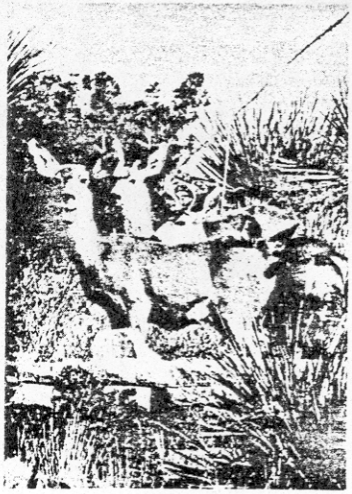
Photo by New Mexico Department of Game and Fish

Biology Conservation Technical Notes



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U. S. DEPARTMENT OF AGRICULTURE NEW MEXICO SOIL CONSERVATION SERVICE

TECHNICAL NOTE No. 27

February 11, 1983

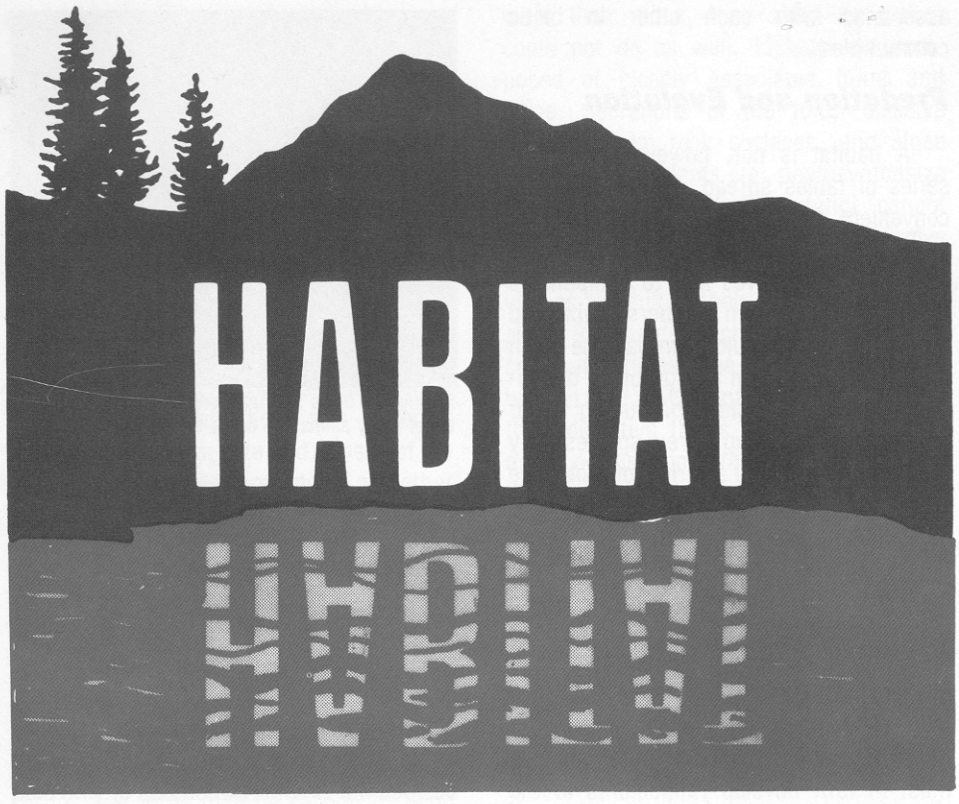
RE: HABITAT

Attached is a single copy of Wildlife Essay No. 1, written by Norma Ames of New Mexico Department of Game and Fish, 1982.

The essay provides a broad viewpoint about the essential interrelationships between habitat components, the impacts of human activities, and the well-being of wild animals.

You may want to refer to this essay when planning wildlife habitat improvements. It is also a valuable reference for the preparation of talks or articles on environmental issues.

Note that interested persons can obtain single copies from the Game and Fish Department. There are no additional copies available from the State Office.



Wildlife Essay No. 1, first printed as a supplement to the July-August 1982 issue of NEW MEXICO WILDLIFE. (Supplement can be removed from magazine by opening the staples at the centerfold.)

While supplies last, additional copies of the folder are available free of charge at offices of the New Mexico Department of Game and Fish. Request the particular Wildlife Essay by its title.

By Norma Ames

All photos by Norma Ames unless otherwise noted on page 15.

What Why Is A Habitat?

The dictionary tells us that habitat is ''the place where a plant or animal species naturally lives,'' but does not say why the species lives there. Habitat *is* where it's at, but it's there for good reasons. It lives there because that particular place provides the conditions that the particular species needs for its life and reproduction. The ocean floor, for example, is not your habitat because you must have free air to breathe.

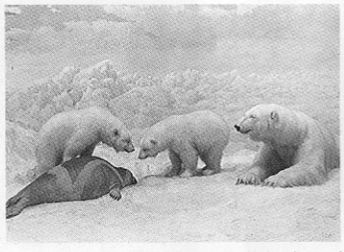
Scientists have placed on the ocean floor a watertight structure supplied with breathable air, drinking water and food so that they could live there for extended periods in order to study the ocean bottom. The structure's walls keep air in and water out. They also shelter the inhabitants from the surrounding cold and from sharks and other dangers. The scientists even call the structure a habitat, and so it is, in a sense. Within it, humans can live — even reproduce if they want to.

Few people, however, would care to spend their lives in this underwater structure, even if adequate air, water and food could be supplied to it for a lifetime. We use our habitat for more than just a source of air, food, water, and shelter. The underwater structure imposes too many restrictions on expression of our psychological needs for frequent and varied social contacts and for freedom to wander. These are also needs that evolved with us as part of our lives in our natural biological habitat, serving other important functions in the life and evolution of our species.

Water habitats, on the other hand, *are* appropriate for fish and other aquatic organisms that are equipped to extract their life-supporting oxygen from water. Varying conditions of water further divide it into more particularized habitats — salt water versus fresh water, for example. Fresh-water habitats may be further divided, as in New Mexico, into two general kinds on the basis of oxygen content. As its temperature rises, water can hold less oxygen and other gases (remember how gases bubble up and away from boiling water). Trout require considerable amounts of oxygen and live therefore in the colder waters of our northern and mountain streams. Trout survive poorly, if at all, in the warmer, oxygen-poorer waters of the lakes of southern New Mexico. Bass and catfish, however, need less oxygen than trout do and are found in those lakes, along with other kinds of ''warm-water fish.''

Among animals that live on land, differing kinds of body shape and covering equip some species for life in warm climates and others for survival in cold regions. Cold-area mammals, for example, tend to be larger, rounder, and furrier, an arrangement that best conserves body heat.

A toad can live on land, but its habitat must include a brook or pond. Its eggs are laid in water, and tadpoles cannot breathe air until they develop lungs.



The polar bear is built and clothed to withstand cold. The thinly coated body and slim legs of the muntjac of southeastern Asia would suffer from deep cold.

Habitat as the Food Source

Both aquatic and terrestrial animals are divided roughly into three groups on the basis of whether they are: (1) herbivores, eating plants, or (2) carnivores, eating other animals, or (3) omnivores, eating both plants and animals.

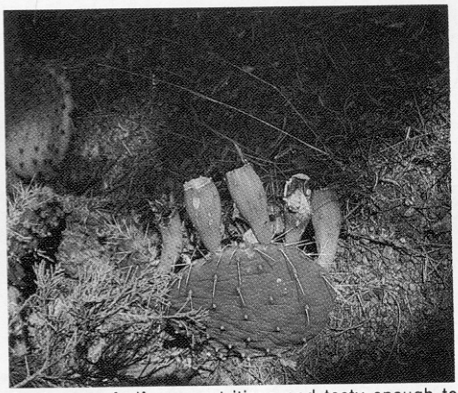
Herbivores can be further divided into groups whose teeth and digestive systems best adapt them for eating particular kinds of plants, such as grasses (elk, for example), or shrubby browse plants (deer), or woody bark and twigs (beaver), and so on. Most carnivores can eat and digest most other kinds of animals, but their bodies have evolved to make them better at catching some kinds than others. Carnivores differ in running ability, size and other factors. Cheetahs, for example, are speedy enough to catch swift prey. A wolf's large size makes it uneconomical for him to wear himself out catching mouse after mouse after mouse; it is better to catch one deer and thus expend less energy per pound of meat caught. Omnivores generally stand a lower risk of starving because they can turn to salads if the meat course is missing, but different omnivores may be adapted to eating different kinds of plants and animals.

