

THEMES FOR WATER-RELATED RESEARCH
AND RESOURCE ASSESSMENTS

WATER RESOURCES DIVISION



NATIONAL PARK SERVICE
1996

WATER RESOURCES DIVISION
NATIONAL PARK SERVICE
1201 OAK RIDGE DRIVE, SUITE 250
FORT COLLINS, CO 80525
TEL: (970) 225-3500

THEMES FOR WATER-RELATED RESEARCH AND RESOURCE ASSESSMENTS

Natural resource managers throughout the National Park Service (NPS) have the responsibility to protect and manage the precious and unique ecosystems under their stewardship. Aquatic resources such as rivers, lakes, wetlands, and marine habitats are almost always a key component of these ecosystems. NPS managers need to protect these resources for future generations, while allowing present day visitors to enjoy the parks. In other words, the mission of the National Park Service is the sustainable management of park ecosystems, including aquatic resources.

To make resource management and planning decisions that are consistent with the sustainable management mission, NPS managers need comprehensive and accurate information about the nature, condition, and trends of the resources under their care. Research, baseline inventories, and long-term monitoring are needed to build this knowledge base. Many parks lack adequate basic resource information while others need specialized research to resolve particular resource problems.

This paper presents an overview of the research needs related to aquatic and marine resources in the national parks. These research needs are organized into nine themes, with examples of research issues presented for each theme. While the nine themes and associated examples are not comprehensive, they do portray the breadth of aquatic information needed in parks throughout the national park system.

We hope that by organizing the NPS water-related research and resource assessment needs into themes we will stimulate discussion among possible cooperators about common interests and the potential for aquatic studies in national parks. We welcome support and collaboration from water resource scientists in other agencies, universities, or institutes.

THEME NUMBER 1:
DEVELOP STANDARDIZED SAMPLING PROTOCOLS FOR AQUATIC RESOURCES

Research is needed to develop practical, standardized protocols for use in aquatic resource inventories, assessments, and monitoring. Parks throughout the National Park System need to conduct basic aquatic resource inventories, assess the impacts of recreational activities on aquatic resources, or make other assessments. Because many parks deal with identical problems and concerns, the NPS would benefit from using standardized sampling protocols. For example, the National Park Service needs standardized fishery sampling protocols that can be employed by resource managers after minimal technical training. With standardized protocols, the techniques, equipment, data, and experiences of aquatic resource management can be more readily shared.

In some cases the development and description of sampling protocols for well-studied topics may be accomplished primarily from researching the published literature or from professional experience, while in other more specialized instances, field research may be necessary. Eight examples of generic protocol needs are displayed in the table below. These examples are based on actual project proposals from parks.

EXAMPLES OF RESEARCH NEEDS

1. Protocols to Assess Impacts on Wetlands: How to assess the effects of groundwater withdrawals, surface diversions, and other water uses on park wetlands.
2. Protocols to Assess Impacts of Backcountry Recreation: How to evaluate the effects of recreational impacts on the sensitive riparian water resources of backcountry areas.
3. Protocols to Assess Boat and Marina Impacts: How to assess contamination of aquatic systems by boats and marinas.
4. Protocols to Assess Riparian Resource/Water Quality Relations: How to assess the relationship between water quality and wetland and riparian conditions, including impacts of land-use activities such as grazing.
5. Protocols to Assess Visitation Impacts: How to evaluate the effects of visitation levels and developments on water resources, water-dependent environments, and riparian zones.
6. Rapid Assessment Protocols for Mining Impacts: How to conduct a rapid assessment of the effects of runoff from abandoned mines on water quality and aquatic ecology.
7. Protocols to Assess Land-Use Changes: How to assess the cumulative impacts of adjacent land-use changes on park aquatic resources.
8. Protocols to Assess Recreational Fishing Impacts: How to evaluate the effects of recreational fishing activities and recreational fisheries management actions on aquatic resources.

