Chapter 7

Spatial and Temporal Variation in Streamside Herbaceous Vegetation of the Upper Verde River: 1996-2001

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Introduction

Streamside environments are inherently dynamic, yet streamside vegetation plays a key stabilizing role on riparian and aquatic habitats (Van Devender and Spaulding 1979; Van Devender and others 1987). Because of its dynamism, streamside vegetation is rarely the subject of classification analyses, yet it is a focal point for land managers regulating land uses, such as livestock grazing, that could potentially impact aquatic communities (Brown and others 1979). Livestock grazing along the UVR has been a politically charged issue, with recent years (1998 to present) witnessing a removal of livestock from the river corridor under Prescott National Forest management. However, livestock still graze on private lands, with some strays roaming onto State and Forest lands (see Chapter 2). During the same period, researchers observed declining populations of native fishes in the UVR, largely attributable to predation by introduced fishes (see Chapter 9), as well as to vast growth of woody plants post-1993 floods (see Chapter 2), and lateral erosion of historical terraces. Concomitantly, researchers have suggested that increases in woody streamside vegetation might be related to the cessation of livestock grazing (Rinne and Neary 1977; Neary and Rinne 1998, 2001a) as well as to other hydrological factors (see Chapter 2).

The objective of this study was to describe quantitatively herbaceous streamside vegetation along the UVR from 1997 to 2001. The study examines patterns of vegetation in relation to major geomorphic and geologic attributes along the river. This analysis examines how streamside vegetation in these different reaches changed during this period of stable flows. By better understanding longitudinal variation, temporal variation, and their interactions within highly dynamic areas of the river, we hoped that the study would yield insights into how these critical streamside habitats can be managed to achieve societal goals. The study was designed as a long-term monitoring project to evaluate changes in vegetation, channel conditions, aquatic habitats, and water quality in response to changes, or lack thereof, in management. The UVR has a long history of land uses (see Chapter 2). Some land uses, e.g., grazing, have been attributed to declining aquatic habitat quality.

Previous Studies of UVR Vegetation and Morphology

Vegetation studies (Brock 1987; Szaro 1989) on the UVR have been general with limited community type descriptions, some of which have been generalized from remotely sensed data (Black and others 2005; Stromberg 2008). Medina (see

Chapter 6) provides the first quantitative descriptions of the woody plant communities of the UVR.

Beyer (1997, 1998) described the Verde River as a highly "fragmented" system, meaning that there was significant and discontinuous longitudinal variability in the river system. She particularly noted changes in river morphology associated with the degree of valley confinement and contributions by tributary streams. Spatial studies of the riverine ecosystem (e.g., Rinne and others 1998) often greatly simplifies such longitudinal variation, perhaps due to the frequent assumption that riverine communities tend to exhibit progressive downstream change in accordance with the River Continuum Concept (Vannote and others 1980). In contrast, Poole (2002), Montgomery (1999), and Benda and others (2004) have proposed alternative explanations that recognize patchy, discontinuous features over a longitudinal gradient, particularly in geologically heterogeneous watersheds. The latter concept is operative on the UVR and documented in this chapter.

One consequence of ignoring meso-scale variation is that localized differences may be attributed to local human impacts rather than to natural hydrogeomorphic attributes. Accordingly, an important objective of this study was to determine the relative importance of progressive longitudinal variation versus fragmentation in herbaceous streamside vegetation.

Methodology

Study Sites

Geology—A complete discussion of UVR geology can be found in Chapters 2, 3, 4, and 5. There are four major bedrock types in the watershed. The first zone is dominated by granitic sediments from Granite Creek and basaltic rocks near Sullivan dam. Substrates in this reach are dominated by whitish sands. The second zone passes through the Redwall limestone, which results in reddening of the sands (the formation is commonly stained red from percolation of hematite in groundwater from overlying formations). The third zone begins as the watershed enters areas overlain by the red interbedded sandstones, siltstones, and mudstones of the Supai Formation. This formation contributes finer-grained, red-brown sediments to the river. The last zone in the study area occurs below the confluence with Sycamore Creek, a large watershed that changes the hydrologic character of the Verde River from a highly stable river into one that experiences much larger floods on a regular basis. This hydrogeographic change coincides with a shift into Tertiary volcanic rocks in the uplands and confinement of the river by basalt flows.

There are two major alluvial basins, Chino Basin and Verde Basin (Nations and others 1981) bisected by the UVR. These basins are dominated by Holocene alluvium (Cook and others 2010a, 2010b, 2010c) and illustrate that floodplain alluvium is very thin and recent. The headwater reach to Tapco (Prescott National Forest boundary) is characterized as alternating wide alluvial valleys and constricted basalt steep-walled canyons. The valleys have historically provided some of the most suitable areas for livestock grazing and native fish habitat (see Chapter 2).

