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Beaver Presence Survey of Upper Verde River
Preliminary Report by Walt Anderson
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Introduction.

Based on an initial proposal by Dale Turner of the Arizona state office of The Nature Conservancy, an agreement was made with the author (Anderson) to use the person-power of his Wetland Ecology and Management class at Prescott College to collect beaver presence data on the Upper Verde River and to write one or more research papers on beaver ecology or management that might help shed light on the beaver influences on the Upper Verde.

Kim Schonek, Verde River Projects manager working out of the Prescott Office of The Nature Conservancy developed the sampling protocols and participated in some of the surveys. The ten students who participated in the sampling were Graham Benton, Carissa Condor, Blaine England, Felipe Guerrero, Mike Jennings, Nelson Lee, Gregory Smart, Elizabeth Sotack, David Wilson, and August York. Walt Anderson also participated in each sampling day. Except for the first day (when all students worked together to learn the process) and the third day (when half the class sampled invertebrates at Campbell Ranch), the class was divided into two teams in order to cover two segments per day.

Data were collected as follows:
A. 8/29/09. Headwaters Springs to Campbell Ranch
B: 9/1/09. Verde Ranch, Up
C: 9/1/09. Verde Ranch, Down
D: 9/3/09. Campbell Ranch, Down
E: 9/4/09. Bear Siding
F: 9/4/09. Perkinsville
G: 9/9/09. Gas Line, Up
H: 9/9/09. Gas Line, Down
I: 9/11/09. Sycamore Creek at Verde
J: 9/11/09. Verde at Sycamore Creek

From high to low in the watershed, segments (and primary ownership) were as follows (letters are the same but are arranged by location rather than date):
A. 8/29/09. Headwaters Springs (**TNC: The Nature Conservancy)** to Campbell Ranch (**AZGFD: Arizona Game & Fish Department**). *(Campbell Ranch, a.k.a. Upper Verde Wildlife Management Area)*
D: 9/3/09. Campbell Ranch, Down (**AZGFD)**
G: 9/9/09. Gas Line, Up (**USFS: United States Forest Service, Prescott National Forest**)
H: 9/9/09. Gas Line, Down (**USFS**)
B: 9/1/09. Verde Ranch, Up (**private**)
C: 9/1/09. Verde Ranch, Down (**private**)
E: 9/4/09. Bear Siding (**USFS**)
F: 9/4/09. Perkinsville (**USFS**)
J: 9/11/09. Verde at Sycamore Creek (**USFS**)
I: 9/11/09. Sycamore Creek at Verde (**USFS**)

Note that some segments sampled may have crossed property lines (e.g., Verde Ranch upstream route crossed a fence onto national forest). Permission to cross private lands was attained in advance of sampling.

Methods.

Sampling followed established Beaver Presence Survey Protocol (to follow, so not repeated here). GPS coordinates were taken at designated points, and mapping in the Prescott College GPS lab was done after sampling was finished. In addition to descriptions of the start and ending points for each reach surveyed (e.g., water and air temperature, stream width and depth, channel type, substrate type, turbidity, riparian and aquatic vegetation, and anthropogenic sign), we collected similar information for the first den or lodge found in each reach. We also took GPS readings for each dam, den, lodge, or den/lodge combination we found. We also recorded beaver chew marks by woody plant species for saplings (under 2" diameter) and trees. Since beaver-cut trees often sprout a multitude of new stems, we did not treat sprouts emerging from a cut trunk as saplings.

Bird surveys were conducted concurrent with the beaver surveys by Walt Anderson and Felipe Guerrero, each working with separate teams.

Results and Discussion

Data sheets are on file with Kim Schonek of The Nature Conservancy, Prescott Office. Data have been transcribed into Excel worksheets, and Kim has already used some of the maps and data summaries for interpretative purposes. She and I plan to mine the data more deeply to see what inferences may be drawn and to suggest what questions might be asked (and answered) in the future. I will simply mention a few points here, and some additional analysis is in the paper by Benton.

