

# Importance of Riparian Ecosystems: Biotic Considerations<sup>1</sup>

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By biotic considerations I am referring to flora and fauna, and specifically I would like to probe the question of the importance that riparian ecosystems play in sustaining the rich biotas of the Southwest, i.e. Arizona and New Mexico. To begin, these two states are among the richest of any in the United States as far as their diversity is concerned in species of plants, terrestrial vertebrates, and many invertebrates. This biotic richness stems from several factors, including the great environmental variety of the region and the fact that several major biotic areas impinge on the area, i.e. the Great Basin, Rocky Mountains, Great Plains, Mexican Plateau, and the Southern (Chihuahuan and Sonoran) Deserts.

New Mexico is the fourth and Arizona the fifth largest of the United States, with areas of 121,666 and 113,909 square miles, respectively. In size these states are thus on a par with such well-known entities as the British Isles, Italy, and the Philippines. In elevation New Mexico ranges from 2800 to 13,161 feet above sea level, while Arizona ranges from near sea level to 12,670 feet. Although often thought of as "deserts", both states support extensive montane forests, and New Mexico especially is crowned with alpine tundra in the north. On the other hand, aridity is a dominant climatic feature of the region, and particularly at elevations below 6000 feet surface water is scarce and naturally restricted to a few thousand miles of generally narrow drainageways in the two states.

Floristic diversity is revealed by the fact that New Mexico supports 3500 to 3600 species of higher native plants within its borders (Wagner, 1977), while the latest summary for Arizona lists 3438 (Kearney and Peebles, 1960). For the continental United States and Canada as a whole, an estimated

40,000 to 50,000 species of higher plants have been recorded. Thus, the floras of New Mexico and Arizona comprise about 7 to 9 percent of the total flora of what might be termed temperate North America.

Among terrestrial vertebrates one finds that even higher percentages of the overall temperate North American faunas are recorded in these two states (Table 1).

Table 1. Vertebrate Fauna of the Southwest, Including Species Totals and as Percentages of the Total Fauna of North America North of Mexico.<sup>3</sup>

<u>Mammals</u>	<u>Arizona</u>	<u>New Mexico</u>
species	134	139
percent	41.6	43.2
<u>Birds</u>		
species (all)	431	413
percent	62.0	59.4
species (breeding)	245	245
percent	38.0	38.0
<u>Reptiles</u>		
species	93	80
percent	35.2	30.3
<u>Amphibians</u>		
species	21	22
percent	13.5	14.2

As one can see, except for amphibians, Arizona and New Mexico harbor disproportionate portions of the terrestrial vertebrates of temperate North America, with figures ranging from about one-third to almost two-thirds among mammals, birds, and reptiles. Amphibians, which mainly depend on water for reproduction, in the two states constitute about one-sixth of the North American fauna.

<sup>3</sup>Data sources include Findley et al., 1975; Hubbard, 1970; Lowe, 1964; Phillips et al., 1964; Stebbins, 1966.

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Fishes, although they face an overall scarcity of habitats in the Southwest, are nonetheless well-represented in the faunas. Arizona has 32 native species (Minckley, 1973), while New Mexico has 59 species recorded within its boundaries (Koster, 1957). The latter area supports a richer fauna by virtue of its location in both the Atlantic and Pacific drainages of the continent. In fact, several species from the very rich Mississippian ichthyofauna reach western limits in New Mexico, including the blue sucker (Cycleptus elongatus). Even with their limited faunas, these two states still host--or hosted--reasonably rich percentages of the overall U.S. fish fauna in their boundaries, i.e. 5.3% in Arizona and 9.3% in New Mexico.

From the above it should be apparent that Arizona and New Mexico are truly diverse in their floras and faunas, even when one largely restricts the discussion of animals to vertebrates. Thousands of species of invertebrates also occur in the two states, including especially terrestrial arthropods. For example, Howe (1975) lists almost 700 species of butterflies from temperate North America, and of these about one-third are recorded from New Mexico and somewhat higher figure from Arizona.

In evaluating the biotic importance of a region, one approach is through the consideration of endemism, i.e. the degree to which species are restricted to an area in question. Both Arizona and New Mexico are host to endemic plants and animals, including vertebrates as well as invertebrates. Although I know of no compendium of such species, several examples illustrate some of the endemism. For example, among vertebrates New Mexico hosts the only known populations of such species as the White Sands pupfish (Cyprinodon tularosa), Jemez Mountain salamander (Plethodon neomexicanus), and Sacramento Mountain salamander (Aneides hardii). Both states boast endemic plants as well, while together they share a number of other endemics that occur nowhere outside the Southwest, including the minnow genera, Tiaroga and Meda, in the Gila Basin.