THEME NUMBER 2: ASSESS ALTERED WATER QUANTITIES

Studies are needed to assess the effects of changes in water quantity on downstream or nearby aquatic systems in parks. For example, groundwater withdrawals near parks can affect springs, upstream water diversions can disturb wetlands, or reservoir releases in headwaters may influence park riparian zone ecology and fisheries. The table below shows eight specific park requests for this type of research.

Research of this type generally calls for relatively short-term field studies in the park, drawing especially on expertise in physical sciences and data analysis. In some cases special biological skills may be required.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Buffalo National River, Arkansas	How do water diversion and impoundment projects affect water resources and aquatic ecology?	Install stream gauging stations (with the U.S. Geological Survey) to measure flow. Develop models to understand how these projects affect water-related attributes. (BUFF-N-120.000)
Grand Canyon National Park, Arizona	Well construction near the park may harm springs below the South Rim.	Conduct analysis of hydrogeologic data; model groundwater flow in order to predict possible impacts on springs. (GRCA-N-360.201)
Rocky Mountain National Park, Colorado	Effects of private water storage facilities, diversion ditches, and other aspects of private water withdrawals need to be quantified in anticipation of park water rights disputes.	Study impacts of water diversions on aquatic resources in the park; conduct necessary monitoring and data collection and develop databases. (ROMO-N-040.100)
Cape Cod National Seashore, Massachusetts	Characteristics of groundwater at Cape Cod and human effects, such as saltwater intrusion, have not been adequately determined.	Conduct a park-wide survey of groundwater resources to refine an earlier U.S. Geological Survey study. (CACO-N-29)
Bandelier National Monument, New Mexico	A federal reservoir is adversely affecting streams and riparian zones in the park.	With other agencies, develop a reservoir management plan to promote a hydrologic regime that will protect park resources. (BAND-N-021.000)
Amistad National Recreation Area, Texas	Analysis of lake levels, sedimentation, eutrophication, and siltation is needed.	Review all available data on sediment, water quality, river management, and land use impacts, and provide interpretation. (AMIS-N-041.000)
Capitol Reef National Park, Utah	A planned upstream dam could affect park aquatic ecosystems. The park needs baseline data to evaluate any future effects.	Gather data on physical, chemical, and bacterial characteristics of the river to provide a baseline for future evaluations of dam effects. (CARE-N-152.000)
Colonial National Historical Park, Virginia	Need to understand how to manage aquifers, wetlands, and riparian zones within the park.	Characterize and map aquifers in key areas of the park. (COLO-N-601.402)

THEME NUMBER 3:
**EVALUATE EFFECTS OF FISHERIES MANAGEMENT PRACTICES AND HABITAT
CHANGE ON AQUATIC COMMUNITIES**

A common concern in parks is the effect of past and present fisheries management practices on native aquatic communities and the loss of native fishes because of habitat loss and water quality degradation. These problems appear in major rivers, in small streams, in reservoirs, and in other waters. The applied research addressing this theme would typically employ relatively routine field assessment, but might also may include long-term evaluations of fish population dynamics, genetics work, habitat restoration, or other complex efforts. The research reports will need to include interpretations and recommendations in a form that park managers can apply.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Katmai National Park, Alaska	Freshwater sockeye salmon production needs to be measured and understood. Data are needed for forecasting production, for commercial fishery management, and other needs.	Conduct field surveys to estimate size, age, and numbers of sockeye salmon smolt leaving the park in springtime. (KATM-N-005.1)
Buffalo National River, Arkansas	Little is known about the significant recreational fishing pressure on the river and the overall effects on park resources.	Obtain fishery expertise to conduct analysis and start a fishery management planning process. (BUFF-N-419-000)
Glen Canyon National Recreation Area, Arizona	No fishery management plan exists to guide the park on questions of stocking and its environmental effects.	Working with state agencies, prepare a sport fishery management plan to avoid damage to park resources. (GLCA-N-443.001)
Curecanti National Recreation Area, Colorado	Reservoirs, fish stocking, nonnative species, and other factors influence fisheries in and near the park. Information is needed on how to manage the fisheries.	Develop a fishery management plan to develop baseline fishery information and to advise park managers on stocking, habitat improvements, and other needed actions. (CURE-N-006.000)
Dinosaur National Monument, Colorado	Angling and the presence of nonnative sport fish are having adverse effects on endangered fish.	Develop an education program for anglers. Design and implement fishing regulations to remove nonnative species. (DINO-N-635.001)
Ozark National Scenic River, Missouri	Fish and wildlife resources in the park are affected by the presence of a non-native trout fishery, turtle/crayfish taking, and trapping. Effects on the park's aquatic ecosystems need evaluation.	Evaluate hunting, fishing, and trapping effects via harvest data, and develop monitoring protocols to track these effects. (OZAR-N-250.000)
Great Smoky Mountains National Park, Tennessee	Brook trout populations in the park are down 75 % due to the effects of nonnative rainbow trout. Selected streams should be rehabilitated to support native brook trout.	In selected streams with appropriate barriers, eliminate nonnative rainbow trout and monitor the recovery of brook trout. (GRSM-N-073.000)
Shenandoah National Park, Virginia	The park lacks a basic understanding of fishery resources and the impacts from fishing, acid precipitation, pollution, etc.	Conduct fisheries monitoring and related research to build the database needed to manage the fishery resources. (SHEN-N-012.000)

