Future Trends in Society and Technology: Implications for Wilderness Research and Management

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Abstract—Judging the impact of social and technological trends on the future of wilderness is complex. Declining public trust, growing demands for scrutiny, a need to recognize the link between biophysical and socioeconomic systems, and the need for criteria to select among alternative futures challenge us. A burgeoning global population will increase resource impacts, but more critically, the growing gap between haves and have-nots will aggravate equity concerns. Future technological changes are problematic; they will enhance understanding of wilderness but also make it more accessible. We lack ethical frameworks for resolving such dilemmas; what we *can do* will almost always outpace our ability to decide what we *should do*.

It is my assignment to discuss how future trends in society and technology might affect how wilderness is both used and perceived, as well as the implications of these changes for the conduct of science in wilderness. I am also to describe the nature of ethical frameworks available to respond to these changes and to the conduct of science in wilderness. This is an ambitious assignment, for not only does it require consideration of two large, complex sectors and their equally complex interactions, but it also implies that the analysis will account for what has not yet happened. Our capacity to anticipate the future accurately has yet to be demonstrated; there are a host of examples of this inability, such as Bill Gates' apocryphal quote "640K ought to be enough for anybody." Speaking specifically of wilderness, Nash (1982) observed "who in the 980s could have foreseen a world in which oil is piped from Alaska, the planet's mightiest rivers are thoroughly regulated, and recreational backpacking threatens to love designated wilderness areas to death? We may be in no better position today to predict the state of wilderness on this planet in 2980." I would agree fully with Nash's assessment, but I doubt our capacity to forecast, with any accuracy, what the situation will be in the next 50 years, let alone the next millennium!

But having said that, we must also recognize that our failure to think reflectively about the future only increases the chance that it will bring neither what we might wish for nor what we might desire. Those who specialize in forecasting (as opposed to prediction) remind us that the future is not some immutable trajectory, determined by our history, the stars, or our genes. As Polak (1961) notes, "history does not unfold itself, but evolves through man's evolving." Instead, it is shaped by the numerous actions and decisions (or perhaps more often, by nonactions and nondecisions) taken today; to a very great extent, we choose our destinies, explicitly or implicitly, and "steer our collective enterprise toward any one of several worlds" (Hammond 1998).

Reflecting upon the nature of tomorrow also leads us see today in ways not previously possible. By looking ahead, we see particular trajectories and outcomes that we might like to avoid or alter; to do so will first require changes in present attitudes, behaviors and institutions. However, such future-oriented feedback is often ignored or denied because to acknowledge it is to presage a need to change current institutions (Michaels 1973). This, in turn, can produce such a state of psychological discomfort that denial becomes the order of the day.

Thus, we are faced with a dilemma: attempting to forecast what is yet to come and which is ultimately unknowable, yet cognizant that our failure to do so could very well produce what we wish to avoid (and even more frustratingly, might well be able to avoid). It is a case of "Catch-22," alive and well!

In this paper, I try to walk the fine line between these two outcomes. First, I present some basic presumptions and caveats. In this section, I outline some of the larger, in most cases global, forces at play with which both wilderness managers and scientists, as well as the whole of society, will need to contend.

Second, I turn to a discussion of selected social trends underway, globally as well as in the United States. Space does not permit a full appraisal of this topic, but hopefully I can provide some basic familiarity with these trends and, more importantly, comment on some of the scientific issues these trends present.

Third, I present a somewhat similar analysis of technological trends. The course of technology in the future is truly confounding—as is its impact on society, resource management, and wilderness. I've tried to avoid either the course of unbounded enthusiasm (technology will free us!), as well as unremitting gloom (technology will imprison us!).

Fourth, I have also been asked to comment on changing ethical systems and how these might affect wilderness and the conduct of science within such areas. I am neither ethicist nor philosopher and do not feel particularly well-suited to comment on this aspect in any depth. However, having said that, I am convinced that the challenges here far exceed those posed by more people and machines. To foreshadow my comments regarding changing ethical frameworks, I argue (1) that *what we can do* tends to outrun our capacity to judge *what we should do* and (2) that *will*, not *wit*, is the most critical deciding factor in the future of wilderness.

Wilderness in the Context of Tomorrow _____

Let me begin by identifying some broad, contextual aspects of the future that will affect not just wilderness and its use, including science, but our lives in general. In most cases, these aspects already have begun to make themselves known, and we have evidence that they imply significant changes in how we, as a society, behave.

Trust Is Declining While Demands for Public Scrutiny Are Increasing

There is growing evidence of disenchantment, anomie and distrust throughout society and between those who govern and the governed. For example, researchers tracking public confidence in six primary institutions between 1973 and 1989 (Cambridge Reports 1990) reported that only about 40% of the public consistently ascribed to itself a "high" degree of trust in the scientific community (the top ranking, shared with medicine; corporations and Congress are at the bottom of the list, each hovering around 20%). More directly related to our concerns here, Kasperson and others (1992) observed that "growing public concern over health, safety, and *environmental protection* has accompanied the erosion of social trust" (emphasis added). Finally, Shindler and O'Brian (1998) reported that while nearly half of the agency personnel surveyed agreed that "federal forest managers in your area are building trust and cooperation with citizens so that people feel the agency is acting in their best interest," 60% of citizens either disagreed or were neutral on the question.

Science is not immune to the question of declining trust. In 1980, then-president of the National Academy of Science Philip Handler, writing in *Science*, opined that "Important to the future of science and technology is the fact that the public has somewhat lost confidence in the ultimate value of the scientific endeavor. It is not that they hold…science or scientists in any less esteem. But they are less certain that scientific research will inevitably yield public benefit." Thus, an attendant feature of declining trust will manifest itself in growing demands for public scrutiny of decisions, including scientific endeavors. Such scrutiny will focus attention on fundamental purposes as well as the nature and distribution of costs, benefits and risks. These demands, and appropriate responses to them, typically will exceed the capacity of the routinized, mechanized and procedurally based public involvement institutions common today.

The specter of the public eye over one's shoulder can be unsettling in any situation, and this is especially true for those who often see their work as requiring extensive training and specialized knowledge and skills. However, the role of citizens in democratic societies long has embraced the notion of *civic participation* (Lee 1993), and growing demands for scrutiny of decision-making processes, including those in the scientific sector, are a logical extension of this role. Such demands, incidentally, are driven, in part, by a growing recognition that science and its results have profound effects on things of great value to us. It is also a recognition that science, left to its own devices, is capable of the same variety of faults and flaws as any other sector of society, ranging from poor judgment to incompetence to evil. At the same time, we must be cognizant of the stresses our society faces as it attempts to deal with what Pierce and Lovrich (1983) described as *the technical information quandary*: "how can the democratic ideal of public control be made consistent with the realities of a society dominated by technically complex policy questions?" However, I would also point out that public scrutiny of "technically complex policy questions" tends to enhance, rather than diminish, the technical rigor, quality and usefulness of investigation. Paehlke and Torgerson (1990), for example, reported that public scrutiny of highly complex technical issues, such as the development of air quality standards in Ontario and the construction of the trans-Alaskan oil pipeline, resulted in more rigorous outcomes than initial plans would have created.

The bottom line is that the practice of science in the future, in all sectors, will be subject to increasing review by society. The effects this will have on what science does, as well as how results are used, are problematic. However, it seems this will be an issue particularly in situations in which there is a perception of significant risk. Risk assessment conventionally involves two distinct dimensions: the likelihood of occurrence (a statistically grounded calculation) and the importance of an occurrence (a value judgment). This has significant implications for the practice of science in wilderness because the very existence of such reserves often can be traced to the strong bonds between them and people. These ties, in turn, derive from a variety of sources: recreational experiences, philosophical convictions about their importance, their importance as a legacy to the future, their biological legacy, their spiritual value and so on. Because wilderness is important for many reasons, actions (including those of science) perceived to affect these areas will attract close scrutiny because people will be concerned that those actions could put these values at risk.

