Ecological condition of the East Fork of the Gila River and selected tributaries: Gila National Forest, New Mexico

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Abstract.-Ecological condition of riparian habitats along the East Fork of the Gila River, Main Diamond Creek, lower South Diamond Creek, and Black Canyon Creek are all in very heavily degraded condition. Channel cross-sections show extensive entrenchment, high width-to-depth ratios, and numerous reaches where banks are sloughing into the stream, especially on the East Fork of the Gila River. Species of floodplain vegetation typifies degraded channel conditions. Absence of woody species disallows bank stabilization except where entrenched to large cobble. Data from channel cross-sections and vegetation sampling validate these conditions.

Numerous anthropogenic factors have been involved in the degradation of these 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 to proper functioning condition is high with management intervention. Stream gradients are moderate to low and sediment loads sufficient for bank formation. All stream reaches are in wilderness areas.

Wildlife values of these habitats are presently very low because of the heavily degraded stream channel, poor herbaceous ground cover, and the virtual absence of understory and canopy foliage layers. Historically, these were habitats for the endangered Gila trout (*Oncorhynchus gilae*) and southwestern willow flycatcher (*Empidonax traillii extimus*).

INTRODUCTION

In the arid Southwest, riparian habitats represent <1% of the landscape yet their importance in water quality, as fish habitat, and for wildlife far outweighs that of any other habitat (Minckley 1973, Carothers et al. 1974). When streams are in Proper Functioning Condition (PFC; Bureau of Land Management 1993), they provide maximum water quality values as well as optimum fish and wildlife habitat. Though many agents are responsible for riparian habitat degradation in the Southwest, the Arizona Comparative Environmental Risk Project listed groundwater pumping, domestic livestock grazing, and water management activities as being the three major stressors to these systems (Patten and Ohmart 1995). Numerous endangered species occur in these habitats and more are in the process of being listed (Horning 1994).

Unmanaged domestic livestock grazing has been extremely degrading to riparian systems because it has been practiced for 100+ years and is generally ubiquitous (Ohmart ms). The initial phase of stream and channel degradation is obvious and rapid, while later phases of degradation are subtle and slow. Riparian habitat deterioration is not apparent to the casual observer and only

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becomes obvious through data collection or with repeat photography.

This paper presents data on stream channel condition and vegetative distribution on a reach of the East Fork of the Gila River on the Gila National Forest in New Mexico. The 12 km of stream reach on the East Fork is a riparian pasture where livestock numbers and time of use should be easily managed. Stream gradient is moderate (0.06%) and the relatively wide floodplain is contained by vertical canyon walls. The watershed for the East Fork is approximately 2,626 km^2. The gauging station is above Gila, New Mexico, and combines flows for the West, Middle, and East forks of the Gila. The recorded 2-yr discharge (bankful discharge) is 1,800 ft3/sec (cfs). Flows -1,800 cfs occur predominately in December-March and August-October (Thomas and Dunne 1981). Winter rainfall patterns are generally widespread so records are probably representative of the combined three forks. Summer/fall rainfall events are usually very localized, so gauged flows may vary from rainfall in a portion of a fork to a combination of all three.

METHODS

Vegetation data were collected on channel cross-sections 1, 3, 4, 5, 7, 9, 10, 12, and 16. This report contains data from cross-section 3. Vegetation transects were superimposed on hydrologic cross-sections, i.e., they were perpendicular to the water flow, but vegetation transects usually extended more laterally than cross-sections to span the width of the floodplain (pediment to pediment).

Plant communities along transects were based on dominant plants in each plant community. Plant communities were mapped as well as the location of plant communities along the transect. Locations of boundaries between, for example, the floodplain and the terrace were also noted. Photographs of major plant communities were taken.

Cover estimates were made inside 1 m^2 plots. Estimates were made of percent cover of each plant species and of nonvegetative cover. Plots were located at the water's edge, at the near-stream edge of the highest terrace, and about halfway across the highest terrace, on both sides of the river, for a total (normally) of 6. Each plot was photographed.

Photographs were taken to characterize the reach containing each transect. On each bank, there were 11 photographic locations about 30 m apart, including 1 location where the transect crossed the stream, 5 locations upstream, and 5 locations downstream. At each location, a photograph was taken across the stream and another downstream. In addition, at the location farthest upstream, one photograph for each transect was taken upstream. The total number of reach photographs for each transect was 45.

