

Carrying Capacity as a Framework for Managing Whitewater Use

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ABSTRACT: With increasing numbers of people using whitewater recreation resources, public land management agencies are called upon to set capacity limits. Currently, as a guide in decision making, such limits are often defined within a carrying capacity framework. By placing use limits within this framework, the implicit assumption that recreation resources can sustain specifiable levels of use has the appearance of being justified.

Initial efforts to determine a carrying capacity for whitewater resources in West Virginia are reviewed. The impetus for establishing riverine use limits in the state is related to the increasing demand for whitewater resources and recent legislative directives. Descriptive carrying capacity information concerning whitewater use is summarized and the utility of this information for the State's Department of Natural Resources is examined. Working from the Cheat River experience, suggestions are made for public land management agencies which contact carrying capacity research.

KEYWORDS: Carrying capacity, whitewater use, recreation resource policy.

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Growth of Participation in Whitewater Rafting

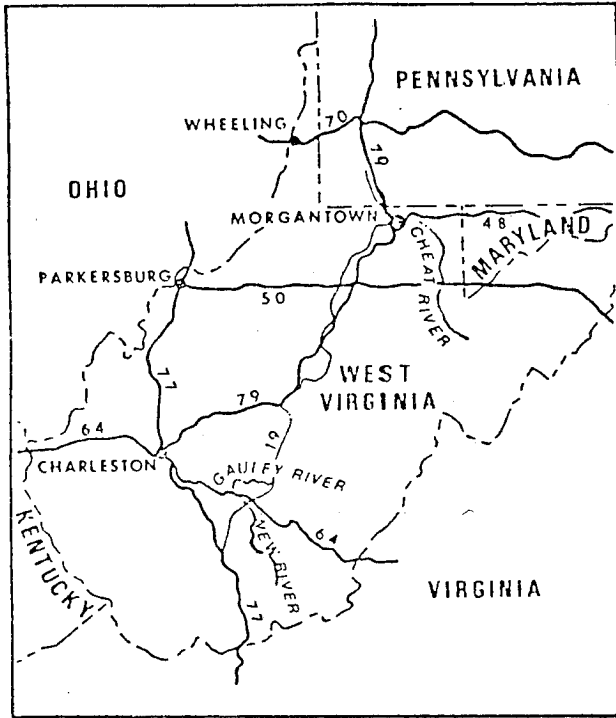
During the last two decades whitewater rafting has been among the fastest growing recreational activities in America (Hecock 1977). Use on many well known western rivers has increased by 20, 50 and even 100% per year (Leatherberry, et al. 1980). Concern with the effects associated with increasing use has recently drawn much public interest.

Although they do not seem to be as popular in the public media, eastern rivers have also been subject to great increases in whitewater use. Commercial whitewater outfitters currently operate on over 25 eastern rivers ranging from the remote Maine wilderness surrounding the Allagash to the urban corridor the James River carves through Richmond, Virginia. In southwestern Pennsylvania the Ohio pyle section of the Youghiogheny River, perhaps the most used whitewater resource in the country, accommodates 150,000 enthusiasts annually.

Whitewater rivers in West Virginia are among the most popular in the east (Figure 1). In the northern portion of the state, approximately 40,000

Figure 1

Location of principal whitewater rivers in West Virginia.



people raft the Cheat River each spring. In the southern portion, 80,000 people raft the New and 25,000 raft the Gauley each year. Other whitewater resources receiving increasing use in the State include the Tygart, Potomac, and Shenandoah Rivers.

Managerial Response to Increasing Whitewater Use

The upward trend in whitewater recreation has led managerial agencies to become more concerned with riverine carrying capacity and public safety. As a result, use restrictions are being placed on an increasing number of whitewater resources. The number of rivers with use restrictions increased from 8 in 1972 to 38 in 1977 (Leatherberry, et al. 1980). Associated with these restrictions has been a trend toward potential users being denied access to rivers (Utter, 1979) and increased use on unregulated rivers (Grim and Wyman, 1974). Obviously, the imposition of use restrictions is a difficult task for public agencies concerned with maintaining constituents' support.

