating out from the central stalk

## Dispersal

- spreads by seed and by sending out long-running **rhizomes** and **stolons** and forming dense turf mats; growth from **stolons**, roots, and **rhizomes** provides tremendous underground spreading
- plant parts, which easily establish when fragmented, are often transported by animals, crops, vehicles and machinery, and running water
- the use of this grass as forage and turf further contributes to its dispersal; it is the most common summer lawn grass in the region



## Habitat Preference

- thrives in a wide range of conditions, but prefers sun, warm temperatures, and **alkaline** or clay soils
- found in disturbed areas where moisture collects, such as water-holes, springs, seeps, irrigation ditches, and along roadsides
- is moderately salt tolerant and can sometimes be found in conjunction with salt cedar or in brackish water
- tolerates drought by becoming dormant, then proliferates when moisture returns

## Impact

- a notorious colonizer, competes with native and agricultural species for space, moisture, and nutrients, removing from the soil the oxygen that natives need to establish
- an extremely successful invader in disturbed riparian areas and may stabilize river banks
- a leading contributor to hay fever in the Sonoran Desert



Ed Northam

Bermuda grass along crop rows

## Management and Control

New infestations of Bermuda grass can be greatly reduced by minimizing soil disturbance and maintaining plant cover that shades soil surfaces. All plant parts, including roots, should be manually removed at the first sighting of small infestations. Once an infestation has established, a combination of control strategies will be needed, depending on infestation size, season, and local conditions. Herbicides can be effective if applied when the plant is actively growing; pre-emergent herbicides should not be used as they do not affect Bermuda grass **rhizomes** but may kill pioneering natives. A site should be re-vegetated following control measures to prevent further invasions.



Barbara Tellman

# Buffelgrass

Poaceae (grass family)

*Pennisetum ciliare*

## Origin

*Buffelgrass is native to arid regions of Africa, the Middle East, Canary Islands, Malagasy, Indonesia, and tropical Asia. It was used as a pasture grass in Texas since the early 1900s, and has been widely promoted as a range grass in Sonora and several sites in Arizona.*



Ed Northam

buffelgrass

## Description

- warm-season, **perennial** bunchgrass often forming dense thickets
- erect flowering stalks shoot out of dense, leafy clumps and can reach over 39 inches (100 cm) tall
- bristly flower heads range from 1½–5 inches (4–13 cm) long and can be purple, gray, or yellowish turning a distinctive golden-brown color when dry



Tom Van Devender

a thick infestation of buffelgrass

## Dispersal

- **inflorescences** form multiple times a year whenever moisture is available, and can reproduce in as little as six weeks
- seeds are primarily dispersed by wind or transported by adhering to animal fur; vehicles and water also carry the seeds
- continued human cultivation of buffelgrass for use as forage increases opportunities for dispersal



## Habitat Preference

- prefers arid, tropical and sub-tropical areas, and can be found from sea level to around 4,265 feet (1,300 m)
- requires summer moisture, but can be found along roadsides encouraged by winter rainfall in chaparral areas in northwest Sonora and Arizona; can attain large densities in agricultural fields, roadsides, and vacant lots
- is extremely fire adapted and responds to burning
- is very drought tolerant
- is not cold tolerant, though a new cold-tolerant strain ("*Frio*") has been recently developed and released in Cananea, in northern Sonora, that can colonize higher elevations and poses a very serious threat

## Impact

- Buffelgrass introduces fire into desert plant communities and displaces native desert plant species. Following a fire, buffelgrass can quickly re-sprout, out-competing or replacing native species. Entire ecosystems may be altered as buffelgrass ultimately dominates the area, which enhances fire events and further restricts native plant growth.
- Habitat modification has a profound negative effect on native animals, especially birds, lizards, snakes, tortoises, and rodents.
- In general, buffelgrass is **invasive** and once established can form dense stands that are too thick for native species to become established. *This is one of the most serious invasive plants for the Sonoran Desert.*

## Management and Control

The only mechanical procedure to control buffelgrass involves complete removal of the plant including all pieces of the plant crown, otherwise re-sprouting may occur. Return to the same place for at least two years in a row to continue to control any plants that remain. Chemical control can be effective if applied when the plant is actively growing. Removing the **inflorescences** before flowering can also help reduce the spread of buffelgrass.



Ed Northam

# Fountain grass

Poaceae (grass family)

*Pennisetum setaceum*

## Origin

*Native to Africa and the Middle East, fountain grass was introduced in the United States as an ornamental landscape plant.*

fountain grass along a roadside



Ed Northam

## Dispersal

- dispersed by vehicles, wind, water, and possibly birds
- humans continue to play a role in its dispersal by planting it as an ornamental

## Description

- **perennial** bunchgrass that grows over 3 feet (1 m) tall
- long, slender, green leaves that appear lush in warm weather when moisture is present
- purple to white **inflorescences** are distinctively long and feathery

## Habitat Preference

- found in a variety of habitats and elevations but prefers dryer, sandy soils in areas with limited rainfall
- in the Sonoran Desert, fountain grass favors desert riparian areas and washes, but also invades grasslands, deserts, canyons, rocky slopes, and disturbed areas such as roadsides and abandoned home sites
- susceptible to freezing temperatures but is more cold tolerant than buffelgrass
- very drought tolerant



## Impact

- crowds out other herbaceous plants, especially seedlings
- spreads quickly, forming dense colonies and choking out native species, especially native grasses, as well as other ornamentals
- escapes from ornamental sites to roadsides where it creates a fire hazard to adjacent desert vegetation
- capable of carrying intense fires, which tend to kill native desert plants



Ed Northam

fountain grass (left) and buffelgrass (right)  
getting a hold on a rocky slope

## Management and Control

Complete removal of the entire plant is the best way to reduce seed production, reduce wildfire threat, and eliminate competition to native species. Seedlings, which are easy to pull up, should be removed immediately. Plants should be dug up by the roots and carefully disposed of in such a manner as to prevent the *inflorescences* or seeds from blowing away. Chemical treatments are effective in eliminating *monospecific* stands of the plant.

crimson, or bronze leaf, variety of fountain grass



Terry Moody

The genetically modified (sterile) variety, crimson or bronze leaf fountain grass, is a better option for landscaping. Look for the characteristic bronze stems to distinguish this variety from common fountain grass.





