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ON THE ECOLOGY OF THE VALLEY OF LA QUEMADA

The area from which all the pollen samples were collected is a subtropical steppe region, but rather high in elevation. Almost all its rainfall is derived from orographic storms of the Mexican Monsoon---certainly it is a rare year when the crops are not completely dependent upon this phenomenon for their maintenance. Temperatures are generally mild, with summer (July) normal temperature in the 80-90° F range, and winter temperatures rarely reaching the freezing point.

There are four fairly distinct vegetation subdivisions in this area, and the same subdivisions appear--from my limited observations--to hold true as far north as Zacatecas and west to Jerez, so they probably hold true over a relatively large region.

The first of these, and the only one which does not grade into the others, is the set of riparian communities. Whether the stream is permanent or intermittent seems to make very little difference in the vegetation associated with it, indicating that it is only during the monsoon season that the stream waters are important--even for the riparian plants. I am here considering only two or three geographical loci as included in riparian: the sometimes narrow, sometimes broad, bed of the stream; sand and gravel bars occurring on that bed; and the elevated floodplain above that bed. The floodplain, however, is restricted only to that area which does flood when the waters are high as indicated by silt deposits on its surface and the character of its vegetation.

The stream beds are invariably devoid of vegetation wherever I have seen them, except for algal deposits on cobbles over which the stream continuously flows. On the margins of the stream bed, and on low sand and gravel bars on the bed, the dominant plant is Baccharis sp. Where the bars are more than a meter ~~from the~~ high from the base of the stream bed, Baccharis is restricted to the margins of the bar and the interior is a dense mass of amaranthaceous and compositaceous weeds with a little grass.

Where it is not composed of bedrock, the floodplain margin is

usually overgrown by a dense thicket of Baccharis but this does not extend in from the margin more than a meter. The Baccharis seems to do ^{best} ~~be~~ where the sediment is a silt or sandy silt. Continuing back from the floodplain margin one encounters an assemblage of mixed annuals probably similar to those of the sand and gravel bars. It was idfficult for me to tell because the ~~growing~~ season was over on my arrival and most of these plants existed only as dried stalks. Amaranths and rank composites are most in evidence, but there are a number of other herbs (including one whose crushed leaves góve off the smell of anise) and some grass. Some of the floodplain is under cultivation. As one progresses back from the margin of the floodplain, to areas less and less often inundated, one encounters vegetation communitées of the other subdivisions.

The trees of the floodplain are willow, cottonwood and mesquite. Willows exist about 10-30 meters back from the margin of the floodplain but I have only seen old, large, trees. This might be due to browsing by cattle. I have heard the men discussing the amount of wood a willow might yield, so I do not consider it unlikely that a number of willows have been lumbered out--- probably the younger, straighter, trees. Mesquite is not common as a floodplain tree, though this might be due to the demand for mesquite as firewood. Some do exist above the floodplain---from what I can observe they are more common away from the streams than near the streams. All the cottonwoods I have observed seem to have been planted as ornamentals along the permanant drainages during the days of the estancias. Nopal cactus is not unusual on the floodplain but only where bedrock, conglomerate gravel or hardpan lies within a foot of the surface.

The second subdivision consists of the agricultural fields. Taking the area from Zacatecas to La Quemada and west to Jerez, these occur in all kinds of conditions from newly plowed and nearly devoid of vegetation to long abandoned and nearly devoid of traces of former cultivation. From what I am able to discover, the fields are usually plowed just before the rainy season begins. After the first rains the corn is planted and squash is put into the same field. Far fewer fields are

put to beans, and I have been unable to determine that crop rotation is practised. The fields are apparently not systematically cultivated with the plow on the theory (known or simply implicit) that the fast-growing maize will shade out its competition. This year, however, the rains did not come at the proper time to keep the young maize plants vigorous and the amount of amaranthaceous and compositaceous weeds in the fields is amazing. About the only way to tell which fields are this year's, now that the corn stalks have been cut, is from the greater or lesser quantity of grass and the occasional ripening squashes. In other respects they look like those which have been fallow for a year or two.

