Threats to Western United States Riparian Ecosystems: A Bibliography

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Abstract

This bibliography is a compendium of state-of-knowledge publications about the threats affecting western U.S. riparian ecosystems and is a companion to the website: http://www.rmrs.nau.edu/awa/ripthreatbib/. The website contains abstracts and access to many of the publications via PDFs, or it directs the readers to websites where PDFs of the publication can be viewed or obtained. The bibliography is ordered alphabetically and the type of threats discussed in each publication is highlighted. These threats include agriculture, climate change, dam construction, disease, drought, invasive species, fire, floods, flow regulation, forest harvesting, grazing, groundwater depletion, insects, mining, recreation, roads, water diversions, urbanization, and water quality.

Keywords: ecosystem, riparian, soil, water, watersheds, hydrology, threats, vegetation, wildlife, drought, floods, grazing, invasive plants

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Cover: *Rocky Mountain Station scientists and technicians working with White Mountain—Fort Apache Nation personnel in evaluating the physical conditions of streams in high elevation riparian areas in the White Mountains, Arizona.*

Summary

In the western United States, riparian ecosystems occupy a small percentage of the landscape (<2%), but they provide essential ecological functions for both human and biotic populations. Despite their small portion of the landscape, western riparian ecosystems provide habitat for about one-third of the plant species. In arid regions like the Southwest and the Great Basin, about 60% of all vertebrate species and 70% of all threatened and endangered species are riparian obligates. This bibliography is a compendium of 480 state-of- knowledge publications about the threats affecting western U.S.A. riparian ecosystems and it is a companion to the website: http://www.rmrs.nau.edu/awa/ripthreatbib/. The website contains Adobe Acrobat PDFs of the publications or it directs readers to journal websites where the PDFs can be downloaded, read, or ordered. This bibliography can be obtained as a hard copy or downloaded as an electronic version from the Rocky MountainResearch Station's Publications website: http://www.fs.fed.us/rm/publications/.

The bibliography presents publications on a range of riparian threats elucidated by Obedzinski and others (2001) and Theobald and others (2010). The topics include agriculture, climate change, dam construction, disease, drought, invasive species, fire, floods, flow regulation, forest harvesting, grazing, groundwater depletion, insects, mining, recreation, roads, water diversions, urbanization, and water quality. Most of the bibliographic entries deal with three or more threats and are listed as multiple threats. The two topics with the most references are grazing and invasive species.

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Introduction

Riparian ecosystems serve critical ecological functions in all ecotones throughout the world. In the western United States, many components of these keystone ecosystems are and have been in decline since European settlement (Obedzinski and others 2001). This bibliography is a compilation of available research results, technical, position and policy papers published between 1938 and 2010 on the threats posed to riparian ecosystems. Over the course of two-thirds of a century, scientists and policy makers have publicly discussed the causes of this constant decline.

The threats identified herein range from agricultural development, climatic changes, dam construction, increases in insect and disease attacks, drought, fire, floods, flow regulation, forest harvesting, improperly managed grazing activities, groundwater depletion, invasion of exotic species, mining, recreation, roads, water diversion, urbanization and degradation in water quality.

While the majority of the papers listed in this bibliography focus on one specific riparian threat, there are several articles that examine the importance of interactions among various factors in causing the decline. Some papers also clarify issues that need to be addressed in order to restore and maintain sustainable riparian ecosystems in the western United States, including the function of vegetation, hydrologic conditions, riparian zone structure, landscape features, geomorphology and management objectives.

Riparian Ecosystems in the Western United States

In the western United States, riparian ecosystems (fig. 1) occupy a small percentage of the landscape, but they provide essential ecological functions for both human and biotic populations (figs. 2 and 3). While riparian ecosystems occur on less than 2% of the total land area in the West (Svejcar 1997a), they provide habitat for about one-third of the plant species. In the arid Southwest and similar arid regions, about 60% of all vertebrate species (Obedzinski and others 2001) and 70% of all threatened and endangered species are riparian obligates (Johnson 1989). These ecosystems are not only unique because they have high species diversity and densities as well as high productivity, but they also allow for continuous interactions to occur between riparian, aquatic, and upland terrestrial ecosystems through exchange of energy, nutrients and species (Johnson and McCormick 1978). Riparian ecosystems are systems with a high water table because of proximity to an aquatic ecosystem or subsurface water and have distinct vegetation and soil characteristics. Aridity, topographic relief and presence

Figure 1—Gunnison River, Colorado (photo by Lisa Lynch, National Park Service).

Figure 2—Rio Grande River, New Mexico (photo courtesy of http://artsblog.freedomblogging.com/).

Figure 4—Colorado River, Arizona (photo by Daniel G. Neary, USDA Forest Service).

Figure 3—Gila River, New Mexico (photo by Daniel G. Neary, USDA Forest Service).

Figure 5—Yellowstone River, Wyoming (photo courtesy of http://wallpaper-s.org/).

of depositional soils most strongly influence the extent of high water tables and associated riparian ecosystems (Johnson and McCormick 1978). Even though riparian zones are not easily delineated, they are composed of mosaics of landforms, communities and environments within the larger landscape (Gregory and others 1991).

Riparian zones range in width from a few to hundreds of meters. Large rivers such as the Colorado can have riparian zones that are narrow (fig. 4) or wide in the case of the Yellowstone River, depending on the geomorphology of the fluvial system (fig. 5). They can be wooded banks of rivers in the Pacific Northwest (fig. 6) (Obedzinki and others 2001). They are found along ephemeral stream channels, such as in southwestern

Figure 6—Spanish Creek, North Fork, Feather River, California (photo courtesy of Plumas National Forest).

arroyos that carry water only during rain or snowmelt events or along perennial streams and flood plains with dense vegetation. This vegetation can vary from aquatic graminoid-sedge wet meadows (fig. 7) to extensive conifer forests (fig. 8). Riparian ecosystems provide an enormous service to watershed function because of their ability to filter out large quantities of sediments, nutrients, pesticides, animal wastes, and other non-point source pollution (Baker and others 2004). Hence, the health of such an ecosystem is usually measured in terms of watershed level function. Riparian vegetation also influences light penetration, air and water temperatures, and trophic interactions such as the transition between aquatic and terrestrial zones (figs.8 and 9). Large woody debris and litter associated with riparian vegetation are often necessary for productive fish habitats (fig. 8) and influence the physical, chemical and biotic characteristic of riparian and instream ecosystems (Naiman and Decamps 1997).

Figure 7—Ord Creek, White River headwaters, Arizona (photo by Alvin Medina, USDA Forest Service).

Figure 9—West Fork, Black River, Arizona (photo by Alvin Medina, USDA Forest Service).

Figure 8—White River, Arizona (photo by Alvin Medina)..

Figure 10—Cache La Poudre River, Colorado (photo courtesy of http:// www.wallpaperdave.com/poudre.htm).

However, in some riparian ecosystems, herbaceous plants provide the functions supplied by woody plants in other locations (fig. 7) (Medina 1996).

Riparian areas in the western United States attract a lot of attention from the human population in the region and across the country because of their scenic beauty, valuable resources and recreation opportunities (figs. 10 and 11). However, human use of riparian ecosystems and management of surrounding uplands have produced a number of threats to their sustainability (Stromberg and others 2004). The National Academy of Science's synthesis of the functions and management strategies for national riparian areas brought out several important points relative to threats to riparian ecosystem sustainability (National Academy of Science 2002). The Academy pointed out that historical and current land use has affected the hydrologic, geomorphic, and biological structures of many riparian areas in the United States. In addition, global climate change processes are likely to aggravate threats to and stresses on riparian ecosystems rather than ameliorate them. The Academy acknowledged that most human development and land-use activities have cumulative effects on riparian ecosystems, but those impacts are rarely considered during land-use planning or management. Several areas of concern were noted relative to potential threats to riparian areas. Assessments of the health of riparian ecosystems are few in number and have been rather localized than regional or national in scope (fig. 12). More importantly, the National Academy of Science concluded that disturbed riparian ecosystems are quite resilient, can be restored and managed to maintain many of their functions and ecosystem services. However, they are not immune to the impacts of poor management and abuse of surrounding landscapes.

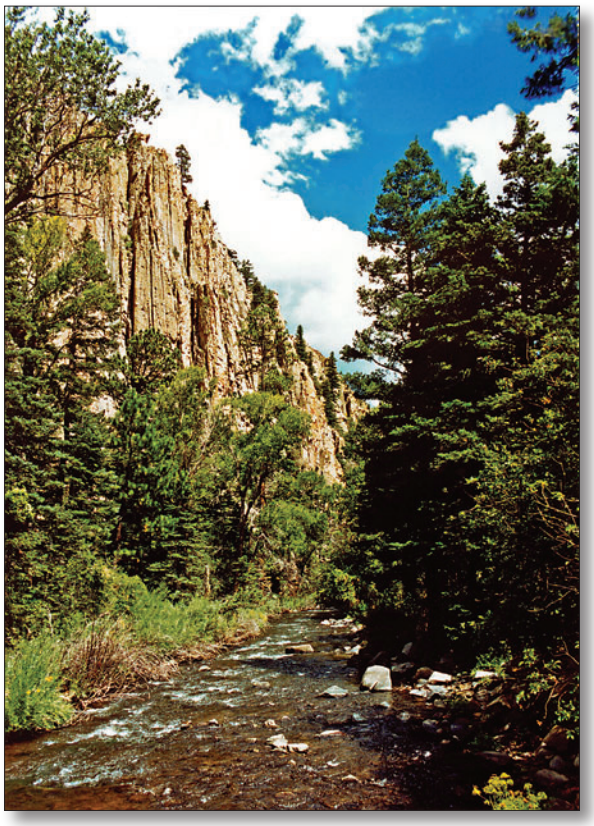

Figure 11—Cimarron River, New Mexico (photo courtesy of http:// www.flickr.com/photos/ stevenm_61/299271362/).

Figure 12—Verde River, Arizona, geomorphic, vegetation, and fish biota survey on the Prescott National Forest by the USDA Forest Service, Rocky Mountain Research Station (photo by Alvin Medina, USDA Forest Service).

Riparian Ecosystem Threats

Riparian Ecosystem Threats

Riparian areas are complex, diverse and constantly changing because of the highly dynamic fluvial systems in which they occur (Svejcar 1997a; Karr 1999). Understanding and managing riparian systems requires recognition of the role of disturbance and the evolutionary experience of riparian organism within the context of regional ecosystems. Like streamflow regimes and hydroclimate, riparian ecosystems exhibit local and regional distinctions and have been subjected to numerous and wide-scale disturbances by human occupation of the western North American landscape (Svejcar 1997b). Land managers must be able to understand and assess the following dimensions of disturbance: (1) type (abiotic, biotic or interactive); (2) regime (intensity, frequency, spatial scale, temporal scales relative to annual or life cycles); (3) ecological/physical system (hydrologic regime, geomorphic type, landscapes, populations, taxa etc.); and (4) regional/local context (within, adjacent to or encompassing riparian zones; Karr 1999).Short-term disturbances in riparian ecosystems are relatively easy to comprehend and observe (Svejcar 1997b). However, a short-term view can bias the observer's perception of the real dynamic state of a riparian ecosystem. The 100-year flood that "surprises" humans is nothing more than another creative disturbance in the long evolution of a riparian zone. Long-term disturbances, particularly those out of the current observational and historical range, may confuse any interpretation of the dynamic state of riparian ecosystems and the real magnitude of observed disturbance. For example, streams and riparian zones in the Great Basin are still adjusting to the drying up of late Pleistocene lakes and consequent lowering of base levels (Chambers 2008a). Streams and their riparian zones in the Southwest have had to respond to the disturbances of four major sequences of aggradation and degradation at intervals of 150 to 400 years over the past 2,100 years (Baker and others 2004).

Agriculture

Riparian ecosystems provided areas for agriculture for Native Americans before the arrival of European settlers (National Academy of Science 2002). With the settlement of the West in the latter half of the 19th Century, riparian areas were extensively developed and altered. This continues today along smaller rivers like the Verde River (fig. 12) in Arizona, but also along larger rivers with broad alluvial plains like the lower Colorado River in Arizona and California, the Sacramento River in California and the Columbia River in Oregon and Washington. Diversion of rivers and groundwater pumping in alluvial riparian plains for agriculture irrigation has contributed to water quality problems and groundwater depletion (Johnson and Riley 1984; Johnson and Haight 1984; National Academy of Science 2002). In the Southwest, salinization of tributaries and the main stem reaches of the Colorado River has been a major water quality problem.

Grazing is an agricultural practice that was concentrated in riparian areas because of the abundance of water and forage. It has had a significant impact on western riparian ecosystems (Kaufmann and Krueger 1984). Because of this, grazing is identified as a separate topic in this bibliography. However, grazing in western riparian zones is not confined to domestic livestock. Native ungulates, such as deer and elk, have had significant impacts on riparian vegetation and soils (Medina 1996; Neary and Medina 1996).

Climate Change

Weather patterns in western North America are normally characterized by periodic wet and dry periods, but climate changes in the future are likely to have more profound impacts (Chambers and Pellant 2008). The overall climate can periodically increase or decrease riparian stress, depending on the degree of variability and sensitivity of the plant or animal species. Alterations in weather patterns due to global climatic processes such as El Nino and La Nina have created significantly drier or wetter conditions historically (Risser 1991).

These climatic factors may predispose some species to the debilitating effects of other factors (insects, diseases, air pollutants, fire, mechanical injury, etc.), while coincidentally improving conditions for other species. For example, during dry periods, some grass species may begin to colonize sites previously dominated by moist-site species such as cottonwood (*Populus* spp.) and willow (*Salix* spp.). Johnson and others (1976) identified the importance of fresh alluvium for the establishment of pioneer species such as cottonwood (*Populus* spp.) and willow (*Salix* spp.). If this alluvial development is prevented by drier weather patterns, then species better adapted to non-disturbance, such as ash (*Fraxinus* spp.), boxelder (*Acer negundo*) or oak (*Quercus* spp.), might begin to dominate.

Climate change can influence riparian ecosystems due to the reliance of these systems on the presence of water

(Naiman and others 2002). Excessive water (floods) or insufficient flows (drought) due to climate change can affect both the biological and physical compositions of riparian areas. Both of these topics are identified as separate riparian threats in this bibliography (Dixon and others 2009). Barnett and others (2008) attributed many of the observed changes affecting riparian ecosystems, such as in river flow, snow packs, temperature, etc., to human activities. Future climate changes will certainly produce vegetation shifts (Abrahams and others 1995; Chambers and Pellant 2008; Huxman and Scott 2007) that may or may not be mitigated with restoration techniques (Seavy and others 2009).

Dam Construction

Construction of a dam in Montana reduced the magnitude and intensity of floods to the point that cottonwood density decreased significantly over a 45-year period (Bradley and Smith 1986). In this case, even though recruitment of cottonwood seedlings continues to occur, survival is low. The problem is that not enough seedlings are growing in the critical zone. This zone needs to be sufficiently above water level to ensure rooting before high water disturbs seedling establishment. It must also be near enough to the surface water table to draw sufficient moisture to survive dry periods. Rood and others (1995) found similar results with dam construction on rivers in southern Alberta.

Hadley and Emmett (1998) found the opposite to be true with dam construction on a tributary of the South Platte River. A dramatic shift in the riparian plants from sparse grasses to dense woody vegetation occurred after dam construction. This rapid change was linked to channel scour, sediment deposition declines, fewer scouring peakflows that damaged woody plants, and an increase in dry season low flows.

The important effect of water diversion is the resultant change in the hydrologic regime and geomorphic conditions. In some parts of the West, riparian woody vegetation is more abundant now due to human-induced disturbances than in pre-European times (Rood and others 2007). Thus, some declines in woody riparian plants currently observed in the western United States can actually be resilience in the riparian ecosystem exhibiting slow recovery to a natural dynamic state. In evaluating the impact of riparian threats, it is imperative to fully understand the nature, dynamics, and trends of past disturbances.

Diseases and Insects

Although a large number of insect species are associated with riparian hardwoods in the western United States (Rogers 1996), the level of threat to riparian areas presented by various insects is largely undocumented (Obedzinski and others 2001). Most insect studies have been conducted in upland landscapes and usually concern large-scale insect outbreaks, such as the western spruce budworm and a large number of bark beetles that impacted western North American forests. The overall effect of insects within riparian zones appears to be much more subtle.

Even though many diseases affect riparian hardwood species in the West (Obedzinski and others 2001), little is known about the influence of disease processes on riparian vegetation. Similar to insects, most of our current knowledge of disease impacts in riparian ecosystems is inferred from research conducted in uplands. Diseases are primarily inciting factors because they tend to weaken plants rather than kill them outright. This weakening process makes riparian woody plants more susceptible to other biotic or abiotic factors. An example provided by Obedzinski and others (2001) is infection by true mistletoe (*Phoradendron macrophyllum*) in Arizona and New Mexico, which results in a loss of vigor (and occasionally death) of riparian species such as cottonwood, ash, sycamore (*Platanus* spp) and walnut (*Juglans* spp.). Invasive species bring new levels of threat to riparian vegetation by predisposing vegetation, especially woody plants, to secondary pathogens or to environmental stress. Disease levels can be indicators of threats and serve as an indicator of stress. With increases in disease levels following stress, trees become highly susceptible to insects, disease-causing organisms, and drought (Obedzinski and others 2001).

Drought

Drought is a major feature of climate change. A good number of the publications listed under climate change address this topic. Drought creates stress by reducing the ability of plants to photosynthesize and by limiting the moisture necessary for germination or the seasonal flooding required by flood-adapted species such as cottonwood (Obedzinski and others 2001). Kranjcec and others (1998) found that groundwater level declines and the lack of seasonal flooding had serious effects on cottonwood reproduction and establishment. Drought also

can influence native riparian species because they cannot compete with exotic species better adapted to drier conditions and minimal flooding. Cleverly and others (1997) and Stromberg and others (2007a) noted that summer flooding, no flooding, or reduced or altered water tables enabled tamarisk invasion of cottonwood-willow systems in Arizona.

Fire

The role of fire in the dynamics of riparian zones is poorly understood (Dwire and Kaufmann 2003). Riparian areas along the Gila River (fig. 3) in the Southwest periodically burned during dry periods (Baker and others 2004). In the Great Plains, tree-dominated riparian woodlands may be somewhat limited by fire (Boldt and others 1978). Fire can also affect germination and establishment of many obligate riparian tree species. Aspen seedling establishment has been observed to be greatest in riparian zones that had burned to mineral soil. Fires have a larger effect on shaping the ecological characteristics of riparian zones than was believed in the past (Petit and Naiman 2007).

Some past, as well as current research, has been exploring relationships among native and exotic plants and fire. For example, Busch and Smith (1995) found that tamarisk had a competitive advantage in water uptake over willow coppice sprouts on burned sites in the Southwest. Accumulation of flammable tamarisk leaf litter also may contribute to the occurrence of episodic fires that destroy native tree species such as willows (Smith and others 2009b).

Wildland fires can affect the amount of sediment that reaches streams, alter the loadings of coarse woody debris into riparian areas, and can significantly affect the vigor and type of riparian vegetation (Baker and others 2004). Prescribed fires and wildfires of low-to-moderate severity usually do not cause much post-fire sedimentation. By contrast, severe fires often produce enough sediment to overload the transport capacity of a stream. While this can provide ecological benefits for aquatic habitats in the short term, that same debris can cause long-term disruptions of fluvial, sediment, and biological processes.

Floods

Floods are major geomorphic forces in most western North American streams. Riparian ecosystems characterized by episodic, high volume, high velocity storm flows produce major shifts in woody riparian vegetation distribution and abundance (Baker and others 2004). Trees established in floodplains between major flows can be scoured out by high velocity flows and eliminated from near-channel terraces. This process is a function of the particular fluvial dynamics and not necessarily human activities. Geomorphology aggravates this situation when stormflows become confined within narrow channels by canyon walls. In the upper Verde River of Arizona, peak flood flows are a threat to fish populations, but they are also particularly important for establishing fish habitat (Rinne 1993).

Flow Regulation

One of the consequences of dam construction that provides both a threat and a benefit to riparian ecosystems is flow regulation. Dams have the effect of reducing peakflows for increased water storage and increasing or decreasing low baseflows. These changes in flow regime can have a substantial affect on both riparian plants and aquatic biota. Crawford and others (1996) and Groenveld and Griepentrog (1985) reported declines in riparian vegetation in flow regulated rivers. Beauchamp and Stromberg (2007) measured no significant changes in *Populus* spp. and *Salix* spp. stands on the Verde River of Arizona due to flow regulation, but *Tamarix* establishment increased. Beauchamp and others (2006) noted marked declines in herbaceous species richness and abundance due to flow regulation. Fluctuating flows produced by flow regulation for electricity generation and irrigation have been known to reduce periphyton density in rivers (Benenati and others 1998).

Forest Harvesting

Native Americans relied heavily on trees, shrubs, and herbaceous plants in riparian woodlands. Settlement of the West in the 19th Century resulted in removal of woody riparian vegetation and the decline of some of these ecosystems. Sands and Howe (1977) indicated that there were about 775,000 ac of riparian woodlands in California in the first half of the 19th Century. By the end of that Century, these woodlands had been reduced significantly by use of trees for fuel wood, fence posts, and building materials as well as by converting land to agriculture. By 1977, only 12,000 ac of the 19th Century riparian woodlands remained intact.

A similar sort of reduction in riparian woodlands of the Southwest occurred to harvesting of riparian forests.

Forest harvesting combined with grazing, conversions to agriculture, and water regulation reduced riparian woody vegetation to only 5 percent of what was originally found at the beginning of the western settlement (Johnson and Haight 1984). Similar situations occurred in the northern Black Hills and the Pacific Northwest.

Logging affects western riparian ecosystems through tree falling, log skidding, road construction, and direct removal of vegetation (DeBano and Schmidt 1989a,b). The first three factors compact and disturb soil, which increases erosion, depresses growth, and further stresses residual vegetation. Removal of vegetation can alter thermal regimes, increase soil loss, diminish ecological characteristics such as structural diversity, alter species composition, and improve site conditions for invasions by non-native plants and other biota.

Grazing

Most of the publications in this bibliography that address a single threat discuss grazing. Past overgrazing by livestock certainly raised the level of threats to western United States riparian ecosystems and exacerbated their decline. However, as livestock numbers are being reduced across the West to balance utilization with productivity, expanding populations of native ungulates, particularly elk (*Cervus elaphus*), have raised the potential to cause significant riparian impacts. Ecological impact concerns have been identified in four areas (Kauffman 1988): (1) soil compaction; (2) herbage removal; (3) physical damage to plants; and (4) changes in fluvial processes that may eliminate germination sites for woody vegetation.

Excessive trampling by ungulates' hooves produces compaction that degrades soil aggregates, reduces associated soil pore space, and results in reduced plant vigor and growth (Elmore and Kauffman 1994; Kauffman and others 1983a,b). This situation decreases infiltration rates, increases surface runoff and erosion, and decreases the water status of plants (Kauffman and Kreuger 1984). By contrast, limited hoof action can assist the recovery of disturbed streambanks. It results in more microsites for seed germination and reduces the angle-of-repose of greatly incised streambanks. Plants will not colonize vertical banks of incised channels, but will quickly become established when streambanks are lowered to angles of 30-60 degrees (Baker and others 2004).

Herbage utilization by grazers, domestic or wild, can alter the ecological character of vegetation by altering structure and species composition (Kauffman and Kreuger 1984). Generally, this change occurs through the selective grazing habits, distribution and intensity of different types of herbivores, and the sensitivity of certain plant species to animal traffic and feeding. Kauffman and Kreuger (1984) noted that riparian overgrazing and site degradation favored the replacement of native bunch grasses with Kentucky bluegrass (*Poa pratensis*). In many locations, the most important cause for unsuccessful riparian plant reproduction was grazing and trampling by domestic livestock (Ehrhart and Hansen 1997). Grazing of cottonwood seedlings was reported to be a major factor limiting regeneration along a southern Arizona creek (Glinski 1977). In Yellowstone National Park, a 95 percent decline of tall willows (*S. bebbiana*, *S. boothii*, *S. lutea*, and *S. geyeriana*) and a virtual elimination of willow seed production was due to repeated elk browsing (Kay and Chadde 1991). Despite substantial decreases in riparian grazing by livestock, large increases in the number of elk in the Southwest in the latter half of the 20th Century have substantially altered the ecological characteristics of riparian vegetation (Clary and Kruse 2004).

Grazing has been implicated in significant stream channel incision during the past century (Trimble and Mendel 1995; Neary and Medina 1996). Cattle, sheep, and elk all have contributed substantially to geomorphic alterations of riparian ecosystems (Medina 1996). Climate changes in the past century have also resulted in strong fluvial degradations and will certainly do more in the current century (Chambers and Pellant 2008). Grazing disrupts aggradation processes in riparian ecosystems through the cumulative effect of herbivory and alteration of the vegetation and soil matrix by hoof action (Neary and Medina 1996). Weakening of streambanks and disruption of substrates that armor channel bottoms precipitate channel incisions. Eventually, channels lose their riffle areas, streams migrate laterally, pools shallow out, water tables lower, and riparian vegetation composition shifts from hydric to more mesic species.

Groundwater Depletion

Groundwater depletion is a function of consumptive use by urban and agricultural users, flow regulation, and dam construction. These alterations of flow regimes have markedly lowered groundwater levels in some areas. Groundwater is important to riparian vegetation during periods of drought or in areas of low seasonal precipitation (Groeneveld and Griepentrog 1985; Stromberg and others 1992). Stress on mesquite woodlands increased with increasing groundwater withdrawal from an ephemeral creek in Arizona (Stromberg and others

1992) and elsewhere in the Southwest (Stromberg and others 2004). Although summer rains and seasonal high flows temporarily reduced water stress, the effects of declining water tables usually are not mitigated and ultimately lead to continued stress and riparian ecosystem declines.

Invasive Species

Invasive species are a major issue in any assessment of threats to riparian ecosystems. Russian-olive (*Elaeagnus angustifolia*), a native of Europe and western Asia, and tamarisk (*Tamarix chinensis*), first introduced into the United States in the early 1800s from Europe, are woody species of concern because of their ability to colonize riparian sites and exclude native species (Howe and Knopf 1991). Obedzinski and others (2001) pointed out that Russian-olive and tamarisk have invaded many sites because: (1) a decrease in the number of flooding events, due to dam construction and flow regulation, as described above; and (2) the life history of the species (Horton 1977). Tamarisk and Russian-olive negatively affect native riparian species germination and establishment in three ways: (1) the exotic species have a longer period to exploit suitable germinating conditions; (2) shading by exotics minimizes the potential for successful cottonwood regeneration; and (3) the exotics are better able to compete for shade and limited moisture (Howe and Knopf 1991) and to tolerate drought (Cleverly and others 1997).

Coupled with its ability to increase soil salt concentrations through autogenic processes, tamarisk has a high salt tolerance that gives it a competitive advantage over many native species (Stromberg and others 2004, 2007b). Tamarisk combines fast growth in wet years with extreme tolerance of water and heat stress (Cleverly and others 1997). Reduction in streamflow by climate change, flow regulation, water diversion or dam construction further aggravates the tamarisk threat. In the Southwest, tamarisk has invaded many mesquite bosques and cottonwood/willow forests along the Rio Grande, the San Pedro, and the lower Colorado River (Stromberg and others 2007b). In Colorado, deteriorating riparian cottonwood stands are being replaced by Russian-olive, raising concerns about the future ecological status of these important riparian ecosystems. In New Mexico, the Rio Grande riparian system will likely be dominated by exotic species within the 21st century (Howe and Knopf 1991).

These shifts towards invasive woody plants in riparian ecosystems could significantly influence wildlife habitat. Reductions in riparian plant diversity, faunal-plant assemblages, uniqueness and critical habitat due to exotic invasions may not only influence terrestrial wildlife and vegetation, but also may affect macroinvertebrates within the stream. Changes in the quality of stream organic material inputs, together with alterations of the duration, intensity, and quality of light transmitted to the aquatic environment, can affect the quality, types and abundances of substrates for many micro- and macroinvertebrates (Obedzinski and others 2001). Further, in parts of the West, invasive fish, crustaceans, and mollusks are creating major threats as well (Rinne 1993).

Mining

Mining has had impacts on riparian ecosystems throughout western North America. The major threats to riparian ecosystems have come from forest harvesting to provide mine timbers and fuelwood for underground mines and flow and sediment alteration due to placer mining and sand and gravel operations (Andrews and others 1985; Heifner 1978). Mines have also had drastic impacts on water quality and altered fish habitats (Martin and Platts 1981).

Multiple Threats

Most of the entries in this bibliography have been classified as *multiple threats* because they deal with three or more threats working in combination on riparian areas. Indeed, most riparian ecosystems in the West are being influenced by a variety of stressors. In most cases it is difficult to clearly distinguish the individual impact of each threat. The effects of an obvious threat might mask those of a more insidious one. For instance, Medina (1996) and Neary and Medina (1996) found that threats to riparian meadows in the White Mountains of Arizona posed by easily observed and obvious cattle grazing were masking those already imposed by elk grazing and climate change. Thus riparian ecosystem threats need to be examined carefully to determine causes and effect. In some instances this may not be possible. However, land managers need to be aware of this in order to make good, science-based decisions.

Recreation

Recreationists are frequently drawn to riparian areas in the West because of the water resource and lush

vegetation (Winter 1993). Despite their value to land managers, recreation activities such as camping, hiking and off-road vehicles use are posing threats to some western riparian systems (Aitchison and others 1977; Johnson and Carothers 1982). Heavy recreational use can mimic damage caused by grazing, producing soil compaction and woody riparian vegetation deterioration by (1) reducing density and diversity of herbaceous plants; (2) lowering tree and shrub vigor; (3) eliminating seedlings and younger trees; (4) increasing tree diseases; (5) shifting plant species diversity in favor of disturbance-adapted species; and (6) increasing the potential for exotic species spread.

Recreation threats are often linked to other threats. Manning (1979) found that younger trees were reduced or eliminated on moderately or heavily used recreational sites. In areas of concentrated use, aspen stands have shown damage from a variety of recreation-related impacts including bark carving, soil trampling, firewood cutting, and removal of young suckers. The results of this damage are: (1) reduced or no advanced regeneration; (2) tree vigor reduction in all size classes; and (3) increased susceptibility to insect attack and disease spread. Changes in flow, climate change, and insect and disease stresses are commonly entwined with recreation impacts.

Roads

Roads are a special case of threats in that they are inciters for threats like recreation and urbanization and are usually associated with mining, forest harvesting, and agriculture (DeBano and Schmidt 1989; Hesseldenz 1984). While usually limited in extent, roads can be a new source of sediment or deliver petroleum-based pollutants into riparian ecosystems (Petrosky and Holubetz 1985; Stevens and others 2005).

Urbanization

While urbanization is a threat to minor streams located within the footprint of urban development, these threats are mostly noticed and addressed by land management agencies on major streams like the Colorado, Rio Grande, Columbia, Snake, Missouri, and Sacramento rivers. However, the associated threats produced by increased human presence in the West produce extensive and intensive impacts across the region (Stromberg and others 2004).

Water Diversion

Dams and irrigation diversion canals often associated with dams have significantly altered habitat for woody riparian vegetation in many parts of the West. Stromberg and others (2004, 2007a) surmised that the altering of water flows, especially by diversions, is among the greatest threats to Sonoran cottonwood-willow ecosystems. Rood and others (2005, 2007) rated river damming and associated water diversion right after livestock grazing and agriculture as primary causes of decline in cottonwood riparian ecosystems.

Water diversion is a special case of flow regulation. Many riparian species are sensitive to changes in the hydrologic regime that affects flooding periodicities and water table depth. Cottonwoods in particular have been significantly affected by water diversion. Like many Western riparian species, cottonwoods are adapted to spring flooding and high water tables. Water diversion has not only significantly reduced flooding events, but also has resulted in substantial lowering of riparian water tables to depths that prevent newly established woody plants like cottonwoods from obtaining moisture. In some cases, root systems of riparian tree species have not been able to grow fast enough to keep up with dropping water table levels (Groeneveld and Griepentrog 1985).

Water diversion and flow regulation also has allowed riparian systems to become dominated by exotic tree species such as Russian-olive and tamarisk, which out-compete species such as cottonwood and willow for available seedbeds. In the Southwest, primary, secondary, and tertiary tributaries of all major rivers have been affected by water diversions of some type. By the middle of the 20th Century, the effects of water diversion on the Gila-Salt-Verde River system were so great that less than 50 percent of their original length remained free flowing (Johnson and Haight 1984).

Water Quality

Water quality changes in streams, lakes, and ponds associated with riparian ecosystems are associated with other threats, chiefly agriculture, grazing, mining, fire, forest harvesting, urbanization, and recreation. While recreation and urbanization produce numerous, but localized non-point source pollution problems, agriculture, including livestock grazing, probably is the largest threat to riparian ecosystems due to nutrient release from fertilizers, bacteria associated with animal fecal material, and salinization

of irrigation return waters (Brown 1984; Mueller and Moody 1984). Mining is often (but not always) a point source of water pollution, as briefly addressed above.

Summary

This bibliography presents publications on a range of riparian threats elucidated by Obedzinski and others (2001) and Theobald and others (2010). The topics include agriculture, climate change, dam construction, disease, drought, invasive species, fire, floods, flow regulation, forest harvesting, grazing, groundwater depletion, insects, mining, recreation, roads, water diversions, urbanization, and water quality. Most of the bibliographic entries deal with three or more threats and are listed as *multiple threats*. The two topics with the most individual references are *grazing* and *invasive species*. In most cases, it is difficult to deal with isolated threats as most occur in combination with other threats. Land managers need to be aware of the multiple threats and their interactions in order to successfully manage riparian ecosystems in the western United States.

A periodically updated electronic version of this bibliography is available at the following web site: http://www.rmrs.nau.edu/awa/ripthreatbib/. The site contains an overview of the Southwest Watershed Science Team and their scientific endeavors including Streamside Management Zones, wildfires, prescribed fires, the Cascabel Watershed Study, Sierra Ancha Experimental Forest, the Upper Verde River, Laupahoehoe Experimental Forest in Hawaii, the Beaver Creek Experimental Watersheds, and the fire and fire surrogates study. A list of Team members, contact information, and publications is also provided.

Bibliography

1. Abrahams, A.D.; Parsons, A.J.; Wainwright, J. 1995. Effects of vegetation change on interrill runoff and erosion, Walnut Gulch, southern Arizona. Geomorphology. 13: 37-48.

Abstract: During the past 100 years, grassland has been replaced by shrubland in many parts of the American Southwest due to overgrazing, climate change or a combination thereof. The effects of this vegetation change on interrill runoff and erosion are investigated by performing field experiments on small and large runoff plots located on contemporary grassland and shrubland hillslopes in Walnut Gulch Experimental Watershed. The experiments indicate that the vegetation change causes runoff and erosion to increase in interrill areas by decreasing resistance to overland flow, decreasing runoff infiltration, increasing the spatial heterogeneity of the plant canopy, and possibly increasing the susceptibility of the soil to frost action. *GRAZING, CLIMATE CHANGE, WATER QUALITY*

2. Acuna, V.; Munoz, I.; Giorgi, A.; Omella, M.; Sabater, F.; Sabater, S. 2005. Drought and postdrought recovery cycles in an intermittent Mediterranean stream: structural and functional aspects. Journal of the North American Benthological Society. 24(4): 919–933.

Abstract: The effects of the intensity of seasonal droughts on stream ecosystems were studied in an intermittent forested stream in a Mediterranean climate. Macroinvertebrate community structure and stream ecosystem metabolism were measured during seasonal summer droughts in 2001, 2002, and 2003. Ecosystem metabolism was profoundly affected by stream intermittency. Organic matter that accumulated during the dry period enhanced ecosystem respiration during the post-drought recovery. Highest biotic diversity was found at low water levels as the stream dried and contracted. *DROUGHT*

3. Adams S.B.; Burnett, K.M.; Bission, P.; Harvey, B.; Nislow, K.H.; Rieman, B.E.; Rinne, J.N. 2009. The role of the Forest Service in aquatic invasive species research. In: Dix, M.E.; Britton, K., eds. A dynamic invasive species research vision: Opportunities and priorities 2009-29; Gen. Tech. Rep. WO-GTR-79/83. Washington, DC: U.S. Department of Agriculture, Forest Service, Research and Development; 55-66.

Abstract: The authors identify some key general research needs as well as areas in which the Forest Service is well positioned to contribute research that other organizations are not addressing. However, the authors believe a more formal process, bringing Forest Service aquatic and riparian scientists together with other biologists and stakeholders, is necessary to effectively identify and prioritize specific research needs. *INVASIVE SPECIES*

4. Aitchison, S.W. 1977. Some effects of a campground on breeding birds in Arizona. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 175-182.

Abstract: Over a 3-year period, breeding bird densities were found to be similar between a constructed campground and a relatively natural area when the campground was closed to campers. However, bird species composition differed between sites, the campground having relatively heavier bodied birds than the control area. Once the campground was opened for human use, the breeding bird population decreased in density and diversity. On the control site the population either remained the same or increased. *RECREATION*

5. Aitchison, S.W.; Carothers, S.W.; Johnson, R.R. 1977. Some ecological considerations associated with river recreation management. In: Proceedings of river recreation management and research symposium; 1977 January 24-27; Minneapolis, MN. Gen. Tech. Rep. NC-28. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 222-225.

Abstract: Drawing from an ecological study on the Colorado River, four river recreation management concerns are discussed: (1) river research vs. river management, their interrelationships and priorities; (2) extensive resource inventories, their role as indicators of environmental deterioration; (3) human impact, its identification and proposed mitigation; and (4) suggested guidelines for identifying unique and ecologically sensitive areas. Other environmental degradations not directly associated with human impact such as habitat destruction by wild asses are also discussed. *RECREATION, GRAZING*

6. Allen, D.R.; Marlow, C.B. 1991. Effects of cattle grazing on shoot population dynamics of beaked sedge. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L.; comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 89-91.

Abstract: To study the effect of cattle grazing on the number of new shoots produced by beaked sedge with the 1989 and 1990 growing seasons, 40 plots were protected and 40 plots were grazed by cattle in June and September each year. Preliminary analysis of monthly shoot production data indicates that the greatest difference between grazed and ungrazed plots was in July. Seasonal mortality on grazed and ungrazed plots was similar, although high rodent-caused mortality in the ungrazed plots may have masked the effects of cattle grazing. The study area lies along an upper reach of Cottonwood Creek in the Montana Agricultural Experiment Station's Red Bluff Research Ranch in southwestern Montana. *GRAZING*

7. Allred, M.D. 1993. Little Bear River hydrologic unit. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 359-363.

Abstract: This paper describes the Little Bear River project, the threats to the river, which include sedimentation and nonpoint source pollution, partly caused by livestock grazing and agriculture, land treatment and best management practices. It discusses public participation and scoping. *MULTIPLE THREATS*

8. American Fisheries Society: Western Division. 1982. The best management practices for the management and protection of western riparian streams. Alberta, Canada: Western Division of the American Fisheries Society. 45 p.