A corollary of this issue that I anticipate is growing demands and pressures for science and scientist involvement in management and policy-making. Again, this is a phenomenon across our whole society, but it has gained particular attention in the natural resource management field; for example, in regional efforts such as the Forest Ecosystem Management Assessment Team (FEMAT) (1993), the Interior Columbia River Basin (ICRB) and the Bitterroot Ecosystem Study in Montana. It is also a key element in recommendations contained in the recent report of the Committee of Scientists to the Secretary of Agriculture (1999). This movement has both supporters and detractors. On the positive side, it heralds an increased recognition of, and support for, the incorporation of our best scientific knowledge into management decisions and policies. However, it also raises serious, legitimate questions about the role of science and scientists in the decision-making process. Such concerns were at the root of Handler's previously cited editorial in *Science*: he wrote "The public image of science and scientists has been distorted by the participation of scientists in public policy formation." Nonetheless, I see the demands for such engagement by the scientific community as growing, not diminishing, notwithstanding serious and legitimate concerns regarding impacts on scientists and the practice of science *vis a vis* policymaking (Jasanoff 1990).

Wilderness Is Part of a Larger Biophysical and Socioeconomic Web

Although not a new idea, it's worth recalling that wilderness exists within, and is given meaning by the larger biophysical and socioeconomic fabric within which it exists. My use of the term "wilderness" here is in the broadest sense; we need to remind ourselves that the concept of wilderness *as a land use* is strongly North American in origin. However, discussions need to embrace a much broader, inclusive view of these areas, irrespective of the name attached to them. For example, if we were to rely on the categories of protected areas recognized by the International Union for the Conservation of Nature (1994), we would include Categories I (*Strict Nature Reserves* and *Wilderness*), II (*National Parks*), III (*National Monuments*) and IV (*Habitat/Species Management Areas*); we would also probably include *Biosphere Reserves* designated by UNESCO, *World Heritage Sites* protected under the World Heritage Convention and *Wetlands of International Significance* protected under the Ramsar Convention. The origins of the wilderness concept derive from European and Middle Eastern experiences; as Nash (1982, p. xii) notes in the Preface to the third edition of *Wilderness and the American Mind,* modern conceptions of wilderness trace to, and beyond, the "Dark and Middle Ages" to the advent of cultivation.

Many kinds of areas, often with no designation at all, also need to be included in our discussions. This range of areas, with an attendant variety of values, uses and benefits, are part of a wider fabric with sociopolitical and environmental conditions that bear directly on the condition of the wilderness. The lines on maps that give form to the members of the National Wilderness Preservation System, for example, are notoriously permeable. As Peter Vitousek's paper in these proceedings suggests, global air and water pollution or the fragmentation of critical habitat operate to erode the very heart of the pledge that wilderness is to be "protected and managed so as to preserve its natural conditions..." (The Wilderness Act of 1964). Similarly, the character and quality of the sociopolitical fabric has direct implications and consequences for the future of wilderness.

There are many examples of this. The horrors of ethnic cleansing in Kosovo or central Africa might seem far removed from the issue with which this conference is concerned, but I would contend they are not. The issue of security—regional, national, global—will be a dark backdrop to many policy discussions in the next century, and to the extent that the factions and frictions that produce a Kosovo or a Rwanda remain unattended, our capacity to maintain areas in which environmental processes operate "untrammeled" or where people have the opportunity to seek restoration and re-creation will prove futile. Writing about the growing culturally-based conflicts of the mid-east and Africa, Kaplan (1994) notes "The savagery of the fighting points to a truth that we lack the stomach to contemplate: a large number of people on this planet, to whom the comfort and stability of a middle-class life is utterly unknown, find war and a barracks existence a step up." How will it be possible to maintain wilderness, in any sense of the word, in such a world?

My point is simply that the ultimate future of wilderness lies not within the boundaries of those places we define on maps with a capital "W," but in the array of economic, institutional and human systems and processes within which such areas are imbedded.

For example, O'Riordan and Rayner (1991) note that about two-thirds of the tropical moist forests logged annually are removed by landless families, many of whom have been forced to leave their homes by the very soil drying process their earlier clearance created. This clearance, in turn, is driven by corruption in government, by favorable tax policies and stumpage fees paid to the rich and famous, etc. Contrary to the view of many, O'Riordan and Rayner argue that the solution to the problem of tropical deforestation does not lie in improved management of these forests. Such a contention derives from a perception of the problem as largely *operational* in origin—that is, as a result of ineffective management, inadequate information, poor operating procedures and so forth. However, because the causes of tropical deforestation are grounded in *systemic* deficiencies, the solution to their sustainable management must be found in systemic reform: changing the structure, incentives, and purposes of international finance, in corporate investment policies of organizations such as the World Bank in developing countries, etc. Systemic problems derive from inherent deficiencies in the underlying socioeconomic and technological systems; solutions must, therefore, embrace fundamental change in those systems (Caldwell 1990).

There Are Many Possible Future Scenarios

Finally, "although we cannot know the future, we can envision it" (Hammond 1998). However, to think about the future isn't useful without some specific parameters. For example, are we talking in the near-term (next year), mid-term (the next decade or generation) or the long-term (next century)? Are we talking about the future of our community, our state or province, the nation, or the world? Most importantly, what are our assumptions about the future? Is our view guided by a belief in humans' fundamental ability to cope or by a view that "there is no hope, we can only cope?" Will humans demonstrate a continual capacity to rise to the challenges that unfold in the future, or will greed, lack of ingenuity and short-sightedness eventually doom us?

Obviously, we each think about the future in different ways. Indeed, the multiplicity of views might lead one to conclude that it is unfruitful at best, and self-delusional at worst, to even bother thinking about tomorrow. However, we must again return to the idea that the future begins now and that the actions and decisions we initiate today can and will shape tomorrow; we do have the capacity to influence what the future holds.

Notwithstanding Santayana's admonition that "those who cannot remember the past are condemned to repeat it," our ability to project events of the past into the future has limited utility. This is especially the case now, when the rates of transition in the socioeconomic and political milieu are so rapid. As Toffler (1980) reminds us, the ability of past events to inform us of the future is diminished during periods of rapid change; this seems very much the case today, with high levels of uncertainty and change characterizing virtually all sectors.

The concept of *scenarios* provides a useful way to think about tomorrow (Hammond 1998). Scenarios are not predictions, projections or forecasts; instead, based on specified assumptions, constraints and logic, they provide a framework within which we can think not only about the future, but perhaps more important, about our present situation in ways that help reveal possibilities and implications. In a way, scenarios are stories about the future, grounded in both science and imagination. Given sufficient rigor, detail and creativity, they can provide images of the future that are plausible, self-consistent and sustainable (Gallopin and others 1997).

However, even within the confines of rigor, plausibility and the other qualities of useful scenarios, a vast range of possible scenarios could be (and have been) constructed. Hammond (1998) provides three scenarios that he defines as "clearly within the realm of the plausible." He notes that even eliminating the extreme, almost science fiction-like, futures aside, the scenarios suggest that humankind still faces starkly different possibilities: (1) a *Market World* in which economic and human progress occur almost automatically, driven by free markets and human initiative; (2) a *Fortress World*, characterized by instability and violence, economic decline and unprecedented human misery; and (3) a *Transformed World*, in which fundamental changes in institutions, norms and beliefs lead to a better life for all humanity.

Gallopin and others (1997) present a similar range to Hammond; they envision (1) the *Conventional World*, characterized by essential continuity to current patterns; (2) *Barbarization*, marked by deterioration of the fundamental social, economic and moral underpinnings of society; and (3) a *Great Transitions* scenario, involving "visionary solutions to the sustainability challenge," involving preservation of natural systems, high levels of welfare through material sufficiency and equitable distribution and a strong sense of social solidarity. They also identify two variants for each class. In the Conventional World scenario, they describe the *Reference* variant, grounded in assumptions of fundamental continuity in population and economic growth and technological change. A *Policy* Reform variant adds comprehensive, coordinated government action to achieve greater social equity and environmental protection. In the Barbarization scenario, they identify a *Breakdown* variant, involving unbridled conflict, institutional disintegration and economic collapse. The *Fortress World* variant features authoritarian and draconian measures, with an elite ensconced in protected enclaves, surrounded by repression, environmental destruction and misery.

