

Landscape Distribution of Woody Riparian Vegetation on Floodplains of the Regulated Dolores River, SW Colorado

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BACKGROUND

River regulation on western rivers has, in many cases, led to an increase in the total cover of woody riparian vegetation in floodplain forests (Webb et al. 2007, Birken & Cooper 2006). This overall increase is observed in spite of the fact that the dominant tree of western riparian zones, the cottonwood (*Populus* spp.), has declined in many river reaches. In its place, tamarisk, Russian olive and native willows have increased their cover on the landscape, hypothesized by most workers to be a result of the loss of high spring run-off flows and/or flow variability, often due to dam regulation (Mortenson & Weisberg 2010, Cooper et al. 2003). While major changes in flow management are unlikely on most rivers, active removal of tamarisk either by mechanical means or as a result of defoliation by the biocontrol agent *Diorhabda elongata* are leading to a new set of rapid changes on the riparian landscape. More understanding of the current pattern of woody vegetation distribution would help us plan for future changes, and give us a better chance of aiding desirable woody species in re-colonizing sites previously dominated by tamarisk.

We conducted a study quantifying woody canopy types and understory plant community composition and structure and associated abiotic environmental variables along 154 km of a regulated reach of the Dolores River, Colorado. As part of this study, we sought to understand the distribution of the dominant woody species across the width of the floodplain.



Figure 2. The Upper Dolores River, above the town of Dolores, CO. Riparian vegetation is dominated by cottonwood-willow woodland. (Photo by S. Bombaci)

EXPERIMENTAL DESIGN & METHODS:

- Six distinct reaches were selected along the lower Dolores River below McPhee Dam (Figure 1). Reaches chosen to represent alluvial sections of the river valley where access could be gained.
- Five line-intercept transects established perpendicular to river within each reach. Transects ran across width of floodplain on alternate sides of the river, from river bank to upland.
- Changes in elevation surveyed along transects (Fig. 4).
- Beginning and ending points of dominant woody species (*Salix* spp., *Tamarix* spp., *Populus* spp) measured, along with other common species assemblages (Table 1).
- Percent cover data used to construct NMS ordination of transects (Figure 5).
- Differences in beginning and ending points of dominant species calculated to determine amount of niche overlap (Figure 6).



Figure 3. The Lower Dolores River, Gateway, CO. Riparian vegetation is dominated by bands of cottonwood (leafing out), tamarisk (brown- no leaves) and willow (just greening on river banks). (Photo by C. Dott)

RESULTS & DISCUSSION:

- There were significant differences (Pseudo F 3.37, p=0.0006) in the floodplain plant communities among river reaches, arising mainly as a result of floodplain width and total elevation change.
- On average, cover by willows (32%) was significantly greater (p=.002) than either tamarisk (10%) or cottonwood (13%).
- Results of the ordination (Figure 5) and indicator species analysis (Table 2) show that each of the dominant woody species, while found in almost all reaches (Table 1), is indicative of particular floodplain habitats:
 - *Salix* dominates low elevation narrow sites
 - *Tamarix* thrives on higher elevation sites of moderate width
 - *Populus* is found mainly on sites with wider floodplains
- The location of each species on the floodplain, as indicated by its position on the transect, give an indication of how much niche overlap exists among these species.
- Differences among both starting distance and farthest distance from the river were significant (F = 5.06, p=.010 and F = 10.17, p=.0005, respectively) (Figure 6).
- Pairwise comparisons indicate that both willow and tamarisk (p=.0005) and willow and cottonwood (p=.019) occupy significantly different portions of the floodplain, while tamarisk and cottonwood do not (p=.597).

CONCLUSIONS:

- On the Dolores River willows occupy a different niche than either tamarisk or cottonwood, and tamarisk has mainly invaded cottonwood habitat.
- Current conditions on the lower Dolores River, with dense stands of willow and reed canary grass on the river banks, are not conducive to the establishment of other woody riparian vegetation (Figure 7).
- Loss of tamarisk appears unlikely to lead to a subsequent increase in other woody riparian species without major intervention.

OBJECTIVES:

- To understand what environmental conditions lead to differences in woody vegetation composition – in particular the presence of tamarisk - on a regulated river.
- To understand the distribution of dominant woody species across the width of the floodplain in multiple reaches of the Dolores River.
- To assess the amount of niche overlap between the dominant native & non-native species.

