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Management Needs Assessment for the Copper River Delta, Alaska

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Abstract

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This report assesses needs, problems, and perceptions relevant to management of the Copper River Delta (Alaska)—the largest coastal wetland on the Pacific coast of North America. The assessment provides a basis for planning and decisionmaking and a framework for ongoing research, development, and application. It also underscores concerns about human impacts and supports the need for a greater understanding of the interrelations among resources and resource uses, and between resources and people.

Keywords: Management needs assessment, decisionmaking framework, Copper River Delta (Alaska).

Summary

The Copper River system, located in south-central Alaska, encompasses the Copper River Delta and the river basin. The 65-mile-wide delta is the largest coastal wetland on the Pacific coast of North America.

The history of the Copper River system is marked by dramatic physical, biological, social, and cultural change. It is a story of complex interrelations between people and the environment. The themes of change and people-environment interrelations provide opportunities to study natural and human-caused change and biological and human responses to change.

Change is imminent, as the potential for development of Copper River system resources is high. The Copper River Delta Institute was established by the USDA Forest Service in 1989 to improve the understanding, use, and management of the Copper River ecosystem. Establishment of the institute provided the catalyst for development of this needs assessment, developed by the Consortium for the Social Values of Natural Resources.

This report assesses needs, problems, and perceptions relevant to management of the Copper River Delta. The assessment provides a basis for planning and decisionmaking and a framework for organizing research, development, and application.

The assessment is based on a workshop and a rating form that was used to identify critical needs.

The need for baseline information to monitor individual species and the interrelations among species, including humans and other species, was given the greatest priority. Eliminating barriers—whether real or perceived—also emerged as a management priority. In addition, maintaining healthy systems was identified as increasingly important, particularly in regard to fish and wildlife populations.

Additional critical needs identified in the rating process include improved understanding of cumulative effects of human activity; better understanding of the interrelations among resource uses and between resources and people; improved processes for managing long-term stewardship and sustainability; and improved processes to address the effects of interspersed ownership—private, State, Native, and Federal.

This assessment underscores concerns about human impacts that may alter the physical and biological components of the Copper River system. It supports the need for a greater understanding of the interrelations among the resources of the Copper River system. Although this management needs assessment was developed for the Copper River Delta Institute, the concerns, issues, and needs identified have significance beyond the Copper River Delta.

Contents

The Purpose of the Assessment

The Consortium for the Social Values of Natural Resources[1] was commissioned to develop a management-needs assessment for the Copper River Delta Institute in Cordova, Alaska. This work parallels a companion effort that identifies opportunities for long-term scientific study.[2] The goals of this report are (1) to identify and assess the needs, problems, and perceptions relevant to management of the Copper River Delta, and (2) to establish an organizing framework that will facilitate research, development, and application activities. A description of the Copper River system is provided to establish a context for presenting and discussing the needs and problems identified by the assessment.

The Copper River System

Overview: The Place and Its Management

The Copper River begins as a stream flowing from the Copper Glacier at the Canada-Alaska border. It winds 287 miles through the Wrangell Mountains and Copper River canyon. At its mouth, the river fans out into the 65-mile-wide Copper River Delta (Delta) that expands from Orca Inlet across both the Copper and Bering River Deltas to Cape Suckling (Thomas and others 1991) (fig. 1.). This is where the river drains into the Gulf of Alaska. The Copper River system encompasses the Delta and the Copper River basin.

Made up of several smaller deltas and outwash fans (fig. 2), the 700,000-acre Delta is the largest contiguous coastal wetland along the west coast of North America (Thilenius 1990). It includes estuaries, mudflats, marshes, and barrier islands. Nutrients carried to the Delta by both the river and the Gulf of Alaska, coupled with complex hydrology and glacial activity, produce a rich and diverse habitat for birds, wildlife, and fish (Bryant and Wissmar 1991).

Management responsibilities for public lands and natural resources there are shared by five State and Federal agencies. The U.S. Department of the Interior, Fish and Wildlife Service, has primary responsibility for managing and protecting migratory birds. The Bureau of Land Management administers land, including Native-selected land, adjacent to the Chugach National Forest. The U.S. Department of Agriculture, Forest Service, manages the Chugach National Forest. When the National Forest was established, waters within its boundary were included, but this has been contested by the State for years, and no agreement has been reached. For now, the Forest Service manages public land above the high-tide line, within the National Forest boundary, with areas below mean high tide and the bed of navigable rivers claimed by both State and Federal agencies.

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[1] The Consortium for the Social Values of Natural Resources embraces the need for a multiorganizational and cross-disciplinary effort to conduct, facilitate, and coordinate research, education, and dialogue about the social aspects of natural resources The consortium is based on the premise that values—be they ecological, recreational, economic, aesthetic, or spiritual—link society to natural resources. Contact the author for further information.

[2] Copper River Science Commission. 1992. Report of the Copper River Science Commission. Portland, OR U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 28 p. Unpublished report On file with: Copper River Delta Institute, 612 2d St., P 0. Box 1460, Cordova. AK 99574.

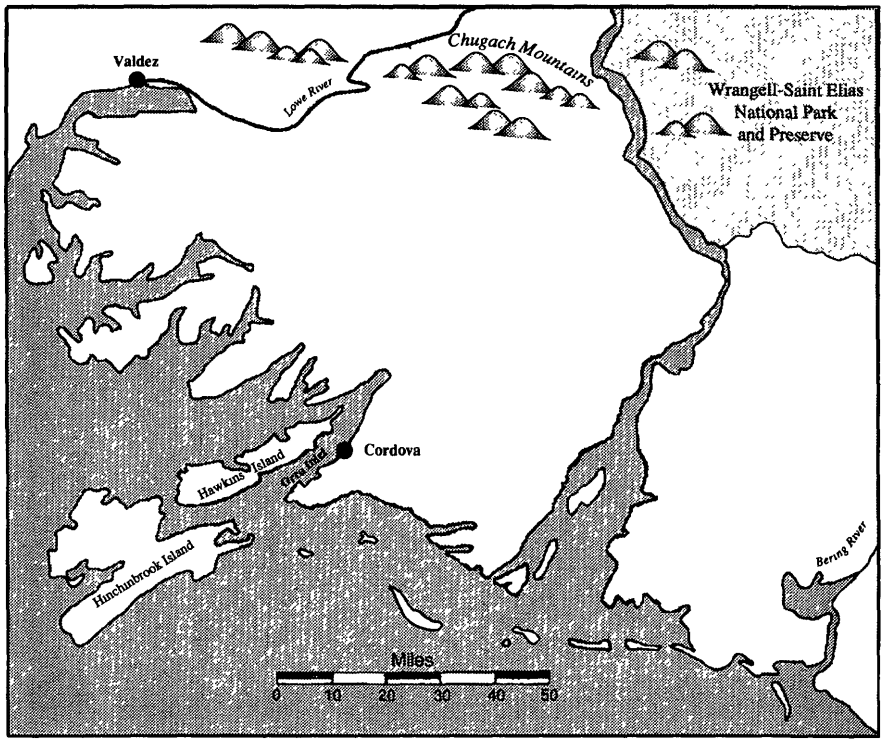

Figure 1—Copper River system showing national park.

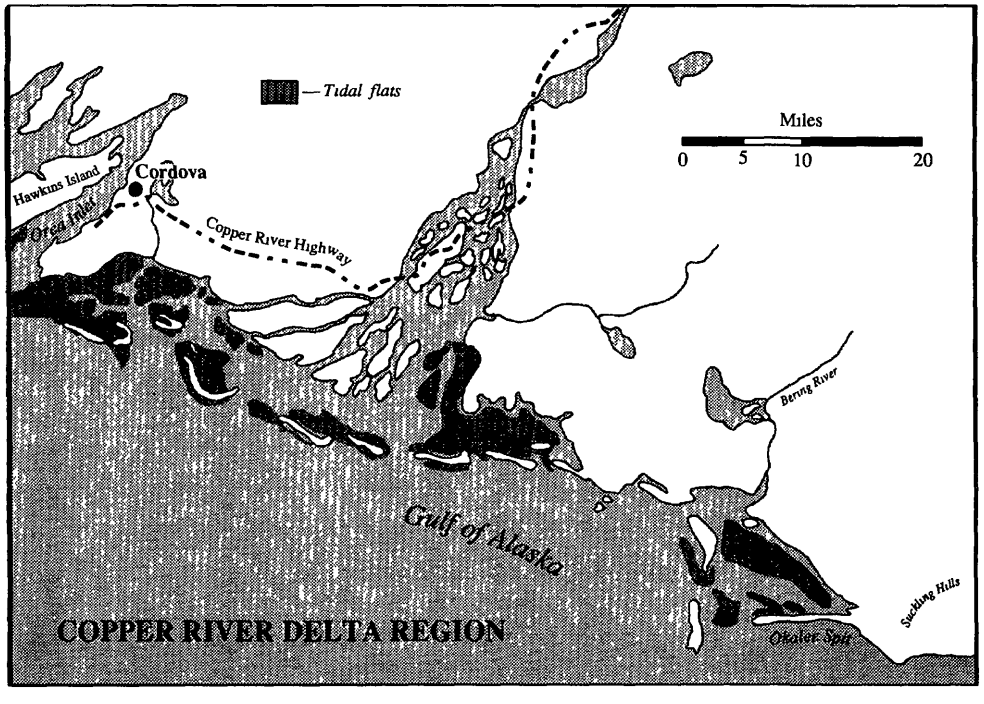

Figure 2—Copper River Delta.

The Alaska Department of Fish and Game is responsible for managing fish and wildlife resources, and the Alaska Department of Natural Resources is responsible for resources other than fish and game on State lands. In recognition of the need to coordinate planning and policy development and to cooperate in management, however, the agencies signed a memorandum of understanding in 1986 establishing the Copper River Delta Fish and Wildlife Management Area.

Under the Alaska Native Claims Settlement Act (1971), parcels of land within the Copper River system were conveyed to private, State, and other Federal agencies. Thus the Delta and the larger Copper River system are characterized by a complex arrangement of ownerships, management jurisdictions, and designations.

Wrangell-St. Elias National Park and Preserve, a complex of 8,331,604 combined Federal and State acres, lies at the northern reaches of the Copper River system. Because of its location upriver from the Delta, management of the park and preserve, as well as other lands along the river, affect the Delta. Whatever management practices occur upstream affect conditions downstream.

Although the Delta is the focus of this assessment, it must be considered within the context of the entire Copper River system. The issues, concerns, and needs identified in this assessment go beyond the system and are being raised at regional, national, and international levels.

Physical Characteristics

The Copper River system is framed by the Alaska Range to the northwest, the Mentasta Mountains directly to the north, the Wrangell Mountains to the northeast, and the Gulf of Alaska to the south. The landscape is punctuated by mountains, glaciers, rivers, wetlands, and forests.

Located at the eastern end of the Aleutian arc, the Delta is one of the most active seismic regions in the world (Thomas and others 1991). A 1964 earthquake measuring 8.6 on the Richter scale caused the most extensive tectonic impacts of the 20th century on the region, with the uplift ranging from 6 to 50 feet (Plafker 1990). The epicenter of the earthquake was located just northwest of the Delta, near the head of College Fiord in Prince William Sound.

But earthquakes are not the most significant agents of change. Land and aquatic features of the Delta constantly change under the influence of glacier and riverine sediments, tectonic uplift, and tidal action (Bryant and Wissmar 1991). All three processes also affect vegetation.

Vegetation—Vegetation differs with soil type, drainage, slope, elevation, and climatic conditions. The vegetation found down river from Child's Glacier includes Sitka spruce,[3] mountain hemlock, blueberry, devils club, willow, and alder at elevations below 2,000 feet. Alder, shrubs, ferns, and grasses occur to about 4,000 feet in elevation with tundra above that (Antonson and Hanable 1984). As the river expands into the Delta, the upland vegetation gives way to various aquatic habitats (Bryant 1991). The uplands and the channel and pond environments on the Delta develop because of sedimentation. Plant succession also increases sedimentation and change (Benda and others 1991). Sedges and forbes are the primary vegetation in sloughs and mature ponds, being replaced by woody shrubs and eventually spruce forests as the

[3] Scientific names of flora, fish, birds, and mammals are given in appendix A.

sites fill and dry. This process of vegetative succession affects both the types and distribution of fish and wildlife populations on the Delta. The process is complex and can be disrupted by shifting channels, earthquakes, and other activity (Benda and others 1991).

Aquatic plant communities are described more specifically by Hansen and Eckel (1971). See also Thilenius (1990), Reimnitz (1966), and Alaback and others (1991).

