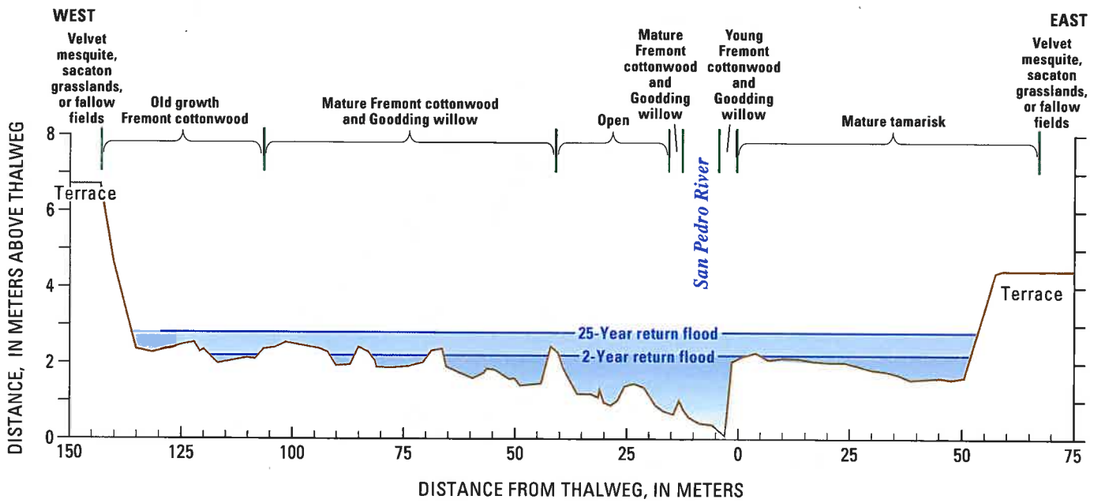

Figure 20. Surveyed cross section for the Palominas site hydrology/biohydrology transect, showing vegetation patches and modeled river stages for 2-year and 25-year return-period floods, San Pedro Riparian National Conservation Area, Upper San Pedro Basin, Arizona.

Table 15. Hydrologic characteristics of the 16 biohydrology study sites, San Pedro Riparian National Conservation Area, Upper San Pedro Basin, Arizona

[min, minimum; max, maximum; N/s, newtons per second; ---, no data]

Reach number	Site name	Streamflow permanence 2002 water year (percent)	Streamflow permanence 2003 water year (percent)	Flood-plain ground-water depth, 2002 water year				Flood stream power	
				Mean (meters)	Min (meters)	Max (meters)	Max-min (meters)	10-year flood (N/s)	100-year flood (N/s)
1	Palominas south	73	49	2.4	2.2	3.0	0.8	11,341	22,922
1	Palominas	71	45	1.7	1.5	2.1	.6	4,164	9,967
2	Kolbe	100	100	1.9	1.7	2.0	.3	14,620	23,486
2	Hereford	100	90	1.1	1.1	1.3	.2	4,259	11,949
3	Hunter	68	63	1.8	1.5	2.2	.7	13,981	21,140
4	Cottonwood	100	100	---	---	---	---	4,697	16,454
5	Lewis Springs	100	100	1.7	1.5	1.8	.3	12,788	18,670
6	Moson	100	100	2.1	1.9	2.2	.3	45,374	52,458
7	Charleston bridge	100	100	1.0	.8	1.1	.3	8,633	15,386
8	Charleston mesquite	100	92	2.6	2.4	3.1	.8	18,063	62,451
8	Boquillas	100	100	2.3	2.2	2.3	.1	7,995	25,615
9	Fairbank	80	69	3.4	3.1	3.9	.7	12,149	33,595
11	Tombstone	65	61	3.1	2.3	4.2	1.9	17,210	51,455
12	Contention	56	40	3.0	2.2	4.2	2.0	14,183	27,448
12	Summers	88	49	2.1	1.9	2.3	.3	12,917	65,172
13	St. David	48	21	2.5	1.7	3.5	1.8	23,453	26,913

