



6-30-1972

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Recommended Citation

Judd, B. Ira (1972) "Vegetation zones around a small pond in the White Mountains of Arizona," *Great Basin Naturalist*: Vol. 32 : No. 2 , Article 4.

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VEGETATION ZONES AROUND A SMALL POND IN THE WHITE MOUNTAINS OF ARIZONA

B. Ira Judd¹

ABSTRACT.— Because of a previous study of wet meadows, an investigation of Carnero Lake, White Mountains of Arizona, which is ecologically advancing toward a wet meadow, was undertaken. Information on eutrophication and successional patterns in ponds of the ponderosa pine is needed for better understanding of that ecosystem. Aerial infrared photographs were taken to delineate areas containing aquatic vegetation and as an aid in identifying zones around the pond. Five zones from open water to ponderosa pine were found. Abundance of vegetation by species was estimated in each zone. Protein analyses are given for 29 of the 32 species listed.

The White Mountains of Arizona encompass many small ponds which are used by migrating waterfowl for resting, feeding, and sometimes as nesting sites. Arizona is located in the Pacific Waterfowl Flyway, with most of the birds in the fall migration arriving in middle to late October. Although the state is not known for its abundance of waterfowl, small mountain ponds provide a quality type of waterfowl hunting for local people. Pond is defined here as being an area where wave action is feeble, thereby allowing a continuous vegetation cover to develop around the shoreline.

Deer, elk, and turkey can be seen around the fringes of these ponds, obtaining forage and water. Intergradations of plant communities from the emergent aquatics in the littoral zone to the ponderosa pine on dry land also provide many niches for small birds and mammals. A previous study² prompted the investigation of a pond that was geologically advancing toward a wet meadow. Information on eutrophication and successional patterns in ponds in the ponderosa pine is needed for a better understanding of that ecosystem.

The reduction of the Apache menace in the 1870s opened the territory of Arizona to farming and ranching. Concurrently, with the increased use of range lands, rivers and streams were dammed and water diverted for irrigation and mining purposes; one such structure in the White Mountains of Arizona was Tyler Reservoir, created by building a dam on Carnero Creek in 1878. Somewhere along the way, the name was changed to Carnero Lake, possibly by the oldtime Basque shepherders.

Carnero Springs which empties into the lake is an old Indian prayer spring. In earlier times many prayer beads and arrowheads could be found there. The name Tyler was for Jack (Poker) Tyler, who was an eccentric character of the local neighborhood. The

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²PATTON, D. R., AND B. I. JUDD. 1970. The role of wet meadows as wildlife habitat in the Southwest. *J. Range Mgmt.* 23(4):272-275.



Fig. 1. Carnero Lake, Apache National Forest, Arizona.

reservoir did not contain much water until a filling ditch was constructed in 1913.

Carnero Lake is in the upper edge of the ponderosa pine forest type at an elevation of 8500 feet. It is located approximately three miles east of Green's Peak (Fig. 1). The lake occupies a portion of the eastern third of the SW $\frac{1}{4}$ of section 6, Township 8 north, Range 27 east of the Gila and Salt River Meridian.

TECHNIQUES

It was evident from reconnaissance visits that there were rather distinct vegetation zones from the pond into the ponderosa pine.