Shorebirds and waterfowl—The Delta is internationally recognized for its migratory shorebird and waterfowl habitat (Isleib and Kessel 1973). It provides important breeding ground for over 36 species of ducks. The Delta has significant value for the stopping, resting, and feeding of migratory birds heading north along the Pacific flyway. The Delta, together with Prince William Sound, is used each spring by up to 20 million migratory waterfowl and shorebirds—one of the largest concentrations of birdlife in the world (Isleib and Kessel 1973). Shorebirds come from as far away as Peru, 7,000 miles away.

Some bird species breed and nest there, whereas others move on to Arctic and tundra ecosystems farther north and west. Between 200,000 and 500,000 ducks migrate to or through the Delta in spring, and as many as 600,000 migrate through on their way south in fall (Brooks and Rausch 1976). The fall migration is much less spectacular because some southbound shorebirds bypass the Delta, flying across the open Gulf of Alaska. The migration is also spread out spatially and temporally, stretching over months from late June through October, with the birds dispersed over a larger area than in the spring, when ice and snow cover much of the area (Mickelson 1989).

For shorebirds, the Delta provides the most extensive intertidal mudflats north of the Fraser River, 900 miles to the south in British Columbia. It may be the most important shorebird staging area in the Western Hemisphere, providing abundant food and undisturbed resting habitat. Longshore currents, tidal action, upwelling, and freshwater outflows interact to produce abundant food in the form of plankton, seaweed, and marine invertebrates (State of Alaska 1974).

Nearly all the Pacific dunlins and western sandpipers arrive on the Delta between late April and early May. They comprise over 90 percent of the migrating birds on the Delta. The importance of the Delta for shorebirds has been recognized by dedicating the Delta as a hemispheric site in the Western Hemisphere Shorebird Reserve Network. The network promotes protection of sites and cooperative management for shorebirds.

The Delta provides nesting, rearing, and staging habitat for the dusky Canada goose, a distinct subspecies that breeds exclusively on the Copper River Delta (Campbell and Comley 1992). The geese are found on the Delta from early April through mid-September or early October. The Delta also provides breeding, nesting, and rearing habitat for one of the densest concentrations of trumpeter swans (Conant and others 1986). An average of 826 trumpeter swans nest or summer in the marshes of the Delta or on nearby lakes and ponds (Groves and others 1990).

There is also a sizable breeding population of Aleutian terns, which breed only in Alaska and the former Soviet Union. The terns, on the Delta from early May to late July, nest in small colonies close to the tidal mudflats (Holtan 1980).

The Delta is home to the nonmigratory Peale's peregrine falcon (Isleib and Kessel 1973). Endangered American peregrine falcons and threatened Arctic peregrine falcons migrate through the area, as they range from the Arctic and northern tundra to the temperate regions of the United States, and southward into Central and South America.[4] Bald eagles, hawks, ravens, crows, magpies, jays, and many other birds are year-round residents. An extensive list of birds occurring on the Delta has been compiled by Isleib and Kessel (1973).

Fish—The Copper River system supports several major fish populations. Fish habitat includes freshwater lakes and shallow ponds, channels of the Copper River, and sloughs influenced by tidal action. Cutthroat trout are found in upland tributaries and ponds (Bryant and others 1991). The Copper River supports five species of salmon, resident and anadromous trout, Dolly varden char, eulachon, and stickleback (see footnote 4). Juvenile coho salmon and sockeye salmon are widely distributed throughout Delta wetlands (Bryant and others 1991). Eulachon, a small candlefish, is a major source of food for both upland and marine mammals (see footnote 4). Halibut and shellfish are abundant in offshore waters.

Other wildlife—Upland areas of the Copper River system provide habitat for mountain goats, Dall sheep, moose, brown and black bears, Sitka black-tailed deer, wolves, beaver and other fur-bearers, and various small mammals. Five hundred or so moose live within the system. Although native to the upper reaches of the river, moose are not native to the Delta but were introduced in 1949. They have successfully established in the area. Serai willow communities provide the most important moose habitat (Le Resche and others 1974). In addition to willow and alder, moose also eat aquatic vegetation. Sitka black-tailed deer were transplanted to the Copper River system between 1916 and 1923 and are found primarily on islands in Prince William Sound.

The population of brown bears on the Delta has increased in recent years. Many bears found on the Delta are females with cubs and immature bears, probably avoiding contact with dominant males and breeding females in inland areas (Campbell and Rothe 1986). While on the Delta, bears forage on sedges and other wetland plants, prey on dusky geese and moose calves, and feed on eulachon. In summer they move off the Delta to take advantage of ripening berries and spawning salmon (see footnote 4).

The harbor seals of the Copper River-Bering River systems are unusual in that they regularly inhabit fresh water in large numbers. The sandbars and gravel banks of the Delta, which provide habitat for haul-outs and birthing areas close to a rich food source, help to explain this unusual occurrence (Bucaria 1979).

Human Activity: Past, Present, and Potential

Indigenous populations—After the retreat of the glaciers, about 9,000 years ago, humans established villages within the Copper River system (Hanable 1982). Archeological sites at least 2,000 years old have been excavated in Prince William Sound, but earlier indigenous occupation is likely to have occurred (see footnote 2).

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[4] Juday, Glenn Patrick; Ott, Robert. 1991. Establishment record for Pete Dahl Slough Research Natural Area within the Chugach National Forest, Alaska. Juneau, AK. Chugach National Forest 53 p. (15 p. maps, photos, and graphics). Unpublished report. On file with- U.S. Department of Agriculture, Forest Service, Federal Office Building, Box 21628, Juneau, AK 99802-1628.

Several groups of native Alaskans have lived along the river and on the Delta. The earliest people there probably were the Eyaks, a culturally distinct group that settled near the Delta, and the Chugach, a Pacific Eskimo group that came to live primarily on islands in Prince William Sound. The Chugach depended primarily on resources from the sea, and the Eyak used a combination of resources from the sea, the river, and upland areas. The Ahtena, an Athapaskan group who lived in the interior (the Copper River basin), depended on the Eyak as intermediaries for trade with the Chugach (Antonson and Hanable 1984). Thus with the river as a trade route, the interior people had access, through the Eyak, to resources from the sea, and the island-dwelling Chugach had access to interior resources.

Early European/Russian contact—Russian contact with indigenous people first occurred in 1741 when Vitus Bering's second Russian expedition landed at Kayak Island at the far eastern end of the Delta (Thilenius 1990). By the 1780s, Europeans were exploring most of the Prince William Sound-Cook Inlet area (see footnote 2). The Russians operated a post on the river from which to explore the river and its environs and trade with the indigenous people. They operated the post on a regular basis until 1835, and then sporadically until 1850.

Mineral development—Contact among indigenous groups and between indigenous and European and Russian parties revolved around trade (see footnote 2). The discovery of gold in the Alaskan interior in the late 1800s, followed by the discovery of copper, coal, and other minerals in the Copper River Valley, soon altered this pattern Mining brought permanent settlement by nonindigenous people to the Copper River system. Shortly after the 1890s gold rush, more than 4,000 mineral claims were staked in the Copper River basin (Hanable 1982). Development of the rich copper deposits at McCarthy, in the Copper River Valley, led to construction of the Copper River and Northwestern Railway in Alaska, and steamship service between Tacoma, Washington, and Cordova provided by the Alaska Steamship Company. The community of Cordova was established in 1909 at the transfer point between the railroad and steamship connection to the rest of the world (Arvidson and Nichols 1984). The railroad was completed in 1911.

Cordova prospered as millions of dollars of copper arrived from the Kennicott mines. The mines at McCarthy, 200 miles north of Cordova, produced between $200 million and $300 million worth of copper in 28 years of operation (Spude and others 1988). But mining declined as copper was depleted, and the mines and railroad closed in 1938, leaving Cordova with access to the interior only by air (Alaska Geographic Society 1986). The town transformed from a mining boom town into a town dependent on its fishing industry.

Fishing industry—Of the wealth of resources found in the Copper River system, the most enduring have been those from the sea. The first cannery in south-central Alaska was built in Cordova, and by the end of the 1880s, Cordova had several (Nielson 1984). In recent years, based on catch value, Cordova ranked as the 10th most significant fishing port in the United States (National Oceanographic and Atmospheric Administration 1989). The oil spill that occurred on March 24, 1989, when the supertanker *Exxon Valdez* grounded on a reef in Prince William Sound, has negatively affected both the fish and the fishing industry in ways and to an extent not yet fully understood. Initial research findings on the social impacts of the oil spill suggest that the community of Cordova was initially disrupted and residents experienced relatively high levels of collective stress (Picou and others 1992). In particular, commercial fishermen and their families seem to have experienced long-term or chronic patterns of stress 3 years after the spill (Picou and Gill 1993). The potential long-term consequences of the technological impacts raise questions regarding changes in lifestyle and the local economy that may characterize residents of the largest community in the Copper River Delta in the future.

That oil spill heightened international awareness of the rich resources and high economic, social, and biological values of the region, and provided a dramatic example of human-induced change. Response to the oil spill has made it clear that "local" resource issues can no longer be addressed in isolation from regional, national, and international issues and trends.

Local lifestyle and economy—Today, Native and non-Native people live interspersed in small communities, villages, and scattered homesteads along the coast and transportation corridors. According to the 1990 census, Cordova, the only community near the Delta, had a year-round population of 2,110. This figure doubles in summer with the seasonal influx of fishermen and workers in seafood processing. The 1990 census found that 11.2 percent of Cordova's population was Alaska Native, down from 15.2 percent reported in 1980.

The economy of Cordova is characterized by full-time employment in government, service, and trade industries (Fried and Stinson 1989). The service and trade components rely heavily on the fishery. A seasonal workforce also labors in mining, construction, and tourism, but fishing is the economic base of the community. The 1986 combined seine, gillnet, longline, crab, and other fisheries in Prince William Sound were worth $23.0 million in gross earnings for Cordova-based permit holders (Minerals Management Service 1993). One-third to one-half of all city revenues come directly from the fishery (Fried and Stinson 1989). Fishing is as much a lifestyle as an occupation, and for Cordova residents, the importance of fishing—commercial, sport, and for subsistence—is greater than is evidenced by numbers of fish harvested or economic value.

Subsistence—Fishing, hunting, and gathering for personal use are significant activities. But subsistence is more than "living off the land;" subsistence activities require special skills and a complex understanding of the local environment that enables people to live directly from the land. It also involves cultural values and attitudes: mutual respect, sharing, resourcefulness, and an understanding that is both conscious and mystical of the intricate relationships that link humans, animals and the environment. To this array of activities and deeply embedded values, we attach the word "subsistence," recognizing that no one word can adequately encompass all these related concepts. (Berger 1985:51).

Dyer and others (1992) found that several edibles are harvested and shared, including berries, marine invertebrates, many types of vegetation, and wild game. A study by Stratton (1989) found that an average 400 pounds of resources were harvested per household, with salmon making up 39 percent of the total.

Some residents base their livelihood entirely on subsistence activities—fishing, hunting, and gathering food and materials for personal use and for sharing with family and friends—whereas others combine subsistence activities with part-time or full-time employment. Stratton (1989) found that 91.3 percent of Cordova households received resources from other Cordova households, and 79.1 percent reported giving resources to other households. Other residents live entirely on employment and business activities.

For members of both Native and non-Native groups, lifestyle and quality of life are important. Subsistence practices and their value for all people who participate in these activities link people to places. These practices have evolved from Eyak culture to contemporary community culture. Both indigenous peoples and relative newcomers who live in the Copper River system have adapted to difficult climatic and environmental conditions. But in return they enjoy many quality-of-life benefits not available in the more comfortable urban settings found across much of North America (see footnote 2).

Tourism—Tourism plays a small but growing role in Cordova's economy. Activities include hunting, fishing, hiking, birdwatching, mountain climbing, glacier travel, river rafting, kayaking, and sightseeing. The spring bird migration, resulting in the greatest concentration of birds in the world (Isleib and Kessel 1973, Mickelson 1989), is gaining international attention. As more people become interested in nature-based tourism, growth in this area can be expected to continue. In 1993, Cordova held its fourth annual shorebird festival. This 10-day event featured natural history classes, field trips, and art and music activities. Visitors have come from as far away as Australia to view the birds during this event.

Potential development of transportation and resources—There is renewed interest in reestablishing the overland transportation route between Cordova and interior Alaska. When the railroad closed in 1938, the abandoned right-of-way was deeded to the Alaska Road Commission for conversion to a highway. Although engineering studies were completed in the 1950s and 1960s, no road has been built. Work delayed by the 1964 earthquake was resumed in the late 1960s, but by then the National Environmental Policy Act (1970) had become law, and an environmental impact statement (EIS) was required for continued work. The EIS and many associated studies were completed in the 1970s, but little was done on the ground (Alaska Department of Transportation and Public Facilities (ADOT-PF1988). New impetus came in 1992, when the State legislature funded new environmental impact studies to fully assess the social, economic, and environmental impacts of road construction. Results of that evaluation will be considered in deciding whether or not construction will proceed (ADOT-PF 1992). The community of Cordova is about equally divided on whether or not they want a road.