RESULTS

Table 1. List of species and species associations measured on floodplain transects for all six river reaches. Average percent cover over all transects in all reaches is given. Reach names : GW (Gateway), BED (Bedrock), BGN & BGS (Big Gyp North & South), SLC (Slickrock), LD (Lone Dome)

Species / Category Name	Ave. % Cover	Reaches Occupied
<i>Salix exigua</i> (sandbar willow)	32.71	All
<i>Tamarix</i> spp (tamarisk)	10.43	All but LD
<i>Populus</i> spp (<i>fremontii</i> , <i>angustifolia</i> , <i>X acuminata</i>) (cottonwood)	12.45	All but BGN
<i>Salix</i> sp. (willow species)	4.16	BGS, LD
Forb – grass mix, several species	23.13	All
<i>Rhus trilobata</i> (3-leaf sumac)	0.79	SLC, LD
<i>Forestiera pubescens</i> (New Mexico privet)		GW, BGN, BGS, SLC
	3.54	
<i>Forestiera - Salix</i> mix	0.31	BGS
<i>Forestiera - Rhus</i> mix	0.30	SLC
<i>Chrysothamnus nauseosus</i> (rabbitbrush)	1.60	BED, BGS, SLC
<i>Artemisia tridentata - Chrysothamnus</i> mix (big sagebrush-rabbitbrush mix)	2.90	BGN, SLC
<i>Phalaris arundinacea</i> (reed canarygrass)		GW, BGN, SLC, LD
	4.00	
Sedge – forb mix, several species	0.19	SLC, LD
<i>Shepherdia argentea</i> (silverleaf buffaloberry)	0.89	LD
cattail swamp, dominated by <i>Typha latifolia</i>	0.27	LD

