



MID-ATLANTIC REGION

RESEARCH/RESOURCES MANAGEMENT REPORT

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Jeffrey L. Marion

INVENTORY AND IMPACT MONITORING
OF RIVER RECREATION SITES WITHIN
THE NEW RIVER GORGE NATIONAL RIVER

Technical Report NPS/MAR/NRTR - 90/047

U. S. Department of Interior
National Park Service



APPROPRIATE RIVER RECREATION USE STUDY

INVENTORY AND IMPACT MONITORING OF RIVER RECREATION
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Technical Report NPS/MAR/NRTR - 90/047

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EXECUTIVE SUMMARY

Increasing recreational use on the New River and concern over the associated ecological impacts prompted this study to develop a recreation site impact assessment monitoring system. Specific objectives were to: (1) determine appropriate recreation site inventory and impact assessment parameters, (2) develop accurate, precise, and efficient measurement procedures, (3) integrate and document parameters and their procedures in the development of a standardized recreation site inventory and impact assessment system for use by New River Gorge managers, (4) conduct coding, computer entry, analysis, and interpretation of inventory and impact assessment data, and (5) explore and document the potential of microcomputer data storage and retrieval for impact assessment and monitoring information.

A review of the literature revealed the types of recreation site impact assessment systems developed for use in other areas. These systems were described and their advantages and disadvantages were discussed with New River Gorge managers. The multiple-parameter impact assessment approach was selected and an evaluation of specific recreation site inventory and impact parameters was conducted.

Field assessment and measurement procedures were developed for each inventory and impact parameter selected. Due to constraints on personnel, all inventory and impact assessments were designed so that two seasonal employees could take the necessary measurements on a recreation site in approximately 15 to 20 minutes. Measurement procedures were field tested and refined and a field data collection form was developed. Field measurements were taken by seasonal and permanent New River gorge employees working part time on this project during the summers 1985-1988. One hundred and thirty four recreation sites were located and assessed. Recreation sites were located from canoe or raft, with foot searches conducted whenever any evidence of vegetative or soil disturbance was noted on the shores.

An evaluation of statistical and database management software packages led to the selection of Dbase iii plus for the storage and analysis of recreation site data. An extensive set of menu-driven dBASE programs were developed to increase accessibility and use of the data by managers. This programming enables managers to obtain basic descriptive listings and conduct a variety of analyses on inventory and impact assessment information for all recreation sites or various subsets of recreation sites. The dBASE database and this programming were used to produce all the information presented in this report.

Both inventory and impact assessment information is presented and discussed in this report. As indicated by the survey, the typical recreation site was about 700 square meters (7,600 square feet) in size and had approximately 60 percent less vegetative ground cover than adjacent undisturbed areas. The typical site also had approximately three damaged trees, consisting of cut or broken limbs, knife-axe scars, or nails; three tree stumps; and approximately 30 meters (100 feet) of shoreline with lost or disturbed vegetation and soil.

This survey provides managers with a comprehensive database describing the current number and distribution of recreation sites, and the type and severity of ecological impacts. This information is valuable in addressing current resource and visitor management concerns and in establishing baseline conditions against which information collected in the future can be compared. It is recommended that the recreation site monitoring program be continued, with inventories conducted at five to six year intervals. Evaluations and experience gained in the development of this program led to many improvements in the accuracy and precision of impact assessment methods and in the use of microcomputers for data storage and analysis. These modified methods were documented and are recommended for use during the next recreation site inventory and for consideration by others who are developing similar programs.

A number of additional management recommendations were offered with respect to the management of both recreation sites and visitors. These include a recommendation to adopt a Limits of Acceptable Change planning framework for the management of recreation sites and their associated resource impacts. Several other recommendations, identifying topics requiring further management and research evaluation, are discussed in the Management Implications section and summarized in the Conclusion section.

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INTRODUCTION

In 1984, the Mid-Atlantic Region of the National Park Service (NPS) entered into a cooperative research agreement with the River Recreation Management Research Unit at North Central Forest Experiment Station (Interagency Agreement Number IA-4000-4-0002). Research studies concerning river recreation use and carrying capacity were conducted in three areas: the Upper Delaware Scenic and Recreational River, the Delaware Water Gap National Recreation Area, and the New River Gorge National River. As stated in the interagency agreement, the primary goal of this research is to help ensure that these river segments are appropriately managed to provide for and to protect the recreational, natural, and cultural values for which they were established.

For organizational purposes, research has been divided into four major components: (1) the environment and impacts resulting from recreation use, (2) the users and their experiences, (3) social and economic impacts, and (4) the management system. This research report addresses one element of the environmental impact component: a baseline inventory of conditions and the development of an impact monitoring system for river recreation sites within the New River Gorge National River. Direction for this research program is formulated in Lime et al. (1985), Marion and Lime (1984), and Marion (1986).

Value of Impact Monitoring

Environmental impacts are inevitable in areas receiving regular recreational use. This is particularly true at overnight and day-use recreation sites where visitors and their associated impacts are concentrated. These impacts include the trampling and subsequent loss of ground vegetation, shrubs and tree seedlings, felling of saplings; erosion of surface litter and humus; exposure, erosion, and compaction of mineral soil; exposure of tree roots; and damage to tree trunks (Settergren 1977, Cole 1982, Marion 1984).

In many areas where the preservation of natural conditions is a primary management goal, managers are concerned about environmental deterioration caused by recreational activities in the nation's backcountry and wilderness areas. This concern has led to the development and implementation of a variety of systems for inventorying and monitoring recreation sites and trails. These management-oriented systems provide site-specific information concerning the nature and severity of resource impacts.

When periodically reapplied as part of an impact monitoring program these impact assessment systems can produce a data base which has significant benefits for the resource manager. A standardized monitoring program provides an objective record of site or trail conditions over time even though individual managers may come and go. This allows for the detection and evaluation of trends by comparing present and past assessments of impacts.

Deteriorating conditions can be detected before severe or irreversible impacts occur, thus allowing managers time to implement corrective actions. Relationships between specific impacts and physical or use-related inventory information may suggest appropriate management actions. Furthermore, an impact monitoring program provides a mechanism for evaluating the success or failure of resource protection measures following their implementation.

And finally, impact assessment systems which are based on quantitative measurements can be incorporated into carrying capacity-based management frameworks such as the Limits of Acceptable Change (LAC) management-by-objectives planning system (Stankey et al. 1985, Marion, Cole and Reynolds 1985). Under this system, numerical standards could be set for individual impact parameters or for summary impact ratings to specify the "limits of acceptable change." These limits define the critical boundary line between acceptable and unacceptable conditions, establishing a measurable reference point to which future conditions can be compared.

Research Objectives

Due to management concern over high levels of river recreation use at New River Gorge and to the high potential for increased use in the future, research was initiated in 1985 to assess the nature and severity of resource impacts at recreation sites along the New River and to develop a standardized system for monitoring recreation site impacts. Specific research objectives were to:

1. Determine appropriate recreation site inventory and impact assessment parameters,
2. Develop accurate, precise and efficient measurement procedures,
3. Develop standardized recreation site inventory and impact assessment system for use by New River Gorge managers,
4. Code, computer enter, analyze, and interpret inventory and impact assessment data collected by park personnel, and
5. Explore and document the potential for microcomputer storage and retrieval of impact monitoring data.

Types of Impact Assessment Systems

Recreation site impact assessment systems differ greatly in the types of information collected, assessment methods, amount of time required, and the accuracy and precision of the information collected. Impact assessment systems can be grouped into three basic categories: (1) photographic systems, based on repeat photographs taken at permanently established photo points; (2) single-parameter systems, based on descriptive visual criteria

of overall site conditions; and (3) multiple-parameter systems, based on individual measurements and/or appraisals of specific resource impacts.

Photographic systems provided the first and easiest means for recording changing resource conditions (Magill 1965). Recording changes over time through photographic means has the advantages of being easy to establish, requires little time for repeat photographs, and yields easily understandable visual records of recreation site conditions. However, this method used alone provides no quantitative measurements of specific changes and is highly dependent upon the quality of the photographs.

Frissell (1978) developed the first single-parameter system which consists of a set of five recreation site descriptions corresponding to increasing levels of impact. To assess the impact at a given site an observer simply selects the recreation site description or "condition class" which most closely matches the conditions of the site being assessed. This type of system is also easy to apply, requires little time for repeat assessments, and yields easily understandable information. However, as with photographic systems, this impact assessment method does not provide quantitative measurements on specific changes. Furthermore, the visual criteria used in these systems are subjective and require careful training of personnel for consistent results.

Multiple-parameter impact assessment systems developed by Parsons and MacLeod (1980), Cole (1983), and Marion (1985) consist of six to 10 impact parameters, each with three to five impact ratings for assessing the severity of impact for that particular parameter. Impact ratings are typically quantitatively defined descriptions of the range of site conditions for a given impact parameter. Among the impact parameters often included are: (1) recreation site area, (2) exposed mineral soil, (3) vegetation loss, (4) tree damage, (5) root exposure, (6) shoreline disturbance, (7) number of access trails, (8) cleanliness, (9) extent of recreation site development, and (10) number of fire sites. To assess the impact at a given site the observer selects an appropriate impact rating for each of the impact parameters. For example, given the impact parameter "Recreation Site Area" with the following impact ratings:

- 1) Recreation site size = $< 90 \text{ m}^2$
- 2) Recreation site size = $91\text{-}200 \text{ m}^2$
- 3) Recreation site size = $>200 \text{ m}^2$

an observer obtains a measurement of 150 m^2 and records a rating of "2" for this impact parameter. A summary impact rating for each recreation site can also be computed by averaging the individual impact parameter ratings.

More recently, researchers have recommended that managers calibrate the ratings for each impact parameter so that approximately equal percentages of sites fall into each category (Marion 1985, Marion and Cole 1987a). Failure to calibrate a system in this fashion can lead to a disproportionate clustering of sites in some categories. Sites that may differ significantly in extent of impact are then included in a single category and pronounced changes could occur without causing them to shift to another category. Perhaps the best approach is to record the actual measured value on field forms, permitting maximum

flexibility in the calibration of ratings or the use of other summarization procedures (Marion and Cole 1987a, Cole 1987).

Multiple-parameter impact assessment systems provide fairly accurate quantitative information on a number of changes occurring on recreation sites. However, precise measurements with these systems require longer assessment times and greater observer training. Further descriptive information concerning impact assessment systems can be found in Cole (1983), Marion and Cole (1987a), and Cole (1987).

STUDY AREA

The New River Gorge National River, established in 1978, is located in southeastern West Virginia, approximately 40 miles southeast of Charleston. The National Park Service currently owns 33,707 acres of the authorized 62,000 acre river corridor. Fifty miles of the New River, offering some of the finest Whitewater rafting and intermediate to advanced Whitewater canoeing in the East, are included within park boundaries. The park, with the river as the primary attraction, receives heavy recreational use, attracting approximately 394,100 visits in 1986 (NFS 1986). Commercially guided rafts account for most of this use, particularly in the lower gorge. Fishing is also an intensive use throughout the national river.