State studies now underway are reviewing several alternatives including taking no action at all, at least for now. Three of the alternatives are variations on building a highway that generally follows the railroad grade. Another proposal is to construct a

highway following the coastline from Cordova to Valdez. One of the State studies, the Copper River Highway scoping document (ADOT-PF 1992), reports that there were 11,600 visitors to Cordova in 1985 and forecasts that, with the opening of a highway, about 84,000 visitors would travel there each year.

The area is becoming known and valued for its wildlife and rugged beauty, but it is not an easy place to reach. Water access would improve with the construction of a deep water port. Such a port could tap into the market of 200,000 visitors who pass through Anchorage each year on cruise and bus tours.

Other potential developments that could directly affect the Copper River system include coal mining, oil drilling, development of hydropower, and further timber harvest (see footnote 2). Coal deposits, located about 50 miles east of Cordova near the Bering River, cover more than 50 square miles. Private interests have expressed an interest in mining and related activity, including construction of roads, transfer sites, and a burning facility (Thomas and others 1991). There are no other large-scale mines in the Copper River Valley, although mining is occurring on small claims. Extensive sand and gravel deposits throughout the Copper River lowlands currently provide the highest economic yield from minerals (Thomas and others 1991).

The Katalla oil field, located 50 miles southeast of Cordova, was Alaska's first producing oil field. Twenty-eight shallow wells were drilled, and about 154,000 barrels of oil were produced before a fire ended production in 1933 (State of Alaska 1974). Additional wells were drilled between 1902 and 1931 and between 1954 and 1969 (State of Alaska 1974). In 1980, a new well was drilled, but the company declared bankruptcy before it produced any oil. A group of Cordova investors has been considering buying the well and reinstating production.

Several potential hydropower sites near Cordova are under review, and others are proposed along the Copper River where it passes through the Chugach Mountains (Thomas and others 1991). Timber harvest currently is confined to younger growth on the western side of the Delta. Eyak Native Corporation has logged 4,376 acres on the Delta near Eyak Lake and the airport since 1988. The corporation also has submitted plans to harvest 2,300 acres on the Eyak River. The only other logging on the Delta is a small, selective cut of about 200 acres administered by the ADOT-PF

Challenges to management—Several issues challenge management within the Copper River system. As mentioned earlier, the land and resources of the system are managed by a diverse group of Federal and State agencies, Native corporations, and private owners. The existing memorandum of understanding between State and Federal agencies recognizes the need to coordinate planning and policy development, as well as protect, maintain, and manage fish and wildlife stocks and habitat But managers report that they do not have the information they need about ecosystems and how they function, or about the ways in which biological and ecological resources are affected by natural and anthropogenic changes (Thomas and others 1991).

The Copper River Delta Institute as a catalyst—Since the early 1980s, the Forest Service has received increasing pressure to expand research, develop partnerships, and share resources and management. The Copper River Delta Institute (CRDI) was established in 1989 in response to those requests and to recognize both the unique opportunities for research and the increasing demand for recreational and other uses of Copper River system resources.

Established by the Pacific Northwest Research Station and the Alaska Region of the USDA Forest Service, CRDI is a partnership among Federal and State agencies, universities, Native corporations, local government, educational organizations, and environmental and natural resource interest groups. A coordinating committee provides policy and program direction. The institute office and staff, including a director, administrative support, and research wildlife biologist, are based in Cordova.

The institute's research encompasses ecosystems, biological communities, specific species, and social values. The education and interpretation program emphasizes wetland ecology, ecosystem research, and natural resource stewardship.

The mission of the CRDI is to "serve people by improving understanding, use, and management of natural resources of the Copper River ecosystem." Steps to achieve this mission are to:

1. Conduct, sponsor, and coordinate basic and applied research and development on the ecosystem of the Copper River Delta wetlands, estuary, and associated marine environments.

2. Develop technology and management guidelines and strategies for use by managers based on knowledge about biological, physical, ecological, social, and economic associations and issues to ensure compatibility of people and long-term sustainability of ecosystems.

3. Conduct symposia, conferences, and workshops that provide technology transfer to managers, other clients, researchers, and the public, and that provide answers and solutions applicable to other coastal areas

4. Establish an environmental education program and interpretive forums to provide information for increasing people's understanding of wetlands, ecosystem processes, and ecological values associated with the resources and people of the region.

Three tasks were identified to provide direction for CRDI programs and activities in science, interpretation and education, and management. One of these tasks, the management needs assessment, is the subject of this report. The assessment was completed in two stages. A workshop was conducted, followed by a rating process carried out through the mail.

Preliminary Workshop

Because management needs should be identified by managers and those concerned about management, a process was developed to involve them in articulating and prioritizing those needs. As the first step, the consortium sponsored a workshop in Anchorage, Alaska, in spring 1991 to facilitate collaboration among managers, scientists, and others interested in management of the resources of the Delta.

The CRDI manager invited 20 representatives of Federal and State agencies, local government, local and regional organizations, Native groups, and interest groups to participate in the workshop.

A nominal group technique (Delbecq and others 1975), commonly used with groups to elicit and prioritize information, was used to solicit response to the questions: "What major issues will managers have to deal with in the next 10 years? " and "What information do managers need to manage the Copper River systems?" Focus areas identified by this process are summarized in figures 3 and 4.

As You think about the next 10 years, what are the major issues that managers of the Copper River ecosystem must deal with?

1. Human modification of the Copper River ecosystem
   - Access
   - Increased human use (recreation and tourism, mineral development and extraction, timber harvest, etc.)
   - Cumulative effects of human activity
   - Increased demand for Copper River resources (for example, wildlife)
   - Scale of human activity
2. Coordinated, integrated planning systems
   - Private-public land management systems (for example, goals, processes, and externalities)
   - Institutional barriers to coordinated planning
   - Piecemeal decisionmaking
   - Allocation among different user groups
   - Development of appropriate scale for planning (for example, definition of Copper River ecosystem)
3. Inadequate knowledge to make appropriate management decisions
   - Baseline data on biological, physical, and social information
   - Maintenance of diversity
   - Lack of knowledge about specific substantive areas (for example, threatened and endangered species, global warming, and ecosystem dynamics)
4. Resource manager, scientist, and public interface
   - Trust
   - Communication
   - Public pressures, special interest pressures
   - Use conflicts
   - Research-manager links
   - Linkages and roles of different institutional players
   - Consensus planning
5. Administrative barriers
   - Funding
   - Staffing
   - Legal

Figure 3—Major issues

What Information do managers need to effectively manage Copper River ecosystems?

1. Improved understanding of Copper River ecosystems

- Basic description:
  - Historical conditions
  - Existing conditions
  - Basic processes presently operating
- Interrelation
  - Wildlife and vegetation (including critical habitats)
  - Fresh water and salt water
  - Predator and prey
  - People and fauna-flora
  - Upper watershed and delta
  - Delta and Gulf of Alaska

2. Human values and uses of the Copper River ecosystem

  - Human desires and demands
  - Understanding of tradeoffs
  - History of human uses of ecosystems
  - Current uses of ecosystems
  - Projected uses of ecosystems

3. Management of Copper River ecosystem

  - Linking management to human desires and demands (role of public participation)
  - Management options for selected species (for example, dusky Canada goose)
  - Criteria to determine consistency in management activity
  - Coverage and compatibility of GIS databases
  - Systems for monitoring management effectiveness and cumulative effects

4. Administrative and organizational issues

  - Jurisdictional authority, interorganizational links
  - Land use patterns and relations
  - Organizational goals and relations
  - Organizational goals and objectives (including private and public players)
  - Legal authority

Figure 4—Information needs.

Concerns identified by workshop participants included the following:

- **Role:** Clarification as to the role of CRDI was provided by the CRDI manager and by examining the CRDI mission—"to serve people by improving understanding, use, and management of natural resources of the Copper River ecosystem." Participants agreed that CRDI should deal not only with the Delta but with the entire Copper River system.
- **Barriers:** Several barriers were identified and discussed. Among them were barriers related to funding, staffing, jurisdictional and legal authorities, and ownership. Although some barriers are real, others are only perceived. The result is the same, however, unless actions are taken to break down and overcome the limiting perceptions. For example, jurisdictional authorities may be perceived as barriers to cooperative management.

Working together allows agencies and other entities to identify and take advantage of opportunities that may not be available to each group on its own. There may be opportunities for creative management that expand the bounds of possibilities rather than remaining within the bounds of perceived barriers. Taking advantage of opportunities to meet across agencies to discuss barrier-related issues will help break them down and allow development of strategies and structures to overcome their limitations.

- **Inventory and monitoring:** Participants expressed the need for effective inventory and monitoring systems that could be used across agencies, with standardized protocols for data collection and management. Inventory and monitoring were seen as integral components of managing and maintaining healthy systems, and emphasis was placed on the need for accuracy and consistency in data collection and maintenance.

Rating Process

After the workshop, the issues and information needs identified by workshop participants were used to develop a rating form. Initially conceived as a two-part Delphi,[5] the process was reduced to one mailing when the information obtained through the first mailing was determined to be sufficient for the study. Instead of soliciting issues and needs from mail respondents, and following that with a second mailing to establish rank order, items from the workshop were supplemented with items from a previous Delphi on management of Alaska wildlands. The resulting 125 items were arranged and presented under three headings:

Copper River ecosystems:

- Structure, functions, processes, and interrelations
- Human values of, uses of, modifications to, and impacts on the Copper River ecosystem

Management of the Copper River ecosystem:

- Development of management models, strategies, processes, and actions
- Consequences and implications

[5] Delphi uses written responses to aggregate judgments of individuals. Essentially brainstorming through the mail, it is used to develop lists of ideas, concerns, needs, solutions, or problems and establish a priority ranking of them (Delbecq and others 1975)

Institutional issues:

- Barriers and opportunities affecting relations among interests and organizations
- Decision making processes: models and approaches
- Public involvement, communications, and education

Opportunities were provided for respondents to add their own items. Comments were encouraged.

Managers, scientists, and interested individuals at institutions and organizations were invited to participate in the rating process. They included (1) participants of prior workshops and Delphi studies who were knowledgeable about the Delta and (2) names submitted by the CRDI manager. Seventy-nine rating forms were mailed Thirty-two responses were tabulated for a response rate of 40 percent, as shown in this tabulation:

Contact	Mailed	Responses	Response rate
	- - - - *Number* - - - -		*Percent*
Federal government	19	7	37
State government	12	6	50
Local government	6	4	67
Industry	8	3	38
Tourism and recreation	9	4	44
Environmental	16	5	31
Native American Corp.	5	1	20
Other	4	2	50
Total	79	32	40

Although the response rate was not high, people from various backgrounds completed the rating form. There were responses from Federal, State, and local agencies, industry, recreation and tourism interests, environmental groups, an educational institution, and a Native-American corporation.

Respondents were asked to rate each question as critical, important, relevant, or not relevant. Critical items were defined as prerequisites of effective management requiring immediate action. Important items, although less time-sensitive than the critical items, were defined as important enough that planning should begin immediately. Relevant items were those whose value depended on how or where the question was applied. For example, a question may be important in some parts of the Copper River system but not in others. Some respondents found certain items not relevant to the Delta or Copper River system.

People, Places, and Processes

Several approaches could have been used to organize the items for analysis and discussion, but the "people, places, and processes" framework developed by Stankey and dark (1992) was chosen. The following discussion of the framework has been adapted from the original.

The relation between the people and natural resources of the Copper River system can be defined by two alternative paradigms. A traditional model of this linkage conceives of people as apart from or external to the natural resource system. Such a model shapes our understanding of the linkage between people and natural resources in particular ways—as an external element, people constitute a disruptive influence on the natural system and its processes. Consequently, the principal attention on people-natural resource interactions is on preventing, controlling, or otherwise mitigating the adverse impacts stemming from human use. It contributes to a reductionist form of thinking, substituting rigid, mechanistic thinking for a more integrative approach.

An alternative model conceives of people as an integral component of the ecosystem. Within this model, two principal questions can be addressed that examine the respective roles of structure and process between human and nonhuman components of the ecosystem: (1) under what conditions do ecosystem variables serve as a prime, facilitating, or consequent factor in the observed social system variation, and (2) under what conditions do social system variables influence the natural ecosystem in such a manner that reciprocal feedback alters the basis of the social system (Burch 1988)?

This latter model derives from earlier traditions of human ecology, but differs from that earlier view in that biological processes become a fundamental part of the explanations in what Burch (1988) calls "social ecology." It is also a model in which it is explicitly understood that the natural resource system—its definition, assessment, and value—is only given meaning through the process of cultural appraisal. As a corollary to this, conceptions of the extent, value, and utility of the natural resource system differ over both space and time, and with these redefinitions will come changes in the associated human institutions considered appropriate and necessary.