Regardless of whether an animal is herbivorous, carnivorous or omnivorous, the whole food chain is based, in the end, on plants. Plants are rooted in those areas that provide the specific kinds of nutrients, water, temperatures, soil quality and other factors required by the specific kind of plant for its life and reproduction. The plant's requirements reflect the fact that each kind of plant has evolved to utilize the particular soil-water-temperature factors available in a particular area.

Because the various kinds of plants are thus rooted in certain areas, the kinds of animals that eat them are likewise ''tied'' to those areas. The larger herbivores and flying animals such as birds can move easily from one area to another to find their preferred food plants. Carnivores, especially the larger ones, can also be more mobile, but in the end they are still ''tied'' to the areas that produce their required or preferred prey. Thus, any area's climate, geographic location, geologic features, soil nature, and water availability determine the kinds of plants and animals that can live and reproduce there. Certain kinds of plants and animals are thus found associated with each other in biotic communities.

Predation and Evolution

A habitat is not, however, simply a series of tables spread for the easy and convenient dining of the inhabitants. Life forms that are eaten by others evolve ways to protect themselves and to compensate for losses of their own numbers. If they did not do this, they would eventually be eaten up, taking with them any group of dependent life forms. Besides producing larger numbers of offspring, prey species stay ahead of the game by a variety of protective strategies, including greater swiftness, camouflaging coloration, strong weapons, hard shells or spines, and toxic or bad-tasting exudates. Even plants defend themselves against herbivores in various ways, such as spines, tough bark, and chemical substances that make them bitter, indigestible, or even poisonous. Animals that eat plants or other animals must in turn develop refinements in the ways they get around the defenses of the eaten.



Pricklypear fruits are nutritious and tasty enough to tempt many animals to brave the prickles for a bite.

Predation, then, is simply one kind of food-getting, a relationship that exists whether we are speaking of foxes preying on rabbits or rabbits nibbling willow shoots. Within any biotic community, however, the various life forms, plant and animal, are related to each other and interact with each other in many ways besides the simple relationship of who eats what or whom.

Evolved adaptations of body form and behavior help ensure a species' survival. The young cottontail does not have to be taught to nibble green plants and keep its long back legs ready to spring from predators.

Competition and Niches

Life forms also compete with each other for the food resources of their habitats. A coyote and a fox might want to make a meal off the same rabbit. The coyote's larger size and longer legs might seem to give it the edge. One could imagine the coyote's catching and eating so many rabbits in an area that the fox got few if any rabbit dinners and starved or left the area. Many factors besides size, however, make the outcome of the competition far from a sure thing. Among them are: differing hunting techniques; size and density of the rabbit population; presence of other dinner-material and the fox's ability and willingness to utilize it; presence or absence of yet other kinds of competitors for rabbit dinners. All too often today, the other-competitor category includes domestic dogs, many of which may be amply fed at home.

Plants, too, compete with each other for their habitat's resources. Seeds of shrubs and forbs may be carried by wind or birds to the floor of a forest of large trees whose tops crowd each other. No understory of shrubbery and forbs will be produced from the seeds if adequate sunlight cannot penetrate to the forest floor. The already established trees are the winners.

A subtler kind of competition is at work where we see a narrow belt of bare ground around a shrub. Only by laboratory analysis do we discover that the root tips of the shrub are producing substances that inhibit the germination of seeds that fall in the area. The substances also discourage the rootlets of other plants from reaching into the shrub's territory — even other plants of the same species. The shrub is really defending its turf.

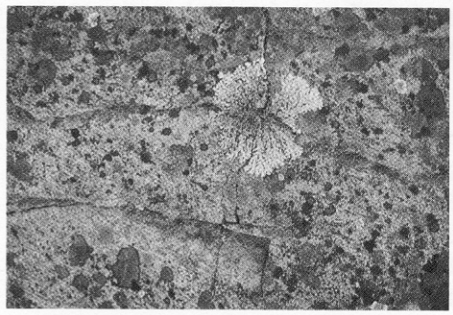
Species that might otherwise compete directly with each other for space also survive by utilizing slightly different aspects of their habitats. Nutcrackers and nuthatches may live in the same pine and piñon trees, one eating the nuts and the other the small insects in the bark. A fine partitioning of the habitat into niches allows more different kinds of life forms to survive in an area.

Partnerships and Parasitism

Some kinds of life forms have developed partnerships with other kinds in order to extract food from their habitats in ways that, alone, they could not do or could not do as well. Lichens are composed of closely associated fungi and algae. Secretions of the fungi dissolve nutrients from rock surfaces, and algae use the nutrients to photosynthesize organic compounds. The fungi cannot photosynthesize, the algae cannot dissolve nutrients from rocks, but both forms survive as a result of their symbiotic partnership. Ruminants such as cows and elk could not digest the cellulose they eat without the microorganisms that live in their digestive tracts. The digested products nourish both the host animals and the microorganisms. The coyote and the badger are said to travel together at times; their individual hunting and digging talents complement each other to ensure a greater production of rodent meals for the pair.

Plants and animals form a worldwide partnership, each utilizing what the other produces to build their own structures as well as to produce what the other partner needs for life. The plants in my room take the carbon dioxide I exhale and combine it, in photosynthesis, with water to produce the carbohydrates of their bodies (which I could eat) and oxygen, which they release to the air and which I breathe. I feed the plants with compost made from parts trimmed from vegetables I eat; decaying plant material nourishes living plants in the wild. The actions of animals — usually insects — pollinate many of the world's flowering plants, enabling the plants to proceed with the process of producing seeds, nuts, fruits and vegetables, by which the plants reproduce themselves and on which many animals feed.

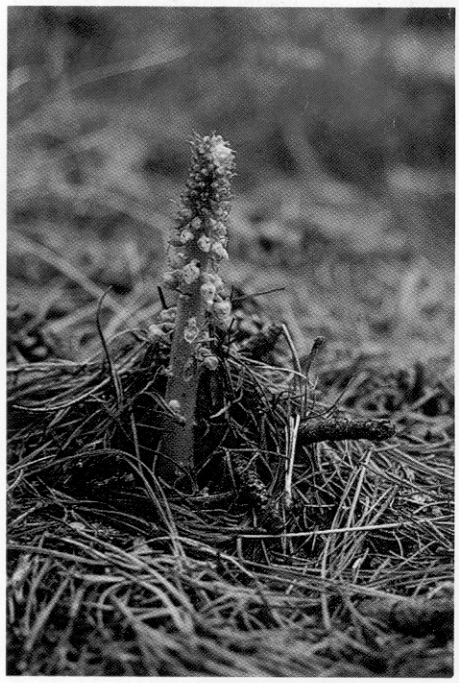
Mushrooms and pinedrops, another saprophyte, feed on nutrients released by decaying organic matter.



Lichens, a partnership of algae and fungi, come in many styles to derive life-support from the rocks.

Often, a close association that looks at first glance like a partnership turns out to be a case of parasitism. The parasite lives on or in its host, drawing its sustenance from the host's body and often causing the host's death, but not before the parasite's seeds or progeny have been released to find new hosts. Many kinds of parasites are found only in specific areas because they are adapted to life in or on very specific hosts or because their life cycles require specific conditions of moisture, temperature, and so on.

While parasites depend on living beings for their lives, some life forms scavenge the dead. There are both animal scavengers and plant scavengers (called saprophytes) such as fungi and bacteria. The actions of soil bacteria decompose dead plant and animal material to release nutrients both to the bacteria and to the roots of plants. Life and death form the ultimate partnership for the production of our wondrous world.



Diversity and Ecological Complexity

An astounding diversity of life forms has evolved to exploit every facet of the physical habitat that can possibly contribute to the sustenance and continuance of life. Under normal circumstances, there are seldom any unfilled niches. The result, as we see it today, is a complexity of life forms and of interrelationships among them that we know and understand only imperfectly. The workings of this house of life earn for it the name ''ecosystem,'' derived from Greek words that mean ''house'' and ''together'' and ''stand,'' a combining of factors to create a house — to shelter life.

No one knows for sure exactly how many kinds of plants and animals exist today in our world. We can count most of the larger life forms: about 20,000 species of fish, 2,600 amphibians, 6,500 reptiles, 8,600 birds, 4,100 mammals, and 250,000 higher plants. The number of smaller forms runs into the millions.

