

TRENDS IN RIVER RECREATION¹

Earl C. Leatherberry, David W. Lime, and Jerrilyn LaVarre Thompson²

Abstract.—Participation in river recreation has been expanding at a rapid rate. This paper reviews selected phenomenon associated with the growing popularity of rivers as recreational resources. The paper will: (1) describe the river recreation resource (the supply situation); (2) present selected indicators of increased river recreation use (the demand situation); (3) present demographic and experience profiles of selected river recreation users; (4) describe some of the environmental and social impacts occurring from increases in river recreation activity; (5) present selected management strategies used to cope with impacts; and (6) speculate some future trends in river recreation.

Interest in rivers for recreation is expanding rapidly. All types of rivers—urban and rural, placid and fast flowing, polluted and clean—are being used increasingly for recreation. And, people are using rivers for a wider variety of leisure activities. Besides water activities such as swimming, fishing, boating, kayaking, and waterfowl hunting, other activities, such as camping, hiking, picnicking and relaxing are often pursued with rivers as an important backdrop.

Rivers used for recreational purposes vary in length and size, and traverse private as well as public lands. Management responsibility is often fragmented, or altogether absent. Recreation use often coexists (sometimes controversially) with nonrecreation uses such as hydroelectric power production, irrigation, timber harvesting, mining, grazing, and nonrecreational commercial traffic. Many of America's rivers, however, offer recreation in a relatively natural or naturally-appearing setting where there are few human-made features and the chance for solitude is fairly high.

The purpose of this paper is to assemble information on trends in river recreation, especially (1) supply, (2) demand, (3) who users are and what they are like, (4) environ-

mental and social impacts, (5) present management techniques, and (6) the future. We focus on those rivers with frequent canoeing, rafting, innertubing, motorboating, fishing, and a variety of shore uses such as hiking, camping, and picnicking. We did not include recreation on large rivers having substantial commercial traffic and large pleasure craft, such as the Lower Mississippi, Ohio, Hudson, Sacramento, and Columbia Rivers.

Despite the dramatic growth in the amount and variety of literature about river recreation (Anderson *et al.* 1978) in the last half decade, as well as interest by public administrators, planners, managers, researchers, and the public, there is little information on trends *per se*. Thus, the paper is intended to assemble much of what is known on this subject.

SUPPLY OF RIVER RECREATION

There are more than 3.2 million linear miles of rivers and streams in the continental United States (Water Resources Council 1968). Alaska has another 365,000 miles. It is difficult to delineate those portions that are utilized for recreation. We do know, however, that most rivers and streams are too small to support on-water recreational activities. For example, only about 700 streams with a combined length of 100,000 miles have a minimum flow of at least 500 cubic feet per second—the minimum flow desirable for on-water recreational activities (Water Resources Council 1968).

¹ Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

² The authors are, respectively, Geographer, Research Social Scientist, Forester, U.S. Dep. Agric. For. Serv., North Central Forest Experiment Station, 1992 Folwell Avenue, St. Paul, MN 55108.

Obviously, not all of this is available for recreation. Much is exploited for nonrecreational uses, resulting in pollution or reduced flow. Other rivers are not readily accessible to the public. Some are far removed from population centers, and others, although near or in densely populated urban areas, are virtually inaccessible because they are bordered by private land, or access is limited, or both.

Because of the lack of "hard" data about the supply of river recreation resources nationwide, the Heritage Conservation and Recreation Service (HCRS) is conducting an inventory of rivers to provide a reliable data base for the nation's river resource. The inventory will also identify the highest quality rivers for possible consideration under federal, state, or local river preservation programs. The national inventory is being conducted in two phases. The first phase focuses on the natural qualities of rivers. All river segments over 25 miles in length are screened against various criteria, mostly factors relating to the extent of human intrusions. The second phase began in 1979 and will identify rivers greater than 5 miles in length with high recreation and aesthetic values that are readily accessible to urban areas.

Most national information comes from rivers specially designated under federal and state programs. The federal Wild and Scenic Rivers System preserves many of the nation's outstanding free-flowing rivers. The system was established in 1968 with eight rivers, and identified 27 additional rivers to be studied for inclusion in the system. Growth in the system was slow; a total of 15 rivers were authorized by 1975. Then between 1976 and 1978 13 additional rivers were authorized as components of the system. Currently the system contains 28 rivers or river segments, totaling 2,318 miles (Table 1). An additional 48 rivers have been designated for study as potential components. Other rivers or river segments including the Current and Jack Fork Rivers in Missouri and the Buffalo River in Arkansas have been designated National Scenic Riverways.

In addition to federal efforts to preserve river resources, 23 States have established river preservation programs (Table 2). The first statewide program was established in Wisconsin in 1965. States passing legislation jumped from 3 in 1968 to 19 in 1972. Since 1975 no new State legislated programs have been implemented, but there are indicators that 40 States are active in river protection efforts (Alling and Ditton 1979). To date, 19 States have designated over 200 rivers or river segments, totaling nearly 6,000 miles. Unlike the federal program, which is uniform in intent

and purpose, state programs range from active, dynamic planning to merely token efforts having minimal administrative responsibilities.

DEMAND FOR RIVER RECREATION

An extensive national survey by the U. S. Coast Guard revealed that the number of kayaks and nonmotorized canoes owned by Americans has grown disproportionately faster than any other type of craft (U. S. Department of Transportation 1978). Between 1973 and 1976, for example, there was a 68 percent increase in the number of canoes and a remarkable 107 percent increase in the number of kayaks. Presently there are an estimated 1 million canoes and 90,000 kayaks nationwide. In Minnesota the growth in canoe and kayak ownership is particularly dramatic. Between 1972 and 1978, the estimated state population increased 3 percent; during the same period the number of canoes and kayaks registered with the Department of Natural Resources increased 143 percent, from 41,675 to 101,322 (State of Minnesota 1979).

There are substantial regional differences in canoe and kayak ownership patterns in the contiguous 48 States. Data from the National Boating Survey in 1973 (U. S. Department of Transportation 1974) and population figures from the same year reveal that the number of canoes owned in the New England and Lake States per unit population is higher than average, while canoes per unit population in the Gulf Coast, East Central, and West Coast regions is lower than average. Kayak ownership per unit population in the New England, Mid-Atlantic, and West Coast regions is high compared to the average, while kayak ownership per unit population in the Gulf Coast, East Central, Midwest/Mountain, and Great Lakes regions is lower.

Some of the most striking ownership patterns are in the New England, Great Lakes, and West Coast regions. New England accounts for roughly 15 percent of the population but 26 percent of the canoe ownership and 29 percent of the kayak ownership. The Great Lakes region has 30 percent of the canoes but only 5 percent of the kayaks, while making up 21 percent of the population. Conversely, the West Coast region, with 13 percent of the population, has only 4 percent of the canoes but 36 percent of the kayaks.