Barbara Tellman

# Giant reed

Poaceae (grass family)

*Arundo donax*

## Origin

*Giant reed is believed to have originated in the Mediterranean region (including North Africa and east to India), but has been naturalized for hundreds of years throughout the New World's warm temperate and tropic regions. In some places, it may have replaced the native reed (Phragmites occidentalis) previously used by Native Americans.*

## Dispersal

- expands its colonies through underground **rhi-zomes** and spreads to new areas through fragmented plant parts, which may be displaced by floods

## Description

- very tall (up to 20 feet or 6 m) **perennial** grass, forms stands that resemble bamboo
- thick, hollow stems may be up to 1½ inches (4 cm) in diameter and are divided by stem **nodes** into numerous sections up the stalk
- green leaf blades, up to 3 feet (1 m) long, grow alternately out of the stem section **nodes**
- flowers are tall, feather-like, cream-colored plumes on top of the tallest stalks
- blooms in early spring to fall

## Habitat Preference

- needs a water source to become established and may be found in river drainages, ditches, seeps, and springs; once established, a water source is not necessary
- prefers warm, sub-tropical climates, and is found in a variety of soil types and can easily establish itself in semi-**saline** soils of estuaries



## Impact

- invades riparian corridors, where it consumes up to three times more water than native plants, causes flood control problems, and displaces native plant and animal species
- extensive, *monospecific* stands increase fire threat



Barbara Tellman

giant reed along the Colorado River

## Management and Control

Before any control measures are taken, be sure the plant is actually giant reed and not the native common reed grass (*Phragmites australis*). These two plants look very similar and can easily be confused; the native plant should not be disturbed.

Giant reed can be eradicated with herbicides used either alone or in combination with mechanical removal. Hand-pulling is effective for plants less than 6½ feet (2 m) tall, as long as all plant parts (especially *rhizomes*) are removed.

pampas grass



Barbara Tellman

**Pampas grass** (*Cortaderia selloana*) is another ornamental grass that may become invasive. Pampas grass spreads primarily by seeds and can crowd out native plants as well as spread fire where it has become established.





Barbara Tellman

# Johnson grass

Poaceae (grass family)

*Sorghum halepense*

## Origin

*Native to the Mediterranean region, Johnson grass is now common throughout warmer parts of the world.*



Barbara Tellman

Johnson grass inflorescence

## Description

- coarse **perennial** grass with stalks reaching from 1½ to over 6½ feet (0.5–over 2 m) tall
- long, bright green leaves provide a very “leafy” appearance
- **inflorescences** are purplish

## Dispersal

- spreads by seeds and extensive **rhizomes**
- dispersed by wind, water, wildlife (especially birds), livestock, and contaminated crops and machinery
- cultivated in some areas for use as forage

## Habitat Preference

- grows primarily in disturbed areas such as cultivated fields, along irrigation canals, bottomlands, and open ground
- adapted to a wide range of soil types, but prefers porous, fertile soils and thrives in warm, subtropical, humid environments with summer rainfall



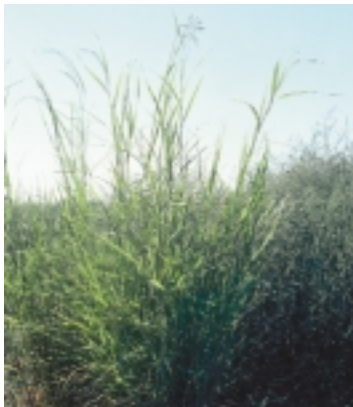
## Impact

- considered a problematic, **invasive** weed in over 53 countries
- invades agricultural crops such as cotton, citrus, corn, and sugar in the southern U.S., Mexico, and Central and South America and is host to several agricultural pathogens
- extensive over-wintering **rhizomes** provide a competitive advantage over both crop and native species by allowing growth early in the season, effectively crowding out other warm-season species
- decreases the availability of water, nutrients, and space to other plants
- studies show that it may inhibit growth of other plants through **allelopathy**
- becomes poisonous to livestock after the first killing frost in the fall

## Management and Control

Johnson grass is very difficult to control. The best strategy is to keep it from invading and remove any individuals that begin to establish. For small infestations, manual removal of the entire plant, including the deep **rhizomes**, is recommended. Spot applications of herbicides may also prove successful. In large infestations, control techniques include mowing, heavy grazing, repeated tilling and plowing, and herbicide applications.

a tall stand of blue panic grass



Bruce Munda

**Blue panic grass** (*Panicum antidotale*) is similar to Johnson grass in its appearance. There is some evidence that blue panic is also invasive, but it is generally considered less invasive than Johnson grass. Blue panic spreads primarily by seeds and can be controlled using the same methods as recommended for Johnson grass.



