A REPORT ON THE VEGETATION OF FIVE BEACHES ON THE COLORADO RIVER, GRAND CANYON NATIONAL PARK

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INTRODUCTION

Early botanical studies of the Colorado River corridor "have generally been limited in scope to specialized studies of specific habitat or plant types" (Wertheimer and Overturf 1975) and have been few in number. Clover and Jotter (1941) published on the distribution of cacti in the Inner Gorge and discussed possible distribution mechanisms. Later, in 1944, Clover and Jotter published a checklist of plants for the Inner Gorge and riparian habitat of the Colorado River. More recent studies have been primarily concerned with specific botanical aspects such as Martin's (1971) unpublished study on the woody vegetation and riparian habitat. Little work has been done on the general ecology of the Colorado River corridor. In 1973 the Museum of Northern Arizona contracted to initiate a multi-functional survey of the natural resources of the Colorado River corridor to provide the National Park Service with baseline information for management decisions on the present ecological conditions along the river. Thi section will report on the vegetational aspect of the ecological survey. This survey was conducted to gather the following information:

1. Determination of the present vegetation patterns established on the beaches of the Colorado River.
2. Detection of any changes in these beach vegetation patterns that could be occuring as a result of controlled river flows.
3. Growth and establishment rates of woody riparian vegetation such as salt cedar (*Tamarix chinensis*), willow (*Salix* spp.), arrowweed (*Pluchea sericea*), and baccharis (*Baccharis* spp.).
4. Determination of any environmental impacts on vegetation patterns resulting from human utilization of the beaches.

METHODS AND MATERIALS

In March and June, 1978, Museum of Northern Arizona personnel established vegetation transects on five beaches along the Colorado River between Lee's Ferry and Diamond Creek. The five beaches were 1) Saddle Canyon, River Mile 47R, 2) Nankoweap, River Mile 52R, 3) Deer Creek, River Mile 136L, 4) National Canyon, River Mile 166L, and 5) Granite Park, River Mile 209L. Each beach was subdivided into three general areas perpendicular to the Colorado River, Deer Creek being an exception with only two areas due to the size of the beach. Differences in woody riparian vegetation composition was the basis for subdivision. Within each subdivision, two permanent variable length transects (March and June) were set up to measure the vegetation from the "old high water line" to the river's edge. These transects are to be read annually.

Along each transect, perennial vegetation was measured by species to determine cover, density and frequency. Cover was measured by line intercept (Canfield 1941) with density and frequency values determined in a 1 to 2 meter wide belt divided into 5 meter blocks. One square meter plots were established in the riparian zone at all beaches except Deer Creek in March to determine recovery and invasion rates of "common" riparian species. Within each plot, plant location and numbers were recorded and the area photographed. All vegetatio was then removed from the plot to simulate as best as possible a pre-dam Colorado River flash-flood. The results of these plots will be presented in a future report because they have not be re-read since establishment.

In addition, riparian zone vegetation profiles were measured by photograph each area with reference poles. This data will provide information regarding growth rates of riparian vegetation. The results of these measurements will be presented after the transects are re-read.

RESULTS

The results presented in this report are preliminary because the transects have not been re-read. Therefore, density values in general terms of grasses, herbs/forbs, and shrub/woody categories will be used to describe the vegetation of subdivisions for the five beaches. This density value will be the two transects (March and June) combined, using total individuals for each category per subdivision.

Saddle Canyon

The Saddle Canyon beach (River Mile 47R) is located at the mouth of Saddle Canyon and represents an example of a side canyon floodplain beach. Subdivisions were established from the downriver end of the beach to the edge of the Saddle Canyon floodplain.

The results for the six transects of Saddle Canyon are presented in Table 1. The first subdivision measures a high density woody riparian vegetation following the interface of a large eddy created by the beach. This area is dominated by the shrub/woody element, having a 615 density value. The grasses are the least represented element, with the herbs/forbs category second. Arrowweed, willow and salt cedar represent the major shrub/woody with *Thelypodium* sp. and wirelettuce (*Stephanomeria* sp.) the major plants in the herbs/forbs element. Dropseed (*Sporobolus* sp.) and a bluestem (*Andropogan* sp.) are the main grasses.

The next subdivision primarily measures the main sandy beach area. Shrub/woody and herbs/forbs are the dominant vegetation elements for this area, with grasses again being the least represented vegetation element. The dominant plants are the same as in the first subdivision, but they are generally represented in much lower density values.

