Grassland biome network: Results of first year

by Joan Lynn Arehart

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Tawny grass floating in an indigo sky bowl . . . pungent sage . . . prickly wind rushing the nostrils . . . deserted homestead, covered wagon tracks . . . tepee circles, dinosaur bones. . . . These are remnants of America gone by. They are also what remain of the American prairies. These, the Pawnee National Grasslands between Nunn, Colo., and Cheyenne, Wyo., serve as headquarters for one of the more ambitious ecological undertakings in the United States today—the grassland biome studies of the International Biological Program (IBP).

What the grassland biome projects boil down to, essentially, is a scientific appraisal of the interactions of weather, soil, plants and animals on 10 grassland sites in Montana, North Dakota, South Dakota, Colorado, Utah, New Mexico, Texas, Oklahoma, Kansas and California. Preliminary results from the Colorado Pawnee Site, headed by executive director George Van Dyne, were available in the summer of 1970 (SN: 9/5/70, p. 204). First-year data from all the grassland sites, however, were presented for the first time in September at the annual meeting of the American Institute of Biological Sciences in Fort Collins, Colo.

The wealth of data was taken from studies conducted by some 200 scientists at 40 universities, colleges and Federal and private laboratories. A trillion measurements of factors that constitute or influence the American grassland are now being fed into computers so a mathematical model of the grassland ecosystem can be developed. The model will evolve as more information becomes available. New directions for research will be quickly identified and the model will be continually tested to ensure that it corresponds to the real grassland situation. Hypothetical stresses, such as the application of a particular chemical pesticide to the grassland, will then be fed into the computer model to predict what would happen to the grassland if these stresses were applied in real life. Once the model reaches this stage, participating scientists hope it will offer practical application in agricultural and natural resources management.

J. K. Lewis of South Dakota State University was charged with "synthesizing the syntheses" presented at the AIBS conference. His team of systems analysts had been working 12 hours a day for three weeks to compile the mass of data gathered. It will be some time before even a tentative mathematical model of the grassland is drawn up, so the scientists presenting biome data have to subjectively select the findings they consider particularly interesting or surprising. Only after the grassland model is developed will they know for sure how crucial each factor is to the over-all grassland picture. The result, for now, is a compendium of observations and findings whose eventual significance will become clearer as the project continues.

John Reuss of Colorado State University, for example, reported that the retention of soil water varies drastically from grassland to grassland, and that while drier soils could have trouble responding to fertilizers containing trace elements, they might do so under the right land management. Nitrogen from rainfall may be enough to sustain short grasses, Reuss said—an unexpected finding. Paul Risser of the University of Oklahoma found that some 45 factors can affect prairie grasses, although moisture seems to be the most critical. Few plant species grow back after being overgrazed, and those that do are usually not palatable to grazing animals.

George Williams of the University of Denver reported that fixation of carbon dioxide by grassland plants is higher in the morning than anticipated and that the plants turn off CO_2 fixation at noon, probably because they find solar radiation too strong. Donald Jameson, director of the Colorado grassland site, reported that an unexpectedly close relationship was found between a plant's leaf area and its water absorption, and

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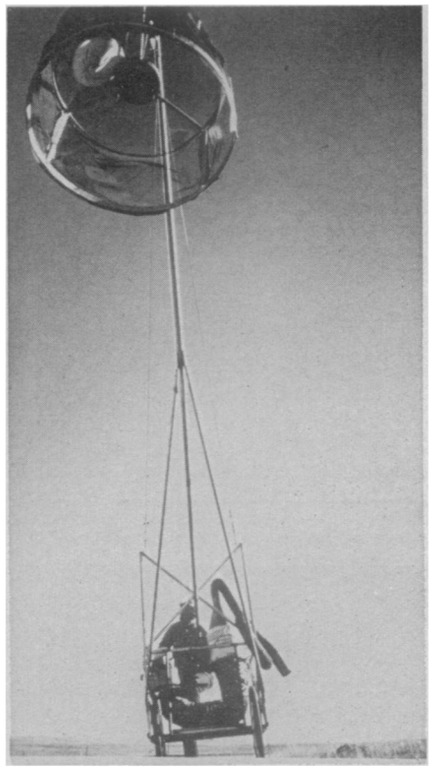
Dietary monitoring of bison. Others wear "diapers" to collect fecal samples.



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Grassland biome insect catcher.

hence its survival. As the wet grassland spring moves to a dry grassland summer, the plants' leaf area and water absorption diminish. Fertilized plants tend to dry out faster. To a point ungrazed plants fare better than grazed ones, but after that point, the grazed plants hold their own better. This survival gradient between grazed and ungrazed plants seems to relate to plant leaf area and water absorption needs.

John Wiens of Oregon State University found that the role of birds on the grassland is minor, compared with their role in the forest; they may live off grassland food and space excesses without especially influencing the total grassland ecosystem.

