

Effectiveness Of Citizens' Environmental Monitoring Program

Project Number: 02667
Restoration Category: Monitoring
Proposer: Cook Inlet Keeper
Lead Trustee Agency: ADEC
Cooperating Agencies:
Alaska SeaLife Center: No
Duration: 1st year, 1-year project
Cost FY 02: \$17,900
Cost FY 03:
Geographic Area: Cook Inlet basin
Injured Resource/Service: This project takes an ecosystem approach towards monitoring and restoration and will result in direct and indirect benefits to all injured resources and lost or reduced services located in the Cook Inlet basin.

ABSTRACT

Cook Inlet Keeper will analyze five years of past data from the Keeper's Citizens' Environmental Monitoring Program (CEMP): the first consistent, credible, and coordinated community-based water quality monitoring program in Alaska. Keeper's Stream Ecologist will determine if sampling frequency, methods, parameters, and site selection are effective at meeting the monitoring objectives of detecting significant changes in water quality over time. The results will assist Cook Inlet Partners (Kenai Watershed Forum, Anchorage Waterways Council, Wasilla Soil and Water Conservation District) refine their community monitoring efforts and may lead to future community-based monitoring programs.

INTRODUCTION

Cook Inlet Keeper is requesting one year of funding from the EVOS Trustee Council through the Ecosystem Synthesis/GEM Transition: Community-Based Monitoring Programs. This project will analyze past data collections that will lead to more effective and scientifically defensible community monitoring efforts.

In 1996, Cook Inlet Keeper established its Citizens' Environmental Monitoring Program (CEMP) to actively involve citizens in collecting reliable water quality data in the Cook Inlet basin. With funding from Alaska's Department of Environmental Conservation and guidance from a Technical Advisory Committee, Keeper developed a Kachemak Bay Pilot Project as a working template that could be adopted by other groups interested in conducting citizen-based monitoring programs. The objectives of CEMP are to 1) inventory baseline water quality in the Cook Inlet basin, 2) detect and report significant changes and track water quality trends, and 3) raise public awareness of the importance of water quality through hands on involvement. Water quality parameters, data quality objectives, and site selection criteria were developed with a Technical Advisory Committee made up of professionals representing various federal, state, and local agencies and diverse scientific backgrounds.

In 1999, Keeper entered into an agreement with the Anchorage Waterways Council and the University of Alaska Anchorage's Environment & Natural Resources Institute to facilitate citizen-based water monitoring and assessment of the Anchorage Bowl. Keeper then entered into a similar agreement with the Wasilla Soil and Water Conservation District to begin monitoring in the Mat-Su Valley. As interest in CEMP continues to grow, there is a need to evaluate the effectiveness of the monitoring protocols and sampling design to meet the monitoring objectives. Keeper proposes to analyze five years of CEMP data to determine if sampling frequency, methods, parameters and site selection are effective at detecting significant change in water quality over time. These results will be useful to GEM when citizen-based monitoring programs are considered for funding in the future.

NEED FOR THE PROJECT

A. Statement of Problem

One of the biggest challenges to restore habitat and water quality following the *Exxon Valdez* oil spill has been the lack of adequate baseline data describing conditions before the spill. Since the oil spill, scientist have worked diligently to collect information describing recovery of species and habitats. But until recently there was no comprehensive long-term study to document water quality conditions in Southcentral Alaska. Baseline information provides a benchmark for measuring future changes in water quality and a basis for developing and implementing pollution prevention and best management practices.

As state and federal budgets for water quality monitoring continue to decline, citizens have stepped in to gauge the health of our public resources. Despite various philosophies on the

environment, everyone agrees that clean water and healthy fisheries should be protected. Diverse stakeholders such as fishermen, landowners, outdoor enthusiasts, Alaska Natives, scientists, educators, families, conservationists, and decision makers are expressing a desire to better understand and protect our water resources. Cook Inlet Keeper is leading the way and providing citizens with the opportunity to expand our knowledge of the Cook Inlet watershed.