In West Virginia, whitewater use restrictions are being considered by the State Department of Natural Resources. Since the first commercial outfitter

began operating on the Cheat River in 1970, participation in whitewater activities in West Virginia has increased at an estimated 12% annual compounded rate (Boteler 1983). Currently, 50 companies are licensed by the State to operate outfitting services. A moratorium has been placed upon licensing any more commercial whitewater companies until use controls are initiated in 1985.

Parenthetically, an initiative by a group of outfitting companies operating in West Virginia led the State to mandate use controls and declare a licensing moratorium. Alarmed by the influx of new outfitting companies, in 1979 a few of the larger, more established commercial outfitters commissioned a lobbyist to work with the State Legislature in responding to the situation. This action was apparently motivated by concern for both protecting the quality of their customers' recreational experience and maintaining a healthy volume of business.

The West Virginia Legislature responded in 1981 by passing Senate Bill No. 398 into law. In the bill the Legislature found:

“the recent increase in the number of persons engaging in the sport of whitewater rafting has resulted in overcrowding, safety and ecological problems along areas and portions of rivers and water in this state.”

The law goes on to direct the Department of Natural Resources to study selected segments of the state's rivers, designated as “whitewater zones”, with the goal of promulgating rules and regulations to control use by 1985. An advisory committee composed of rafting company owners, DNR personnel, and citizens from representative parts of the state was appointed to assist in developing rules and regulations. Before implementation, any new rules and regulations for the industry must be approved by a legislative committee.

To develop such rules, the need to determine use limits for the whitewater zones became obvious. Recreational carrying capacity was adopted as the decision making framework for determining such use limits. The Department of Natural Resources was directed to study those whitewater zones which presented serious problems requiring immediate attention.

Description of the Study Site

Since the Cheat River was thought to present the most pressing concern, researchers were first commissioned to study carrying capacity and safety operations associated with it. To begin the study, use of the major whitewater zone on the Cheat was examined. A description of this use is detailed below.

The section of the Cheat River used by commercial whitewater outfitters proceeds 12 miles through a steep walled canyon with limited access. Since the free flowing water is not dam regulated, the majority of use occurs during the spring season when water levels are relatively high (over the last sixty years, water flow during this season has averaged from 1000 to 3000 feet per second). Customers in commercially guided rafts are conducted through a

series of 10 rapids ranging in size from class III to V (American Whitewater Association River Classification System).

During the 1982 study period, 17 commercial outfitters were licensed to operate on the river. These companies ranged between large, established operators and new, small entrepreneurs. Survey data collected from river users indicated that 98% of the enthusiasts who ran the river were outfitted by commercial companies and 65% were return customers (Boteler, 1983).

Jurisdiction and land ownership of the river and riparian environment obviously have a great effect on management of whitewater operations. Outfitting companies own or lease all of the ingress and egress points for running the Cheat Canyon. However the State has jurisdiction over the river (shore to shore). Commercial outfitter operations may be controlled by the DNR because licenses to operate on the river are a privilege, not a right, afforded by the State of West Virginia.

Carrying Capacity as a Framework for Decision Making

After investigating use of whitewater zones on the Cheat River, a major research effort was expended in examining the concept of carrying capacity and how it could be applied to West Virginia's rivers. Originally developed by Verhulst in 1838, the carrying capacity paradigm was later popularized by wildlife management. Specifically, these scientists were interested in determining the number of grazing animals which rangeland could support.

However, carrying capacity has not been a simple concept for range scientists to work with. Criteria for determining range carrying capacity have been found to be highly variable (Stoddart and Smith, 1943)—perhaps so variable that the concept may only function as a metaphor (Burch, 1981).

Scientists first became concerned with the effects of overuse on recreation resources in the 1930's (e.g., Adams, 1930, Leopold, 1934, Meinecke, 1929). Following this, many researchers concerned with recreation speculated that the carrying capacity concept had potential applications to recreation resource management (e.g., Clawson, 1959; Dana, 1957; LaPage, 1963; Lime, 1970; Lucas, 1965; Stankey, 1973; Wagar, 1964).

