HELPING TO BETTER MANAGE OUR ENVIRONMENT

L. Ketchum

Consumers and Urban Growth

Economically, the most efficient way for a city to grow is by high-density infill where maximum advantage is taken of existing infrastructure, low travel distances and the energy benefits of common walls. Tucson's growth, however, in spite of the city having an unusually high proportion of undeveloped land, is occurring predominantly by low-density expansion into rural areas in single-family detached homes.

Land use in Pima County is changing today at a rate unprecedented in history. Even though county and city planners are well aware of the need for intelligent land use planning, stringent zoning and effective enforcement for resource conservation, the sheer volume of work keeps them from being able to comprehensively protect all the resources that should be protected. Valuable wildlife habitat is being lost; potential high value scenic and recreational resources are being compromised; and, most importantly, watershed characteristics are being permanently altered to the detriment of the area's long-term water supply.

Nine hundred Tucson area households responded to a survey assessing characteristics, attitudes and perceptions that might reflect on their decision to locate in a more urban (higher density) or a more rural (lower density) setting. Census tracts were chosen to obtain a sizeable sample of urban, suburban and rural respondents.

Rural respondents reported both a higher overall satisfaction with where they live, as well as a strong tendency for their satisfaction to increase with time. All three categories of respondents favored a move to a more rural (lower-density) setting if forced to move. All strongly preferred detached single-family housing over attached housing, yards or outdoor space to do with as they pleased, and a view of desert or mountains. Advantages of

location and better public services for urban dwellers, and the disadvantages of location for rural respondents seem to be relatively unimportant in influencing satisfaction with present housing or desires for new housing.

This study suggests, for the time being, that, in spite of urban infill being the more economically efficient mode of growth, a more dispersed residential pattern is still more desirable for the majority of people in the Tucson and Pima County area. Because of this, one can expect continued pressure for urban expansion, even in the unlikely event that population growth in the area stopped.

Landscape architects and planners are presented with a clear challenge in these findings. If, as the data suggest, the perceptions of quietness, privacy, of being uncrowded, and of having good views of the surrounding desert and mountains are the primary motivators for living in rural areas, one can't help but wonder to what extent innovative design and planning could create such perceptions in high density settings. Cluster residential development, which is now growing in popularity, may provide one fruitful approach to this challenge.

Dr. Don Wilkin
Renewable Natural Resources

Fungi Helps Revegetate Disturbed Land

There are various species of vesicular-arbuscular mycorrhizal fungi (VAMF) that have been identified on roots of native plants in the Sonoran Desert, as well as similar species found in many other parts of the world. They have significance not only for the longevity and health of indigenous plants, but can be quite useful in assisting reestablishment of vegetation on disturbed or despoiled soils.

The soils dredged from deep in the desert to construct the Central Arizona Project's canal are nearly devoid of spores and hyphae of VAMF, but many contain adequate nutrients for desert plant growth. Mycorrhizal fungi provide assistance to plants in assimilating phosphorus, zinc, iron, magnesium, potassium and other essential nutrients, and making these nutrients available through hyphal attachments in cortical cells of roots.

A trial was established in 1987 along the CAP canal dikes in cooperation with the Bureau of Reclamation, U.S. Department of the Interior and the UA.

Native grasses, including bluestems, Arizona cottontop, and bristlegrass, along with native acacias, palo verde, mesquite, brittlebush, desert marigold and desert willow were planted in the early summer of 1987 along the dike slopes of the canal at four sites in the Avra Valley west of Tucson.

Growth increments (height) in nearly all species were statistically significant in replicated blocks inoculated with a mixture of spores of two fungi compared to blocks of non-mycorrhizal control plants. Analyses of desert soils from two sites indicate that the greatest benefit from adding mycorrhizal fungi is obtained in plants grown in soil low in available phosphorus. Since the benefits derived from VAMF are to enhance phosphorus uptake, analyses of soils in despoiled zones showing low available phosphorus may benefit from applications of VAMF. The VAMF spores can be hydroseeded with mixtures of appropriate seeds of grasses and forbs to establish a population in roots and soil. Population of VAMF increased 40-fold on the sites.

The establishment of a source of symbiotic microflora along with analyses of soil phosphorus should make possible a working model for achieving maximum potential from soil and microbial amendments in reestablishing native vegetation in disturbed desert ecosystems.

Dr. H.E. Bloss
Plant Pathology

Breeding Behavior of Harris' Hawks

The Harris' hawk is one of only two hawks in the world that frequently breed cooperatively in groups of more than two individuals. Little, however, is known about the behavioral interactions of Harris' hawks either within or between groups. We studied the behavior of Harris' hawks at 53 nests in Arizona from 1984 to 1986. We captured 362 hawks during the study and marked them with plastic colored leg bands to permit us to identify individuals. We observed hawks during breeding and nonbreeding periods for approximately 2,500 hours from fully enclosed blinds or vehicles.