Dan Robinett

# Lehmann lovegrass

Poaceae (grass family)

*Eragrostis lehmanniana*

## Origin

*Native to South Africa, Lehmann lovegrass was introduced in the 1930s for use in range restoration. It has become strongly established in southern Arizona.*

## Dispersal

- spreads by seed to form large, continuous stands
- used in many areas of the Chihuahuan and Sonoran Deserts for roadside erosion control, range restoration, and rehabilitation of disturbed sites

## Description

- warm-season, **perennial** grass growing up to 20–24 inches (50–60 cm) tall
- stems often have elbow-like bends
- open, soft **inflorescences** borne on numerous seed stalks

## Habitat Preference

- prefers sandy soils in semi-arid desert shrub and desert grassland areas
- requires summer rains of at least 4–6 inches (10–15 cm)



## Impact

- early production and maturation of an abundance of seeds, pioneer of disturbed sites, unpalatable in summer, and aggressive, spreading nature give Lehmann lovegrass a competitive advantage over native grasses
- responds positively to fire and grazing; over time displaces and replaces native grasses
- known to shift mesquite shrubland toward grassland
- though some wildlife use this grass for cover or nesting, it is typically not preferred over native habitat
- although it has been introduced as a forage plant, it is not particularly good forage



Dan Robinett

large area infested with Lehmann lovegrass, notice the characteristic light straw color

## Management and Control

Lehmann lovegrass is one of the worst **invasive** plants in the Sonoran Desert. Caution should be taken, however, in its control because it can be easily confused with a number of native grasses;

be sure it has been positively identified as Lehmann lovegrass before attempting to control it.

Herbicides and specifically timed, controlled burns have been used to control Lehmann lovegrass; seeding of native species must immediately follow such treatments. Research on control of Lehmann lovegrass is currently being conducted on desert grassland study sites.



Sue Rutman



Joe DiTomaso

# Mediterranean grass, Arabian grass

Poaceae (grass family)

*Schismus barbatus*,  
*Schismus arabicus*

## Origin

*Mediterranean grass originated in Africa and the Mediterranean region; Arabian grass originated from southern Russia west to Greece. They were first documented in the 1920s to early 1930s in southern Arizona, and are now widespread in the southwest United States and Baja California.*

## Dispersal

- seeds are dispersed primarily by wind and water (through sheet flooding)
- activities that disturb the soil and reduce ground-cover (such as off-road vehicles and improper grazing) contribute to its spread

## Description

- cool-season, small **annual** grass that spreads to form extensive carpets where established
- tufted, greenish-purple **inflorescences** grow on erect stalks 4–8 inches (10–20 cm) long

## Habitat Preference

- common in agricultural and urban areas, occurring along roadsides, in cultivated fields, and other disturbed areas as well as undisturbed sites
- invades river bottoms, plains, and hill-sides in desert areas
- responds positively to winter rains, but needs minimal rainfall to germinate
- although drought tolerant, most plants die with the onset of summer heat



## Impact

- emerging in the early spring, the first stems and leaves tend to spread out and carpet the ground, preventing native *ephemerals* from establishing
- dead foliage, which may remain on the ground for up to two years, may increase intensity and frequency of wildfires



Joe DiTomaso

Arabian grass (small, straw-colored tuft grass) invading desert shrub land

## Management and Control

Spot applications of herbicides may work to decrease the grasses when non-target species can be avoided. Burning promotes growth of Mediterranean and Arabian grasses and is not recommended, particularly in desert ecosystems.

Mediterranean grass



Joe DiTomaso

**Mediterranean grass** (*Schismus barbatus*) and **Arabian grass** (*Schismus arabicus*) are very similar in appearance. They both are considered to be *invasive*. Arabian grass tends to favor desert lowlands, especially sandy soils on flats, washes, and dunes, and Mediterranean grass generally is found at higher elevations, though they may also overlap in range.





Tom Van Devender

# Natal grass

Poaceae (grass family)

*Melinis repens*  
(=*Rhynchelythrum repens*)

## Origin

*Natal grass is native to South Africa, and now widely introduced.*

## Dispersal

- seeds are dispersed by wind and other carriers

## Description

- short-lived summer **perennial** grass growing up to 39 inches (100 cm) tall
- flat leaf blades are 2–8 inches (5–20 cm) long
- fluffy **inflorescences** are unique among grasses of the region; they are 6 inches (15 cm) long and red or purplish, turning silvery pink with maturation

## Habitat Preference

- dry, disturbed areas up to 6,235 feet (1,900 m)
- found on rocky slopes with warm exposures
- generally found in areas receiving 13–16 inches (32.5–40 cm) annual rainfall
- is intolerant of cold (though found at relatively high elevations) and dies back after the first frost



## Impact

- **invasive** in desert grasslands in northern and eastern Sonora
- has established substantial populations in coastal canyons near Guaymas in southern Sonora and in desert scrub areas of the central coast of the Gulf of California
- in south-central Mexico, it has invaded large areas and crowds out native plants
- presently is a minor component of Sonoran Desert habitats in Arizona, and may not become dominant, but is probably still expanding its range and should be watched



Tom Van Devender

fire damage caused by natal grass

## Management and Control

Management and control methods are not well known.



