and grazing system, to calculate livestock numbers by kind and class of animal based on forage availability and the animal's forage requirements, to evaluate alternate grazing plans, and to maintain accurate, useable records of grazing by pasture and grazing system and by kind and class of animal.

Computer requirements: Apple II, II+, or IIe; 48k; 1 or 2 disk drives; 40 to 80 column screen; printer with parallel interface card.

Availability: Range Management Software, 1216 So. Ridefield, College Station, Texas 77840

Cost: $125

8. Program name: COPLAN
Purpose: To determine animal requirement with range forages and supplements on the basis of dry matter and protein availability, and to determine economic feasibility of range improvements and animal alternatives.

Computer requirement: Written in Standard ASCII FORTRAN IV. Has been used on various mainframes.

Availability: Range Science Dept., Colo. State Univ.; other versions available at other locations. Available to SCS personnel through SCS.

9. Program name: 205 DAY WEANING WEIGHT AND PERFORMANCE ANALYZER
Purpose: To calculate the adjusted 205-day weaning weights and weight ratios for a group of calves and to allow the user to sort the calves by size, sex, and dam.

Availability: Extension Computer Technology Group, Texas A&M University, College Station, TX

Cost $40 plus $25 disk set-up fee ($25 for Texas residents).

10. Program name: BULL GAIN TEST ANALYSIS
Purpose: To assist cattle producers who are in the business of selling breeding bulls to maintain records of some performance measures related to yearling bulls.

Computer requirements: CP/M-80 version 2.2; 56k with microsoft BASIC 5.2.

Availability: Extension Computer Technology Group, Texas A&M University.

Cost: $15 plus $25 disk set-up fee ($10 for Texas residents).

The Grazing Land Simulator

John R. Lacey, Kris M. Havstad, and John R. Amend

Grazing lands have historically been held in low esteem by the general public. This philosophy has been responsible for the inconsistent political policies and inadequate fiscal support that has characterized grazing land management. Consistent policies and adequate funding will not be possible until urban youth, consumers, adult groups, and policy makers recognize the value of the food, fiber, water and recreation provided by grazing lands, and understand some of the basic principles of grazing land management.

It has been difficult to increase the public's understanding of grazing land. The urban population has become proportionately larger than their rural counterpart. Funding to train instructors and develop appropriate educational materials for the urban classroom has been inadequate. More excitement, challenge, and vividness is needed to stimulate the interest of the general public, and to encourage more instructors to teach grazing land management.

As a direct response to this need, a Grazing Lands and People project has been implemented at Montana State University. The key to this educational project has been the development of a Grazing Land Simulator. This effort was made possible by financial support from Cooperative State Research Service, National Cattleman's Association, Cooperative Extension Service, Bureau of Land Management, Bureau of Indian Affairs, US Forest Service, and the Soil Conservation Service.

