

Yellowstone Ecosystem

By Franz J. Camenzind

Editor's Note: The following paper was written for the Greater Yellowstone Coalition, 40 E. Main, Bozeman, MT 59715, and submitted to Park Science by Coalition Director Robert Anderson. Park Science editorial board members enthusiastically favored publication of the Camenzind article, with special attention to its usefulness as source material and as a model for interpretation at Yellowstone and others of the great natural National Parks.

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In the past 20 years the words **ecology** and **ecosystem** have entered nearly everyone's vocabulary and yet attempts to define and apply them to specific areas often end in confusion. **Ecology** literally means the study of the "house" or place where a plant or animal lives (habitat or environment), and **ecosystem** refers to the workings (interrelationships) of all the parts of the "house" (Odum 1971, Whittaker 1970).

Outlining the boundary of any ecosystem is difficult (Evans 1965). In the broadest sense, everything around us plays a part in our lives and it is appropriate to think of the entire planet (ecosphere) as our **environment** and **ecosystem**. This serves to place human beings' position on this planet into proper perspective, but it does not provide us with a politically manageable entity. The area of immediate concern must be reduced to something with tangible boundaries, clearly defined elements and, for our psychological benefit, it must be discrete enough to enable us to think that we can significantly affect its intrinsic ecological interrelationships.

Ecologists have tackled this problem by dividing the **ecosphere** into smaller components. For example, all living things appear as species, all species exist as populations, and all populations of closely interacting species constitute a community. The community interacting with the nonliving components in its **environment** constitute the **ecosystem** (Kormondy 1969, Whittaker 1970).

This approach provides a conceptual definition of an **ecosystem** but problems still exist when the idea is transported from our minds to a geographical location. Where on earth should these boundaries be placed? And where are the components of neighboring **ecosystems** sufficiently dissimilar to form an **ecotone** (ecosystem boundary)?

For example, the survival of many birds that summer in the Greater Yellowstone Region depends upon environmental conditions in the southern states and perhaps all through Central and South America; terrestrial and aquatic habitats and the animals that depend upon them may be altered by acid rain originating far outside the region. Clearly, the summer and winter habitats of the migratory birds are extremely dissimilar and widely separated and yet the species require both to survive. Should these remote winter ranges and the distant industrial sites be considered in the Greater Yellowstone Ecosystem management plan? Ecologically, the answer should be yes, but from practical and political standpoints, they may have to be ignored.

To come to grips with this problem, we must remember that the **ecosphere** is made up of all living



LANDSAT-1 satellite scene shown here covers most of the greater Yellowstone ecosystem. The image was obtained Nov. 23, 1972 in the photographic infrared portion of the electromagnetic spectrum (MSS channel 7). This type of data is used by the NPS as a tool for inventorying and managing park resources via digital image processing and computerized geographic information systems (GIS).

and nonliving components interrelating with one another. The nonliving elements are relatively easy to comprehend and evaluate when compared to the living components, which vary far more over time (evolutionary changes) and space (local adaptations to different environmental conditions). The key concept involves the number and types of **interrelationships** (Kormondy 1969). Biologists and ecologists consider genetic exchange within a population and between adjacent populations of a species to be one of the most important **interrelationships** in nature (Emmel 1976). Genetic variability, which is potentially greatest within large gene pools, enables a species to adapt to changes in the living and nonliving components of its environment. Genetic variability is essential to species survival in the ever-changing **environment** (Ehrlich and Ehrlich 1981).

