Community-Based Monitoring of Alaska's Coastal and Ocean Environment

›› *Best Practices for Linking Alaska Citizens with Science*

MARILYN SIGMAN, EDITOR

ALASKA SEA GRANT

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Table of Contents

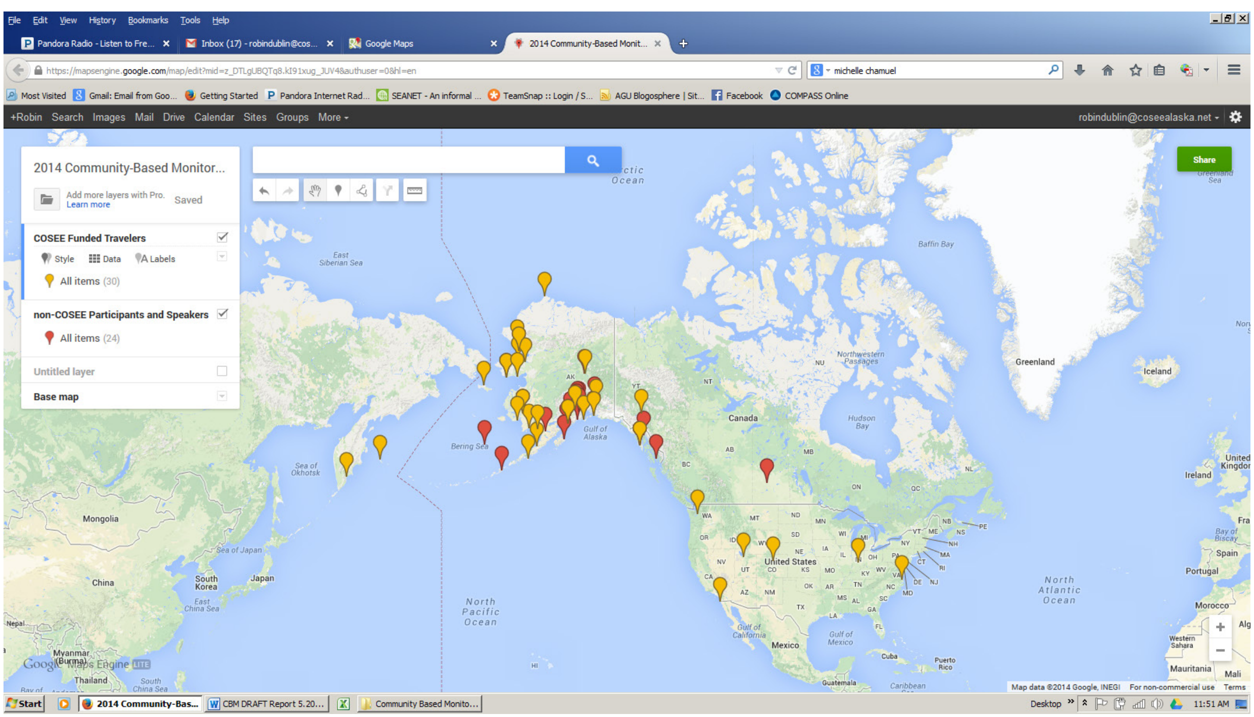
Word cloud of all of the notes taken at break-out sessions during the Anchorage Community-Based Monitoring workshop, held in April 2014.

Acknowledgments

This handbook is dedicated to more than 100 people from 34 Alaska communities, six Lower 48 states, Canada, and Kamchatka, Russia, (see map) who participated in a workshop in Anchorage, Alaska, April 1-2, 2014, and to the hundreds of partnerships between citizens and organizations that monitor change in the Alaska environment and the health of the ecosystems upon which people depend.

The Steering Committee that planned the workshop was co-chaired by Molly McCammon, director of the Alaska Ocean Observing System (AOOS), and Paula Cullenberg, director or Alaska Sea Grant (ASG). Members were Robin Dublin, director of the Alaska Center for Ocean Sciences Education Excellence; Lillian Na'ia Alessa, director of Alaska EPSCoR (University of Alaska) and Center for Resilient Rural Communities (University of Idaho); Ellen Tyler, AOOS; Marilyn Sigman, ASG and COSEE; Carolina Behe, Inuit Circumpolar Council; Maryann Fidel, Aleut International Association; and Gary Freitag, ASG.

The information in this handbook is based on the success of programs that involved thousands of hours provided by volunteers or paid observers in programs throughout Alaska and the Arctic. These programs have greatly expanded the scope of detection and understanding of the rapid environmental changes that are occurring in Alaska, particularly in the Arctic. The information gained has increased the capability of communities and government agencies to respond adaptively to changing conditions they are alerted to as data are monitored. It is our hope that this handbook will support communities in environmental monitoring and contribute to the detection and solution of environmental problems, on local to global scales.



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Executive Summary

A Community-Based Monitoring (CBM) workshop was convened in Anchorage, Alaska, on April 1-2, 2014. The purpose was to bring together scientists, practitioners, community members, and funders involved in CBM to identify and respond to common issues and share successful practices for CBM in Alaska. The best practices presented here are the results of presentations and discussions at the workshop. Subject areas explored included a comparison of the perspectives of diverse participants in Alaska CBM programs; designing for success; collecting, interpreting, and using scientific data and Traditional Knowledge; and measuring success.

The best practices for successful CBM programs that emerged from the workshop include

- The need for monitoring and the intended use of the data are clearly identified.
- The program has clearly identified benefits for the community, including the involvement of youth whenever possible.
- A scientist, agency, or organization is committed to manage the program, to be responsive to community needs, and to meet the scientific needs of the intended users of the data.
- Data collection, analysis, and management:
    - The methods are scientifically defensible.
    - The community has been consulted about appropriate methods for data analysis and dissemination and their involvement in these aspects of the program is clearly specified.
    - The methods are feasible and appropriate to the capability and culture of the community.
    - A strategy for recruiting, training, and retaining data collectors is in place.
    - Data and data products will be accessible to potential data users, including the community or community partners.
    - Sensitive data (e.g., Traditional Knowledge, subsistence and other harvest data) and intellectual property rights are recognized and protected.
    - A long-term plan is in place for data and metadata management and archival.
- Communication is planned throughout the program that is appropriate to the partners in terms of both methods and frequency.
- A strategy is in place for evaluating objectives and outcomes related to data collection, data quality, sustained participation, and benefits to the community participants.
- The program is or will be managed adaptively; i.e., information gained through evaluation and assessment will be used to improve the program.
- An exit strategy is in place in case objectives are met or opportunities for continuation and expansion are exhausted.

Leonard Fitka, of the Ohogamiut Traditional Council, samples the Yukon River at Marshall, Alaska.

Introduction

Three out of four Alaskans, in about 260 communities, live either along the state's coastline or along the rivers that bridge freshwater and marine coastal environments. Alaskans understand the dynamic nature of our coasts and river watersheds, and depend on the long-term health of these resources for food, recreation, and economic value. With climate change hitting Alaska hard, particularly in the circumpolar arctic region, an accelerated pace of change has heightened interest in local observations.

Alaskans in communities all along Alaska's coast and rivers are participating in monitoring environmental changes. Community members are collaborating with scientists, engineers, and natural resource agencies outside their communities to ensure the observations and data they collect can be used to detect significant trends that have implications for the future health of the environment and of their communities. In some situations it is the "outside" partner—scientist, engineer, or government agency—who initiates and provides leadership for the program, and in other situations the community is the initiator or leader. Communities are also choosing to participate in data management and many use the data to guide local decision-making, planning, and engineering. Scientists, engineers, and government agencies use the data in a variety of ways and also provide science outreach and take part in meaningful community engagement.

The people involved in monitoring programs use a variety of terms to describe what they do, such as citizen science, observing networks, contributory research, participatory monitoring, and collaborative research. In this handbook, we use "community-based monitoring" as an umbrella term for all of the diverse efforts in Alaska that involve a collaboration between community members who collect local observations and data and their partners outside the community who support the collection, management, and use of the observations and data in some way.

Some monitoring programs refer to what is being collected as "observations" and others use the term "data." Some groups working together over the geographic area of several communities refer to themselves as observing networks. The distinction between "observations" and "data" is that the term "data" implies collection using standardized protocols to ensure accuracy and precision while "observations" can refer to those made opportunistically or to those collected systematically using standardized protocols. The Local Environmental Observer (LEO) Network, for example, consists of tribal professionals in 100 Alaska and Canadian communities who share opportunistic observations of anomalous local environmental events such as unusual wildlife sightings or harmful algal blooms (also known as red tides) or rely on their personal observation skills and local knowledge to determine what is unusual. Weather observations, on the other hand, are collected by individuals in many locations along Alaska's coast and rivers using standardized procedures and equipment to ensure that the information is accurate, precise, and comparable and thus scientifically defensible. In this handbook, we use the term "data" to refer to information collected systematically using standardized protocols.

The communities engaged in monitoring are diverse. Geographically they range from people who live in the same community to people who live in the same region of Alaska, to people who live in communities throughout the international Arctic (e.g., the eight villages in Alaska and Russia in the Community Observation Network for Adaptation and Security, CONAS). CBM communities range topically from groups of birders and beach-walkers collecting data about birds that wash up on local beaches as part of the West Coast/Alaska Coastal Observation and Seabird Survey Team (COASST), to the network of individuals throughout Alaska who collect water quality data, weather observations, and shellfish for testing for paralytic shellfish poisoning. Alaska's youth participate in monitoring, both at school where they gain important skills and environmental knowledge, and after school and during summer programs that provide opportunities to contribute to their communities.

Alaska's diverse Native communities contribute their cultural perspective and Traditional Knowledge to place the results of current monitoring into the context of observations collected and handed down over generations of people living in the same place over thousands of years. A large number of Alaskans engaged in community-based monitoring programs are volunteers and an equally large number are engaged in monitoring as part of their professional environmental work.