THEME NUMBER 4:
ASSESS VISITOR IMPACTS ON AQUATIC RESOURCES

Increasing visitation is forcing most national parks to deal actively with visitor impacts on natural resources. Visitor impacts can alter the physical and biological integrity of rivers, streambanks, wetlands, lakes, riparian zones, creeks, and watersheds. Research relating to this topic normally involves applied field investigations to not only assess changes in the resources but also to understand the processes involved. These studies provide park managers with information needed to correct existing problems or protect resources from future impacts. (Sampling protocol development for this work also is described under Theme 1.)

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Denali National Park and Preserve, Alaska	Recreational and commercial uses on the Nonana River have grown rapidly and pose threats to aquatic resources.	Conduct a study of the effects of recreational boating and commercial activities adjacent to the park on park resources. (DENA-N-210)
Yosemite National Park, California	Visitor use may be causing water contamination in high-use areas.	Monitor bacteria, protozoa, and other human health parameters to determine if contamination is occurring. (YOSE-N-103.001)
Dinosaur National Monument, Colorado	Visitor activities such as camping, hiking, and floating cause impacts on the park's natural resources.	Investigate natural resource impacts of river users. Assess effectiveness of the present river management system in addressing these effects. (DINO-N-625.002)
Pictured Rocks National Lakeshore, Michigan	Park managers lack information on backcountry visitor impacts such as pollution, wastes, and erosion.	Conduct baseline inventories of selected "condition indicators" to assess backcountry resource damage and effects of any corrective actions. (PIRO-N-601.000)
Glacier National Park, Montana	Human wastes in the backcountry and along roads pollute aquatic ecosystems to an unknown degree.	Conduct investigations to quantify and analyze the impacts of human waste in aquatic ecosystems. (GLAC-N-551.000)
Delaware Water Gap National Recreation Area, Pennsylvania	Park managers need a good database on river use and associated resource impacts in order to plan for sustainable recreational use of the river.	Conduct the data collection and analyses necessary to develop a database on river use, visitor satisfaction, riparian effects, and other parameters in order to develop a river management plan. (DEWA-N-001.000)
Mount Rainier National Park, Washington	The park lacks data for managers to understand the effects of human use on the aquatic ecology of oligotrophic backcountry lakes.	Collect baseline information on the impacts on water quality and aquatic ecology that are caused by backcountry recreationists. (MORA-N-017.010)

THEME NUMBER 5:
**DOCUMENT THE STATUS AND TRENDS OF CONTAMINANTS IN WATER
 AND SEDIMENT**

Aquatic resources in some parks are polluted by contaminants from nearby urban development, agriculture, industry, abandoned mines, or from some park activities. Many seashore parks are subject to the effects of oil, debris, wastes, and other contaminants brought into parks by oceanic currents.

Research is needed in and adjacent to parks to understand the status and trends of contaminants in water and sediment and to understand the effects that these contaminants have on aquatic biota.