Each species depends on the functioning existence of other life forms and, at bottom, on the normal inputs of air, water and soil from our physical world. Habitats are not just places; they are functioning, interacting ecosystems.

The activities of soil bacteria are affected by the availability of dead plant and animal materials, by the presence and quality of moisture, and by air and ground temperatures. By decomposing dead materials, soil bacteria affect the quantity and quality of nutrients available to plants through their roots. Temperature, climate, hours of sunshine are a few of the other factors affecting the productivity of plants and, thereby, the flow of nutrients through the plant- and animal-eating forms of the ecosystem. Predation, competition, disease and accidents are among the factors that shift the numbers of individuals of various plant and animal species in the ecosystem. The birth or death of any animal affects the ecosystem, if only by decreasing or increasing the resources available to the other animals.

Perhaps we fail to appreciate the enormous complexity of natural ecosystems because we humans create complex structures and systems and we understand our own creations. We can be proud of our computers and space shuttles. Nevertheless, they are still simpler and more easily understood creations than the human brain or a fully functioning animal body or a tropical ecosystem. We understand the structures and processes we provide for the storage, transportation and burning of fuel inside rockets. We are still trying to understand exactly how soluble nutrients inside the small intestine diffuse through intestinal membranes and what the exact nature of the diffusion barrier is. Numerous similar comparisons could be made between mechanical or electronic processes and those of living and interacting organisms. Our own creations are simpler, more readily understood, and they function only when we supply the fuel or power and push the buttons.

Our electronic and mechanical creations develop malfunctions rather frequently. That fact alone should instill in us admiration for the powerful and productive functioning of normal, complex ecosystems. It should also make us respectfully timid about tampering with the workings of ecosystems that took millions of years to evolve to their present state. Yet we tamper, usually with the best of intentions.

The outcome is all too often similar to that following the use of DDT in Borneo for mosquito control. The DDT reduced the numbers of certain predatory wasps that earlier controlled the numbers of certain caterpillars, which now increased and ate the thatched roofs of houses, which fell in. Gecko lizards that formerly kept down indoor housefly numbers died of DDT poisoning and were eaten by house cats, which in turn died. There ensued a plague of rats, which ate people's food and brought the threat of bubonic plague, and Borneo's government had new cats parachuted into the threatened areas.

Habitats - Micro, Macro and Global

How big is a habitat? It seems at first it is just as big as it must be for the particular life form under discussion.

A tiny alpine plant structures a microhabitat within the inches-high layer of comparative warmth above the rocks and thin soil of the otherwise cold habitat of the mountaintops. There it drinks from dews and melted snows and produces flowers. Small insects can live within the warm microhabitat and assist the winds in pollinating their benefactor. Invaders from other larger habitats, however, can destroy this microhabitat by grazing or trampling. This microhabitat's existence could also be affected by worldwide, or even areawide, climatic changes.

Farther down the mountain, the elk herd's existence requires a much larger and more complicated habitat. While the elk is a grazer of grasses, it also needs lesser amounts of the nutrients available from forbs and browse plants. When snows cover grasses deeply, the elk must turn to reachable browse for sustenance. The edges of forest clearings offer the grasses, as well as the browse. In addi-

The microhabitat of small alpine plants can be affected by changes in the larger world beyond.

tion, they provide the readily accessible cover of the forest to hide the elk from predators and from other disturbance for necessary periods of rest and for the birthing and care of vulnerable calves. The elk is large and must also have access to ample supplies of water. Elk survival also requires freedom to seek lower-altitude, less snow-covered pastures in winter and higher summer pastures where plant growth has been restored in the absence of grazing elk and where cooler breezes offer relief from biting and blood-sucking insects.

The elk's requirements for life and reproduction are thus greater and more complex than those of an alpine plant. Satisfaction of these requirements is also derived from a much greater area of habitat. The elk's necessities arrive by way of a larger number of channels of input. In a sense, then, the elk is as vulnerable as the alpine flower because its needs are greater and satisfaction of them can be interfered with in more ways. Livestock, or an excessive elk population, could eat up the elk's grass. Influxes of large numbers of recreation-seekers could create enough disturbance to interfere adversely with the elk's normal scenarios of reproduction and calf-raising. Because the elk utilizes a large area of habitat, chances are increased for contact with disease organisms.

The alpine flower, the elk, we humans, and all life forms are all inhabitants of our global habitat, the earth. The workings of the global ecosystem are vast and complex indeed.

The world's animal life, for example, depends on the oxygen that constitutes about 21 percent of our atmosphere and that is produced by the photosynthetic activities of green plants. That atmosphere also contains nitrogen, which is a necessary part of the protein of animal tissue, but animals cannot obtain the nitrogen by breathing. Instead, certain microbes convert the nitrogen to substances that can be used by plants and thus make it available via the plant-animal food chain. The carbon dioxide produced by animal life is absorbed by oceans and used by green plants in photosynthesis. The system is hard put to cope with vast amounts of carbon dioxide produced today by the burning of fuels in transportation, heating, manufacturing and other facets of human technology. Even small increases in atmospheric carbon dioxide can change the average global temperature with subsequent effects on growing-season length and on rainfall distribution.

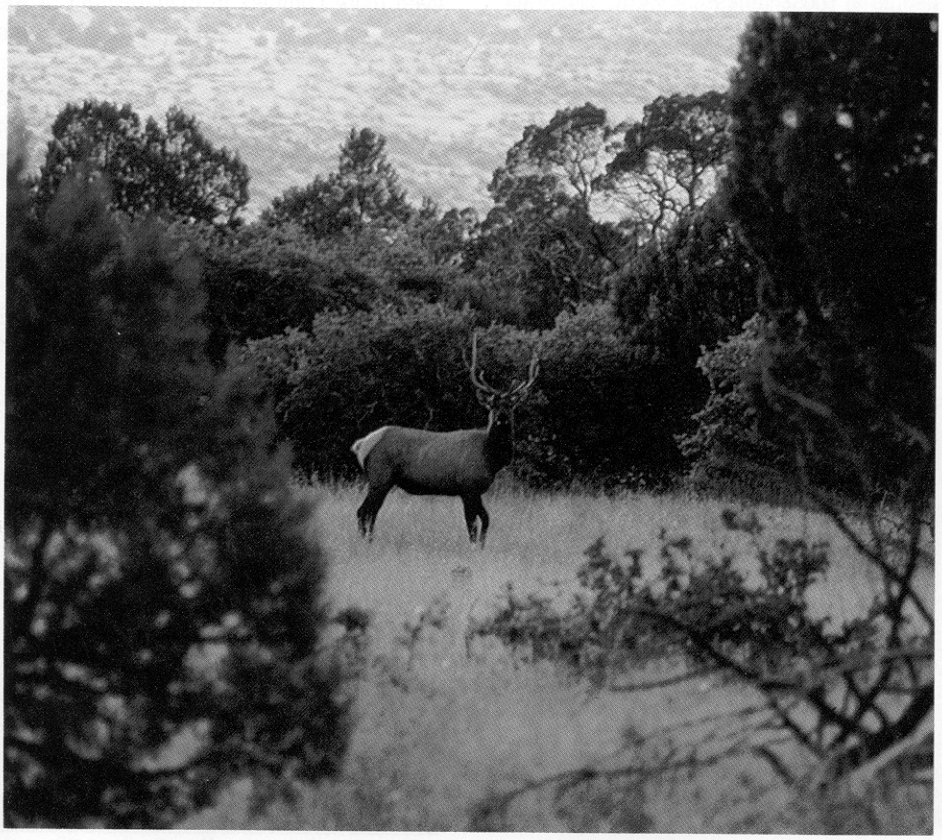
The world's patterns of air circulation, and thus its weather and climate, are affected by the topographical patterns of mountains and plains and by the existence of large forests. The Amazon Basin, for example, recycles much rainfall and causes vast cloudy areas, thereby cooling and moistening such a large region that the world climate is affected.

It takes but little damage to destroy the microhabitat, more to invalidate the macrohabitat, but apparently a vast catastrophe to have a significant adverse effect on the global ecosystem. Note, however, that we do not have to destroy completely the macrohabitat of the elk herd to jeopardize the herd's survival. Just remove the critical winter range, for example, and some elk starve and others are put in too poor condition to produce the usual numbers of healthy calves in spring. Create widespread disturbances at rutting or calving time, and you've added more critical stress.