Finally, this model, by definition, recognizes the interrelated nature of the system components, the potentially constraining effects of institutional, disciplinary, and legal boundaries that ignore basic biological processes, and the need for an integrative approach to thinking at both conceptual and implementation levels (dark and Brown 1990, dark and Buscher 1990).

This analysis rests firmly on the latter model. People are considered as part of the ecosystem—they derive material and nonmaterial goods and services from ecosystems; they live, work, and play in settings ecosystems provide; and their attitudes, behavior, and knowledge of the system affect it in both direct and indirect ways, including the definition of values associated with the Copper River setting. Thus, any activity that alters the structure and processes of the biological system will alter the human system that interacts with it; moreover, the way in which the human system perceives the area will affect how that biological system will be altered.

There are three key elements around which most natural resource management problems and issues can be defined. These three elements involve **people** (including their distribution, values, organization, and behavior), **places** (both the geographic and symbolic dimension), and **processes** (the ecological processes, human activities, and institutions that affect people, places, and their interactions).

This analysis encompasses and integrates the ecological and sociocultural components of the Copper River system. In the broadest terms, it addresses two basic questions of concern: how do biological and physical components of the Copper River system affect people, the places they value and use, and processes of which they are a part; and, conversely, how do people affect components of the biological and physical systems? It is essential these reciprocal effects be understood. How will the changes in ecological conditions affect people in terms of aesthetic enjoyment, onsite recreation use, and resource use? How do people participate in decisions regarding how the area should look, and how will they respond when it takes on attributes considered unacceptable? More generally, how do changes in the nature of place affect the behavior of people, and how do processes such as research, public participation, and the law come into play?

When there is little or no agreement on the magnitude or relative importance of different values, or over the use of resources for different values, conflicts arise Such conflicts are extremely difficult to deal with, especially given the traditional technical-rational model of decisionmaking. It is necessary to identify the kinds of values society holds with regard to the natural resource systems, how those values differ across space and time, how these values are formed and changed, and how managers can enhance the realization of a wide range of values—both amenity and commodity. This would include ways in which different interests can better represent their values and in how management can integrate these values into decisionmaking. Complex land tenure in the Copper River system makes this a particularly difficult task.

The issues identified in this assessment focus on development of an improved understanding of three critical components of, and interactions within, ecosystems: (1) the people who own, use, and think about the Copper River system; (2) the places—including resources—they use and value; and (3) the processes—both ecological and sociocultural—that link people to places. All involve units of analysis that differ in importance, depending on the nature of the problem with which one is concerned. These relations are shown in a Venn diagram (fig. 5).

People

The people component includes a basic description of the structure of society in terms of number, distribution, and characteristics. It includes an understanding of various concepts used to describe and understand the attitudes and behavior of people—their knowledge, beliefs, motives, expectations, and preferences—as well as the factors underlying them. Our focus on people, and examples of the kinds of questions we would consider, will differ according to their organization.

Individuals—This basic unit of analysis includes individuals from the public as well as from within organizations. What is the range of knowledge about ecological processes among individuals, and what factors account for the differences? How important is lifestyle, and how has it influenced what the people of the Copper River system think and do in the area? How are perceptions influenced by where one resides: At the headwaters? At the Copper River Delta? Elsewhere in Alaska? Outside Alaska? How do these perceptions differ between cultures? Occupations?

Groups—Groups are informal associations of individuals, built around social networks, kinship groups, or mutually shared interests. In what ways do natural resources and their management unite or splinter groups interested in them? How do values (whether commodity, scientific, recreational, or spiritual) influence where people live and what they do?

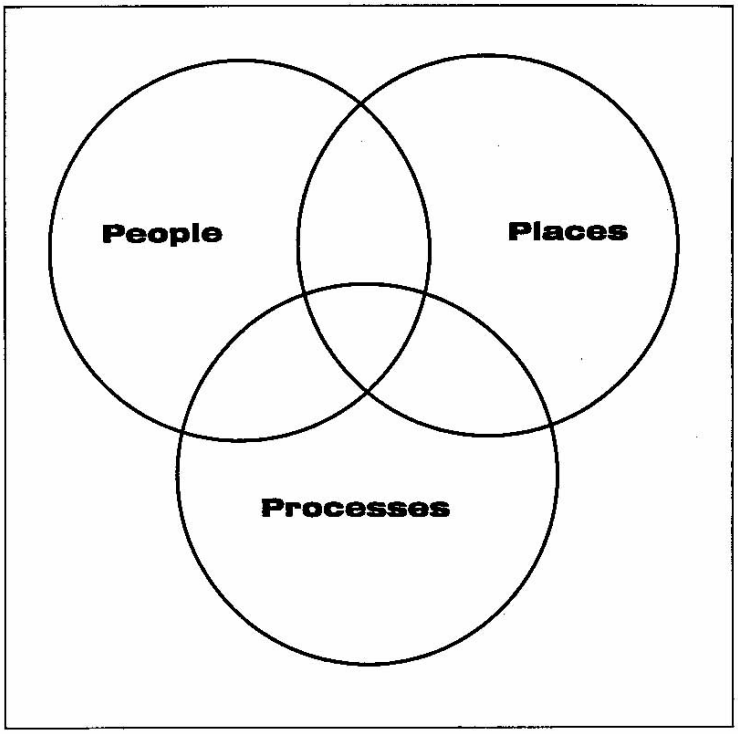

Figure 5—People, places, and processes framework.

Organizations—Organizations are formal groups, linked by work, professional, cultural, political, or other interests. These may be joined over space by common concern in certain issues, thus forming a "community of interests." How do the activities of citizens or managers produce coalitions among different organizations to further their political agendas? What unique organizations have emerged in response to the conditions found in the Copper River system?

Communities—There are many different conceptions of community. At least three distinctive definitions exist, including community as a geographic locale, as a local social system, and as a sense of shared identity which may or may not involve a geographic locale where interaction occurs. Irrespective of definition, however, the key concern is how changes in use of resources and in management might affect community social structure and the various institutions providing order in the community (Lee and others 1990). For example, how do changes in use of resources affect education and other social services in local communities? What factors underlie long-term stability of Native cultures and local non-Native communities? Which values are shared or are in conflict among residents of the Copper River system?

Populations—Populations are large-scale aggregations of individuals, typically diverse in structure, interests, and economic activity. What are the trends in population structure (age, education, and residence), and what are the implications of these trends in terms of resource uses and values for Copper River ecosystems in the future? How will increasing interest in Pacific Rim countries and their resources affect the people of the Copper River system?

Places

Places represent both geographic locations and human values. They can be described either in objective terms and attributes or by means of the images and symbols they convey. People value these places and the resources associated with them, and it is the management of places on which resource professionals focus. In some cases, direct human use of places defines the value of the location, but in others, the meaning and symbolic importance attached to these locations give them great value, irrespective of direct on-site use. Various scales of analysis are appropriate depending on the issue or point of view.

Sites—Small locations or sites, can involve only a few square yards and a few trees in forested areas. For example, how will site changes, whether from natural or human-induced causes, affect present or future recreational or subsistence uses of key sites?

Small patches of land—Relatively small units of land, perhaps 100 acres, involving a mix of species and structure for natural productivity and resilience to stress. Viable areas are typically defined by experts, but what are the relevant units of analysis used by various publics? How might these differ from the Copper River Delta to the headwaters of the Copper River and its tributaries?

Drainages—Drainages range considerably in size, from a few hundred to thousands of acres. They are defined by surface configuration but likely have a major effect on the behavior of many people. What are the cumulative effects of significant alteration of contiguous drainages on recreation, subsistence, or local resource-dependent communities and villages?

Landscapes—Landscapes are roughly defined by watershed boundaries, are often comprised of more than one drainage, and range from 100 to 100,000 acres or more depending on topography. They may involve many stands of forests, thousands of acres of icefields, glaciers, tundra, and estuaries, and many small sites. What is the acceptable mix of attributes and conditions as defined by people at the landscape level? How does the presence or absence of human habitation influence such judgments?

Region—A region is large scale, involving several thousand square miles, a range of ecological conditions, and multiple political and administrative jurisdictions. How do alterations in natural conditions at the regional scale affect the range of social, economic, and environmental diversity sought by local communities, regional populations, and tourists?

Continents—Continents involve very large areas of land and water, perhaps with national boundaries as subunits. In addition to the large scales involved, highly varied environmental, political, and cultural conditions would be typical. What are the physical, social, and economic factors that contribute to the comparative advantage or disadvantage of one region over another?

Global—The unit of global analysis transcends national political boundaries, possibly involving differing legal and economic systems and cultural characteristics. What aspects of different systems of resource stewardship and property rights found in other cultures might be adapted to natural management in the United States? In the Copper River system? How do areas similar to the Copper River system function with respect to social and cultural systems?

The appropriate scale of analysis for any given issue is situationally specific—depending on the nature of the question and the factors affecting it, one scale or more may be appropriate. We need an improved understanding of the relations between the scope of an issue and the appropriate geographic scale(s) at which analysis should be performed; for example, site-specific problems should not necessarily be treated as site-specific issues. To treat the two as synonymous may be to confuse symptom and cause. Additionally, the appropriate boundary for analysis also may differ for example, socioeconomic considerations (native ownership, recreation home ranges) may lead to a definition of appropriate scale quite different from, and more relevant than, that imposed by purely ecological concerns.

Processes

Processes comprise the final component of this conceptual framework. These include both basic ecological processes (succession, disturbance) as well as those sociocultural processes that influence the relations among people and between people and places. They may be taken singly or in combination, and their specific characteristics may differ over time and space; the scales and rates of change associated with a process may lead to highly variable impacts on people or the environment. Five broad classes of processes, with specific examples of each, include (depending upon the circumstances, specific techniques might fit in more than one broad category; for example, public participation);

Prescriptive processes—Prescriptive processes include allocation, planning, and management activities. How do concepts of property rights such as those among villages and regional corporations and other resource managers affect the implementation of multijurisdictional planning approaches? How well are diverse human values dealt with under such conditions?

Information processes—Communication, education, diffusion-adoption, information, marketing, monitoring and evaluation, public participation, research, development, application programs, and choice processes are considered information processes. In what way do agency public-involvement programs favor, or discriminate against, different values and constituencies?

Conflict resolution processes—Conflict resolution processes include policy formation, judicial activity, political activity, and mediation. How can changes in perceptions of property rights facilitate complementary management on adjacent lands? Whose values take precedence? Why?

Social and psychological processes—Socialization, assimilation, selective perception, and adaptation are social and psychological processes. How do communities accommodate the changing values resulting from in-migration? Changing resource use patterns?

Ecological processes—Succession, disturbance, adaptation, and migration are examples of ecological processes. How do changes in fundamental ecological processes (rates of change, human alteration) impact dependent human communities? And how do human-induced changes affect ecological processes? How do they differ over time and space?

Although it is possible, and often essential, to describe each of the above components individually, the interaction between and among the components is more commonly what we are interested in. As figure 6 shows, it is possible to identify seven distinct relations: (1) people, (2) places, (3) processes, (4) people-places, (5) people-processes, (6) places-processes, and (7) people, places, and processes It is within such a framework that the relations among studies of social values and those of other biophysical research programs can be seen.

The people, places, and processes framework provides a tool for organizing items that are complex, holistic, and integrative. Further, using the framework helped to assure adequate attention to the full spectrum of social, cultural, ecological, and biological components of the Copper River Delta system, and to the need for improved understanding of the three main components and the interactions among them.

The people, places, and processes framework helps arrange priorities so that the diverse needs of managers are addressed and all the components are adequately represented. Results of this assessment are presented within this framework.

Results

Although only seven items (6 percent) were rated as critical by most respondents, 91 percent of the items were rated as either critical or important by over 50 percent of the respondents. Respondents indicated that immediate action—planning at a minimum—is needed in response to 114 of the 125 items offered.

A sample question from each component of the framework is provided to help illustrate the kinds of items in each grouping. The complete list of items, grouped by the people, places, and processes components, is provided in appendix B:

- People—What are the differences between values and preferences of local as compared with nonlocal users?
- Places—How are resources interrelated?
- Processes—How can recreational and wildland management be integrated with planned and potential development?
- People-processes—How can subsistence and cultural values be integrated with wildland resource management?
- People-places—What are the key attributes of the coastal setting that serve recreation and tourism needs?
- Places-processes—How can we develop a system for planning by ecosystem rather than by individual species to help address system sustainability?
- People, places, and processes—How can managers minimize the disruptive effects of mining and other resource uses on wildlands?

A list of keywords and concepts was developed to help assure consistency in classifying the items within the components (fig. 6). The list was developed through an iterative process, moving between the framework and the data, to fine-tune the framework while grounding it in the data. Recognizing that any particular classification scheme is arbitrary, this iterative process allowed the framework to be customized to better organize and present these data.