This book provides practical guidance to members of community groups, scientists, engineers, and agency staff working on, or planning to start, a community-based monitoring program. The emphasis is on collecting scientifically defensible data and systematic, rather than opportunistic, observations. Scientifically defensible data are required to provide baselines, detect trends, and set thresholds for triggering responses to environmental changes.

"LEO [Local Environmental Observer Network] is a system for sharing a wide range of observations occurring all the time in communities . . . We're trying to tap into all of the resources and knowledge that are available in Alaska and all of the observations and powers available from people who live close to the land and who are so familiar with the resources that it's like their family."

Michael Brubaker,
Alaska Native Tribal Health Consortium

"The essential components of community-based monitoring are answering questions and making connections . . . recognizing the things that are important and connecting the dots."

Henry Huntington, Social Scientist

How to Use This Handbook

This handbook provides practical guidance for planning and implementing a collaborative community-based monitoring program. Because CBM programs require that people work together, it is strongly suggested that you share this handbook with the other people you want to work with. Successful CBM projects require clear, continuing communication. Read the Introduction first to determine if what you are planning to do, or are doing, fits the definition of community-based monitoring. Pay particular attention to how the term "data" is used in the handbook and the emphasis on guidance for collecting scientifically defensible data.

Next, work through the flowchart in Section A together to better define how partners will be involved. As you move through the flowchart, keep in mind that an individual's perspective as a scientist from a university, agency, or company may differ greatly from that of a community organizer. Discuss assumptions as you go. If you don't have a strong commitment from a community partner **and** a scientist, engineer, agency, or organization that can provide the needed scientific expertise, review the criteria in the handbook and then find the partners you need before trying to proceed.

After reviewing the flowchart together and reaching the conclusion that you want to pursue a CBM program, use the checklist in Section B as a planning tool to organize the project and determine the project scope. These items are for your consideration in planning. You do not have to check all of the boxes to have a successful project.

The numbers in the checklist refer to additional information in Section C. If you have an ongoing CBM program, you can use the checklist and guidance to communicate about ways to improve your program or describe it to a potential partner or funder.

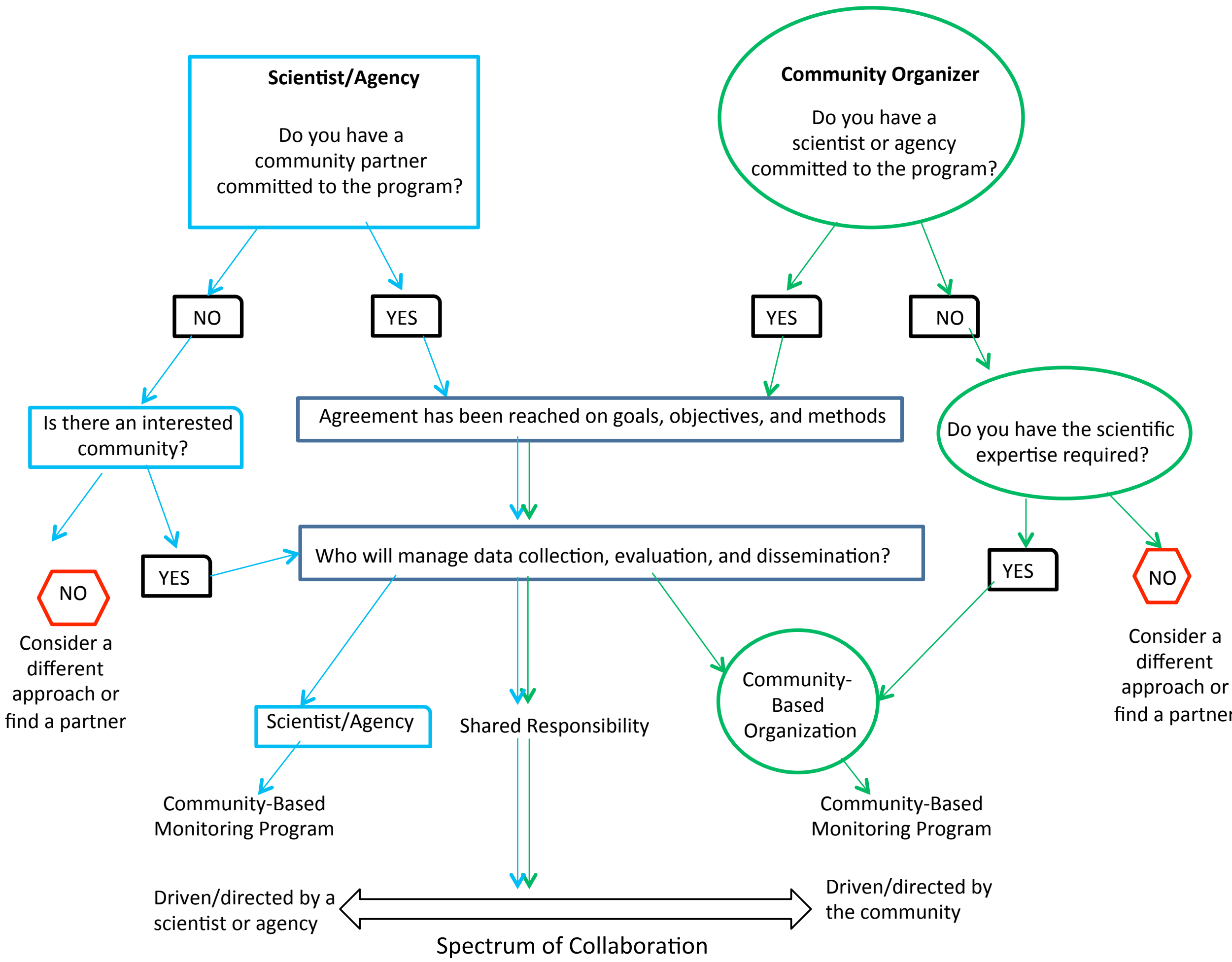
Section D is a summary of other considerations and tips for you to think about during program design and implementation. If you are already running a CBM program, you may want to read this with an eye to how your program can be improved. Reviewing these considerations will help your group further define who to reach out to and how to address potentially challenging situations that may arise. You and your group should think through everything that can and should be included and consider aspects that can potentially go wrong and go right. But remember that science and CBM projects evolve over time and that you simply cannot plan for everything. It is best to remain open and flexible.

"Flexibility keeps community-based monitoring programs relevant and useful."

Maryann Fidel,
Aleut International Association

Throughout the handbook are quotes like the one above. Most are by keynote presenters and session facilitators at the Community-Based Monitoring workshop held in Anchorage, April 1-2, 2014.

Section A. Is a Community-Based Monitoring Program the Right Approach?



The Community-Based Monitoring Flowchart

Section B. Best Practices Checklist for CBM Programs

The following checklist of best practices for community-based monitoring programs may be helpful in designing new programs and evaluating and improving ongoing programs, and can also be useful as criteria for funders. The numbers in parentheses at the end of each best practice refer to further guidance in Section C. These items are for your consideration in planning. You do not have to check all the boxes to have a successful project.

1 GENERAL CONSIDERATIONS FOR ALL CBM PROGRAMS

- ○ The program is collaborative and designed to benefit all partners. (**1a**)
- ○ Partner roles are well defined and the partners have the capacity to fulfill them. (**1b**)
- ○ The program will produce scientifically defensible results that will detect significant environmental change and/or inform natural resource management and also benefit the participating community.
- ○ The program does not duplicate other efforts and will contribute to environmental monitoring networks collecting similar data where possible.
- ○ Community participants will be provided with the "bigger picture" or real-world purpose for the data collection.
- ○ A strategy exists to sustain the program if an individual ceases his or her participation.
- ○ The scope of the program fits the available or requested resources.
- ○ The program has a realistic timeline and budget. Where possible, the program is designed to front-load start-up costs and maintain the monitoring with a lower level of annual funding.
- ○ All necessary permissions and permits are identified and will be obtained in a timely fashion.
- ○ Potential sources of funding and in-kind support are identified and realistic.

PROGRAM CHARACTERISTICS

2 ROLE OF PARTNERS

- ○ Program is primarily driven and directed by the community or community-based organization. (**2a**). If not, see **2b**.
    - ○ Community partners are committed to carry out the program.
    - ○ Community partners have the capability for directing and managing the program.
    - ○ Scientific or engineering expertise has been used to develop the program, to provide scientifically defensible results, and to support the interpretation of results.
    - ○ Partners who are outside the community who will use or manage the data are specified and committed, and potential uses are specified.

- ○ The community has a data plan that includes sharing results.
- ○ The community will provide appropriate recognition to the partners outside the community to help sustain their participation.
- ○ Youth will be involved in the program if at all possible.

○ Program is primarily driven and directed by a scientist, engineer, government agency, or organizational partner outside the community. (**2b**) If not, see **2a**.

- ○ The outside partner is committed to carry out the program in partnership with the community and is responsive to community needs and capacity.
- ○ The outside partner has the capacity to sustain the program with at least one person as the nexus with the community to facilitate the partnership.
- ○ Community partners are committed to carry out the program **or** the recruitment and training program for community participants is feasible.
- ○ Strategies for recruiting and retaining volunteers are appropriate to the community **or** compensation has been budgeted for data collectors and program coordinators in communities where this is more appropriate.
- ○ Results will be shared with the community.
- ○ Youth will be involved if at all possible.
- ○ Appropriate recognition will be provided to the community partners.

3 ENVIRONMENTAL OBSERVING PROGRAM

○ The program will collect opportunistic individual observations.

○ The program will collect systematic observations by individuals.

4 PARTICIPANTS

○ Program will involve Traditional Knowledge holders. (**4a**, see also Engaging Alaska Native Communities in CBM in Section D)

○ Informed consent for the monitoring program has been obtained from tribal and/or Elders' councils prior to the initiation of data collection.

○ Traditional Knowledge holders will be involved in the development of data collection methods to ensure they are culturally appropriate.