Tom Van Devender

natal grass





mature red brome

Tom Van Devender

# Red brome, foxtail brome

Poaceae (grass family)

*Bromus rubens*

## Origin

*Native to the Mediterranean region, red brome was first established in California during the mid 1800s and is now found throughout the Sonoran Desert—in disturbed and undisturbed areas—and is expanding its range south to southern Baja California, north to the Great Basin, and east to Texas.*

## Dispersal

- seed-bearing spikelets are primarily dispersed by animals (easily becoming lodged in fur), and by wind over short distances
- humans disperse this grass, as it attaches itself to clothing, equipment, and vehicles

## Description

- **annual**, cool-season grass often growing over 10 inches (25 cm) tall
- characteristic, brush-like **inflorescences** are green and become reddish-purple when mature
- extensive stands impart a distinctive, reddish-purple tinge to the landscape during maturation of **inflorescences**

## Habitat Preference

- abundant in the spring throughout the Sonoran Desert, mainly below 5,000 feet (1,500 m)
- widespread; can be found along roadsides, in cultivated fields, in open woodlands, across hillsides, and on rangelands
- as a cool-season **annual**, it thrives in winter and spring and dies back in the heat of summer



## Impact

- competes with native species for moisture, nutrients, and space, in some places replacing stands of native **perennial** grasses
- persistent stems and foliage increase threat of wildfire, spreading and intensifying fires that do occur; in turn, these fires can kill non-fire-adapted native species, such as saguaro, and alter desert habitats
- seed-bearing spikelets are very sharp and stiff and can become lodged in the fur, feet, ears, and eyes of native and domestic animals



Tom Van Devender

dense stand of red brome in Sonoran Desert upland

## Management and Control

*This is considered to be the most serious **invasive** plant in the Sonoran Desert.* In springs following wet winters, red brome can grow in very dense stands and can readily carry fire. Manual removal of plants through pulling and hoeing can be effective if done before seeds mature, but is usually feasible only with small infestations. In small infestations, covering the ground with mulch or black plastic (solarization) will reduce plant growth.



Tom Van Devender



Tom Van Devender

# African rue

Zygophyllaceae (caltrop family)

*Peganum harmala*

## Origin

*Native to the Middle East and Africa, African rue was introduced in New Mexico in 1928 in a study of drought-resistant plants, and has since spread west to California, east to Texas, north to Washington, and south into Mexico.*

## Dispersal

- seeds dispersed by water, animals, and human activities such as road and agricultural projects
- seeds have been found in crop seed
- roots will produce new shoots when fragmented

## Description

- **perennial** herb growing 1–2 feet (30–60 cm) tall
- bright green foliage with numerous, multi-branched stems
- white flowers have five petals and develop a very small green to brown **capsular** fruit
- flowers are produced in the late spring through early fall
- roots may extend 2 feet (60 cm) deep in sandy soil

## Habitat Preference

- prefers dry desert habitats primarily in disturbed areas such as roadsides and fields
- grows in sandy and clay soils, and is tolerant of **saline** and **alkaline** conditions
- although drought tolerant, grows best when it receives some run-off water



## Impact

- contains toxic **alkaloids**, and is generally unpalatable to livestock
- known to exhibit **allelopathy**, reducing growth of near-by native species
- early spring growth provides a competitive advantage over later-sprouting native plants

## Management and Control

Manual removal that includes the roots can successfully eradicate an infestation if diligently employed over several years. Repeated spot applications of select herbicides have also been a successful control method in some cases. To help prevent spreading the plant, remove weed seeds and soil from clothing and equipment.



Tom Van Devender

African rue



Ed Northam

# Filaree

Geraniaceae (geranium family)

*Erodium cicutarium*

## Origin

*Native to the Mediterranean region, filaree has become widely naturalized across North America and elsewhere in the world, particularly in non-tropical regions.*

## Dispersal

- the long, corkscrew-like beak on each fruit segment uncoils when moistened and screws the sharp-pointed, seed-bearing end into the ground
- seeds are also dispersed by birds and other animals (in their fur)

## Description

- cool-season, **annual** herb that develops as a flat **rosette** with fern-like leaves
- flowering stems grow out from **rosettes** and may reach up to 12 inches (30 cm) tall
- small, purplish to pink flowers with five petals, form on umbrella-like stalks
- flowers produce a distinctive, five-lobed fruit pod resembling a heron's bill
- flowers February to May

## Habitat Preference

- flourishes in a wide range of habitats up to 6,900 feet (2,100 m)
- tolerates a wide range of conditions, but is commonly found in disturbed urban and agricultural areas including roadsides and fields, and in many natural habitats including sandy-gravelly washes and sand flats



Filaree

*Erodium cicutarium*

## Impact

- competes with native herb and grass seedlings for moisture, nutrients, and space



Ed Northam

filaree fruit or seed pods

## Management and Control

Filaree quickly makes a small tap root that can be pulled up to control small infestations; for large infestations, plants should be hoed or pulled before they set seed, and treated areas should be replanted with native species. Herbicides may be applied in the late fall or early spring when plants are actively growing. Perhaps the best way to control filaree is to avoid soil disturbances and establish plant cover in disturbed sites to help prevent infestations.