Since Cook Inlet Keeper established Alaska's first consistent, credible, and coordinated volunteer water quality monitoring program in 1996, other groups throughout Alaska have requested Keeper's assistance in establishing volunteer monitoring in their communities. Toward that end, Keeper has formally partnered with the Anchorage Waterways Council, Kenai Watershed Forum, and Wasilla Soil and Water Conservation District to train more than 200 volunteers throughout the Cook Inlet watershed to monitor more than 90 freshwater and estuarine sites. With five years of data collected, it is important to ensure that sampling frequency, methods, parameters, and site selection are effective at meeting the monitoring objectives of detecting significant changes in water quality over time.

B. Rationale/Link to Restoration

Developing a monitoring system to detect and recognize significant change is challenging because natural systems are inherently dynamic and spatially heterogeneous. Many changes are not a result of human activity and are reflective of natural variability. An important step of every monitoring program is determining if the project objectives can actually be attained by the methods, parameters, and analyses used. To determine if a monitoring program is successful at detecting real change and not just natural variability, the statistic power of the monitoring design needs to be assessed.

With five years of data collected, Keeper can now determine if the CEMP protocols influence data variability which can affect data interpretation. Improvements in sampling protocols can then be made to better represent water quality in the Cook Inlet basin. Determining the effectiveness of CEMP protocols will ensure that monitoring projects developed by current partners (Anchorage Waterways Council, Kenai Watershed Forum, and Wasilla Soil and Water Conservation District) as well as future citizen-based programs around the Gulf of Alaska will be successful in detecting changes in water quality over time.

C. Location

The Cook Inlet watershed was hit hard by the *Exxon Valdez* oil spill. The currents in the Gulf of Alaska caused oil to move up into Cook Inlet, along the Kenai Peninsula and back down the Alaska Peninsula, soaking much of the shoreline and ocean floor with crude oil. As a result, many of Cook Inlet's coastal resources, and the services which they support, were impacted.

Although some recovery has occurred, Cook Inlet's sensitive resources face ongoing threats from a host of unsustainable activities, including rapid filling of wetlands; additional oil spills from an aging oil and gas infrastructure; discharge of pollutants from industrial activities; and increased nonpoint runoff from population growth and sprawl. Approximately 400,000 people, nearly 2/3 of Alaska's population, live in the vast Cook Inlet watershed, and a population

increase of 600% over the past thirty years has substantially magnified pressures on Cook Inlet's sensitive resources.

Communities involved in and affected by Keeper's Citizen Environmental Monitoring Program include Wasilla, Anchorage, Kenai, Soldotna, Ninilchik, Anchor Point, Homer, Seldovia, Port Graham, Nanwalek, and others. Citizens throughout the Cook Inlet watershed will benefit from refinements or changes that are made to CEMP protocols based on the results of this project. Citizens in other Gulf of Alaska watersheds will benefit when future citizen-based monitoring programs are developed.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Because citizens are the true owners of public water resources, Keeper strives to involve them in hands on activities aimed at improving and protecting habitat and water quality and promoting resource stewardship. Citizen-based monitoring is a community-owned and community-driven effort. It is a highly effective way to bridge the gap between citizens and natural resource agencies. Citizens are directly involved in collecting and tracking water quality information, and have a greater sense of ownership of the monitoring findings.

Citizen monitoring is also an important way to integrate traditional environmental knowledge (TEK) with science. Many of the citizens who become involved in the monitoring efforts have a long history with their local regions. Keeper is set to begin working with Alaska Native organizations, including the Port Graham/Nanwalek Watershed Council and Ninilchik Traditional Council in citizen monitoring efforts. Keeper recognizes the powerful role that TEK can play to further water quality monitoring goals. Visual and other observations through narration, photographs and sketches may be one way to better incorporate TEK into citizen-based monitoring, and Keeper will continue to work to strengthen TEK components.

As part of citizen-based monitoring, participating communities have access to project information because they own and drive the project. Keeper compiles and presents all collected water quality monitoring findings in a variety of ways. In addition to publishing formal reports with narrative, charts, graphs, GIS maps and photos, Keeper also publishes monitoring information in its bi-annual newsletter and on its web page. Keeper often incorporates photos and GIS maps of water quality monitoring sites in its reports, articles, and web page as visual tools to help citizens understand the monitoring efforts.