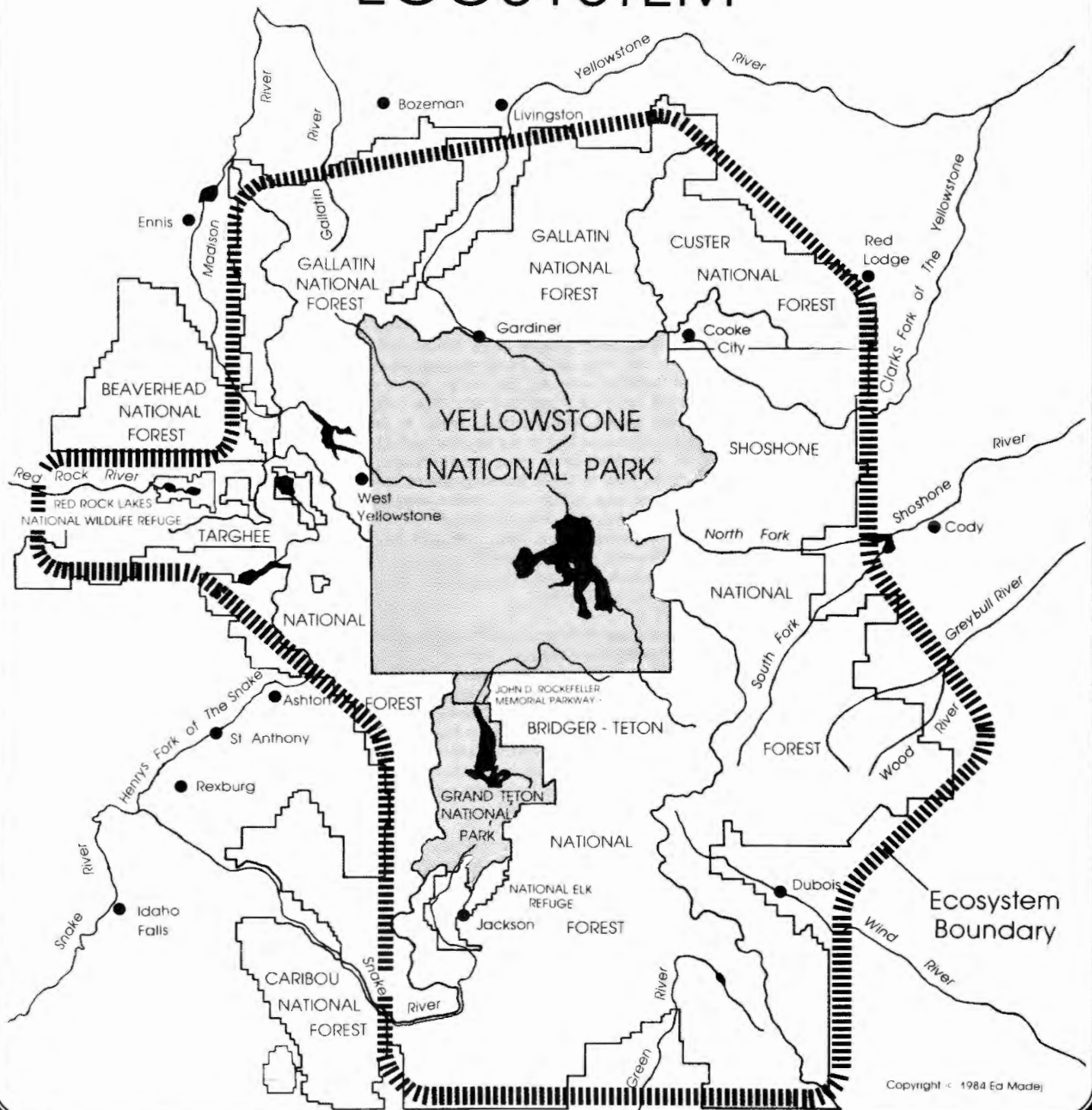
For our purpose we will view the area of northwestern Wyoming, southwestern Montana, and eastern Idaho at two levels: first the Greater Yellowstone Region, second the Greater Yellowstone Ecosystem.

The Greater Yellowstone Region consists of approximately 18 million acres of wild and semi-wild land

characterized by environmental similarity and geographic continuity. Within it lie the headwaters of the Missouri (Mississippi), Snake (Columbia), and Green (Colorado) rivers. It includes Yellowstone and Grand Teton national parks and all or parts of the Bridger-Teton, Shoshone, Targhee, Gallatin, and Custer national forests. It also includes the National Elk Refuge, Red Rocks Lake National Wildlife Refuge, Harriman State Park (Idaho), and numerous parcels of state and private lands. In all, over 25 different political units overlap the area of the Greater Yellowstone Region, each with different jurisdictions and each with different ideas as to how best to utilize and manage the unique natural resources of the area.

Topographically, the Greater Yellowstone Region is comprised of several mainly north-south oriented mountain ranges and the high plateau of Yellowstone National Park. The region is bounded by the Madison and Gallatin ranges on the northwest; the Beartooth Mountains on the north and northeast; the Absaroka Range on the east; the Wind River Range on the southeast; the Gros Ventre Range, Grayback Ridge, and the Snake River Range on the south and south-

THE GREATER YELLOWSTONE ECOSYSTEM



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Boundary clashes are inherent in the situation illustrated here – the Greater Yellowstone Ecosystem (shown in railroad-tie outline) enclosing or crossing the borders of more than two dozen political entities that fall within the Greater Yellowstone Region. The Region, shown here as backdrop for the ecosystem, consists of approximately 18 million acres of wild and semi-wild land, characterized by environmental similarity and geographic continuity.

west; and the Teton Range, Yellowstone Plateau, and Centennial Range on the west. Included are adjacent foothills and lowlands that provide essential winter range for ungulate species that seasonally occupy the higher, mountainous core of the region.

At the core of the Greater Yellowstone Region lies the Greater Yellowstone Ecosystem. From a practical standpoint, an **ecosystem** is an area that functions largely as a self-contained, natural unit, requiring little more than air, water, and radiant energy from outside its boundaries to exist in perpetuity. The core of the Greater Yellowstone Region approximates such an **ecosystem**; within it occur most of the components present when the area was first discovered by the furtrappers and explorers 150 years ago.