The third subdivision of Saddle Canyon measures the upriver large rock and boulder area which is the edge of the canyon floodplain. The grasses element is the dominant vegetation for the area with a density figure of 179. The shrub/woody element is second with the herbs/forbs element last. The grass composition is a dropseed, a needle-and-thread (Stipa sp.) and a three-awn (Aristida sp.). The same shrub/woody plants are represented in this area with salt cedar densities increased and baccharis (Baccharis sp.) added to the composition. Herbs/forbs composition is essentially the same as the other subdivisions with wirelettuce contributing considerably to the density value.

Nankoweap

The Nankoweap beach study area (River Mile 52R) is located downstream from the main campsite area and is very similar in structure to Saddle Canyon. Because of the similarity, beach subdivision followed the pattern of Saddle Canyon, from the downriver end thru the rocky-boulder upriver end. Nankoweap beach is smaller in area than the Saddle Canyon beach.

Results of the six variable length transects are presented in Table 2. Shrub/woody are the most important vegetation elements for the first subdivision, followed by herbs/forbs and grasses with 498, 253, and 161 total density values respectively. Arrowweed, willow, and broom snakeweed (Gutierrezia sarothrae) are the main shrub/woody with spiny aster (Aster spinosus) and wire lettuce the main herbs/forbs. Dropseed, Indian ricegrass (Oryzopsis hymenoides) and bluestem are the major grasses.

The second subdivision is again dominated by the shrub/woody element with a density value of 297. Herbs/forbs are second with 277 and grasses third with a density value of 188. Broom snakeweed, salt cedar and willow, respectively, are the most important shrub/woody vegetation. The same plants of the first

subdivision for the herbs/forbs are represented in this area with the addition of fleabane (Erigeron sp.). The grass composition is changed by the addition of bristlegrass (Setaria sp.), found mainly as an understory within the riparian habitat.

The shrub/woody composition for this third subdivision is consistent with the other two, varying only in that willow has higher densities than salt cedar. The herbs/forbs composition changes with wirelettuce, dogweed (Dyssodia sp.) and false tarragon sagebrush (Artemisia dracunculoides) in decreasing order of importance. Grass composition is essentially the same with a muhly (Muhlenbergia sp.) becoming the riparian habitat understory.

Deer Creek

Because of the restricted size of the beach, Deer Creek beach (River Mile 136L) has only two subdivisions. The first subdivision, approximately the downriver half of the beach, is dominated by grasses, followed by shrub/woody and herbs/forbs element (Table 3). Dropseed, bluestem, Indian ricegrass and vine mesquite (Panicum obtusum) are the major grasses with broom snakeweed, salt cedar, and Mormon tea (Ephedra nevadensis) the dominant shrub/woody vegetatio The herbs/forbs element is mainly wirelettuce and spiny aster.

The shrub/woody element becomes dominant in the second subdivision, followed in order by the grasses and herbs/forbs vegetation elements (Table 3). The main plants of the shrub/woody element are salt cedar, broom snakeweed and longle brickellia (Brickellia longifolia). The grasses include only Indian ricegrass and a bluestem while the herbs/forbs element includes wirelettuce, false tarragon sagebrush, and goldenweed (Haplopappus spinulosus).

National Canyon (Upper)

The National Canyon beach (upper, River Mile 166L) is located in the floodplain of National Canyon with beach development probably influenced by National Canyon flash-floods. Variable length transects are established in the three subdivisions, the first subdivision being the downriver rocky boulder area, the second in the central main sandy beach area and the third subdivision in the National Canyon floodplain. In order to avoid sampling the southwest flowing National Canyon drainage, transects begin on the river side of that drainage.

The results of the six transects established are presented in Table 4. The herbs/forbs is the main element in the first subdivision with a density value of 83, followed by the grasses and shrub/woody elements. Wirelettuce and camissoni (*Camissonia* sp.) are the dominant herbs/forbs while dropseed and needle-and-thread are the main grasses. The shrub/woody element is mainly baccharis (*Baccharis glutinosa* and *B. sarothroides*), brickellia, and arrowweed, all in low densities.