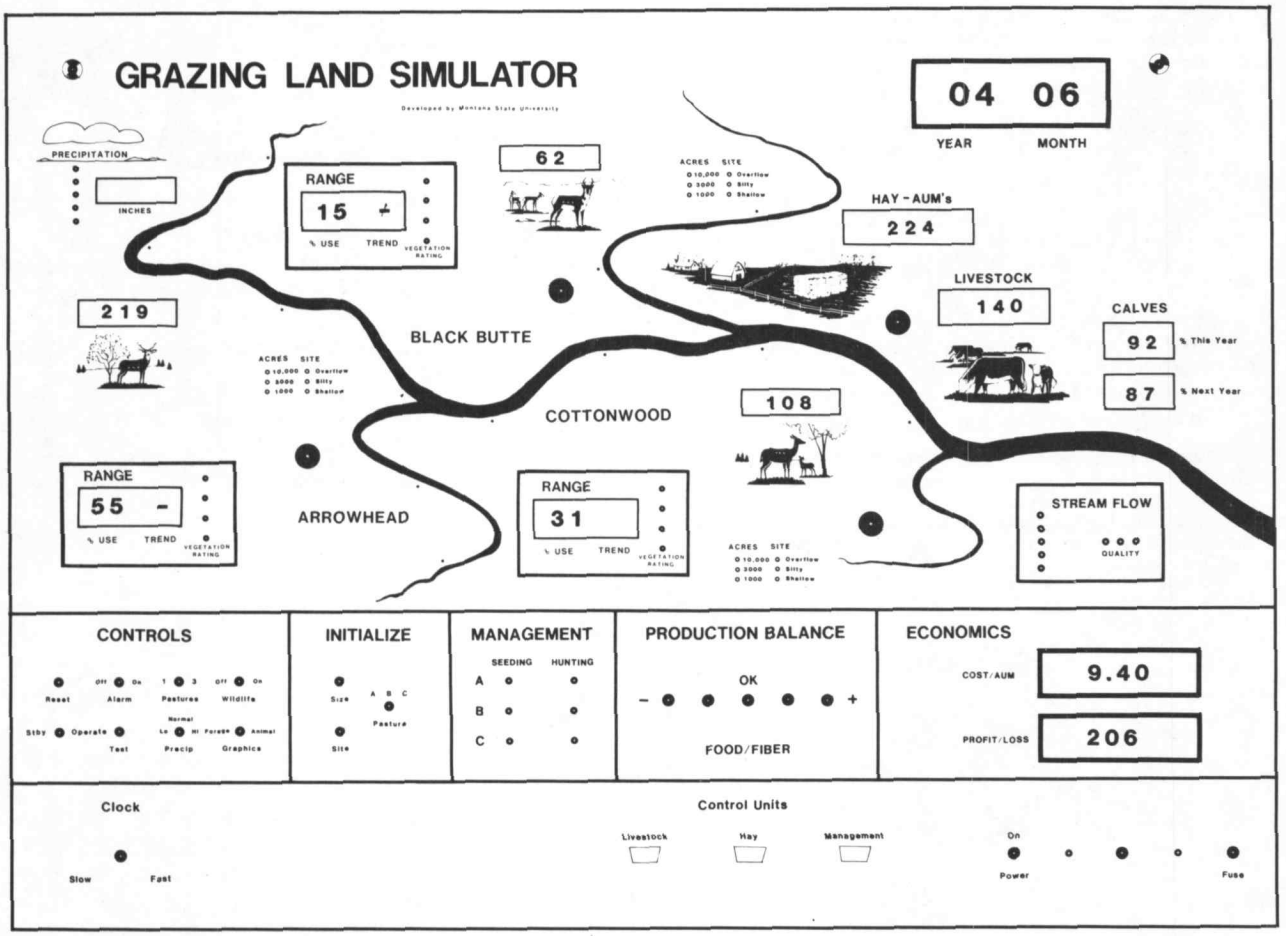
The authors are Extension range management specialist; associate professor, Department of Animal and Range Science; and professor, Chemistry Department, respectively, at Montana State University, Bozeman.

What Is the Grazing Land Simulator?

The simulator is a digital computer that models the ecology of rangeland. Although the present model is programmed with data from southeastern Montana and has a Northern Great Plains flavor, data form other locations can easily be incorporated into the program. Thus, the Grazing Land Simulator has wide applicability.

This simulator differs from standard digital computer simulations in that (1) it has a clock that records the the months and years during a run—each biological event is synchronized with the appropriate passing month (about 8 seconds per month); (2) it presents information on all of its variables simultaneously during the run; and (3) participants may interact with the model at any time by using simple controls to implement their grazing management decisions. It is not an answer-giving machine. It is a problem-causing machine. As the simulator operates, the challenges of managing range, wildlife, and livestock in an environmentally sound manner develop naturally. Participants are confronted with problems, make decisions, and are forced to live with the consequences of their actions.

The front panel of the Grazing Land Simulator depicts a ranch with three pastures—Arrowhead, Black Butte, and Cottonwood. Size and range site for each pasture is set at the beginning of the simulation. Wildlife populations, percent use, range trend, and vegetation rating are influenced by environmental factors and change as the simulator proceeds



The front panel of the Grazing Land Simulator. This version, approximately 18 X 24 inches in size, is mounted in an aluminum suitcase for easy portability and contains two digital computers using approximately 102 K of memory.

through a run. These relationsips can be easily monitored by observing the respective display.

A clock in the upper right corner of the panel shows passage of time in months and years, and a display in the upper left records the amount of annual precipitation. The quantity and quality of run-off water is shown by a downstream display in the lower right, and the balance between food and fiber production and population demand is shown by a balance indicator in the lower center. Animal health and reproductive capability can be monitored by watching the small colored lamps located in the animal's body.

Decisions concerning management of livestock, wildlife, and grazing land are made by participants using small handheld control consoles. The economic impact of these management decisions—cost per animal unit month, project percent calf crop for the current and coming year, and cumulative profit or loss, are displayed on indicators in the lower right. Long-term cause and effect relationships are visible as the simulator plots amount of precipitation, number of animals grazing, and forage production and use on a color graphic display.

Is the Grazing Land Simulator an Effective Tool?

You bet it is! The Grazing Land Simulator was rated the "best program" at the 1983 North Dakota Youth Range Camp. Participants ranged from 14-18 years in age.

