

SOME ECOLOGICAL CONSIDERATIONS ASSOCIATED WITH RIVER RECREATION MANAGEMENT

Stewart W. Aitchison, *Field Biologist*
Steven W. Carothers, *Head, Biology Department*
Museum of Northern Arizona
Flagstaff, AZ

R. Roy Johnson, *Senior Research Scientist*
National Park Service
Grand Canyon, AZ

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ABSTRACT.--Drawing from an ecological study on the Colorado River, four river recreation management concerns are discussed: (1) river research vs. river management--their interrelationships and priorities; (2) extensive resource inventories--their role as indicators of environmental deterioration; (3) human impact--its identification and proposed mitigation; and (4) suggested guidelines for identifying unique and ecologically sensitive areas. Other environmental degradents not directly associated with human impact, but nevertheless a source of concern for river managers, such as habitat destruction by wild asses are also discussed.

River management is a new and challenging discipline. Within the last few years use of our wilderness rivers has increased explosively, creating a myriad of problems for the various State and Federal agencies entrusted with the care of these resources (Huser 1975). Many managers lack basic information about their particular river: for instance, what kinds of plants and animals occur in the river and on its beaches; what effect do river users have on wildlife; how many people can the beaches support without causing irreversible damage; how many campsites are there; and so on. Realistic management plans cannot be developed without this information. I would like to consider the development of such information as it applies to the Colorado River through Grand Canyon National Park, perhaps the ultimate in white-water travel.

Between 1967 and 1972, river running in the Grand Canyon grew from 2,099 users to 16,432, an increase of 682 percent. This alarming user-growth rate forced the National Park Service to limit the number of boaters. The commercial allotment for 1972 was set at 105,000 passenger days (pds). Of these, only 88,135 were used

so for 1973 the allotment was lowered to 89,000 pds. In 1973, 86,264 pds were used, therefore the 89,000 figure has been maintained to date.

The National Park Service quickly realized that this tremendous increase in the number of river runners was damaging portions of the rivering environment. Another consideration was that the quality of the river experience was in jeopardy as a direct result of increasing numbers of users. Additionally, private users complained that permit allocations were prejudicial in favor of the commercial outfitters. These and other problems added to the complexity of determining an equitable management solution.

RESEARCH PROGRAM

In 1973 the National Park Service initiated a multidisciplinary research program designed to examine the physical, sociological, and ecological factors affecting the carrying capacity of the river environment (Aitchison 1976). From 1973 to 1976 investigators from more than a dozen research institutions par-

ticipated in this project (Johnson and Martin 1976).

The road from recognition of a problem through research to development of management alternatives and then, finally to actual implementation of a management policy is long and difficult. River recreation on the Colorado River within the Grand Canyon has proven to be no exception.

User Impact

Information concerning the spatial use patterns of the river runners was sought. Through a "visitor usage card" given to each trip leader, data on campsites used, number of people in party, whether or not a wood fire was built, whether or not the contents of the portable toilet were buried, etc., were obtained. Surprisingly, the results showed that more than 300 campsites were used along the 280 river miles between Lee's Ferry and Pierce Ferry. The next obvious step was to identify and categorize the types of human impact. Impacts or problems discovered included fire, littering, trampling of vegetation, and human waste disposal.

Fire is integral to any natural terrestrial ecosystem. However, man-caused fires are generally detrimental. In riparian systems impact may range from small sand-scarred fire-rings to entire stands of beach vegetation being consumed in a holocaust. In Grand Canyon, fires have been caused by careless burning of toilet paper. Short-term biological effects may include elimination of actual or potential wildlife nesting sites, foraging sites, and displaying sites. Large burns may kill or force movement of certain animals and may encourage the introduction of non-native pioneer species.

Littering, and this includes the practice of dumping juices out of canned food and leftover organic waste at campsites, may increase populations of certain noxious insects or vertebrates. In the Grand Canyon, heavily used campsites seem to have correspondingly higher densities of harvester ants (*Pogonomyrex californicus*), commonly known as red ants. Because of its painful, toxic sting, this species presents a minor health hazard to the camper. The flesh fly (*Sarcophagidae*) and blow fly (*Calliphoridae*) populations also show

this increase at "messy" campsites. These insects could become a source of fly-vectorized diseases.

The increases in insect populations have also caused an increase in certain vertebrates. Lizards congregate near dirty campgrounds. Two exotic bird species, house sparrow (*Passer domesticus*) and starling (*Sturnus vulgaris*), have been introduced in remote areas, specifically the Deer Creek and Granite Park areas, primarily through the improper disposal of garbage. Four species of mammals (skunks, *Spilogale gracilis*; ringtails, *Bassariscus astutus*; rock squirrels, *Citellus variegatus*; and mule deer, *Odocoileus hemionus*) have increased in high-use areas, probably as a result of an increased food supply. Unfortunately these unnaturally high densities have caused these mammals to be in poor health, creating a potential human health hazard.

An outstanding direct impact caused by the river user has been vegetation trampling. In many areas multiple trails, all with the same ending and beginning place, are maintained simply through large numbers of people trampling the vegetation. This condition invites accelerated soil erosion and dramatically changes the flora of these areas. On the other hand, some beach areas would probably become uncampable if the vegetation (such as the exotic salt cedar, *Tamarix chinensis*) were not held in check through this trampling.

Human waste disposal is a concern everywhere but even more so when the number of campers is high, the areas for burial of sewage are limited, and decomposer bacteria are scant. This is the situation in the Grand Canyon. Even after a year fecal coliform bacteria were still viable in the beach sands (Knudsen *et al.* In press). Because of this and limited burial areas, it is not uncommon to unearth a previous human waste dump when digging a hole to empty your portable toilet. A potential health hazard exists with a solution still in the future.