Keeper values community participation, and believes the best way to involve people is by traveling to communities to gain a better understanding of local needs and interests. In 1998, Keeper produced the *Cook Inlet GIS Atlas* on CD ROM which synthesizes more than 125 computer map layers of pollution, habitat, streams, and other information. Keeper worked with over 20 community-based groups to take the CD ROM to 13 Cook Inlet communities to give citizens a visual understanding of their local watersheds, and to share Keeper's GIS mapping and water quality monitoring information. Since that time, Keeper has had several groups from throughout Cook Inlet request information and services to assist them with their efforts to understand their local watersheds.

PROJECT DESIGN

A. Objectives

The overall objectives of CEMP are to 1) inventory baseline water quality in the Cook Inlet basin, 2) detect and report significant changes and track water quality trends, and 3) raise public awareness of the importance of water quality through hands on involvement. The proposed project has the following objectives:

1. Evaluate whether CEMP sampling frequency, sampling methods, water quality parameters, and site selection are effective at detecting significant changes in water quality over time.
2. Generate recommendations for improvements to CEMP protocols to better represent water quality in the Cook Inlet, which will lead to more effective and scientifically defensible community monitoring efforts.

B. Methods

Keeper staff will analyze five years of CEMP data using 1) descriptive statistics, graphs, and analysis of variance to determine variability within sites, between sites, and over time and 2) power analysis to determine the statistical power of the sampling program to detect change.

The CEMP database consists of data collected from 1996 to 2001 at a total of 89 sites (47 estuarine, 42 freshwater) in the Kachemak Bay watershed. Surface water samples are taken at all monitoring stations monthly between September and April and twice monthly from May through August for a total of 16 sampling events per site per year. Primary parameters (water temperature, turbidity, pH, salinity, and dissolved oxygen) are measured using standard EPA-approved procedures and/or methods which are in use by established citizen volunteer monitoring programs (e.g. Friends of Casco Bay's Citizens Water Quality Monitoring Program, Texas Watch's Volunteer Environmental Monitoring Program). Methods for additional parameters (apparent color, conductivity, nitrate-nitrogen, ortho-phosphate, fecal and total coliform bacteria) are taken from the "Volunteer Estuary/Lake/River/Stream Monitoring: A Method's Manual" published by U.S. EPA.

All data are reviewed by Keeper's Research Coordinator to ensure they meet program data quality objectives. The data quality objectives and quality assurance procedures for this program have been designed to identify and correct problems in data collection and reporting. Should the results of quality assurance reviews indicate that the integrity of data are questionable and data quality objectives are not being met, the data are flagged as unacceptable for inclusion in the CEMP database. None of the suspect data will be included in the proposed data analysis.

The null hypothesis for the CEMP is that there will be no significant mean difference in water quality parameters over time. For the CEMP data to be sufficiently powerful enough to test this, Keeper needs to determine if 1) sample size for baseline data is adequate, 2) precision of CEMP methods are adequate, and 3) temporal and geographic coverage is adequate. The robustness of

the CEMP protocols to reject the null hypothesis will be analyzed with SPSS Base 10.1 for Windows and SamplePower 2.0 software.

Preliminary analysis will entail generating descriptive statistics and graphical presentations of the data from all sites. Descriptive statistics will include overall mean, standard deviation, and range and will be generated for each site for each water quality parameter. Outliers will be identified and interpreted. A temporal analysis using analysis of variance (ANOVA) will measure changes in water quality parameters over a variety of temporal scales (i.e. annual, seasonal, monthly) at each sampling site.

A power analysis, using sample size and standard deviations, will be performed for each parameter for each site. This analysis will determine what magnitude of change (i.e. effect size) the present sampling design can detect. If the effect size detectable is deemed too large, results from the power analysis will reveal what sample size and/or precision are needed to measure the desirable effect size. These results will provide insight into adequate sampling frequency as well as appropriate sampling methods and parameters.

In an effort to understand spatial trends in the data, sites will be grouped by location within the Kachemak Bay. Groupings could include freshwater vs. estuarine sites, north vs. south side-of-the-bay sites. ANOVA tests will be used to detect significant differences between sites and site groupings. These results will be valuable for determining if the geographic coverage of CEMP sites is adequate.