Keywords and concepts drawn from the data used to define the components.

A. People

- Individuals, groups, organizations, and governmental units
- Land ownership
- Culture, subcultures
- Human values, knowledge, beliefs, attitudes, and preferences
- Human uses of the natural-nonhuman environment

B. Places

- Attributes of the natural environment (plants, animals, physical or biological habitat, biodiversity, ecosystems, and wildland resources).
- A specific kind of place (wildlands, wetland, and old growth) or a specific location within the Copper River Delta and the broader Copper River system.

C. Processes

- Ecological (nonhuman) processes: succession, disturbance, adaptation, migration. All ecological processes are categorized under processes but not necessarily under places, even though by definition ecological processes involve place.
- Human processes
- Prescriptive processes: allocation, planning, and management
- Information processes: communication; education; public participation; decisionmaking; research, development and application; inventory, monitoring, and evaluation measurement
- Conflict resolution processes: policy formation, judicial activity, political activity, mediation, alternative dispute resolution
- Sociopsychological processes: socialization, assimilation, adaptation

Figure 6—Keywords and concepts

By using the Venn diagram (fig. 7), the items were graphically displayed based on their classification within the seven components of the framework. The location of items within the framework is revealing: (1) Only one item—How are resources interrelated?— was classified as solely related to places; but when interaction with the people and processes components was considered, one-third of the items involved places. (2) More than one-half of the items explicitly related to people, and again, most of those involved interactions with the other components. (3) Processes comprised 85 percent of the items, including 51 percent involving interaction with other components. As mentioned previously, it is more commonly the interactions between components that we are interested in.

The items were ordered within the framework according to their critical score. Without the organization provided by the framework, most items involving people—recreation, subsistence, tourism, cultural, and other noncommodity values—come out at the bottom of the list of ordered items. But managers recognize that most of their problems involve people. In a study of concerns of Forest Service supervisors and District Rangers, Jakes and others (1990) found "few of the key issues relate to technical

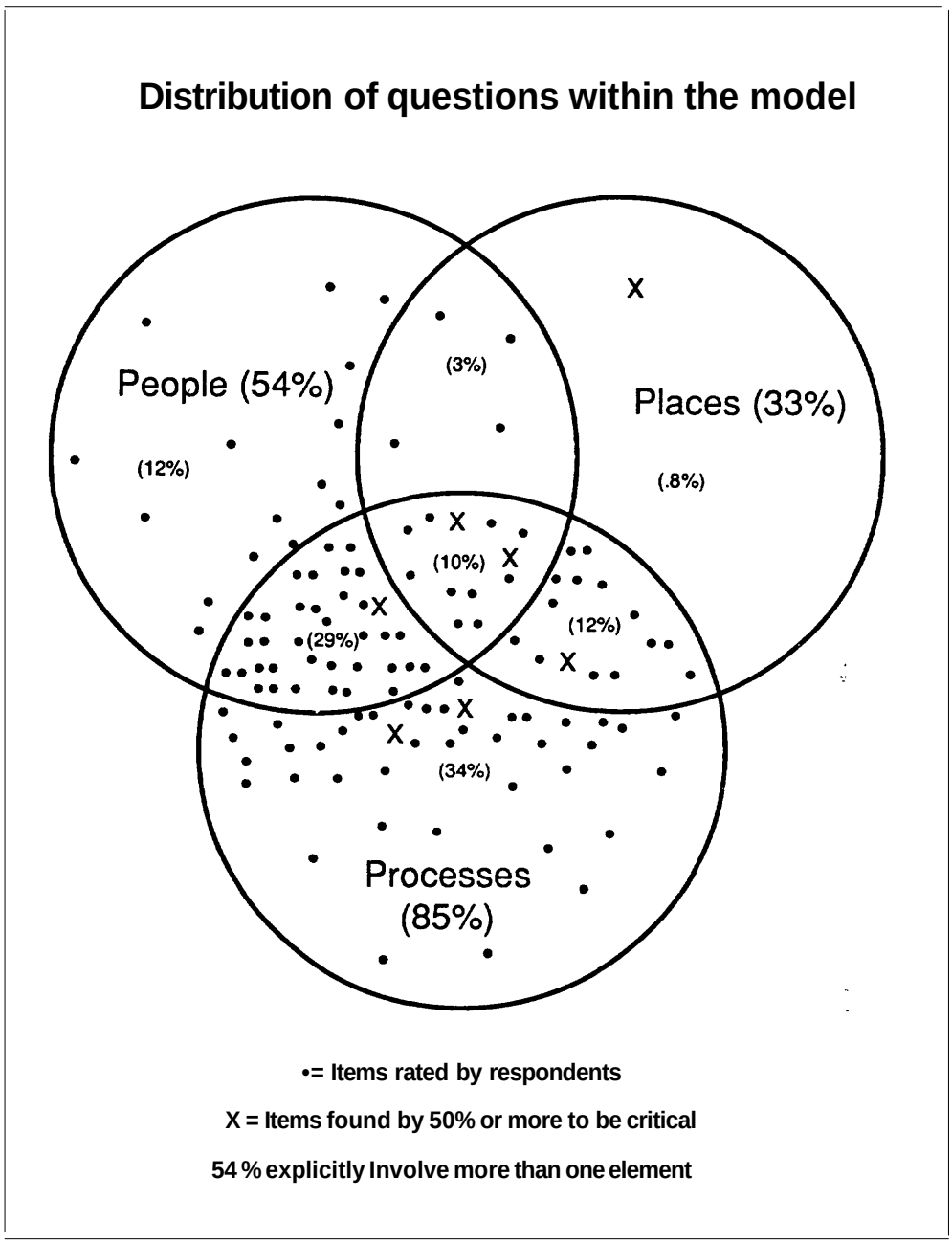

Figure 7—People, places, and processes framework with data.

aspects of forest management and use. Rather, the issues relate to the people problems...." In fact, they found that four out of five of the most important issues deal with conflict resolution (Jakes and others 1990). **The people component is a key consideration if managers are to achieve socially acceptable answers to management issues.**

A short list of 13 priority items was developed by taking the top 2 items from each of six components and the single item from the seventh. Three themes underlie these 13 items. The seven questions found by more than 50 percent of the respondents to be critical, items submitted by respondents, and additional questions developed during the assessment process to help define the topic areas are provided to illustrate these themes. Critical questions are shown in bold print.

Theme 1: Understanding the impacts and cumulative effects of human activity. Four items address this theme. There is interest in identifying the impacts, cumulative effects, evaluation, and determination of when one activity impacts another use or value. The items are general. Most can be applied to issues related to fish, wildlife, habitat, sociocultural values, or interrelations.

- **What are the impacts of increased reading, access, and assorted human uses?** What is the significance of a Copper River highway? How do conditions change with access?
- **What are the cumulative effects of human activity?** What is the impact of enhanced fish production on nonenhanced wild stock?
- When does one kind of use diminish, disturb, or destroy another? How can thresholds for change be defined and management strategies be developed to meet those thresholds?
- How might we evaluate the effects of oil, gas, mineral, and other resource development activities on wildlands? When are silviculture, mining, and oil and gas development not compatible with wildland values?

Theme 2: Improving our understanding of the interrelation among resources and between resources and people. Improved understanding is critical if we are to develop better processes for integrating subsistence, cultural values, recreation, aesthetic, and other amenity values into resource management activities.

How we define natural and healthy populations of wildlife and values of wetlands are items that relate to identification of the stakeholders—those scientists, managers, and members of the public directly affected by the way in which resources and values are defined. Wetlands, for example, can be defined as either an extremely valuable component of the Copper River system or as a wasteland having negative value until filled and developed. Who is involved in the definition process and what this process is must be considered.

- **How are resources interrelated?** What are the associations among moose, vegetation, and beaver? Why is this important to understand?

- **What information and techniques are needed to more accurately define and effectively integrate management of recreation, scenery, wildlife, and other amenity values into planning and management?** What is an effective design for baseline inventory and monitoring of the human element in the ecosystem? How do different silvicultural techniques affect interrelations among plants, animals, and humans? How can the range of values be incorporated at the front end of decisionmaking?
- **How do we define and maintain natural and healthy populations of wildlife?** What studies are needed to define and evaluate ecosystem processes?
- What values can be assigned to wetlands in the area? What role do wetlands play in providing critical fish, bird, and wildlife habitat?
- What is the interrelation between wildland resources and culture? If only certain components of habitats are sustained, what is the effect on the whole of those components that are lost?
- Who are the stakeholders in the area, and what are their zones of influence? What are existing institutional relations and how are relation with other groups and agencies developed?

Theme 3: Resource management philosophy. How to develop a process to move toward long-term stewardship and sustainability, and how to address the effects of Native American ownership within conservation units. The latter question is part of the larger issue of how to implement ecosystem management across multiple ownerships.

- **How can we shift from short-term economic and political benefits to long-term stewardship and sustainability?** How do we clarify goals regarding the optimum mix of certain benefits, goods, and services on a sustainable basis?
- **How can we address the effects of Native land ownership within conservation units?** How can human values be investigated and managed regionally and involve adjacent landowners?
- How can subsistence and cultural values be integrated with wildland resources management? How can we develop a conceptual model of ecological elements, including social and cultural components, and interactions through integrated research efforts? Integration of social and cultural items in research will pave the way toward integration of these considerations in management.

Insight into some of the ratings, particularly why some respondents thought particular items were not relevant, was gained by analyzing respondent comments. Several respondents identified certain issues as "beyond the scope of CRDI." One respondent wrote, "...most items relate to human values, management processes, economics, institutional arrangements, etc., which bear little resemblance to the charter of CRDI." This comment helps explain the low ranking of many items dealing with social and cultural issues. Other respondents commented that research should emphasize "local issues." Illustrating this sentiment, several items addressing issues with application beyond the Copper River system received a not relevant response from some respondents.

One respondent expressed the view that priority should be placed on the "functioning of natural ecosystems"—specifically Delta ecosystems—and that social and economic values should not be a focus This assumes that the function of CRDI is to provide biological data for better decisionmaking but not to consider related social, cultural, and economic factors.

Ecosystems play an obvious role in the economy. They also influence social structures, cultural expression, and spirituality. Human activities may alter the environment to such a degree that those changes in turn bring about social and cultural change. Human activities often result in changes in the physical and biological components of the ecosystem. Thus, study of biological systems without consideration of human influences could be misleading.

Two respondents noted the importance of looking at the history and prehistory of indigenous people and the need for geological and paleontological studies. Three respondents expressed concern for the beauty and pristine nature of the area, seeking management that would protect aesthetic values. One respondent wrote, "CRDI is in the prime location to serve as a catalyst for the public to gain a better understanding of the natural values of the Copper River Delta and River ecosystem."

In retrospect, it seems surprising that there were no items or comments related to the 1989 *Exxon Valdez* oil spill, only 50 miles away in Prince William Sound, or to potential effects of future oil spills. An initial perception of CRDI's role as limited to the Delta may have led to an assumption that the impact of oil spills was beyond the scope of CRDI. With the clarification that CRDI will address the entire Copper River system, items related to the effects of oil spills on ecological, cultural, and social systems clearly become relevant. The work being done by Picou (1992) at the University of South Alabama on the social impacts of the oil spill is one example of many oil spill studies relevant to the Delta. These studies will add to our understanding of interrelation across the Copper River system as we see changes in inland use patterns reflecting impacts on coastal resources.

Exploring the themes presented in this assessment raises questions about the implications of global change. The most visible effects of global change will occur along coastlines where water tables will rise and salt water will move up into rivers and flood into aquifers (Silver and DeFries 1990). Silver and DeFries (1990) report that "wetlands... may be a prominent victim of sea level rise." They go on to say that a rise in sea level would most severely impact river deltas. Not knowing how the Copper River Delta may be affected by the projected rise in sea level and other aspects associated with global change provides additional incentive to collect baseline data and to study how people are affected by and respond to a changing environment.

In addition to the science and education-interpretation reports commissioned by CRDI, several other reports supplement the findings of this management-needs assessment. The research agenda, "Alaska Wildlands Social Science"[6] poses several research questions applicable to the Copper River system. The questions are arranged in three

[6] Lee, Robert G ; Bray, Martha 1991. Alaska wildlands social science: a research agenda. Portland, OR: U.S Department of Agriculture, Forest Service, Pacific Northwest Research Station. 37 p. Unpublished report On file with: People and Natural Resources Program, Forestry Sciences Laboratory, Pacific Northwest Research Station, 4043 Roosevelt Way NE, Seattle. WA 98105.

categories: local communities, the role of State and Federal agencies, and national and international influences. Lee and Bray (see footnote 5) will expand each category with propositions developed from the Alaska Wildlands Delphi, conducted in 1989, and from personal interviews they conducted in 1991. The authors highlight identification of interrelations among sustaining local community life, including subsistence, and ecosystem management, and between agencies and agencies and communities. They also identified a need for interagency cooperation to assure compliance with regional and national goals while satisfying local needs.