Of great interest are our rather surprising results concerning the amount of impact versus the number of users. No significant correlation was found between the number of campers and the total amount of impact. It appears that small to large

groups are capable of producing about the same amounts of impact. Perhaps Grand Canyon beaches have a very low threshold of tolerance for users. Or more probably the camping practices play a more important part in determining impact than total numbers of campers. For managers this implies that setting carrying capacity limits based simply on total users may not alleviate environment degradation; modifying visitor behavior may be the solution (Lime and Stankey 1971).

Along with delineation and quantification of the various types of human impact there is also a need to identify biologically unique or ecologically sensitive areas. The guidelines for doing this would vary somewhat for each specific river. For example, along a silt-choked desert river, clear side tributaries become an important habitat to much of the native wildlife; whereas, on a mountain river, a quiet pool may be biologically important for breeding fish. The point is, the expertise of the ecologist is needed to decide what areas in or adjacent to the river must receive top priority in terms of protecting the biotic resource.

The biologist working in Grand Canyon is greatly handicapped by a lack of previous research. Even though John Wesley Powell did his pioneering geologic investigations more than 100 years ago, the first extensive, systematic biological work did not begin until 1970, seven years after construction of Glen Canyon Dam (Wertheimer and Overturf 1975). Without extensive resource inventories there is no way to discern whether or not changes are taking place. Biological inventories of plants and animals, their types and numbers, their location and habits, and other pertinent information all aid in establishing a bank of data to be drawn upon by the field ecologist.

Impact of Glen Canyon Dam

Probably far exceeding any damage the river runner could inflict upon the Canyon have been the effects of Glen Canyon Dam. In 1963, the gates of Glen Canyon Dam were closed and the river ecosystem was altered by the hand of man as never before. Instead of a river of mud and silt, "too thick to drink and too thin to plow", a clear, cold green flow was released from the dam. Indigenous fish species were

reduced in numbers because of cooler water (Suttkus 1976). Annual scouring and replacement of beaches by high volume flooding has been eliminated. An entirely new, primarily exotic riparian community has developed.

For Colorado River rafters, the hydroelectric dam presents mixed blessings. On the one hand, daily river level fluctuations now occur in response to power demands in distant cities. Sometimes these fluctuations make certain rapids unnavigable. Commonly a boat moored at "high water" is left high and dry by next morning's "low water". On the other hand, controlled release of water makes trips possible during dry years when natural runoff would have been insufficient to float a boat. Also, the relatively clean, clear water is welcomed for drinking and bathing.

The river manager is essentially dealing with a man-made ecosystem, a somewhat ironic situation when one remembers that the National Park Service is charged with the protection of our natural and supposedly native habitats. How does the manager confront this dilemma? He or she has two alternatives: (1) lobby for the removal of Glen Canyon Dam, that would return the Colorado River ecosystem to its native state, or (2) manage the existing river environment as if it were the native condition. At the present time, alternative 1 is not practical (however, future environmental conditions and political considerations may change this). Therefore, at this time, alternative 2 is the only choice the manager has. He or she must consider the management of the changing Colorado River ecosystem with the conservation ethic of the National Park Service as the prime guideline.

Animal Impacts

In the Grand Canyon, the presence of Glen Canyon Dam and the numbers and activities of river recreation enthusiasts are not the only problems facing the manager. Recent investigations (Carothers *et al.* In press) have demonstrated that the feral ass (*Equus asinus*), descended from released or escaped domesticated stock of early explorers and prospectors, is causing serious damage to the river

resources and to some extent interfering with the quality of the river recreation experience. For the most part, the impact of the feral ass is concentrated in the western portion of the Grand Canyon and the damage is mediated in the form of overgrazing, trampling, soil compaction and the fouling of campable beaches. Many areas within the National Park are suffering irreversible damage. The management implication here is clear: these animals must be removed from the Park.

RESEARCH IMPLEMENTATION

Once research has been completed, management alternatives can be proposed. Sometimes these recommendations conflict with current management policy; sometimes they require the manager to reexamine his goals.

River research can *only* answer *how* impacts are being made and then suggest appropriate mitigation. River managers, on the other hand, in addition to considering ecological factors, must also consider certain political and economic constraints before deciding what becomes an "acceptable" level of impact. This, of course, is a complex problem and not necessarily based on resource impact. Priorities must be examined. What becomes acceptable impact in the middle of a crowded campground may be totally unacceptable in a primitive setting. Perhaps a partial solution lies in defining the resource (Leonard 1976). For example, if an area is defined as Wilderness and to be managed as such, then legal constraints serve as guidelines for the manager.

Unfortunately, implementation of the

management policy may be the weakest link in the chain, especially if the new policy differs greatly from previously enforced regulations. The river user stubbornly refuses to accept new regulations, preferring to stick to "old and accepted ways". Some openly defy managers; others are simply ignorant of the new rules. Education of the river runner may be one solution, because regulations are usually easier to accept when the rationale behind them is understood.

Specific management objectives, purposes, and regulations must be devised for each river system. A generalized plan does not work because each river is unique. What may be applicable to a slow-moving desert river may not be appropriate or practical on a rampant mountain torrent.

SUMMARY

We have seen then, that the ecologist's role in river management is an important one. He or she must inventory this biotic resource, identify the types of river running and related impacts on the biota, and recommend appropriate alternatives to the river manager. Additionally, the ecologist can suggest guidelines for identifying unique and sensitive areas to help in preserving the naturalness and wilderness aspect of our National Parks.

Then the manager must establish and implement policies. Time is short; these management decisions must be made now, tempered with continuing ecological research. If management procrastination persists and bureaucracy red tape prevails, we may lose our wilderness rivers.