Geologic Variation and Vegetation—A description of geomorphic variation along the river was used to provide a framework for interpreting longitudinal variation in streamside vegetation. Two kinds of variation were particularly important: (1) degrees of channel confinement by bedrock, and (2) substrate quality associated with lithologic transitions in the watersheds. These two types of variation were related to hydrologic variability because confluences with large tributaries were associated with changes in valley form and substrates. To account for channel confinement, the width across the valley was measured between bedrock outcrops using an alluvial geology map (Pearthree 1993). All reaches less than 250 m (820 ft) wide were designated as confined, and all reaches greater than 250 m (820 ft) were designated as unconfined. These widths are generally coincident with canyon bound reaches and wide valley bottoms. A 250-m threshold is generally consistent with the distinctions suggested by Cook and others (2010a, 2010b, 2010c). In bedrock lined reaches, the UVR floodplain may be confined to 30- to 122-m (100- to 400-ft) widths across, whereas in less confined reaches, the Holocene floodplain typically is 305 to 915 m (1,000 to 3,000 ft) wide.

Site Selection—Potential study sites (100) were selected during reconnaissance of the 56-km (35-mile) reach from the headwaters to the Prescott National Forest boundary to the east from 1994 to 1996. These sites were categorized into riffle or pool/glide habitat and dominant vegetation type—woody or herbaceous. Using these stratifications, 42 stations were randomly selected for sampling both to describe longitudinal variation along the river and to characterize distinctive vegetation types. Sites were established to provide long-term monitoring points for vegetation and channel conditions. Reaches immediately adjacent to side drainages and those near major changes in channel gradient were avoided. Based on these initial samples, additional stations could be added in time. Streamside vegetation was sampled at the 42 stations along the UVR (fig. 7.1). Permanent study plots were installed on the most homogenous area of each station. Descriptive techniques were employed to reveal longitudinal and temporal patterns along the river. For all sampling work, the convention of denoting right and left streambanks, facing upstream, was used.

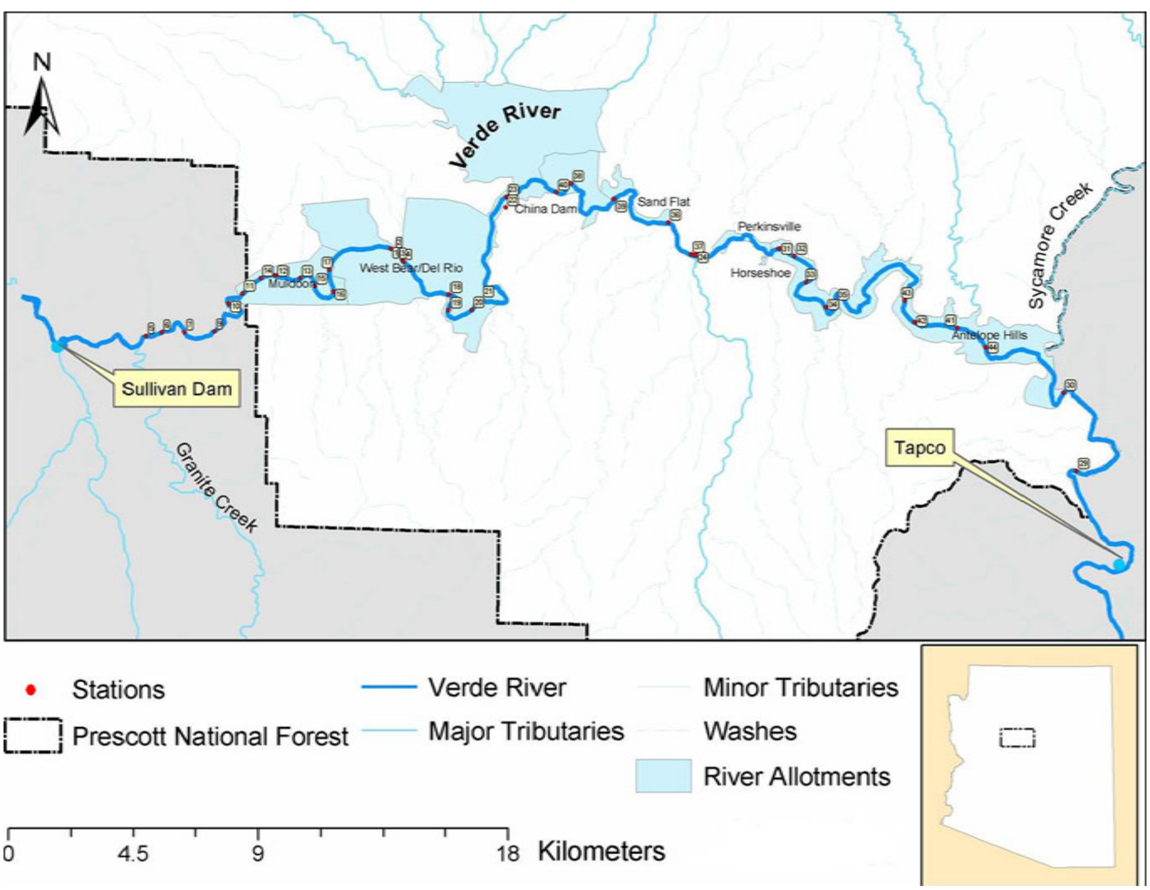

Figure 7.1—UVR vegetation monitoring transects, Prescott National Forest, Arizona.

