

## MID-ATLANTIC REGION

# RESEARCH/RESOURCES MANAGEMENT REPORT

U.S. DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE



MID-ATLANTIC REGIONAL OFFICE  
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APPROPRIATE RIVER RECREATION USE STUDY

Identification and Preliminary Analysis  
of River Recreation Impacts on Fish  
and Wildlife:

The New River Gorge National River

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## Abstract

The goal of this research project was to identify wildlife species on the New River Gorge National River that are or might in the future be impacted by river recreation use. Telephone interviews with 20 people believed to be knowledgeable about wildlife on the river identified 8 potentially impacted species. A questionnaire was then sent to the experts to obtain more information on the nature and seriousness of the perceived impacts, behavior of recreationists causing the impacts, and possible strategies to reduce impacts. The survey also provided the respondents the opportunity to add other species to the study list, and 16 additional species or types of animals were listed.

While opinion among experts varied a great deal, there was greatest consensus and concern about impacts to wood ducks and black bears. Several respondents felt that recreational activities are altering the distribution of wood ducks during the nesting season, resulting in increased predation and possibly causing a population decline. Experts expressing concern about black bears most often cited encroachment upon existing or potential habitat by recreationists in boats or ORVs. Besides the wood duck and the black bear, only two species, the turkey and the turkey vulture, were listed as receiving the very serious current impacts by at least one expert. None of the species listed by the study participants have rare or endangered status, but three (the black duck, red-shouldered hawk, and screech owl) are on the Audubon Society's blue list. This list includes birds

believed by regional experts to have shown significant population declines in recent years.

Respondents were not able to provide much detail on the specific location of the impacts or on management programs to reduce them. This likely reflects lack of knowledge about recreational use patterns, user characteristics, and the complex relationships between recreation use and impacts. Increased monitoring of recreational use patterns, species populations, and species' distributions is needed. Species showing declines should be examined in more detail. The Park Service should determine management goals for these species, specify criteria for defining unacceptable recreational impacts, and identify all factors contributing to the change in abundance.

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## INTRODUCTION AND OBJECTIVES

Nonconsumptive uses of wildlife have increased dramatically in recent years, and research suggests that such values may outweigh direct consumptive values (Shaw and King 1980, Lyons 1982). Resource planners and managers in agencies such as the National Park Service must not only respond to the growing demands for wildlife study and observation, they must also assess the impacts of these and other recreational activities (rafting, camping, etc.) on wildlife and wildlife habitat.

Boyle and Samson (1983) recently published a bibliography with 536 references on the effects of nonconsumptive outdoor recreation on wildlife. In addition, bibliographies by Ream (1980) and Hall and Dearden (n.d.) contain many references dealing with such impacts. However, most of the cited papers are anecdotal in nature, while long-term, quantitative studies are rare (Boyle and Samson 1985). Only a relatively small proportion of the studies considered riverine wildlife species or habitats. There have apparently been almost no studies of recreational impacts on wildlife on National Park Service rivers in the eastern United States. Dawson et al. (1981) found no specific data on recreation impacts to fish and wildlife on the Upper Delaware Scenic and Recreational River. Managers of New River Gorge National River and the Delaware Water Gap National Recreation Area know of no such study in their areas.

The few studies dealing with recreational impacts in riverine environments have indicated that wildlife impacts may occur along high



use rivers. Boating has caused waterfowl and bald eagle behavioral changes and movements to less disturbed areas on the Mississippi, Skagit, and Nooksack rivers (Thornburg 1973, Batten 1977, Knight and Knight 1984, Stalmaster and Newmann 1978). Camping along rivers can reduce habitat diversity by trampling of vegetation and compaction of soil (Liddle 1975). This can increase the numbers of some common or widespread wildlife species, but reduce the overall number of species and diversity of wildlife (Garton et al. 1977, Guth 1978). Visits by recreationists to passerine and waterfowl nests can increase nest losses to predators (Dwernychuk and Boag 1972, Bart 1977, and Lenington 1979). Colonially nesting birds are particularly vulnerable, and disturbance by recreationists can cause nest abandonment (Hunt 1972, Ellison and Cleary 1978), trampling of nests (Johnson and Sloan 1976), intraspecific predation (Hand 1980), and interspecific predation (Schreiber and Risebrough 1972, Anderson and Keith 1980).

Wildlife observers and photographers seek out and approach wildlife, especially rare or unusual species. Ospreys and eagles are a favorite target on and along rivers. Research on the impacts of such activities has produced mixed results. Some indicate little impact due to human intrusion (Ames and Mersereau 1964, Schroeder 1972, French and Koplín 1977), while others suggest that human disturbance may significantly impact reproductive success (Garber 1972, Swenson 1979).

Rock climbers on cliffs in riverine environments may disturb nesting raptors (Olsen and Olsen 1980) and other cliff-dwelling

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Rock climbers on cliffs in riverine environments may disturb nesting raptors (Olsen and Olsen 1980) and other cliff-dwelling

species. Disturbance of even one nesting pair of rare or sensitive species, such as the peregrine falcon, may be unacceptable.

Finally, Marnell et al. (1978) have reported concern among river managers in the Ozarks that canoeists were disturbing stream substrates near beaches and popular camping spots. This may be reducing or locally eliminating such benthic invertebrates as mayflies and stoneflies. Also, this Ozark research indicates that recreational watercraft disrupted the nest guarding behavior of male longear sunfish and caused temporary nest abandonment. This appeared to result in increased nest predation.

The research presented here had two broad goals: (1) to determine if knowledgeable individuals felt that recreation was affecting fish and wildlife on the New River Gorge National River Area; and (2) to use information acquired in this manner to suggest strategies managers might use to lessen such impacts. More specific objectives are:

1. To identify fish and wildlife on the study river that appear to be currently impacted by river recreation. Particular attention will be given to sensitive, rare, and endangered species.
2. To estimate the kind, extent, and severity of current recreation impacts upon fish and wildlife.
3. To identify fish and wildlife that will likely be impacted if river recreation use continues to grow.
4. To identify critical fish and wildlife habitat that is or will likely be impacted by river recreation use.

5. To identify the river use or user characteristics that appear to cause the fish and wildlife impacts.
6. Where possible, to suggest management programs to both reduce fish and wildlife impacts and maintain high quality river recreation experiences.
7. Where possible, to suggest a program of research to gain information to reduce critical impact problems.

#### PROCEDURES

Two strategies were used to identify and gain understanding of the impacts of recreationists on wildlife within the New River Gorge National River. The first was to obtain lists of the fish, birds, and mammals of the river from area managers, area wildlife inventories, and state lists. A general literature review was then completed to document studies of recreational impacts on these species and their habitats.

The second strategy was more focused. We identified and questioned area managers, scientists, and other people knowledgeable about New River Gorge wildlife to obtain their opinions on the amount, type, location, and severity of recreational impacts on wildlife and wildlife habitat. This was done in a two-step process. First, we asked the area's resource management specialist to suggest the names of people knowledgeable about the river. We interviewed these individuals by phone to obtain preliminary lists of possibly impacted species, reasons for the impacts, and names of other individuals believed to

be knowledgeable about the subject matter. These individuals were then telephoned to obtain their views, and they too were asked to provide additional names. This iterative process continued until the same names kept reappearing. Twenty "experts" were thus identified for the New River Gorge (Appendix A).

We then developed a questionnaire to obtain additional information from the study participants. The survey form (Appendix B) requested opinions on (1) wildlife species currently impacted or likely to be impacted in the future by river recreationists; (2) the seriousness of such impacts; (3) the nature, location, time and consequences of the impacts; (4) the recreationists' characteristics or behavior causing the impacts; (5) possible means to reduce the impacts; (6) and the existence and severity of detrimental alteration of wildlife habitat. After a postcard reminder and two questionnaire follow-ups, 14 of the 20 experts (70%) returned a completed survey.