Finally, the Great Transitions scenario is divided into (1) the *Eco-communalism* variant, incorporating bioregionalism, face-to-face democracy and appropriate technology, and (2) the *New Sustainability Paradigm* variant, sharing the characteristics of its sibling but emphasizing changes in the urban industrial civilization, rather than its elimination, and a greater focus on an equitable civilization, as opposed to a retreat into localism.

Future scenarios for wilderness have also been fashioned. For example, Nash (1982) describes two ways in which we might think about the wilderness of tomorrow. First, there is a wasteland scenario, one which envisions a ravaged, paved and poisoned planet (similar to the Barbarization scenario described above). The second, and the more serious threat in Nash's judgment, is the garden scenario. Here, wilderness as we think about it today is gone, not through violent, destructive industrialization and urbanization, but ironically, through beneficence; today's wildlands are replaced by sculpted, cultivated and civilized landscapes. It is a scenario wholly consistent with the Jeffersonian ideal; "but wilderness is just as dead in the garden as it is in the concrete wasteland" (Nash 1982).

Such scenarios are examples of the kinds of futures that could plausibly unfold; such scenarios facilitate our ability to reflect on the kinds of actions and strategies we need to consider now in order to prevent undesirable outcomes. Although both of Nash's scenarios are grim, they are not inevitable. If both the garden and the garbage dump represent unacceptable futures, what are we called upon to do *now* to fashion a more acceptable alternative? I'll return to this issue in the conclusion.

Space and time do not permit a full exposition of plausible scenarios in this paper. However, I do want to acknowledge that my view of the future is founded on the idea of plausibility rather than possibility. I acknowledge the possibility that, despite the best efforts of Bruce Willis, a mammoth comet could smash into the earth, obliterating all forms of life and converting what's left into a first-rate *de facto* wilderness. I acknowledge the possibility that unbridled nationalism, racial and religious bigotry and blind greed could turn the world into an armed camp, where "survival of the fittest" becomes our creed.

Despite the current headlines, I do envision a global society that is capable of finding a more benevolent, less acrimonious future. In short, I retain confidence that a worldwide cataclysm, either natural or human-induced, is not imminent. At the same time, I am no Pollyanna or even particularly optimistic. Changes in social and technological trends carry significant import for the future, not just for wilderness, but all of society. We have major choices before us and we still have a considerable capacity and range of options that we can exercise; within that capacity and those choices, we can make both good and bad decisions. My sense of the future is that the trends in social and technological change are certainly a factor that will affect the wilderness of tomorrow, but a much more important issue is the extent to which we can mobilize fundamental reform in the institutional arena—systemic change as opposed to operational (Caldwell 1990). As suggested earlier, our future is primarily a function of the collective will that society can bring to bear, not only on the wilderness and environmental challenges that will confront us, but an array of pressing social issues. However, the extent to which we do so remains problematic.

With this background, let me turn to a discussion of some of the key social and technological trends with which we must be concerned. As noted earlier, it is not possible to discuss all these trends in detail, but I have attempted to select key dimensions that seem particularly relevant to the topic of this conference.

Social Trends and Their Implications for Wilderness Science

We are all familiar, at least in general terms, with projections of global and national populations. The United Nations (1996) reports that the world is now home to about six billion people, with a projected growth to nearly ten billion by the year 2050. This growth will occur despite a dramatic decline in the world's average annual growth rate. Between 1950 and 1990, the world's population grew at an annual average of nearly 2%; between 1990 and the year 2050, estimates indicate this will decline about half and, between 2050-2100, is estimated to decline to .2% per year (United Nations 1992). However, it's important to treat such projections and estimates cautiously; global population projections made by the UN in 1992 and 1994, for example, differ fairly sharply, with the 1992 estimate of the year 2050 population being 10 billion and the 1994 estimate 9.4 billion, a difference of about 600 million people in only two years! Significant changes in assumptions about rates of population growth and fertility (both lower than expected) combine to explain the differences. But the fact remains that world population in the near future will be substantially larger. However, there are competing hypotheses as to what a larger population implies, both for society in general and for environmental protection in particular. On the one hand, there are estimates that general economic prosperity will increase; Hammond (1998) reports that the global average per capita income will more than double over the next 50 years. To the extent that we make progress on alleviating poverty, we might hypothesize some reduction in adverse environmental impacts. On the other hand, the "ecological footprint" associated with higher levels of living might only grow larger, resulting not only in more people, but in more people having higher incomes that facilitate increased rates of resource consumption and impact. As Rees (1996) argues, the world's "advanced" nations are, in large part, advanced because they have accumulated large and unaccounted ecological deficits at the expense of the rest of the planet. However, estimates of future economic conditions are notoriously unreliable, even more perplexing, they might be accurate on average, but wide variation means that while the rich get richer (and consume more), the poor get poorer (with attendant impacts on the environment as they struggle to survive). The result is disheartening: While socio-economic inequities grow larger, environmental impacts also worsen, with their effects disproportionately borne by those least able to contend with them.

The relationship between economic condition and resource utilization is complex. It is confounded by the fact that while global population growth rates might be in decline, significant differences remain (and are projected to remain) between these rates in the so-called "most developed regions" (MDR) and the "least developed regions" (LDR). For example, while the population growth rates of the MDR regions is estimated to drop to –0.1% in the period 2045-2050, it will remain at .6% in the LDRs (United Nations 1996). The implication here is that those without will continue to grow more rapidly than those with; the growing inequity between "haves" and "have-nots" will further aggravate not only the demands for resources for survival, but the state of global security, which, as noted earlier, places the array of reserves, parks and wilderness around the world at even greater risk.

This is especially a concern because long-range population forecasts also suggest major changes in the distribution of the world's population. For example, the United Nations (1992) reports that in 1990, about 20% of the world's population resided in developed nations in Europe, North America and Oceania; by 2050, this percentage will decline to only about 12%. Perhaps the converse is more revealing: people living in the lesser developed countries (Africa, Latin America, China, India) will grow from slightly less than 80% to nearly 90% of the total world population. The burgeoning populations in these lesser developed countries also imply rising levels of impact on resources and, by implication, further pressures on reserves in which human use and occupation is limited if not outright prohibited.

The social and equity pressures created between haves and have nots are not just phenomena of the Third World. In the United States, Census Bureau figures indicate that since 1969, there has been an increase in income inequality; for example, in 1997, the share of aggregate household income controlled by the highest quintile increased from 43 to nearly 50 percent, while the bottom quintile declined from 4.1 to 3.7 percent. More noticeably, the share of income controlled by the top five percent of households increased from around 17 to nearly 22 per cent (Weinberg 1996).

The annual population growth rate in Canada and the U.S. has slowed dramatically in recent years. In 1995, the population of the two countries was about 293 million, and it is projected to reach 389 million by 2050; annual growth rates in both countries is now about 1%. However, there are important trends in the structure and distribution of the population that hold significant implications for those charged with the management of wilderness, parks and reserves. For example, of the 10 states projected to have the largest increases in population between 1995 and 2050, three are in the West (AZ, CA, WA), where many of these reserves are found. Perhaps more important than absolute growth rates, six of the ten fastest growing states are in the West (AZ, CA, ID, NM, NV, and UT). In these states, where we find millions of acres of classified wilderness, population is projected to increase between 4% and 5% per year, largely as a function of high levels of in-migration (Biyearly and Deardorff 1995).