○ Traditional Knowledge holders will be involved in data analysis and decisions to provide access to sensitive observations and data. (**4a.1**)

○ Agreements are in place to ensure that intellectual property rights are protected. (**4a.2**)

○ Program will involve K-12 teachers and/or students. (**4b**)

- ○ The educator(s) and the school or informal education organization are committed to carry out the data collection.
- ○ Data collection methods and quality assurance/quality control procedures are appropriate to student-collected data.
- ○ Access to data is user-friendly and supported for classroom use. Students will be provided opportunities to analyze the data and will be encouraged to communicate results to other students and/or their community.

Numbers 5-12 provide the key elements of a program description and a checklist of best practices for each element.

5 PURPOSE STATEMENT

- ○ The program has a purpose shared by the partners.

6 GOALS

- ○ The program has one or more goals shared by the partners.

7 OBJECTIVES

- ○ The program has SMART objectives: Specific-Measurable-Achievable-Realistic-Time-specific.
- ○ If the goal of the program is to establish a baseline or increase the community's capacity in specific ways, an end point for the program is specified in the objectives.
- ○ If the goal of the program is to become sustainable, the objectives specify what will be sustained.

8 OUTPUTS, OUTCOMES, AND IMPACTS

- ○ Outputs and their time frames are specified. (**8a**)
- ○ Desired outcomes are specified and include benefits for both data users and data collectors. (**8b**)
- ○ Desired long-term impacts are identified. (**8c**)

9 DATA COLLECTION METHODS

- ○ The data collection methods are appropriate for community members. (**9a**)
- ○ The data collection methods are designed to be as simple as possible with equipment that is portable and durable enough to withstand Alaska conditions. (**9b**)
- ○ Provisions are included to pilot and, if necessary, adapt data collection methods to fit the capacity of the data collectors or provide additional training to data collectors. (**9c**)
- ○ A plan for recruiting volunteers or hiring paid data collectors is specified, with attention to training and retention through appropriate incentives. (**9d**)
- ○ Safety of data collectors and liability to the partners in case of injury have been considered during the development of methods.
- ○ The environmental impacts of data collection have been minimized.

10 DATA MANAGEMENT AND ANALYSIS

- ○ A data management plan addresses database development and support, data entry procedures, quality assurance/quality control procedures, management of metadata, data access, protection of sensitive information, and long-term archiving.
- ○ Community partners will be involved in data interpretation and/or analysis, if appropriate.

University of Alaska students learn how to take river measurements near Fairbanks.

11 COMMUNICATION

- ○ A communication plan ensures timely, repeated, and meaningful two-way communication among the partners.
- ○ The communication plan includes providing community participants with summaries of the data and data trends, information about uses that have been made of the data, and feedback and recognition of individual efforts.
- ○ Communication methods for the purpose of promoting the program broadly and to disseminate results are appropriate to the community and have been developed with input from community participants.
- ○ Language translation will be provided where appropriate.

12 EVALUATION OF PROGRAM SUCCESS

- ○ Strategies have been developed to assess program operations and efficiencies.
- ○ Methods have been developed to evaluate program success in terms of quantity and quality of program outputs, outcomes, and impacts.
- ○ Assessment and evaluation methods are appropriate and use appropriate indicators of environmental change.
- ○ Program assessment and evaluation results are or will be used to manage the program adaptively, i.e., information gained through evaluation and assessment will be used to improve the program. (**12a**)
- ○ A final program assessment and evaluation will occur. (**12b**)
- ○ The program has a specified end point or has plans for expansion or scale-up when the objectives are met. (**12c**)

Section C: Guidance for CBM Best Practices

1 GENERAL CONSIDERATIONS FOR ALL CBM PROGRAMS

1a Collaboration

Community-based monitoring programs are by definition collaborative, with (1) community members who collect observations and data, and (2) a local organization partner or partners beyond the community who support data collection, data management, and data use in various ways. Collaboration often continues for data analysis, data management, dissemination of results, and the use of data, both locally and beyond.

CBM programs in Alaska are often driven by a community organization with a mission related to environmental research, conservation, or education. The organizations either have scientists on staff to design data collection and data management, or they partner with scientists in universities or natural resource agencies.

In Alaska Native communities, CBM programs may be driven by tribal organizations when it is appropriate that Traditional Knowledge be used to guide the selection of meaningful observations and data collection methods that are both culturally appropriate and relevant to long-term observations. Additional considerations for programs involving the use of Traditional Knowledge are described below.

1b Capacity of Partners

Community capacity is a consideration in all types of CBM programs. Members of small communities in Alaska are often motivated to collect observations and data about changes in the environment that may affect their well-being and livelihoods. At the same time, they may lack the scientific and technical expertise to fully design a CBM program and to support data management systems. Community-based organizations, such as nonprofits or local tribes, also may lack management capacity for CBM programs and personnel with skills to sustain programs with grant writing, program assessment, evaluation, and reporting.

Initial conversations among partners should include a candid assessment of capacities and expectations about specific roles the partners will play in the program, as well as opportunities to increase community capacity over the course of the program.

Agreements about what data will be collected and how the data will be used are important at the outset of a program (see sidebar).

"[The scientists] are helping us do what we want to do."

Frank Pokiak, Tuktoyak
Source: Henry Huntington, Social Scientist

IF YOU ARE A COMMUNITY ORGANIZER: HOW TO FIND SCIENTIST OR AGENCY PARTNERS

If you are seeking someone who will use your data or help you ensure that it is scientifically sound to address a community concern, find out who has jurisdiction over the type of data you want to collect (e.g., the Alaska Department of Environmental Conservation for water quality data) or consult people involved in a similar CBM project. It's advisable to find an expert early on to help with project design to yield scientifically defensible data. It's also important to establish contacts in agencies who can respond to "red flag" situations that require an immediate response, such as harmful algal bloom observations or evidence of disease in a subsistence food animal.

To find University of Alaska research partners, contact the Vice Chancellor for Research at the University of Alaska Fairbanks and the Vice Provost for Research at the University of Alaska Anchorage. Several public agencies may be able to provide support with data collection protocols, such as the National Weather Service, US Geological Survey, US Natural Resource Conservation Survey, Alaska Department of Environmental Conservation, and Alaska Department of Fish and Game.

IF YOU ARE A SCIENTIST OR AGENCY/ORGANIZATION STAFF PERSON: HOW TO FIND COMMUNITY PARTNERS

If you are seeking a community partner and don't have personal connections to someone in a community, find someone who does, such as a local nonprofit organization. For more guidance on developing partnerships with Alaska Native communities see Engaging Alaska Native Communities in CBM in Section D.

BUILDING TRUST IN A COMMUNITY

When the impetus for the program is coming from outside the community, initial conversations should address

- how the data are relevant to the community, how the data will be used, how the data will be made accessible to the community, and expectations of the data users and community members, along with limitations on the efforts of both;
- what is being requested in terms of local participation and resources, and what will be brought to the community such as leveraging funds or other types of resources; and
- planning support, training, etc.

Any concerns that the data could be used against the interests of the community (e.g., use of subsistence data for regulatory actions) must be addressed.

"Be aware of a community's cultural norms. . . . Build trust. Don't just come into an indigenous community and say 'Here I am. I'm here to help you!' Go in politely, quietly. Build that communication. [Introducing yourself] by who your family is and where you come from is still practiced as a means of introduction."

Heidi McCann, ELOKA

2 ROLE OF PARTNERS

The design of a collaborative CBM program depends, to a great extent, on where the original impetus for the CBM program originated. (**2a**) A program may be initiated by a local concern and driven by a community partner, or (**2b**) a program may be initiated by the need for data from a scientist, engineer, agency, or other type of organization outside of the community who then seeks a community partner.

Projects that are driven by scientists, engineers, or agencies may run the risk of failing to engage sufficient community involvement. Conversely, projects driven by communities need to produce scientifically defensible data that are useful for an intended purpose.

3 ENVIRONMENTAL OBSERVING PROGRAMS

Opportunistic observations of unusual environmental events can stimulate subsequent systematic effort to monitor an event or phenomenon over a larger geographic area or time period. This handbook is geared to systematic observations that produce scientifically defensible data, but the quality and usefulness of opportunistic observations also requires attention to methods to verify the reliability of the observations and systems to share and archive them.

Community members gather debris on Saint Paul Island, Alaska.

4 PARTICIPANTS

4a Traditional Knowledge holders

The involvement of Traditional Knowledge holders in CBM can expand the context for how data are interpreted and provide insights into the types of observations and data to collect related to human well-being.

"Who is your audience? At what level? What questions are you trying to answer? You need to engage TK holders at the beginning so there can be a co-production of knowledge."

CAROLINA BEHE, INUIT CIRCUMPOLAR COUNCIL

4a.1 Involvement of Traditional Knowledge holders in data analysis and reporting

"From the very beginning, everybody we chose to interview [to develop subsistence mapping] was recommended by the Native communities, by the villages, tribes and Native governments. All of the data came from interviews with individual members in the communities. We constantly are going back to our communities and showing them the data we've got, to make sure we report them, to . . . make sure [the results] jibe with what they think is accurate, because the data we've got is only a sample of the people; we realize there might be data missing. We're constantly going back to them for input and feedback."

DAMIAN SATTERTHWAITE-PHILLIPS,
NORTHWEST ARCTIC BOROUGH

4a.2 Respect for intellectual property rights

"Arctic indigenous people have been systematically observing their environment for millennia. They are not only 'citizens' as in citizen science; they are also TK holders and rights holders. Their ways of observing and understanding have distinct methods and purposes that may overlap and diverge from Western science. . . . Respect the fact that this is their knowledge, not 'ours.' Be patient. Show an appreciation for what communities provide and allow you to record."

HEIDI MCCANN, ELOKA

See also Engaging Alaska Native Communities in CBM in Section D.