Time of Sampling—Vegetation was sampled during summers (June to August) of respective years. Twenty-four stations were sampled in 1997, 16 more in 1998, and 2 additional in 2000, totaling 42. Sampling was staggered across years because the goal was to establish 40+ permanent stations and because of budget constraints. Twenty of 42 stations were sampled in 2000. Finally, all but two of the stations were sampled again in 2001. This study design allowed evaluation of longitudinal variation as well as temporal variation, although the two components of variation are not completely separable because temporal and spatial variation was somewhat confounded, owing to differences in time (i.e., 1997 versus 1998) when sampling occurred. The 2001 dataset allows comparison of most of the reaches during a single growing season. The three- to four-year time frame of the dataset is relatively short, but it represents an ecologically significant period. Near record floods scoured the river in 1993 and a second large event struck in 1995. Shortly thereafter, livestock grazing was removed from the Prescott National Forest in 1998. Grazing continued only on small private parcels. Between 1993 and 1998 spikedace populations went from common to absent. From 1995 through 2001, the UVR experienced no two-year recurrence interval floods at the Paulden and Clarkdale gauges (see Chapter 5).

Sampling and Analysis Methods

Vegetation Sampling—At each site, two permanent vegetation plots (8 x 40 m or 26.2 x 131 ft) were established parallel to the channel. Measurements of streamside herbaceous and woody plant foliar cover were made within the plots (fig. 7.2). Since woody taxa respond more slowly than herbaceous taxa, changes in their cover and frequency were also less informative. Data on woody riparian communities are better represented by the larger macroplots than by the streamside

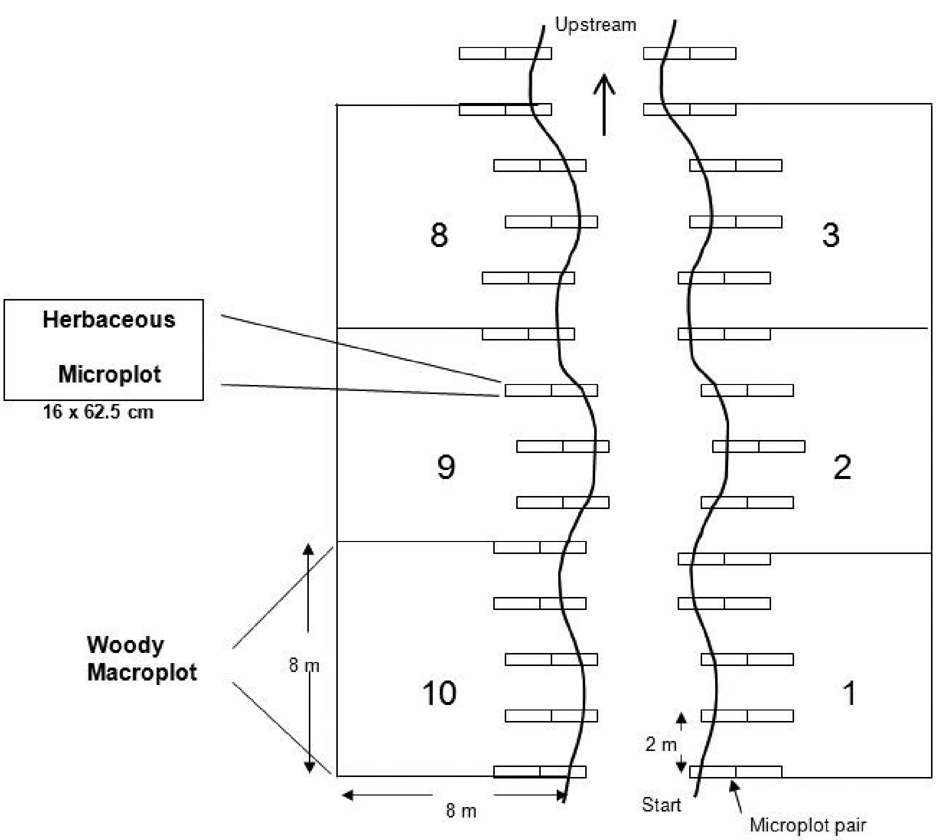

Figure 7.2—Layout of herbaceous microplots within each vegetation sampling plot, UVR.

microplots (see Chapter 6). The herbaceous transect (1.25 x 40 m or 4.1 x 131 ft) followed the water's edge, projected unto the water. A major purpose of measuring herbaceous vegetation aligned with the water's edge was to focus on streambank vegetation that was most likely utilized by ungulates and subject to channel erosion or physical ungulate impact. The starting point of each transect was marked with rebar and a T-post. The study plot was photographed crossways, reverse, and oblique-aerial from adjacent slopes, where feasible. Additionally, rock monuments (with rebar) were established perpendicular to the starting point rebar at slope locations above flood heights. These were used to re-establish buried or lost markers and re-photograph points.

Herbaceous and woody plant foliar cover was estimated using a modified Daubenmire (1959) approach (Medina 1986). Within each sampling station, herbaceous and woody vegetation was sampled within quadrats (16.0 x 62.5 cm [6.3 x 4.6 in]) located along two 40-m (131-ft) transects (one on each streambank) (fig. 7.2). These transects followed the edge of the stream channel and thus were not straight lines. Transects contained 40 quadrats positioned in pairs at 2-m (6.6-ft) intervals. Quadrats were orientated with their long axis perpendicular to the stream channel. One quadrat of each pair extended 25 cm (9.8 in) into the stream channel to sample aquatic plants, while the other quadrat was placed adjacent to the first and extending away from the channel. Foliar cover within quadrats was separated by species and assigned to the categories (table 7.1) developed by Bailey and Poulton (1968). Cover of fine-textured soil (<2 mm diameter [0.08 in]), gravel (2 mm to 7.5 cm [0.08 to 0.3 in]), rock (>7.5 cm [0.3 in]), litter, and cryptogams was also recorded.