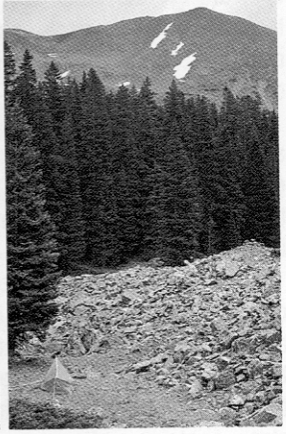
Similarly, the operations of our global habitat are so interdependent that disrupting one function has the potential of causing other parts of the system to malfunction, with significant consequences to the ecosystem's dependent inhabitants. If, for example, the percentages of gases in the world's atmosphere were re-ordered so that oxygen constituted 25 percent rather than 21 percent, it is predicted that forests such as those of the Amazon Basin would burn uncontrollably, with all the consequences of loss of that significant ecosystem. Fortunately, an increase in the atmosphere's oxygen percentage is unlikely, but the example serves to illustrate the fine-tuning of the ecosystem.

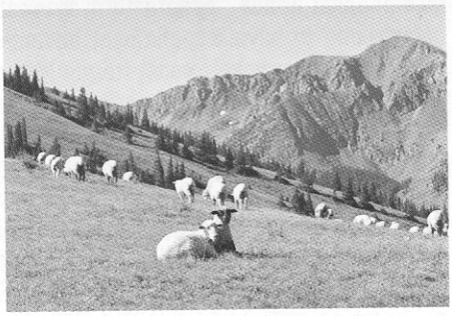
Today, our environment is gradually becoming more acid, apparently primarily because of human activities. As that happens, the atmospheric content of nitrous oxide is increasing, threatening a continuing decline in ozone concentration, the feature of our atmosphere that shields life from damaging ultraviolet radiation.

The point is that our global habitat is vulnerable because its functions are interdependent. Another point is that the numbers and activities of humans are now of such a scale that we can influence — are influencing — the functioning of the global ecosystem.



The macrohabitat of elk is wide and varied. As a result, it is open to many influences.





Some ''multiple-users'' of the high country: domestic sheep, bighorn, and humans.

Habitat Protection and Management

For microhabitats, macrohabitats and global habitats, proper management can prevent or minimize the incidence of some of the potentially damaging events mentioned.

Obviously, the smaller the habitat is, the easier it likely is to manage. To ensure the continuing existence of representative plots of the alpine flowers, it might suffice — assuming climate and other large-scale conditions remained stable — to keep out the animals that might eat up or trample the plants. Over any sizable area, however, that entails problems because those animals may include bighorn sheep, domestic sheep, and humans, among others. Already we must make choices.

To protect and manage habitat for the benefit of elk herds requires a good deal more of us. It's not that we wouldn't know what steps would be good for the elk. That's easy. Removing some of the vegetation of little value as elk food and revegetating ranges with good elk-food plants would certainly help the elk by providing them with more food, particularly if we did this on their vital winter ranges. We could also improve the elk's food supply by protecting the herds' winter and summer ranges from use by animals, such as livestock, that eat what elk eat. If the number of elk increased beyond the ranges' ability to provide ample food for them, we could remove some, by hunting or by transplanting some of them elsewhere, or we could acquire more elk range to allow herds to expand. If elk numbers declined, we could seek and remove the cause of the decline and help numbers rebuild by curtailing hunting and removing predators. If we found that elk populations were declining or not increasing because of excessive disturbance at critical periods of the elk's yearly cycle, we could seek regulations to close elk ranges to entry by people at those times.

''Just one darn minute''? Is that what you said? You're right, of course, but I did say — at the start — that we *knew* what steps would benefit the elk. In the real world, however, our elk habitat is a large area that is not only used to raise elk but also used by people for livestock production, outdoor recreation, homes, timber production, mining, and so on. All these uses, including production of elk, must be accommodated and balanced somehow. This is the multiple-use concept under which we manage our public lands, such as the national forests and Bureau of Land Management lands that make up a large part of our elk habitat.

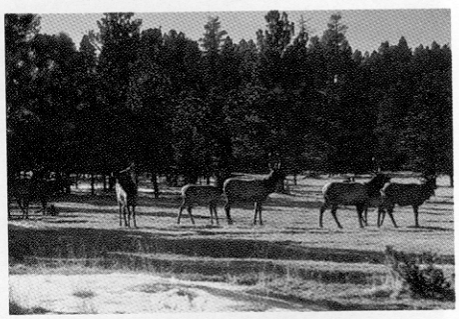
Our elk ranges include, moreover, both these public lands and private lands, such as large ranches, small farms and home areas. The landowner is not obliged to manage his land for the benefit of elk, although some landowners might do this by personal preference or for profit to be gained from sale of privileges and services to persons who want to hunt or view elk on their lands.

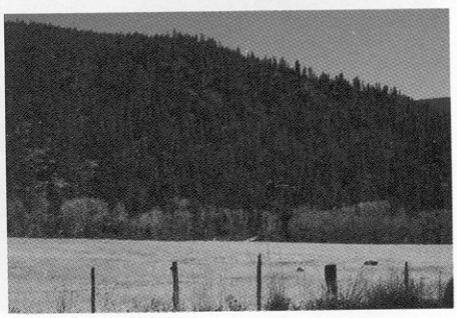
Management of larger habitats, such as elk ranges, is therefore no simple task, complicated as it is by people's quite proper rights and interests in other uses of the same ranges. We would be wrong, moreover, to omit mention of yet another factor that complicates the picture. What about wildlife species other than elk that find their habitats within elk habitat? Alteration of the habitat to benefit elk could conceivably make it less favorable for some other animal or bird that lives there. If this proves to be the case, the relative values to man of various kinds of wildlife must also enter into our habitat-management decisions .

The needs of the elk themselves involve the integrity of the ranges, forests, meadows and streams. Managing the habitat for elk's benefit is therefore unlikely to damage the involved ecosystem's natural capacity to serve us in many ways such as holding soils, preventing floods by retaining snowmelt and rainfall, and purifying water and air. Our problems arise when we try to balance management for elk with all the other justifiable demands for uses of the same habitat. We have used elk as our example here, but the same could be said of managing large areas of habitat for many other wildlife species.

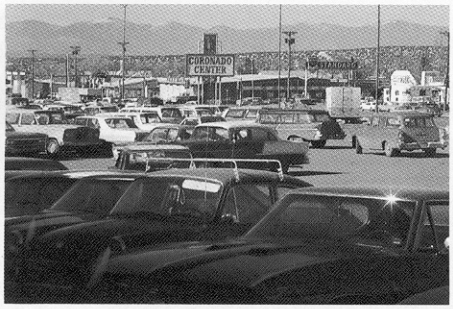
Coordination of competing interests is even more complex in management of the global ecosystem. Let's consider just one case.

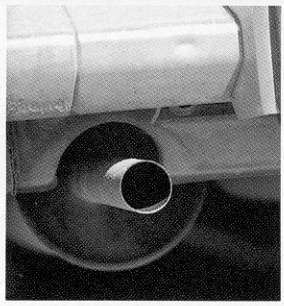
Factory and powerplant stacks and automobile exhaust pipes release oxides of sulfur and nitrogen that are converted in





Elk country also belongs to ranchers.





the atmosphere to sulfuric and nitric acids. Falling as acid precipitation, these substances have raised the acidity of many lakes in the eastern United States, Canada and northern Europe to points at which they can no longer support aquatic life. They also damage soil organisms and result in possible threats to forest ecosystems and other plant life. A switch to other fuels is difficult and expensive and also affects the economy by increasing costs of products and services. Because of air currents, the oxides can be released in one country and fall as acid precipitation in another. Solutions cannot, therefore, be adopted by just one or two countries. Failure to act, however, could have disastrous consequences for both the people and the wildlife of many of the world's countries.

Some areas of our country are less susceptible to the effects of acid precipitation because their soils are high in natural buffers. The West is not immune to harm. California, for example, is concerned that acid precipitation could threaten aquatic life in Sierra Nevada lakes. Significant, and increasing, amounts of mineral acids have been detected in precipitation in the high mountains of Colorado. The area of concern extends into north-central New Mexico.

Large-scale habitat management is obviously a difficult problem.

