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

## Forage Resources of the Scabland Prairies and the Effects of Grazing Upon Them.

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For the past few years we have been interested spectators of a major land development project here in the Northwest, the Grand Coulee Dam. We are told that when this gigantic structure is put into operation a region which is now a sparsely populated desert will be turned into fertile agricultural land which will support a great many more people.

With the farms limited to 40 acres per person, as now planned for the region to be irrigated, correct utilization of each tract will be necessary if the owner is to make a living off his land. The desert vegetation in this area is not uniform in composition, and since these plant communities are the result of centuries of adjustment to climate and soil, we may wel lexpect fundamental diversity in the soils occupied by each vegetation type. Studies elsewhere in the arid and semiarid portions of the United States have shown that the original vegetation types provide the most reliable indicator of crop potentialities (Kearney, 1914; Kelley, 1922; Shantz, 1911; Shantz and Piemeisel, 1924). Such studies have never been made in Washington, nor are the specific results of the studies made elsewhere applicable here.

The development of the Washington irrigation project, in contrast to the misguided history of the "dust bowl" of the Middle West, promises to follow a course dictated by the findings of scientific research. These findings must be the synthetic product of specialists: ecologists, soil scientists, agronomists, engineers, etc.

The first type of research needed of the ecologist consists of a definition of the vegetation types, and a study of their dynamic interrelationships and general ecology. Such a study will be significant only if based on a larger area than the irrigated lands alone; it should include the entire Big Bend country. The writer has begun this preliminary study, and has gained considerable data along this line.

A second phase which follows logically in order will be a series of soil investigations by either the ecologist or the soil scientist. When we have determined the range of soil conditions which each plant-cover type indicates, we will have a guide to the crop potentialities of the various regions, and to the type of management which will maintain the soils in their most productive states.

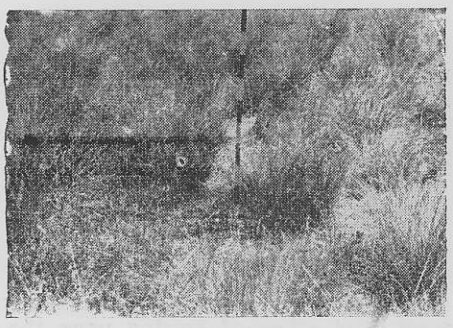
We must extend the horizon of research to include the region surrounding the irrigated lands, for readjustments must also be expected here. For example, as irrigation removes a large part of the desert from its present use as range land, new pressure will fall on the surrounding pasture lands. Outside of the desert there are extensive areas of scablands which can never be used for wheat or for irrigated agriculture, and over much of their extent they will produce considerable forage if handled properly.

Today these scablands are in a sorry condition. So badly have they been overgrazed that no one knows just how much forage such lands are capable of producing under less injurious treatment. The effect of grazing upon the various species, and the inflence of grazing systems upon the vegetation types are matters of unquestionable significance. Studies of these problems have been under way, and sufficient

progress has been made to warrant a preliminary report on the composition of the virgin scabland prairie, and the effects of grazing upon it.

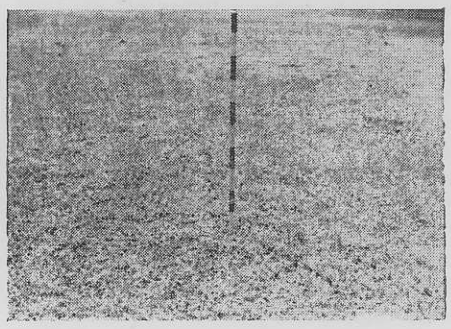
Although remnants of virgin prairie in the scablands of Washington are exceedingly difficult to find today, considerable search has brought to light one such area in Franklin County which is in excellent condition. In the vicinity of this stand there also occur pastures which have been subjected to varying intensities of heavy grazing, and which consequently exhibit several degrees of retrogression. When all these areas are lined up in the proper sequence they give a picture of the vegetational changes brought about by overgrazing, and also show the response of each species to the grazing factor.

In order to grasp the significance of the changes which accompany grazing, it is desirable to know the relative amount of forage produced each year by the various species of the virgin prairie. By clipping each species at the ground line at the time of its maximum seasonal development, the amount of oven-dry matter produced each year has been determined (Table 1.). From this table it is apparent that wheatgrass contributes about 85% of the forage, with bluegrass and cheatgrass contributing about 5% each.



Station 1. An area which was lightly grazed prior to 1911, and which is apparently typical of the association in virgin condition. The dominant Agropyron bunches contribute 85% of the annual forage output in this community, with the smaller interstitial plants of Bromus and Poa each contributing 5%.