All data, sketchy as they are, show a steady upward trend in river recreation from the late 1960's on (Table 3). On many rivers the number of visitors increased by as much as 20, 50, or even 100 percent per year. Rivers

Table 1.-- River mileage classifications for components of the national wild and scenic rivers system as of December 1979^a

Rivers in the national system	Designated	Administering agency	Wild	Scenic	Recreational	Total
	Year		----- Miles -----			
1. Middle Fork Clearwater, Idaho	1968	USFS	54	--	131	185
2. Eleven Point, Missouri	1968	USFS	--	44.4	--	44.4
3. Feather, California	1968	USFS	32.9	9.7	50.4	93
4. Rio Grande, New Mexico		BLM/USFS	51.75	--	1	52.75
(Rio Grande Mgt. by Agency)		(BLM)	(43.90)	--	(0.25)	(44.15)
	1968	(USFS)	(7.85)	--	(0.75)	(8.60)
5. Rogue, Oregon		BLM/USFS	33	7.5	44	84.5
(Rogue Mgt. by Agency)		(BLM)	(20)	--	(27)	(47)
	1968	(USFS)	(13)	(7.5)	(17)	(37.5)
6. St. Croix, Minnesota and Wisconsin	1968	NPS/FS	--	181	19	200
7. Middle Fork Salmon, Idaho	1968	USFS	103	--	1	104
8. Wolf, Wisconsin	1968	NPS	--	25	--	25
9. Allagash Wilderness Waterway, Maine	1970	State of Maine	95	--	--	95
10. Lower St. Croix, Minnesota and Wisconsin	1972	NPS	--	12	15	27
11. Little Miami, Ohio	1973	State of Ohio	--	18	48	66
12. Chattooga, N.C., S.C., and GA.	1974	USFS	39.8	2.5	14.6	56.9
13. Little Beaver, Ohio	1975	State of Ohio	--	33	--	33
14. Snake, Idaho and Oregon	1975	USFS	32.5	34.4	--	66.9
15. Rapid, Idaho	1975	USFS	24	--	--	24
16. New, North Carolina	1976	State of NC	--	26.5	--	26.5
17. Lower St. Croix, Minnesota and Wisconsin	1976	States of MN, WI	--	--	25	25
18. Missouri, Montana	1976	BLM	72	18	59	149
19. Flathead, Montana	1976	FS/NPS	97.9	40.7	80.4	219
20. Obed, Tennessee	1976	NPS/State of TN	45.2	--	--	45.2
21. Pere Marquette, Michigan	1978	USFS	--	66.4	--	66.4
22. Rio Grande, Texas	1978	NPS	95.2	96	--	191.2
23. Skagit, Washington	1978	USFS	--	99	58.5	157.5
24. Upper Delaware, New York and Pennsylvania	1978	NPS	--	25.1	50.3	75.4
25. Middle Delaware, New York, PA and NJ	1978	NPS	--	35	--	35
26. American (North Fork), California	1978	USFS/BLM	38.3	--	--	38.3
		(USFS)	(26.3)	--	--	--
		(BLM)	(12)	--	--	--
27. Missouri, Nebraska, and South Dakota	1978	Interior/Corps of Engineers	--	--	59	59
28. Saint Joe, Idaho	1978	USFS	26.6	--	46.2	72.8
		TOTAL	841.15	774.2	702.4	2,317.75

^aU.S. Department of the Interior, Heritage Conservation and Recreation Service.

Table 2.—Twenty-three state river protection programs^a

State	Year legislation enacted	Rivers designated to date	River miles designated to date	Rivers considered for future designation	Ownership of majority of corridor	Protective features of the program		
						Prohibit instream modifications	Land use controls	Management of use and users
California	1972	9	1,030	N/A	Both	Yes	Yes	Yes
Georgia	1969	0	0	115	N/A	Yes	Yes	Yes
Indiana	1973	2	59	N/A	Private	Yes	Yes	Yes
Iowa	1970	1	80	0	Private	No	No	No
Kentucky	1972	8	110	0	Public	Yes	Yes	Yes
Louisiana	1970	43	N/A	N/A	Private	Yes	No	Yes
Maryland	1969	9	441	0	Private	Yes	Yes	No
Massachusetts	1971	0	0	1	Private	Yes	Yes	Yes
Michigan	1970	6	641	25	Private	Yes	Yes	No
Minnesota	1973	4	200	14	Private	No	Yes	Yes
New York	1972	70	1,214	60	Private	Yes	Yes	Yes
North Carolina	1971	2	36	4	Both	Yes	Yes	Yes
North Dakota	1975	1	213	3	Private	Yes	No	No
Ohio	1968	8	415	4	Private	Yes	Yes	Yes
Oklahoma	1969	5	151	0	Private	Yes	No	No
Oregon	1970	8	523	6	50/50	Yes	Yes	Yes
Pennsylvania	1972	0	0	112	Private	Yes	No	Yes
South Carolina	1974	2	60	20	Private	N/A	N/A	N/A
South Dakota	1972	0	0	2	Private	Yes	Yes	Yes
Tennessee	1968	11	350	0	Private	Yes	Yes	Yes
Virginia	1970	2	53	35	Private	Yes	No	Yes
West Virginia	1969	5	205	0	Private	Yes	No	No
Wisconsin	1965	3	91	0	50/50	Yes	Yes	Yes
TOTAL		199	5,872	401				

^aAlling and Ditton (1979).

Table 3.--Recreation use, in visits, of selected U.S. rivers by region (1965-1979)^a

River by Region	Number of visits for years data have been collected ^b														
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
EAST															
Allagash River (Maine)	--	4,141	4,539	3,789	4,820	5,460	6,345	8,260	8,337	7,477	9,447	8,619	9,278	9,734	8,932
Youghiogheny River (Pa.)	--	--	--	--	--	17,000	--	--	--	80,000	--	--	--	--	--
St. John's River (Maine)	--	--	--	--	--	--	--	--	--	--	1,151	1,294	2,408	2,639	2,971
MIDWEST															
Buffalo River (Ark.)	--	--	--	--	--	--	--	--	--	15,505	18,748	--	--	--	--
Current River, Ozark Nat.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Scenic Riverway (Mo-Ark)	--	40,000	--	--	--	--	--	--	--	164,500	202,857	--	242,000	--	--
Eleven Point River (Mo.)	--	--	--	--	--	--	--	--	--	--	--	--	10,528	11,128	9,906
Pine River (Mich.)	--	13,000	--	--	--	--	50,000	--	64,000	--	80,000	90,000	96,000	76,341	69,836
Upper Iowa River (Iowa)	--	--	--	--	--	--	--	1,464	1,795	--	--	--	--	--	--
St. Croix River, Upper (Minn-Wis)	--	--	--	--	--	--	--	--	--	--	--	--	--	117,000	118,000
St. Croix River, Lower (Minn-Wis)	--	--	--	--	--	356,000	--	--	--	--	--	--	832,649	--	--
WEST															
Colorado River, Cataract Canyon, Canyonlands Nat. Pk. (Utah)	--	--	--	--	585	889	1,670	2,439	4,422	4,096	4,042	4,869	4,809	5,595	5,786
Colorado River, Grand Canyon Nat. Pk. (Ariz.)	547	1,067	2,099	3,609	6,019	9,935	10,885	16,432	15,219	14,253	14,305	13,912	11,830	14,356	14,576
Colorado River, Westwater Canyon, (Colo.-Utah)	--	--	--	--	--	318	--	500	--	--	--	--	4,496	6,586	7,181
Delta River, (Alaska)	--	--	--	--	--	--	--	356	--	--	888	800	1,500	1,550	2,511
Gulkana River, (Alaska)	--	--	--	--	--	--	--	--	--	--	500	433	450	500	607

(Continued)