Barbara Tellman

filaree rosette with flowers and fruit





Patty West

# Iceplant

Aizoaceae (aizoon family)

*Mesembryanthemum crystallinum*

## Origin

*Native to South Africa, iceplant has naturalized extensively along the Pacific coast of the Californias and South America and the Mediterranean region. It is found widely in Sonora and in parts of southern Arizona.*

## Dispersal

- spread is promoted when purposely used as roadside groundcover, erosion control (including dune stabilization), and as an ornamental landscape plant
- seeds are also dispersed by wildlife—especially herbivorous mammals

## Description

- spectacularly fleshy greenish to reddish plants covered with tiny, watery, crystal-like vesicles
- **succulent**, trailing, cool-season **annual**
- tiny flowers are white to pink with many slender “petals”

## Habitat Preference

- prefers sandy soils and disturbed habitats such as roadsides and upper beaches; sometimes also found in natural areas



Patty West



Iceplant

*Mesembryanthemum crystallinum*

## Impact

- spreads prolifically over the ground, competing with native species (particularly spring wildflowers) for space, nutrients, and especially water
- known to prevent establishment and growth of native species by altering soil chemistry, primarily by increasing nitrate and salt levels



Patty West

iceplant infestation

## Management and Control

Iceplant has shallow roots and is relatively easy to pull or “roll” up. Prior plans should be made for disposal of the removed plants, which can be heavy and extensive. Plant native species immediately after removal of iceplant. In some cases, spot application of herbicides is effective in reducing iceplant populations.



Patty West

This iceplant (*Mesembryanthemum crystallinum*) is known as crystalline iceplant, another species (*Mesembryanthemum nodiflorum*), known as slender-leaf iceplant, is also found in this region and has similar invasive qualities.





Larry Howerly

# Malta starthistle

Asteraceae (sunflower family)

*Centaurea melitensis*

## Origin

*Native to Eurasia, Malta starthistle has been in the Tucson area since at least 1901, though probably more recent to other parts of the Sonoran Desert.*



Sue Rutman

Malta starthistle

## Description

- erect, winter **annual** that grows up to 2 feet (50–60 cm) tall, often in dense, impenetrable stands
- grayish-green foliage
- yellow, thistle-like flower heads with distinctive sharp spines bloom primarily in May and June
- produces its first flower heads while still in **rosette** stage

## Dispersal

- humans facilitate the spread of starthistle through livestock, roadside disturbances, contaminated crop seed, disturbances associated with urban development, and especially through vehicular travel (seed heads are known to be transported on the undercarriages of all types of vehicles)
- to a lesser extent, seeds are dispersed by mammals (as seed heads get caught in the fur) and seed-eating birds; otherwise, most seeds tend to fall near the plant and are not generally wind dispersed but can be transported by water runoff



## Habitat Preference

- common in disturbed sites such as roadsides, but also found in grasslands, rangelands, open woodlands, fields, and pastures generally below 3,900 feet (1,200 m)
- prefers full sun and well-drained soils

## Impact

- successful competitor for space, displacing both native and agricultural plant species
- known to reduce wildlife habitat and forage
- although Malta starthistle is not known to be toxic, a relative, yellow starthistle (*Centaurea solstitialis*), causes a neurological disorder (chewing disease) when eaten by horses



Larry Howerly

Malta starthistle infestation

## Management and Control

Proper timing of management strategies is essential, especially during late-season control efforts. Mature plants are much harder to control with herbicides than immature plants in the **rosette** stage. For mature plants, the best time to initiate most suggested control strategies including grazing (by cattle, sheep, or goats), tillage, or mowing, is before the plant's flowering. Flowers will produce viable seeds in only eight days, therefore eradication of the plants before flowering will prevent seed production. It generally requires several years of careful, integrated management to reduce the seed bank and control infestations. Spot eradication (by manual removal or use of post-emergent herbicides) is effective for small infestations. Pre-emergent herbicides may be applied from late fall to early spring for additional control.



Ed Northam

# Sahara or African mustard

Brassicaceae (mustard family)

*Brassica tournefortii*

## Origin

*Sahara mustard is probably native to North Africa and Central Asia, but now is found in warm, arid regions worldwide. In the Sonoran Desert, it was established in southeast California by 1938; the earliest record in Arizona is from Yuma in 1957; and has been recorded in Sonora since the mid-1960s.*

## Description

- **annual**/spring herb forming **rosettes** generally 6–12 inches (15–30 cm) in diameter
- stems are 12–47 inches (30–120 cm) tall and grow from the basal **rosette**
- leaves are widely variable in size and have tiny bristles
- small, pale yellow flowers are produced from January to April or May
- tiny reddish seeds are borne in narrow pods

## Dispersal

- prolific production of small seeds; when moist, the seeds become very sticky and adhere to animal fur and other means of conveyance such as the undercarriages of vehicles
- wind dispersed when dead mature plants are blown across non-infested landscapes

## Habitat Preference

- prefers sandy soils in washes, flats, and at the bases and inter-trenches of dunes below 3,000 feet (900 m), but also found on rocky slopes
- common on cultivated land and roadsides



## Impact

- tends to establish quickly in the winter and early spring
- dominates later-flowering spring **annuals**
- in large stands, prohibits wildlife movement and use of the habitat
- dead herbage increases wildfire fuel loads, which threatens species not naturally adapted to fires



Tom Van Devender

Sahara mustard leaves of the basal rosette, with stalks extending upward

## Management and Control

There have been few reactive control strategies studied and applied, but suggested strategies include hand-pulling small infestations and application of herbicides early in its life cycle. Reduce soil disturbance and maintain groundcover to proactively prevent the establishment of Sahara mustard.

London rocket



Sue Rutman

**London rocket** (*Sisymbrium irio*), also in the mustard family, is similar to Sahara mustard except that its leaves don't have bristles. London rocket can coexist with native plants and has less environmental impact than Sahara mustard.