Research in this area usually will require sophisticated analyses as well as routine physical and chemical assessments so that impacts on aquatic ecosystems can be characterized. Interpretations for park managers that can be used in developing corrective actions are essential products of these investigations.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Buffalo National River, Arkansas	Upstream wood treatment plant wastes could be affecting river water quality and contaminating fish.	Analyze fish to determine if they contain residues of toxic chemicals at levels of concern to health. (BUFF-N-114.000)
Glen Canyon National Recreation Area, Arizona	Existing monitoring is inadequate to evaluate contamination from marina operations.	Evaluate contamination and impacts by studies of water, soils, and sediment. Interpret results to advise park managers. (GLCA-N-094.000)
Channel Islands National Park, California	Urban, agricultural, and industrial pollutants are likely to be bio-accumulating in marine organisms in the park.	Design and initiate a marine pollutant monitoring program to assess possible bio-accumulation in marine organisms. (CHIS-N-100.124)
Pipestone National Monument, Minnesota	Odors, vegetative impacts, and other indicators of organic or toxic pollutants are evident in a park creek.	Determine the types of organic contaminants and identify the sources and extent of the impacts. Establish a monitoring protocol for future use. (PIPE-N-008.000)
Grant-Kohrs Ranch National Historic Site, Montana	Upstream mining operations have damaged aquatic ecosystems. The park has new areas where this damage has not yet been assessed.	Evaluate the mining impacts in a new section of the park's river corridor, working in cooperation with a certified laboratory. (GRKO-N-004.000)
Pecos National Historical Park, New Mexico	Fish in the park contain high metal and PCB levels according to very limited, preliminary testing.	Analyze the preliminary fish contaminant data to evaluate health risks or aquatic damages, and recommend new sampling and testing needed to properly define the extent of the problem. (PECO-N-005.004)
Cuyahoga Valley National Recreation Area, Ohio	Assessments of major pollutants in water, sediment, and fish are needed to develop remedial actions for cleanup.	Study river toxicity problems via biological assessments to identify pollution sources and cleanup needs. (CUVA-N-110.003)

THEME NUMBER 6:
EVALUATE THE EFFECTS OF NONNATIVE AQUATIC ORGANISMS
ON AQUATIC ECOSYSTEMS

Nonnative aquatic organisms have been introduced into the waters within or adjacent to many national parks. For example, nonnative trout have become established in streams and exotic aquatic plants have invaded many wetlands and estuaries. These introduced species can drastically alter aquatic ecosystems through competition with native species, predation, transfer of pathogens, genetic introgression, and habitat alterations.

Research addressing these problems usually involves biological assessments, requiring expertise in ecology and related applied sciences such as fisheries management. These studies ideally will lead to recommended actions for park managers and the development of reclamation or restoration plans.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Sequoia-Kings Canyon National Parks, California	Nonnative trout have hybridized with natives in certain streams, contaminating the gene pool.	Survey rainbow trout genotypes in certain park streams to identify native gene pools. (SEKI-NO40.031)
Redwood National Park, California	The effects of nonnative fish on native fish in park waters is not known or understood.	Survey streams, ponds, and lagoons to identify nonnative fish as a basis for an eradication program, if needed. (REDW-N255-000)
Assateague Island National Seashore, Maryland	Common reed (<i>Phragmites australis</i>) is invading the seashore and may pose a threat to aquatic ecosystems. The park needs to quantify its extent and determine if control is needed.	Inventory invasion, quantify status and trend, and develop protocols for monitoring. Develop a control program, if needed. (ASIS-N-037.001)
Glacier National Park, Montana	Effects of nonnative fish and effects of removal of these fish on lake aquatic communities are not understood.	Study the effects of removing nonnative fish on aquatic ecology. (GLAC-N-404.000)
Great Smoky Mountains NP, Tennessee	The effects of nonnative trout on native fish is not well understood.	Conduct a literature review on the interspecific competition of trout to develop plans for a mitigation program. (GRSM-N-104.000)
Guadalupe Mountains NP, Texas	The park suspects that nonnative fish are eliminating native species.	Have an ichthyologist determine the status of various fish species in order to determine if a program to restore native fish is needed. (GUMO-N-028.000)
Mount Rainier National Park, Washington	Native lake salamanders are adversely affected by nonnative fish. Baseline data are lacking to evaluate and monitor these impacts.	Survey salamander distributions and abundances in lakes and ponds. Assess fish impacts on salamanders and their habitats. (MORA-N-017.015)
North Cascades National Park, Washington	Past fish stocking may have affected vertebrate and invertebrate species in lakes previously without fish.	Evaluate the impacts of stocked trout on biological communities in the lakes. (NOCA-N-16)