Although endemism is an important means of evaluating the biotic importance of an area, other considerations also pertain. For example, the kinds of assemblages of plants and animals are important, and in these two states virtually unique associations have arisen because of the interdigitation and/or mingling of diverse biotas. Such associations are interesting and important from evolutionary, ecological, and other biological points of view. Unique or unusual assemblages of

plants and animals provide scientists and others the extended opportunity to understand better our ecosystems and life itself. An example of a notable biological assemblage is the breeding avifauna of the lower Gila Valley of New Mexico, where species characteristic of the Sonoran, Mexican Plateau, and Holarctic avifaunas occur side-by-side (Hubbard, 1971). That fauna has been compared to another in the ecologically similar San Juan Valley, 250 miles to the north and in the same drainage basin (i.e. Colorado River). Both avifaunas have similar numbers of species (i.e. 105 versus 112 in the Gila), but they differ importantly; for example, only 58.7% of the Gila species breed in the San Juan, while only 64.8% of the species in the latter area breed in the Gila (Schmitt, 1976).

The essence of the above comparisons is that not only are Arizona and New Mexico biotically diverse and host to certain endemics, but they also show significant and important area-to-area differences in the composition of biotas occupying similar situations. Each river valley, mountain range, hot spring, or alkaline playa is apt to differ from those occurring nearby, and this fact alone underscores even more the biotic importance of these two states. This is not to imply that other regions are lacking in biotic importance, for such is not the case. However, Arizona and New Mexico stand apart from most other states in having both very rich floras and faunas and in having many factors that promote ecological departures from the "norm", i.e. disjunct or limited habitats, varied biotic sources, and so on.

Having established the credentials of the Southwest in terms of richness and importance of its floras and faunas, let us turn to the question of how riparian ecosystems may be important in perpetuation of these features. In terms of any one group for which such riparian ecosystems must be regarded as essential, certainly no question exists that the most important would be fishes. I have already mentioned that Arizona hosts--or hosted--32 native species and New Mexico 59. Together these total 75 species when combined, no fewer than 6 of which are federally endangered, i.e. Colorado River squawfish (Ptychocheilus lucius), humpback chub (Gila cypha), woundfin (Plagopterus argentissimus), Gila trout (Salmo gilae), Gila topminnow (Poeciliopsis occidentalis), and Pecos gambusia (Gambusia nobilis), plus one species that is threatened, the Apache trout (S. apache). In addition, the New Mexico Department of Game and Fish lists 30 species of native fishes as endangered in the state, including the squawfish, Gila trout, topminnow, and gambusia mentioned above. On a percentage

basis, about half of New Mexico's ichthyofauna is regarded as endangered at the state level, whereas 8 percent of the overall southwestern fauna is federally endangered.

It is obvious that riparian ecosystems are of paramount importance in the survival of native fishes in the Southwest, where the vast majority of the species are riparian (versus lacustrine) in their habitat occupancy. The major threat to the survival of these fishes involves degradation of the required habitats, including lowering of the water table, construction of dams, diversions, and reservoirs, vegetation clearing, pollution, roads, grazing, and the introduction of exotics. This degradation will no doubt continue, for it is partly an outgrowth of man's quest for water and the environments that it fosters. There is little that the dependent biota can do to stem this quest, and man continues to take the aqueous spoils and leave the biota high and dry. Obviously, this approach cannot continue if the ichthyological portion of the rich and important biota of the Southwest is to persist.

Next to fishes, there is no single large group of southwestern vertebrates so dependent for survival on water, that essential and basic element of riparian ecosystems. Yet, there are aquatic plants and invertebrate animals that are just as dependent, including invertebrates. Among the latter are certain mollusks and arthropods, such as Exosphaeroma thermophilum--an endemic crustacean confined to a warm spring run near Socorro, New Mexico. Some animal and plant species are seasonally dependent of riparian ecosystems, such as many amphibians which breed in water. The exact numbers of non-fish species dependent on aquatic habitats in the area has not been determined, but it is significant.

So far, 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 cases 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. A great variety of plants utilize stream courses in the Southwest, including both obligate and facultative species. Typical of the obligates are cottonwoods (Populus spp.), willows (Salix spp.), alders (Alnus spp.), and other broadleaf trees. Facultative species are those that invade stream courses from other habitats, but which may survive without riparian systems. Over 100

kinds of woody plants occur regularly in floodplains in New Mexico, of which about 40% are obligates (Hubbard, ms.).

Riparian plants are biologically important from a number of standpoints. One aspect of their importance is an individual species, for some are restricted in range, numbers, or both. For such species, degradation of the riparian ecosystem could be especially detrimental, even critical to survival. Conversely, for some such species the continued availability of acceptable riparian ecosystems is essential if survival is to continue. Another aspect of importance is at the level of plant assemblages, such as vegetational communities. The matter of communities is especially important, for a great deal of diversity exists among riparian communities in the Southwest (Hubbard, ms.) and this deserves perpetuation. In addition, the assemblage concept is important from the standpoint of revealing evolutionary, ecological, and other biological information, such as any divergence among fragmented populations. There is even a historic (or prehistoric) consideration, in that we may view the broadleaf assemblages of trees and shrubs along many southwestern streams as the major remnant of the ancient Arctotertiary Flora that was dominant in North America 50 to 100 million years ago.

