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Assessing and Evaluating Recreational Uses of Water Resources: Implications for an Integrated Management Framework

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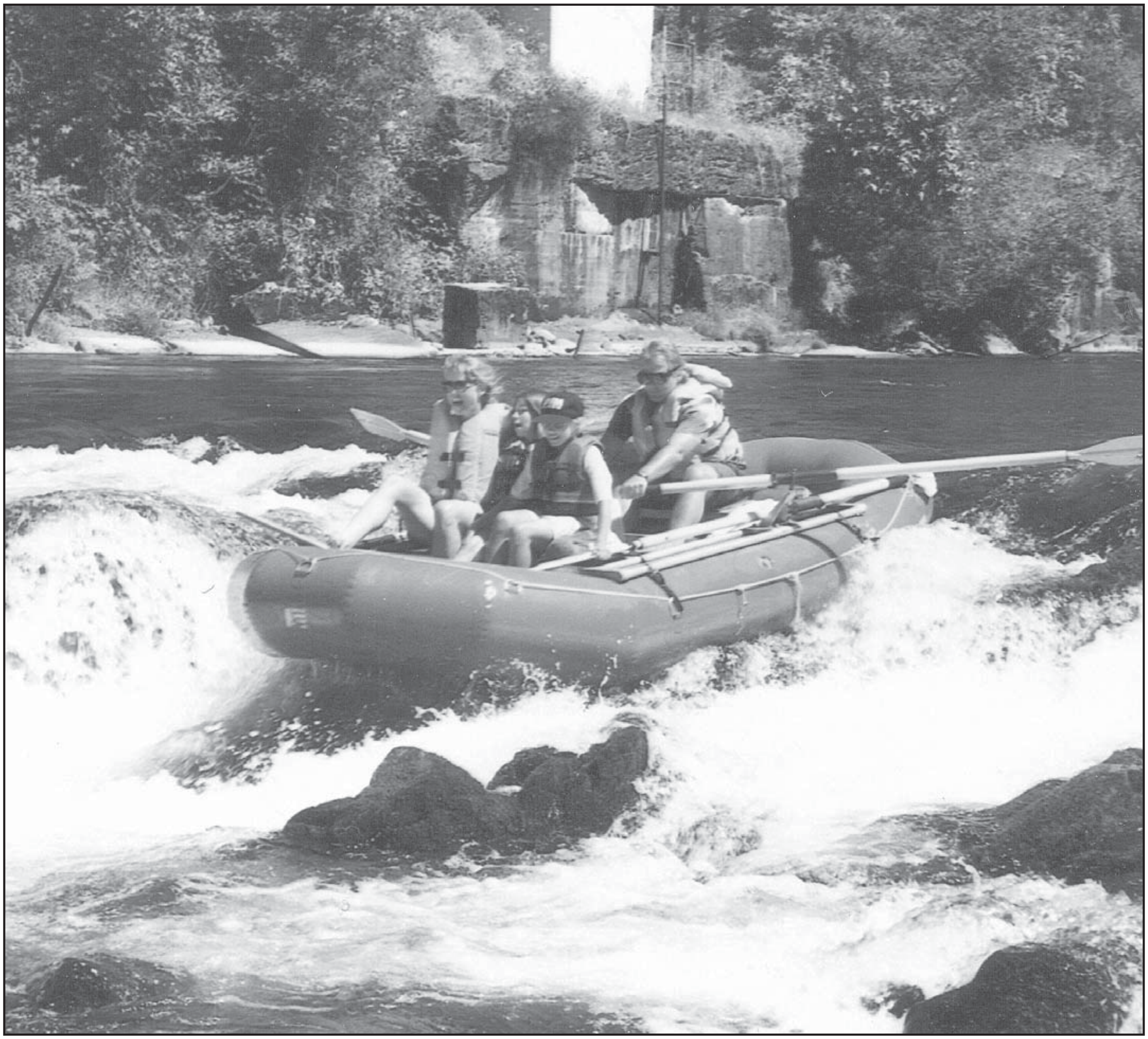

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Abstract

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To resolve conflicts over water, we need an understanding of human uses and values for water. In this study, we explore how water-based recreation affects and is affected by the water regime and water management and how key social trends might influence future water-based recreation. We found that although water is a critical component of many recreational experiences, our failure to understand current and anticipated water-based recreation use trends hampers our ability to effectively manage for recreation. Furthermore, we examined certain key drivers of social change, including population growth and migration, that will likely alter future recreation trends in the Pacific Northwest.

We identified changes to the water resource, such as altered flow regimes, that have important consequences for the availability and quality of recreation opportunities. Although there are a variety of conflicts among recreationists and between recreation and other uses of water, we have a limited understanding of how to resolve them. Effective management will require examining the links between recreational opportunities and water management to minimize negative impacts to both recreation and the water regime.

Keywords: Recreation, water management, demographics.

Summary

An understanding of human uses and values for water is necessary to resolve conflicts concerning water. The purpose of this synthesis is to explore the impact of water-based recreation on the water regime and the reciprocal impact of water management on water-based recreational experiences. Because recreation use occurs within a social context with which management has to contend, we also examined how key drivers of social change will influence future trends in recreation and water management.

Water is an important component of recreational opportunities and experiences. In addition to being an essential medium for conducting water-based activities, proximity to water also enhances the experiences of many recreational activities (e.g., hiking) not strictly dependent on the water resource. Consequently, there may be no simple substitute for water in many recreational activities.

Our ability to manage natural resources effectively for recreation is hampered by a lack of understanding of basic recreation use trends. Current recreation data, supported by anecdotal information, would suggest that water-based recreation is increasing; however, because of methodological limitations, coupled with incomplete, and sometimes non-existent data records, our ability to specifically characterize this growth—its magnitude, nature, location, and timing—is often problematic. The inability to describe recreation use in accurate basic terms raises troubling questions as to how managers can manage recreational opportunities effectively.

Our examination of key drivers of social change revealed trends that will play a role in water-based recreation patterns in the Pacific Northwest. Population growth, migration shifts, population aging, increasing diversity, technological advances, and shifts in leisure time will impact long-term recreation use trends. An awareness of the direction of these trends is necessary for anticipating shifting recreation demands. Population growth in the United States suggests that future recreation demand will rise. Current shifts in migration of residents to rural, amenity-rich locations, particularly in the South and the West, suggest that demands for recreation will increase in these locations. Perhaps more significantly, it also suggests that, as people relocate near public lands, greater public scrutiny will be placed on federal land management around the urban-forest interface.

Other key social trends might have a dampening influence on water-based recreation, particularly in wildland settings. The increasing proportion of U.S. residents over 65 years of age suggests that the demand for outdoor recreational activities, particularly those that are physically demanding, likely will decline. The increasing racial and ethnic diversity of the United States also suggests that the popularity of certain water-based recreational activities might change over time, with more people participating in urban-based recreational activities rather than wildland activities. Perceptions of declines in leisure time might reduce participation in wildland activities requiring extensive traveling, which will create greater demand for recreation near residential communities.

Technological advances will have a complex and unclear role in water-based recreation trends. Although advances in technology have the potential to increase recreation pressure and site degradation as people gain easier access into wildland settings, technology also can increase efficiency of recreational equipment, thereby reducing impacts (e.g., pollution) on the water regime. The complexity of the effects associated with these various drivers of change will confound attempts to accurately predict their

overall impact on recreation trends. Perhaps the only certainty is that resource managers will have to contend with recreation issues in an era of rapid social and technological change.

Through our examination of water-based recreation, we found that recreation typically impacts the water regime on a much smaller scale than other uses (e.g., irrigation) and that these impacts are usually localized, both spatially and temporally. Management of the water regime for various uses impacts water-based recreation. For example, changes to flow regimes can substantially impact water-based recreation by influencing the safety of the recreational experience and perceptions of crowding, scenic beauty, or recreational quality. Although conflicts over competing uses of water (including conflicts among recreationists) are expected to grow, we lack an understanding of how to integrate recreation with other water uses. The need to manage in these complex and contentious settings places a particular premium on the availability of integrated planning and management frameworks that facilitate an examination of alternatives, implications, and consequences across different resource sectors and over both space and time. Without the kind of understanding such frameworks provide, we will have difficulty managing for diverse, competing uses of water without displacing recreationists to other locations, which can subsequently lead to unintended consequences elsewhere.

Recreation and water are often inextricably linked. Changes to the water regime will have important consequences for recreation opportunities and experiences. Effective management depends on anticipating future trends and preparing for potential difficulties to minimize negative impacts on recreation or on the water regime.

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Introduction

This work arises out of the Sustainable Water Research Initiative of the USDA Forest Service, Pacific Northwest Research Station. The Sustainable Water Initiative recognizes that water is a key link within, as well as among, biophysical and socioeconomic systems. Changes in either system often are transmitted to the other via water; i.e., changes in the magnitude, quality, frequency, duration, timing, or rate of water production, induced either by natural changes (e.g., floods) or through socioeconomic changes (e.g., industrialization). Such processes are often quickly and dramatically evidenced in changes in systems, sectors, or locations. Often, such processes are unanticipated, inadvertent, or ignored until it is too late.

One of the four major themes of the Sustainable Water Research Initiative is to "recognize the competing demands, uses, and management opportunities to resolve conflict over water." The development of a strategy that can balance these competing demands requires that we better understand human values for water. The range of social values of natural resources is diverse and includes commodity, amenity, environmental quality, ecological, spiritual, and public use values, such as subsistence, tourism, and recreation (Stankey and Clark 1992). The Forest Service 2000 Recreation Agenda (USDA Forest Service 2000) notes that recreation is the fastest growing use on national forests and grasslands.

Water has long played a significant role in the types, patterns, and levels of recreation use in many areas. Studies of past recreation use patterns, as well as projected trends in recreation use, indicate a continuing close link between water resources and this human behavior. For this reason, we specifically examine recreation as a proxy for other social values of water and uses of water. Thus, this project focuses on a systematic synthesis of the literature on the interactions between water (excluding snow and ice) and outdoor recreation, a significant socioeconomic subsystem. Although the extent and rate of changes in the biophysical system (e.g., global warming, species extinction) remain in dispute, there is much more certainty and consistency in projections of socioeconomic changes (e.g., population growth, technological trends). Because these socioeconomic changes will be profound (Rayner and Malone 1998), it is critical that we examine the impact they will have on water resources in the future. The purpose of this study is to examine the reciprocal effects of recreation on the water resource and the management of the water resource on water-based recreation. There are three main objectives in this report:

1. Describe national and regional trends in water-based recreation and how population growth and demographic components of population change might influence future recreation trends (propositions 1-5).
2. Examine the effect of water-based recreation on the water regime including the impact on water quality, quantity, and flow (proposition 6).
3. Examine the effect that water management can have on water-based recreational experiences (propositions 7-8).

This report is organized around eight propositions; each summarizes what we know about a particular topic, question, or issue. Propositions are tentative statements reflecting a conclusion; we recognize that their validity and applicability are arguable and subject to validation and testing. However, they are primarily intended to facilitate discussion and analysis. They derive from an assessment of both the research literature and management experience and, where relevant, describe knowledge gaps surrounding these topics.

Proposition 1

The presence of water surfaces is essential to or enhances the satisfaction of recreationists engaged in most outdoor recreation activities.

The presence of water contributes to many recreational opportunities, including both water-dependent and water-enhanced recreational activities. Water-dependent activities are those in which water is essential to conducting the activity such as fishing, boating, water-skiing, swimming, kayaking, rafting, canoeing, sailing, and most waterfowl hunting. Water-enhanced recreational activities are those in which water is not required in order to participate in the activity, but in which it greatly contributes to the recreationist's overall experience. These activities include, but are not limited to, hiking and camping along bodies of water, viewing scenery, and studying nature. These categories are rarely distinct, even within a specific recreational activity. Depending on the species sought (e.g., waterfowl, pheasants, or deer), hunters may or may not require access to water. In addition, campers who are traveling long distances and are unable to carry sufficient water will require water sources periodically. Furthermore, recreationists seldom fall solely into one category, but instead often conduct several activities during a visit to a recreation site. For example, boating also allows people to participate in other water-based recreational activities such as water-skiing, waterfowl hunting, and fishing.

Both water-dependent and water-enhanced recreational opportunities can be influenced by the management of the water regime, either positively or negatively, inadvertently or purposefully. Recreationists participating in water-enhanced activities may be as affected by changes in the water resource as participants in water-based activities. Furthermore, they may find it equally as difficult to locate adequate substitutes if their traditional, water-oriented sites are no longer available. To effectively manage the water resource for the various uses of water, including recreation, we must understand how recreationists use and value water in their outdoor experiences. Studies of visitor attitudes and preferences indicate that water is a fundamental component of many forms of recreation on public lands and can contribute to recreationists' satisfaction with a site (Rollins and Chambers 1990). Studies of campground users consistently have found that access to water is one of the most important characteristics that recreationists look for in a campsite (Bumgardner et al. 1988, Clark et al. 1984, Lime 1971, Lucas 1970, Moore et al. 1990).

Water is often rated by recreationists as the most important attribute of their chosen setting, and the amount of land/water edge and surface water are positively related to increased scenic value of the area (Zube et al. 1975). In a survey of visitors to the Aravaipa Canyon Wilderness in Arizona, for instance, (Moore et al. 1990), respondents ranked 13 characteristics of the Canyon in order of importance; water was the most frequently mentioned item. In a study developing a typology of site attributes desired for camping, Brunson and Shelby (1990) noted that one of the three most important attributes needed to provide a minimum-level quality camping experience was proximity to water.

Water is important not only as an essential component of water-dependent recreational activities but also as an "aesthetic backdrop for nonwater oriented activities" (Field and Martinson 1986). In a study to examine how people make choices about recreation sites, Vining and Fishwick (1991) allowed 10 subjects to verbalize their thought processes as they chose between 45 pairs of outdoor recreation sites. The authors noted that most subjects used the presence and absence of water in their evaluation. They discovered that water was considered more important than simply serving as a “medium” for conducting an activity. Instead, attributes of water (such as miles of shoreline) were associated with contributing to the peaceful or secluded atmosphere of a site that was important to the subject. Thus, not only is water essential to many water-based recreational opportunities, studies indicate that symbolic aspects of water, such as its calming and relaxing effect on individuals, is also important to the quality of outdoor recreation activities.

Proposition 2

Flawed and inconsistent methods limit accurate recreation use data; however, available data suggest that participation levels in water-dependent activities continue to increase although rates of participation are slowing.

Information on recreation participation levels is important for effective management of natural resources for recreation. For example, knowledge of recreation trends can help managers direct monetary resources or personnel most appropriately. However, obtaining accurate recreation use data is difficult, particularly for dispersed recreational activities.

One of the principal limitations of recreation use data stems from the lack of cost-effective, valid sampling methods. Consequently, although many research studies have collected recreation data, our ability to compare across these different studies is limited. Currently, recreation data are not consistent enough to compare information from one year to the next (Loomis 2000). For example, depending on the survey, questions referring to boating can include sailing, canoeing, kayaking, rowing, floating, rafting, motorboating, water-skiing, or jet-skiing. Without a clear understanding of how recreation categories have been compiled, it is not possible to accurately compare recreation use across different survey instruments, areas, or time. Perhaps even more problematic is the lack of continuity in the questions asked on recreation surveys. The tendency to alter survey instruments by dropping or rephrasing particular recreation use questions in subsequent versions of the questionnaire effectively eliminates the possibility of comparing recreation use trends over time.

The difficulties of comparison across studies is compounded by the use of two different measurements of recreation units, visits and visitor days, each of which measures a different aspect of recreation intensity. Recreation use data are further confounded by the fact that participation is always a function of supply; participation rates in selected activities are influenced by availability and access to the activity, not solely by demand for participating in the activity (Manning 1999). As a result, activities that are widely abundant are reflected in high participation rates, whereas more preferred, but not easily accessible, activities reflect low participation rates.

In summary, the accuracy of recreation data is generally uncertain as are the methods used to obtain recreation use figures. This is and has been a fundamental, recurring problem in recreation management. Furthermore, in many instances, recreation data are not available. As a component of this report, a case study on one county in the Pacific Northwest was planned. It was envisioned that the case study would provide an opportunity to examine the impacts that demographic changes (e.g., population growth, migration patterns) have on water-based recreation in a specific county. However, the analysis of the case study was contingent on having some fundamental base of recreation use information. These data were lacking however, and so the case study analysis was abandoned. The possibility or even the likelihood of inaccurate or nonexistent data from one county alone raises serious questions as to how managers can determine how to appropriately allocate limited resources, both staff and time, for the entire National Forest System.