The shrub/woody element is the dominant vegetation of the second subdivision and is mainly salt cedar, willow, arrowweed and baccharis. The herbs/forbs element is second with the grasses element the least represented. Sand verbena (*Abronia elliptica*), primrose and wirelettuce are the main components of the herbs forbs while dropseed is the only grass recorded for this subdivision.

The third subdivision, measuring the canyon floodplain, is dominated by the shrub/woody element with baccharis (*B. emoryi*), broom snakeweed, and salt cedar the main plants. The June transect, running down the center of the wash, recorded 8 seedling and young catclaw (*Acacia greggii*), 8 seedling and young emory baccharis and one young salt cedar. The grasses element is second in importance and is mainly dropseed, bluestem, and a species of three-awn. The herbs/forbs element is mainly camissonia, wirelettuce and bedstraw (*Galium* sp.).

Granite Park

The Granite Park beach (River Mile 209L) is located between two canyon floodplains, one un-named canyon upriver and Granite Park Canyon downriver. The first subdivision is the rocky-gravelly floodplain of Granite Park Canyon with the second subdivision in the sandy beach area upriver from Granite Park Canyon. The third subdivision measures the sandy area from the head of the eddy towards the un-named canyon floodplain.

The most important vegetation element for the first subdivision is shrub/woody with camelthorn (Alhagi camelorum), willow, baccharis, brickellia and salt cedar the main plants. Within the two transects, 6 individuals of catclaw are present. Grasses is the next element, including dropseed, bluestem and muhly species while the herbs/forbs is mainly dogweed, sand verbena and wirelettuce. The sandy areas within this subdivision are commonly stabilized by medium to dense Tortula cover.

The second subdivision is dominated by the shrub/woody element with the herbs/forbs element second in importance. The composition of the shrub/woody element is camelthorn, arrowweed and baccharis. Twenty-six seedling/young longleaf brickellias are present along the June transect. Sand verbena and evening-primrose (Oenothera pallida) are the main plants in the herbs/forbs element while dropseed and brome (Bromus sp.) are the major grasses. The brome is generally confined to the mesic understory of the riparian zone.

The third subdivision, measuring the head of the eddy, is dominated by the herbs/forbs element, mainly spiny aster, dogweed and goldenweed. Grasses are the second in importance with muhly, inland saltgrass (Distichlis stricta) and dropseed the main species. Shrub/woody element is represented by arrowwwed, willow and salt cedar.

DISCUSSION

To date, the area of the Colorado River corridor vegetatively sampled by the Museum of Northern Arizona Ecological Survey has been restricted to that zone that has always been influenced by the Colorado River. This area would have been an unstable habitat with respect to vegetation communities in pre-Glen Canyon Dam times. Therefore it follows that the vegetation within this zone would normally have been in various stages of primary or secondary succession and would only rarely, if ever, have been in a climax vegetative condition prior to the Glen Canyon Dam. The flow of the Colorado River is now effectively controlled and as a result of control eliminating peak flood river flows, we see changes in the ecology of the river corridor. Changes in existing vegetation would be early indications of a changing ecosystem in the zone influenced by the river flows. One would expect to see successional changes that would lead to the stabilization of this previously unstable plant community. Assessment of the extent of successional trends toward stabilization is made difficult by the general lack of in-depth pre-dam vegetation surveys. However, in certain vegetational aspects, initial results of the botanical studies of the Museum of Northern Arizona Ecological Survey indicate that this trend towards stabilizat is indeed in progress.

With the control of one environmental impact leading to stabilization, a ne important environmental impact, human utilization of the beach areas, was introduced, maintaining beach plant associations in a disturbed state. This impact is of a high density-high intensity nature for many beaches, but utilizat levels vary widely. The five beaches surveyed and the subdivisions within each beach area are representative of these various ecologically changing areas and differing levels of human impact found along the river corridor.

Present Vegetation and Stabilization Trends

It is generally acknowledged that the woody riparian vegetation of the Colorado River is now becoming permanently established (Carothers et al. 1976). Clover and Jotter (1944) reported salt cedar, baccharis and willow "are most prominent in the vegetation found in wet sand near the river's edge" but also reported that periodic high floods could and did completely remove this vegetation. The periodic high floods are no longer and it becomes obvious that the shrub/woody vegetation element is important and becoming increasingly instrumental in the successional development of beach plant associations along the Colorado River. Of the fourteen subdivisions sampled on the five beaches, 10 (71%) were dominated in density values by the shrub/woody element. The major plant contributors to these high density values are the "typical" riparian vegetation, i.e., the introduced salt cedar and various species of bacchris and willows depending upon location along the river corridor. This element is also becoming increasingly important in the dry sandy shore and the rubble and boulder areas of the interior beach. Arrowweed, broom snakeweed, brickellia and introduced camelthorn are commonly found in various densities throughout the interiors of numerous beaches. This permanent woody perennial vegetation establishement suggests a trend to habitat stabilization for all areas of the beaches.