It did not take long to discover that the four miles in four hours suggested by the protocol was not reasonable. Some surveyors had to walk the banks with varying degrees of obstruction (cliffs, dense vegetation at times), while others had to wade (even swim) in order to look for well-hidden bank dens (as most of them were). Recording data also was time-consuming, and some routes had to be shortened because of threats of thunderstorms (with possible flooding). In fact, the river experienced several flash floods right before and during our sampling period, making banks slippery with mud and causing water to be higher and muddier than usual, which impeded our movements. High water may also have hidden some bank dens.

We are confident that we found all dams (7), but our total of active dens/lodges (17) may have been somewhat of an underestimate. As another measure of fresh, localized beaver activity, we noted clusters of ten or more chew marks in a concentrated area; this suggested the possible presence of a nearby den. If we did find a den, then the cluster factor was not recorded there. We found 9 such clusters, suggesting that there could have been up to 26 dens in the reaches surveyed.

How does the Verde compare with other beaver streams? Colony density for six North American beaver streams in Alaska, California, Massachusetts, Wyoming, New Brunswick, and Minnesota (see Gurnell 1998:170 in Benton references) ranged from 1.6 - 2.0 colonies per mile. River density for colonies in Kansas ranged from 0.1 – 2.2. If we take our most conservative estimates of number of Upper Verde colonies, actual dens/lodges located (17), we would have an average estimate of 1 colony per mile. If we include dense chew clusters where dens were not located, then the total of dens/lodges/chew clusters (26) would give us an average of 1.5 colonies per mile of river. Either estimate (1 to 1.5) seems pretty impressive for an arid river in the Southwest. Of course, beaver sign is not uniform along the river; there are high-density areas and low ones. Further mining of the data may suggest possible reasons for the variation (e.g., food supply, hydrology and geology, land uses such as grazing intensity, and so forth) that could stimulate future question-focused research.

It is clear that beavers have significant effects on both aquatic and riparian ecosystems. Benton's paper on how dams affect hydrology and nutrient cycling in the Verde is particularly illuminating.

Of course, even when beavers have bank dens, they can have notable effects on local conditions, though dams are especially important ecologically.

I personally revisited one site of intense beaver activity twice after the initial beaver surveys, and I would like to briefly describe what I saw. Downstream from the Campbell Ranch (Game & Fish access point), there are several bank dens and considerable beaver activity as evidenced by chew marks, trails, stripped branches in the channel, and so forth. Further down there is a series of three dams and ponds that may extend for close to a mile of stream. The upper dam is relatively small, as the channel is narrow. The second dam is substantial, and many trees are inundated in the long pool that extends all the way up to the first dam. The lower (third) dam is perhaps a half mile downstream, but it backs water up almost to the middle dam. Rather than a simple dam spanning the stream, it consists of many smaller dams that connect between anchor points such as trees or spits of land. Total dam length for this meandering structure is an amazing 351 feet. A large lodge is in the pool perhaps a hundred feet above the dam front.

When flash floods raced down the river in late August and early September, there was considerable large debris movement that collected perhaps six feet up in trees and other obstacles. The raging torrents also carried large sediment loads and redistributed soil, resulting in muddy banks. I saw evidence that when the floods hit this beaver dam complex, the upper dam suffered some breakage, but held, thus slowing the force of the flood. The second dam also held and slowed the flood, which then was further dissipated by the long, deep pool with considerable emergent vegetation of bulrush and cattails (some up to 15 feet tall!). In other words, this series of three dams with pools supporting thick vegetation (especially cattails and willows) functioned to take the punch out of the floods. We sampled a number of sites downriver after the floods, and though we could see high water marks, we did not see significant erosion, thanks, most likely, to beaver activities and dam architecture. As Benton notes in his paper, the beaver ponds capture not just debris but also nutrients.

In addition to active dams, there are traces of former dams, now abandoned. Many of these had become substrates for growth of cattails and willows, perhaps some sprouting from materials placed in the dams by beavers. In the lower dam in the complex mentioned above, some of the dams had short vertical hedges of Coyote Willow sprouts that had been trimmed by the beavers. They had created a living dam of shrubby willows with anastomosing roots reinforcing the structure and a renewable food supply!

Parts of the Verde River have steep cutbanks from erosional history. As ponds build up organic and inorganic matter, they replace former degradation with aggradation. The abundance of vegetation that develops in and next to the ponds further stabilizes the system.