Correlation coefficients between parameters will be examined to see which water quality characteristics are related to each other. Correlations with ancillary data (i.e. precipitation, wind speed and direction, solar radiation) from Homer Airport's meteorological record will be explored.

Based on the results of the analysis, recommendations to improve the CEMP protocols will be proposed and presented to the CEMP Technical Advisory Committee. These improvements will be disseminated to the Cook Inlet partners in a project report. Keeper will also convene an annual water quality conference among current and potential monitoring partners and agencies to communicate findings from the analysis and to facilitate CEMP planning and development.

C. Cooperating Agencies, Contract, and Other Agency Assistance

Cook Inlet Keeper is the only organization requesting funds for this project.

SCHEDULE

A. Measurable Project Tasks for FY 02 (October 1, 2001 – September 30, 2002)

October 2001 – July 2002:	Analyze CEMP data to determine effectiveness of protocols
August– September 2002:	Production and release of project report which will include recommendations for improvements to CEMP protocols
Ongoing:	Work with new potential partners to help them develop

credible monitoring programs. Potential new partners include: Port Graham/Nanwalek Watershed Council, Ninilchik Native Association, Eklutna Tribal Council, Native American Fish and Wildlife Society

December 2002: Convene meeting with current and potential monitoring partners and agencies to communicate findings from analysis

March 2003: Incorporate suggestions into the CEMP Quality Assurance Project Plan

April 15, 2003: Submit final report to EVOS (FY02)

B. Project Milestones and Endpoints

The first project objective, which is completion of data analysis, will be complete by July 31, 2002. Production/release of analysis report, project objective #2, will be complete by September 30, 2002. Implementation of suggestions for refinement to CEMP protocols generated from analysis and agreed upon by the Technical Advisory Committee and partner groups will occur during FY 2003 and are not part of the proposed project objectives.

C. Completion Date

All of the project objectives will be met by the end of FY 2002. The final project report will be submitted to EVOS Trustee Council by April 15, 2003.

PUBLICATIONS AND REPORTS

In October 2001, Keeper will released “Cook Inlet Citizens’ Environmental Monitoring Project Annual Water Quality Status Report” which will present five-years of water quality data collected by volunteers in the Kachemak Bay watershed. As with previous annual reports, the October 2001 report will be distributed to concerned citizens, agency personnel, tribal councils, and the press. Previous annual reports are available on the Keeper's web page at <http://www.inletkeeper.org/cemp/cempd1.asp>.

In September 2002, Keeper will release the proposed project report: “Evaluating the Effectiveness of Citizen’s Environmental Monitoring Project”, which will be distributed to current and potential partner groups, agencies, and concerned citizens.

PROFESSIONAL CONFERENCES

No travel funds beyond the Trustee Council’s Annual Restoration Workshop are budgeted for FY 2002

NORMAL AGENCY MANAGEMENT

Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORTS

Cook Inlet Keeper has a close relationship with many of the restoration efforts that have been funded by the Trustees Council. Most notably, Keeper shared its *Cook Inlet GIS Atlas* on CD ROM and Annotated Bibliography to assist the Kachemak Bay National Estuarine Research Reserve's Ecological Characterization Project, and the Cook Inlet Information Monitoring and Management Systems database project. Keeper is linked to the CIIMMS web page, and once its water quality database and interactive GIS maps become available on the Internet, they will be integrated with the CIIMMS database. The information Keeper shares with CIIMMS contributes greatly to a more holistic understanding of Cook Inlet's resources, pollution sources, and other conditions.

Keeper is working with Kachemak Bay National Estuarine Research Reserve to bring together citizen volunteer monitors and professional researchers to deploy a systematic array of electronic sensors along the south and north sides of Kachemak Bay, which will coincide with volunteer water quality monitoring sites, to assess water circulation patterns throughout the Bay. Keeper also collaborates with UAA's Kachemak Bay Campus which makes an in-kind contribution of lab space for water quality laboratory analysis.