Table 3.--Continued

Green and Yampa Rivers															
Dinosaur Nat. Monuments															
(Colo.-Utah)															
Green River, Desolation Canyon, (Utah)	--	--	2,493	3,755	5,740	9,762	14,145	17,159	16,739	12,874	13,710	13,580	13,114	14,559	12,803
Owyhee (Oregon)	--	--	--	--	--	1,600	--	--	--	--	--	5,189	4,946	5,941	5,793
Rio Grande River, Big Bend	--	--	--	--	--	--	--	--	--	482	557	738	80	989	1,483
Nat. Pk. (Texas-Mexico)	926	1,540	2,741	2,389	3,996	4,006	4,478	4,421	4,850	7,651	6,069	4,823	5,421	4,157	3,178
Rogue River (Oregon)	--	--	--	--	--	--	2,800	4,800	5,885	7,210	8,855	10,836	--	--	--
Salmon River, Middle Fork	1,260	1,260	1,299	1,396	1,624	3,028	3,250	3,972	4,372	4,036	4,682	5,964	3,767	6,904	7,026
(Idaho)	--	--	--	--	--	--	--	--	4,003	3,057	2,477	3,955	3,817	4,569	6,089
Salmon River, Lower Main	--	--	--	--	--	--	--	--	2,593	2,931	3,201	--	--	--	--
(Idaho)	--	--	--	--	--	46	194	406	419	439	345	350	359	441	629
Selway River (Idaho)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Snake River, Grand Teton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nat. Pk. (Wyo.)	--	18,000	--	--	--	--	--	71,256	73,885	51,906	83,096	77,412	81,210	87,925	--
Snake River, Hell's Canyon	--	--	--	--	--	--	--	--	1,184	1,485	1,797	2,118	2,474	3,213	4,276
(Ore.-Idaho)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Snake River, Grand Canyon	--	--	--	--	--	--	--	--	27,364	30,462	43,576	55,739	60,914	68,959	--
(Wyo.)	--	--	--	--	--	--	--	--	25,000	31,807	29,180	--	--	34,683	--
Stanislaus River (Calif.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toulumne River (Calif.)	--	--	--	--	--	--	--	--	--	2,700	--	596	0	3,330	3,550
SOUTH															
Chattooga River (So. Carolina,															
Georgia)															
Everglades Canoe Trails (Fla.)	--	--	100	100	300	800	800	7,600	21,000	28,800	22,800	15,200	17,400	29,000	28,800
Nantahala River (No. Carolina)	--	--	--	--	--	--	--	--	4,000	5,000	--	--	--	--	--
Okefenokee Canoe Trails (Georgia)	--	--	--	--	--	--	--	1,000	3,000	4,000	--	--	--	--	--
Hiwassee (Tennessee)	--	--	--	--	--	--	300	500	800	2,000	--	--	--	--	--
Ocoee (Tennessee)	--	--	--	--	--	800	1,200	--	2,000	3,000	--	--	--	--	120,000
	--	--	--	--	--	--	--	--	--	--	--	--	7,000	23,000	40,000

^aExpanded from Hecock (1977).^bData from various published and unpublished sources.

showing the greatest increases are nearest large population centers in the Midwest, East, and far West.

The upward trend in river recreation has led public agencies to restrict use on some rivers. Rivers with some use restrictions increased from 8 in 1972 to 38 in 1977 (McCool et al. 1977, Utter 1979). As a result use on these rivers has been stable or has even declined (Table 3). We suspect, however, that measures to limit use, while effective at their intended locales, have caused corresponding dramatic increases on other rivers where no restrictions yet exist.

Closely associated with the trend toward greater regulation of use on rivers has been the trend toward potential users being denied access to rivers (Grimm and Wyman 1974). On many rivers the number of persons applying for permits has been four to five times the number receiving them. For instance, on the Selway River in 1978, only 62 of the 703 persons applying for a permit through a lottery system actually were awarded one—a 9 percent rate of success.

Growing membership in river-oriented organizations, sponsored river events, and the circulation of magazines oriented to river recreation all point to an accelerated interest in rivers for recreation. For example, membership in the American Canoe Association was 1,000 in 1965 and is expected to exceed 5,000 during 1980. The number of Sierra Club river outings has more than doubled since 1969, up to 47 in 1978. Circulation of Canoe Magazine, which began publication in 1973, jumped from 5,000 in that year to over 45,000 in 1979.

Commercial enterprises in river recreation have correspondingly increased. For example, the Grumman Rent-A-Canoe directories (Grumman 1973, 1978) show canoe rental agencies listed increased 115 percent between 1973 and 1978 (from 427 to 917). Enterprises and individuals that outfit or lead river trips also have increased. The newly formed National Association of Canoe Liveries and Outfitters report 168 businesses in 33 States in their 1979 directory. They expect the number of businesses to at least double in the 1980 directory (Couch 1979). In 1962, the Western River Guide Association counted only 15 members. By 1979, the number of members had risen to 1,374. The companion Eastern Professional

River Outfitters Association was founded in 1976 with 14 members. Three years later the organization had more than doubled to 29.

Full-time lobbyists for several conservation organizations with a vital interest in river protection as well as recreation use have been established. The American Rivers Conservation Council, for example, was founded in 1973, and is based in Washington, D. C. A major national lobby, they call for widespread river preservation programs and for informing a variety of interested persons about river planning, management, and conservation.

The growing number of regional, national, and international conferences and symposia focusing specifically on river recreation is another indicator of the widespread interest in river resources. During the 1970s, no less than 10 major gatherings focused on such topics as river planning and management, the impact of proposed dam construction on river resources, in-stream flow requirements for recreation and other uses, research on river recreation, and public programs to preserve river environments.

The following factors should be influential in keeping demand high: the crowded conditions associated with other recreation activities; the reduction in pollution on many waterways (especially in and near urban areas) resulting from legislation such as the Water Quality Act of 1965; the increased emphasis on physical fitness; a surge in interest by people in challenging, even dangerous recreation activities; the growing number of books, magazines, films, advertisements by commercial river outfitters, and television programs on the out-of-doors and rivers in particular; growth in the number of commercial outfitters and boat liveries that provide relatively inexpensive services to a broadening, inexperienced segment of society; and, new technology in outdoor recreation equipment and related industries (Lime 1977a).

THE RIVER RECREATIONISTS: WHO ARE THEY?

As river recreation has increased so have studies of river recreationists to determine their social and economic makeup, why they visit rivers, reactions to encountering various amounts and types of river users, opinions of specific river management practices, etc. (Anderson et al. 1978). Unfortunately,

most studies of river use and users have been one-time efforts without follow-up inquiry. And, most have been case studies of short duration using different survey techniques (Anderson *et al.* 1978). However, there is enough evidence from various studies to make some tentative observations about these recreationists. Generally, river recreationists are atypical of the population as a whole, as frequently reported in analyses of other outdoor recreationists. However, there are characteristics of river recreationists that distinguish them from other outdoor recreationists.

River recreationists here are defined as people who travel on rivers or streams in rafts, canoes, kayaks, innertubes, or relatively small motorboats, but not large motorized watercraft or sailboats. Fishermen, shore users, and riparian landowners are also excluded.

Most studies have shown that river recreationists are predominantly young (Hecock 1977). Data from the 1978 phase of the Forest Service's National River Recreation Study³ revealed that 67 percent of the river recreationists surveyed were between the ages of 20 and 40, and 45 percent were between 20 and 30 years of age. Similar distributions are found in other studies of river recreationists (Bassett *et al.* 1972, Heberlein and Vaske 1977, Seitz 1974, Solomon and Hansen 1972).