However, despite the caveats associated with recreation use data, some general recreation trends can be explored. In the 1970s and 1980s, many studies identified trends in water-based or water-enhanced recreation. Snepenger and Ditton (1985) used data from a national survey of hunting and fishing taken every 5 years to determine general trends in these activities. They noted that while participation in hunting [as a percentage of U.S. population] had declined from 1955 to 1980, participation in fishing had increased over the same period. In addition, they found that increasing numbers of anglers and hunters lived west of the Mississippi, in part reflecting the general westward migration trend across the United States. Warnick and Vander Stoep (1990) studied water-based trends by geographic region from 1979 to 1989 and found that national participation rates for three water-based activities (sailing, power boating, and water-skiing) had gradually declined over the 9-year period. In contrast, in the early 1980s, Hof and Kaiser (1983) predicted that participation in outdoor recreation would increase, with snow and ice-based recreation showing the highest rates of increase, followed by water-based recreational activities, and lastly, land-based recreational activities.

Recreation use data are obtained from descriptive national surveys including the National Survey on Recreation and the Environment, which is conducted every 5 years (Cordell et al. 1997), and the annual national survey administered for the Recreation Roundtable (Recreation Roundtable 2000). Until peer-reviewed studies analyze the sensitivity and the accuracy of these data in more detail, these surveys provide the best overview, albeit primarily a descriptive overview, of the major national trends in recreation. These recent surveys reveal that water remains an important aspect of recreation for North Americans. When respondents were asked about their outdoor recreation participation in 1995, water-based activities such as swimming, boating, and fishing were three of the most frequently mentioned outdoor recreation activities (table 1). A comparison of these three most popular water-based activities from 1982-83 to 1994-95 showed that the percentage of people boating and swimming increased over this period, while the percentage of people fishing decreased—although participation in sheer numbers remained high (table 2). Other findings also reveal that boating is one of the most widely conducted outdoor recreational activities in the United States. The National Marine Manufacturers Association (1997) estimates that 78 million people participated in recreational boating in 1997. Industry estimates of recreational boats sold show that the number of boats owned has grown steadily except for a short decline in the mid-1990s, with an estimated 13.2 million outboard motor boats owned in 1997. A more recent national survey in 1999 again identified swimming, fishing, and boating as the three most popular water-based activities, with swimming and fishing being within the five most popular outdoor recreation activities overall (Recreation Roundtable 2000).

Table 1—Participation in outdoor recreational activities as a percentage of the total population of the United States[a]

Activity	Percent	Activity	Percent
Swimming (nonpool)	39.0	Floating, rafting	7.6
Boating (any)	30.0	Canoeing	6.6
Fishing (any)	29.1	Sailing	4.8
Studying nature near water	27.6	Personal watercraft riding	4.7
Camping (any)	26.8	Rowing	4.2
Freshwater fishing	24.4	Migratory bird hunting	2.1
Motorboating	23.4	Windsurfing	1.1
Saltwater fishing	9.5	Kayaking	0.7
Water-skiing	8.9		

[a] The percentage of people 16 and older who participated in the activity at least once in the past 12 months.
Source: USDI and USDC 1996.

Table 2—Percentage of change in boating, nonpool swimming, and fishing participation from 1983 to 1995

Activity	Number in 1982-1983	Number in 1994-1995	Percent change
	- - - - - - - - - - - *Millions*	- - - - - - - -	
Boating:	49.5	58.1	+25.0
Sailing	10.6	9.6	-9.4
Motorboating	33.6	47.0	+39.9
Water-skiing	15.9	17.9	+12.6
Swimming/nonpool	56.5	78.1	+38.2
Fishing	60.1	57.8	-3.8

Source: Cordell and others 1997.

A focus on national trends can obscure differences among the various regions of the country; as a result, some studies have analyzed recreation use data at smaller scales. In a study that examined water-based recreation use trends from 1979 to 1987 among four regions of the United States, Warnick and Vander Stoep (1990) found that participation in swimming was evenly distributed across the country, whereas participation in water-skiing and motorboating was more prevalent in the Midwest and the South. However, their method of grouping a large number of diverse states (e.g., North Dakota and Kansas make up part of the "Midwest"; all states from Washington to Arizona compose the "West") makes it difficult to examine regional differences most relevant for Forest Service research stations.

To better understand the complex issues relating to to recreation and water in the Pacific Northwest,[1] we examined region-specific water-based recreation use trends. The Pacific Northwest is an area abundant in public lands available for water-based recreation. Alaska contains over 3,660 miles of rivers designated as National Wild and Scenic Rivers or as State Recreation Rivers, Oregon has 1,692 miles, and Washington has 177 (Zinser 1995).

[1] In this report, the "Pacific Northwest" refers to Alaska, Oregon, and Washington.

At the state level, Statewide Comprehensive Outdoor Recreation Plans (SCORP) often contain recreation participation information for water-based activities. Each state's SCORP, however, is administered separately and often cannot be compared across states. Oregon's SCORP (Oregon Parks and Recreation Department 1994) found that water-based recreational activities ranked high in terms of recreation participation in Oregon. The second and third most frequently conducted activities out of 19 dispersed recreational activities presented to respondents included swimming in lakes, rivers, or the ocean, and boat fishing, which were noted by 59 and 41 percent of the households, respectively. In addition, between 24 and 40 percent of the households surveyed engaged in nonmotorized boating, motorized boating, and bank or dock fishing.

The Alaska SCORP (Alaska Department of Natural Resources 1999) revealed that the most popular water-based activities undertaken by Alaskans included sportfishing (76 percent), clamming and beachcombing (53 percent), motorboating (42 percent), and canoeing, rafting, or floating (31 percent). Interestingly, when Alaskans were asked which activities they did not participate in, but would like to, the top five responses (snowmobiling, downhill skiing, sea kayaking, jet-skiing, and cross-country skiing) were activities all dependent on water. In Washington, a survey found that 72 percent of Washington households had participated in some type of water activity (e.g., swimming, water-skiing, sailing, boating) in the past year, and 57 percent had participated in fishing (Washington Interagency Committee for Outdoor Recreation 1995). In fact, as a result of conducting the SCORP process, the Interagency Committee for Outdoor Recreation in Washington found that the public's strong demand for water access was not being met and recommended that the state invest in 2,000 acres of public water access sites in the future.

Boating is a popular water-based activity in the Pacific Northwest. According to the National Marine Manufacturers Association (1997), Alaska, Oregon, and Washington rank 25th, 15th, and 24th, respectively, in the number of boating registrations on a per capita basis. Fishing is even more popular than boating in the region. A national survey of fishing, hunting, and wildlife-based recreation compared data on fishing among the states of the Pacific Northwest region (USDI and USDC 1996). For numbers of anglers, days of fishing, and fishing expenditures, Washington ranks first in the Pacific Northwest, followed by Oregon, and then Alaska (table 3). As a percentage of the state population, however, Alaska contains more anglers, followed by Oregon and Washington. The influence of nonresident anglers is also greater in Alaska. Nonresident anglers fishing in Alaska accounted for about 40 percent of the total days of fishing, whereas nonresident anglers accounted for only 6 and 7 percent of the total days of fishing in Oregon and Washington, respectively. These figures suggest that natural resource decisions in Alaska will impact a more geographically diverse constituency and that management decisions in Alaska will be driven more by out-of-state individuals than will similar debates in Oregon and Washington. In all three states, freshwater fishing is preferred over saltwater fishing (table 4), implying that management changes in freshwater resources would have greater implications for recreation participation than would changes in saltwater resources.

As previously discussed, there is an absence of current peer-reviewed studies examining recreation use trends. In contrast, research examining trends in recreation use generally has been replaced with studies that focus more specifically on particular components of the recreation experience, such as visitor satisfaction or visitor perceptions of crowding.

Table 3—Anglers and days of fishing for the Pacific Northwest region

State	Anglers (resident and nonresident)	Anglers (as a percentage of state population)	Days of fishing
			Millions
Alaska	463,000	29	5.3
Oregon	658,000	16	8.0
Washington	1,000,000	15	12.9

Source: USDI and USDC 1996.

Table 4—Total days of freshwater and saltwater fishing in the Pacific Northwest in 1996[a]

State	Total days of freshwater fishing	Total days of saltwater fishing
Alaska	3,602,000	1,949,000
Oregon	7,118,000	870,000
Washington	10,975,000	2,135,000

[a] Includes state resident and nonresident.
Source: USDI and USDC 1996.

Although this latter research was needed to better understand recreation behavior, it is important that researchers also continue to examine and to project recreation use trends in the United States. Because different methods are used to obtain recreation data, it is important for peer-reviewed studies to examine long-term trends in recreation while accounting for the limitations arising from inconsistent methods. Without better and continuous monitoring of recreation trends, managers may be caught unaware of the changing needs of the recreating public and may not be prepared to deal with the potential impacts of recreation use shifts on the water resource.

Most recent survey data indicate that in the Pacific Northwest, water remains essential to people's ability to continue participating in their preferred recreational activities. Because water is such a critical element in many recreation opportunities, managers must carefully design water management strategies that acknowledge the importance of recreation to the public and the importance of water resources to recreation.

Proposition 3

Population growth and migration will influence the spatial distribution of recreation in the United States and will affect the local public's acceptance of water management strategies.[2]

A discussion on future trends in recreation is incomplete without an examination of the major determinants of recreation trends–population change, migration, and demographic components of population. An understanding of these shifts in population is critical to understanding the future of outdoor recreation trends in the United States.

[2] Much of the research literature discussing the link between demographic changes and recreation is not specific to water-based recreation. Therefore, key drivers of change will focus on how demographic variables influence general recreation. The few examples of research studies that examined the effect of demographics on water-based recreation are included.

Table 5—Population and percentage of population change for the Pacific Northwest

State	1999 population (estimate)	Population change (1990-1999)	2025 population (projection)	Population change (1999-2025)
		Percent		*Percent*
Alaska	619,500	12.6	885,000	43
Oregon	3,316,154	16.7	4,349,000	31
Washington	5,756,361	18.3	7,808,000	36

Source: USDC Bureau of the Census 1997.

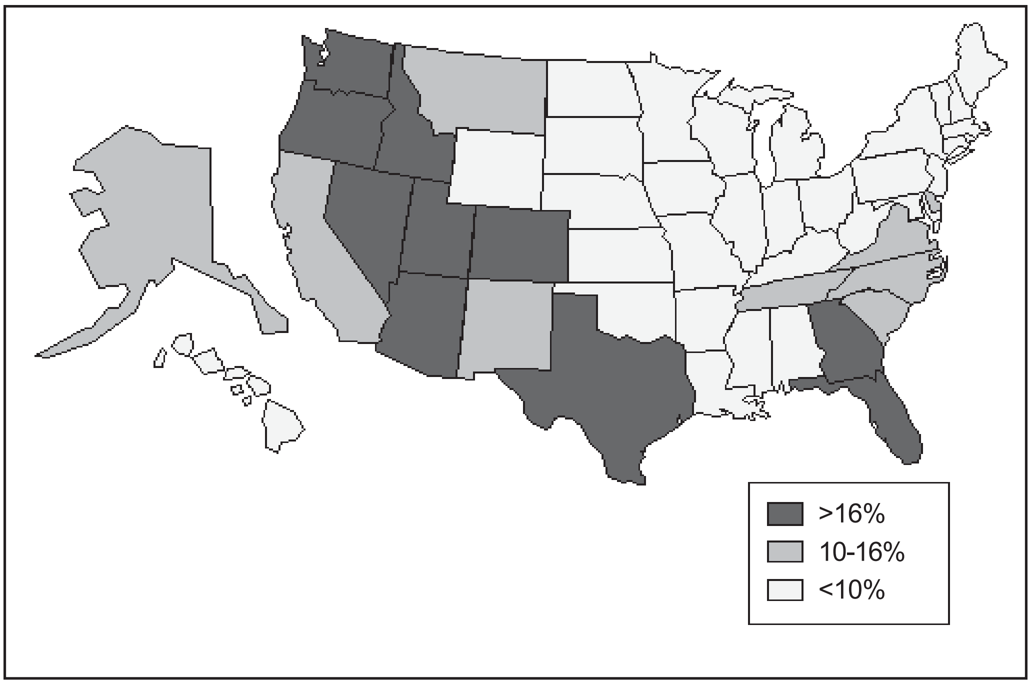

Figure 1—Percentage of population change for the United States, 1990-1999 (USDC Bureau of the Census 2001a).

Population Growth

Many societal trends will influence water-based recreation in the Pacific Northwest, but none appear to have as great a potential impact as population growth and the demographic components of population change. Although the population growth rate of the United States has been declining for some time, the 1999 estimate for population growth in the Pacific Northwest shows a rapid increase in population for all three states (table 5, fig. 1). Both Oregon and Washington were within the top 10 fastest growing states in the Nation in the 1990s (10th and 7th, respectively) while Alaska was 13th. Furthermore, if census 2025 projections for population growth in the region are reasonably accurate, the population of all three states will grow between 31 and 43 percent in the next quarter century (USDC Bureau of the Census 1997).

Considered by itself, this dramatic increase in the Pacific Northwest population suggests that additional demands will be placed on natural resources for recreation in general, and on water resources in particular. Assuming the acreage of federally owned lands remains relatively constant, the increase in population will decrease the amount of federal public land available per person. However, it is not enough to consider the effects of increased

Table 6—Projections for net domestic and international migration for the Pacific Northwest, 1995-2025

State	Net domestic migration	State ranking	Net international migration	State ranking
Alaska	-84,000	37th	28,000	41st
Oregon	712,000	8th	197,000	19th
Washington	931,000	5th	394,000	11th

Source: USDC Bureau of the Census 2001b.

population growth alone. Demographic components of this population growth—such as migration, shifting age structure and racial composition–confound the effects of population growth on management of natural resources in the future (McCool and Kruger, n.d.). We examine each of these components in detail under propositions 3 and 4.

Regional Migration

Not only will the increase in population have profound impacts on future recreation patterns and management of water, but the spatial distribution of these population shifts across the United States will further complicate future scenarios. The trend throughout the United States is for residents to migrate from the Northeast, Midwest, and Plains states to the South and the West; the growth in the Pacific Northwest reflects these national migration shifts (fig. 1). The population of the Pacific Northwest continues to grow owing to natural increase (births minus deaths) and increased international and domestic migration. Census projections for net domestic and international migration into the Pacific Northwest estimate that Oregon and Washington will continue to rank high in both net international and particularly net domestic migration (table 6), while in contrast, Alaska's rate of inmigration will slow.

Whether or not the population is growing or declining in specific regions of the country holds important implications for the conflicts over water for recreation and other uses. Current trends hold particular significance because they reveal a general pattern of migration from more water-rich regions of the United States toward more arid, Western States. These regional migration patterns potentially will have dramatically different effects on diverse regions of the country—bringing increased conflicts over scarce water resources in some locations (e.g., southern California) while having less impact in regions of lower growth, particularly those already with an abundant water supply (e.g., Michigan). An interesting question arising from these regional migration patterns is whether or not water should be more equally distributed among the regions (e.g., water transported from the Great Lakes to the Southwest) or whether each region must fulfill its own water needs through local water supplies. Even in the Pacific Northwest, a region commonly considered to have abundant water resources, variations in climate result in extremes of both wet and arid conditions within Washington and Oregon. Thus, the spatial pattern of rainfall coupled with the spatial pattern of migration into the Pacific Northwest will result in diverse impacts on different regions of the states. The implications of these migration patterns on recreation and water management is further discussed in the following section.

Urban to Rural Migration

The recent movement of people from urban to rural locales is another important migration trend in the United States, reflecting a pattern of population "deconcentration" (Johnson and Beale 1998). Throughout the early half of the 20th century, internal migration in the United States consistently reflected a migration from rural to urban areas. However, in the 1970s there was a shift in net inmigration of people from metropolitan to nonmetropolitan areas, including remote, highly rural counties (Blahna 1990, Fuguitt 1985). This trend, termed the "rural renaissance" or "population turnaround," revealed a pattern in which natural increase contributed less to the population growth in nonmetropolitan counties than did inmigration (Johnson 1993).

In the 1980s, this pattern reversed as people began moving back to urban areas in greater numbers, in part because of the economic recession and the farm crisis of 1980-86 (Johnson and Beale 1994). Consequently, many researchers believed that the population turnaround of the 1970s was an aberration in the traditional rural to urban migration pattern that characterized most of the 20th century. However, data from migration patterns in the early 1990s once again revealed increasing numbers of people moving from metropolitan to nonmetropolitan areas (Johnson and Fuguitt 2000). This suggests that the period of slower growth of nonmetropolitan areas in the 1980s was atypical of the overall pattern of urban to rural migration in the past three decades (Shumway and Davis 1996).