"Forestry Research: A Mandate for Change" a report of The National Research Council (NRC) (1990) lists several major issues facing society. The recommendations found in the NRC report parallel the findings of this assessment, calling for strengthening research of ecosystem function and management and human-environment interactions. The report recommends an outreach to a much larger audience than in the past, and a larger leadership role for scientists in communicating knowledge.

Recommendations found in "Land Stewardship in the Next Era of Conservation" (Sample 1991) reflect the need to understand human impacts, interrelation, the need for baseline information to make responsible decisions, and the importance of monitoring if we are to achieve long-term stewardship and sustainability. Several components of the four principles of stewardship identified by Sample can be found within the priority questions of this needs assessment The principles are:

- Management activities must be within the physical and biological capabilities of the land, based on comprehensive, up-to-date resource information and a thorough scientific understanding of the functioning and response of the ecosystem
- The intent of management, as well as monitoring and reporting, should be making progress toward desired future conditions, not on achieving specific near-term resource output targets.
- Stewardship means passing the land and resources—including intact, functioning forest ecosystems—to the next generation in better condition than they were found.
- Land stewardship must be more than good "scientific management"—it must be a moral imperative.

In addition to these and many other reports, the Ecosystem Management policy, initiated by the Forest Service in mid-1992, focuses on improving three key activities critical to management of the Copper River system. These are public involvement, partnerships, and the integration of science and management. The four principles underlying this policy are also embedded within the questions identified as important by this assessment. The principles are (1) take care of the land; (2) take care of the people and their cultural diversity; (3) use resources wisely and efficiently; (4) and strive for balance, equity, and harmony between people and the land.

Conclusions

This assessment shows that there is concern about how human impacts alter the physical and biological components of the Copper River system. A closely related issue is how social and cultural components are affected, and how they respond to change. To reduce and mitigate adverse impacts on the Copper River system, a greater understanding of the Copper River system's resources, and of interrelations among the physical, biological, and human components of the Copper River system is needed (Thomas and others 1991). A greater understanding of social values, how

they change, and how this is related to how people adapt when confronted with changing conditions, is needed to minimize and mitigate negative social and cultural impacts.

Humans have been a part of the Copper River system for several thousand years. The Copper River system has been influenced by events ranging from advancing and retreating glaciers and severe earthquakes to shifting river courses and minor tremors Human-induced change has included invasions from other cultures, resource use and development, and associated transportation activities. The Science Commission Report (1992) noted that "the history of the region testifies to the human ability to adapt quickly to circumstances of adversity."

The concerns expressed by respondents in this assessment reflect both an opportunity and a need to identify, evaluate, and study both human impacts and the human and ecological responses to environmental change. Because people have been a part of the Copper River system for centuries, opportunities exist for studying how humans have adapted to the environment and the resources the area offers. It also provides opportunities to understand how human use has affected the ecosystems that comprise the Copper River system. Some areas warranting study have been identified in this assessment. The three broad people, places, and processes questions presented earlier—How does place (the environment) affect people? How do people affect place? and What processes are involved?—encompass several questions:

What are the environmental effects on people? Patterns of ecosystem components dramatically affect how, when, and where human habitation and use will occur. Key questions underlying this relation include:

- What are the perceptions and uses of the Copper River ecosystem? How are perceptions shaped by where one resides? Does the point of view of the resident or visitor differ according to where they are located—within the Copper River Delta, at the headwaters of the Copper River, or outside the area?
- How have changes in the Copper River ecosystem affected people in the past and present, and how will they affect people in the future? What are the historical roots of present day values and uses?
- How do microelements and macroelements of the Copper River ecosystem landscape (glaciers, sloughs, rivers, forests, mountains, and estuaries) affect human values and uses? To what extent has technology been used through time to accommodate human use to the Copper River ecosystem?
- How does the Copper River ecosystem affect our ability to do science as compared to elsewhere? What questions is the Copper River system uniquely suited to answer?

What are the effects of people on the environment? People have resided within or visited the Copper River ecosystem for many years. Key questions about their uses of, and effects on, the area include:

- What role have people played in the present configuration of the Copper River ecosystem? What implications do these changes have for other ecosystem components? For other people and their activities? For example, the most obvious human changes are the communities in which people reside and their transportation systems. The historical legacy may provide an infrastructure that influences present or future use or both. For example, the Copper River railroad bed and the

Million Dollar Bridge may affect not only present human use patterns, but the presence of these structures, as well as the use made of them, may have effects on waterfowl, wildlife, and streamflows among other things. If so, how do such changes differ through time and space? How important are they vis-a-vis other changes? Remnants of the railway and mining in the upper Copper River greatly affect use and habitation in these areas as well.

- To what extent do upstream human uses affect downstream ecosystem components? How might growing backcountry use and river floats affect ecosystems within the area?
- What are the historical and contemporary differences and similarities between the Native and non-Native communities and cultures? What influences have Native Indians and early explorers and settlers had on the Copper River ecosystem?
- How do changes that occur from human activities affect resource health and sustainability?

What are the processes involving people and places? There are many potential biological-physical-sociocultural processes that might be studied within the Copper River system. Some of these include:

- Various interactions between people and their uses, and between people and other system components.
- Human adaptation to natural systems and processes, changing economic conditions (copper, gold, oil, and fisheries).
- How have people adapted to the area through changing technology such as transportation, river rafts, snow machines, fishing gear?
- Displacement is one form of adaptation from changes in natural processes (climate, uplift, and oil spill) or from other people and their uses (subsistence, tourism). What, if any, displacement has occurred in the Copper River ecosystem? Shifts of people and their activities from one place to another or from one time to another? Changes in lifestyle and other social values? Changes in use? How have these differed in time and space?
- Institutional use of knowledge: how well do different institutions obtain, understand, and use knowledge about diverse values of resources and their role in human systems'? How can the inherent diversity in human systems be combined with diversity in biological systems to better understand the consequences of change, whether natural or human induced?

The nature of these questions requires an integrated, interdisciplinary approach, often requiring the involvement of science, management, and the public in a shared learning process. The questions provide several challenges: How do we integrate the social and natural sciences? How do we bring together management, research, and the public? How do we bring together those from different land management agencies and private land owners? How do we place local issues in the context of a global environment?

Recognizing the lack of baseline data, but facing a need to take action, we need to identify what it is possible to learn from other sources that can be applied here. A systematic analysis and synthesis of existing knowledge is appropriate. Aspects unique to the Copper River Delta, however, must be studied on site. Threats to these unique aspects must be identified and actions taken to preserve both what is unique and the opportunities for long-term study.

Managers, policymakers, scientists, and the public need information. Baseline data are critical as a reference point for monitoring change, to allow definition of what activity and how much activity is appropriate, and to support informed decisions. It is important to gather information before it is needed because the time of need cannot be predicted, and, as in the case of the *Exxon Valdez,* it then may be too late. As scientists shared the results of their research about the effects of the *Exxon Valdez* oil spill, they commented on how they had begun assessing damage empty-handed:

> With the exception of a few isolated studies, the only complete census and study of wildlife in the Sound was nearly 13 years old. And that study was done by two underfunded biologists who had to borrow a friend's boat to do their work, according to Karen Laing, a US Fish and Wildlife biologist.
>
> There are weaknesses in our knowledge about almost every injury, said [the government's] chief [spill] scientist Spies. A lot of that is due to the fact we did not have the baseline data before the spill. We weren't prepared...for damage assessment. (Anchorage Daily News 1993).

This assessment identifies the critical need for baseline data on ecosystem processes and conditions, human values and uses, and impacts and cumulative effects. Tools are needed to measure change and response to change; to collect and manage data; to facilitate longitudinal studies, to conduct predictive modeling; and to integrate social, cultural, physical, and biological considerations. Specific information is needed to meet the priority needs identified in this assessment.

Effective understanding of the interrelation between people and other components of the Copper River system depends on several fundamental needs:

- To develop good baseline information and inventories of people and the places they value, and what those values are, including ecological, social, and economic conditions, processes, and influences; and cultural uses. Baseline information was the highest priority need identified at the workshop. The rating form helped to clarify which types of information are most critical. Baseline information is needed on specific species such as the dusky Canada goose, as well as on interrelations among species, such as the interrelations among moose, beavers, and vegetation, and the interrelations of human activities with plants, fish, and wildlife.
- To examine the historical roots of present (and future) use patterns and human values associated with the Copper River system, looking at adaptation and other responses to change. How are changes in the nonhuman systems related to changes in human systems?
- To develop longitudinal research and monitoring to document changes over time and space, with special attention to social, cultural, biological, and physical components, and components that are fragile and vulnerable to development and other human activity.

- To develop a common database—common data, common Geographic Information System (GIS), a protocol consistent across agencies, and to initiate GIS mapping not only of physical and biological features but also of social and cultural data.
- To develop predictive modeling to help anticipate and prepare for the future. Both microscales and macroscales must be addressed

In addition to traditional research, other mechanisms can improve mutual understanding and reduce real or perceived barriers among agencies, organizations, and the public, and between research and management. Some of these mechanisms are:

- Expansion and improvement of public participation, going beyond traditional public involvement to develop and implement shared learning experiences and collaborative activities.
- Development and facilitation of forums for debate, discussion, and sharing of ideas and knowledge among researchers, managers, the public, and policymakers.
- Development of tools and techniques for use in planning and management.
- Development of demonstration projects for applying and sharing ideas, information, tools, and techniques.
- Promotion and facilitation of interagency coordination, collaboration, joint planning, and management—expanding beyond interagency coordination.
- Encouragement of interdisciplinary approaches to research and management.

The challenges and opportunities are great. Through coordinating efforts of agencies, organizations, and individuals, CRDI may provide a link not only within the Copper River system but with other systems in this country, in neighboring countries, and with international agencies (see footnote 2) The opportunities CRDI has for outreach include the challenges of spanning disciplinary, agency, and public-private boundaries, and bridging the gap between specialist and nonspecialist.

There is a need to improve communication, collaboration, and understanding among researchers, managers, the public, and policymakers. Communication issues include questions of trust, public and special-interest pressure, use conflicts, research-manager links, technology transfer, institutional roles and linkages, and use of consensus in planning and decisionmaking. Better systems are needed for sharing knowledge—both scientific knowledge and the traditional and local knowledge held by people who live, work, and play on the land. Scientific knowledge must be translated for nontechnical people, and "folk" knowledge—the knowledge of nonscientists who have come to know the land through traditions handed down from past generations and from personal experience on the land— must be accorded a legitimate role.

Outreach, both to involve individuals and organizations in activities and to obtain and share information, must be expanded to a much larger audience than in the past. It extends beyond the local Copper River system, and includes many groups and individuals who traditionally may not have been involved in local resource decisions. Scientists must take a leadership role in communicating knowledge (National Research Council 1990; also see footnote 2).

With the wide range of perspectives on the scope of CRDI, the need for a clear, well-defined scope and clearly communicated roles and responsibilities is obvious. If people are to support CRDI, they need a clear understanding of what it is, what role it plays in management and research, and of the role people play in the environment.

Several barriers to collaboration and coordination were identified in this assessment. Among them were funding, staffing, legal, jurisdictional, and administrative considerations that form real or perceived barriers and affect whether issues are confronted and addressed or not. It will be important to address these barriers, developing structures and processes to help overcome the limitations they impose. A systems approach that recognizes the interrelationships of all parts of the Copper River system may help to reduce some of these barriers (Agee and Johnson 1988).

Coordinated, integrative planning by ecosystem rather than by single species must be refined and implemented (dark and Lucas 1978). Planning and development need to address private-public land management systems and coordinated planning across ownerships. Institutional barriers to coordinated planning have resulted in piecemeal decisionmaking and inefficient and inequitable allocation of resource use among user groups. Use of the appropriate scale for planning is needed for each particular planning situation.

Although this management needs assessment was developed for the Copper River Delta Institute, the concerns, issues, and needs identified may have significance beyond the Copper River system. International concern for human impact on the environment is increasing (Silver and DeFries 1990, World Commission on Environment and Development 1987) as impacts such as those from the *Exxon Valdez* oil spill are dramatically and vividly telecast around the globe. There is a concurrent shift in attention from balancing multiple uses to blending use with ecosystem health and long-term sustainability, with an emphasis on multiple values over time and space (Silver and DeFries 1990; Stankey and others 1992; dark and others, in press).[7] Managers, researchers, policymakers, and the public—both within the Copper River system and beyond—should find this assessment useful, as similar needs are being voiced in other locations.

Literature Cited

Agee, James K.; Johnson, Darryll R., eds. 1988. Ecosystem management for parks and wilderness: Proceedings of a symposium; 1987 April 6-10; Seattle, WA. Seattle, WA: University of Washington Press. 237 p.