Photographic data is with Susan Schock of GilaWatch, Silver City, New Mexico. Other data, including plant specimens, is at the Center for Environmental Studies, Arizona State University, Tempe, Arizona.

RESULTS

The floodplain was subdivided into 13 segments from left to right along the cross-section (fig. 1). Each segment represents an area either where there was major topographic or vegetational change across the floodplain. In figure 1 it can be seen that the river (old channel) had moved toward the left pediment about 26Êm. The left bank is a high gravel bar and supports scattered nonriparian plant species. The right bank and segments up to and including the old channel are presently the primary floodplain and of the 26 species in these segments, 22 are riparian plant species.

Channel incisement has lowered the water table across the floodplain, consequently, second terraces (two leftmost segments and three rightmost segments) seldom receive overbank watering and groundwater table recharge except in large flood events. Of the 20 species occurring in these segments only 6 were riparian species. Vine mesquite (*Panicum obtusum*) occurred as a relict producing occasional seed heads. Willows (*Salix* spp.) reached their maximum densities in the outermost segments near the mountain pediments where soil moisture levels are maintained by surface runoff. Numerous upland species have invaded these segments.

Riparian species were present in these segments, but their abundance was low (table 1), especially the woody element *Salix* spp. At the right edge of water only 50% of the area supported these riparian species. *Cyperus* sp. dominated the area with