Fallow fields of the first year or two are thickly overgrown with summer annuals, but grass is a quick invader and efficient competitor. The site of Presa de Ambosco is located in a field reported to have been last cultivated about 10 years ago and it is almost solid short grassland. Hardy compositaceous biennials or shrubs seem able to withstand the grass competition in still disturbed locales (e.g. on the margins of anthills), or where the soil mantle is thin or the slope promotes a lot of sheet erosion.

The site of Puente Viejo is in an abandoned field, but apparently not abandoned more than a couple of years since I did see a couple of maize stalks there from this year's growing season and the furrows are still quite deep. Much of this field is in tall grass (knee to waist high) mixed with comps and amaranths and much is in dense comp thicket. Digging revealed a thick loess-silt mantle, much disturbed by plow, above ~~an~~ a sandy gravel in part of the test pit and above an indurated silt in another part. Puente Viejo seems to be located on an ancient, filled, channel of the nearby Arroyo Coyote and very likely the site and the abandoned field in which it is located are subject to anomalous cover because of anomalous soil conditions. In any case, it is quite obvious that most of the cornfields are located in natural grassland, and when abandoned this community is re-established relatively quickly.

The third subdivision is the grassland itself. I have observed both tall and short grassland, almost pure in the season I was there but probably well

mixed with annual forbes during the spring and summer. The two types may be ~~xxxxxxdxxxxxxnfxixnxxxxxxyhxxxxxxdxxxx~~ due to soil conditions or they may be successional stages, or both. In all of the really old abandoned fields, or in the areas not now and apparantly never cultivated (as in the rooms at Chicomostoc or around the site of Paloverde) the grass is very short, only 1 1/2 to 2 1/2 cm tall. Grazing, of course, may play a role.

The fourth subdivision is a catch-all category for the Nopal cactus community, the mixed Nopal-Huizache, Nopal-Mesquite, Huizache and Huizache-Huiscolote communities. Nopal is a *Opuntia*. It grows to 7 or 9 feet and attains quite a barked, woody, stem with age. Judging by the differences in color and flavor of the fruits there are a number of varieties; the men distinguish over 10 different types of Nopal on the basis of the flavor and texture of the fruits (tunas). Huizache is a sparse small tree which achieves a flat crown with maturity. It rarely grows over 9 feet tall and has its leaves nearly sessile on the branches. Where growing as a sparse savanna one is reminded of the savanna communities of the African steppe. Huiscolote is another thorny leguminous plant, but is a many stemmed shrub. It is rarely over 4 feet tall and has much the general appearance of acacia in its brushy habit.

It is clear that all of these plants are variously adapted to conditions effectively too arid for pure grassland for one reason or another. The almost pure Nopal communities are to be found on very rocky slopes where there is too little soil to support any other dominant. This grades into mixed nopal-huizache communities where there is a lot of rock but some soil accumulation as well, and at Paloverde we see this as nopal thickets mixed with huizache separated by more or less large stretches of short grassland. The nopal-huizache thickets are growing on the ruins of ancient habitations where there is a combination of a lot of rock and a very loose, porous, sediment. Some of these thickets are pure nopal. As one leaves the main habitation area one comes across more and more huizache mixed in, then the nopal and huizache thin out and occur in more scattered clumps.

Nopal-Mesquite thickets are noted for the Presa de Ambosco area, where there is a lot of rock at the surface and the slope promotes much sheet wash. This seems to be a wetter expression of the more common nopal-huizache community.

Huizache occurs as the dominant without nopal in a number of areas, as on the margin of the Paloverde area. In such locales, however, one usually finds huiscolote mixed with huizache on the grassland margin. Pure stands of huiscolote occur rarely, and where I have seen them they occur as a buffer zone between grassland and huizache or huizache-nopal.