Data Analysis—Analyzing riparian vegetation in a highly dynamic fluvial setting demands considerable efforts to generate meaningful results. Cluster analysis was considered to describe different types of herbaceous streamside vegetation along the river, but the results revealed that there were not distinct groups at the herbaceous level. Varying abundances of several dominant taxa with smatterings of less (numerically) important taxa were observed. Consequently, a data ordination approach was used to visualize variation within the herbaceous plant assemblage, as well as to highlight sites with distinctive vegetative composition. Any ordination is a highly abstracted view of reality that is intended to separate meaningful environmental variation from noise. The purpose of applying ordination was to reduce the data so that relationships among the sites would become more apparent.

This survey focused on hydrophytic vegetation (facultative and obligate wetland taxa), as identified in USDA Natural Resources Conservation Service (2011), because non-hydrophytic taxa are likely to be less persistent and reliable descriptors

Table 7.1—Herbaceous plant cover classes, UVR herbaceous plant transects.

Range in plant foliar cover	Percent value recorded
%	%
Present on site	0.01
< 1	0.5
1–5	3
5–25	15
25–50	38
50–75	62
75–95	85
95–100	98

Table 7.2—Steps to reduce the herbaceous plant taxa dataset for ordination.

Step of reduction	Rationale for reduction	Reduced number of taxa
		Number
All taxa sampled in microplots	Focus on streamside environment	140
Problematic species combined (*Typha angustifolia/latifolia/x glauca*, *Eleocharis palustris/parvifola*, *Scirpus pungens/americanus*, *Juncus balticus/mexicanus*)	Difficulty in identification of species could induce differences due to sampling rather than environmental	135
Herbaceous taxa only	Woody plants slower to respond and represented better by macroplots	99
Perennial taxa only	Annual plants vary seasonally; therefore, fluctuations likely to reflect time of sampling	62
Hydrophytic vegetation only (facultative and obligate wetland species)	Non-hydrophytic vegetation likely to be less persistent and reflections of local disturbance	42
Native vegetation only (excluding *Mentha spicata, Rumex crispus, Plantago major, Potamogeton crispus, Agrostis alba, Festuca arundinaceae, Polypogon viridis)*	Nonnative taxa are weedy species that tend to fluctuate greatly	35
Only taxa present in at least four samples	Rare taxa more likely to represent sampling	29
Remaining taxa present in 2000-2001 samples	Excluded from second period analysis only	22

of the riverine environment. By focusing on hydrophytic vegetation, all nonnative taxa were excluded. The analysis was reduced to 29 taxa that were included in at least 4 samples to reduce the potential influence of very rare taxa that were not persistent (table 7.2).

To analyze change through time, data were grouped into two time periods—1997 to 1998 (period 1) and 2000 to 2001 (period 2)—along with two additional sites not included in the original sampling that were sampled both in 2000 and 2001. For the ordination, data were used from herbaceous, perennial, hydrophytic, and native taxa that were sampled in the streamside microplots. The primary analyses were restricted to perennial herbaceous taxa in order to focus on changes in the streamside environment at the scale of years. Annual species were excluded because their cover and frequency varies seasonally.

Nonmetric multidimensional scaling (NMDS) was selected to analyze the herbaceous plant data because it was evident that the underlying data were nonlinear and non-normal (Anderson 1971). NMDS was run using PC-ORD with 50 runs of the real data along with 100 runs of randomized data. For the remaining taxa, frequency (number of microplots in which the taxon was sampled/80 per transect) and cover were calculated. Cover of these perennial herbaceous, hydrophytic, native plants ranged widely across the samples, from 4% to over 70%. The sites with lowest cover values were typically dominated by weedy annuals such as beggarstick (*Bidens laevis*). To compensate for variation in cover of these plants, cover was relativized for each taxon by the total percent contribution of those taxa. In addition, the number of species sampled at each site was calculated. Overall species richness at sites ranged from a high of 44 to a low of 8, with a mean of 22.6 (SD = 8.2).

Results

Species Ordination

A NMDS ordination of all the sites when first sampled shows a slight downstream progression in the data along the Y-axis (fig. 7.3). However, because the lower half of the sites were sampled one year later than the upper half, this longitudinal pattern could represent time as well as distance along the river. In addition, some vegetation differences are also expected because of historical grazing patterns throughout the corridor and respective of specific allotment. Some allotments were year-long grazing while others were seasonal use. Confinement (X-axis) does not appear to differentiate among groups. However, a geological clustering difference is evident between sites under confined/unconfined Limestone and confined Supai and appears strongly longitudinal downstream (Y-axis). A seemingly strong clustering difference appears between confined Granite Basalt groups and Confined Supai groups, likely due to substrate and/or a contributing artifact of distance.