Data were gathered to identify recreational impacts by asking our respondents to describe in their own words the impacts they believed were occurring, where and when the problems were occurring, and the consequences of the impacts to the wildlife species in question. Data were summarized for those species most frequently believed to be receiving serious impacts and for sensitive species.

#### LITERATURE REVIEW

The literature review on documented impacts of recreationists to wildlife species found on the New River was obtained through

standard library searches of books and periodicals and resource agency research project reports. Few studies of recreational impacts were found, even though the literature review was not limited to studies of the New River or even rivers in general.

#### BLACK BEAR

The primary recreational impact on black bears (Ursus americanus) appears to be habituation to unnatural food supplies associated with recreational use (Hammit and Cole 1987). Artificial food sources have lead to concentrations of bears in areas which would not ordinarily support such populations (Zardus and Parsons 1980). In the 1960's Yellowstone National Park had two separate bear populations. One population utilized backcountry areas and the other roadside areas (Barnes 1967, Bray 1967). The most important component of the roadside bear population's diet was artificial food. In Kings Canyon and Sequoia National Parks, availability of unnatural food supplies has been identified as the cause of increased bear/human conflicts. (Zardus and Parsons 1980).

In Yosemite, bear/human interactions have resulted in changes in bear behavior, foraging habits, distribution, and population levels (Keay and Van Wagtendonk 1983). While studying radio collared black bear in Idaho, Amstrup and Beecham (1976) found that alterations in bear behavior induced by human disturbance was only short lived. In the Great Smoky Mountains National Park, bear activity on a park wide

scale seemed to be independent of visitor use (Pelton 1972). However, density of bears in local areas appeared to be influenced by people.

Manville (1980) felt that human activity near bear dens in the winter could have a negative impact. Bears in the lower Michigan peninsula fled dens during 49 % of his attempted approaches, 82 % fleeing while he was still 70 - 125 m from the den. However, a female used a den which was only 70 m from a snowmobile trail, even though the trail was actively used all winter. A second female denned 90 m from a snowmobile trail, abandoning it only after researchers attempted to anesthetize her. In Shenandoah National Park, six females utilized ground dens within 30 m of heavily used foot trails (Carney 1985). Similar, unused den sites were available at distances farther from the trails. Three of these females successfully raised cubs. Visitor use appeared to cause den abandonment in only one instance. This den was only 10 m from a popular overlook. In Pennsylvania, a female black bear with two newborn cubs was found denning in a drainage pipe under Interstate 84 (Alt 1983).

In Great Smoky Mountains National Park, black bears used areas around limited access roads and frequently crossed them (Carr and Pelton 1984). However, in some areas roads appear to influence bear movement. Male black bears in Shenandoah National Park avoided light duty roads, primary roads, and fire roads (Garner 1986). Abandoned roads and jeep trails received little use. Female bears seemed to prefer fire roads, but avoided light duty and primary roads. Black bears in Maine avoided major highways (Hugie 1982). While these

highways were not absolute barriers to movements, they were found to restrict bear movements.

#### WHITETAIL DEER

Disturbance of whitetail deer (Odocoileus virginianus) during winter may lead to behavior which is inconsistent with energy conserving adaptations (Moen 1976). Possible consequences of recreational harassment to deer include:

1. Increased metabolism which leads to increased energy demands
2. Death, illness, or decreased productivity
3. Displacement
4. Avoidance or abandonment of specific areas
5. Inefficient foraging patterns (Geist 1978).

Research has centered on the impacts of snowmobiles. However, Eckstein et al. (1979) noted that deer in Wisconsin appeared to react more to a walking person than a snowmobile, and Behrend and Lubeck (1968) observed that deer in the Adirondacks were more sensitive to approach by vehicle than by canoe.

Several studies have addressed the impact of snowmobiling on whitetail deer. Deer in Minnesota reacted to low intensities of vehicular traffic (Dorrance et al. 1975). Displacement occurred in areas adjacent to snowmobile trails. Furthermore, deer movement increased when snowmobiles were in use. Dorrance et al. (1975) found



no significant difference between home range sizes when comparing an area with snowmobile use to one without snowmobile use, but did note a trend toward larger home range sizes in the area with snowmobile use. Some deer completely changed the location of home ranges when their original home ranges were subject to intrusion by men and vehicles. However, deer may change winter home ranges even in the absence of snowmobile use (Bollinger et al. 1973).

In Wisconsin, deer home range size and habitat use did not differ significantly between areas with and without snowmobile use (Eckstein et al. 1979). Snowmobiling did cause some deer to leave the immediate vicinity of snowmobile trails, but snowmobile use appeared to have little impact on daily activity patterns of deer. Deer were most affected when within 61 m of a snowmobile trail. In Maine, snowmobiling did not cause deer to desert preferred bedding areas and feeding sites (Richens and Lavigne 1978). Deer fed along snowmobile trails even when the trails were used by snowmobilers several times a day. Deer were also found to use snowmobile trails as paths between deer trails, especially as the severity of the weather increased. Richens and Lavigne (1978) considered this to be a beneficial impact since snowmobile trails were more compacted and reduced energy expenditure.

Some researchers suggest that deer might become accustomed to disturbance through prolonged exposure (Behrend and Lubeck 1968, Dorrance et al. 1975, Richens and Lavigne 1978). However, deer may react to snowmobiles without changing observable behavior (Moen 1982).

For example, Moen reported that heart rates of captive deer exposed to snowmobiles averaged 2.5 to 2.9 times greater than predisturbance rates. He found no evidence of habituation in this type of response.

#### INDIANA BAT

Indiana bat (Myotis sodalis) populations have declined in recent years (Humphrey 1978). The decline has been attributed to a variety of factors including destruction of summer and winter habitat, pesticides, and disturbance by biologists and amateur spelilogists (Humphrey 1978, Greenhall 1973). Since 87 % of all known Indiana bats hibernate in only seven caves, human disturbance of bats in winter hibernacula is of particular concern (Humphrey 1978). Vandalism is partially responsible for the problem. For example, in 1961, 10,000 bats were stoned or torched in Carter Caves State Park, Kentucky (Humphrey 1978). Mohr (1977) believed that 20 years of commercial cave and amateur spelunker traffic caused three bat populations in Pennsylvania to abandon their winter hibernacula. At Carter Caves State Park in Kentucky, a population decline of 60,000 between 1955 and 1975 has been attributed to disturbance by park visitors (including vandals and park organized tours) and biologists (Humphrey 1978).

Even mild light and sound stimuli are sufficient to arouse bats during winter hibernation (Humphrey 1978). Heat produced by humans under bat clusters on low ceilings may cause arousal and flight. When disturbed, bats may not recluster for 30-60 minutes. Repeated

disturbance during a winter may result in malnourished bats and higher than normal spring mortality.

Little is known about the summer activities of this bat; however it appears to be restricted to riparian forests during the summer (Cope 1978). Loss of this type of habitat through channelization of streams and construction of reservoirs is considered to be the major human/bat conflict during this time of year.

#### OTHER MAMMALS

Research concerning recreational impacts to small and medium sized mammals has dealt mainly with impacts at campgrounds and impacts by off road vehicles. Deer mice (Peromyscus maniculatus) in Yosemite showed increased populations at campgrounds (Foin et al. 1977). Aitchison et al. (1977) found that the populations of skunks, rock squirrels, ringtail cats, and mule deer had increased as a result of artificial food supply associated with recreation use of the Colorado River. Clevenger and Workman (1977) concluded that generalists (e.g. deer mice and woodrats (Neotoma spp.)) may be found in higher densities in campgrounds due to their ability to take advantage of the new food source. On the other hand, specialists with limited dietary adaptability do not exhibit higher densities in campgrounds.