Larry Harris of Colorado State University reported that the density of small mammal populations on the grassland seems to correlate with annual precipitation, populations tend to double on irrigated plots. Richard Rice of the University of Wyoming said that, contrary to expectations, bison and cattle digestions differ. Microbes in the bison's rumen will digest both its own and cattle's dietary fare; cattle microbes will not return the favor. Inoculating bison microbes into cattle rumen did not help the cattle digest the bison diet. The bison is least selective in his tastes; cows and sheep, somewhat so; antelope, the most selective of all. Cattle will eat more and gain more if grazing grasses are available. The large herbivores seem to play a relatively crucial role in maintaining the energy balance of the grassland.

Preliminary results from the Eastern Deciduous Forest Biome study in Oak Ridge, Tenn., were also presented at the AIBS meeting. Although not the subject of reports to the AIBS conclave, the western coniferous desert and tundra biome projects are also making considerable progress. They are behind the grassland biome network in their research but are a little ahead of the grassland in modeling. Grassland, forest, desert and tundra biomes are also being pursued in other countries. Like the American ones, they got their start under the IBP (SN: 6/29/68, p. 617).

The ultimate aim of all these projects is not just to draw up comprehensive pictures of the various kinds of environments, but to compare data from the various studies. The model of an American forest, for example, might be compared with the model for a tropical rain forest. The greater the exchange of information among biome project scientists, the stronger the basis for making decisions that affect these ecosystems. Frank Blair, the University of Texas ecologist who is chairman of the U.S. Committee for the IBP, believes that the tropical rain forest biome studies could have particularly crucial ramifications for land management in the developing countries.

Whether the biome projects in either the United States or in other countries will continue after the IBP is completed in July 1974 is not now certain. There are indications that the studies will continue because, says Blair, they have proven themselves. IBP representatives from the United States, France and England presented a resolution to the International Council of Scientific Unions in early September to continue the biome studies after IBP ceases. The ICSU has agreed to have its newly established committee, SCOPE (Scientific Committee of Problems of the Environment), examine ways by which the biome projects could continue under SCOPE auspices, or perhaps under a UNESCO umbrella. Any decisions including UNESCO, however, will have to consider UNESCO's biome tack, which will be taken up in Paris around the middle of November. SCOPE will report its recommendations to ICSU in January 1972.

In November the future of the American biomes will be mapped out. Key figures in the decisions will be Frank Blair and Thomas Malone, chairman of the Committee for International Environmental Programs of the National Academy of Sciences. This committee serves, along with other functions, as the American arm of SCOPE.

The continuing success of the biome, of course, will depend on more than international and national approval arrangement. One crucial factor is the continuing cooperation among hundreds of scientists representing several dozen specialties. The biome is a blatantly collective effort, running counter to the traditionally solitary, keenly competitive scientific research approach. For this reason, says Norman French, comprehensive network director of the American Grassland Biome, "We are making a strong effort to recognize the many persons who are contributing biome data either full- or part-time."

No less vital to the future of the biome studies are continuing funds and support from the public. Currently the grassland biome projects are being financed almost entirely by the National Science Foundation, as are the other American biomes. Each biome network has been allotted $2 million for fiscal 1972.

"The criticism NSF officials and we at the grassland biome usually hear about the biomes," Larry Nell, administrative assistant at the grassland biome project, says, "boils down to questions such as, when will we see the practical results of the studies, or, how do the studies benefit me or my constituents? To criticism of this nature I usually reply that the biomes were not designed to bring in quick dollar-and-cent returns such as better crop yields or instant land-managing techniques. Rather, the biomes were designed to probe the overwhelmingly complex variables which make up different kinds of environments, in order to arrive at both a broad and deep understanding of these environments. Such vision is absolutely necessary if we Americans are going to make informed decisions on how to handle our rapidly vanishing natural resources.

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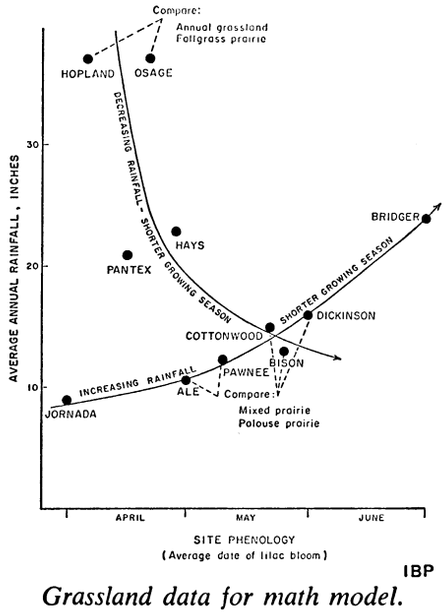

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Grassland data for math model.