Some Forest-Soil Relationships

Contributions to the Ecology of the Big Bend Area of Washington:

II. Indicator Significance of the Natural Plant Communities in the Region of the Grand Coulee Irrigation Project

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Conservation may be defined as the management of natural resources to give the maximum number of people the fullest benefits of every resource. Such an objective obviously necessitates a thorough understanding of these resources in order to plan their utilization in accordance with their potentialities. Improper administration of a resource may not only result in wasted investment, but the value of the resource itself may be greatly impaired, such as has been the case with the soils of the Dust Bowl area of the Great Plains.

The few undeveloped areas which still remain in the United States and its possessions offer a challenge to the abilities of man to practice what conservation principles he has learned by his past mistakes. The irrigation project which is being developed in the Big Bend area in Washington presents just such an opportunity.

Superficially it appears that we have a fairly level desert area which needs only water to convert it into a uniformly valuable agricultural region. Apparently all that is needed is to grid the area into tracts of 40 acres as is now planned, supply irrigation water, and let the success of the project rest entirely upon the diligence of the farmers. But nature has not endowed this area with uniform soil conditions, and farmers who settle tracts of good soil will prosper while their nabors may have a difficult time of finding subsistence on a tract of equal size and with the same amount of irrigation water. The question immediately arises as to whether or not there is some way of evaluating different tracts, some method of distinguishing those so relatively unsuited to agriculture that they will demand special preparation, and predicting which are suited to one group of crops and which to another. There is a practical answer to this question, and it is contained in the natural vegetation.

To the layman desert vegetation appears monotonous and perhaps confused, but the trained ecologist sees in the same region a pattern of communities each of which has its own very distinct environmental relations.

Nature has long been at work with plant life. It is probably safe to say that every square yard of soil surface in eastern Washington has at some time received at least one seed of practically every plant in this region. Therefore the fact that the vegetation is not uniform throughout this region cannot be due to all species not having had equal opportunity to migrate into every part of it, the heterogeneity must be attributed to a corresponding heterogeneity in environment which has allowed only certain plants to survive in each type of habitat. In the course of time the net effect of this selective action of the environmental variation is to produce more or less distinct plant communities on different habitat types. Wherever the same environmental complex is met, the same plant community is repeated. Wherever sand or alkali soils occur, their characteristic plant

communities are repeated. Such plant communities, developed through long periods of vegetational adjustment, clearly reflect the nature of the soils in the Big Bend region. Consequently, when the communities* are defined, and their indicator significance is worked out, we have a botanical yardstick to evaluate the characteristics of the soil in terms of plant growth. A fact which makes this practice especially applicable in Washington is that the natural vegetation has not yet been so greatly disturbed but that the area originally covered by each of the major plant communities can usually be recognized in the field.

Prior to the survey undertaken by the writer, no attempt had previously been made to classify and evaluate the indicator significance of the natural plant communities in the region of the Grand Coulee Irrigation Project, although good use has been made of this principle in other parts of the country. All parts of the Big Bend area have been studied in order to arrive at a classification of the natural plant communities, and to ascertain their soil characteristics.

All of the natural plant communities of any significance in this connection may be classified under one of the following five types:

I. Saltgrass Type.
II. Greasewood Type.
III. Hop-sage Type.
IV. Sagebrush Type.
V. Rabbitbrush Type.

I. Saltgrass Type. Nearly pure stands of saltgrass **(Distichlis stricta)** are well distributed over the Big Bend country. Wherever this type occurs it indicates (1) a harmful degree of salinity, and (2) a high water table for at least part of the year. The latter characteristic of these soils would signify that some provision for drainage must be made when irrigation water is applied, for such a degree of salinity cannot develop without a basin-like obstruction to drainage below the ground surface. Where drainage is feasible, these soils may be leached free of most of their alkali, and salt-tolerant crops such as sugar beets, clovers, alfalfa, etc., may be grown.

II. Greasewood Type. Soils with only slightly less alkali but with a lower water table are covered with greasewood **(Sarcobatus vermiculatus).** Herbaceous species of Atriplex, saltgrass and other halophytes commonly grow on the ground beneath these shrubs.