As the rural renaissance trend began to unfold, researchers sought to determine the causes underlying this migration. Although economic needs for employment fueled much of the migration from rural areas to cities in the first half of the century, the population turnaround of the 1970s was influenced by other factors. Fuguitt et al. (1989) noted several possible causes, including narrowing wage differentials between urban and rural areas, increased accessibility to rural areas through modernization, and a relative shift in the value placed on economic as opposed to noneconomic (e.g., amenity) factors affecting personal decisions to move. Ploch (1978) found that quality-of-life factors such as a rural orientation, slower pace of life, peacefulness, environmental quality, and natural beauty were primary motivations for inmigration to Maine.

The finding that this migration shift is closely related to the presence of environmental amenities in rural counties is well documented. Johnson (1993) found that the two fastest growing groups of counties in the 1980s were retirement counties and recreational counties (as determined by hotel, motel, trailer park, and camp spending per capita). In an examination of nonmetropolitan population growth in the mountain West from 1970 to 1995, Shumway and Davis (1996) found that the counties that experienced the greatest net migration were adjacent to metropolitan counties, contained high amenities for retirees, high percentages of federal land, numerous recreation opportunities, and few extractive industries. In the interior Columbia River basin, counties experiencing recent growth have been found to be economically different from traditional boom and bust counties because they typically contained high concentrations of environmental amenities (Troy 1998). Similarly, Rudzitis and Johansen (1989, 1991) found that counties adjacent to wilderness areas had higher rates of growth from migration than did more distant counties.

The urban to rural migration pattern has many implications for natural resource management. The pattern of population deconcentration reflected in the movement of people from dense cities to less settled rural locations has likely contributed to changes

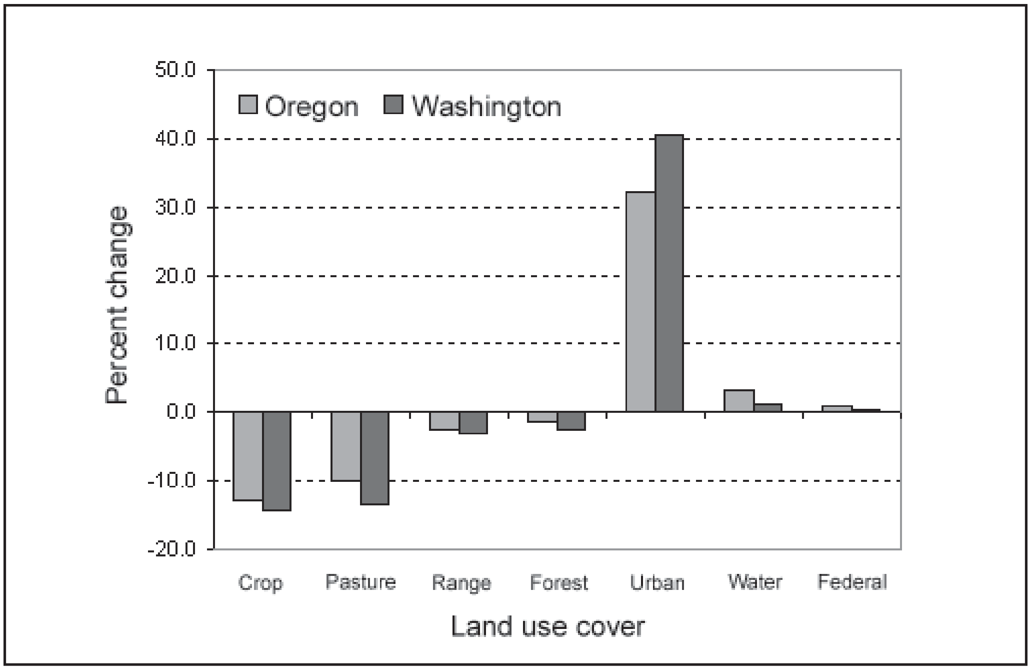

Figure 2—Percentage change in Oregon and Washington's dominant land use cover from 1982 to 1997. (From 1997 preliminary data from National Resources Inventory [USDA NRCS 1997]). Note: urban lands were combined with rural transportation lands.

in land use patterns in these nonmetropolitan regions (Johnson and Beale 1994). Land use changes can include the increased conversion of rural land to built-up uses. In the Pacific Northwest, data on land use from the National Resources Inventory from 1982 to 1997 (USDA NRCS 1997) reveal that both Oregon and Washington indicate a decline in crop, pasture, range, and forest land with a simultaneous increase in urban and rural transportation land use (fig. 2).

The influence of these land use changes on public land recreation is uncertain. Declining access to private forest and pastureland may increase the demand for recreation on federal and other public lands. A study in Michigan's rural Upper Peninsula found that residents were negatively affected by increased migration from the urban southern region of the state because these new migrants often posted their properties "no trespassing" (McDonough et al. 1999). The effect of both increased development and the posting trend was to reduce access to private lands on which residents historically conducted outdoor activities. As a result, the availability of public land on which residents could continue to participate in outdoor recreational and subsistence activities became more important. More examination of the potential relation between land use changes on private land and public demand for federally managed land for recreation is needed.

The effect of land use changes on water management can be profound. Not only can the growth of residential developments in the urban-forest interface lead to forest fragmentation, disruption of habitat, and disruption of ecological processes such as water drainage, but land use changes resulting from increased migration will impact what is considered socially acceptable forest management. The finding that most migration to rural counties was influenced by amenity factors suggests that recreation is an important factor in quality of life for many of these new migrants and that these migrants will be aware of, and concerned about, the management of their local resources. As more people move into the urban-forest interface and as these people demand a greater voice in forest management, conflicts over management decisions are likely to grow. Thus, the spatial context of management decisions will be important to consider because residents' preferences for natural resource management strategies are often influenced by NIMBY (not in my backyard) reactions.

Researchers examining forest management practices at the urban interface have observed that certain timber harvesting scenarios found publicly acceptable in a general sense are often unacceptable when situated in a familiar, highly valued location (Brandenburg and Carroll 1995, Johnson et al. 1994). Coupled with the fact that many migrants are moving to forested areas—a phenomenon described as the exurbanization of the countryside (Egan and Luloff 2000)—the influence of the NIMBY responses has the potential to increase conflicts over what has traditionally been considered acceptable natural resource management.

Population growth in rural, forested locations will place increased pressure on management for water, fire, recreation, wildlife, and so forth. However, even beyond the problem associated with the sheer numbers of people moving in, considering the urban to rural migration pattern for natural resource management is important because the composition of the new residents will likely influence acceptance of management decisions (Troy 1998). Even if the net effect of migration into a county is zero, the compositional change in communities may be significant for resource management. Much of the interest in the population redistribution (both from the North and East to the South and West and from urban to rural counties) is that it often changes the demographic composition of residents, which in turn results in shifting values, attitudes, behaviors, and knowledge regarding resource management (McCool and Kruger, n.d.).

Shifts in migration patterns raise many questions about the effect these incoming residents will have on recreation patterns and on management of water in their new residence. Super and Cordell (1990, p. 813) noted that the recreational use of the Nation's public lands reflects the "values, tastes and preferences of the U.S. population—a very diverse population that is ever evolving in the types of recreation it demands." By influencing the predominant values held by the local citizenry, population change will therefore create new challenges for resource managers who will need to adapt to shifting recreation needs and shifting notions of what are acceptable water management strategies. Without a better understanding of the nature of these changes, managers will lack preparedness for the magnitude and direction of future recreation and water management needs.

The shifting composition of incoming residents is particularly important because research suggests that new inmigrants often hold different values and attitudes toward natural resource management than long-time rural residents. Rudzitis and Johansen (1989, 1991) noted that rural migrants held higher levels of environmental concern and were more likely to support management of public lands for environmental benefits instead of commodity production. In an examination of migration patterns in Maine in the 1970s, Ploch (1978) noted that families migrating to rural counties were younger, smaller, more educated, and more likely to hold professional and managerial occupations than were Maine residents. The author also noted that the inmigrants' desire to maintain the rural atmosphere and quality of life that they migrated for could come into conflict with local individuals' desire to promote economic growth. Fortmann and Kusel (1990) found little difference in environmental attitudes of long-time residents and newcomers, but instead found that, because of their willingness to express dissatisfaction with forest management decisions, newcomers provided a "voice" for proenvironmental attitudes already existing in the community. These findings suggest that the migration of politically savvy newcomers to rural communities will increase public scrutiny of natural resource management decisions.

Most research has found that new residents differ from long-term residents in terms of demographic variables; many studies have examined the influence of these differences in demographic characteristics on environmental concern and knowledge. Although these studies have mixed findings, research indicates that levels of environmental concern are influenced by gender, residence, political ideology, education, and particularly age. Typically, researchers have found that women, urban dwellers, people with a liberal political ideology, well-educated people, and younger cohorts tend to show more environmental concern than their more conservative counterparts (Jones and Dunlap 1992, Steel et al. 1994, Van Liere and Dunlap 1980). Thus, the makeup of individuals migrating into a region can have an impact on levels of environmental concern and subsequent natural resource management actions, programs, and policies. Higher levels of environmental concerns could then translate into shifts in the acceptability of specific water management strategies.

The public's level of knowledge also influences their judgments of acceptability. However, public attitudes or knowledge is not fixed; it may evolve in response to new information, experience, peer-pressures, etc. One of the best-known examples of this was the Smokey Bear campaign, based on the premise that fire should always be suppressed in natural ecosystems. Although the original campaign was successful in terms of public support, in recent years the public's increasing knowledge of the beneficial role of fire in natural ecosystems has led to greater public acceptance of practices besides total fire suppression (Shelby and Speaker 1990, Stankey 1976).

In summary, the increase in population and redistribution occurring across the United States likely will have a major impact on recreation trends and water management in the Pacific Northwest, both in terms of sheer increase in numbers and in terms of changing demographic composition of incoming residents.

Table 7—Percentage of population over 65 years, 1998 and 2025

State	Population over 65 years (1998)	Population over 65 years (2025)
	- - - - - - - - - - - - - - - *Percent* - - - - - - - - - - - - - - - - -	
Alaska	5.5	10.4
Oregon	13.2	24.2
Washington	11.5	20.2

Source: USDC Bureau of the Census 1996.

Proposition 4

Changing demographics—such as age, race, and ethnicity—will alter trends in water-based recreation, which may necessitate a shift in water-based recreation management in the Pacific Northwest.

Age

A demographic change expected to have a major influence on recreation participation in the future is the aging of the population. Projected population trends suggest that the 15- to 24-year-old age group could decrease from 18.7 percent of the U.S. population in 1980 to 13.1 percent of the total population by 2030. In contrast, the elderly population is expected to increase from 11.3 percent to 20.1 percent over this same period (USDC Bureau of the Census 2001b). Unlike changes in migration patterns and racial and ethnic makeup, the aging of the population is expected to similarly occur throughout the United States. In 1995, only five states had greater than 15 percent of their population over 65 years of age. By 2025, 48 states are expected to have over 15 percent of their population over 65 years of age (USDC Bureau of the Census 1997). In the Pacific Northwest, both Oregon and Washington are expected to have high percentages of older Americans by 2025 (table 7).

The increasing proportion of the population in people over age 65 reveals the importance of examining specific components of population change in the United States. Models that only use total population of the Nation to understand and predict the future pattern of outdoor recreation will be inaccurate owing to the confounding effects of age or racial makeup, for example, on recreation behavior. Without a better understanding of changes in these variables, it is difficult to estimate how projected population increases will affect future demand for recreation or for specific facilities and programs.

Population aging likely will have a great impact on recreation participation trends because the relation between age and participation is often negative (i.e., as age increases, participation decreases), particularly in high-intensity activities such as water-skiing. For activities such as motorboating, the relation is more stable, or shows the highest rates of participation at middle age. Thus, the demand for some activities will grow faster than the population grows, while for others it may drop rapidly. One complicating factor is that people over 65 today are more active than the same cohort decades ago. Although Wood et al. (1990) noted that the population of 70 to 90 year olds are healthier and more mobile today than their predecessors and they still participate in recreational activities, the nature of these activities appears to change over their lifetimes. For instance, Luloff and Krannich (1990) found that hunters tended to be younger on average than were anglers. Specifically, they found that 2 percent of hunters were over 65 years old, whereas nearly 7 percent of anglers and 7 percent of nonconsumptive recreation participants were over 65 years old. These findings suggest that participation rates in hunting are likely to be more negatively affected by the population aging than are participation rates in fishing.

Table 8—Percentage of population in racial and ethnic groups, 1995 and 2025 projection

	Alaska		Oregon		Washington	
Race and ethnic groups	**1995**	**2025**	**1995**	**2025**	**1995**	**2025**
	- - - - - - - - -	- - - - - - - - -	- - - - - - *Percent*	- - - - - - -	- - - - - - - - -	- - - - - - - - -
Non-Hispanic White	73.0	57.1	89.5	82.0	85.0	76.1
Non-Hispanic African Americans	4.0	3.9	1.7	2.0	3.1	3.1
Non-Hispanic Asian/Pacific Islander	4.3	21.5	2.8	4.7	5.0	8.8
Non-Hispanic Native American/Eskimos/Aleuts	15.0	10.7	1.3	1.5	1.6	1.8
Hispanics (any race)	3.8	6.7	4.8	9.8	5.2	10.2

Source: USDC Bureau of the Census 1996.

In summary, the most important implication of the large percentage of older Americans is that many high-intensity water-based recreational activities will show a slowing in the growth rate, whereas certain lower intensity activities favored by older citizens may show stable or increasing participation rates (Murdock et al. 1991).

Increasing Racial and Ethnic Diversity

Increasing racial and ethnic diversity in the United States is another major component that will likely affect rate of participation in certain types of recreation.[3] A combination of both high rates of natural increase (births minus deaths) and immigration of ethnic populations will increase the proportion of minorities in the United States. Unlike the aging of the population that will affect the entire United States, increasing racial and ethnic diversity is expected to be greatest in the South and Southwest. Although the rate of increase will be slower in the Pacific Northwest than elsewhere, race and ethnic diversity are still predicted to increase over time (table 8). Much of the increase in diversity in the Pacific Northwest will come from increases in populations of non-Hispanic Asian/Pacific Islanders and Hispanics.

Like the aging of the population, the effect of increasing racial and ethnic diversity may have a profound influence on future recreation trends. The different ways in which various racial and ethnic groups recreate and their potentially different levels of acceptability for natural resource management practices are important factors to consider. Much research has reported differences in the recreation patterns of various racial and ethnic groups, particularly among Blacks, Whites, and Hispanics.

One consistent finding is that racial and ethnic groups differ in the recreational activities in which they traditionally participate. Whereas Blacks and Whites are significantly more likely to participate in more active recreational activities, Hispanics are more likely to participate in sedentary recreational activities such as picnicking (Hutchison 1987, Hutchison and Fidel 1984). White households are significantly more likely than Black

[3] An ethnic group is typically defined as a collection of people (e.g., Hispanics) who have in common a particular set of attributes such as language, culture, or religion (Husbands and Idahosa 1995). In contrast, race is defined in the American Heritage Dictionary (2000) as a "local geographic or global human population distinguished as a more or less distinct group by genetically transmitted physical characteristics" (e.g., Blacks, Asians).

households to participate in a variety of water-based or water-enhanced recreational experiences such as nonpool swimming, large or small horsepower motorboating, river canoeing, and primitive camping (Dwyer and Hutchison 1990). Similar results from the 1994-95 National Survey on Recreation and the Environment (USDI and USDC 1996) found that Whites were much more likely to have participated in selected water-based recreational activities at least one time in the past 12 months than were Blacks (Wellner 1997). For example, the survey found that 43 percent of Whites versus only 17 percent of Blacks had participated in nonpool swimming, 26 percent of Whites had gone fresh-water fishing versus 15 percent of Blacks, 10 percent of Whites had gone water-skiing versus 1 percent of Blacks, and 9 percent of Whites had gone floating or rafting versus 2 percent of Blacks.

An understanding of the differences in rate of participation in certain recreational activities between various racial and ethnic groups is important because models that attempt to predict future outdoor recreation trends will likely misrepresent rates of recreation change if they assume that minority groups will participate at the same rate as Whites. If minority recreational participation rates remain constant, the growth in minority populations likely will lead to an increase in the rate of certain activities in which they tend to participate more, such as fishing and saltwater swimming, while possibly suggesting a slowing of the increase in the participation rate for activities in which they are less likely to participate, such as motorboating.

Studies have not only revealed differences in the types of recreational activities participated in by minorities and Whites but also have identified different reasons for participating in certain recreational activities. For example, in a study of anglers in two Mississippi communities, Toth and Brown (1997) examined how race influences various meanings that recreational groups have for fishing. They noted that Black anglers evidenced a greater focus on fishing for subsistence, whereas White anglers gave greater importance to fishing as a sport.

