

"Wanted: A Suitable Herbivore"

by Paul S. Martin

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WANTED: a suitable herbivore to convert 600 million acres of Western scrubland to protein. All replies held in strictest confidence. Please send photo. Box AD 2000, N.H.M.

The ecologist's concept of a niche refers to the "job" or "trade" by which a species makes its living without excessive competition with others. An empty niche then implies neglected opportunities for utilizing available food energy. It is a common belief that nature abhors such vacuums and quickly fills them. Yet when seen in the provocative perspective of the last million years, there is evidence to indicate that some rather large niches within the American range remain unfilled. Perhaps the long-lauded home where the buffalo roam is also the land where camel and eland should play, as well as an array of other exotic large mammals usually regarded as more suitable for zoos than for meat production.

The matter is of more than theoretical interest. In confronting the calorie crisis associated with unbounded population growth, ecologists associated with the International Biological Program are seeking out sources of "new" energy. But this meticulous search has overlooked the forage potential of the shrub-dominated arid lands of the southwest United States and Mexico: a vast territory that is largely unexploited at present.

by Paul S. Martin

Cattle and Creosote Bush

Looking to the future, specialists in animal husbandry and range management generally attempt to increase range productivity with only one goal in mind: creating the best possible environment for the genus *Bos*. Water supplies are developed and pastures are rotated; native plants that are not consumed by *Bos* are destroyed if possible. When the range dries out in southern New Mexico, for instance, a herd may be trucked 500 miles to greener pastures in Colorado. Animal breeders work with geneticists in seeking to develop cattle more suited for life in arid or tropical areas. The only approach to raising productivity not being seriously tried at present is the introduction of new grazing species capable of utilizing certain types of plant life that cannot be consumed by domestic cattle. For all practical purposes, experiments with domestication of large wild herbivores ended in the Neolithic and have not been systematically attempted since.

In the New World, ranchers operating west of the Pecos or south of the Rio Grande seem to have inherited the wrong species to start with, for tradition demands that they stock a grass-preferring herbivore, *Bos*, in a land of little grass. Over approximately one million square miles of the southwest United States and Mexico, the dominant vegetation is composed of shrubs, often protected by thorns or by repellant aromatic oils. Cattle may browse seasonally on mesquite or even on cactus, but they are not well adapted for this role. Most shrubs such as creosote bush (*Larrea tridentata*) go untouched.

Ecological theory offers the expectation that to the proper herbivores, the shrubs, no less than the grass, would yield ample forage. In one part of Cochise County, Arizona, botanists Bob and Alice Chew found that a representative desert shrub community produced 1,200 pounds of dry matter per acre, per year—twice the annual grass production in many short-grass prairie ranges in the western cattle belt. But in this case, production was mainly in the form of leaves and stems of creosote bush, an energy source that cattle

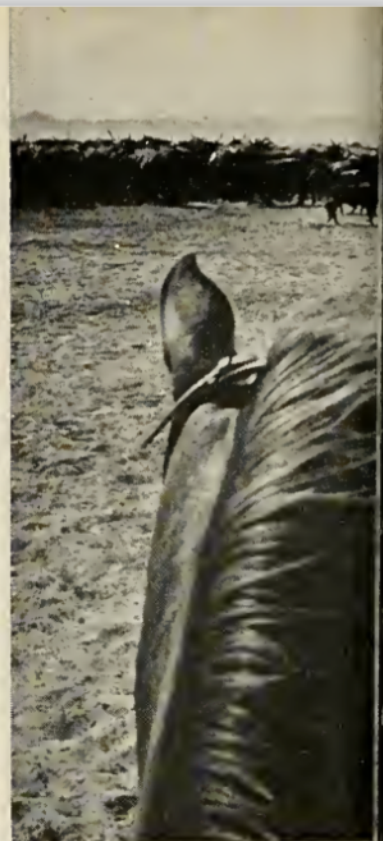
avoid. In these desert shrub communities cattle barely survive even at a population density of from two to six head per square mile.

While cattle and sheep avoid many browse plants, we know from an examination of Pleistocene animal droppings that at least one herbivore of that epoch consumed creosote bush, yucca, and agave. The Shasta ground sloth and other large browsing mammals, such as native camels, disappeared over 10,000 years ago; their niches have apparently not been reoccupied or refilled.

A Pleistocene Perspective

One major objection to the introduction of exotics has been the belief that at the time of discovery by Western man, the New World fauna was in a "natural" state, a balance allegedly struck after millions of years of evolutionary adjustment among plants and animals throughout the Late Cenozoic. Most conservationists believe that to bring in exotics would crowd the native species out of their niches, vulgarize the habitat, and perhaps hazard flooding the countryside with an animal as destructive to native vegetation as the rabbit in Australia and the red deer in New Zealand. At first blush, the arguments against upsetting the natural (A.D. 1492) state of affairs seem thoroughly sound. In terms of the known destructive potential of introduced fish, birds, and small mammals, the arguments are certainly valid. Without careful advance planning and research, the haphazard introduction of any species, large or small, can be challenged. In the words of ecologist Ed Deevey, "we have one witless menagerie in New Zealand and we certainly don't need another."

