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SMALL BUT MIGHTY!

By Park Naturalist E.D. McKee

Birds and mammals have been visiting the residential area on the South Rim of Grand Canyon in exceptionally great numbers this fall. The lack of a crop of Pinyon nuts, the dryness of the season, and the absence of cats and dogs have probably combined to account for this great increase in the feathered and fur-bearing visitors. In the months of September and October alone I have seen 24 species of birds at my feeding station and bird bath. Of these many were undoubtedly in migration, but others have come and stayed long enough to become quite tame and well acquainted. The list includes four species of Juncos and two each of Sparrows, Jays, and Nuthatches.

Among the common birds of this past fall, it has been interesting to notice the individual desires and motives for coming. Some, such as the Bluebirds and Finches, apparently have come only to bathe, others, including the Juncos and Sparrows, have been equally interested in the crumbs and seeds scattered about, and still. others have devoted practically all of their time to eating or carrying away pinyon nuts.

Except for the many Long-crested Jays which apparently will eath anything, and everything if possible, the Chickadees, Titmice, and Rocky Mountain Nuthatches have the best balanced diets. They eat nuts, crumbs, many kinds of fruits, and a great variety of scraps which have been put out as experiments. The tiny Pigmy Nuthatches, on the other hand, limit their meals almost entirely to Pinyon nuts and because of their great craving for these have become extremely bold and teme.

While in most parts of the country the Chickadees are found to be the tamest of the birds - the ones that will most commonly feed from one's hands, at Grand Canyon they are far outclassed in this respect by the Pigmy Nuthatches. These latter - the smallest of the permament residents, will now usually come when called. In pairs or in small flocks, they will arrive among nearby trees, and will take turns in feeding from an outstretched hand. I know of only one case of a Grand Canyon Chickadee becoming so intimate.

Not only are the "Pigmies" bold where man is concerned, but also among mammals and other birds. I have frequently seen them dart down behind a large feeding squirrel and snatch a nut almost from beneath him. None other of our common bird visitors would dare such a venture: Javs, Woodpackers, chipmunks, and all others go unheeded when the Pigmy Nuthatch desires some food. A BRIEF ECOLOGICAL COMPARISON OF LIFE ZONES ON THE KAIBAB PLATEAU

By Ranger-naturalist-Fauline Mead

The Piute Indians gave the plateau its name "Kaibab" which means "Mountain lying down," and from a distance it appears as a long, low, blue line against the horizon. Rising rather gradually from the sage brush plains in the north and from the precipitous walls of Kanab Creek Canyon in the west, this forested plateau reaches an altitude of a little more then 9,000 feet, and then, from its highest point slopes gradually 'southward for a distance of about 16 miles, down to the North Rim of the Grand Canyon. Along the east rim of the plateau steep slopes and narrow camyons dip suddenly into House Rock Valley, a semi-desert where the Colorado river runs south through Marble Canyon.

Grand Canyo Black Meadows Datted Dark shaded-Transition Zone Light shaded-Upper Sonoran Zone

Rolling hills, mature valleys, sink holes and a few young canyons characterize the surface topography-of-the Kaibab plateau. The surface of the plateau is made up of late Permian sandstone and limestone called the "Kaibab limestone" which averages about 500 feet in thickness and forms the topo layer of rock of the Grand Canyon.

The vegetation of the Kaibab Plateau ranges from that of the Upper Sonoran Zone through the Transition Zone to the Canadian Zone, according to C. Hart Merriam's theory of Life Zones. It is made up of flora typical of the Rocky Mountains and the plains of Utah and Colorado.

Vogetation of the Zones

Upper Senoran Zone (5000-7000 feet altitude)