Studies also have shown differences in the manner in which the groups typically participate in recreational opportunities. Hispanics, more so than Whites, tend to recreate in larger groups—typically expanded family groups—and when camping, prefer campsites with other campers nearby (Hutchison 1987). Hutchison and Fidel (1984) found that the average size of recreating Mexican-American groups was 5.7, whereas the average size for recreating Anglo groups was 2.5 persons. In addition, their research noted that Mexican-American recreating groups more often contained people of mixed ages. Among Whites and Blacks, it has been noted that Black households show a preference for meeting people—particularly peers—and recreating in group-based activities in developed urban settings, whereas White households show a preference for individual-oriented wildland recreation and for getting away from others in their outdoor recreation experiences (Dwyer and Hutchison 1990, Edwards 1981, Irwin et al. 1990).

Furthermore, some studies have noted, even after accounting for sociodemographic characteristics such as income, that Black households were less likely to travel long distances to find recreational opportunities than were White households (Dwyer and Hutchison 1990, Kelly 1980, Washburne and Wall 1980). This finding helps explain why Blacks have lower participation rates in activities such as wildland recreation that require extensive traveling. Manning (1999) summarized findings from studies that have examined the differences in recreation participation between Whites and minority groups.

In general, minority groups, as compared to Whites, tend to use highly developed, urban recreation facilities that are close to home; recreate in larger groups that contain a diversity of ages; conduct more sport and fitness-type activities; have a longer length of stay; and participate in land-based activities more than water-based activities (Manning 1999).

There are two major theories as to why research studies find significant differences in recreation participation patterns among racial and ethnic groups: the marginality and the ethnicity theories (Husbands and Idahosa 1995). The marginality theory explains the racial and ethnic differences in recreation patterns through the groups' differences in demographic variables (such as age and urban-rural distribution), poverty, and discrimination (Washburne 1978). The theory posits that differences in these characteristics lead to different opportunities to access recreational resources (Edwards 1981). It acknowledges that traditional minority participation rates may not reflect their real demand for recreation (Dwyer 1995). Historically, Blacks have had more limited recreational experiences than Whites in part owing to lack of resources (e.g., money) and reduced access to both public and private recreational opportunities.

The ethnicity theory posits that recreation differences are a function of the values, norms, and experiences of the different ethnic groups (Husbands and Idahosa 1995). Meeker et al. (1973) suggest that the noted preference of Blacks for urban-based activities results from their view of the city as a place of greater refuge from racism than natural landscapes. Whereas national parks are seen by Whites as virgin lands (e.g., the "Garden of Eden") untouched by human activities where one could find escape from civilization; this mystic surrounding nature was not a part of the cultural systems of other groups such as Blacks and Native Americans.

Unlike the culture of European settlers where nature was considered separate from human activities and thus needed to be protected from civilization, the culture of Blacks and Native Americans ascribed more to a philosophy in which humans are more integrated with natural processes (Meeker et al. 1973). Furthermore, Taylor (2000) notes that since their inception, national parks and wilderness areas have been used primarily by middle class Whites and that minority populations traditionally have felt more uncomfortable recreating in these areas. This reluctance was likely formed and sustained by the celebration of White "discoveries" of areas previously known to, and used by, Native Americans and Chicanos; the lack of minorities employed in land management agencies; and the lack of minorities in books, guides, and films of wildland areas.

The differences between these theories holds certain implications for recreation management as the diversity of the United States increases over time. If research suggests that the marginality hypothesis accounts for most of the differences in recreation participation among racial and ethnic groups, then programs could be developed to make recreation more accessible to individuals at all socioeconomic levels. On the other hand, if research suggests that cultural norms and values account for variations in recreation participation, then recreation managers could attempt to redistribute more resources to activities preferred by those racial and ethnic groups whose populations are increasing (Edwards 1981). A better recognition of how race and ethnicity influence the meaning of recreational activities is needed for resource professionals to manage natural resources for diverse participants.

The Combined Influence of Demographic Variables

Our examination of major shifts in certain demographic variables in the United States suggests certain major trends in the future. The U.S. population is growing, although at a slower rate than in the past. Americans are becoming increasingly older, more racially and ethnically diverse, and more likely to reside in the South and the West. Although participation rates in outdoor water-based recreational activities will not increase rapidly, there will certainly be a substantial shift in the demographic makeup of recreationists (Schuett 1995). Because demographic variables are important determinants of recreation participation, changes in the demographic composition of the American population will have profound effects on future recreation use trends, especially owing to the interrelated effects of age, ethnicity, and race. These variables work in combination, and will mean an increase in some activities and a decrease in others.

Because of the increasing proportion of older residents and minorities, rates of increase in most outdoor recreational activities will slow (Murdock et al. 1991). Owing to the slower growth of minority populations in the Pacific Northwest as compared to other regions (e.g., Southwest), racial and ethnic differences in recreation participation will have less of an impact in the Northwest than in other parts of the country. However, if the growth in minority populations in the Northwest primarily occurs in certain geographic locations (e.g., urban areas), it will have a greater influence on recreation participation in those areas than overall percentage of growth rates in Northwest minority populations might first suggest. Possible differences in the spatial pattern of increasing minority populations in the Pacific Northwest highlight the importance of having site-specific information on demographic trends. Because there is a clear relation between race and ethnicity and recreation participation, changes in the constituency of a particular area will have strong implications for recreation management.

In the Pacific Northwest, however, in general, the influence of population aging is likely to have more of an impact on recreation trends than will increasing racial and ethnic diversity. This suggests that the Pacific Northwest may see increasing demand for water-based recreational activities in which older adults participate—such as motorboating on lakes or camping in developed campgrounds near lakes (Cordell et al. 1997). In contrast, high-intensity activities such as primitive camping along rivers will likely see a decline in the rate of growth. Activities such as saltwater fishing that have high participation rates for both minorities and older Americans are predicted to have a higher rate of growth in the future (Murdock et al. 1990).

Owing to the complexity of demographic variables influencing recreation, there is a need for models that can account for these combined effects (Murdock et al. 1990). Because demographic groups have different participation rates in leisure activities, it is not sufficient to simply project current recreation participation rates to future populations to predict future recreation trends. The uncertainty surrounding modeling and predictions of recreational behavior make it particularly important to have consistent monitoring of recreation use to prepare managers for changing recreational demands (Dwyer 1995).

Proposition 5

Our knowledge of other causal factors affecting demand for recreation—such as the role of technology and the influence of leisure time—is limited.

Technology

The influence of technology trends on water-based recreation patterns is not well documented in the research literature. In part, we are limited in our ability to understand how technological change may impact water-based recreation and recreation management in the future owing to the rapid rate of technological change. In recent years, new technologies have been created at an accelerated pace, creating a situation in which there is some uncertainty as to what the future will hold. Rayner and Malone (1998) point out that although it took 100 years, from 1844 to 1936, for people to develop commercial telegraphy, the telephone, broadcast radio, and television, it took only 20 years for video cameras, computers, cellular phones, and the Internet to become widespread.

Compounding the confusion over the influence of technology on water-based recreation and management is the reality that technology is neither inherently beneficial nor harmful. Two extreme, but simplistic, viewpoints—that technological improvements will solve all problems or that technology creates problems—both inadequately describe the complexity of the impact that technology may have on water-based recreation. The effect technology will have on water-based recreation will depend on how the technology is applied.

Depending on the circumstances, technology can have both negative and positive impacts on water-based recreation and management. Several examples illustrate this point. The technology that led to the advent of the motorboat has arguably resulted in increased pollution in lakes and rivers. However, given that motorboats exist and are used extensively in recreation, further improvements in the efficiency of these motors will instead have a beneficial impact on pollution levels in waterways. In another example, technological improvements in recreational equipment (e.g., snowmobiles) have given people greater access to recreation sites, including remote wildland sites, with relatively little effort. In addition, advances in technology now allow people to jet-ski into locations previously too shallow to access otherwise.

The effect of increased access is twofold. On the one hand, advances in technology increase recreational opportunities by removing some of the barriers to access into remote locations and by allowing more people to participate in recreational opportunities (e.g., elderly or disabled individuals). By allowing a broader spectrum of society to participate in recreational experiences, technological increases also may have a positive effect on political interest in recreation and recreation management. If there are more people who value recreational opportunities, there will be more people who will attempt to influence the political system with regard to recreation. This is particularly true of older Americans who typically are much more politically active than younger cohorts (Steel et al. 1998). On the other hand, improved access resulting from technological advances could lead to detrimental impacts on surrounding riparian habitat. Improved access expands available recreational sites by allowing individuals to recreate in locations previously considered too remote. Improved access can intensify the use of existing sites that may be unable to withstand additional recreational pressure. Furthermore, to some individuals, the mere presence of technology in wildland areas is antithetical to their value systems, as evidenced by the recent controversy over snowmobiles in Yellowstone National Park.

Advancements in technology also influence demographic trends, such as the urban to rural migration pattern, that affect water-based recreation and management. Johnson and Beale (1998) note that advances in transportation and communication (e.g., satellite technology, the Internet) have given people the ability to reside in nonmetropolitan communities without needing to consider proximity to urban areas or the availability of local employment. Improvements in transportation corridors also have resulted in growth of rural counties that are now considered within commuting distance to major metropolitan centers such as Seattle. On the other hand, Johnson and Beale (1998) note that the urban to rural migration also is fueled by negative aspects of technology because traffic congestion in urban areas has increased people's desire to leave cities for less populated rural areas. The growing numbers of people migrating into rural counties will likely increase recreation pressure in these locations and, as a result, will increase the conflicts over management of water resources for different uses and values. As previously discussed, technological advances not only will increase population growth in remote, rural counties but also will increase the number of individuals holding different values, beliefs, and knowledge about natural resource management.

Another important technological trend that may impact water-based recreation and management is the information technology explosion. As before, this trend will result in both positive and negative impacts for management of recreation and the water resource. The increase in information technology has and will continue to greatly expand the opportunities for individuals to obtain information about recreational activities and potential recreation sites with relative ease (e.g., through Web sites). The Internet gives management agencies the ability to spread real-time information and visual pictures about recreational opportunities. However, Stankey (2000) noted that not only is there a possibility for dissemination of inaccurate information about a recreation site, such as on private, nonofficial Web sites, but widespread information about appealing recreation sites can result in increased crowding in formerly pristine locations. Furthermore, advances in Internet and e-mail technologies give individuals and organizations the ability to become informed almost instantaneously about potential management strategies and also gives them the ability to quickly mobilize a wide public to place pressure on agencies for particular natural resource management strategies.

The Influence of Leisure Time

Because the availability of leisure time is related to the ability to participate in recreational activities, leisure trends in the United States are important for projecting future recreation patterns. Leisure time is defined as the available free time a person has after completing paid work time, unpaid work time (e.g., household chores, childcare), and personal care (e.g., sleeping, eating) (Robinson and Godbey 1997).

Some polling in the United States reveals an increase in the median number of hours Americans work per week and a corresponding decline in leisure over the past 30 years. By asking respondents to estimate how long they work per week (including commuting time), the Harris Poll (Taylor 2000) found that the median number of work hours had increased from 41 hours in 1973 to 50 hours in 2000. When adults estimated how much leisure time was available to them each week, the poll found that the median number of leisure hours decreased from 26 hours per week in 1973 to 20 hours per week in 2000. In her book, "The Overworked American," Schor (1991) estimated that the average employed person worked 163 hours more in 1987 than they did in 1969. Data from the Bureau of Labor Statistics' Current Population Survey similarly shows that leisure time is less available for working Americans, particularly single parents or dual career couples with children (Burtless 1999). In contrast, older Americans and younger adults without children tend to have more free time today than did their predecessors (Lagerfeld 1998).

Some researchers dispute the claim that leisure time has declined in recent decades for Americans overall. Using time diaries, Robinson and Godbey (1997) found that not only had the overall number of paid work hours fallen from 1965 to 1985, but that people responding to surveys significantly overestimated how much time they had spent at work the previous week. However, their results also showed that increased leisure time was concentrated in certain groups of Americans: the unmarried, the 18- to 24- and their 55- to 64-year-old cohorts, and those without children. These findings were consistent with most research on leisure, which has found great variation in leisure time among different groups of individuals.

It is generally acknowledged that, for whatever reasons, Americans feel more pressed for time now than ever before (Lagerfeld 1998). Davidson (1994) suggests that American's real or perceived decline in leisure time likely results from five "mega-realities": population growth, increasing volumes of information, increasing media coverage, growth in the paper trail, and an overabundance of choices. For example, the author notes that vast increases in knowledge and mass media coverage in the United States overwhelm people by bombarding them with information, while population growth has contributed to increasing gridlock on transportation routes and longer commuting times for work and other tasks. Furthermore, Schor (1991) points out that consumerism (e.g., trying to "keep up with the Joneses") locks workers into a work-and-spend cycle. To understand the impact of leisure on recreation trends, the **perceptions** of Americans' of their leisure time are more important than their actual leisure time because it is their perception that will influence decisions about when, where, and how often to recreate.

The quality of leisure time is just as important as the quantity of leisure time. For example, Bittman and Wajcman (2000) found that although men and women have similar amounts of free time, the nature of their available time suggests that a gender gap in leisure exists. By comparing time diaries in 10 countries, the authors discovered that the leisure time of men was more likely to be uninterrupted and of longer duration and was less likely to be associated with unpaid work such as childcare than was the leisure time of women. There are some indications that, in general, recreation patterns of Americans are shifting owing to changes in the duration of leisure time. Americans are now more likely to split their leisure time into several, small minivacations or long weekends rather than go on a few extended vacations (Hartmann et al. 1988). In addition, Lime et al. (1995) noted that recreation areas that are more developed and accessible have experienced greater growth in visitation than have backcountry settings.

This trend can have an important impact on recreation patterns resulting in an increase in the numbers of visitors at urban-proximate recreation sites, particularly day-use sites, and a decrease in the numbers of visitors to more remote locations that require longer traveling or longer stays. In combination with the preference of Americans for recreation around water, this shifting pattern of leisure time suggests that there will be increasing pressure on water resources close to urban areas for water-based or water-enhanced recreation. This will place further pressure on water resources for differing values such as for clean drinking water, riparian habitat, or industrial use. In contrast, these trends suggest that wildland recreation may face less pressure as people have limited time to reach those sites. In general, trends in leisure time suggest that water recreation management requires focusing on sites located near population centers.

Proposition 6

Certain water-based and water-enhanced recreation activities have been found to negatively impact the water regime.

Water-based and water-enhanced recreational activities are often less detrimental to water quantity and quality compared to many other human uses of water (e.g., agriculture, industry, etc.). Nevertheless, the impact of recreation on the water regime still presents challenges to managers attempting to create opportunities for recreational activities while maintaining water and environmental quality. Recreational activities that negatively affect water resources not only reduce the quality of water-based experiences or pose health concerns for other recreationists, but they also can present problems with using water for other functions, such as for a municipal drinking water supply. Water quality remains a concern, not only for environmental quality of riparian areas but also for public health. Between 1993 and 1994, 14 outbreaks of waterborne diseases (e.g., *Giardia, Cryptosporidium, Shigella,* and *E. coli*) in the United States affected about 1,437 people associated with water recreation. Over this same period, over 405,000 people were affected by disease outbreaks associated with drinking water (Kramer et al. 1996), although it is unclear whether or not recreation played any factor in these outbreaks.

Recreational activities can impact water resources both directly and indirectly. Direct impacts result when recreational activities, such as swimming or boating, occur directly on the water. Indirect impacts result when land-based recreation activities, such as camping or hiking, occur close to shore (Kuss et al. 1990). These distinctions are often described as water-based and shore-based activities (Liddle and Scorgie 1980). Occasionally, impacts are observed regardless of the type of activity. For example, both shore- and water-based recreational activities can disturb waterfowl populations sensitive to disturbance from humans (Liddle and Scorgie 1980).

Both direct and indirect recreational activities have the potential to produce biophysical or chemical changes to surrounding riparian areas, which can then impact the water resource itself. Research studies examining the impact of recreation on water quality reveal variable findings. Hammitt and Cole (1987) review many studies that differed over the impact of recreation on water quality as indicated by nutrient influx of nitrates, phosphates, and coliform bacteria. Some studies found nutrient increases owing to recreational activity in the area (King and Mace 1974); however, other studies note that recreational use has little effect (Silverman and Erman 1979), or that certain indicators such as suspended solids fall to nearly predisturbance levels after recreationists leave the site (Gary 1982).

The problem of determining whether recreation has an adverse impact on the water regime is compounded by the fact that it is often hard to distinguish if high levels of nutrients are coming from natural or human sources. Water quality reflects a combination of many physical, chemical, and biological factors as water moves through and across the land (Peters and Meybeck 2000). Owing to different lake morphology, geology, or deposition of sediment, water bodies can respond in a variety of ways to disturbance and pollution

(Kuss et al. 1990). For example, oligotrophic lakes may be more influenced by small nutrient influxes; therefore, erosion may be more of a management concern in these locations (Hammitt and Cole 1987). The diversity of lake and stream characteristics increases the difficulty of obtaining consistent findings in studies examining impacts on water.