Shifts in internal migration, rather than increased birth rates, could have significant effects on many wildernesses. For example, the recently completed Interior Columbia River Basin (ICRB) ecosystem assessment (Quigley and Arbelbide 1997) reports that alternative population projections for the region for the year 2040 differ by a factor of well over two! From a 1990 population of less than three million people, the region's population could range from virtually no growth by 2040 to nearly seven million people. Much of the difference derives from fundamental assumptions about rates of in-migration.

As we think about trends in population, we need to be mindful of the fact that absolute growth is only one factor in the implications of population change for wilderness. To illustrate this, let me discuss two examples of how structural changes in the U.S. population might affect wilderness.

Throughout the industrialized western nations, average ages are increasing. In 1980, about 12% of the U.S. population was over 65; by the year 2030, that figure is projected to reach 20%. Median age in the United States has gone from 30 in 1980 to about 35 today and is projected to reach 38 by 2035 (Day 1996).

Structural changes in age are of concern because studies of recreation participation rates have long noted the dampening effects of increased age; that is, participation declines as age increases. Cordell and others (1989), for example, note that the pattern varies with the specific type of activity (some rates increase with age, such as walking for pleasure), but that in general, more physically demanding recreation activities show the sharpest decline. For example, within the age cohort 20-29, about 15% of individuals report participating in backpacking and around 17% report camping in primitive campgrounds; however, the participation rates in these two activities for the age cohort 50-59 decline to 4% and 9%, respectively (Hartmann and Cordell 1989).

If the average age of the American population continues to increase, what effects might such changes have on the use of wilderness and on the importance of such areas? What are some of the research questions such changes raise? First of all, will use actually decline? Historically, recreation use has diminished as age increases, but what happened then might no longer be relevant. The increased interest in, and concern with, health and fitness likely means that the "shelf life" of wilderness users is longer than in the past. A history of socialization into a "wilderness-enhanced" lifestyle might also mean that the patterns of behavior, social connection and lifestyle choices will combine to create more persistent use patterns; that is, participation rates will be more resistant to increased aging than previously observed.

Such questions present wilderness researchers with an interesting opportunity and challenge. For example, longitudinal studies that permit us to track the behavior of wilderness users over extended periods would be especially helpful. Not only would they provide valuable time-series data on use, they would also provide an improved sense of the entire use dynamic. This would include such things as changes in the social group (family, friends) with whom one participates, the effect of factors such as lifestyle or family stage affecting patterns of entry and exit into the activity, patterns in the source of new users and adequate substitutes for former users and so forth.

Another facet of the shifting age structure has, in my judgment, significant relevance for the future of wilderness and its management. I would hypothesize that over the past 35 years (going back to approximately the passage of the Wilderness Act), we have created a generation of individuals deeply entrenched in the politics of wilderness protection. It is a population that includes direct users, such as recreational users, as well as indirect users. These are people who, either through direct use and its attendant effect on them or their continuing political and advocacy actions, remain deeply committed to the wilderness ideal and to its adequate protection. Thus, we have a population whose continued direct recreational use of such areas as they age might be problematic, but who will remain intensely involved in the creation and management of such areas. This means heightened levels of scrutiny of management plans and of proposals for adjacent developments that might jeopardize key wilderness values, of organizational commitment to wilderness in terms of staff and budgets and of efforts to either add to or delete from the existing system. Moreover, this is a population that often will bring sophisticated capacities and skills to the political arena in which wilderness is managed and protected. It is also a population that possesses "voice," which can be defined as an understanding of political and legal processes as well as an articulate capacity to specify concerns, well-developed social and negotiation skills, etc. (Fortmann and Kusel 1990). They are people who will have major effects and impacts—for good or bad—on future wilderness management.

This phenomenon reinforces earlier comments about the context within which future wilderness management might operate—an environment of increased scrutiny. It represents an important opportunity to capitalize upon, and benefit from, a large body of experiential knowledge held by such individuals and to utilize their commitment and interest to secure the necessary understanding and support to implement effective management programs, not only within wilderness but in adjacent lands, communities and cities as well. This raises some important questions for science to consider: How might this rich experiential knowledge be better integrated with the formal knowledge of science? What are the most effective forums and mechanisms to elicit such knowledge?

However, if we extend our conception of the future beyond the next generation or so, we can envision a very different set of circumstances. To frame this as an hypothesis: Will the present generation, raised in a "virtual-reality" world, have minimal interest in, commitment to and use of wilderness? Will the ever-expanding world of computer games, simulations and interactive capacity replace direct, personal interaction with our environment? As Nash (1982) writes, "the movement for the appreciation and then the preservation of wilderness may have succeeded in accomplishing something posterity will find irrelevant." There is an obvious irony here, because the supporters for wilderness preservation have always noted the importance of maintaining options for the future; what we might find is that future generations exercise that option by either converting the wilderness to other uses or simply letting it decline through neglect.

Nearly 50 years ago, geographer Edward Ullman (1954) published a paper entitled "Amenities as a factor in regional growth," an early exploration of the role of factors other than jobs and economic considerations in people's decisions to move elsewhere. More recently, Gudzitis (1996) has explored this issue specifically with regard to the role of wilderness as a factor affecting migration. Comparing population change from 1960 to the 1990s in counties where classified wilderness was found with those where it was not, he found significant differences; during the 1960s, wilderness counties had population increases three times greater than other nonmetropolitan counties. During the 1970s, they grew at twice the rate, and this increased to a six-fold difference in the 1980s. These trends appear to be continuing as we close out the 1990s.

Gudzitis (1996) also reported that the individuals involved in these movements tended to be young, educated professionals; only about 10% were over 65 years old. Moreover, most were not dissatisfied with their former places of residence; their decisions to move appear motivated not by

flight from urban crime, pollution or congestion, but rather by an attraction to the amenities their new homes offered. Only about one-quarter reported that employment was the reason for their move; almost 50% reported a decline in income.

The role of wilderness as a factor in regional growth is, like many social trends, one characterized by both positive and negative outcomes. The idea that wilderness designation will have an inevitable and adverse impact on local and regional economies is without foundation; the nature and characteristics of such effects warrants increased attention by economists. However, the growth of communities and residential areas proximate to wilderness could also have significant effects on use and conditions within these areas. For example, extensive developments adjacent to wilderness could produce micro-climatic effects within the wilderness, disrupt historical wildlife corridors and critical winter habitat and produce changes in public access and use patterns by altering or closing entry points.

Demographers report that since the turn of the century, the U.S. has experienced two major trends in migration: (1) migration to the Western and Southern states and (2) migration from rural to urban areas. However, a "rural renaissance" emerged in the 1970s, marked by movement from urban to rural areas and the resulting "gentrification" of many rural communities. Then, during the '80s, traditional migration patterns returned; for example, in Interior Columbia River Basin, 41% of the counties reported population declines as people left rural regions for the cities, largely in response to changes in economic conditions (Quigley and Arbelbide 1997). The volatility continued into the 1990s, with yet another reversal, marked by urban to rural movement. Johnson and Beale (1994) reported that nationwide, about 43% of the population growth occurred in nonmetropolitan counties. In the Interior Columbia River Basin, nearly two-thirds of the net population increase between 1990 and 1994 was attributed to migration.

As suggested above, the reasons for such internal movement vary widely and are driven by both positive attributes (or at least what are perceived to be positive—the "grass is greener" syndrome) as well as negative. However, there is a common hypothesis that the economic well-being enjoyed by many people carries with it an increasing capacity to live where one wants to live. This is facilitated by the fact that we have an increasing number of people who have sufficient wealth (including a growing number of retirees whose pensions, transfer payments, etc. provide considerable latitude) or who can utilize the burgeoning technology of communication in ways that permit them to take their jobs with them. For whatever reasons, our population is increasingly characterized by substantial flows and eddies that result in "new" residents (with new interests, knowledge, values, uses and beliefs) and the loss of former residents (who take with them knowledge, concerns, etc.).

