

DESERT IRONWOOD PRIMER EXECUTIVE SUMMARY

Desert ironwood, or *palo fierro* in Spanish, provides many wildlife and plants with habitat and resources critical to their survival. While scientists do not consider ironwood endangered or threatened as a species, its populations are dwindling rapidly and recover extremely slowly after exploitation. Its ecological importance comes largely through the roles it plays for over 500 other species of plants and animals in the Sonoran Desert. This report confirms ironwood's critical role as a *keystone species* and *nurse plant* in maintaining desert biodiversity and makes recommendations for its future protection.

Initiated with funding from the United States Department of Interior Border XXI project, our binational team launched this region-wide assessment to help guide land use decisions impacting ironwood habitat on both sides of the border. The study compiles nearly all previously published literature on ironwood ecology and analyzes data from 148 new study plots. The report consists of two parts: first, an overview of the ecological and historical background of desert ironwood; then a discussion of the first comprehensive binational study on perennial plant diversity of ironwood habitats in the Sonoran Desert, completed by our research team for this report.

Ironwood ecology

A hardy legume tree, ironwood's range closely matches the boundaries of the Sonoran Desert, the only place in the world where it occurs. The only species in the genus *Olneya*, ironwood is notable for its slow growth rates and extremely dense wood. Its wood even sinks in water. While scientists consider ironwood to be the "old growth" tree of the desert, standard tree-ring dating of its wood is difficult. The Ironwood Alliance is currently pursuing alternative methods to date ironwoods. Estimates show some trees to be 800 years old, and it is likely that they live even longer. Though long-lived, ironwoods face many threats, both as seedlings and as mature trees, from habitat fragmentation, grazing, woodcutting, and competition from exotic species.

Ironwoods bloom profusely in the spring and their blossoms lend a purple hue to the landscape. The pea-type pods mature at a time of year when little else is producing fruit in the Arizona Uplands, leading to a high dependence of wildlife on its seeds. Unlike other desert trees, ironwood rarely sheds all its leaves, so that its canopy provides shade and protection from frost and extreme heat year round.

Ironwood as a Keystone Species and Nurse Plant

Ironwood functions as a *habitat modifying keystone species*, that is, a species that exhibits strong influences on the distribution and abundance of associated species. Ironwood generates a chain of influences on associated understory plants, affecting their dispersal, germination, establishment, and rates of growth as well as reproduction. Scientists call these ecological dynamics "nurse plant ecology". Mesquites and palo verde also play this role, however, each tree caters to slightly different sets of plants in its "nursery". Ironwood is the dominant nurse plant in some subregions of the Sonoran Desert.

As nurse plants, ironwoods provide safe sites for seed dispersal, seedling protection from extreme cold and freezes, and sapling protection from extreme heat and damaging radiation. They also function as prey refugia, providing herbs and cacti protection from herbivores preying on vulnerable plant seedlings. Finally, like other legumes, they alter the soil composition beneath their canopies, enriching the soil with nutrients such as nitrogen.

Ironwood, often the tallest tree in its habitat, attracts birds and other seed dispersers who roost in its branches and generate a literal "rain" of seeds and whole fruit. The mere presence of ironwood and other legume trees can increase the number of bird species in desert scrub habitat by 63%. Germination rates are higher and seedling survival rates better due to the improved soil conditions. Plant health, survival and growth are also improved by the shade and protection from frost that ironwood's canopy offers. Thorny, low-sweeping branches keep out herbivores, promoting plant growth further. In turn, the greater diversity of plants growing in ironwood nurseries attracts a greater diversity of birds, both breeding and migratory.

The relationship between succulent cacti and ironwoods is especially well documented. Recent studies show that without the protective cover of desert legumes, the distributional ranges of saguaro, organ pipe, and senita cactus would retreat many miles, to more southern, frost-free areas. On freezing nights, the canopies of ironwood, below which the temperature may be 4° C warmer than in adjacent open areas, make the critical difference for vulnerable seedlings.

Ironwood plays a similar role in sheltering seedlings and saplings sensitive to extreme heat and radiation. Its canopy minimizes heat, damaging radiation, and water stress among plants established in its shade. When stripped of ironwood's protective cover above them, some cacti actually suffer sunburn and die.

In addition to serving as a buffer from such abiotic stresses as soil and moisture conditions, ironwood buffers nursery plants from some biotic stresses, especially that of herbivores. Thorny nurse plants can dramatically reduce the amount of predation on seedlings by large and small herbivores such as cows, rabbits, and rodents. In some places, the high number of animals that nest, burrow or seek refuge under ironwoods reduces this effect.

Ironwood as a Cultural Resource

The many indigenous and ethnic cultures of the Sonoran Desert have long valued ironwood for its cultural, as well as ecological, resources. Traditional products and uses of ironwood include food, medicines, agricultural and household implements, and ceremonial and ritual uses. Because most of these uses utilized either renewable resources (pods, seeds, flowers) or salvaged wood from already dead trees, their impact on ancient ironwood forests was negligible.

