Livestock Research Briefs and Cattle Growers' Short Course

March 30–31, 1995

Agricultural Experiment Station
Cooperative Extension Service
College of Agriculture and Home Economics

and the New Mexico Cattle Growers' Association

U.S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

JORNADA EXPERIMENTAL RANGE

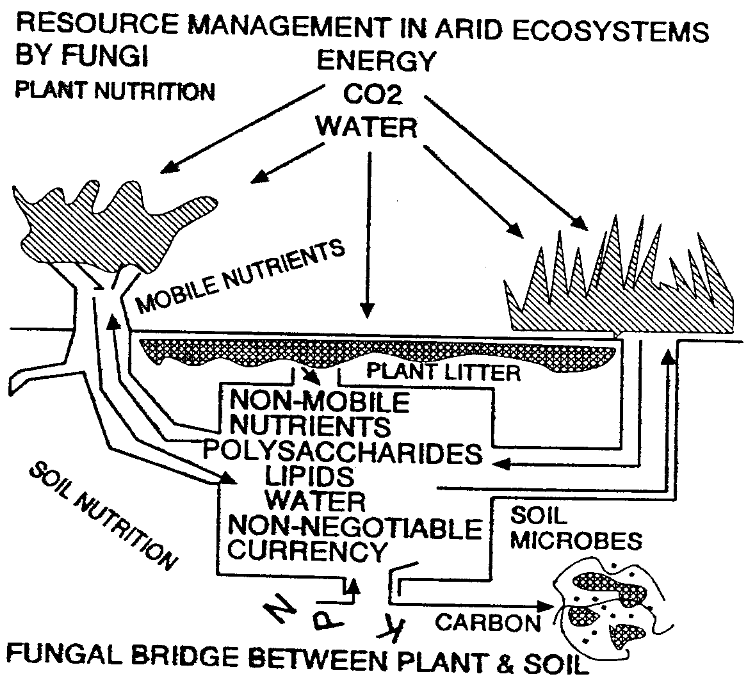
Our mission is to develop new knowledge of ecological processes as a bases for management and remediation of desert rangelands. The following information is a brief cross-section of the research conducted at the Experimental Range. Please contact us by mail (Box 30003, NMSU, Dept. 3JER, Las Cruces, NM 88003), INTERNET email (khavstad@nmsu.edu), telephone (505-646-4842), or in person (401 E. College, Las Cruces) for information. We conduct tours of the Experimental Range and require only a few days advance appointment. Our next large tour, in conjunction with the Departments of Animal and Range Sciences and Biology at NMSU, is scheduled for Wednesday, May 24, 1995. Please contact our office for details.

RANGELAND RESEARCH IN THE CHIHUAHUAN DESERT

DESERT ECOLOGY

Soil Organisms

Three major classes of symbiotic fungi were identified in the roots of native grasses and shrubs on arid rangelands of the southwestern U.S. The first class is vesicular-arbuscular mycorrhizae, common to most higher plants. These fungi enhance nutrient and water uptake in plants. The second major class of symbiotic fungi are common soil or saprobic fungi. Because of their association with the host plant their capacity is enhanced to access nutrients from immobile inorganic and complex organic resources and supply them to the plant. One demonstrated benefit of a saprophytic seed-borne fungus, *Alternaria alternata*, was that it decomposed the seed capsule at germination and transferred nutrients to the germinating seedling, improving chances for survival and establishment. These fungi likely play a role in the management of carbon resources in the ecosystem. Third major class of fungi regularly associated with grass and shrub roots were *Chytridiomycetes*, a primitive aquatic fungus. These fungi appear to regulate the colonization by the other two fungal classes. These fungi, acting in concert with each other, enhance nutrient and water uptake of native plants. They directly affect survival ability and competitiveness of all plant species in arid rangelands. We are researching these fungi because we think that new technologies for rangeland revegetation of degraded areas will require the presence of these fungal classes for successful reestablishment and survival of native plant species.



