Chapter 4

Invasive Species in Southern Nevada

Matthew L. Brooks, Steven M. Ostoja, and Jeanne C. Chambers

Executive Summary

Southern Nevada contains a wide range of topographies, elevations, and climatic zones that are emblematic of its position at the ecotone between the Mojave Desert, Great Basin, and Colorado Plateau ecoregions. These varied environmental conditions support a high degree of biological diversity, but they also provide opportunities for a wide range of invasive species. In addition, the population center of Las Vegas valley and agricultural areas scattered throughout Clark, Lincoln, and Nye counties, all connected by a network of roads and highways, plus ephemeral and perennial watercourses, provide abundant opportunities for new invaders to be transported into and within southern Nevada. Invasive species are a major concern for land managers because of their capacity to compete with native species, change habitat conditions, and alter ecosystem properties.

Executive Order 13112 issued by President Clinton in 1999 called for the establishment of the inter-departmental National Invasive Species Council (NISC) and creation of a national plan to serve as a comprehensive blueprint for Federal actions on invasive species. This plan identifies five strategic goals: prevention, early detection and rapid response, control and management, restoration, and organizational collaboration. It defines an invasive species as "a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Many non-native species do not cause harm and are actually beneficial to humans (e.g., crop species). Others are clearly invasive and harmful outside of their native range (e.g., European starling). Still other non-native species are considered invasive by some, but beneficial or otherwise desirable by others (e.g., some ornamental plants, wild horses, and burros). Land managers, policy makers, and society in general must determine which non-native species are invasive and pose the greatest threats. This chapter provides information that will help land managers develop strategies to achieve Sub-goal 1.2 in the SNAP Science Research Strategy, which is to "Protect southern Nevada's ecosystems from the adverse impacts of invasive species" (see table 1.1).

Invasive Plants

Uplands

The majority of invasive plant species that dominate upland areas in southern Nevada are annuals. Annuals complete their entire lifecycle in 1 year—germinating, growing, reproducing, and dying—typically from winter to spring. They are ideally suited to avoid the most inhospitable arid conditions that characterize most of the year by remaining dormant as seeds in the seedbank. Seeds also provide an ideal mechanism for dispersal, allowing annual species to spread both within and among areas. Major species of concern include cheatgrass (*Bromus tectorum*), red brome (*Bromus rubens*), Mediterranean split-grass (*Schismus barbatus*, *Schismus arabicus*), red-stemmed filaree (*Erodium cicutarium*), and various mustard species (*Brassica tournefortii, Hirshfeldia incana, Sisymbrium irio, Sisymbrium altissimum*, *Malcomia africana*).

The greatest threat that invasive plants pose to upland areas of southern Nevada is the alteration of fire regimes. Invasive plants also outcompete native plants for limiting resources. In addition, the seeds of some invasive plants (e.g., red brome, red-stemmed filaree) are eaten and dispersed by native granivores. The desert tortoise will consume red brome if there is little else to eat, and this may cause physiological problems associated with potassium levels.

Annual plants are notoriously difficult to manage. Their seeds are easily dispersed and often remain viable for many years. Preventing their transport into new areas of southern Nevada is the best first line of defense, followed by eradication or containment of nascent populations. Washing of equipment and removal of propagules from shoes and clothing before leaving infested areas also can help reduce dispersal rates. Repeated treatment over a period of years is generally required until the soil seedbank becomes exhausted.

Riparian/Aquatic and Springs

Riparian and spring ecosystems are characterized by both annual and perennial invasive plant species. Perennial species that have clonal or rhizomatous life forms or that are capable of root sprouting are ideally suited to survive the scouring floods and sediment deposition that often typify arid riparian ecosystems. These species are also often highly competitive with native riparian species. Facultative or obligate riparian species include the perennials, giant reed (*Arundo donax*), Russian olive (*Elaeagnus angustifolia*), camelthorn (*Alhagi pseudalhagi*), and perennial pepperweed (*Lepidium latifolium*), and the annual rabbitsfoot grass (*Polypogon monspeliensis*). Upland species that utilize seasonal increases in water availability or that occur at the periphery of these ecosystems include Russian knapweed (*Acroptilon repens*), invasive annual grasses such as ripgut brome (*Bromus diandrus*), red brome, and cheatgrass, and invasive mustards.