In addition to providing alternative food sources, recreational use of campgrounds may affect small mammals indirectly through alteration of the habitat. Clevenger and Workman (1977) believed that

reduced ground cover caused by heavy recreational use resulted in increased predation of small mammals at study sites in Utah.

Snowmobiles have a negative impact on subnivean mammals through compaction of snow. Compaction can form a mechanical barrier which inhibits movement (Bury et al. 1976). Compaction along snowmobile trails also resulted in abnormally cold temperature in subnivean habitat (Neumann and Merriam 1972). As an example of the seriousness of this impact, Neumann and Merriam stated that for a 20 gram shrew (Blarina brevicauda), a 3 degree celsius drop in temperature would increase metabolic demands by 25 calories per hour. Data collected by Neumann and Merriam in Ontario also indicated that snowshoe hare (Lepus americanus) avoided snowmobile trails, while red fox (Vulpes vulpes) activity was greater near trails. The increase in fox activity is believed to result from increased mobility along snowmobile trails.

#### OSPREY

Research concerning recreational impacts to osprey (Pandion haliaetus) has produced conflicting results. Swenson (1979) found lower osprey reproduction at Yellowstone Lake than along streams in Yellowstone National Park. The major problem was low hatching of eggs, which he attributed to higher incidence of human disturbance occurring at Yellowstone Lake. Nests more than one km from campsites were more successful than those closer to campsites. Boating seemed to have less of an impact on nesting success than activities occurring along the shoreline. Garber (1972) reported that 36% of osprey egg and nestling

loss in 15 California nests were caused by human disturbance. Campers parked near one nest caused the adults to desert it, despite the fact that it contained eggs.

At Eagle Lake in Lassen National Forest, moderate losses due to human disturbances occurred during incubation (Kahl 1972). Four eggs in one nest were lost when the adults were prevented from incubating for two days by a group camped near the nest. Eleven birds were frightened from nests during fledgling counts, apparently flying for the first time. Some losses occurred when fledglings were forced from nests before they were ready for flight. Reese (1977) stated that human disturbance of incubating or brooding birds may be the most important factor influencing the nesting success of osprey in the central Chesapeake Bay area.

On the other hand, Ames and Mesereau (1964) did not believe that human disturbance was a major factor in the low hatching rates of nests observed in Connecticut. Fifteen of 19 young hatched on Great Island from 1960 to 1963 were in nests frequently visited by boaters and fishermen. Furthermore, a greater number of inland nests (which received less visitation) showed low hatchability. However, two nests were deserted in 1960 due to the repeated presence of picnickers which prevented the birds from incubating, and speeding motorboats were found to cause the loss of several eggs from ground nests. These eggs were damaged because birds left the nest directly from the incubation position. French and Koplin (1977) found no evidence that camping, fishing, swimming, or sightseeing had negative impacts on nesting

success of osprey in northwestern California. One nest was in a 76 m redwood in a median between lanes of US highway 101. A second nest was located in a 70 m redwood 6 m from an off ramp of the same highway.

Young were successfully hatched from two osprey nests in Idaho despite frequent occurrence of recreational boating (Schroeder 1972). Schroeder concluded that human disturbance was not seriously impacting overall osprey reproductive success despite occasional failures due to human disturbance. Poole (1981) found equivalent reproductive rates when comparing isolated nests to nests exposed to continuous activity. He found no evidence to suggest that trapping breeding adults, research activities, or other human activities caused adverse affects, although he noted that climbing nest trees may have attracted raccoons and resulted in a greater incidence of predation.

Swenson (1979) suggested that one possible explanation for the mixed findings may be due to differences in both the timing of disturbance and the degree of habituation of the osprey involved. For example, where human use is already present when ospreys initiate nests, birds may be more tolerant of human activity.

#### TURKEY VULTURE

Coleman (1985) studied turkey vultures (Cathartes aura) in Gettysburg National Military Park. He reported that these birds apparently were not disturbed by moving vehicles, but were often flushed from roosts when cars stopped or people approached on foot. He felt that birds avoided roost trees in one area during the summer

due to high levels of human activity. Coleman suggested that frequent human visitation of potential nesting caves in one area may have discouraged vultures from nesting.

#### TURKEY

Lindzey (1967) believed that heavy recreational use was not compatible with turkey (Meleagris gallopavo) management and that even light use may cause nest abandonment. During a study of nesting turkeys in Florida, 11 of 64 hens were flushed when investigators discovered the nest, resulting in seven nest abandonments (Williams et al. 1971). Hens only flushed from nest when investigators were within 8 feet (2.4 m), and since turkeys prefer to nest in brushy areas, Williams (1981) suggested that this type of disturbance may not be important where high quality nesting habitat is available. Some hens were flushed repeatedly without causing them to desert nests. On 20 occasions, research investigators frightened hens away while they were returning to the nest, but this did not result in any nest abandonments.

At Land Between the Lakes, Kentucky, no turkeys were found to inhabit areas closer than one km to active campgrounds, although one adult utilized a campground when it was closed in the winter (Wright and Speake 1975). In 1973, a new trail was opened in an area which had a high turkey population the previous year. The trail was used by 100 visitors per week in 1973 and 125 people per week in 1974. Suitable habitat along the trail was searched for turkeys and turkey sign in

1973 and 1974. In 1973, only one turkey was observed and no turkey sign was located; while in 1974, no turkeys or evidence that turkeys were present were ever observed. On the other hand, turkeys and fresh turkey sign were always observed on control areas, suggesting that hiking trails and associated human disturbance may reduce the amount of available turkey habitat.

However, turkey populations can be established in agricultural areas which have only 25-30% forest cover and which receive considerable human activity (Wunz 1985). One wild trapped and released turkey population in Pennsylvania has been self-sustaining for 14 years in an area where road density is 2 km/square km and human density is 67 people/square km. However, Wunz described another area where turkeys avoided open forests and sought brushy areas to avoid human contact. This was thought to result in greater predation. Wunz (1971) stated that hikers also used the brushy areas (up to two per hour), but the dense cover reduced the likelihood of visual contact.

Disturbance is thought to have caused turkeys to increase their home range size or abandon their territories in some areas. Wheeler (1948) believed that frequent disturbance caused turkeys in Alabama to abandon one area. Mosby and Handley (1943) suggested that turkeys exposed to continuous disturbance have larger home range requirements than turkeys in undisturbed areas. Bowman et al. (1979) suggested that unusually extensive fall movement of two radio collared hens in North Carolina was caused by disturbance by deer hunters.



However, turkeys in Florida did not desert home ranges as a result of hunting, even though 80% of the population was harvested annually. He also reported that normal hunting, logging, and agricultural activities did not cause turkeys to abandon home ranges. In Georgia, movement and behavior of turkeys did not appear to be affected in areas used by deer hunters even though hunter densities reached 17.1 hunters/sq. km (Folk and Marchinton 1980). Everett et al. (1978) reported that deer hunter densities of 1 hunter/42 ha caused only minor turkey movements and did not result in movement out of established ranges.

Two studies have examined the effects of off-road vehicles on turkeys. Wright and Speake (1975) reported that a flock of 3 hens and 24 poults abandoned their initial brooding area and moved 3.2 km after being disturbed by ORVs at least twice in one week at Land Between the Lakes in Kentucky. However, male turkeys intentionally harassed by motorcycles on several occasions did not abandon their summer range. Turkey observations and track counts in Pennsylvania revealed that turkeys avoided areas receiving high levels of snowmobile use (Hayden 1972).