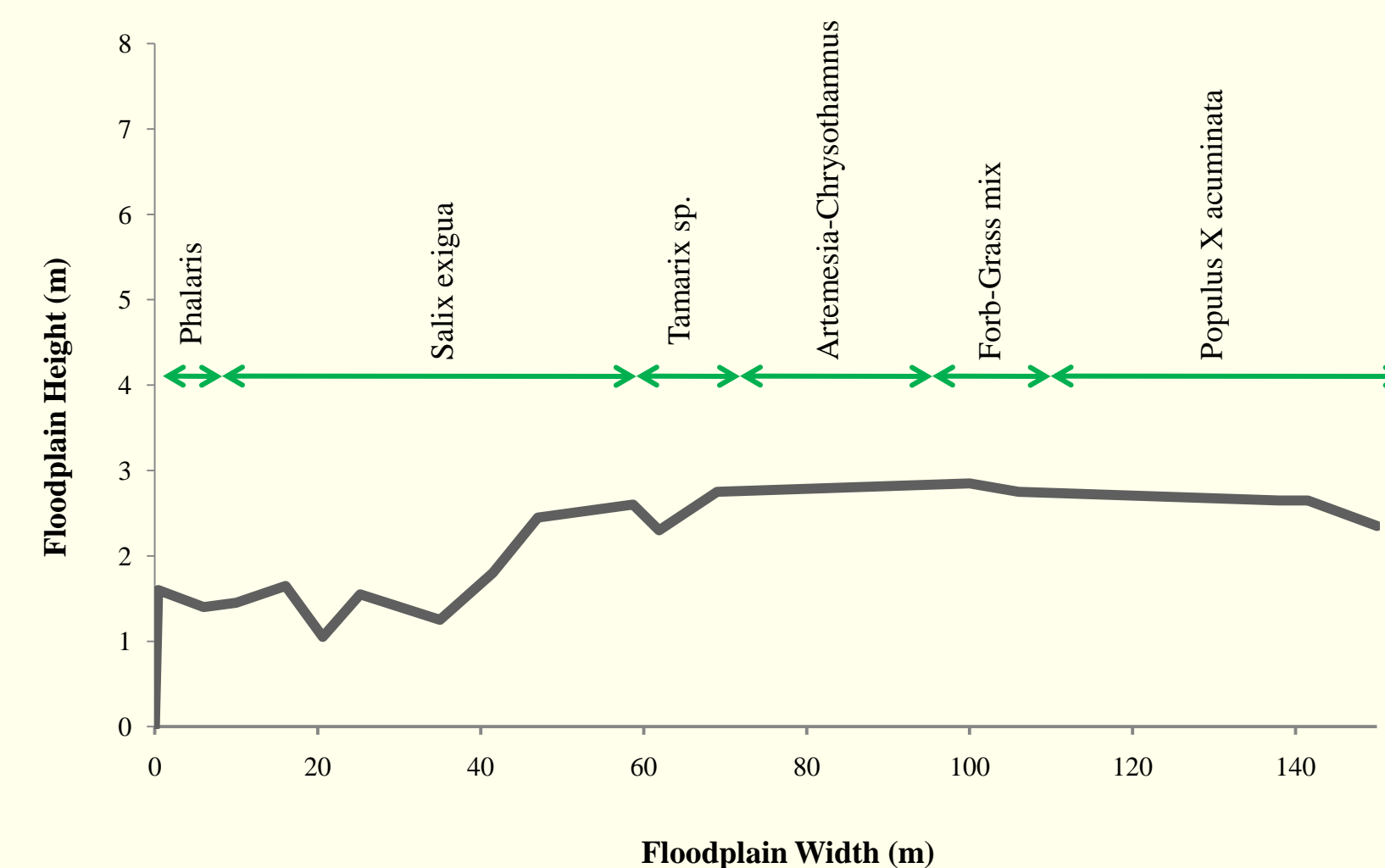


Figure 4. Typical floodplain elevation profile (black line), with bands of dominant vegetation types shown (green arrows). 0 m is edge of river channel in July 2010; data from Slickrock reach, transect 2. Note vertical scale exaggeration.