Abstract: This position paper presents the opinion of the WDAFS on the status of impacts on, and concern for western-aquatic-riparian habitats. It addresses seven primary impacts on riparian resources: livestock grazing, mining, water development and irrigation, road construction, agriculture, urbanization, and timber harvest. *MULTIPLE THREATS*

9. Ames, C.R. 1977.Wildlife conflicts in riparian management: Grazing. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A Symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 49-51.

Abstract: Grazing has a negative impact on riparian zones. These zones constitute a small but critically important part of the range resource. The riparian types in southern Arizona have increased from what they were 100 years ago. The increase has occurred through stream eutrophication and is most noticeable where the streams pass through the grassland type. Protection of the riparian type, where grazing is an established use, can only be effectively achieved though fencing. *GRAZING*

10. Amlin, N.M.; Rood, S.B. 2002. Comparative tolerances of riparian willows and cottonwoods to water-table decline. Wetlands. 22(2): 338-346.

Abstract: Cottonwoods (*Populus* sp.) and willows (*Salix* sp.) generally dominate riparian landscapes across western North America. To investigate their relative tolerances to water-table decline, rooted shoot cuttings (saplings) of two willows, and two cottonwoods, were grown in rhizopods, controlled growth devices that allow water-table manipulation. The willow and cottonwood saplings were similarly affected by abrupt water-table decline, but willow seedlings were slightly more vulnerable than cottonwood seedlings. *GROUNDWATER DEPLETION*

11. Anderson, B.W.; Ohmart, R.D. 1979. Riparian revegetation: An approach to mitigating for a disappearing habitat in the Southwest. In: Swanson, G.A., ed. The mitigation symposium: A national workshop on mitigating losses of fish and wildlife habitats. Gen. Tech. Rep. RM-65. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 481-487.

Abstract: This study tested the feasibility of riparian revegetation efforts along the Colorado River to mitigate habitat losses for operational enhancement. Using 6 years of plant

and vertebrate data on two 20 to 30-hectare plots, significant plant and animal correlations were developed through community models. These correlations led to the design of species compositions that would yield optimum wildlife values and aid in mitigating disappearing riparian habitat. *MULTIPLE THREATS*

12. Anderson, B.W.; Ohmart, R.D. 1982. Revegetation for wildlife enhancement along the lower Colorado River. Boulder, NV: U.S. Bureau of Reclamation, Lower Colorado Region. 215 p.

Abstract: The use of riparian vegetation by wildlife and the effect of rapidly disappearing habitat on species, mostly due to saltcedar, are discussed. The report is the result of a 2-year study using soil and salinity data of dredge spoil and refuge sites. The report investigates the effect of deep tillage, irrigation on growth distributions, and component analysis. Wildlife use and density are defined according to the study and a summary and synthesis is provided. *INVASIVE SPECIES*

13. Anderson, B.W.; Ohmart, R.D. 1985. Riparian revegetation as a mitigating process in stream and river restoration. In: Gore, J.A., ed. The restoration of rivers and streams. Boston: Butterworth Publishers: 41-80.

Abstract: This chapter summarizes the results of field studies of riparian habitats on the lower Colorado River and the efforts to use field-collected data to develop plant community designs that would house as many vertebrate species as possible and support high densities of wildlife. The authors present designs and methodologies that can be used in habitat improvement, mitigation, and operational enhancement in totally managed rivers systems where native revegetation has been curtailed or stopped. *MULTIPLE THREATS*

14. Anderson, B.W.; Higgins, A.; Ohmart, R.D. 1977. Avian use of saltcedar communities in the lower Colorado River Valley. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 128-136.

Abstract: Bird densities and bird species diversities in saltcedar stands of the lower Colorado River Valley were determined on a seasonal basis from May 1974 through February 1977. Comparisons were made between six saltcedar structural types. A method of determining the relative value of the communities, as well as the saltcedar structural types, based on density, bird species diversity, number of species, structural diversity, and size of census area is described. Results show the saltcedar community supported fewer birds than native communities, although tall, dense stands were valuable for nesting doves and rarer bird species in riparian communities along the lower Colorado River. *INVASIVE SPECIES*

15. Anderson, B.W.; Ohmart, R.D.; Allen, H.A., Jr. 1984. Riparian birds in the riparian/agriculture interface. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley and Los Angeles, CA: University of California Press: 30-36.

Abstract: The interface between riparian and agricultural systems supports relatively large number of bird species and individuals because it offers a variety of food and structural resources that are especially apparent in winter. The interface can be used to compensate effectively for loss of natural habitats by interspersing agricultural lands with native vegetation. *AGRICULTURE*

16. Anderson, J.W.; Beschta, R.L.; Boehne, P.L.; Bryson, D.; Gill, R.; Howes, S.; McIntosh, B.A.; Purser, M.D.; Rhodes, J.J.; Sedell, J.W.; Zakel, J. 1993. A comprehensive approach to restoring habitat conditions needed to protect threatened salmon species in a severely degraded river—The Upper Grande Ronde River anadromous fish habitat protection, restoration and monitoring plan. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 175-179.

Abstract: The Upper Grande Ronde River has undergone severe sedimentation caused by the cumulative effects of high levels of erosion generated from road construction, mining, logging, grazing, and wildfire. The Upper Grande Ronde River Plan was developed in response to several environmental and social issues and is summarized in this paper. *MULTIPLE THREATS*

17. Anderson, M.C. 2009. Livestock and elk grazing effects on stream morphology, brown trout population dynamics, movement and growth rate, Valles Caldera National Preserve, New Mexico. Masters Thesis. Las Cruces, NM: New Mexico State University. 173 p.

Abstract: Goals of this research were to assess changes in stream morphology and response of a brown trout population, to exclude cattle and elk from riparian areas, and to monitor spatial variability among individual and population level characteristics in brown trout to changing biotic and abiotic conditions. However, livestock and elk grazing had no impacts on stream morphology or brown trout populations and individual levels characteristics. *GRAZING*

18. Andrews, J.; Fishburn, E.; Frazier, B.; Johnson, R. 1985. North Fork John Day River habitat improvement: Annual report FY 1985. In: Natural Propagation and Habitat Enhancement, Volume I—Oregon. Project No. 84-8.

Portland, OR: U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife: 222-261.

Abstract: Gold dredging activities have changed the natural course and hydrology of the North Fork John Day River in Oregon. High flow channels were created by the gold dredging. To date, the anadromous fish rearing habitat in this portion of the river has not recovered from the impacts of this dredging. The overall project goal described by this report has been to increase the production of spring Chinook salmon. *MINING*

19. Anzinger D.; Radosevich, S.R. 2008. Fire and nonnative invasive plants in the Northwest coastal bioregion. In: Zouhar, K.; Kapler, J.; Sutherland, S.; Brooks, M.L., eds. Wildland fire in ecosystems: Fire and nonnative invasive pants. Gen. Tech. Rep. RMRS-GTR-42-vol. 6. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 197-224.

Abstract: This chapter discusses the relationship between fire (natural and prescribed) and nonnative plants species with major vegetation communities of the Northwest costal bioregion, including riparian forests. It specifically addresses the roles of fire in promoting nonnative species invasions, the effects of nonnative species on fire regimes, and usefulness of fire as a management tool for controlling nonnative species. *FIRE, INVASIVE SPECIES*

20. Armour, C. 1986. Impacts of present management on fisheries. In: Smits, J.H., ed. Management of riparian areas. Washington, DC: Public Lands Council: 37-38.

Abstract: This paper briefly discusses the impacts of riparian management in the mid-1980s and what research is needed to preserve functioning fisheries in the western United States. *MULTIPLE THREATS*

21. Athearn, F.J. 1988. Habitat in the past: Historical perspectives of riparian zones on the White River. In: Mutz, K.M.; Cooper, D.J.; Scott, M.L.; Miller, L.K. tech., coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium of the Rocky Mountain Chapter of the Society of Wetland Scientists; 1988 November 14-16; Denver CO: 73-75.

Abstract: This paper provides a brief description of how western riparian areas along the White River in Colorado have changed in the past 200 years. *MULTIPLE THREATS*

22. Bahre, C.J. 1991. A legacy of change: Historic human impact on vegetation in the Arizona Borderlands. Tucson, AZ: University of Arizona Press.

Abstract: This book examines historical land uses and the impact they have had on natural vegetation in southeastern Arizona. The author investigates livestock grazing, fire, fuelwood cutting, exotic plant introductions, agriculture, logging, and haying and shows how poorly understood the relationship between human activities and vegetation changes are. The most apparent directional changes, however, have been the introduction of exotic species and the removal of native vegetation for settlement purposes. *MULTIPLE THREATS*

23. Baker, M.B., Jr.; Ffolliott, P.F.; DeBano, L.F.; Neary, D.G., eds. 2004. Hydrology, ecology and management of riparian areas in the southwestern United States. Lewis Publishers: 408 p.

Abstract: The authors provide decision makers, land-use planners, land managers, technical experts, and other riparian stakeholders with state-of-the-art information for sustaining environmentally sound riparian areas. Some of the threats to riparian zones considered in the 18 chapters include invasive species, grazing, dam construction, flow alteration, drought, recreation, roads, forest harvesting, and urbanization. *MULTIPLE THREATS*

24. Barnett, T.P.; Pierce, D.W.; Hidalgo, H.G.; Bonfils, C.; Santer, B.D.; Das, T.; Bala, G.; Wood, A.W.; Nozawa, T.; Mirin, A.A.; Cayan, D.R.; Dettinger, M.D. 2008. Human-induced changes in the hydrology of the Western United States. Science. 2319: 1080-1083.

Abstract: The authors present a regional, multivariable climate change detection and attribution study, using a high-resolution hydrologic model forced by global climate models, focusing on the changes that have already affected this primarily arid region. The results show that up to 60% of the climate related trends of river flow, winter air temperature, and snow pack between 1950 and 1999 are human-induced. *CLIMATE CHANGE*

25. Barro, S.C.; Wohlgemuth, P.M.; Campbell, A.G. 1988. Post-fire interactions between riparian vegetation and channel morphology and the implications for stream channel rehabilitation choices. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990s; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 51-53.

Abstract: This study investigated post-fire interactions between riparian vegetation and channel morphology in the upper Santa Ynez River drainage basin. The intensity of the fire through the riparian area was indicated by the damage to trees and the understory. In addition to removing vegetation, the fire caused changes in soil characteristics, which have led to accelerated erosion on hillside slopes. *FIRE*

26. Barrows, C.W. 1993. Tamarisk control: II. A success story. Restoration and Management Notes. 11: 35-38.

Abstract: This paper describes a tamarisk control project in a heavily infested 10-hectare wetland in Riverside County,

California. The results have been encouraging and suggest, while complete and perpetual eradication of tamarisk is unlikely in most situations, control followed by restoration of historic vegetation is a viable option in many watersheds. *INVASIVE SPECIES*

27. Barry, W.J. 1984. Management and protection of riparian ecosystems in the state park system. In: Warner, R.E.; Hendrix, K.M. eds., California riparian systems: ecology, conservation, and productive management. Berkeley and Los Angeles, CA: University of California Press: 758-766.

Abstract: Preserving California's natural heritage is one of the California Department of Parks and Recreation's three primary missions. The general objectives of policies formulated for riparian ecosystems are to restore, protect, and maintain riparian ecosystems in as near a natural state as possible. This paper discusses the on- and off-site impacts with specific examples of resource management problems, policies, and programs. *RECREATION*

28. Bateman, H.L.; Chung-MacCoubrey, A.; Snell, H.L.; Finch, D.M. 2008. Abundance and species richness of snakes along the Middle Rio Grande riparian forest in New Mexico. Herpetological Conservation and Biology. 4: 1-8.

Abstract: This study provides basic information on trapping success, species richness, and capture rates for snakes inhabiting the bosque along the Middle Rio Grande in New Mexico. *MULTIPLE THREATS*

29. Bateman, H.L.; Harner, M.J.; Chung-MacCoubrey, A. 2008. Abundance and reproduction of toads (*Bufo*) along a regulated river in the southwestern United States: Importance of flooding in riparian ecosystems. Journal of Arid Environments. 72: 1613-1619.

Abstract: Abundance and size of toads were related to precipitation, river flow, and groundwater over 7 years along the Middle Rio Grande. Results demonstrated that small, managed floods can positively affect abundance of toads by providing off-channel, aquatic habitats along regulated rivers. *FLOW REGULATION*

30. Beauchamp, V.B.; Stromberg, J.C. 2007. Flow regulation of the Verde River, Arizona encourages *Tamarix* recruitment but has minimal effect on *Populus* and *Salix* stand density. Wetlands. 27: 381-389.

Abstract: This investigation compared *Populus*, *Salix*, and *Tamarix* stem density in 63 stands on unregulated and regulated reaches of the Verde River. Results from this study suggest that where major flooding still occurs in regulated reaches, or where managed flooding is an option, recruitment of *Populus* and *Salix* is possible at similar levels to unregulated reaches. *FLOW REGULATION, INVASIVE SPECIES*

31. Beauchamp, V.B.; Stromberg, J.C. 2008. Changes to herbaceous plant communities on a regulated desert river. River Research and Applications. 24: 754-770.

Abstract: This investigation examined differences in herbaceous species richness, abundance and composition in *Populus-Salix* stands along an unregulated and regulated reach of the Verde River in Arizona. It also contrasted flood inundation frequency and edaphic conditions (soil moisture, nutrients, and texture) between reaches and interpreted the vegetation difference in light of observed differences in environmental conditions. Results demonstrate that sediment transport within riparian corridors is important for maintenance of herbaceous communities and that restoration of flow regimes alone may be insufficient to restore herbaceous flora on some regulated reaches. *FLOW REGULATION*

32. Beauchamp, V.B.; Stromberg, J.C.; Stutz, J.C. 2005. Interactions between *Tamarix ramosissima* (Saltcedar), *Populus fremontii* (Cottonwood), and mycorrhizal fungi: Effects on seedling growth and plant species coexistence. Plant and Soil. 275: 221-231.

Abstract: Throughout the western United States, riparian forests dominated by *Populus* species are declining due to disruptions in natural flood cycles and groundwater levels by dams, groundwater pumping and water diversions. The regional decline of riparian gallery forests has occurred concomitantly with the spread of *Tamarix* (saltcedar) into riparian areas. Little is known about the composition and function of the mycorrhizal fungal community in riparian areas, or its importance in competitive interactions between *Populus fremontii*, a dominant tree in southwestern United States riparian forests that forms arbuscular and ectomycorrhizas, and *Tamarix*. The results of this study indicate that *Tamarix* is non-mycotrophic and that in this greenhouse experiment inoculation altered patterns of coexistence between *Populus* and *Tamarix*. *INVASIVE SPECIES*

33. Beauchamp, V.B.; Stromberg, J.C.; Stutz, J.C. 2006. Flow regulation has minimal influence on mycorrhizal fungi of a semi-arid floodplain ecosystem despite changes in hydrology, soils, and vegetation. Journal of Arid Environments. 68: 188-205.

Abstract: In this study, floodplain soil texture and chemistry, herbaceous cover and richness, and arbuscular mycorrhizal fungi (AMF) richness and colonization were compared between unregulated and regulated reaches of the Verde River, Arizona. Despite differences in floodplain soils characteristics, AMF colonization, richness, and community composition were similar between reaches. *FLOW REGULATION*

34. Behnke, R.J. 1978. Grazing and the riparian zone: Impacts on aquatic values. In: Graul, W.D.; Bissel, S.J., tech. coords. Lowland river and stream habitat in Colorado: A symposium; 1978 Oct 4-5. Greeley, CO: Wildlife Society and Colorado Audubon Council, Colorado Chapter: 126-132.

Abstract: Multiple use conflicts arise where grazing has long been a dominant use and other values have been neglected. Of special concern is the fact that livestock concentrate in riparian zones and this problem is particularly acute in arid and semi-arid regions where the most ubiquitous and significant damage occurs to riparian vegetation. *GRAZING*

35. Behnke, R.J.; Raleigh, R.F. 1978. Grazing and the riparian zone: Impact and management perspectives. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 263-267.

Abstract: Livestock overgrazing on riparian vegetation is magnified in arid and semi-arid regions. Typical stream habitat changes resulting from overgrazing of riparian vegetation, trampling of stream banks, and increased erosion include: widening and shallowing of the streambed, gradual stream channel trenching or braiding, silt degradation of spawning and invertebrate food producing areas, loss of streamside and instream cover, increased water temperatures and velocities, decreased terrestrial food inputs, and a 3-4 fold decrease in trout biomass in grazed versus ungrazed areas. Recent livestock/fisheries study results and livestock grazing management options to repair, maintain and protect riparian habitats are presented. *GRAZING*

36. Belsky, A.J.; Matzke, A.; Uselman, S. 1999. Survey of livestock influences on stream and riparian ecosystems in the Western United States. Journal of Soil and Water Conservation. 54: 419-431.

Abstract: This paper summarizes the major effects of livestock grazing on stream and riparian ecosystems in the arid West. The authors focused primarily on results from peer reviewed, experimental studies, and secondarily on comparative studies of grazed vs. naturally or historically protected areas. Results were summarized in tabular form. Livestock grazing was found to negatively affect water quality and seasonal quantity, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation, and aquatic and riparian wildlife. *GRAZING*

37. Belt, G.H.; O'Laughlin, J.; Merrill, T. 1992. Design of forest riparian buffer strips for the protection of water quality: Analysis of scientific literature. Report No. 8. Moscow, ID: University of Idaho, Idaho Forest, Wildlife and Range Policy Analysis Group. 35 p.

Abstract: This report identifies, evaluates and synthesizes research-based information relating riparian buffer strips to forest practices, water quality and fish habitat. This literature review suggests that scientists are at different stages in their understanding of the several important functions provided by buffer strips, which include temperature moderation, sediment filtration, and LOD recruitment. *MULTIPLE THREATS*

38. Benenati, P.L.; Shannon, J.P.; Blinn, D.W. 1998. Desiccation and recolonization of phytobenthos in a regulated desert river: Colorado River at Lees Ferry, Arizona, USA. Regulated Rivers. 14: 519-532.

Abstract: The daily and seasonal fluctuating flows characteristic of hydroelectric peaking power facilities can have detrimental effects on the growth and survival of downstream benthos. The operation of Glen Canyon Dam and the presence of Lake Powell have modified the Colorado River benthic food base in Grand Canyon since 1963. Prior to impoundment, production in the muddy Colorado River was driven primarily by allochthonous input, with occasional clear-water periods and limited algal growth. However, productivity has decreased in the varial zone owing to periodic atmospheric exposure resulting from fluctuating flows. The authors tested the recolonization of the phytobenthic community in the tailwaters of Glen Canyon Dam following long and short-term experimentally induced desiccation. The response of *Cladophora glomerata*, *Oscillatoria* spp., miscellaneous phytobenthos species, and periphyton was studied over 18 weeks using three treatments: (1) undisturbed control cobbles from the submerged zone; (2) cobbles desiccated and replaced into the submerged zone; and (3) cobbles desiccated and replaced into the varial zone. Periphyton density and compositional response resulting from these treatments were also examined. Recovery and maintenance of benthic resources are hindered by fluctuating flow regimes driven by electricity and irrigation requirements. Repeated desiccation of the phytobenthos has major effects on the bottom-up interactions in the Colorado River ecosystem. *FLOW REGULATION*

39. Bergthold, P.M. 1978. Arizona State Park's Natural Area Program. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 243-247.

Abstract: A Natural Area Program within Arizona State Parks identifies and registers important sites within the State. Over half of the identified Natural Areas contain riparian elements. Developing protective strategies, cooperating with land managing agencies, and public education show promise for maintaining an important southwestern resource. *MULTIPLE THREATS*

40. Beschta, R.L.; Bilby, R.E.; Brown, G.W.; Holtby, L.B.; Hofstra, T.D. 1989. Stream temperature and aquatic habitat: Fisheries and forestry interactions. In: Salo, E.O.; Cundy, T.W., eds. Streamside management: Forestry and fishery interactions. Institute of Forest Resources Contribution 57. Seattle, WA: University of Washington: 191-232.

Abstract: The temperature of water entering a forest stream system typically resembles that of the watershed's subsoil environment. Logging activities can initiate pronounced

temperature changes by the removal of forest vegetation along channels. Although direct mortality of fish is probably not a major concern throughout the Pacific Northwest when stream temperatures are altered by management activities, temperature changes can influence rates of egg development, rearing success, species competition, and other factors. *FOREST HARVESTING*

41. Betancourt, J.L. 1990. Tucson's Santa Cruz River and Arroyo Legacy. PhD. Dissertation. Tucson: University of Arizona. 239 p.

Abstract: Tucson's Santa Cruz River, often cited in the arroyo literature, offers a unique opportunity to chronicle the arroyo legacy and evaluate its causes. The study presented reconstructs both the physical and cultural circumstances of channel entrenchment along the Santa Cruz River. Primary data include newspaper accounts, notes and plants of General Land Office surveys, eyewitness accounts, legal depositions and repeat photography. *MULTIPLE THREATS*

42. Bilby, R.E. 1988. Interactions between aquatic and terrestrial systems. In: Raedeke, K.J., ed. Streamside management: Riparian wildlife and forestry interactions. Institute of Forest Resources Contribution 59. Seattle, WA: University of Washington: 13-30.

Abstract: The interactions between aquatic and terrestrial ecosystems must be considered in assessing the potential impacts of change in either. Although the type and magnitude of the interactions may vary from site to site, the linkages between the two systems are still largely responsible for the physical, chemical, and biotic characteristics of the riparian and aquatic habitats. For example, small streams are more severely affected by riparian vegetation than larger ones. *MULTIPLE THREATS*

43. Bisson, P.A.; Rieman, B.E.; Luce, C.; Hessburg, P.F.; Lee, D.C.; Kershner, J.L.; Reevfes, G.H.; Gresswell, R.E. 2003. Fire and aquatic ecosystems of the western U.S.A.: Current knowledge and key questions. Forest Ecology and Management. 178: 213–229.

Abstract: This paper synthesizes information from the Fire and Aquatic Ecosystems Workshop, which identified concepts and tools emerging from current science, explored research strategies that will improve understanding, and identified management implications. The ultimate goal was to help managers identify ecologically sound and socially acceptable ways to protect and restore aquatic ecosystems and processes that are influenced by fire and its management. In this paper, the authors summarize the important points that emerged from the workshop and related research. The authors also suggest research questions that, when answered, will aid in formulating socially and ecologically acceptable fire management policy. They propose a path toward improved understanding that involves managers, scientists, and the public. *FIRE*

44. Bisson, P.A.; Quinn, T.P.; Reeves, G.H.; Gregory, S.V. 1992. Best management practices, cumulative effects and long-term trends in fish abundance in Pacific Northwest river systems. In: Naiman, R.J., ed. Watershed management: Balancing sustainability and environmental change. New York: Springer-Verlag: 189-225.

Abstract: In this article the authors review the difficulties in describing cumulative effects of forest management on fishes of the Pacific Northwest. Despite uncertainties in interpreting long-term trends from catch and escapement statistics as well as widespread programs of hatchery production, many local fish populations are declining. *MULTIPLE THREATS*

45. Blinn, C.R.; Dahlman, R.A. 1996. Riparian harvesting with a soft footprint. In: Laursen, S.B., ed. At the water's edge: The science of riparian forestry. Proceedings of the science of riparian forestry conference; 1995 June 19-20; Duluth, MN. University of Minnesota: 76-81.

Abstract: A variety of approaches can be utilized to leave a soft footprint when harvesting within a riparian management zone (RMZ). A selection of planning considerations, harvesting strategies, equipment options, and alternatives for temporary crossings of streams and areas with weak or wet soils are discussed. The specific practices selected for operating in a particular RMZ need to consider the operational capabilities and economic constraints that the logger faces. *FOREST HARVESTING*

46. Bock, C.E.; Saab, V.A.; Rich, T.D.; Dobkin, D.S. 1992. Effects of livestock grazing on neotropical migratory landbirds in western North America. In: Finch, D.M; Stangel, P.W., eds. Status and management of neotropical migratory birds; 1992 September 21-25; Estes Park, CO . Gen. Tech. Rep. RM-229. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 296-309.

Abstract: Livestock grazing is a widespread and important influence on neotropical migratory birds in four major ecosystems in western North America: Grasslands of the Great Plains and Southwest, riparian woodlands, Intermountain shrubsteppe, and open coniferous forests. The objective of this article is to provide a succinct management-oriented overview of species-specific avian responses to grazing in the aforementioned habitats. *GRAZING*

47. Boeer, W.J.; Schmidly, D.J. 1977. Terrestrial mammals of the riparian corridor in Big Bend National Park. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ . Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 212-217.

Abstract: Thirty species of terrestrial mammals inhabit riparian habitats in Big Bend National Park (BBNP), but only one species (the beaver) is restricted to these areas. Major changes in the vegetation during the past 30 years, involving an increase in basal and canopy cover, have resulted in the elimination of at least one species from the river corridor as well as increased abundance and distribution for two other species. Compared to the other major plant communities in BBNP, the rodent fauna of the riparian community has lower evenness, richness, and diversity indices. Human use and trespass livestock grazing are the major impacts acting on the natural riparian communities in BBNP. *MULTIPLE THREATS*

48. Boggs, K.; Weaver, T. 1991. Response of riparian shrubs to declining water availability. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 48-51.

Abstract: Community dominance, productivity and grazing effects were recorded in a cottonwood sere along the Yellowstone River. The sere progressed from seedlings of Great Plains cottonwood and sandbar willow, to cottonwood forests with a dense shrub understory, and then to grasslands. Total shrub canopy cover and biomass rose as sandbar willow matured, declined as they died, rose again as shrubs developed under the cottonwood canopy, and declined as grasslands dominated. *GROUNDWATER DEPLETION*

49. Bohn, B.A.; Kershner, J.L. 2002. Establishing aquatic restoration priorities using a watershed approach. Journal of Environmental Management. 64: 355–363.

Abstract: This article introduces the watershed analysis procedure as an important tool to help restoration practitioners identify, prioritize and implement aquatic restoration activities at the appropriate ecosystem scale. *MULTIPLE THREATS*

50. Bohn, C. 1989. Management of winter soil temperatures to control streambank erosion. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L. eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 69-71.

Abstract: Temperature modifications resulting from vegetative cover appear to be sufficient to reduce the number of freeze-thaw cycles along the streambank face. Riparian management should be designed to provide sufficient vegetative cover over the winter to insulate streambanks and maintain soil strength. *WATER QUALITY*

51. Bohn, C.C.; Buckhouse, J.C. 1985. Some response of riparian soils to grazing management in Northeastern Oregon. Journal of Range Management. 38: 378-381.

Abstract: Infiltration, sediment production, penetrometer penetrability and bulk density were measured on control/treatment paired plots of several grazing schemes in a riparian zone of northeastern Oregon. Treatments were in effect over a period of 5 years. Restoration favored the hydrologic parameters measured, while deferred rotation and season-long grazing did little to enhance, and sometimes hindered, hydrologic expression. Late-season grazing in September demonstrated a positive hydrologic response, whereas late-season grazing in October was negative—probably due to the onset of fall rains and a change in soil moisture conditions. *GRAZING*

52. Boldt, C.E.; Uresk, D.M.; Severson, K.E. 1978. Riparian woodlands in jeopardy on the northern high plains. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 187-189.

Abstract: There is considerable evidence that riparian woodlands are decadent as evidenced by rotten trees with broken and snag tops. Some woodlands have been replaced by grasses and forbs. Many of these woodlands are in advanced stages of deterioration. Small patches of shrubs and trees are found in the draw systems. Many of these shrub-tree stands are near the end of their life spans, are vulnerable to damage by insects, disease, and humans. Other factors that may influence long-term changes in these woodlands are alteration of the local hydrology, climate change, geology, soils, plant succession, and protection from wildfire. *MULTIPLE THREATS*

53. Boone, S.G. 1976. Problems of irrigation return flows. In: Environmental aspects of irrigation and drainage; 1976 July 21-23. Ontario, Canada: University of Ottawa: 673-689.

Abstract: There are water quality problems with irrigation return flows. The quality of the receiving water is usually degraded by irrigation flow or at least modified in quality. This paper discusses the significance of the water quality problems and what can be done to reduce water pollution, especially in the western United States. *WATER DIVERSION*

54. Borden, F.Y.; Turner, B.J.; Strauss, C.H. 1977. Colorado River campsite inventory. In: Proceedings of river recreation management and research symposium; 1977 January 24-27; Minneapolis, MN. Gen. Tech. Rep. NC-28. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 226-231.

Abstract: With the influx of river-running recreationists into undeveloped sections of rivers, the wilderness aspects of these

environments may be endangered by overuse. Visitor carrying capacity of a river section for river-running is a function of the number of beaches for campsite use, their locations, and their individual capacities. The first phase of a project to assess the overall carrying capacity of the Grand Canyon river-running system was the campsite inventory described in this article. RECREATION

55. Borden, T.B. 1978. Cottonwood as a crop in Colorado. In: Graul, W.D.; Bissel, S.J., tech. coords. Lowland river and stream habitat in Colorado: A Symposium; 1978 Oct 4-5; Greeley, CO: Wildlife Society and Colorado Audubon Council, Colorado Chapter: 114-117.

Abstract: This paper addresses the threats to riparian communities when cottonwood is used as a crop. *MULTIPLE THREATS*

56. Boydstun, C.; Fuller, P.; Williams, J.D. 1995. Nonindigenous fish. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 431-433.

Abstract: Intentional and unintentional aquatic introductions have enabled nonindigenous fish to become permanent residents in the U.S. aquatic system. This article analyzes reports of nonindigenous fish introductions with a cut-off date of 1800. *INVASIVE SPECIES*

57. Braasch, S.; Tanner, G.W. 1989. Riparian zone inventory. Rangelands. 11(3): 103-106.

Abstract: This paper summarizes two studies that (1) evaluated the capacity of mountain stream channels to resist detachment of bed and bank materials, (2) provided information about the capacity of streams to adjust to and recovery from potential changes in water flow and/or increases in sediment production , and (3) evaluated the successional state and range condition of the riparian plant community. These studies provided a better understanding of the relationships between livestock grazing and riparian zone protection/preservation and the enhancement of fish habitat. *MULTIPLE THREATS*

58. Braatne, J.H.; Rood, S.B.; Goater, L.A.; Blair, C.L. 2008. Analyzing the impacts of dams on riparian ecosystems: A review of research strategies and their relevance to the Snake River through Hells Canyon. Environmental Management. 41: 267-281.

Abstract: This article provides an assessment of dams and river flow regulation on riparian ecosystems. The authors conclude that multiple study approaches are essential to provide confident interpretations of ecological impacts downstream from dams and propose a comprehensive study for Hells Canyon that integrates multiple research strategies. *DAM CONSTRUCTION*

59. Bradley, C.E.; Smith, D.G. 1986. Plains cottonwood recruitment and survival on a prairie meandering river floodplain, Milk River, Southern Alberta and Northern Montana. Canadian Journal of Botany. 64: 1433-1442.

Abstract: Age, distribution, and density of two populations of plains cottonwood (*Populus deltoides* var. *occidetltalis* Rydb.) on the floodplain of the Milk River, southern Alberta and northern Montana, were studied in relation to historical river hydrology and sedimentation regimes. In Alberta, cottonwood recruitment leading to long-term survival on river meander lobes (point bars) correlates with years when daily maximum flows during the period of seed dispersal (June 1 to July 10) attain a stage equal to or greater than the 2-year return flood, based on the annual flood series. Such flood events, during the seed dispersal period, occur an average of once in 5 years. In Montana, on the floodplain for 25 km downstream of Fresno Dam, built in 1939, the densities of cottonwoods recruited since 1939 are significantly lower than on floodplain sites upstream, in Alberta. Results suggest that this is due to a marked reduction in flood magnitude and frequency, rates of sedimentation and meander migration. Based on this study, the prospects for cottonwood survival on floodplains downriver from dams in this and other prairie river valleys are not encouraging unless management measures are taken to reverse the trend. *DAM CONSTRUCTION*

60. Breeding, N.A. 1995. Management plan for the Rio Cebolla watershed Sandoval County and Rio Arriba County, New Mexico. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 346-350.

Abstract: This paper discusses a proposed watershed management plan to remediate water quality problems of the Rio Cebolla watershed in northern New Mexico. These issues include eutrophication of Fenton Lake Reservoir, riparian damage and heavy sediment in the river. As a result, fish productivity and fishing is poor and scenic enjoyment is spoiled. *WATER QUALITY*

61. Briggs, M.K. 1992. An evaluation of riparian revegetation efforts in Arizona. Master Thesis. Tucson: University of Arizona. 229 p.

Abstract: This thesis evaluated 25 riparian revegetation projects and two alternative mitigation projects in Arizona. Riparian revegetation is limited in its ability to improve degraded riparian ecosystems and is most effective when the causes of site degradation are addressed. Interrupting natural river flow, a drop in the water table, intense competition from animals and plants, and unstable substrate were cited as probable causes of site deterioration. *MULTIPLE THREATS*

62. Briggs, M.K. 1996. Riparian ecosystem recovery in arid lands. Tucson: University of Arizona Press. 160 p.

Abstract: The book presents a review of watershed characteristics and an examination of drainage systems, then proceeds to a determination of the causes of riparian decline. It describes the factors that have a significant effect on the results of riparian rehabilitation and offers case studies that demonstrate how revegetation has been used both effectively and ineffectively. It also discusses strategies other than revegetation that may be effective. *MULTIPLE THREATS*

63. Briggs, M.K.; Roundy, B.A.; Shaw, W.W. 1994. Trial and error: Assessing the effectiveness of riparian revegetation in Arizona. Restoration and Management Notes. 12: 160-167.

Abstract: Improvement of degraded riparian ecosystems by revegetation has some limitations. Riparian revegetation is most effectively used in areas where artificially planted vegetation survives without being obscured by natural regeneration of the same species that were planted. Addressing the causes of site degradation is the most important factor in successful riparian revegetation. *MULTIPLE THREATS*

64. Brinson, M.M.; Swift, B.L; Plantico, R.C.; Barclay, J.S. 1981. Riparian ecosystems: Their ecology and status. Report FWS/0BS-81/17. Kearneysville, WV: U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program. 155 p.

Abstract: This paper documents and interprets the information that is available on riparian ecosystems so that the consequences of their alteration and deterioration can be assessed at a national level. The common functional properties of these ecosystems and their attractiveness to wildlife make it possible to address riparian ecosystems as discrete and manageable entities. *MULTIPLE THREATS*

65. Brinson, M.M.; Malvárez, A.I. 2002. Temperate freshwater wetlands: types, status, and threats. Environmental Conservation. 29(2): 115-133.

Abstract: This review examines the status of temperate-zone freshwater wetlands and makes projections of how changes over the 2025 time horizon might affect their biodiversity. Information from the recent technical literature, general accounts in books, and some first-hand experience provided the basis for describing major wetland types, their status and major threats. Loss of biodiversity is a consequence both of a reduction in area and deterioration in condition. Factors responsible for losses and degradation include diversions and damming of river flows, disconnecting floodplain wetlands from flood flows, eutrophication, contamination, grazing, harvests of plants and animals, global warming, invasions of exotics, and the practices of filling, dyking, and draining. *MULTIPLE THREATS*

66. Brock, J. H. 1994. *Tamarix* spp. (saltcedar), an invasive exotic woody plant in arid and semi-arid riparian habitats of western USA. In: de Waal, L.C.; Child, L.E.; Wade, P.M.; Brock, J.H., eds. Ecology and management of invasive riverside plants. Chichester, NY: John Wiley and Sons Ltd.: 27-44.

Abstract: This chapter chronicles the introduction and effects of saltcedar on riparian systems of the arid and semi-arid west. The ecology of this invasive species is discussed as well as various management techniques used to curb its growth and prevalence. *INVASIVE SPECIES*

67. Brode, J.M.; Bury, R.B. 1984. The importance of riparian systems to amphibians and reptiles. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley, CA: University of California Press: 30-36.

Abstract: California has about 120 native herpetofauna species. Riparian systems provide habitat for 83% of the amphibian and 40% of the reptile species. Harvesting timber and creating reservoirs are detrimental to amphibians and reptiles in the zone of influence of such activities. These activities have their greatest effects upon reptiles and amphibians whose entire life histories occur in the riparian zone. *MULTIPLE THREATS*

68. Brookshire, D.S.; McKee, M.; Schmidt, C. 1996. Endangered species in riparian systems of the American West. In: Shaw, D.W.; Finch, D.M., tech. cords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station : 238-241.

Abstract: This paper examines the economic impact of critical habitat designation for three fish species endemic to the Virgin River of Arizona, Nevada, and Utah: the woundfin, the Virgin River chub, and the Virgin River spinedace. The authors state that the impact of critical habitat designation is very small when viewed in the context of the regional economy. *AGRICULTURE, URBANIZATION*

69. Brothers, T.S. 1984. Historical vegetation change in the Owens River riparian woodlands. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley, CA: University of California Press: 75-84.

Abstract: This study evaluates human-caused vegetation change in the riparian woodland of Owens River. The greatest change occurred below the intake of the Los Angeles Aqueduct, where drying of the channel has eliminated most native riparian cover and allowed invasion by saltcedar and Russian olive. Fire, water management, and other factors may have reduced tree cover above the aqueduct intake and

encouraged proliferation of weedy native shrubs. The scarcity of tree seedling suggests that one or more of these factors continue to inhibit tress regeneration. *MULTIPLE THREATS*

70. Brown, B.T.; Johnson, R.R. 1985. Glen Canyon Dam, fluctuating water levels, and riparian breeding birds: The need for management compromise on the Colorado River in the Grand Canyon. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 76-80.

Abstract: Large water releases from Glen Canyon Dam in May and June are harmful to riparian breeding birds along the Colorado River in the Grand Canyon. Nest inundation can be avoided by releasing surplus water at times other than the breeding season. Habitat loss is the most serious long-term threat to riparian birds. *WATER DIVERSION*

71. Brown, D.E.; Lowe, C.H.; Hausler, J.F. 1977. Southwestern riparian communities: Their biotic importance and management in Arizona. In: Johnson, R.R.; Jones, D.A. tech. coords. Importance, preservation and management of riparian habitat: A symposium. 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 201-211.

Abstract: The various riparian communities occurring in Arizona and the Southwest are described and their biotic importance discussed. Recommendations are made concerning the management of streamside environments and their watersheds. These include recommendations pertaining to the classification and inventory of riparian habitats; the determination of limiting factors for key riparian species; the establishment of study areas; the regulation and elimination of livestock grazing; the greater consideration of streamside vegetation in authorizing water management projects; and the more conservation use of our watersheds. *MULTIPLE THREATS*

72. Brown, H.T. 1984. A case study of a salinity control program, Uinta Basin, Utah. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of the 1983 international symposium on state-of-the-art control of salinity; July 13-15; Salt Lake City, UT. Boston: Butterworth Publishers: 275-284.