A model of endophytic fungi in arid ecosystems

Soil Development

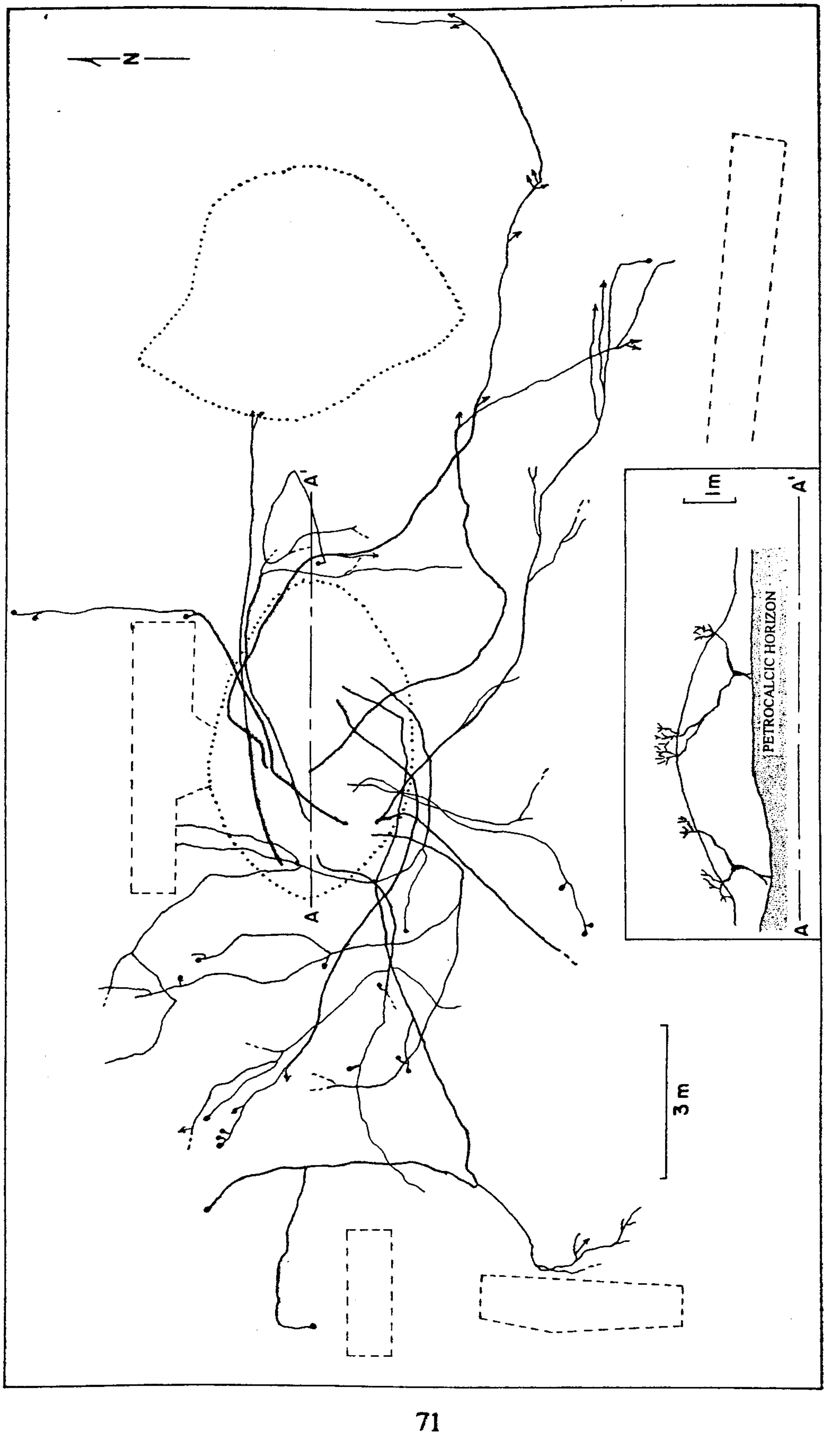
Development and maintenance of good soil structure is essential for promoting root growth, minimizing runoff, and maximizing soil water storage. Many processes, including trampling by animals and raindrop impact, break apart soil aggregates and fill in the pores which transmit and retain water. If these processes are not balanced by others which regenerate soil structure, the dispersed aggregates form impermeable crusts and the soil beneath the surface becomes increasingly compacted.