Perennial species can attain large size, displace native vegetation, and significantly affect the physiographic structure of vegetation stands. Tamarisk (*Tamarix* spp.) is perhaps the most infamous of these species in southern Nevada. Conversion of native riparian vegetation to tamarisk stands can affect wildlife habitat quality and ecosystem properties associated with fire and hydrologic regimes. Even so, this ecosystem continues to support a diversity of species including two birds of conservation concern.

Challenges associated with controlling and managing riparian invasive plants differ from those of uplands. Many perennial species have persistent below-ground roots and rhizomes that make eradicating populations difficult (e.g., giant reed, perennial pepperweed). Also, seeds and other propagules are readily transported in flowing water and by the animals that utilize these ecosystems. Mechanical or prescribed fire treatments often are used initially to reduce aboveground biomass and stimulate resource re-allocation from belowground to aboveground tissue. Then, after regrowth has occurred, chemical treatments are used as a follow-up to kill the plants. Treatment of resprouts may be necessary during subsequent years. Long-term of success of these treatments is dependent on restoration with native species and continued monitoring to detect reoccurring or new invasions.

There are few aquatic plant invaders in southern Nevada, and those that are currently present do not pose serious threats. However, there are a few that pose real threats and are poised to invade southern Nevada. Eurasian water-milfoil (*Myriophyllum spicatum*) occurs along the Colorado River in the vicinity of Parker Arizona and giant salvinia (*Salvinia molesta*) has been reported farther downstream at the Imperial National Wildlife Refuge. Both species have the potential to choke out waterways, increase eutrophication, disrupt food webs, and otherwise significantly alter aquatic habitats of southern Nevada. These changes could threaten everything from endemic animals such as pupfish and spring snails, to game species such as sunfish, bass, and trout. Options for controlling aquatic plants are limited once the species have established. Educational programs promoting watercraft washing and periodic inspections at entry points are potentially the most effective way to prevent transport and colonization of new waterways.

Invasive Animals

Terrestrial

While perhaps less conspicuous and less abundant than invasive plants, invasive animals can have significant ecological and economic consequences in southern Nevada. Species of concern include Argentine ants (*Linepithema humile*), imported red fire ants (*Solenopsis* spp.), and feral dogs (*Canis familiaris*), cats (*Felis catus*), and cattle (*Bos primigenius*). Wild horses (*Equus ferus*) and burros (*Equus asinus*) also can impact natural resources and could be considered an invasive species as defined by the National Invasive Species Council. However, these species also are viewed by many as a national cultural treasure, emblematic of the pioneer spirit of the West, and are specifically protected by the 1971 Wild Free-Roaming Horse and Burro Act (Public Law 92-195).

Argentine ants are successful and voracious predators in part because they will combine territories and attack other insects including native ant colonies, lizards, snakes and small mammals. Red imported fire ants compete with native fire ants, prey on invertebrates and vertebrates, and may affect plant assemblages through selective seed removal. Wild horse, burros, and cattle can cause damage by trampling vegetation, soil compaction, and overgrazing, especially near watering sites. Feral cats and dogs prey on birds and other wildlife and are among the main predators of the Federally protected desert tortoise.

Control of invasive ants can be difficult. Aside from baiting and chemical control, few options exist and even these may have some residual impact on non-target groups. Trapping and other removal techniques are effective control strategies for wild horses, burros, cattle, and feral cats and dogs. However, these methods are generally not implemented due to animal rights concerns, and comprehensive feral dog and cat programs can be very difficult to implement.