4b K-12 teachers and/or students

Engaging K-12 students in data collection can be an effective way to enhance science, geography, and social studies education through participation in real-world environmental issues. The data collection and analysis must be carefully planned to fit the class or field trip time that teachers have available and must be aligned with the school curriculum and educational standards. Whenever possible, professional development should be provided to the educators, along with the development of a collegial community of practice with scientists and agency staff for ongoing support. In addition to project leaders making data available to students, students should also be provided with structured opportunities to analyze the data and encouragement to communicate the results to the local community or students in other communities.

5 PURPOSE STATEMENT

The purpose statement is the "why we are doing this" statement. It answers the questions: Why do you want to collect data? What aspect(s) of the environment do you desire to monitor and why? How will the data be used? Purpose statements for CBM programs usually relate to one or more of the following:

a. detecting what environmental changes are occurring

b. determining which changes are of concern to a community

c. determining responses the community is planning, to address the changes

d. determining the consequences to or trade-offs for different results of changes

6 GOALS

Goals are qualitative statements about what the partners will strive to achieve in terms of broad characteristics or qualities, such as sustainability, environmental health, and adaptation. CBM projects often have two different types of goals related to (1) the uses to which the data will be applied, and (2) changes in the community as a result of their participation. The goals can be combined into the purpose statement. Both types of goals need to be articulated at the outset of a CBM program, and shared by the partners. In formulating the goals of a CBM program, a tension often exists as a result of community needs, concerns, and capability to collect data; data standards of the scientific community; and funder requirements. The tension is a natural one that can be negotiated throughout the life of a program, if the partners and funders can maintain their focus on the shared goals and be as flexible as possible with respect to the methods used.

> *"The 'so what?' Bearing witness. Finding the pattern. Creating the pattern. Figuring what creates that pattern and then, being able to assess what happened when that pattern changes is a really central 'so what.'"*
>
> Julia Parrish, COASST

7 OBJECTIVES

Objectives define what will be done, in measurable terms. CBM projects should have objectives related to (1) the collection of scientifically defensible data such as the number of sites to be sampled and schedule of sampling, and (2) community involvement in data collection, for example the number of community members to be recruited and number of training sessions to be held. As with goals, objectives need to be articulated at the outset of a CBM program as part of defining respective expectations.

Scientific objectives are usually defined in terms of the methodology and quantity and quality of the data, while the community objectives measure gains in such things as the number of people engaged in the program, increases in knowledge about scientific concepts, changes in attitudes and behavior relative to specific environmental problems, and contributions of local and Traditional Knowledge in appropriate ways.

> *"Results mean different things to different people. Is it a graph, a chart, a recommendation, a management intervention, good stewardship, food on the plate, or dots on a graph?"*
>
> Michael Svoboda,
> Arctic Borderlands Ecological Cooperative

Monitoring programs can have the sole purpose of educating community members or K-12 students; however, if there is no use for the data, this type of program is unlikely to garner funding to support it.

8 OUTPUTS, OUTCOMES, AND IMPACTS

8a Outputs

Outputs are program results in the form of products to be completed within a specific timeframe. All outputs are the product of the collaboration, but some may benefit only data users or only data collectors, or they may benefit both. Some outputs may be internal to the program, such as the duration of relationships among partners and the amount and type of communications that happen in various forms.

Examples of outputs:

- The amount of a specific type of data collected
- A database
- Reports
- A peer-reviewed science journal article
- Hours of volunteer time

Science outputs are generally presentations of the two basic ingredients of science, discovery and explanation, though the form in which these are presented varies greatly. Of course, there are published articles in scholarly settings like refereed journals, books and conference proceedings, the standard outlets for scientists in academia. However, there are also reports of a myriad of different kinds, which may not be considered published in an academic sense and are often referred to as the "gray literature." For a science output to be considered "published" it must generally appear in a recognized outlet and be available, at least in principle, to anyone.

Outcomes . . . are also important and, arguably more important . . . (they) really represent the results of science . . . in terms of . . . what people think, say and do.

Graham H. Pyke (Pyke 2014)

8b Outcomes

Outcomes are mid-term results of CBM programs, such as an environmental baseline for specific aspects of the environment or the use of monitoring data to address a local environmental problem or influence fish and wildlife management decisions. Outcomes can be either quantitative or qualitative.

Examples of outcomes:

- CBM data (e.g., subsistence mapping) were used in resource management decision-making.
- The capacity of a community to identify and solve problems was increased.
- Long-term relationships were developed between scientists and communities or agencies and communities.
- Scientists became better at communicating about how their research affects communities.
- A baseline was established for specific environmental parameters and used as a basis for continued monitoring to detect trends.
- A "sentinel" capacity to detect particular types of environmental change (e.g., the spread of invasives or disease) was established.

"Who benefits from CBM? The scientists benefit from it. Certainly, agency managers benefit from it, and all of us in communities benefit from becoming more engaged and having a sense of ownership and stewardship about our land, our fish, and our wildlife. All of it has value."

Molly McCammon,
Alaska Ocean Observing System

8c Impacts

Impacts are the long-term results of CBM programs, which may or may not be measurable.

"So what? Who cares? Who's going to use this information? What can this wave of information touch?"

Michael Svoboda,
Arctic Borderlands Ecological Cooperative

Examples of impacts

- The capacity of the community to carry out CBM programs increased to the point that they could continue without the help of a scientist or other partner outside the community.
- The appropriate agency or agencies responded to significant environmental changes detected by CBM.
- Local resilience to environmental change was increased as a result of participation in monitoring.
- Data generated through CBM was used to address a community problem or support decision-making about the management of subsistence resources.

Photo by Deborah Mercy
University of Alaska Fairbanks

Scientists from the Smithsonian Environmental Research Center deployed over 100 plates in the Ketchikan area to sample for invasive tunicates, during a 2013 bioblitz event.

9 DATA COLLECTION METHODS

The methods for collecting CBM data should be the simplest possible that will produce the desired quantity and quality of scientifically defensible data. Observations are often made in terms of presence/absence or the occurrence of unusual events (e.g., harmful algal blooms, disease in marine mammals, storm events, species out of typical range). Monitoring programs require a sampling design to ensure that the data are representative and enough data are collected for statistically sound data analysis.

9a Cultural context

The appropriateness and manner in which Traditional Knowledge is collected are of the utmost importance. Social science methods can be used to design TK collection in ways considered valid from a quantitative Western science perspective, while TK holders should be involved in defining the types and methods of data collection that are culturally appropriate.

The highest-quality information will result from approaching TK holders to engage them in respectful conversation. Be patient and allow time for the interviewee to express their feelings on the subject. Isolation is one characteristic of living a subsistence lifestyle. Allow time to develop a rapport with the interviewee. In Alaska Native cultures, providing a small gift such as tea or coffee shows appreciation for the time and effort of the interviewee. It is important to let them know what will become of the data collected.

Data collection schedules need to be feasible for community participants, for example collection of biological specimens and other data by hunters during hunting seasons, time available from volunteers, and classroom time for K-12 students. In community-driven programs, data collection methods may be a balance between what is feasible to collect, what community members want to collect, and the types of data that are culturally appropriate to collect.

"Data have a cultural context. It's not disassociated from people, landscape, or animals. . . . In TEK systems, data are often observed but not measured (in Western science terms), but the descriptors can be translated or linked to Western science. For example, the color of whale blubber can be linked to algal diet and the firmness of whale blubber to oil content. . . . Cultural knowledge is needed to understand and apply a theory of measurement that compares an unknown dimension with a known one (type of unit) with the help of aids (scales) that are traditional, cultural ones. The burden is on scientists to translate and standardize."

RAPHAELA STIMMELMAYR,
NORTH SLOPE BOROUGH WILDLIFE DEPARTMENT

Community members are often the best source of knowledge important to selection of accessible sampling sites.

9b Technology level

Selection of data collection methods should take into account the amount of training needed to use and operate sampling equipment. More training is needed with less familiar, more sophisticated devices, which may be available online. Equipment should typically be portable and durable. If remote sensing technology will also be used, it should be mounted so manual readings are possible and have automatic telemetry to check or repower it and to retrieve internal recordings. The procedures for repair or replacement of equipment should be arranged.

9c Flexibility

Flexibility is often required with respect to data collection methods. Procedures often change after field-testing the system with community-based data collectors. Also, buy-in by community participants is often increased when the effort is made to adapt rigorous protocols to local conditions. A tension often exists between matching methods to the dynamics of community capacity and striving to stay consistent. Training programs can familiarize community members with scientific techniques and increase their capacity as competent data collectors. The training programs should be designed to the anticipated level of science and math knowledge and skills of the data collectors.

> *"You can use 'rough scales.' Start with broad categories, let the observations tell you when you need to refine the categories. . . . The project may shape-shift as community issues change, but it all contributes to community capacity. . . . Allow the project to be organic."*
>
> Raphaela Stimmelmayr,
> North Slope Borough Wildlife Department

9d Paid coordinators

The data collectors in citizen science CBM programs are usually volunteers; however, paid program coordinators or facilitators within remote communities can be critical to moving any type of CBM program forward. If community interviewers are used, they can coordinate data collection schedules with other community events and subsistence activities. In Alaska's rural communities, participants in CBM programs are usually paid.

Other Considerations

Special handling of samples. Getting samples from the field to the lab may require special handling when live specimens, pathogens, or chemicals are involved. In rural Alaska, arrangements with airline companies may need to be made well in advance when speed of handling is critical.

Standardization of data collection methods. The standardization of methods used to record and report data may be necessary among sites in an observation network. This can be challenging in international collaborations (e.g., between Americans and Russians), as can translating local expressions of magnitude (e.g., buckets of clams, boatloads of fish) into scientific scales of measurement. Web-based reporting systems can facilitate conversions. Standardizing data collection may take a substantial amount of time and communication during program design and pilot testing.

"Red flag" data. For situations that require an immediate response due to human health concerns (e.g., evidence of disease in subsistence food animals), procedures for additional documentation in the form of photographs or videos should be available and communicated to data collectors.

