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Academic Writing Sample

Threats to Riparian Ecosystems in the American West and a Call for Their Protection

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Water is the blood of the American Southwest. The landscapes are defined by it; the deserts by how little, the canyons by how forceful, and the forests by how frequent. The veins that carry this blood are rivers, creeks, and streams. Riparian corridors are the immediate habitats along these bodies of water. They contain high biodiversity and offer critical habitat for many endangered species (Poff et al., 2012). Riparian systems are easily altered and exist within a delicate balance (University of Arizona, 2006). In an area of much scarcity, the contentious debate for water management is of primary concern for a wide variety of stakeholders. Farmers, land owners, government agencies, indigenous peoples, and environmentalists carry contrary perspectives that complicate discourse and compromise (Singh, 2024). Riparian ecosystems are at the center of these debates and frequently see firsthand the adverse effects of anthropogenic activity (Krueper, 1996) (Poff et al., 2012). Due to the fragility of riparian ecosystems, the ecological value of the associated habitats, and historic mismanagement, riparian ecosystems should be the focus of environmental protection policies in the American Southwest.

Riparian ecosystems are some of the most productive ecosystems in North America; however, their ecological value is disproportionate to their size and distribution (University of Arizona, 2006). In the arid Western United States, riparian habitats occur on less than 2% of the total land area (University of Arizona, 2006). In exceptionally dry states, riparian distribution is even further drastically sparse. Within Arizona, for example, there is only 396 square miles of land covered by perennial water, equivalent to 0.3% of the total land area of the state, (Water

Science School, 2018) and an estimated 0.4% of land representing riparian habitat (University of Arizona, 2006). Though the range and distribution of these habitats are relatively low, they house one-third of the plant species in the West (Poff et al., 2012). These diverse riparian plants are essential for the success of pollinators, such as native bees who rely on flowering shrubs that provide forage, habitat, and shade (Mitchell et al., 2021). In addition, riparian ecosystems are responsible for providing habitat to 60% of the Southwest's vertebrate species (Poff et al., 2012). They are critical habitats for many endangered species as well, with 70% of the Southwest's endangered species finding refuge here (Poff et al., 2012). Aside from being unique and valuable habitats, riparian ecosystems are responsible for a myriad of ecological functions that set them aside from the surrounding plains, mountains, and deserts of the Southwest (University of Arizona, 2006).

Ecological functions are the processes, interactions, and dynamics within an ecosystem that define, characterize, and sustain the system as a whole (University of Arizona, 2006) (Jax, 2005). In riparian ecosystems, these are: providing habitat, filtering sediment, altering chemical inputs, and mediating the exchange of energy between aquatic and upland ecosystems (University of Arizona, 2006) (Poff et al., 2012). These functions contribute to the dynamism of Arizona's riparian corridors by tying together the climatic contrast of arid deserts and aquatic ecosystems while providing a continuous connection between habitat specific elevation gradients (Krueper, 1996). Riparian habitats have a high water table (Poff et al., 2012), which when combined with stream bank stabilization provided by vegetation, allows for a continually changing streambed regime (University of Arizona, 2006). For example, the Southwestern riparian aster, *Baccharis salicifolia*, commonly referred to as seep-willow, is a riparian shrub responsible for the retention of streambeds and erosion control (Buckley et al., 2020). The shrub forms streamside thickets that help direct the flow of water by fortifying the river's banks and beds with their meandering roots and dense growth (Buckley et al., 2020). During heavy rain events in which waters surge, the seep-willow's flexible stalks bend under the force of the

stream, covering the plant in sediment and encouraging new saplings to grow from the buried stalk (Buckley et al., 2020). This plant's continuous dispersal contributes to the anastomosing of streams in the Southwest and plays an essential role in the constantly evolving nature of riparian corridors.

From a cultural perspective, water and riparian areas are of critical importance in the Western United States. Indigenous peoples have relied on the plants, animals, and material products of riparian habitats for subsistence purposes long before the arrival of European colonizers (Nania, n.d.). Beyond subsistence, waterways are a cultural cornerstone for Native American communities and are the center of celebration and ceremony for many tribes (Nania, n.d.). Today, with the systematic removal of indigenous people from their lands (Nania, n.d.), many riparian areas are left without stewards and are at higher risk of development and overuse (Kennedy et al., 2023).

Riparian habitats are subject to heavy use (University of Arizona, 2006) as they offer a refuge from the heat of the desert and offer scenic destinations (Poff et al., 2012). Activities that draw people to these areas include hunting, fishing, boating, horseback riding, cycling, wildlife watching, camping, and OHV riding (University of Arizona, 2006). The multiple-use standard of federal land management agencies, specifically the U.S. Bureau of Land Management, promotes heavy traffic within these sensitive ecosystems and threatens their ecological integrity and viability as refuge for wildlife (Poff et al., 2012).

Alterations to the biochemical systems within many riparian habitats throughout the U.S. are the result of anthropogenic activity in the form of development and land use (Poff et al., 2012). The health and sustainability of riparian ecosystems are often not considered when development occurs (Poff et al., 2012). Pollutants and disturbance from development at higher points in a watershed can accumulate in riparian areas (Poff et al., 2012). Bioaccumulation of pollutants, namely mercury, has been found in riparian trees and sediments, posing health concerns for wildlife and the ecosystem at large (Morelli et al., 2024). Riparian areas are valued

for their function as a ‘living filter’ of pollutants, however, pollution still poses risk for wildlife inhabitants (Cohen, 2014).