The grasses and herbs/forbs vegetation elements were each the dominant element in subdivisions on 2 (14.5%) occurrences. Both of these elements are important in beach stabilization, primarily because of their numbers and growth habits. The grasses are important throughout the beach from the muhly, bermuda grass and bristlegrass/brome understory of the riparian zone to the dropseed and Indian ricegrass hummocks in the dry sandy beach and the bluestem and three-awn establishment between the rocks in the rubble and boulder areas. The l e

variety of herbs and forbs found in every area of the beach stabilize the shifting dry sandy beach areas and hold the soil deposited in the rubble and boulder areas. Wirelettuce is ubiquitous throughout the subdivisions, while sand verbena, spiny aster, goldenweed, primrose and dogweed are commonly found in the sandy and rocky areas of the beach. All of these plants would have been periodically removed in the pre-dam floods, but now are apparently becoming permanently established as beach stabilization progresses.

Human Impact

Both Saddle Canyon and Nankoweap are right side beaches and have developed very similar gross beach morphology which allows comparison of the different subdivisions found on each beach. The Saddle Canyon study area receives medium to light human utilization while the Nankoweap study area receives little or no human use. This allows Nankoweap to be considered as a control for the "natural" ecological changes towards stabilization, while Saddle Canyon is under heavy human impact.

Table 1 and 2 show that the subdivision structures are generally the same for the two beaches. The beaches differ in that the same vegetation elements show different density values, with the Nankoweap study area generally higher. This higher density trend is especially true in a second subdivision comparison. The Saddle Canyon area recives human utilization through trampling and camp site This utilization apparently is detrimental to the vegetation of the area, especially for the herbs/forbs and grasses elements. The first subdivision at Saddle Canyon contains the "kitchen area" of the beach and again the human activity in the area is detrimental to the herbs/forbs and grasses element.

Data presented in Tables 6 and 7 also confirms the difference in vegetation established in the respective subdivisions of these two beaches. Species diversity is generally higher on the Nankoweap study area and with only two

exceptions, total absolute ground cover percentages are higher. From th indications, it becomes apparent that human impact on the Saddle Canyon beach, reflected in lower density values, lower ground cover values, and lower species diversities, is similar to the pre-dam high level floods in that both impacts retard establishment and periodically remove permanent perennial vegetation.

An indication for the intensities of the two impacts is also apparent from the data in Tables 6 and 7. The interior unstable shifting dry sandy beach areas found in the second subdivision would be expected to be dramatically altered in a flash-flood, probably being the "most" impacted area of the beach. Human utilization patterns of Saddle Canyon indicates that the same area could be considered as the "most" concentrated impacted area. The wet sand woody vegetation and the rubble and boulder subdivisions would be expected to be relatively less impacted by high waters in that the dense root development of woody plants would tend to "anchor" stands in place and shifting of rubble and boulders would be important for plant disturbances in the third subdivision. Both of these areas receive limited impact from human use. This intensity similarity along with the differences in element densities, the variations in species diversity and absolute ground cover indicate that the introduced impact of human utilization at Saddle Canyon simulates, on a smaller scale, the periodic and catastrophic pre-dam Colorado River floods.

The data from the Deer Creek study area tends to confirm the existence of human impact on beach plant associations. Both subdivisions of this beach are areas of high human use. As shown in Table 3, grasses are dominant in the first subdivision, containing the kitchen area, primarily as small clumps and rhizometous shoots in limited human impact pockets between the rocks. Grasses are sparsely represented in the second subdivision, the main camping area of the beach. The herbs/forbs element is apparently the most severely affected by trampling action preventing plant establishment. It is the least represent

vegetation element within both subdivisions.

The shrub/woody element dominates the extreme ends of the transects, in the vicinity of the interior rockwall base and in the limited riparian zone of the beach which is best developed in the second subdivision. These two areas receive limited human impact and density figures reflect this lack of human use.