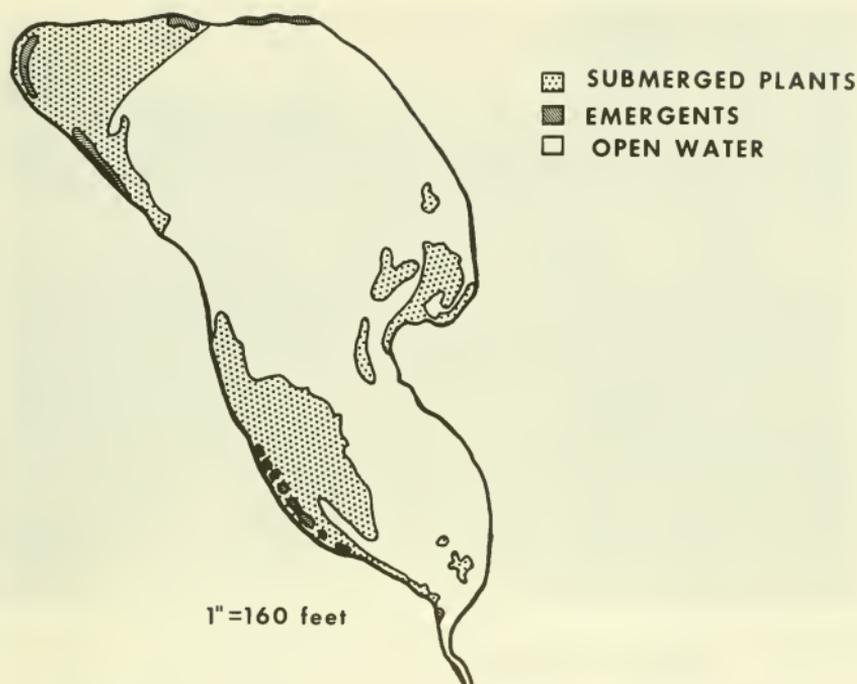


Fig. 2. Location of aquatic vegetation in Carnero Lake.

Abundance of vegetation by species was estimated in each zone as very rare, rare, infrequent, abundant, and very abundant.³ Each species was collected for reference and a sample taken for protein analysis. Protein samples were composite samples collected in July and August. Aerial infrared photographs were taken to delineate areas containing aquatic vegetation and as an aid in identifying zones around the pond.

RESULTS AND DISCUSSION

Total surface area of Carnero Lake is 7.83 acres. Infrared photographs showed two areas containing aquatic plants. Submerged aquatics occupied 1.76 acres, emergents 0.31 acres, and open water 5.96 acres (Fig. 2).

Five vegetation zones were identified (Fig. 3):

1. Water—containing aquatic plants.
2. Wet—shoreward zone, frequently inundated.
3. Mesic—occasionally inundated, moist part of the time.
4. Intermediate—slightly moist.
5. Forest edge—drier than intermediate.

³OOSTING, H. J. 1942. The study of plant communities. (2nd Ed.). W. H. Freeman, San Francisco.

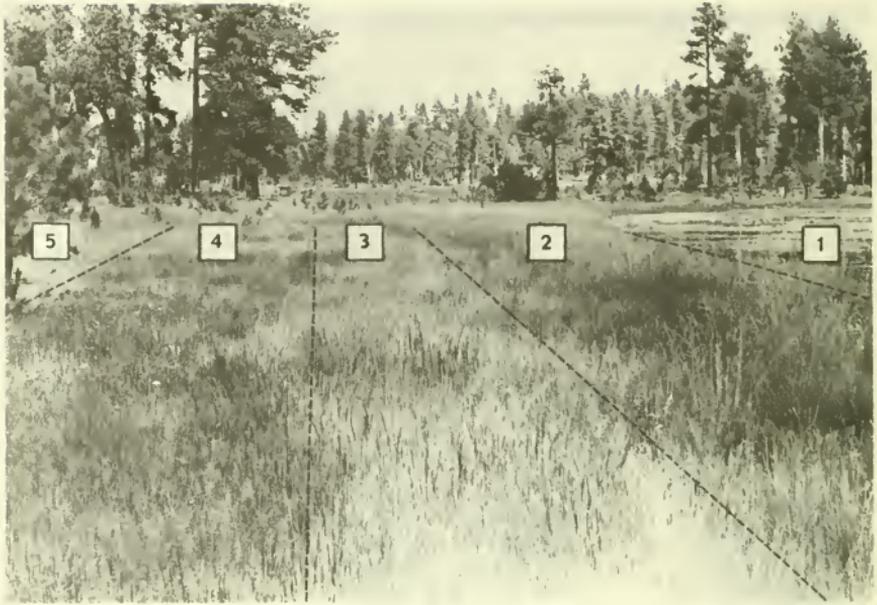


Fig. 3. Vegetation zones from open water to ponderosa pine.

Table 1 lists the species found in each zone with their abundance and protein content. The five zones contained 32 different plant species. Vegetation was well defined on the north side of the pond but the south side had a steeper bank and the zones were not well defined. One of the first species which gains a foothold on sandbars or sloping beach is Needle spikesedge, a small perennial. It is found most abundantly in the Mesic Zone.

It is interesting that Arizona fescue, normally one of the principal grasses under ponderosa pine is also found in a thin belt along the waterline. When the area was visited in early August the fescue next to the water had mature seed heads while plants of the drier site were still green.

Protein is considered the most important animal nutrient and crude protein content of plants can give an indication of forage value for wildlife. From Table 1 it is obvious that protein is variable but in general all zones leading to the forest edge contain some plants high in protein. Two species, watercress and curlydock, had exceptionally high protein content. Little information is available on watercress as a wildlife food but it is not uncommon to see deer foraging on curlydock in meadows.