Alaback, P.; Naiman, R.; Pastor, J. 1991. Plant ecology. In: Bryant, Mason D., tech. ed. The Copper River Delta pulse study: an interdisciplinary survey of the aquatic habitats. Gen. Tech. Rep. PNW-GTR-282. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 34-39.

Alaska Department of Transportation and Public Facilities. 1988. Final compendium report, Copper River Highway. Federal Project RS-0851 (43). Fairbanks, AK: Alaska Department of Transportation and Public Facilities. [Not paged].

Alaska Department of Transportation and Public Facilities. 1992. Copper River Highway environmental impact studies, scoping meeting. Fairbanks, AK: Alaska Department of Transportation and Public Facilities, Division of Design and Construction. [Not paged].

[7] dark, Roger N., Stankey, George H , Kruger, Linda E. Presentation given at the second Canada/U.S. workshop on visitor management in parks, forests and protected areas; May 13-16; Madison, WI. On file with: Pacific Northwest Research Station, Forestry Sciences Laboratory, 4043 Roosevelt Way NE, Seattle, WA 98105

Alaska Geographic Society. 1986. Where mountains meet the sea: Alaska's gulf coast from Cape Spencer to Prince William Sound and the Kodiak Island group. Alaska Geographic Quarterly. 13(1): 1-191.

Alaska Native Claim Settlement Act (ANSCA). Act of Public Law 92-203, 85 Stat. 688. (1971).

Anchorage Daily News. 1993. Scientists bring ideas to oil spill symposium. February 1; Sect. A: (col. 1).

Antonson, Joan M.; Hanable, William S. 1984. Alaska's heritage. Alaska Historical Commission studies in history 133. Anchorage, AK: Alaska Historical Commission. 197 p.

Arvidson, Rose C.; Nichols, Ralph; Weathers, Rose. 1984. Cordova, the first 75 years: a photographic history. Cordova, AK: Fathom Publishing Co. 97 p.

Benda, L; Lisle, T.; Sullivan, K. 1991. Geomorphology. In: Bryant, Mason D., tech. ed. The Copper River Delta pulse study; an interdisciplinary survey of the aquatic habitats. Gen. Tech. Rep. PNW-GTR-282. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 6-13.

Berger, Thomas R. 1985. Village journey: the report of the Alaska Native Review Commission. New York: Hill and Wang. 202 p.

Brooks, J.W.; Rausch, R.A., eds. 1976. Alaska's wildlife management plans, southcentral, Alaska. Anchorage, AK: Alaska Department of Fish and Game. 291 p.

Bryant, M.D.; Wissmar, R.C. 1991. Synthesis. In: Bryant, Mason D., tech. ed. The Copper River Delta pulse study: an interdisciplinary survey of the aquatic habitats. Gen. Tech. Rep. PNW-GTR-282. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 40-41.

Bryant, Mason D., tech. ed. 1991. The Copper River Delta pulse study: an interdisciplinary survey of the aquatic habitats. Gen. Tech. Rep. PNW-GTR-282. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 43 p.

Bucaria, Garvan Pat. 1979. Copper River Delta area wildlife resource review, Chugach National Forest. Anchorage, AK: U.S. Department of Agriculture, Forest Service. 114 p. (plus appendices).

Burch, William R., Jr. 1988. Human ecology and environmental management. In: Agee, James K.; Johnson, Darryll R., eds. Ecosystem management for parks and wilderness. Seattle, WA: University of Washington Press: 145-159. Chapter 9.

Campbell, Bruce H.; Cornley, John E., comps. 1992. The dusky Canada goose *(Branta canadensis occidentalis),* an annotated bibliography. Resour. Publ. 188. Fort Collins, CO: U.S. Department of the Interior, Fish and Wildlife Service. 29 p.

Campbell, Bruce H.; Rothe, Thomas C. 1986. Annual report of survey-inventory activities: waterfowl. Federal aid in wildlife restoration. Project W-22-4, Job 11.0. Juneau, AK: Alaska Department of Fish and Game. 36 p. Vol. 16. Part 14.

dark, R.N.; Buscher, R.F. 1990. Managing lands adjacent to wilderness. In: Lime, David W., ed. Managing America's enduring wilderness resource: Proceedings of the conference; 1989 September 11-17; Minneapolis, MN. St. Paul, MN: Extension Service, University of Minnesota: 440-445.

dark, Roger N.; Brown, P.J. 1990. The emerging web of integrated resource management. In: Proceedings of the IUFRO 19th world congress; 1990 August 5-11; Montreal, Canada. Vienna, Austria: International Union of Forest Resources Organizations. 6: 24-33.

dark, Roger N.; Lucas, Robert C. 1978. Outdoor recreation and scenic resources: the forest ecosystem of southeast Alaska. 10. outdoor recreation and scenic resources. Gen. Tech. Rep. PNW-66. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 116 p.

Conant, B.; Hodges, J.I.; King, J.G.; Cain, S.L. 1986. Alaska trumpeter swan status report—1985. Juneau, AK: U S Department of the Interior, Fish and Wildlife Service. 12 p.

Delbecq, Andre L; Van de Ven, Andrew H.; Gustafson, David H. 1975. Group techniques for program planning: a guide to nominal group and delphi processes. Glenview, IL: Scott, Foresman and Co. 174 p.

Dyer, Christopher L.; Gill, Duane A.; Picou, J. Steven. 1992. Social disruption and the Valdez oil spill: Alaskan natives in a natural resource community, sociological Spectrum. Washington, DC: Hemisphere Publishing. 12: 105-126.

Fried, Neal; Stinson, Holly. 1989. Prince William Sound: five economies in turm(oil). Alaska Economic Trends. 9: 1-16.

Groves, Deborah J.; Conant, Bruce; King, Rodney J.; Logan, Daniel. 1990. Trumpeter swan surveys on the Chugach National Forest 1987-1989. Juneau, AK: U.S. Department of the Interior, Fish and Wildlife Service; U.S. Department of Agriculture, Forest Service. 6 p. (plus maps and tables).

Hanable, William S. 1982. Alaska's Copper River: the 18th and 19th century. Studies in History 21. Anchorage, AK: Alaska Historical Commission. 99 p.

Hansen, W.R.; Eckel, E.B. 1971. Setting and the effects of the earthquake. In: Committee on the Alaska Earthquake, eds. The great Alaska earthquake of 1964-geology. Washington, DC: National Academy of Science: 5-27.

Holtan, Lars H. 1980. Nesting habitat and ecology of Aleutian terns on the Copper River Delta, Alaska. Corvallis, OR: Oregon State University. 85 p. M.S. thesis.

Isleib, M.E.; Kessel, B. 1973. Birds of the North Gulf coast-Prince William Sound region, Alaska. Biol. Pap. 14. Fairbanks: University of Alaska. 151 p.

Jakes, Pamela; Gregerson, Hans; Lundgren, Alien; Bengston, David. 1990. Emerging issues in forest management and use. Journal of Forestry. 4: 25-28, 34.

Lee, Robert G.; Field, Donald R.; Burch, William R., Jr., eds. 1990. Community and forestry: continuities in the sociology of natural resources. Social behavior and natural resources series. Boulder, CO: Westview Press. 301 p.

Le Resche, R.; Bishop, R.H.; Coady, J.W. 1974. Distribution and habitats of moose in Alaska. Naturaliste Canadien. 101: 143-178.

Mickelson, P. 1989. Natural history of Alaska's Prince William Sound and how to enjoy it. Cordova, AK: Alaska Wild Wings. 210 p.

Minerals Management Service. 1993. Social indicators study of Alaskan coastal villages. Tech. Rep. 155. Anchorage, AK: Minerals Management Service: 154-172.

Naiman, R.J. 1988. Animal influences on ecosystem dynamics. Bioscience. 38: 750-752.

National Environmental Policy Act. Act of Publication Law 91-190. 83 Stat. 852 1970., codified as amended at 42 U.S.C. 4321^370 1982.

National Oceanic and Atmospheric Administration. 1989. Fisheries of the United States. In: O'Bannon, Barbara K., ed. Current Fisheries Statistics 8900. Silver Springs, MD: National Marine Fisheries, Fisheries Statistics Division.

National Research Council, Committee on Forestry Research. 1990. Forestry research: a mandate for change. Washington, DC: National Academy Press. 84 p. In cooperation with: Board on Biology, Commission on Life Sciences; Board on Agriculture.

Nielsen, Nicki J. 1984. From fish and copper: Cordova's heritage and buildings. Alaska Historical Commission Studies in History 124. Cordova, AK: Cordova Historical Society. 66 p.

Picou, J. Steven; Gill, Duane A. 1993. Long-term social psychological impacts of the *Exxon Valdez* oil spill. In: Proceedings, *Exxon Valdez* oil spill symposium abstracts; 1993 February 2-5; Anchorage, AK. Anchorage, AK: Exxon Valdez Oil Spill Trustee Council: 223-226.

Picou, J. Steven; Gill, Duane A.; Dyer, Christopher L.; Curry, Evans W. 1992. Disruption and stress in an Alaskan fishing community: initial and continuing impacts of the Valdez oil spill. Industrial Crisis Quarterly. 6(3): 235-257.

Plafker, George. 1990. Regional vertical tectonic displacement of shorelines in south-central Alaska during and between great earthquakes. Northwest Science. 64(5): 250-258.

Reimnitz, E. 1966. Late quaternary history and sedimentation of the Copper River Delta and vicinity, Alaska. San Diego, CA: University of California. 160 p. Ph.D. dissertation.

Sample, V. Alaric. 1991. Land stewardship in the next era of conservation. Milford, PA: Grey Towers Press. 43 p.

Silver, Cheryl; Simon, DeFries; Ruth, S. 1990. One Earth one future: our changing global environment. Washington, DC: National Academy Press. 196 p.

Spude, Robert L.; Faulkner, Sandra McDermott, comps. 1988. Cordova to Kennecott Alaska. Cordova, AK: Cordova Historical Society. 51 p.

Stankey, George H.; Brown, Perry J.; Clark, Roger N. 1992. Allocating and managing for diverse values of forests: the market place and beyond. In: Integrated sustainable multiple-use forest management under the market system: Proceedings of the IUFRO international conference; 1992 September 7-12; Pushkino, Moscow Region, Russia Copenhagen, Denmark: International Union of Forestry Research Organizations: 257-271.

Stankey, George H.; Clark, Roger N. 1992. Social aspects of new perspectives in forestry: a problem analysis. Pinchot Institute for Conservation Monograph Series. Milford, PA: Grey Towers Press. 33 p.

Stratton, Lee. 1989. Resource use in Cordova- a coastal community of south-central Alaska. Tech. Pap. 153. Anchorage, AK- Alaska Department of Fish and Game, Division of Subsistence. 172 p.

Thilenius, J.T. 1990. Woody plant succession on earthquake uplifted coastal wetlands of the Copper River Delta, Alaska. Forest Ecology and Management. 33/34: 439-462.

Thomas, G.L; Backus, E.H.; Christensen, H.H.; Weigand, J. 1991. Prince William Sound, Copper River, north Gulf of Alaska ecosystems. [Washington, DC- J Dobbins Press.] 13 p. In cooperation with: Prince William Sound Science Center; Copper River Delta Institute.

Wheelwright Lithography Co. 1974. Alaska regional profiles: Southcentral Region. State of Alaska Office of the Governor. Salt Lake City, UT: Wheelwright Lithography Co. 255 p.

World Commission on Environment and Development 1987. Our common future Oxford, England: Oxford University Press. 383 p.

Appendix A
Common and Scientific Names of Selected Species of the Copper River Delta

Common name	Scientific name
Flora:	
Sitka alder	*AInus sinuata* (Reg.) Rydb.)
Thinleaf alder	*AInus tenuifolia* Mutt.
Sedge	*Carex* spp.
Devils club	*Echinopanax horridum*
Sitka spruce	*Picea sitchensis* (Bong.) Carr.)
Willow	Sa//x spp.
Mountain hemlock	Tsi/ga *mertensiana* (Bong.) Carr.
Blueberry	*Vaccinium* spp.
Fish:	
Threespine stickleback	*Gasterosteus aculeatus*
Pacific halibut	*Hippoglossus stenolepis*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*
Coho salmon	*Oncorhynchus kisutch*
Sockeye salmon	*Oncorhynchus nerka*
Chinook salmon	*Oncorhynchus tshawytscha*
Cutthroat trout	*Saimo clarki*
Dolly varden	*Salvelinus malma*
Eulachon	*Thaleichthys pacificus*
Birds:	
Dusky Canada goose	*Branta canadensis occidentalis*
Pacific dunlin	*Calidris alpina pacifica*
Western sandpiper	*Calidris maun*
Northwestern crow	*Corvus caurinus*
Common raven	*Con/us corax*
American peregrine falcon	*Faico peregrinus anatum*
Peale's peregrine falcon	*Faico peregrinus pealei*
Arctic peregrine falcon	*Faico peregrinus tundrius*
Bald eagle	*Haliaeetus leucocephalus*
Trumpeter swan	*Olor buccinator*
Black-billed magpie	*Pica pica*
Aleutian tern	*Sterna aleutica*
Mammals:	
Moose	*Alces alces*
Gray wolf	*Canis lupus*
Beaver	*Castor canadensis*
Sitka black-tailed deer	*Odocoileus hemionus*
Mountain goat	*Oreamnos americanus*
Harbor seal	*Ovis dalli*
Dall sheep	*Phoca vitulina*
Brown (grizzly) bear	*Ursus arctos*
Black bear	*Ursus americanus*

Appendix B
List of Questions With Ratings

A rating form with 125 items was mailed to 79 potential participants. Originally conceived as a two-part Delphi, the rating process was completed in one mailing. Thirty-two people rated the items as critical (requiring immediate attention), important (requiring immediate planning); relevant (not requiring immediate action); or not relevant. The items were organized according to a framework developed around concepts of people, places, and processes. The framework is described more completely in the text but is shown in a Venn diagram (fig. 7).