Larry Howerly

# Camelthorn

Fabaceae (pea family)

*Alhagi pseudalhagi*  
(=*A. camelorum*, *A. maurorum*)

## Origin

*Native to Asia, camelthorn was introduced to California in the late 1800s in packing material for date palms imported from Northern Africa.*

## Dispersal

- seeds are dispersed by livestock, water, wind, and contaminated hay
- heavy equipment contaminated with seeds or **rhizomes** contribute to dispersal
- once established by seed, primarily spreads through extensive, hardy **rhizomes**, at a rate of up to 26 feet (8 m) a year

## Description

- spiny, **perennial** shrub growing to 3 feet (1 m) tall
- numerous, thorny, deciduous branches with simple leaves die each season; new branches emerge from plant crowns each spring (around April)
- small, pea-like, pinkish to maroon flowers are borne on spines near the top of the plant and produce fruit as a red-dish-brown pod

## Habitat Preference

- grows in a variety of soil types, but prefers those that are **alkaline**
- found in arid agricultural crops (typically dates, alfalfa, and citrus), pastures, urban fields, open rangeland, and along rivers and canals
- drought tolerant, but long roots can tap deep soil moisture





## Impact

- out-competes both native and agricultural plants, usurping space, nutrients, and moisture
- an expensive nuisance on roads and sidewalks due to its ability to crack asphalt and concrete



Ed Northam

camelthorn flowers

M

## Management and Control

Successful eradication methods have included deep plowing and herbicide treatments. Mechanical removal methods such as cutting and tilling are discouraged as they promote *rhizome* growth. Preventative measures include using weed-free hay, restricting grazing in infested areas, and maintaining healthy, native ecosystems.



Ed Northam

camelthorn



Barbara Tellman

# Salt cedar, tamarisk

Tamaricaceae (tamarisk family)

*Tamarix ramosissima*

## Origin

*Native to Eurasia and areas of northern Africa, salt cedar escaped cultivation in the western United States in the late 1800s and has become naturalized in preferred habitats, including the Sonoran Desert.*

## Dispersal

- produces numerous wind-borne seeds
- original dispersal into western United States by intentional plantings for stream bank protection, erosion control, and wind breaks
- changes in flow regimes downstream from reservoirs in western rivers has contributed to the establishment of salt cedar

## Description

- a large, bushy shrub or small tree typically growing 8–16 feet (2.5–5 m) tall and often forming dense thickets
- small, leafy twigs are winter deciduous
- sparse, slender branches are covered with tiny, scaly, grayish-green leaves
- pinkish or whitish flower clusters are grouped at the end of the branches and bloom from January to October

## Habitat Preference

- salt cedar tolerates a wide range of conditions and grows in many types of soil, including those that are partly **saline** or **alkaline**; it is most common in desert and desert grasslands from near sea-level up to 6,000 feet (1,800 m)
- typically found in the desert riparian areas, along irrigation ditches, seeps, springs, and bottomlands, but has been found in drier conditions including rocky dry canyons
- though drought tolerant, needs wet soil to establish



## Impact

- especially threatening to native stands of riparian and wetland vegetation by crowding out and replacing native riparian species such as cottonwood, willow, and mesquite
- even though some birds (including the Southwest Willow Flycatcher) use salt cedar for nesting and cover, it generally has lower wildlife value than native vegetation
- uses substantial quantities of water, to the extent that it lowers water tables
- stands can become very dense in riparian areas and increase sediment deposition, widen floodplains, and restrict movement of flood water
- concentrates salt in the leaves; the accumulation of fallen leaves creates **saline** soil conditions around the plants, hindering germination and growth of native species



Barbara Tellman

salt cedar established along a riparian area

## Management and Control

Before employing any eradication methods, evaluate the potential for re-invasion. Control methods should be carefully considered based on the size of the stand, its proximity to native species, and other site characteristics. Methods for control primarily involve manual or mechanical removal and the application of herbicides. In areas where there are desirable natives interspersed with the salt cedar, the cut-stump method is recommended. This involves manually cutting the trees to the ground then immediately applying an herbicide to the individual stumps. In extensive, **monospecific** stands, application of herbicides is often recommended. In the same setting, the above-ground foliage may be removed

through a controlled burn, bulldozing, or other mechanical cutting, followed by an application of herbicides. Re-vegetation must be initiated soon after salt cedar plants are removed.



Barbara Tellman





Terry Moody

# African sumac

Anacardiaceae (flowering tree family)

*Rhus lancea*

## Origin

*Native to South Africa, African sumac is widely cultivated in the Sonoran Desert as an ornamental tree.*



Terry Moody

one of the oldest African sumac trees in Tucson

## Description

- single or multi-stemmed tree, 15–33 feet (4.6–10 m) tall
- leaves are palmately compound in groups of three; shiny, dark green leaflets are 2–4 inches (5–10 cm) long
- small, inconspicuous, whitish-green flowers on female trees
- fissures in the dark gray trunk reveal orange color beneath

## Dispersal

- dispersed by seed

## Habitat Preference

- requires full sun to partial shade
- is drought tolerant once established
- prefers well-drained soils



## Impact

- re-seeds easily and naturalizes in urban landscapes and riparian areas
- one of the many allergenic trees in the Southwest
- thought to be *allelopathic* and inhibits the growth of other plants in its area



Terry Moody

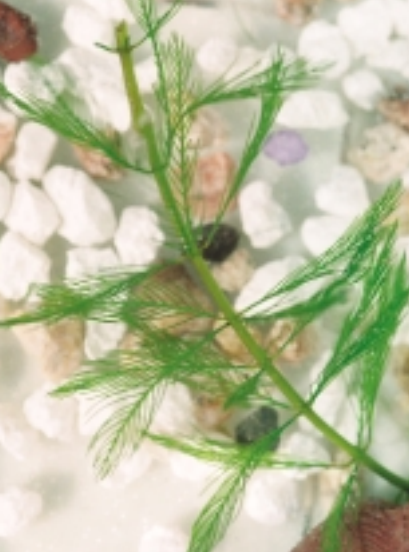
## M Management and Control

Although African sumac is not extremely common, it has the potential to become *invasive* and should not be encouraged to grow in the region. When trees are found, they should be destroyed.