Abstract: This paper discusses the problems and solutions related to the salt contribution to the Colorado River due to irrigation. These include the water supply and use, soils, and geologic formations. *WATER QUALITY*

73. Bryant, L.D. 1982. Response of livestock to riparian zone exclusion fencing. Journal of Range Management. 35: 781-785.

Abstract: In this study the major portion of a streamside riparian zone was excluded by fencing. Use by cows with calves and by yearlings was evaluated on the remaining portion of the riparian and upland zones during the summer grazing season. Regardless of aspect, both classes of livestock generally selected the riparian zone over the uplands throughout most of the summer grazing season. Both classes of livestock reversed their selection in favor of upland vegetation in the latter part of the season. Slopes less than 35% were preferred throughout the grazing season. Cows were more selective in use of certain plant communities than yearlings and, contrary to usual findings, distributed themselves over the range better than yearlings. Neither salt placement nor alternate water location away from the riparian zone influenced livestock distribution appreciably. *GRAZING*

74. Bryant, L.D. 1985. Livestock management in the riparian ecosystem. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: Reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 285-289.

Abstract: Intensive, long-term livestock grazing has occurred along most streams in the western United States. Although most livestock grazing on public lands is now under some form of management, many riparian areas are below "good" in ecological condition, with forage production considerably below. Eight years of research at Meadow Creek, Starkey Experiment Forest and Range, Wallowa-Whitman National Forest, in northwestern Oregon, indicates that herbage production was increased 1- to 4-fold through timing and intensity of grazing. Rest-rotation, deferred rotation, and season-long grazing systems were tested. Although there were no statistically different changes in plant composition, the production of both graminoids and forbs increased dramatically. *GRAZING*

75. Buckhouse, J. 1991. Grazing practice relationships: Predicting riparian vegetation response from stream systems. In: Bedell, T., ed. Watershed management guide for the interior Northwest. Oregon State University Extension Service. Corvallis, OR: 47-52.

Abstract: Grazing management can be either helpful or detrimental to riparian systems. The natural stress of a stream system (prevailing climate, gradient, soil, rock, water flow, etc.) ranges from stable to unstable. Management-induced stress (grazing intensity, season of use, logging practices, roading systems, etc.) can range from minimal to dramatic. *GRAZING*

76. Bull, W.E. 1997. Discontinuous ephemeral streams. Geomorphology. 19: 227-276.

Abstract: Initiation of arroyo cutting may be too complex to be attributed to a single cause such as change in mean annual precipitation or grazing by livestock, but is most likely associated with a decrease in density of protective plant cover on hillsides and along valley floors. Relatively larger unit stream power makes downstream reaches more susceptible to initial entrenchment during floods than headwater reaches, and favors persistent arroyos. Entrenchment continues until an equilibrium longitudinal profile is briefly attained. Then, channel widening occurs: streambanks are undercut, and aggradation begins. This paper attempts to answer a variety of questions related to discontinuous ephemeral streams. However, the emphasis in this paper departs from that of most past literature in two ways. First, discussions include the hydrology of aggrading reaches, as well as degrading reaches. Second, conceptual models, including the base level of erosion, threshold of critical power, and time lags of response are used to evaluate the characteristics of discontinuous ephemeral streams. The author concludes that changes in vegetation density on hillslopes and along valley floors, either as a result of short-term climatic change or because of the actions of humans, profoundly influences the responses of discontinuous ephemeral streams. *MULTIPLE THREATS*

77. Bunn, S.E.; Arthington, A.H. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. Environmental Management. 30(4): 492-507.

Abstract: This literature review is focused around four key principles to highlight the important mechanisms that link hydrology and aquatic biodiversity and to illustrate the consequent impacts of altered flow regimes: (1) flow is a major determinant of physical habitat in streams; (2) aquatic species have evolved life history strategies primarily in direct response to the natural flow regimes; (3) maintenance of natural patterns of longitudinal and lateral connectivity is essential to the viability of populations of many riverine species; and (4) the invasion and success of exotic and introduced species in rivers is facilitated by the alteration of flow regimes. The impacts of flow change are manifest across broad taxonomic groups including riverine plants, invertebrates, and fish. *MULTIPLE THREATS*

78. Bunn, S.E.; Davies, P.M.; Mosisch, T.D. 1999. Ecosystem measures of river health and their response to riparian and catchment degradation. Freshwater Biology. 41: 333-345.

Abstract: This paper assesses stream ecosystem response to catchment disturbance, particularly to the loss of riparian vegetation by quantifying the sources and fate of energy and nutrients. Benthic gross primary production (GPP) and respiration (R24) provided measures of the amount of organic carbon produced and consumed within the system, while stable isotope analysis was used to trace the fate of terrestrial and instream sources of organic matter in the aquatic food web. A decline in the health of forest streams was observed when GPP exceeded R24, especially when instream primary producers switched from palatable unicellular algae to prolific filamentous green algae and macrophytes. Accumulation of these plants has led to changes in channel morphology, loss of aquatic habitat, and a decline in water quality. *MULTIPLE THREATS*

79. Burke, M.; Jorde, K.; Buffington, J.M. 2009. Application of a hierarchical framework for assessing environmental impacts of dam operation: Changes in streamflow, bed mobility and recruitment of riparian trees in a western North American river. Journal of Environmental Management. 90: S224-S236.

Abstract: This case study demonstrates how a process-based, hierarchical framework can be used for quantifying environmental impacts of dam operations over space and time, and provides an approach for evaluating alternative management strategies. *DAM CONSTRUCTION*

80. Burkham, D.E. 1976. Hydraulic effects of changes in bottomland vegetation on three major floods, Gila River in Southeastern Arizona. Professional Paper 655-J. Washington, DC: U.S. Geologic Survey. 14 p.

Abstract: The main purpose of this report is to describe the apparent differences in hydraulic characteristics of the Gila River during three major floods owing to changes in bottom-land vegetation. The types of change in vegetation is the replacement of salt-cedar and mesquite trees with grass, which is likely to cause changes in rates of erosion and deposition, in channel width, depth, sinuosity, gradient, roughness, and even channel location. *FLOODS*

81. Burns, J.W. 1978. Planning for riparian vegetation management on the Sacramento River, California. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 178-183.

Abstract: Natural resource values of the Sacramento River are being threatened by agricultural encroachment, flood control, erosion control and water development projects. The methods for preserving riparian vegetation that have been explored include zoning, modifying flood and erosion control construction and maintenance practices, regulating timber harvesting, mitigating losses, acquiring land, developing a resource atlas to guide future planning, and developing a waterways management plant for the river. *MULTIPLE THREATS*

82. Bury, R.B.; Corn, P.S. 1988. Response of aquatic and streamside amphibians to timber harvest: A review. In: Raedeke, K.J., ed. Streamside management: Riparian wildlife and forestry interactions. Contribution No. 59. Seattle, WA: University of Washington, Institute of Forest Resources: 165-181.

Abstract: Stream-dwelling amphibians, which can be the dominant vertebrates of small streams in forests of the Pacific-Northwest, are prototypic riparian organisms. Impacts of timber harvest vary among species, physical habitats, and regions of the Pacific Northwest. Populations of giant salamanders increased following clear cutting in the Oregon Cascades, while in the Oregon Coast Range long-term effects of logging were negative and severe for all species. *FOREST HARVESTING*

83. Busby, F.E. 1978. Stream and stream ecosystems, livestock grazing and multiple-use management. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 November 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 6-12.

Abstract: This paper emphasizes stream and riparian ecosystems and their use as trout habitat. The problem generally attributed to the relationship between these ecosystems and livestock grazing include (1) vegetation deterioration in the riparian zone near the streams, (2) stream bank destruction, (3) shallower and wider streams, (4) higher stream water temperature, (5) sediment-covered stream bottoms, (6) loss of trout spawning beds, and (7) loss of trout. *GRAZING*

84. Busch, D.C.; Smith, S.D. 1995. Mechanisms associated with decline of woody species in riparian ecosystems of the southwestern U.S. Ecological Monographs. 65(3): 347-371.

Abstract: This paper evaluates the interactions of dominant woody riparian taxa of the lower Colorado River systems under two primary hypothesis: (1) that hydrologic variation has significant effects on riparian plant community structure and function; and (2) that varying salinity in floodplain environments also affects these attributes. The persistence of *Salix*, but not *Populus*, on the Colorado River appears to be due to greater water and salinity stress tolerance in *Salix* than in *Populus*. *MULTIPLE THREATS*

85. Busch, D.E.; Scott, M.L. 1995. Western riparian ecosystems. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 286-290.

Abstract: This article contrasts the roles played by natural and human-induced disturbances in structuring western riparian ecosystems and draws data from the lower Colorado and upper Missouri. Decline in riparian forest dominated by cottonwood and willow have been attributed to change in the physical environment and to the extensive invasion of tamarisk. This article also focuses on how water and land-use management may threaten valuable ecological resources. *MULTIPLE THREATS*

86. Busch, D.E.; Smith, S.D. 1991. Fire in a riparian shrub community: Postburn water relations in the tamarix-salix association along the lower Colorado River. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 52-55.

Abstract: Higher potentials in recovering burned salt-cedar relative to unburned plants and the opposite situation in willow provide evidence that postfire water stress is reduced in the former but not the latter. Similarily, diurnal patterns of stomatal conductance in these taxa are consistent with the existence of more vigor in burned salt-cedar than willow. Plots of water potential and transpiration demonstrate that hydraulic efficiencies may contribute to differences in fire recovery. *FIRE*

87. Campbell, C.J.; Green, W. 1968. Perpetual succession of stream-channel vegetation in a semiarid region. Journal of the Arizona Academy of Science. 5: 86-97.

Abstract: In this paper the authors separate riparian from the proposed term "pseudoriparian," thus making riparian of an obligate nature and pseudoriparian facultative. Pseudoriparian would apply to woody plants capable of completing their life cycle in relatively xeric or mesic sites, but which achieve maximum size and density when additional subsurface moisture is available. Special management problems created by exotic species are also discussed. *INVASIVE SPECIES*

88. Cannon, R.W.; Knopf, F.L. 1984. Species composition of a willow community relative to seasonal grazing histories in Colorado. Southwestern Naturalist. 29: 234-237.

Abstract: This paper describes the consequences of long-term grazing upon the species composition of a shrub willow community in Colorado. *GRAZING*

89. Capelli, M.H.; Stanley, S.J. 1984. Preserving riparian vegetation along California's south-central coast. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 673-686.

Abstract: California's south central coast contains over 400 km of riparian vegetation within the Coastal Zone, concentrated principally in narrow corridors bordering short coastal streams. A great deal of this vegetation has been disturbed or destroyed by urban, agricultural, and related flood control activities. *MULTIPLE THREATS*

90. Carothers, S.W.; Brown, B.T. 1991. The Colorado River through Grand Canyon: Natural history and human change. Tucson: University of Arizona Press: 235 p.

Abstract: This book chronicles change in the natural world of the Colorado River as it flows through the Grand Canyon. The authors discuss pre-dam conditions and the effects damming of the river has had on natural conditions and processes. They describe how these natural systems have adjusted to and persisted through human induced environmental alterations. The authors rely on a large body of research to detail current conditions, management concerns, and restoration/rehabilitation options. Their discussion on the effects of regulated flow due to damming on the riparian areas covers numerous management issues such as: vegetation increases, invasive species abundance, and sediment deposition rates. *DAM CONSTRUCTION*

91. Carothers, S.W.; Johnson, R.R. 1981. Status of the Colorado River ecosystem in the Grand Canyon National Park and Glen Canyon National Recreation Area. In: Adams, V.D.; Lamarra, V.A., eds. Aquatic resources management of the Colorado River ecosystem; Proceedings of the 1981 symposium on the aquatic resources management of the Colorado River ecosystem; 1981 November 16-18; Las Vegas, NV. Ann Arbor Science Publishers: 139-160.

Abstract: This report summarizes the known ecological changes that have occurred within the aquatic and riparian ecosystems of the Colorado River Glen and Grand Canyons that result from structural control of the river and the more recent recreational use taking place. In addition, it discusses the issues and concerns that influence the capability of the National Park Service to carry out its mandate to maintain these administrative areas for the good of present and future generations. *MULTIPLE THREATS*

92. Carothers, S.W.; Mills, G.S.; Johnson, R.R. 1990. The creation and restoration of riparian habitat in southwestern arid and semi-arid regions. In: Kusler, J.A.; Kentula, M.E., eds. Wetland creation and restoration: The status of the science. Washington, DC: Island Press: 351-366.

Abstract: This paper discusses the creation and restoration of riparian habitats in Southwestern arid and semi-arid regions. In most cases, creation and restoration projects have involved the planting of vegetation and not the creation of conditions suitable for the natural regeneration of riparian habitats. Important considerations for riparian creation or restoration projects include the elimination or control of the threats to the ecosystem, which include: soil salinity and texture, amount and frequency of irrigation, protection from rodent and rabbit predation, elimination of competing herbaceous weeds, protection from vandalism, off-road vehicles, and livestock. *MULTIPLE THREATS*

93. Case, R.L. 1995. Ecology of riparian ecosystems of Northeast Oregon: Shrub recovery at Meadow Creek and the structure and biomass of headwater Upper Grande Ronde ecosystems. Master's Thesis. Corvallis, OR: Oregon State University. 137 p.

Abstract: This thesis documents late 20th century headwater riparian structure and biomass in the Upper Rio Grande Ronde Basin and provides an ecological perspective related to riparian restoration and management. Further, the response of riparian hardwood species to the termination of livestock and wild ungulate grazing is quantified. *GRAZING*

94. Chambers, J.C. 2008a. Climate change and the Great Basin. In: Chambers, J.C.; Devoe, N.; Evenden, A., eds. Collaborative management and research in the Great Basin—examining the issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 29-32.

Abstract: This paper provides a short overview of past and projected climate change for the globe and for the Great Basin region. *CLIMATE CHANGE*

95. Chambers, J.C. 2008b. Invasive plant species and the Great Basin. In: Chambers, J.C.; Devoe, N.; Evenden, A., eds. Collaborative management and research in the Great Basin—examining the issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 38-41.

Abstract: This paper provides a short overview of how invasive plant species have affected the Great Basin and what the consequences are for native ecosystems and the services they provide. *INVASIVE SPECIES*

96. Chambers, J.C. 2008c. Water resources and the Great Basin. In: Chambers, J.C.; Devoe, N.; Evenden, A., eds. Collaborative management and research in the Great Basin—examining the issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 20-23.

Abstract: This paper provides a short overview of the key issues affecting the water resources in the Great Basin region. *MULTIPLE THREATS*

97. Chambers, J.C.; Pellant, M. 2008. Climate change impacts on northwestern and intermountain United States rangelands. Rangelands. 30(3): 29-33.

Abstract: This paper provides a short overview of the projected climate change and the resulting consequences for the Northwestern and Intermountain U.S. rangelands, including their riparian ecosystems. *CLIMATE CHANGE*

98. Chaney, E.; Elmore, W.; Platts, W.S. 1990. Livestock grazing on western riparian areas. Eagle, ID: Northwest Resource Information Center. 45 p.

Abstract: This document is aimed at the broad and growing audience of people interested in improved management of livestock grazing on western riparian areas and adjacent uplands. Its purpose is to provide general insight into the problems and opportunities. *GRAZING*

99. Chaney, E.; Elmore, W.; Platts, W.S. 1993. Managing change—livestock grazing on western riparian areas. Eagle, ID: Northwest Resource Information Center. 31 p.

Abstract: This document is designed to foster broader understanding of how improved grazing management on western riparian areas can enhance water quality and overall productivity of rangeland watersheds. *GRAZING, WATER QUALITY*

100. Chen, H.; Qualls, R.G.; Blank, R.R. 2005. Effect of soil flooding on photosynthesis, carbohydrate partitioning and nutrient uptake in the invasive exotic *Lepidium latifolium*. Aquatic Botany. 82: 250–268.

Abstract: *Lepidium latifolium* L. is an invasive exotic crucifer that has spread explosively in wetlands and riparian areas of the western United States. To understand the ecophysiological characteristics of *L. latifolium* that affect its ability to invade riparian areas and wetlands, this study examined photosynthesis, chlorophyll concentration, carbohydrate partitioning and nutrient uptake in *L. latifolium* in response to soil flooding. The results suggested that the maintenance of relatively high photosynthesis and the accumulation of soluble sugar in roots of flooded plants are important adaptations for this species in flooded environments. Despite a reduction in photosynthesis and disruption in nutrient and photosynthate allocation in response to flooding, *L. latifolium* was able to survive 50 days of flooding stress. Overall, *L. latifolium* performed like a facultative hydrophyte species under flooding. *INVASIVE SPECIES, FLOODS*

101. Chischilly, S. 1993. The San Juan River. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests; A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 323-327.

Abstract: This paper describes the San Juan River, its watershed, riparian vegetation, and the threats to the river, which include river alteration caused by saltcedar and Russian-olive. *INVASIVE SPECIES*

102. Clark County Board of Commissioners. 1978. Clark County 208 water quality management plan. Clark County, NV. Las Vegas, NV: Clark County Sanitation District. 188 p.

Abstract: The draft Clark County 208 Water Quality Management Plan presents the objectives, policies, and programs for managing water quality in the county. The plan addresses municipal wastewater treatment, ground water management, storm water programs, Las Vegas Wash, agriculture diffuse sources, and water quality standards revisions. An environmental assessment of the proposed plan is also included. *WATER QUALITY*

103. Clary, W.P. 1995. Vegetation and soil responses to grazing simulation on riparian meadows. Journal of Range Management. 48: 18-25.

Abstract: Riparian areas have not responded consistently to grazing systems, suggesting that more knowledge is needed to explain how different areas respond to specific stresses. Several studies were conducted to determine herbaceous plant response to simulated grazing on riparian areas. Results suggest that many of the land management agency riparian guidelines would maintain biomass productivity in these sedge-dominated communities. *GRAZING*

104. Clary, W.P. 1999. Stream channel and vegetation responses to late spring cattle grazing. Journal of Range Management. 52: 218-227.

Abstract: A 10-year riparian grazing study was conducted on a cold, mountain meadow riparian system in central Idaho in response to cattle grazing-salmonid fisheries conflicts. Six pastures were established along Stanley Creek to study the effects on riparian habitat of no grazing, light grazing, and medium grazing during late June. Stream channels narrowed, stream width-depth ratios were reduced, and channel bottom embeddedness decreased under all three grazing treatments as the area responded to changes from heavier historic grazing use. Streambank stability increased and streamside willow communities increased in both height and cover under all treatments. Plant species richness increased on both streamside and dry meadow areas during the years of grazing and moderate drought. Many improvements were similar under all three treatments indicating these riparian habitats are compatible with light to medium late spring use by cattle. *GRAZING*

105. Clary, W.P.; Medin, D.E. 1991. Vegetation, breeding bird, and small mammal biomass in two high-elevation sagebrush riparian habitats. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 100-110.

Abstract: Two riparian areas, one in Nevada (Deer Creek) and one in Idaho (Summit Creek), were compared on the basis of vegetation, breeding bird, and small mammal characteristics. The objectives of the study were to (1) investigate similarities and dissimilarities of riparian areas otherwise alike in a number of environmental conditions, and (2) examine their response to grazing stress. *GRAZING*

106. Clary, W.P.; Booth, G.D. 1993. Early season utilization of mountain meadow riparian pastures. Journal of Range Management. 46: 493-497.

Abstract: In the Western United States, the greatest impact on small stream riparian areas often has been from grazing by domestic livestock. This is particularly true for riparian areas within arid or semiarid rangelands. In 1987 a grazing study was initiated on Stanley Creek located within the Sawtooth National Recreation Area, Sawtooth National Forest, in central Idaho. The general objectives were to determine vegetation, wildlife, fishery, and stream channel responses to grazing management. Observations suggest spring grazing of riparian areas is a good management strategy because of a reduced tendency for cattle to concentrate along streams during that season. In this study, June cattle distribution was examined within four experimental pastures located along Stanley Creek. Two pastures were grazed at a light stocking rate and two pastures were grazed at a medium stocking rate. Utilization of riparian plant communities during this early summer period had no relationship to the amount of plant moisture content, but was negatively associated with surface soil moisture. *GRAZING*

107. Clary, W.P.; Kinney, J.W. 2002. Streambank and vegetation response to simulated cattle grazing. Wetlands. 22(1): 139–148.

Abstract: Simulated grazing techniques were used to investigate livestock impacts on structural and vegetation characteristics of streambanks in central Idaho, U.S.A. The treatments, continued over 2 years, consisted of no grazing, simulated moderate early summer grazing, simulated moderate mid-summer grazing, and simulated heavy season-long grazing. Ten months after the last treatment application, the average spring foliage growth was 20–43% lower on the moderate treatment plots and 51–87% lower on the heavy season-long treatment plots than on the untreated control plots. *GRAZING*

108. Clary, W.P.; Kruse, W.H. 2004. Chapter 11: Livestock grazing in riparian areas: Environmental impacts, management practices and management implications. In: Baker, M.B., Jr.; Ffolliott, P.F.; DeBano, L.F.; Neary, D.G., eds. 2003. Hydrology, ecology and management of riparian areas in the southwestern United States. Boca Raton: Lewis Publishers: 237-258.

Abstract: This chapter examines the impacts of grazing in Southwest riparian areas since Spanish introduction of cattle in the 1500s. In the early 20th Century, major environmental damage occurred because of excessive grazing with little or no management. Current grazing management is aimed at balancing cattle grazing with other impacts from agriculture, mining, and recreation. *GRAZING*

109. Cleverly, J.R.; Smith, S.D.; Sala, A.; Devitt, J.R. 1997. Invasive capacity of *Tamarix ramosissima* in a Mojave Desert floodplain: the role of drought. Oecologia. 111: 12-18.

Abstract: *Tamarix ramosissima* is a woody phreatophyte that has invaded thousands of hectares of floodplain habitat in the southwestern United States. This study examined the response of gas exchange and stem sap flow of *Tamarix* and three co-occurring native phreatophytes (*Pluchea sericea, Prosopis pubescens*, and *Salix exigua*) to drought conditions in an early successional floodplain community in the Mojave Desert of southern Nevada. In an analysis of a size/age series of each species across the whole floodplain (both mature and successional stands), stem growth rate was lowest for *Tamarix*. However, along the same successional chronosequence, *Tamarix* came to dominate the 50+ year old stands with dense thickets of high stem density. This analysis suggests that the invasive *Tamarix* is the most drought tolerant of the four species, whereas *Salix* transpires the most water per unit leaf surface area and is the least tolerant of seasonal water stress. Therefore, *Salix* appears to be well adapted to early successional communities. However, as flood-plains in this arid region become more desiccated with age, *Tamarix* assumes greater dominance due to its superior drought tolerance relative to native phreatophytes and its ability to produce high density stands and high leaf area.
INVASIVE SPECIES, DROUGHT

110. Clifton, C. 1989. Effects of vegetation and land use on channel morphology. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings MT. U.S. Department of the Interior, Bureau of Land Management: 121-129.

Abstract: Spatial and temporal morphologic variability in mountain streams may be attributed to local prevailing conditions. Morphologically distinct reaches of Wickiup Creek, in the Blue Mountains of central Oregon, result from differences in the composition and structure of streamside vegetation, physiography, and land use. Comparisons of grazed and ungrazed meadow reaches and a forested reach loaded with large organic debris reveal specific differences related to the local environmental setting. Over a 50-year period without grazing, a 94% reduction in channel cross section area occurred. *GRAZING*

111. Cohan, D.R.; Anderson, B.W.; Ohmart, R.D. 1978. Avian population responses to salt cedar along the lower Colorado River. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 371-382.

Abstract: Avian population responses to saltcedar were studied seasonally for 3 years along the lower Colorado River. Bird densities and diversities were examined in saltcedar and three additional types of riparian vegetation, all similar horizontal and vertical configurations. Significantly fewer insectivores used saltcedar than would be predicted on the basis of insect biomass. Avoidance of saltcedar by insectivores may be related to the sticky exudates, which may damage the plumage. Frugivores were absent from saltcedar because of the near total absence of available fruits and berries. *INVASIVE SPECIES*

112. Colborn, T.; Thayer, K. 2000. Aquatic ecosystems: Harbingers of endocrine disruption. Ecological Applications. 10(4): 949-957.

Abstract: This invited paper stresses that the existence of synthetic chemicals in the environment can no longer be left out of management considerations as was done in the 1950-1970s. Further, it points out that by neglecting to prevent their release into the environment their cryptic, transgenerational, developmental effects would never have been discovered. If it had not been for wildlife harbingers, endocrine disruption might have continued to be overlooked. *WATER QUALITY*

113. Colorado River Basin Salinity Control Forum. 1975. Proposed water quality standards for salinity including numeric criteria and plan of implementation for salinity control, Colorado River system. Colorado River Basin Salinity Control Forum (The Program). 134 p.

Abstract: This report, prepared by the 7-State Colorado River Basin Salinity Control Forum, presents, in a single document, the water quality standards for salinity submitted for adoption by each of the states within the Basin. *WATER QUALITY*

114. Conine, K.H.; Anderson, B.W.; Ohmart, R.D.; Drake, J.F. 1978. Responses of riparian species to agricultural habitat conversion. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 248-262.

Abstract: Approximately 1,100 ha of agricultural land and 540 ha of riparian habitats were censused over a 14-month period in the lower Colorado River Valley to examine relative use of these areas by riparian birds. Many species did not use agricultural lands at all; insectivorous species suffered severe losses through agricultural conversions, while others used agricultural area to a high degree. Also, agricultural-riparian edge was beneficial to certain species. *AGRICULTURE*

115. Cooper, D.J.; Emerick, J.C. 1987. The effects of acid mine drainage on a *Carex aquatilis* fen in the Colorado Rocky Mountains. In: Mutz K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle, WA. Denver, CO: Planning Information Corp.: 96-100.

Abstract: A *Carex aquatilis* dominated fen in the Peru Creek drainage, Colorado Rocky Mountains, has been impacted by drainage from the Pennsylvania Mine. Metal concentrations in leaves, roots, and standing dead leaves were analyzed and it was determined that Zn, Cu, and Al were probably the leading cause of poor plant health. WATER QUALITY

116. Cooper, D.J.; Merritt, D.M.; Anderson, D.C.; Chimner, R.A. 1999. Factors controlling the establishment of Fremont cottonwood seedlings on the Upper Green River, USA. Regulated Rivers: Research and Management. 15: 419-440.

Abstract: Declines in cottonwood (*Populus* spp.) recruitment along alluvial reaches of large rivers in arid regions of the western United States have been attributed to modified flow regimes, lack of suitable substrate, insufficient seed rain, and increased inter-specific competition. We evaluated whether and how these factors were operating during 1993–1996 to influence demographics of Fremont cottonwood along reaches of the Green and Yampa Rivers near their confluence in northwestern Colorado. The data presented herein suggest that dense tamarisk thickets preclude or hinder cottonwood establishment by depleting soil moisture and creating shade. Tamarisk removal prior to a controlled flood could facilitate cottonwood seedling establishment in existing tamarisk stands. *MULTIPLE THREATS*

117. Courtois, L.A. 1984. Temporal desert riparian systems—the Mojave River as an example. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 688-693.

Abstract: During years of high precipitation, temporal riparian zones form on the dry lake playas within the Mojave River drainage and can exist for several years. This is followed by establishment of pioneer aquatic species, which eventually give way to halophytes as surface waters recede. Once surface water evaporates the alkali sink vegetation becomes reestablished. The greatest threat to this ecological balance is the increased human demand for water and the establishment of permanent agriculture. *AGRICULTURE*

118. Crawford, C.S; Ellis, L.M.; Molles, M.C., Jr.; Valett, H.M. 1996. The potential for implementing partial restoration of the Middle Rio Grande ecosystem. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 93-99.

Abstract: The Rio Grande currently inundates only a small portion of its riparian forests during late spring runoff. Such flood events were once responsible for the germination of cottonwoods and willows along the river, for a mosaic of wetland mixed with different aged stands of forest, and for enhancement of decomposition and nutrient cycling. River regulations in this century have decoupled the linkage between the floodplain and the river and led to senescence without replacement of the once dominant native cottonwoods in the Middle Rio Grande reach. *FLOODS, FLOW REGULATION*

119. Croonquist, M.J.; Brooks, R.P. 1991. Use of avian and mammalian guilds as indicators of cumulative impacts in riparian-wetland areas. Environmental Management. 15(5): 701-714.

Abstract: This paper presents a method of assessing cumulative effects of human activities on bird and mammal communities by using response guilds to reflect how species theoretically respond to habitat disturbance at the landscape level. The authors hypothesized that the response-guild approach would predict post-disturbance wildlife community changes more efficiently than a single-species approach. They found that avian response guilds reflected habitat disturbance more accurately than mammalian response guilds. *MULTIPLE THREATS*

120. Crouch, G.L. 1961. Inventory and analysis of wildlife populations and habitat, South Platte River Valley. Final report. Federal Aid in Wildlife Restoration Project W-104-R-1-2. Colorado Game and Fish Department. 68 p.

Abstract: This investigation sought to determine the relative difference in wildlife populations and habitat conditions on grazed and ungrazed bottomlands along the South Platte River in Logan County, Colorado. Results of wildlife counts showed that significantly larger numbers of ducks, deer, pheasants, quail, cottontail rabbits, squirrels, hawks, crows, and small birds were seen on the ungrazed land; more shorebirds were counted on the grazed tract, while there were no significant differences in the numbers of doves, eagles, horned owls, or magpies. *GRAZING*

121. Crouch, G.L. 1978. Effects of protection from livestock grazing on a bottomland wildlife habitat in northeastern Colorado. In: Graul, W.D.; Bissel, S.J., tech. coords. Lowland river and stream habitat in Colorado: A symposium ; 1978 Oct. 4-5; Greeley, CO. Lyons, CO: The Wildlife Society, Colorado Chapter; Boulder, CO: Colorado Audubon Council: 118-125.

Abstract: Vegetation on a bottomland wildlife habitat protected from grazing for 7 and 25 years was compared to an adjacent grazed tract along the South Platte River in northeastern Colorado. Overall cover and height of the understory was about twice as great on the ungrazed area for each evaluation, but did not change appreciably over the 18-year interval. A significant decrease in the number of cottonwood trees on both areas, particularly the grazed area, requires attention by wildlife habitat managers. *GRAZING*

122. Crouse, M.R. 1987. New approaches to riparian area management on public lands. In: Mutz K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle, WA. Denver, CO: Planning Information Corp.: 32-35.

Abstract: Riparian areas are among the most productive ecosystems found on lands managed by the U.S. Bureau of Land Management (BLM). Conflicts often occur over what land uses are appropriate for these areas. This paper traces the BLM's current multidiscipline approach for managing riparian areas, including timber harvest practices and grazing options. Case histories of successful stream restoration are presented. *MULTIPLE THREATS*

123. Crumpacker, D.W. 1984. Regional riparian research and a multi-university approach to the special problem of livestock grazing in the Rocky Mountains and Great Plains. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 413-423.

Abstract: This paper presents a selected survey of Rocky Mountain/Great Plains riparian research with emphasis on livestock grazing impacts and management. An analogy is made to California, considering the State as a region. *GRAZING*

124. Dahl, T.E. 2005. Status and trends of wetlands in the conterminous United States, 1998 to 2004. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service: 112 p.

Abstract: This report provides scientific and statistical results on the progress that has been made toward achieving national wetland quality goals. The Status and Trends Study collects data on wetland acreage gains and losses; it does not assess the quality or condition of the nation's wetlands. *MULTIPLE THREATS*

125. Dahl, T.E.; Johnson, C.E. 1991. Status and trends of wetlands in the conterminous United States, mid-1970's to mid-1980's. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. 28 p.

Abstract: This report covers the mid-1970s to the mid-1980s, a period in which Federal, State, and local government programs and policies began to affect wetland use and conversion. Even though the data contained in this report generally predates more recent wetlands legislation, they provide information that can help to assess the effectiveness of public policies and programs that have been intended to reduce the loss of the Nation's remaining wetlands. *MULTIPLE THREATS*

126. Dahlem, E.A. 1978. The Mahogany Creek watershed – with and without grazing. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 November 3-4; Denver CO. Arlington, VA: Trout Unlimited: 31-34.

Abstract: Heavy livestock use in the Mahogany Creek watershed had led to deterioration of trout habitat and to a general decline in vegetative condition, both riparian and non-riparian. In 1976 fencing excluded livestock grazing first from the creek and than from the entire watershed. Only after complete removal of livestock was significant riparian habitat improvement accomplished along the creek. *GRAZING*

127. Davis, F.W.; Keller, E.A.; Parikh, A.; Florsheim, J. 1988. Recovery of the chaparral riparian zone after wildfire. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 194-203.

Abstract: After the Wheeler Fire in southern California in 1985, sediment deposition and vegetation recovery was monitored in a section of the severely burned chaparral riparian zone of the North Fork of Matilija Creek. Increased runoff was accompanied by low magnitude debris flow and fluvial transport gravel, most of which was added to the channel and nearby hillslopes by post-fire dry ravel. The pre-burn riparian forest was dominated by white alder, California sycamore, and coastal live oak. Regeneration of these species was entirely by resprouting, due to the absence of local viable seed sources. Recovery of the herb layer was affected strongly by the seeding of Italian ryegrass. Species richness of annuals decreased considerably in the second year, when perennials dominated the riparian zone. *FIRE*

128. Davis, G.A. 1977. Management alternatives for the riparian habitat in the Southwest. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 59-67.

Abstract: Exploitation by man has significantly altered the riparian habitat in the Southwest. For decades, the primary or dominant use of riparian habitat has been water management; other values were not considered. Management alternatives and objectives are evaluated for environmental consequences. *FLOW REGULATION, GROUNDWATER DEPLETION*

129. Davis, T. 1995. The Southwest's last real river: Will it flow on? High Country News. 27(11): 1, 10-11.

Abstract: This paper describes the threats the San Pedro River faces at the beginning of the new millennium. *MULTIPLE THREATS*

130. Deardorff, D.; Wadsworth, K. 1996. Cooperative management of riparian forest habitat to maintain biological quality and ecosystem integrity. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 227-229.

Abstract: The New Mexico State Land Office has initiated a rare plant survey of State trust land, an inventory and assessment of riparian areas on the trust land, and the development of a biological resources data base and information management system. Some riparian sites that still belong to the trust have been negatively impacted by livestock such that biological quality and ecological integrity of these sites have been reduced. This paper reviews potential solutions of how the State Land Office can manage trust land and restore riparian sites. *GRAZING*

131. DeBano, L.F.; Ffolliott, P.F. 1996. Flow of water and sediments through Southwestern riparian systems. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 128-134.

Abstract: This paper describes streamflow, sediment movement and vegetation interactions within riparian systems of the southwestern United States. Intermittent streamflow coupled with the discontinuous storage and subsequent movement of sediment though channel systems in response to fire and other disturbances is extremely complex, and can be difficult to interpret when assessing responses of southwestern riparian system to management. *MULTIPLE THREATS*

132. DeBano, L.F.; Hansen, W.R. 1989. Rehabilitating depleted riparian areas using channel structures. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management:

An educational workshop; 1989 May 8-11; Billings MT. U.S. Department of the Interior, Bureau of Land Management: 143-148.

Abstract: Abusive land use activities have deteriorated valuable riparian areas in the southwestern United States. Loss of protective cover causes erosion, which reduces soil moisture and channel stability that is necessary for maintaining riparian areas. Review of three rehabilitation projects in New Mexico and Colorado indicate that channel structures store sediment, stabilize channels, raise water table, and enhance riparian vegetation. *MULTIPLE THREATS*

133. DeBano, L.F.; Schmidt, L.J. 1989a. Improving southwestern riparian areas through watershed management. Gen. Tech. Rep. RM-182. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 33 p.

Abstract: The overall objectives of this document are to provide (1) a state-of-the-art report on riparian hydrology in the Southwest, and (2) general guidelines for improving hydrologic relationships in naturally occurring and man induced riparian areas throughout the arid Southwest. As a result, the document focuses on improving riparian areas in harsh arid environments where intermittent and ephemeral streamflow predominate. This document is not intended to be a review of the direct effect of grazing on riparian areas for fishery habitat. *GRAZING, FLOW REGULATION*

134. DeBano, L.F.; Schmidt, L.J. 1989b. Interrelationship between watershed conditions and health of riparian areas in southwestern United States. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings MT. U.S. Department of the Interior, Bureau of Land Management: 45-52.

Abstract: Sensitive hydrologic interrelationships exist between watershed condition and the health of associated riparian areas in the southwestern United States. The impact of extensive unmanaged livestock grazing, wildfires, and past forest clearing, coupled with numerous small linear perturbations such as travelways, low standard roads, and livestock trails, has dramatically illustrated the interrelationship between watershed conditions and riparian health. *MULTIPLE THREATS*

135. DeBano, L.F.; Rinne, J.N.; Medina, A.L. 1996. Understanding and managing southwestern riparian-stream ecosystems: national forest systems and forest services research partnership. In: Neary, D.G.; Ross, K.C.; Coleman, S.S., eds. In: Proceedings of the national hydrology workshop; 1992 April 27- May 1; Phoenix, AZ. Gen. Tech. Rep. RM-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 96-102.

Abstract: Partnerships between research scientists and land managers can facilitate the application of research findings. Successful partnerships developed between Rocky Mountain Station scientists and Southwestern Region staffs have been involved in addressing riparian-stream interactions. These successful partnerships involve several interpersonal and organizational considerations. Examples and keys to successful partnerships are described. *MULTIPLE THREATS*

136. Dennis, N.B.; Ellis, D.; Arnold, J.R.; Renshaw, D.L. 1984. Riparian surrogates in the Sacramento/San Joaquin Delta and their habitat values. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 566-576.

Abstract: The distribution and condition of riparian vegetation in the Sacramento/San Joaquin Delta has been highly modified during 130 years of land reclamation, construction, and maintenance of the present levee system and the conversion of the land to agricultural cultivation. A variety of vegetation complexes with partial riparian attributes exists under a few natural, but primarily induced conditions in the Delta, providing some of the wildlife values associated with historic Delta riparian vegetation. *AGRICULTURE*

137. Dewine J.M.; Cooper, D.J. 2008. Canopy shade and the successional replacement of tamarisk by native box elder. Journal of Applied Ecology. 45: 505-514.