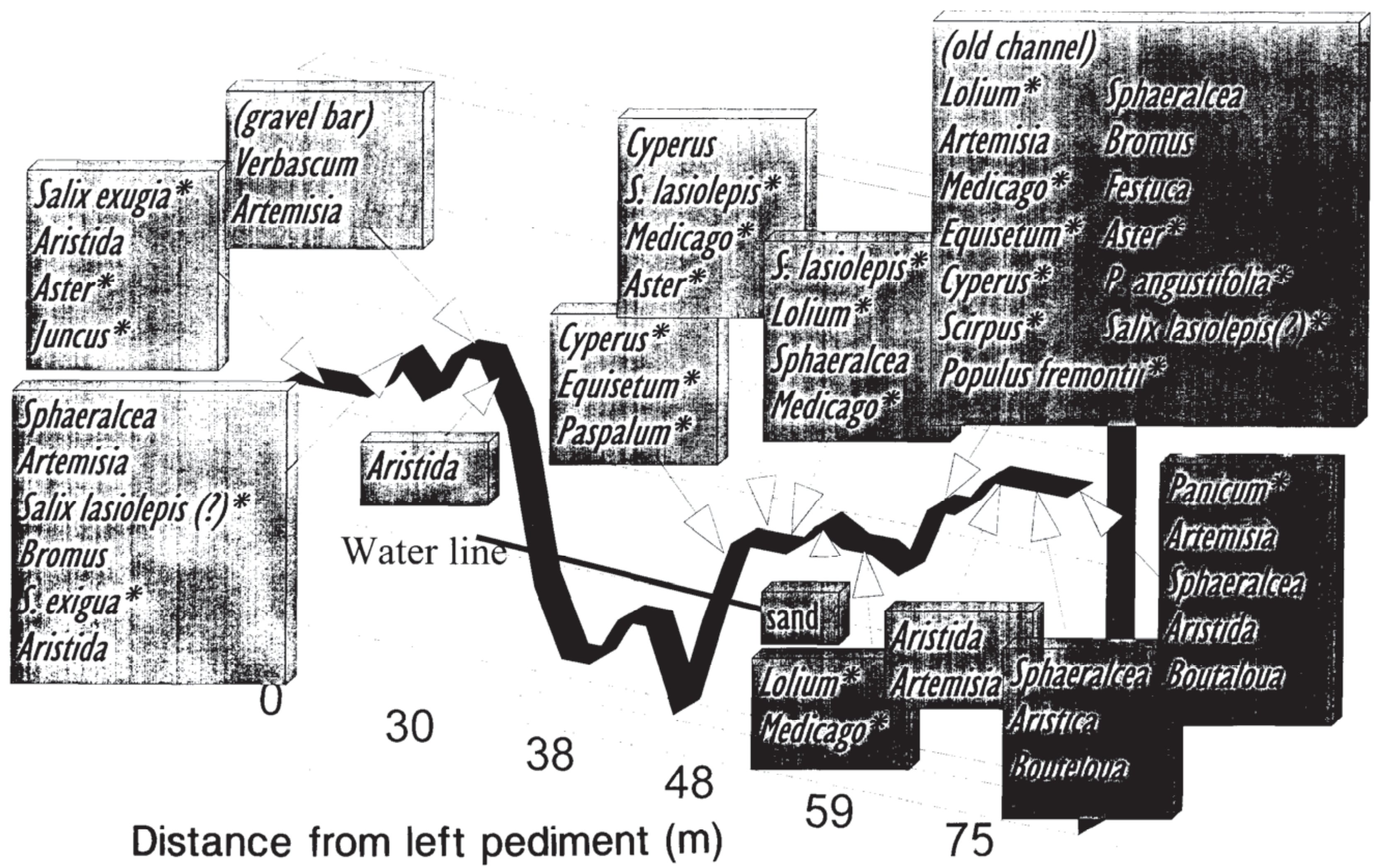

Figure 1. Plant species distribution along a cross-section of the East Fork of the Gila River, Gila National Forest, New Mexico.

Table 1. Location of vegetation, cover type, and percent cover by species on a cross-section on the East Fork of the Gila River, Gila National Forest, New Mexico.

LOCATION	COVER TYPE	% COVER	PLANT SPECIES	% COVER
Right edge of water	Vegetation	50	*Cyperus**	**90**
	Litter	**45**	*Paspalum**	1
	Water	**5**	**Equise** *tum**	**9**
Right edge of highest terrace	Vegetation	98	*Aster**	**IO**
	Litter	**2**	***Medicago****	**15**
			Equise *tum**	1
			*Paspalum**	10
			Fes *tuca*	5
			Muhlenbergia	**IO**
			Sphaeralcea	5
			*Salix**	3
Right, ½ across terrace	Vegetation	**20**	***Eriogonum***	5
	Nonvegetation	80	*Panicum**	2
			Yellow composite	3
			Unknown seedling	1
			A ris tida	**IO**
Left edge = edge of highest terrace	Soil	**5**	**A ris tida**	**95**
	Litter	**2**	***Aster****	1
			Sphaeralcea	1
			Equise *tum**	1
Left edge, ½ across terrace	Soil	**5**	**A ris tida**	88
	Litter	**3**	*Salix**	**15**
	Vegetation	92	***Artemisia***	**3**
			*Cyperus**	1
			Bromus	1
			Rumex	1
			Sphaeralcea	1

*Indicates riparian species

90% cover along with *Equisetum* sp. and knotgrass (*Paspalum distichum*) being only 1%. Along the right floodplain halfway across the terrace there was 20% vegetative cover with vine mesquite covering only 2% of the floodplain. The left floodplain halfway across supported the highest amount of vegetation (92() with *Aristida* sp. dominating (88%) and *Salix* sp. covering 15%. Most of the species were from the upland habitat.

DISCUSSION

The major tributaries of the East Fork of the Gila River discussed in this paper are Main Diamond, South Diamond, and Upper Black Canyon creeks. I have hiked some of the other tributaries, but my experience and field notes are more complete on the above streams. The logistics of visiting streams on the Gila and Aldo Leopold wilderness areas requires extensive amounts of time and hiking to visit and collect data.

The East Fork of the Gila River is in a highly degraded state primarily because of 100+ years of unmanaged livestock grazing. Its ecological condition fits the three phases of western stream degradation (Ohmart ms) and is a Phase III where the collapse of the mature cottonwood (*Populus* spp.)-willow association has occurred. Scattered mature and decadent narrow-leafed (*P. angustifolia*) and Fremont (*P. fremontii*) cottonwoods persist, but the gallery forest no longer exists. Small, young populations of willows and cottonwoods occasionally occur along the floodplain, but these are primarily located adjacent to the mountain pediments where livestock seldom forage. There are sparse, scattered stands of larger trees (20-30 yrs of age) which appear to be from a 10-yr period when stocking rates were much lighter.over the allotment.