Certain ages are associated with certain craft. Tubing enthusiasts tend to be younger than other river recreationists. On the Apple River in Wisconsin, for example, more than two-thirds of the tubers surveyed were under 25 years of age (Shaffer and McCool 1973). Youthfulness among tubers is further exemplified from a study on the Bois Brule

³The National River Recreation Study is a nationwide survey of river recreationists being conducted by the North Central Forest Experiment Station. The focus is to develop and apply standardized survey techniques for describing patterns of behavior, characteristics, and management preferences of recreation users across a variety of rivers and over time (Lime *et al.* 1979). So far, 39 different rivers or river stretches throughout the country (including Alaska) have been studied: 11 were studied in 1977, 13 in 1978, and 23 in 1979. Five rivers were studied in more than one use season.

River, also in Wisconsin (Heberlein and Vaske 1977). At least 30 percent of the tubers were judged to be under 14. In contrast, youthfulness is not a dominant characteristic of whitewater enthusiasts, perhaps because that activity requires considerable investment in equipment and/or commercial services (Hecock 1977). On the Colorado River in the Grand Canyon, for example, the average age of rafters was 36 (Shelby 1975). Similar patterns have been reported from other studies (Howard *et al.* 1976, Schreyer and Nielson 1978).

As with many outdoor recreational pursuits, river recreationists are often students and more educated than average. Most past age 18 have completed several years of formal training beyond high school. Half of those over 18 years in the National River Study (1978 data), for instance, had completed at least 4 years of post high school training. Similarly, Schreyer and Nielson (1978) found that about a third of the visitors surveyed on two whitewater rivers in Utah had completed more than 4 years of training beyond high school. And, Leatherberry (1979), found both canoe and kayak owners in Minnesota, on the average, had completed more than 2.5 years training after high school.

More river recreationists are professionals or white-collar workers than average and have higher incomes (Boster 1972, Heberlein and Vaske 1977, Howard *et al.* 1976, Leatherberry 1979, Pfister and Frenkel 1974, Seitz 1974, Solomon and Hansen 1972). The National Recreation Survey (Bureau of Outdoor Recreation 1973) found that canoeists have higher incomes than most other outdoor recreationists and the population as a whole. Leatherberry (1979) in Minnesota found that a fifth of the State's households had annual incomes in excess of \$25,000 in 1976 while about a third of the canoe and kayak owner families had incomes exceeding that figure.

In general, river recreationists begin participating at a later age than others such as hunters, fishermen, and wilderness visitors (Hendee *et al.* 1968, Klessig and Hale 1972). For example, canoe owners in Minnesota, on the average, went on their first canoe outing when they were 20 years old; kayak owners were 26 (Leatherberry, 1979).

River recreationists are unique in that so many are newcomers to a given river and to river recreation in general. In Hecock's

review (1977) he found no studies where first-time visitors accounted for less than a third of the total population studied. The pattern has remained constant in studies completed since then (e.g., Schreyer and Nielson 1978, Heberlein and Vaske 1977). In the National River Recreation Study (1978 data), 56 percent of all respondents had never before been on the river where they were sampled. However, there was considerable range in the percentage of first-time visitors--from 23 percent on the Salt River, a tubing river in Arizona, to 74 percent on the Colorado River, a whitewater stream, in central Colorado.

Many river recreationists are novice. In the National River Study, we asked respondents to identify other river trips they had taken by innertube, canoe, raft, kayak, or other watercraft. From the 1978 phase of the study, nearly a quarter were on their first river trip.

Partly because of their lack of experience, many participants rent rather than own their watercraft. On the Pine and Au Sable Rivers in Michigan and the Current and Jacks Fork Rivers in Missouri, about 80 percent of all canoes were rentals (Bassett *et al.* 1972, Marnell *et al.* 1978, Solomon and Hansen 1972). On many whitewater rivers, particularly in the West, most participants use rented watercraft or ride in crafts piloted by commercial guides. In 1978 on the Snake River in Hell's Canyon, for example, 63 percent of all visitors travelled in commercially outfitted groups (Shelby and Danley 1979).

Most river trips involve at least some preplanning, and most river recreationists decide to go on their trip at least a week in advance. Sometimes, especially where river camping is involved, the decision is made further in advance than for day trips. For example, 52 percent of the campers in the National River Study (1978 data) decided to go on their river trip more than a month in advance. By contrast, day trippers are much more spontaneous in their planning. From the National River Study, 43 percent of the day users planned their outing no more than a week in advance--11 percent of all day users surprisingly planning their trip within 24 hours. Heberlein and Vaske

(1977) found most tubers in Wisconsin did no advance planning or at most, planned 1 or 2 days ahead. Most canoeists on the Au Sable River in Michigan were day users and made plans for their trip no more than a week in advance (Bassett *et al.* 1972).

Although the size of groups can vary considerably among rivers and types of visitors (such as between kayakers and commercially outfitted rafters), group size tends to be considerably higher than in many other recreational pursuits such as hunting, hiking, wilderness camping, fishing, and snowmobiling. In the National River Recreation Study (1978 data), the median group size was 9 but ranged from 5 persons per group on the Salt River in Arizona to 20 persons on the Kings River in California; 11 percent of all visitors were in groups of more than 30 people. Organizational groups tend to be larger than groups of family members or friends (Marnell *et al.* 1978) and, in most instances groups that use commercial services are larger than privately outfitted groups. In a 1974 study of the Rogue River in Oregon, for example, 75 percent of the commercially outfitted parties ranged from 16 to 25 people while only 13 percent of the noncommercial parties consisted of that many (Pfister 1977).

River recreationists take river trips for a variety of reasons. The National River Recreation Study (1978 data) preliminary analysis suggested that among the most important reasons for taking river trips are: (1) to be with other people, (2) to escape the day-to-day demands at home, (3) to get exercise, and (4) to learn about nature. Similar results were found in other studies (Bassett *et al.* 1972, Heberlein and Vaske 1977, Solomon and Hansen 1972).

The reasons recreationists had for taking river trips are generally quite different than the reasons for participating in some other recreation activities. For example, data from the National River Study and from urban residents in three midwestern cities suggest that people who play sports, visit zoos and museums, or go to the theatre do so for different reasons than people who take river trips (Peterson *et al.* 1978). For example, people who take river trips had a stronger desire to get away from the day-to-day demands of life at home.

River recreationists often pursue activities far from home. The distance river recreationists travel may be related to the site attractiveness or site "demand" of the resource (Peterson *et al.* 1979). Data from the National River Study (1977 data) confirmed that whitewater rafters and kayakers tend to travel further from home than do the more casual canoeists. On the Main Salmon and Middle Fork of the Salmon Rivers in Idaho, visitors travelled an average of more than 800 miles (one way) to float those rivers. On the other hand, visitors to the Mohican River in central Ohio, a flat-water canoe stream, travelled an average of only 76 miles.

PROBLEMS ASSOCIATED WITH INCREASED POPULARITY

Multiple access and egress points, multiple land ownership patterns, variations in water flow, and a recreating public in search of a variety of outdoor experiences have caused headaches for resource administrators.