Industry and development in or near riparian areas expose these habitats to negative externalities (Cohen, 2014) (Poff et al., 2012). Within agriculture and ranching, common practices such as flow regulation, water diversion, and damming involve intensive water use, deplete groundwater, and strain riparian ecosystems (Poff et al., 2012). Dams and flow regulation greatly alter how water moves through riparian areas by storing and releasing water, disrupting the natural flow (MacCarter, 2001). The temperature of released dam water is lower than that of the naturally flowing streambed and native aquatic life is often not suited for the shift (MacCarter, 2001). In the Colorado River, the construction of upstream dams threatened the Colorado pikeminnow, a fish adapted to warmer rivers, with changes to flow regimes and decreased temperatures (MacCarter, 2001) (Poff et al., 2012). The Colorado pikeminnow is now listed as endangered on federal and Arizona State endangered species lists and is considered essentially extinct in the state of Arizona (Magaña & Rinne, 2002). Agriculture can lead to the pollution of streams and bodies of water through nutrient runoff from water-soluble chemical fertilizers (World Resources Institute, 2017). Pollution from excess nutrients in waterways leads to eutrophication, a process which creates aquatic dead zones through oxygen depletion and algal blooms (World Resources Institute, 2017).

Cultural disconnect plagues the conversation around the environmental impacts of livestock grazing partly because the image of the Western cowboy supersedes any criticism of grazing practices (Krueper, 1996). Open rangelands of grazed plain have replaced what was once native grassland both in reality and in the American psyche. Separate from the ethical problems associated with livestock production, open grazing can adversely affect ecosystems and plant communities of wide varieties (Milchunas, 2006). For example, grazing negatively impacts the saguaro cactus, an iconic plant equal to the cowboy in Western symbolism (Hall et al., 2005). Livestock can trample saguaro seedlings, consume nurse plants that young saguaros need for

shade, and eat young established saguaros (Hall et al., 2005). Though saguaros exist in the upland of the transition zone outside of riparian areas, they are a strong example of the widespread impacts of grazing on plant communities.

Historically, lowland ecosystems of the Southwest evolved without heavy grazers (Krueper, 1996). Ungulates such as mule deer and pronghorn exist within these ecosystems but do not consume in patterns large enough to allow plants to develop resilience to grazing (Krueper, 1996). It was not until several generations after Spanish missionaries introduced livestock that grazing became a regular practice (Krueper, 1996). In 1694, roughly 100,000 cattle were grazing the San Pedro and Bavispe Rivers and headwaters (Krueper, 1996). The continuous growth of livestock production to the present day has had a tremendous impact. Krueper (1996) quotes Wuerthner (1994), "Agriculture - both livestock production and farming - rather than being compatible with environmental protection has had a far greater impact on the western landscape than all the subdivisions, malls, highways, and urban centers combined" (Krueper, 1996).

The effects of livestock grazing on riparian areas for over 300 years have all but eradicated any example of what a healthy and un-grazed riparian area might look like in the American Southwest (Krueper, 1996). Native shrubs and trees of riparian habitats are not suited for continuous grazing. Grazing pressures promote the lateral growth of branches on young trees and shrubs, both weakening them and altering their usefulness for wildlife species that are adapted to ecosystems of a mature vegetative state (Krueper, 1996). Heavy grazing removes vegetation from riverways, reducing ecologically important native vegetation and altering stream bed retention (Milchunas, 2006). Trampling of vegetation in riparian areas by livestock can expose soils to a risk of erosion (Krueper, 1996). Erosion is a secondary effect of livestock grazing that can lead to the uprooting of cottonwood trees during flood events and the freeing of alluvium (Milchunas, 2006). Erosion from rangelands upstream can cause sediment and runoff to collect in riparian settings (Krueper, 1996). Removal of native plant species and disturbances like

erosion can provide a favorable environment for invasive plant species (Krueper, 1996). In Southwestern riparian ecosystems, native plant species are frequently replaced by *Elaeagnus angustifolia*, commonly referred to as Russian olive and Tamarix, or saltcedar (Krueper, 1996). These non-native species do not provide the same habitat benefits for riparian fauna as they are less productive in their ecological function (Krueper, 1996).

Grazing of plants in riparian areas also contributes to the decline of animal inhabitants (Krueper, 1996). Higher levels of silt in streams due to grazing decrease habitat viability for native fish species by raising temperatures and decreasing oxygen levels (Krueper, 1996). Small mammals that rely on the dense vegetative conditions of riparian areas decrease in species richness in areas of high grazing (Krueper, 1996). Further, avian, invertebrates, amphibians, and reptiles all show reduced numbers and lack of diversity in grazed areas as their forage and shelter opportunities are reduced (Krueper, 1996).

Restoration efforts of ecosystems can only go so far if the root problem continues to persist. Before river cleanup can occur, the source of pollution needs to be addressed. There is a tendency in environmentalism to skip the first step. Why begin to cleanse the oceans of plastic if we continue to produce and use disposable plastics each day? For riparian ecosystems, protective policies must halt any further degradation. Riparian areas are valuable, and perform important functions to both surrounding ecosystems and human culture (Nania, n.d.) (University of Arizona, 2006). As riparian areas house more ecological diversity relative to surrounding areas and are responsible for maintaining the health of aquatic environments (Poff et al., 2012), they should be the focus of policy, protection, and restoration efforts. With the protection of riparian areas, surrounding ecosystems will benefit as well, as riparian systems are the heart of the American West.

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