The difference between these soils and those covered by saltgrass is one of degree, although the appearance of the plant cover is greatly different. These soils should be more easily flushed to a suitable depth, so that their reclamation may be expected to require less investment.

III. Hop-sage Type. A stand of hopsage **(Grayia spinosa)** indicates definite though mild conditions of alkali. Here the salt content is not high enough to permit the dominance of greasewood, yet is high enough to prevent sagebrush from dominating the areas.

Around alkali basins the vegetation is frequently zoned with a saltgrass area on the wettest and saltiest soil, a zone of greasewood next, followed by hop-sage and then sagebrush. Mixtures of hopsage with sagebrush indicate slightly less alkali, while mixtures of hopsage with greasewood indicate slightly more alkali, than occurs in soils where the hop-sage occurs alone.

IV. Sagebrush Type. Fortunately for agriculture, a high percentage of the soils in the Big Bend country suppor

*The use of **plant communities** as indicators has been proven valid by numerous detailed studies, but the indicator value of **individual** specimens or even species is very doubtful. Furthermore, all statements in this paper refer to the **characteristic** habitats of each community. As in all biotic phenomena, there are exceptions to the rules.

stands of sagebrush **(Artemisia tridentata).** The presence of these can usually be taken to indicate a deep, porous, and fertile soil. This type occurs on soils ranging all the way from loessal silt-loams to alluvial gravel-loams.

On alluvial sandy soils sagebrush is frequently accompanied by bitterbrush **(Purshia tridentata).** The fertile orchard soils of the Wenatchee region appear to have been developed from such land, and similar alluvial terraces such as those near Pasco may be expected to have equal potentialities when they get water.

In certain localities the sagebrush country has been burned over to improve the grazing conditions. In such cases the appearance of charred stumps, seedlings, or the recollections of old residents may be used to ascertain the boundaries of the original stands.

V. Rabbitbrush Type. The most complex vegetation in the Big Bend area is that of the glacio-fluvial deposits and their dune derivatives. Clearly, in all the vegetation of the sandy soils, rabbitbrush **(Chrysothamnus nauseosus** and **C. viscidiflorus)** is the most ubiquitous. On the peculiar blackish dune sands just west of Neppel, bitterbrush is associated with rabbitbrush. Here and elsewhere there are occasional stands of needlegrass **(Stipa comata)** and Indian ricegrass **(Oryzopsis hymenoides).** All of these communities indicate sandy soil, but the differences in the environment which determine the dominance of one species or another are not evident. It is altogether quite possible that these variations in vegetation of the sandy soils reflects past disturbances rather than variation in soil.

Under cultivation all of these soils are susceptible to blowing, especially in winter, but if they are kept moist by irrigation, or covered with crops, or protected by windbreaks they will probably not be a hazard from this standpoint.

Good orchards have been maintained in the irrigated Yakima region on such sandy soils, in spite of their tendency to be infertile. It may prove that the application of fertilizer will yield economic return, especially after the first few years of cropping these soils. Most certainly these soils will have to be irrigated with the greatest care to prevent the leaching of fertility below the depth of plant roots.

In Conclusion.

Native vegetation represents the final outcome of the operation of ecologic factors which have influenced plants throughout centuries, and which are operating today not only on the remnants of the original flora, but on our crop plants as well. It seems clear that distinct vegetational differences are correlated with important soil variations in the Big Bend area, and consequently the various types of vegetation constitute a biologic measuring stick of every acre of soil. Different soil types require different preparations of the land, different amounts and methods of application of water, and will be more suited to certain crops than to others. The development of virgin land into irrigated farms is an expensive process, and we should take advantage of every bit of knowledge to insure the success of the operation.

Five key types of vegetation are designated and their indicator value discussed. It is recommended on a basis of this survey that as the area to be irrigated is divided into tracts, a map of the vegetation of each tract be sketched and kept on record. Such maps can be made by non-technical assistants after they are taught to recognize the important indicator types, and they should prove of very material value to anyone interested in getting the most good out of his land from the very start.