As the character and composition of residents living adjacent to wilderness changes, how does this affect the levels of knowledge and understanding, the types of uses or the political commitment such people have to wilderness and its management, and even to the practice of science in such areas? I acknowledge that wilderness management must accommodate a wider range of concerns and interests than those held by people who "live next door;" at the same

time, these constituents are important. Moreover, as noted earlier, the change in people may bring important changes in abilities and capacities to act effectively in the legal and political arena.

A specific example will help. There is growing appreciation that human intervention in historical fire regimes has had a dramatic effect on the underlying ecological structure, processes and composition of many wildernesses. Consequently, efforts have been made to restore fire to such regimes have been undertaken. However, as McCool and I have noted (Stankey and McCool 1995), "wilderness and fire join two of the most evocative terms in natural resource management." Concerns of local people about increased air pollution and threats to life and property, as well as the potential threats to wilderness values they deeply treasure, can easily become the center of mobilization efforts designed to resist implementation of fire restoration, either set by nature or humans.

In response to such public resistance, the typical tendency has been to mount yet another "education" program, grounded on a presumption that public opposition derives from a lack of knowledge. The track record here is dismal, in part because we fail to acknowledge the underlying value of the issue. Using fire as an example, questions of credibility, trust and confidence are probably more critical to gaining public understanding and support than adding another decimal point to estimates of flame height or spread rate!

But this example, in many ways, understates the magnitude of the problems that will face wilderness managers and scientists in the future. As our population changes, and especially as it becomes increasingly urbanized, we can only hypothesize about how the values, uses and knowledge regarding wilderness will change. However, we can anticipate that, as a society, we will continue to be confronted with competing demands and social needs—poverty and homelessness, health and medical care for the elderly, education. What will be the effects on political interest and support (a close sibling of the budget allocation process) in wilderness *vis a vis* other social priorities as more and more of our country's population lives in the city?

Two dramatically contrasting hypotheses can be offered. The "out of sight, out of mind" theory hypothesizes that as the geographic and psychological distance grows between people and the land (wilderness), the sense of urgency and importance regarding its protection diminishes. Alternatively, the "absence makes the heart grow fonder" theory hypothesizes that the importance and significance of such places increases in direct proportion to the distance society finds between itself and wilderness. Confirmation of either hypothesis presents significant challenges to managers, scientists and interested citizens alike. To the extent that we find the former process unfolding, we would be challenged to better understand the implications and consequences of the disconnection between people and nature; we would need to identify what strategies, processes and experiences, under what conditions, most effectively operate to re-establish the human-nature connection or what substitutes (if any) might serve to provide the benefits that have been lost. Confirmation of the latter hypothesis would create challenges related to how to accommodate growing use pressures on wilderness and how to promote appropriate, low-impact use. We would need to address the role of the burgeoning information

technology (more about this later) and how it can be most effectively used. Even if public interest in, and commitment to, wilderness remains high, we will face the possibility that changing public conceptions of wilderness and its appropriate use and management might change.

Let me briefly mention another dimension of the changing population that presents both intriguing management/policy and science questions. We are becoming a more racially and ethnically diverse country. Although whites remain the dominant race, their proportion is changing, from 84% in 1995 to an estimated 75% in 2050. Perhaps one of the most dramatic ethnic changes underway involves people of Hispanic origin. In 1995, about 9% of the population was Hispanic origin; by 2050, this percentage is estimated to rise to 25% (Day 1996).

In some regions of the country, these changes will be (or already are) significantly greater. For example, in the American Southwest, people of Hispanic origin already constitute about 25% of the region's population, with Texas reaching one-third, and 37% and 45%, respectively in California and New Mexico.

My purpose in citing this ethnic change is to remind us of the need to be aware of new and different cultural conceptions of wilderness. This is not to suggest that people of other cultures and races are indifferent or uninterested in wilderness. However, at its core, wilderness is a cultural construct, given meaning and importance within a particular cultural context; we need to be cognizant that as culture changes, so too will the use, meaning, value and political priority accorded to it.

In many ways, the changing cultural fabric of the nation already confronts us. The growing urban nature of the nation is as much a cultural shift as it is a demographic change. Our norms, beliefs, values and conceptions about such things as the role of humans *vis a vis* nature, the role of science as a source of knowledge to inform decision-making, and the notion of our moral obligation to future generations are all embedded in a cultural web; when differing cultural conceptions confront one another, the opportunity for misunderstanding and conflict is great. Thus, as we track society's changing racial and ethnic make-up, we can anticipate the emergence of new conceptions and values associated with wilderness, its management and its relative significance compared with other social priorities and programs.

Technological Trends and Wilderness: Salvation or Iconoclast? _____

By this subheading, I wish to convey the idea that trends and changes in technological development will (and do) present an enormous enigma, in terms of their potential effects on wilderness and its management (and, for that matter, on most of our society). As Hughes (1985) notes, "rate of technological change is both largely unmeasurable and very uncertain." If any issue deserves characterization as "Janus-like," technology is it.

The conceptual relation between wilderness and technology is fascinating and complex, and it has attracted attention from scientists as well as philosophers, historians and ethicists. Although there is a conventional sense that wilderness is where technology is not, in reality, there is a close, dependent relationship between the concepts. Indeed, it was the growth of technology that helped create a sense of the need for wilderness, for places where one might escape that technological presence. Prior to the advent of technology, probably dating to the onset of cultivated agriculture and the domestication of animals, there was no "meaningful distinction between man and culture, no dualism" (Nash 1982). However ironic it might appear, technology was, and continues to be, what gives meaning to the concept of wilderness.

Picture, if you will, a vintage wilderness campsite scene: Two or three people are gathered around a small crackling fire, sipping a hot drink, listening to the sounds of the night, the stars shining brightly above. Upon closer inspection, we see the state-of-art North Face tent, Eddie Bauer ultra-light sleeping bags, Sierra Club cup and REI self-contained propane stove. Kelty titanium-frame backpacks lean against a tree. The evening meal of *boeuf Bourguignon*, complete with blanched onions and mushrooms, came from a sealed packet, requiring only water from the stream (but only after being filtered for Giardia through a micro-porous filter). The group is examining printouts downloaded from a Web site about routes and attractions for tomorrow's journey. One of the group checks her GPS unit to confirm their exact location, then dials home on her cell phone to confirm the pick-up time at the trailhead (probably in a Subaru Forester!).

It's a scene that's not hard to imagine, and reaction to it will probably vary, but I suspect many would find it repugnant. But how does this differ from a scene many years ago, when a match was used to start the fire, when a horse and Decker pack saddle helped move gear, when canvas and cast iron were the materials of choice, and when the decisions about where to go tomorrow are based on a USGS map? In both cases, current technology facilitates the use.

Of course, the ambivalence of the society-technology relationship is not peculiar to wilderness. The role—positive or negative—of technology in our future is one wrought with uncertainty. Much of the debate has been characterized by the extremes; on the one hand: the *deus ex machina* view that all current problems are largely insignificant because technology will ultimately provide answers and, on the other side, the view that technology ultimately will doom us. Indeed, it is difficult to find any type of dispassionate, reasoned discussion about technology, a disconcerting situation when it is clear that abandoning or disregarding the role of technology simply is not possible.

Hughes (1985) attributes much of this to the inordinate complexity and uncertainty surrounding the trajectory of future technological change. He notes, "...as difficult as forecasting population growth or energy demand over the next twenty years might be, such forecasts are trivial compared to the difficult task of anticipating technological developments...a major difficulty is our inability to measure or quantify technology in a meaningful way..."

Technology is such a central feature of life today that we have become oblivious to its profound effects on our lives, for good or bad. A fascinating glimpse into this was revealed by

Platt (1969), who compiled a list of changes over the past 100 years. But his list is even more revealing because it is already 30 years old! Even at that time, we had witnessed an increase in data handling speed by a factor of 10,000 and an increase in speed of communications by a factor of 10 million. These changes, as extraordinary as they are, were well before the era of Pentium III chips and microprocessors, high speed modems, satellite communication systems, etc.