The Values of Ecosystems

In preceding pages we have already looked quickly at some of these values. The functioning of natural ecosystems benefits us in its effects on climate and on our atmosphere, particularly in replenishment of oxygen. Ecosystems store precipitation and release water that has been purified by its passage through soil. Vegetation protects soil from erosion, and soil is produced and enriched by the decay of plant and animal matter. Other wastes such as the carbon dioxide we exhale are absorbed by plant life. The recycling of nutrients benefits agriculture. Birds eat insect pests, and other life forms destroy other organisms that cause damage or disease. Natural ecosystems produce and shelter myriads of life forms, many of which may prove of use to humans in treatment of disease or as sources of energy and other needed products. Many life forms of natural habitats are already valued as wildlife that we now use and enjoy.

A Brief History of Wildlife Management and Conservation in the United States

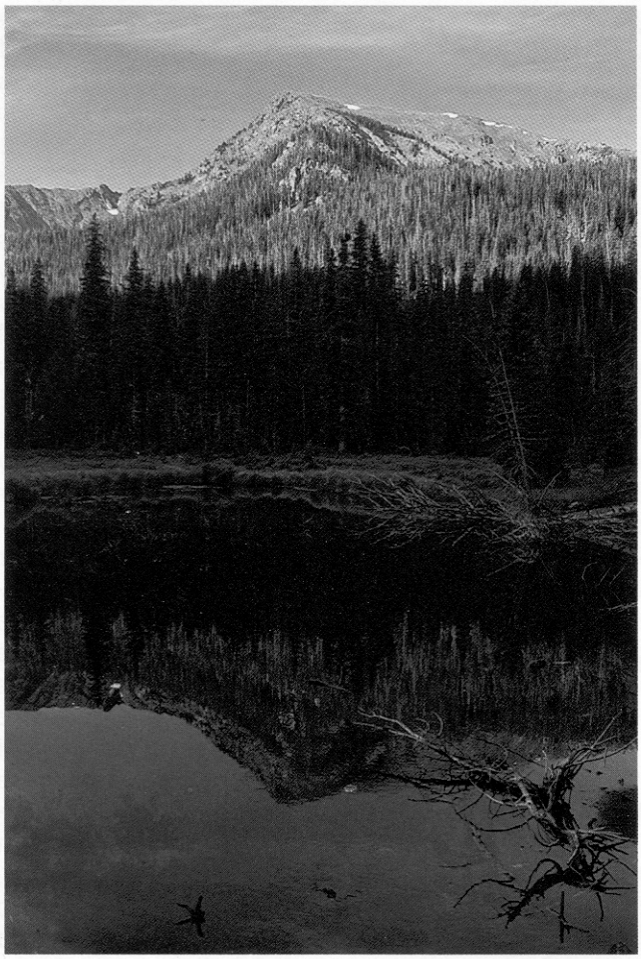
Early in the 20th century, a considerable area of wildlife habitat had already been converted to human uses unfavorable to wildlife, particularly in the eastern United States. At that time, however, wildlife generally was less seriously threatened by habitat loss than by uncontrolled exploitation and deliberate eradication. The ''good'' species were taken in great quantities for meat, fur, hides and feathers, and the ''bad'' species were destroyed to reduce losses of livestock and crops.

Fortunately for wildlife, concerned persons supported passage of protective laws and establishment of agencies to administer those laws. The laws that were passed were almost entirely for the protection of ''good'' species of immediate use to man for products or sport. The science of wildlife management that developed in this atmosphere was primarily one of game management. Nongame species, however, also benefitted when the measures taken included protection of habitat. The past work of the state wildlife agencies has been financially supported almost entirely by hunters, fishermen and trappers through their purchases of licenses and of equipment subject to federal excise taxes that produce funds allotted to state agencies for the restoration of fish and wildlife. Under these programs, the decline of many game species was reversed and their populations were increased.

In recent years, concern has grown for the welfare of nongame species. That concern led to laws and programs for the benefit of rare wildlife faced with possible extinction. Also in recent years, there has been steady growth of knowledge of the workings of ecosystems and awareness of their values. We have come to recognize the benefits — to man and wildlife alike — of richly diversified natural ecosystems in healthy, productive condition. Accordingly, wildlife management today is expanding to include programs for both game and nongame species.

It is therefore fitting that means are being developed to enable persons who may not hunt, fish or trap also to contribute funds for wildlife management programs. Many states now have laws to allow taxpayers to donate their state income tax refunds to their states' work for wildlife. States' general funds are also beginning to finance some wildlife programs. In New Mexico, for example, part of the work of the endangered species program is funded in this way.

Young hawks and young squirrels are among New Mexico's varied nongame species.



New Mexico is fortunate in having thousands of acres of wildlife habitat that range from Sonoran desert lowlands to alpine peaks.

The factor that spurs our concern today for the welfare of *all* wildlife is the accelerating loss of wildlife habitat. Few of our techniques for managing and conserving wildlife can be put into practice unless the habitat is also conserved and managed for wildlife. This makes public interest of paramount importance, because the wildlife-managing agencies own relatively little land outright.

In New Mexico, we are fortunate in having many acres of yet-undeveloped lands that can still provide habitat for wildlife. Our largest wild tracts are those lands that are administered by the United States Forest Service and Bureau of Land Management. The managers of our public lands can be proud of the many benefits that their work has provided to wildlife. Wildlife benefits, however, constitute only one of the many uses of these lands. In New Mexico, much acreage is set aside as wilderness areas, and other uses compete less with wildlife for those particular lands. Despite these advantages, the future of wildlife habitat is not secure, even in New Mexico. Let us look at some of the factors involved.

Energy Development and Biomass Use

Some of the threats facing wildlife habitats today may not drift across international borders as acid precipitation may, but many are deeply affected by international events. The need for oil and other energy sources, for example, is the focus of many of our foreign and domestic policies today. The search for new domestic sources has turned attention to the fossil fuels that could be extracted from the Rocky Mountains. These mountains are also rich in the strategic minerals that many persons consider to be vital to our national security, minerals such as cobalt, chromium, manganese, platinum and titanium.

Even if reclamation projects later attempt to restore soils and vegetation that have been removed for mining purposes, the disturbance to wildlife is exceedingly large. Some species probably cannot be successfully restored in such areas. Energy developments, moreover, cause additional losses of habitat to provide homes, services and recreation to the many workers and other people drawn into the area by the projects.

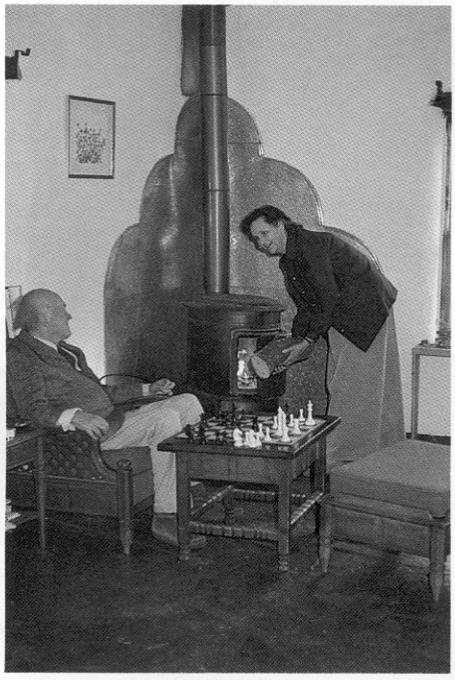
Some scientists are also recommending that agricultural crops and forest products be used as alternative and additional sources of both energy and chemicals. Such sources are lumped under the term ''biomass.'' There are many plant and animal materials from which substances can be extracted for use in the chemical industry and which can be converted to energy. Biomass use can be of residues from crops or trees already being harvested for other purposes. It may also be of crops and trees harvested directly for production of chemicals and energy.

While biomass could provide a renewable source of energy and chemicals, the net benefits are still limited today by high energy costs for collection, transportation and processing. Environmental threats are also seen in resulting soil erosion, water runoff, and nutrient loss, particularly in the use of crop and forest residues.

Much thought must yet be given to biomass proposals. Obviously, too, increasing harvest of crops and trees for

biomass energy and chemicals will have effects on wildlife habitats. New areas may be harvested directly or may be needed for added production of crops when some existing agricultural endeavors are converted from crops for food and fiber to crops for energy or chemicals. If corn is to be grown for gasohol, additional acreage is needed if we are still to produce adequate amounts of corn for people and livestock.

Each of us with a fireplace or wood stove is already a biomass user. As more of us turn to wood to reduce our fuel costs, the managers of our forests have found it necessary to regulate woodcutting to prevent excessive use of particular areas and particular tree species. Supervision of woodcutting is important, too, to avoid excessive destruction of dead trees and den trees that provide homes for many species of wildlife.