Since that time, a large amount of recreation-related carrying capacity research has been conducted—particularly by USDA Forest Service researchers. In an annotated bibliography, Stankey and Lime (1973) list over 200 separate studies. But unfortunately as Frissel and Stankey (1972) note:

“Although a reasonable body of empirical literature has developed regarding carrying capacity, the lack of a systematic conceptual framework to guide decision making has been a significant shortcoming.”

Recently, Shelby and Heberlein (1981) have completed a draft for a text which attempts to develop this holistic framework of analysis for the concept of carrying capacity. They begin by pointing out that the carrying capacity concept has been grounded in three different traditions: a minimum, maxi-

imum, and optimum viewpoint. A minimum carrying capacity could involve the number of users deemed necessary to keep a recreational facility open. For instance, outfitting companies are concerned with maintaining enough customers to insure an adequate return on investment. A maximum number is reached when the recreational facilities are full. For example, there may not be any more spaces available in a parking lot or no more sites left in a campground.

In contrast to the minimum or maximum perspective, optimal carrying capacity introduces several additional criteria. An intuitive logic would indicate that the optimal concept is most appropriate for public lands. Obviously, management goals on public land are not directly oriented toward "packing in" as many people as possible or maintaining minimum numbers in order to insure profit returns for business. Usually many factors must be compared and weighed in order to come to some optimal solution in managing public land.

Due to this comparison, the idea of an optimal (as opposed to maximum or minimum) number necessarily entails value judgements on the part of agency personnel. Researchers seem to agree that those in charge of public recreation areas must consider human values to determine limits of acceptable change to be permitted on the recreation site and to the users' experiences (Chilman, et al. 1981, Lime and Stankey, 1971).

These limits of acceptable change, stem from the values land managers associate with natural resources. For instance, rivers designated as wild under the Wild and Scenic Rivers Act have a legislative mandate to preserve their natural values. As a result, limits of acceptable change may be much lower than on other rivers.

On federal domain, agency empowering legislation and testimony from Congressional hearings may give some indication regarding what values (and therefore what limits) are to be associated with the area. For example, areas included in the National Wilderness Preservation System are to provide opportunities for solitude.

However, such legislative direction does not exist for rivers under state jurisdiction in West Virginia. Relevant legislation (Code of West Virginia 20-2-23a 1981) limits itself to stipulating that users are entitled to safe and equitable enjoyment of the sport. As a result, the DNR has been called upon to establish carrying capacities without adequate statutory direction as to what human values should be considered paramount in decision making.

Given the situation, human values concerning whitewater use limits are extremely difficult to interpose into the carrying capacity process. Competing constituent groups, placing differing demands upon the resource, call for various management strategies developed from the values they hold most important for the area. Thus, the DNR is faced with the task of justifying use capacity limits, to important constituents who are poised to criticize with charges of arbitrary and capricious decision making.

This situation makes setting a carrying capacity for the Cheat River a contentious task for the DNR. Indeed, at the initiation of the Cheat River Study it appeared that some people hoped an objective scientific effort could define a carrying capacity for the river without dealing with human values. In retrospect, the major utility of the Cheat River study may have been in explaining the carrying capacity paradigm for those concerned with the situation, and as a result, giving them a common vocabulary to work with concerning some of the more salient phenomena they are concerned with.

Application of The Carrying Capacity Paradigm to Cheat River

After an initial review of the literature, it was decided to address the situation by developing a carrying capacity model for those involved by reviewing the relevant literature. In his formative work, Stankey (1971) suggested that carrying capacity has at least two aspects. There is a physical facet which relates to environmental concerns and a social facet which concerns the users' experiences. More recently, this concept has been expanded to include four kinds of carrying capacity relevant to whitewater settings—ecological, physical, facilities, and social (e.g., Heberlein, 1977). Each of these types of carrying capacity is reviewed below and related to the Cheat River situation.