At the same time, we have ample evidence of our extraordinary capacity to overstate technological achievement. Three decades ago, Ayres (1969) forecast that vehicles would reach the speed of light by 1982, immortality would be achieved by 2000, and a single individual would control the energy equivalent of the sun by 1981. An apocryphal quote attributed to Charles H. Duell, former commissioner of the U.S. Office of Patents, sums up the limits of our capacity to accurately foresee the future of technology: Arguing for closure of the Patent Office in 1899, he supposedly noted, "Everything that can be invented has been invented!"

The breadth and complexity of technological trends makes them difficult to address in a paper such as this. However, I have chosen to focus on two particular areas of technological development because I believe they hold special import for questions of future management and science in wilderness.

Perhaps the most extraordinary example of technological change that confronts us daily is the burgeoning array of developments related to information technology. This is not called the "Information Age" for nothing; nearly 20 years ago, Naisbitt opened his best selling book *Megatrends* by noting, "This book is about ten major transformations taking place right now in our society. None is more subtle, yet more explosive…than the *megashift* from an industrial to an information society" (Naisbitt 1982, emphasis added). What he was referring to was the phenomenal expansion in the creation and dissemination of knowledge; moreover, it involved far more than simply a lot more numbers and facts. It has fundamentally restructured our economy and our lives. For example, it had been a central role in the "uncoupling" of the historic link between a primary products economy to an industrial economy as well as between industrial production and industrial employment (Drucker 1986). The implications of such "uncoupling" are still unfolding, but as noted earlier, they are at least partially revealed in the growing capacity of people to elect where they live and work, as well as in the decline of historic primary production industries, which have often been in conflict with wilderness preservation efforts.

The Information Explosion: A Two-Edged Sword?

Let me address a small piece of this phenomenon. The wilderness management and research literature has devoted extensive discussion and attention to the role of information as a potentially powerful management tool. It has been seen as a more desirable alternative than reliance upon rules, regulation and law enforcement. This view derived from a sense that many of the problems confronting wilderness managers, social as well as ecological, stemmed not from purposeful or malicious behavior, but from uninformed or inappropriate use. Moreover, there was a conviction that if people only understood the "right" way to behave,

many problems would disappear. It also derived from a sense that the reason many people came to the wilderness was to escape the normal regimen of the world; the idea of "policing" wilderness visitors simply seemed wrong.

The provision of information, then, has long had appeal as a wilderness management strategy of great potential, one that was both respectful of the experience and effective in preventing or reducing problems. However, the record of experience shows that the use of information has not achieved its hoped-for potential. The relationship of information to visitor behavior is extraordinarily complex; what types of information should be provided, at what point, to whom, in what forms—all are questions that plague this issue. Even more fundamentally, one might question whether improved and/or more accessible information will have *any* effect. Bardwell (1991), for example, argues that it is "people's attention, not information, that is the scarce resource." Continued scientific examination of these issues seems appropriate and potentially valuable.

Newly emerging information technologies provide a challenging opportunity to revisit some of these questions. The capacity, for example, to deliver increasingly complex and site-specific information is very high. Opportunities for learning, either through formal distance-learning models or interactive web sites, could be tested. The relative efficacy of information transmitted through such means, as compared to "traditional" methods (brochures, signs and the like) or direct, on-site efforts could be examined.

These new technologies also mean there is more opportunity to supply real-time information to visitors—for example, about use levels along trails and at campsites, about trail conditions, temporary closures, special management problems, such as nesting time for an endangered species.

However, there is a dark side to the information explosion, about which concern is already developing. Because of the open-access to the Web, there are few, if any, controls on either what kinds of information are provided or its quality or accuracy. A number of years ago, managers of the Bridger Wilderness in Wyoming recounted an article published by *Sunset Magazine* regarding fishing for Golden Trout in the high lakes of the Wilderness. When summer arrived, so did the crowds. What the story had failed to convey, however, was that the trailhead was at 9,000 feet, and the lake was 10 miles from the trailhead. Would-be fishers arrived in cut-offs, t-shirts and flip flops, with no food or water, expecting a full creel by noon. What they often ended up with were headaches, heat exhaustion and blisters, with Forest Service personnel coping with a host of emergency calls, litter and complaints.

It's not hard to visualize a similar scenario, made even more dramatic by the increased capacity to disseminate information through the new technologies. In only a matter of minutes, using the Web to search on "wilderness," I found close to one million hits; joining the term "future" to wilderness doubled that figure! A major challenge confronting managers will concern how to cope with both the scale and speed of information dispersal, with few, if any, opportunities to influence or even comment on its accuracy or appropriateness. The important challenges for research will involve developing improved understanding of the effects of such information dispersal and for strategies and programs that might be utilized to mitigate problems associated with inaccurate and/or inappropriate information.

Monitoring Ecological and Social Change in Wilderness

When the Wilderness Act passed in 1964, a key feature of that legislation was that its creation of a system of areas in which historic ecological processes would be allowed to operate, to the maximum extent possible, outside human influence; this is the meaning of the idea of "untrammeled." Implicit was the idea that by understanding the ways in which ecological systems changed over time, we would gain important understanding of the systems dominated by human occupancy and use; wildernesses would provide a baseline against which human-induced changes could be tested and evaluated.

However, our record in capitalizing upon this role for wilderness is not particularly notable. Indeed, if we think about the value of monitoring environmental conditions in general, we find more rhetoric than performance in virtually all sectors. We have had the National Wilderness Preservation System for 30+ years, and I would challenge our ability to say much about how that system has changed, why, where things are headed, and what it all means for either management or further scientific inquiry.

But the burgeoning technological revolution has an important role in helping us improve this in the future. The array of remote sensing technologies, for instance, now provides a capacity to develop site-specific, real-time and ongoing measures of changes, whether induced by direct on-site recreation use, air pollution from distant metropolitan areas or subtle evolutionary shifts. These techniques also provide an opportunity to enhance our understanding of ecological processes, functions and structure in ways that minimize so-called "destructive" sampling.

But again, we need to be mindful of the "Janus-like" character of these developments. Technology will also create new dilemmas as it improves knowledge. For example, the same technology that enables us to better understand ecological changes and environmental impacts on wilderness environments will also enhance abilities to locate new resources and values, which might contradict what is commonly considered appropriate in wilderness. Years ago, at a wilderness conference in New Zealand, a representative of the mining industry told delegates that the reason the industry wanted to repeatedly survey the mineral potential of remote areas was that each time they did a survey, the likelihood of finding something increased! This was because the technologies of discovery and recovery, as well as the markets for those products, constantly were improving. Combined with technological improvements and discoveries of new uses, we have a potent likelihood that wildernesses will be found to hold a range of values and uses, many of which might not be consistent with the areas' classification.

A response to this might be that "the Wilderness Act will not allow it." That's true...now. Let me again remind you that wilderness is as much a political construction as it is an ecological condition. For example, resisting the demands of the mining industry is one thing; what if the discovery entails a cure for cancer, AIDS or Alzheimer's disease? This would present us with a perplexing moral quandary, because the argument for the preservation of wilderness has often been grounded in the idea that such areas help protect as yet unknown values that might eventually be required for society. However, if realizing these values requires actions and impacts upon the wilderness inconsistent with our conventional and accepted standards of appropriate wilderness behavior, what then?

Technological developments also have the potential to confuse ends and means. Our capacity to accumulate data has been greatly enhanced by technology; this is both good news and bad news. On the one hand, it has the potential to provide accurate, real-time understanding about changes and trends underway in the wilderness. On the other hand, these data are only numbers on a sheet or screen; they do not constitute information, knowledge or understanding until they are processed and evaluated. The conversion of data to information and knowledge begins with good questions; without questions, we can literally be inundated with massive accumulations of data, collected simply because it is possible to do so. This can reach a state of paralysis, in which people charged with interpretation don't know where to begin or when to stop.