Aquatic

Several notable aquatic invasive species exist in southern Nevada including the quagga mussel (*Dreissena rostriformis*), American bullfrogs (*Rana catesbeiana*), red swamp crayfish (*Procambarus clarkii*), mosquitofish (*Gambusia* spp.), red shiner (*Notropis leutrensis*), shortfin molly (*Poecilia mexicana*), cichlids (*Oreochromis* spp.), and tilapia (*Tilapia* spp.).

Quagga mussels can clog pipes and compromise water intake systems, encrust boats, docks and associated facilities, alter the aquatic food web, impact sport fishing and litter beaches with their small sharp shells. Bullfrogs are aggressive and voracious predators of native toads and frogs, reptiles, small mammals, and birds, some of which are listed under the Endangered Species Act. Mosquitofish, red shiner, and cichlids have adversely affected native invertebrates, amphibians, and fishes. Shortfin mollies prey on larval fish including the Federally Endangered Moapa dace (*Moapa coriacea*) and Moapa White River springfish (*Crenichthys baileyi moapae*).

Prevention is the key to quagga mussel control because even if adults are killed the larvae have the ability to evade control measures and later recolonize. Physical methods for control of bullfrogs and crayfish include de-watering and temporary habitat removal, but this can affect native species. Chemical control methods for fish include picicides (e.g., rotenone); however, the effective dosage required will also kill most other co-occurring organisms.

Knowledge Gaps and Management Implications

Prevention is clearly the first line of defense against invasive species. The most effectively managed invasive species are those that are kept from being transported to, and colonizing within, southern Nevada. Species can be transported accidentally by people and equipment, and this mode of transport can be minimized by washing tools and vehicles, especially when leaving sites with known local infestations. Other species can be transported purposefully into a region, and then spread on their own into wildland areas. These purposeful introductions can be discouraged by preventative regulations for state and Federal noxious species, and by public education and partnerships with the agricultural and ornamental horticultural community for other high priority species to help find less invasive alternatives.

Early detection and rapid response requires significant pre-planning to be effective. Because there are more species than can be managed, a prioritization process is key to refine early detection plans to improve their detectability. Depending on the types of existing information and resources available to process the information, a generalized, prioritized, or optimized monitoring plan can be developed to improve the efficacy of monitoring efforts (fig. 4.1).

Control and management also require prioritization to triage nascent populations for rapid response control actions, and the same prioritization concepts can be used as those applied to early detection (fig. 4.1). It is also important to continue monitoring and retreating these areas for a few years to ensure that there are no surviving individuals. Ideally, monitoring should be designed to evaluate the efficacy of control treatments, and adjust them accordingly in the future. If the ultimate objectives of control treatments are to benefit other species (e.g., natives), biological diversity (e.g., native species diversity), or ecosystem properties (e.g., reduce fire spread potential), then those factors should also be targeted for monitoring.

Restoration of robust native ecosystems can improve the resilience of degraded areas to subsequent biological invasions. Unfortunately, the specific factors that increase resistance to invasion are poorly understood. As a result, restoration guidelines are generally focused on maximizing characteristics like abundance and diversity of native species, diversity of functional types, and groups of species important for critical aspects of ecosystem function (e.g., nutrient cycling). All restoration projects should be carefully monitored to both determine if their restoration targets are achieved and to evaluate their effects on invasion resistance.

Organizational collaboration is required to effectively manage invasive species because they truly know no political boundaries, and if neighboring land owners are not doing their part, then efforts to prevent invasions and the problems that follow will often be in vain. Sharing resources and expertise by Federal and local agencies through