In summary, there seems to be one special ecological conditions--the riparian one--and one grading ecological conditon. In the latter, one can think of the nopal cactus being the extreme on the dry side, the pure grassland being the extreme on the wet side, and and weedy flora of the cultivated fields being the extreme on the disturbed side. Grading from most to least effectively arid are: Nopal, huizache, huiscolote, mesquite, grass. Grading from most to least disturbed are: amaranth-compositae, compositae-huiscolote, compositae-grass, grass.

By effectively arid, I clump conditøons where: the soil is porous; there is little soil above bedrock; the soil mantle is thick but there is much rock due to natural or human deposition.

While I have observed short grass with wide-spaced huizache or nopal-huizache thickets where the soil mantle is thin, I have never observed nopal, huizache or huiscolote doing well where a thick soil mantle without rock is evident. Admittedly, almost any area where there is a thick soil mantle without rock is under cultivation, and one cannot discount the possibility of removal of huizache and huiscolote for firewood. There does seem reason to suspect, when the area is observed, that the nopal, huizache and huiscolote are limited to the thin soils and effectively arid places, while the area is basically a natural grassland and the ~~grass~~ grass can even compete well enough against the huizache-

huiscolote to invade the thin soil areas and become well established there.

An interesting photograph was shown us by Sr. Sescosse taken from the site of Chicomostoc in 1874 looking south to La Quemada. Very little of the land was in cultivation then, by comparison, and seems to have been in grass at that time. It is obvious that nopal has made great headway in this past 90 years, whether due to an increased aridity or to land disturbance creating mre effectively arid habitat I cannot say.

NOTES ON THE ALLUVIAL GEOLOGY

The area I have become familiar with is that south of Chicomostoc to the junction of Arroyos Trujillo and Coyote, west to Puente Viejo and east to the Rio Mal Paso. I do not consider myself an expert on alluvial geology, but since the matter of soil deposition relates directly to the pollen problem I shall here express my views and the evidence for them.

The drainages I have observed tend to run at present on bedrock, on an indurated cobble-gravel deposit, or on indurated hardpan. The distribution of these beds has no doubt ~~xxx~~ limited the width and depth of the drainage net in the past as it is doing today. Above these beds, along the drainages named, is what appears to be a single silt unit, sometimes as thick as 3 or 4 meters (as below site # 40), sometimes only a few inches thick.

This may be contrasted with an area north of the village of Colonia, where an arroyo profile shows a very thick deposit above hardpan consisting of a number of successive sand-gravel and clay lenses. This profile should have been collected for pollen analysis, but there was no time.

In excavating the causeway on the east side of the studied area, the hardpan recovered at the base of this structure was a whitish, indurated, material locally called terra monte. In excavating at Potrero Nuevo, Presa de Ambosco and El Constantido, the hardpan recovered at the base of the occupation level was a red indurated material, locally called tepetate.

The arroyo that runs beside the highway just south of the Chicomostoc crossroads contains two indurated beds below a superficial cap of silt: the upper one is whitish and appears much like terra monte, the lower is red and appears much like tepetate (except that tepetate is sometimes gravelly and this bed is not).

I think that the red indurated sediment is derived from the parent rock of the region and the terra mote further derived from it. In the western part of the

THE POLLEN PROBLEM

All of the pollen samples were collected with an eye toward the resolution of a specific problem. This problem is not a usual one, in palynological terms, and so the pollen analyst who approaches the processing and interpretation of these samples must modify his usual outlook and orientation. The concern here is not with the construction of a pollen chronology or with the reconstruction of prior vegetation communities per se. The question to be resolved is the qualitative difference in environmental conditions existing at the time of aboriginal occupation and at present.

At the time of the entrada of the Spanish to the area, in the mid 16th century, the region was not inhabited by the people who had constructed the main site of Chicomostoc or its surrounding villages---the sites sampled for pollen analysis. The archaeologist is primarily concerned with finding out when these sites were inhabited, for how long, why they were built where they were, and why they were abandoned before the 16th century. The absolute date of occupation is not the palynologist's real concern, though a rough date probably can be given by comparison with the Southwestern USA pollen record. The major question asked of the pollen analyst is: was the vegetation pattern at the time these sites were occupied sufficiently different from that of the present to indicate that a different environmental pattern served as a raison d'être for their existence. Also, did major vegetation changes occur before and after occupation which might be interpreted as causal factors in the abandonment of the region by agriculturalists.