Although research findings typically reveal that the impact of recreationists is often localized both temporally and spatially within the watershed (Clark et al. 1985), studies suggest that different recreational activities have diverse impacts on the water regime. Research studies examining the impact of recreation activities on water primarily have focused on motorboating, camping, and, less often, swimming. In general, studies have found that boating has the greatest adverse impacts to the water regime, followed by camping, and lastly, swimming and fishing (Kuss et al. 1990). Owing to the relations among fishing, boating, and hiking along shorelines, the impact of fishing on the water regime is not discussed independently of the other two activities in this report. Furthermore, fishing has been found to have the greatest impact on fish populations (Clark et al. 1985) rather than on the water resource examined in this study.

Boating

The greatest recreational impacts on water and riparian quality result from boating, particularly motorboating. Motorboating creates various physical and chemical disturbances to the water regime and results in impacts much more significant than swimming, unless swimming is heavily concentrated. Physical impacts from motorboating include increased wash, turbulence, cutting action from propellers, direct contact, and disturbance (Liddle and Scorgie 1980). The overall impact of these physical changes on the water regime are influenced by the dimensions of the water body and the types of habitat it contains (e.g., sensitive versus hardy).

Turbulence from propellers and wakes can cause erosion of the shoreline and can disturb sediment, a particular concern in fish spawning areas. Motorboats, especially those with outboard engines, create turbulence, which can cause erosion of the shoreline and a subsequent release of nutrients in the sediment (Kuss et al. 1990). Although most of these impacts are created primarily by motorboats, turbulence also can result from use of rafts, canoes, and rowboats. In one study, findings revealed that about 0.5 m^2 of vegetation in a shallow lake could be uprooted by the turbulence resulting from one oar stroke (Liddle and Scorgie 1980). Furthermore, Cole and Marion (1988) found that sites used by commercially outfitted rafting parties had a 50 percent greater area of disturbance and an area of devegetation that was four times as large as sites used by local fishermen.

Although nonmotorized boats create some physical impacts to the water regime, most chemical impacts result from motorboating. Chemical impacts include pollution from outboard motors—particularly motors of the two-stroke design—and sewage discharged directly from boats into water. Discharge from motors contributes much of the waste generated from recreational activities. In an early study of motorboating, Jackivicz and Kuzminski (1973) found that, depending on the engine design, two-stroke outboard motors discharged an average of 10 to 20 percent of their fuel into the water—with some engines discharging up to 55 percent. The high variability in the amount of engine discharge results from differences in the size of motor, intake and exhaust design, size of crankcase, speed of operation, tuning of the engine, and recycling of crankcase drainage. The discharge typically contains raw fuel, nonvolatile oil, volatile oil, lead, and phenols, which negatively affect plant and animal species within riparian environments (Stewart and Howard 1968).

In 1970, it was estimated that 100 to 160 million gallons of raw fuel was discharged into water owing to the inefficiency of outboard motors (Jackivicz and Kuzminski 1973). Newer technologies in engine design may result in a much smaller discharge and resulting impact on water; however, motorboats are much more prevalent now than during the 1970s, when most of these studies were conducted. As previously discussed under water-based recreation trends, recreational motorboating has increased 40 percent from 1982-83 to 1994-95, with nearly 23 percent of the U.S. population participating in the activity in 1994 (Cordell et al. 1997). Furthermore, the fact that there were 13.2 million outboard motor boats owned in 1997 (National Marine Manufacturers Association 1997), more than almost any other year, indicates that increased efficiency of engines may not be enough to compensate for the absolute increase in motorboat numbers.

Camping and Hiking

Camping sites along water bodies also are associated with both physical and chemical impacts to the water regime as compared to control sites. Physical impacts to water quality from camping can include many different indicators such as increased soil compaction; runoff; erosion rates; lower soil moisture; reduced flow of air, water, and nutrients through the soil; higher pH; lower number of roots in the soil; a loss of vegetative cover; and increased eutrophication of nearby water bodies (Green 1998, Lockaby and Dunn 1984).

Physical impacts caused by camping and hiking near water have many different interrelated effects. For example, a decline in vegetation near the shoreline leads to a reduction in soil microbial activity in the top 6 inches of soil in disturbed sites versus undisturbed sites (Zabinski and Gannon 1997). In addition, a loss of vegetation on the shore increases erosion of the shoreline, which in turn can heighten nitrogen and phosphorus loading into streams, causing eutrophication (Hammitt and Cole 1987). In an examination of the long-term impact of trampling along the waters of Pink Lake, Canada, Dickman and Dorais (1977) found that as recreation visitation grew over a 20-year period, so did the density of phytoplankton in the lake, which resulted in a reduction in water clarity. Although an object 16.4 to 22.9 feet beneath the water surface could be seen in 1956, water clarity was reduced to 5.6 feet beneath the surface in 1974.

Research studies differ as to the amount of camping and hiking along water that is possible without reaching certain levels of physical impacts. Some research findings distinguish between impacts from high- vs. low-intensity camping sites. In an Arizona riparian area, Green (1998) found that runoff and sediment loss was significantly higher from heavily used camping sites than from lower intensity sites because the high-use sites had significantly less herbaceous vegetation and more soil compaction. Cole and Marion (1988) observed significant differences among high-use and low-use sites including larger areas of disturbance, greater tree damage, greater exposure of mineral soil, loss of tree reproduction, and greater soil compaction in the high-use sites. However, they also observed dramatic changes in certain environmental indicators in low-use sites, leading the researchers to suggest that the quality of low-use sites is more comparable to high-use sites than to control sites.

In fact, some studies have found that even light recreational use of campsites has rapid and considerable impacts (Cole 1986, Cole and Marion 1988). These studies suggest that recreation has a curvilinear relation to site degradation; low or moderate use of a site creates significant impacts, and little additional damage is contributed by higher intensity use (Marion 1995, Marion and Cole 1996). This finding is consistently found in research studies conducted across the United States in various habitats, including riparian forests on the east coast and riparian forests of the mountainous Western States that have a much harsher environment (Cole and Marion 1988, Stohlgren and Parsons 1996).

Another consistent finding from the literature on the physical impacts of camping is that most campsite degradation occurs rapidly, within the first year of use. As a result, the common management strategy of closing developed campground areas temporarily to allow them to recover is not effective in many back-country locations because campgrounds deteriorate much more quickly than they recover (Marion and Cole 1996).

Instead, other management strategies could better limit negative impacts to the water regime. The most important aspects of an effective plan are reducing the number and size of campsites so that people do not keep expanding outward in areas of high recreational use (Cole and Marion 1988). Marion (1995) found that reducing the number of campsites (to the lowest number that could still accommodate high usage) and installing firegrates (which constrained people spatially within the campsite area) were the two most effective strategies for improving campsites overall. These strategies were effective because they reduced the area of degradation by concentrating recreation use in established, legitimate campsites. Green (1998) notes that management could reduce runoff by prohibiting particular recreational activities when the activity is most likely to result in soil compaction. Based on a study of channel changes in the Merced River in Yosemite National Park, Madej et al. (1994) suggest that park managers control foot traffic near the river and channel it to more stable locations to reduce erosion, sediment loading, and channel widening in riparian areas. Because different sites have different levels of recreational activity and ability to withstand impacts, managers could use various strategies to address possible concerns (Leung and Marion 1999).

Biological and chemical changes from camping and hiking activities on water resources also can impact water quality. Specifically, studies have monitored levels of bacteria (e.g., fecal coliform bacteria), protozoans, and viruses such as *Giardia, Cryptosporidium,* or *Gastroenteritis*. High levels of bacteria are typically associated with high recreation use. For example, improper disposal of human waste can contaminate drinking water or harm human health through direct contact or through transmission of bacteria and viruses (Cilimburg et al. 2000). However, in a review of a 12-year period at a water recreation site, Nelson and Hansen (1984) observed that increased recreational activity over the years had not led to a corresponding increase in fecal coliform levels. Because fecal coliform levels are influenced by various factors including seasonal variations, number of recreationists, lake currents, and possible supplies of fresh water from upstream dams, it can be difficult to determine the exact source of higher densities (Nelson and Hansen 1984).

In general, these studies conclude that the impact of recreationists on water biology and chemistry is often spatially localized around recreation sites and temporally intermittent. Negative impacts are typically concentrated in the immediate location of the camping site. In a study examining the effect of recreation at two camping sites on water quality in the Mount Baker-Snoqualmie National Forest in Washington, Christensen et al. (1978) found that although upstream densities were consistently low, densities of total coliforms, fecal coliforms, and fecal streptococci downstream of campsites increased over weekends, when 90 percent of the recreation occurred. Another study in the Snoqualmie National Forest also found high levels of certain indicators (total coliforms, fecal coliforms, and fecal streptococci, *Salmonella* and *Shigella* species) downstream from heavily used motorized camping sites (Varness et al. 1978).

Studies also have found that indicator densities differ temporally, and typically correspond to seasonal (i.e., winter levels are lower because of lower recreation use), weekly (i.e., higher weekend use), and daily variation in recreational activity in the area. Interestingly, both Christensen et al. (1978) and Varness et al. (1978) observed rapid increases in the indicator densities once human use occurred. The rapid rise in these indicators has led researchers to suggest that much of the increase in bacterial density is resulting from disturbance of the sediment, which as discussed previously, is thought to contain higher levels of bacteria than surface water. This rapid rise in coliform densities poses some potential health hazards during periods of intense recreational use.

In general, levels of bacterial and viral populations exceeding regulation standards appear to be infrequent. In a review of water quality records from water recreation sites in Arizona's Tonto National Forest, Nelson and Hansen (1984) found that few violations in levels of fecal coliform bacteria populations occurred over a 12-year period. However, during periods of peak recreation use, public health concerns are valid. Management strategies to address the potential for increased biological and chemical contamination from camping and hiking could include developing facilities or educating visitors about proper waste disposal. For example, in a review of the literature on the disposal of human waste in wildland recreation, Cilimburg et al. (2000) found that the most appropriate management strategy to avoid transmission of pathogens or contamination of water sources in wildland recreation is to deposit waste in 6- to 8-inch-deep cat holes about 200 feet away from the nearest water source. Because of the possibility for human health risks, further examination of the impact of recreation on water chemistry is warranted.

Swimming

Although swimming is less detrimental to water quality than are other recreational activities, swimming can still negatively impact water in three primary ways. First, recreational activities involving body contact, such as swimming, have the potential to introduce pathogens into water through direct contact. Secondly, swimming may increase bacterial concentrations by creating turbulence that disturbs the bottom sediment, which may contain higher concentrations of bacteria than surface water (Hendricks 1971, Kuss et al. 1990). Third, swimmers can increase the turbidity of water by eroding the bank at popular entry points.

The potential for recreational impacts from swimming are particularly important to consider in reservoirs built primarily as a source of drinking water. In a study examining the potential impact of recreational activities involving body contact on reservoir drinking water, Anderson et al. (1998) found that their model predicted possible high levels of *Cryptosporidium*, rotavirus, and poliovirus during the high recreation use of the summer months. In another municipal water supply reservoir, Wagenet and Lawrence (1974) observed a highly localized increase in fecal coliform densities associated with peak recreation use that exceeded standards for recreational waters. Because increased coliform densities were so localized and far removed from the location from which water was extracted for municipal purposes, the authors believed that the reservoir could still be used for dual recreational and drinking water purposes. However, they also felt that the more significant health impact may result from water recreationists coming into direct contact with water containing high coliform densities.

In summary, research studies have found that both water- and shore-based recreation have negative impacts on the water regime. For example, water-based activities such as motorboating create increased wash and discharge pollutants into the water; shore-based activities tend to impact riparian areas through trampling. The level of impact differs by recreational activity. Studies note that boating has the greatest adverse impacts to the water regime, followed by camping and swimming. The different types of disturbances to water and the riparian environment are typically categorized as either physical or chemical impacts. Physical impacts include propeller action, trampling, and turbulence; chemical impacts include increases in bacteria, protozoans, or viruses, owing to direct contact or improper disposal of human waste.

Most studies suggest that although impacts resulting from recreation occur rapidly, they are primarily localized in time and space. Research on recreation intensity finds that even at low recreational levels, some disturbance in the water regime is observed. However, because specific data on recreation use levels are often lacking in recreation impact studies, it is difficult to accurately and quantitatively specify cause and effect. In general, the management strategy of concentrating camping and hiking recreation (e.g., limited number of camping sites, smaller campsites) is probably the best method of minimizing the overall impact of those recreational activities on water. More research is needed, however, to address the best management strategies for effectively dealing with impacts from swimming and, especially boating, particularly because little research has been done on many of these topics since the 1970s and early 1980s.

Proposition 7

Conflicts over competing uses of water—including recreation, municipal uses, industrial uses, irrigation, habitat, etc.—will likely grow in the future.

As noted in the Sustainable Water Initiative, any decision that results in changes to the water resource will have impacts, either intentional or unintentional, on management of water for other uses and values. Because water is a crucial but limited resource, conflicts will increase over water requirements for various uses: urban needs, irrigation, hydro-electric power, recreation, municipal water supply, private ownership of property with water frontage, and habitat conservation (Naeser and Smith 1995). Proposition 6 described the impact that recreational activities could have on water quality for other uses such as riparian habitat restoration or drinking water supply. However, not only does recreation have the potential to impact the water regime for other uses, but these other uses of water can have the reciprocal effect of negatively influencing the quality of water-based recreational experiences.

Because of the spatial arrangement of both water resources and population growth, there will continue to be a spatial component to the conflicts related to water use. In the United States, major urban centers historically have developed adjacent to rivers and other waterways that served as transportation corridors. Today, many cities (e.g., Portland, Oregon) are proximate to major water sources that are used for drinking water, transportation, hydropower, and recreation. Although conflicts over water use and distribution would have occurred regardless, social trends such as population growth and migration shifts in the Pacific Northwest will undoubtedly escalate water conflicts in the coming decades. In particular, population growth and redistribution—especially to arid regions of the Northwest—will bring water conflicts to the forefront more quickly. By 2025, the populations of Oregon, Washington, and Alaska are expected to increase by about 3.4 million people; as a result, limited water resources, whether for recreation or municipal uses, will need to be distributed among more and more people, particularly in urban centers.

Rapid population growth only serves to increase both the probability of water shortages in the future and the difficulty of deciding how to allocate water among different, often incompatible, uses. As the United States becomes more diverse (culturally and racially, with an aging population), more people will have different expectations for water use. Furthermore, the continued adoption of new technologies in recreational equipment and the resulting diversification of recreational opportunities is likely to escalate conflicts among recreationists, particularly if recreation participation continues to grow (Manning 1999).

An understanding of the conflicts related to the distribution of water is important because these conflicts negatively affect water-based recreation. For some recreationists, conflicts can lead to reduced satisfaction in an activity, whereas for other recreationists, conflict can lead them to engage in coping behaviors in an attempt to evade the conflict. Conflict for an individual is defined as “goal interference attributed to another’s behavior” (Jacob and Schreyer 1980). The level of perceived conflict is not constant among all recreationists, but instead differs in response to a variety of factors. An individual’s sensitivity to conflict is often influenced by activity style (i.e., personal meanings associated with a recreational activity), resource specificity (i.e., the importance placed on a particular resource such as a swimming hole), lifestyle tolerance (i.e., willingness to share resources with members of other lifestyle groups), and mode of experience (i.e., preferred ways of experiencing the environment), (Jacob and Schreyer 1980). For instance, many individuals have expectations that a recreational experience, particularly in wildland settings, will not involve encounters with other people. Consequently, the discovery that one is not alone in the wilderness can detract from the recreationist’s experience (Stankey 1973).

Recreation conflict can be classified into three main categories: recreation versus other uses of the water resource, interactivity recreation conflict, and intra-activity recreation conflict (Schreyer 1990).

Recreation Versus Other Uses of Water

Although many studies have been conducted on how different logging practices impact recreation (e.g., visual quality of camping sites) (Brunson and Shelby 1992, Langenau et al. 1980), much less research has been conducted on conflicts between water-based recreation and management of the water resource for other uses. Water conflicts can occur when alternative uses of water are not compatible. For example, water appropriated for out-of-stream uses (e.g., irrigation) reduces the flow of water available for recreational opportunities. There is extensive literature on how flow impacts water-based recreational experiences (Shelby et al. 1992b) (see "Proposition 8"); however, we still have little understanding of how industrial or commercial water use, for example, affects decisions to recreate.

Robertson (1989) noted both direct and indirect impacts on recreation from other uses of urban waterways. Some direct impacts include private ownership of waterfront properties and subsequent development and problems associated with the navigation of large ships into commercial ports. Indirect impacts to recreationists include reduced opportunities to view wildlife, a reduction in the visual quality of a recreation site, or increased noise (Clark 1986, Robertson 1989). For much of the history of the United States, urban rivers and waterways were designated primarily for commercial and industrial purposes overseen by the Army Corps of Engineers (Robertson 1989). With the increase in people recreating in urban-proximate waters, recreationists have come into conflict with industrial and commercial activities using the same water resources.