Social problems

Large groups of river recreationists often infringe on the enjoyment of smaller groups. Groups of over 120 people have been observed on Michigan's Pine River (Solomon and Hansen 1972). On Oregon's Rogue River, one party contained 38 rafts! Though only a small proportion of total use, they may have a disproportionate impact on the experience of others. Many large groups are organizations, clubs, and fraternal groups, and they float rivers primarily for a social experience. The value that large groups attach to their trip is often different from those of smaller groups (Stankey 1973, Lime 1972). Some studies have revealed that objection to seeing large groups is not so much related to their numbers but rather their inconsiderate behavior, such as yelling or shouting (Driver and Bassett 1975, Bassett *et al.* 1972). Often, inconsiderate behavior is related to the consumption of alcoholic beverages. On many rivers the stream bed and banks are littered with cans and bottles. Clean-up crews on the Pine River in Michigan reported 1,000 containers within a 1-mile section; most were beer cans and bottles (Marek 1979).

Congestion is a common problem on many rivers. Large "armadas" have been observed on one stretch of river while other stretches of

the same river are nearly deserted (Warren 1977). These large concentrations often occur because of the seasonal, weekly, and daily peaks in use. Most trips are taken between Memorial Day and Labor Day, during the latter part of the week and on holidays, and begin in mid-morning. Since most groups travel at about the same speed, they tend to create congestion at access and egress points, campsites, rapids, and other attractions.

The congested conditions on some rivers has led to animosity among different groups of recreationists. A common situation is heavy competition for campsites, often expressed in open hostility (Warren 1977). Some recreationists resent others who use different types of watercraft. Heberlein and Vaske (1977) found canoeists consistently disliked meeting other recreationists more than tubers did. In the Boundary Waters Canoe Area Wilderness (BWCAW), Lucas (1964) and Starkey (1973) found paddle canoeists strongly objected meeting motorboaters. On the Colorado River in the Grand Canyon, recreationists travelling in oar-powered rafts objected to motorized rafts because of their noise (Shelby 1975).

Research shows that while recreationists in nonpowered craft oppose meeting motorized groups, most motorized parties don't mind meeting nonmotorized groups. In the BWCAW, for instance, nearly half of the motorboaters studied said it wouldn't matter how many other parties they met per day (Lime 1977b). Significantly fewer motor canoeists (29 percent) and paddle canoeists (13 percent) felt that way.

Some river recreationists have altered their participation patterns because of what they perceive to be unacceptable conditions. In some areas such feelings have resulted in significant numbers of recreationists being displaced. Becker and his associates in studying the St. Croix and Mississippi Rivers in southeastern Minnesota (1979), for example, found that recreationists seeking social experiences tended to gravitate to one section of the river system while those seeking low density experiences went to another section. They also found that some recreationists were purposefully avoiding areas and times when use densities were highest.

Commercial outfitters and noncommercial users often compete for the opportunity to float rivers (Utter 1979). Competition has been particularly prevalent on western white-water rivers, but the problem is growing nationwide. The competition has resulted in direct and indirect conflicts among recreationists, expressed in threatened and actual lawsuits and Congressional inquiry. On the Colorado River in Grand Canyon, for example, a battle has been raging since the early 1970s over the 92:8 split in the allocation of use permits between commercial and private parties. The National Park Service, with support from private users, proposes to increase the proportion of private trip permits while most commercial operators want to maintain the status quo (U. S. Department of Interior 1979). Such intense debate inhibits management initiative and often results in long legal deliberations (Jensen 1979, Shelby 1979).

River recreation use causes conflicts with other uses and users of rivers. In Michigan, for example, there are several rivers with high quality trout fishing but canoeing on weekends has increased to where fishermen have found it difficult to fish. And, many have had to alter their regular fishing times or have stopped fishing those streams (Marek 1979, Bassett et al. 1972).

On some popular rivers there are conflicts between riparian landowners and river recreationists. Some of the most serious problems center around littering and trespassing (Countess et al. 1977, Cox and Argon 1979). Other conflicts arise from vandalism, invasion of privacy, and noise (Bassett et al. 1972). In some areas landowners respond by posting their land (Cox and Argon 1979) or have threatened to take or have taken the law into their own hands.

Ecological problems

Destruction of native ground vegetation is common along many streams and rivers (Aitchison et al. 1977, Manning 1979, Marnell 1978). The most common cause of vegetation destruction is trampling; but, since recreationists spend a large portion of their time on the river, impacts to ground vegetation does not occur uniformly throughout the river corridor. Instead, impacts usually are concentrated at accesses, campsites, and near other popular stopping points.

In areas where use is especially concentrated such as at campsites, studies have determined that after the first few seasons when ground vegetation is fairly rapidly reduced to some low point, there is a natural recovery or adjustment in the vegetation (Settergren 1977). Generally, however, there is a shift to more recreation-tolerant species (Merriam and Smith 1974). But under sustained use, the ground vegetation will be progressively reduced until it cannot recover naturally. On heavily used areas along the Current and Jacks Fork Rivers in Missouri, for example, researchers found that the rise in density of replacement species moderated the decline in original ground cover vegetation (Marnell et al. 1978). However, with further increase in recreation all ground vegetation was eventually lost.

The removal of trees and shrubs by recreationists is a problem where impacts are concentrated. Numbers of smaller seedlings and saplings decrease and vegetation patterns are affected over prolonged periods (Schmidly et al. 1976). Recreationists sometimes cut or remove vegetation to enlarge campsites. In the BWCAW, Merriam and his associates (1973), found that newly constructed campsites approximately doubled in size during a 3-year period.

Malicious chopping of exposed roots, trunks, or limbs, and live-tree cutting late in the use season when deadwood becomes scarce, can reduce standing vegetation (Marnell et al. 1978, Schmidly and Ditton 1978).

Loss of vegetation often results in soil erosion. On riverbanks soil erosion is accelerated because of the contour of the land and/or the properties of the soil. The sandy or depositional nature of the soil can contribute to the lack of stabilizing vegetation and erosion often is rapid and devastating. Hansen (1975), for example, found on the Pine River in Michigan that streambank erosion was dramatic as a result of recreationists sliding down steep sandy banks. Merriam and Smith (1974) found in the BWCAW that campsites were subject to considerable recreation-induced erosion. On footpaths along the Colorado River in Grand Canyon, Dolan and his associates (1974) found surface erosion up to two feet deep. The season, duration, and intensity of use influences the extent and nature of erosion in such arid environments. A site

may be very durable during drier months, but heavy use during spring when the water table is higher can result in greater and more pronounced erosion.

Motor vehicle use in river corridors and in the stream bed also causes soil erosion. Tracks left by vehicles roughens the soil which accelerates erosion. Such traffic can alter the natural form and distribution of gravel deposits in stream beds and affect normal shifting and development of gravel bars (Marnell *et al.* 1978). Riverside campsites accessible by road also are particularly vulnerable to heavy use followed by erosion. On the Rio Grande River in Big Bend National Park, riverside auto campsites were among the most heavily used (Ditton *et al.* 1977); the same along Michigan's Pine River (Hansen 1975).

Sedimentation from erosion in turn affects the water quality. Increased sedimentation causes increased turbidity, nutrient enrichment, and the smothering of bottom flora and fauna. On some high quality, sensitive trout streams, for example, sedimentation has destroyed the fishery resource. In most instances, however, recreational impact is localized (Merriam and Smith 1974), and does not contribute significantly to sedimentation (Marnell *et al.* 1978).