River rangers estimate that approximately 5-10% of the river visitors camp overnight along the river, primarily at undeveloped sites on public or private land. The National Park Service currently owns approximately 50 percent of the land adjoining the river; an active land acquisition program is rapidly increasing this percentage. Recreation sites were defined as areas of disturbed vegetation, surface litter, or soils caused by human use either as overnight camping sites or day-use recreation sites. These undeveloped river bank recreation sites have traditionally served both day and overnight users such as local fishermen, who access the sites most commonly by land. Rafting has also become a predominant use. Rafters have used the recreation sites primarily as lunch sites, although overnight trips are increasing in popularity. All existing recreation sites along the river have been visitor-selected. Camping policies, regulations, facilities, and signs have not yet been developed to manage this use.

The New River flows northwest through the region which is largely undeveloped and forested. Valley walls are steep and narrow through the northern one-third of the park but broaden out considerably to the south. Water levels in the river are controlled by a Corps of Engineers dam located a few miles south of the park boundary. Railroad tracks run the entire length of the river valley; tracks, roads, and houses are occasionally visible from the river.

The plant communities along the New River are dominated by *Platanus occidentalis* (sycamore), *Salix nigra* (black willow), and *Betula alleghaniensis* (yellow birch) growing on sandy soils subject to annual flooding.

RESEARCH METHODS

Research objectives called for the development of a standardized impact assessment system to monitor resource impacts on recreation sites along the New River. Research was initiated in 1985 with a review and evaluation of the different types of impact assessment systems which have been developed for use in other areas (as described in the Introduction, Types of Impact Assessment Systems section). Following discussions of the systems available and their advantages and disadvantages it was decided that the multiple-parameter format provided the best approach and mix of information needed by the park.

The next step involved the identification of appropriate recreation site inventory parameters (such as type of site access or site capacity) and recreation site impact parameters (such as area of disturbance and vegetation loss) (Marion and Lime 1984). This began with a search of the literature for parameters found to be important in previous studies of recreation site impacts, particularly in river settings. No previous research on recreational impacts had been conducted at New River Gorge or in other similar eastern environments. Site visits with resource managers to view recreation site conditions helped identify relevant and important impact parameters.

Field assessment and measurement procedures were developed for each inventory and impact parameter selected. Discussions with resource managers revealed the desired level of accuracy based on information needs and personnel constraints. As with any field measurements, there is a trade-off between measurement time and data accuracy. Due to personnel constraints, procedures were designed so two employees could complete the necessary measurements at each site in approximately 15 to 20 minutes.

Measurement procedures were field tested and refined and a data form using the standard NFS Case Incident Form was developed by the park's Resource Manager. Field instructions, assessment procedures and the data form are included in Appendix 1. The monitoring system was applied by New River Gorge seasonal employees who incorporated the recreation site inventories into their summer work duties beginning in July of 1985 and ending in November of 1988. Measurements were taken on all river accessible recreation sites located within park boundaries. Recreation sites were located by raft, kayak or canoe, with foot searches conducted whenever any evidence of vegetative or soil disturbance was noted along the shores. Sites were numbered consecutively within each river mile, which were numbered consecutively beginning at the southern park boundary. This numbering system was devised to simplify site renumbering when future inventories are conducted. Sites were also photographed and their locations were described and mapped on field forms.

A problem associated with all resource inventory and monitoring programs is the efficient storage and evaluation of collected data. File cabinets which are seldom opened too often serve as the final resting ground for this information. Because of the extensive time involved in data evaluation, much monitoring data is never interpreted or used in the planning/management process as originally intended. To alleviate this reoccurring problem,

the use of microcomputers for the storage and evaluation of impact assessment data was investigated. Microcomputers have the potential of greatly increasing the efficiency of data storage and evaluation, particularly with the user-friendly database management software programs available today.

An evaluation of statistical and database management software packages led to the selection of dBASE III Plus for the storage and analysis of the recreation site inventory and monitoring data. An extensive set of menu-driven dBASE programs were also developed to increase the accessibility and use of the data by managers. This programming enables managers to obtain basic descriptive statistics and to display various types of information for all recreation sites or various subsets of sites. This programming, for example, was used to generate all the information reported in the results sections of this report. A complete description of the database/programming and its use is included in Appendix 2.

All resource impact parameters were measured using interval scales, allowing more latitude in mathematical computations (Marion and Cole 1987a). This permitted the computation of a summary impact score, providing a single measure of impact to facilitate comparisons between groups of recreation sites and to rank individual recreation sites. Six impact parameters were included in this summary score: recreation site size, vegetation loss, damaged trees, tree stumps, fire sites, and shoreline disturbance.

Computation of the summary impact score required that the six impact parameters be standardized using a statistical procedure known as the z-score transformation. The standardized values for the impact parameters were then summed for each recreation site and divided by six, to obtain what will be called the summary impact score. For this score, impacts increase in severity from smaller (-) values to larger (+) values with 0.00 representing average impact levels from the entire survey.

INVENTORY AND MONITORING RESULTS

Recreation Site Distribution

The distribution of recreation sites is shown in Table 1. Of the 134 recreation sites located, 58 (43%) were in the upper river segment (Hinton to McCreery), 35 (26%) were in the middle river segment (McCreery to Thurmond), and 41 (31%) were in the lower river segment (Thurmond to Teays Landing). Recreation site densities (the number of recreation sites per mile of river) were exceptionally uniform for the three river segments, averaging 2.6 to 2.7 sites/mile. A larger number of sites were found on the left side of the river (82, 61%) than on the right side (52, 39%), perhaps due to the presence of a railroad line along the lower gorge on river right.

Table 1. Distribution of New River recreation sites by river segment and side of river.

River Segment ¹	Recreation Sites				Row	
	River	Left	River	Right	Totals	
	#	%	#	%	#	%
Upper	45	33	13	10	58	43
Middle	17	13	18	13	35	26
Lower	20	15	21	16	41	31
Column Totals	82	61	52	39	134	100
-----number/mile-----						
Upper		2.0		0.6	2.6	
Middle		1.3		1.4	2.7	
Lower		1.3		1.4	2.7	
Column Average		1.6		1.0	2.7	

1 - Upper Segment: Hinton to McCreery, Middle Segment: McCreery to Thurmond, Lower Segment: Thurmond to Teays Landing

Inventory Parameters

Information was collected on a wide variety of inventory parameters which relate to particular site features as opposed to environmental impacts. This information is presented in Table 2 in frequency distribution format with the number and percent of surveyed recreation sites listed for each inventory parameter category. Metric parameters, those for which a measurement or count was taken, were divided into categories for display of frequency distributions. Where possible, the categories for these parameters were defined so that approximately equal numbers of recreation sites fell into each category.

Recreation Site Access. River recreation sites are accessed both by land (roads, railroads, and trails) and by water. Only 13 sites (10% of all sites) were judged to be accessible solely by river, with an additional 14 sites accessible by river and trail. Approximately 50 sites (38%) are accessible by road and 28 sites (21%) are accessible by railroad.

Amount of Site Use. Workers were asked to judge the approximate amount of use each site receives over a typical season based on their prior experience in viewing site occupancy levels. By their estimates, approximately 37 (28%) of the sites are heavily used, 63 (47%) receive moderate use, and 34 (25%) receive low use.

Overnight Site Capacity. Based on size and number of tenting areas, the majority of recreation sites (86, 64%) could accommodate 4 to 25 individuals for overnight stays. A fairly large number of sites (33, 25%) were judged to be too small to accommodate more than 3 individuals while 15 sites appeared to be large enough to accommodate over 25 individuals. The smaller sites are primarily day-use fishing sites while the largest sites are those used by the large rafting groups as lunch sites. This information might be used in future efforts to facilitate the matching of group sizes with campsite sizes; large groups in small sites can cause considerable and unnecessary resource damage.

Substrate of Recreation Site. Approximately half of the recreation sites occur on sand substrate, perhaps because sandy beaches at the shoreline are easier on boats and are more attractive than other substrates. A number of sites (20%) had combinations of two or more substrates, many had rock at the shoreline and sand or soil under the site itself.

Other Sites Visible from Site. Visitors have a strong potential for obtaining solitude while camping; visitors would see no other sites from approximately half of the recreation sites, and would see only 1 other site from an additional third of the recreation sites. However, sites are clustered in at least one area; visitors to five of the sites would see four or more other sites.

Trails. Excessive development of impromptu trails around recreation sites does not appear to be a problem, approximately 113 (85%) of the sites had two or fewer trails associated with them. Only ten sites had four or more trails.

Table 2. Number and percent of surveyed recreation sites for selected inventory parameters.

<u>Inventory Parameter</u>	<u>Recreation Sites</u>	
	<u>number</u>	<u>percent</u>
<u>Recreation Site Access</u>		
River only	13	10
River and Road	50	38
River and Trail	14	11
River and Railroad	28	21
Combinations	28	21
<u>Amount of Site Use</u>		
High	37	28
Moderate	63	47
Low	34	25
<u>Recreation Site Capacity</u>		
1-3 people	33	25
4-25 people	86	64
>25 people	15	11
<u>Substrate of Recreation Site</u>		
Rock	5	4
Cobble	15	11
Sand	69	52
Soil	17	13
Combinations	27	20
<u>Other Sites Visible from Site (#)</u>		
0	63	47
1	43	32
2	15	11
3	7	5
≥4	5	4
<u>Trails (#)</u>		
0	16	12
1	62	47
2	35	26
3	10	8
≥4	10	8
<u>River Bank Slope</u>		
Sloping Bank	95	73
Steep Bank	36	27

(continued on next page)

Table 2. Number and percent of surveyed recreation sites for selected inventory parameters.

Inventory Parameter	Recreation Sites	
	number	percent
<u>Human Waste (# locations)</u>		
0	110	85
1	13	10
2	1	1
3	2	2
≥4	4	3
<u>Volume of Trash (# of 30 cral. baas)</u>		
0	8	6
1	64	48
2	21	16
3-5	24	18
≥6	15	11
<u>Source of Trash: River (%)</u>		
0	55	44
1-25	31	25
26-50	21	17
51-75	3	2
≥76	16	12
<u>Source of Trash: Recreational (%)</u>		
0	1	1
1-25	13	10
26-50	20	16
51-75	11	9
≥76	81	64
<u>Type of Trash: Small (%)</u>		
<20	1	1
21-40	5	4
41-60	7	6
61-80	7	6
≥81	103	83
<u>Type of Trash: Larae (%)</u>		
<20	101	82
21-40	8	7
41-60	6	5
61-80	4	3
≥81	4	3

(continued on next page)

Table 2. Number and percent of surveyed recreation sites for selected inventory parameters.

Inventory Parameter	Recreation Sites	
	number	percent
<u>Predominant Use: Camping/Fishing (%)</u>		
<10	16	12
11-30	21	16
31-50	33	25
51-70	8	6
≥71	56	42
<u>Predominant Use: Boater Lunch (%)</u>		
<10	106	79
11-30	7	5
31-50	10	7
51-70	0	0
>71	11	8
<u>Predominant Use: Bank Fishing (%)</u>		
<10	58	43
11-30	36	27
31-50	23	17
51-70	3	2
≥71	14	10
<u>Predominant Use: Other (%)</u>		
<10	120	90
11-30	5	4
31-50	5	4
51-70	0	0
≥71	4	3

River Bank Slope. The development and use of recreation sites in areas with excessively steep river banks should be discouraged to minimize soil erosion. Approximately one-quarter of the sites were judged to have steep river embankments.