Use of wood for home-heating is a growing factor in human utilization of wildlife habitat.

Human Population Growth

The average human population density in New Mexico is still low, 10.7 people per square mile in 1980, as compared to 64 per square mile in the United States as a whole or 979 for a highly urbanized state such as New Jersey. Recent growth of New Mexico's population, however, is rapid and increasing as people choose to retire to or work in the Sun Belt states where home-heating costs can be expected to be less and where remaining natural areas can be enjoyed. While the United States population, as of 1980, had increased nearly ten times since 1850, or nearly three times since 1900, the population of New Mexico has increased over 21 times and nearly seven times in those same respective periods.

Growth in numbers of people is far from the whole story when we consider impacts on wildlife. We are not speaking only of space pre-empted for houses, for service businesses, for farming, ranching, timbering, mining and other activities needed to support the lives of the added people. We are not speaking only of wildlife habitat pre-empted for summer homes and cabins and for commercial recreational developments such as ski areas. We are also speaking of general outdoor recreation, an activity that has acquired entirely new dimensions since 1900. It is no longer an occasional picnic in nearby fields and woods for the adventuresome and the hardy. It has become a technologically equipped, industrially encouraged invasion of even the remotest areas of the wilds. An enormous amount of outdoor pleasure is made available to multitudes of people by today's roads, recreational vehicles, camping equipment and clothing, and efficient and easily portable photographic equipment.

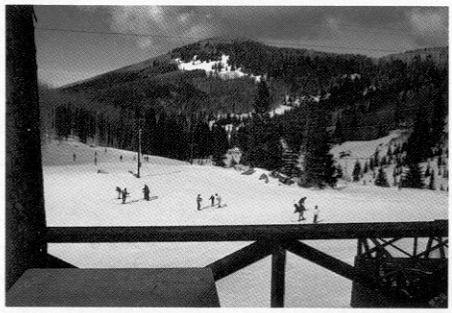
It is, in fact, almost unsettling to realize that, in a state with an average of only ten to eleven people per square mile, recreational use of remote wilderness areas has increased to the point that it must be limited via an entry-permit system to preserve the feeling of wilderness for those who enter. It is also startling to think that increases in people's interest, in accessibility to wild areas, and in portability of fine equipment for viewing and photographing have produced situations in which the nearness of groups of humans has sometimes interfered with birds' nesting activities.

Later, we will return to these subjects with suggestions.

Agricultural Land Trends

In the mid-1900s, persons interested in wildlife's welfare recognized two related facts: (1) Much wildlife habitat had to be converted to agricultural use if people were to be fed and clothed, but (2) agricultural lands could still sustain certain kinds of wildlife if appropriate practices were followed. Accordingly, efforts were made to advise farmers of the benefits available through planting windbreaks, maintaining woodlots, developing farm ponds and stocking them with fish, and avoiding ''clean'' farming that destroyed fence-row vegetation where wildlife might shelter and feed. Those ideas are still good and workable, but today the increase in human population fosters efforts to make every acre produce maximum amounts of food and fiber.

Even more significant is the concern over loss of agricultural lands. In the period 1967 to 1977, 30.8 million acres of the United States' agricultural land were converted to residential subdivisions, industrial sites, cemeteries, sanitary land fills, highway rights-of-way, and other similar uses. Another estimate holds that this conversion now proceeds at the rate of 220 acres per hour. This continuing conversion produces pressure for maximum



Today, human pre-emption of habitat can affect most wildlife more significantly than does direct killing of wildlife.

production from remaining agricultural lands. The situation leaves relatively little room for sheltering wildlife on those lands. In addition, ''clean'' farming becomes more and more a necessary procedure with the use of modern machines for planting, cultivating and harvesting on the huge acreages of today's agribusinesses.

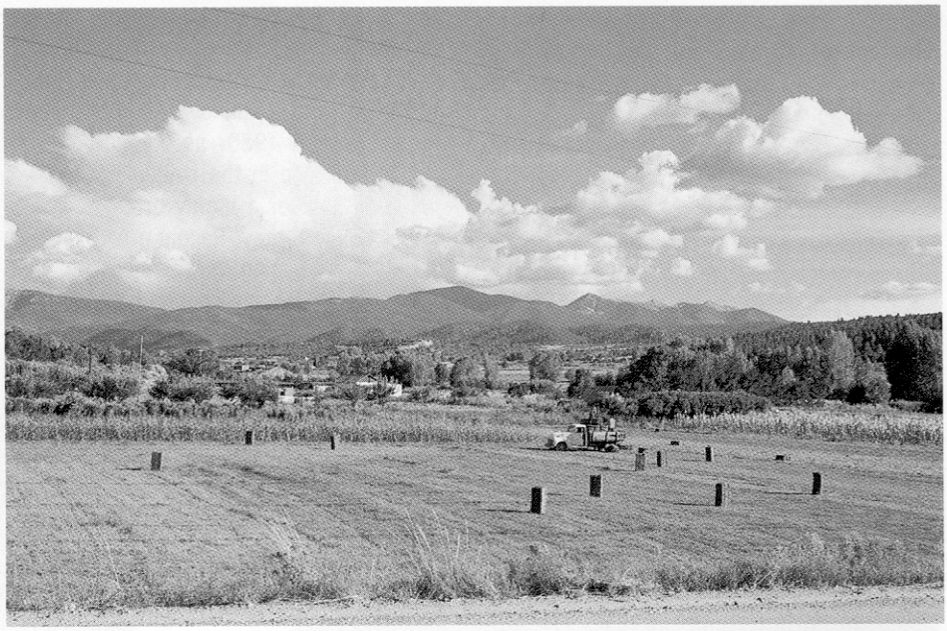
Of even greater importance to wildlife, losses of agricultural land stimulate the conversion of yet more wild lands to agricultural use, in some cases lands of marginal productivity as croplands. For this purpose, forests are cleared, deserts irrigated, and wetlands drained — a total of about 1.3 million acres annually in the United States.

Laws have been proposed in many areas, and adopted in some, to encourage retention of land in agricultural use by providing such land with lower valuation for taxation purposes. The benefit intended is not concerned, of course, with wildlife, but rather with the efficiency and economy of agricultural operations and the resulting benefit to the American public. Nonetheless, such matters have indirect relevance to wildlife habitat.

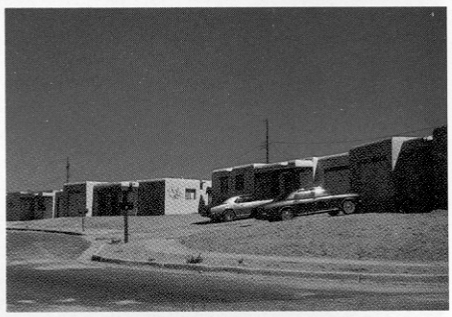
In New Mexico, 290,000 acres were converted from agricultural to nonagricultural use in the 1967-1977 period. In New Mexico, however, 96 percent of the prime farmland acreage is already in cropland use, a situation that also creates pressure to utilize existing farmland fully to produce products other than wildlife.

More of New Mexico's acreage is devoted to livestock ranching than to plant crop production. Both game and nongame wildlife live on these cattle ranches and on their frequently associated grazing allotments on public lands. Hunting of several of the big game species is available on many of the ranches, and a few ranches have chosen to favor big game production over livestock production.

Objections could be raised that habitat management for big game or for big game and livestock combined is not the kind of whole-ecosystem management that might benefit more kinds of wildlife. Nevertheless, private ranches and public lands managed at least in part for wildlife are to be preferred for wildlife conservation to sale of such properties for residential subdivisions. For many years, New Mexico has had a law to provide a lower valuation for taxation purposes for lands used primarily for agricultural purposes but not for those used to benefit wildlife. A landowner who wishes to use his lands to benefit wildlife must usually enter into some agricultural operations in order to avoid the unaffordably high taxes that might result from classification of his land as nonagricultural and residential. High taxes could force the landowner to sell the land for subdivision and wildlife would lose.



Some wildlife can find homes in agricultural areas. When those areas are converted to residential subdivisions, little shelter and food remain for wildlife.