THEME NUMBER 7: ***WATERSHED, STREAM, WETLAND, AND ECOSYSTEM RESTORATION***

Parks sometimes acquire lands that retain scars from mining, farming, or other land uses. Often, channels, riparian zones, or other disturbed areas need to be restored. In the process of "ecosystem restoration," resource managers attempt to re-create something close to the original state of the resource. In south Florida, for example, resource managers might try to restore the natural hydroperiods of marshes impacted by roads or levees. Ecosystem restoration differs from "reclamation," where the land is returned to a useful state, but not necessarily to the original condition. For example, riparian zones that have been mined for gravel may be reclaimed as open-water habitat rather than being restored to the original vegetation communities.

Commonly available physical and biological land reclamation techniques may not be consistent with the National Park Service's mission to restore ecosystems. Restoration methods need to be developed for some common situations such as how to restore filled wetlands and avoid invasion by exotic plants. Restoration techniques are also needed for unusual circumstances such as how to restore riparian zones when old reservoirs are destroyed. In these situations, the attempt to restore an ecosystem can be pioneering research.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Denali National Park and Preserve, Alaska	The park needs assistance in assessing methodology, evaluating sites, and implementing projects for the restoration of placer-mined streams and riparian zones.	Develop techniques to reconstruct properly-functioning channels, floodplains, and riparian zones along placer-mined streams. (DENA-N-530)
Russell Cave National Monument, Alabama	Streambank erosion upstream from the cave causes impacts in the park. Exact sources and causes of the erosion are not well known.	Study flows, erosion sources, and erosion processes of the stream and recommend erosion protection measures. (RUCA-N-002.00)
Channel Islands National Park, California	Grazing needs to be managed to protect stream water quality.	Conduct research on the relationship between riparian condition and water quality, and assess appropriate "best management practices." (CHIS-N-100.107)
Sleeping Bear Dunes National Lakeshore, Michigan	Human-induced erosion of dunes needs to be stopped and corrected. Restoration techniques need refinement.	Hold a seminar to share dune restoration experience and methods. Conduct research on restoration methods on perched and shore dunes. (SLBE-N-008.000)
Canyonlands National Park, Utah	Impacts of trampling on cryptogamic soils by backcountry visitors.	Identify trampling impacts to biological (microbial) and hydrological properties of soils and conduct research on restoration of soil microbial and hydrologic processes.
Olympic National Park, Washington	Information is needed to direct ecosystem restoration following removal of a dam.	Develop models to predict reservoir sedimentation, erosion, and downstream deposition. Study interdependencies between sediment transport and lateral channel processes. Identify techniques for revegetation of old reservoir bottoms.

THEME NUMBER 8:
DEVELOP ECOLOGICAL PROFILES AND CONCEPTUAL MODELS OF AQUATIC ECOSYSTEMS THAT ARE RELATIVELY UNDISTURBED

Some parks still contain near-pristine aquatic ecosystems. We neither understand how these relatively undisturbed ecosystems function nor always have enough knowledge and skill to protect them.