Figure 7.4 presents an NMDS ordination of all the sites when sampled for the second time. The goal is to determine whether the environmental relationships and species associations in the ordination appear similar to fig. 7.3. Because all of the sites except the two lowermost—River Kilometers 66.6 and 72.2 (River Miles 37.5 and 45.1)—were sampled in 2001, longitudinal variation (distance along the river is roughly associated with movement from left to right) is most likely associated with spatial attributes of the river. Groups are not necessarily "tighter" as they are different in their orientation, with a seemingly uniform shift in all data points,

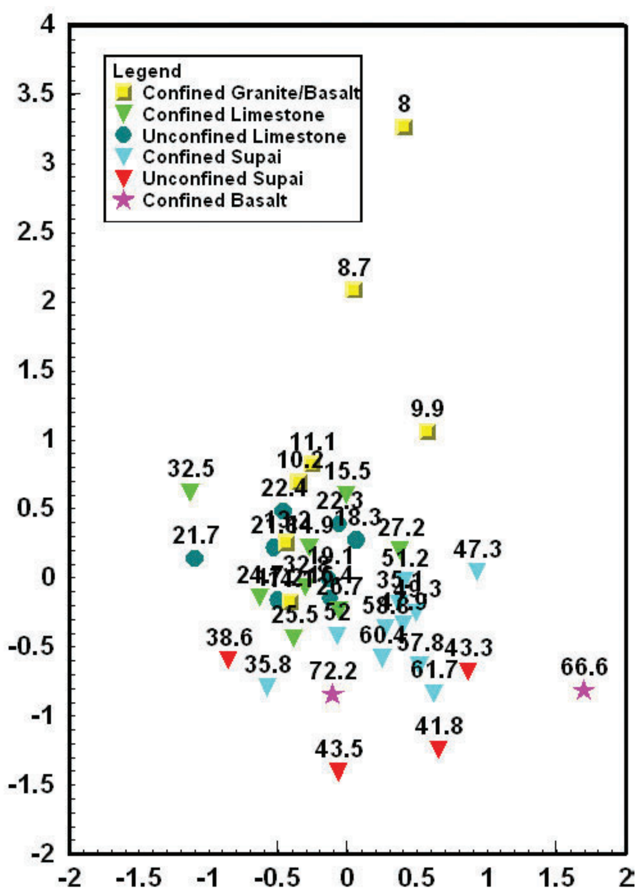

Figure 7.3—Ordination of sites in period 1 (1997 to 1998), labeled by distance in kilometers along the UVR downstream from Sullivan Dam to the Prescott National Forest boundary at Tapco.

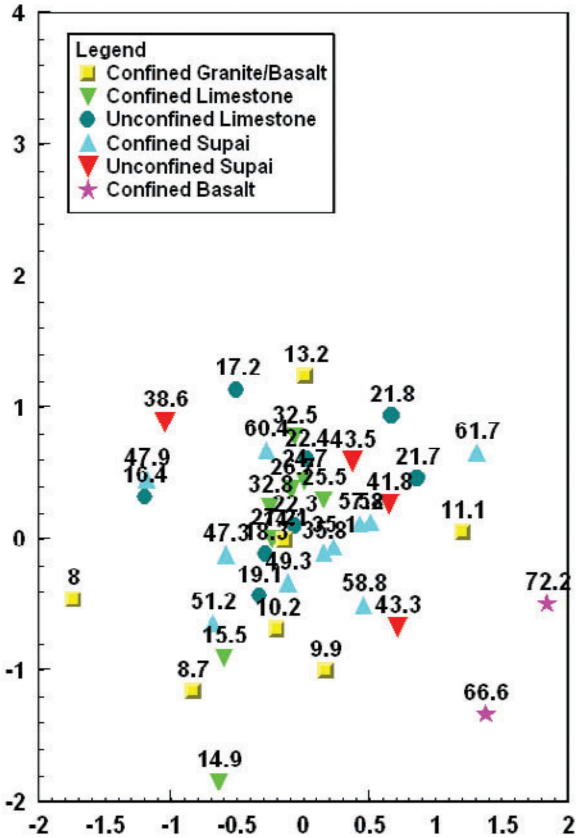

Figure 7.4—Ordination of sites in period 2 (2001 for all sites except 66.6 and 72.2, which were sampled in 2000), labeled by distance in kilometers along the UVR downstream from Sullivan Dam to the Prescott National Forest boundary at Tapco.

respectively, which gives the appearance of greater overlap. This effect may be the result of differences in plant cover between years (greater in the second year).

Figure 7.5 combines the information in the two ordinations into a single ordination. Samples are connected with lines showing their change from the initial sample to the second sample (all lines point north except for site 38). Many of the outlying samples in previous ordinations have shifted more than others, suggesting greater homogenization of the streamside vegetation.