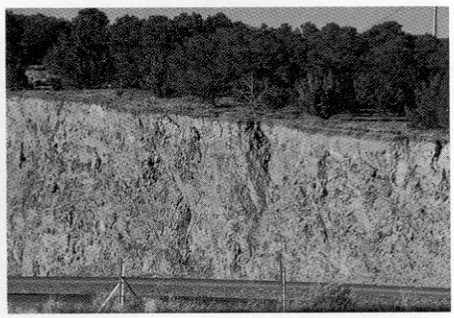
The Significance of Soil Conservation

Yet another significant factor intensifies pressures on agricultural lands today and thus has importance to wildlife habitat. This is soil degradation. Agricultural productivity is lowered when poor management practices cause soils to be compacted or low in organic matter. Use of excessively saline or alkaline irrigation water also makes soils less productive. The chief problem today, however, is soil erosion.

One estimate is that over one square mile of United States topsoil is washed or blown away every hour, another that we are losing 6.4 billion tons of soil annually through soil erosion. Average figures for the United States, however, may be deceptive because soil erosion is more drastic in some areas of the country than in others and on some types of lands than on others. Also, the productivity of some soils is more easily lowered by erosion than is the case with other soils. Nevertheless, the United States Soil Conservation Service in 1978 judged that the average annual loss of eight to nine tons of topsoil per acre was roughly double the acceptable level.

The resulting pressures on agriculture affect wildlife habitat in much the same way as does the loss of agricultural land to urban development. The need to maximize productivity dispossesses more wildlife from farmlands. Soil sediment, moreover, is a primary pollutant of streams, rivers and lakes, reducing their suitability for aquatic life.

Soil erosion and compaction can also affect the quality of wildlife's forest habitat. The way we manage our forests



In much of the Mountain West, topsoil forms only a thin, vulnerable layer over infertile rock and caliche.

from water sources to points of human use. Such measures would damage or destroy wild ecosystems that not only support wildlife but also provide necessities and amenities for human lives.

Genetic Vulnerability

Through the decades, agricultural scientists have developed more productive and disease-resistant strains of corn and other crops. The most productive strains have been widely adopted, and both farmers and consumers have benefitted. Today, however, many agricultural scientists are concerned that the genetic uniformity of the strains so widely used may present a danger.

You will recall that life forms have a way of developing new adaptations to overcome the defenses developed by the plants and animals they wish to exploit. A new form of disease organism or pest, able to overcome the resistance of crops restricted to a very few varieties, could cause significant damage to our food supplies. If several different strains of a crop had been planted, quite likely at least some of them would still be resistant to the new threat. Those who are concerned about this genetic vulnerability urge that many more different strains of the various crops be not only ''banked'' as seed stock but also used in our croplands.

Many persons see the continuing and accelerating extinctions of life forms as a similar, if less immediate, danger to life itself. As the varieties of forms within any species are whittled down to one remaining, the chances increase that a common catastrophe could entirely wipe out the remaining individuals of that species. We are becoming ever more aware of the many values that exist in maintenance of a maximum diversity of life forms. Preventing destruction of the world's, or the nation's, ecological equilibrium and genetic heritage keeps options open for future survival and for future enhancement of the joy of life.

Again, it comes down to conservation of adequate areas of healthy habitat, whether we are speaking of fields for varieties of corn or diversified, functioning natural ecosystems for maintenance of as wide a variety of life forms as possible. Our conservation of habitats can run the whole gamut from large wilderness areas and biosphere reserves to backyard gardens planted with small wildlife in mind.

Three birds of rare occurrence in New Mexico: Gila woodpecker (left, above), least tern (left), and white-tailed ptarmigan. With our help they may be retained among the diverse avifauna of this state.

Band-Aids and Major Surgery

The U.S. Environmental Protection Agency estimates that up to 2 million acres of America's wildlife habitat will disappear annually in just the next 20-year period. While man's needs must be met, and sometimes at the expense of wildlife habitat, perhaps more thoughtful compromises can be made to mitigate adverse impacts on wildlife. What can you — or any of us — do to enlarge the fraction of wildlife habitat that is protected in our multiple-use world?

Broad brushwork in painting a picture of ecological equlibrium can be done by supporting measures that prevent, or even delay as long as possible, major alteration of existing, functioning, large-area natural ecosystems. Wilderness areas and biosphere reserves are examples, as is the Amazon Basin, where large-scale clearing threatens extinction of many species. ''Alteration'' of an ecosystem should be interpreted broadly to include not only mechanical destruction but also slower and perhaps less visible invalidation through pollution. Good existing regulations to minimize air and water pollution should be retained and, in some areas, even strengthened. Research into ways to cope with all kinds of pollution must be continued.

Express your thoughts when public input is sought on projects or planning programs affecting large natural areas already managed at least in part for wildlife's interests and for protection of ecological processes that benefit all life. Knowledgeable advice on such matters is available from biologists in both wildlife-managing and land-managing agencies, such as the state game and fish department, the U.S. Fish and Wildlfe Service, U.S. Forest Service and Bureau of Land Management. In any proposals for relinquishment of existing governmental control of lands used partly or wholly for wildlife, work to guarantee that protection of wildlife values will be assured.

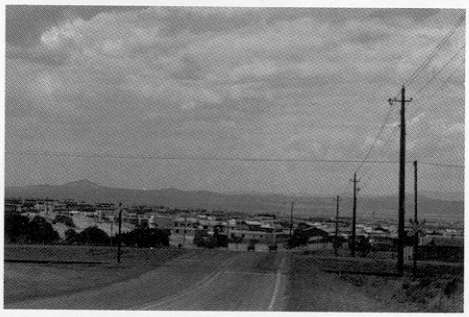
Support the work of agencies and organizations that work specifically for wildlife. Especially deserving of your support are those that directly manage some wildlife habitat and whose advice is sought by owners and managers of other lands, public or private, where wildlife can still be accommodated. Supporting the work of such wildlife agencies means providing not only financial support, but also respect for the agencies' decisions and regulations and helpful input of your own ideas when you disagree.

As urban growth encroaches on surrounding natural areas, your input is valuable in the development of zoning regulations and community plans. Benefits accrue, for example, not only to the community but also to streams and lakes when the natural hydrology of areas under development is retained as much as possible. One way is through retention and natural absorption of runoff water to avoid flash-flooding from highly paved areas. Proper waste management is important, too, to avoid pollution of streams. Even though western states still have much undeveloped land, the preservation of open

Some of the ways we pre-empt and alter wildlife habitat:

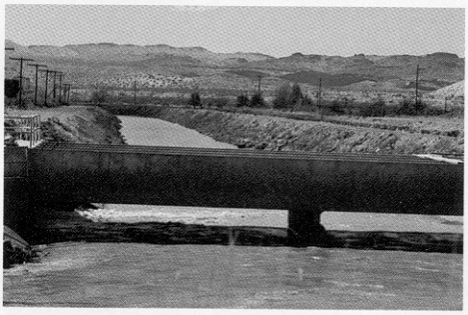
Clearing of vegetation

Subdivision development



Water pollution

Stream channelization



space in planned communities brings amenities to community residents and space for at least some of the otherwise displaced wildlife. The presence of that wildlife will also bring pleasure to the community's residents.

For some people, the presence of wildlife is not a pleasure. Others say they'd enjoy having the critters around if only they wouldn't dig and nibble in the garden, get into everything, and leave such messes. Perhaps you could convince these people that, before turning to poisons and traps, they might try keeping pests out with physical barriers and chemical repellents. Live-trapping and removal to more remote areas could work for some animals; calling the game department to do it is necessary in the case of legally protected species. If the pests are insects, the presence of insect-eating birds could be encouraged and other insects that prey on insect pests could be used.

What we are talking about, at bottom, is changing attitudes toward wildlife. Your own yard and garden might set an example, and the state wildlife agency will be able to help you with suggestions. Providing a dependable watering place is sure to bring in many enjoyable birds, as will plantings that provide shelter, nesting places, fruits and seeds. Many people have begun to garden with native wild plants, but do try to get your plants from specialized nurseries rather than rob the wild. You might also try to interest owners of large tracts and ranches in protecting and enhancing wildlife habitat on their lands; it is another good way of helping to see that private lands also provide homes for wildlife.

On your camping trips, you will of course leave no litter, avoid polluting streams and lakes, and be as gentle on the wild environment as you possibly can. This includes avoiding any harassment of wildlife and especially any unnecessary disturbance of nesting and young birds and animals. You will not drive off established roads. Such vehicle use in arid southwestern lands increases the amount and frequency of water runoff and erosion by decreasing soil porosity and infiltration capacity, and these effects are long-lasting

We can enjoy the sight of many birds and small mammals by attracting them to our gardens with water, food and nesting places.

and result from even slight off-road vehicular use.