flowering branches of the African sumac



Barbara Tellman



Ed Northam

# Eurasian watermilfoil

Haloragaceae (watermilfoil family)

*Myriophyllum spicatum*

## Origin

*Eurasian watermilfoil is native to Eurasia and North Africa.*

## Dispersal

- spreads through fragmented stems that can be transported by water birds, aquatic wildlife, and boating activities
- removal of native vegetation creates space for this plant to invade

## Description

- aquatic plant that grows in dense, thick mats near the water surface
- feathery leaves, mainly submersed, are formed in whorls of four around its dark green to reddish stems
- stems held above the water display small, pinkish flowers

## Habitat Preference

- found in freshwater lakes, rivers, canals, and reservoirs
- prefers slower-moving waters
- primarily roots in the bottom substrate of shallow water, but will invade waters up to 33 feet (10 m) deep
- thrives with nutrient runoff and in disturbed substrates



## Impact

- clogs waterways, impedes watercraft and recreation, and reduces the overall quality of the habitat
- horizontal and vertical spread in water impedes the movement of fish and other aquatic wildlife
- increases mosquito habitat by slowing water movement

## M Management and Control

Manually or mechanically eradicating Eurasian watermilfoil requires pulling up roots and removing all plant parts from the water. Manipulating reservoir water levels can help restrict growth. Preventative measures include washing boats and equipment to stop the transport of plant fragments.



Ed Northam

watermilfoil (right) compared to egeria (left) and hydrilla (middle)



Ed Northam

# Giant salvinia

Salviniaceae (floating fern family)

*Salvinia molesta*

## Origin

*Native to South America, giant salvinia was probably introduced as an ornamental pond or aquarium plant.*

## Dispersal

- spreads by fragmented plant parts, which are dispersed through connected waterways, both by water flow and watercraft
- spreads overland by contaminated vehicles, watercraft, and anything else that enters infested waters
- strictly vegetative reproduction; does not produce viable spores

## Description

- **perennial**, floating, aquatic fern relative forming dense mats up to 2 feet (0.6 m) thick
- small, oblong leaves stack upon themselves into upright layers

## Habitat Preference

- prefers warm freshwater in temperate and sub-tropical climates
- found in slow-moving water or still water canals, ponds, rivers, lakes, and reservoirs



## Impact

- similar to other aquatic **invaders**, giant salvinia forms rapidly spreading mats that block out light and reduce dissolved oxygen in the water below, clog waterways, interfere with boating and swimming, and reduce overall habitat quality

## Management and Control

Preventative measures will help reduce the spread of most aquatic **invaders**: all boating equipment, boats, and anything else entering infested waters should be washed. Research is being conducted on the use of a weevil, *Cyrtobagous salviniae*, as a biological control to giant salvinia. Aquatic herbicides that are approved for control of giant salvinia do exist; but as with any chemical application, especially in water, caution should be used.



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giant salvinia covering waterway near Blythe, California





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# Hydrilla

Hydrocharitaceae (frog's bit family)

*Hydrilla verticillata*

## Origin

*A native to Eurasia and North Africa, hydrilla was likely introduced as an aquarium plant.*

## Dispersal

- grows from fragmented stems and sprouting tubers and is dispersed through water movement, wildlife, and human activities such as boating and fishing
- spreads horizontally in the water with tuber-bearing **rhizomes**

## Description

- **perennial**, aquatic plant, mainly submersed though portions float to the water surface
- spear-shaped, triangular leaves are formed in whorls of 2–8 around the stem
- flowers are tiny and inconspicuous

## Habitat Preference

- found mainly in freshwater aquatic systems, but can tolerate low **salinity** and is sometimes found in the upper reaches of estuaries
- found in shallow water, but in clear water can survive down to 49 feet (15 m)
- prefers muddy substrates
- agricultural and urban runoff enhances growth



## Impact

- extensive mats of hydrilla slow stream flow, impede boating and swimming, and degrade the overall aquatic habitat by diminishing water quality and increasing sediment deposits
- dominates submerged native aquatic plants

## Management and Control

To reduce spread by human transport, infested areas should be quarantined. Divers can remove small infestations manually, but areas of large infestations likely need to be drained and dredged. Herbicides are not recommended in aquatic settings except in very controlled situations.



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hydrilla in a Tucson golf course pond





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# Water hyacinth

Pontederiaceae (water hyacinth family)

*Eichhornia crassipes*

## Origin

*Native to the Amazon region of tropical South America, water hyacinth has spread to tropical and subtropical areas worldwide. It was introduced in the United States in the late 1800s as an ornamental aquatic landscape plant.*

## Description

- **perennial**, floating aquatic plant that may form thick mats completely covering the water surface
- round to oval leaves up to 4 inches (10 cm) wide; leaf stems swell to form an oblong to round spongy float
- large, attractive, lavender flowers are borne on stalks held 2–6 inches (5–15 cm) above the water and bloom from mid-summer to fall

## Dispersal

- long-distance dispersal by plant fragments form colonies and spread by **rhizomes**
- seeds germinate in bottom substrate then float to the surface, then are sometimes dispersed by birds' feet
- humans disperse this species by propagating it for ornamental purposes and allowing plants to escape in natural and man-made aquatic environments