Turkeys may avoid larger roads. Adams and Geis (1981) found no turkey sign within 400 m of interstate highways and county roads. In a study in West Virginia, only 1% of all turkey sign along a new four lane highway was closer than 160 m to the road (Michael 1978). However, infrequently used forest roads may be beneficial to turkeys. Turkeys may use these roads for loafing, as a source of heat on cold days, as

feeding areas, as strutting areas, or as a source of grit (Mosby and Handley 1943, McDougal 1986). Turkeys have also been found nesting within 50 ft (15 m) of roads receiving only light traffic (Williams 1981).

#### WOOD DUCK

Wood ducks (Aix sponsa) in Missouri were sensitive to disturbance by fishermen (Hartman 1972). Disturbance appeared to be related to the amount of noise. Birds were frightened by boats making loud noises at distances of approximately 137 m. During one observation of a silent canoe approach, a pair allowed a canoe to approach within 47 m before moving. Hens were much more tolerant during incubation, often allowing boats to approach within a few meters before flushing. However, Hartman observed an increase in nest abandonments in popular fishing areas and on Easter and Memorial Day weekends. This may have been caused by vandalism and intentional disturbance. Fishermen were seen striking nest boxes with oars and fishing poles and one clutch is known to have been taken by humans. If hens were disturbed while calling young from the nest, they would lead the brood away from the area, deserting any chicks which remained in the box. Chicks abandoned in this manner either perished in the box or were forced to survive without the hen's protection.

## HERON

Human disturbance of great blue heron (Ardea herodias) nesting colonies has been cited as a major problem in Alberta (Markham and Brechtel 1978). Harassment has resulted in increased nestling mortality, abandonment of nests, and even abandonment of colonies. Taylor and Michael (1971) observed complete reproductive failure in a little blue heron (Florida caerulea)/green heron (Butorides striatus)/common egret (Casmerodius albus) colony in Texas. The failure was due primarily to predation, which the investigators believed was enhanced by human activity in the colony. In Quebec, Tremblay and Ellison (1979) found that visitation of black-crowned night heron (Nycticorax nycticorax) colonies caused nest abandonment and increased egg predation. Early visits to colonies inhibited laying, and frequent visits apparently discouraged late nesting birds from attempting to nest. However, in successful nests initiated early in the season, clutch size and fledging success did not differ between frequently (10 - 15 visits) and infrequently (2 visits) disturbed colonies.

Human activity has also been found to disturb feeding herons. Snowy egret (Egretta thula) and little blue heron nestlings in Florida regurgitated their last meal when disturbed by investigators (Jenni 1969). Green heron use of the main river channel in Ozark National Scenic Waterway for feeding decreased as human use increased (Kaiser and Fritzell 1984). The length of foraging bouts were also reduced during periods of high human use.

## RAVEN

Two studies suggest that ravens (Corvus corax) can successfully nest in proximity to humans. Craighead and Mindell (1981) found four successful nests within 0.5 km of houses in Wyoming. Three of these nests were also within 100 m of a paved road. In a Virginia study, successful nesting attempts were typically closer to roads and dwellings than unsuccessful nests (Hooper 1977). Successful nests less than 0.4 km from roads averaged more fledglings than nests farther away.

Hooper also reported that four young ravens successfully fledged from one nest, even though a researcher had rappelled to it once a week during incubation. The nest had also been successful the previous year when a researcher had rappelled to it one time. However, the nesting site was not used during the next two years even though a pair of ravens was seen in the area.

## RED-SHOULDERED HAWK

Portnoy (1974) reported that red shouldered hawks (Buteo lineatus) abandoned four nests when disturbed by humans during incubation. Craighead and Mindell (1981) believed that increasing human disturbance had a role in decreasing raptor populations in the Jackson Hole area. In 1975, three red tailed hawk nesting attempts within 0.6 km of houses or paved roads failed.

## OTHER BIRDS

While studying canada geese (Branta canadensis), brant (Branta bernicla), and other birds in Alaska, Mickelson (1975) observed temporary nest abandonment caused by human presence and the sounds of boats, resulting in increased exposure to predators. He estimated that losses to avian predators doubled when a researcher was present.

Owen and Morgan (1975) examined the impact of night lighting and banding operations on American woodcock (Philohela minor) in Maine. No increase in predation was observed as a result of these activities, and birds remained in the same vicinity after the disturbance. However, birds avoided the site of disturbance for at least a week.

Nest record data for robins (Turdus migratorius), redwing blackbirds (Agelaius phoeniceus), mourning doves (Zenaida macroura), and eastern bluebirds (Sialia sialis) indicated higher nest loss on the first day after a visit during the egg laying period than on subsequent days (Bart 1977). Data on barn swallows (Hirundo rustica) did not exhibit this trend. During the incubation period loss rate increased on the first day after visitation for robins and bluebirds (data for other species was not available). During the nestling phase, mourning doves showed an increase in mortality on the first day after visitation (data for other species was not available). Bart concluded that the increase in mortality was caused by humans leading predators to the nest site.

Reviewing 12 studies on redwing blackbirds nesting in marshes, Lenington (1979) found that nesting success declined an average of

22.9% after the first year of study. He attributed this decline to researchers leading predators to nests. Lenington's review of five studies in upland sites yielded mixed results. Predation increased in two studies, but decreased in three. Around six lakes in Ontario, Robertson and Flood (1980) found eastern kingbirds (Tyrannus tyrannus) had reduced nesting success in areas which received recreational use along the shoreline. They believed that recreational use attracted raccoons and resulted in increased nest predation.

#### FISH

Impacts of recreational use on fish populations are poorly documented. Most impacts are thought to be indirect effects such as eutrophication, increased turbidity, and mechanical disturbance of vegetation (Hammit and Cole 1987). Lagler et al. (1950) concluded that prolonged use of outboard motor boats on experimental ponds did not affect fish production or fishing success. Mueller (1980) found that longear sunfish (Leponis megalotus) in the Ozark National Scenic Riverways were often chased from their nests when paddled and motor powered canoes approached nests (0 - 4.5 m) at slow speeds (1 m/sec). This increased the potential for nest predation. Canoes moving at fast speeds (5 m/sec) or at greater distances rarely caused nest abandonment. High speed passes did increase turbidity and could possibly increase nest predator success.

## RESULTS

### QUESTIONNAIRE RESPONSE

#### List of Impacted Species

During telephone interviews our study participants identified eight species as currently or likely in the future to be subject to river recreation impacts: wood duck, black bear, black duck, turkey, whitetail deer, mallard, red-tailed hawk, and red-shouldered hawk (Table 1). These eight species were listed in a questionnaire (Appendix B) and mailed to the same study participants for further evaluation of impacts. The questionnaire also provided space for respondents to add additional species to the list (species which they felt were now or might in the future be impacted by recreationists, but which they forgot to mention in the phone interview). Sixteen species were added (Table 2). National Park Service managers had expressed concern about recreational impacts on fish in the New River, but only one of the study participants felt this was a problem. That person felt that smallmouth bass were currently being impacted.

A majority of the experts expressing an opinion felt that wood ducks, black bears, and black ducks are currently impacted by recreational use or are likely to be impacted in the future (Table 1). The number of respondents who felt impacts are or will occur to the remaining species was approximately equal to the number who felt that no impacts will occur. The wood duck was most frequently cited (5) as receiving the most serious impacts at the present time (Table 3).

Two other individuals rated waterfowl in general as receiving the most serious impact. Turkey and bear were the next most frequently mentioned as receiving the most serious impact now or in the future.