To the north and cast of the Kaibab Plateau lie arid lowlands covered with sagebrush (Artemisia Tridentata), chella cactus (Cpuntia acanthecarpa) shadscale (Atriplex canescens) match brush (Petradoria pumila) and associated plants. A few stunted specimens of Utah juniper (Juniperus utahensis) occur widely scattered at the base of the plateau on the north and west. The juniper grows quite abundantly on the lower slopes of the plateau, but at the upper limits of the Upper Sonoran Zone, gives way almost entirely to the pinyon pine (Pinus cdulis). The cliff rose (Cowania stansburiana), scrub oak (Quercus gambelii) and antelope bush (Purshia tridentata) are common shrubs of this region. Other typical plants are Spanish bayonet (Yucca baccata), contury plant (Agave utahonsis) pincushion cactus (Mamillarin radiosa grizonica) hodgehog cactus (Echinocorcus coccincus) and several prickley pears (Opuntias). Conspicuous flowering herbs are the ercoping pentstemon (Pentstemon linarioides), the pink pentstemon (Pentstemon palmeri) scarlet bular (Pentstemon bridgesii), wild sunflower (Hymenopappus lugeus), globe mallow (Sphaeralcea marginata) and the thistle poppy (Argomone hispida).

Transition Zone (7000-8200 fect altitude)

The Transition Zone is characterized by the dominance of the western yellow pine (Pinus ponderosa) which grows in pure open stands ferming a wide belt around the north and west boundaries of the Canadian Zone. The belt is narrow on the east side of the plateau where the slope to the Upper Sonoran Zone is steep, and along the North Rim of the Grand Canyon. The trees are of all sizes showing that the yellow pine is probably the elimax type and therefore permanent. Some of the trees are very large, from tw 200 to 400 years old. Except in the clearings the forest floor is comparatively clean with little underbrush and only a few herbs.

At the lower limits of the Transition Zone seru! o.k, mountain mahogany (Corecearpus Montanus) New Mexican Locust (Robinia neomexicana), cliff rose and red codar (Juniperus scopulorum) grow under the yellow pines. At the upper limits of the Transition Zone are groves if quaking aspen (Populus aurea) white fir (Abies concolor) and douglas fir (Pseudotsuga mucronata).

Blue bonnet (Lupinus barbider) is one of the commonest herbs grewing under the yellow pine. Indian paintbrush (Castilloja linariaefolia,), owl's clover (Orthocarpus pierpurce albus) and pink evening primress (Anogra corenopifolia) are found in open rocky places. Other prominent plants of the Transition Zone are the flea bane (Erigeron divergens) goldenred (Solidago ciliosa) cranesbill (Geranium foreatum) and in rather damp places the wild rese is found (Rosa Neomexicana), also a wild strawberry (Fragaria platypetala)

Canadian Zone (8200-9200 feet altitude)

In the Canadian Zone the forest is confined to the hills, and the depressions are covered by meadows or grass lands. The Colorade blue spruce (Picea pangens) is the dominant tree of this zone, but quaking aspen is conspicuous. The engineen spruce (Picea engelmanii) subalpine fir (Abies lasiocarpa) and a great many of the lower altitude trees such as yellow pine, white fir and douglas fir are found.

On the meadows are many grasses such as Stipa columbiana, Comata intermedia, Thleum alpinum, Agrostis hiemalis, Poa pratensis and a great many herbs as the Colorado rub er plant (Actinea richardsoni) silver sinkfoil (Argentina anserina) an orchid (Obidium romanzoffianum) four species of wild buckwheat, delphiniums (Delphinium nelsonii and D. menziesii), several buttercups and wild geraniums.

Comparison of Environmental Factors of the Zones.

It is a well known fact that climate varies with altitude and that plant distribution is determined largely by climatic conditions. Therefore a quantitative study of climatic factors in the different life zones explains in part the distribution of plants. Such a study was made on the Kaibab Plateau during the summer of 1929.

A weather station was set up in each zone, on open places in the woodlands. A maximum-minimum registering the rmoneter was placed 36 inches above the ground and enclosed in a wooden box open below and on the shady side se that the direct Pays of the sun did not strike the thermometer. Livingston atmometer cups were also placed 36 inches above the ground. They were fitted up with rain correction valves made by placing a drop of mercury between two small tufts of glass wool in the glass tube. The instruments were enclosed in a wire fence. It was possible to take readings of the atmometer ever a period of three weeks only. The averages of maximum and minimum air temperature readings, taken throughout the summer are shown in figure II.