Along many recreational rivers, the disposal of human waste is a serious and growing problem and a potential public health hazard. Sanitation facilities are generally not available. Improper disposal of human waste can cause biological contamination or nutrient enrichment of rivers. Merriam and his colleagues (1973) found that recreational use of some campsites increased coliform bacteria and phosphate concentrations in lake water to a point higher than public health standards allowed for drinking water. On some rivers, especially those in canyon settings, the area available for sewage burial is very limited. Aitchison and his associates (1977) report that on the Colorado River's most popular beaches in Grand Canyon National Park, it was not uncommon to uncover previous human waste sites. A number of cases of infectious illness due to inadequate sanitation practices occurred among recreationists on the river (Knudsen *et al.* 1977).

The severity of the human waste problem and the attendant health hazard is related, in part, to the character of the local ecosystem. On the Current River in Missouri, for instance, the warm humid climate, rich vegetation, and porous soil lessens the problem because decomposition is so rapid. Also, periodic flooding leaches residual wastes from the floodplain (Marnell *et al.* 1978). In contrast, on the Colorado River, the hot, dry climate prohibits the proliferation of decomposer bacteria. Harmful bacteria accumulate in beach sands, partly because an upstream dam has eliminated floods that formerly scoured and shifted beaches. Even after a year, fecal coliform bacteria of unacceptable levels were present in beach sands (Aitchison *et al.* 1977).

Litter or solid waste poses another challenge to river recreationists, resource administrators, and the general public. Managers on Michigan's Pine River estimated 20,000 beverage containers were strewn along a 40-mile stretch (Doehne 1977). Recreationists there are sensitive to this problem. When a sample of canoeists were asked what was "the low point of your river trip", litter was the most frequent complaint (Solomon and Hansen 1972). Besides being aesthetically displeasing, litter or solid waste is a potential human health hazard because it creates a potential food supply for insects and animals. The artificial food supply may lead to unnaturally high densities of some mammals which can lead to poor health among populations and transmittal of diseases (Aitchison *et al.* 1977).

RESPONSE TO RIVER RECREATION POPULARITY

Before the 1960s, active river recreation management was virtually nonexistent. However, some federal agencies and state governments did attempt to protect free-flowing rivers in their natural state, but most efforts were rather passive with few or no provisions for recreation management. Any management that was done was largely secondary or incidental to other concerns such as watershed protection, irrigation, and hydroelectric production. Some State and Federal agencies that owned riparian lands, did provide facilities such as boat ramps, campsites, and picnic tables. State agencies and the U. S. Coast Guard were responsible for management, most of which centered on

enforcing compliance to federal and state water regulations, license requirements, and site maintenance.

As river recreation use grew during the late 1960s and early 1970s, the need for strong management became evident. In 1968 the national Wild and Scenic Rivers Act (Public Law 90-542) was established to preserve certain selected rivers in a free-flowing condition. That same year the President's Council on Recreation and Natural Beauty (1968) recommended a nationwide protection of natural rivers through State action. Legal efforts such as the national Wild and Scenic Rivers Act, and State programs, helped focus attention on rivers as recreational resources but they did not mandate specific actions. These were left to the field units.

During the 1970s, management activities proliferated--especially establishing management objectives. Managers tried to define the type of recreation experience the river environment would provide by deciding what kinds and amounts of use to allow on the river.

Management ranged from trying to change behavior by rules and regulations to trying to change it by suggestion through printed and spoken media. Some approaches used to deal with increased use are presented below.

Use has been restricted where the demand is judged to exceed supply. An allocation or rationing scheme is used. Typically, an upper limit is set on use (i.e., on the number of people, number of groups or visitor days). Use opportunities are systematically allocated to competing river recreationists. As mentioned, on some western whitewater rivers commercial outfitters and private users compete heavily, so managers must establish use ratios between competing groups. Generally, ratios have been determined either by past use in a given year or are arbitrarily chosen (Elliott 1977). On the Colorado River in Grand Canyon, the current ratio is a 92:8 commercial to private split, the Selway River in Idaho has a 20:80 commercial to private split. Most rivers under the control of the Bureau of Land Management have a 50:50 split (Elliott 1977).

Many rationing mechanisms can be used (Stankey and Baden 1977). Most commonly potential recreationists and commercial outfitters apply for a use permit. From the pool of applicants a predetermined number of permits

are issued. For example, managers of the BWCAW established daily entry point quotas for overnight campers by travel zones. The quotas were computer generated using a travel behavior model that predicted the number of people that could be allowed at an entry point without exceeding a predetermined capacity (Peterson 1977). Recreationists are encouraged to apply for a permit before their trip. When a zone reaches capacity no other recreationists are permitted to enter. Instead they must wait another day or until an entry permit becomes available, or select another entry not yet at capacity (Higgins 1977).

Managers sometimes prohibit certain uses to reduce conflicts. When attempts are made to prohibit an activity it often is debated in the political arena and decided by the legislative process. These attempts have had varying degrees of success. In the BWCAW, for example, efforts by conservationists and others were only partly successful in prohibiting motorized craft on waterways, and only after a lengthy legislative process. In Michigan, the Department of Natural Resources sought, among other things, to reduce the number of canoes allowed on the Pine River by 40 to 60 percent. Opposition by local canoe outfitters resulted in a 7-year legal battle over the authority of the State to restrict use (Marek 1979).

Zoning techniques have been used to reduce conflicts among recreationists. On a major portion of the Lower St. Croix River between Minnesota and Wisconsin, "no wake zones" have been established to lessen the conflict between canoes and motorized craft. Horsepower limitation zones have also been used; e.g., 10 horsepower on the majority of motorized routes in the BWCAW.

Time zoning is another way to separate incompatible users. On some trout streams in Michigan fishermen are encouraged to use the river in the early morning and late afternoon hours when canoeing is prohibited. Another popular use of time zoning is the scheduling of trip departure times--from the day down to the hour. On the Chattooga River, for example, commercial outfitters are limited in the number of trips they can make on weekends and are assigned departure times at least an hour apart (Craig 1977).

Informing future visitors about past use in the BWCAW has been successful in reducing congestion and crowding. A brochure pointed out heavily used places so recreationists can avoid crowded areas and peak use periods (Lime and Lucas 1977).

Simulation modeling is a useful tool for managing river recreation use. Lime and his associates (1978) perfected a simulation model to predict patterns of river use occurring under a variety of conditions on the Green and Yampa Rivers in Dinosaur National Monument. The simulation and actual patterns of use were compared to test the simulator's validity and were found to be in close agreement.

To control ecological impacts, limiting party size and assigning campsites are widely used. The assignment of campsites provides an opportunity for vegetation to recover from previous use. On the Middle Fork of the Salmon River in Idaho, trips are scheduled so a particular site is vacant at least 4 of every 10 nights. In the BWCAW only 67 percent of the campsites in a travel zone are expected to be occupied at any one time based on the distribution system now in use. Other techniques used to control ecological impacts include the requirement that recreationists carry fire pans and portable toilets (Mak *et al.* 1977). In many locales either a ban on cans and bottles or a pack-in - pack-out policy are in force. In the BWCAW, the can and bottle ban has been successful in reducing visual blight. On the Eleven Point River in Missouri, the pack-in - pack-out policy has been reported to be successful (75 to 90 percent of empty cans are removed) (Craig 1977).

Because rivers have common management problems most resource administrators recognize the need for coordinated management among rivers. In response to this need, river managers in the West in 1973, formed the Interagency Whitewater Committee (IWC), composed of representatives from the Forest Service, Bureau of Land Management, Park Service, and Coast Guard. For the most part, the IWC membership is made up of field managers not upper management. The IWC's primary function is to serve as a forum for the exchange of ideas and experiences and to foster a unified interagency approach to river management. The IWC has been instrumental in coordinating western whitewater management activities through the development of the Interagency Management Guidelines (Yearout *et al.* 1977).