Sanitation. Recreation sites do not currently have any facilities for accommodating human waste. In spite of this, little evidence of fecal waste was found during the site surveys. Workers were instructed to follow trails and search out likely locations where human waste might be found. No evidence of fecal human waste was found on 110 (85%) of the sites and only seven sites had two or more human waste locations. These findings indicate that fecal human waste does not appear to be a problem at the time the survey was conducted. As visitation is predominantly daytime oriented, particularly for the heavily used sites, there may be more cause for concern regarding urine than fecal material.

Amount. Sources and Types of Trash. At the outset of this study discussions with managers indicated that trash along the river was a significant problem about which little was known. A number of parameters relating to the amount, sources, and types of trash were therefore included. Results indicate that considerable quantities of trash were found on many of the recreation sites. For example, 60 (45%) of the sites had two or more 30 gallon plastic bags of trash present; 15 (11%) of the sites had six or more bags! Only eight sites had no trash.

Managers had also indicated that some of the trash was from non-recreational sources, primarily from the households of residents in the region who lacked sanitation services. Garbage dumped over road embankments or along the banks of the New River and its tributaries can be carried downstream by floodwaters and deposited on river banks as the river recedes. Therefore, workers also estimated the percentage of the trash which was deposited on the sites by the river versus that which was left by recreationists. Survey results indicate that approximately three-quarters of the trash is indeed recreation related. For example, on 81 (64%) of the sites workers estimated that more than 75% of the trash present was left by site users. In contrast, workers estimated that more than 75% of the trash was deposited by the river on only 16 (12%) of the sites.

The majority of the trash (an average of 86%) consists of smaller items such as paper, cans and plastic bottles. The remainder are large items such as tires and even household appliances, many of which are transported to the recreation sites in vehicles and discarded.

Predominant Use. Workers were also asked to estimate the percentage of site usage for several types of visitor use based on their prior experience in viewing sites and their occupants. According to their assessments, the predominant use of these sites is for camping (primarily by fishermen): approximately 56 (42%) of the sites receive more than 70% of their use from this activity. Bank fishing (primarily daytime) was the predominant activity for 14 (10%) of the sites and 11 (8%) of the sites were considered to be primarily used as lunch sites for rafters and other boaters.

Resource Impact Parameters

This section reports information relating to the types and severity of environmental impacts associated with use of the recreation sites. Parkwide results for several impact parameters are presented in Table 3 and discussed below, followed by a comparison of impacts by river segment.

Recreation Site Size. Recreation sites ranged in size from 18 to 15,188 square meters (193 to 163,481 square feet) with an average of 706 square meters (7,600 square feet). The average site would be equivalent to an area of about 85x85 feet. Many of these recreation sites are quite large, 24 (20%) of the sites were over 700 square meters (7535 square feet) in size. Only 14 (12%) of the sites were less than 100 square meters (1076 square feet) in size.

Shoreline Disturbance. Shoreline disturbance was defined as the length of shoreline where vegetation is absent or disturbed from human trampling, in comparison to adjacent undisturbed shorelines. This disturbance is typically caused by the landing, unloading, and loading of boats and bank fishing activity associated with the recreation site. Shoreline disturbance ranged from 0 to 400 meters (0 to 1312 to feet) with an average of 30 meters (98 feet). Only one-quarter of the sites had a shoreline disturbance of less than 10 meters (33 feet). In contrast, over one-quarter of the sites had a shoreline disturbance over 30 meters (98 feet).

Vegetation Loss. The percent cover of ground vegetation was assessed in five categories (0-5%, 6-25%, 26-50%, 51-75%, and 76-100%) within recreation site boundaries and in adjacent undisturbed areas selected to be environmentally similar to the recreation sites. Using category midpoints, recreation site cover was subtracted from offsite cover to obtain an estimate of how much vegetative cover was lost on each recreation site. The maximum vegetation loss using this approach is 85 percent (87.5 - 2.5). Clearly, some recreation sites may have lost up to 100 percent of their vegetative cover. The reported vegetation loss values, while adequate for comparative purposes, should be regarded as rough approximations of the true vegetation loss.

Vegetation loss ranged from -25 percent (an increase in cover on recreation sites) to 72 percent, with an average loss of 58 percent. Ground cover vegetation in most riparian forests is quite susceptible to trampling; 57 percent of the recreation sites lost more than half of their ground cover. Only one recreation site had more vegetative cover onsite than offsite; such an occurrence may be due to a loss of trees on the recreation site which increases ground cover by allowing greater sunlight penetration.

Number of Damaged Trees. Tree damage, consisting of human-caused damage (cut or broken limbs, knife and axe scars, and nails), ranged from 0 to 51 trees/site with an average of 3.2 trees/site. Twenty-one percent of the recreation sites had five or more damaged trees. For mature trees there was little evidence that this damage was causing increased tree mortality, however.

Table 3. Number and percent of surveyed recreation sites for selected impact parameters.

Impact Parameter	Recreation Sites	
	number	percent
<u>Recreation Site Size (m²)</u>		
<100	14	12
101-200	22	18
201-300	28	24
301-700	31	26
≥701	24	20
<u>Shoreline Disturbance (m.)</u>		
<10	33	25
11-20	37	28
21-30	25	19
31-50	25	19
≥51	14	10
<u>Vegetation Loss f%)¹</u>		
0	5	4
1-25	11	8
26-50	41	31
51-75	75	57
<u>Damacred Trees (#)</u>		
0	39	29
1	20	15
2	14	11
3-4	32	24
≥5	28	21
<u>Tree Stumps (#)</u>		
0	51	38
1	30	23
2	15	11
3	13	10
≥4	24	18
<u>Fire Sites (#)</u>		
0	11	8
1	72	54
2	34	25
3	10	7
≥4	7	5

1 - Categories refer to average vegetation loss.
Refer to text for discussion.

Number of Tree Stumps. The ultimate form of tree damage is, of course, when campers chop or saw down a tree. The number of tree stumps on recreation sites ranged from 0 to 46 with an average of 2.6 stumps/site. Approximately one-quarter of the sites had three or more stumps present.

Number of Fire Sites. The number of fire sites was included as an impact parameter because the heat of a fire can sterilize and physically alter the soil, retarding subsequent recovery of soil organisms and vegetation. The number of fire sites ranged from zero to seven, with an average of 1.5 fire sites/site. Multiple fire sites are somewhat of a problem; 17 (12%) of the sites had three or more fire sites.

Resource Impacts by River Segment

Analysis of impacts for recreation sites stratified by river segment yielded additional results of interest to managers. The severity of recreation site impacts were found to vary both by river segment and within river segments by type of impact (Table 4). For example, recreation sites in the middle segment were more than three times larger than those of the other two segments, ten sites were over 1000 square meters (one was over 15,000 square meters). In contrast, damage to trees on recreation sites in this segment was considerably less than in the other segments, 15 sites had no tree damage. Shoreline disturbance was also substantially greater on the middle segment. Damage to trees and the cutting of trees were almost twice as severe on the lower segment as on either of the other segments. However, much of this damage was concentrated on just a few of the sites in this segment. Vegetation loss and the number of fire sites were essentially the same for all three segments.

As described in the Methods Section, each impact parameter was transformed to standardized scores and then averaged to produce a single summary impact score for comparative purposes. Each impact parameter received equal weighting in this artificial measure. Based on the summary impact score, recreation sites in the upper segment were least impacted, resource impacts on recreation sites in the lower and middle segments were equivalent and slightly more impacted.

Resource Impact Rankings

All surveyed recreation sites were ranked by amount of impact for the summary impact score, recreation site size, and shoreline disturbance. The ranked impact scores as well as information identifying the 12 worst recreation sites (the dirty dozen) are listed in Appendix 3. This information identifies the most highly impacted recreation sites so that managers can begin to assess the acceptability of the current impacts, address the issue of setting impact standards, and evaluate the need for recreation site rehabilitation work.

Table 4. Recreation site impacts by river segment.

Impact Parameter	River Segment		
	Lower N=41	Middle N=35	Upper N=58
	----- average -----		
Recreation Site Size (m ²)	450	1503	389
Shoreline Disturbance (m.)	32	48	18
Vegetation Loss (%)	61	55	57
Damaged Trees (#) Tree	4.3	1.6	3.3
Stumps (#) Fire Sites (#)	4.1	2.0	2.0
	1.4	1.6	1.5
Summary Impact Score ¹	0.1	0.1	-0.1

1 - The summary impact score was computed by averaging standardized values for each of the impact parameters listed above (see the Methods section for additional detail). This score provides a single summary measure of impact for comparative purposes. Impacts increase in severity from smaller (-) values to larger (+) values with 0.00 representing average impact levels from the entire survey.

MANAGEMENT RECOMMENDATIONS

Recreation Site Impact Monitoring Program

The implementation of the recreation site impact monitoring program for recreation sites along the New River yielded a considerable amount of data, including information on the number and distribution of recreation sites, various inventory characteristics, and the nature and severity of environmental impacts. The resulting database not only provides meaningful data on current recreation site numbers and conditions, but serves as a reference point for comparison with data collected in the future. It is recommended that all recreation sites be reinventoried every five to six years to permit the detection and evaluation of changes in recreation site numbers and condition (see Introduction, Value of Impact Monitoring). It is estimated that future surveys will require two seasonal employees approximately two months to complete, including data entry but not data analysis and report writing.

A number of modifications were made to the field data form and procedures used in this survey based on experience gained at the New River Gorge and elsewhere. These revisions include the addition and deletion of parameters and improvements in field procedures and data coding and recording to increase data accuracy and precision. A detailed manual describing each inventory and impact parameter and how each is to be assessed and recorded was prepared and is recommended for use with future recreation site inventories (Appendix 4). Where necessary, this manual should be updated to reflect any future changes in procedures. Where practical, care should be taken to maintain comparability with existing data. Copies of all manuals, along with the dates they were in effect, should be stored permanently.

Recreation Site Numbers and Distribution

Survey data indicates that recreation site distribution is fairly uniform, there do not appear to be any significant gaps or concentrations of sites. While this survey documents the current number and distribution of all recreation sites it is not clear whether there are "enough" sites or if they are in the "right" places. This information needs to be evaluated by park management to make these determinations. Recreation site occupancy surveys conducted by river rangers during peak use holiday weekends could provide additional information for evaluating the adequacy of existing recreation site numbers and locations.

How recreation site distribution and occupancy information is used by managers depends on management objectives relating to river recreation use. Management must clearly define the type of camping and day-use experiences that are to be created and/or maintained for visitors. Should river recreation sites be out of sight and sound from each other, offering a solitude oriented camping experience, or should they be grouped, permitting many visitors to camp together in close proximity? It is possible to offer both types of camping

experiences by defining different management objectives for different river segments or locations.

Following the establishment of management objectives, perhaps one of the first issues managers should address is what general strategy or approach should be followed to minimize recreational impacts in the future. A traditional approach has been to disperse visitors over a large number of sites, thereby avoiding severe impacts at any given site. Unfortunately visitors generally will not disperse to the extent necessary for recreation sites to stabilize at lightly impacted levels. Research has shown that significant impacts occur with only initial or light use (less than 12 nights/year) while the rate of additional damage diminishes rapidly with increasing use levels (Merriam et al. 1973, Cole and Fichtler 1983, Marion and Merriam 1985). Such findings suggest that a dispersal strategy, except where use is very light, will simply result in a significantly larger total area of resource alteration.