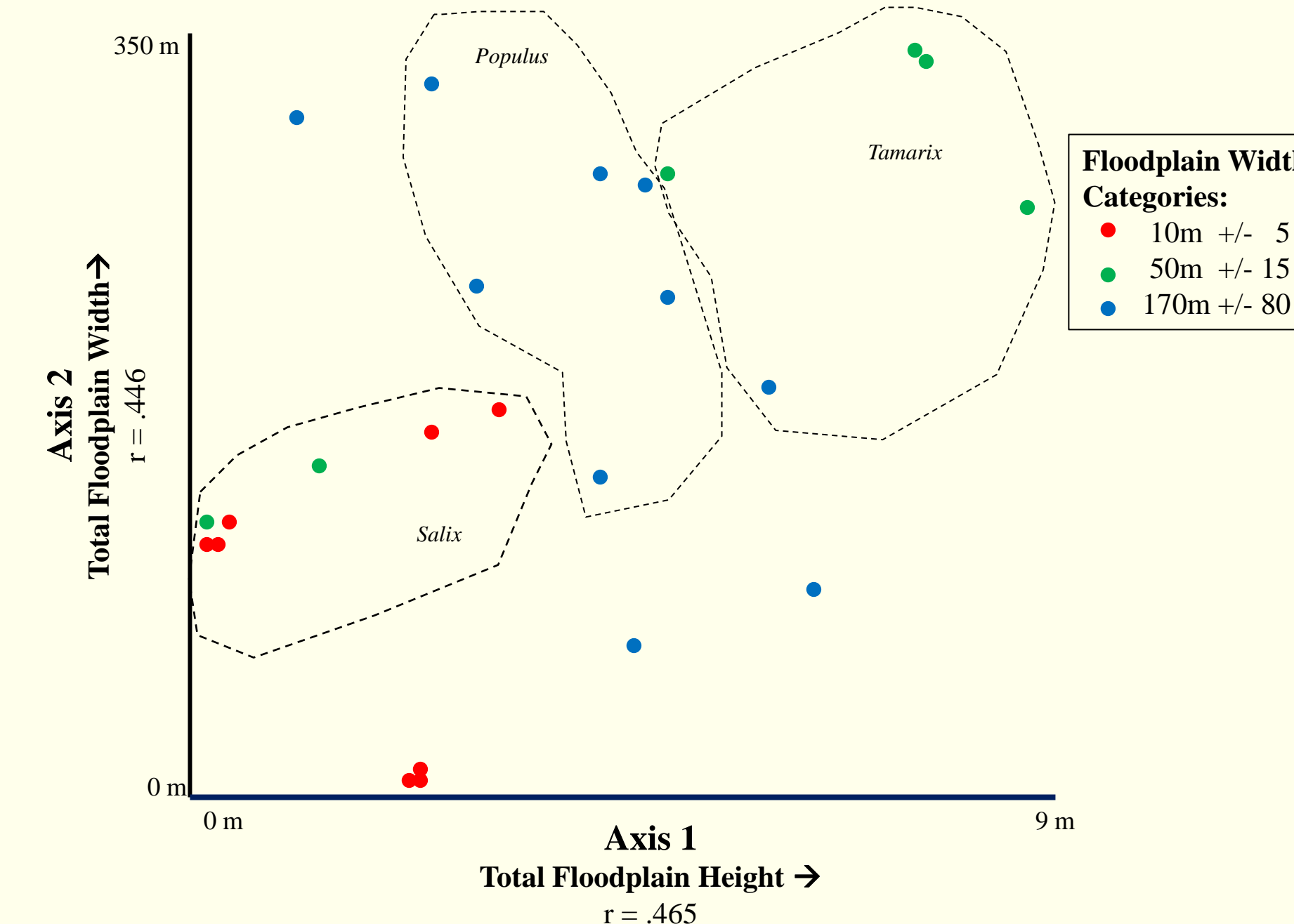


Figure 5. NMS ordination of floodplain transects based on vegetation cover data. First axis correlates with increasing total height of the floodplain (r=.465); second axis correlates with increasing total floodplain width (r=.446). Different colored symbols represent floodplain width categories. Willows are most abundant on low, narrow floodplains; cottonwoods on wide floodplains. Tamarisk is most abundant on medium-width floodplains that reach maximum heights above the river channel.

Table 2. Results of Indicator Species Analysis for woody vegetation in different floodplain width categories. Each of the dominant woody vegetation types is an indicator of a different floodplain width category, with tamarisk in the middle range.

Species	Floodplain Width Category	Indicator Value (%)	p-Value
<i>Salix exigua</i>	10 m +/- 5	59.3	.004
<i>Tamarix</i> spp.	50 m +/- 15	49.7	.038
<i>Populus</i> spp.	170 m +/- 80	53.1	.046

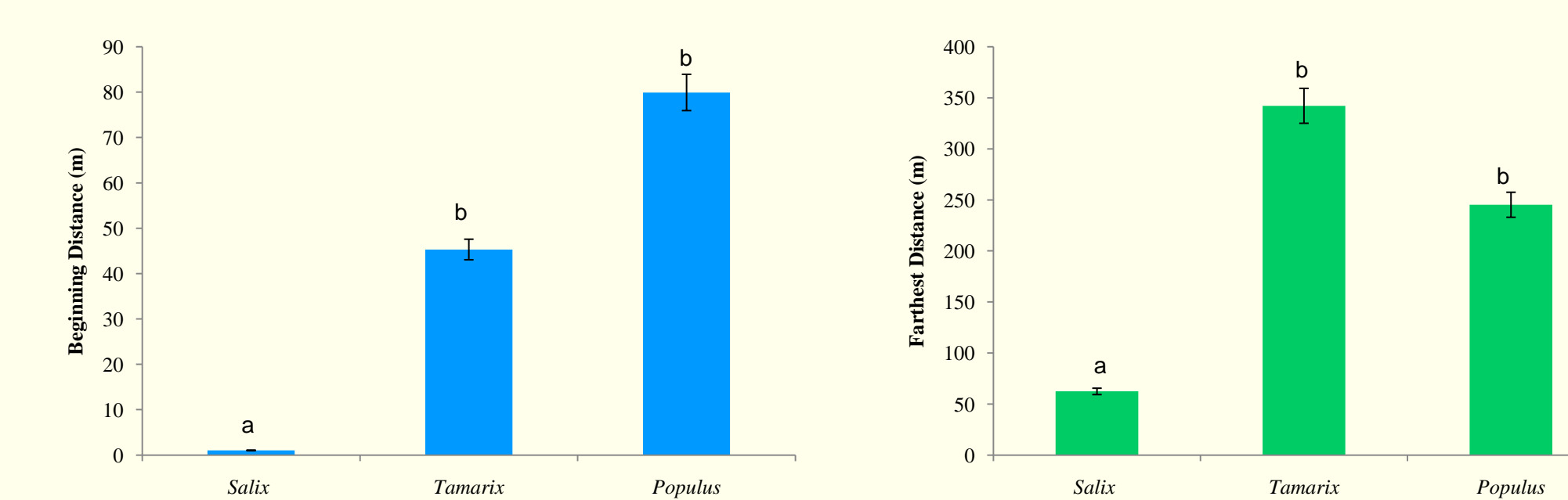


Figure 6. Average beginning distance (left) and average ending distance (right) in meters from river bank of *Salix* spp., *Tamarix* spp., and *Populus* spp. on floodplain transects at six reaches of the Dolores River, SW Colorado. Significant differences (p<.05) between vegetation types based on pairwise comparisons with Bonferroni adjustment are indicated by different letters.