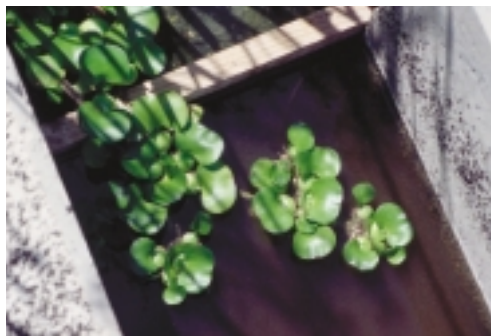
## Habitat Preference

- found in freshwater aquatic systems such as ponds and slow-flowing portions of streams
- prefers tropical and sub-tropical climates with warm, shallow waters and lots of light
- cannot tolerate **salinity**



## Impact

- degrades aquatic habitats by reducing open water and displacing native plants
- reduces water quality when decomposing
- creates mosquito habitat
- obstructs navigable waterways and clogs irrigation ditches and hydroelectric equipment
- increases water loss due to high transpiration rate



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juvenile water hyacinth in an artificial wetland

## Management and Control

Eradicating water hyacinth requires the manual removal of all plant parts from a body of water. Control strategies include the use of floating barriers to contain the plants, or dredging then dragging plants to shore and disposing of them. Prevention of its spread includes educating people about the problem, keeping equipment clean, and not introducing plants into uninfested waters.

water hyacinths established in an artificial wetland, water treatment ponds



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## Glossary

***Alkaline*** having a pH greater than 7. A pH of 7 is considered neutral, less than 7 is acidic, and greater than 7 is considered basic or alkaline.

***Alkaloid*** an organic base compound, usually containing nitrogen, that occurs in many vascular plants and some fungi and is often poisonous to animals and humans. Many alkaloids, such as nicotine, quinine, cocaine, and morphine, are known for their poisonous or medicinal properties.

***Allelopathy*** a chemical process in which plants produce substances harmful to other plants to exclude them from their space; ***allelopathic*** exhibiting properties of allelopathy

***Annual*** a plant that completes its life cycle in one growing season and reproduces only by seed

***Capsular*** referring to a specific type of fruit that, like a capsule, opens along a seam; the capsule is rounded with thin walls and the seeds are contained inside

***Ephemeral*** plants complete their life cycle in a single season; for example, those that are dependent upon spring or summer rains

***Exotic*** not naturally found in a particular place or region; foreign; ***non-native***

***Inflorescence*** the flowering part of a plant, or arrangement of flowers on a stalk; may be seed bearing

***Invasive*** the ability to rapidly colonize diverse environments and geographic sites; ***invaders*** invasive plants that have established themselves in a site

***Monospecific*** plant community of a single species

***Node*** a place on a stem where a leaf, root, or new stem is formed

***Non-native*** (see ***exotic***)

***Perennial*** plants that live for more than two growing seasons; spread and reproduction is both sexual (seed) and asexual (vegetative)

***Prostrate*** flat growth form that spreads across the surface of the ground

***Rhizome*** a creeping, underground stem that contributes to the spread of a plant by rooting at the ***nodes*** and producing buds

***Rosette*** a circular, basal cluster of leaves

***Saline*** salty, containing salts; ***salinity*** pertaining to the amount of salts present

***Stolons*** a horizontal stem (or “runner”) that creeps across the soil surface and often produces roots at the ***nodes***

***Succulent*** leaves and stems having a fleshy and juicy structure

## References

- Bossard, Carla C., John M. Randall, and Marc C. Hoshovsky. 2000. *Invasive Plants of California's Wildlands*. University of California Press: Berkeley and Los Angeles, California.
- Felger, Richard S. 2000. *Flora of the Gran Desierto and Río Colorado of Northwestern Mexico*. University of Arizona Press: Tucson, Arizona.
- Felger, Richard S. 1990. *Non-native Plants of Organ Pipe Cactus National Monument*. Cooperative National Park Resource Studies Unit, University of Arizona Technical Report 31. Tucson, Arizona.
- Howery, Larry D. and Gina Ramos (eds.). 2000. *Arizona's Invasive Weeds*. University of Arizona Cooperative Extension, College of Agriculture and Life Sciences: Tucson, Arizona.
- Kearney, Thomas H. and Robert H. Peebles. 1951. *Arizona Flora*. University of California Press: Berkeley and Los Angeles, California.
- Parker, Kittie F. 1972. *An Illustrated Guide to Arizona's Weeds*. University of Arizona Press: Tucson, Arizona.  
Also found at:  
<http://www.uapress.arizona.edu/online.bks/weeds/species.htm>
- Tellman, Barbara, ed. 2002. *Invasive Exotic Species in the Sonoran Region*. University of Arizona Press: Tucson, Arizona.
- Whitson, Tom D., ed. 2000. *Weeds of the West*. The Western Society of Weed Science, the Western United States Land Grant Universities Cooperative Extension Services, and the University of Wyoming: Jackson, Wyoming.
- Stowaways and Invited Guests: How Some Exotic Plants Reached the American Southwest*, by Barbara Tellman <http://www.caleppc.org/symposia/96symposium/tellman.html>
- Exotic Plants in the Sonoran Desert Region, Arizona and Sonora*, by Thomas R. Van Devender, Richard S. Felger, and Alberto Búrquez M. <http://www.caleppc.org/symposia/97symposium/vandevender.html>
- Arizona's noxious weed list  
<http://agriculture.state.az.us/PSD/psd/htm>
- Federal noxious weed list  
<http://www.plants.usda.gov>