The major topographic features of the Greater Yellowstone Region are relatively young. Most of the surface of Yellowstone National Park was formed by volcanic action approximately two million years ago and by more recent glaciation (Sutton and Sutton 1972). Much of the Teton Wilderness and the Absaroka Range are covered by material from this and earlier volcanic activity (Smith and Peltan 1979, Smith and Christiansen 1980).

The Teton Range is an uplifted, fault block mountain range of relatively recent origin (less than 10 million years ago). The gneiss and schist which form the mountains are approximately 2.5 billion years old and very resistant to erosion. This, coupled with the short time they have been exposed to erosion and sculpturing by glaciers accounts for their rugged and sharp features (Love 1968). The most recent major geologic influences upon the land immediately east of the Teton Range (Jackson Hole) were the glaciers which swept south out of the Yellowstone highlands as recently as 15 thousand years ago. These glaciers deposited layer upon layer of finely ground mineral material throughout the valleys and left moraines and lakes as they retreated; consequently, the soils of much of this region are young and poorly developed (Love 1968).

The origin of the Wind River Range is similar to that of the Tetons, but much older (perhaps 50 million years old). The Gros Ventre Range, Grayback Ridge, and the Snake River Range are all of sedimentary origin. The Gros Ventres have been uplifted and moderately folded, while Grayback Ridge and the Snake River Range have undergone extensive folding and thrusting, forming the Overthrust Belt (Blackstone 1971), which has potential for oil and gas production.

These and many other physical features have influenced the plant and animal communities as well as the mineral wealth and subsequent human and industrial development of the Greater Yellowstone Region.

Situated as it is at the headwaters of three of our nation's major river systems, it is not surprising that at least seven floras of quite distinct compositions and histories coalesce in the Greater Yellowstone Region. A southern Rocky Mountain flora includes species such as Englemann spruce, Colorado blue spruce, Douglas fir, limber pine, Rocky Mountain juniper, narrowleaf cottonwood, green gentian, and Parry's primrose. There are more members of the Pacific Northwest flora (Sitka-Oregonian flora (Taktajan 1978,

Cronquist 1982)) such as beargrass, false huckleberry, shootingstar and Sitka alder. Prominent members of the Great Basin flora include several sagebrush species, antelope bitterbrush, winterfat, mountain mahogany and balsamroot. Northern Rocky Mountain floral elements include lodgepole pine, subalpine fir and whitebark pine as well as western mountain ash and Scouler willow. The Boreal North American floral elements include white spruce, prostrate juniper, balsam poplar, quaking aspen and one-flowered wintergreen. In addition, two more or less circumpolar floras are represented: the boreal (dwarf juniper, tufted hairgrass, kinnikinnick, fringed sagebrush and white wintergreen) and arctic-alpine (Dorn 1977, Booth 1966, Davis 1952, Hitchcock and Cronquist 1973).

The combination of diverse plant communities, rugged topography, high altitude, and remote location has enabled the Greater Yellowstone Region to maintain a diverse and relatively intact fauna. Some of the species key to the region include the bald eagle, osprey, peregrine falcon, great gray owl, whooping crane (Dorn 1979), trumpeter swan (Banko 1960), grizzly bear (Craighead 1979), blackfooted ferret (Clark 1983), bison (Meagher 1973), bighorn sheep (Honest and Frost 1942), moose (Houston 1968), fisher, wolverine, river otter, pine marten, lynx, and mountain lion (Weaver and Clark 1979). Few if any of these species were historically unique to the Greater Yellowstone Region, but they now exist only in this area (black-footed ferret) or occur nowhere else in the "lower 48" United States in greater concentrations (elk, bison, bighorn sheep, moose, whooping cranes (summer populations) and trumpeter swans). Some indigenous species, notably the wolf, have been eliminated, but the potential for restorations of these species exists so long as the ecological integrity of the region is maintained.

Unfortunately, wildlife populations do not recognize the bold political boundaries described by the 25-plus political units that overlap the Greater Yellowstone Region. Many species, particularly ungulates, require areas within several different jurisdictions and even some far removed regions to complete their life cycle. Consequently, the **ecosystem** boundaries seldom follow the political boundaries; instead they are constantly being redefined by the varying requirements of the diverse wildlife populations.

Because our knowledge of the ecological requirements of many of the species present in the Greater Yellowstone Region is incomplete, the boundaries for the **ecosystem** must remain vague. The most important point to remember is that an **ecosystem** must contain all the elements required to perpetuate all species indigenous to the area. In this case, only the habitats located within the Greater Yellowstone Region will be considered as part of the Greater Yellowstone Ecosystem. Our larger area of concern, the Greater Yellowstone Region, can be more specifically, although somewhat arbitrarily, defined by including all lands ecologically similar and geographically contiguous. If we err, we must err in favor of the resource by concerning ourselves with too large rather than too small a region.

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