An alternate approach, visitor concentration, is more effective in areas receiving moderate to heavy use. Visitors are encouraged or required to use a limited number of well-established and damage resistant sites, thus avoiding more easily damaged areas. Such a policy might be phased in by first simply encouraging visitors to select and use moderately impacted sites and to avoid, where possible, lightly and severely impacted sites (Cole and Benedict 1983). If this proves ineffective or if use increases, managers may then require visitors to use only designated sites. Such regulations need not be unduly restrictive provided the number and location of sites are matched to visitor numbers and use patterns.

Restrictions on the number of sites do not appear to be necessary or appropriate at the current time. Capacities should be considered as only one of many possible approaches for addressing resource impacts (see discussion on Limits of Acceptable Change below). When necessary, managers in other areas have based capacities on a variety of factors: (1) capacities inherent in the geography of the landscape, ie. there may be a limited number of locations with the proper slope, vegetation, and river access which permit an adequate recreation site, (2) capacities based on a freeze of the number and/or distribution of existing recreation sites and use levels to maintain current recreational and resource conditions, (3) capacities based directly on management objectives defining the type of recreational experiences that management is seeking to create and/or maintain for visitors, and (4) capacities based directly on impact levels as compared to management standards defining limits of acceptable change.

If management objectives allow for the addition of new recreation sites, the occupancy surveys discussed above could provide information on how many are needed and in what locations. However, managers must determine whether new recreation sites will be developed to meet typical weekend demand or peak use holiday demand. An objective of supplying enough recreation sites to meet peak use holiday demand is inadvisable as it would require a large number of recreation sites which are used less than 10 nights each year. This would cause considerable resource impact as demonstrated by research defining the use/impact relationship conducted both at Delaware Water Gap and in other areas (Cole and Marion 1987, Cole 1982, Marion 1984). Resource impacts will be minimized by maintaining as few recreation sites as are necessary to meet the "average" demand.

Problems with managing demand during peak use holidays are best controlled through a program to better inform visitors of recreation site locations and, eventually, through the establishment of a recreation site permit system possibly combined with limits or capacities.

Discussion of Inventory Data

Site Access. More than half the recreation sites appear to be accessible by vehicle (railroads are often used for vehicle access to recreation sites). As discussed above, park managers must define the types of recreation opportunities they are seeking to provide in the area to determine the appropriateness or acceptability of vehicular access to the river and recreation sites. For example, managers at Delaware Water Gap have limited river camping opportunities to boaters on overnight trips from one access to another when the distance between these points is too great to be covered in one day. A large number of roads which provided river access were permanently closed or restricted to administrative access only. Such restrictions are not necessarily recommended, they serve only to illustrate the range of possibilities.

Trash/Litter. Trash on recreation sites is a major problem and one which has no easy solutions. The amount of litter is unquestionably excessive and unacceptable given the national status of the river and the recreational opportunities it is mandated to provide. This survey indicates that most of the litter originates with recreationists rather than from trash transported downstream by the river. Furthermore, survey data indicates that the sites commonly used by commercially outfitted rafters are generally quite clean. The problem appears to stem largely from non-outfitted visitors.

The litter problem might be addressed from several angles: visitor education, facility development, and law enforcement. A strong in-park and outreach visitor education program to further develop environmental ethics through interpretive talks and the distribution of materials is recommended. This program would need to address the underlying causes of the litter problem and must be well-supported and ongoing over many years to succeed. Facility development would include the placement of trash receptacles at additional accesses and/or river rest stops. Road closures would also help to alleviate the trash problem as most of the larger trash items (household appliances and car parts) and some smaller residential trash are transported to the sites by vehicle. Finally, an increased law enforcement presence and more vigorous enforcement of littering violations would help to reinforce the interpretive message that littering is not an acceptable practice.

Sanitation. The survey did not find improper human waste disposal to be a significant problem. Little evidence of human fecal waste was found, perhaps because of the heavy orientation to day use. However, research in recreation environments does show that human fecal waste can pose a significant health threat (Christensen 1979, Temple et al. 1980, Temple et al. 1982, Brickler et al. 1983). These and other studies indicate that fecal contamination of water bodies becomes a problem only when recreational use is very high and wastes are improperly disposed. However, research has also shown that pathogens in buried fecal materials can remain infectious for several months, perhaps longer. Little

research has been done on the effects of urine; several authors note that urine poses a minimal threat to health.

A variety of options are available to managers for resolving human waste problems. The most expedient option is visitor education to encourage more widespread adoption of the "cat-hole" method of human waste disposal. This will likely be insufficient or inappropriate in areas of heavy use, however. For rafters, various methods for packing out human waste exist, typically involving the use of large ammo cans, plastic resealable pails, or commercially available devices. Such methods are commonplace on rivers in the west, where they are either mandatory or simply recommended. Managers on the Lower Salmon River in Idaho even provide a receptacle for visitors to deposit the wastes at the primary takeout site (Grussing 1984).

Other options include the seasonal or permanent placement of pit or vault toilets at selected sites along the river. These options are constrained to some extent by wide yearly fluctuations in river water levels (up to 20 feet) in the New River. Permanent facilities would have to be placed well above the average annual high water mark. This would effectively limit their use to a very small number of sites due to the river valley's steep topography and the close proximity of railroad tracks along much of the river. Alternatively, lighter weight facilities could be placed on recreation sites following spring flooding and moved to higher ground or to storage in the fall. A wide variety of toilet facilities are commercially available for both pit and vault toilets. If vault toilets are used they would have to be road accessible for pumping (a pump and tank could be carried by a 4-wheel drive pickup) or, conceivably, removable smaller vaults could be replaced and rafted out by river.

Other options include the use of composting toilets, which facilitate rapid decomposition of wastes and destroy pathogens through high temperatures. Commercially available composting toilets, such as the Clivus Multrum, are expensive and difficult to transport to remote sites but have been effective at Delaware Water Gap, where several have been in use on primitive river sites for nearly ten years. Cheaper in-house constructed bin composting systems have been designed and successfully used in other areas (Plumley and Leonard 1981, Weisberg 1988). While these systems do not require pumping to remove wastes they do require routine maintenance to prevent anaerobic conditions and to monitor the decomposition and sterilization process.

Efforts to install and encourage the use of toilets at put-ins should also be pursued. The locations of toilets in these areas should be obvious and convenient or adequately signed, and visitors should be encouraged to use them prior to embarking on river trips. These suggestions also pertain to any future installations of toilet facilities on recreation sites along the river.

Discussion of Resource Impact Data

Site Size, Vegetation Loss, and Shoreline Disturbance. Previous scientific investigations on a sample of New River recreation sites found them to be significantly larger than sites at the other two study areas (Upper Delaware Scenic and Recreational River and Delaware Water Gap) and elsewhere (Cole and Marion 1987, Cole and Marion 1988, Marion and Cole 1987b). This survey, which included all recreation sites, supports this finding with an average site size (706 m²) considerably larger than the earlier work suggested (286 m²). Again, the acceptability of such large sites must be evaluated in accordance with area management objectives.

One reason for such large site sizes is the extremely large size (up to 80 individuals) of some outfitted rafting groups which lunch on the sites. Large groups camping on sites or smaller groups on extended stays also tend to expand the sizes of recreation sites. Finally, a number of sites abut primitive roads and are expanded by vehicles which require space to park and turn around. Visitor education to encourage smaller party sizes and the use of minimum impact practices could be effective in reducing the area of disturbance on recreation sites. Managers should consider defining a recommended or required maximum party size for groups lunching or camping on park lands. It is clear that a large group can do more resource damage to a site in one day/night than the same total number of people using the site in smaller groups over several days/nights. Restrictions on length of stay and vehicle access should also be evaluated.

A number of site maintenance techniques can also be effective in controlling site expansion and shoreline disturbance. These include the improvement of areas within the desired site boundaries and the restoration (through the placement of vegetation, rocks and logs) of unnecessary use areas. These and other procedures have been implemented in the Boundary Water Canoe Area Wilderness, Minnesota and are described in Marion and Sober (1987).

Vegetation and soil loss at the shoreline may be one of the more serious resource impact problems identified by this survey. As noted previously, shoreline disturbance ranged up to 1,312 meters, and averaged 30 meters, more than twice that of any other area previously studied. In some instances, the lack of vegetation along the shoreline is a natural phenomena, caused by scouring and depositional processes associated with river flooding. Some of these areas may have originally been selected by boaters due to their sandy beaches and lack of vegetation. It is difficult to ascertain after their use whether vegetation loss and soil disturbance both along the shoreline and on-site are caused by recreational use or natural factors.

Regardless of the above, it is clear that recreational use does cause the loss of considerable vegetation cover (approximately 60% on the typical site) and that the effects of flooding are likely to be more severe on soils lacking vegetative cover. Shoreline disturbance can be minimized by educating boaters to concentrate rather than disperse their landings to specific areas, reduce their party sizes and avoid trampling shoreline vegetation. Where possible, sites with steep easily-erodible embankments should be avoided.

Tree Damage, Stumps, and Fire Sites. The results of this survey and the earlier research shows that tree damage at New River Gorge, while fairly commonplace, was still less than that in the two other study areas (Upper Delaware and Delaware Water Gap). However, a much larger number and percentage of the trees on New River sites had been felled than these other areas. During earlier field research work at the New River we noted that fishermen commonly used saplings for fishing poles when bank fishing. Presumably some trees are also cut for firewood. Many of the rafting lunch sites also had very high numbers of cut stumps; some had areas which looked as though large numbers of smaller trees were intentionally cut to clear additional lunching space.

Tree damage and the cutting of trees is typically addressed through visitor education programs instructing visitors to collect only dead and downed wood for fires and to leave their axes and saws at home. Factors other than firewood collection appear to be important here so additional measures might be considered. For example, restrictions on party size and more salient law enforcement activity might be necessary to curb the cutting of trees.

Multiple fire sites and more importantly, fire sites which are constantly moved around recreation sites, can cause long-term soil and vegetative impacts by sterilizing the soil and altering its chemistry. These impacts can be reduced by encouraging or requiring visitors to use and not relocate a single fire site. Steel fire grates securely anchored to the ground might be provided to increase the effectiveness of these policies.

In the absence of management standards for recreation site impacts it is recommended that managers examine some or all of the recreation sites included in Appendix 3, which lists the 12 "worst" recreation sites for selected impact parameters. Some of the recreation sites listed are prime candidates for rehabilitation work and possible closure. As compared to research conducted in the Midwest and West, continuing research on several Delaware Water Gap recreation sites closed to use in 1986 indicates that recovery rates are quite rapid, particularly for sites with more open overstories. This suggests that heavily impacted recreation sites might recover sufficiently after 2 to 4 years of closure to be reopened, providing use can be successfully prevented during closure.

Limits of Acceptable Change and Impact Standards. Sources of human influence, both internal and external to park boundaries, threaten the environmental quality of our national park resources. External influences include subtle, yet disrupting problems such as acid rain; internal influences include alterations due to the construction and use of roads and facilities and recreational activities. However, the values associated with park lands lie in their continued naturalness, especially as adjacent lands become increasingly modified by man. It is the responsibility of park managers to preserve these values by monitoring both internal and external influences and taking appropriate actions to minimize or mitigate their effects.