Abstract: In this study the authors investigated the establishment chronology, competition, and comparative shade tolerances of tamarisk and box elder to determine the superior competitor and to predict successional trajectories in mixed stands. The study found box elder to be a superior competitor to tamarisk and attributes the success of tamarisk in North America to its high stress tolerance, superior dispersal ability and absence of natural enemies. *INVASIVE SPECIES*

138. Dieter, C.D.; McCabe, T.R. 1989. Habitat use by beaver along the Big Sioux River in eastern South Dakota. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 135-140.

Abstract: Habitat use by beavers was investigated in grazed and ungrazed areas along the Big Sioux River in eastern Sioux River in eastern South Dakota. A greater proportion of trees were cut by beavers in ungrazed than in grazed areas. Over half of the trees damaged by beaver either resprouted or remained alive and standing. *GRAZING*

139. Ditton, R.B.; Schmidly, D.J.; Boeer, W.J.; Graefe, A.R. 1977. A survey and analysis of recreational and livestock impact on the riparian zone of the Rio Grande in Big Bend National Park. In: Proceedings of river recreation

management and research symposium; 1977 January 24-27; Minneapolis, MN. Gen. Tech. Rep. NC-28. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 256-266.

Abstract: The Rio Grande of the Big Bend National Park has experienced dramatic increases in recreational and water resource use. This paper assesses the actual and potential impact on the river and on associated land area ecosystems from present levels of human usage. *MULTIPLE THREATS*

140. Dixon, M.D.; Stromberg, J.C.; Price, J.T.; Galbraith, H.; Fremier, A.K.; Larsen, E.W. 2009. Chapter 8: Potential effects of climate change on the Upper San Pedro riparian ecosystem. In: Stromberg, J.C.; Tellman, B.J., eds. Ecology and conservation of the San Pedro River. Tucson, AZ: University of Arizona Press: 57-72.

Abstract: The upper San Pedro is used as a case study to explore the effects of climate change. This study uses a range of climate change scenarios to explore the sensitivity of the riparian ecosystem, in particular the composition and dynamics of riparian vegetation. The authors state that their results are considered preliminary and suggest that several successional changes in the riparian vegetation of the upper San Pedro floodplain are likely. *CLIMATE CHANGE*

141. Dotzenko, A.D.; Papamichos, N.T.; Romine, D.S. 1967. Effects of recreational use on soil and moisture conditions in Rocky Mountain National Park. Journal of Soil and Water Conservation. 22: 196-197.

Abstract: This study found that soil compacting effect of intensive recreational use produces infiltration, runoff and erosion problems. Heavy use significantly reduced the surface soil moisture content. *RECREATION*

142. Dougherty, S.T.; Berry; C.A.; Deimel, M.A. 1987. Hydrology and vegetation in montane and subalpine wetlands of Colorado. In: Mutz K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists. 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 81-84.

Abstract: Limited published information is available on the relationships between hydrology and vegetation in montane and subalpine wetland of the central and southern Rocky Mountains. This paper addresses hydrology and vegetation of these wetlands and cites two recent research projects related to this topic. It also suggests the considerations in predicting impacts for wetland systems. *MULTIPLE THREATS*

143. Duncan, K.W.; Schemnitz, S.D.; Suzuki, M.; Homesley, Z.; Cardenas, M. 1993. Evaluation of saltcedar control—Pecos River, New Mexico. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests; A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 207-210.

Abstract: This paper introduces the Pecos River Native Riparian Restoration Project, which aims to (1) demonstrate native wetlands and wildlife habitat improvement through saltcedar management, (2) demonstrate effective, economical and environmentally sound salt cedar control, and (3) monitor possible hydrologic effects from saltcedar control and management. *INVASIVE SPECIES*

144. Dwire, K.A.; Kauffman, J.B. 2003. Fire and riparian ecosystems in landscapes of the western USA. Forest Ecology and Management. 178: 61–74.

Abstract: The objectives of this paper are to: (1) synthesize the limited research conducted on fire regimes in riparian areas relative to uplands, (2) summarize the distinctive features of riparian zones that influence the properties of fire, (3) discuss the impacts of land use as they may affect fire behavior in riparian areas, and (4) describe the adaptations of riparian plant species to fire. *FIRE*

145. Ehrhart, R.C.; Hansen, P.L. 1997. Effective cattle management in riparian zones: A field survey and literature review. Riparian Technical Bulletin No. 3. Billings,MT: U.S. Department of the Interior: Bureau of Land Management: 92 p.

Abstract: This report contains (1) a brief review of the characteristics and functions of riparian ecosystem in the western United States and the impact livestock grazing has had on them, (2) a presentation and analysis of the data collected over four field seasons, (3) a "Principles and Techniques" section that suggests general principles for developing successful grazing management strategies for the riparian areas and offers examples of good management techniques based both on field observations and the current literature, (4) a selected bibliography identifying especially useful material readily available to land managers and private operators. *GRAZING*

146. Ellis, L.M.; Crawford, C.S.; Molles, M.C., Jr. 1998. Comparison of litter dynamics in native and exotic riparian vegetation along the Middle Rio Grande of central New Mexico, U.S.A. Journal of Arid Environments. 38: 283–296.

Abstract: This paper presents a long-term study of how southwestern riparian ecosystems have been altered by both changed river flow regimes and introduced exotic plants, by investigating structural and functional aspects of the Rio Grande riparian forest in central New Mexico. The study compares (1) litter production, (2) litter decomposition, and (3) quantities of stored organic litter at cottonwood- and saltcedar-dominated sites during 1991 through 1996. It also compares the responses of these two vegetation types to experimental flooding. *INVASIVE SPECIES*

147. Elmore, W. 1986. Riparian management issues, overview and background. In: Smits, J.H., ed. Management of riparian areas. Washington, DC: Public Lands Council: 1-4.

Abstract: This paper briefly discusses riparian processes and the management challenges of the livestock industry to do more with lands management than they have done in the past. *GRAZING*

148. Elmore, W. 1988. Rangeland and riparian systems. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 93-95.

Abstract: The management and recovery of degraded riparian systems is a major conservation issue. Presently there are many grazing management strategies being applied based on the name of the technique with little incorporation of basic stream processes. Managers must understand the exact workings of grazing strategies and the individual processes of each stream before prescribing solutions to degraded riparian systems. *GRAZING*

149. Elmore, W. 1992. Riparian responses to grazing practices. In: Naiman, R.J., ed. Watershed management: Balancing sustainability and environmental change. New York: Springer-Verlag: 442-457.

Abstract: By the early 1900s many of the stream systems throughout the western rangelands were severely damaged or eliminated because of improper livestock use. Riparian exclosures throughout the West have proven that livestock grazing is not necessary to improve stream riparian systems. However, recent experience has shown that with proper grazing, livestock can be present while stream systems are improving. *GRAZING*

150. Elmore, W.; Beschta, R.L. 1987. Riparian areas: Perception in management. Rangelands. 9(6): 260-265.

Abstract: The objectives of this paper are (1) to promote awareness and discussion of riparian issues by and among livestock owners, land managers, environmentalists, biologists and the general public; (2) to identify the characteristics and benefits of productive riparian systems; and (3) to encourage managers of public and private lands to reconsider the effects to control channels structurally. *GRAZING*

151. Elmore W.; Kauffman, B. 1994. Riparian and watershed systems: Degradation and restoration. In: Vavra, M.; Laycock, W.A.; Pieper, R.D., eds. Ecological implications of livestock herbivory in the West. Denver CO: Society for Range Management: 212-231.

Abstract: This chapter examines causes of degradation of riparian ecosystems and upland watersheds. It looks at historical reasons for their current state and at present restoration efforts and strategies. *GRAZING*

152. Emerick, J.C. 1988. The restoration potential for wetlands impacted by acid mine drainage in the Colorado Rocky Mountains. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter, 109-111.

Abstract: Water pollution by acid mine drainage is a significant environmental problem in Colorado and other western States. There are close to 10,000 inactive mines in Colorado, many that discharge acid mine drainage, or produce leachate with characteristics similar to mine dumps or mill tailings. This paper discusses the impacts effects and solutions to this problem. *MINING*

153. Engel-Wilson, R.W.; Ohmart, R.D. 1978. Floral and attendant faunal changes on the lower Rio Grande between Fort Quitman and Presidio, Texas. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 139-147.

Abstract: Written and photographic documentation from explorers and settlers demonstrate that the floodplain was historically dominated by cottonwood-willow and screwbean mesquite communities. Past and present land and water use practices have resulted in an almost complete elimination of native tree species and dominance by the exotic saltcedar. Avian census data from the area show higher bird population densities and diversities in the select mature cottonwood-willow communities than in mature saltcedar communities. *INVASIVE SPECIES*

154. England, A.S.; Foreman, L.D.; Laudenslayer, W.F., Jr. 1984. Composition and abundance of bird populations in riparian systems of the California deserts. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 694-705.

Abstract: Avian population diversity, density, and species richness in desert riparian systems were analyzed. Riparian systems associated with permanent water are very limited. From a management standpoint the greatest threats to these systems are posed by recreationists, grazing, livestock and feral burros, as well as mining operations. *MULTIPLE THREATS*

155. Ewel, K.C. 1978. Riparian ecosystem: Conservation of their unique characters. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 56-62.

Abstract: Riparian ecosystems have two essential characteristics: laterally flowing water that rises and falls at least once within a growing season , and a high degree of connectedness with other ecosystems. Other pulses such as fire and hurricanes may also be important in ecosystem maintenance. Changes in hydroperiod or amplitude of water level fluctuation produce the most dramatic changes in riparian communities. Changes in neighboring ecosystems that have high rates of exchange of energy and nutrients with riparian ecosystems, may also have significant effects. *MULTIPLE THREATS*

156. Fenchel, G.; Oaks, W.; Swenson, E. 1989. Selecting desirable woody vegetation for environmental mitigation and controlling wind erosion and undesirable plants in the Rio Grande and Pecos River Valleys of New Mexico. Five-year interim report (1983-1987). Los Lunas, NM: U.S. Department of Agriculture, Soil Conservation Service, Plant Materials Center.

Abstract: Soil erosion along the Rio Grande and Pecos Rivers and flood plains has detrimental effects on the riparian habitat and the environment. Actions of man and the spread of undesirable species such as saltcedar have been associated with the decline of the riparian and flood plain habitats. River channel maintenance activities, as mandated by law, can require measures such as revegetation. This report describes the work conducted by the USDI Bureau of Reclamation and the USDA Soil Conservation Service to control erosion at the Elephant Butte and Caballo Reservoirs. *MULTIPLE THREATS*

157. Fenner, P.; Brady, W.W.; Patton, D.R. 1985. Effects of regulated water flows on regeneration of Fremont cottonwood. Journal of Range Management. 38: 135-138.

Abstract: This study investigated the effects of releasing water from dams on the establishment of riparian vegetation. The hypothesis examined was that dams modify local conditions to the extent that some plant species find the riparian zone less favorable or even unfavorable as habitat. *DAM CONSTRUCTION*

158. Fierke, M.K.; Kauffman, J.B. 2005. Structural dynamics of riparian forests along a black cottonwood successional gradient. Forest Ecology and Management. 215: 149–162.

Abstract: The objectives of this study were to quantify and describe successional change, stand development, and biomass accumulation in black cottonwood riparian forests of the Willamette River, Oregon from recently established seedlings on fresh alluvial substrate to late-successional stands. *FLOODS*

159. Finch, D.M. 1996. Research and management of soil, plant, animal, and human resources in the Middle Rio Grande Basin. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 69-76.

Abstract: The Rocky Mountain Forest and Range Experiment Station initiated a research program in 1994 called, "Ecology, diversity, and sustainability of soil, plant, animal, and human resource of the Rio Grande Basin." Its mission focuses on the development and application of new knowledge to sustain ecological systems and human populations in the Middle Rio Grande Basin. Research studies emphasize upland ecology and management, linkages between watersheds and riparian zones, sensitive fish and wildlife populations and species of concern, and past and present cultural resources. *MULTIPLE THREATS*

160. Finch, D.M. 1999. Recovering southwestern willow flycatcher populations will benefit riparian health. In: McCabe, Richard E.; Loos, Samantha E., eds. Transactions of the 64th North American Wildlife and Natural Resources Conference; 1999 March 26-30; Burlingame, CA. Washington, DC: Wildlife Management Institute: 275-291.

Abstract: This paper briefly reviews the distribution, taxonomy and population status of the southwestern willow flycatcher then follows with a survey of problems and threats faced by fragmented flycatcher populations in the Southwest. It concludes with a summary of potential actions that various stakeholders, including private citizens, can take to benefit the flycatcher as well as important strides to take in conserving and recovering riparian ecosystems. *MULTIPLE THREATS*

161. Fleischner, T.L. 1994. Ecological costs of livestock grazing in Western North America. Conservation Biology. 8(3): 629-644.

Abstract: Livestock grazing is the most widespread land management practice in western North America with seventy percent of the western United States both public and private land being grazed. This paper discusses the many ecological costs of grazing, such as loss of biodiversity, disruption of ecosystem functions, and change in the physical characteristics of both terrestrial and aquatic habitats. This research pertains particularly to riparian ecosystems, which is where livestock often congregate and can have the greatest impact. The author advocates for the involvement of conservation biologists in the ongoing social and scientific dialogue on grazing issues to promote healthy ecosystems. *GRAZING*

162. Fleming, C.M.; Kunkle, S.H.; Flora, M.D. 1996. Riparian wetlands and visitor use management in Big Bend National Park, Texas. In: Shaw, D.W.; Finch, D.M., tech.

coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 212-215.

Abstract: Resource impacts, resulting from careless use and overuse, has been documented by several surveys at a number of the more popular areas in the Big Bend National Park's riparian or wetland habitats. This paper discusses these impacts and the park management actions that are underway or under consideration to deal with them. The management actions are aimed at limiting resource damage to wetland and riparian habitat while permitting visitor use of the resources. *RECREATION*

163. Flenniken, M.; Mceldowney, R.R.; Leiniger, W.C.; Frasier G.W. 2001. Hydrologic responses of a montane riparian ecosystem following cattle use. Journal of Range Management. 54: 567-574.

Abstract: Riparian areas link streams with their terrestrial catchments and decrease water pollution by trapping sediments from upland sources before they reach streams or lakes. Livestock grazing in riparian areas is a controversial practice. If not properly managed, cattle can cause degradation to both the riparian zone and adjacent water body. Vegetative, soil microtopographical, microchannel, and hydrograph parameters were measured in a montane riparian community in northern Colorado to quantify the effects of cattle on overland flow and runoff characteristics. Results from this study have improved our understanding of flow and runoff processes following cattle use of a riparian ecosystem. *GRAZING*

164. Follstad Shah, J.J.; Dahm, C.N. 2008. Flood regime and leaf fall determine soil inorganic nitrogen dynamics in semiarid riparian forests. Ecological Applications. 18(3): 771-788.

Abstract: This study examines the effects of flood regime on plant community and soil inorganic nitrogen dynamics in riparian forests dominated by native *Populus detoides* var. *wislizenii* Eckenwalder (Rio Grande cottonwood) and nonnative *Tamarix chinensis* Lour. (saltcedar) along the regulated middle Rio Grande of New Mexico. The authors recommend utilizing naturalized flows that help maintain riparian groundwater elevations between 1 and 3 m in reaches with mature *P. deltoides* or where *P. deltoides* revegetation is desired. Other recommendations include identifying areas that naturally undergo long periods of inundation and consider restoring these areas to seasonal wetlands and using native xeric-adapted riparian plants to revegetate long and short inter-flood interval sites where groundwater elevations commonly drop below 3 m. *FLOODS, INVASIVE SPECIES*

165. Fonseca, J. 1993. A county government perspective. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 22-24.

Abstract: The Pima County hydrologist describes how the county is dealing with the threat of losing riparian vegetation due to development and land use change on private lands. *URBANIZATION*

166. Fornwalt, P.J.; Kaufmann, M.R.; Huckaby, L.S.; Stohlgren, T.J. 2009. Effects of past logging and grazing on understory plant communities in a montane Colorado forest. Plant Ecology. 203: 99-109.

Abstract: The authors investigate the long-term impacts of settlement-era activities on understory plant communities by comparing understory composition at a historically logged and grazed site to that of an environmentally similar site that was protected from past use. The study found that species richness and cover within functional groups rarely differed between sites in either upland or riparian areas, though compositional differences were apparent in riparian zones. *MULTIPLE THREATS*

167. Fort, D.D. 1993. The protection of riparian areas: New approaches for new times. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H. tech., coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 70-75.

Abstract: In this brief paper, an appraisal of the opportunities and barriers to riparian protection and restoration is presented. The focus is on public policy and current opportunities for riparian protection. *MULTIPLE THREATS*

168. Fox, K. 1977. Importance of riparian ecosystems: Economic considerations. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 19-22.

Abstract: Efforts to preserve riparian habitat must recognize man's growing demands to put this area to other use. Economic pressures, at conflict with environmental concerns, pose an inevitable threat to vegetation and wildlife. A compromise in the balance or preservation and development must be maintained. *MULTIPLE THREATS*

169. French, R.H.; Woessner, W.W. 1981. Erosion and salinity problems in arid regions. In: Proceedings of the specialty

conference; 1981 Aug. 10-14; San Francisco, CA. ASCE Water Forum 81. New York: American Society of Civil Engineers: 1319-1326.

Abstract: The mineral quality problem in southwestern rivers is a complex problem, which is critically important on a regional, national and international basis. Mineral quality, commonly termed salinity or total dissolved solids, is a particularly serious water quality problem on the main stem of the Colorado River. Man-made sources of salinity include municipal and industrial consumptive use of water, irrigation, and evaporation from reservoirs. *WATER QUALITY*

170. Furman, D. 1988. San Joaquin River riparian habitat below Bellow Friant Dam: Preservation and restoration. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 79-82.

Abstract: Riparian habitat along California's San Joaquin River in the 25 miles between Friant Dam and Freeway 99 occurs on approximately 6 percent of its historic range. It is threatened directly and indirectly by increased urban encroachment such as residential housing, certain recreational uses, sand and gravel extraction, agriculture, and road construction. *MULTIPLE THREATS*

171. Gage, E.A.; Cooper, D.J. 2004. Constraints on willow seedling survival in a Rocky Mountain montane floodplain. Wetlands. 24(4): 908-911.

Abstract: In this study, authors analyzed the influence of soil texture and relative elevation on patterns of willow seedling survival along a relatively degraded, small-order montane stream. Results indicate that both soil water availability and scour by spring floods influence the spatial and temporal patterns of willow seedling survival on point bars along small-order montane streams. A better understanding of the factors governing willow seedling survival can help managers identify potential constraints on the natural recovery or restoration of degraded riparian communities and to predict vegetation responses to anthropogenic and natural disturbances, such as large floods and climate change. *FLOODS, CLIMATE CHANGE*

172. Gazal, R.M.; Scott, R.L.; Goodrich, D.C.; Williams, D.G. 2006. Controls on transpiration in a semiarid riparian cottonwood forest. Agricultural and Forest Meteorology. 137: 56-67.

Abstract: This paper presents the seasonal patterns of cottonwood transpiration at two contrasting riparian sites in order to better understand how the trees transpire in relation to canopy structure, evaporative demand, and groundwater depth along the San Pedro River in southeastern Arizona. Riparian cottonwood forests are exposed to extreme fluctuations in water availability and transpiration demand throughout the growing season, and their access to shallow groundwater sources determines their structural and physiological responses to drought. Spatial and temporal variation in depth to groundwater induces drought stress in cottonwood, threatening their productivity and existence along the river systems throughout much of western United States. *GROUNDWATER DEPLETION, DROUGHT*

173. Gergel, S.E.; Turner, M.G.; Miller, J.R.; Melack, J.M.; Stanley, E.H. 2002. Landscape indicators of human impacts to riverine systems. Aquatic Sciences. 64(2): 118-128.

Abstract: This paper briefly reviews the chemical, biotic, hydrologic and physical habitat assessment approaches commonly used in riverine systems. It then discusses how landscape indicators can be used to assess the status of rivers by quantifying land cover changes in the surrounding catchment, and contrasting landscape-level indicators with the more traditionally used approaches. *MULTIPLE THREATS*

174. Gillen, R.L.; Krueger, W.C.; Miller, R.F. 1985. Cattle use of riparian meadows in the Blue Mountains of Northeastern Oregon. Journal of Range Management. 38: 205-209.

Abstract: The objectives of this study were to (1) determine the intensity and pattern of cattle use of small riparian meadows under continuous and deferred rotation grazing management and (2) compare the temperature and relative humidity regimes of riparian and upland plant communities. *GRAZING*

175. Glinski, R.L. 1977. Regeneration and distribution of sycamore and cottonwood trees along Sonoita Creek, Santa Cruz County, Arizona. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 116-123.

Abstract: This study describes the effects of livestock grazing and streambed erosion on the regeneration and distribution of sycamore and cottonwood trees. Sycamore reproduce from root and trunk sprouts and, because of this, their distribution is not as likely to change significantly. Cottonwood reproduction was nearly absent in areas grazed by cattle, and was confined to the narrow erosion channel. If this regeneration pattern continues, the future maximum width of the cottonwood forest will decrease nearly 60%. *GRAZING*

176. Gradek, P.; Saslaw, L.; Nelson, S. 1988. An application of BLM's riparian inventory procedure to rangeland riparian resources in the Kern and Kaweah River watersheds. In: Abell, D.L., coord. Proceedings of the

California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA; Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 109-115.

Abstract: The Bakersfield District of the Bureau of Land Management conducted an inventory of rangeland riparian systems using a new method developed by a Bureau-wide task force to inventory, monitor, and classify riparian areas. Data on vegetation composition were collected for 65 miles of streams and entered into a hierarchical vegetation classification system. Ratings of hydrologic function, vegetative structure, and vegetative use by grazing animals were employed to measure impacts by land uses and potential for recovery with proper management. *GRAZING*

177. Graf, W.L. 2006. Downstream hydrologic and geomorphic effects of large dams on American rivers. Geomorphology. 79(3-4): 331-360.

Abstract: This paper explains the specific methods and results for investigating the downstream effects of large dams on hydrology, and geomorphology. It also addresses regional variation of hydrology and geomorphology as affected by dams, and explores the ecologic implications of downstream influence of dams. *DAM CONSTRUCTION*

178. Gray, M.V.; Greaves, J.M. 1984. Riparian forest as habitat for the Least Bell's Vireo. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 605-611.

Abstract: Data are presented on vegetation structure in Least Bell's Vireo breeding habitats. A discussion of vegetation and several other factors relevant to breeding success of this endangered species is presented. Recommendations are made for actions, such as limiting grazing and recreation, to ensure the future of the subspecies as a breeding inhabitant of riparian forests. *MULTIPLE THREATS*

179. Green, D.M.; Kauffman, J.B. 1989. Nutrient cycling at the land-water interface: The importance of the riparian zone. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 61-68.

Abstract: Recent research has shown that low reduction-oxidation potential result in denitrification and that phosphorus immobilization processes occur within intact riparian ecosystems, thereby greatly influencing water quality. The effects of grazing and other anthropogenic disturbances can alter these biogeochemical cycles resulting in drastic alterations in riparian vegetation composition and productivity, aquatic ecosystems and water quality. *WATER QUALITY*

180. Green, D.M.; Kauffman, J.B. 1995. Succession and livestock grazing in a Northeastern Oregon riparian ecosystem. Journal of Range Management. 48: 307-313.

Abstract: Comparisons of vegetation dynamics of riparian plant communities under livestock use and exclusions over a 10-year period were quantified in a Northeastern Oregon riparian zone. Results indicate that influences of herbivory on species diversity and evenness varies from one community to another, and basing management recommendation on one component ignores the inherent complexity of riparian ecosystems. The objective of this study was to quantify changes in vegetation species composition over 10 years of eight grazed and ungrazed riparian plant communities. *GRAZING*

181. Gregory, S.V.; Swanson, F.J.; McKee, W.A.; Cummins, K.W. 1991. An ecosystem perspective of riparian zones: Focus on links between land and water. Bioscience. 41: 540-551.

Abstract: Bank erosion is integral to the functioning of river ecosystems. It is a geomorphic process that promotes riparian vegetation succession and creates dynamic habitats crucial for aquatic and riparian plants and animals. River managers and policymakers, however, generally regard bank erosion as a process to be halted or minimized in order to create landscape and economic stability. Bank erosion is now recognized as a desirable attribute of rivers. Recent advances in the understanding of bank erosion processes and of associated ecological functions, as well as of the effects and failure of channel bank infrastructure for erosion control, suggest that alternatives to current management approaches are greatly needed. A conceptual framework for alternatives is developed in this paper that addresses bank erosion issues. The alternatives conserve riparian linkages at appropriate temporal and spatial scales, consider integral relationships between physical bank processes and ecological functions, and avoid secondary and cumulative effects that lead to the progressive channelization of rivers. By linking geomorphologic processes with ecological functions, the significance of channel bank erosion in sustainable river and watershed management is addressed. MULTIPLE THREATS

182. Groeneveld, D.P.; Griepentrog, T.E. 1985. Interdependence of groundwater, riparian vegetation, and streambank stability: A case study. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 44-48.

Abstract: Groundwater is closely coupled with streamflow to maintain water supply to riparian vegetation, particularly where precipitation is seasonal. A case study is presented where Mediterranean climate and groundwater extraction are linked with the decline of riparian vegetation and subsequent severe

bank erosion on the Carmel River in Carmel Valley, California. *GROUNDWATER DEPLETION, FLOW REGULATION*

183. Hadley, R.F.; Emmett, W.W. 1998. Channel changes downstream from a dam. Journal of the American Water Resources Association. 34: 629-637.

Abstract: A flood-control dam was completed during 1979 on Bear Creek, a small tributary stream to the South Platte River in the Denver, Colorado, area. Before and after dam closure, repetitive surveys between 1977 and 1992 at five cross sections downstream of the dam documented changes in channel morphology. During this 15-year period, channel width increased slightly, but channel depth increased by more than 40 percent. Within the study reach, stream gradient decreased and median bed material sizes coarsened from sand in the pools and fine gravel on the rime to median coarse gravel throughout the reach. The most striking visual change was from a sparse growth of streamside grasses to a dense growth of riparian woody vegetation. *DAM CONSTRUCTION*

184. Hain, F. 2006. New threats to forest health require quick and comprehensive research response. Journal of Forestry. 104(4): 182-186.

Abstract: Exotic pest introductions are a global threat occurring at an unprecedented rate. Comprehensive research programs are required at the onset to prevent the spread of the invasive insects, pathogens, or plants, and rehabilitate and restore native habitats and ecosystems. Unfortunately, much of the current research on invasives is piecemeal. Past experiences with exotic and native pests provide some valuable lessons about how we should approach research programs on invasive organisms. The infrastructure required for effectively administering comprehensive research programs is complex. An example is discussed. *INVASIVE SPECIES, INSECTS AND DISEASE*

185. Hair, D.; Stowell, R. 1986. South Fork Clearwater River habitat enhancement: Annual report FY 1985. In: Natural propagation and habitat improvement Volume II. Project No. 84-5. Portland, OR: U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. 282 p.

Abstract: This annual report deals with additional treatments to improve fish habitat in the South Fork Clearwater River that had not been covered in previous reports. Fish habitat problems are the result of overgrazing and previous dredge mining for gold, which eliminated the riparian meadow. *MULTIPLE THREATS*

186. Hall, F.C. 1988. Characterization of riparian systems. In: Raedeke, K.J., ed. Streamside Management: Riparian wildlife and forestry interactions. Institute of Forest Resources Contribution 59. Seattle, WA: University of Washington: 7-11.

Abstract: The purpose of this introductory paper is simply to bring together in a general way some of the more important factors influencing riparian ecosystems. These include natural factors, such as seasonal flows, floods, beavers, and fire. Management activities such as livestock grazing, timber harvest, and the building of roads, dams, and other structures generate unnatural impacts. *MULTIPLE THREATS*

187. Hancock, J.L. 1989. Selling a successful riparian management program: A public land manager's viewpoint. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 1-3.

Abstract: The purpose of this paper is to discuss the human relationship keys to selling a successful riparian area management program. Giving riparian areas in central Oregon as examples, the author shows how to deal with management threats to riparian areas, such as livestock grazing. *GRAZING*

188. Haney, J. 2007. Rivers and water management in the Southwest. Southwest Hydrology; 6(3): 22-23, 34-35.

Abstract: The web of water law, policy, and management in the West has developed over decades, varies by State, and is exceedingly complex. That complexity reflects an attempt to achieve equity among the various water use sectors: municipal, agricultural, mining, and commercial/industrial. This paper discusses how water management can be used to prevent further loss and impairment of southwest rivers and wetlands. *MULTIPLE THREATS*

189. Hansen, P. 1993. Developing a successful riparian-wetland grazing management plan for the Upper Ruby River cattle and horse allotment in southwestern Montana. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests; A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 328-335.

Abstract: The major concern with the Upper Ruby cattle and horse grazing allotment has been the health of the riparian zone. The historic use of the riparian zone along the Upper Ruby River and its major tributaries has left much of it in a degraded state. This paper provides background information, identifies problems, describes how to develop management objectives, and proposes a monitoring plan. *GRAZING*

190. Hedlund, J.D. 1984. USDA planning process for Colorado River Basin salinity control. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of

the 1983 international symposium on state-of-the-art control of salinity; 1984 July 13-15, Salt Lake City UT. Boston MA: Butterworth Publishers: 63-77.

Abstract: Man-caused increases in salinity result from diversion, consumptive use, and salt-loading in return flows. The largest man-induced increase in salinity is caused by the concentrating effect of irrigated agriculture and salt loading associated with it. This paper discusses the problem and solutions in more detail. *WATER QUALITY*

191. Hehnke, M.; Stone, C.P. 1978. Value of riparian vegetation to avian populations along the Sacramento River system. In: Johnson, R.R.; McCormick, J.F. tech., coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 228-235.

Abstract: The purpose of this study was to determine the value of riparian habitat to birds along the Sacramento River. Spring and fall migratory peaks of bird density and diversity were higher in riparian and associated vegetation than in riprapped and associated vegetation. Riparian vegetation appears to control avian density and diversity in associated vegetation. *MULTIPLE THREATS*

192. Heifner, M.A. 1978. Sand and gravel mining in Colorado riparian habitats. In: Graul, W.D.; Bissel, S.J., tech. coords. Lowland river and stream habitat in Colorado: A symposium; 1978 October 4-5; Greeley, CO. Greeley, CO: Wildlife Society and Colorado Audubon Council: 141-147.

Abstract: This paper discusses the extent and general areas of sand and gravel mining in riparian habitats along Colorado streams and rivers. It emphasizes the impacts of mining on the loss of long-established terrestrial wildlife habitats and the prospects of loss mitigation by replacement with a combined terrestrial/aquatic habitat. *MINING*

193. Hendrickson, D.A.; Minckley, W.L. 1984. Cienegas—Vanishing climax communities of the American Southwest. Desert Plants. 6(3): 131-175.

Abstract: This paper discusses various factors that have led to the destruction of cienegas in the American Southwest. The authors state that cienegas conditions can be restored at historic sites by provision of constant water supply and amelioration of catastrophic flooding events. *FLOODS, FLOW REGULATION*

194. Henszey, R.J.; Wolff, S.W.; Wesche, T.A.; Skinner, Q.D.; Hubert, W.A. 1988. Assessment of a flow enhancement project as a riparian and fishery habitat mitigation effort. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 88-93.

Abstract: As part of mitigation procedures for impacts caused by the Cheyenne Stage II water development project in the Little Snake River Drainage, Wyoming, the flow in a previously ephemeral watercourse on the east slope of the Laramie Range is being enhanced to create a perennial stream. Water used to enhance this flow is obtained by trans-basin diversion. The mitigation is being done in hopes of enhancing the riparian and fishery habitat. This paper describes the overall mitigation project, the study design, and preliminary results. *WATER DIVERSION*

195. Henszey, R.J.; Pfeiffer, K.; Keogh, J.R. 2004. Linking surface- and groundwater levels to riparian grassland species along the Platte River in Central Nebraska, USA. Wetlands. 24(3): 665-687.

Abstract: This study suggests that for Platte River riparian grasslands, high water levels are more influential than mean, median, or low water levels. Land-management practices (i.e., grazing, haying, and extended rest) affected six species by a change in frequency or a shift in position along the water-level gradient. Four general plant communities composed of species responding individually to the water-level gradient and other factors were identified for Platte River riparian grasslands: emergent, sedge meadow, mesic prairie, and dry ridge. Plant response curves are the first step toward predicting how plants responding to riparian-grassland water levels might also respond to river management. *MULTIPLE THREATS*

196. Hesseldenz, T.F. 1984. Developing a long-term protection plan for the McCloud River, California. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 784-794.

Abstract: The McCloud River drainage in northern California hosts numerous species with rare or threatened status that have, until recently, been indirectly protected by a history of private ownership and inaccessibility of large parts of the drainage. Dam construction, water diversion, road construction, timber harvest, angling pressure, and limestone quarrying now threaten the drainage and have encouraged intensive planning efforts to lessen their impacts. *MULTIPLE THREATS*

197. Hink, V.C.; Ohmart, R.D. 1984. Middle Rio Grande biological survey. Tempe: Arizona State University, Center for Environmental Studies. 160 p.

Abstract: The objectives of this study were to identify the major types of riparian habitat within the study reach, and to characterize the vegetation and terrestrial vertebrate communities of each type. The study focused on the area within and including the drains and levees that parallel the river. *MULTIPLE THREATS*

198. Hirsch, A.; Segelquist, C.A. 1978. Protection and management of riparian ecosystems: Activities and views of the US Fish and Wildlife Service. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 344-352.

Abstract: Land use changes and water resource development activities are jeopardizing valuable riparian ecosystem. Current activities of the Fish and Wildlife Service providing for the protection of riparian resources are described, and several initiatives are outlined to strengthen riparian ecosystem protection and management programs. *MULTIPLE THREATS*

199. Holway, D.A. 2005. Edge effects of an invasive species across a natural ecological boundary. Biological Conservation. 121: 561–567.

Abstract: This paper examines the spatial pattern and ecological effects of a biological invasion at well-delineated and abrupt edges between riparian corridors and coastal sage scrub at 10 sites in southwestern California. In general, edge effects occurring at natural boundaries should receive increased attention as they might disrupt ecosystems not greatly altered by human activity. *INVASIVE SPECIES*

200. Hook, D.D.; Murray, M.M.; DeBell, D.S.; Wilson, B.C. 1987. A technique for assessing the influence of shallow water table levels on red alder (*Alnus rubra* Bong.) family performance. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 248-252.

Abstract: Depth of rusting on iron rods placed in the soil near red alder trees was used to assess the relationship between tree height at age 5 years and the soil water table level during the dormant season. The iron rods proved to be a sensitive indicator of water table levels. By using regression and covariance analysis, differences in family response were found over the range of 0 – 30 cm deep water tables. It was concluded that the technique is sensitive, simple to use, and inexpensive. *GROUNDWATER DEPLETION*

201. Hoover, D.E.; Gipson, P.S.; Pontius, J.S.; Hynek, A.E. 2001. Short-term effects of cattle exclusion on riparian vegetation in Southeastern Kansas. Transactions of the Kansas Academy of Science. 104(3–4): 212–222.

Abstract: This paper describes the effects of cattle exclusion on the structure and composition of riparian vegetation observed in a 2-year study in southeastern Kansas. A significant difference in the percentage of bare ground and herbaceous vegetation height was observed between the grazed and ungrazed study sites. Excluding cattle from closed canopy riparian woodlands in southeastern Kansas resulted in a positive short-term response of understory herbaceous vegetation. Results suggest that riparian fencing may be an effective management tool for restoring understory vegetation in riparian communities grazed by cattle in the eastern Great Plains. *GRAZING*

202. Horton, J.L.; Kolb, T.E.; Hart, S.C. 2001. Responses of riparian trees to interannual variation in ground water depth in a semi-arid river basin. Plant, Cell and Environment. 24: 293-304.

Abstract: The study presented in this paper investigated the physiological and growth responses of native (*Populus* and *Salix*) and exotic (*Tamarix*) riparian trees to groundwater availability at the free-flowing Hassayampa River, Arizona, during dry (1997) and wet (1998) years. *GROUNDWATER DEPLETION, INVASIVE SPECIES*

203. Horton, J.L.; Kolb, T.E.; Hart, S.C. 2001a. Physiological response to groundwater depth varies among species with river flow regulation. Ecological Applications. 11(4): 1046–1059.

Abstract: This paper presents findings of an investigation of the physiological condition of two native species, *Populus fremontii* and *Salix gooddingii*, and one invasive exotic, *Tamarix chinensis*, along gradients of groundwater availability at a dam-regulated river and a free-flowing river in the Sonoran Desert in Arizona. *DAM CONSTRUCTION, INVASIVE SPECIES*

204. Horton, J.S. 1977. The development and perpetuation of the permanent tamarisk type in the phreatophyte zone of the Southwest. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 124-127.

Abstract: Several species of tamarisk were introduced into the United States in the 19th century for ornamental use. Saltcedar became naturalized and by the 1920s was a dominant shrub along the southwestern rivers. Its aggressive character suits it to be a permanent dominant in much of the phreatophyte vegetation of this region. Successful management of this vegetation for any resource must carefully consider its ecological characteristics. *INVASIVE SPECIES*

205. Houghton, C.J.; Michny, F.J. 1988. Middle Sacramento River refuge: A feasibility study. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 83-87.

Abstract: The woodlands and other streamside habitat of Sacramento River's riparian system have been severely reduced within the last century. This riparian habitat and its ability to sustain diverse populations of fish, migratory birds, mammals, and other wildlife have been significantly impacted by water control projects, agriculture developments, and other land uses. *MULTIPLE THREATS*

206. Howard, S.W.; Dirar, A.E.; Evans, J.O.; Provenza, F.D. 1983. The use of herbicides and/or fire to control saltcedar (*Tamarix*). Proceedings of the Western Society of Weed Science. 36: 65-72.

Abstract: Experiments conducted over 2 years have indicated that managed burning and spraying to control saltcedar is only effective in July. Burning in late July prevented 64 percent of the plants from resprouting the year following the treatment, whereas spraying the resprouts with herbicide 1 month after prevented 99 percent or better, of the plants from resprouting. *INVASIVE SPECIES*

207. Howe, W.H.; Knopf, F.L. 1991. On the imminent decline of Rio Grande cottonwoods in central New Mexico. The Southwestern Naturalist. 36(2): 218-224.

Abstract: The combination of paucity of cottonwood regeneration over the last 30 years, the rapid colonization during this century of Russian-olive and saltcedar into the valley, and the current river channel management practices suggest that the Rio Grande riparian woodland will become dominated by the exotic shrubs over the next 50 to 100 years. *INVASIVE SPECIES*

208. Hubbard, J.P. 1977. Importance of riparian ecosystems: Biotic considerations. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 14-18.