The pollen data will have to be gathered with an eye toward the problem of agricultural potential. The modern pollen samples should be method is just barely economically practical. The fossil samples may show a similar condition, a wetter one, or a dryer one, but I doubt that there will be too much variation in species composition between the modern and fossil samples.

If the pollen record of the period of occupation appears to indicate a conditionn wetter than present, or drier than present, the pollen analyst must be prepared to be able to evalnaae the possibility that irrigation was being practised. There is no direct archaeological evidence for irrigation in the form of canals, but there are archaeolgical data which might well be interpreted as representative of knowhedge of measures of water control: the villages are all located close to permanent water resources and none are located close to intermittant water resources; there are terraces on hill shopes, apparantly designed to slow down runoff; some engineering practises in the causeways indicate that the erosive power of rushing water was comprehended and measures were taken to prevent its acting to destroy the causeways.

POLLEN SAMPLE INVENTORY

Potrero Nuevo	13 samples
Presa de Ambosco	2 "
El Constantido	6 "
Paloverde	8 "
Loma San Anbonio	23
Chicomostoc	13 "
Modern Surface	17
TOTAL	82 samples

MODERN SURFACE POLLEN SAMPLE COLLECTION

All samples were collected by the "pinch" technique, wherein a series of no less than 10 or more than 20 small samples of sediment are collected from the surface of an area about 25 or 30 meters on a side. An attempt was made to gather sediment that appeared to have been deposited in the past season, as in the furrows of a plowed field.

- Sample A: Collected from Cornfield at Potrero Nuevo. Weedy growth of Composites and amaranths most obvious. Corn from this year's crop cut.
- Sample B: On east slope of Matta Granda Mesita due W of Chicomostoc. Contact of fairly pure grassland and nopal-huizache community.
- Sample C: Below Rancho Junta del Refugio on W floodplain of Arroyo Coyote. Mostly grassy area near edge of Nopal thicket.
- Sample D: Same area as C, but collected from this year's sand and silt deposit in the arroyo. Near Baccharis communities of the sand bars and arroyo edges.
- Sample E: On site #10 of Porter's field notes of Nov. 6. Site #40 of the site survey. Mixed Nopal and huiscolote near grassland margin.
- Sample F: ~~Main~~ Undisturbed area is Hall of Columns, Chicomostoc. Short grass dominant, weeds (mostly Comps) in disturbed areas of this building.
- Sample G: Nopal forest below Chicomostoc near road. Some Compositaceous shrub growth, but mostly bare ground between nopal thickets. Some grass.
- Sample H: Riverlain silt under Baccharis clumps at point on Rio Mal Paso E of Paloverde. Near willows. A large sandbar 50 M away has good growth of cheno-ams and comps.
- Sample I: Riverbank community; willows and mixed cheno-ams, Baccharis, Comps.
- Sample J: Floodplain cornfield on the bank of Rio Mal Paso. Samples H, I, J in same general area.
- Sample K: At Paloverde. Nopal clumps about 5-10 M apart with very short grassland between. Scattered huizache, grazed.
- Sample L: At Paloverde. As sample K, but Nopal clumps 20-50 M apart. Grazed.
- Sample M: At Puente Viejo. Abandoned cornfield, now overgrown with grass, mostly. Amaranth and Compositaceous weeds also doing well.
- Sample N: At Loma San Antonio. Rocky slope with Nopal-grass mixture as well as annual and perennial comps.

- Sample O: At La Majada. Nopal-Mesquite association on the margin of a grassy area.
- Sample P: At Presa de Ambosco. On nopal-mesquite edge where grass (short) and comps predominate with a few huiscolote.
- Sample Q: Cornfield at El Constantido. This year's field with plenty of weeds.