Figure 7.6 charts changes in relative canopy cover at sites from period 1 to period 2 for the seven perennial native hydrophytic herbaceous taxa that showed the most change in relative cover (figures for changes in relative cover reveal the same patterns but are less straightforward to interpret quantitatively). Beggarstick, a weedy annual not used in the ordination, was included in fig. 7.6 because it was observed to dramatically increase at many sites. Beggarstick, rice cut-grass (*Leersia oryzoides*), cattails (*Typha* spp.), and cutleaf water-parsnip (*Berula erecta*), all predominantly aquatic species, showed an overall increase in cover across the sites. Rice cut-grass increased in relative cover at 32 of the 40 sites, cattails increased at 27 sites, and beggarstick increased at 23 sites, although a few sites (e.g., Muldoon 13) experienced large increases in cover of this weed. Cover of cutleaf water-parsnip increased at 19 of the sites and decreased in the other 21. Horsetail (*Equisetum* spp.), spikerush (*Eleocharis* spp.), common three-square bulrush (*Schoenoplectus pungens*), and knotgrass (*Paspalum distichum*) exhibited decreases in relative cover from period 1 to period 2 in at least 30 sites. Decreases in relative cover of knotgrass occurred at 36 of the 40 sites, but decreases were most pronounced at the downstream sites where knotgrass was initially more abundant. Reductions in relative cover of three-square bulrush were most pronounced at the upstream sites. Changes in plant cover could be detected if the original streambank changed

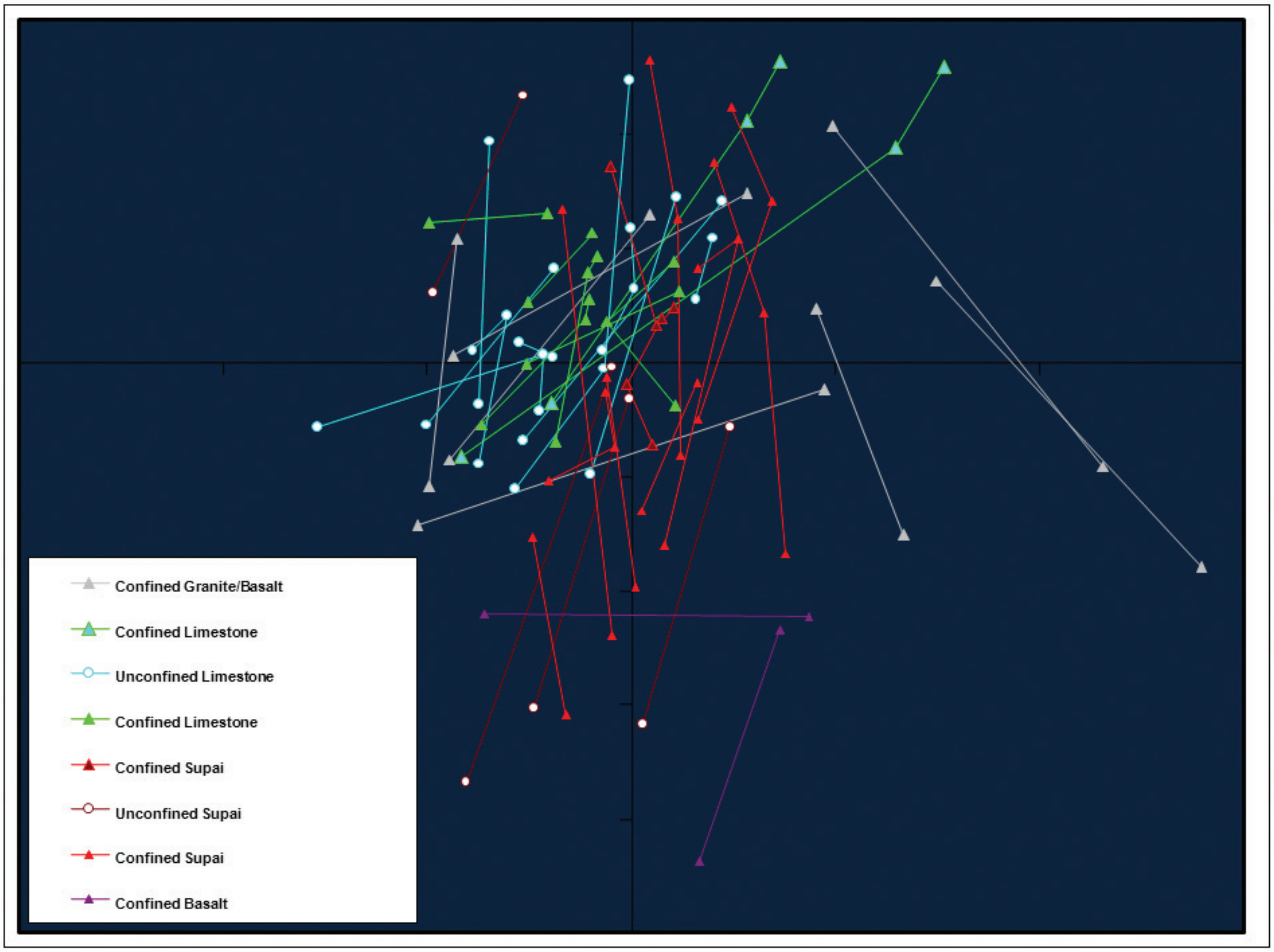

Figure 7.5—Ordination of all UVR sites, with lines indicating changes from initial samples to subsequent samples at individual sites.

in response to erosion or flooding. Hence, measuring changes over multiple years is best to detect species relationships to events and local conditions. Photo points illustrate a general increase in aquatic taxa between the two periods despite inter-year differences for some species. Mean species richness at the 40 sites decreased from 26.5 (SD = 9.4) in period 1 to 19.8 (SD = 6.2) in period 2. This is a common response when taller perennial aquatic taxa (e.g., bulrushes [*Schoenoplectus* spp.], sedges [*Carex* spp.], and rushes [*Juncus* spp.] increase in local abundance and out compete or shade out smaller annuals.