Station 2. Heavy grazing has eliminated the smallest Agropyron bunches and reduced the size of those remaining. The ground is developing a cover of small plants, some of which are annuals and some perennials. The stake is marked off into decimeter units.

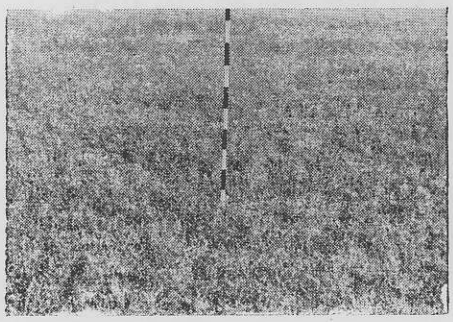


Station 3. Agropyron bunches are eaten back to the ground line so that the short weak shoots which are put forth each year can be distinguished only with close study.

A statistical comparison of three grazed and one virgin areas of grassland was made by the frequency method. In each of the four areas studied a station consisting of 100 frequency plots was laid out. The plots were 2 x 5 dm. in dimensions, and were arranged in five parallel rows one meter apart. Each plot of the 400 was studied at three critical dates (April 7 or 8, April 30 or May 1, and May 21 or 22) which were so timed that the entire vascular flora (part of which is very ephemeral) could be studied.

**TABLE 1.**
**OVEN-DRY WEIGHT OF FORAGE PRODUCED BY VEGETATION IN POUNDS PER ACRE**

| | |
|---|---|
| *Agropyron spicatum* | 6 749 |
| *Poa secunda* | 388 |
| *Bromus tectorum* | 367 |
| *Brodiaea douglassii* | 102 |
| *Antennaria dimorpha* | 76 |
| *Astragalus spauldingii* | 67 |
| *Lithospermum ruderale* | 33 |
| *Plagiobothrys tenellus* | 14 |
| *Achillea lanulosa* | 11 |
| *Plantago purshii* | 10 |
| *Festuca pacifica* | 6 |
| *Erodium cicutarium* | 6 |
| *Sisymbrium longipedicellatum* | 4 |
| *Agoseris glauca* | 3 |
| *Calochortus macrocarpa* | 3 |
| *Madia exigua* | 1 |
| Total | 7,840 |



Station 4. Agropyron is completely eliminated here but the soil is fairly well covered with a community of small unpalatable species which is dominated by the perennial Poa and a group of annual dicots. Apparently a biotic climax. All four pictures were taken on May 21, 1938.

The results of this study are contained in Table 2. According to their responses to the grazing factor, the tabulations show that the plants may be divided into four groups.

Group one includes those species which decrease in frequency as the intensity of grazing increases. This decrease in some if not most cases seems directly due to stock eating the aerial shoots. In perennials, such as Agropyron, the underground organs become weakened due to undernourishment caused by the repeated removal of photosynthetic tissue, and the decline in vigor of such plants is gradual until the plant succumbs. With an annual which is grazed, such as Bromus, the first few years during which the stock feed on the plants so heavily that no seeds are matured spell a rather sudden extinction of these plants from the range.

It is significant from the point of range management that 90%, by dry weight, of the total output of shoots in this Agropyron bunchgrass association is produced by two members of this group of species: Agropyron 85%, and Bromus 5%. The amount of this forage available in the extremely overgrazed range is negligible.

A second group of plants includes a few which seem to be favored by grazing. These plants for the most part are not palatable (except for the basal leaves of Lepidium and Agoseris and small amounts of the young shoots of Cryptanthe), are not seriously injured by trampling, and their shoots can withstand exposure to the full force of drying winds and intense insolation. Apparently these species are kept out of the virgin prairie by competition afforded by the dominants of that community. Most of the plants in this group are small annuals, and members of the borage family are conspicuous among them.

A third group of species is made up of plants which are immediately benefitted by the removal of the competitive influence of the original dominants, but which are not very well adapted to the biotic and aerial factors which accompany the final stages of range deterioration.

The fourth and last category is an assemblage of hardy unpalatable plants whose abundance seems scarcely increased or reduced by the radical changes in environment which are brought about by intense grazing. All were present in the virgin prairie, have

persisted through the period of deterioration, and are among the relatively undesirable species which dominte the overgrazed range.

From the foregoing it is evident that due to the influence of heavy grazing, plant succession leads from the virgin prairie, a wheatgrass-bluegrass-cheatgrass association, to an association dominated by bluegrass and small, annual, dicotyledonous plants. Since Agropyron and Bromus together form 90% of the virgin prairie, any plan of range management which maintains the vegetation in a condition most nearly approximating the virgin state would be most desirable.