Use of electronic communication technologies for data entry. Electronic communication technologies (e.g., ArcGIS, smart phones and apps, Google Earth/Google Ocean) can be a low-cost means for data entry to avoid multiple opportunities for error, and can provide a way to easily access databases. Internet connectivity of remote areas in Alaska needs to be taken into account, however, as well as the amount of training that may be required for people who don't already use these technologies. Support for electronic communications will need to be 24-7 in many situations to minimize the frustration of data collectors.

10 DATA MANAGEMENT AND ANALYSIS

Data management should be planned from a long-term perspective before any data are collected, including the identification of a permanent data repository. Unbiased methods of **data analysis** are critical to producing scientifically defensible results and interpretations of the data. Decisions are required when data conflict and when data are collected that is outside the expected range of values.

Over-interpreting data can hurt the credibility of CBM programs. The responsibility for scientific data analysis may be that of the scientist or agency staff, but the interpretation and analysis of Traditional Knowledge, even when collected using social science methods, is more appropriately analyzed with the participation of TK holders. To accomplish this, CBM programs that involve TK holders and the collection of TK often employ a strategy for the community to review preliminary data, discuss possible interpretations, and determine limitations on the release of sensitive information. In all CBM programs, even those that don't involve Alaska Native TK, community members can often provide insight into the interpretation of local data, so opportunities to review raw data or preliminary data analyses should be considered and scheduled prior to reaching conclusions based on the data.

Data management

Selection or development of a database is one of the most critical decisions for a program and one that may need to be revisited if data collection methods change, the program grows in scope, or opportunities arise to share data. Database managers should consider that the collected data may be useful in the future in a way that can't be anticipated earlier. Whenever possible, new CBM programs should seek to network with programs collecting similar data and share data management procedures and/or consolidate data into a single database. University partners are a good source of support for database development, data processing, and the development of quality control procedures. The costs of data management should be included in budgeting and, if possible, front-loaded at the time of program start-up, and maintenance funding budgeted for future upgrades.

Methods that ensure data quality, termed **quality assurance and quality control procedures** (QA/QC), are critical components of program design because they determine the scientific defensibility of the data. Data quality can be increased through statistical methods (e.g., more samples), by minimizing and detecting human error in data collection and entry into a database, and by minimizing and quantifying any bias inherent in the data collection methods. Standard methods for assuring and controlling the quality have been developed for many types of data (such as water quality data) and are available from programs doing similar types of monitoring. GPS latitude-longitude coordinates for sampling locations are critical for tying the data to the collection site.

"We had our hypotheses (about PSP incidence). We had our partnerships. Partners are important, including the Elders. And protocols. I'm a scientist so we had to have rules for collecting data. We trained people in the communities so everyone would collect data in the same way using the same methods, so it would be defensible, repeatable data, so it would be good scientific data."

Bruce Wright,
Aleutian Pribilof Islands Association

One approach to validating data and/or quantifying the associated human error in data collection by community members is to verify a subset of the data via a more highly trained expert or another method. This can be accomplished by periodically having a trainer accompany volunteers or paid observers. Cross-checking also can be done between individual data gatherers and against existing, validated data. Another approach is the collection of photographs, audio recordings, or other types of physical records that can be used by experts to verify a subset of the data and calculate an error rate for categorizations, such as species identifications, made by data collectors.

Challenges in data management that may need to be addressed

Collecting and archiving metadata. It is critical that accurate metadata, such as information about how the data were collected, is entered into the database so that people can compare the data to similar types of data collected using other methods. Metadata should be archived in such a way that they can be accessed with the data.

Maintenance of data quality through training and retraining data collectors. Providing uniform training to data collectors is key to the quality of the data. In addition to receiving enough training to follow the data collection protocols with few errors, data collectors especially need training in how to interpret difficult or ambiguous situations.

Identification and treatment of anomalous data. Data that lie outside the expected range of values present a problem in interpretation. If they are the result of human error and are included in the data analysis, the analysis may be skewed. But if they are real data points and are eliminated, the analysis will fail to take them into account. Local knowledge may be helpful in explaining the unexpected value. A method for identifying anomalous data is a feature of most database software, and it can provide a way to flag these data so they can be considered carefully during data analysis. Storing the data can provide the opportunity to look for changes in expected patterns over a longer time period.

Access to data and reporting. Access to data and metadata by community members should be negotiated among the partners during program planning. Planning should address the form of the data, level of data detail, how frequently the databases will be updated, and which individuals will have access to sensitive information. Appropriate access to data is usually extremely important to communities who have initiated and are driving CBM programs, to networks who are sharing observations, and in situations where the data will be used by the community in personal or local decision-making, such as resolving environmental problems. Access to the results of data analysis may be important to citizen scientists, as well as teachers and students who may use the data as part of science or cultural education. A user-friendly interface is key to community access to the data online. Local data archives, particularly interviews and map information, should also be considered.

Access to sensitive data may be specified by legal restrictions or by community participants and/or Traditional Knowledge holders. Examples of strategies to protect sensitive data include (1) an interface that requires acceptance of a voluntary code of conduct before access is granted (e.g., ELOKA); (2) protection of access at different levels of security; (3) data shared but without attachment to a name; and (4) a user registration process that requires community approval for data requests. When access is restricted, the program leaders should periodically reevaluate which individuals should have access.

Local trained responders, marine mammal specialists, federal agency personnel, and harbor crews responded to a boat-struck humpback whale near Kodiak, Alaska, in 2014.

11 COMMUNICATION

Communication between the partners should begin well before data collection begins. How the data will be collected and their subsequent use should be transparent to all partners. It is particularly critical that community partners understand how the data collection is relevant to the community and how the data will be used. Regardless of who initiated a monitoring program, community participation will be higher when what is being monitored is important to the community. This two-way communication is needed during the project design phase to begin building relationships and establishing trust. Because of the need to communicate and negotiate collaborations, CBM projects often require financial support during this planning stage. This should be taken into account by funders who wish to support CBM programs.

"[Everyone needs to be] really clear about the use of the data before it's collected, so people understand and trust you if you're a scientist, and if you're someone helping to collect the data, you need to really understand the purpose of it."

Sue Mauger, Cook InletKeeper

After data collection begins, regular communication with data collectors is important for motivation. Highlight how the data are being used and the efforts of individual community members. Use communication methods that will work best for your community. This is often a combination of "high touch" face-to-face communication and phone calls, and "low touch" social media to those who use it regularly. Other communication tools include emails, periodic digital and print newsletters, and holiday cards. Also consider low investment events for the broader community, such as a "bioblitz" event, to sustain community interest in the program. (A bioblitz is an intense period of biological surveying to record all the living species in a designated area, usually involving scientists and volunteers.)

The local program leader/organizer can be key to the success of the program in terms of his/her communication skills and capability to connect to the community (culture, norms, respect, etc.).

"Tell your story—what you're doing, why you're doing it, how you're doing it, why others should be part of what you're doing. Tell your story."

Fran Ulmer, US Arctic Research Commission

12 PROGRAM ASSESSMENT AND EVALUATION OF SUCCESS

Assessment is the review of work to date to identify successful aspects and also identify inefficiencies or failures in program design that need to be addressed. Assessment can take place at many levels within a CBM program and should be done as part of the collaborative process. The process is usually internal to the program, although decisions to make significant changes to a program often require communication among the program partners and may require communication with funders. Assessments can be made of program components such as data collection methods, data management methods, and communication methods (e.g., use of social media or online newsletter vs. mail-outs).

Evaluation is the process of looking critically at the success of the program in the context of the program's goals, objectives, and desired results. While assessment focuses on whether all aspects of the program design are efficient and effective, evaluation focuses on what is being accomplished and how well, and has an external aspect of responsibility to funders who may require an external evaluator.

EVALUATING COMMUNITY SUCCESS

Science & Rigor   Participants & Learning

Community Capital

- Knowledge-base/Social Infrastructure
- Decision-making/Empowerment

(Source: julia parrish)

A Citizen Science Model

Methods for evaluating the success of the program should be developed up front during the planning phase along with a schedule for carrying out evaluations at various points during the program (formative evaluation: "How are we doing so far?") and at the completion of the program (summative evaluation: "What did we accomplish?"). A variety of evaluation methods is often required, because CBM programs often have different objectives for community data collectors, community partner organizations, partners not based in the community, and additional organizations or government agencies interested in uses of the data. Indicators or metrics (that is, what is measured) to evaluate program success can be quantitative or qualitative. Scientists and agency partners are more likely to define success by the quantity and quality of the data collected; community participants are more likely to include the quality of their participation and their perceived benefits in their definition of success.

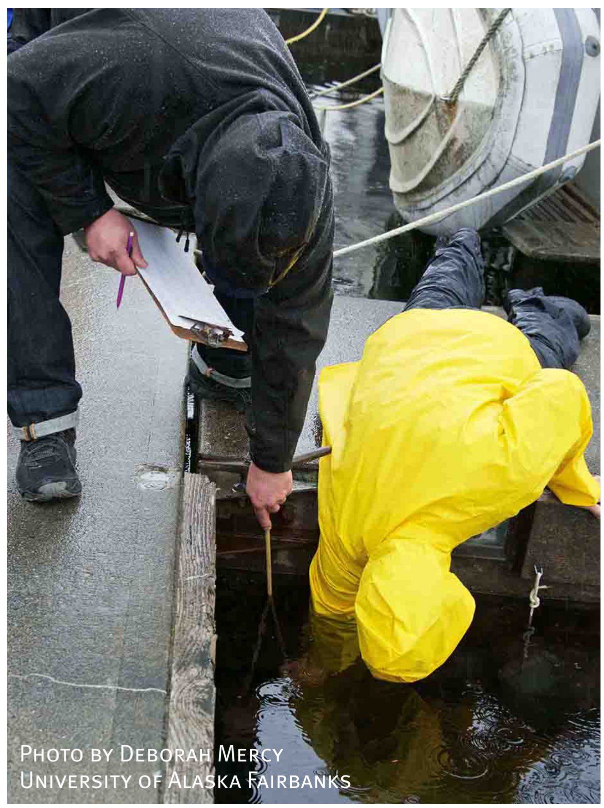


Photo by Deborah Mercy
University of Alaska Fairbanks

More than 30 community volunteers took 200 samples in the Ketchikan area for early detection of invasive marine species, during a 2013 bioblitz event.