Abstract: The emphasis on the importance of riparian ecosystems to the biota of the Southwest has concentrated mainly on the question of surface water, as in the case of fishes and of certain other animals and plants. However, there are other riparian features involved that should also be mentioned, and among the most important is the vegetation characteristic of these ecosystems described in this paper. *MULTIPLE THREATS*

209. Hubbs, C.; Miller, R.R.; Edwards, R.J.; Thompson, K.W.; Marsh, E.; Garrett, G.P.; Powell, G.L.; Morris, D.J.; Zerr, R.W. 1977. Fishes inhabiting the Rio Grande, Texas and Mexico, between El Paso and the Pecos confluence. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 91-97.

Abstract: The fishes of the middle part of the Rio Grande can be divided into three fauna assemblages: the saline Rio Grande fauna upstream from the Conchos confluence; the Rio Conchos-Rio Grande fauna in the Rio Grande between Conchos and Pecos; and the tributary creek fauna that depend on tributary creeks for all or part of their life history stages. Endangered species are found in the last assemblage, but two presumed endangered species seem to have been eliminated already. *MULTIPLE THREATS*

210. Hunter, W.C.; Anderson, B.W.; Ohmart, R.D. 1985. Summer avian community of Tamarix habitats in three southwestern desert riparian systems. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 128-134.

Abstract: Data from three southwestern river systems were used to assess avian response to saltcedar. Species were grouped by breeding biology and groups responded differently in their occurrence in saltcedar among the valleys. Biogeographical and climatic factors may explain these differences. *INVASIVE SPECIES*

211. Huxman, T.E.; Scott, R.L. 2007. Climate change, vegetation dynamics, and the landscape water balance. Southwest Hydrology. 6(1): 28-37.

Abstract: Elevated CO_2 concentrations favor woody plants over grasses and may accelerate woody-plant thickening or encroachment. Changes in the ratio of woody plants to grasses can influence the landscape water balance by affecting recharge and streamflow. Larger woody vegetation populations would be expected to increase the amount of water leaving landscapes as evapotranspiration. *CLIMATE CHANGE*

212. Jackson, J.; Ball, J.T.; Rose, M.R. 1990. Assessment of the salinity tolerance of eight Sonoran Desert riparian trees and shrubs. Final Report. Reno, NV: Desert Research Institute, University of Nevada System, Biological Sciences Center: 102 p.

Abstract: Eight species of Sonoran Desert riparian trees and shrubs were examined in a greenhouse-based study of salinity tolerance at six levels. The publication addresses the results of these studies. A serious problem related to plant growth in arid regions is the accumulation of salt in soil. Whereas salts in humid soils are leached by continuous precipitation, arid soils zones accumulate high salt content through processes of evaporation and upward capillary movement of moisture from the water table. *WATER QUALITY*

213. Janda R.J. 1977. Summary of watershed conditions in the vicinity of Redwood National Park, California. Open-File Report 78-25. Menlo Park, CA: U.S. Department of the Interior: Geological Survey: 82 p.

Abstract: The Redwood Creek Unit of Redwood National Park is located in the downstream end of an exceptionally rapidly eroding drainage basin. Spatial distribution and types of erosional landforms, observed in the field and on time-sequential aerial photos, measured sediment load. The lithologic heterogeneity of streambed materials indicate (1) that sediment discharges reflect a complex suite of natural and man-induced mass movement and fluvial erosion processes operating on a geologically heterogeneous, naturally unstable terrain, and (2) that although infrequent exceptionally intense storms control the timing and general magnitude of major erosion events, the loci, types, and amounts of erosion occurring during those events are substantially influenced by land use. Erosional impact of past timber harvest in the Redwood Creek basin reflect primarily the cumulative impact of many small erosion problems caused not so much by removal of standing timber as by the intensity and pattern of ground surface disruption accompanying removal. *FOREST HARVESTING*

214. Jensen, S.; Platts, W.S. 1987. Processes influencing riparian ecosystems. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists. 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 228-232.

Abstract: A primary function of rivers, the transport of water and sediments, is influenced by the interaction of geologic, climatic, hydrologic, geomorphic, pedogenic, and biotic processes. These same processes are principally responsible for the development of riparian ecosystems, which regulate the flux of water and sediments. The distribution, values, qualities and dynamics of riverine/riparian ecosystems may be viewed as responses to these co-evolutionary processes. As man assumes a dominant role in orchestrating the dynamics of watersheds, an understanding of these relationships is essential for proper management of riverine/riparian ecosystems. *MULTIPLE THREATS*

215. Jensen, S.E.; Platts, W.S. 1990. Restoration of degraded riverine/riparian habitat in the Great Basin and Snake River Regions. In: Kusler, J.A.; Kentula, M.E., eds. Wetland creation and restoration: The Status of the Science: Washington, DC: Island Press: 307-404.

Abstract: This paper addresses restoration of degraded riverine/riparian habitat in the Great Basin Hydrographic Region and the Snake River Subregion of the Columbia River Hydrographic Region. It discusses degraded habitat and how to identify when values and beneficial uses have been impaired. Further, it describes how to achieve the goal of restoration by returning a habitat to a less impaired state. In its appendix it gives nine examples of riparian restoration projects, including cause of their degradation as well as past and current threats to these riverine/riparian habitats. *MULTIPLE THREATS*

216. Johnson, A.S. 1989. The thin green line: Riparian corridors and endangered species in Arizona and New Mexico. In: Mackintosh, G., ed. Preserving communities & corridors. Washington, DC: Defenders of Wildlife: 35-46.

Abstract: The paper provides a historical account of the riparian communities in Arizona and New Mexico. It describes the negative impacts of grazing and land use change, namely agriculture, on these systems. 149 vertebrate species are listed for both States. This paper provides a detailed list for both States listing the threatened and endangered species occurring in each major riparian community. *MULTIPLE THREATS*

217. Johnson, B.; Merritt, D. 2009. The effects of wildfire on native tree species in the Middle Rio Grande bosques of New Mexico. Fort Collins, CO: Colorado State University. 43 p.

Abstract: The cottonwood bosques along the Middle Fork of the Rio Grande (MRG) form a ribbon of surviving habitat in what was once a vast ecosystem. Acknowledging the reality that widespread restoration of the historical hydrogeomorphic conditions that would support natural cottonwood reproduction is highly unlikely, management strategies for bosque forests have seen an increasing emphasis on preservation of the existing habitats and the established trees within. The objective of this study was to examine the effects of wildfires on cottonwood forests along the MRG to help inform the best management practices for these highly valued natural systems. *FIRE*

218. Johnson, B.A.; Riley, J.A. 1984. Price/San Rafael River Basin salinity investigation. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of the 1983 international symposium on state-of-the-art control of salinity; 1984 July 13-15; Salt Lake City, UT: Boston, MA: Butterworth Publishers: 407-416.

Abstract: The Price and San Rafael River Basins are located in east-central Utah and annually contribute 434,000 tons of salt to the Colorado River. Historical evidence indicates that agricultural practices are responsible for the greatest contribution. This paper discusses the problem and solutions in more detail. *AGRICULTURE, WATER QUALITY*

219. Johnson, R.R. 1978. The Lower Colorado River: A Western system. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 41-55.

Abstract: The historic look at the Colorado River illustrates the dramatic effects of human activity on most Western rivers. Engineering features for the management of water and electric power have resulted in increased evaporation, associated salinity, and other physiochemical changes; drastic reduction in many native plant and animal populations; increasing population of introduced species; and changes in erosional and sedimentation rates. *MULTIPLE THREATS*

220. Johnson, R.R.; Carothers, S.W. 1982. Riparian habitat and recreation: Interrelationships and impacts to the Southwest and Rocky Mountain region. Eisenhower Consortium Bulletin 12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 31 p.

Abstract: Riparian habitats are characterized by outstanding species richness and population densities of both plants and animals. Increasing recreational pressures on these ecotones between water and surrounding uplands are forcing management agencies to re-analyze consumptive versus nonconsumptive resource allocations. *MULTIPLE THREATS*.

221. Johnson, R.R.; Haight, L.T. 1984. Riparian problems and initiatives in the American Southwest: A regional perspective. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 404-412.

Abstract: Destruction of much of the Southwest's riparian zone is the result of waters by consumptive uses and by mechanical damages from grazing, mining, engineering activities and more recently with suburban and urban development. Only by an increase in active, scientific based management will we succeed in leaving even a viable remnant of Southwestern riparian ecosystems for posterity. *MULTIPLE THREATS*

222. Johnson R.R.; McCormick, J.F. 1978. tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Proceedings of a symposium; 1978 December 11-13. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 410 p.

Abstract: This symposium brought together scientists from across the U.S.A. to discuss and develop strategies for managing and protecting wetlands and riparian ecosystems. Threats to that goal were addressed in numerous papers. *MULTIPLE THREATS*

223. Johnson, W.C.; Burgess, R.L.; Keammerer, W.C. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. Ecological Monographs. 46: 59-84.

Abstract: The study area, bounded by two large reservoirs, includes the most extensive remnant of floodplain forest in the Dakotas. Structure and composition of the forest overstory are strongly related to stand age and horizontal and vertical position on the floodplain. *Populus deltoids* and *Salix amygdaloides* predominate in young stands on low terraces near the center of the floodplain. *Fraxinus pennsylvanica*, *Acer negundo*, *Ulmus americana*, and *Quercus macrocarpa* predominate in old stands on high terraces near the edge of the floodplain. Stands intermediate in composition are uncommon because of the discontinuous meandering pattern of the river across its floodplain. Surface soil environment and species diversity change markedly during the course of succession. The soils of young stands are generally sandy and low in organic matter. Soil nutrient content and available water capacity are generally higher in older stands because of higher organic matter content and repeated inputs of nutrient rich silt from past floods. Tree species diversity initially increases as stands age, reaches a maximum in stands with mixtures of both pioneer and terminal species, and declines slightly in the oldest stands. Analyses of population structure indicate a recent decline in the establishment of small stems of *Acer* and *Ulmus*. Available data suggest that these changes can be attributed to the removal of periodic spring flooding caused by the presence and operation of the reservoirs. It is also hypothesized that the lack of seedling-sapling stands of *Populus* in the region is the result of a reduction in the meandering rate of the river following reservoir construction and poor seedbed conditions in the absence of flooding. *DAM CONSTRUCTION*

224. Johnson, R.R.; Haight, L.T.; Simpson, J.M. 1977. Endangered species vs. endangered habitats: A concept. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 68-79.

Abstract: Although the great diversity within riparian ecosystems was recognized earlier, their extreme productivity was not discovered until this decade. The highest densities of nesting birds for North America have been reported from Southwest cottonwood riparian forests. Complete loss of riverine habitat in the Southwest lowlands could result in extirpation of 47 percent of the 166 species of birds which nest in this region. *MULTIPLE THREATS*

225. Johnson, T.D.; Kolb, T.E.; Medina, A.L. 2009. Do riparian plant community characteristics differ between *Tamarix* (L.) invaded and non-invaded sites on the upper Verde River, Arizona? Biological Invasions: doi 10.1007/s10530-009-9658-2.

Abstract: This study sought to determine whether riparian vegetation characteristics differed between sites where *Tamarix* was present and sites where *Tamarix* was absent during invasion of the upper Verde. The results are contrary to other reports of *Tamarix* association with depauperate riparian

plant communities, and suggest that *Tamarix* invasion of a watershed with a relatively natural flow regime and a robust native plant community follows similar establishment patterns as the native riparian plant community. *INVASIVE SPECIES*

226. Johnson, W.C. 1992. Dams and riparian forests: Case study and the upper Missouri River. Rivers. 3: 229-242.

Abstract: This research examined the effects of altered flow and meandering rate of the Missouri River in central North Dakota on the compositional dynamics of floodplain forests. This was accomplished by estimating the rates of river erosion and deposition during pre-dam and post-dam periods from historical maps and aerial photographs. Future changes in forest composition were simulated using a simple mathematical model based on measured rates of forest succession and river meandering for pre- and post-dam periods. Simulations indicated a future decline in the areal extent of pioneer forests (cottonwood, willow) due to river regulation. Later successional species will dominate the future forests. Experimentation is needed to regenerate pioneer forests to maintain current levels of species diversity on the floodplain. *DAM CONSTRUCTION*

227. Johnson, W.C.; Dixon, M.D.; Simons, R.; Jenson, S.; Larosn, K. 1995. Mapping the response of riparian vegetation to possible flow reductions in the Snake River, Idaho. Geomorphology. 13: 159-173.

Abstract: This study was conducted to determine the relationship between the middle Snake River environment and its riparian vegetation, as a means of estimating the effects of possible future flow alterations on the quantity, quality, and distribution of riparian zone plants. Future flow reductions, either caused by greater water use or by climate change, could have a pervasive effect on riparian vegetation because streamflow is often the most important of all environmental factors affecting pattern and process in the riparian ecosystem. This paper presents the results of the subproject to map portions of the riverbed, which may be sensitive to vegetation expansion if flows are reduced in the future. One flow reduction scenario was developed and examined by combining field measurements of riparian vegetation gradients and river cross-sections, digital elevation modeling, and a geographic information system. *CLIMATE CHANGE, FLOW REGULATION*

228. Jonez, A.R. 1984. Controlling salinity in the Colorado River Basin, the arid West. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of the 1983 international symposium on state-of-the-art control of salinity; 1984 July 13-15, Salt Lake City UT. Boston MA: Butterworth Publishers: 337-347.

Abstract: The Colorado's most insidious problem is increasing salinity. By the time the Colorado reaches Hoover Dam it is carrying 9 million tons of salt annually. About half of the present salt pollution comes from natural sources, while the other half is human caused. This paper discusses the problem and solutions in more detail. *WATER QUALITY*

229. Jonez, A.R.; Sharpe, F.P.; Strauss, P.; Deason, W.O. 1978. Interaction of water management and riparian ecosystems: Attitudes, practices, and effects. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 284-288.

Abstract: Under its broad mission of planning, developing, and managing water and related land resource projects, which supply water for agriculture, domestic, and industrial use in the 17 western states, the Bureau of Reclamation also fulfills the mission of preserving or mitigating riparian habitat. *MULTIPLE THREATS*

230. Judd, B.I.; Laughlin, J.M.; Guenther, H.R.; Handegrade, R. 1971. The lethal decline of mesquite on the Casa Grande National Monument. Great Basin Naturalist. 31: 153-159.

Abstract: This study attempts to determine what factors may have been responsible for the massive lethal decline of the mesquite trees on the Casa Grande National Monument. The author concludes that the decline of the water table and mistletoe infestation may be the major contributors, with age of trees, insect infestation and natural successional process as secondary factors. *MULTIPLE THREATS*

231. Karr, J.R. 1999. Defining and measuring river health. Fresh Water Biology. 41(2): 221-234.

Abstract: Society benefits and depends on rivers, yet over the past century humans have dramatically changed rivers in the United States, even threatening river health. The concept of river health is a logical outgrowth of scientific principles, legal mandates, and changing societal values. This paper argues that the success in protecting the health of rivers depends on realistic models of human actions, landscapes, and river interactions, as well as biological monitoring, the use of multimetric biological indices, and the ability to communicate the observed results to citizens and political leaders. Several examples are given including rivers in Oregon and Washington. *MULTIPLE THREATS*

232. Katibah, E.F.; Dummer, K.J.; Nedeff, N.E. 1984. Current condition of riparian resources in the Central Valley of California. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 314-321.

Abstract: This paper describes the current condition of the remaining riparian resources in the Central Valley as evaluated with the aid of low-altitude aerial photography. A discussion of several factors influencing riparian resources—grazing, stream channelization, intra-zone and adjacent land uses—is presented. *MULTIPLE THREATS*

233. Kauffman, J.B. 1988. The status of riparian habitats in Pacific Northwest forests. In: Raedeke, K.J., ed. Streamside management: Riparian wildlife and forestry interactions. Institute of Forest Resources Contribution 59. Seattle, WA: University of Washington: 45-55.

Abstract: The status of a riparian ecosystem is a value judgment and the needs of society must therefore be considered in ascertaining it. Management activities should vary according to the unique feature of the riparian zone, the desired land uses, and wildlife species. The management philosophy that will influence the future of riparian wildlife populations, water quality, timber production, or livestock production will ultimately reflect the importance of these resources to the citizens of the Pacific Northwest. *MULTIPLE THREATS*

234. Kauffman, J.B.; Krueger, W.C. 1984. Livestock impacts on riparian ecosystems and streamside management implications: A review. Journal of Range Management. 37: 431-438.

Abstract: This literature review focuses on the threats that livestock pose to riparian ecosystems and how management actions can reduce these impacts. It also discusses the importance and functions of riparian ecosystems. *GRAZING*

235. Kauffman, J.B.; Beschta, R.L.; Otting, N. 1997. An ecological perspective of riparian and stream restoration in the Western United States. Fisheries. 22(5): 12-24.

Abstract: There is an unprecedented need to preserve and restore aquatic and riparian biological diversity before extinction eliminates the opportunity. Ecological restoration is the reestablishment of processes, functions, and related biological, chemical, and physical linkages between the aquatic and associated riparian ecosystems; it is the repairing of damage caused by human activities. The first and most critical step in ecological restoration is passive restoration, the cessation of those anthropogenic activities that are causing degradation or preventing recovery. Given the capacity of riparian ecosystems to naturally recover, often this is all that is needed to achieve successful restoration. Prior to implementation of active restoration approaches (e.g., instream structures, channel and streambank reconfiguration, and planting programs), a period of time sufficient for natural recovery is recommended. Riparian and stream ecosystems have largely been degraded by ecosystem-wide, off-channel activities and, therefore, cannot be restored by focusing solely on manipulations within the channel. While ecological restoration comes at a high cost, it also is an investment in the natural capital of riparian and aquatic systems and the environmental wealth of the nation. *MULTIPLE THREATS*

236. Kaufmann, J.B.; Krueger, W.C.; Vavra, M. 1983a. Effects of late season cattle grazing on riparian plant communities. Journal of Range Management. 36: 685-690.

Abstract: Livestock impacts on riparian plant community composition, structure, and productivity were evaluated. After 3 years of comparison between fall grazed and exclosed (non-grazed) areas, 4 plant communities out of 10 displayed some significant species composition and productivity differences. Two meadow types and the Douglas hawthome (*Crategus douglasii*) community type had significant differences in standing biomass. These also were utilized more heavily than any other communities sampled. Shrub use was generally light except on willow (*Salix* spp.) gravel bars. Succession appeared to be retarded by livestock grazing on gravel bars. Few differences were recorded in other plant communities sampled, particularly those communities with a forest canopy. *GRAZING*

237. Kauffman, J.B.; Krueger, W.C.; Vavra, M. 1983b. Impacts of cattle on streambanks in Northeastern Oregon. Journal of Range Management. 36: 683-685.

Abstract: Impacts of a late season livestock grazing strategy on streambank erosion, morphology and undercutting were studied for 2 years along Catherine Creek in northeastern Oregon. Streambank loss, disturbance and undercutting were compared between grazing treatments, vegetation type, and stream-meander position. No significant differences were found among vegetation types or stream-meander location. Significantly greater streambank erosion and disturbance occurred in grazed areas than in exclosed areas during the 1978 and 1979 grazing periods. Over-winter erosion was not significantly different among treatments. However, erosion related to livestock grazing and trampling was enough to create significantly greater annual streambank losses when compared to ungrazed areas. *GRAZING*

238. Kauffman, J.B.; Case, R.L.; Lytjen, D.; Otting, N.; Cummings, D.L. 1995. Ecological approaches to riparian restoration in Northeast Oregon. Restoration and Management Notes. 13: 12-15.

Abstract: The degradation of riparian ecosystems associated with the upper Snake River in Oregon and Idaho has contributed significantly to the precipitous declines of resident and anadromous salmonids. Given the economic, ecologic, and cultural importance of trout and salmon in the Pacific Northwest, the recovery of these ecosystems through restoration at landscape scales is necessary. This paper discusses the importance of understanding the inherent resilience of riparian vegetation to disturbances in the restoration of these ecosystems. *MULTIPLE THREATS*

239. Kay, C.E.; Chadde, S. 1991. Reduction of willow seed production by ungulate browsing in Yellowstone National Park. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comp. Proceedings of the symposium

on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 92-99.

Abstract: This paper explores the impact native ungulates (elk, moose, mule deer, pronghorn, bighorn sheep, and bison) in Yellowstone National Park are having on sexual reproduction of willows. Long-term grazing exclosures were used to compare seed production in unbrowsed versus browsed willow communities. *GRAZING*

240. Keller, C.; Anderson, L.; Tappel, P. 1978. Fish habitat changes in Summit Creek, Idaho, after fencing the riparian area. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 Nov. 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 46-52.

Abstract: The rapid response of aquatic and riparian habitat to fencing is surprising. The unique environment of Summit Creek has contributed to dramatic habitat changes in only two growing seasons. The high water table, constant streamflow, deep soil, low stream gradient and moderate stream temperatures enabled the stream/riparian ecosystem to respond quickly after fencing. *GRAZING*

241. Kennedy, C.E. 1977. Wildlife conflicts in riparian management: Water. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 52-58.

Abstract: This paper is a summary of observations of the need for a better understanding of the interactions of stream-riparian-vegetation-energy-nutrients-water production—aquatic life and terrestrial life. Most of the riparian ecosystem interactions have had very little attention in Arizona and New Mexico. *MULTIPLE THREATS*

242. Kennedy, L.J.; Tiller, R.L.; Stutz, J.C. 2002. Associations between arbuscular mycorrhizal fungi and *Sporobolus wrightii* in riparian habitats in arid Southwestern North America. Journal of Arid Environments. 50: 459–475.

Abstract: The objective of this study was to determine the extent of the interaction between AM fungi and *S. wrightii* by examining the seasonal dynamics of mycorrhizal colonization in roots of *S. wrightii*, and determining the AM fungal communities associated with *S. wrightii* in four different riparian habitats along the San Pedro River in south-east Arizona. Samples were collected from lower floodplains where *S. wrightii* is a component of mixed vegetation communities, which also include Fremont's cottonwood, mesquite and the exotic saltcedar, and from upper terraces that are sacaton grasslands. Because many rivers of arid environments exhibit perennial streamflow in some stretches and intermittent streamflow in other reaches, both perennial and intermittent reaches were examined. *INVASIVE SPECIES*

243. Key, J.W.; Gish, M.A. 1988. Clark Canyon (Mono County) riparian demonstration area. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 127-134.

Abstract: Destabilization of meadow sections of the stream and the upper stream reaches contributed to an increase of suspended sediments, turbidity, and stream channel widening in the lower stream reaches of the Clark Canyon riparian demonstration area within the East Walker River sub-basin. Several different treatments have been implemented to (1) restore meadow riparian area to high levels of productivity, (2) stabilize active erosion and gully development, (3) improve aquatic habitat from poor to good condition, and (4) improve wildlife cover and downstream fish habitat. These treatments include changes in grazing management practices. *GRAZING*

244. Klebenow, D.A.; Oakleaf, R.J. 1984. Historical avifaunal changes in the riparian zone of the Truckee River, Nevada. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 203-209.

Abstract: Comparisons of populations of the present avifauna with observations made during 1868 along the lower Truckee River show species changes in abundance. The most noticeable changes in the avifauna involved species that require dense understory of woody riparian vegetation, wet meadow, and marsh. Numerous species have declined in abundance; many not found in recent counts were abundant or common in 1868. The apparent population decline can be related to the compounding effects of farmland development, river channeling operations, and overgrazing. *MULTIPLE THREATS*

245. Knight, A.W.; Bottorff, R.L. 1984. The importance of riparian vegetation to stream ecosystems. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 160-167.

Abstract: Riparian vegetation is very important in determining the structure and function of stream ecosystems. The manner in which riparian systems are managed and protected is commonly related to their value as buffer strips, stream bank stabilizers, and fish and wildlife habitat. These strips of streamside vegetation may be the only habitat remaining for some wildlife species. As riparian vegetation is modified or destroyed by grazing, logging, urbanization, road construction, water development, mining and recreation, interest in

its importance is increasing. The objective of this paper is to briefly review the role of riparian vegetation in the structure and function of stream ecosystems, especially headwater streams. *MULTIPLE THREATS*

246. Knight, R.L. 1988. Relationships of birds of prey and riparian habitat in the Pacific Northwest: An overview. In: Raedeke, K.J., ed. Proceedings of the Southwest raptor management symposium; Washington, DC: National Wildlife Federation: 79-91.

Abstract: This paper presents a review of information on raptor communities: nesting, foraging, nocturnal roosting, seasonal use, and the effects of human perturbations (e.g. logging, recreational activities). It also discusses management practices used to mitigate conflicts between human and raptor uses of riparian zones. *MULTIPLE THREATS*

247. Knopf, F.L. 1986. Changing landscapes and the cosmopolitism of the eastern Colorado avifauna. Wildlife Society Bulletin. 14: 132-142.

Abstract: The development of a riparian forest on the Great Plains has provided a corridor for the movement of forest birds across those grasslands that have historically served as an ecological barrier to dispersal. Almost 90% of the contemporary avifauna of northeastern Colorado was not present at the turn of the century. The corridor has resulted in secondary contact of many congeneric species, which currently hybridize on the Great Plains; the hybridization may be interpreted either as reversing 10,000 years of speciation, or alternatively as promoting hybrid vigor within. *INVASIVE SPECIES*

248. Knopf, F.L. 1986. Wildlife considerations in seasonal grazing of riparian zones. In: Smits, J.H., ed. Management of riparian areas. Washington, DC: Public Lands Council: 39-40.

Abstract: This paper concludes that 10 to 12 years is insufficient time for a riparian community to recover from a history of excessive grazing. While fish habitats respond quickly to changes in grazing practices, terrestrial communities take considerably longer. *GRAZING*

249. Knopf, F.L. 1988. Riparian wildlife habitats: More, worth less, and under invasion. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 20-22.

Abstract: This paper gives a general overview of riparian ecosystems in the American West, the potential conflicts these systems face, and how they have changed over time. *MULTIPLE THREATS*

250. Knopf, F.L.; Cannon, R.W. 1982. Structural resilience of a willow riparian community to changes in grazing practices. In: Wildlife livestock relationships symposium: Proceedings 10. Moscow, ID: University of Idaho Forest, Wildlife, and Range Experiment Station: 198-207.

Abstract: The objective of this study was to quantify the impact of cattle on the physical structure of a high-altitude willow community in Colorado. The willow community tolerated heavy grazing pressures well initially, but recovered slowly when damaged. *GRAZING*

251. Knopf, F.L. and T.E. Olson. 1988. Naturalization of Russian-olive: Implications to Rocky Mountain wildlife. Wildlife Society Bulletin. 12: 289-298.

Abstract: This paper (1) alerts natural resource conservation personnel to naturalization of Russian-olive in the West, (2) reports on the avian and mammalian associations of monotypic stand of Russian-olive in three western States, (3) discusses similarities of those associations to vertebrate communities occurring in nearby native riparian and upslope vegetation types using an analytical approach, and (4) speculates on implications of the continued naturalization of Russian-olive to Rocky Mountain avian and mammalian communities. *INVASIVE SPECIES*

252. Knopf, F.L.; Sedgwick, J.A.; Cannon, R.W. 1988. Guild structure of a riparian avifauna relative to seasonal cattle grazing. Journal of Wildlife Management. 52: 280-290.

Abstract: The avifauna within the willow community on the Arapaho National Wildlife Refuge was dominated by 11 species of passerine birds during the summers of 1980-1981. Population densities of the eurytopic response guild differed little between healthy (historically winter-grazed) and decadent willow communities (historically summer-grazed) within a year. Densities of species in the mesotopic response guild differed more dramatically, and stenotopic response-guild species were absent or accidental in decadent willows. The authors hypothesize that the response-guild structure primarily reflects the impact of cattle upon the horizontal patterning of the vegetative community. *GRAZING*

253. Knopf, F.L.; Johnson, R.R.; Rich, R.; Samson, F.B.; Szaro, R.C. 1988. Conservation of riparian ecosystem in the United States. Wilson Bulletin. 100: 289-298.

Abstract: This paper describes two potential dangers in developing management policy based on a site-specific information, viewed from a national perspective: (1) local information can foster erroneous conclusions regarding the biological contribution of a specific association to the continental avifauna; and (2) the tendency to view site-specific data as finite, bounded information. *MULTIPLE THREATS*

254. Knudsen, A.B.; Johnson, R.; Johnson, K.; Henderson, N.R. 1977. A bacteriological analysis of portable toilet effluent at selected beaches along the Colorado River, Grand Canyon National Park, Arizona. In: Proceedings of river recreation management and research symposium; 1977 January 24-27; Minneapolis, MN. Gen. Tech. Rep. NC-28. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 290-295.

Abstract: Portable toilet effluent buried at nine beaches along the Colorado River, Grand Canyon National Park, Arizona, was examined. Viable total and fecal coliforms were isolated 84 percent of the time. Organisms migrated up to 8 inches away from the burial sites at 22 percent of the beach locations. Coliforms were present throughout the strata to a depth of 2 feet. No direct relationship was evident when comparing percent soil moisture, percent coarse sand, and numbers of organisms. Ground temperatures directly affected the numbers of organisms present. A definite public health hazard is seen in the numbers of coliforms and associated organisms surviving from one season to the next. *RECREATION*

255. Konopacky, R.C.; Bowles, E.C.; Cernera, P.J. 1985. Salmon River habitat enhancement: Annual report FY 1984. Project No. 83-359. Portland, OR: U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife.

Abstract: The objectives of this study were (1) to determine the feasibility of enhancing anadromous fish habitat, and (2) to evaluate effects of habitat enhancement on the habitat and fish community in various reaches of the Salmon River in Idaho, where increased sedimentation caused by mining activities had resulted in degradation of the aquatic habitat. *MINING*

256. Konopacky, R.C.; Cernera, P.J.; Bowles, E.C.; Montgomery, J.M. 1986. Salmon River Habitat Enhancement: Annual Report FY 1985. Project No. 83-359. Portland, OR. U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. 445p.

Abstract: This study evaluates the effects of habitat enhancement on the habitat and fish community in various reaches of the Salmon River in Idaho, where increased sedimentation caused by mining activities had caused degradation of the aquatic habitat. In particular the Bear Valley Creek (Middle Fork Salmon River), Yankee Fork Salmon River, and East Fork Salmon River/Herd Creek were evaluated. *MINING*

257. Korte, N.; Kearl, P.; Koehler, D. 1993. Strategies to define and implement large-scale watershed restoration project policy on the Navajo Nation. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 198-202.

Abstract: Typical effects of poor land-management practices on riparian zones are evident throughout the Navajo Nation. After many years (50-100 or more) of overgrazing by livestock, the original riparian vegetation is gone. For a restoration project to have lasting beneficial effects, the tribe has to be an active participant. Examples of training, experience, and additional research needs are given in this paper. *GRAZING*

258. Kovalchik, B.L. 1991. Growth and yield of willows in central Oregon compared to reports in world literature. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 83-88

Abstract: Many willow dominated sites have been degraded to less stable plant communities in response to improper management activities such as overuse by livestock. This paper summarizes world literature on willow growth and compares the information with willow growth in central Oregon. *GRAZING*

259. Kovalchik, B.L.; Elmore, W. 1991. Effects of cattle grazing systems on willow dominated plant associations in central Oregon. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L. comp. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 111-119.

Abstract: Improper cattle grazing has severely affected the stability of riparian zones, especially those once dominated by willows. The authors reviewed willow literature and combined pertinent information with experience and described grazing system effects on willow-dominated plant associations in central Oregon. *GRAZING*

260. Kranjcec, J.; Mahoney, J.M.; Rood, S.B. 1998. The responses of three riparian cottonwood species to water table decline. Forest Ecology and Management. 110: 77-87.

Abstract: The present study demonstrates that tolerance to water table decline varies across cottonwood genotypes and that *Populus balsamifera* saplings were the most vigorous. This is relevant to the natural distribution in which *P. balsamifera* occurs in mountain regions where stream stages and riparian water table depths often change abruptly. The vigor of *P. balsamifera* is also consistent with the reproductive mechanism of "branch propagation," a process of clonal

recruitment in which browsed or broken branch fragments root along stream edges, enabling dispersive propagation, particularly of *P. balsamifera* and *P. trichocarpa*. *GROUNDWATER DEPLETION, DROUGHT*

261. Kriegshauser, D.; Somers, P. 2004. Vegetation changes in a riparian community along the Dolores River downstream from McPhee reservoir in southwestern Colorado. In: van Riper III, C.; Cole, K.L., eds. The Colorado Plateau: Cultural, biological and physical research. Tucson, AZ: The University of Arizona Press: 129-137.

Abstract: This paper describes the long-term study, which was undertaken to determine whether, and to what extent, a regime of low, constant river flow would affect a set of riparian communities of various ages and composition. *WATER DIVERSION*

262. Krueper, D.J. 1992. Effects of land use practices on western riparian ecosystems. In: Finch, D.M.; Stangel, P.W., eds. Status and management of neotropical migratory birds; 1992 September 21-25; Estes Park, CO: Gen. Tech. Rep. RM-229. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 321-330.

Abstract: This paper reviews impacts to Western United States riparian ecosystems along with mitigation and conservation recommendations for resource managers. *MULTIPLE THREATS*

263. Krueper, D.J. 1996. Effects of livestock management on Southwestern riparian ecosystems. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 328-301.

Abstract: Within the past 100 years, an estimated 95% of the riparian habitat in western North America has been altered, degraded, or destroyed due to a wide variety of land use practices such as river channelization, clearing for agriculture, livestock grazing, water impoundments, and urbanization. This has resulted in negative impacts on native wildlife population including insects, fish, reptiles, amphibians, birds, and mammals. The importance of riparian habitats and the negative impacts to the native wildlife are described in this paper. *GRAZING*

264. Lacy, M.; Stuart, A.; Smith, B. 1985. John Day River enhancement: Annual Progress Report FY 1985. In: Natural propagation and habitat enhancement, Volume I—Oregon. Project No. 84-21. Portland, OR: U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife: 212-221.

Abstract: A variety of man's activities have impacted salmon and steelhead habitat in the John Day River system in Oregon. Dredging, overgrazing, road building, logging, landowner clearing, increased water withdrawals, and channelization created further fish habitat problems by disturbing or destroying riparian vegetation and destabilizing streambanks and watersheds. The purpose of the in-stream and riparian restoration work described in this report is to maintain wild gene pools and enhance production of smelts and adults. *MULTIPLE THREATS*

265. Lafayette, R.A.; Pruitt, J.R.; Zeedyk, W.D. 1992. Riparian area enhancement through road design and maintenance. In: Neary, D.G.; Ross, K.C.; Coleman, S.S., eds. Proceedings of the national hydrology workshop; 1992 April 27- May 1; Phoenix, AZ. Gen. Tech. Rep. RM-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 85-95.

Abstract: This paper has several main objectives: (1) present a historical perspective on road-related impacts on riparian areas in the Southwest, (2) discuss how these impacts were recognized and analyzed, (3) list typical problems associated with road/riparian conflicts, (4) present suggested solutions, and methods to avoid future problems or correct existing ones, and (5) discuss program progress to date and likely future accomplishments. *ROADS*

266. Lambert, D.J.; Hannon, S.J. 2000. Short-term effects of timber harvest on abundance, territory characteristics, and pairing success of Ovenbirds in riparian buffer strips. The Auk. 117(3): 687–698.

Abstract: In managed forests, riparian buffer strips typically are maintained to protect water quality. If properly designed, buffer strips also may act as wildlife reserves. However, forest managers have lacked the information to develop standards for buffer strips to maximize benefits for wildlife species. This study assessed the conservation potential of 20-, 100-, and 200-m wide buffers for an area-sensitive songbird in boreal mixed-wood forest in Alberta. The authors measured abundance, territory characteristics, and pairing success of Ovenbirds (*Seiurus aurocapillus*) at treatment and control lakes one year before and after upland timber harvest. The data indicate that 20-m buffer strips do not support breeding Ovenbirds, whereas 100- and 200-m buffers retain Ovenbirds during the year following harvest. *FOREST HARVESTING*

267. Larsen, R.E.; Krueger, W.C.; George, M.R.; Barrington, M.R.; Buckhouse, J.C.; Johnson, D.E. 1998. Viewpoint: Livestock influences on riparian zones and fish habitat: Literature classification. Journal of Range Management. 51: 661-664.

Abstract: This study used a key to classify articles about livestock influences on riparian zones and fish habitat into 3 classes: papers that contained original data, those that

were commentary, and reports about methodology such as classification systems, policies, and monitoring criteria. Four hundred and twenty-eight of the total articles were directly related to grazing impacts on riparian zones and fish habitat. Only 89 of these grazing impact articles were classified as experimental, where treatments were replicated and results were statistically valid. This analysis revealed several limitations of riparian grazing studies: (1) inadequate description of grazing management practices or treatments, (2) weak study designs, and (3) lack of pre-treatment data. More long-term, replicated treatment studies are needed in the future. *GRAZING*

268. Leal, D.A.; Meyer, R.A.; Thompson, B.C. 1996. Avian community composition and habitat importance in the Rio Grande corridor of New Mexico. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 62-68.

Abstract: Generally, avian communities preferred cottonwood and other native woody species as dominants over those that are highly manipulated and/or monotypic, such as mowed river edge, pecan orchards, and pure stands of saltcedar. Bird occurrence and distribution in the Rio Grande corridor is not so neatly related to composition of native vegetation as is sometimes characterized. Exotic plant species, such as saltcedar and Russian olive, are utilized to varying degrees by the existing avian community. *INVASIVE SPECIES*

269. Leonard, S.; Kinch, G.; Elsbernd, V.; Borman, M.; Swanson, S. 1997. Riparian area management: Grazing management for riparian-wetland areas. Technical Reference 1737-14. Denver, CO: U.S. Department of the Interior, Bureau of Land Management: 63 p.

Abstract: Depending on condition and potential, riparian areas usually respond more quickly than drier upland ranges to changes in grazing management. This document presents information from various land managers and researchers to guide livestock management in riparian areas using their unique responsiveness to accomplish management objectives. *GRAZING*

270. Lesica, P.; Miles, S. 2004. Ecological strategies for managing tamarisk on the C.M. Russell National Wildlife Refuge, Montana, USA. Biological Conservation. 119: 535–543.

Abstract: The purpose of this study was to provide descriptions of habitats and geomorphologic settings threatened by tamarisk invasion. Knowing which stands can be killed by inundation and which stands most threaten native biological diversity will aid managers in planning integrated tamarisk management. Specifically this study (1) determines the types of vegetation in which tamarisk occurs or is likely to occur, (2) provides information on the age of tamarisk stands and how they are likely to alter native plant communities, (3) develops criteria for managers on how to identify stands that are most likely to adversely affect native plant communities and the biological diversity they support, and (4) determines which hydrologic regimes destroy tamarisk at which elevations. *INVASIVE SPECIES*

271. Lewis, D.E.; Marsh, G.G. 1977. Problems resulting from the increased recreational use of rivers in the west. In: Proceedings of river recreation management and research symposium; 1977 January 24-27; Minneapolis, MN. Gen. Tech. Rep. NC-28. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 27-31.