None of the species listed by our wildlife experts have rare or endangered status. However, three (the black duck, red-shouldered hawk, and screech owl) are included on the most recent "blue list" of sensitive species (Tate 1986).<sup>1</sup> As indicated in Table 1, six of our respondents felt the black duck is susceptible to impacts from recreationists, now or in the future. None, however, ranked black ducks as receiving the most serious impacts. There was some concern about red-shouldered hawks--two individuals felt they are being impacted now, and another two said impacts were likely in the future. These impacts were not, however, believed to be serious. Only one person was concerned about screech owls, and that was a concern about future impacts. That person did not rank the screech owl among his three most seriously impacted species.

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<sup>1</sup> This list is prepared by the Audubon Society and includes bird species which are not federally listed, but are considered by regional experts to have shown significant population declines in recent years.



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## DESCRIPTION OF IMPACTS BY SPECIES

Our study participants identified 24 species or types of animals that may be receiving impacts from river recreationists, but there was little consensus about which individual species merited the most concern (Tables 1, 2, and 3). We used three criteria to select species from the study list for further discussion of their impacts and possible management or research needs: (1) the species was listed as receiving current or future impacts from recreationists by more than half of our respondents who had an opinion (i.e. wood duck or black bear), or (2) the species was ranked first in seriousness of current impacts by at least one respondent (i.e. turkey and turkey vulture), or (3) the species was on a sensitive, rare, or endangered status list (i.e. black duck, red-shouldered hawk, and screech owl).

### Wood Duck

Seven (50%) of the respondents believed that wood duck are currently being impacted, and two (14%) felt that wood duck will be impacted by recreational use in the future (Table 1). Five of the experts felt that the wood duck is currently the most seriously impacted species (Table 2).

Four of the respondents were concerned about disturbances during brood rearing. Disturbance to feeding was specifically mentioned by one respondent. Additionally, two respondents were concerned about disturbance to nesting habitat. One of these believed the removal of cavity-nest trees by campers along the river is a problem. Two

respondents felt that disturbance is influencing the distribution of wood duck, and one believed that broods are being forced into areas with higher predation rates. A third thought recreational disturbance is causing a population decline.

Opinions varied on the location of impacts. Many respondents simply said "along the entire river". One said "all brood habitats in commercially used areas". Another said "the upper section of the river where there are more pools and islands, such as at Sewell and Quinnimont", "Hinton to Meadow Creek", "Thurmond at Stonecliff beach", "Fayette Station along both sides of the river", "Terry along both shores", "near Terry/Prince" and "Sandstone at the falls and overlook."

Our wildlife experts had little agreement about the river use and user characteristics causing wood duck impacts. Two simply said the noise and frequency of commercial and private rafting, kayaking, canoeing, and other boating were causes. One individual cited high rafting use during the summer months between Thurmond and Fayette Station/Teays, higher motorized vehicle traffic through this section, and heavy ORV, camping, and fishing use along the river between Prince and Thurmond. Another person said the impacts came primarily from private rafters and canoeists who tend to travel more leisurely than commercial trips. These individuals have time to rest and explore quiet areas where ducklings live, and this causes most of the disturbance. Finally, one expert said that local residents who camp and fish along the river are causing impacts.

Solutions to wood duck impacts were among the most specific of any wildlife species considered. A few experts called for the maintenance or reduction of current rafting numbers. One solution was to eliminate rafting use in river areas of known wood duck use during the two or three critical months of the season (presumably the nesting and hatchling stage). This might be done by placing buoys on the river to direct river traffic away from the protected zones. Others felt that controlling vehicular traffic along the edge of the river would be most effective in reducing wood duck impacts. This might be done by curtailing camping in some areas, especially around Sandstone (although the respondent acknowledged that this might not be practical, since virtually all the land is privately owned). Another person felt that motorized traffic along the new Mary Draper Ingles trail should be restricted, and four wheel drive roads, especially near Terry, should be blocked. Finally, one person recommended education of river users about wood duck survival requirements and how to reduce human impacts.

#### Black Bear

Five of the eight respondents who listed black bear as one of the three most seriously impacted species were concerned about human encroachment upon existing or potential habitat. Types of encroachments were described as disturbance of bears by ORV and all-terrain-vehicles and encounters between humans and bears. One respondent mentioned hunting out of season. One was concerned about habitat loss due to

the construction of I-64. The final respondent did not specifically identify a type of impact.

Our experts felt that the major consequence of the impacts is loss of habitat - either through actual destruction of habitat or through avoidance due to high human use and noise. Some individuals felt this was resulting in decreasing bear populations, but others felt this would simply prevent the expansion of the bear population in the New River Gorge. Currently the black bear population is increasing in the general area of the river.

Virtually all of the respondents listed the time of impacts as the "recreation season" or the "warm weather season". A few individuals specifically stated spring, summer, and early fall. One respondent said "all year long". A final expert felt that impacts wouldn't occur until 10-20 years in the future.

The majority of respondents who felt bear impacts were a problem said those impacts occurred along most or all of the river corridor. One cited ridges and sand bars along the river. A final individual was more specific. He noted the "Glade Creek area (from Mill Creek to Glade Creek), areas such as Cunard and roads near there that parallel the river, and near Stonecliff along those roads paralleling the river".

Five types of recreational use or user characteristics were cited as potentially causing impacts to black bear. Two respondents simply said the presence of people on and along the river encroaches upon bear habitat. One other person was more specific, saying that camping and

the loss of spring feeding areas and the existing or future loss of the interspersion of bottomland and upland habitats. One respondent was concerned about the destruction of habitat through road building and ORV use. One person mentioned the disturbance of broods and scattering of flocks. Another cited disturbance of feeding and nesting patterns. Additionally, one individual believed increased hunting pressure in the future might cause population stresses. All respondents believed these impacts would result in declining populations.

No single time period was listed as being the most critical. Most respondents said summer and fall, while others said spring, summer, and fall. One person specifically mentioned impacts during nesting periods and another listed impacts on broods in early spring and summer. Most said that the impacts occur throughout the river corridor. One individual was more specific; that person said impacts on turkeys are most common between Thurmond and the slackwater at Hawks Nest dam, and are also prevalent near Prince and Thurmond.

Our respondents were not very specific in their descriptions of recreational use patterns causing impacts on turkeys. Two simply mentioned heavy or relatively constant recreational use, two noted commercial and private river boating. Noise by recreationists, hiking, and camping activities were each mentioned by one respondent. A final expert feared future impacts from hunting pressure and ORV use.

Three kinds of solutions were offered to reduce recreational impacts on turkeys. Two experts called for additional monitoring--

one to better understand the relationship between increased hunting and turkey populations and the other to relate habitat loss due to road construction and other development to the number of turkeys. Another said adopting and implementing the best turkey management practices currently available would reduce problems. Several others called for limiting use, either rafting or ORV's. The final person said that there was no practical solution; with use there would inevitably be impacts.

#### Turkey Vulture

One respondent added turkey vulture to the list and described it as the most seriously impacted species. He listed three types of impacts: turkey vultures being shot at, nest sites being constantly disturbed, and vultures being moved out of preferred habitat. He stated that he was seeing vultures less frequently than in the past, and thought the population may be declining. He felt that water-based users (fishermen, boaters, rafters) were responsible for the disturbances and that disturbance was occurring all year long during the daylight hours. He thought disturbance was occurring on all flat water areas. His suggested the use of public education to reduce impacts.

#### Black Ducks

Only two of our respondents provided additional insights into potential impacts on black ducks. One noted that black ducks are seldom seen along the river, either during the nesting season or during

migration. The other felt that impacts are on the nesting patterns. The section from Hinton to Sandstone Falls (and possibly on down river as far as Glade) was identified as the area where impacts are believed to be most common. Both respondents felt that disturbance would result in fewer nesting pairs on the river.