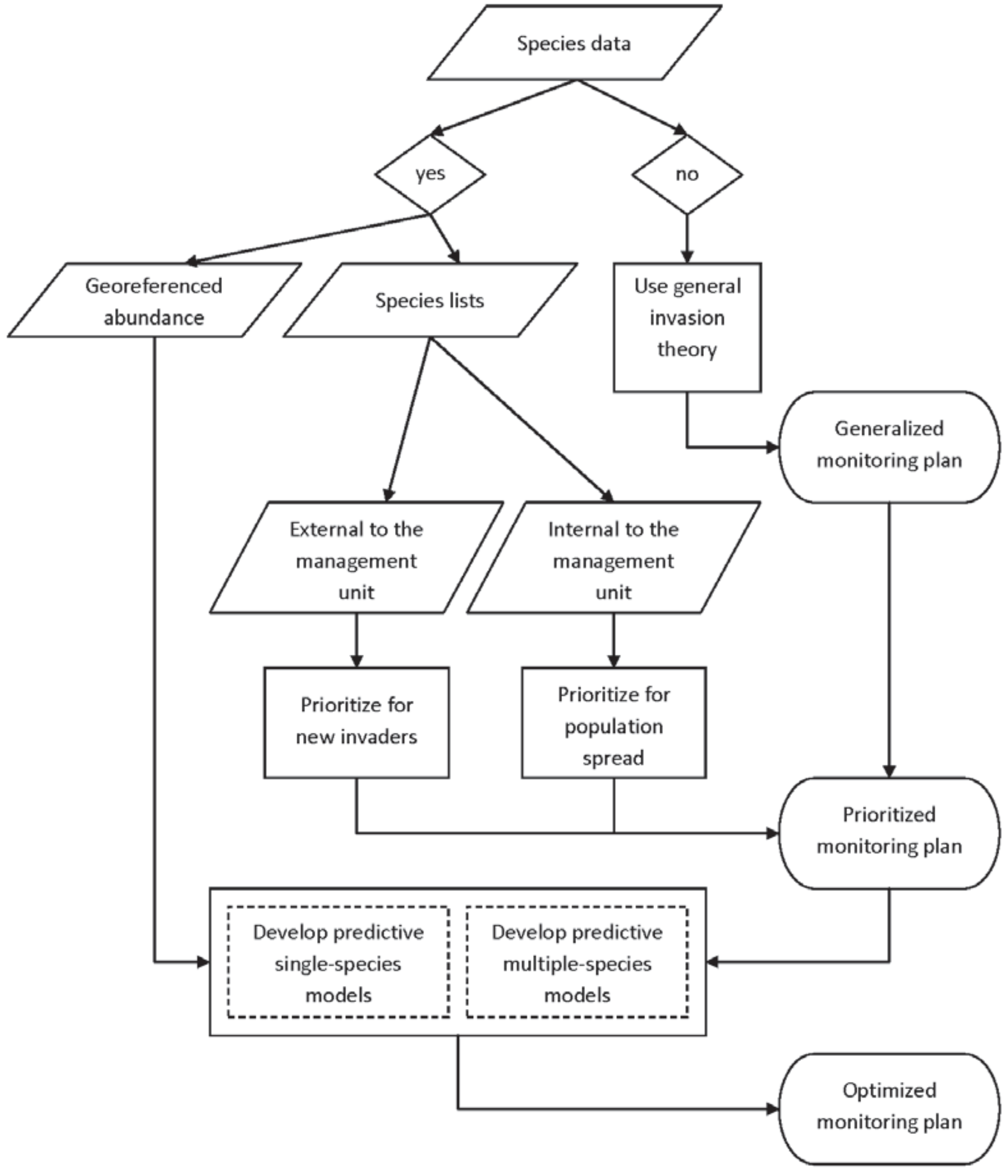

Figure 4.1–Steps for developing early detection monitoring plans (reprinted with permission from Brooks and Klinger 2009)

cooperative agreements and through the interagency Southern Nevada Restoration Team can assist with the process of collaboration. Cooperative Weed Management Areas (CWMA) are formal groups that also can facilitate this process, especially by ensuring that species priorities are consistent across land management units and that coordinated management plans are maintained over time. For a complete discussion of topics in this executive summary, see *Chapter 4, Invasive Species in Southern Nevada,* in "The Southern Nevada Agency Partnership Science and Research Synthesis—Science to Support Land Management in Southern Nevada" (RMRS-GTR-303).