Abstract: This paper discusses impacts and conflicts created by increasing recreation use of rivers in the western United States. Problems addressed include environmental, social, and administrative interrelationships on rivers. *RECREATION*

272. Lite, S.J.; Stromberg, J.C. 2005. Surface water and ground-water thresholds for maintaining *Populus-Salix* forests, San Pedro River, Arizona. Biological Conservation. 125: 153–167.

Abstract: The purpose of this study was to (1) identify hydrologic thresholds for maintaining *Populus fremontii-Salix. gooddingii* forests; (2) quantify changes in *P. fremontii, S. gooddingii*, and *Tamarix ramosissima* population stand structure traits (size class diversity, canopy cover, basal area, vegetation volume, and stem density) across gradients of ground-water depth and fluctuation and surface flow permanence; and (3) assess how community composition and biomass structure vary across these hydrologic gradients. *GROUNDWATER DEPLETION, INVASIVE SPECIES*

273. Livingston, M.F.; Schemnitz, S.D. 1996. Summer bird/vegetation associations in Tamarisk and native habitat along the Pecos River, southeastern New Mexico. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 171-180.

Abstract: This paper describes research that is part of a long-term study investigating hydrological and wildlife response to tamarisk removal on the Pecos River in New Mexico. Factors including vegetation structure, grazing, habitat patchiness, and human disturbance are offered to explain differences in bird community pattern between sites. *INVASIVE SPECIES*

274. Loper, D.; Sun, D.; Taliaferro, B. 1987. Rancher initiated riparian management along the Oregon Trail. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian

ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists. 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 276-279.

Abstract: Riparian areas along the Oregon Trail were, historically, overused and abused. Many of these areas have been improving and can improve even more through sound ranch management. The Sun Ranch and the Green River Ranch and Livestock Company are using in-stream structures to raise the water level within creeks on their ranches. *GRAZING*

275. Lucas, R.W.; Baker, T.T.; Wood, M.K.; Allison, C.D.; Vanleeuwen, D.M. 2004. Riparian vegetation response to different intensities and seasons of grazing. Journal of Range Management. 57: 466-474.

Abstract: This study, in the Black Range of western New Mexico, compared effects of different seasons of use (cool season, warm season, and dormant season) and grazing intensities (light, moderate, and none) of cattle on young narrowleaf cottonwood populations, and herbaceous vegetation in two adjacent southwestern riparian areas. The authors concluded that no single riparian area management approach is best in all situations, but the grazing treatments used in this study appear to have been successful at maintaining riparian communities. *GRAZING*

276. Mahoney, D.L.; Erman, D.C. 1984. The role of streamside bufferstrips in the ecology of aquatic biota. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 168-176.

Abstract: Riparian vegetation is important as a source of food to stream organisms, as shade over small-order streams, and as a bank-stabilizing force to prevent excessive sedimentation and to intercept pollutants. Logging may significantly affect each of these factors unless proper protective measures are employed. Analysis of algal samples from 30 streams shows light intensity and chlorophyll concentrations are major factors related to legging intensity that affect instream primary production. Transportable sediment from 24 streambeds has shown that this measure of sediment is higher in logged and narrow buffered streams than in controls 7 to 10 years after logging. *FOREST HARVESTING*

277. Malmqvist, B.; Rundle, S. 2002. Threats to the running water ecosystems of the world. Environmental Conservation. 29(2): 134-153.

Abstract: This paper reviewed long-term trends that currently impact running waters with the aim of predicting what the main threats to rivers will be in the year 2025. The main ultimate factors forcing change in running waters, such as ecosystem destruction, physical habitat, and water chemistry alteration, direct addition or removal of species, stem from proximate influences from urbanization, industry, land-use change, and water-course alterations. *MULTIPLE THREATS*

278. Manci, K.M. 1989. Riparian Ecosystem Creation and Restoration: A Literature Summary. U.S. Fish and Wildlife Biological Report 89(20). Fort Collins, CO: U.S. Department of the Interior, Fish and Wildlife Service: 59 p.

Abstract: This summary provides an overview of the status of riparian ecosystems in the United States. Case studies of various riparian ecosystem creation or restoration projects are used to demonstrate various techniques and to report some results of their use. *MULTIPLE THREATS*

279. Manning, R.E. 1979. Impacts of recreation on riparian soils and vegetation. Water Resources Bulletin. 15: 30-43.

Abstract: The magnetic attraction of water resources for recreation has direct implications for land resources that are needed to provide access and support facilities. This paper reviews and synthesizes the literature dealing with the impacts of recreation use on riparian soils and vegetation. Part one of the paper sets forth the major negative impacts of recreation use on soils and vegetation. A seven-step soil impact cycle is identified, beginning with the scuffing away of leaf litter and other organic material and working through the soil erosion and sedimentation process. Four major kinds of impacts of recreation use on vegetation are then outlined, and the relationship between impacts on soil and vegetation is demonstrated. Part two identifies several spatial and temporal patterns of environmental impact caused by recreation use. The node and linkage pattern of recreation use, campground and trail expansion, ground cover response and succession, rates of soil compaction, and resource response to various intensities of recreation use are important aspects. The final part of the paper deals with measuring environmental impacts caused by recreation use. Management implications of the research findings are considered throughout the paper. *RECREATION*

280. Marcus, L. 1988. Riparian reforestation and watershed management: Some examples from the California Coast. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA; Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 204-210.

Abstract: Managing and restoring watersheds often involves re-creation of riparian habitats. Examples from rural and urban areas illustrate how riparian restoration can be integrated into watershed projects. *MULTIPLE THREATS*

281. Marlow, C.B.; Pogacnik, T.M. 1986. Cattle feeding and resting patterns in a foothills riparian zone. Journal of Range Management. 39: 212-217.

Abstract: Cattle impact on riparian areas is dependent upon both their behavior and utilization of streamside vegetation. Development of grazing strategies for riparian environments would be enhanced by an understanding of cattle behavior in riparian and adjacent uplands. Results of a 2-year behavior study indicate that a seasonal trend in cattle use of riparian and upland areas exists. *GRAZING*

282. Marlow, C.B.; Olson-Rutz, K.; Atchley, J. 1989. Response of a southwestern Montana riparian system to four grazing management alternatives. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 111-116.

Abstract: The effects of deferred rotation, time-control, season-long and livestock exclusion on streambank stability and trout habitat condition in a southwestern Montana riparian zone has been monitored for 3 years. Decreasing the length of time cattle have access to a stream reach and adjusting the grazing period to coincide with low streambank moisture levels shows promise for the improvement of riparian zone conditions. *GRAZING*

283. Marnell, L.F. 1995. Cutthroat trout in Glacier National Park, Montana. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 153-154.

Abstract: The introduction and entry of non-native species to the indigenous fishery of Glacier National Park has radically altered the park's pristine condition. The non-native species introduction has adversely affected the native westslope cutthroat trout. Effects of fish introductions in Glacier National Park include establishment of non-native trout populations in historically fishless waters, genetic contamination and ecological interferences with various life-history stages of native trout. *INVASIVE SPECIES*

284. Martin, D.W.; Chambers, J.C. 2001. Restoring degraded riparian meadows: Biomass and species responses. Journal of Range Management. 54: 284-291.

Abstract: Riparian meadows in central Nevada are highly productive and have been extensively utilized for livestock grazing. Consequently, many have been severely degraded resulting in changes in species composition and decreases in productivity. During a 3-year study, the authors examined the responses of mesic meadow systems to yearly nitrogen addition and clipping to increase their understanding of grazing effects. They also examined the effects of a one-time, fall aeration and revegetation (removal of existing vegetation and reseeding) to evaluate the restoration potential of these sites. Changes in total biomass, species aerial cover and frequency, and surface basal cover were used to evaluate treatment responses. The results were influenced by high spatial and temporal variability in water table elevations. *GRAZING*

285. Martin, K.E. 1984. Recreation planning as a tool to restore and protect riparian systems. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 748-757.

Abstract: This paper examines planning strategies that assure the protection of riparian systems from recreationists while providing for recreation use. A riparian forest adjacent to a densely populated area and subject to intensive recreation use is investigated. The popular recreation activities that occur in connection with a riparian system are identified and methods for controlling recreation use are discussed. *RECREATION*

286. Martin, S.B.; Platts, W.S. 1981. Effects of mining: Influence of forest rangeland management on anadromous fish habitat in western North America. Gen. Tech. Rep. PNW-119. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 15 p.

Abstract: This report describes the methods of mining and the effects on aquatic ecosystems of mine-caused sediment, changes in pH, and toxic heavy metals. *MINING*

287. Martin, S.C. 1978. Evaluating the impact of cattle grazing on riparian habitats in the national forests of Arizona and New Mexico. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 Nov. 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 35-38.

Abstract: The objective of this paper is to determine when and where cattle are least likely to damage riparian sites, and to assess the feasibility of reducing damage by changing schedules of grazing, developing additional livestock waters, or by other range-management practices. *GRAZING*

288. Masters, L.S.; Burkhardt, J.W.; Tausch, R. 1991. The geomorphic process: Effects of base level lowering on riparian meadow communities. Rangelands. 13: 280-284.

Abstract: The drying of the Pleistocene lakes has resulted in widespread downcutting and headward erosion that is continuing throughout watersheds in the Great Basin. However, this knowledge has largely been ignored or overlooked. It is important to recognize and understand these relationships so that responsible management decisions can be made. Removing or reducing domestic livestock from a meadow will not prevent the loss of that valuable land, if the more dominant erosion processes associated with base-level adjustments are driving current stream channel changes. Climatically driven lake level changes, crustal tectonics, or man-made channel alterations produce similar results. Road construction, bridge

and culvert installation, reservoirs and water diversions, channelizing, and revetment projects can all affect local stream base levels and initiate subsequent upstream and downstream channel adjustments. *MULTIPLE THREATS*

288. Masters, R.A.; Sheley, R.L. 2001. Principles and practices for managing rangeland invasive plants. Journal of Range Management. 54: 502-517.

Abstract: Invasive plants reduce the capacity of ecosystems to provide goods and services required by society, alter ecological processes, and can displace desirable species. They can reduce wildlife habitat quality, riparian area integrity, rangeland economic value, and enterprise net returns. The invasion process is regulated by characteristics of the invading plant and the community being invaded. The presence and spread of invasive plants is often symptomatic of underlying management problems that must be corrected before acceptable, long-term rangeland improvement can be achieved. Invasive plant management programs must be compatible with and integrated into overall rangeland resource management objectives and plans. Because of the complexity of managing invasive plants, it is imperative that relevant ecological and economic information be synthesized into user-friendly decision support systems. *INVASIVE SPECIES, GRAZING*

289. McCormick, F.H.; Contreras, G.C.; Johnson, S.L. 2009. Effects of non-indigenous invasive species on water quality and quantity. In: Dix, M.E.; Britton, K., eds. A dynamic invasive species research vision: Opportunities and priorities 2009-2029. Gen. Tech. Rep. WO-GTR-79/83. Washington, DC: U.S. Department of Agriculture, Forest Service, Research and Development: 111-120.

Abstract: This paper identifies desired resource outcomes, addresses management strategies and systems needed to achieve the outcomes, discusses potential effects on riparian systems and water resources, and identifies research and actions needed to achieve the desired outcomes. *INVASIVE SPECIES*

290. McCluskey, D.C.; Brown, J.; Bornholdt, D.; Duff, D.A.; Winward, A.H. 1983. Willow planting for riparian habitat improvement. Tech. Note 363. Washington, DC: U.S. Department of the Interior, Bureau of Land Management: 21 p.

Abstract: This report is designed for field personnel who are interested in employing willow planting as a technique for riparian habitat improvement. *MULTIPLE THREATS*

291. McGuire, J.R. 1978. A riparian policy for changing times. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 341-343.

Abstract: The Forest Service recognizes the importance and unique values of riparian ecosystems, and the increasing public awareness of these values. Policy directions state that these lands on the National Forest System will be managed for their unique values, following the principles of multiple use and sustained yield, and meeting stewardship responsibilities for protecting soil, water, and vegetative resources. *MULTIPLE THREATS*

292. McInnis, M.L.; McIver, J. 2001. Influence of off-stream supplements on streambanks of riparian pastures. Journal of Range Management. 54: 648-652.

Abstract: Accelerated erosion of streambanks in grazed riparian pastures is of concern to land managers. We tested the hypothesis that providing cattle free-choice off-stream water and trace mineralized salt would lessen negative impacts of grazing on cover and stability of streambanks compared to pastures lacking these amenities, and may therefore reduce the potential of accelerated erosion. The study was conducted on Milk Creek at the Hall Ranch Unit of the Eastern Oregon Agricultural Research Center near Union, Oregon. Three replications each of three grazing treatments were examined: (1) non-grazed control, (2) grazed with supplemental water and trace mineralized salt provided, and (3) grazed with no supplemental water or salt. *GRAZING*

293. McKinstery, M.C.; Hubert, W.A.; Anderson, S.H. 2004. Wetland and riparian areas of the Intermountain West: Ecology and management. Austin TX: University of Texas Press: 319 p.

Abstract: This book consists of twelve articles, which examine issues ranging from laws and regulations affecting habitats, to the unique physiographic features of the region, the importance of wetlands and riparian areas to fish, wildlife, and livestock, the ecological function of these areas, and their value to humans and the methods to evaluate these habitats. The authors also address the human impacts on the land from urban and suburban development, mining, grazing, energy extraction, recreation, water diversion, and timber harvesting, and suggest ways to mitigate such impacts. *MULTIPLE THREATS*

294. McNatt, R. 1978. Possible strategies for preservation of the San Pedro River riparian community. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 201-206.

Abstract: Because of the scarcity of riparian habitat in Arizona and its obvious importance to fish and wildlife, the U.S. Fish and Wildlife Service is investigating methods to preserve remaining riparian areas along the San Pedro River in southeast Arizona. Possible strategies include acquisition under the Unique Ecosystem program, enactment of local ordinances, and State-wide legislation. *MULTIPLE THREATS*

295. Medin, D.E.; Clary, W.P. 1989. Small mammal populations in a grazed and ungrazed riparian habitat in Nevada. Res. Pap. INT-413. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 6 p.

Abstract: This paper compares community composition and the relative abundance of small mammal populations between a riparian habitat grazed by cattle and a comparable adjacent exclosure on the West Fork of Deer Creek in northeastern Nevada. *GRAZING*

296. Medina, A.L. 1996. Native aquatic plants and ecological condition of southwestern wetlands and riparian areas. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 329-335.

Abstract: Research on montane wetland and riparian systems has shown the relative importance of native aquatic plants in maintaining the systems in a functional condition. The presence or absence of key species is used as an indicator of ecological condition, and desired ecological condition of composition and abundance of native aquatic plants. This type of information is needed by resource managers in defining the endpoint of their management actions. Information is presented on the functional role of these species in sustaining the biological and physical integrity of these habitats. *INVASIVE SPECIES*

297. Medine, A.J. 1981. Potential impacts of energy development upon water quality of Lake Powell and the Upper Colorado River. In: Adams, V.D.; Lamarra, V.A., eds. Aquatic resources management of the Colorado River ecosystem. Proceedings of the 1981 symposium on the aquatic resources management of the Colorado River ecosystem; 1981 November 16-18; Las Vegas, NV. Ann Arbor Science Publishers: 399-424.

Abstract: The objective of the study described in this paper was to examine the projected oil shale scenarios with respect to environmental concerns, particularly the impact of water quality in the upper Colorado River. *WATER QUALITY*

298. Meehan, W.R.; Swanson, F.J.; Sedell, J.R. 1977. Influences of riparian vegetation on aquatic ecosystems with particular reference to salmonid fishes and their food supply. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. RP-RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 137-145.

Abstract: The riparian zone has important influences on the total stream ecosystem including the habitat of salmonids. Shade and organic detritus from the riparian zone control the food base of the stream, and large woody debris influences channel morphology. Temporal and spatial changes in the riparian zone, the indirect influences of riparian vegetation on salmonids, and the effects of man's activities are discussed. *MULTIPLE THREATS*

299. Meents, J.K.; Anderson, B.W.; Ohmart, R.D. 1984. Sensitivity of riparian birds to habitat loss. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 619-625.

Abstract: The extent and composition of riparian plant communities in the lower Colorado River valley have historically been altered, primarily by man. Some of these communities are disappearing (cottonwood and mesquite), and others are expanding (saltcedar and arrowweed). We examined the avian community associated with riparian vegetation and identified avian habitat specialists. Nearly all of these specialists are concentrated in cottonwood/willow or honey mesquite communities. Saltcedar generally supported no avian species with narrow habitat breadth. *INVASIVE SPECIES*

300. Mehlhop, P.; Vaughn, C.C. 1993. Threats to and sustainability of ecosystems for freshwater mollusks. In: Covington, W.W.; DeBano, L.F., tech. coords. Sustainable ecological systems: Implementing an ecological approach to land management; 1993 July 12-15; Flagstaff, AZ. Gen. Tech. Rep. RM-247. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 68-77.

Abstract: This paper examines the ecological and life history characteristics of two groups of mollusks of North America—prosobranch snails and riverine bivalves—that have suffered declines due to human activities or appear to be threatened with declines in the future. *MULTIPLE THREATS*

301. Merritt, D.M.; Poff, N.L. 2010. Shifting dominance of riparian *Populus* and *Tamarix* along gradients of flow alteration in western North American rivers. Ecological Applications. 20(1): 135-152.

Abstract: The study presented in this paper was a natural experiment in eight ecoregions in arid and semiarid portions of the western United States, measuring *Tamarix* and native *Populus* recruitment and abundance at 64 sites along 13 perennial rivers spanning a range of altered flow regimes. Based on their results the authors infer that *Tamarix* would have naturalized, spread, and established widely in riparian communities in the absence of dam construction, diversion, and flow regulation in the western United States. However, *Tamarix* dominance over native species would likely be less extensive in the absence of human alteration of river-flow regimes. *INVASIVE SPECIES*

302. Minckley, W.L.; Brown, D.E. 1982. Southwest wetlands. Biotic communities in the American Southwest United States and Mexico. In: Brown, D.A., ed. Desert Plants. Vol. 4, No. 1-4, part 6. Tucson, AZ: University of Arizona Press: 223-288.

Abstract: Part 6 of this publication differentiates and/or shows maps of aquatic, riparian and other wetland biotic communities of the American Southwest. It classifies aquatic habitats, wetlands and riparian communities, gives a brief description of each, provides examples, and addresses threats and other management challenges. *MULTIPLE THREATS*

303. Mortenson S.G.; Weisberg, P.J.; Ralston, B.E. 2008. Do beavers promote the invasion of non-native *Tamarix* in the Grand Canyon riparian zone? Wetlands. 28: 666-675.

Abstract: A spatial analysis was conducted to assess whether the presence of beavers correlates with the relative of *Salix* and *Tamarix*. Results showed that riparian surfaces covered by *Tamarix* was significantly greater for sites where beavers were present. This indicates that either *Tamarix* and beavers co-occur in similar habitats, beavers prefer habitats that have high *Tamarix* cover, or beavers contribute to *Tamarix* dominance through selective use of its native woody competitors. *INVASIVE SPECIES*

304. Mosley, J.C.; Cook, P.S.; Griffis, A.J.; O'Laughlin, J. 1997. Guidelines for managing cattle grazing in riparian areas to protect water quality: Review of research and best management practices policy. Report No.15. Moscow, ID: University of Idaho: Idaho Forest, Wildlife, and Range Policy Analysis Group: 67p.

Abstract: This report attempts to reply to three focus questions about riparian grazing: what management strategies are indicated by research, how are BMPs administered, and how does state policy protect water quality? *GRAZING*

305. Mount, J.W.; Krausman, W.; Finch, D.M. 1996. Riparian habitat change along the Isleta-Belen reach of the Middle Rio Grande. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 48-68.

Abstract: This paper provides a summary of vegetation changes over an 11-year period (1984-1995) in the middle reach of the Rio Grande. Over this time span the bosque vegetation has aged, exotic woody species, saltcedar, and Russian olive have increased in cover. In some cases, introduced species have replaced other vegetation such as coyote willow. Thirty-one fire events, which altered vegetation, had also been recorded. *MULTIPLE THREATS*

306. Mueller, D.K.; Moody, C.D. 1984. Historical trends in concentration and load of major ion in the Colorado River System. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of the 1983 international symposium on state-of-the-art control of salinity; 1984 July 13-15, Salt Lake City UT. Boston MA: Butterworth Publishers: 181-192.

Abstract: During the early 1970s salinity in the lower Colorado River was recognized as a basin-wide problem. This paper reports on the method developed to generate mean monthly discharge and concentration values and present preliminary results of the trend analysis. *WATER QUALITY*

307. Mueller, G.; Marsh, P. 1995. Bonytail and razorback sucker in the Colorado River basin. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 324-326

Abstract: The dramatic decline prompted the listing of the bonytail as endangered in 1980, and a similar listing for the razorback sucker followed in 1991. Although both fishes are Federally protected and recovery programs began over 15 years ago, these species continue to edge toward extinction. The problem lies in the complexity of the environmental and legal issues, combined with possible conflicts in land, water, and fishery- management philosophies. *MULTIPLE THREATS*

308. Myers, L.H. 1989. Grazing and riparian management in southwestern Montana. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 117-120.

Abstract: A subjective analysis of riparian vegetation response in 34 grazing systems was completed. Common denominators to both poor and good riparian management are discussed and recommendations are provided. *GRAZING*

309. Naiman, R.J.; Décamps, H. 1997. The ecology of interfaces: Riparian zones. Annual Review of Ecology and Systematics. 28(1): 621-658.

Abstract: This article provides an overview of important characteristics of riparian zones, describes physical effects on adjacent environments, summarizes ecological characteristics, and discusses consequences of environmental alterations on ecosystem form and function. *MULTIPLE THREATS*

310. Naiman, R.J.; Turner, M.G. 2000. A future perspective on North America's freshwater ecosystems. Ecological Applications. 10(4): 958-970.

Abstract: This article explores trends in alterations to freshwater ecosystems, discusses the ecological consequences of biophysical alterations expected to occur in the next 20–30 years, and identifies some of the major scientific challenges

and opportunities to effectively address the changes. Topics discussed include altered hydrological regimes, biogeochemical cycles, altered land use, riparian management, life history strategies, and relations between climate change and water resource management. *MULTIPLE THREATS*

311. Naiman, R.J.; Bunn, S.E.; Nilsson, C.; Petts, G.E.; Pinay, G.; Thompson, L.C. 2002. Legitimizing fluvial ecosystems as users of water: An overview. Environmental Management. 30(4): 455-467.

Abstract: This article articulates some fundamental relationships between physical and ecological processes, presents basic principles for maintaining the vitality of fluvial ecosystems, identifies several major scientific challenges and opportunities for effective implementation of the basic ecological principles, and acts as an introduction to three specific articles to follow on biodiversity, biogeochemistry, and riparian communities. All the objectives, by necessity, link climate, land, and fresh water. Additionally, forecasting the ecological consequences of changing water regimes is a fundamental challenge for science, especially as environmental issues related to fresh waters escalate in the next two to three decades. *CLIMATE CHANGE*

312. National Academy of Science. 2002. Riparian areas: Functions and strategies for management. Washington, DC: National Academy Press. 428 p.

Abstract: This report by the National Academy of Science examines the structure and functioning of riparian ecosystems, how they have been altered by human activity, their legal status, and their potential for management and restoration. *MULTIPLE THREATS*

313. Neary, D.G.; Medina, A.L. 1996. Geomorphic response of a montane riparian habitat to interactions of ungulates, vegetation and hydrology. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 143-147.

Abstract: Wildcat Creek, a tributary of the Black River on the Apache-Sitgreaves National Forest is being studied to determine the impacts of cattle and elk grazing on riparian wet meadows. Grazing and trampling impacts of elk and cattle were found to affect the aggradation/degradation process in a pool-riffle sequence in two ways: (1) overgrazing of stream banks resulted in exposure of the soil fabric and loss during high flows, sloughing banks, channel widening, and a reduction in the ability of plants to trap sediments; and (2) trampling at animal crossing initiated a degradation of riffles by breaking down the armoring gravels that are held in place by native aquatic plants. *GRAZING*

314. Nelson, S.M. 2003. The Western Viceroy butterfly (Nymphalidae: *Limenitis archippus obsoleta*): An indicator for riparian restoration in the arid southwestern United States? Ecological Indicators. 3: 203–211.

Abstract: The purpose of this study was to study the autecology of the Western Viceroy butterfly (*Limenitis archippus obsoleta*) against the background of riparian restoration. Studies took place on the Bill Williams River, which contains a naturally functioning cottonwood/willow ecosystem. *INSECTS, MULTIPLE THREATS*

315. Nilsson, C.; Berggren, K. 2000. Alterations of riparian ecosystems caused by river regulation. BioScience. 50(9): 783-792.

Abstract: Hydrological alterations—to ensure water for agricultural, industrial, and domestic purposes, for hydroelectricity or for flood protection—have changed ecosystem structures and processes in running waters and associated environments the world over. In this article, the authors discuss the global-scale ecological changes in riparian ecosystems resulting from dam operations including examples in western North America. *DAM CONSTRUCTION*

316. Noll, W.; Williams, S.; Boyce, R. 1988. Grande Ronde River Basin: Fish habitat improvement implementation plan. Oregon Department of Fish and Wildlife; U.S. Department of Energy, Bonneville Power Administration: 39p.

Abstract: This plan identifies existing habitat problems, solutions, goals and objectives, priorities, estimated project costs and associated fishery benefits. The program provides for treatment of approximately 66 miles of stream habitat from 1988 to 1991. The primary factor limiting Chinook and steelhead production is rearing habitat including (1) high summer water temperatures, (2) low summer flows, (3) lack of riparian vegetation, (4) lack of habitat diversity, and (5) poor channel stability. *MULTIPLE THREATS*

317. Norcross, E.; Calvo, G. 1993. Private lands river protection: Balancing private and public concerns. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 55-69.

Abstract: This paper describes the state of the nation's rivers including the threats posed to riparian areas. Further, it explains some of the difficulties inherent in managing rivers on private lands, and provides a summary of existing and proposed private lands river protection tools. *MULTIPLE THREATS*

318. Oakley, A.L.; Collins, J.A.; Everson, L.B.; Heller, D.A.; Howerton, J.C.; Vincent, R.E. 1985. Riparian zones and freshwater wetlands. In: Brown, E.R., ed. Management of wildlife and fish habitats in forests of western Oregon and Washington, Part. 1. Portland, OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Region: 57-80.

Abstract: Riparian zones and freshwater wetlands are among the most heavily used wildlife habitats occurring in forest lands of western Oregon and Washington. Biologists have recognized this for years but only recently has the significance of riparian and wetland productivity been well quantified by research studies. Of the references cited in this chapter, the majority have been published since 1970. Results of ongoing research are expected to further substantiate and expand our knowledge of wildlife use in these habitats. *MULTIPLE THREATS*

319. Obedzinski, R.A.; Shaw, C.G.; Neary, D.G. 2001. Declining woody vegetation in riparian ecosystems of the Western United States. Journal of Applied Forestry. 16(4): 169-181.

Abstract: This article examines the decline of woody vegetation in keystone riparian ecosystems and clarifies what issues need to be addressed for successful and sustainable riparian restoration. It is an overview of the factors implicated in the decline of woody riparian vegetation and the interactions among these factors. Causes of decline discussed include: exotic species invasion, stress-induced mortality, increases in insect and disease attack, drought, beaver, fire, climate change, and anthropogenic activities, such as agricultural development, groundwater depletion, dam construction, water diversion, grazing, recreation, urbanization, timber harvesting, and mining. *MULTIPLE THREATS*

320. Ohmart, R.D. 1996. Ecological condition of the East Fork of the Gila River and selected tributaries: Gila National Forest, New Mexico. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 312-317.

Abstract: Numerous anthropogenic factors have been involved in the degradation of Gila River riparian systems to their current condition, but the major degrading force has been unmanaged domestic livestock grazing either season-long or year-long. Potential to recover these fluvial systems or proper functioning condition is high with management intervention. Stream gradients are moderate to low and sediment loads sufficient for bank formation. *MULTIPLE THREATS*

321. Ohmart, R.D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. Krausman, P.R., ed. Rangeland wildlife. Denver, CO: Society of Rangeland Management: 245-279.

Abstract: There are many agents of riparian destruction and degradation other than overgrazing by domestic livestock. Most of these have been along major western streams, while unmanaged livestock degradation, the focus of this chapter, has been ubiquitous and at all elevations. *GRAZING*

322. Ohmart, R.D.; Anderson, B.W.; Hunter, W.C. 1985. Influence on waterbird, wader, and shorebird use along the lower Colorado River. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 117-122.

Abstract: Waterbird, wader, and shorebird use of the Colorado River was restricted to habitats in or immediately adjacent to the river prior to agriculture development. The authors studied agricultural habitats systematically for three years and identified those agricultural settings that were most important for individual species and groups of waterbirds, waders, and shorebirds. *AGRICULTURE*

323. Ohmart, R.D.; Deason, W.O.; Burke, C. 1977. A riparian case history: The Colorado River. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 35-47.

Abstract: Historically to present, cottonwood communities have declined in abundance along the lower Colorado River to the condition that the future of this natural resource is precarious. Avian species showing strong specialization to cottonwood communities may be extirpated should the cottonwood community be lost from the river. Only through the concern and action by responsible agencies can we assure the persistence of this natural resource. *MULTIPLE THREATS*

324. Olson, R.W.; Armour, C.L. 1978. Economic considerations for imposed livestock management approaches for fish and wildlife in riparian/stream areas. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems. 1978 Nov. 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 67-71.

Abstract: In this paper complex interrelationships between various range uses are conceptualized. A perspective is presented about monetary values of rangeland use of ranchers, consumers, and hunters. Additionally, economic ramifications of implementation of improved riparian management techniques on fish and wildlife resources are addressed. *GRAZING*

325. Olson, T.E.; Gray, M.V. 1988. Characteristics of least Bell's vireo nest sites along the Santa Ynez River. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 278-284.

Abstract: Due primarily to alteration of riparian vegetation and nest parasitism by brown cowbirds, the least Bell's vireo has undergone a tremendous decline in range and numbers since the 1920s. The objective of this study was to characterize nest sites of least Bell's vireos and to describe trends in use of nesting habitat within the Santa Ynez River drainage. *INVASIVE SPECIES*

326. Olson, T.E; Knopf, F.L. 1986a. Agency subsidization of a rapidly spreading exotic. Wildlife Society Bulletin. 14:492-493.

Abstract: Establishment of Russian-olive in North America has been promoted by State and Federal agencies using the species in plantings and providing seedlings to private landowners at less-than-market value. Because seedlings continue to be made available from these agencies, the rate of naturalization will surely continue to increase in western states and possibly in some areas of Canada and Mexico. *INVASIVE SPECIES*

327. Olson, T.E.; Knopf, F.L. 1986b. Naturalization of Russian-olive in the western United States. Western Journal of Applied Forestry. 1: 65-69.

Abstract: Since its introduction into the United States, Russian-olive has escaped cultivation at many locations. This exotic tree is now present in every western State, especially within riparian zones. The species has high value for wildlife, but can interfere with agricultural practices and has potential to displace native riparian trees. *INVASIVE SPECIES*

328. Omernik, J.M.; Abernathy, A.R.; Male, L.M. 1981. Relationships between surface water nutrient levels and proximity of agricultural and forest land to receiving waters. In: Stefan, H.G., ed. Proceedings of the symposium on surface water impoundments (Vol. 1); 1981 June 2-5; Minneapolis, MN. New York: American Society of Civil Engineers: 323-334.

Abstract: The primary objective of this study was to clarify the buffer strip/surface water nutrient level relationship by determining whether or not consideration of proximity of two land use types (agriculture and forest) to streams improved the ability to predict stream nutrient levels over simply using the proportion of watershed occupied by each land use. WATER QUALITY

329. Parmenter, R.R. 2009. Applying hydrology to land management on the Valles Caldera National Preserve. Southwest Hydrology. 8(2): 22-23.

Abstract: This paper provides a brief summary of the management history, challenges, and future plans that will affect the hydrology and riparian ecosystems within this National Preserve. *MULTIPLE THREATS*

330. Petrosky, C.E.; Holubetz, T.B. 1985. Idaho habitat evaluation for offsite mitigation record: Annual report FY 1984. Report to U.S. Department of Energy, Bonneville Power Administration, Contract No. 1984BP13381, Project No. 198300700. Boise: Idaho Department of Fish and Game.

Abstract: Man's activities in Idaho, namely logging, intensive livestock grazing, mining and agriculture, have degraded many streams. The purpose of this study is to (1) document physical changes in habitat, (2) measure changes in steelhead and Chinook production attributable to habitat enhancement projects, (3) measure changes in standing crops of resident fish species due to enhancement, and (4) determine project effectiveness. *MULTIPLE THREATS*

331. Pettit, N.E.; Naiman, R.J. 2007. Fire in the riparian zone: Characteristics and ecological consequences. Ecosystems. 10: 673-687.

Abstract: The authors review the current understandings of the frequency, spatial distributions, mechanisms, and ecological consequences of fire in riparian zones. They conclude that riparian fires are potentially important in shaping ecological characteristics in many regions, but that this is poorly quantified and that a better understanding is essential to access the effects of fire in helping shape the complex ecological characteristics of the riparian zones over the longer-term. *FIRE*

332. Pinay, G.; Clément, J.C.; Naiman, R.J. 2002. Basic principals and ecological consequences of changing water regimes on nitrogen cycling in fluvial systems. Environmental Management. 30(4): 481-491.

Abstract: This article addresses three basic ecological principles driving the biogeochemical cycle of nitrogen in river systems: (1) how the mode of nitrogen delivery affects river ecosystem functioning, (2) how increasing contact between water and soil or sediment increases nitrogen retention and processing, and (3) the role of floods and droughts as important natural events that strongly influence pathways of nitrogen cycling in fluvial systems. New challenges related to the cumulative impact of water regime change, the scale of appraisal of these impacts, and the determination of the impacts due to natural and human changes are discussed. It is suggested that cost of long-term and long-distance cumulative impacts of hydrological changes should be evaluated against short-term economic benefits to determine the real environmental costs. *MULTIPLE THREATS*

333. Pister E.P.; Kerbavaz, J.H. 1984. Fish Slough: A case study in management of a desert wetland system. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 929-933.

Abstract: Fish Slough is a remnant of a once widespread, shallow aquatic/riparian wetland in the arid Owens Valley. Fish Slough supports a variety of rare species, including the endangered Owens pupfish. Water exports and introduction of exotic fish species has led to the near extinction of this endangered species. Successes and failures of management efforts at Fish Slough hold lessons for management of other endangered species and natural areas. *MULTIPLE THREATS*

334. Platts, W.S. 1974. Geomorphic and aquatic conditions influencing salmonids and stream classification. U.S. Department of Agriculture, Forest Service, Surface Environment and Mining Program: 199 p.

Abstract: Investigations were conducted of (1) the physical structure of aquatic environments in grantic, mountainous lands in Idaho, (2) the relationship between the physical stream structure and fish populations, (3) the influence of geomorphic process of aquatic ecosystems, (4) the relation of order within landforms in relation to uniformity in aquatic environments, and (5) the potential for classifying aquatic environments from land classification systems. A 397 square mile area in the upper south fork of the Salmon River watershed was stratified into four geologic process groups and 12 geomorphic types. Within that area, 38 streams were studied by analyzing 2,482 transects for physical aquatic and streambank environments, while 291 areas were investigated as to fish populations. *MULTIPLE THREATS*

335. Platts, W.S. 1978. Livestock grazing and riparian/stream ecosystems—an overview. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 Nov. 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 39-45.

Abstract: Streams have been subjected to damaging events since the day they were formed, initially by such natural events as glaciation, floods, climatic temperature changes and droughts, and, more recently, by man colonizing along stream banks and using the stream and its surroundings for mining, lumbering, livestock grazing, road construction, and sewage and waste disposal. This paper points out that (1) solutions to grazing problems are not easily found; (2) no single discipline possesses the skills and knowledge for all problem-solving; (3) past studies have identified many problems and offered some guidance; (4) more studies are needed to develop better understanding; (5) agencies responsible for the management of the streamside environment have not adequately considered the influence of livestock grazing; and (6) not all answers will be found in the near future. *GRAZING*

336. Platts, W.S. 1984. Riparian system/livestock grazing interaction research in the Intermountain West. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 424-429.

Abstract: This paper presented research that identifies the influences livestock grazing has on riparian and aquatic ecosystems. A research study was initiated in 1975 by the USDA Forest Service that studied grazing influences and developed solutions so managers would have the best information to evaluate range management alternatives. Preliminary findings on continuous and rest-rotation grazing systems are discussed. *GRAZING*

337. Platts, W.S. 1989. Compatibility of livestock grazing strategies with fisheries. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 103-110.

Abstract: A better understanding of management strategies with respect to their stream-riparian compatibility should help fishery specialists work more closely and effectively with range conservationists in rangeland management. These strategies are discussed here. *GRAZING*

338. Platts, W.S.; Nelson, R.L. 1989. Characteristics of riparian plant communities and streambanks with respect to grazing in northeastern Utah. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 73-81.

Abstract: Streambanks and associated riparian vegetation were studied in grazed and ungrazed pastures along Big Creek, Utah, to determine whether differences in streamside community type composition and condition were related to differences in streambank morphology. Considerable structural difference was observed between grazed sites and sites where grazing has been suspended or greatly reduced for nearly 2 years. *GRAZING*

339. Platts, W.S.; Gebhardt, K.A.; Jackson, W.L. 1985. The effects of large storm events on basin-range riparian stream habitats. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: Reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 30-34.

Abstract: Large storm events had major impacts on stream riparian reaches that had received heavy livestock grazing.

One ungrazed rehabilitated stream reach actually improved in habitat condition while two adjacent grazed stream reaches decreased. Each stream reacted differently to channel erosion, with two streams showing mainly lateral channel movement and the third stream exhibiting vertical channel movement. *GRAZING*

340. Poff, B.; Tecle, A. 2002. Bacteriological water quality trend analysis in Oak Creek Canyon, Arizona. In: Proceedings: Ground water/surface water interactions. 2002 summer specialty conference; 2002 July 1-3. Keystone, CO: American Water Resources Association: 431-436.

Abstract: This paper analyzes the temporal and spatial distribution of bacterial contamination at Slide Rock Park in Oak Creek Canyon, Arizona. Sources of contamination include livestock and wildlife grazing in the forests above the creek, domesticated and wild animals, residential homes inside the canyon and the recreationist visiting the canyon. The data shows some correlation between the numbers of visitors and E. coli counts at the Slide Rock State Park. *WATER QUALITY*

341. Poff, N.L.; Zimmerman, J.K.H. 2010. Ecological responses to altered flow regimes: A literature review to inform the science and management of environmental flows. Freshwater Biology. 55: 194-205.