Previous work at the Jornada and in other parts of the world indicate that ants and termites may play roles in creating and/or destroying soil structure. Some of the work at the Jornada suggests that termites increase infiltration and reduce runoff on bajadas by creating pores in the soil. However, we have also observed that the soil tunnels (new soil structure) created on surface litter and vegetation frequently do not persist for more than a few weeks. The net impact of termites on soil structure is unknown. There is even less information on ants. Some species clearly create large pores in the soil, but many also create bare areas around their nests, exposing the soil to erosion.

We have initiated research to determine what role ants and termites play in the creation and maintenance of soil structure. The results of the studies should help us to better understand why some soils are better able to recover from disturbances which destroy soil structure. The results should also allow us to design new management systems which complement and reinforce existing natural processes. By substituting natural processes for mechanical approaches we hope to reduce overall management costs while increasing productivity.

Root Systems

Mesquite has been a successful invader of desert grasslands. One reasons for the success of mesquite is the ability of its root system to exploit the soil environment. For example, mesquite roots of a single coppice dune were measured to extend laterally for 52 feet, traversing a complex pattern of four different soil types (see figure). The roots readily penetrated all soil horizons to depths exceeding ten feet except the continuously indurated caliche. However, the roots grew along the top of the caliche and in places found locations of penetration, such as cracks and soil pipes. In a playa with a Haplocalcid soil, mesquite roots descended to a depth of at least 18 feet. In both dune and playa sites, mesquite roots grew vertically upward to within two inches of the soil surface, enabling the plants to harvest water from small rainfall events. Thus, the successful establishment of mesquite is in no small part due to the ability of mesquite roots to adapt to a wide variety of soils and soil condition to take advantage of the sparse precipitation; to their ability to greatly proliferate while spreading laterally over long distances; to descend to great depths along cracks and other openings in the soil, down which soil water also penetrates, and thus to their ability to utilize available soil water at all depths. This is a principle reason that herbicide control of native mesquite plants is such a marginal practice. Long-term strategies for controlling mesquite establishment and developing techniques for establishing other species in mesquite infested areas are required to improve rangeland conditions.


N
A'
A
1m
PETROCALCIC HORIZON
3 m

Map of horizontal distribution of mesquite roots within a single dune. Solid circles denote a vertical downward extension of roots, dashes indicate dead roots, and arrows indicate live roots which were not followed. Dotted lines represent dune boundaries and dashed lines delineate trenches. Vertical profile of dune along line A-A' is shown in insert with a diagrammatic representation of buried and emergent mesquite branches.