Research in these systems calls for assessments over a time span adequate to understand the natural ecosystem functions and processes. Studies must integrate ecological and hydrologic expertise and energy and nutrient cycling typically will be an important consideration. Interpretation of research results will provide managers with guidance for how to best protect these near-pristine sites in the face of growing recreational and development pressures.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Bering Land Bridge National Park and Preserve, Alaska	Little accurate baseline data exists for watersheds in the preserve.	Develop standardized methods and conduct a baseline survey of water resources in the preserve for flow and water quality. Report and interpret results. (BELA-N-107.1)
Katmai National Park and Preserve, Alaska	No baseline data are available for the park's freshwater resources.	Collect baseline data on water resources and establish a monitoring program. (KATM-N-015)
Gates of the Arctic National Park and Preserve, Alaska	The park contains many major lakes for which limnologic processes are not understood.	Monitor the seasonal stratification patterns of several lakes to understand thermal conditions and lake processes. (GAAR-N-107)
Kaloko-Honokohau National Historical Park, Hawaii	Ponds (pools) inside the park are wetland habitats critical to organisms, but their characteristics and processes are largely unknown.	In cooperation with the U.S. Geological Survey, evaluate physical, ecological, and water quality characteristics of these unique ponds. (KAHO-N009.000)
Cape Cod National Seashore, Massachusetts	Need data and information for use in managing the 120 kettle ponds in the park in order to protect their water quality.	Develop monitoring programs for chemistry, algae, invertebrates, and other water constituents. (CACO-N-28)
Acadia National Park, Maine	No comprehensive baseline data on park invertebrates (especially insects) are available.	Sample insect fauna and compare to previous data. (ACAD-N-47.000)
Ozark National Scenic River, Missouri	Resource databases are incomplete and inadequate for proper management in many caves.	Conduct ecological assessments in caves, including water quality, nutrient flow, and other water resource components. (OZAR-N-212.000)

THEME NUMBER 9:
IDENTIFY AQUATIC RESOURCE "REFERENCE" SITES AND CONDITIONS

Whereas Theme 8 describes our the need to understand relatively pristine sites, Theme 9 recognizes our lack of understanding of more typical watersheds, such as those where significant human influences are present. How do these aquatic ecosystems function, and how can we develop meaningful objectives and guidelines for their protection, restoration, impact mitigation, and future management?

Research of this type draws on ecological expertise, but also typically incorporates a knowledge of land use and human impacts and how to quantitatively assess these influences.

EXAMPLES OF RESEARCH NEEDS

PARK & STATE	PROBLEM OR NEED	ACTION PROPOSED (NPS Project Number)
Antietam National Battlefield, Maryland	The Antietam Creek watershed contains mixed farming, woodland, and rural residences common to the region, with threats of pollution typical of this type of setting.	Conduct a comprehensive aquatic biological and habitat baseline inventory. (ANTI-N-004.002)
Isle Royale National Park, Michigan	Need to interpret existing biogeochemical monitoring data in the park to develop protocols and a strategy for long-term monitoring.	Assess the existing biogeochemical monitoring data and produce a report on what is known and how to monitor in the future. (ISRO-N-020.000)
Pictured Rocks National Lakeshore, Michigan	In order to manage an Outstanding National Resource Water and Biosphere Reserve, the park needs baseline water quality information.	Evaluate water quality standards and regulations and develop a sound long-term monitoring program for the designated area. (PIRO-N-710.000)
El Malpais National Monument, New Mexico	Ice Cave Springs is a unique freshwater resource at the park, but this resource is poorly understood.	Establish a monitoring program to evaluate the resource and to identify any impacts or problems. (ELMA-N-001.012)
Delaware Water Gap National Recreation Area, Pennsylvania	The park needs baseline nutrient and biochemical oxygen demand data in order to develop water quality models.	Collect water quality data, with focus on nutrients and biochemical oxygen demand. (DEWA-N-002.004)
Colonial National Historical Park, Virginia	This tidewater park lacks baseline natural resources data, including information on aquatic resources.	Review the park's inventory and monitoring activities. Develop protocols for inventories and monitoring (with a peer group), test these protocols, and refine the inventory and monitoring program. (COLO-N-603.000)
Mount Rainier National Park, Washington	Little is known about the basic ecology of high mountain ponds. This information is needed to detect any human-caused impacts.	Evaluate pond characteristics (using water quality and biological parameters) for various size ponds in the park. (MORA-N-017.014)

INTERESTED IN WATER-RELATED RESEARCH IN NATIONAL PARKS?