Key References

Abella, S.R.; Newton, A.C. 2009. A systematic review of species performance and treatment effectiveness for revegetation in the Mojave Desert, USA. In: Fernandez-Bernal, A.; De La Rosa, M.A. (eds.). Arid environments and wind erosion. Hauppauge, NY: Nova Science Publishers, Inc.: 45-74

Abella, S.R.; Spenser, J.E.; Hoines, J.; Nazarchyk, C. 2009. Assessing and exotic plant surveying program in the Mojave Desert, Clark County, Nevada, USA. Environmental Monitoring and Assessment. 151:221-230.

Brooks, M.L. 2009. Spatial and temporal distribution of non-native plants in upland areas of the Mojave Desert. In: Webb, R.H.; Fenstermaker, L.F.; Heaton, J.S.; Hughson, D.L.; McDonald, E.V.; Miller, D.M. (eds.). The Mojave Desert: Ecosystem Processes and Sustainability. Reno, NV: University of Nevada Press: 101-124.

Brooks, M.L.; Chambers. J.C. 2011. Resistance to invasion and resilience to fire in desert shrublands of North America. Rangeland Ecology and Management. 64:431-429.

Brooks, M.L.; Esque, T.C. 2002. Alien annual plants and wildfire in desert tortoise habitat: status, ecological effects, and management. Chelonian Conservation and Biology. 4:330-340.

Brooks, M.L. and R.C. Klinger. 2009. Practical considerations for detecting and monitoring plant invasions. Pages 168-195 In: Inderjit (ed.). Management of Non-native Invasive Plant Species. Springer, Heidelberg, Germany.

Brooks, M.L.; Lusk, M. 2008. Fire management and invasive plants: a handbook. Arlington, VA: U.S. Fish and Wildlife Service. 27 pp.

Brooks, M.L.; Pyke, D. 2001. Invasive plants and fire in the deserts of North America. In: Galley, K.; Wilson, T. (eds.). Proceedings of the invasive species workshop: The role of fire inthe control and spread of invasive species. Fire Conference 2000: The First National Congress on Fire Ecology, Prevention and Management. Miscel. Publ. No. 11. Tallahassee, FL: Tall Timbers Research Station: 1-14.

Courtenay, W.R., Jr.; Deacon, J E. 1983. Fish introductions in the American southwest: a case history of Rogers Spring, Nevada. Southwestern Naturalist. 28:221-224.

Hubbs, C.; Deacon, J.E. 1964. Additional introductions of tropical fishes into southern Nevada. Southwestern Naturalist. 9:249-251.

National Invasive Species Council. 2001. Meeting the invasive species challenge: National invasive species management plan. 80 p. Online: http://www.invasivespeciesinfo.gov/docs/council/mp.pdf. [2012, Oct 29].

National Invasive Species Council. 2008. 2008-2012 National invasive species management plan. 35 p. Online: http://www.invasivespeciesinfo.gov/council/mp2008.pdf. [2012, Oct 29].

Radosevich, S.; Holt, J.; Ghersa, C. 1997. Weed ecology: Implications for management. New York, NY: John Wiley and Sons. 589 p.

Richardson, D.M.; Pysek, P.; Rejmanek, M.; Barbour, M.G.; Panetta, F.D.; West, C.J. 2000. Naturalization and invasion of alien plants: concepts and definitions. Diversity and Distributions. 6:93-107.

Scoppettonni, G.G. 1993. Interactions between native and nonnative fishes of the upper Muddy River, Nevada. Transactions of the American Fisheries Society. 122:599-608.

Turner, K.; LaVoie, A.M.; Ronning, C.J.; Sharp, R.M.; Palmer, C.J.; Miller, J.M. 2009. SNAP Science and Research Strategy (Strategy). Southern Nevada Agency Partnership. Online: http://snap.gov/upload/SNAP-S-R-Strategy-2009r.pdf. [2011, April 6].