With respect to recreational use and its associated resource impacts, managers turned to the concept of carrying capacity, borrowed from the wildlife and range management sciences. Early failures in implementing carrying capacities for parks and wildernesses led to an evolved concept known as the Limits of Acceptable Change (LAC) described more completely in Marion, Cole, and Reynolds (1985) and Stankey et al. (1985). Under LAC,

a planning framework is provided for managers to first define the desired resource and social conditions that they seek to create or maintain for a particular park or management zone and then manage recreational use (eg. amount, type, timing, and location) and resources to maintain those conditions. This management framework requires managers to identify and define standards for natural resource and social indicators of change and then periodically monitor these indicators for comparison with standards.

The adoption of an LAC management framework, at least with respect to the management of recreation sites and their associated resource impacts, is recommended. Adoption of this framework will allow managers to more objectively balance recreational uses and their associated environmental impacts. The research and development of the recreation site inventory and impact monitoring program presented in this report was conducted with this management framework in mind. The impact parameters and measurement procedures recommended for future use (Appendix 4) may serve as indicators of change for monitoring recreation site impacts.

Managers must first specify the resource conditions they wish to maintain along the river and then set appropriate standards for each impact parameter. Impact standards define the critical boundary line between acceptable and unacceptable conditions; they should reflect challenging yet realistic goals for managers. Furthermore, it is important to note that standards represent the upper limits of acceptable change. Conditions should not be permitted to deteriorate to this **highest** common denominator. Managers should be concerned with any deterioration in resource conditions, not just when conditions begin to exceed the specified standards.

Defining impact indicator standards is not a straightforward process. Managers must reach agreement on a dividing line between situations (both for recreation site numbers and distribution and for level of impact at individual sites) that reflect their management objectives. These must then be specified in terms of measurable standards. It is recommended that managers begin this process by visiting representative recreation sites which illustrate moderate to high impact levels for each impact parameter. Managers can then begin to formulate standards for each impact parameter which define their "limits" of acceptable impact. As a consensus is reached, a different set of recreation sites representing varying levels of impact should be visited to test the appropriateness of the proposed standards. These standards could be defined for the entire river or for individual river segments or even groupings of recreation sites. They may also be changed in the future to reflect changes in management objectives.

CONCLUSION

The National Park Service operates under dual legal mandates requiring the "preservation" of natural environments and their ecological processes while still permitting public access and "use" of these environments. This often results in a management paradox for park managers faced with balancing recreational uses and their associated resource impacts. In the past, managers often relied on intuitive judgments to assess resource change. This was perhaps appropriate when visitor use was low. However, increasing urban populations seeking to recreate in natural environments, particularly in the East where there are few wildland areas, will necessitate more objective impact assessment and monitoring methods operating within well-defined resource protection and visitor management frameworks.

The recreation site inventory and impact assessment study described in this report was initiated in recognition of the needs described above. The inventory documented the number and distribution of recreation sites, and the type and severity of ecological impacts for 134 recreation sites at New River Gorge. This information is valuable in addressing current resource and visitor management concerns and in establishing baseline conditions against which information collected in the future can be compared. It is recommended that the recreation site monitoring program be continued, with inventories conducted at five to six year intervals. Evaluations and experience gained in the development of this program led to many improvements in the accuracy and precision of impact assessment methods and in the use of microcomputers for data storage and analysis. These modified methods were documented and are recommended for use during the next recreation site inventory and for consideration by others who are developing similar programs (Appendix 4).

A number of additional management recommendations were offered with respect to the management of both recreation sites and visitors. These include a recommendation to adopt a Limits of Acceptable Change planning framework for the management of recreation sites and their associated resource impacts. This will require additional management objectives specifying the types of resource conditions and recreation experiences that managers are seeking to provide, in addition to the establishment of indicator standards to evaluate those conditions.

Increasing recreational use pressures on the limited park resources of New River Gorge National River will require the intensification of natural resource and visitor management efforts. Effective management policies based on objective scientific information is essential if the qualities of naturalness and limited human-related impacts are to be maintained. The value society places on park environments lies in their continued "naturalness." Recreational impacts, if not monitored and controlled, will compromise the inherent value of parks and ultimately reduce the quality of recreational experiences.

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APPENDIX 1

RECREATION SITE INVENTORY AND IMPACT ASSESSMENT DATA FORM AND PARAMETER DESCRIPTIONS

Note: The following data form and inventory and impact parameter descriptions were those used to collect the information presented in this report.

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SUPPLEMENTARY CASE/INCIDENT RECORD

10-1474

ORGANIZATION (PARK) NAME New River Gorge National River		CASE/INCIDENT NUMBER 870314	
LOCATION OF INCIDENT River Segment: <u>Upper</u> Site Location: <u>18R2</u> <u>MERDOW CREEK to McCREERY</u>		DATE OF INCIDENT MO DA YR <u>1</u> <u>0</u> <u>0</u> <u>2</u> <u>8</u> <u>7</u>	
NATURE OF INCIDENT Resource Management Monitoring 80-20-17			
COMPLAINANT'S NAME		COMPLAINANT'S ADDRESS	

RESULTS OF INVESTIGATION

- Site capacity (persons who can use site):
(a) 0 (b) 1-3 (c) 4-25 (d) 25+
- Number of other sites visible from site: 1
- Surface of site:
(a) rock (b) cobble (c) sand (d) soil (e) other
- Site access: (a) river only (b) river & road
(c) river & foot path (d) river & railroad
- Shoreline disturbance (measured at treeline): 8 m
- Herbaceous vegetation cover on site: (a) 0-5% (b) 6-25%
(c) 26-50% (d) 51-75% (e) 76-100%
- Herbaceous vegetation cover off site: (a) 0-5% (b) 6-25%
(c) 26-50% (d) 51-75% (e) 76-100%
- # Trees with human-caused mutilations on trunk scars: 2
- # Tree stumps caused by axes or saws: 2
- Total number of trees at site, including borders: 14
- # Trails to and from site: 1
- # Fire sites: 1
- Crude seats: (a) yes (b) no (c) if yes, #
- Developed structures: (a) yes (b) no (c) if yes, describe
structures present (tables, shelters, etc.) Table Frame between trees
- Trash (source): (a) % deposited by river 0
(b) % caused by recreationists 100
- Trash (volume): # trash bags it can fill 1/2
- Trash (type): (a) % of paper, cans, plastic bottles, etc. 100
(b) % large items (car parts, household appliances, etc.) 0
- Human waste/toilet paper visible from site: 0
- Site use frequency, if known: (a) (b) moderate+
(c) low
- Predominant use (%): (a) bank fishing only %
(b) rafting/canoeing picnic area % (c) camping fishing
100% (d) other % (describe)
- Topographic features (circle): (a) sloping bank to site
(b) steep bank to site
- Comments: Hinton Gage 1.67
TENT ON SITE (HAS BEEN HERE MOST OF SUMMER)

SUBMITTED BY (SIGNATURE AND DATE) <u>Dean Bonifacio</u> <u>10-7-87</u>	APPROVED BY (SIGNATURE AND DATE) <u>M. Thunberg</u> <u>10-13-87</u>
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U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SUPPLEMENTARY CASE/INCIDENT RECORD

10-14 PA

ORGANIZATION (PARK) NAME New River Gorge National River		CASE INCIDENT NUMBER 870314
LOCATION OF INCIDENT River Segment: <u>UPPER</u> <u>MERCOC CREEK to MCCREERY</u> Site Location: <u>18R2</u>		DATE OF INCIDENT MO DA YR 10 02 87
NATURE OF INCIDENT Resource Management Monitoring 80-20-17		
COMPLAINANT'S NAME	COMPLAINANT'S ADDRESS	

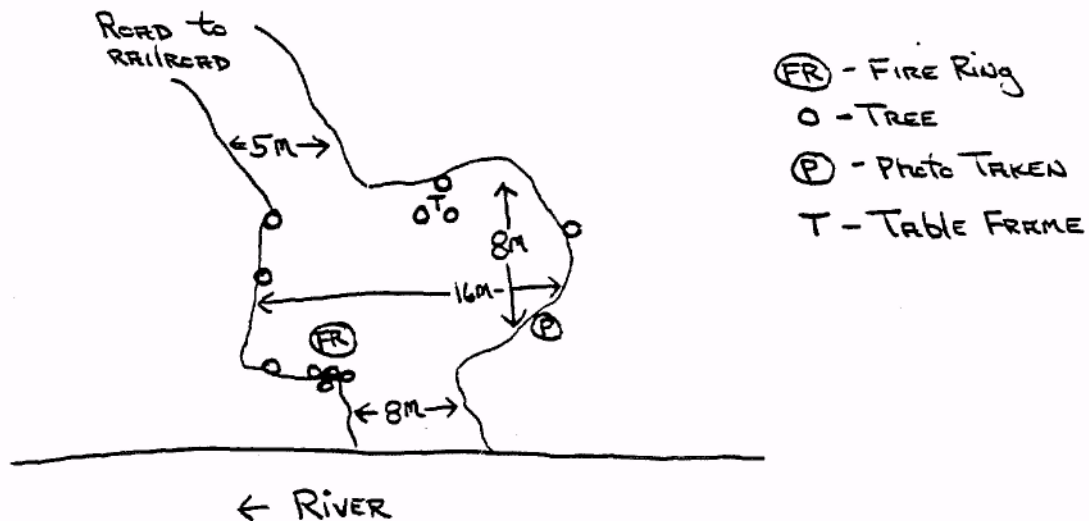
RESULTS OF INVESTIGATION

23. Description of site (Site should be described so someone else can find it 3-5 years later. Photographs should be taken if possible).

Accessible by road coming off of railroad at "Camp"
Railroad sign.

Directly across from 18L1
Upstream of "ZV Rapid".

24. Sketch of site with measurements indicated:



SUBMITTED BY (SIGNATURE AND DATE) Dean Bonifacio 10-7-87	APPROVED BY (SIGNATURE AND DATE) M. Murray 10-13-87
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INVENTORY AND IMPACT PARAMETER DESCRIPTIONS

The following measurements are to be completed for each recreation site found. Recreation sites are defined as areas of disturbed vegetation, surface litter, or soils caused by human use either as overnight camping sites or day-use recreation/picnic sites. A fire site may or may not be present.

Case/Incident Number: Record last two digits of the current year followed by a number.

River Segment: Record Upper (Hinton to McCreery), Middle (McCreery to Thurmond), or Lower (Thurmond to Teays Landing).

Site Location: Record the river mile within which the site is located, an "R" or "L" to indicate the right or left side of river as you travel downstream, and site number within that river mile.

Date: Record date on which measurements were taken.