A. Ecological carrying capacity.

Ecological carrying capacity concerns limits of acceptable change to the recreation resource (Lime and Stankey 1971). Examples of this might include changes in the composition of vegetative or wildlife species, exposure of humans to excessive human wastes, or unacceptable losses of topsoil. For instance, it is suspected that contact with fecally contaminated water led to outbreaks of shigellosis (a severe gastro-intestinal infection) among Grand Canyon whitewater rafters in 1972 and 1979 (Brickler, et al., 1983). When referring to ecological carrying capacity, the term "change" is preferred to "damage" or "impact" since the latter two words connote value judgements (Stankey, 1971).

Ecological concerns were found to be of little utility in setting use limits for the Cheat River. Since potential impact zones (ingress and egress into the canyon) are owned by the rafting companies, they tend to take care of their own land and ameliorate any undesirable ecological conditions. Also, intermittent flooding, rocky shores, and frequent freeze-thaw cycles do much to alleviate any evidence of rafting use in the canyon.

B. Physical carrying capacity.

Physical carrying capacity concerns the number or density of people which a system can accommodate. For white water resources this usually involves the density of craft which the riverine system can support. The concept has been operationalized by examining the relationship of queue time

(waiting time at rapids resulting from backups) to use density. Typically, the GPSS computer simulation model is used for this (Schriber, 1974; Schechter, 1975; Schechter and Lucas, 1978).

Like ecological carrying capacity, physical carrying capacity had little utility for setting a reasonable limit on commercial use. Beside simulating a use level at which the riverine system would simply jam shut with craft, no criteria were available for establishing a lower use limit. Although it was useful in describing an upper use limit the relationship of queue times to user density, some value judgement concerning maximum acceptable queue time was needed for the Cheat River.

C. Facilities carrying capacity

Facilities carrying capacity refers to the maximum number of people recreational facilities on the site can accommodate. Typically, this concerns an adequate number of parking lot spaces, availability of public boat ramps, and appropriate waste disposal systems. As one would expect, facilities carrying capacity is directly related to the level of technology invested into an area. To a point, capacity can be increased by adding new parking lots, providing more boat ramps, or providing more wastes disposal facilities.

Shelby and Heberlein (1981) note that administrative personnel use facility related carrying capacities as a method of symbolizing use capacity to visitors who must be turned away. For instance, it is much simpler to turn a potential user away because "the parking lot is full" than because an additional person in the area would detract from everyone's experience. Without such managerial presence, inadequate provision of facilities can result in public trespass and increased conflict between recreationists and riparian land owners (Bassett, et. al., 1972).

For the Cheat River, facility carrying capacity had little to offer in setting use limits. In order to attract return customers, commercial outfitters provide adequate facilities. Indeed, to realize a greater return on investment, many companies are more interested in expanding tourism facilities (e.g., restaurants, motels, souvenir stands, . . .) than they are in increasing river use.

D. Social carrying capacity

Social carrying capacity deals with the type (or level) of experience users derive from a recreation site. For instance the Wilderness Act directs that users should have opportunities for solitude and a primitive and unconfined form of recreation. Experiences available for whitewater use range from a primitive, unconfined recreation to a high density, very social activity.

The conventional wisdom seems to hold that there is a relationship between use density and the quality of recreation experiences. However, researchers have uncovered little relationship between use density and indicators of derived satisfaction (Absher and Lee, 1981; Gramman, 1982; Heberlein, 1979; Holland, 1979; Roggenbuck and Schreyer, 1977; Shelby

and Heberlein, 1981). On the Cheat, enthusiasts indicated on surveys that they enjoyed themselves even when queues of 20 minutes occurred.

In general, since the concern with measuring recreation satisfaction first developed, researchers have had difficulty in quantifying meaningful differences in the amount of satisfaction derived by users. There have been consistent reports of high satisfaction in most river recreation studies.