Many conservationist groups have developed codes of ethics and lists of recommended practices for outdoor recreationists. Your membership in such groups will benefit you, as well as their work. Your state and federal wildlife and land-managing agencies are also good sources of related information.

All the foregoing suggestions about what you can do to conserve wildlife habitat could be classified as Band-Aids, or at most bandages, on the wounds that continue to occur to wildlife habitat and to the global habitat on which we humans also depend. Major surgery, however, is also needed, and this requires awareness that extinctions of plant and animal species, pollution of air and water, continuing losses of soil and destruction of natural ecosystems do constitute a trend toward ecological degradation. Reversing the trend also entails a willingness to develop solutions even if they require attempts to change basic attitudes and philosophies that may now be proving counterproductive in the continuing existence of life.

When we review relationships between our basic attitudes and the natural environment, one topic we should include is the sensitive and difficult one of human population growth. Today, that growth is about 75 million people a year. The world's human population has grown more in the last 50 years than it did in all the previous thousands of years that human beings existed. Satisfying the needs and wants of all those people draws heavily on a natural environment that is not inexhaustible.

Even if we feel powerless to fight on such a global scale, we in the western United States have much to protect. We are fortunate in being heirs of past efforts to conserve a healthy environment that includes major areas of fine wildlands and good wildlife populations. We are even more fortunate in the wild heritage itself. New Mexico, for example, includes seven life zones, from the lower Sonoran desert to mountain alpine areas. The wildlife of those zones is varied and rich. New Mexico still provides homes for about 140 species of mammals, 435 species of birds, 80 species of reptiles, 22 species of amphibians, and 60 species of fishes. All this is worth keeping, as are the beautiful, productive wild lands in which these animals live.

Education, Ethics, and Existence

In the 1930s and 1940s, Aldo Leopold was already writing about the continuing destruction of wildlife habitat and loss of biotic diversity. He spoke of the needs, not only for increased knowledge of ecological processes and for conservation education, but also for development of ethical attitudes toward the land, which was for him not just the soil but the entire biological ecosystem. Even then, Leopold deplored the fact that past experience and awareness had not produced much in conservation-attuned practices and attitudes. ''Despite nearly a century of propaganda,'' he wrote, ''conservation still proceeds at a snail's pace.''

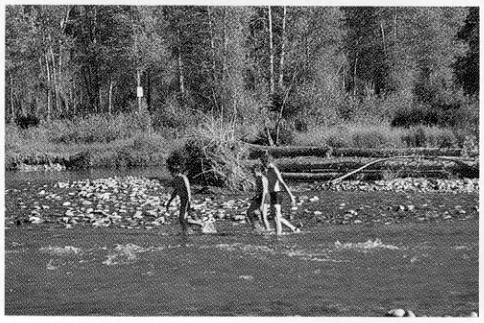
In 1959, Joseph Wood Krutch harkened back to Leopold's words and again noted that, as Leopold had put it: ''Conservation is a bird that flies faster than the shot we aim at it.'' Krutch, too, concluded that conservation knowledge and education

were not enough. ''Hardly two generations ago,'' Krutch said, ''Americans first woke up to the fact that their land was not inexhaustible. Scientists have studied the problem, public works have been undertaken, laws passed. Yet everybody knows that the using-up still goes on.'' Krutch felt that, even more than an ethical attitude, what was needed was ''love, some feeling for, as well as some understanding of, the inclusive community of rocks and soils, plants and animals, of which we are a part.'' He felt that man would be more able to make the concessions needed to ensure continuity of other life forms if he could ''learn to love and to delight in the variety of nature.''

Apparently another incentive for conservation has been added in the predictions of collapses of major portions of the world ecosystem. Surely self-preservation is a good incentive. It may be, however, that many people will not act to ensure conservation until their own individual existences are clearly threatened. By then, the trend toward environmental collapse would be too far advanced to reverse.

Regardless of whether environmental degradation will continue to the point of rendering the human habitat unfit for humans, the extinction of other species continues today, largely through destruction of their habitats. At the present rate, one-fifth of all species alive today will be extinct by the year 2000. Leopold said, ''There are some who can live without wild things, and some who cannot.'' He thought of himself as one who could not, and his concern was based on ethics and love. The projections of today's ecologists seem to indicate that, in the end, none of us can live without wild things, regardless of how much or how little we may love them and regardless of whether or not we are ethically offended by their extinction.

Each bit of habitat saved for wildlife contributes to the preservation of the world ecosystem on which man's own survival depends. Saving habitat for wildlife will benefit our lives in the future, and our souls today.



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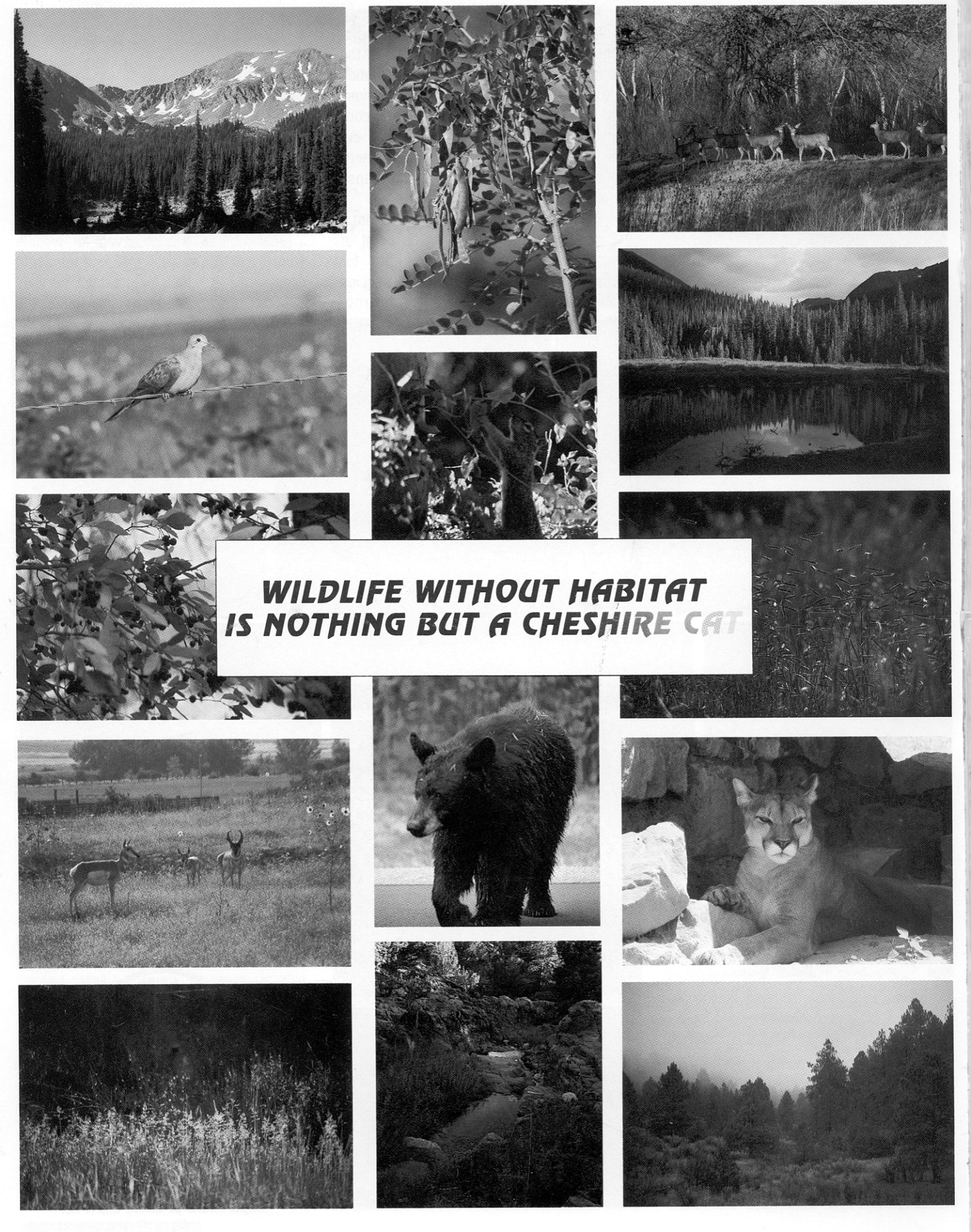
WILDLIFE WITHOUT HABITAT
IS NOTHING BUT A CHESHIRE CAT