"I don't think there's a one-size-fits-all for CBM programs because the goals vary so widely. Generally, indicators of success fall into two categories: How well it's doing within the scientific community and how well it's doing with the partner communities that it works with. How happy people are with it. For most projects to continue to get funding, there needs to be success on both sides of this. The longevity could be a good indicator that people are doing something right. . . . The projects need to provide something useful for the communities they work with and for society as a whole. They need to avoid redundancy. . . . How do you know if the project is offering something that people want? The data are getting used on the scientific side and in the communities. For communities, it may be contributions to capacity, training, employment, or useful data products that can address a community concern."

Maryann Fidel,
Aleut International Association

"Think about it from the point of the view of the individuals and from the point of view of the program. How is the program helping the people and how are the people helping the program?"

Julia Parrish, Scientist and Director, COASST

In Alaska, methods to evaluate scientific results of a CBM program are fairly well developed in the scientific community, but the expertise to evaluate CBM programs with respect to community involvement is fairly limited. Options for program evaluation include hiring an outside evaluator as a consultant, forming an evaluation review committee, and networking with other organizations to design appropriate methods. Very few professional external evaluators are based in Alaska. To reduce costs, some programs make use of graduate students or consult with external evaluators.

12a Formative assessments and evaluations

Formative assessments and evaluations occur at various times during the program and should be done collaboratively. A tension often exists among community needs, concerns, and capability to collect data; data standards of the scientific community; and funder requirements. This is normal, but it often requires some flexibility and change in data collection methods over the course of the program, taking into account the impact of changing collection methods on the consistency and reliability of the data. Feedback on the way the program is going from the viewpoints of the community and partners that are not based in the community may also lead to shifts in leadership and direction.

A formative program assessment asks the following questions:

- Is the program (or an aspect of the program) meeting its objectives or targets? If not, why not?
- What changes should be made to meet the objectives/targets?
- Should the objectives/targets be modified to better match the reality of community capacity to participate, or for another reason that wasn't anticipated during the design phase?
- Are the outputs and outcomes of the program still realistic?

12b Summative program assessment

A **summative program assessment** is a "lessons learned" exercise, which may guide the next phase of an evolving program or provide guidance for people engaged in similar CBM programs.

Summative program assessment questions include:

- Was the program implemented as originally envisioned?
- What changes were made and why?
- What are the next steps to address the program goals?

"[For our K-12 student community] we ask: are we engaging students? Are we contributing data to real science projects? Are the students excited about science? Are the teachers satisfied about the ways we've enhanced science education for their students?"

Beth Trowbridge, Center for Alaskan Coastal Studies, Kachemak CoastWalk Program

"Citizen science can be evaluated in terms of how it affects the resiliency of a social-ecological system. For individuals, that would be in terms of their ability to adapt and shape change in the system. . . . The human aspects of resilience include science process skills, social capital (Do they trust scientists more? Are there new social networks?), and science conceptual knowledge."

Katie Villano Spellman, Melibee Citizen Science Project

12c End point

Programs can have a natural **end point** when objectives are met or when a start-up phase builds community capacity to continue monitoring efforts without an outside partner.

"Have an exit strategy. Know when you will have enough data to establish a baseline."

Sue Mauger, Cook InletKeeper

"Scaling up" can mean monitoring expanded to a larger geographic area, more participants collecting data, more types of data collected, or an expansion in networking to share data. Expansion can begin through the collection of new types of data opportunistically (e.g., collecting observations about tsunami debris on beach walks focused on monitoring beached birds) and through encouraging data collectors to be observant of other environmental changes that may prove to be significant (e.g., have an "other" column on the data sheet).

"[CBM] can tell us an awful lot. It can answer questions that no one had the answers to. This points to the crossing of scales. Local observations, not surprisingly, tend to be local, but connecting them across different places, spotting the connections—the phenomena happening in one place to something happening in another place or time—is an important feature of a CBM network."

Henry Huntington, Social Scientist

Scaling up . . . What's the bigger picture? . . . For monitoring and understanding the environment, you need to look at the bigger picture, just as much as you need to look at the local environment, not just a local bay or coastal area, but what's going on everywhere . . . understanding change requires context.

Michael Svoboda, Arctic Borderlands Ecological Cooperative

Section D: Additional Guidance

TIPS FOR ENGAGING COMMUNITY MEMBERS AND SUSTAINING PARTICIPATION

- Recruiting community participation is usually much easier than sustaining it.
- Community members are motivated by the belief that what they are doing is important to the community along with their own personal enthusiasm and passion. They are also often motivated by connection to a specific place.
- Turnover of observers and data collectors should be expected. It will likely be a challenge to sustain volunteer monitoring over long periods and during summer. Training programs will need to be designed to be ongoing.
- Be prepared to provide retraining to maintain or improve data quality. Retraining periods are also an opportunity to increase the knowledge and understanding of the data collectors about the overall program.
- Build local leadership in training if possible (see Developing a Budget). Look for ways that long-term participants can be assigned more responsibility and new tasks.
- The time of community members should be treated as valuable.
- Provide opportunities for feedback about data collection (e.g., field sheets with a miscellaneous observations section) and communication methods. Have a plan to review any feedback received and make changes if needed.
- If rigorous data collection methods are required, consider two tiers of community participants—one tier that performs less rigid data collection and a smaller tier of highly trained data collectors who operate complicated equipment or have the capacity for higher rigor (e.g., identifying marine invertebrates to species).
- People are usually motivated by both individual feedback and collective recognition of contributions to the community or the health of the environment. It's important to know what motivates a particular community (e.g., parties in Homer, rural heating oil vouchers in rural Alaska, professional development credit for participating in training for teachers, increased role in environmental decision-making or co-management), and individuals (e.g., public recognition with awards and local press, increased responsibility and complexity of tasks).
- Participation in observation and monitoring programs that rarely detect significant change, such as monitoring for invasive species, is hard to sustain. Emphasizing the importance of being ready through early detection and response can be motivating. Embedding these types of observations in broader programs and networks can also sustain interest. Understanding why a certain data collection protocol is required can help with motivation to repeat tedious and rigorous procedures.
- Reports and scientific publications should provide credit and acknowledgments of the contributions of community participants and partners.

"None of this goes anywhere without enthusiasm, without passion."

Henry Huntington, Social Scientist

"Everybody who is working in my [COASST] project is working with me, not for me. . . . I have a responsibility to motivate them, to continue to motivate them, allow them to learn, deepen their knowledge, and in doing so, inform me."

Julia Parrish, COASST

COMMUNICATE, COMMUNICATE, COMMUNICATE

- CBM requires two-way communication between partners, in which both parties gain in understanding. The process requires patience, especially when communicating across scientific disciplines and across different cultures, for example scientists and non-scientists, Western science and indigenous cultures, scientists and K-12 educators, and Americans and Russians. Communications from partners outside the community designed solely to "educate" community members rarely furthers collaboration.

- Develop a common vocabulary. Whenever possible, demystify science and emphasize the potential usefulness of the data. Everyone involved in a CBM program should understand the "so what" of data collection, and why it would matter if the aspect of the environment being monitored were to change significantly.

- Keep telling your story to the community. Build relationships, networks, and friendships in a variety of ways.

- Encourage feedback from community members on what works and what doesn't work, especially in regard to methods in intangible or qualitative data collection. Certain types of data collection will require culturally appropriate methods.

- Network with other people collecting similar data, not only to avoid duplicating efforts but also to provide synergy in the usefulness of the data over a larger geographic area or region (e.g., water quality data at different places in the same watershed, evidence of diseases in marine mammals, harmful algal blooms, invasives). Develop an alert system to provoke communication about the scope of specific types of changes, and provide a way for people outside the network to report relevant observations.

- Remember that communication is also required among data collectors, data users, funders, the larger community that data collectors represent, and other stakeholders.

- Ensure that communication back to the community meets residents' expectations in terms of frequency and degree of detail. If the program ends, a final report to the community is critical.

- Examples of communication methods used by Alaska CBM programs include annual one-page updates, emails or blogging for interim updates, use of social media for updates, community potlucks with simple updates and question and answer sessions, annual reports to stakeholders, and videos.

- Make it fun!

"It's a circle with information moving back and forth. I think of it as a circle; the local monitors are feeding into the coordinators and scientists, and the scientists and coordinators are feeding back, and everything is circular. . . . Every piece is vital."

LINDA SHAW, NOAA INVASIVE SPECIES MONITORING

"[The Beluga Whale Commission, a co-management group] now discusses the questions and how we can best answer them. Sometimes the answer is to put radio transmitters on belugas. Sometimes the answer is to take DNA samples. Sometimes the answer is to ask the Elders. Sometimes the answer is what people are observing about weather or changes in the ice or body condition of the animals they harvest.

HENRY HUNTINGTON, SOCIAL SCIENTIST

"Be calm and be kind."

JULIA PARRISH, COASST

Marine Advisory agent Julie Matweyou and student assistant monitor for invasive tunicates on Kodiak Island.

CBM AND SCIENCE OUTREACH

If you are a scientist seeking research funds, a well-designed CBM program can provide an outstanding and effective outreach activity to satisfy the broader impact, community involvement, or community engagement outreach requirements of funders such as the National Science Foundation, North Pacific Research Board, or Alaska Sea Grant. Be sure to budget sufficiently for CBM outreach activities (see Developing a Budget below).