Of the two individuals that described recreationist behavior that might be causing impacts on black ducks, one said "Sunday drivers" are scaring the skittish ducks away from areas they formerly used. The other said boaters encroached upon habitat and slapped their paddles on the water when they sighted the ducks.

Few solutions were offered regarding black duck problems. The most specific response was that this species seems to be declining nationwide, and the cause of the reduction may be far larger than recreational use.

#### Red-shouldered hawk

Two individuals described impacts on red-shouldered hawks in greater detail. Both mentioned the actual or potential destruction of nesting habitat, and one mentioned change of feeding habits. Both said the nesting season is the most sensitive time period. The only specific location mentioned was the area known as Beauty Mountain near Edmond, West Virginia. The consequences of existing or potential impacts were listed as fewer and more transitory birds, and fewer sightings of hawks by recreationists. Three kinds of recreation behavior were believed to impact upon hawks: motorized traffic,



climbers and hikers along the ridges of the gorge, and noise levels in the Gorge. The experts listed two possible solutions: (1) limit people on the river and at the Beauty Mountain Area and (2) limit motorized traffic in the area. One respondent openly acknowledged that allowing fewer people may not be a philosophically or managerially viable strategy.

#### Screech Owl

No one listed the screech owl among the three most seriously impacted wildlife species, either now or in the future. Therefore, we have no additional information about the nature of impacts to this species.

#### CRITICAL FISH AND WILDLIFE HABITAT

Because wildlife is dependent upon availability of suitable habitat for its survival, we asked study respondents to list and describe any habitat types along the New River which they felt might be vulnerable. Table 4 lists the wildlife habitat types that our respondents felt were currently or likely in the future to be disturbed by recreational development or use. The three most frequently rated as most seriously threatened were river banks, riparian habitat, and bottomlands or wetlands. The next most frequently cited was river tributaries.

Perhaps we could have collapsed the riparian habitat and the bottomlands or wetlands into one category because our respondents may

have been referring to the same habitat. We chose to summarize the data using the words our experts gave us. They felt the vulnerable riparian zones were along the river shoreline and adjacent bottomland vegetation. Most said the vulnerable habitat occurred throughout the entire river corridor, but one respondent noted this habitat type was most widespread in the Upper Gorge, particularly bordering the large pools on the river there.

Respondents indicated where the vulnerable bottomland habitat was located in two ways: location along the length of river and distance back from the river. Some said the vulnerable bottomland was located along the entire river corridor. Some simply said "the floodplains". One said from the toe of the hillside to the riparian zone. Two were more specific. One cited several areas between Terry and Thayer, and the other said threatened habitat was common between Hinton and Glade Creek, and between Hinton and the I-64 bridge.

River bank areas seen most vulnerable to habitat change were popular areas for camping, fishing, picnicking, and rafting lunch stops. Habitat change that concerned respondents was loss of ground cover vegetation, compaction of soil, and litter. While some respondents felt these impacts were occurring throughout the river's entire length, several were more specific. Several said along river pools, and mentioned specific places like Sandstone Falls, the I-64 bridge, across the river from Quinnimont and Prince, across from Sewell, Terry, and Stone Cliff and at Stretcher's Neck. Many said

We recommend that the Park Service address these concerns in the following manner. First, the Park Service needs to conduct an inventory to estimate the current population, current level of productivity, amount of available nesting and brood rearing habitat, and the number of wood ducks this habitat could potentially support. A description of wood duck habitat and a model for evaluating wood duck nesting and brood rearing habitat in riverine environments is presented in Sousa and Farmer (1983). This model is based on 3 variables (number of potentially suitable nesting cavities/0.4 ha, number of nest boxes/0.4 ha., and percent of water surface covered by potential brood cover), and it is used to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimal habitat). Descriptions of these variables, procedures to apply the model, model assumptions (e.g. expected brood survival in optimal habitat), and limitations of the model are presented in the Sousa and Farmer publication. Alternative models are also briefly discussed.

Next, the Park Service needs to define its objectives for wood duck management by:

1. Determining what an acceptable population of wood ducks is, given the quantity and quality of available nesting and brood rearing habitat.
2. Determining the level of productivity necessary to maintain the population at this level.

3. Determining what types of recreational impacts are unacceptable (e.g. one that causes direct wood duck mortality, or one that causes productivity to fall below that necessary to maintain a stable population).

If the population is lower than the desired level or productivity is lower than necessary to maintain the desired level, the Park Service should initiate a study which examines whether or not recreational use is adversely affecting wood duck breeding behavior and productivity. This study should determine the types of activities or visitor behaviors which have an adverse impact on wood ducks, the consequences of these disturbances, and the period of time over which wood ducks are sensitive to recreational disturbance. On the other hand, if the population and productivity are acceptable, the Park Service should simply continue to monitor the population.

If unacceptable impacts are occurring, we suggest that the Park Service attempt to resolve the problem using light-handed approaches, only restricting the amount of use as a last resort. For example, if there is a shortage of natural nesting cavities, providing predator proof nest boxes may solve the problem. Informing and educating the public about the status of wood ducks, potential recreational disturbances, and means to reduce these disturbances may encourage visitors to change behaviors which adversely affect wood ducks. If use restrictions are necessary, the Park Service should limit only those

activities which are responsible for the disturbance, and these should be restricted only during the sensitive part of the breeding season.

#### Black Bear

There was less agreement, but still a great deal of concern about current of future recreational impacts to the black bear. Sixty-seven percent of the respondents expressing an opinion were concerned about present or future impacts, and all of these respondents listed black bear as one of the three most seriously impacted species. All but one of the respondents expressing concern about the black bear were concerned about loss of potential bear habitat. However, it is not clear whether recreational activities or changes in land use was the most important cause of bear habitat loss.

We recommend that the Park Service use the following approach. First they should estimate the current population, amount of available habitat, and the number of bears the habitat can support. A habitat suitability index model similar to the one described above for wood duck is available for black bear (Rogers and Allen 1987). This model describes black bear habitat, summarizes studies of black bear home range sizes and densities, describes procedures for implementing the model, and discusses model limitations. However, this model was developed for use in the Great Lakes region. Another model for use in New England's conifer-deciduous forests is currently being developed (McLaughlin et al. 1987).

Next the Park Service should determine their objectives for black bear management within the park by:

1. Determining the desired population level;
2. Defining the habitat necessary to support this population in terms of size, shape, and vegetation types;
3. Developing criteria to define unacceptable recreational impacts.

If the population is lower than desired, the Park Service should initiate a study to determine black bear reproductive success, activity patterns, mortality factors, and dispersal patterns. This study should address the question of whether or not recreational activities are influencing these factors to an unacceptable degree, and if so, the user behaviors or characteristics which cause bears these impacts. On the other hand, if the population is at an acceptable level, the Park Service should continue to monitor the population to determine whether or not it remains at an acceptable level.

#### LOWER PRIORITY CONCERNS

Study respondents showed a lack of consistency regarding the existence of recreational impacts to the remaining wildlife species. Often the respondents who expressed an opinion were about equally divided over whether or not impacts are occurring. This problem has been noted in other reviews and may be caused by complicated interrelationships among the factors involved, lack of baseline data,

## Turkey

As with black bear, respondents were concerned with turkey habitat loss, particularly those habitats used for nesting, brood rearing, and during the fall. The Park Service should estimate the current population and inventory the amount of available habitat. A description of turkey habitat and a model for evaluating this habitat on the basis of seasonal food components and cover is presented in Schroeder (1985). This model produces an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). Descriptions of model variables, model assumptions, and model are presented in Schroeder (1985). Alternative models are also briefly discussed. Then the Park Service should define its management objectives for this species by:

1. Determining the desired population level;
2. Defining the habitat necessary to support this population in terms of size, shape, and vegetation types;
3. Developing criteria to define unacceptable recreational impacts.