Besides assemblages of plants, aggregations of considerable biological importance are those involving animals as well. Perhaps the aggregation that has attracted most attention recently involves riparian vegetational communities and their attendant bird-life. Although virtually unstudied until recent decades, this biotic aspect of the Southwest has now become better known, and studies have included such streams as the Verde (e.g. Carothers and Johnson, 1973) and Colorado (Ohmart, mss.) in Arizona and the San Juan (White and Behle, 1961; Schmitt, 1976) and Gila (Hubbard, 1971) in New Mexico. All of these systems are extremely rich in breeding birds; for example these two New Mexico river valleys support 16-17% of the entire breeding avifauna of temperate North America over the course of only a few score of miles.

The requirements of these avifaunas involve both the aquatic and the vegetational aspects of riparian ecosystems, but the greater, direct dependence is on the plant communities. Actually, on both the San Juan and the Gila, aquatic habitats other than the river per se are limited, and thus few aquatic species are present. Considering both aquatic and vegetational aspects together

as constituting together riparian habitats, one finds that in the Gila Valley some 25.0% of the 112 breeding bird species are restricted to them, while 24.1% occur in them primarily (Hubbard, 1971). Neither group of bird species, totalling 49.1% of the breeding avifauna, would probably occur in the area in the absence of these riparian habitats. The figures for the 105 breeding species in the San Juan Valley are similar, i.e. 26.5% and 19.4%, or a combined total of 45.9% showing riparian dependence (Schmitt, 1976). In addition, 22.3% of the Gila species and 28.6% of the San Juan species also show some to much utilization of riparian habitats, and several species achieve maximal numbers in them. Clearly, in these two areas the presence of riparian habitats is extremely important, and in essence they double the avian diversity that might otherwise be present. The same degree of importance no doubt pertains elsewhere in the Southwest, and is apparent that riparian ecosystems play a key role in maximizing avian diversity in the region.

Other riparian faunal-plant assemblages seem to have been little studied, but there is no doubt that others will show a strong relationship between biotic diversity and the presence of riparian ecosystems. For example, although there appear to be fewer southwestern mammals than birds with a strong riparian dependence, nonetheless there are certainly some species that do show this, e.g. water shrew (Sorex palustris), Arizona gray squirrel (Sciurus arizonensis), beaver (Castor canadensis), meadow vole (Microtus pennsylvanicus), muskrat (Ondatra zibethica), raccoon (Procyon lotor), mink (Mustela vison), and otter (Lontra canadensis). The same can be said of reptiles, such as various turtles (e.g. Kinosternon spp., Trionyx spp.), green snakes (Opheodrys spp.), water snake (Natrix erythrogaster), and garter snakes (Thamnophis spp.). On the other hand, amphibians show a pronounced dependence on riparian--or at least aquatic--ecosystems, because of the general need of water for reproduction, e.g. in various toads and frogs.

At this point, I believe that it has become readily apparent that riparian ecosystems are of paramount importance in producing and maintaining a large degree of the biotic diversity of the southwestern United States. Although this importance is perhaps most apparent in fishes and best quantified in birds, it is clear that, for many plants and animals, riparian ecosystems are critical for them to flourish or even survive in the region. I am hopeful that more studies will be done to quantify this

importance, particularly with reference to the degrees of dependency that exist among biotic elements on these ecosystems and to the niches that are occupied. It goes without saying that the better we understand these aspects, the better we can anticipate the needs of the biota and manage for its preservation. We have already witnessed extremely widespread destruction and modification of riparian ecosystems in the Southwest, mainly as the result of man's activities over the last several decades. As population pressures and the demands on the riparian ecosystem grow, we will be hard-pressed to preserve what is left of the southwestern riparian biota. Yet, if we do not meet the challenge and achieve better preservation, we will have allowed one of the richest of all of the world's temperate floras and faunas to have been diminished.

The time to obtain data and take positive management steps is all too short, but at the same time it is not too late to act. For example, several important examples of riparian ecosystems remain in the Southwest, such as in the lower San Francisco Valley in southwestern New Mexico and southeastern Arizona. This particular tract lies in U.S. National Forest, and with more enlightened management it could provide along over 30 river miles of public land for the maintenance of the very rich lowland riparian biota. At the present time, grazing and off-road vehicles are causing much damage to the tract, which embodies everything about a wilderness or wild river except in terms of management. At higher elevations, more extensive riparian ecosystems lie on public land and are available for preservation, although management again is frequently not accomplishing this.

The sad fact is that even public lands have priorities upon them that are not in the best interest of preserving riparian ecosystems, and changing this outlook for even limited areas is often difficult. On private lands the situation is generally worse, although here and there some degree of preservation has been obtained for some tracts. There is a critical need for a better education of managers of both public and private lands supporting riparian ecosystems as to their importance and values, which range from esoteric to the practical. For example, points of practical importance and value include the role of vegetation in soil retention, effect on climate, and in the harboring species that provide both consumptive and non-consumptive recreation. These practical uses combine with esoteric considerations to provide a telling argument in favor of better preservation

of our native riparian ecosystems, fragmented and misused as they have become. Hopefully, individuals and agencies will soon join forces to ensure such preservation, which is long overdue and which cannot be delayed much longer.

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