Because of the large area and general beach morphology, human impacts on vegetation elements for both National Canyon (Upper) and Granite Park beaches is more dispersed and less obvious than on the smaller beaches. The second subdivision of National Canyon encompasses the main area of human utilization including both the kitchen area and the main camping areas. The trailing and trampling actions are the primary impact on the vegetation within this subdivision. The trailing throughout the sand dune areas of the second subdivision is the main human impact seen on the Granite Park beach .

CONCLUSIONS AND PROSPECTIVE BOTANICAL ASPECTS

Ecology

Two general but distinct plant associations have developed along the corridor of the Colorado River since the Pleistocene, both of which have been shaped by the influence of water. The two associations can be readily identified, the first being the general area extending from the "old high water line" down to the river's edge, and the second being the area above the "old high water line" extending upwards throughout any talus slope that has developed.

The first plant association has always been subjected to the unpredictable but periodic catastrophic impact of a Colorado River high water flood. This event has been reported to affect the riparian vegetation of the area in that plants would be "torn out completely or barely retain a footing on the crumbling shore until sand again packs around the roots" (Clover and Jotter 1944). In addition, the vegetation of the dry sandy beach and the rubble and boulder depositional areas would be similarly affected in plant removal and habitat alteration. At the upper high water line of the periodic spring floods, a "dry riparian" community dominated by *Prosopis juliflora* (mesquite), *Acacia greggii* (catclaw), and *Fallugia paradoxa* (Apache plume) developed. This old riparian zone differed from the present riparian zone in that once established, the trees survived for years without further inundation by the river. They survive today on available soil moisture and presumably deep root systems that tap the river water table. They are not reproducing, however, because they are not subject to the floods needed for seedling establishment.

The second plant association has developed from the slow but consistent influences of rain and wind, basically exempt from the erratic catastrophic influence of the river. The area and vegetational development of this associatio is dependent upon the weathering durability of the various exposed geologic

formations that dictates the talus slope development. Being a more xeric habitat, its plants would be expected to have adapted ecological strategies such as water conservation, slow-consistent growth patterns and broad tolerances to exist in a stable but extreme habitat. Primarily due to slope and soil type, this plant association is much more susceptible to disturbance (such as human impacts) with its slow recovery rate, while the first plant association is better adapted to major disturbances.

Edaphic influences associated with the two general plant associations must also be considered in the ecology of established vegetation patterns along the Colorado River corridor. The substrate in the first plant association will be of a depositional nature from side canyons and the river and "flood-plain deposits are variable, ranging texturally from gravel and sands to silt and clay" (Buckman and Brady 1969). The soil of the second plant association will be largely derived from colluvial accumulation and "is usually coarse and stony, as physical rather than chemical weathering has been dominant" (Buckman and Brady 1969).

The first plant association can be divided into three general areas, each area having its own particular substrate and/or vegetation. These areas are generally 1) normally dense woody riparian vegetation in the "margin of moist sand" (Clover and Jotter 1944) typically in greatest densities on the downriver end of the beach, 2) the dry shifting sandy interior beach area with plants typically forming hummocks for habitat stability and 3) the rubble and boulder area typical of a canyon floodplain or the upriver boulder armament of the Colorado River creating numerous microhabitats within these rock-boulder fields.

Species diversity detected from data analysis generally follows an increasing trend from the riparian area to the rubble-boulder area. This trend can best be explained in that the rubble and boulders increase habitat diversit thus allowing greater species diversity. The boulders provide shelter for seed

germination while plant parts washed down "and lodged between boulders frequently take root" (Clover and Jotter 1944).

Transects were established within the floodplains of National Canyon and Granite Park Canyon with the thought of sampling an area still subjected to periodic flashfloods. Although on a smaller scale, this flashflooding action should simulate the pre-dam periodic flashfloods of the Colorado River. From data obtained in sampling these areas, atypical plants such as catclaw have been found. By monitoring the growth and establishment rates of plants found within these areas, it is hoped that a better understanding of plant responses to flashflood activity will be gained.