The average number of hawks per group was 3.8, and group sizes ranged from two to seven. A typical group included a dominant (alpha) male breeder, an alpha female breeder, a secondary (beta) male helper, and from one to four tertiary (gamma) helpers. Alpha and beta hawks generaly were adults. Gamma hawks were either adults or immatures (i.e., less than 1 year of age). Most (72 percent) of the immature gamma hawks were offspring from the previous breeding attempt and were helping their parental group. The alpha males excluded gamma helpers from the vicinity of the nest, but tolerated the presence of beta helpers for short periods. Helpers usually did not incubate or brood, but provided food to the alpha pair who fed it to the nestlings. Our observations of copulations and attempted copulations by alpha and beta males suggest that most groups consisted of a monogamous pair with one or more nonbreeding helpers. During the nonbreeding period, group members occasionally perched and hunted with members from adjacent groups on the perimeters of their territory. Group members did not, however, tolerate the presence of nonmembers in the nesting area during breeding, except at sources of open water.

Information about the behavior of cooperatively breeding animals is important because it forms the basis for models of the evolution of cooperative breeding systems. Information about the Harris' hawk is of particular interest because this species represents a group in which cooperative breeding rarely occurs and whose ecological and behavioral traits differ markedly from other groups in which cooperative breeding has been thoroughly studied.

Dr. James W. Dawson
Dr. R. William Mannan
Renewable Natural Resources

Feeding Captive Bighorns

Forage selection and diet composition have been quantified using fecal analysis, rumen analysis, esophageal fistulation, estimates inferred from habitat use, observation of restrained animals, and bite-count observations. Difficulties that create biases associated with the use of these techniques have been described. In addition to problems associated with traditional methods of determining forage selection

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and diet composition, economic limitations are inherent in studies using large herbivores. Consequently, conclusions are based on small sample sizes or group data.

We adapted a technique from the dairy sciences and modified a feeding system that allowed us to quantify forage selection and diet composition of captive desert bighorn sheep. Our objectives were to determine if the gate system could be modified for use by desert bighorn sheep and to quantify individual forage consumption using the Calan system.

The Calan feeding control system is a patented door with a solenoid lock. Individual doors are controlled by a removable solid state circuit board that operates on 24 volts. The solenoid lock is electronically controlled by an individual sensing key that is suspended around the animals neck. Installation of the gate requires construction of a feeding frame and wiring. A wooden feeding bunk was mounted in the frame to hold individual rations. Bighorn sheep required 14 days prior to the first feeding trial to acclimate to the gate. We set the solenoid locks in an open position to allow free access to either bunk and observed feeding patterns to determine which gate was used most often by an individual. The bunk used most often by an individual was assigned to it. Sheep were immobilized and fitted with the sensing key and color coded mesh collars.

We conducted feeding trials in June and September 1987, and January 1988, to quantify seasonal consumption and forage selection of native browse, forbs and grass. Trials were conducted for seven, six and five days, respectively. Terminal shoots (15cm) of native browse and entire native grass and forb plants were hand-clipped to ground level from desert bighorn sheep habitat (Pusch Ridge Wilderness, Tucson, Arizona). Vegetation was placed in plastic bags and frozen at -10° C until used. Animals were fed native plants 10 days prior to feeding trials to allow for rumen inoculation. Animals were fed daily at 11:00 am. Known amounts of browse, forbs, and grasses were mixed and presented in the Calan gate feeders. Forage remaining in the feeding bunks after 24 hours elapsed was retrieved and hand separated to determine total consumption of vegetation, and percentages of browse, forbs and grasses selected. Native diets were supplemented with Stockman's ration during the duration of the trial and water was provided ad libitum.

Animals required 14 days prior to the first feeding trial to adapt to the Calan feeding system. Upon termination of the first seven-day feeding trial we resumed feeding the maintenance diet using the Calan gates. The animals became familiar with the system which facilitated its use in future trials. Attempts to monitor forage selection by desert bighorn sheep using the Calan gate system were successful. Spillage associated with the feeding and removal of forage was minimized (less than 1 percent) and did not present a problem when using the apparatus. Modifications of the feeding bunk to accommodate desert bighorn sheep were adequate.

Methods used to estimate ruminant diets require an adequate sample size. Many animals and repeated feeding trials should be used to eliminate bias due to animal preference, season, time of day and behavioral training. The Calan feeding system can be incorporated into maintenance programs for penned, wild species and provide an alternative method for data collection. The low cost ($298/gate) and easy installation allows for expansion of the system to accommodate multiple feeding positions and diets.