- 1) Capacity: Record the number of persons who could comfortably use this site.
a = 0, b = 1-3, c=4-25, d=>25
- 2) Number of Other Sites Visible from Site: A count of the number of other sites which are visible from the recreation site. This is a social variable to assess site intervisibility, ie. to assess where visitors might experience solitude or camp with other visitors in a more social setting.
- 3) Surface of Site: Record the type of substrate on the recreation site. If more than one substrate category is present, select only the predominant category based on area, a=rock, b = cobble, c=sand, d=soil, e = other
- 4) Site Access: Record the type(s) of site access.
a = river only, b=river & road, c = river & foot path, d = river & railroad
- 5) Shoreline Disturbance: Distance (to the nearest meter) of shoreline where vegetation is absent or disturbed from human trampling in comparison to adjacent shoreline.
- 6) Vegetative Ground Cover Onsite: An estimate of the percentage of vegetative ground cover within campsite boundaries using the coded categories listed below. This can be assessed by imagining a 1x1 meter quadrat placed repeatedly around the site. Areas with greater than 25 percent vegetative cover should be mentally combined and compared to the entire site area to determine the percentage of the site with vegetative cover. a=0-5%, b = 6-25%, c=26-50%, d=51-75%, e=76-100%

- 7) Vegetative Ground Cover Off site: An estimate of the percentage of vegetative ground cover in an adjacent but undisturbed area similar to the campsite in tree canopy cover, vegetation composition, and environmental conditions. Code as above. The objective here is to locate an area which would closely resemble the campsite area had the campsite never been used.
- 8) Tree Damage: A count of the number of trees within or on campsite boundaries with large branches cut or broken off and/or large or extensive knife or axe scars. Treat multiple-stemmed trees as one tree.
- 9) Tree Stumps: A count of the number of tree stumps cut by axes or saws within or on campsite boundaries.
- 10) Total Trees in Use Area: A count of the total number of trees within or on campsite boundaries. Multiple tree stems which are joined at the base at or above ground level should be counted as one tree. This parameter will be used to determine the percent of campsite trees which are damaged.
- 11) Trails: A count of all easily discernable trails connected directly to the recreation site, including the river landing access trail.
- 12) Fire Sites: A count of all fire sites within recreation site boundaries.
- 13) Crude Seats: Note presence of log or stone seats.
a=Yes, b = No, if yes, record the number present
- 14) Developed Structures: Note presence of tables or shelters.
a = Yes, b = No, if yes, describe the structures present
- 15) Trash (Source): Evaluate the source of trash present on site.
a) River - record the % of total, b) Recreationists - record the % of total
- 16) Trash (Volume): Record the number of NFS trash bags which can be filled with trash from the recreation site.
- 17) Trash (Type): Evaluate the type of trash present on site.
a) Small - paper, cans, plastic bottles
b) Large - tires, appliances, car parts
- 18) Human Waste/Toilet Paper: Record the number of individual human waste sites as evidenced by human feces or toilet paper
- 19) Site Use: Based on personal experience of viewing site occupancy, estimate site useage.
a=high, b = moderate, c=low

- 20) Predominant Use: Based on personal experience of viewing site occupancy, estimate the percentage of site usage by type of use.
a = bank fishing only, b = rafting/canoeing picnic area, c = camping/fishing, d = other
- 21) Topographic Features: Evaluate the slope of the river embankment.
a = sloping bank, b = steep bank
- 22) Comments: List any pertinent comments about the site or measurements.
- 23) Description of Site: Describe the location of the site so that others can locate it in the future to repeat monitoring measurements. One or more photographs should also be taken of each site.
- 24) Site Sketch Map: Draw a map of the site, noting relationship to the river and obvious site features. Record all measurements (in meters) necessary to compute the size(s) of all disturbed use areas.
- Submitted By: Record the names of site survey workers.

APPENDIX 2

DESCRIPTION AND USE OF RECREATION SITE INVENTORY AND IMPACT ASSESSMENT DATABASE

IMPACT ASSESSMENT AND MONITORING DATABASE FOR RTVER RECREATION SITES

Data derived from the river recreation site survey was entered into dBASE III Plus, a database management software package, on an IBM compatible microcomputer. A database file was developed along with various supporting files and an extensive set of dBASE programs. The programs serve to isolate the user from the dBASE environment through user-driven menus which permit data entry, editing, analysis, and summary. The user is able to select all recreation sites or various subsets of recreation sites to obtain pre-formatted tables and data listings. The database, supporting files, and program operating instructions are described below.

Database and Supporting Files

The following dBase III files are necessary for program operation:

NRCAMP.DBF	Database file containing all data
NRBAK.DBF	Backup database file for NRCAMP.DBF
NRCAMP.PRG	Primary program file with initial menus which call and loop to other programs
NRDATA.PRG	Program file which permits data entry/editing
NRUPDATE.PRG	Program file which updates NRCAMP.DBF following data entry and editing
NRFREQ.PRG	Program file which computes/displays frequency distributions for inventory/impact parameters
NRSITE.PRG	Program file which computes/displays recreation site distribution information
NRLISTPV.PRG	Program file which lists data for specified inventory/impact parameter values
NRLISTS1.PRG	Supporting program file for NRLISTPV.PRG
NRSUMRY.PRG	Program file which computes average, min, and max for inventory/impact parameters
NRRANK.PRG	Program file which rank orders data for specified inventory/impact parameters
NRLIST.PRG	Program file which lists data for inventory/impact parameters
NRZSCORE.PRG	Program file which displays standardized z-scores for impact parameters
NRZDEX.NCX	Index file used by NRZSCORE.PRG for standardized scores
NRTEST.NDX	Index file used and erased by NRRANK.PRG to rank data for specified inventory/impact parameters
NRADD.FMT	Format file used by NRADD.PRG for data entry/editing screen
NRZSCOR.FRM	Report file used by NRZSCORE.PRG to display standardized z-scores for impact parameters

The structure for the NRCAMP.DBF database file is listed on the following page.

Structure for database: C:\NRCAMP.dbf
Number of data records: 134

Field	Field Name	Type	Width	Dec
1	CASEID	Numeri c	6	
2	DATE	Date	8	
3	SEGMENT1	Numeric	2	
4	SEGMENT	Character	6	
5	MILE	Numeric	2	
6	SITE	Numeric	2	
7	SIDE1	Numeri c	2	
8	SIDE	Character	5	
9	ACCESS1	Numeric	2	
10	ACCESS	Character	17	
11	SIZE	Numeric	5	
12	CAPACITY	Character	4	
13	CAP1	Numeric	2	
14	VISIB	Numeric	2	
15	SUBSTRATE	Character	6	
16	SUB1	Numeri c	2	
17	SHORE	Numeric	3	
18	VEGON	Character	8	
19	VEGOFF	Character	8	
20	VEGON 1	Numeric	2	
21	VEGOFF1	Numeric	2	
22	TREEDAM	Numeric	2	
23	STUMPS	Numeric	2	
24	TOTALTREE	Numeric	3	
25	TRAILS	Numeric	2	
26	FIRESITES	Numeric	2	
27	SEATS	Numeric	2	
28	STRUCTURE	Character	4	
29	STRUCT	Numeric	2	
30	TRASHRIV	Numeric	3	
31	TRASHREC	Numeric	3	
32	TRASHVOL	Numeric	2	
33	TRASHSM	Numeric	3	
34	TRASH LG	Numeric	3	
35	WASTE	Character	7	
36	WASTE1	Numeric	2	
37	USE	Numeric	2	
38	USEAGE	Character	6	
39	BANK	Numeric	3	
40	RAFT	Numeric	3	
41	CAMP	Numeric	3	
42	OTHER	Numeric	3	
43	TOPO	Numeric	2	
44	SLOPE	Character	7	
45	HERBLOST	Numeric	4	
46	PCT TREEDM	Numeric	3	
47	ZSIZE	Numeric	5	2
48	ZSTUMPS	Numeric	5	2
49	ZTREEDAM	Numeric	5	2
50	ZSHORE	Numeric	5	2
51	ZFIRE	Numeric	5	2
52	ZVEG	Numeric	5	2
53	ZSUM	Numeric	5	2
** Total **			210	

Program Operating Instructions

The program is most efficiently run if the files listed earlier are placed on a hard disk in a subdirectory such as C:\dbase\nrcamp. The program is initiated by typing: DO NRCAMP < cr > at the dot prompt in dBASE III. This brings up an opening menu followed by the program's Main Menu. From this menu the user can select the following options:

- A: Data Entry and Editing
- B: Recreation Site Distribution
- C: Inventory/Impact Parameter Information
- D: Standardized Impact Parameter Scores
- E: Back Up Database
- F: Exit to dBASE III
- G: Exit to MS-DOS

Each of these options are described in the following sections.

A. Data Entry and Editing

This menu selection permits the entry and editing of data and the deletion of records (all data associated with a single recreation site). A format file is used to customize the computer screen for viewing individual records during each of the functions above. This screen displays full parameter names rather than the shortened dBASE field names and also includes category definitions for most of the coded parameters. At the conclusion of work for this menu selection the user is asked if any data was changed, a yes response initiates a program which updates the database. The updating process includes the copying of full descriptive names to additional database fields for several of the coded parameters, calculation of standardized scores for the impact parameters, and sorts the database file according to site number.

Missing Data - A "-9" should be entered into the database for all parameters for which the information is missing. Missing data are excluded from all calculations such as the computation of averages and standardized scores. This is necessary because dBASE III treats blank numeric fields as if the value 0 had been entered. This would cause problems for many of the calculations and lead to erroneous results.

B. Recreation Site Distribution

This menu selection produces a table showing the number and percent of recreation sites by river segment and by side of river. The distribution table can be produced for all sites or various subsets of sites by site access type and site usage category.

C. Inventory/Impact Parameter Information

This menu selection permits the user to specify selected groups of recreation sites (all sites or sites by river segment, side of river and type of access) and then presents the following options:

1) List Data by Parameter - This option allows the selection of one or more inventory and impact parameters and then lists data for the selected parameter(s) and other site identification information.

2) Average. Min. Max by Parameter - This option produces a table of average, minimum and maximum values for either the primary impact parameters or for the numeric inventory parameters.

3) Frequency Distribution by Parameter - This option allows the selection of one or more inventory and impact parameters and then produces a frequency distribution table showing the number and percent of recreation sites in several categories for each of the selected parameters. For coded or categorical parameters the categories used are simply the separate codes, for metric parameters the categories are defined numerically so that approximately equal percentages of recreation sites fall into each of the categories.

4) Rank Sites in Order by Parameters - This option allows the selection of a numerical inventory or impact parameter, orders the sites by this parameter, and lists data for the selected parameter and site identification information.

5) List Sites by Defining Parameter Values - This option allows the selection of one or more inventory and impact parameters and then allows the user to specify categories for which data is then listed. For coded parameters the codes define the categories. For example, all sites for which the slope of the access trail is "steep" could be listed. For numerical parameters the categories are user-defined by specifying the range of values to be included in the listing with the following options: sites less than, greater than, less than and greater than, and equal to. For example, if a recreation site size standard of 300 m² were defined by management, this option could generate a list of all sites which exceeded this standard.

D. Standardized Impact Parameter Scores

This menu selection permits the listing of standardized z-scores for the primary impact parameters. Z-scores are statistical computations which can be used to compare the relative amount of impact for parameters measured in different units, for example, recreation site size (m²) and damaged trees (#). For these scores, impacts increase in severity from smaller (-) values to larger (+) values with 0.00 representing average impact levels from the entire survey. A summary impact score, computed by averaging the z-scores for the eight primary impact parameters, is also included in the output. A second menu option outputs only the summary z-scores along with recreation site number and name for all the recreation sites ranked in order of the summary z-score. In other words, this output orders all the

recreation sites from least impacted to most impacted, as identified by the primary impact parameters selected and measured in this monitoring program.