The simulator has also proven effective with urban sixth graders. Their perception of the simulator as a teaching tool is reflected in the following note:

Dear Mr. Lacey,

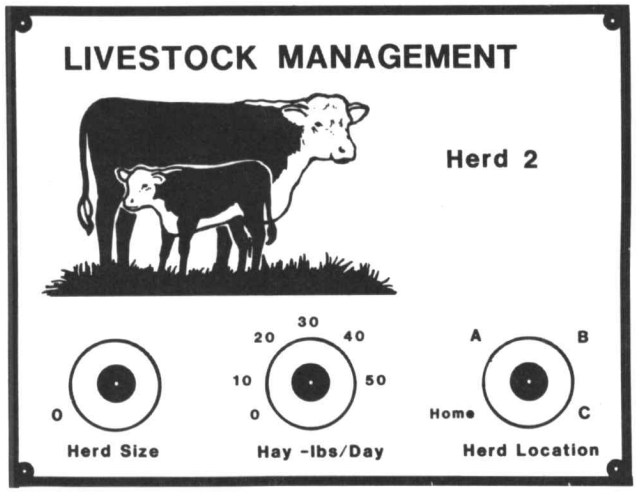
I sure liked the presentation. It was very interesting and I learned a lot. I sure wish we could have had more time. I wanted to see how you operate the cows. I hope you can come again. !PLEASE!

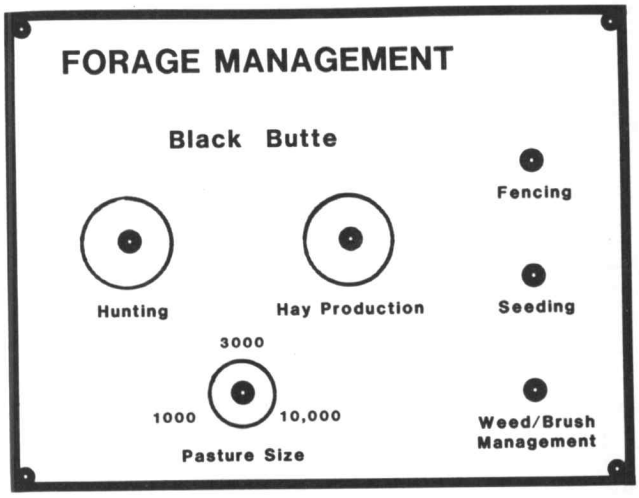
The simulator was used in a biology class at the Bottineau Branch of North Dakota State University in the fall of 1984. Student comments indicated that the simulator was equally effective in this situation,

". . . very helpful in giving an overall picture into ecosystems."

"This lab was very interesting because you had to manage the ecosystem yourself."

"I thought the range computer was the best thing we've done all year."



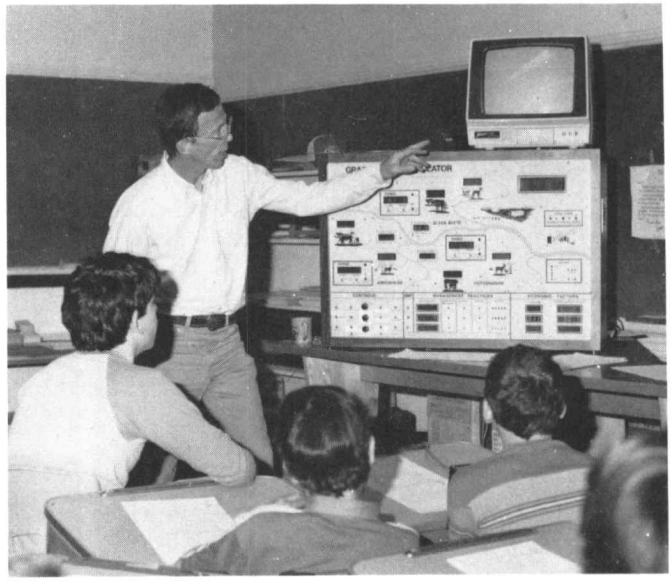


Small control consoles are used by participants to implement management decisions.

"I didn't realize there were so many things involved."
". . . it helped me understand the processes in an ecosystem better."

The merit of computer simulation as a teaching tool was formally evaluated by Dr. Dennis Cartwright at the University of Idaho in 1980. His evaluation was done with an energy simulator that modeled energy resource/demand situations. A group of college students was tested and carefully divided to assure that both groups contained individuals with similar skills in abstract reasoning. One group of the students participated in a slide-illustrated lecture concerning energy resources and exponential growth, while the remaining students participated in the Energy-Environment Simulator presentation. Instructors for both presentations were chosen on the basis of similar ability and educational background, and the same principles and concepts were included in both presentations. After the presentation, both groups of students were given an examination to determine their understanding of energy problems and concepts.