Competing demands on the water resource often alter the quality of the recreation experience. Using a survey of park visitors to an urban waterway, Robertson (1989) found that two-thirds of recreationists felt that poor water quality, smells from treated wastewater, and increased siltation detracted from their recreational experience. In a study examining the impact of commercial and industrial uses of water on recreation in a Midwest urban river corridor, Robertson and Burdge (1993) found that impacts to water quality associated with commercial navigation and water withdrawals (e.g., siltation, turbidity, water pollution) significantly reduced recreationists' satisfaction with their water-based experience.

The effect that other uses of water have on recreation depends on the extent to which the public perceives negative impacts to the water regime. Studies of public perceptions of water quality suggest that people make determinations about water quality based primarily on vision (Smith et al. 1991) and secondarily on smell and touch (Lant and Mullens 1991). In a survey of adults in Wisconsin, David (1971) found that people identify polluted water by the presence of algae, suds and foam, and murky, dark water. Using photographic slides of water settings that varied only by water color and amount of litter, Dinius (1981) found that people believe increased litter corresponds to decreased water quality at the site.

Public perceptions of pollution influence decisions to recreate. Some impacts to the water regime from other uses may be so great that they eventually displace recreationists to other locations or convince recreationists to stop their activity altogether. Water clarity is important for swimming suitability. David (1971) noted that the presence of green scum or algae would prevent 80 percent of recreationists from swimming, whereas the presence of cans or glass in the water would prevent 70 percent of respondents from swimming. In a study of swimmers in New Zealand, Smith et al. (1991) found that the ability to see to 2.2 meters in depth was a necessary distance for 90 percent of recreationists to consider the water suitable for swimming. Similarly, water color influences recreation decisions with blue being most suitable, followed by green, and lastly yellow (Smith and Davies-Colley 1992). Perceptions of water quality also influence people participating in water-based activities that do not involve body contact with water. Whisman and Hollenhorst (1998) found that perceptions of environmental quality along the river corridor positively influenced satisfaction for private boaters. In an examination of water-based recreation at Lake Red Rock in Iowa, Robertson and Colletti (1994) found that 45 percent of the boaters surveyed had either reduced the frequency of their visits or had avoided the site altogether because of problems with excessive siltation.

Interestingly, although recreationists use visual cues to determine the level of water pollution of waterways, water quality measures for gauging public health traditionally include nonvisual indicators such as bacteria levels or toxicity of organic compounds. On the Salt River in Arizona, Nelson and Hansen (1984) found no relation between water clarity and fecal coliform levels in recreation sites. These findings suggest that efforts to improve water quality for recreationists will have to include improving visual indicators from the recreation site such as the amount of litter and the water clarity. Otherwise, water that is considered of good quality by toxicity or bacterial standards, may still be perceived as unclean by recreationists (Dinius 1981).

Interactivity Conflicts

Most studies on recreation conflict have examined interactivity conflict—conflict that occurs among recreationists participating in different activities. Empirical research on water-based recreation has observed problems between anglers and water-skiers (Gramann and Burdge 1981), anglers and canoeists (Driver and Bassett 1975), and particularly between motorized and nonmotorized boaters (Shelby 1980). For example, jet skis often disturb people engaged in other recreational activities such as fishing or swimming (Burger 1998).

A common finding throughout these research studies has been the asymmetrical character of interactivity conflict: although people participating in a certain recreational activity may not mind the presence of recreationists of another activity, these congenial feelings often are not reciprocated by the participants of the second activity. For example, studies have clearly documented an asymmetric conflict between motorized boaters and nonmotorized recreationists such as canoeists. Although motorboaters are typically indifferent or even have positive associations with their encounters with canoeists, canoeists dislike encounters with motorized recreationists (Lime 1977, Shelby 1980). In the Boundary Waters Canoe Area of Minnesota, Adelman et al. (1982) found that 71 percent of paddling canoeists disliked meeting or seeing motorcraft users, but only 8 percent of motorcraft users disliked meeting or seeing paddling canoeists. Furthermore, these motorcraft users typically were unaware that other recreationists were disturbed by their activities. Over 85 percent of these motorcraft users believed that they seldom or never disturb paddling canoeists, although 79 percent of paddlers felt they were occasionally or frequently disturbed by motorcraft users. This asymmetrical aspect to recreation conflict complicates management of water resources for recreation.

Intra-Activity Conflicts

Intra-activity conflicts are those conflicts that arise between recreationists who are participating in the same activity (Schreyer 1990). Crowding is a well-researched example of this form of recreation conflict. For example, in a study of boating on the Cheat River in West Virginia, Whisman and Hollenhorst (1998) found that 64 percent of commercial boaters and 84 percent of private boaters experienced higher than normal levels of crowding. Crowding is defined as a "negative evaluation of a certain density or number of encounters" (Shelby et al. 1989). Crowding can result from a combination of increased visitation, relatively stable facility or transportation infrastructure, and changes in visitor use patterns such as bus tours (Lime et al. 1995).

Many studies have attempted to document perceived levels of crowding. Shelby et al. (1989) reviewed 35 studies in the United States and New Zealand that used the same single measure of crowding (rated along a 9-point scale from not at all crowded to extremely crowded). The studies had a wide range in levels of perceived crowding by recreationists—from 17 percent of goose hunters experiencing crowding on the Grand River Marsh in Wisconsin to 100 percent of boaters experiencing crowding on the Deschutes River in Oregon. The review also noted that perceptions of crowding appear to vary by time and season of use (e.g., holidays, summer), resource abundance or availability (e.g., opening day of fishing season), resource accessibility or convenience (e.g., near population centers), and management actions (e.g., management restricting density) (Shelby et al. 1989).

It is important to understand perceived crowding because studies suggest that after a certain level of visitation, there is some reduction in the quality of the recreation experience. Particularly in wilderness settings where the opportunity for solitude is considered an important aspect of the recreation experience, perceived lack of crowding is important to having a quality recreation experience. An unacceptable level-of-use density has the potential to drive recreationists into seeking alternative forms of leisure activities to pursue.

Recreation Substitutability

Recreation substitutability is the degree to which a particular recreational experience can be an acceptable substitute for another (Manning 1999). The need for recreation substitutes arises when circumstances (such as increased crowding or a limitation on use) detract from the recreation experience in a fundamental way and compel recreationists to somehow modify their leisure activity. The notion of substitutability is important owing to the multiple demands placed on water resources for both recreation and other uses. These competing demands (both among different uses or within recreation itself) increase the likelihood that some recreationists will be forced to find alternative forms or locations owing to management decisions affecting the character of the water regime.

The extent to which there are alternatives to a recreation experience is highly variable. Depending on the characteristics of an activity, "real" choices are limited for those displaced by some management action. For example, deer hunters have fewer acceptable substitutes than goose hunters because deer hunters tend to place greater importance on specific attributes that compose the hunting experience such as social interaction, participation by peers, and importance of obtaining game (Baumgartner and Heberlein 1981). When management actions affecting the water regime are envisioned, however, there is often an erroneous and implicit presumption that recreation users can always

		Resource	
		Same	Different
Activity	Same	A. Temporal/strategic substitute	C. Resource substitute
	Different	B. Activity substitute	D. Resource and activity substitute

Figure 3—A typology of substitution alternatives (Shelby and Vaske 1991).

find adequate substitutes by relocating or by participating in another activity. Particularly for highly specialized or unique activities such as kayaking, the required presence of a particular combination of physical and environmental attributes (e.g., gradient, flow, obstructions) might mean that few, if any, readily accessible substitutes exist.

In addition, because of a long history of involvement with a particular place, such as a fishing hole, people often form strong bonds with specific landscapes over time (Brown and Perkins 1992). Sites that hold special place meanings for recreationists are often irreplaceable, and therefore, the existence of strong place attachments often is sufficient to mobilize people into challenging management decisions perceived as harmful to a valued location. Although place-based sentiments are often overlooked in natural resource management decisions, the strength of the meanings and ties that people have with particular places within the natural environment are an important consideration for water management (Mitchell et al. 1993).

Under certain circumstances, if a recreationist is unable to continue participating in a recreational experience, they might find an acceptable substitute by modifying a particular aspect of the experience such as the timing or access to the activity, the resource setting, or the resource activity (Brunson and Shelby 1993). Shelby and Vaske (1991) have created a typology of alternatives for recreation substitutability (fig. 3). If a recreationist can substitute a different time for conducting the activity or a different means of gaining access to the resource (fig. 3, box A), the same activity and resource setting can be retained. However, if the resource setting is kept constant, but the activity is changed (box B), the recreationist has undergone an activity substitute (e.g., switching from fishing to swimming in the same lake). A resource substitute (box C) occurs when a recreationist moves to a new resource setting yet continues participating in the same activity (e.g., switching from fishing in a lake to fishing in a river). Finally, if a recreationist changes to both a new setting and a new activity, such as switching from fishing on a river to swimming in a lake, they have made a resource and activity substitute (box D).

Research on recreation substitutability has discovered that activities considered to be similar activity types (e.g., waterfowl hunting and deer hunting) are not necessarily equivalent substitutes from the recreationist's perspective (Baumgartner and Heberlein 1981). As a result, recent studies place greater emphasis on understanding the recreationist's subjective judgment as to what makes an acceptable substitute to a recreation experience. In particular, research suggests that instead of altering activities, recreationists typically attempt to substitute a different setting, time, or access method (Manfredo and Anderson 1987, McCool and Utter 1982). For example, if a free-flowing river was converted to a reservoir, river recreationists were more likely to seek other rivers on which to float as opposed to boating in the reservoir. As a result, changes in the management of any one area can have profound consequences on other similar, nearby riparian areas to which recreationists become displaced.

Our understanding of recreation substitutability suggest that it is important to know how any given management action relative to the water regime might affect recreation. This could include the possibility of actions that create substitutes for recreation opportunities that are lost elsewhere. For example, the loss of a reservoir because of a decision to increase flow for power or salmon restoration could possibly be offset by the creation of a reservoir elsewhere. In other cases, negative consequences resulting from management actions cannot be offset by creating or locating a substitute. The potential for affecting recreationists illustrates the importance of having a sound understanding of both the preferred and minimum conditions of attributes associated with different recreation activities. It also suggests that we should have available comprehensive inventories of water resources that transcend organizational boundaries in order to define locations of possible substitutes. Finally, it highlights the importance of a planning framework that facilitates an understanding of cross-sectoral impacts and consequences (e.g., Clark and Stankey 1979a).

Management Implications

There is a paucity of research that examines how natural resource managers can reduce conflicts between water-based recreation and other uses of water. More work in this field is needed. Instead, most research on water management strategies for reducing conflicts with recreation is limited to inter- and intra-activity conflicts. In particular, most of this research is concerned with how to reduce crowding of recreation sites in order to avoid excessive damage to riparian habitats or to avoid reducing the quality of the recreation experience. A reduction in the quality of a visitor’s recreation experience can lead to displacement of recreationists to a different area of the site, a different time, a different location, or to altering their recreational activities altogether (Robertson and Colletti 1994). From a manager’s perspective, it is important to understand the impacts of recreationists becoming displaced from one setting to another or from one activity to another so that unintended consequences such as site degradation are not simply transferred to a new location.

Managers often have to decide whether to minimize crowding (or a recreationist’s perception of crowding) by redistributing use, promoting off-peak times, or limiting overall use. Before restricting access by limiting overall use, managers can first attempt indirect or direct methods to limit visitors or visitor damage (Bates 1992). Indirect approaches attempt to modify behavior without regulations that limit a person’s choice. For instance, if the behavior of recreationists is a problem, providing education and information may reduce visitor damage. Educational programs that establish a code of conduct and increase tolerance of different recreational groups and activities also could reduce conflict (Manning 1999). In addition, informing recreationists about the numbers of people using a resource gives visitors the opportunity to choose alternative sites in which to recreate. However, when increased visitation is the underlying problem affecting the resource or the perception of crowding, these indirect methods of limiting visitors and damage may be inadequate.

Under these circumstances, direct options—which apply regulations to affect behavior—are often necessary. A more direct method of reducing visitation is accomplished through implementing a limited visitor permit system (e.g., allocating boating permits on limited-entry rivers) (Bates 1992, Shelby 1991). The system of distributing these limited permits can include advance reservation; lottery; first come, first served; price; merit; zoning; and priority for first time users (Shelby 1991, Wikle 1991). For example, a price-based system, which is commonly used, requires a user fee to recreate at the site, whereas a lottery system distributes permits randomly in an applicant pool.

The type of system applied is important because it will determine the pool of recreationists that are willing and able to continue participating in these recreational activities. A user fee system may discriminate against lower income individuals, whereas a reservation system would not work well for people who do not plan for their recreation far in advance. Differences also can exist between the preferred rationing policies of recreationists and managers. In a study examining opinions of recreationists and managers about three policy scenarios, Wikle (1991) found that although river users were more likely to accept advance reservation and merit as rationing policies, managers were more likely to prefer zoning. For this reason, it is important to consider on what information (and from what sources) water management decisions are based.

In addition, other conflict management strategies, such as binding arbitration, facilitation, mediation, and nonbinding arbitration, also can successfully resolve natural resource conflicts. These dispute-resolution techniques differ primarily in the level of responsibility that the facilitator has over the process and in the level of obligation to accept the outcome (Susskind and Cruikshank 1987), and so the choice of assisted negotiation technique used often will depend on the level of conflict and complexity of the natural resource issues under dispute.

In summary, population growth and redistribution in the United States suggest that water conflicts will continue to escalate in the future. In this proposition, three types of recreational conflict were explored—conflict between recreation and other uses of water, interactivity conflict, and intra-activity conflict. Among these three forms of recreation conflict, much more is known about the variety of management techniques for reducing or avoiding intra-activity conflicts over crowding. However, much less is understood about how conflicts between water-based recreation and other uses of water are resolved. Because it is likely that much of the future conflict and debate over water management will involve diverse uses of water, we need a better understanding of the relation between water-based recreation and other uses of water and how management can reconcile their different water needs.

Proposition 8

Management alterations of flow regimes can have a substantial impact on water-based recreation opportunities and experiences.

At the same time that conflicts over out-of-stream uses of water such as irrigation or drinking water have increased, greater attention is being given to maintaining **instream** flows for various purposes. Instream flows affect many uses of water including hydropower, recreation, navigation, transport of waste materials, and fish and wildlife habitat (Narayanan 1986). Conflicts over streamflow result from different water uses (and even different recreational activities) requiring different optimum levels of streamflow. For example, increasing flow in the upper Arkansas River for rafting reduced the quality of fishing experiences on the river. More rafters decreased the angler's desired solitude, and the increased flow diminished the fishery (Naeser and Smith 1995). The diversity of preferred streamflow levels suggests that decisions about tradeoffs among these different uses are necessary.

In recent years, much study has focused on the relation between streamflow and fisheries. In the Pacific Northwest, changes in the level and timing of instream flows as a result of hydroelectric dam construction have contributed to declines in anadromous fish populations. Although streamflow also affects water-based recreational experiences, only recently has a substantial body of literature addressed the impact of flow on recreation (Shelby and Whittaker 1995, Shelby et al. 1992b). However, understanding the interaction between water-based recreation and streamflow is more important than ever as the Federal Energy Regulatory Commission (FERC) begins relicensing many hydropower projects.

Although the Federal Power Act initially gave the FERC considerable flexibility in licensing nonfederal hydroelectric power projects, Congress and the courts have recently established progressively more restrictive procedural requirements for the commission (Spence 1999). These new regulations require the FERC to give environmental concerns more consideration in their deliberations over dam relicensing applications. Specifically, the Electric Consumers Protection Act of 1986 requires the government to consider fish and wildlife habitat, aesthetics, environmental quality, protection of archaeological sites, and recreation as much as it did energy development (Baker 1994, Burkardt and Lamb 1997). It requires the FERC to assess the impact of hydropower projects and, if necessary, to deny the application outright or to require conditions be met for approval (Baker 1994). Although relicensing of hydroelectric power projects typically occurs every 30 to 50 years, many projects are scheduled for renewal in the near future (Baker 1994). For this reason, it is even more important that we have a clear understanding of how streamflow influences water-based recreation.

The Impact of Flow on Recreation

The influence of streamflow on recreational opportunities and experiences is often substantial. Variations in flow have a strong influence on various recreational experiences including fishing (Loomis et al. 1986), rafting and floating (Shelby and Whittaker 1995), and hiking along rivers (Shelby et al. 1997). Many water-based recreational activities require a minimum streamflow. Whitewater rafters are particularly limited by streamflow in their attempts to find suitable rivers (Shelby and Lime 1986). Rapid fluctuations in river flow from changing dam operations also impact water-based recreational activities. Cole (1989) revealed how unanticipated changes in streamflow owing to higher than expected releases of water can influence a floating trip when he described waking one morning and witnessing the Colorado River sweeping through his campsite.