E. Back Up Database

This menu option copies the database file "NRCAMP.DBF" to a file named "NRBAK.DBF" which serves as a backup file in the same hard disk directory in which the programs reside. It is a good idea to also store a backup file on a floppy disk.

F. Exit to dBASE III

This menu option closes all files and returns all settings to normal before exiting the program to the dBASE dot prompt.

G. Exit to MS-DOS

This menu option closes all files and exits the program and dBASE III to MS-DOS.

APPENDIX 3

RECREATION SITE RANKINGS FOR SELECTED IMPACT PARAMETERS

The 12 worst recreation sites based on summary impact score¹.

Case Incident Number	River Mile	Recreation Site	Segment	Summary Impact Score
880339	23	4	Upper	0.60
850177	45	5	Lower	0.61
880315	22	1	Upper	0.69
850078	47	5	Lower	0.69
880318	23	2	Upper	0.82
880461	26	1	Upper	0.86
880352	23	1	Upper	0.95
860081	31	2	Middle	1.20
850084	42	2	Lower	1.66
850132	42	3	Lower	1.79
860087	31	3	Middle	2.23
860159	38	1	Middle	2.54

Case ID.	Camp Size	Veg. Loss	Damaged Trees	Tree Stumps	Fire Sites	Shore. Disturb.
----- Standardized Impact Scores -----						
880339	0.00	0.71	2.00	0.58	0.47	-0.14
850177	0.17	0.71	3.30	-0.45	-0.48	0.43
880315	0.41	0.71	2.00	-0.11	1.42	-0.32
850078	—	-0.38	-0.03	-0.45	0.47	3.83
880318	0.42	0.71	2.93	0.07	0.47	0.34
880461	-0.06	0.71	-0.03	-0.11	5.24	-0.61
880352	0.02	0.71	0.90	0.07	3.33	0.67
860081	2.21	0.71	0.16	1.28	1.42	1.40
850084	0.42	0.71	0.90	7.49	-0.48	0.90
850132	0.19	-4.11	8.84	6.46	-0.48	-0.16
860087	8.79	-0.38	-0.58	-0.28	1.42	4.39
860159	4.12	-0.38	0.34	0.41	2.38	8.34

1 - The summary impact score was computed by averaging the standardized impact scores for each of the impact parameters listed above (see the Methods section for additional detail). The summary impact score and the standardized impact scores provide standardized measures of impact for comparison purposes. Impacts increase in severity from smaller (-) values to larger (+) values with 0.00 representing average impact levels from the entire survey.

Comment: The individual standardized impact scores are provided to aid in the interpretation of the summary impact score. For example, **recreation site number 860087** is the second most heavily impacted recreation site in the park, as inferred by the summary impact score and the six standardized impact scores upon which it is computed. The individual standardized impact scores indicate that this recreation site, relative to all the surveyed recreation sites, is extremely large in size, has extensive shoreline disturbance and has an above average number of fire sites and below average amounts of vegetation loss, damaged trees and tree stumps.

The 12 worst recreation sites based on recreation site size.

Case Incident Number	River Mile	Recreation Site	Segment	Recreation Site Size (m ²)
860162	31	1	Middle	1285
880315	22	1	Upper	1386
880318	23	2	Upper	1400
850084	42	2	Lower	1400
860084	32	2	Middle	1775
860086	30	3	Middle	1824
850180	34	3	Middle	2000
860242	18	2	Upper	4000
860081	31	2	Middle	4343
850217	33	2	Middle	4700
860159	38	1	Middle	7500
860087	31	3	Middle	15188

The 12 worst recreation sites based on shoreline disturbance.

Case Incident Number	River Mile	Recreation Site	Segment	Shoreline Disturbance (m)
850128	43	1	Lower	57
880352	23	1	Upper	60
850084	42	2	Lower	70
850085	54	2	Lower	70
860195	29	1	Middle	75
860081	31	2	Middle	92
850180	34	3	Middle	95
860242	18	2	Upper	100
860086	30	3	Middle	114
850078	47	5	Lower	200
860087	31	3	Middle	225
860159	38	1	Middle	400

APPENDIX 4

REVISED RECREATION SITE INVENTORY AND IMPACT ASSESSMENT DATA FORM AND PARAMETER DESCRIPTIONS

Note: The following data form and inventory and impact parameter descriptions are a modification of those employed in this study. Changes were based on experience in implementing these systems at New River Gorge and elsewhere and on research specifically designed to improve the accuracy and precision of campsite impact assessment measurements. Some loss of comparability will result although many parameters are the same, they simply employ more refined measurement or estimation procedures. This new monitoring system is recommended for use during the next recreation site inventory and may serve as an example to others involved in developing similar monitoring systems.

NEW RIVER GORGE RECREATION SITE MONITORING FORM

- 1) Site Number: _____ 2) River Segment: L=Lower, M = Middle, U=Upper
3) Describe location of site so others could find it: _____
4) Inventoried by _____ 5) Date ____ / ____ / ____

INVENTORY PARAMETERS

- 6) Site Access: W=Water, T=Trail, R=Road, L=Railroad _____
7) Substrate of Landing Area:
B=Bedrock, C = Cobble, S = Sand, D=Dirt _____
8) Length of Shoreline Disturbance (ft): _____
9) Number of Other Sites Visible from Site: _____
10) Number of 8x10 Tent Pads: _____
11) Tree Canopy Cover Over Site: 1 = 0-25%, 2 = 26-50%,
3=51-75%, 4 = 76-100% _____

IMPACT PARAMETERS (Begin with Site Boundary Determination)

- 12) Condition Class: _____
13) Vegetative Ground Cover Onsite: (Use categories below) _____
(1=0-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96-100%)
14) Vegetative Ground Cover Offsite: (Use categories above) _____
15) Soil Exposure: (Use categories above) _____
16) Tree Damage: None _____ Some _____ Much _____
17) Root Exposure: None _____ Some _____ Much _____
18) Number of Tree Stumps _____
19) Number of Fire Sites _____
20) Number of Trails _____
21) Number of Garbage Bags of Litter Present: _____
22) Source of Litter, % Contributed by Recreationists _____
23) Type of Trash, % Consisting of Small Items: _____
24) Number of Human Waste Sites: _____

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25) Comments/Recommendations: _____

26) Take Center Point and Site Photographs

Center Point References

- 1)
- 2)
- 3)
- 4)

Satellite Site Dimensions

Bearing and Distance from Centerpoint to Closest Edge of each Satellite:

Island Site Dimensions

Bearing and Distance from Centerpoint to Closest Edge of each Island:

Office: Site Area _____

+ Satellite Area _____

- Island Area _____ =

27) Total Site Area _____ (sq. ft.)

Transect Data

Bearing Distance

- | | | |
|-----|-------|-------|
| 1) | _____ | _____ |
| 2) | _____ | _____ |
| 3) | _____ | _____ |
| 4) | _____ | _____ |
| 5) | _____ | _____ |
| 6) | _____ | _____ |
| 7) | _____ | _____ |
| 8) | _____ | _____ |
| 9) | _____ | _____ |
| 10) | _____ | _____ |
| 11) | _____ | _____ |
| 12) | _____ | _____ |
| 13) | _____ | _____ |
| 14) | _____ | _____ |
| 15) | _____ | _____ |
| 16) | _____ | _____ |
| 17) | _____ | _____ |
| 18) | _____ | _____ |
| 19) | _____ | _____ |
| 20) | _____ | _____ |
| 21) | _____ | _____ |
| 22) | _____ | _____ |
| 23) | _____ | _____ |
| 24) | _____ | _____ |
| 25) | _____ | _____ |

11/90

NEW RIVER GORGE RECREATION SITE MONITORING PROGRAM

DESCRIPTION OF SITE ASSESSMENT PROCEDURES

Recreation sites are defined as areas of disturbed vegetation, surface litter, or soils caused by human use as day-use recreation sites or overnight camping sites. In areas with multiple sites there may not always be undisturbed areas separating sites and an arbitrary decision may be necessary to define separate sites.

- 1) Site Number: Record the river mile within which the site is located, an "R" or "L" to indicate the right or left side of river as you travel downstream, and site number within that river mile. Verify the accuracy of any site numbers obtained from the earlier survey.
- 2) River Segment: Indicate river segment: L=Lower, Thurmond to Teays Landing; M=Middle, McCreery to Thurmond; U = Upper, Hinton to McCreery
- 3) Describe Site Location: Describe the location of the recreation site using local geographic features and distances in sufficient detail so that someone five years later could relocate the site.
- 4) Inventoried By: List the names of field personnel involved in data collection.
- 5) Date: Month, day, and year the site was evaluated (eg. June 12, 1989 = 06/12/89).

INVENTORY PARAMETERS

- 6) Site Access: Record any of the codes listed below which apply W = Water (River), T=Trail, R=Road, L=Railroad
- 7) Substrate of Landing Area: The landing area is defined as the area of human disturbance extending from average water level up to where the recreation site access trail begins. Use your best judgement concerning where average water level is. If more than one substrate category is present, select only the predominant category based on area.
 - B=Bedrock - shelf bedrock
 - C=Cobble - includes gravel size stone and up
 - S=Sand - includes sandy beach soils which do not form a surface crust in trampled areas
 - D=Dirt (Soil) - includes clays to loamy sands
- 8) Length of Shoreline Disturbance: Distance (to the nearest foot) of shoreline where vegetation is absent or disturbed from human trampling in comparison to adjacent shoreline This distance should be measured approximately three feet beyond (above) the average vegetation/river shoreline boundary, ie. the average line of first vegetation in adjacent undisturbed areas. If the landing area and adjacent undisturbed shorelines are barren due to natural causes (ie. bedrock or gravel bars) then enter one meter (the width of a trail) for shoreline disturbance. Measure and record shoreline disturbance only for the ck»esj recreation site in areas with multiple sites. Enter a 0 for shoreline disturbance for all other sites which share this site's landing and have no landing of their own.
- 9) Number of Other Sites Visible from Site: Record the number of other recreation sites and/or their landings, which if occupied, would be visible from the recreation site or its landing. This is a social variable to assess site intervisibility, ie. to assess where visitors might experience solitude or camp with other visitors hi a more social setting.

- 10) Number of 8x10 foot Tent Pads: Number of relatively level and rock/stump-free sites where an 8x10 foot tent could be comfortably erected within recreation site boundaries, including "satellite" areas, taking into account how close to each other tents would be set up when the site is used by a larger party. We want to be able to rank recreation sites by tenting capacity so that recommendations can be made to groups based on their group size.
- 11) Tree Canopy Cover Over Site: Estimate the percentage of tree canopy cover extending over the recreation site:
1=0-25%, 2=26-50%, 3=51-75%, 4=76-100%

IMPACT PARAMETERS

The first step is to establish the recreation sites' boundaries and measure its size. The following procedures describe the use of the Variable Radial Transect method for determining the sizes of campsites. This is accomplished by measuring the lengths of linear transects radiating from a permanently defined center point to the site boundary.