The U. S. Forest Service and the Bureau of Land Management are drafting river recreation management supplements to their manuals. In addition both agencies have conducted fact finding reviews concerning river recreation management activities.

Between the 1960s and late 1970s river recreation management activities grew from largely passive efforts to rigorous innovative activities. But, much management was done by intuition alone. There is now a generation of river managers who have gotten their "feet wet" and who recognize the need for comprehensive and systematic information to assist in the decision process. In fact, the Forest Service and Bureau of Land Management have been given legislative mandates to manage in a more systematic fashion (Lime *et al.* 1979). As a result, management is now more active and managers are searching for information from research and/or public involvement to establish objectives and solve problems.

FUTURE PERSPECTIVES

In the years ahead the "supply" of river recreation will be threatened by our expanding consumptive needs. Government at all levels, and conservation and other organizations will continue their efforts to identify and protect river recreation resources. But, the intensity of urban and second home development, farming, lumbering, mining, manufacturing, and energy production along rivers will probably reduce recreation opportunities.

Opposition to the administrative designation of rivers for recreation, will increase, especially from local landowners and residents. We suspect that opposition will be based, in part, on people's mistrust and misunderstanding of government intentions in designating rivers for recreation. The cry of "public land grab" will persist and become louder. And, in areas where private land adjoins rivers posting will increase.

Management intervention will increase. In the "near" future, demand for river recreation will continue to increase at a rapid rate. More inexperienced recreationists will be creating safety hazards for themselves and for others. Conflicts among different river recreationists will increase along with increased competition for use of the resource. Some recreationists will probably shift their use to lesser used rivers while others will

stop participating altogether. Rationing of use opportunities will become more widespread and will remain controversial and challenged.

Over the long term--20-30 years--demand will level off. The leveling off is expected because the nation's population growth declined markedly in the last decade and will continue to do so. The post World War II "baby-boom" generation makes up the bulk of current river recreationists. As they age and as the effects of a lower birth rate is felt, river managers will be serving a "different" and less rapidly expanding clientele (Marcin and Lime 1977). Future research and management will be oriented towards determining and serving the needs and preferences of the changing clientele.

In the future many management decisions will be decided through the legal and legislative process. Managers will be directed to devise strategies that will insure a spectrum of opportunities. Regional coordination will become more important so that use can be allocated uniformly and efficiently.

Technological innovations will influence demand. Although we will not predict what innovations might occur, some speculation is possible. Technology will assist managers as well as create new problems. Computer technology will be used more widely to aid managers. Technology will also cause management problems by creating equipment that will be capable of performing beyond current expectations.

Energy costs will affect participation in river recreation. People will probably limit their visits to more distant rivers and will probably stay longer. Day trips to rivers closer to home will become more prevalent.

Research will become more important to management. The demands placed on the resource necessitate more systematic evaluation. Pioneer research by academicians and others will assist in setting policy. Also, research by field agencies will increase. Field agency research will monitor the river management to evaluate its success.

REFERENCES

- Anderson, Dorothy H., Earl C. Leatherberry, and David W. Lime. 1978. An annotated bibliography on river recreation. USDA For. Serv. Gen. Tech. Rep. NC-41, 62 p.
- Aitchison, Stewart W., Steven W. Carothers, and R. Roy Johnson. 1977. Some ecological considerations associated with river recreation management. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 222-225.
- Alling, Curtis E., and Robert B. Ditton. 1979. Obstacles to creation of state river protection systems. *J. Soil & Water Conserv.* 34(5):229-232.
- Bassett, John R., Beverly L. Driver, and Richard M. Schreyer. 1972. User study: characteristics and attitudes on Michigan's AuSable River. *Sch. Nat. Resour., Univ. Michigan.* 78 p.
- Becker, R. H., B. J. Niemann, and W. A. Gates. 1979. Displacement of Users within a river system: social and environmental trade-offs. Paper presented at the Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.
- Boster, Mark A. 1972. Colorado River trips within the Grand Canyon National Park and Monument: a socio-economic analysis. *Dep. Hydrol. Water Resour. Rep. 10, Univ. Arizona.* 83 p.
- Bureau of Outdoor Recreation. 1973. Outdoor recreation: a legacy for America. USDI Bureau of Outdoor Recreation. 89 p. Washington, D. C.
- Couch, P. Roy. 1979. Personal Correspondence. Executive Director, National Association of Canoe Liveries and Outfitters.
- Countess, Michael L., Walter L. Criley, and B. R. Allison. 1977. Problems and conflicts associated with river recreation programming and management in the East. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 147-150.
- Cox, William E., and Keith A. Argow. 1979. River Recreation: Public Access vs. Riparian Rights. *Water Resources Bulletin* 15(3):728-739.
- Craig, William S. 1977. Reducing impacts from river recreation users. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 155-162.

- Ditton, Robert B., David J. Schmidly, William J. Boer, and Alan R. Graefe. 1977. A survey and analysis of recreational and livestock impact on the riparian zone of the Rio Grande in Big Bend National Park. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 256-266.
- Doehne, Harry A. 1977. Experiences in managing river recreation, and river use in Michigan. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 110-116.
- Dolan, Robert, Alan Howard, and Arthur Gallenson. 1974. Man's impact on the Colorado River in the Grand Canyon. *Am. Sci.* 62(4):392-401.
- Driver, B. L., and John R. Bassett. 1975. Defining conflicts among river users: a case study of Michigan AuSable River. *Naturalist* 26(1):19-23.
- Elliott, Robert L. 1977. Commercial river outfitting: its educational role and responsibilities to the future. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 213-219.
- Grimm, Gary, and Richard Wyman. 1974. Public rights to rivers. Public wild River Environmental Project, Eugene, Oregon. 21 p.
- Grumman Boats. 1975. Rent-a-Canoe Directory. 21 p. Grumman Allied Industries, Marathon, NY.
- Grumman Boats. 1978. Rent-a-Canoe Directory. 21 p. Grumman Allied Industries, Marathon, NY.
- Hansen, Edward A. 1975. Does canoeing increase stream bank erosion? USDA For. Serv. Res. Note NC-186, 4 p.
- Heberlein, Thomas A., and Jerry J. Vaske. 1977. Crowding and visitor conflict on the Bois Brule River. Tech. Rep. WIS--WRC-77-04, 100 p. Univ. Wisconsin.
- Hecock, Richard D. 1977. Recreational usage and users of rivers. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 279-284.
- Hendee, John C., William R. Catton, Jr., Larry D. Marlow, and Frank Brockman. 1968. Wilderness users in the Pacific Northwest--their characteristics, values, and management preferences. USDA For. Serv. Res. Pap. PNW-61, 92 p.
- Higgins, Joseph H. 1977. A distribution program for the Boundary Waters Canoe Area. *Naturalist* 28(4):22-29.
- Howard, Gordon, John Bethea, Jr., Dee Kiger, and Rebecca Richardson. 1976. Chattooga River visitor survey. 75 p. Dep. Recreation and Park Administration. Coll. For. and Recreation Resour. Clemson Univ.
- Jensen, Marvin O. 1979. Information from the social sciences: a critical need of back-country managers. Paper presented at the Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.
- Klessig, Lowell, and James Hale. 1972. A profile of Wisconsin hunters. Tech. Bull. 60, 24 p. Wisconsin Dept. Nat. Resources.
- Knudsen, A. B., R. Johnson, K. Johnson, and N. R. Henderson. 1977. A bacteriological analysis of portable toilet effluent at selected beaches along the Colorado River, Grand Canyon National Park, Arizona. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 290-295.
- Leatherberry, Earl. C. 1979. Minnesota canoe and kayak owners: their characteristics and patterns of use. USDA For. Serv. Res. Pap. NC-171, 8 p.
- Lime, David W. 1972. Large groups in the Boundary Waters Canoe Area--their numbers, characteristics, and impact. USDA For. Serv. Res. Note NC-142, 4 p.
- Lime, David W. 1977a. Research for river recreation planning and management. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 202-209.
- Lime, David W. 1977b. When the wilderness gets crowded...? *Naturalist* 28(4):1-7.
- Lime, David W., Dorothy H. Anderson, and Stephen F. McCool. 1978. An application of the simulator to a river recreation setting. In Simulation of Recreational use for Park and Wilderness management. Chapter 9, p. 153-174. Resources for the Future, John Hopkins University Press, 220 p.
- Lime, David W., Richard C. Knopf, and George L. Peterson. 1979. The national river recreation study: growing new data base with exciting potential. Paper presented at the Second Conference on Scientific Research in the National Park, San Francisco, CA., November 26-30.
- Lucas, Robert C. 1964. The recreational capacity of the Quetico-Superior area. USDA For. Serv. Res. Pap. LS-15. 34 p.