POINTS OF CONTACT FOR FURTHER INFORMATION

The National Park Service's Water Resources Division is headquartered in Fort Collins, Colorado. If you wish to learn more about the National Park Service's needs for water resources research or want to discuss the research themes described in this paper, contact the National Park Service Water Resources Division, 1201 Oak Ridge Drive, Suite 250, Fort Collins, Colorado, 80525, 970-225-3501.

If your research interest focuses on a particular geographic area shown in the map (Figure 1), you can also contact the following National Park Service Water Resources Program Managers (organized by cluster):

New England/

Adirondack:	Charley Roman	(401) 874-6885
	National Biological Service	(401) 874-6887 fax
	URI, Narragansett Bay Campus	
	South Ferry Road, Box 8	
	Narragansett, RI 02882-1197	

Allegheny:	DeNise Cooke	(717) 296-6952
	Delaware Water Gap NRA	(717) 296-4706 fax
	HC 38	
	Milford, PA 18337	

Chesapeake:	DeNise Cooke	
	same as above	

Atlantic Coast:	Megan Greiner	(404) 331-4916
	75 Spring Street, SW	(404) 331-4943 fax
	Suite 1092	
	Atlanta, GA 30303	

Gulf Coast:	Megan Greiner	
	same as above	

Appalachian:	Megan Greiner	
	same as above	

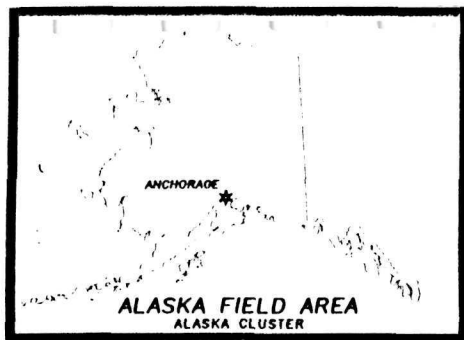
Great Lakes:	Rich Klukas	(402) 221-3603
	1709 Jackson Street	(402) 221-3461 fax
	Omaha, NE 68102	

Great Plains:	Rich Klukas	
	same as above	

Rocky Mountain:	Tom Wylie National Park Service P.O. Box 25287 12795 West Alameda Parkway Denver, CO 80225-0287	(303) 969-2970 (303) 987-6676 fax
Colorado Plateau:	Janet Wise National Park Service P.O. Box 25287 12795 West Alameda Parkway Denver, CO 80225-0287	(303) 987 6678 (303) 969-2644 fax
Southwest:	Nancy Skinner 1220 South St Francis Dr. P.O. Box 728 Santa Fe, NM 87501-0728	(505) 988-6862 (505) 986-5214 fax
Pacific/Great Basin:	Mietek Kolipinski 600 Harrison St., Suite 600 San Francisco, CA 94107-1372	(415) 744-3959 (415) 744-3932 fax
Pacific Island:	Mietek Kolipinski same as above	
Columbia/Cascades:	Shirley Clark 909 First Ave Seattle, WA 98104-1060	(206) 220-4098 (206) 220-4159 fax
Alaska:	Ross Kavanagh 2525 Gambell St. Anchorage, AK 99503-2892	(907) 257-2563 (907) 257-2448 fax
National Capital:	Doug Curtis 4598 MacArthur Blvd, NW Washington, DC 20007	(202) 342-1443 X228 (202) 282-1031 fax

+++++

The principal participants in assembling this paper and its data were Sam Kunkle (coordinator), Dan Kimball, Bill Jackson, Mark Flora, Frank Panek, Norm Henderson, and Joel Wagner. Lissa Fox provided valuable editorial assistance, and Patty Hennessy assembled and proofed the final document. Special thanks also are due to Nancy Deschu and John Karish for their input.