Soil samples for soil moisture determinations were taken so that conditions for both dry and rainy seasons could be observed. The rainy season began about the 10th of July in the Canadian Zone and about the 18th of July in the Transition and Upper Sonoran Zones. The rains continued until the last of August. Soil samples were taken June 17th and 23rd, July 8th, 15th and 22nd, August 7th and September 2nd. Samples were taken 3 inches and 12 inches below the surface of the ground. Determinations of percentage water content were made at the Desert Botanical Laboratory, Tucson, Arizona. The results are shown in figure III.

Results

Evaporation

The environmental data show that evaporation in the Upper Sonoran Zone is much greater than in the Transition Zone. Evaporation in the Transition is greater than that in the Canadian Zone. The same degree of difference occurs in the air temperature of the different zones, there being a much higher maximum and minimum in the Upper Senoran than in the Transition Zone and both Upper Sonoran and Transition Zones are warmer than the * A few Ph determinations (using the colorimetric method) were made in the different zones. They show that soil conditions are alkaline in the Upper Schoran Zone and verge more toward the acid condition in the Transition and Canadian Zone. This would be expected from the fact that the substratum is made up largely of limestone, and that there is less humus in the soil of the Upper Sonoran than in that of the other two zones. In all cases the subsoil is more alkaline than the surface soil, probably because of leaching and the presence of humus in the surface soil. This difference is most striking in the Upper Sonoran Zone.

Soil Moisture

The soil moisture determination shows that conditions are more uniform in the Canadian Zone than in the other zones. The soil wis more moist during the dry season, and less moist during the rainy season than it is at lower elevations. There is also less difference between the moisture content of the surface and the subsoil. In the Canadian Zone, during the dry season, the subsoil is more moist than the surface soil while in the rainy season the surface soil is the more moist. In the other zones the subsoil is more moist throughout the time the observations were made. Apparently the surface soil of the lower elevations is more pervious than it is in the Canadian Zone.





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FOSSIL MOUNTAIN

By Park Naturalist Edwin D. McKee

One of the most aptly named buttes in the Grand Canyon is the one to the west of Havasupai Point known as Fossil Mountain. The upper part of this pointed knoll which stams not far from the Canyon rim is formed of Kaibab Limestone and is literally covere? with sea shells and other fossils.

Fossil Mountain appears to have been sliced through the middle and had its east side entirely removed. Only by the long ridge and more gentle slope to the south may it be easily climbed, but by following this route an interesting trip is experienced. As one approaches the summit of the hill, ledge after ledge of sandy limestone is encountered, and beautifully preserved specimens of various forms of sea life are seen in practically every one of . these. Even the ground is covered with shells which have been weathered from the rock and these, according to one visitor, can be gathered by the bushel.

Most of the fossils at Fossil Mountain have been petrified - replaced by the mineral quartz in various forms. In some cases, however, probably due to recent rapid erosion of this hill, seashells have been uncovered which are still composed of their original shell meterial. In two cases at least, moreover, shells have been found in which their color markings are preserved. This feature is of such unusual occurrence that it is well worthy of record, especially since the shells involved are those of long extinct animals. The species referred to were both of the genus Chonetes. They retained a beautiful pale pink color. Whether or not this was their original color it is impossible to say. but from the condition of these shells and the rocks which contained them this seems probable.

Choneles

Not only the wast number of sea animals, but also the variety of types represented at Fossil Mountain is of exceptional interest. A person need not be a paleontologist or zoologist to notice that many different species were associated there. In a single afternoon recently, Ranger Soper and the writer collected from this place over 30 distinct species of seashells, as swell as numerous corals, sponges bryozoans, and sea lilies (crinoids).



By far the most abundant and conspicuous of the shells found on Fossil Mountain, and indeed in the Kaibab Limestone as a whole, are those of the genus Productus. Of this group six species are represented. Productus occidentalis All of these are rotund in shape, and characterized by many spines and ribs and by a deep central depression of the upper shell which runs parallel to its ribs

and divides the shell into two equal parts. Mony of the Producti are of large size, one specimen found on Fossil Mountain measuring three inches across. The spines were probably used for anchorage.