Where the beaver ponds occur and where cattle grazing is limited or absent, extensive marsh vegetation develops. Cattails colonize easily, as their airborne seeds disperse widely. Once established, cattails clone by means of spreading rhizomes. Where depths are suitable and erosion minor, cattails and bulrushes form dense thickets. The beaver ponds provide them with relatively stable water levels even during the dry seasons. The plants are also resistant to flash floods, partly because they bend over to let the flood waters pass over them without damage and because the submerged rhizomes sprout if exposed leaves do get torn away. Floating debris gets caught in emergent aquatic plant thickets, as well as in willows, cottonwoods, and other riparian plants, and all this structure further slows the forces of floods and helps build soil.

Beavers have been known to reduce tree cover by cutting larger trees down, but this is partly offset by the sprouting of cottonwoods and willows; beavers can thus change tree structure by favoring smaller stem diameters. While one might expect a large pond complex like we found to have much-reduced density of large trees, most of the larger trees were not harvested. I believe this is because the ponds create such extensive cattail and bulrush beds and perhaps sources of other edible aquatic plants, and sprouting willows provide plenty of high quality food requiring less harvest effort than do large trees.

The extensive tree growth in and around the beaver ponds tends to produce considerable shade and a source of allochthonous material (energy) into the stream ecosystem. The diversity and structure further attract birds and other organisms, creating biotic hot spots. On a visit to the ponds on 10/22/09, I saw bear, otter, and elk sign; a Cattle Egret and an American Coot (neither likely on river stretches without the beaver ponds); and almost all of the Marsh Wrens and Song Sparrows seen that day.

Though beavers are not likely to be seen by a group of people in daylight, we did see two swimming beavers in Sycamore Creek and found a dead, decaying beaver at the Verde Ranch.

Bird species lists for each site follow the protocol pages. I suggest that intensive bird surveys comparing areas of beaver activity with areas without might further support the suggestion that beavers create biological hotspots.

Student Research Papers

The following are papers written by students during this Wetland Ecology and Management class. All students submitted their papers to two peers for review, then also received comments from the instructor. Two students who participated in the beaver surveys had not submitted finished papers at the time of this report. The relevance of these papers to the beaver study are roughly in descending order below.

Graham Benton: The Effects of Beaver Dam Construction in the Southwest on the Hydrology and Nutrient Cycling of Riparian Ecosystems, with a Focus on the Verde River

David Wilson: Bridge Creek Basin Restoration Facilitated by Beaver as a Model for Upper Verde River Management

Elizabeth Sotack: The Effect of Beaver-Otter Relationships on Native and Non-Native Fish Species in the Verde River, Arizona

Gregory G. Smart: Anthropogenic Change and Invasive Species Impacts on Native Fish Populations in the Verde River, Arizona

Mike Jennings: Impacts of Bullfrog on the Native *Rana* Species of the Southwest and Subsequent Mitigation Possibilities

Nelson Lee: Conservation Efforts on the San Pedro River

Felipe Guerrero: Biological and Ecological Impacts of Recreational Fishing: Angling Pressures on Target Species and Aquatic Ecosystems

August York: Wetland Construction

Collection of Beaver-related Papers

I have collected a number of potentially useful references for the benefit of anyone who continues to work with this or subsequent data sets.

Riparian Trees of the Verde River Field Guide by Walt Anderson (donated to TNC)

Photographs of study reaches, students, and organisms by Walt Anderson (donated to TNC)

The following tables, chart and map were produced by Kimberly Schonek and inserted here to illustrate the data.