Many researchers have attempted to identify why whitewater users report high levels of satisfaction even in situations that appear to be crowded. Several concepts have developed from such investigations including the displacement hypothesis, the uninitiated newcomer effect, and ideas centering around normative standards.

Displacement or succession concerns the observation that as the level of user density increases in an area, a successive series of previous user groups preferring lower density levels is displaced to another recreation site (Anderson, 1980; Becker and Nieman, 1981; Hartman, 1979; Nielson and Endo, 1977). Since these sensitive users are continually being replaced, on-site social surveys will not reveal their dissatisfaction.

The uninitiated newcomer effect may result when users are on-site for the first time and have no previous experience in making judgements. Since recreation activities are freely chosen and relatively spontaneous, some speculate that some users may make a good time out of even the worst of situations.

Other work centers around the normative expectations users bring to the recreation site. A growing body of literature suggests that dissatisfaction results (and therefore social carrying capacity is exceeded) when there is a discrepancy between the expectation users have before engaging in the activity, and the psychological outcomes, users derive from engaging in the activity (Bultena and Klessig, 1969; Griest, 1968; Graefe, 1977; Hendee, 1974; Holland, 1979; Nielson, et al. 1977; Peterson, 1974; Roggenbuck and Schreyer, 1977). In a series of river studies Shelby and Heberlein (1981) found that the "personal psychological standards people brought with them were more important than the actual number of groups met on the river" in effecting users' perceptions of crowding. Working from this work, they suggest the following "mandatory rules" as a prerequisite for the determination of social carrying capacity:

- 1) There must be a known relationship between use level or other management parameters and experience parameters.
- 2) There must be agreement among relevant groups about the type of recreation experience to be provided.
- 3) There must be agreement among the relevant groups about appropriate levels of experience for users.

However, for the Cheat River, the DNR has few of these "rules" to work from. There is not enough time (or financial resources) to do the kind of longitudinal research necessary to relate varying use levels to experience parameters. Also, there is little agreement among groups concerned with the

situation regarding what kind of experience is most appropriate for the river. Some constituents believe a wilderness-like experience offering opportunities for solitude is best, whereas others prefer the social factors associated with higher densities of use. Due to the proximity of major metropolitan areas, a sufficient market would seem to exist for any type of experience offered on West Virginia's rivers.

Conclusions Concerning Carrying Capacity Policy in Recreational Settings

Based upon the Cheat River Study, the determination of carrying capacity appears to be impossible in the absence of pre-established agency objectives which incorporate human values. To be useful for those attempting to set use limits, such objectives must be relatively specific by referring to criteria such as maximum acceptable queues, desired use density, unacceptable changes in flora and fauna, or appropriate type of experience to be offered.

However it is usually the case that legislative directives concerning public recreation management are seldom explicit enough to singularly justify specific agency objectives. As Burch (1981:211) reasons:

“The carrying capacity notion seems to have been a useful heuristic for recreation research. However, the legislative ambiguities regarding park and wildland management have made the responsibilities of researcher and manager equally ambiguous.”

Obviously, such ambiguities place land management agencies in difficult positions. Without skilled public relations efforts, agencies run the risk of alienating important constituent groups who bring competing values into the decision making process.

Faced with the politically difficult task of setting recreational use limits, some agencies may be tempted to call upon academic researchers to suggest carrying capacities. However, for the Cheat River Study, objective scientific efforts could do little to derive optimum carrying capacity levels in the absence of some reference to human values.

Along these lines, Stankey (1971) alludes to two dimensions of carrying capacity—descriptive and prescriptive. Without explicit managerial objectives to work from, objective scientists are limited to identifying descriptive information concerning recreational use. Yet for managerial agencies, the focal point is usually placed upon a prescriptive carrying capacity determination (i.e., a use limit).

Before contracting carrying capacity research, it is suggested that public land management agencies must determine if descriptive or prescriptive results are needed. Descriptive results are useful for initially analyzing the situation. However, if use capacity limits are needed, prescriptive use limits can only be determined after relatively specific agency objectives incorporating human values have been developed.

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