The main sandy beach areas are generally the areas most impacted by human activities. The herbs/forbs element is normally the most affected vegetation element, primarily affected by trampling and camping. The grasses element is also impacted but grasses established in a large hummock growth habit are generally undisturbed. The shruby/woody element, mainly the riparian zone pla , is the least impacted of the three general vegetation categories. Human travel in the woody riparian area is largely restricted to established trails in that travel "off-trail" is often quite uncomfortable. This trailing action is the main impact to the shrub/woody vegetation element of the beaches along the Colorado River.

Closing Prospectives

If indeed the river-influenced plant association is decreasing in area, which would be expected with a decrease in river flows re-charging and maintaining a reduced area, the area of the second plant association would be expected to increase to occupy the vacany. With the idea that certain plants are ecologically adapted to their respective plant associations and by correlating this

distinctiveness of habitat preference to certain edaphic characteristics, a monitoring system based on indicator plants could be developed to detect the current ecological changes occuring along the Colorado River corridor. The changing position of these indicator plants within the plant communities near the river would suggest such ecological changes.

The information obtained from the proposed indicator plant monitor system in conjuction with continued detailed quantitative measurements of the river-influenced plant community will provide greater understanding of the changing ecosystems of the Colorado River. This information will provide the necessary baseline for management decisions concerning the ecology of the Colorado River corridor.

Table 1. General plant category ratings according to density values for the subdivisions of Saddle Canyon.

Subdivision	Subdivision	Subdivision
Shrub/woody - 615	Shrub/woody - 135	Grasses - 179
Herbs/forbs - 184	Herbs/forbs - 78	Shrub/woody - 151
Grasses - 7	Grasses - 33	Herbs/forbs - 137

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Table 8. Number of species/densities of Deer Creek.

	Subdivision		Subdivision	
	March	June	March	June
Grasses	5/78	3/51	2/9	2/8
Herbs/forbs	5/15	2/5	2/2	4/7
Shrub/woody	4/22	2/14	4/48	4/24
Absolute cover %	21.51	6.9	30.69	22.19
Total length	42.4 m	30.6 m	48.1 m	43.0 m

Table 7. Number of species/densities of Nankoweap.

	Subdivision		Subdivision		Subdivision	
	March	June	March	June	March	June
Grasses	4/109	6/52	3/94	5/94	4/80	4/70
Herbs/forbs	5/160	3/93	5/159	5/118	8/161	6/47
Shrub/woody	5/211	3/287	5/171	6/126	3/195	4/95
Absolute cover %	41.18	39.85	62.26	54.62	40.14	31.48
Total length	53.35 m	58.00 m	61.45 m	65.00 m	66.12 m	60.00 m

Table 6. Number of species/densities of Saddle Canyon.

	Subdivision		Subdivision		Subdivision	
	March	June	March	June	March	June
Grasses	2/3	3/4	1/4	3/29	5/102	4/77
Herbs/forbs	4/82	2/102	3/29	4/49	8/78	4/59
Shrub/woody	4/375	4/240	5/82	5/53	7/121	3/30
Absolute cover %	31.89	49.91	25.26	17.86	32.58	35.10
Total length	89.15 m	66.00 m	70.00 m	76.90 m	92.40 m	59.80 m

Table 5. General plant category ratings according to density values for the subdivisions of Granite Park.

Subdivision	Subdivision	Subdivision
Shrub/woody - 472	Shrub/woody - 170	Herbs/forbs - 207
Grasses - 164	Herbs/forbs - 170	Grasses - 145
Herbs/forbs - 30	Grasses - 124	Shrub/woody - 104

Table 4. General plant category ratings according to density values for the subdivisions of National Canyon (Upper).

Subdivision	Subdivision	Subdivision
Herbs/forbs - 83	Shrub/woody - 352	Shrub/woody - 92
Grasses - 49	Herbs/forbs - 71	Grasses - 71
Shrub/woody - 36	Grasses - 12	Herbs/forbs - 21

Table 3. General plant category ratings according to density values for the subdivisions of Deer Creek.

Subdivision	Subdivision
Grasses - 129	Shrub/woody - 72
Shrub/woody - 36	Grasses - 17
Herbs/forbs - 20	Herbs/forbs - 9

Table 2. General plant category ratings according to density values for the subdivisions of Nankoweap.

Subdivision	Subdivision	Subdivision
Shrub/woody - 498	Shrub/woody - 297	Shrub/woody - 290
Herbs/forbs - 253	Herbs/forbs - 277	Herbs/forbs - 208
Grasses - 161	Grasses - 188	Grasses - 150