NATIONAL PARK SYSTEM

FIELD AREA AND CLUSTER BOUNDARIES

- FIELD AREA BOUNDARIES
- CLUSTER BOUNDARIES
- * FIELD DIRECTOR OFFICE LOCATIONS

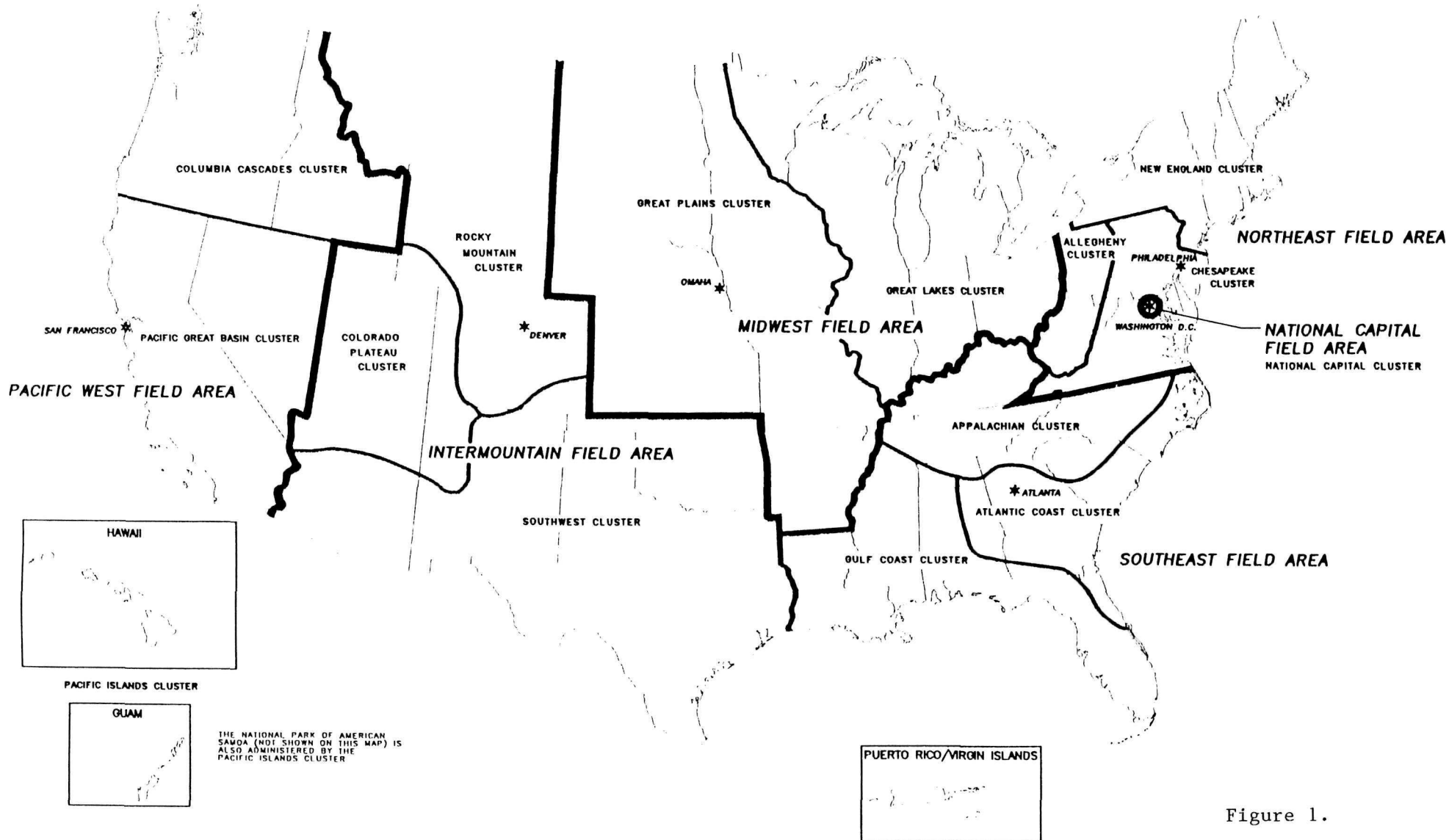


Figure 1.