The items are organized within the seven components of the framework and are prioritized according to their critical score. There were 32 responses. Each person did not rate every item so the number of responses differs from question to question.

Framework	N[1]	C **as** %[2]	I as %[3]
People:			
When does one kind of use diminish, disturb, or destroy another?	27	41	30
Who are the stakeholders in the area, and what are their zones of influence^	28	39	32
What are the subsistence and cultural values of the area?	28	36	36
What are the alternatives to economics in valuing amenity resources?	27	33	41
How much impact will users tolerate before their experiences are compromised?	27	30	30
What obligations do resource agencies have to local communities?	27	30	30
What are the implications and opportunities of land ownership patterns?	26	27	42
What are the economic values of noncommodity and secondary resource products?	26	23	38
Who are current and potential users?	27	22	48
What is the relation between subsistence and recreation?	27	15	48
What is the importance of recreation opportunities for the social, cultural, and economic well being of residents?	27	11	67
What are the differences between the values and preferences of local as compared with nonlocal users?	28	11	61
What portion of users are tourists?	26	08	46

Framework	N[1]	C as %[2]	I as %[3]
Do managed old-growth stands offer the same social values as unmanaged old-growth stands?	27	07	26
How do a person's values affect the type of recreation they engage in?	28	07	32
Places:			
How are resources interrelated?	28	54	29
Processes:			
How can we shift from short-term economic and political benefits to long-term stewardship and sustainability?	25	56	20
What information and techniques are needed to more accurately define and effectively integrate management of recreation, scenery, wildlife, and other amenity values into planning and management?	16	50	6
How might managers move from a single resource-species concept of sustained yield to the concept of multiple-resource yields derived from a sustained ecosystem?	25	48	20
How can we get an increasingly urbanized public to understand the ecological complexities of resource management, and the need to manage for the biological and long-term stability and health of the forest?	27	48	11
What criteria can be used to assess cumulative effects?	26	46	38
How can recreation-wildland management be integrated with planned and potential development?	27	44	41
How can we resolve conflict among resource exploitation, wildlands preservation, and wildlife protection?	28	43	39
How can ecological concerns be incorporated into management efforts in a proactive way?	27	41	44
What proactive planning needs to occur in the face of inevitable development so as not to repeat past bad examples?	27	37	33

Framework	N[1]	C as %[2]	I as %[3]
How can we improve communication, understanding, cooperation, and integration between research and management?	27	37	44
How can we increase the use of research information in management decisions?	28	36	46
What interactions occur between set-aside lands and surrounding disturbed or developed lands?	26	35	23
How can resource management decisionmaking be changed to reduce polarization and legal challenges?	28	32	43
Is there a need to document what management practices have worked and why, and identify those which have not worked and why?	27	30	48
How can the planning and management process become more participatory and more open without becoming paralyzed?	27	30	44
What criteria should be used in decisionmaking?	26	27	35
How can the effectiveness of public information programs be improved?	26	27	54
What standards can be used to monitor and evaluate ecosystem response to management?	27	26	59
What analytical procedures can we develop to assess impacts of management decisions on local communities?	27	26	44
How can we prepare resource managers for ethical, responsive, and effective public communication^	27	26	41
How will ecosystem management be addressed in light of the focus on biodiversity?	26	23	35
What is required to develop an information gathering and management system that will grow and adapt to change?	26	23	46
How can we increase the usefulness of technologies such as Geographic Information Systems (GIS)?	26	23	62
How do we develop a synthesis of existing knowledge, and improve its accessibility and useability?	26	23	42
How can new information be incorporated into the decisionmaking process?	26	23	50

Framework	N[1]	C as %[2]	I as %[3]
What education and information methods are most effective in enhancing visitor safety and appreciation of wildlands?	27	22	44
How can we improve strategies for the use of volunteer and partnership programs that will promote resource management understanding?	27	22	48
What strategies might improve the understanding of public sentiment, expectations, values, desires and feedback on issues at the local, regional, and international levels?	27	19	44
How can we improve the ability to identify economic costs associated with developmental options (for example, loss of scarce recreation national, habitat, scenic sites)?	26	19	50
How can we use demonstration areas to show various management options?	26	19	58
How can we improve the way information obtained from the public is used and better demonstrate results from public involvement?	26	19	24
What will be the effects of global warming and climate change?	29	17	17
How can we identify, evaluate, and incorporate the nondollar values of firewood harvesting and other forest activities into decisionmaking and planning?	27	15	41
How can we identify and evaluate mechanisms for allocating and managing noncommodity benefits and values?	27	15	44
What techniques will help make information more available and adaptable?	26	15	46
What barriers reduce effective integration and coordinated planning?	26	15	50
How can we develop educational techniques that demonstrate resource allocation conflicts and involve participants in designing alternatives for conflict resolution (that is, management simulation games)?	26	15	42
What are the keys to attaining and maintaining effective management programs?	27	11	52

Framework	N[1]	C as %[2]	I as %[3]
How can we improve methods for measuring remote recreational use?	27	11	52
When is it more acceptable to allocate lands to a single-resource use than to practice integrated resource management?	27	11	59
What methods can be developed to identify and assess direct, indirect, and external costs of management practices?	26	04	58
What are the pros and cons of different public participation processes?	26	1	50
People, processes:			
How can we address the effects of Native land ownership within conservation units?	2	56	22
How can subsistence and cultural values be integrated with wildland resource management?	27	37	48
How can we address the needs, preferences, interests, and demands of different and potentially competing user groups?	26	35	46
With differing agency missions and political frameworks, how can public agencies be encouraged and enabled to work across agency and political boundaries to resolve large-scale management issues?	26	35	42
How are resource allocations made relative to user groups^	26	35	38
What are the existing institutional relations, and how do we develop relations with other agencies and groups?	28	32	50
How can managers more effectively communicate with the public?	28	32	50
What is the relation between the decisionmaking process and public trust?	26	31	35
Can special-interest groups be brought together into coalitions for long-term, multiuse ecosystem management? .	27	30	33
Science and technology may not answer or address social concerns and may lack public support. How do we deal with this?	27	30	33

Framework	N[1]	C as %[2]	I as %[3]
What are the barriers to effective public participation in resource decisionmaking?	27	30	44
To what extent can wildland management programs contribute to stable rural community economics?	26	27	42
How can public participation processes be improved to overcome cultural differences?	26	27	42
How can wildland managers coordinate management to achieve common goals?	27	26	56
Can we resolve conflicts among resource users without simply allocating land to an exclusive or dominant use?	27	26	44
How can the full range of public values be incorporated at the front end of decisionmaking?	27	26	37
How can we improve approaches to identify, evaluate, and incorporate a full range of social values into decisionmaking?	27	26	48
What forums are available where reasonable solutions can be worked out among various interest groups?	28	25	54
What are the effects of resource management on the subsistence needs of area residents?	26	23	62
What is the relation between public values and science?	27	22	41
How much change can occur before tourism marketability decreases?	28	21	25
How can we establish economic values of non-commodity and secondary resource products?	27	19	52
What planning procedures are responsive to a wide range of public interests and values?	27	19	37
What programs would most benefit community economic stability?	27	19	48
How do current organizational structures facilitate or hamper integrative management?	27	19	48
How do we weigh or accommodate values, desires, and expectations that differ among local, regional, and national levels?	26	15	58
How do we identify and evaluate the value people place on the area even if they do not plan to visit?	27	15	22

Framework	N[1]	C as %[2]	I as %[3]
How can we manage our recreation resources for Alaskans and still generate revenue from tourism?	26	15	46
What determines social values, and how are they influenced by education and information?	28	14	25
How can key attributes for recreation and tourism be most effectively managed?	27	11	52
How do resource managers deal with the difference in values and preferences between local and nonlocal forest users and other clients?	27	11	56
How can we determine social and economic value and importance of recreation and tourism, as well as the consequences of management decisions on them?	27	11	59
How do we deal with changes in knowledge, science, issues, and public values?	27	11	37
Can improved processes be developed to assist the public in articulating their true underlying interests rather than giving a position statement?	26	8	46
By accommodating various recreation needs of visitors, are we displacing those attributes most valued by Alaskans?	27	7	52
How can we predict the change in public values for wildlife and wildland resources as a consequence of the change in the make-up of communities, urbanization of the population, and increasing diversity?	26	4	42
People, places:			
What values can be assigned to wetlands in the area?	28	32	54
What is the interrelation between wildland resources and culture?	28	18	43
What are the key attributes of the coastal setting that serve recreation and tourism needs?	28	18	46
What is the relation of area wildlands to mental, emotional, and psychological health and well being?	28	07	29
Places, processes:			
How do we define and maintain natural and healthy populations of wildlife?	27	52	37

Framework	N[1]	C as %[2]	I as %[3]
How might we evaluate how oil, gas, mineral, and other resource development activities affect wildlands?	27	44	52
How can we identify critical habitats for wildlife species?	28	43	46
What are the best measurement approaches for ascertaining ecosystem health?	26	42	46
What are the ecological tradeoffs (which species benefit and which suffer) that result from the pursuit of various resource objectives?	26	42	54
How do we deal with the impacts on wildlands caused by new roads in remote areas?	27	41	44
How can wilderness and wildlands be maintained in view of increasing development and decreasing resource management budgets?	27	41	44
How can we develop a system for planning by ecosystem rather than by individual species to help address system sustainability?	25	36	52
What plant communities and wildlife habitat components of old-growth forest can be sustained through the use of new management approaches?	27	30	37
What plant communities and wildlife habitat components of old-growth forest can be sustained through the use of new practices?	27	30	41
What are the relations between biodiversity and resource sustainability?	28	29	36
How do we obtain and maintain consistent data about places and resources?	26	27	58
How do alternative silviculture techniques affect interrelations between plants and animals?	25	24	48
How are threatened and endangered species, global warming, and ecosystem dynamics related?	29	17	21
What features of natural systems are necessary for maintaining biodiversity?	27	15	33
People, places, processes:			
What are the impacts of increased reading, access, and assorted human uses?	28	61	25
What are the cumulative effects of human activity?	28	54	25

Framework	N[1]	C as %[2]	Ias%[3]
What are the effects of human use on wildlife and plant species?	28	39	36
How can increased numbers of visitors be accommodated without losing the "virgin" character of wildlands?	28	36	43
How will the area be managed for various of resources while protecting key values which draw visitors?	27	33	33
How can we better integrate wildlife and recreation as a basis for tourism in the area?	28	32	43
How much visitor use is occurring in specific locations?	28	32	39
Can tourism and other economic diversification be compatible with ecosystems and social values?	27	26	33
How can we evaluate the effects of snowmobiles, ATV's, and other off-road activity on plant and animal communities?	27	26	48
How can managers minimize the disruptive effects of mining and other resource uses on wildlands?	27	26	63
What and where are the recreation opportunities in the area?	28	18	46
How can we determine the effects of resource management activities that alter visual conditions on tourism and tourism marketing?	27	11	48

[1] N = number of responses.
[2] C as % = percentage of critical responses.
[3] 1 as % = percentage of important responses.

Kruger, Linda E.; Tyler, Catherine B. 1995. Management needs assessment for the Copper River Delta, Alaska. Gen. Tech. Rep. PNW-GTR-356. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 45 p.

This report assesses needs, problems, and perceptions relevant to management of the Copper River Delta (Alaska)—the largest coastal wetland on the Pacific coast of North America. The assessment provides a basis for planning and decisionmaking and a framework for ongoing research, development, and application. It also underscores concerns about human impacts and supports the need for a greater understanding of the interrelations among resources and resource uses, and between resources and people.

Keywords: Management needs assessment, decisionmaking framework, Copper River Delta (Alaska).

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