Studies of streamflow and recreation often include both a descriptive component and an evaluative component (Shelby and Heberlein 1986). Descriptive components involve objective information about the resource (e.g., number of rapids in a river) and how management affects these characteristics. Evaluative components describe how humans react to descriptive components (e.g., low flows may be too easy for whitewater rafters or may prevent use completely) and are used to determine which of the descriptive conditions are the most or least desirable for recreation. Through an examination of both descriptive and evaluative components, researchers have found that changes in streamflow affect recreational experiences in various ways.

Streamflow impacts recreation by altering the safety of recreational activities and recreationists' perceptions of crowding, scenic beauty, and recreational satisfaction or quality (Shelby et al. 1992b). Streamflow can increase the danger of certain water-based recreational activities (such as the difficulty of rapids) or recreationists' perceptions of safety. In an Arizona river, Moore et al. (1990) found that as streamflow fell below 23 cubic feet per second (cfs), visitors were more likely to treat creek water before drinking it. Because changes in streamflow can alter the safety of recreational experiences, what a recreationist perceives as an acceptable level of flow often depends on their experience and skill level. In a study of the flow preferences of backcountry hikers in Zion National Park in Utah, Shelby et al. (1997) found that challenge-oriented hikers believed high streamflows were more acceptable than did scenic hikers whose skill levels were low to intermediate. Depending on whether hikers desired a scenic hike or a challenging hike, the acceptable level of flow ranged between 30 and 150 cfs, owing to the increased difficulty associated with crossing rivers at high streamflow.

Streamflow also affects recreationists' perceptions of crowding. In a study of private and commercial boaters, Tarrant and English (1996) observed a negative relation between perceived crowding and flow on the Nantahala River of North Carolina. Assuming a constant level of perceived boater crowding, an increase in flow from 400 to 600 cfs was shown to allow for an additional 670 private boaters on the river. Research also has shown that streamflow influences recreationists' evaluations of the scenic beauty of the surrounding environment. Using video sequences from the Cache La Poudre River in Colorado, Brown and Daniel (1991) observed a concave relation between flow and scenic beauty with lowest scenic beauty evaluations at very low and very high water flow levels, and the highest scenic beauty rating around a medium flow level of 1,300 cfs.

The relation between streamflow and recreationists' satisfaction with the quality of the recreational experience has been explored in greater depth. Whisman and Hollenhorst (1998) found that waterflow levels and related adventure experiences had a relatively strong impact on whitewater boating satisfaction. In the Aravaipa Creek in Arizona, Moore et al. (1990) discovered that as streamflow decreased below the median flow, there was a 45-percent greater chance that recreationists would find water levels unacceptable. In a study of whitewater recreation, Herrick and McDonald (1992) examined the effects of eight independent variables on visitor satisfaction with their recreational experience and noted that satisfaction was most affected by the setting characteristics, such as waterflow and number and difficulty of rapids.

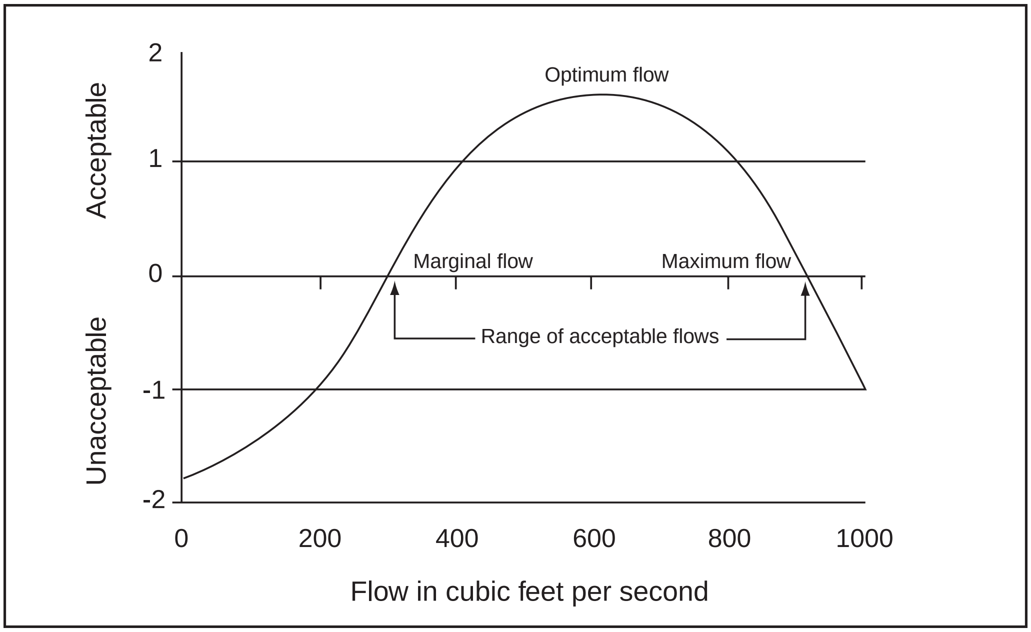

Figure 4—Relation between recreation quality and streamflow (Shelby and Whittaker 1995).

Flow evaluation curves are used to quantitatively assess recreationists' evaluations of conditions at various levels of streamflow. In research studies, evaluations of flow often follow a bell-shaped or an inverted U-shape (fig. 4), with very low and very high flows being least acceptable for recreationists and intermediate flows contributing to the highest levels of recreational quality (Shelby et al. 1992a).

Although flow evaluation curves typically follow an inverted U-shape, the optimum flow level in cubic feet per second differs depending on the skill level of the recreationists or the recreational activity. For example, the acceptable level of flow for hikers may be too low for boating; both groups of recreationists have similar, bell-shaped flow evaluation curves, although over different magnitudes of flow. In this way, different recreational activities have different "niches" of acceptable flow. On the Dolores River in Colorado, Shelby and Whittaker (1995) observed large differences in the flow evaluations of visitors using open canoes as compared to other watercraft (e.g., large and small rafts and kayaks), with open canoeists more likely to desire lower flow levels. Furthermore, greater agreement on minimum level of flows was observed as compared to agreement over optimum levels of flows. Research studies on flow and recreation also have found that specific elements of a river trip—such as time to reach camp, availability of camping sites, safety of rapids, or the challenge of the trip, are affected differently by flow and therefore have different levels of acceptable flow (Shelby et al. 1992a, 1998). Because the level of acceptable flow in cubic feet per second is dependent on so many variables, including the unique attributes of streams or rivers, it is not possible to generate a quantitative number for flow that can represent the optimum level of streamflow across all recreational activities or river types.

Implications for Research and Management

Because optimum streamflow varies by activity, it is important for research studies to examine the relation between flow and various water-based recreational activities. Although some studies have examined the impact on fishing from reduction of flow owing to hydropower development or irrigation (e.g., Johnson and Adams 1988), most studies examining the relation between streamflow and recreation have focused on rafters and boaters (see Brown et al. 1991, Shelby et al. 1992a for reviews) and, to a lesser extent, on hiking or swimming (e.g., Moore et al. 1990). More work on the effect of streamflow on various recreational activities is needed. Managers who release different amounts of water from dam-controlled rivers offer an opportunity for researchers to examine the relation of flow to recreation by observing the subsequent advantages and disadvantages to various water uses. An ideal controlled flow experiment would include the release of a full range of flows while recording recreationists' responses to the different flow levels. As a result of the FERC relicensing process, controlled experiments are more easily arranged, although many difficulties (e.g., inability to release a full range of flows) could limit the potential of this approach (Shelby et al. 1998, Whittaker et al. 1993).

Natural resource managers may have some influence over streamflow levels and the resulting impacts on recreation. Under some circumstances, water from high spring runoff can be stored and released in summer when flows naturally decrease (Brown and Daniel 1991). However, one of the management difficulties is that flow often is subject to demands from users who own proprietary rights to the resource (Naeser and Smith 1995). If managers are not able to manipulate flow to achieve a desired level, managers instead could provide recreationists current and accurate information on flow levels so that recreationists could make informed decisions (Whisman and Hollenhorst 1998). In certain circumstances, recreationists could substitute different activities when management decisions affect streamflow, such as when a formerly free-flowing river with its corresponding recreational activities becomes a reservoir with a different set of recreational activities.

Owing to various uses of water, it is unlikely that complete agreement on optimum flow levels is possible. However, managers should still try to combine research recommendations about the acceptable or necessary flow levels for recreation with the necessary flow levels for other uses of water such as fish habitat or channel maintenance so as to produce the best decision with the available information (Shelby et al. 1992a).

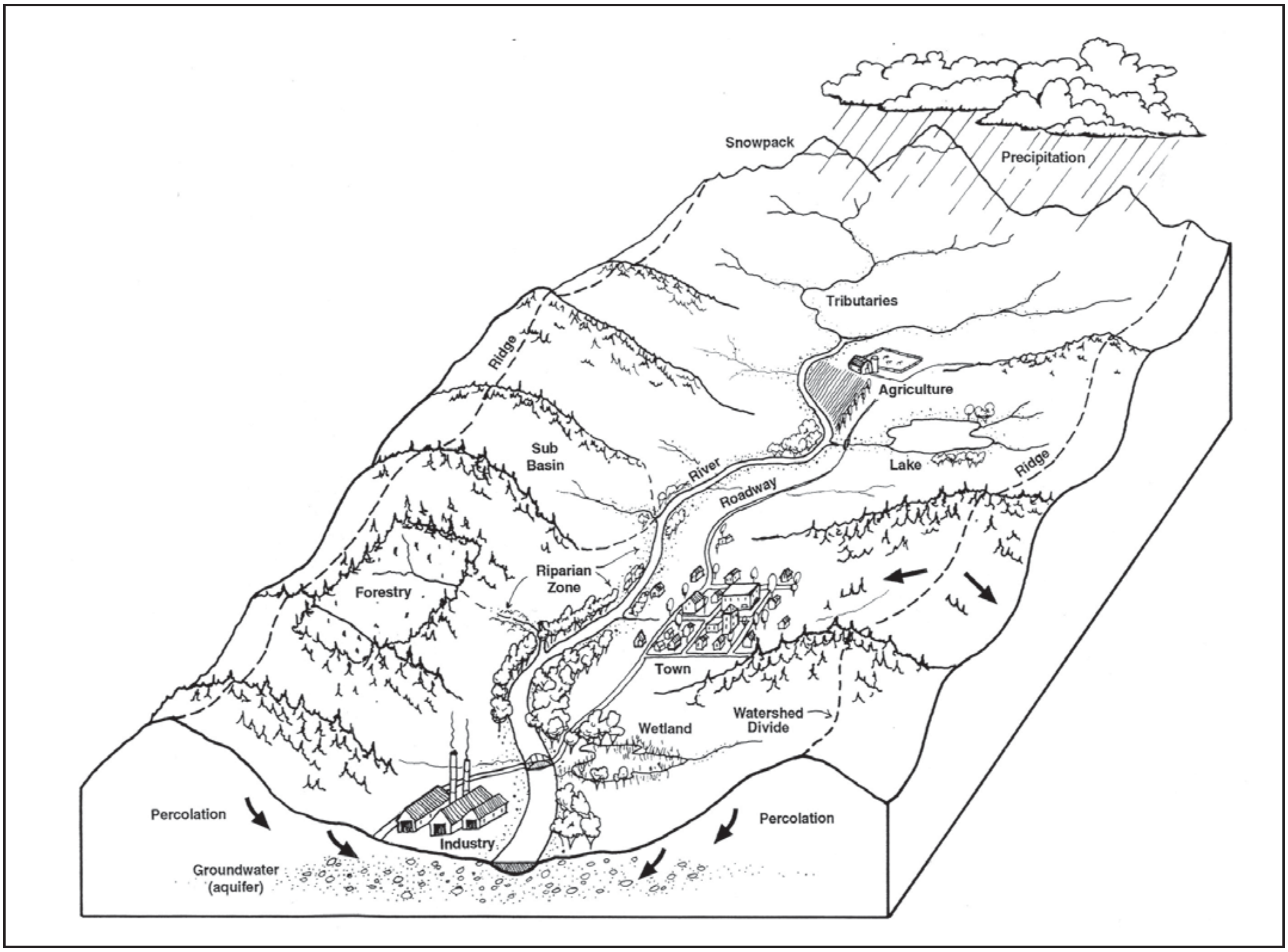

Figure 5—Interrelated processes (physical, ecological, and socioeconomic) occurring within watersheds of the Pacific Northwest (From Lane Council of Governments, Eugene, OR).

Integrating Recreation and Water Resource Management

Premises and Challenges to Integrated Resource Management

A fundamental premise of an ecosystem-based management approach is that natural resource systems and human systems are linked; i.e., actions taken in one system will affect both systems. For example, a decision to alter riparian management will affect both natural resources (stream conditions and adjacent vegetation) as well as the human uses and values associated with that particular location. However, there is often much uncertainty surrounding these complex interrelations, making it difficult to predict the effects, particularly at the secondary and tertiary level, of any given action. This high uncertainty increasingly typifies natural resource management actions, increasing, in turn, the possibility of undesirable, unanticipated, or even irreversible effects stemming from such actions.

A second fundamental premise is that implementation of more-informed natural resource management programs and policies is constrained by the lack of effective institutional structures and processes (Cortner and Moote 1994, Ingram et al. 1984). This is particularly the case in water resource management; even a cursory literature review reveals problems related to antiquated laws, inefficient pricing schemes, gaps in or overlapping of administrative authority, and ineffective public educational programs.

Thus, a major challenge facing resource managers is developing planning and management frameworks that more effectively identify and accommodate uncertainty and that facilitate the delivery of informed action. More specifically, the challenge is in developing ways to strengthen the process of making **informed choices** about resource management objectives and actions. In particular, how can we gain an improved sense of the consequences and implications associated with a given decision or action, especially where the effects of decisions are often distributed across other resource management sectors and over space and time?

To help clarify the nature of this problem, consider the panoramic landscape shown in figure 5. This reveals a diverse and complex landscape, varying in topography, land use, vegetative cover, weather, and so on. Although not explicitly shown, it also likely involves a variety of jurisdictions and tenures. Across this landscape, various decisions and actions are underway, often with little or no knowledge of one another, let alone the kinds of consequences and implications each might hold for the other. For example, decisions to road or log highland regions will have biological consequences not only for the specific locales in which these actions take place but for the lowlands and associated riverine system. The practice of agriculture will produce downstream consequences for other river uses and users: municipal water supply, recreation, and fish. Similarly, the decision to promote recreational use of the reservoir might require the need for further water treatment or result in impacts on the amounts and timing of water releases over the dam.

It is apparent a complex array of interactions and consequences are unfolding at any given time in the drainage portrayed in figure 5. In actuality, however, it is even more complex because the effects associated with the examples noted above also extend beyond the boundaries of the drainage; moreover, these effects might only become noticeable over an extended period.

The problems of identifying, let alone assessing, the many effects of any resource management decision across a range of spatial and temporal scales, multiple sectors and tenures, and which involve a host of values and uses, are formidable, perhaps to the point of either producing paralysis or the simple decision to ignore the consequences beyond the immediate location, time, and sector. Increasingly, however, these approaches are untenable, given widespread and intensive public scrutiny and an increasingly demanding legal environment.

Such issues are particularly apparent in the management of water resources, in part because of the crucial role of water as an element of environmental quality, cultural identity, and economic activity and because of its fluid nature; i.e., it moves across the landscape irrespective of who claims jurisdiction or what land uses are involved. Indeed, it is these very qualities that are responsible in large part for this Sustainable Water Initiative.

The challenges of dealing with such complex interrelations attract attention among managers and scientists interested in natural resource-based outdoor recreation. Beginning in the early 1970s, concern among both natural resource managers and recreation researchers began to emerge over the need for an improved planning framework to accommodate recreation and various other land management activities and issues. For example, decisions about transportation systems, often driven by engineering and timber management concerns, could lead to significant impacts, both positive and negative, on recreation uses and opportunities. Decisions to build roads in a previously inaccessible drainage could open up new recreation opportunities for camping or hunting; however, it could simultaneously eliminate other types of uses and values. However, functional planning systems and the lack of processes and frameworks that encouraged and facilitated more integrative, holistic, and comprehensive thinking often led to questionable decisions that had adverse effects on people and resources.