- Step 1.** Walk the recreation site boundary and place flagged wire pins at locations which, when connected with straight lines, will define a polygon with sides closely approximating the site boundaries. Look both directions along site boundaries as you place the flags and try to balance areas of the site which fall outside of the lines with offsite (undisturbed) areas which fall inside the lines. Project adjacent site boundaries straight across locations where trails enter the site. The goal of this procedure is to use as few pins as necessary while accurately matching the straight lines between pins with the site boundary (refer to attached diagrams). Experience has shown that most recreation sites can be adequately flagged with 8-14 pins.

Identify recreation site boundaries by pronounced changes in vegetation cover, vegetation height, vegetation composition, or surface organic litter. Many sites with dense forest overstories will have very little vegetation and it will be necessary to identify boundaries by examining changes in organic litter, ie. leaves which are untrampled and intact vs. leaves which are pulverized or absent. In defining the recreation site boundaries be careful to include only those areas which appear to have been disturbed from human trampling. Natural factors such as dense shade and flooding can create areas lacking vegetative cover. Do not include these areas if they appear "natural" to you. When in doubt, it may also be helpful to speculate on which areas typical visitors might use based on other factors such as slope or rockiness.

- Step 2.** Select a recreation site center point which is: 1) visible from all the recreation site boundary pins, and 2) easily referenced by distinctive permanent features such as larger trees or boulders, taking care not to place the centerpoint near the boundary. Place a steel stake at the centerpoint and reference it to at least three features. Try to select reference features in three opposing directions as this will enable future workers to triangulate the center point location. For each feature, take a compass bearing (nearest degree) and measure the distance (nearest inch) from the center point to the center of trees or the highest point of boulders. Be extremely careful in taking these bearings and measurements as they are critical to relocating the exact location of the centerpoint in the future. Also measure the approximate diameter of trees at 4.5 feet above ground (dbh). Record this information on the back of the form. See the following examples:

Sycamore, 7" dbh, 12'4" at 52° (only Sycamore in area)
Red Maple, 12" dbh, 23*2" at 208° (forked at 8')
Boulder, 179" at 312°, (distance and bearing to highest point)

Take a photograph which clearly shows the centerpoint location in relation to nearby trees or other reference features. Record photo description and site number in the photo log.

Options: Some sites may lack the necessary permanent reference features enabling the center point to be accurately relocated. If only one or two permanent reference features are available, use these and take additional photographs from several angles. If permanent features are unavailable simply proceed with the remaining steps without permanently referencing the center point. This option will introduce more error in comparisons with future measurements, particularly if the recreation site boundaries are not pronounced. Note your actions regarding use of these options in the Comments section.

Step 3. Standing directly over the centerpoint, identify and record on the back of the form the compass bearing (azimuth) of each recreation site boundary pin working in a clockwise fashion (in the exact order you would encounter them if you were walking the site boundary). Be careful not to miss any pins hidden behind vegetation or trees. Be extremely careful in identifying the correct compass bearings to these pins as error in these bearings will bias current and future measurements of recreation site size. Next, anchor the end of your tape to the centerpoint stake and, beginning with the pin you started with above, measure and record the straightline distance out to each pin in clockwise fashion as above. Be absolutely certain that the appropriate pin distances are recorded adjacent to their respective compass bearings. Leave all boundary pins in place until you finish with all other measurements.

Step 4. Identify any undisturbed "islands" of vegetation inside recreation site boundaries (often due to dumpings of trees or shrubs) and disturbed "satellite" use areas outside recreation site boundaries (often due to tent sites or cooking sites). Consider a use area to be a satellite site only if it is separated from the main recreation site boundaries by a short trail which traverses undisturbed areas. Disturbed areas greater than 30 feet from the main recreation site boundary should be considered to be separate recreation sites. Use the recreation site boundary definitions for determining the boundaries of these areas. Take any necessary measurements (nearest foot) of one or more geometric figures whose sides closely approximate the shapes of these areas (lengths/widths of rectangles, bases/heights of right triangles, or radii of circles; see attached reference for further assistance). Record the types of figures used and then" dimensions on the back of the form; the sizes of these areas should be computed in the office with a calculator.

12) Condition Class: Record the Condition Class using the following categories:

Class 1: Recreation site barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.

Class 2: Recreation site obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.

Class 3: Vegetation cover lost and/or organic litter pulverized on much of the site, some bare soil exposed in primary use areas.

Class 4: Nearly complete or total loss of vegetation cover and/or organic litter, bare soil widespread.

Class 5: Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullying.

13) Vegetative Ground Cover Onsite: An estimate of the percentage of live non-woody vegetative ground cover (including herbs, grasses, and mosses and excluding tree seedlings, saplings, and shrubs) within the flagged recreation site boundaries using the coded categories listed below. Exclude from this assessment any "islands" of largely undisturbed vegetation, and include any "satellite" use areas. For this and the two following parameters, it is often helpful to first select the two closest categories and then concentrate on the boundary that separates them. For example, you might decide that it is either category 2 (6-25%) or category 3 (26-50%); you would therefore concentrate on whether the vegetative cover on the recreation site is greater than 25%.

1=0-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96-100%

14) Vegetative Ground Cover Offsite: An estimate of the percentage of vegetative ground cover in an adjacent but undisturbed area similar to the recreation site in slope, tree canopy cover (amount of sunlight penetrating to the forest floor), vegetation composition, and other environmental conditions. Code as below. The intent is to locate an area which, in your best judgement, would closely resemble the recreation site area in terms of vegetation cover had the recreation site never been used. In instances where you cannot decide between two categories, select the category with less vegetative cover. The rationale for this is simply that, all other factors being equal, the first campers would have selected a site with the least amount of vegetation cover.

1=0-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96-100%

15) Soil Exposure: An estimate of the percentage of soil exposure, defined as ground with very little or no organic litter or vegetation cover, within the recreation site boundaries and satellite use areas. Code as below.

1=0-5%, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-95%, 6=96-100%

16) Tree Damage: Tally each live tree (> 1 inch diameter at 4,5 feet) within or on recreation site boundaries to one of the tree damage rating classes described below. Include trees within undisturbed "islands" and disturbed "satellite" areas. Multiple tree stems from the same species which are joined at or above ground level should be counted as one tree when assessing damage to any of its' stems. Assess a cut stem on a multiple-stemmed tree as tree damage, not as a stump. Do not count tree stumps as tree damage.

Take into account tree size. For example, damage for a small tree would be considerably less than damage for a large tree. The intent is to include only trees which have more recent (last five years) human-caused damage (ie. do not include trees with damage that you cannot clearly attribute to human causes).

None - none or slight damage such as broken or cut smaller branches, one or two nails, or a few superficial trunk scars.

Some - numerous small trunk scars and nails or one moderate sized scar.

Much - trunk scars numerous with many that are large and have penetrated to the inner wood; any complete girdling of tree (cutting through tree bark all the way around tree).

17) Root Exposure: Tally each live tree (>1 inch diameter at 4.5 feet) within or on recreation site boundaries to one of the root exposure rating classes described below. Include trees within undisturbed "islands" and disturbed "satellite" areas. The intent is to include only trees which have human-caused root exposure. Do not count trees with exposed roots when you feel certain that flooding rather than foot traffic is the primary cause.

None - none or slight root exposure or root exposure which is normal for the area; compare against offsite trees.

Some - tops of many of the major roots exposed.

Much - tops and sides of many of the major roots exposed.

18) Number of Tree Stumps: A count of the number of human-cut tree stumps (> 1 in. diameter) within or on recreation site boundaries. Include tree stumps within undisturbed "islands" and in disturbed "satellite" areas. Do not count stumps which lack axe or saw marks or a cut stem from a multiple-stemmed tree.

19) Number of Fire Sites: A count of all sites within recreation site boundaries exhibiting obvious or recent evidence that a fire was built there in the past, ie. blackened rocks, charcoal, or ashes. Do not include locations where charcoal or ashes have been dumped. Include firesites within satellite areas.

- 20) Number of Trails: A count of all trails leading away from the outer recreation site boundaries, including satellite sites. Do not count extremely faint trails which have untrampled tall herbs present in their tread or within-site trails such as those connecting the recreation site to satellite sites.
- 21) Number of Garbage Bags of Litter Present: An estimate of the number of NFS 40 gallon garbage bags within 100 feet of recreation site boundaries which could be filled with litter and tied at top. Use decimals to indicate fractions of a bag (eg. 0.5 equals half a bag). Record a 0 if the site has only a handful of smaller items.
- 22) Source of Litter: Examine the trash present on the site carefully and estimate the percentage you feel was left by recreationists on the site, as opposed to that deposited by the river during high water.
- 23) Type of Trash: Estimate the percentage of smaller trash items (paper, cans, plastic bottles) present on the site by volume, as compared to larger trash items (tires, appliances, car parts).
- 24) Number of Human Waste Sites: A count of the number of sites with human waste and/or toilet paper present within 100 feet of recreation site boundaries. In particular, follow all non-access trails and look in adjacent off-trail areas.
- 25) Comments/Recommendations: An informal list of comments concerning the site: note any assessments that you felt were particularly subjective, problems with monitoring procedures or their application to this particular recreation site, suggestions for clarifying monitoring procedures, recommendations regarding site management, or any other comments.
- 26) Recreation site Photographs: Take a picture of the recreation site from the water or water's edge using Kodacolor 400 print film (a 35mm wide angle lens is desirable). If necessary, take another picture which includes as much of the site as possible and references the center point location (identified by a person standing over it or some other object placed over it). The intent is to obtain photographs which characterize and document site conditions and provide an additional aid to future workers in making a positive identification of the recreation site and its center point location. Record photo descriptions and recreation site numbers in the photo log. At the earliest possible date label the backs of 3x5 prints with their respective recreation site numbers; also store and label the negatives. Staple the recreation site picture, the center point documentation picture, and any others to a blank sheet of paper and attach to the recreation site form.
- 27) Total Recreation site Area: Recreation site area in square feet, including satellites, excluding islands, as provided by the computer program.
- * Collect all recreation site boundary pins, the centerpoint stake, and all other equipment.

MATERIALS NEEDED

Compass with sighting mirror (not corrected for declination)
 Tape measure, 100 foot
 Flagged wire pins (25 minimum), one larger steel centerpoint stake
 Camera, 35mm SLR, 35mm lens preferable, Kodacolor 400 print film recommended, photo log
 Topographic maps, pocket altimeter
 Clipboard, pencil, field forms (some on waterproof paper), field procedures

SITE REMEASUREMENT

During remeasurement (perhaps every 5 to 10 years) the centerpoint will be relocated and all recreation site boundary pin locations will be identified according to the initial compass bearings and transect lengths. Boundary pin locations will then be reassessed based on the following procedures:

- 1) Keep the same transect length if that length still seems appropriate, ie. there is no compelling reason to alter the initial boundary determination.
- 2) Record a new transect length if the prior length is inappropriate, ie. there is compelling evidence that the present boundary does not coincide with the pin and the pin should be relocated either closer to or further from the centerpoint along the prescribed compass bearing.
- 3) Establish additional transects where necessary to accurately measure any changes in the shape of recreation site boundaries.

These additional procedures are designed to eliminate much of the measurement error associated with many different individuals making subjective judgements on those sites or portions of sites where boundaries are not pronounced. These procedures may only be used for sites with relocatable centerpoints.



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of Me through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride hi America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NFS D-56 December 3, 1990