CBM IN THE CONTEXT OF CONTROVERSIAL RESOURCE MANAGEMENT ISSUES

It can be difficult to set up a monitoring program in a controversial situation, for example for a resource such as king salmon whose allocation is contested during a period of scarcity. It's important that the partners undertaking CBM have credibility with people on different sides of an issue, that the data will be reliable and provide common ground to inform the debate rather than to inflame it, and that the communication plan is well-thought-out with respect to the controversy. An independent, neutral facilitator can help guide the program. The data collection may need to be clearly separated from advocacy efforts to avoid the appearance of bias.

ENGAGING ALASKA NATIVE COMMUNITIES IN CBM

The engagement of Alaska Native or other indigenous communities in community-based monitoring provides the opportunity for the co-production of knowledge by Western scientists and Traditional Knowledge holders. The Inuit Circumpolar Council (ICC) reached a consensus on the definition of TK shortly after the 2014 CBM workshop in Anchorage. TK is defined here to underscore its nature and the respect it should be accorded in CBM programs involving Native groups and communities. The ICC definition reads, "Traditional Knowledge is a systematic way of thinking applied to phenomena across biological, physical, cultural and spiritual systems. It includes insights based on evidence acquired through direct and long-term experiences and extensive and multi-generational observations, lessons and skills. It has developed over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation." (ICC 2014) The ICC also recognized that "TK goes beyond observations and ecological knowledge, offering a unique 'way of knowing' to identify and apply to research and monitoring needs which will ultimately inform decision makers."

When scientists or agencies partner with Alaska Native communities in CBM programs, the ways in which TK is sought and incorporated into the program should ensure that informed consent has been obtained prior to the collection of any TK, that the cultural perspective is accurately represented, and that the cultural integrity and rights of all participants in the research endeavor are protected. In recent years, Alaska Native communities have initiated an increasing number of CBM programs and are building their capacity to detect and solve local and regional environmental problems as well as to adapt to a rapidly changing environment.

Western science and Traditional Knowledge systems are not equivalent. When Traditional Knowledge is used with scientific knowledge, the two knowledge bases need to be woven together through the collaboration of TK holders with Western scientists.

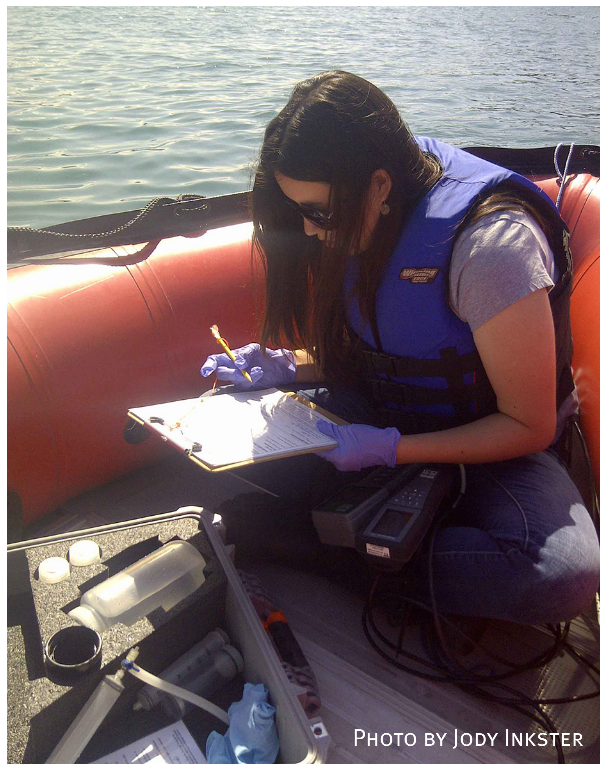


PHOTO BY JODY INKSTER

Shelley Inkster, of the Ross River Dena Council, samples the Yukon River near Whitehorse, Yukon Territories, Canada. Members of tribes and First Nations from the headwaters to the Yukon River Delta sample water biweekly during summer as part of the Yukon River Inter-Tribal Watershed Council Indigenous Observation Network. Participants have contributed over 13 years of data to a baseline study.

Guidelines for developing partnerships with Alaska Native communities or organizations

Scientists and agency staff seeking Alaska Native partners should first determine whether the scope of the program would best be served with partnerships with individual tribal governments or regional organizations, or both. Most villages have a tribal government in the form of a tribal council or other entity organized under the terms of the Indian Reorganization Act (IRA), as well as a village corporation, and some villages have Elders' councils. Each of Alaska's 12 regional Native for-profit corporations have a counterpart nonprofit organization that provides social, educational, and often environmental services. A number of tribes and tribal organizations employ a tribal environmental specialist, who would be a good first point of contact. In addition, a number of co-management groups such as the Beluga Whaling Commission and the Arctic Eskimo Whaling Commission are active in research and monitoring related to the management of individual species, and they should be consulted to avoid duplication of effort and for guidance on priorities and data collection protocols.

Both email and phone are recommended for initial contacts, but whenever possible face-to-face meetings in a village or community are a better way to begin and sustain partnerships. Necessary permissions from tribal governments are often approved during regularly scheduled meetings that can provide an opportunity to explain the intended use of the data and begin building trust. Getting a spot on the agenda of these meetings often requires advance planning to have the permissions in hand before data collection is scheduled to start.

Communication with local governments and organizations in Alaska's small, rural communities can be difficult and may not go smoothly, particularly during the start-up of a new program. Be persistent and patient.

Coastal community cleanup on Saint Paul Island, Alaska.

Photo by Deborah Mercy, University of Alaska Fairbanks

Guidelines for the Incorporation of Traditional Knowledge into CBM Programs

The following are adapted from guidelines for research developed by the Alaska Native Science Commission.

- All research, including CBM, should be conducted in accordance with community research standards and protocols such as the National Science Foundation Principles for the Conduct of Research in the Arctic or the research protocols adopted by the Alaska Federation of Natives.
- Prior to the collection, storage, or use of Traditional Knowledge, the appropriate permissions and informed consent must be obtained from the TK holders. A strategy should be developed to monitor and verify that the agreements are honored, and that the desired confidentiality of any information provided is maintained.
- Alaska Natives possess both collective and individual Traditional Knowledge. Most TK is shared among community members but some TK may be specific to an individual. For example, some Elders and resource-users will be the only source of certain types of TK because of different life experiences.
- Alaska Natives own the intellectual property rights to their Traditional Knowledge, even if much of it has yet to be written down. No one has the right to document or use TK without permission. And when their knowledge is recorded by others, Natives have the right to insist that it not be taken out of context or misrepresented. When TK is cited by others, Natives have the right to insist that the source of this knowledge be properly acknowledged. In other words, Native people have the rights to own and control access to their Traditional Knowledge.
- Local people should be hired, whenever possible, to assist with monitoring. Stipends are customarily paid to people sharing Traditional Knowledge through interviews or other ways.
- Community members should be involved in the preparation of locally held knowledge and decisions about its release and use.
- Alaska Native communities place a high value on the active involvement of youth in research. Student learning through Elders should be encouraged and promoted whenever possible. Youth often ask good questions that can help in the development of monitoring programs, and when data are returned and effectively communicated to the community the data can be used to generate new investigations.
- For additional guidance and sources of sample agreements, see Selected Literature and Resources in this handbook.

DEVELOPING A BUDGET

- CBM programs require financial resources. Don't underestimate the costs!
- Costs related to time and travel required for collaboration should be included in the budget, as well as the time and travel for supporting volunteers or training local people to participate.
- Stipends and travel costs are traditionally paid to Traditional Knowledge holders who participate in interviews, and to program advisory committees.
- In-person feedback to community members involved in data collection and reporting of results is most effective when it is done throughout the project. Budget travel and time in communities accordingly.
- Determine if translators will be needed for meetings in Native communities or when working internationally, and include the costs in the budget.
- Be clear about community capacity and expectations with respect to the availability of volunteers or paid data collectors. Data collectors in Alaska Native communities usually expect to be paid.
- In developing budgets for grant proposals, volunteer time can be used as required in-kind match to leverage grant funding. To find the current value of volunteer time, go to https://www.independentsector.org/volunteer_time. In 2013, the value was $26.50 per hour in Alaska.
- Consider budgeting substantial funding during a CBM program start-up phase to build the program infrastructure, and to pay for equipment, a training program for data collectors, local program coordinators, and hardware and software for data management. This strategy should reduce the funding needed on an annual basis in later years.

TIPS FOR SEEKING FUNDING TO SUPPORT ALASKA CBM PROGRAMS

- Start small and build the program slowly to develop a solid funding base.
- Obtain sufficient funding during the start-up phase to create needed infrastructure (equipment, a database, training manual) so maintenance funding requirements are lower.

"Be strategic when/if you find pots of money."

Sue Mauger, Cook InletKeeper

- Develop a compelling story to tell funders that highlights why the program matters.
- Plan for growth (some funders like to fund the expansion of a successful model).
- Be bold; don't be afraid to ask for support for something of importance to your community, and emphasize community support to funders who have this as a priority.
- Although some CBM programs begin with concerns held by a small group of people in a community, most funding sources will not make grants to individuals. Ally yourself with a community-based organization.
- Program results may point the way to a different type of monitoring and different funding sources.
- Consider crowd-funding. Crowd-funding is the practice of funding a project or venture by raising monetary contributions from a large number of people, typically via the Internet.

"Be fearless about funding. I knock on everybody's door. I am fearless about asking for money and it's because I believe in my program and I believe in the people who are spending all of their time and effort and energy. And that belief translates."

Julia Parrish, COASST

Final Thoughts about Community-Based Monitoring in Alaska

Fran Ulmer, Chair of the US Arctic Research Commission, gave closing comments at the 2014 workshop. Following is an excerpt.

Here's what I heard were important ingredients in a successful CBM program: purpose, relevance, enthusiasm, usefulness, community engagement, partnerships, protocols, data that are reliable, persistent, and manageable; cultural awareness, long-term relationships, networking, marketing, communication, communication, communication.