Abstract: For this literature review 165 papers published over the last four decades were assessed, with a focus on more recent papers. This analysis does not support the use of the existing global literature to develop general, transferable quantitative relationships between flow alteration and ecological response. However, they do support the inference that flow alteration is associated with ecological change and that the risk of ecological change increases with increasing magnitude of flow alteration. *CLIMATE CHANGE, FLOW REGULATION*

342. Poff, N.L.; Olden, J.D.; Merritt, D.M.; Pepin, D.M. 2007. Homogenization of regional river dynamics by dams and global biodiversity implications. Proceedings of the National Academy of Science. 104: 5732-5737.

Abstract: The authors used 186 long-term streamflow records on intermediate-sized rivers across the continental United States to show that dams have homogenized the flow regimes on third- through seventh-order rivers in 16 historically distinctive hydrologic regions over the course of the 20th century. Such quantitative analysis provides the basis for conservation and management actions aimed at restoring and maintaining native biodiversity and ecosystem function and resilience for regionally distinct ecosystems at continental to global scales. *DAM CONSTRUCTION*

343. Potyondy, J.P. 1992. Technical issues related to nonpoint source management. In: Neary, D.G.; Ross, K.C.; Coleman, S., eds. Proceedings of the national hydrology workshop; 1992 April 27- May 1; Phoenix, AZ. Gen. Tech. Rep. RM-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 65-73.

Abstract: Non-point source control strategies rely primarily on the application of Best Management Practices (BMPs) as the means to achieve protection of designated beneficial uses. The continued use of BMPs appears to offer important advantages over instream water quality standards and their continued use is suggested. In the long-term, monitoring data accumulated to evaluate BMPs can be used to build a sound scientific basis for eventual evolution to water quality based approaches. *WATER QUALITY*

344. Prange, R. 1993. Duck Creek riparian habitat restoration project. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 395-396.

Abstract: This paper describes the successful restoration of the Duck Creek riparian habitat, through fencing to protect streambanks from livestock grazing. *GRAZING*

345. Pringle, C.M. 2000. Threats to U.S. public lands from cumulative hydrologic alterations outside of the their boundaries. Ecological Applications. 10(4): 971-989.

Abstract: This paper is based on synthesis and summary of existing information and emerging trends. It highlights immediate problems facing managers of freshwater resources on public lands and is not meant to be a comprehensive treatise. Major goals are to (1) describe regional differences in the availability of fresh water, rates of human population growth, and the distribution of public lands in the United States; (2) summarize the general extent and magnitude of current pressures on water resources in those categories of public lands where there is a strong emphasis on managing aquatic ecosystems for environmental needs (i.e., national parks, national forests, and national wildlife refuges); and (3) discuss two case studies where science-management linkages have been effective in implementing some localized solutions, yet where many landscape-scale problems remain to be addressed. This analysis is intended to place the water resources issues faced by public lands into a broader context and to illustrate the increasing need to understand the cumulative and long-term ecological effects of hydrologic alterations outside of public land boundaries. *MULTIPLE THREATS*

346. Queheillalt, D.M.; Morrison, M.L. 2006. Vertebrate use of a restored riparian site: A case study on the central coast of California. Journal of Wildlife Management. 70(3): 859-866.

Abstract: The primary objective of the study described in this research note was to determine use by vertebrates of

a riparian restoration site (Carmel-by-the-Sea, California, U.S.A.). The study can be used as an example of how the effectiveness of an ongoing restoration project can be assessed and modified. *MULTIPLE THREATS*

347. Radtke, D.B. 1990. Environmental contaminants in the lower Colorado River Valley, Arizona, California and Nevada. In: Proceedings of the Arizona Hydrological Society's second annual symposium; Water quality and quantity issue into the 1990s: Adaptation to current realities; 1990 September 14-16; Casa Grande, AZ. Arizona Hydrological Society: 21 p.

Abstract: This paper presents the results of a reconnaissance irrigation drainage study in the lower Colorado River Valley, Arizona, California, and Nevada. Water, bottom sediment, and biota were sampled and analyzed for selected inorganic and synthetic organic constituents that may be present at toxic concentrations. Selenium was the only inorganic constituent that exceeded any existing standard, criterion or guideline for protection of wildlife resources. *WATER QUALITY*

348. Rashin, E.B.; Clishe, C.J.; Loch, A.T.; Bell, J.M. 2006. Effectiveness of timber harvest practices for controlling sediment related water quality impacts. Journal of the American Water Resources Association. 42(5): 1307-1327.

Abstract: Timber harvest best management practices (BMPs) in Washington State were evaluated to determine their effectiveness at achieving water quality standards pertaining to sediment related effects. Practices for ground-based harvest and cable yarding in the vicinity of small streams without buffers were ineffective or only partially effective at preventing water quality impacts. Recommendations are given for practices that provide a high confidence of achieving water quality standards by preventing chronic sediment delivery and avoiding direct channel disturbance. *FOREST HARVESTING*

349. Ray, D.; Woodroof, W.; Roberts, R.C. 1984. Management of riparian vegetation in the North Coast region of California's Coastal Zone. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 660-672.

Abstract: Riparian vegetation has important habitat and economic values. The Coastal Act requires protection of both of these sets of values. Local coastal plans have attempted to resolve this policy conflict by protecting riparian corridors and habitat patches. Protection of large areas of riparian vegetation by land-use regulation has proven difficult. *MULTIPLE THREATS*

350. Reeder, R., ed. 1994. Riparian road guide: Managing roads to enhance riparian areas. Washington, DC: Terrene Institute. 32 p.

Abstract: This short booklet provides a description of how anthropogenic activities, (road construction in particular) has negatively impacted riparian systems in the semi-arid Southwest. It also provides examples of successful measures to avoid these negative impacts. *ROADS*

351. Reichard, N. 1988. Restoring and maintaining riparian habitat on private pastureland. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 211-216.

Abstract: Protecting riparian habitat from livestock grazing on private land is a complex task that requires paying attention to sociological and economic as well as physical and biological factors. Six livestock exclusion fencing projects on private property in northwestern California are described. The importance of long term maintenance and the need for landowner incentives are discussed. Significant gains may be made via a statewide, coordinated effort to encourage the protection of riparian habitat on private land. *GRAZING*

352. Reid. L.M. 2010. Cumulative effects of fuel treatments on channel erosion and mass wasting. In: Elliot, W.J.; Miller, I.S.; Audin, L., eds. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 101-125.

Abstract: This chapter describes characteristics of channel erosion and mass-wasting processes, the environmental factors that most strongly influence erosion processes, the mechanisms by which fuel treatments can influence those controlling factors, outlines strategies for determining whether such influences will occur, and describes how erosion evaluations might be incorporated into a cumulative impact analysis. The erosion processes discussed here include channel-bank erosion, gullying, soil creep, landsliding and related processes. *FOREST HARVESTING*

353. Richards, C.; Cernera, P.J. 1987. Salmon River habitat enhancement: Annual report FY 1986. Project no. 83-359. U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife.

Abstract: This study evaluates the effects of habitat enhancement on the habitat and fish community in various reaches of the Salmon River in Idaho, where increased sedimentation caused by mining activities had caused degradation of the aquatic habitat. In particular, the Bear Valley Creek (Middle Fork Salmon River), Yankee Fork Salmon River, and East Fork Salmon River/Herd Creek were evaluated. *MINING*

354. Richter, H.E. 2006. Participatory learning on the San Pedro: Designing the crystal ball together. Southwest Hydrology. 6: 24-25.

Abstract: The contribution of groundwater from the regional aquifer to both the alluvial aquifer and baseflows in the river is essential to sustain the lush habitats of the San Pedro River in southeastern Arizona. However, increasing human water demands, in combination with drought, have the potential to alter the hydrologic context that sustains this riparian vegetation and impacts those species dependent on it. *DROUGHT*

355. Rieger, J.P.; Kreager, D.A. 1988. Giant Reed: A climax community of the riparian zone. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 222-225.

Abstract: Active management of coastal streams is needed to ensure the continued existence of significant riparian systems in Southern California. The concept of a dynamic self-replacing plant community is no longer a truism there. In the past decade, one exotic species in particular, Giant Reed, has had an ever-increasing negative role in the succession of riparian systems. The aggressiveness of this exotic has enabled it to invade disturbed areas along many watercourses in Southern California. *INVASIVE SPECIES*

356. Rieman, B. 2003. Status of native fishes in the western United States and issues for fire and fuels management. Forest Ecology and Management. 178: 197-211.

Abstract: This paper suggests that progress toward more integrated management of forests and native fishes will require at least three steps: (1) better integration and development of a common conceptual foundation and ecological goals, (2) attention to landscape and ecological context, and (3) recognition of uncertainty. *FIRE, FOREST HARVESTING*

357. Rink, L.P.; Windell, J.R. 1988. Riparian wetland enhancement in the San Miguel River Valley, Telluride, CO. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K. tech., coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 102-108.

Abstract: This paper describes a wetland mitigation project that was implemented concurrent with a development project and involved approximately 3 acres of riparian wetland enhancement. *MULTIPLE THREATS*

358. Rinne, J.N. 1985. Livestock grazing effects on southwestern streams: A complex research problem. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: Reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 295-299

Abstract: Conducting viable research on the effects of domestic livestock grazing on stream environments and biota in southwestern National Forests is problematic. The multiple-use concept, spatio-temporal factors, inadequate control and replication, and changes in land management objectives and direction render it difficult to effectively study grazing impacts. *GRAZING*

359. Rinne, J.N. 1990. Minimizing livestock grazing effects on riparian stream habitats: Recommendations for research and management. In: Proceedings of a national conference on enhancing the states' lake and wetland management programs; 1989 May 18-19; Chicago, IL. Northeastern Illinois Planning Commission: 15-28.

Abstract: Over 70 percent of historic riparian habitats in the United States have been lost through various land use practices, including grazing. Although grazing on public lands has been regulated for 50 years, this land use practice continues to have detrimental effects on riparian systems in the arid American Southwest. To date, much research on grazing effects on riparian systems has been deficient in design and brief in duration. *GRAZING*

360. Rinne, J.N. 1990. The utility of stream habitat and biota for identifying potential conflicting forest land uses: Montane riparian areas. Forest Ecology and Management. 33/34: 363-383.

Abstract: This paper reviews the literature on the use of fine sediment, aquatic macroinvertebrates, and fishes as indicators for identifying and describing the effects of various land-use practices on riparian-stream systems. Also, it presents the results of research on the effects of land-management activities on these three variables for several southwestern United States montane streams. *MULTIPLE THREATS*

361. Rinne, J.N. 1993. Declining southwestern aquatic habitats and fishes: Are they sustainable? In: Covington, W.W.; DeBano, L.F., tech. coords. Sustainable ecological systems: Implementing an ecological approach to land management; 1993 July 12-15; Flagstaff, AZ. Gen. Tech. Rep. RM-247. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 256-265.

Abstract: Rinne (1) discusses and summarizes the nature of the decline of aquatic resources in the region, (2) suggests necessary actions to halt and perhaps reverse this decline, and (3) attempts to answer the question: Are aquatic habitats and fishes sustainable in the American Southwest? *MULTIPLE THREATS*

362. Rinne, J.N. 2000. Fish and grazing relationships in southwestern national forests. In: Jemison, R.; Raish, C., eds. Livestock management in the American Southwest: Ecology, society, and economics. New York: Elsevier Science: 329-371

Abstract: This paper discusses the state of knowledge of relationships between fish, fish habitat, and grazing throughout the West and examines these relationships more specifically in Arizona and New Mexico. In the arid Southwest, riparian and instream areas frequently serve as fish habitat and are critical to the survival of threatened and endangered native fish species. Riparian and instream areas are also where domestic animals congregate to graze, which can have a considerable impact on riparian vegetation, which impacts fish habitat and populations. *GRAZING*

363. Risser, P.G. 1991. Impacts on ecosystems on global environmental changes in Pacific Northwest Watersheds. In: Naiman, R.J., ed. Watershed management: Balancing sustainability and environmental change. Seattle, WA: University of Washington, Center for Streamside Studies: 12-24.

Abstract: Climate change is producing subtle but measurable changes in ecosystem processes that are best measured at watershed scales. This paper examines ecosystem process change in a number of Pacific Northwest watersheds with long-term climate and watershed input-output data sets. Alterations in weather patterns due to global climatic processes, such as El Nino and La Nina, are creating significantly drier or wetter conditions and resultant decreases and increases in water flow. *CLIMATE CHANGE*

364. Roath, L.R.; Krueger, W.C. 1982. Cattle grazing influence on a mountain riparian zone. Journal of Range Management. 35: 100-103.

Abstract: A combination of management and physical topographic constraints caused cattle to concentrate on the riparian zone early in the grazing season in 1977 and 1978. A large percentage of cattle days and vegetation utilization on the riparian zone occurred in the first 4 weeks of the grazing period. Utilization on herbaceous vegetation was 76 and 72% in 1977 and 1978, respectively. Impact of grazing on the most prevalent species, Kentucky bluegrass, was minimal. Shrub use increased with increased maturity of herbaceous vegetation. Utilization of major shrubs was not excessive in either year, and very likely had no long-term effects on either the abundance or vigor of the shrubs. The interactions between herbaceous vegetation maturity and availability with shrub utilization are discussed. The measurements of vegetation use combined with observations were used to develop a qualitative assessment of livestock influences. *GRAZING*

365. Roath, R. 1986. Livestock management on riparian areas. In: Smits, J.H., ed. Management of riparian areas. Washington, DC: Public Lands Council: 41-43.

Abstract: Livestock influences on riparian areas can be regulated by management. However, for managers to regulate the impacts on riparian areas, a thorough understanding of the vegetation, livestock, and the interactions between both is required. *GRAZING*

366. Roberts, T.C., Jr. 1991. Political and social aspects of riparian area management. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 120-122.

Abstract: The author discusses three reasons why progress on riparian areas have been slow and suggests means for improvement. *MULTIPLE THREATS*

367. Roelle, J.E.; Hagenbuck, W.W. 1995. Surface cover changes in the Rio Grande floodplain, 1935-1989. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 290-292.

Abstract: Agricultural conversion, urban and suburban expansion, water development, recreation, and invasion by non-native species such as Russian olive and saltcedar have severely reduced the extent and quality of riparian vegetation communities particularly in the arid and semi-arid Southwest. This article documents changes between 1935 and 1989 in cover types of the floodplain of the Rio Grande in central New Mexico. *MULTIPLE THREATS*

368. Rogers, T.J. 1996. Insects of the riparian. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 154-156.

Abstract: This paper describes life histories, defoliation problems and other activities of insects associated with forest tree species growing along high elevation streams and riverbanks. In addition, examples of insects and diseases associated with lower elevations riparian areas are given. *INSECTS, DISEASE*

369. Rood, S.B.; Mahoney, J.M. 1990. Collapse of riparian poplar forests downstream from dams in western prairies: Probable causes and prospects for mitigation. Environmental Management. 14(4): 451-464.

Abstract: This paper reviews reports of popular decline downstream from dams to determine and suggest mitigation and revegetation strategies. *DAM CONSTRUCTION*

370. Rood, S.B.; Mahoney, J.M.; Reid, D.E.; Zilm, L. 1995. Instream flows and the decline of riparian cottonwoods along the St. Mary River, Alberta. Canadian Journal of Botany. 73: 1250-1260.

Abstract: The St. Mary Dam enables water storage and diversion for irrigation. Consequently, river flows downstream are dramatically reduced during summer months. To assess historical changes in the abundance of riparian cottonwoods *(Populus balsamifera, Populus angustifolia,* and *Populus deltoides),* airphoto analyses were conducted for 40-km river reaches upstream and downstream from the dam and along adjacent dammed and undammed rivers. Cottonwoods along the lower St. Mary River are confined by steep-walled canyons to narrow bands. Analyses of the lineal river distance associated with cottonwoods revealed a 68% decline from 1951 to 1985. The decline was progressive during the period. Analyses of historical stream flows indicated that the cottonwood mortality was drought induced as a result of insufficient flows during the hot, dry summer periods and abrupt flow reductions following the high-flow period in the late spring. The riparian water table was determined to be closely coordinated with river stage, as changes in river elevation were followed by quantitatively similar changes in water table depth. Along the St. Mary River, reduced sedimentation downstream from the dam was not considered to be responsible for the cottonwood decline. The historically sparse cottonwood abundance along the lower St. Mary River may have reflected environmental conditions that were naturally only marginally suitable, and those groves may have been particularly vulnerable to the impacts of river flow regulation. *DAM CONSTRUCTION, CLIMATE CHANGE*

371. Rood, S.B.; Samuelson, G.M.; Weber, J.K.; Wywrot, K.A. 2005. Twentieth-century decline in streamflows from the hydrographic apex of North America. Journal of Hydrology. 306: 215-233.

Abstract: This study analyzed historic patterns of streamflow from the North American hydrographic apex with rivers selected (1) to represent headwaters that flow into the three oceans, (2) from watersheds with minimal human impacts, (3) from relatively free-flowing reaches upstream from major dams or diversion, and (4) with statistically sufficient hydrologic records. *CLIMATE CHANGE*

372. Rood, S.B.; Goater, L.A.; Mahoney, J.M.; Pearce, C.M.; Smith, D.G. 2007. Floods, fire and ice: Disturbance ecology of riparian cottonwoods. Canadian Journal of Botany. 85: 1019-1032.

Abstract: This literature review presents an assessment of the influences of three prominent physical disturbances, floods, fire, and ice on cottonwood population ecology along rivers from the central Rocky Mountain zone around the Canada–U.S. border. The authors conclude that (1) riparian cottonwoods are tolerant of and dependent on occasional physical disturbance for population rejuvenation; (2) differing disturbance responses contribute to niche differentiation across the *Populus* species; (3) different disturbances enable varied spatial and temporal patterns of cottonwood establishment; and (4) natural disturbance regimes favor native cottonwoods and disfavor some invasive woody plants. *MULTIPLE THREATS*

373. Rosen, P.C.; Schwalbe, C.R. 1995. Bullfrogs: Introduced predators in Southwestern wetlands. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 452-454.

Abstract: Introduced predators, such as the bullfrog, can have devastating effects on faunas that evolved without equivalent predatory types. The bullfrog, as an exotic in the absence of key original enemies, attains tremendous population densities and can lead to regional extinctions and may account for some unexplained amphibian declines. Especially in Arizona, inaction could lead to the extinction of at least three native leopard frog species within a decade. *INVASIVE SPECIES*

374. Rucks, J.A. 1978. Comparison of riparian communities influenced by grazing. In: Graul, W.D.; Bissel, S.J., tech. coords. Lowland river and stream habitat in Colorado: A symposium; 1978 Oct. 4-5; Greeley, CO: The Wildlife Society and Colorado Audubon Council, Colorado Chapter. 100-113.

Abstract: The Bureau of Land Management in Colorado evaluated abundance and diversity of plant, bird and small populations in three study areas each with different grazing management practices. Significant differences in both abundance and diversity of each species was shown in the representative grazing sites. *GRAZING*

375. Rucks, M.G. 1984. Composition and trend of riparian vegetation on five perennial streams in southeastern Arizona. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 97-107.

Abstract: The Gila River, San Francisco River, Bonita Creek, Mescal Creek, and Aravaipa Creek were studied in the summer of 1980 to establish baseline data to be used for management decision and future monitoring. Cattle browsing appears to be the major contributing factor to the downward trend of broadleaf riparian communities. The only system in this study with an upward trend in the broadleaf riparian community is Aravaipa Creek, where cattle have been excluded since 1973. *GRAZING*

376. Sada, D. 2008. Great Basin riparian and aquatic ecosystems. In: Chambers, J.C.; Devoe, N.; Evenden, A., eds. Collaborative management and research in the Great Basin—examining the issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 49-52.

Abstract: This paper provides a short overview of key issues affecting the riparian and aquatic ecosystems, which are dominated by isolated springs in the Great Basin region. *MULTIPLE THREATS*

377. Sanders, S.D.; Flett, M.A. 1988. Montane riparian habitat and willow flycatchers: Threats to a sensitive environment and species. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 262-266.

Abstract: Mountain meadows provide critical habitat for California's dwindling population of Willow Flycatchers and for many other breeding birds. Most meadows in the western United States are managed for livestock or other consumptive uses rather than for wildlife. The potential threats to Willow Flycatchers and their habitat are discussed, and suggestions to protect and enhance mountain meadow habitat for this and other riparian species are offered. *MULTIPLE THREATS*

378. Sands, A.; Howe G. 1977. An overview of riparian forest in California: Their ecology and conservation. In: Johnson, R.R.; Jones, D.A., tech. coords. Importance, preservation and management of riparian habitat: A symposium; 1977 July 9; Tucson, AZ. Res. Pap. RM-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 98-115.

Abstract: This paper is comprised of abstracts from presentations made at the symposium on riparian forests in California: their ecology and conservation. The purpose of this symposium was to encourage a strong alliance of individuals and agencies who will work together to establish protection for the endangered riparian ecosystems of California. *MULTIPLE THREATS*

379. Sarr, D.A. 2002. Riparian livestock exclosure research in the western United States: A critique and some recommendations. Environmental Management. 30(4): 416-526.

Abstract: This paper reviews, critiques, and provides recommendations for the improvement of riparian livestock exclosure research. Several initial ideas for strengthening the scientific basis for livestock exclosure research are presented: (1) incorporation of meta-analyses and critical reviews, (2) use of restoration ecology as a unifying conceptual framework, (3) development of long-term research programs, (4) improved exclosure placement/design, and (5) a stronger commitment to collection of pretreatment data. *GRAZING*

380. Schindler, D.W.; Newbury, R.W.; Beaty, K.L.; Prokopowich, J.; Ruszcynski, T.; Dalton, J.A. 1979. Effects of a windstorm and forest fire on chemical losses from forested watersheds and on the quality of receiving streams. Canadian Journal of Fisheries and Aquatic Science. 37: 328-334.

Abstract: A severe natural windstorm followed by a high intensity forest fire caused significant increases in runoff and in losses of nitrogen, phosphorus, and potassium from two Precambrian watersheds. Both the windstorm and the fire had significant effects on water and chemical yields. Both increased concentrations and increased flow volumes appear to be responsible for the increased nutrient loss. *FIRE, WATER QUALITY*

381. Schlorff, R.W.; Bloom, P.H. 1984. Importance of riparian systems to nesting Swainson's hawk in the Central Valley of California. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 612-618.

Abstract: Once a common breeding bird of the Central Valley and elsewhere in California, the Swainson's Hawk has experienced a severe population decline due to, among other things, loss of riparian system that provided trees for nest sites. The pattern of land use prevalent over the past 130 years has reduced riparian systems of the Central Valley to a tiny fraction of their former extent. It will be necessary to maintain and restore stands of vegetation in riparian systems if the Swainson's Hawk is to continue as a breeding species in the Central Valley. *AGRICULTURE*

382. Schmidly, D.J.; Ditton, R.B. 1978. Relating human activity and biological resources in riparian habitats of Western Texas. In: Johnson, R.R.; McCormick, J.F., tech. coords. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service: 107-116.

Abstract: This paper discusses the recreational and wildlife values of riparian habitats along the Rio Grande in western Texas. Several human activities have the potential to impact or have impacted riparian resources in this region: (1) irrigation diversions and stream channelization, (2) reservoir construction, (3) agriculture, (4) overgrazing from domestic livestock, (5) introduction of exotic plants and fishes, (6) increases in human recreation activity, and (7) pesticide build-up. This paper seeks to place these impacts into broader land use perspective so that riparian resources can be more effectively managed in western Texas. *MULTIPLE THREATS*

383. Schmidt, L.J. 1987. Recognizing and improving riparian values: The Forest Service approach to riparian management. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 36-38.

Abstract: The Forest Service has a continuing commitment to conservation of riparian areas following the concept of "wise use." Goals and decisions reflected in Forest Plans recognize the importance of riparian values. These plans have identified long-term objectives, guidelines, standards, and management requirements to protect the unique values of riparian areas. *MULTIPLE THREATS*

384. Schulz, T.T.; Leininger, W.C. 1990. Differences in riparian vegetation structure between grazed areas and enclosures. Journal of Range Management. 43: 295-299.

Abstract: Resource managers need to know how degraded riparian areas respond to changes in management, such as reduction and elimination of grazing. Differences in vegetation structure were examined in a montane riparian zone in north-central Colorado after 30 years of cattle exclusion and continued, but reduced, grazing pressure. In order to assess the changes in the riparian community, canopy coverage, density, and standing crop of important riparian species were measured in 1985 and 1986. *GRAZING*

385. Scott, M.L. 1988. Landscape analysis of woody riparian vegetation along a portion of the Cache La Poudre River, CO. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 63-70.

Abstract: Infrared aerial photography was used to assess the extent of woody riparian vegetation along a gradient from urban to agricultural areas on the Cache La Poudre River, a tributary of the South Platte River, CO. Although the aerial extent of riparian vegetation in the urban area is not significantly different from that in the agricultural area, detailed examination of land use patterns indicated a change in occurrence and nature of riparian vegetation from urban to agricultural land uses. *URBANIZATION*

386. Scott, M.L.; Shafroth, P.B.; Auble, G.T. 1999. Responses of riparian cottonwoods to alluvial water table declines. Environmental Management. 23(3): 347-358.

Abstract: Human demands for surface and shallow alluvial groundwater have contributed to the loss, fragmentation, and simplification of riparian ecosystems threatening dominant riparian *Populus* species. This research examines the role of surface and groundwater dynamics on the establishment of new, and maintenance of existing *Populus* stands. *GROUNDWATER DEPLETION*

387. Seavy, N.E.; Gardali, T.; Golet, G.H.; Griggs, F.T.; Howell, C.A.; Kelsey, R.; Small, S.L.; Viers, J.H.; Weigand, J.F. 2009. Why climate change makes riparian restoration more important than ever: Recommendations for practice and research. Ecological Restoration. 27: 330-338.

Abstract: This paper addresses (1) how and why riparian restoration prepares ecosystems for climate change, (2) how riparian restoration can be enhanced to accommodate climate change, and (3) research needed to ensure that riparian restoration is robust to climate change. *CLIMATE CHANGE*

388. Sedgwick, J.A.; Knopf, F.L. 1987. Breeding bird response to cattle grazing of a cottonwood bottomland. Journal of Wildlife Management. 51: 230-237.

Abstract: This paper discusses the avian relationships and the impact of grazing on breeding densities of selected migratory birds in a plains cottonwood bottomland in northeastern Colorado. Moderate, late-fall grazing had no detectable impact on calculated densities in the six studied species. Habitat associations suggested that common yellowthroat and yellow-breasted chats were most unique and most likely to respond negatively to higher levels of grazing. *GRAZING*

389. Sedgwick, J.A.; Knopf, F.L. 1991. Prescribed grazing as secondary impact in a western riparian floodplain. Journal of Range Management. 44: 369-373.

Abstract: The effect of late-autumn cattle grazing on plant biomass was examined in a western Great Plains cottonwood riparian zone prone to catastrophic flooding every 5 to 8 years. Following 1 year of pre-treatment data collection in 1982, five 16-ha pastures were grazed from 1982 to 1984 and compared to five control pastures within the South Platte River floodplain in northeastern Colorado. *GRAZING*

390. Sewards, M.A.; Valett, H.M. 1996. Effect of livestock grazing on nutrient retention in a headwater stream of the Rio Puerco Basin. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 135-142.

Abstract: Sediment and nutrient loss from headwater streams of sedimentary basins in the semi-arid Southwest have been attributed to both over-grazing by livestock and to climatic cycles that influence arroyo formation. Considerable effort has been directed toward the influence of livestock grazing on riparian species abundance and diversity. Less work has concentrated on the influence of livestock on in-stream processes and communities. This paper considers the interaction of flooding and livestock grazing on hydrologic and nutrient retention in a headwater stream of the Rio Puerco Basin, New Mexico. *GRAZING*

391. Shafroth, P.B.; Auble, G.T.; Stromberg, J.C.; Patten, D.T. 1998. Establishment of woody riparian vegetation in relation to annual patterns of streamflow, Bill Williams River, Arizona. Wetlands. 18(4): 577-590.

Abstract: This paper retrospectively examines establishment of four woody riparian species along the Bill Williams River, Arizona, in the context of annual pattern of streamflow for the years 1993-1995. *CLIMATE CHANGE*

392. Shafroth, P.B.; Stromberg, J.C.; Patten, D.T. 2000. Woody riparian vegetation response to different alluvial water table regimes. Western North American Naturalist. 60(1): 66-76.

Abstract: The objective of this study was to add to the sparse database of plant response to measured water table decline in western riparian ecosystems, by quantifying the response of three woody riparian species to different water table dynamics and to clarify factors that are likely to be important in determining plant response. The authors examined the growth and survival of saplings of populous, *Salix* and *Tamarix* at three sites with different groundwater regimes over a 3-year period along the Bill Williams River in western Arizona. *INVASIVE SPECIES*

393. Shanfield, A.N. 1984. Alder, cottonwood, and sycamore distribution and regeneration along the Nacimiento River, California. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 196-202.

Abstract: Distribution and regeneration of alder, cottonwood, and sycamore was assessed for much of the Nacimiento River. Alder, abundant along narrow reaches, had well-distributed height classes. Cottonwood, now rare along the river, exhibited low numbers of saplings; overgrazing of cattle is believed primarily responsible for the decline. Sycamore had good regeneration along narrow reaches and poor regeneration on broader bottomlands. *GRAZING*

394. Shapiro, A.M. 1984. Geographical ecology of the Sacramento Valley riparian butterfly fauna. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 934-941.

Abstract: The Sacramento Valley butterfly fauna is depauperate and uniform in the riparian corridor from Redding to the Sacramento-San Joaquin Delta. There are few obvious pre-American relicts and only one taxomonically recognized endemic. Historical reasons for these conditions are discussed. Land-use change and habitat fragmentation posses the greatest threats to the fauna. *MULTIPLE THREATS*

395. Shaw, N.L. 1991. Recruitment and growth of Pacific willow and sandbar willow seedlings in response to season and intensity of cattle grazing. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 130-137.

Abstract: In this report, the effects of cattle grazing treatments on recruitment and growth of Pacific willow and sandbar willow seedlings was monitored over a 4-year period on a degraded low-elevation stream in the sagebrush-steppe zone of eastern Oregon. *GRAZING*

396. Shaw, N.L.; Clary, W.P. 1996. Willow establishment in relation to cattle grazing on an eastern Oregon stream. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 128-156.

Abstract: Natural regeneration and growth of coyote willow and whiplash willow were monitored from 1987 to 1993 on a low-elevation eastern Oregon stream degraded by more than a century of heavy livestock grazing. Browsing by deer each summer substantially reduced willow growth in all pastures, possibly masking treatment differences. Few willows have grown beyond browsing height to increase site stability and begin providing on-site seed sources. *GRAZING*

397. Shepard, B.B. 1989. Evaluation of the U.S. Forest Service "COWFISH" model for assessing livestock impacts on fisheries in the Beaverhead National Forest, Montana. In: Gresswell, R.E.; Barton, B.A.; Kershner, J.L., eds. Practical approaches to riparian resource management: An educational workshop; 1989 May 8-11; Billings, MT. U.S. Department of the Interior, Bureau of Land Management: 23-33.

Abstract: The COWFISH fish habitat model developed by the U.S. Forest Service was evaluated during 1986 and 1987 at 43 stream sites within the Beaverhead National Forest, Montana, to determine the ability of the model to assess effects of livestock grazing on trout fisheries. Use of the COWFISH model by range professionals and livestock permittees increased their awareness of the effects of livestock grazing on aquatic resources. *GRAZING*

398. Sherman, H. 1989. Streambank plants vital to water quality. Agricultural Research. 8: 19.

Abstract: This article gives a brief description of the research conducted by T. Svejcar of the USDA-ARS to reduce damage to streambanks caused by human activities, such as livestock grazing, mining, road building and recreational uses. *MULTIPLE THREATS*

399. Simonds, G. 1988. Riparian habitat: Deseret's point of view. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 178-179.

Abstract: This paper provides a brief description of how riparian areas in the Deseret Ranch located in northeastern Utah have changed in the past. *GRAZING*

400. Skagen, S.K.; Kelley, J.F.; van Riper, C., III; Hutto, R.L.; Finch, D.M.; Krueper, D.J.; Melcher, C.P. 2005. Geography of spring landbird migration through riparian habitats in Southwestern North America. The Condor. 107: 212–227.

Abstract: This project represents a synthesis of several western migration studies, is an initial step in identifying regions and landscapes important during migration stopover, and may enhance efforts for conserving migration habitats of landbirds that breed in Southwestern North America. *MULTIPLE THREATS*

401. Smith, D.M.; Finch, D.M.; Hawksworth, D.L. 2009a. Black-Chinned Hummingbird nest-site selection and nest survival in response to fuel reduction in a southwestern riparian forest. The Condor. 111(4): 641-652.

Abstract: The Black-Chinned Hummingbird nests primarily in riparian forests where humans have altered the structure and composition of this habitat. There have been few studies regarding hummingbirds' nest survival, have been limited in scale and have not addressed effects of habitat change. This study examines the response of Black-Chinned Hummingbirds to habitat alterations caused by fuel reduction. The researchers found a negative relationship of nest height and survival in cottonwood, the substrate most commonly used after fuel reduction. They suggest replacing exotic vegetation with native vegetation of low stature such as New Mexico olive to prevent decreases in nest survival. *FOREST HARVESTING*

402. Smith, D.M.; Kelly, J.F.; Finch, D.M. 2007. Avian nest box selection and nest success in burned and unburned southwestern riparian forest. Journal of Wildlife Management. 71: 411-421.

Abstract: This study evaluated the effects of high-intensity spring and summer wildfire on the quality of breeding bird habitat in the Middle Rio Grande Valley. The results show that certain bird species will successfully breed in burned riparian forest if nest sites are available. *FIRE*

403. Smith, D.M.; Finch, D.M.; Gunning, C.; Jemison, R.; Kelly, J.F. 2009b. Post-wildfire recovery of riparian vegetation during a period of water scarcity in the Southwestern USA. Fire Ecology Special Issue. 5(1): 38-55.

Abstract: The observations of this study suggest that in the absence of ideal hydrologic and climatic conditions, fire can reduce cottonwood density in the bosque (riparian forest) along the Middle Rio Grande of central New Mexico and promote the spread of saltcedar. Further, it suggests that the increasingly xeric conditions predicted under most climate change scenarios could result in greater recovery of exotic saltcedar over native vegetation. *FIRE, INVASIVE SPECIES,CLIMATE CHANGE*

404. Smith, J.J. 1988. Recovery of riparian vegetation on an intermittent stream following removal of cattle. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 217-221.

Abstract: In 1984-1987 the recovery of riparian willows and sycamores was studied on two short, intermittent stream sections in a newly acquired portion of a state park in central California. Prior to removal of cattle in 1983, the plots contained mature sycamores, one young sycamore and five willows. By 1985 over 320 willows, 16 sycamores and 1 cottonwood had appeared, and basal sprouts had developed on the mature sycamores. Young willows and sycamores grew slowly, and establishment and growth generally ceased as surface flows disappeared. Because of slow growth at the sites, a significant willow corridor is probably only possible in the absence of cattle browsing. *GRAZING*

405. Smith, M.A.; Rodgers, J.D.; Dodd, J.L.; Skinner, Q.D. 1992. Habitat selection by cattle along an ephemeral channel. Journal of Range Management. 45: 385-390.

Abstract: Because of widespread concern about cattle grazing effects on riparian zones of public lands, seasonal habitat selection by cattle was studied along a cold desert area ephemeral waterway of north-central Wyoming. Little is known of grazing effects on ephemeral streams compared to perennial streams. Cattle activity was monitored in small pastures and a surrounding large allotment in spring, summer, and fall. Observations included activity and habitat where it occurred. Concomitantly, utilization levels, protein content, and dry matter content of forages were determined in the small pastures. *GRAZING*

406. Snider, G.B.; Daugherty, P.J.; Medina, A.L. 1998. An ecological and economic approach for analyzing the costs and benefits of riparian restoration projects. In: Hydrology and water resources in Arizona and the Southwest. Arizona-Nevada Academy of Science: 47-50.

Abstract: Successful restoration of threatened riparian ecosystems should be analyzed using a combined ecological and economic approach. The disciplines of ecology and economics

need to recognize the mutualistic relationship between these biophysical and socioeconomic systems in order to achieve successful restoration. This requires a shift of focus from a narrow single-species approach to the integrity of the entire system recognizing the mutualistic connectedness between ecology and economics. *MULTIPLE THREATS*

407. Snyder, W.D. 1988. Stem cutting propagation of woody phreatophytes in eastern Colorado. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 151-156.

Abstract: Seven species of native woody phreatophytes and one exotic species were planted using stem cutting techniques at sites with relatively high groundwater levels along eastern Colorado rivers from 1984 to 1986. This paper reviews and evaluates stem cutting propagation trial in eastern Colorado. *MULTIPLE THREATS*

408. Sommarstorm, S. 1984. Riparian regulation: Random, redundant or rational? In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 274-280.

Abstract: The purpose of this paper is (1) to identify the primary local, State, and Federal regulatory agencies and laws responsible for conserving riparian systems on private lands; (2) to analyze these regulatory responsibilities from the perspective of the regulators as well as those regulated; (3) to propose some improvements in the current regulatory approach; and (4) to stimulate discussion regarding the traditional assumption about environmental regulation as a conservation tool. Further, this paper discusses the various threats to riparian systems from a regulatory point of view. *MULTIPLE THREATS*

409. Spear, M.J.; Mullins, C.L. 1987. Riparian habitat of the Middle Rio Grande—A case study for more effective protection. In: Mutz, K.M.; Lee, L.C., tech. coords. Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 45-47.

Abstract: One of the most extensive remaining gallery cottonwood forests in the Southwest is located along the Middle Rio Grande. This riparian zone supports a diversity and density of wildlife unmatched by other habitat types in the Southwest. However, Federal, State and local programs to protect wetlands, of which riparian ecosystems are a part, have been ineffective in the Middle Rio Grande. Accordingly, the unique value of this area makes it an ideal candidate for special attention or protection. *MULTIPLE THREATS*

410. Spencer, D.F.; Ksander, G.G.; Whitehand, L.C. 2005. Spatial and temporal variation in RGR and leaf quality of a clonal riparian plant: *Arundo donax*. Aquatic Botany. 81: 27–36.

Abstract: The purpose of this study was to determine if growth, plant quality, and nutrient availability varied temporally and spatially in a northern California population of *Arundo donax*, which has invaded riparian zones in California where it acts as a transformer species. Because plant growth and leaf quality influence the effectiveness of management techniques, this study sought to determine if these characters varied. *INVASIVE SPECIES*

411. Spotts, R. 1988. Conflicts in river management: A conservationist's perspective on Sacramento River riparian habitats—impacts, threats, remedies, opportunities and consensus. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 521-525.