Table 16. Means and standard deviations of hydrologic variables for biohydrology sites, classified into three hydrologic classes, San Pedro Riparian National Conservation Area, Upper San Pedro Basin, Arizona

[±, plus or minus]

Site sample size	Hydrologic class	Flow permanence, 2002 water year (percent)	Flow permanence, 2003 water year (percent)	Mean flood-plain ground-water depth, 2002 water year (meters)	Maximum flood-plain ground-water depth, 2002 water year (meters)	Ground-water fluctuation, 2002 (meters)
(8)	Perennial	100 ± 0	98 ± 4	1.8 ± 0.6	2.0 ± 0.7	0.3 ± 0.2
(6)	Intermittent-wet	74 ± 8	56 ± 10	2.4 ± 0.7	2.9 ± 0.9	0.9 ± 0.5
(2)	Intermittent-dry	52 ± 6	29 ± 16	2.8 ± 0.3	3.8 ± 0.5	1.9 ± 0.2

Hydrology variables included site values for streamflow permanence, annual mean and maximum depth to ground water (spatially and temporally averaged across the flood plain), and annual extent of ground-water fluctuation. Unless otherwise indicated, statistical analyses were conducted using ground-water values for the 2002 water year and using streamflow permanence values averaged across water years 2002 and 2003.

Biomass structure and species richness were analyzed in relation to average long-term flood intensity at a site, as indicated by total stream power of the 10- and 100-year recurrence-interval floods (table 15), using values for the SPRNCA resulting from flow modeling (see chapter B). Total stream power for the recurrence-interval floods for the 16 SPRNCA biohydrology sites was calculated with HEC-RAS 3.1 using hydrologic and cross-section data supplied by the USGS. Total stream power (Ω), derived from Gordon and others (1992) may be expressed as

$$(\Omega) = \gamma RSVW, \qquad (2)$$

where

γ = unit weight of water (9,799 N/m^3),
R = hydraulic radius (m),
S = hydraulic slope,
V = velocity (m/s), and
W = width (m).

To account for effects of fire, correlation coefficients were calculated between hydrology and vegetation variables using data that included all biohydrology study sites (four of which were burned recently) and data that included only unburned sites (n=12). Vegetation variables were related to mean flood-plain width (for flood-plain zone vegetation) and to site elevation (which is synonymous with distance downstream) by using correlation analysis.

Prior to statistical analysis, percentage values (for example, plant cover, streamflow permanence) were square-root transformed to approximate normal distributions. For assessment of statistical significance, alpha was set at 0.10 and beta at 0.90, to minimize the chances of committing a "Type II" error in which one fails to detect a relationship when one exists (an issue of concern in conservation-focused studies). This alpha level was chosen because of the relatively small site sample sizes and the complexity of riparian ecosystems, in which many environmental factors interact to shape the riparian vegetation.

Woody Vegetation Biomass Structure

Only a few biomass structure variables varied significantly with water availability at the site scale. The strongest correlation was for vegetation height. Wetter sites had significantly higher values for maximum flood-plain vegetation height, reflecting the capacity of wetter sites to support tall hydromesic trees such as cottonwood (tables 17 and 18). Mean maximum vegetation height at the two driest SPRNCA sites (Contention and St. David) was 13 ± 0 m, compared to 21 ± 4 m at the eight wettest sites (appendix 7, table 7-A; figure 21). Appendix 6 lists the common and associated scientific names for plants included in this study. Riparian zone fire reduced canopy height, so the relations with hydrology variables were generally weaker when including burned sites in the data set.

Mean flood-plain vegetation volume ranged among SPRNCA sites from 1 to 3.7 m^3/m^2, whereas vegetation volume in the upper canopy layers (above 8 m) ranged among sites from 0 to 2.0 m^3/m^2 (appendix 7, table 7-B).