Discussion

Separating Noise from Meaningful Variation

Streamside herbaceous vegetation provides inherently noisy data. An attempt was made to reduce that noise by focusing on perennial, hydrophytic, native species. However, the efforts to reduce the dataset to more interpretable data might have missed other patterns that are ecologically significant. Nevertheless, the reductions identify ecological patterns that are more likely to be persistent and informative. To understand these patterns would require multiple years of sampling since various hydrological, biological, and climatic factors are operative on a daily basis.

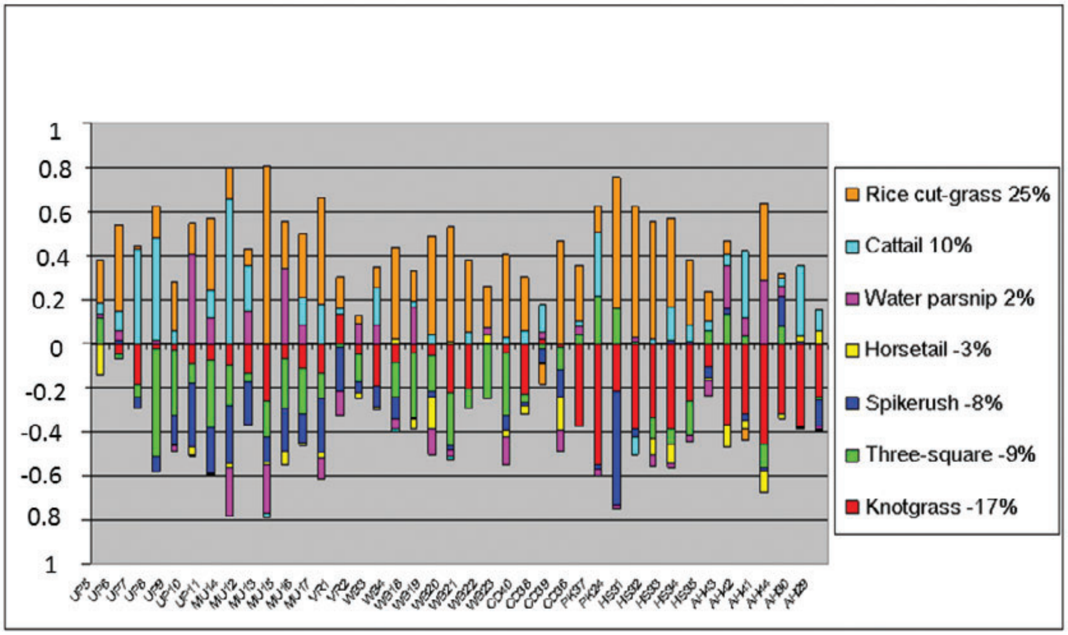

Figure 7.6—Changes in relative cover of key perennial hydrophytic herbaceous taxa between periods 1 (1997 to 1998) and 2 (2000 to 2001).

Patterns in Longitudinal Variation

These analyses show that progressive longitudinal patterns in vegetative are important. The dominant plants are widespread, which is not surprising since riparian vegetation can move upstream and downstream along the river corridor, and since our sampling methodology focused on the narrow bands of streamside vegetation that are present in nearly all reaches. The consistent changes along the entire study reach support the proposal that patchy habitats may persist throughout the corridor and are likely subject to similar temporal variability. An analysis focusing on other vegetation types, such as woody plants, or using larger sampling units, might have revealed more variation associated with valley confinement.

Some species become more dominant at particular points along the river, probably due to a variety of factors, including changes in base flow and substrates, local landscapes and bedrock influences, presence or absence of shading, grazing from ungulates (e.g., elk and stray livestock), beaver dams, or flood-induced erosion of terraces (see Chapter 2). For example, several aquatic forbs (monkey flower, [*Mimulus guttatus*], watercress [*Rorippa nasturtium-aquaticum*], and duckweed [*Lemna* spp.] were initially quite prominent at the upstream reaches, where highly stable spring-fed flows provide preferred habitat. Knotgrass (*Paspalum distichum*) was more abundant in the lower half of the sites, likely due to increased clay-silt content since it prefers fine-textured soils (USDA Natural Resources Conservation Service 2011). However, the UVR is undergoing major terrace erosion throughout the study reach, and the deposition of fine materials has led to expansion of other species like knotgrass. Swamp carex (*Carex senta*) was sampled only at a few sites at the downstream end of the river, but it became locally very important at the lowermost site below Sycamore Creek. Swamp carex is particularly common along Sycamore Creek, perhaps due to an association with steeper, bouldery habitat and/or the cooler climate of the narrow canyon. Its occurrence downstream and upstream from the confluence may reflect changes in geology and topography in that region. In contrast, sedges such as clustered field sedge (*Carex praegracilis*) and wooly sedge (*C. pellita*) are common in abandoned wetland habitats that have become localized relative to current streambank habitats. These species require open habitats typical of unconfined valleys and are rare in the steep, narrow canyon bottoms.