Abstract: This paper provides a conservationist's perspective on how resource loses could be stopped and eventually reversed, through a combination of less-damaging bank protection methods, reliable mitigation for unavoidable impacts, willing seller acquisitions and restoration projects. *MULTIPLE THREATS*

412. Starnes, W.C. 1995. Colorado River Basin fishes. In: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Washington, DC: U.S. Department of the Interior, National Biological Service: 149-152.

Abstract: This paper examines the trends of the population make up of the Colorado River Basin fishes: native versus non-native species. The author states that the abundance of non-native fishes can be an indicator of the degree of alteration of the Colorado River ecosystem and can impair future studies of biodiversity. *INVASIVE SPECIES*

413. Stednick, J.D. 2010. Effects of fuel management practices on water quality. In: Elliot, W.J.; Miller, I.S.; Audin, L., eds. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 149-163.

Abstract: Fuel management practices occur infrequently ranging from once every year to once over several decades. These activities, which influence riparian ecology, should be

implemented with best management practices to minimize or prevent water quality changes or non-point source pollution. *FIRE*

414. Stern, V.M. 1984. Pest and beneficial insects associated with agriculture and riparian systems. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 970-982.

Abstract: Vast changes have occurred in the California landscape over the past 100 years. In agriculture, many of these changes favor the buildup of pest populations over biological control. The manipulation of pest populations is a complex study is applied ecology. *AGRICULTURE*

415. Stevens, L.E.; Stacey, P.B.; Jones, A.L.; Duff, D.; Gourley, C.; Catlin, J.C. 2005. A protocol for rapid assessment of southwestern stream-riparian ecosystems. In: van Riper III, C.; Mattson, D.J., eds. The Colorado Plateau II: Biophysical, socioeconomic and cultural research. Tucson, AZ: The University of Arizona Press: 397-420.

Abstract: This paper presents an improved method for rapid stream-riparian assessment, measuring the functioning condition of these habitats. *MULTIPLE THREATS*

416. Stevens, R.; McArthur, E.D.; Davis, J.N. 1991. Reevaluation of vegetative cover changes, erosion, and sedimentation on two watersheds—1912-1983. In: Clary, W.P.; McArthur, E.D.; Bedunah, D.; Wambolt, C.L., comps. Proceedings of the symposium on ecology and management of riparian shrub communities; 1991 May 29-31; Sun Valley, ID. Gen. Tech. Rep. INT-309. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 123-128.

Abstract: This paper outlines two approaches to watershed restoration and their results in the two Ephraim Canyon watersheds—Watersheds A and B—by evaluating changes in cover type, erosion, and sedimentation in the years 1952, 1958, 1961, and 1983. *MULTIPLE THREATS*

417. Stone, K.R.; Pilliod, D.S.; Dwire, K.A.; Rhoades, C.C.; Wollrab, S.P.; Young, M.K. 2010. Fuel reduction management practices in riparian areas of the Western USA. Environmental Management. 46: 91-100.

Abstract: Two decades of uncharacteristically severe wildfires have caused government and private land managers to actively reduce hazardous fuels to lessen wildfire severity in western forests, including riparian areas. Because riparian fuel treatments are a fairly new management strategy, this paper documents the frequency and extent on Federal lands in the western United States and found that well-designed monitoring of the consequences of riparian fuels treatments on fuel loads, fire risk, and ecological effects is needed to provide a scientifically defensible basis for the continued and growing implementation of these treatments. *FOREST HARVESTING, FIRE*

418. Storch, R.L. 1978. Livestock/streamside management programs in eastern Oregon. In: Cope, O.B., ed. Proceedings of the forum—grazing and riparian/stream ecosystems; 1978 Nov. 3-4; Denver, CO. Arlington, VA: Trout Unlimited: 56-59.

Abstract: Uncontrolled livestock grazing has seriously affected the water quality of streams. Indiscriminate use of streams by livestock results is breaking down the streambanks, eating and trampling shrubs that shade the streams and/or provide habitat for wildlife, and disturbing the stream bottoms. The effects of such use have been erosion of streambanks, higher water temperatures, increased sedimentation, soil compaction, and reduction of quality and quantity of forage. *GRAZING*

419. Strahan, J. 1984. Regeneration of riparian forests of the Central Valley. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 58-67.

Abstract: Riparian forests of the Sacramento River have an overstory and a regeneration pattern corresponding to the successional stage and fluvial landform associated with the forest stands. Land use and water development projects alter fluvial landforms and fluvial events to create changes in forest composition and regeneration. *MULTPLE THREATS*

420. Stromberg, J.C. 2001. Restoration of riparian vegetation in the southwestern United States: Importance of flow regimes and fluvial dynamism. Journal of Arid Environments. 49: 17-34.

Abstract: This paper describes changes that have occurred within riparian ecosystems of the southwestern United States, reviews the role of key environmental factors that structure riparian plant communities, and assesses various ways in which riparian vegetation can be restored by naturalizing ecological processes. *MULTIPLE THREATS*

421. Stromberg, J.C.; Tiller, R.; Richter, B. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro, Arizona. Ecological Applications. 6(1): 113-131.

Abstract: A major threat to riparian ecosystems is groundwater depletion. This paper confirms the importance of hydrologic factors, notably depth to groundwater and inundation frequency, in structuring the San Pedro River plant community. Utilizing a space-time continuum model the authors predict the eventual "desertification" of riparian flora (i.e. loss or reduction of cover of species based on their probability of occurrence in wetlands) as one potential response to groundwater decline. *GROUNDWATER DEPLETION*

422. Stromberg, J.C.; Tress, J.A.; Wilkins, S.D.; Clark, S.D. 1992. Response of velvet mesquite to groundwater decline. Journal of Arid Environments. 23: 45-58.

Abstract: Mesquite bosques are groundwater-dependent riparian woodlands that were once widespread in the American Southwest. Temporal and spatial variation in plant water potential, leaflet size, leaflet number, canopy height, and live and dead vegetation volume all indicate that the bosque requires a shallow aquifer and that bosque traits change continually with groundwater depth. This paper quantifies the relationships between groundwater depths and bosque traits using an ephemeral creek in the Sonoran Desert. *GROUNDWATER DEPLETION*

423. Stromberg, J.C.; Wilkins, S.D.; Tress, J.A. 1993. Vegetation-hydrology models: Implications for management of *Prosopis velutina* (velvet mesquite) riparian ecosystems. Ecological Applications. 3(2): 307-314.

Abstract: Velvet mesquite forests are one of the many types of arid-land riparian ecosystems that are threatened by groundwater pumping and other types of water development. The authors developed vegetation and hydrologic models for velvet mesquite stands across a xeric to mesic moisture gradient that can be used in the management of these threatened ecosystems. They found that stand structure was strongly related to water availability. The application of these models includes the ability to identify minimum water table depths for riparian stand maintenance and to detect stressful hydrologic conditions, via water potential measurements, before the onset of structural degradation. *GROUNDWATER DEPLETION*

424. Stromberg, J.C.; Beauchamp, V.B.; Dixon, M.D.; Lite, S.J.; Paradzick, C. 2007a. Importance of low-flow and high-flow characteristics to restoration of riparian vegetation along rivers in arid southwestern United States. Freshwater Biology. 52(4): 651–679.

Abstract: This paper addresses relationships between stream flow regimes and riparian vegetation of the arid southwestern United States, focusing mainly on rivers within Arizona's Gila River drainage basin. Specifically, it examines relationships of low flows and high flows with plant species diversity, plant species composition, and landscape heterogeneity. *DROUGHT, FLOODS*

425. Stromberg, J.C.; Briggs, M.; Gourley, C.; Scott, M; Shafroth, P.; Stevens, L. 2004. Chapter 6: Human alterations of ecosystems. In: Baker, M.B., Jr.; Ffolliott, P.F.; DeBano, L.F.; Neary, D.G., eds. Hydrology, ecology and management of riparian areas in the southwestern United States. Boca Raton, FL: Lewis Publishers: 99-126.

Abstract: This chapter discusses the ways in which Southwest riparian ecosystems have been changed by water management. Special attention is given to dams and groundwater pumping, which can act synergistically to change riparian biota, sediment dynamics, and water flow. Restoration strategies for hydrologically altered riparian zones are discussed. *MULTIPLE THREATS*

426. Stromberg, J.C.; Lite, S.J.; Marler, R.; Paradzick, C.; Shafroth, P.B.; Shorrock, D.; White, J.M.; White, M.S. 2007b. Altered stream-flow regimes and invasive plant species: The *Tamarix* case. Global Ecology and Biogeography. 16(3): 381–393.

Abstract: This paper aims to test the hypothesis that anthropogenic alteration of streamflow regimes is a key driver of compositional shifts from native to introduced riparian plant species. Results indicate that *Populus* and *Salix* were the dominant pioneer trees along the reaches with perennial flow and a natural flood regime. In contrast, *Tamarix* had high abundance (patch area and basal area) along reaches with intermittent stream flows (caused by natural and cultural factors), as well as those with dam-regulated flows. *INVASIVE SPECIES, DAM CONSTRUCTION*

427. Stromberg-Wilkins, J.C.; Patten, D.T. 1987. Mast cropping in Arizona walnut. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 309-314.

Abstract: Arizona walnut is a facultative wetland tree, which grows is a variety of riparian habitats. Populations exhibit different degrees of masting, that is, periodic production of large crops. Stream flow characteristics and moisture availability are associated with masting patterns among walnut populations. *DROUGHT*

428. Stuber, R.J. 1985. Trout habitat, abundance and fishing opportunities in fenced vs unfenced riparian habitat along Sheep Creek, CO. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: Reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 310-314.

Abstract: Fencing was used to protect 40 hectares of riparian stream habitat along 2.5 km of Sheep Creek, CO, from adverse impacts due to heavy streamside recreation use and cattle grazing. Fish habitat within the fenced area was narrower, deeper, had less streambank alteration, and better streamside vegetation than comparable unfenced section. There was a higher proportion of non-game fish present in unfenced sections. *GRAZING, RECREATION*

429. Studenmund, R.G. 1993. The Nature Conservancy's Sweetwater River project. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 356-358.

Abstract: This paper provides a background on the Sweetwater River in Wyoming and gives the reason for the decline of its riparian degradation. Further, it describes the Nature Conservancy's efforts to restore the riparian ecosystem of the river. *MULTIPLE THREATS*

430. Sudbrock, A. 1993. Fighting back: An overview of the invasion, and a low-impact way of fighting it. Restoration and Management. 11: 31-34.

Abstract: This paper offers an overview of the ecological problems related to saltcedar and recommends a proven, low-impact method for eradicating it. *INVASIVE SPECIES*

431. Sun, K. 1987. Building and restoring riparian zones through ranch management. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 271-275.

Abstract: The condition of the Sweetwater Valley in Wyoming during the late 1800s is well documented. Pictures and pioneer journals characterize the overgrazed condition. Shifting sand bars, lack of brush and trees and unstable banks speak of the poor stream condition. Recent pictures show abundant willows, grassy banks and narrower stabilized stream. Flood irrigation has raised the water table, and return flow has helped to stabilize the flow during dry months. Careful grazing practices permit good use of forage and wildlife is abundant. *GRAZING*

432. Sun, K. 1988. Historical perspective of riparian areas along the Oregon Trail. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 71-72.

Abstract: This paper provides a brief description of how western riparian areas along the Oregon Trail have changed in the past 200 years. Several photographs are presented. *MULTIPLE THREATS*

433. Svejcar, T. 1997a. Riparian zones: 1) What are they and how do they work? Rangelands. 19(4): 4-7.

Abstract: This is an informative paper that defines and describes riparian zones. It covers the importance of riparian zones, their structure and function, and the dynamic nature and long-term cycles of riparian ecosystems. *MULTIPLE THREATS*

434. Svejcar, T. 1997b. Riparian zones: 2) History and human impacts. Rangelands. 19(4): 8-12.

Abstract: This paper outlines the history of human impacts on riparian zones. Svejcar focuses on post-settlement impacts covering the broad categories of beaver populations removal, livestock introduction, herbicide use, mechanical treatment application, logging, mining, and recreation. Other factors that are mentioned include human induced changes in upland vegetation and alien species introduction. *MULTIPLE THREATS*

435. Swanson F.J.; Fredriksen, R.L. 1982. Sediment routing and budgets: Implications for judging impacts of forestry practices. In: Swanson, F.J.; Janda, R.J.; Dunne, T.; Swanston, D.N., tech. eds. Workshop on sediment budgets and routing in forest drainage basins. Gen. Tech. Rep. PNW-141. Portland OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Forest and Range Experiment Station. 129-137

Abstract: Sediment budget and routing studies offer some improvements over traditional studies of small drainage basin manipulations and individual erosion processes for analysis of impacts of forestry practices on soil erosion from hillslopes and sedimentation in streams. Quantification of long-term (century) and short-term (decades) impacts waits a more detailed analysis of the dynamics of sediment storage in stream channels and at hillslope sites prone to failure by debris avalanches. *MULTIPLE THREATS*

436. Swanson, F.J.; Lienkaemper, G.W. 1978. Physical consequences of large organic debris in Pacific Northwest streams. Gen. Tech. Rep. PNW-69. Portland, OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Forest and Range Experiment Station: 12 p.

Abstract: Large organic debris in streams controls the distribution of aquatic habitats, the routing of sediment through stream systems and the stability of streambed and banks. Management activities directly alter debris loading by addition or removal of material and indirectly by increasing the probability of debris torrents and removing standing streamside trees. *MULTIPLE THREATS*

437. Swanson, S. 1988. Using stream classification to prioritize riparian rehabilitation after extreme events. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management,

and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 96-101.

Abstract: Riparian grazing can be managed in a variety of ways to avoid detrimental effects. A useful alternative to a riparian exclosure is a riparian pasture that can be managed for optimum riparian resource values. *GRAZING*

438. Swanston, D.N. 1980. Influence of forest and rangeland management on anadromous fish habitat in western North America: Impacts of natural events. PNW-GTR-104. Portland, OR: U.S. Department of Agriculture Forest Service, Pacific Northwest Forest and Range Experiment Station: 27 p.

Abstract: Natural events affecting vegetative cover and the hydrology and stability of a stream and its parent watershed are key factors influencing the quality of anadromous fish habitat. High intensity storms, drought, soil mass movement, and fire have the greatest impacts. Wind, stream icing, and the influence of insects and disease are important locally. *MULTIPLE THREATS*

439. Swenson, E.A. 1988. Progress in the understanding of how to reestablish native riparian plants in New Mexico. In: Mutz, K.M.; Cooper, D.J; Scott, M.L.; Miller, L.K., tech. coords. Restoration, creation and management of wetland and riparian ecosystems in the American West: Proceedings of a symposium; 1988 November 14-16; Denver, CO. Boulder, CO: Society of Wetland Scientists, Rocky Mountain Chapter: 144-150.

Abstract: This paper reports on the development of a dormant pole planting technique and cites the results of several operational projects. In addition, species evaluation and superior accession selections are described. A description of the deteriorated riparian vegetation is included as well. *MULTIPLE THREATS*

440. Szaro, R.C.; Belfit, S.C.; Aitkin, J.K.; Rinne, J.N. 1985. Impact of grazing on a riparian Garter Snake. In: Johnson, R.R.; Ziebell, C.D.; Patton, D.R.; Ffolliott, P.F.; Hamre, R.H., tech. coords. Riparian ecosystems and their management: Reconciling conflicting uses. First North American riparian conference; 1985 April 16-18; Tucson, AZ. Gen. Tech. Rep. RM-120. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 359-363.

Abstract: Numbers of wandering garter snakes were significantly higher where cattle grazing was excluded than along grazed portions of the Rio de las Vacas. Differences can be attributed to the regeneration of streamside vegetation and increased amount of organic debris. *GRAZING*

441. Tainter, J.A.; Tainter, B.B. 1996. Riverine settlement in the evolution of prehistoric land-use systems in the Middle Rio Grande Valley, New Mexico. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 22-32.

Abstract: This paper describes changes in prehistoric land-use in part of the Middle Rio Grande Valley, New Mexico. Processes of economic change, land-use intensification, and regional abandonment suggest that there were periods of significant prehistoric disturbance to both upland and valley ecosystems. *MULTIPLE THREATS*

442. Taylor, D.M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. Journal of Range Management. 39: 254-258.

Abstract: Nine transects, in areas with different histories of cattle grazing, were established along the Blitzen River in Oregon. Counts of birds and measurements of vegetation were made in the summers of 1981 and 1982. Increased frequency of grazing on an annual basis correlated significantly with decreases in bird abundance, shrub volume, and shrub heights. The longer the time since a transect was last grazed correlated significantly with increases in bird abundance, shrub volume, and shrub heights. Bird abundance increased significantly with increased shrub volume and taller shrub heights. Bird species richness decreased with increased grazing. Bird counts were 5 to 7 times higher on an area ungrazed since 1940 than on 2 areas grazed annually until 1980, and 11 to 13 times higher than on a transect severely disturbed by extensive grazing and dredging activities. Disturbances from camper activities also appeared to reduce bird populations. *MULTIPLE THREATS*

443. Tellman, B.; Yarde, R.; Wallace, M.G. 1997. Arizona's changing rivers: How people have affected the rivers. Tucson: University of Arizona, College of Agriculture, Water Resources Research Center: 198 p.

Abstract: This book describes how humans have been changing Arizona's Rivers for centuries and how the changes since the mid-19th century have been more profound than earlier changes. The great dams on the Colorado River are the most visible of those modern activities. Arizona's population explosion of the 20th century accelerated those changes, many of which are irreversible. *MULTIPLE THREATS*

444. Tettemer, J.M. 1987. A joint venture to preserve, enhance and maintain wetlands and riparian systems. In: Mutz, K.M.; Lee, L.C., tech. coords. Wetland and riparian ecosystems of the American West: Proceedings of the eighth annual meeting of the Society of Wetland Scientists; 1987 May 26-29; Seattle WA. Denver, CO: Planning Information Corp.: 286-288.

Abstract: This paper observes that wetlands preservation through a joint venture is a practical alternative to the current conflicts. It identifies the objectives for riparian and wetland systems, obstacles in reaching those objectives, and the developer's interests. It encourages master planning of riparian and wetlands areas. *MULTIPLE THREATS*

445. Theobald, D.M.; Merritt, D.M; Norman, J.B., III. 2010. Assessment of threats to riparian ecosystems in the western U.S. Prepared for the Western Environmental Threats Assessment Center, Pineville, OR: 56 p.

Abstract: This report provides an initial, coarse-scale assessment of historical, current and future threats to streams and riparian areas in the western United States. *MULTIPLE THREATS*

446. Tiedemann, A.R.; Helvey, J.D.; Anderson, T.D. 1978. Stream chemistry and watershed nutrient economy following wildfire and fertilization in Eastern Washington. Journal of Environmental Quality. 7: 580-588.

Abstract: During the first 3 years after a severe wildfire in 1970, maximum concentration of nitrate-N instream water increased from pre-fire levels on a burned, unfertilized watershed and on two watersheds that were burned and fertilized. Relative background conditions and levels observed in the control stream, the fire exerted protracted impact on the chemistry of these streams. Results, however, indicate that fire and fertilization exerted negligible effects on chemical water quality for municipal use. *FIRE, WATER QUALITY*

447. Tiner, R.W., Jr. 1984. Wetlands of the United States: Current status and recent trends. National Wetlands Inventory. U.S. Department of the Interior, U.S. Fish and Wildlife Service. 59 p.

Abstract: This report identifies the current status of U.S. wetlands and major areas where wetlands are in greatest jeopardy from the national standpoint. It also presents regional and national information on wetland trends, including past and current threats. *MULTIPLE THREATS*

448. Tremble, M. 1993. The Little Colorado River. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 283-289.

Abstract: This paper describes the Little Colorado River, its watershed, riparian vegetation, and the threats to the river, which includes river alteration caused by saltcedar. *INVASIVE SPECIES*

449. Trimble, S.W.; Mendel, A.C. 1995. The cow as a geomorphic agent: A critical review. Geomorphology. 13: 233-253.

Abstract: The authors of this paper believe that both empirical studies and deterministic modeling can provide insights as to the effects of grazing on geomorphology. *GRAZING*

450. Troendle, C.A.; Olsen, W.K. 1992. Potential effects of timber harvest and water management on streamflow dynamics and sediment transport. In: Covington, W.W.; DeBano, L.F., tech. coords. Sustainable ecological systems: Implementing an ecological approach to land management; 1993 July 12-15; Flagstaff, AZ: Gen. Tech. Rep. RM-247. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 34-41.

Abstract: This paper addresses the flow parameters that influence sediment transport and the implications of changing flow dynamics, whether from flow or forest management, and the effect it has on the transport process. MULTIPLE THREATS

451. Tyree, M.T.; Kolb, K.J.; Rood, S.B.; Patiño, S. 1994. Vulnerability to drought-induced cavitation of riparian cottonwoods in Alberta: A possible factor in the decline of the ecosystem? Tree Physiology. 14: 455-466.

Abstract: This paper examines the vulnerability of xylem to loss of hydraulic conductivity caused by drought induced cavitation of three riparian cottonwood species. These species suffer a 50% loss of hydraulic conductivity when xylem pressure fell to –0.7 MPa for *Populus deltoides* and –0.1.7 MPa for *P. balsamifera* and *P. augustifolia*, making them the three most vulnerable tree species reported so far in North America. The authors also address the role of drought-induced xylem dysfunction to the decline of riparian ecosystems in dammed rivers. *DROUGHT*

452. Unsicker, J.E.; White, C.A.; James, M.R.; Kuykendall, J.D. 1984. Protecting stream environment zones to preserve water quality in the Lake Tahoe Basin. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 808-814.

Abstract: Stream environment zones can provide effective natural removal of pollutants in precipitation runoff, which would otherwise adversely affect the waters of Lake Tahoe. Human disturbance—mostly development and related activities—of some stream environment zones in the Tahoe Basin has drastically reduced their treatment capability. *WATER QUALITY*

453. Uresk, D.W.; Boldt, C.E. 1986. Effect of cultural treatments on regeneration of native woodlands on the Northern Great Plains. Prairie Naturalist. 18(4): 193-202.

Abstract: The objectives of this study were to determine the response of shrubs and trees in the northern Great Plains to livestock grazing and exclusion of grazing and in unthinned woodlands and thinned woodlands in which low vigor trees were removed and woody plants transplanted. A riparian-like woodland system in the upper reaches of Magpie Creek drainage near Belfield was selected. *GRAZING, FOREST HARVESTING*

454. U.S. Department of the Interior. 2005. Water management of the regional aquifer in the Sierra Vista subwatershed, Arizona—2004 Report to Congress. Upper San Pedro Partnership: 36 p.

Abstract: The report first discusses and defines the concept of sustainable yield and sets specific goals for the reduction of ground-water overdraft. The report then presents specific planned water-use management and conservation measures intended to facilitate the achievement of sustainable yield. The water-management measures presented in this report were either selected from among the options the Partnership has previously evaluated, or are measures implemented by individual members. Finally, a monitoring plan is outlined that will verify the effectiveness of management measures in reducing overdraft. *GROUNDWATER DEPLETION*

455. U.S. Fish and Wildlife Service. 1989. National wetlands priority conservation plan. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service: 87 p.

Abstract: This document discusses wetland values and losses and provides evaluation criteria to be used in making wetland acquisition determinations. Guidance is also provided on the use of the National Wetland Priority and Conservation Plan and its relationship with other legislation, plans, policies, and programs. *MULTIPLE THREATS*

456. USDA Soil Conservation Service. 1977. On-farm program for salinity control: Final report of the Grand Valley salinity study. Grand Valley Project, Colorado. U.S. Department of Agriculture, Soil Conservation Service and Agricultural Research Service.

Abstract: The overall objectives of the Grand Valley Salinity Control studies are to determine (1) the salt loading from irrigated and related upland areas and (2) the opportunity for reducing salt loading through improvements on irrigated farmland and reducing erosion and sediment delivery from privately owned upland areas. *WATER QUALITY*

457. USDA Soil Conservation Service. 1979. USDA salinity report for the Uintah Basin unit: Colorado River Basin salinity control study: State of Utah. Salt Lake City, UT: U.S. Department of Agriculture, Soil Conservation Service, Forest Service, and Agricultural Research Service.

Abstract: The Uintah Basin Unit is predominantly an agricultural area. Irrigation was introduced in the Basin in 1905 and has steadily increased since. There has also been a steady increase in saline land areas and in salt concentration in the river systems. One of the main objectives of this study is to determine the present contribution of salinity from irrigated cropland and related upland watersheds. *WATER QUALITY*

458. USDA Soil Conservation Service. 1981a. USDA salinity control and environmental assessment: Moapa Valley subevaluation unit, Nevada of the Virgin River Unit. Reno, NV: U.S. Department of Agriculture, Soil Conservation Service, Colorado River Basin Salinity Control Program.

Abstract: Moapa Valley Subevaluation Unit, a portion of Virgin River Unit, is a drainage to Colorado River. Moapa Valley Subevaluation Unit was identified as a problem area where irrigation and erosion are diffuse sources of salinity. During the study, alternative solutions were identified and estimates were made of effects of the plans to reduce salt loading to Colorado River. *WATER QUALITY*

459. USDA Soil Conservation Service. 1981b. USDA salinity control and environmental assessment: Virgin Valley subevaluation unit of the Virgin River Unit. Reno, NV: U.S. Department of Agriculture, Soil Conservation Service, Colorado River Basin Salinity Control Program.

Abstract: This report suggests that by reducing salt loading, the value of the Nation's output of goods and services will be increased. In addition, this paper describes the Environmental Quality (EQ) and Economic Development (ED) objectives as follows: (1) The EQ objective is to improve water quality by reducing the sediment and salt load to the Colorado River and enhance fish and wildlife resources; (2) The ED objective is to increase the efficiency of agricultural production by improved irrigation efficiency and reduced downstream salinity damages. *WATER QUALITY*

460. USDI Bureau of Reclamation Engineering and Research Center. 1977. Final environmental statement INT FES 77-15. Colorado River water quality improvement program (Vol. 1). U.S. Department of the Interior, Bureau of Reclamation; U.S. Department of Agriculture, Soil Conservation Service.

Abstract: This environmental impact statement is intended to provide a regional analysis of the basin-wide alternatives and cumulative effects of salinity control works, measures, and facilities. Las Vegas Wash and Crystal Geyser are addressed in a more detailed manner. *WATER QUALITY*

461. USDI Bureau of Reclamation. 1981. Saline water use and disposal opportunities: Colorado River water quality improvement program. Denver, CO: U.S. Department of the Interior, Bureau of Reclamation: 165 p.

Abstract: In order to meet the overall salinity control objective for the Colorado River Basin, approximately 2.8 million tons of salt per year will have to be removed from the river

system around the turn of the century. Environmental impacts of salinity control are discussed in two broad categories—impacts associated with interception and/or collection of saline water and impacts associated with transport use and/or disposal of saline water. *WATER QUALITY*

462. USDI Bureau of Reclamation. 1989. Lower Gunnison Basin unit, North Fork area: Preliminary findings report. Colorado River water quality improvement program. Denver, CO: U.S. Department of the Interior, Bureau of Reclamation.

Abstract: Of the 422,000 tons of salt contributed annually to the Colorado River system from the study area, about 274,000 tons are attributed to on-farm sources, about 148,000 tons are attributed to off-farm sources, and less than 1 percent is attributed to saline flows from abandoned oil and gas wells. *WATER QUALITY*

463. Van Cleve, D.H.; Comrack, L.A.; Wier, H.A. 1988. Coyote Creek (San Diego County) management and restoration at Anza-Borrego Desert State Park. In: Abell, D.L., coord. Proceedings of the California riparian systems conference: Protection, management, and restoration for the 1990's; 1988 September 22-24; Davis, CA. Gen. Tech. Rep. PSW-110. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station: 148-153.

Abstract: Despite its status as part of a State park, its relative inaccessibility, and the wilderness designation of much of the surrounding area, the Coyote Creek area suffers from numerous threats to its ecological health and its value as a refuge to humans and sensitive fauna. These threats include the impacts of humans on the natural, cultural and esthetic features and the effects of alien species on native flora and fauna. *MULTIPLE THREATS*

464. Vandersande, M.W.; Glenn, E.P.; Walworth, J.L. 2001. Tolerance of five riparian plants from the lower Colorado River to salinity, drought and inundation. Journal of Arid Environments. 49: 147-159.

Abstract: The purpose of this controlled greenhouse study was to determine the interaction of salt and water stress on the survival, salt tolerance, water-use characteristics, and growth rates of plant species currently found along the Colorado River. The study also aimed to determine the tolerance of the same species to long-term inundation of the root zone. *MULTIPLE THREATS*

465. Walters, C. 1997. Challenges in adaptive management of riparian and coastal ecosystems. Conservation Ecology. 1(2):1. Online: http://www.consecol.org/vol1/iss2/art1/.

Abstract: This paper discusses four reasons for low success rates in implementing policies of adaptive management. First, modeling for adaptive-management planning has often been supplanted by ongoing modeling exercises. Second, effective experiments in adaptive management often have been seen as excessively expensive and/or ecologically risky, compared to best use baseline options. Third, there is often strong opposition to experimental policies by people protecting various self-interests in management bureaucracies. Fourth, there are some very deep value conflicts within the community of ecological and environmental management interests. *MULTIPLE THREATS*

466. Warner, R.E. 1984. Structural, floristic and condition inventory of Central Valley riparian systems. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 356-374.

Abstract: This paper reports a ground-based inventory of 51 riparian sites. Morphological structures, floristics, plant diversity and site condition were quantified using an inventory methodology designed for that purpose. Condition trends are assessed, and human-use impacts are discussed. *MULTIPLE THREATS*

467. Welsch, D.J. 1991. Riparian forest buffers: Function and design for protection and enhancement of water resources. NA-PR-07-91. Radnor, PA: U.S. Department of Agriculture, Forest Service, Forest Resources Management, Northeastern Area, State and Private Forestry. 20 p.

Abstract: This document provides a description of streamside forest ecosystems and the adverse affects of their removal on water resources. Further it describes how streamside forests are beneficial to water quality. It also gives an example for the establishment of effective forest buffers based on current research findings. *WATER QUALITY*

468. Wesche, T.A. 1985. Stream channel modifications and reclamation structures to enhance fish habitat. In: Gore, J.A., ed. The restoration of rivers and streams. Boston: Butterworth Publishers: 103-163.

Abstract: This chapter discusses the basic instream components of fish habitat, the impacts of various channel modification activities on habitat diversity, as well as channel restoration procedures and structures to enhance fish habitat from a planning aspect and from a design and installation approach. *MULTIPLE THREATS*

469. Wheeler, G.P.; Francher, J.M. 1984. San Diego County riparian systems: Current threats and statuary protection efforts. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 838-843.

Abstract: The effectiveness of present laws in conserving San Diego County riparian systems is examined. Agencies are more effective when several laws apply, when credible statuary authority and enforcement exists, and when public

support is generated. Population pressures and development pose the greatest threats to San Diego County riparian systems. *URBANIZATION*

470. Whitney, J.C. 1996. The Middle Rio Grande: Its ecology and management. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 4-21.

Abstract: The Rio Grande is regulated for water supply (primarily irrigation) and flood control. The effects of this interaction have contributed to the character of the riparian ecosystem in its expression. Over 40% of New Mexico's population lives within the Middle Rio Grande reach. This paper discusses the climate, geology, hydrology, subsequent river morphology, and anthropogenic factors that contribute to the past and current expressions of the riparian habitat associated with the Middle Rio Grande. *MULTIPLE THREATS*

471. Williams, C.D. 1984. The decline of Ash Meadows, a unique desert ecosystem. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 716-719.

Abstract: Ash Meadows is a unique hydric ecosystem of the Amargosa desert. The approximately 162 km^2 area is dominated by over 30 springs and seeps that support a wide variety of plant and animals life, including nearly 30 endemics. Ash Meadows was apparently heavily used by several Indian cultures. Since the late 1960s, the area has been subject to a variety of agricultural, industrial, residential and mineral development schemes, the most recent of which threatens to cause the demise of the ecosystem. *MULTIPLE THREATS*

472. Williams, D.F.; Kilburn, K.S. 1984. Sensitive, threatened, and endangered mammals of riparian and other wetland communities in California. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 950-956.

Abstract: Studies of the distribution, habitat requirements, and population status of species and subspecies of mammals in California were conducted in order to identify taxa threatened with extinction. It was found that destruction of riparian and other wetland communities is the principle factors jeopardizing 21 taxa. *MULTIPLE THREATS*

473. Williams, J.E.; Kobetich, G.C.; Benz, C.T. 1984. Management aspects of relict populations inhabiting the Amargosa Canyon ecosystem. In: Warner, R.E.; Hendrix, K.M., eds. California riparian systems: Ecology, conservation, and productive management. Berkeley: University of California Press: 706-715.

Abstract: Amargosa Canyon is one of three areas within the 264-km Amargosa River drainage of Nevada and California that contains permanently flowing water. The extensive riparian community and associated habitats of Amargosa Canyon contain a large number of relict populations. Although the USDI BLM has designated Amargosa Canyon a roadless area, the ecosystem is threatened by illegal off-road vehicle use, exotic species, upstream urbanization, and mining of groundwater aquifers. *MULTIPLE THREATS*

474. Winter, P.L. 1993. Positives and negatives of recreation in riparian areas. In: Tellman, B.; Cortner, H.J.; Wallace, M.G.; DeBano, L.F.; Hamre, R.H., tech. coords. Riparian management: Common threads and shared interests. A western regional conference on river management strategies; 1993 Feb 4-6; Albuquerque, NM. Gen. Tech. Rep. RM-226. Fort Collins, CO: U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station: 155-158.

Abstract: This paper summarizes work conducted by the Pacific Southwest Research Station's Wildland Recreation and Urban Culture project conducted from 1987 to 1993. This project has conducted many studies in riparian day-use areas because these areas have been found to be a reliable point of contact for recreationists. *RECREATION*

475. Woessner, W.W.; Mifflin, M.D.; French, R.H.; Elzeftawy, A.; Zimmerman, D.E. 1984. Salinity balance of the Lower Virgin River basin, Nevada and Arizona. In: French, R.H., ed. Salinity in watercourses and reservoirs: Proceedings of the 1983 international symposium on state-of-the-art control of salinity; 1984 July 13-15;Salt Lake City UT. Boston MA: Butterworth Publishers: 145-156.

Abstract: This 12-month study developed additional hydrologic data for the development of salinity budgets in the Lower Virgin River Valley, Nevada and Arizona, a tributary of the Colorado River. Results indicate a complex hydrologic system with concentration, storage, and transport of salt occurring in the study area. Water and salt budget analysis indicate a 36% net loss of water and a 34% net loss in salt for a 61-km reach of river. The majority of water loss is attributed to saltcedar consumptive use. Salt concentrations associated with saltcedar consumptive use exceeded consumptive concentration of salt by agriculture and direct evaporation by 2.6 times. Data indicate that saltcedar areas play a major role in salt accumulation and storage. *INVASIVE SPECIES, WATER QUALITY*

476. Wohl, E.; Cooper, D.; Poff, N.L.; Rahel, F.; Staley, D.; Winters, D. 2007. Assessment of stream ecosystems function and sensitivity in the Bighorn National Forest, Wyoming. Environmental Management. 40: 284-302.

Abstract: This paper presents a hierarchical analysis of stream ecosystem distribution and sensitivity to natural and

anthropogenic disturbances for the Bighorn National Forest, WY. The assessment presented here highlights the regional uniqueness and importance of watersheds within the forest, which contain predominately high-gradient stream dominated by snowmelt and mixed snowmelt and rainfall runoff. *CLIMATE CHANGE*

477. Wozniak, F.E. 1996. Human impacts on riparian ecosystems of the Middle Rio Grande Valley during historic times. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 33-43

Abstract: The development of irrigation agriculture in historic times has profoundly impacted riparian ecosystems in the Middle Rio Grande Valley of New Mexico. A vital relationship existed between water resources and settlement in the semi-arid Southwest since prehistoric times. Levels of technology have influenced human generated changes in the riparian ecosystems of the Middle Rio Grande Valley. *AGRICULTURE*

478. Wright, H.E., Jr. 1981. The role of fire in land/water interactions. In: Mooney, H.A.; Bonnicksen, T.M.; Christenson, N.L.; Lotan, J.E.; Reiners, W.A., tech. coords. Fire regimes and ecosystem properties: Proceedings of the conference; 1978 December 11-15; Honolulu HI. Gen. Tech. Rep. WO-26. Washington, DC: U.S. Department of Agriculture, Forest Service: 421-444.

Abstract: Forest fires cause a temporary increase in runoff to streams and lakes. Mass transport of nutrients and cations also increase. The charcoal and pollen stratigraphy of annually laminated lake sediments provides a record of past fire frequency. Lake-sediments studies also document forest history over thousands of years showing the shift from fire-adapted forest to resistant forest, or the reverse. *FIRE*

479. Yeager, T.D. 1996. Critical groundwater hydroperiods for maintaining riparian plant species (Thesis). Laramie, WY: University of Wyoming: 52 p.

Abstract: This study specifically reports on how three important riparian plant species responded to variable water table conditions. The three herbaceous riparian species chosen for this experiment were Nebraska sedge, tufted hairgrass, and Kentucky bluegrass. *DROUGHT*

480. Yong, W.; Finch, D.M. 1996. Landbird species composition and relative abundance during migration along the Middle Rio Grande. In: Shaw, D.W.; Finch, D.M., tech. coords. Desired future conditions for southwestern riparian ecosystems: Bringing interests and concerns together. Gen. Tech. Rep. RM-272. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 77-92.

Abstract: This paper reports species composition and relative abundance of stopover migrants during spring and fall migration along the middle Rio Grande in 1994. Comparisons of relative abundance from previous studies demonstrated that population of many species have remained relatively stable over approximately 6- and 12-year periods, while some species have become more common or rare. Research recommendations focusing on bird use of stopover habitats during migration along the Rio Grande are provided. *MULTIPLE THREATS*

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Rocky Mountain Research Station








The Rocky Mountain Research Station develops scientific information and technology to improve management, protection, and use of the forests and rangelands. Research is designed to meet the needs of the National Forest managers, Federal and State agencies, public and private organizations, academic institutions, industry, and individuals. Studies accelerate solutions to problems involving ecosystems, range, forests, water, recreation, fire, resource inventory, land reclamation, community sustainability, forest engineering technology, multiple use economics, wildlife and fish habitat, and forest insects and diseases. Studies are conducted cooperatively, and applications may be found worldwide. For more information, please visit the RMRS web site at: www.fs.fed.us/rmrs.

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