The mean score for the simulation group was 17.6 percent higher than that of the lecture group, indicating that the simulator was slightly more effective at developing conceptual understanding than was the lecture presentation. However, significant differences became apparent when a statistical regression was made correlating the student's abstract reasoning ability with his or her score on the energy concept awareness examination. Students with high abstract reasoning ability scored equally well whether they participated in the simulator or slide-lecture presentation. However, when the students with lower abstract reasoning ability were compared, the group participating in the simulator presentation scored significantly higher than the group receiving the slide/lecture presentation. This experiment was significant at the 0.05 level, meaning that here was only a 5 percent chance that the conclusions were due to random statistical variation.



Grazing Land Simulator was an effective teaching tool in a sixth grade classroom at Bozeman, Mont.

Why Is the Simulator an Effective Tool?

The first step in any learning process involves gaining the student's attention and interest. If the student does not perceive the problem as interesting and significant, little learning will be accomplished. The simulator's panel design and visual impact gains immediate attention and the structure of the problem area is communicated. Users realize that they are faced with a computer model of a ranch, and that they can control some of the variables. They are going to be participants, not observers.

The importance of active participation and immediate feedback cannot be over-emphasized. The simulator offers opportunity for input and presents concrete information. While making decisions, the users are simultaneously synthesizing data and evaluating alternatives. Thus, users with lower abstract reasoning ability gain the conceptual understanding expected only from those who can reason at a more abstract level.

What about the Future?

Three Grazing Land Simulators are presently being

rotated around Montana. Usage is expected to increase as the number of potential instructors (school teachers, range conservationists with federal and state agencies and extension service personnel) increase. For further information, contact Natural Resources Education Project (Phone: 406-994-5380), 127 Gaines Hall, Montana State University, Bozeman, Montana 59717-0003.

It seeems that the effort to upgrade existing educational material on grazing land management into an attractive, contemporary, well-illustrated package needs to be continued. But why not also incorporate the Grazing Land Simulator into the overall educational system? Our experience confirms that it is instructive, informative, and interesting. It creates interest and clearly illustrates the importance of grazing lands and the fundamental principles of grazing land management. Without doubt, the Grazing Land Simulator is potentially valuable as an educational tool.

Pearls of Wisdom from the Conference

Multispecies Grazing: the State of the Science

Frank H. Baker

The following statements are the report of a conference held June 25-28, 1985.

Eldon White, American Sheep Producers Council. Care must be given to build upon the tried and true practices of yesterday by adding the latest technology in the area of multispecies grazing.

John Merrill, National Cattlemen's Association. Our objective is to increase biologic and economic efficiency of livestock users. The bottom line is how to select livestock to most efficiently harvest and market available forage on a sustainable basis, with minimum inputs, for a relatively stable market and for a profit. The application of good ecology and good economics will go far toward assuring the survival and success of livestock producers.

Walter Wedin, American Forage and Grasslands Council. Multispecies grazing aids in reducing insults to the environment such as soil and water loss and pesticide application. This objective can be supported by everyone.

Peter Jackson, Society for Range Management. Four cardinal rules can help achieve the real potential of multispecies grazing: (1) pick and choose carefully among the new advances in technology, (2) diversify, (3) be conservative and plan ahead, (4) work hard.

Donald Davis, Texas A&I University. If prevention and control of diseases and parasites are combined with proper management of habitat, animal losses in most cases can be minimized.

Lynn Drawe, Welder Foundation. If a rancher wants to 'have his cake and eat it too' in terms of livestock and wildlife, he must select management goals and use available knowledge to work toward them.

Ronald H. Thill, Forest Service. The potential for combined production of timber, livestock, and wildlife in the South is unexcelled by any other region of comparable size in the country. Increasing resource demands will ultimately dictate greater reliance on integrated management strategies for southern forests.

The Multispecies Grazing Conference was developed in response to livestock producers' inquiries as to whether combining sheep with cattle would improve the economic efficiency of midwestern farms. We came together to summarize the state of the science for the benefit of U.S. livestock producers and key individuals in research and education. The interest in the subject matter and the concept motivated the following organizations to support the conference by providing travel support, speakers, and participants:

Agricultural Research Service, USDA
American Forage and Grasslands Council
American Sheep Producers Council
Colorado State University
Extension Service, USDA
Forest Service, USDA
Hawkeye Institute of Technology
Kerr Foundation
Iowa State University
Mississippi State University
National Cattlemen's Association
Oklahoma State University
Oregon State University
Radakovich Hereford Farm
Rob and Bessie Welder Wildlife Foundation
Society for Range Management
Texas A&M University
Texas A&I University
Texas Christian University
University of Arkansas
Winrock International

The Sheep Industry Development Council provided special financial support to assist with publication and travel costs.

The 30 Conferees from key areas of the United States met at Winrock International in June 1985. They included (1)