Other species do not demonstrate clear longitudinal associations, but rather are associated with valley confinement. For example, the dominants do become much less abundant in some confined reaches, while other plants, including horsetails (*Equisetum hymenale* and *E. arvense*) and Baltic rush (*Juncus arcticus*) become more important. These patterns reinforce the idea that riverine systems have properties of a continuum and fragmentation. As such, some longitudinal structure may be dictated to responses to substrate and confinement, but many species are common throughout the river.

Temporal Variation

This analysis observed a strong temporal pattern, as nearly all sites demonstrated increased relative cover of aquatic species (rice cut-grass, beggarstick, and cattails) that could have outcompeted or shaded out species that are important for streambank stability (three-square bulrush, spikerush, and knotgrass). Knotgrass and spikerush could have declined simply due to successional processes, given that both species are known to colonize bare sediments. However, three-square bulrush and horsetail have been observed to maintain dense stands even after several years without disturbance (Long and others 2003). The growth of aquatic plants appeared to increase cover and retain fine, organic sediments locally. However, many other cool-season species are largely unaccounted for and their contribution to vegetation patterns is unclear. Long-term personal observations support the premise that streamside vegetation is highly subject to hydrological influences, more so than other landscape factors. Coupled with the long-term grazing influence of riparian wetlands, some plants persist vigorously locally while others appear randomly distributed longitudinally and subject to local conditions, e.g., point bars.

The 1997 to 1998 data suggest more variation associated with the geologic-geomorphic classification. The 2001 data show greater similarity among the sites. Periods of stable flow can alter riverine dynamics such that biotic processes become dominant relative to abiotic influences (Gasith and Resh 1999). Therefore, this could account for the reduced association between streamside vegetation and abiotic features.

Stable baseflows, especially spring derived, appear more important in structuring plant communities in the long term. This is evidenced in the period pre-1993 when sedge-dominated wetland habitats were common and streambanks were populated with assemblages of rushes and sedges.

Management Implications

Land managers and researchers must account for temporal change, longitudinal variability, and the interactions between those two along the UVR. This variation may be particularly important in the UVR it is geomorphically fragmented and because its dynamics may shift during periods of quiescence following large floods. The temporal and longitudinal variability observed along the UVR during a period of stable baseflow cautions against attempts to strictly define “baseline” conditions. Instead, examinations of streamside vegetation need to account for locations along the river in relation to geologic structuring forces, as well as the time since the last major scouring event. Depending on purpose, assessment of long-term vegetation-hydrologic changes should compare conditions at the same intervals following major flood events (i.e., 1993 and 2005). Comparisons using repeat measurements or repeat photography are particularly useful for examing changes in species composition relative to land uses or other environmental changes. Emphasis on effects of land uses has been particularly contentious, and it's vitally important to not assume cause and effect relationships from only temporal vegetation data.

While increases in streamside vegetation are often assumed to be desirable, the particular shifts that were observed in this study may not be desirable, particularly in terms of sustaining native fishes in the presence of exotic predators. The increase in tall, weedy aquatic species (e.g., beggarstick and cattail) may crowd out native herbaceous species associated with long-term bank stability, increase hiding cover for predatory nonnative fish, induce narrowing and deepening of low-flow habitat, and retain fine organic substrates. Scientific testing is needed to elucidate the relationships between streamside vegetation and fish habitat. This analysis shows that some sites (e.g., Muldoon 13) shifted much more than others (e.g., Verde Ranch 2) (fig. 7.6). While inherent geomorphologic differences such as confinement may mediate the capacity for change, management actions such as grazing also influence streamside vegetation dynamics. As a consequence, research and management need to incorporate both types of factors into their design when evaluating the relationship of streamside vegetation to desired conditions. Many in-channel influences important to fish can occur independently of streambank dynamics. There is potential for assuming that changes between two points separated by long intervals represent long-term changes or that a lack of change between two periods represents a lack of change. Instead, particular reaches may exhibit rapid change as part of their nature, while other reaches may exhibit relatively little change.

Summary and Conclusions

This chapter examined patterns of vegetation in relation to major geomorphic and geologic attributes along the river. The analysis showed that, during a period of stable flows, streamside vegetation generally became more homogeneous, shifting toward several tall aquatic species and likely structuring the plant community in the long term. Evaluations of herbaceous streamside vegetation need to account for the influence of geologic structuring forces and flood dynamics. While increases in streamside vegetation are often assumed to be desirable, the particular shifts that were observed may not be desirable in terms of sustaining native fishes in the presence of exotic predators. Research and monitoring to test these hypotheses on the UVR must account for geomorphic variation as well as hydrologic dynamics that change rapidly. Another conclusion is that though substrate and channel confinement may initially dictate some vegetation structure longitudinally, many species are widely distributed throughout the river corridor. Lastly, across the various years many vegetation changes have been observed and docu¬mented. In this on-going dynamic situation, confined reaches are more likely than unconfined reaches to incur short-term changes, relative to major erosional changes of the current condition of stream channels and terraces, as well as encroachment of woody vegetation.