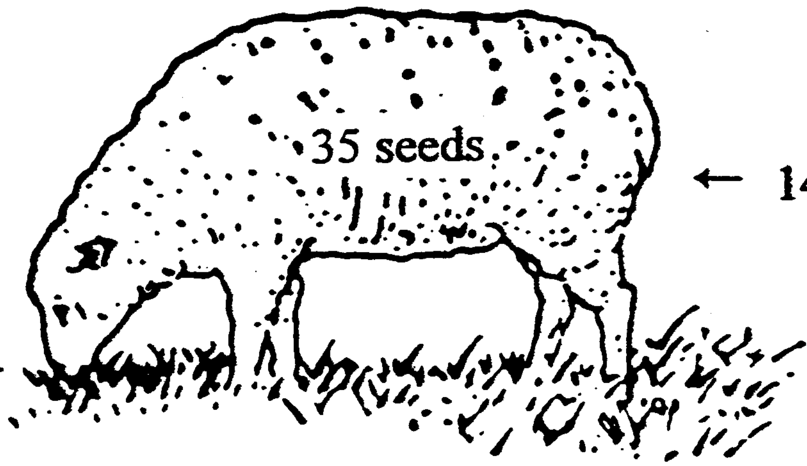
LIVESTOCK INTERACTIONS

Diet Selection

Using a shrub model, we have begun to grasp the importance of low molecular weight carbon compounds in affecting herbivore dietary preferences. Our studies support earlier research that suggests plant succulence and mineral content enhance the plant's acceptability to livestock. But, acceptance of the plant by livestock is further modified by small carbon compounds found within the surface of the plant's leaf. For example, ewe lambs may spend more than 50% of their time grazing the Chihuahuan Desert shrub "tarbush," while other years they may graze this plant less than 1% of the time. These differences in plant palatability are affected by plant water and mineral content, and specific molecules in a class of compounds known as "terpenes." Like animal preference for tarbush, tarbush terpene concentrations are highly variable within a grazing season and from year to year. Previously these compounds were believed to enhance the plant's survivability in harsh desert environments by lessening herbivory by fungi, bacteria and insects. Modifying livestock herbivory may be another function attributed to these compounds.

Seed Dissemination

In 1932, several South African grasses were imported to the southwestern United States to reclaim land damaged by a combination of overuse and drought. Among these grasses, Lehmann lovegrass was easily established and flourished in areas too harsh for other reseeding species. After eight years of seeding trials, this plant was seeded throughout southwest Texas and southern New Mexico and Arizona. Although this grass lessens erosion and provides good early season forage, it is also a highly competitive plant that is largely unpalatable during most of the growing season. Furthermore, due to its competitive nature, Lehmann lovegrass is replacing many more palatable and nutritious native grass species resulting in pure stands of Lehmann lovegrass. The area Lehmann lovegrass has invaded into and occupies is currently greater than the total area that has been seeded. Expansion of Lehmann lovegrass in Texas and New Mexico may further increase due to recent development and release of cold hardy varieties. Currently, it is believed that expansion of Lehmann lovegrass has occurred due to seed dissemination by wind and surface water movement. Our research suggests nearly half of the seeds ingested by sheep remain undamaged by mastication with minimal decreases in seed viability due to ruminal and intestinal digestion. These data suggest that if seeds are ingested and seedlings survive, then dissemination of seed by livestock may help explain the very high rates of Lehmann lovegrass expansion into nonseeded areas. We are looking to develop recommendations for livestock grazing of Lehmann lovegrass that minimize animal dispersal of seed.



Ingestion of Lehman lovegrass seed by sheep results in passage of germinable seed within four days of ingestion. Approximately 14% of ingested seed will germinate within 21 days following excretion.

Predation Protection

Mixing cows in a herd with sheep in a flock that have been previously socialized (bonded) to cattle through close confinement produces an animal group we term a "flerd". Flerds can provide benefits to mixed grazing management strategies. Sheep losses from coyote predation can be significantly reduced, mainly due to the close and enduring association bonded sheep have with cattle. The cattle's mere size and aggressiveness towards canines can intimidate coyotes. Because flerd sheep stay with cattle, the time required in locating the two species under free-ranging conditions can be reduced. Minimal fencing, adequate to hold cattle, will also contain bonded sheep provided cattle are not present in adjoining pastures since bonded sheep do not bond to specific cows but to cattle. Because of the enduring and close association of bonded sheep to cattle a larger spatial distribution of the flerd sheep may be realized during grazing compared to grazing by only a flock. Current research is focusing on manipulating endocrine systems within the sheep to reduce the length of time sheep must be close to cattle early in their lives to form an enduring bond that will remain throughout the remainder of their lives.

RANGELAND MONITORING AND ASSESSMENT

Developing Indicators

Under the direction of Walt Whitford, Senior Ecologist with the EPA stationed at the Jornada, we are in the process of putting together a manual on how to do assessments of rangelands. We are concentrating on testing the sensitivity of a variety of indicators using reference sites on the Jornada to examine which sets of indicators provide relatively unambiguous differences among sites that differ in their history of use and disturbance. We have done the initial analyses on vegetation parameters and size of unvegetated soil patches (erosion cells). A principle value of the Experimental Range in this research is the array of sites available for study in combination with the historical records of rangeland conditions.