If the population is lower than acceptable, the Park Service should initiate a study to determine reproductive success, mortality factors, and activity patterns. This study should determine if recreational use affects the turkey in an unacceptable manner, and if so, the user behaviors or characteristics which cause these impacts. However, if the population is at an acceptable level, the Park Service

recreation.<sup>2</sup> In fact, one of the two respondents who discussed his concerns about black ducks related his concerns more to the national population decline than recreational use. The other respondent was concerned about recreational impacts to nesting ducks, but was addressing impacts to nesting waterfowl in general rather than specifically black ducks. Because West Virginia is not a major breeding area for black ducks (Johnsgard 1975) and there is a national decline attributed to factors other than recreational use, we believe that further examination of recreational impacts to this species should be given low priority. Instead, the Park Service might participate in an interagency, regional study of population reproduction and survival problems of the black duck.

#### Red-shouldered Hawk

Most respondents (60%) expressing an opinion thought that no recreational impacts were occurring to this species. One individual thought that this was the most seriously impacted species and one individual thought that it would be the most seriously impacted species in the future. The two individuals who described concerns in more

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<sup>2</sup> Black ducks have been declining throughout their range since the mid 1960's. Suspected factors in the decline are hunting mortality, urbanization, changes in agricultural practices, and hybridization with mallards (Rogers and Patterson 1984).



detail were concerned about loss of nesting habitat. Again, these individuals may have been expressing a general concern for this species (which has been on the Audubon Society's Blue List since 1972 (Tate 1986)), and the problems they noted may reflect the national decline rather than recreational disturbance. As with the turkey vulture, the most efficient approach may be to identify current and potential nesting areas and determine whether or not these areas are disrupted by recreational use.

#### Screech Owl

One individual expressed concern about future recreational impacts to the screech owl. However, he did not consider the screech owl to be one of the three most seriously impacted species, so he did not describe his concerns in detail. We suggest the Park Service respond to this issue by cooperating in a regional study to (1) gain a better understanding of the population status of this species and (2) if declining, identify factors responsible for the decline.

Table 1. Number of respondents (N=14) that believe various wildlife species receive river recreation impacts at the New River Gorge, 1986.

Species	Current Impacts	Future Impacts	No Impacts	Don't Know/ No Response
Wood Duck	7	2	1	4
Black Bear	4	4	4	2
Black Duck	4	2	3	5
Turkey	4	2	6	2
Whitetail Deer	3	3	6	2
Mallard	3	2	4	5
Red-tailed Hawk	3	2	6	3
Red-shouldered Hawk	2	2	6	4

Table 2. Number of respondents who added wildlife species potentially impacted by river recreation use at New River Gorge, 1986.

Species	Current Impacts	Future Impacts
Beaver	2	1
Woodcock	-	2
Canada Geese	2	-
Ruffed Grouse	-	2
Bobcats	-	2
Smallmouth Bass	1	-
Screech Owls	-	1
Turkey Vulture	1	-
Raven	-	1
Song Birds	1	-
Muskrat	1	-
Mink	1	-
Squirrel	-	1
Fox	-	1
Small Mammals	1	-
Snakes	1	1

Table 3. Number of respondents assigning various ranks of seriousness of impacts to wildlife at New River Gorge, 1986.

Rank	1*		2		3		1,2, or 3	
	Now	Future	Now	Future	Now	Future	Now	Future
Wood Duck	5	-	-	-	-	-	5	-
Black Bear	2	3	3	-	-	-	5	3
Turkey	1	1	1	-	2	1	4	2
Black Duck	-	-	1	-	1	-	2	-
Whitetail Deer	-	-	-	1	2	-	2	1
Red-shouldered Hawk	-	1	-	-	1	-	1	1
Red-tailed Hawk	-	-	-	1	-	-	-	1
Ruffed Grouse	-	2	-	-	-	-	-	2
Woodcock	-	-	-	2	-	-	-	2
Bobcat	-	-	-	-	-	2	-	2
Turkey Vulture	1	-	-	-	-	-	1	-
Song Birds	-	-	1	-	-	-	1	-
Beaver	-	-	1	1	-	-	1	1
Small Mammals	-	-	-	-	1	-	1	-
Mink	-	1	-	-	-	-	1	-

\*Rank 1 is most serious.

Table 4. Number of respondents assigning various ranks of vulnerability of wildlife habitat at New River Gorge, 1986.

Habitat type	Rank 1*		Rank 2		Rank 3	
	Now	Future	Now	Future	Now	Future
River Banks	2	-	1	-	-	-
Bottomland, Wetland	-	3	1	2	-	-
Riparian Habitat	3	-	-	-	2	-
River Corridor	1	-	-	-	-	-
Rock Outcrops, Rimrock	-	-	-	-	1	-
Rock Ledges Along River	1	1	-	-	-	-
River Tributaries	1	-	2	-	-	-
Woodland Ponds	-	-	-	-	-	1
Early Successional Stages	-	-	-	2	-	-
Upland Forests	-	-	-	-	2	1
Beach Areas	1	-	1	-	-	-

\*Rank 1 is most vulnerable.

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**APPENDIX A  
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APPENDIX B  
QUESTIONNAIRE

III. Please tell us the impacts that you believe recreationists are currently having on the wildlife species you ranked 1, 2, and 3 in Question II. Start with the species listed as most seriously impacted. (If you need additional space to answer any question, use the back of the page.)

1. Most seriously impacted species is \_\_\_\_\_ (taken from 1 in Question II).
  - a. Describe the impact that you believe is occurring (e.g. disturbance of nesting behavior, disturbance of spawning, etc.)
  - b. What are the consequences resulting from the impact described above? (e.g. declining populations, change in species distribution, etc.)
  - c. What are the recreationists' characteristics (e.g. group size or type of boating uses), use patterns (e.g. number of recreationists or time of use) and behaviors (e.g. activities or noise level) that you believe are causing these impacts?
  - d. Where on the river or in the river corridor do you believe the impacts are occurring. Describe these places as specifically as you can (e.g. the impacts are occurring along the entire river, or they only occur on certain cliffs, or in certain pools). Also mark these areas on the attached map with a "1".
  - e. What time period do you feel the impacts are most critical (e.g. during nesting season, during winter, etc.)?
  - f. What suggestions do you have for reducing the severity of these impacts?

If you listed only one wildlife species in Question II, go to Question IV. on page 5.

second most seriously impacted species is \_\_\_\_\_ (taken from 2 in question II).

- a. Describe the impact that you believe is occurring.
- b. What are the consequences resulting from the impact described above?
- c. What the recreationists' characteristics, use patterns and behaviors that you believe are causing these impacts?
- d. Where on the river or in the river corridor do you believe the impacts are occurring? Describe these places as specifically as you can. Also mark these areas on the attached map with a "2".
- e. What time period do you feel the impacts are most critical?
- f. What suggestions do you have for reducing the severity of these impacts?

If you listed only two wildlife species in Question II, go to Question IV on page 5.

3. Third most seriously impacted species is \_\_\_\_\_ (taken from 3 in Question II).

a. Describe the impact that you believe is occurring.

b. What are the consequences resulting from the impact described above?

c. What are the recreationists' characteristics, use patterns and behaviors that you believe are causing these impacts?

d. Where on the river or in the river corridor do you believe the impacts are occurring? Describe these places as specifically as you can. Also mark these areas on the attached map with a "3".

e. What time period do you feel the impacts are most critical?

f. What suggestions do you have for reducing the severity of these impacts?