What I heard in terms of challenges: Matching the right researcher with the right community or vice versa, kind of like speed-dating for the issues. . . . Many of them [the researchers] need to be mentored, not only in terms of what's culturally appropriate, but even how to frame questions so they are relevant and purposeful. Data storage and repositories. Consistent facilitation so you have continuity. Training and evaluation techniques, how to involve youth.

Why what you are doing is important and relevant:

You are expanding the capacity of the science community—the researchers—by giving them tools, by expanding and making the information they use in their process more connected to place. You are answering important questions. You are providing tools to not only your community and to decision-makers in your community but to people in the region, the state, and beyond. You are helping to make science fun. And that is so important. You are expanding scientific literacy, which we know in this country is at a historic low. And by engaging youth, by engaging Elders, and by engaging the community, and making clear how science relates to decisions and the important things in a community's life, you are not only making it more fun, but you are teasing people to get better educated in science and in math and communication skills. You are empowering community members and citizens to be part of solving problems both locally and globally. We all know science budgets are getting cut in many agencies and many universities. . . . At a time when there's less money to do research, it's even more important to use all the tools that are available, including empowering local people to be part of the information base.

In terms of the Arctic, let's remember that the Arctic has 4 million people that call the Arctic home . . . people who have been of this place for hundreds and thousands of years, people who not only call it home, but have the knowledge about this place, and a deep-seated commitment to making sure this place remains the special place that it is and always has been. There, more than ever, it seems incredibly important that CBM be a connected part of the decision-making process. . . . Now more than ever, what you are doing is not only incredibly important, but essential.

"It all comes down to focus on the art of the possible and what you can do with the resources you have."

Michael Svoboda,
Arctic Borderlands Ecological Cooperative

Selected Literature and Resources

CITATIONS

ICC (Inuit Circumpolar Council). 2014. Application of Traditional Knowledge in the Arctic Council. Available at: http://www.iccalaska.org/servlet/content/icc_alaska_projects.html. Last accessed Dec. 15, 2014.

Pyke, Graham M. 2014. Science: How does it happen and where does it lead? Blog post to Millennium Assessment of Humanities and the Biosphere. May 20, 2014. Available at: http://mahb.stanford.edu/blog/science-how-and-where/

GUIDANCE FOR CITIZEN SCIENCE PROGRAMS

Phillips, T., M. Ferguson, M. Minarchek, N. Porticello, and R. Bonney. 2014. User's Guide for Evaluating Learning Outcomes from Citizen Science. Ithaca, NY: Cornell Lab of Ornithology. Available at: http://www.birds.cornell.edu/citscitoolkit/evaluation

Pocock, M.J.O., D.S. Chapman, L.J. Sheppard, and H.E. Roy. 2014. Choosing and Using Citizen Science. Available at: http://www.ceh.ac.uk/products/publications/documents/sepa_choosingandusingcitizenscience_interactive_4web_final_amended.pdf

GUIDANCE FOR ALASKA AND ARCTIC COMMUNITY-BASED MONITORING PROGRAMS

Alaska Community-Based Monitoring (includes literature summary, funding resources, etc.)
www.AlaskaCommunityBasedMonitoring.org

Community Based Monitoring Handbook: Lessons from the Arctic and Beyond (Conservation of Arctic Flora and Fauna, CAFF)
http://www.caff.is/monitoring-series/view_document/9-community-based-monitoring-handbook-lessons-from-the-arctic-and-beyond

Citizen Science Resource Page (Centre for Ecology and Hydrology, Natural Environment Research Council)
http://www.ceh.ac.uk/products/publications/understanding-citizen-science.html

Choosing and Using Citizen Science: A Guide to When and How to Use Citizen Science to Monitor Biodiversity and the Environment (Centre for Ecology and Hydrology)
http://www.ceh.ac.uk/news/news_archive/choosing_and_using_citizen_science_guide_2014_23.html

GUIDANCE FOR USE OF TRADITIONAL KNOWLEDGE

Guidelines for indigenous communities in negotiating research relationships
https://depts.washington.edu/ccph/pdf_files/env-negotitiating-research-relationships.pdf

Guidelines for respecting cultural knowledge
http://www.nativescience.org/html/guildlines_cultural.htm

Sample partnership agreement between western science researchers and community researchers and code of ethics
http://www.nativescience.org/html/Code%20of%20Research%20Ethics.html

A toolkit in the field-testing stage to support documentation of Traditional Knowledge
http://www.wipo.int/export/sites/www/tk/en/resources/pdf/tk_toolkit_draft.pdf

National Science Foundation arctic research guidelines
https://www.nsf.gov/geo/plr/arctic/conduct.jsp

Workshop Agenda

(Go to http://seagrant.uaf.edu/conferences/2014/community-based-monitoring/index.php for links to presentation PDFs, audio recordings, and speaker biographies)

TUESDAY, APRIL 1, 2014
Focus: Purpose, Objectives, Outcomes, Indicators

9:00–9:10 a.m.
Welcome, *Paula Cullenberg*

9:10–9:55 a.m.
Can You Send Me a Thermometer or Something?, *Henry Huntington*

9:55–10:05 a.m.
Why involve communities in monitoring? Who benefits and how?, *Molly McCammon*

10:20–11:40 a.m.
Community-based monitoring: A collage of perspectives

Paralytic Shellfish Poisoning, *Bruce Wright, Senior Scientist, Aleutian Pribilof Islands Association*

Citizen Science: Promoting Successful Community-Education Partnerships, *Kathryn Kurtz, STEM Curriculum Coordinator for Anchorage School District*

Michael Brubaker, Center for Climate and Health, Alaska Native Tribal Health Consortium

Combining Iñupiaq and Scientific Knowledge, *Cyrus Harris, Native Village of Kotzebue*

Observing Alaska's Coasts and Oceans—National Weather Service *Aimee Devaris, Deputy Director, National Weather Service Alaska Region*
Facilitated by Paula Cullenberg

11:40 a.m.–12:00 p.m.
How do you measure success? Discussion from prior research efforts to develop best practices, focusing on program purpose, objectives, and outcomes, *Marilyn Sigman*

1:00–1:30 p.m.
Traditional Ecological Knowledge: Tools of Measurements, *Raphaela Stimmelmayr*

1:30–2:30 p.m.
Designing for success: Stories from facilitation leaders about getting started and sustaining community-based monitoring programs

Community-Based Water Quality Monitoring, *Sue Mauger*

Community-Based Monitoring: Marine Invasive Species in Southeast Alaska, *Linda Shaw*

2:30–4:30 p.m.
Facilitated breakout groups: 4 groups each rotate through 2 guided work sessions

I: Designing a process for what to collect and how to collect it; data collection protocols for traditional knowledge; targeting, training, and enabling local monitors. *Led by Mette Kaufman, Glenn Seaman, Carolina Behe, and Linda Shaw*

II: Maintaining data consistency across time; funding, motivating, and providing incentives to participants; meeting expectations for quality control. *Led by Aimee Devaris, Raphaela Stimmelmayr, Orson Smith, and Sue Mauger*

4:45–5:15 p.m.
Summaries and highlights reported back to the group by discussion leaders

6:00–8:00 p.m.
Reception

WEDNESDAY, APRIL 2, 2014
Focus: Observations with a scientific, resource management, or policy purpose

8:30–9:00 a.m.
Adaptive Methods: Building Win-Win Partnerships with Arctic Indigenous Communities, *Heidi McCann*

9:00–9:30 a.m.
Defining and Evaluating Success: Citizen Science in the 21st Century, *Julia Parrish*

9:30–10:30 a.m.
Continuation of designing for success: Stories from facilitation leaders about using data and evaluating community-based monitoring programs

Melibee Citizen Science Project, *Katie Villano Spellman*

Kachemak Bay CoastWalk, *Beth Trowbridge*

The Northwest Arctic Borough Subsistence Mapping Project, *Damian Satterthwaite-Phillips*

10:30 a.m.–12:30 p.m.
Facilitated breakout groups: 4 groups each rotate through 2 guided work sessions

I: Troubleshooting and using observations. *Led by Michael Brubaker, Damian Satterthwaite-Phillips, Michael Svoboda, and Brad Benter*

II: Evaluating programs and meeting expectations. *Led by Julia Parrish, Maryann Fidel, Katie Villano Spellman, and Beth Trowbridge*

12:30–2:00 p.m.
Lunch and time to explore expo of interactive technology and tools

2:00–3:00 p.m.
Summaries and highlights reported back to the group by discussion leaders, and time for discussion

3:00–3:30 p.m.
Community perspectives: Documenting change and effects to well-being, *Maryann Fidel, Margie Coopchiak, Verna Immingan, Lisa Jackson, Alice Kalmakoff, Regina Kava, Svetlana Petrosyan, and Marina Sheetova*

3:30–3:40 p.m.
Closing remarks and next steps, *Paula Cullenberg*

3:40–4:30 p.m.
Community-based monitoring in the context of Arctic science and policy, *Fran Ulmer, Chair, US Arctic Research Commission*


Photo courtesy of Bruce Wright

Bruce Wright, Aleutian Pribilof Islands Association, collects mussels to test for paralytic shellfish poisoning in the Russian Komandorski Islands.

Community-Based Monitoring of Alaska's Coastal and Ocean Environment

Whether initiating a community-based monitoring program or working with a continuing program, Alaska communities, scientists, engineers, and agencies will find this guide indispensable for implementing best practices. To make a CBM program work, the need for monitoring and the intended use of the data must be identified, benefits for the community should be clearly stated, and a scientist, agency, or organization must be committed to manage the program, to be responsive to community needs, and to meet the scientific needs of the data users. The emphasis is on collecting scientifically defensible data via systematic observations, and on enjoying the group effort!

NOAA · National Oceanic and Atmospheric Administration · U.S. Department of Commerce

UAF University of Alaska Fairbanks
School of Fisheries and Ocean Sciences