There is another, perhaps more subtle, yet nonetheless critical dimension to the explosion of information that challenges wilderness management. Throughout the history of the wilderness movement, commentators from Bob Marshall to Roderick Nash, from Joseph Sax to Joseph Wood Krutch, have observed that the first increment in the loss of wilderness comes when the pen touches the map—when the blank space on a map that so motivated Marshall becomes filled in with place names and boundaries. When the notion of wilderness as *terra incognitae* is replaced by full and comprehensive understanding, does wilderness remain? Nash (1982) argues that because "all the blank spaces are being filled in…(T)oday, not 1890, is the real end of the American frontier". In the Information Era, will wilderness be lost, not because of increasing recreation use and impacted trails and campsites, but by the flood of information about it? When web sites, constantly updated with real time reports, exist for every wilderness and when every user is equipped with a GPS module and cell phone on their belt, will wilderness remain? During my Web search on wilderness, for example, I located one site which asked "What kinds of news do you want information on? …*secret* places/hikes…?" (my emphasis; the paradoxical nature of the statement is truly breathtaking!). There are a host of "dot.com" addresses featuring all you ever wanted to know about wilderness: World Wide Wilderness Directory, Wilderness Press, Wilderness Maps, even The School of Wilderness Arts and Technology!

The issue of technology *vis a vis* wilderness will likely represent one of the major future dilemmas with which we must contend. The vast array of specific issues far exceeds the time and space available here for discussion in any detail, but let me note a couple of examples. The potential impacts of genetic engineering, cloning and gene splicing hold profound implications, obviously not only for wilderness but for all of society. How meritorious are the arguments for wilderness preservation to protect future options when we have the capability to preserve those options in the test tube? How will we resolve issues of endangered species protection when we can capture the full genetic makeup of the wolf and grizzly bear in the lab? Or, even more perplexing, what would be the compelling reasons not to maintain populations of a species such as the grizzly bear when we have the genetic capacity to alter the species in such a way

that it does not represent a threat to domestic livestock or backpackers?

It's easy to label such issues as fantasy, much as we did with issues such as space travel, cloning and television not so many years ago. Whether these things eventuate is arguable; what is not, it seems to me, is the formidable ethical challenges with which we shall be confronted.

Can We? Should We? The Ultimate Challenge _____

"Surely one of the messages of the twentieth century to posterity will be that our science and technology persistently outran our ability to govern our expanding capacity to change the world and ourselves" (Lee 1993).

Kai Lee's perceptive, yet troubling observation encapsulates the most formidable challenge before us. As noted earlier, I am neither ethicist nor philosopher, so I am especially pleased that such individuals are a part of this conference. However, as I reflect on the problems, issues and challenges that face the future place and role of wilderness in our society, I am concerned that the matter of *what we can do* will dominate the question *of what we should do*. This should come as no surprise; in a society that prides itself on technological achievement, economic growth and dominance, this is the norm. Our natural resource management organizations take great pride in being depicted as "can do" agencies. Our capacity to resolve the question of whether what we can do should be done is much less well-developed, as well as much less valued.

Caldwell (1990) argues that when we consider both the causes of and solutions to problems related to what he calls "environmental impairment," we have a strong tendency to see these problems (and their solutions) as either incidental in nature (the result of carelessness) and thus solvable through exhortation ("give a hoot, don't pollute") or moral persuasion ("just say no!") or as operational, the result of inefficiencies in process (not enough public meetings), insufficient data or inadequate laws. But there is another whole class of problems, which Caldwell labels systemic; these derive from fundamental flaws in the underlying socio-economic-technologic system. For example, debates about whether it is possible to have a sustainable society under a capitalistic economic system fall into this category.

As noted earlier, solving systemic problems requires systemic solutions, not just fine-tuning our array of operational policies, writing new laws or exhortations to "do better." A central feature of systemic change is that it requires new ways of thinking about the world around us and our relationship and obligation to that world. It requires acknowledgment that many of the profound questions that will confront us (and of which wilderness and its future are only one) are, at their core, moral issues. When my colleagues Roger Clark, Margaret Shannon and I prepared the social assessment to FEMAT, we posited two rhetorical questions: Why should we be concerned with the preservation of endangered species, such as the northern spotted owl? And why should we worry about the fate of the region's rural communities? We responded that these questions are fundamentally moral in character. Yet the actual response to such questions was largely done in operational terms—that is, they were treated as scientific questions—with millions of dollars spent, thousands of hours invested, and something on the order of 1,500 pages written.

I would argue that, in part, the FEMAT response, grounded in a scientific paradigm, was a failure of problem-framing. But it also reflects, in my judgment, either the paucity of our ethical frameworks for coping with such issues and/or the impermeability of our institutions, organizations, disciplines and our general mindset to new ways of thinking and acting.

This is not to say that powerful new ways of thinking about human-nature relationships are not available. Whatever criticisms one might level at our conceptions of the ethical relationship between society and nature need to be tempered by a realization of how much those conceptions have changed over the past century (for example, Nash 1989). Society's ethical stance toward nature is an evolving position; the more challenging issues concern its pace and the extent to which it becomes part of the cultural norm, rather than the exception.

Examples of emerging alternative ethical frameworks include the idea of extending legal rights and standing to objects of nature (Stone 1972), the work of Naess (1973) and Devall and Sessions (1984) on the concept of deep ecology, the growing impact of work on ecofeminism (for example, Warren 1994), the new insights offered by scholars examining ecological economics (such as Costanza and Daly 1992) and critiques of the dominant Western worldview of the relationship between humans and the wilderness, especially the notion of a dualism in which civilization is distinct from the wilderness (Gomez-Pompa and Kaus 1992). More generally, the work of Riley Dunlap and Kent Van Liere (1978) in fostering the New Environmental Paradigm (NEP) is also applicable to this topic.

There have also been indications of growing concern about the relationship between humans and nature among organized religions. Contrary to the view that our Judeo-Christian origins are largely responsible for our domination and subjugation of nature (White 1967), some scholars argue that there has long been a tradition of concern for stewardship (Bratton 1986). For example, *The Oregonian*, the Portland, Oregon newspaper, recently reported that the Roman Catholic bishops of the Pacific Northwest and British Columbia have drafted a "reflection" as an attempt to inject a greater role for religion and morality into discussions over the future of the Columbia River drainage basin. In the draft, they argue that the well-being of salmon is not only a sign of ecological health of the river, but also of the "spiritual vitality" of the watershed (O'Keefe 1999). The story notes the growing debate within formal religious circles over the need for enhanced stewardship of the environment. For example, in 1997, the leader of the Orthodox Christians declared degradation of the natural world a "sin." There are also the recent efforts of environmentally conscious congregations to link together, including creation of The National Religious Partnership for the Environment and the Evangelical Environmental Network.

However, the extent to which these evolving ethical frameworks will influence the dominant social paradigm (DSP) remains problematic. I believe that the issue of the ethical/moral framework within which we think about, and from which our actions derive, regarding nature in general and wilderness in particular will be the most critical factor

influencing the future of wilderness. However, I see little evidence that of any major breakthrough on the immediate horizon. In the short-term, I see the debate over wilderness—its management and use—played out largely in the political arena (an area, incidentally, in which wilderness advocates have proven exceedingly skilled). It might very well be that innovative ethical frameworks will follow the successes achieved in the political arena, rather than the other way around. In my conclusions, I turn to some summary comments on the nature of actions that I see as critical to sustaining society's commitment to wilderness preservation.

Conclusions

The breadth of the assignment which I've been assigned is truly breathtaking. I can only hope that my brief remarks have in some way provided a sense both of the nature of the social and technological trends underway around the world and in the United States, and their potential implications for wilderness and science. However, I believe it is important to draw together some concluding remarks on what I see as necessary courses of action.