IV. In Column 2 of Question I you checked the wildlife species that you feel are not currently being impacted by recreationists but are likely to be impacted in the future. Rank these species in terms of their likelihood of being impacted, where 1 is the species most likely to be affected.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

V. We would like you to discuss the impacts you believe that recreationists will likely have on the wildlife species you ranked 1, 2 and 3 in Question IV, starting with the species most likely to be impacted.

1. Species most likely to be impacted is \_\_\_\_\_. (taken from 1 in Question IV.).

a. Describe the impact that you believe will occur.

b. What will be the consequences resulting from these impacts?

c. What are the recreationists' characteristics, use patterns, and behaviors that you believe will cause these impacts?

d. What time period do you feel the impacts will be most critical?

e. What suggestions do you have for postponing or reducing the likely severity of these impacts?

If you listed only one species in Question IV, go on to Question VI, on page 8.



Species second most likely to be impacted is \_\_\_\_\_ (taken from 2 in Question IV).

- a. Describe the impact that you believe will occur.
- b. What will be the consequences resulting from these impacts?
- c. What are the recreationists' characteristics, use patterns and behaviors that you believe will cause these impacts?
- d. What time period do you feel the impacts will be most critical?
- e. What suggestions do you have for postponing or reducing the likely severity of these impacts.

If you listed only two species in Question IV, go on to Question VI on page 8.

## Recreationists Impacts on Wildlife Habitat

In telephone interviews, some of you did not identify individual wildlife species impacts, but you expressed concern over current or potential alteration of wildlife habitat by recreationists or recreational development. Please describe as specifically as you can any sensitive habitats (e.g. cattail marshes, talus slopes, etc.) that you believe are now, or will likely be, impacted and should therefore be protected.

Describe the habitat type most vulnerable to disturbance by recreational development or use.

- a. In your opinion, is this habitat disturbed now, or will it likely be in the future (check one)?

\_\_\_\_\_ Now

\_\_\_\_\_ Not now, but in future      How soon? \_\_\_\_\_

- b. Describe where along the river that this habitat exists. (Be as specific as possible.)

2. Describe the habitat type next most vulnerable to disturbance by recreational development use.

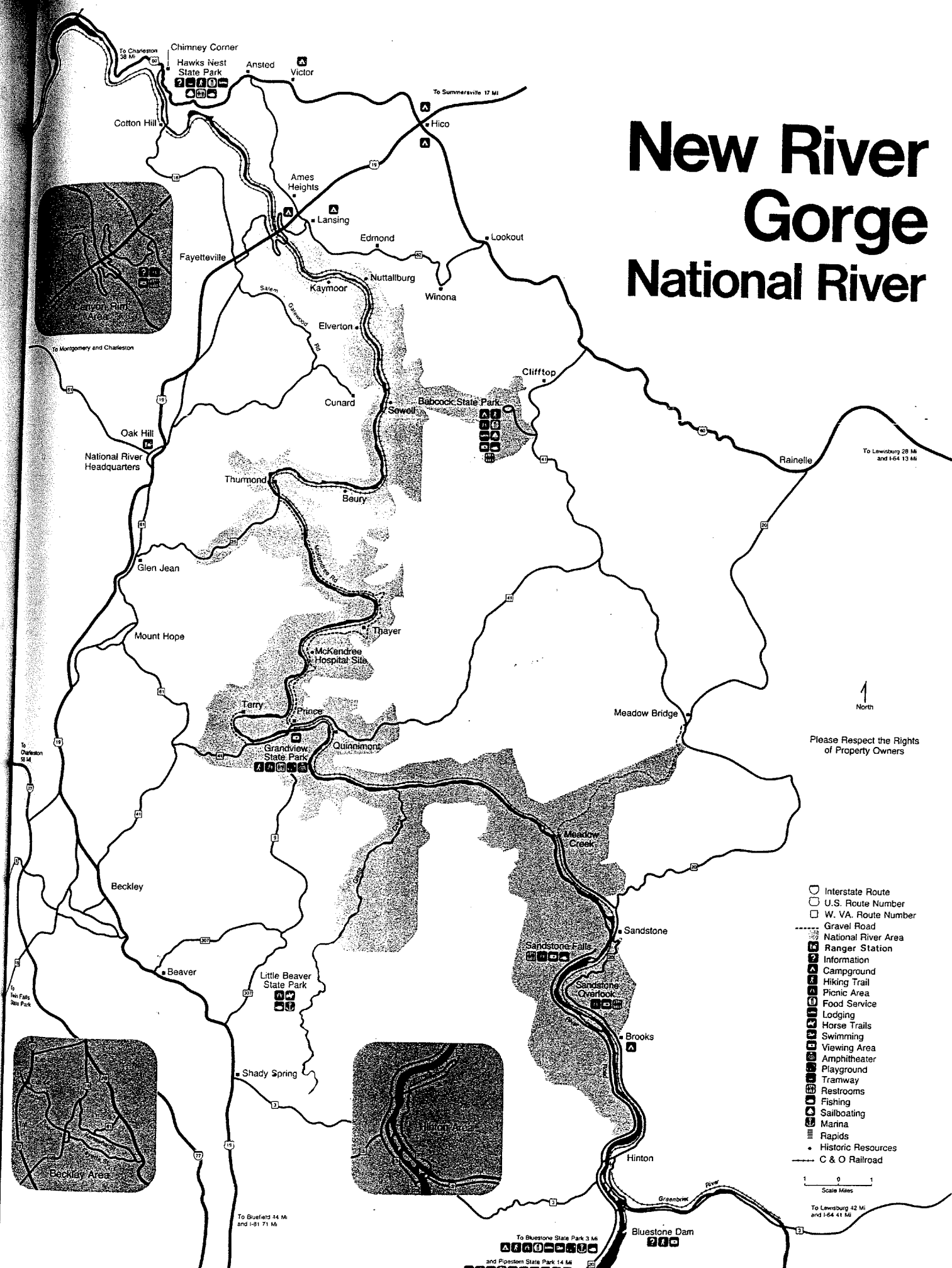
- a. In your opinion, is this habitat disturbed now, or will it likely be in the future (check one)?

\_\_\_\_\_ Now

\_\_\_\_\_ Not now, but in future      How soon? \_\_\_\_\_

- b. Describe where along the river that this habitat exists. (Be as specific as possible)

# New River Gorge National River



Please Respect the Rights  
of Property Owners

- Interstate Route
- U.S. Route Number
- W. Va. Route Number
- Gravel Road
- National River Area
- Ranger Station
- Information
- Campground
- Hiking Trail
- Picnic Area
- Food Service
- Lodging
- Horse Trails
- Swimming
- Viewing Area
- Amphitheater
- Playground
- Tramway
- Restrooms
- Fishing
- Sailboating
- Marina
- Rapids
- Historic Resources
- C & O Railroad

Scale Miles  
0 1

To Lewisburg 42 Mi  
and I-64 41 Mi

To Bluestone State Park 3 Mi  
and Phipps State Park 14 Mi

To Bluefield 44 Mi  
and I-81 71 Mi

To Lewisburg 28 Mi  
and I-64 13 Mi

To Summersville 17 Mi

To Charleston 28 Mi

To Charleston 53 Mi

To New Falls State Park

Describe the habitat type next most vulnerable to disturbance by recreational use development or use.

- a. In your opinion, is this habitat disturbed now, or will it likely be in the future (check one)?

\_\_\_\_\_ Now

\_\_\_\_\_ Not now, but in future      How soon? \_\_\_\_\_

- b. Describe where along the river that this habitat exists. (Be as specific as possible).

Thank you for your participation in this important study. Your ideas will help the National Park Service select its management strategies and prioritize research efforts.

Would you like a copy of the study results?

\_\_\_\_\_ Yes

\_\_\_\_\_ No

Please use the remaining space for any additional comments you may have.