Yet, by examining the fossil record of the Pleistocene one finds that certain "alien" mammals may have a perfectly valid claim to the continent. If game managers will look at the record with the perspective of paleontologists, they will discover that some of the natives are considerably less American than certain aliens. During the last few million years there has been an active exchange of fauna between America and Eurasia; horses and camels





**Rangeland Browse Plants—
Western U.S. and Mexico**

- A. sagebrush
- B. saltbush
- C. creosote bush
- D. chaparral
- E. saguaro
- F. paloverde
- G. mesquite
- H. thorn forest
- I. thorn scrub



The presence of the genus Bos, as a meat producer, and the family Equidae, as a work animal, may have more to do with tradition than with the ecological adaptation of these grazers to the one million square miles of browseland that cover eleven western states and Mexico. In addition to its present crop of domestic livestock, it is suggested that this area might support several million large herbivores, such as the eland, giraffe, and springbok. Predominant browse plants within this rangeland are keyed on map at left.

Browseland area includes:
Arizona, 80,000 sq. miles;
California, 60,000 sq. miles;
Colorado, 10,000 sq. miles;
Idaho, 50,000 sq. miles;
Nevada, 100,000 sq. miles;
New Mexico, 40,000 sq. miles;
Oregon-Washington,
50,000 sq. miles;
Texas, 70,000 sq. miles;
Utah, 25,000 sq. miles;
Wyoming, 65,000 sq. miles;
Mexico, 411,000 sq. miles.

evolved in this continent and spread west, while a variety of bovids, elephants, and deer moved in the opposite direction across the Bering bridge. This exchange involved more Eurasian immigrants than American emigrants. By the end of the Pleistocene (essentially within the last 100,000 years) an Asian horde, including caribou, mountain goats, mountain sheep, muskoxen, moose, and, in Alaska, even *Bos* itself (represented by a species of yak) had immigrated into the New World.

In the perspective of the fossil record, one finds that Asian camels represent a lineage that has a far longer history on this continent than the American bison, a genus that arrived only in the middle of the Pleistocene many millions of years after the American origin of camels. When introduced by the U.S. Army over 100 years ago, the camel demonstrated remarkable adaptability to the American Southwest. Near Uvalde, Texas, on the way to California in 1857, George Beale, an army officer, wrote: "As soon as they [the camels] arrive they are turned loose to graze, but appear to prefer to browse on the mesquite bushes and the leaves of a thorny shrub, which grows in this country everywhere, to the finest grass." Near Devil's River, Texas, Beale wrote of camels eating greasewood (*Larrea tridentata*) with great relish. He noted: "It is certainly very gratifying to find these animals eating, by their own preference, the coarse and bitter herbs, hitherto of no value, which abound always in the most sterile and desolate parts of every road." In northwestern Arizona, he reported that "With all this work they are perfectly content to eat anything, from the driest greasewood bush to a thorny prickly pear, and, what is better, keep fat on it." According to another observer, the Army camel fed on cactus and sagebrush, preferring such food to that which ordinary cattle require. This adaptability would not have surprised the nineteenth-century observers had they known that the camel was merely refilling the niche he had left years earlier.

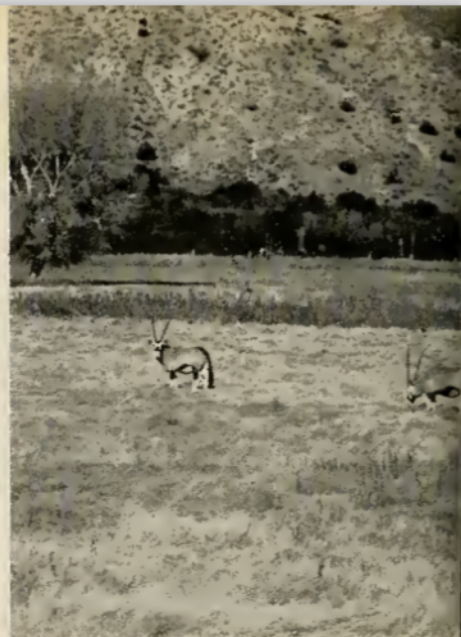
What did cause the extinction of large Pleistocene mammals? In an

earlier issue of *NATURAL HISTORY* and in a recent book (*Pleistocene Extinctions*, P. S. Martin and H. E. Wright, Jr., eds., Yale University Press), I attempted to show that on a world basis the spread of prehistoric big game hunters matches a progressive pattern of megafaunal extinction that began in Africa and southeast Asia and followed the path of the Paleolithic hunters into all parts of the world. But whether or not man was the unique cause of the extinctions, as I conclude, there is still good cause to examine New World ranges on the basis of our knowledge of the fossil record. Niches were suddenly emptied 10,000 years ago; should they now be refilled?