Similar issues confront the relation between water resource management and recreation. For example, in the Pacific Northwest, management actions taken to achieve the objectives of the aquatic conservation strategy (ACS) have emphasized closure of riparian zones. However, in many cases, these areas are also popular recreation venues experiencing significant levels of recreation use. Although such use impacted the riparian setting (e.g., loss of streamside vegetation, erosion), many impacts have long since stabilized. With closures to facilitate biophysical restoration, however, these traditional recreation venues are no longer available. Such closures have resulted in vegetation recovery in many areas; whether significant gains in other environmental variables crucial to achievement of the ACS objectives have occurred is unclear.

Even less clear is the nature of the consequences and implications of the site closures on recreation use. In short, what has happened to the use and users who once came to these locations? Have they moved into adjacent drainages or stream stretches where such closures are not yet in effect? And if this was the response, what are the associated impacts on these newly occupied areas; have the impacts on vegetation, soil, and water that once occurred in the now-closed area simply been displaced to some new location? In general, information about the consequences of such policies and management actions are poorly understood, or completely unknown. Inadequate planning frameworks that fail to facilitate a more comprehensive and integrated assessment of problems, alternatives, consequences, and implications exacerbate the problem.

Developing an Integrated Framework for Management of the Water Regime

A framework is “a structure for supporting or enclosing something else . . . it is a fundamental structure, as for a system of ideas” (Houghton Mifflin 2000). Another way to think of a framework is to conceive of it as a kind of “mental scaffold” that provides a way of thinking about problems; a framework should help frame the issue, consider alternatives, understand relations, and consider implications and consequences. A framework also should help identify alternative ways to state problems, describe who and what values and uses might be affected by a decision, and identify the nature of important links with other actors, events, and institutions. Finally, frameworks should help make explicit the assumptions that underlie proposed policies and actions (Stankey and Clark 1998).

In short, a framework should focus, facilitate, and inform the decisionmaking process. It should help ensure a thorough problem-framing process; i.e., it clarifies the various participants’ assumptions and preconceptions about the various problems requiring attention, thereby increasing the likelihood that efforts to resolve the problem are appropriately focused. An Interaction Associates (1986) report claims that a large proportion of the effort spent on problem solving ends up solving the wrong problem, stating the problem so that it cannot be solved, solving a solution, stating the problem too generally, or trying to reach agreement on the solution before there is agreement on the problem.

Appropriate processes and structures that help achieve the above conditions facilitate problem solving; e.g., venues and processes that encourage clarification of assumptions underlying how one understands a problem (Bardwell 1991). All too often, such processes and structures do not exist; not uncommonly, barriers to developing such common understanding exist, including the functional organization of agencies and the underlying budgetary processes. Finally, the framework should help ensure that those charged with making decisions and choices have a comprehensive understanding of the alternatives before them, the consequences associated with those choices, and the implications of alternative choices.

Key Attributes of a Framework

The roles and functions that frameworks should perform also suggest something of the attributes that should characterize them. First, it is important that a framework facilitate a **collaborative** approach to problem definition, framing, and solution. By collaborative, we mean that it fosters participation by diverse interests, perspectives, and parties. Wondolleck and Yaffee (2000, p. xiii) citing the work of Gray (1985, p. 912), define three components of a collaborative process: (1) the pooling of appreciations or tangible resource, e.g., information, money, labor, etc., (2) by two or more stakeholders, (3) to solve a set of problems that neither can solve individually. To facilitate the choice process, a framework must help articulate not only the problem-framing process but also identify available resources and capacities that exist in order to fashion solutions.

Second, a framework needs to be **integrative** in nature. In reviewing the extensive body of literature on the relation between recreation use and the water regime, it is apparent that a diverse range of academic and disciplinary perspectives are involved; the biophysical sciences of hydrology, engineering, silviculture, wildlife management, and chemistry meet and mingle with the social sciences of psychology, sociology, political science, and geography. Moreover, these disciplinary perspectives play out against a complex administrative and cultural background in which various rules, laws, policies, and norms are in effect. Both the nature of the problems that one can tease out from this complex web as well as the range of possible alternative solutions used affect, and are affected by, the multitude of individual components. For example, the decision to build a road on a drainage produces impacts on local hydrology that affect the flow regime, which affects the type and timing of recreation use, which can affect downstream water quality, and so on.

Third, a framework should facilitate thinking and analysis at **multiple** scales, including both spatial and temporal and across multiple jurisdictions. The sources of influence on the water regime, for example, often extend far beyond the drainage where the water body is located. Changes to the water regime often produce consequences far beyond the drainage basin, and some impacts only become apparent long after the management action occurs. Finally, if the scope of analysis becomes restricted to only those lands administered by the managing agency, it is easy to miss both sources of impacts, as well as consequences of actions.

Finally, a framework must emphasize the need for an **adaptive management** approach. As noted earlier, risk and uncertainty characterize many of the decisions to which a framework might be addressed; in addition, problems evolve and change, new information appears, the sociopolitical environment changes, new technologies appear, and so on. This means there is a need for ongoing learning and adaptation to these new conditions. The framework needs to both acknowledge the need for an adaptive approach as well as to facilitate creation of the structure and processes that promote adaptation. This begins with clear problem definition, the explicit specification of assumptions, documentation of hypotheses and anticipated results, and an ability to portray and compare what is expected with what occurs.

As the preceding review and synthesis of the literature reveals, there are complex links between water and recreation use. Changes to one component (e.g., recreation access, flow regimes) can produce significant consequences for other components; such changes also can have effects beyond the water and recreation sectors. These are not necessarily negative; e.g., altering flow regimes for the purpose of salmon restoration also could result in conditions conducive to certain types of recreation. However, the opposite is also true; often, the nature, extent, and consequences of these secondary or tertiary effects are taken into account or even recognized. This problem has persisted for many years and has attracted considerable attention among managers and researchers who have come to realize that the pressing need was not so much for more data but rather for a framework to better identify, display, assess, and evaluate interrelations, impacts, and consequences.

This concern led to development of the recreation opportunity spectrum (ROS) (Clark and Stankey 1979, Driver and Brown 1978). The ROS was grounded in the need for an improved framework within which the effects of changes in resource management uses, policies, and actions on recreation opportunities could be better identified and, when adverse, mitigated or prevented. Recreation opportunities were defined as the combination of biological, physical, social, and managerial conditions that give recreational value to a place. Thus, rather than a traditional focus on recreation uses and activities, the ROS gave particular attention to the settings in which these uses and activities occurred. This had the advantage of focusing attention and action on resource settings and conditions; it enabled managers to begin to consider how changes (e.g., a new road to serve a timber sale) might affect existing or potential recreation settings and the recreational uses and experiences associated with those settings.

The ROS highlighted the role of management objectives in order to evaluate the consequences of any given change. Some frame of reference as to what conditions were desired was necessary in order to frame options. For example, a new road might be seen as having an adverse consequence for existing recreation opportunities (e.g., because it led to increased use of a "primitive" opportunity). However, these adverse consequences might be prevented or mitigated by design considerations (e.g., where the road was to be located, the design standards to which it would be built, the rules governing access to the road, the timing of when haulage would be permitted, etc.). Alternatively, the road might be seen as a way of fostering a new, perhaps highly demanded kind of recreation opportunity, featuring motorized access. This option, in turn, required an assessment of the existing supply of such opportunities, the managing organization's capability and role, and various other factors. In short, the ROS provided a systematic, deliberate, and purposeful way of thinking about the relation of recreation management with other resource management activities.

A key element of the ROS framework was its operationalization of recreation opportunity settings: by varying the level and character of specific attributes of the setting, each of which was subject to management control or influence, the framework provided a "common language" for discussion among various specialists, be they in silviculture, wildlife, water resource management, or recreation. For example, recreation settings could be described in terms of the type and level of access, the nature of other resource management activities appropriate to that setting and type of use, the types and levels of recreation use, or the nature of appropriate site management. This facilitated the ability of managers to see how a proposed action or policy might alter the nature of that setting and how that, in turn, would affect the nature and level of recreation use. Conversely, actions proposed for the recreation site could be analyzed in terms of how they might affect other resource uses and values.

The ROS framework was designed to deal, in general, with problems related to the management of recreation and the integration of recreation with the management of other natural resource sectors, such as timber and road construction. However, the potential application of these tools to improve the link between recreation and management of water and riparian systems seems obvious and apparent. For example, it would be possible to identify explicitly the kinds of changes to recreation opportunities and key attributes associated with specific water or riparian management actions. As noted earlier, there are many areas in the Pacific Northwest region where extensive riparian closures have taken place. However, such closures often have resulted in the loss of key, favorite recreation settings used by families and friends for many generations. With these closures come a number of problems. The displaced use might have moved elsewhere, with a consequence that the impacts on riparian and aquatic systems simply have been moved from one place to another. Another possibility is that these users have "dropped out"; a consequence of this result is unhappy citizens who seek redress through administrative appeals or litigation. This in turn can mean that legitimate resource management objectives become subject to overturn; at a minimum, it can lead to increased distrust and acrimony between citizens and managers.

With use of the ROS planning framework, such undesirable outcomes might have been prevented or mitigated. Initially, it could have helped foster a more thoughtful, deliberative discussion about the extent to which a complete closure was needed. For example, would closures only at certain times, or in particular places have been more useful? Were other management alternatives possible (e.g., site design measures to restrict direct access to streambanks) and, if so, how might they have been implemented to both protect the riparian resource as well as the experiences of users? If closures were needed, what kinds of information, delivered to whom, might be appropriate to offset adverse public reactions? If users will be displaced, are there real substitutes for these locations? People often have long-standing attachments and histories with particular places; simply finding another stream stretch where someone can set up a tent might not constitute a legitimate alternative. If substitutes are available, what kinds of management actions are appropriate at these locations to prevent another wave of unacceptable resource impacts from developing? This latter question points out the need for coordination within, as well as outside, the managing organization (e.g., if the alternative locations are on state or private land).

The ROS framework also helps develop relevant indicators of resource impacts and specific standards of conditions associated with specific management actions. For example, the ROS framework helps identify how the biophysical impacts associated with recreation use might be managed. A key assumption in much recreation management is that resource impacts in recreation settings are unacceptable. However, both the scientific literature on the recreation use/impact relation, as well as studies of recreation visitor attitudes, challenge such an assumption. Recreation impacts (e.g., soil compaction, vegetative loss) are inevitable; any use produces impacts. Moreover, depending on the recreation opportunity, as specified in area management objectives, and the types of recreation use involved, such impacts might either constitute a major need for management intervention or be of no consequence at all. Thus, in the case of water-based recreation, we might examine the utility of such indicators as water quality, visibility, and temperature and how changes in these conditions might impact different types of recreation opportunities.

Clark and Stankey (1979b) argued that in developing measures of what constitutes appropriate and inappropriate impact, it was necessary to distinguish between the **magnitude** of the impact and its **importance**. Magnitude refers to the quantitative aspect of the phenomenon under study. Typically, independent observers can reliably measure it. Importance, on the other hand, reflects a value judgment assigned to some phenomenon, such as vegetative loss or water pollution. Two individuals observing the same magnitude of impact can differ greatly in the importance they assign to that impact. In turn, these different judgments could lead to very different management responses (e.g., see Driver and Bassett 1977, Wollmuth et al. 1985).

Using sound as an example, Clark and Stankey (1979b) describe how the ROS framework could help managers. In this case, sound is a physical phenomenon susceptible to objective, quantitative measurement. When either the level of sound, or the particular form of sound, are judged as inappropriate or unacceptable, they are defined as “noise,” a measure of importance. As one considers a given level and source of sound (e.g., highway traffic), and reflects on them across different kinds of recreation settings (ranging, for example, from a highly developed car access campground to a wilderness), one finds that what constitutes “noise” changes dramatically. In a wilderness, any mechanized sound, irrespective of the decibel level, is often defined as noise. In a highly developed campground, sounds not noticed at mid-day might become noise at 2 a.m.

The ROS framework therefore can help managers in thinking about, and developing appropriate management responses for, a particular type of impact. It forces an explicit consideration of assumptions (e.g., the idea of “no impact”), it requires managers to think across functional and jurisdictional boundaries (e.g., what types of sounds, their origin), and it provides the opportunity for consideration of alternatives (e.g., banning the source, buffering its effects, altering its timing, informing users about it, etc.).

A final benefit of the ROS, as noted in the above discussion, is that it helps make explicit the underlying assumptions and value systems of those involved in the management decisionmaking process (Driver et al. 1987). These assumptions and values are often ignored even though they are a major driving force in the kinds of actions, policies, and programs that are initiated. For example, the belief that all human-induced impact is “bad” and should be controlled at all costs can easily lead to an onerous, regulatory-ridden management regime that might or might not produce any desirable benefits for the very values, conditions, or species they are designed to protect, while at the same time producing high costs for recreationists.

However, the usefulness of the ROS in dealing with the complex problems associated with recreation and water is dependent on the availability of sound, reliable information. For example, as the previous discussion in this report details, we lack basic understanding of such fundamental descriptive information as the types, levels, and distribution of existing recreation use. We similarly lack an understanding of the extent to which attributes of natural resource settings, such as specific flow regimes for kayaking, are essential to an activity as opposed to simply preferred. Also limited is the ability to describe the nature of the cause-and-effect relations that exist between and among recreation uses and water; the ability, for example, to describe the specific impacts associated with particular patterns, types, or levels of recreation use on water and riparian settings generally is poor. The lack of basic information about both supply and demand elements of outdoor recreation resources and use compromises our ability to use frameworks, such as the ROS, in an effective manner.

Other constraints affect the capacity to deliver effective decisionmaking. For example, it has become increasingly obvious that land management organizations are faced with serious challenges of organizational capacity and memory; for the ROS framework, we routinely find that despite the widespread use (and understanding) of these tools that were commonly found 5 to 10 years ago, much of this experience and knowledge is now lost. The continued functional structure and funding of resource management organizations also constrains the ability to think and act integratively; such institutional constraints often prove difficult to alter, despite their impact on more effective planning and management (Clark et al. 1999).

Conclusions

This report examines water-based recreation as a proxy for understanding social values and uses of water in the Pacific Northwest. Our investigation of the reciprocal relation between recreation and the water regime has improved our understanding of the state of knowledge surrounding these issues and of the potential challenges facing recreation and water management.

One primary finding is that future management of the water regime will be greatly influenced by external influences (regional, national, and global) beyond the control of management. Much of the predicted change in future recreation patterns will result from demographic shifts occurring across the country, including the migration of residents from Eastern States to the West and the rapidly aging population. Furthermore, technological advances allowing people to recreate in locations distant from their primary residence increases the potential that nonresident recreationists will strongly influence the future direction of water management in the state (e.g., Alaska). Because these drivers of change will greatly affect recreation, an understanding of social trends is critical for anticipating and preparing for future recreation demand. Although the complexity associated with the combined impacts of demographic and technological variables make accurate forecasts difficult, sufficient data are available to anticipate the trajectory of some of the key social and demographic trends influencing recreation.

In contrast, a fundamental problem facing water management for recreation is the pervasive lack of adequate data on various aspects related to recreation use, including who recreates, how often they recreate, in what recreation activities people participate , and so forth. Our inability to accurately gauge current recreation use trends makes it difficult, if not impossible, for managers to anticipate long-term recreation patterns. Without this information, managers will be fundamentally disadvantaged, because they will not have adequate data to make informed decisions about shifting recreation demands. Some research on recreation trends was conducted in the 1970s and 1980s; however, continuous updating of this work is necessary to account for shifting patterns over time. Particularly considering the influence of rapid technological change on recreation, conclusions based on prior information might not be applicable today.

Although a thorough understanding of recreation use patterns is needed to make informed choices about water use and distribution, we cannot afford to postpone management decisions until full and complete information becomes available. Limitations in recreation use data simply mean that we will have to work in an environment of higher uncertainty. Decisions affecting water-based recreation cannot be avoided because the failure to act is itself a decision with its own set of consequences. Instead, managers will need to move in a more conservative, thoughtful manner, giving particular emphasis to sound monitoring programs and an adaptive approach to management. A substantial body of knowledge exists on other aspects of recreation and water management from which insights may be drawn and later revised as new knowledge is gathered.

Lastly, we need to better understand how to integrate our knowledge of water-based recreation with other uses of water. Although there are many interconnections between management of water for recreation and other values (e.g., municipal water supply), our understanding of these relations is limited. We need to acknowledge that decisions cannot be made in isolation; management changes to the water regime for one purpose will have consequences and implications for other uses, including recreation. For example, management decisions in response to declining fish populations can have implications, either positive or negative, for recreation or for other aspects of the water regime. Furthermore, management decisions have the potential to indirectly influence the water regime in other locations by shifting demand to other sites. The relations among various uses of water, including both direct and indirect consequences to recreation and the water regime, need to be considered and fully accounted for in water management decisions.

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Metric Equivalents

When you know:	Multiply by:	To find:
Inches	2.54	Centimeters
Feet	0.305	Meters
Cubic feet per second	0.028	Cubic meters per second
Miles	1.61	Kilometers
Gallons	264.2	Cubic meters

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