First, although I have noted that there are clear signs that world population growth is beginning to slow, population growth will remain a crucial concern, both in general terms and specifically affecting wilderness. Under the most conservative growth projections, we face a doubling of the world population over the next 200 years. And whether we see a continuing disparity between rich and poor or a general rise in well-being for everyone, the likely sum effect will be an increasing level of demand on, and consumption of, environmental goods and services. Rees' (1996) concern with the "ecological footprint" of society reminds us that the "good life," which almost all of us enjoy, carries a substantial price tag that is largely subsidized, as well as ignored. As population burgeons, demands on the world's land base will similarly grow, and the competition for resources will intensify. The capacity to maintain, let alone expand, wilderness under such conditions will be increasingly problematic.

A conventional response to concerns with population growth is to argue that technological change will not only keep pace, but will make it possible to continue to grow and prosper—to have our cake and eat it too. As my earlier discussion about the role of technology acknowledged, the future of technological change and its impact on society is extraordinarily difficult to estimate. There is little question that technology has achieved marvelous breakthroughs and that the capacity of human ingenuity, imagination and creativity has taken us beyond our wildest dreams. The question is, will those dreams turn to nightmares?

There are disquieting signs of trouble. In the United States, per capita energy consumption has increased nearly 20-fold in the last 200 years. Global consumption of net production of terrestrial photosynthesis now exceeds 40%; global fisheries yields have fallen since 1989 (Rees 1996). All of these indicators reflect population growth and, even more importantly, rising levels of living. Thus, an expanding world population, coupled with rising aspirations, has a clear potential for substantially increasing environmental impact. Despite our technological prowess, there are growing concerns that these achievements cannot be sustained

indefinitely. "Technology," Ayres (1979,) wrote, "everyone's favorite *deus ex machina*, cannot continue to multiply the proverbial loaves and fishes without limit."

What to do? Clearly, there are no simple answers. The right to bear children is deeply ingrained in religious dogma, in governmental policies and in fundamental beliefs in the rights of free people. Ironically, technology represents one "solution," the improved technology of birth control has had important beneficial effects in reducing birth rates. But just as ironically, technological achievements in increasing life spans often have offset the gains in reduced birth rates. Governmental intervention through draconian means seems unacceptable to many, yet our failure to reform other sectors—economic, religious—might eventually make such steps difficult to avoid.

Second, I see an important need for the creation of innovative institutional structures and processes for the future management of wilderness. Let me quickly point out that this does not include the idea of some kind of "National Wilderness Service." In my judgment, this would only exacerbate the current functional, nonintegrative nature of resource management, and it would do little for either the interests of wilderness or its supporters.

The topic of institutions seems dry and arcane. However, if one defines institutions to include the array of formal and informal norms, rules, processes and structures that govern our thinking and behavior, it is clear that institutions are key (Cortner and others 1996). It's been interesting to note that in the literature dealing with the issue of ecosystem management, a central conclusion is that, whatever the idea of ecosystem management means, it will *be institutional constraints* that most seriously challenge its implementation. I see interesting parallels to wilderness.

For example, I envision a growing role for more locally grounded structures, akin to the "Friends of…" movement common in many national parks. Such organizations not have only the capacity to serve a fund-raising function, but perhaps more importantly, they represent a venue in which local knowledge, expertise, skills and energy could be mobilized to deal with problems confronting wilderness managers. This goes well beyond trail maintenance and litter cleanup; it could involve participating in decisionmaking processes, collecting and analyzing data, monitoring, etc. Wondolleck (1988), for example, has argued about the importance of the concept of "joint fact-finding" as a mechanism to build trust and confidence between forest managers and citizens; similar processes could be initiated in wilderness.

I can anticipate criticisms of such a move. For example, the Federal Advisory Committee Act (FACA) has had a dampening effect on efforts to involve citizens in a more direct fashion in resource decision-making. Although the basis for the act was legitimate concern about the undue influence of interest groups, it is also clear that it tends to run counter to growing interest in implementing a social learning model of decision-making. But laws are changed all the time, and what seems important now is to begin building the compelling arguments for reforming this legislation.

Another concern is that a heightened role for citizens in the land management process will somehow challenge the authority and credibility of land managers. Frankly, given the current state of acrimony and contentiousness, it's hard to imagine how things could be any worse. As noted earlier,

the diminishing levels of trust and credibility have reached epidemic proportions, and it seems time to consider significant reform in our management processes. Some of these concerns, and the need to respond to them, are foreshadowed in the recommendations of the Committee of Scientists report (1999).

The "upside" of increased participation, it seems to me, is that it provides a venue through which a highly committed group of citizens can lend their various talents to the challenges confronting wilderness management. Yankelovich (1991) argues that the key ingredient currently lacking in much of the American political structure is a forum for *working through*—venues where contentious and complex public policy issues can be debated, alternatives considered and consequences and implications weighed. Too often, the venues purported to serve such functions actually facilitate antithetical qualities: They promote adversarial stances and self-interest and do little to inform or to promote learning.

Another key role such forums will play is to help in the process of problem-framing. Earlier, in the discussion of technological change, I noted the importance of asking good questions. Sound processes for problem-framing are the first step to effective problem-solving; "problem definition is critical to the subsequent organization of one's understanding of and approach to that problem" (Bardwell 1991). Questions guide analysis. If the set of questions is incomplete or misdirected, there is little chance the resulting analysis will provide useful insight and understanding. Who gets to participate in framing questions is probably as important as the kinds of expertise they hold; if the problem-formulation stage is restricted to the expert, it is likely to fail. New approaches (forums)—grounded on the principles of inclusion, full disclosure, honesty, respect and openness—are critical to facilitate informed problem-framing, as well as effective problem-solving.

Third, it is essential that we not forget the interconnected nature of wilderness—the larger biophysical and socioeconomic fabric of which it is an inextricable part. Although it might be easy to acknowledge this, I see it as key to the future (or lack thereof) of wilderness. I am convinced that the future of wilderness depends largely on what happens outside its boundaries. The extent and quality of wilderness in the United States, for example, will eventually prove to be directly related to the quality of our decisions about our youth, about our cities, about our educational systems, about our farms. The competition for scarce financial resources and for *informed* political attention (even scarcer) means that the values of wilderness to society—recreational, spiritual, economic, scientific—will need to be communicated and linked to the wider sociopolitical system. I frankly acknowledge that this is an anthropocentrically grounded perspective, but in the foreseeable future, I foresee little success associated with the various "intrinsic" rights arguments.

More specifically, with regard to wilderness as a place, I think we need positive, serious attention and commitment to the creation, protection and management of a spectrum of wildland settings. No less of an authority than Henry David Thoreau said it best: "in Wildness is Preservation of the world" (cited in Nash, 1982). Not "wilderness," but "wildness." Yet, everyday, purposefully or incidentally, wildness is lost. As I write this, I am sitting and looking over the freshwater marsh that separates our house from the Pacific Ocean along the Oregon coast. Although I've lived here for over a year, I can still spend hours staring out the window at the marsh, watching the seasonal and diurnal changes that move across it. Yet, like the magnificent agricultural and rural landscape in the Willamette Valley 50 miles east, each year more of these lands disappear. Everyone has their own version of this scenario. And with each lost acre, I fear, the connections are further eroded between society and wild nature. How long, I wonder, can this go on before our ability and our willingness to sustain the wildest portions of this spectrum—wilderness—languishes and dies?

As Moir and Mowrer (1993) argue, we need landscapes that are diversified in "shades of gray along spatial and temporal gradients rather than as a mosaic of black and white ecosystems." By that, they mean the active and positive provision of an array of places between wilderness and those landscapes devoted to development and utilization. In a recent article in *The Seattle Times* (1998), William Meadows, president of the Wilderness Society, argued that many of the values associated with wilderness—solitude, clean water, abundant fish and wildlife, beauty—can also be found in our own backyards, and he called for creation of a nationwide network of wildlands, such as Seattle's Mountains-to-Sound Greenway. If our maps become divided into only two colors or categories—wilderness on the one hand, urbanization and development on the other—the loss of values, in whatever terms one might choose, will be incalculable. Moreover, it will be an inexorable step on the way to the eventual loss of our wilderness.

Acknowledgments _____

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