Thorns, Oils, and Browsers

The evolution of arid-land biota began in the Miocene some 20 or 30 million years ago when many mammals increased in size, developed cursorial habits, and evolved high-crowned teeth. At that time desert plants began to evolve defenses against overconsumption by native mammals. One defense may be the terpenes and other repellant oils found in natural concentrations of up to 5 per cent fresh weight in the foliage of many desert shrubs. Those western shrubs not containing repellant oils are typically armed with thorns. Apparently one of these adaptations is used largely to the exclusion of the other—there are few species of desert shrubs that have both spinescence and aromatic foliage. Some shrubs also lose their leaves for a certain portion of each year, another “defense” against browsing.

Range experts have long recognized that the oily, resinous, or thorn-protected shrubs have limited forage value for domestic livestock. In the case of the ubiquitous and unpalatable creosote bush, chemist Peter Duisberg of El Paso found that without its aromatic and highly repellant resins, the plant would be equivalent to alfalfa in feed value for cattle. According to ecologist Linton Gardner of the U.S. Department of Agriculture, if the essential oils of the sagebrush, an abundant shrub over many parts of the West's Great





eral herbivores have been introduced to the Southwest. Above: African oryx in New Mexico. At left, the camel, alive before its Pleistocene extinction, was reintroduced by U.S. Army in mid-nineteenth century. While its food habits are well adapted to southwestern deserts, its cantankerous disposition made it a popular target for the criticism of firearms of frontiersmen. Below: since introduction of the rhinoceros, efforts to improve the productivity of western rangeland have centered on cattle, animals adapted to most of the land's dry, oily, or woody shrubs.



Basin, could be used in an industrial process that would partly pay the cost of removal "... the West would have an almost untouched source of livestock feed." But no inexpensive method of oil removal has yet been found, and both the thorny and oily shrubs continue to spread throughout the desert grassland where they are despised by ranchers as worthless weeds.

The extinction of Pleistocene mammals must have radically altered the dynamics and structure of vegetation in western America. As the niches emptied, the desert plants were left largely uneaten, save for the forage consumed by the small number of surviving large mammals and smaller herbivores. Thus, the removal of the large, browsing herbivores may have permitted the recent spread of "brush" plants, which are of little use to domestic livestock. In Africa, this did not occur since a wide assortment of grazers (zebra, buffalo, wildebeest) and browsers (kudu, giraffe, black rhinoceros) survived the Pleistocene and now provide balanced consumption of both grass and shrubs. In fact, where there are large numbers of elephant, as in Tsavo National Park, Kenya, they bark or topple trees, permitting a "grass invasion"—an ecological shift that American cattlemen might applaud.

The meat production potential of African game has recently been considered by such wildlife experts as Raymond Dasmann of the Conservation Foundation and Lee Talbot of the Smithsonian Institution, who note the superior quality of game relative to beef carcasses. Furthermore, wild game drink less than domestic livestock, grow faster, and can be stocked in greater numbers without damage to the range. Dasmann's study shows that the net annual profit to a rancher cropping game may be three to five times that of raising cattle.

The eland, which Dr. Livingstone a century ago anticipated as suitable for domestication, is now herded with cattle, which forage on grasses. The eland browse on shrubs and trees and the shared range is well utilized. According to Dasmann, eland are more gentle and easier to

manage than domestic cattle, grow faster and larger and produce excellent meat. They are already on the way toward becoming an important domestic animal in South Africa. Ecological studies indicate that other strong candidates for African livestock ranching are the giraffe, roan antelope, and springbok. Even elephants may prove superior to cattle as a meat source in parts of the tropics.

In view of the shrub invasion in ranges of the New World, the following remark by Julian Huxley, relating to African range, is especially provocative: "The browsers also prevent the country from turning into an impenetrable thicket." Would the proper assortment of African browsers on New World ranges control the current bush invasion in addition to providing a new source of protein, hides, and fertilizer? Would they restore the greater proportion of grassland that existed at the end of the Pleistocene?

With the development of New World pastoralism through the introduction of domestic animals about 450 years ago, Western man did little to increase forage consumption. Much of the western range industry came about simply through substitution of grazing animals such as cattle and sheep for other grazers such as the bison and antelope. But the browsing niches remained devoid of shrub-consuming herbivores. Browse habitats now prevail over roughly one million square miles on either side of the United States-Mexican border. Theoretically, this range might support 15 to 30 million new animals consuming available energy presently going to waste.

Perhaps massive experiments with alien large mammals is not as dangerous as conservationists sometimes predict. In light of America's unfilled niches and unutilized browse, there now seem to be some good ecological reasons for careful experiments with potentially valuable large African mammals in the New World. "Meanwhile (to quote Ed Deevey in *Pleistocene Extinctions*) to destroy any more ecological order, deliberately, in the interest of propagating cattle, would seem—no stronger word is helpful—simply daft."