- Mak, Kenneth R., Marvin O. Jensen, and Thomas L. Hartman. 1977. Management response to growing pressures in western whitewater rivers--the art of the possible. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 102-109.
- Manning, Robert E. 1979. Impacts of recreation on riparian soils and vegetation. *Water Resources Bulletin* 15(1):30-43.
- Marek, Gary. 1979. Environmentalist at large: paddling the Pine to death. *Audubon*, 81(5):132-144.
- Marein, Thomas C., and David W. Lime. 1977. Our changing population structure: what will it mean for future outdoor recreation use? *In* Outdoor recreation advances in application of economics. USDA For. Serv. Gen. Tech. Rep. WO-2, p. 42-52.
- Marnell, L. F., D. Foster, and K. Chilman. 1978. River recreation research at Ozark National Scenic Riverways. *National Park Service*. 139 p.
- Merriam, L. C., Jr., C. K. Smith, D. E. Miller, Ching tiao Huang, J. C. Tappeiner, II, K. Goeckerman, J. A. Bloemendal, and T. M. Costello. 1973. Newly developed campsites in the Boundary Waters Canoe Area. *Univ. Minnesota Agric. Exp. Stn., Bull.* 511, For. Ser. 14, 27 p.
- Merriam, L. C., Jr., and C. K. Smith. 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. *J. For.* 72(10):627-630.
- Peterson, George L. 1977. The computer takes a canoe trip. *Naturalist*. 28(4):9-11.
- Peterson, G. L., A. Anas, F. S. Kappleman, and P. R. Stapher. 1978. Prediction of urban recreation demand. Final Report, NSF Grant No. Apr.-19086, Northwestern University, Evanston, IL.
- Peterson, George L., David W. Lime, and Dorothy H. Anderson. 1979. Attraction of recreationists to rivers: a nationwide view. Paper presented at Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.
- Pfister, Robert E., and Robert E. Frenkel. 1974. Field investigations of river use within the wild river area of the Rogue River, Oregon. *Rogue River Study Rep.* 1, 108 p. Dep. Geogr., Oregon State Univ.
- Pfister, Robert E. 1977. Campsite choice behavior in the river setting: a pilot study on the Rogue River, Oregon. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 351-358.
- President's Council on Recreation and Natural Beauty. 1968. From sea to shining sea: a report on the American environment--our natural heritage. 304 p. Washington, D.C.
- Schmidly, David J., Robert B. Ditton, W. J. Boer, and A. R. Graefe. 1976. Interrelationships among visitor usage, human impact, and the biotic resources of the riparian ecosystem in Big Bend National Park. Paper presented at the First Conference on Scientific Research in the National Parks, New Orleans, LA.
- Schmidly, David J., and Robert B. Ditton. 1978. Relating human activities and biological resources in riparian habitats of western Texas. *In* Proceedings of the Symposium on Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems, Callaway Gardens, Georgia. December 11-13, 1978.
- Seitz, William K., III. 1974. Patterns of recreational use and characteristics of users on the Upper Iowa River. Ph.D. diss. 193 p. Iowa State Univ.
- Settergren, Carl D. 1977. Impacts of river recreation use on streambank soils and vegetation--state-of-the-knowledge. *In* River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 55-59.
- Shaffer, Ron E., and Stephen F. McCool. 1973. Who's tubing down the Apple? *Tech. Rep.* 4, 31 p. Univ. Wisconsin.
- Shelby, Bo. 1975. Social-psychological effects of motorized travel in wild areas: the case of river trips in the Grand Canyon. 66 p. *Human Ecol. Res. Serv., Inc.*
- Shelby, Bo. 1979. Politics and research utilization: a case study of river research in Grand Canyon. Paper presented at Second Conference on Scientific Research in the National Parks, San Francisco, CA, November 26-30.
- Shelby, Bo, and Mark Danley. 1979. Allocating river use. 130 p. Oregon State University.
- Shreyer, Richard, and Martin L. Nielson. 1978. Westwater and Desolation Canyons: white-water river recreation study. 196 p. Institute for the Study of Outdoor Recreation and Tourism. Dept. of Forestry and Outdoor Recreation. Utah State University.

- Solomon, Michael J., and Edward A. Hansen. 1972. Canoeists suggestions for stream management in the Manistee National Forest of Michigan. USDA For. Serv. Res. Pap. NC-77, 10 p.
- Stankey, George. 1973. Visitor perception of wilderness recreation carrying capacity. USDA For. Serv. Res. Pap. INT-142, 62 p.
- Stankey, George H., and John Baden. 1977. Rationing wilderness use: methods, problems, and guidelines. USDA For. Serv. Res. Pap. INT-192, 20 p.
- State of Minnesota, Office of Hearing Examiners. 1979. Report of the hearing examiner for the Department of Natural Resources on the proposed inclusion of the Cannon River in the Minnesota Wild, Scenic, and Recreational Rivers system. DNR-79-021-AK.
- U. S. Dept. of Interior. 1979. Colorado River Management plan. Grand Canyon National Park, Arizona, Final Environmental Statement.
- U. S. Dept. of Transportation, Coast Guard. 1974. Recreational boating in the continental United States in 1973: the nationwide boating survey. 104 p. Office of Boating Safety.
- U. S. Dept. of Transportation, Coast Guard. 1978. Recreational boating in the continental United States in 1973 and 1976: the nationwide boating survey. 121 p. Office of Boating Safety.
- Utter, Jack G. 1979. Wild river recreation management: a case study of the use allocation issue. Ph.D. dissertation. University of Montana, 305 p.
- Warren, Sam E. 1977. How to ration river floating use: the Middle Fork of the Salmon experience. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 151-154.
- Water Resources Council. 1968. The nation's water resources. Washington, D. C.
- Yearout, Robert, Arthur Seamans, and Larry Lee. 1977. Regional river recreation management. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 188-192.