The most well known contemporary cultural use of ironwood is by the Seri and Mexican carvers of coastal Sonora. The Seri began to carve elegant, abstract renderings of native animals in the 1960's. They always use dried, already dead ironwood. Nearby Mexican communities quickly copied the successful forms of the Seri carvings. However, their use of machines allows them to produce carvings at a rate which is depleting the local supply of ironwood. Attempts to protect the ironwood forests in this area have so far been unsuccessful.

The dense wood of ironwood burns extremely hot, making it the preferred fuelwood in communities in the northern Mexico, where any type of fuelwood is scarce. Mesquite charcoal production for export to the U.S. consumes even more ironwood. Ironwood grows in mixed stands with mesquite and is cut down as an illegal "by-catch" in much the same way tuna nets kill dolphins and other species, though its harvest is usually intentional rather than accidental. The Mexican charcoal industry boomed in the 1980's after the U.S. environmental laws banned highly polluting earthen pits, a grossly inefficient method where 60% of the energy is lost. Through the requests of the Seri and others, the Mexican government now requires permits for ironwood cutting, and no permits are given to cut ironwood for charcoal production. However the laws are difficult to enforce, and the incentive to cut dense, heavy ironwood is high among poor woodcutters paid by the weight of wood collected per day.

Threats to Ironwood

In Mexico, woodcutting alone causes an average 17% reduction in ironwood's dominance in the vegetation of the areas studied. The demand for wood even sends Mexicans over the U.S. border to cut ironwood from Organ Pipe Cactus National Monument and other protected areas. Other impacts threaten ironwood habitat on both sides of the border, especially habitat fragmentation due to the rapid growth of cities such as Tucson, Yuma, Phoenix, Hermosillo and Mexicali, and the conversion of ironwood habitat to agricultural lands.

Grazing and competition by exotic species such as buffelgrass pose additional serious threats to ironwood. Buffelgrass, a popular forage grass for cattle, is highly invasive. Studies show it decreases plant species richness and diversity in native plant communities and increases the frequency of fires. Fueled by buffelgrass, these hot burning wildfires destroy ironwood and other trees and cactus. Among other threats, the population explosion in the Sonoran Desert has led to increasing recreational impacts in ironwood habitat.

Ironwood Diversity Study

After establishing the various potential benefits mature ironwood trees could provide to native flora and fauna in their habitats, our team surveyed 16 sites scattered across the Sonoran Desert to determine whether ironwood's presence influenced biodiversity in the same manner at all sites. Sampling the perennial vegetation in 148 new plots in 3 states, we determined ironwood's presence to be equally high in ecological importance in every subregion of the Sonoran Desert where we measured it.

In other words, the loss of ironwood from habitats in any Sonoran Desert subregion would diminish the overall lushness of vegetative cover, especially of vines. Nonetheless, the presence of ironwood in each subregion influenced the diversity of associated plants in different ways, with great dissimilarities in the types of understory plants found below ironwoods in the Arizona Uplands and the Central Gulf Coast of Sonora. In short, protecting ironwood habitat in Pima County, Arizona, will benefit a different mix of native species than would be conserved in

ironwood habitats currently being protected on the islands or coasts of the Gulf of California. Although ironwoods and mesquites found in the same habitats share most of the same understory species, ironwood favors some vines and shrubs more than others, while mesquite favors a somewhat different mix.

The abundance and cover of understory plants found beneath ironwoods varies according to their location, from the banks of dry washes in valleys to those growing along small drainages on rocky slopes. In addition, all sizes of ironwoods do not necessarily function equally as nurse plants for other species. Young trees provide hardly any protective microenvironment at all, while the large, dense canopies of ancient trees can become too shady to allow much plant growth beneath them, and their higher branches allow cows to forage under them in grazed areas.

Recommendations

Using several different measures of species diversity, richness, and ecological importance, we have selected several sites as priorities for new protection and for strengthened conservation management. In the U.S. state of Arizona, the sites are: Ragged Top on the boundary of Pinal and Pima Counties; and the Cocoraque Rock and Ironwood Picnic Areas on either side of Brawley Wash in Avra Valley, Pima County. In Sonora, Mexico, the sites are: Punta Santa Rosa north of Kino Bay, and Tecomate on Tiburón Island, both on Seri Indian lands; the southern reaches of the Sierra El Pinacate north of Puerto Peñasco (Rocky Point); and Rancho El Carrizo, a private ranch and masked bobwhite quail refuge near Carbo, Sonora. Although other areas undoubtedly deserve further study and protection, these sites, with the already protected sites in Saguaro National Park, Cabeza National Wildlife Refuge, and Organ Pipe Cactus National Monument, could provide the cornerstones for a regional reserve network to protect the biodiversity associated with ironwood habitats in the Sonoran Desert.