Keeper cooperates with agencies that conduct water quality monitoring in the Cook Inlet basin. These agencies include: U.S. Geological Survey, Alaska Department of Environmental Conservation, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, Alaska Department of Fish and Game, Alaska Department of Natural Resources, and the Cook Inlet Regional Citizens Advisory Council. Representatives from each of these agencies participate as members of Keeper's TAC. Also, DNR's Division of Forestry invited Keeper to present its water quality information at a planning meeting to help it determine a need for monitoring forestry activities and impacts on the Kenai Peninsula, and the ADF&G has used Keeper's water quality reports to help guide their future plans for monitoring, so as not to duplicate existing efforts.

In addition to Trustees-funded Restoration Projects, Keeper collaborates with numerous other local and national groups and agencies. For example, Keeper is a partner in the Pratt Museum's Kachemak Bay Discovery Project, a member of the River Network and a member of the National Water Keeper Alliance. Keeper works closely with all monitoring efforts in Cook Inlet including those conducted by: the Anchorage Waterways Council, University of Alaska Anchorage's Environment and Natural Resources Institute, Wasilla and Homer Soil and Water Conservation Districts, Kenai Watershed Forum, Anchor Point Community Rivers Planning Coalition, Seldovia Oil Spill Response Team, and Port Graham/Nanwalek Watershed Council (memorandums of understanding attached). Keeper plans to include more partners in the future such as the Chickaloon Native Village, Ninilchik Traditional Council, Kenai National Wildlife Refuge, and more.

Cook Inlet Keeper's monitoring project has been funded through ADEC by EPA 319 nonpoint source grant money over the last three years, along with other sources to meet EPA's required 40% non-federal match. Keeper's other monitoring support has included grants from the Skaggs Foundation (\$8,000 in 1999 and \$5,000 in 2001), Norcross Wildlife Foundation (\$10,000 in 1999 and \$13,000 in 2001), River Network Watershed Assistance Grant (\$20,000 in 1999), Bullitt Foundation (\$10,000 in 2000), individuals and businesses (~\$10,000/yr.) fees for GIS services (~\$5,000/yr.), and in-kind contributions of time and services (~\$25,000/yr.).

Keeper's monitoring budget for FY 02 is \$205,313. Keeper anticipates a few more years of funding from EPA, including \$105,000 in FY 02. Keeper will raise additional funding including grants, individuals, businesses and fees for services. Keeper currently has a grant pending with the U.S. Fish and Wildlife Foundation. Keeper is also exploring the feasibility of a business fundraising effort to solicit businesses to adopt monitoring sites for the cost of sampling equipment needed to monitor that site for one year.

Keeper is requesting \$16,700 from EVOS for FY 02 to cover Keeper staff time and office supplies to perform the needed analysis, which will ensure the consistency and credibility of citizen-based monitoring in Alaska. Funding from EVOS will also help Keeper make citizen-collected data more useful to scientists and to make the data available for public access. This project will provide agencies and the public with the information needed to better understand threats to, and solutions for coastal resources, and will lead to improved stewardship and coastal watershed and wildlife habitat protection in Alaska.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Not applicable.

PROPOSED PRINCIPAL INVESTIGATOR IF KNOWN

Name:	Sue Mauger, Stream Ecologist
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PRINCIPAL INVESTIGATOR

Sue Mauger is the Stream Ecologist for the Lower Kenai Peninsula Watershed Health Project at Cook Inlet Keeper. Sue joins the staff in Homer after completing a Masters in Fisheries Science at Oregon State University. Sue also has a B.S. in Zoology from Duke University and worked in the Chesapeake Bay studying Blue Crabs and coordinated research projects for Earthwatch Institute in Massachusetts. Sue became director of the volunteer monitoring project for the Xerces Society in Portland, Oregon in 1994, working with high school students and local citizens to develop benthic invertebrate monitoring programs in watersheds along the Oregon coast.

OTHER KEY PERSONNEL

Joel Cooper, Research Coordinator

Joel joined Keeper's staff in 1998 to coordinate and oversee Keeper's citizen water quality monitoring program. Prior to joining Keeper, some of Joel's work experience included conducting stream surveys for the U.S. Forest Service, serving as an Organic Chemist for the Rocky Mountain Analytical Laboratory, and working as Environmental Scientist for the Southern Illinois University Department of Pollution Control. Joel holds a B.S. in Environmental Studies focusing on forestry, chemistry, plant and soil sciences from Southern Illinois University.