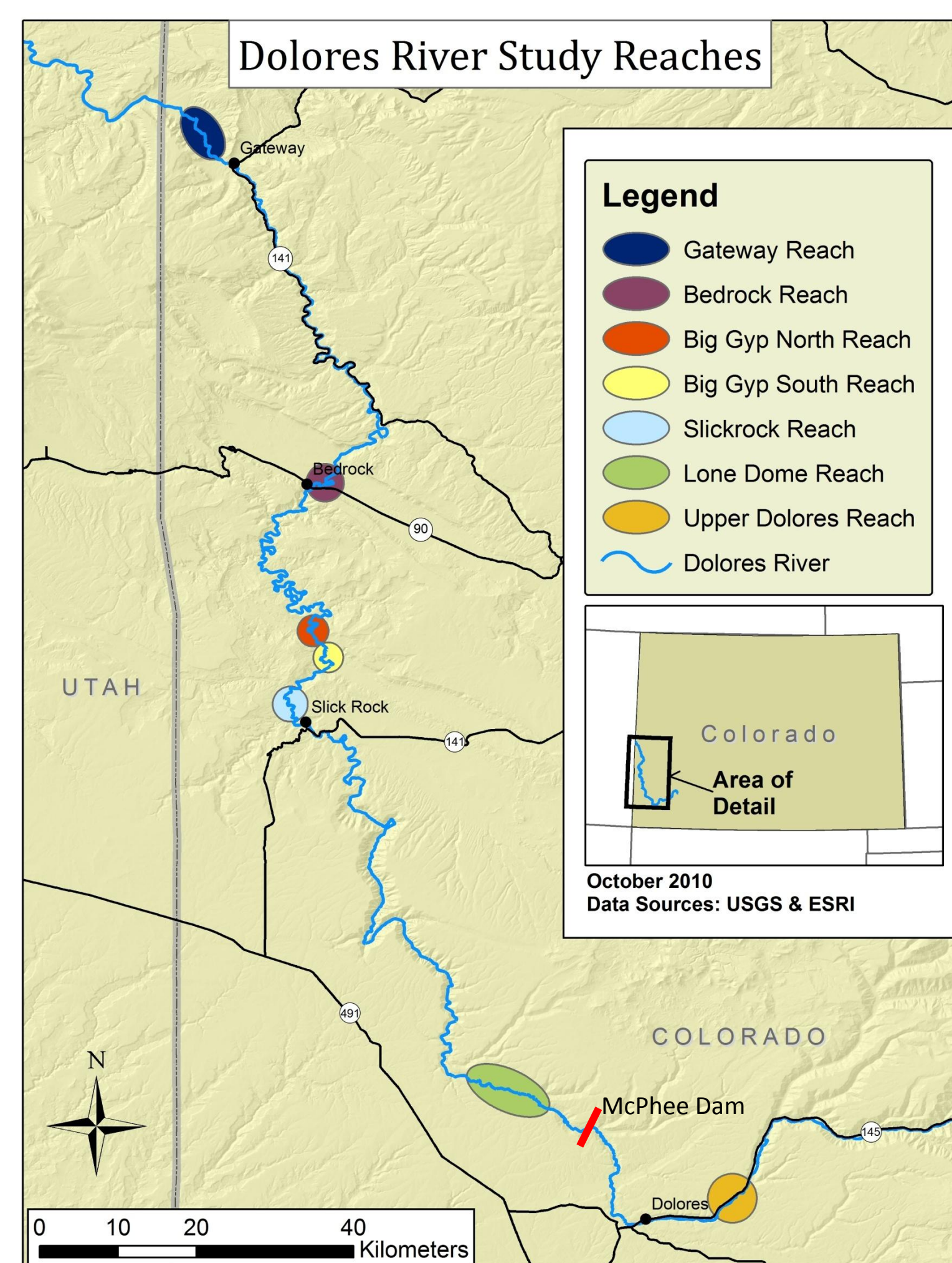


Figure 1. Map of the lower Dolores River showing locations of six study reaches below McPhee Dam. This section of river is 154 km long, with elevations from 1370-1980 m. (4500'-6500') Inset map shows location of the Dolores River in southwestern Colorado. (map by S. Bombaci)



Figure 7. The Lower Dolores River in the Big Gypsum Valley. Dense cover by *Salix exigua* and *Phalaris arundinacea* on stream banks prevents establishment of other native woody species. (Photo by C. Dott)

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