Some significant information on this point has been derived from observations of a station in central Whitman County. Here there is a good remnant of near-virgin prairie between the fence and the roadside. Within the fence livestock are permitted to graze in fall and winter, but not in spring and summer. During the growing season, the prairie within the fence assumes an aspect very similar to that outside the fence, and although the cured shoots are eaten to the ground each winter, this system of grazing seems to have very little detrimental effect upon the native prairie whereas spring-fall grazing reduces the forage production tremendously. A desirable grazing system would therefore emphasize fall or winter utilization of cured shoots and minimize spring use of the range.

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## LITERATURE CITED

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TABLE 2. FREQUENCY OF PLANTS AS AFFECTED BY GRAZING

| Behavior under influence of heavy grazing | SPECIES | FREQUENCY OF OCCURRENCE Climatic Climax | Early Retrogr. | Late Retrogr. | Biotic Climax | Annual (aa) or Perennial (p) |
|---|---|---|---|---|---|---|
| Decreasing in Frequency | *Agropyron spicatum* (Pursh) Scribn. & Smith* | 70% | 53 | 22 | +** | p |
| | *Bromus tectorum* L. | 100 | 3 | 31 | 2 | aa |
| | *Epilobium paniculatum* Nutt. | 58 | 17 | 4 | | aa |
| | *Agoseris heterophylla* (Nutt.) Greene | 16 | 9 | 9 | 10 | p |
| | *Achillea lanulosa* Nutt. | 6 | 3 | + | + | p |
| | *Calochortus macrocarpus* Dougl. | 4 | | | | p |
| | *Cogswellia macrocarpa* var. *artemisiarum* (Piper) St. J. | 3 | 6 | | | p |
| | *Astragalus spauldingii* Gray | 2 | | | + | p |
| | *Erodium cicutarium* (L.) L'Her. | 1 | + | + | | aa |
| | *Gilia gracilis* Hook. | 1 | | | | aa |
| | *Lagophylla ramosissima* Nutt. | 1 | | | | aa |
| | *Festuca idahoensis* Elmer | + | + | | | p |
| | *Cogswellia triternata* (Pursh) M. E. Jones | + | + | 1 | | p |
| | *Sisymbrium longipedicellatum* Fourn. | 1 | | | | aa |
| | *Lithospermum ruderale* Dougl. | + | | | | p |
| | *Delphinium nelsoni* Greene | | 2 | + | | p |
| Increasing in Frequency | *Plantago purshii* Nutt. | 84 | 100 | 100 | 100 | aa |
| | *Plagiobothrys tenellus* (Nutt.) Gray | 12 | 2 | 28 | 100 | aa |
| | *Cryptanthe flaccida* (Dougl.) Greene | | 53 | 56 | 100 | aa |
| | *Pectocarya penicillata* (H. & A.) A. DC. | | | | 79 | aa |
| | *Lepidium densiflorum* var. *elongatum* (Rydb.) Thell. | | | | 67 | aa |
| | *Lappula redowskii* (Hornem.) Greene | 1 | | | 32 | aa |
| | *Erigeron concinnus* (H. & A.) T. & G. | | | | 30 | p |
| | *Antennaria dimorpha* (Nutt.) T. & G. | + | 3 | 2 | 8 | p |
| | *Agoseris glauca* (Pursh) Steud. | 1 | + | 2 | 6 | p |
| | *Stephanomeria paniculata* Nutt. | | | | 2 | aa |
| Characteristic of Intermediate Stages | *Lithophragma bulbifera* Rydb. | 25 | 98 | 100 | 36 | p |
| | *Festuca pacifcia* Piper | 63 | 100 | 70 | 8 | aa |
| | *Alchemilla occidentalis* Nutt. | | 79 | 69 | | aa |
| | *Sisymbrium altissimum* L. | + | 2 | 61 | 2 | aa |
| | *Cogswellia farinosa* (Geyer) M. E. Jones | + | 27 | 2 | | p |
| | *Madia exigua* (Sm.) Gray | | 32 | | | aa |
| | *Ranunculus glaberrimus* Hook. | | 1 | 2 | | p |
| Frequency Scarcely Affected | *Poa secunda* Presl. | 99 | 100 | 100 | 100 | p |
| | *Draba verna* L. | 100 | 100 | 100 | 100 | aa |
| | *Brodiaea douglasii* Wats. | 21 | | 66 | 23 | p |
| | *mosses* (all Bryales) | 99 | 100 | 100 | 100 | p |

*Includes A. inerme (Scribn. & Smith) Rybd. which is considered by the writer as one form of A. spicatum. All have identical ecology in our region.

**Presence in the community, although not frequent enough to have been included in one of the plots is indicated by a +.