Mike Gracz, Geographic Information System (GIS) Specialist

Mike is a forest ecologist with degrees from State University of New York College of Environmental Science & Forestry (B.S.) and the University of Washington (M.S.). He has backgrounds in computer mapping technologies, forest disturbance ecology and botany. Prior to joining Keeper in 1997, Mike worked for the Kenai National Wildlife Refuge, Alaska Maritime National Wildlife Refuge, and Olympic National Park.

Carl Schoch, Kachemak Bay Science Coordinator, Oceanographer/Quantitative Ecologist

Carl Schoch is the science coordinator for the Kachemak Bay Research Reserve in Homer, Alaska (a NOAA NERR), and adjunct researcher at Oregon State University. He has a Ph.D. in Oceanography from the College of Oceanic and Atmospheric Sciences at Oregon State University. Carl will serve as the statistical advisor for this project.

**EVOS Trustees Council
Budget Form
October 1, 2001 - September 30, 2002**

Budget Category:	Authorized FY 2001	Proposed FY 2002						
Personnel		\$11.0						
Travel		\$0.5						
Contractual		\$1.6						
Commodities		\$0.1						
Equipment		\$2.0						
Subtotal		\$15.2	LONG RANGE FUNDING REQUIREMENTS					
Indirect		\$1.52	Estimated FY 2003					
Project Total		\$16.7						
Full-time Equivalents (FTE)		3.9						
Dollar amounts are shown in thousands of dollars.								
Other Funds								
Cook Inlet Keeper is requesting the full \$16,700 for this one-year project from the EVOS Trustees Council.								

FY 02

Project Number: 02667
 Project Title: Effectiveness Of Citizens' Environmental Monitoring Program
 Agency: Cook Inlet Keeper

Prepared:
12-Apr-00

**EVOS Trustees Council
Budget Form**

October 1, 2001 - September 30, 2002

Name	Position Description		Budgeted	Costs	Overtime
S. Mauger	Stream Ecologist		3.0	2.8	
J. Cooper	Research Coordinator		0.8	2.9	
M. Gracz	GIS/Web Specialist		0.1	3.0	
		Subtotal	3.9	8.7	0.0
					Personnel Total
Travel Costs:					
	Description	Ticket Price	Round Trips	Total Days	Daily Per Diem
	1 - RT Homer to Anchorage - Annual Restoration Workshop	0.17	1	2	0.05
	1 Rental Car - 2 days for Annual Restoration Workshop (\$50/day)				
	Accommodation 2 nights - Annual Restoration Workshop (\$50/day)				
					Travel Total

FY 02

Prepared:
12-Apr-00

Project Number:
Project Title: Effectiveness Of Citizens' Environmental
Monitoring Program
Agency: Cook Inlet Keeper

Contractual Costs:	
Description	

**EVOS Trustees Council
Budget Form**

October 1, 2001 - September 30, 2002

Communications (phone, fax, email) with TAC, other monitoring groups, etc. Postage Printing/copying of final report	
Contractual Total	
Commodities Costs:	
Description	
Supplies	
Commodities Total	

FY 02

Project Number:
Project Title: Effectiveness Of Citizens' Environmental
Monitoring Program
Agency: Cook Inlet Keeper

Prepared:
12-Apr-00

New Equipment Purchases:		Number of Units	Unit Price
Description			
SPSS Base 10.1 Software for Windows		1	1.0
Sample Power 2.0		1	1.0

EVOS Trustees Council
Budget Form
 October 1, 2001 - September 30, 2002

Indicate replacement equipment with an R.	New Equipment Total
Existing Equipment Usage:	Number of Units
Description	
19' patrol skiff	1
36' research vessel	1
Computers	8
Printers	2
GIS Map Plotter	1
Xerox machine	1
monitoring kits	41
monitoring meters	5

FY 01

Project Number:
 Project Title: A Prototype Citizen-based Monitoring and Watershed Assessment
 Agency: Cook Inlet Keeper

Prepared:
 12-Apr-00