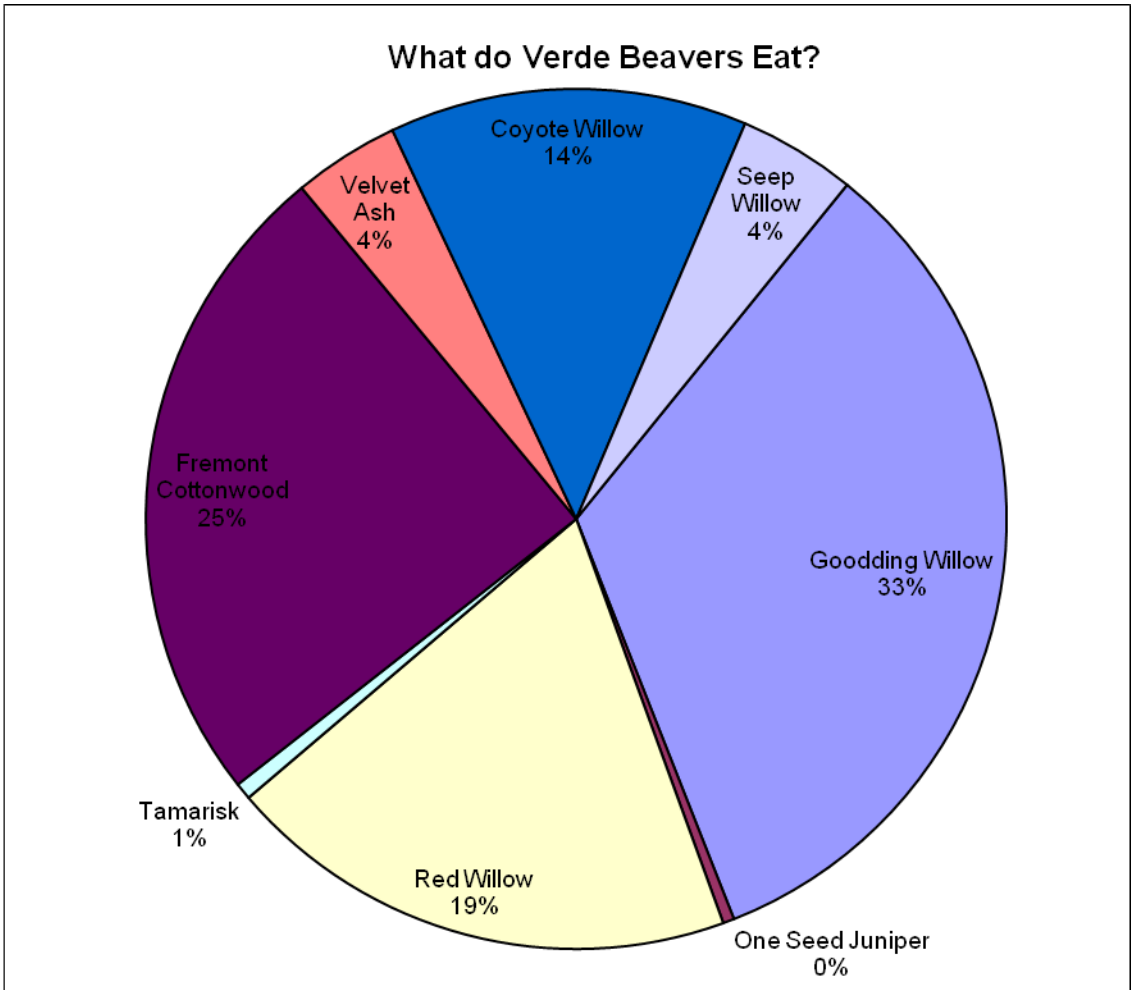
Survey Results by Reach

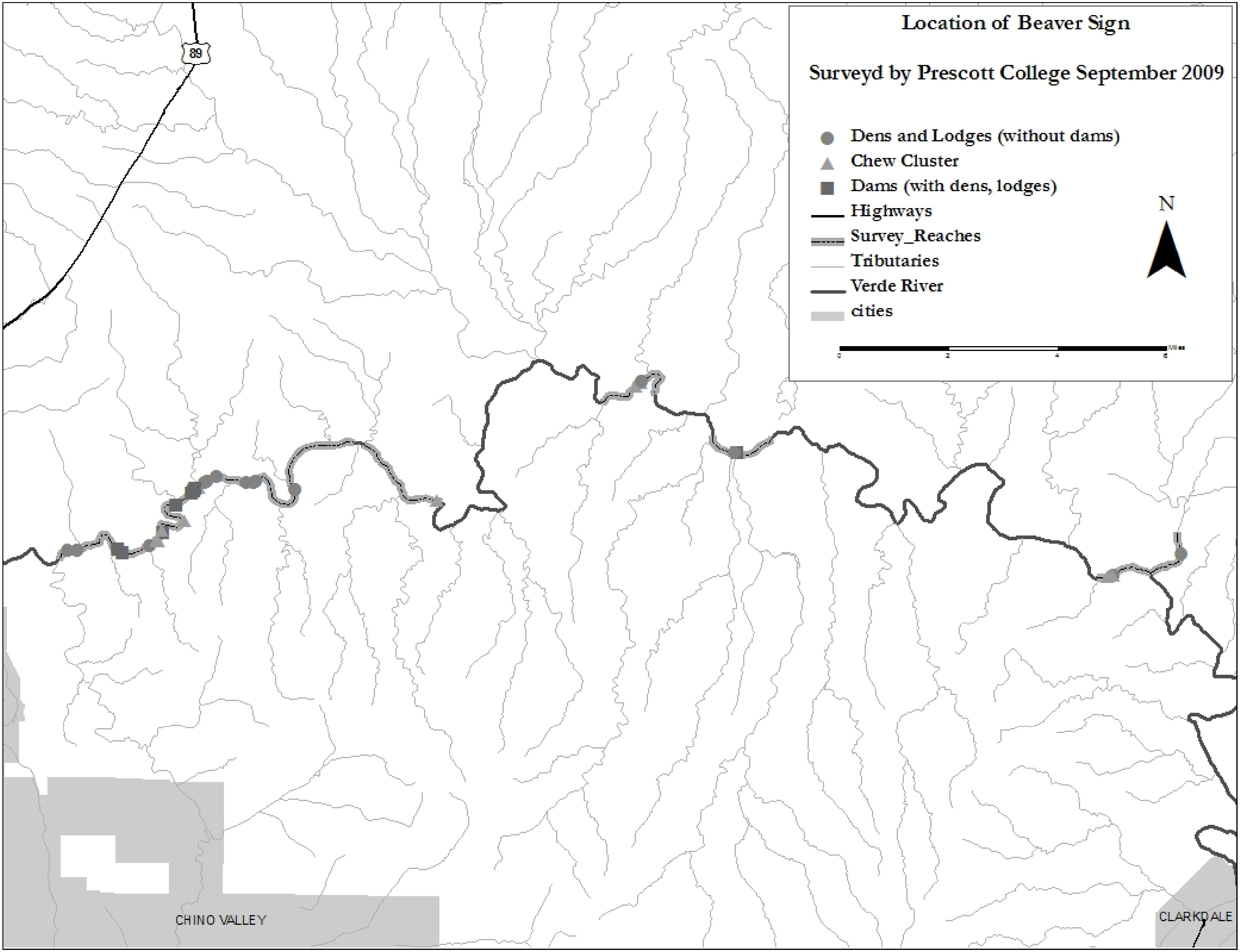
Reach Name	Miles	Chew Clusters	Dens/Lodges	Dams
HW to UVWMA	2.3	0	5	1
UVWMA Down	1.7	4	0	2
Pipeline Up	1.3	1	4	3
Pipeline Down	0.8	0	3	0
Verde Ranch Up	2.5	0	1	0
Verde Ranch Down	2.0	1	0	0
Bear Siding Down	1.7	2	1	0
Perkinsville	1.4	0	1	1
Sycamore	1.1	0	1	0
abv Sycamore	1.1	3	1	0
Total	**15.8**	**11.00**	**17.00**	**7.00**

Dams per mile:	0.4
Dens/Lodges per mile:	1.1

Total number of Chew marks divided by species and size

Species	<2 inches	>2 inches	total
Goodding Willow	76	82	158
One Seed Juniper	2	0	2
Red Willow	41	51	92
Tamarisk	3	0	3
Fremont Cottonwood	23	94	117
Velvet Ash	8	11	19
Coyote Willow	36	28	64
Seep Willow	18	3	21


What do Verde Beavers Eat?
Coyote Willow 14%
Seep Willow 4%
Velvet Ash 4%
Fremont Cottonwood 25%
Goodding Willow 33%
Tamarisk 1%
Red Willow 19%
One Seed Juniper 0%



Location of Beaver Sign
Surveyd by Prescott College September 2009
Dens and Lodges (without dams)
Chew Cluster
Dams (with dens, lodges)
Highways
Survey_Reaches
Tributaries
Verde River
cities
N
0
2
4
6
Miles
89
CHINO VALLEY
CLARKDALE