This portion of the Gila River is a riparian pasture and the past stocking rate has been 70 bulls during the nongrowing season. My observations of these animals grazing habitats show them using primarily 3 m on either side of the river. During the past 5 yrs I have hiked total or partial reaches of this stream at least 10 times in the growing season. Trespass cattle numbers have ranged from a minimum of 4 up to 27 head, again their primary grazing activity being concentrated along the stream edges.

Though knotgrass occurs relatively abundant along many stream edges along with scattered sedges (*Carex* spp., *Cyperus* spp.) and rushes (*Juncus* spp.) these species alone are incapable of preventing bank erosion during flood events. Without the woody root mix of willows floodwaters are too erosive (Beschta and Platts 1986, Clifton 1989, Elmore 1992). Very few willow stems can be observed along the stream edge and those that appear are quickly browsed back.

The significant reduction and loss of riparian vegetation along the tributaries and the East Fork of the Gila River are similar to what Jackson (1994) reported in the Zuni Mountains on the Cibola National Forest in New Mexico. He estimated a 70 to 90% reduction in riparian vegetation as streams entrenched and water tables dropped thus narrowing the active floodplain and riparian vegetation. Domestic livestock were involved along with other stressors such as logging and roads. An area that once supported 10,000 head now has 1,000 animals grazing it (Jackson 1994). Riparian habitat losses on the East Fork of the Gila River are 95% or more.

It could be argued that elk (*Cervus elaphus*) and cattle are both contributing to the problems of overutilization along the floodplain. Occasional elk pellet groups were observed along the floodplain, but the preponderance of the fecal material is domestic livestock. Along South Diamond Creek, a tributary of the East Fork, scat counts in belt transects show a ratio of 4 elk to 100 cattle.

This stream reach was once important habitat for the endangered Gila trout (*Oncorhynchos gilae*) and willow flycatcher (*Empidonax traillii extimus*). Unmanaged livestock grazing has reduced it to a warm-water fishery with high sediment loads and virtually no shade (U.S. Forest Service 1995). With 8-10 yrs of rest and the planting of willow slips along the water's edge, the area could provide valuable habitat for these endangered species, quality recreational experiences, and some livestock forage.

Water quality data (U.S. Forest Service 1995) show that the state standard of 10 nepholometric turbidity units (NTU) were exceeded by 17 NTUs on the upper end of the riparian pasture on the East Fork and by 19 NTUs on the lower end of the 12 km reach. Sediment standards were also exceeded by 1.5 NTUs on Diamond Creek where it exits the allotment. Data on microinvertebrates, which compared existing conditions to expected, showed community structure and composition (species richness) to be impaired on the East Fork of the Gila River above the confluence with Diamond Creek (U.S. Forest Service 1995).

The above data combined with shade estimates of 0-5% (U.S. Forest Service 1995) for the East Fork demonstrate why this stream reach is no longer suitable habitat for Gila trout. Trout, as a group, require clean, cold water with trees and shrubs providing 70% shade from 10 AM to 4 PM for optimum habitat conditions (Armour 1978, Bowers et al. 1979, Oregon-Washington Interagency Wildlife Committee 1979, Reiser and Bjornn 1979). Trees and shrubs not only provide shade to prevent solar heating of the water, but 99% of the energy in the stream comes from exogenous sources (Borman and Likens 1969, Likens and Borman 1974), such as leaves and twigs of the vegetation along the stream channel. The woody roots of these trees and shrubs combined with the fibrous roots of the herbaceous vegetation stabilize banks and create overhanging banks for further shade and hiding cover for trout.

Present conditions of the East Fork with a wide, shallow channel characterized by sloughing banks with no woody vegetation demonstrate why this stream is now a warm-water fisheries and no longer suitable for native trout. Small populations of this trout persisted in the small headwaters of Main Diamond and South Diamond creeks, but these populations have been recently extirpated because of ash from fires on the watersheds. Upper Black Canyon Creek is a larger headwater stream than Main or South Diamond creeks, but its degraded condition is worse than the East Fork and unsuitable for trout. Willows have been virtually extirpated and the cottonwood forest is down and dead along Upper Black Canyon.

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