The zones shown in Fig. 3 represent successful development from open water to ponderosa pine. As the pond fills with sediment and debris, mats form at the edge. Conditions are made unsuitable for the submerged aquatics and sedges and rushes advance centripetally with each zone being repeated from wet to dry conditions.

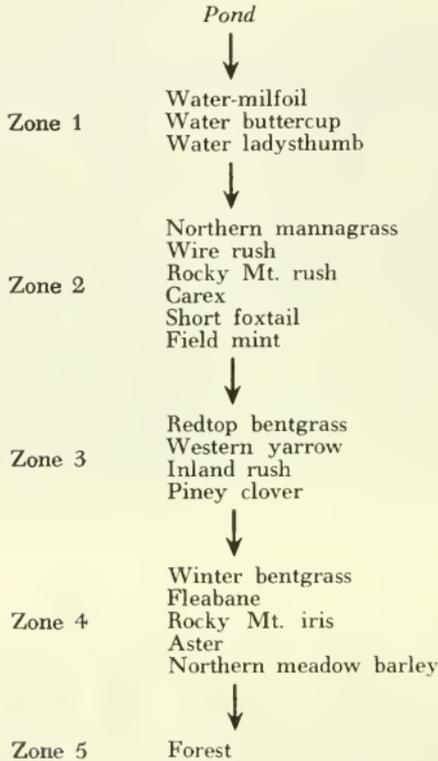
TABLE 1. List of principal species found at Carnero Lake by zones with percent protein and abundance.

Scientific Name ¹	Common Name	Percent Protein	Abundance ²	Zone
<i>Myriophyllum exalbescens</i>	Water-milfoil	11.7	5	1
<i>Ranunculus aquatilis</i>	Water buttercup	10.3	5	1
<i>Carex rostrata</i>	Beaked sedge	9.5	3	1
<i>Polygonum amphibium</i>	Water ladysthumb	14.4	5	1
<i>Scirpus californicus</i>	California bulrush	6.3	2	1
<i>Carex canescens</i> L.	Sedge	11.2	4	2
<i>Eleocharis macrostachya</i>	Bighead spikesedge	11.3	2	2
<i>Festuca arizonica</i>	Arizona fescue	6.1	3	2
<i>Glyceria borealis</i>	Northern mannagrass	10.8	5	2
<i>Juncus balticus</i>	Wire rush	12.0	4	2
<i>Juncus saximontanus</i>	Rocky Mt. rush	7.9	4	2
<i>Pedicularis grayi</i>	Wood-betony	11.6	3	2
<i>Alopecurus aequalis</i>	Short foxtail	9.2	2	3
<i>Eleocharis acicularis</i>	Needle spikesedge	8.0	4	3
<i>Mentha arvensis</i> L.	Field mint	12.4	4	3
<i>Rorippa sphaerocarpa</i>	Watercress	23.9	3	3
<i>Achillea lanulosa</i>	Western yarrow	14.1	4	4
<i>Agrostis alba</i>	Redtop bentgrass	8.3	5	4
<i>Juncus interior</i>	Inland rush	7.4	4	4
<i>Trifolium pinetorum</i>	Piney clover	10.8	4	4
<i>Agrostis scabra</i>	Winter bentgrass	7.9	5	5
<i>Aster foliaceus</i>	Aster	8.9	4	5
<i>Campanula rotundifolia</i>	Bluebell	**	3	5
<i>Cirsium Parryi</i> (Gray)	Parry thistle	7.2	3	5
<i>Deschampsia caespitosa</i>	Tufted hairgrass	7.4	3	5
<i>Erigeron bellidifolium</i>	Fleabane	**	4	5
<i>Hordeum brachyantherum</i>	Northern meadow barley	8.1	4	5
<i>Iris missouriensis</i>	Rocky Mt. iris	9.9	4	5
<i>Polygonus bistortoides</i>	American bistort	12.8	3	5
<i>Potentilla hippiana</i>	Horse cinquefoil	11.5	3	5
<i>Rumex crispus</i>	Curlydock	17.1	2	5
<i>Rumex fueginus</i>	Dock	**	1	5

¹Scientific nomenclature follows Kearney and Peebles (1960).²1, very rare, 2, rare, 3, infrequent, 4, abundant, and 5, very abundant.

**No data.

With some modification of abundance of individual species succession should follow the pattern below.



ACKNOWLEDGMENT

The author is indebted to David R. Patton, research wildlife biologist, Rocky Mountain Forest and Range Experimental Station, in cooperation with ASU, for his helpful suggestions during the course of the study and wishes to express his sincere appreciation for this assistance.