Although the Productus was rare in Devonian time - the Age of Fishes the genus became exceedingly prolific during the succeeding periods (the Carboniferous and Permian) which are represented at Grand Canyon by the Red Wall and Kaibab Limestone. This tends to show that conditions must have been ideal for such forms of life at that time. Before the close of the Permian period, however, that genus became extinct all over the world. The discovery of a Productus in rocks is therefore generally considered good evidence that they are of Carboniferous or Permian Age. Many wonder Acoductus iresi why a form of life which was so abundant and widespread, later became extinct. The exact reason is impossible to give. Perhaps they had outlived their usefulness and other forms more adapted to the changing conditions at that

usefulness and other forms more adapted to the changing conditions at that time took their place. Some suggest that other animals preyed upon them to the point of extinction. At any rate, all over the world the Permian : : sediments which are represented in Grand Canyon by the Kaibab Limestone, contain the last record of their losing struggle for existence.

Invertebrate Fauna Collected at Fossil Mountain

Derbya mullistriata Productus eccidentalis Productus ivesti Productus subhorridus Productus irginae Composita subtilita Meekella pyramidalis Chonetes aff. hillianus Dielasna sp. Lophophyllum Allerisma capax Squamularia sp. Spiriferina sp. Schizodus sp. Deltopectin sp. Aviculipecten sp. (2 species) Acanthopecten coloradensis? Rhynchonella sp.? Sponge Pugnax osagensis? Camarophoria sp.? Fenestella sp. Septopora Stenopora Polypora Several others not identified.

PRELIMINARY REPORT ON THE GERMINATION OF NATIVE WILD FLOWER SEEDS

By Ranger-naturalist Pauline Mead

An experiment on germination of wild flower seeds is being conducted at Grand Canyon in order to obtain information as to the behavior of native wild flower seeds when placed under germinating conditions. This information will be of considerable assistance in the spring in making wild flower gardens. It is proposed to treat seeds in various ways before planting them, such as soaking them in water, treating them with acid to dissolve the hard seed coats, subjecting them to heat to increase water absorption etc. The seedlings will then be transplanted to a hot bed and grown under several different conditions of soil and moisture.

The results so far are from a set of seeds grown under conditions made as normal as possible. On December 11, 19 species of seeds, in most cases 100 seeds each, were planted in a light sandy loam in the greenhouse. They were covered with soil from 1/8 to 1/16 of an inch thick and watered daily The seeds that germinated best in the experiment so far were, first the prickly aster, second the apache plume and third the globe mallow. Pink pentstemon, scarlet buglar and cliff rose lead among the seeds that are slow in germinating. Seeds of Indian paint brush, vine figwort and geranium have not yet germinated. One of the two Pentstemon glaber seedlings started to grow but died in a few days.

The results observed December :	26 ere as	follows:	
Nu	mber of	Number seed-	
Name of Plant seed	s planted	lings above	% Germination
	,	ground	
Sulphur Flower (Eriogonum stellatum	30	1	3 1/3%
Western Virgin's-bower (Clematis			
ligusticifolia	100	2	2%
Mountain Mahogany (Cercoacarpus			1
montanus)	20	2	10
Cliff Rose (Cowania stansburiana)	100	3	3%
Apache Plume (Fallagia paridoxa)	100	1	1%
Cat's-claw (Acacia greggii)	5	1	20%
Cranesbill (Geranium incisum)	3	0	0%
New Mexican Locust (Robinia new-			
mexicana)	50	1	2%
Trefoil (Lotus wrightii)	10	3	30%
Blue Bonnet (Lupinus barbiger)	4	3	75%
Globe Mallow (Sphaeralcea margin-			
ata)	100	9	9%
Creeping Penstemon (Pentstemon			
linarioides)	100	. 2	2%
Tall Blue Pentstemon (Pentstemon			
glaber)	100	2	2%
Pink Pentstemon (Pentstemon palmeri)	100	3	3%
Scarlet Buglar (Pentstemon torrevi)	100	3	3%
Red Pentstemon (Pentstemon bridgesij) 100	1 .	1%
Indian Paint Brush (Castilleja linar	-		
iaefolia)	190	0	0
Vine Figwort (Maurandia antirrhini-	-		
flora)	100	0	0
Prickly Aster (Macharenthera angusti	-		
flora)	100	18	18%

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On the 24th and 25th of December large cakes of ice were observed floating down the Colorado River. The cakes were so large that they could easily be seen from the rim of the Canyon. At times, the stretch of river just above Hermit Rapids was almost completely blocked by the floes.