Rosemary Mazaika
Dr. Paul R. Krausman
Renewable Natural Resources
Dr. Frank M. Whiting
Animal Sciences

Monitoring Rangeland

Ten years ago researchers in the Division of Range Management were investigating the value of plant frequency measurements to document changes in range vegetation over time. Procedures emerging from this research, and subsequent comparisons with other possible techniques for monitoring vegetation changes, have resulted in wide use of frequency data to document long term trends on private, state and federal rangelands.

Plant species frequency is defined as the percentage of plots in which a plant species is found when a series of plots are sampled. The concept dates back to 1913. Since the data are unique to the size of plot used in sampling, plot size is a major consideration in use of the technique for specific vegetation.

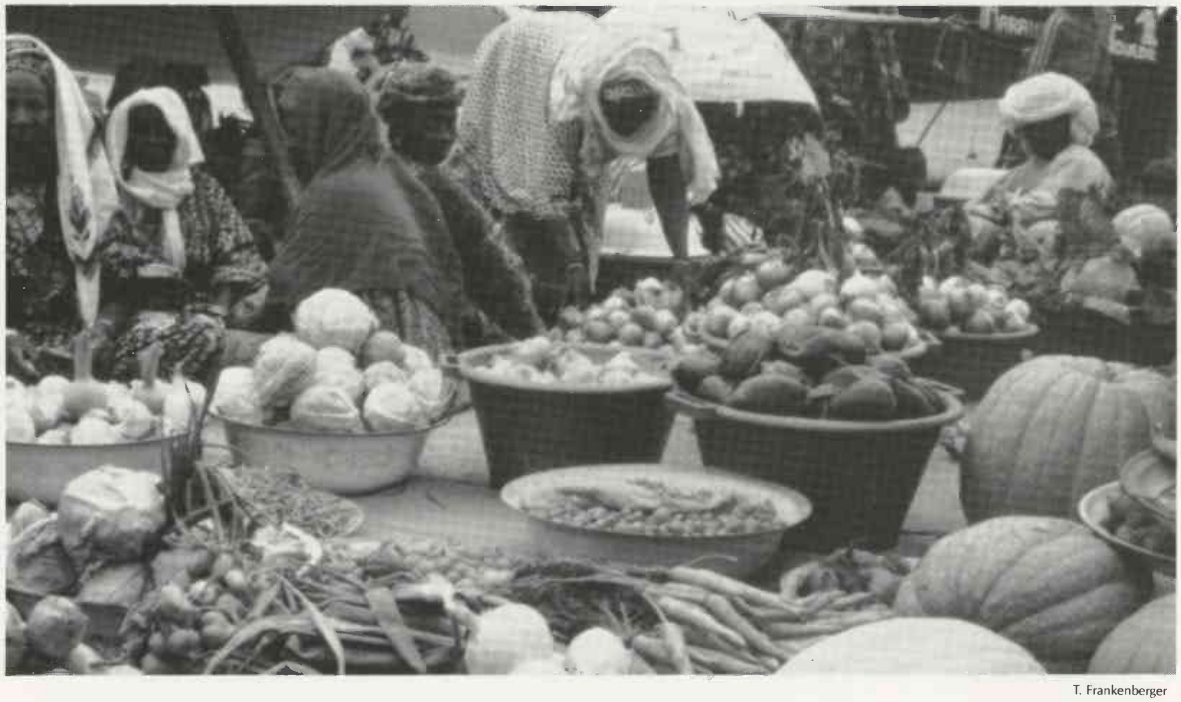
Research by UA range scientists over a wide range of vegetation types in Arizona showed that plot sizes of about 40 X 40 centimeters provided adequate data to document change in the common plant species. Data are consistent over years, even when collected by different individuals. The only judgement required is to call the plant in or out of a plot and to properly identify the plant. Consistency of data over years is a primary prerequisite of a suitable monitoring technique. Change in the frequency of a plant species documents how a particular species changes in number of plants and/or distribution of plants over the period in question.

UA Extension range specialists, county agricultural agents, State Land Department range conservationists, Soil Conservation range conservationists, Bureau of Land Management range conservationists, Forest Service range conservtionists, Arizona Game and Fish specialists, and ranchers have cooperated in locating plant frequency monitoring plots in key areas over Arizona rangelands. Some of these areas now have as many as nine consecutive years of data collected on them. The frequency data document what is observed on the locations sample and provide the basis for adjusting management to meet the goals of the agencies and individuals responsible for managing specific management units.

Dr. Phil R. Ogden
Dr. E. Lamar Smith
Renewable Natural Resources

M. Longstreth

M. Longstreth



T. Frankenberger