International Community-Based Environmental Observation Alliance for the Arctic Observing Network

Bering Sea Sub-Network

Sharing Knowledge – Improving Understanding

Pilot Phase Final Report

CAFF Monitoring Series Report Nr. 2

ARCTIC COUNCIL

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3. Pilot Project Overview

3.1. Project Goals

The Bering Sea Sub Network is a regional initiative of community-based organizations in Western Alaska and Northeastern Russia. It operates as a distributed network which uses humans as individual, coordinated sensors for local environmental observations throughout the year. The overall goal of the Bering Sea Sub Network (BSSN) is to improve knowledge of the environmental changes occurring in the Bering Sea that enables scientists, arctic communities and governments to predict, plan and respond to these changes.

The objective of the pilot phase was to develop a framework to enable residents in remote and diverse Arctic communities to systematically document observations of physical and social changes occurring in their region and to organize the gathered data in standardized data sets so that potential users (academia, natural resource managers and local residents) could discover them and apply this knowledge in their research and management.

BSSN addresses Scientific Questions about:

- The historical and current distribution and properties of economic and subsistence species, as derived from collective indigenous and traditional knowledge.
- Types of major variables and indicators that can be correlated with western science to develop predictive models based on indigenous and traditional knowledge
- Spatial and temporal convergence and divergence of community-derived data and western science.

BSSN contributes to the following broader issues:

- Social awareness in the broader community around the Bering Sea
- Investments in community-based research and observations
- Communities' resilience and adaptation to change
- A more prominent role for indigenous and traditional knowledge in modern science

3.2. Scope of Work

The pilot phase operated from 2007 to 2009. The main tasks included:

- Formation of the network components
- Formalizing agreements with participating communities
- Developing a survey instrument and refining survey methodology
- Setting up a system for data processing
- Developing a communication plan
- Conducting interviews in the villages
- Processing completed questionnaires
- Summarizing data
- Delivering data summary reports to participating communities

3.2.1. Network Components

BSSN Secretariat is co-located with AIA's offices. It provides a central location for coordination of all project activities and safe storage of data. The staff consists of the Survey Manager who oversees all aspects of survey administration and data organization and the Senior Project Coordinator who is responsible for communication with village personnel, logistics, and for providing assistance to the communities.

Figure 5. BSSN structure.

BSSN Steering Committee (SC), made up of one member from each community, was created to advise the research team on the issues that may be sensitive for their respective villages and on the community relations. These individuals were nominated by community self-governing bodies and have such authorities as signing off the release of BSSN reports containing data from their communities. In the future, BSSN SC members will be reviewing outside requests for access to the data from their communities.

Community Research Assistants (CRA) were local residents hired to conduct interviews. They received training and ongoing support from the BSSN Secretariat. In Alaska, CRAs are often active harvesters and not employed in other fields. In Russia, most of the CRA are professionals who are long-term residents in the communities.

3.2.2. Agreements with participating communities

In Alaska, BSSN sub-awardees were local Tribal organizations that administered the pilot project in their respective villages by providing logistical support that allowed for the use of office space and bookkeeping services and facilitated necessary staff hiring.

In Russia, the agreements were signed with two non-profit organizations located in regional centers, one in Petropavlovsk–Kamchtasky and one in Anadyr, to provide overall project activities management in the villages and to serve as fiscal agents for the project in Russia.

3.2.3. Survey instrument and methodology

The survey utilized semi-structured interviews. Sampling was purposive and non-random. Survey questionnaires contained open-ended, close-ended and multiple choice questions. All surveys were administered in the interview format. Whenever permission was granted, the interviews were recorded using a digital voice recorder. Questionnaires were filled out by local interviewers to capture exact answers. An electronic version of each interview was sent to the Survey Manager at the BSSN Secretariat, who enters information in the original language, English or Russian, with English translation into the data management programs. Monthly teleconferences with local interviewers are used to provide feedback and to address any problems to assure quality control.

The survey questionnaire was designed to capture:

- Changes in climate and environmental conditions
- The abundance and quality of the resource
- Changes in migration patterns and habitat
- The effect of changes on the availability of resources, on food supply, and on the livelihood of communities
- The local knowledge base associated with marine resources:
    - Resource availability
    - Quality of the catch
    - Quality at the time of preparation
    - Quality at the time of consumption
    - Environmental change
    - Shifts or changes in harvesting locations
    - Comparisons between past and present
- Any observations of unusual occurrences

The survey focused on harvesting events. The survey instrument, entitled "The Bering Sea Coastal Community Observations of Traditional Hunting and Fishing", consisted of a pre-event questionnaire, post-event questionnaire, and a Manual for Community Research Assistants.

In addition, a short questionnaire was designed specifically for Elders. About 30 elders were interviewed but these interviews are not part of the main sample contained it the BSSN pilot phase data bases. These interviews will be used for a deeper analysis of the gathered data during the second phase of the project. Elders retain long memories of local environmental conditions and through extensive land schooling, so their information may paint stronger image of the changes that have occurred (Alessa et al 2007).

The survey questionnaires are products of collaborative efforts by the research team and community representatives. The drafts were developed at the October 2007 workshop and, after gaining approval from network members, they underwent extensive expert review by consultants at Westat, Maryland, U.S. Cognitive test interviews were conducted in all villages. Three test interviews per village, eighteen totals, were analyzed for comprehensibility of the questions. The final version of the questionnaire in English and Russian was completed and sent to villages in April, 2008.

3.2.4 Survey Data Management

Data management is a key component of this project. The data are being physically entered and stored at the BSSN Secretariat until the time when communities have the capacity to manage and distribute the database.

Confidentiality is one of the main concerns. Sensitive data, such as exact locations of hunting and fishing sites, are safeguarded. Tracking sheets are utilized to disassociate names from surveys. Completed surveys are kept confidential and secure. All data and survey results are the property of BSSN member communities. BSSN will retain full control of the data to the extent permissible by law. The BSSN Steering Committee is charged with handling data access issues on behalf of the communities surveyed.

The BSSN research team and community representatives discussed data ownership issues at length. While it is possible to have a distributed database with individual community data stored at the villages, it was recognized that most of them do not have capacities to maintain such data bases. Until such capacities are developed, the BSSN communities agreed to keep all project data at a centralized place, the BSSN Secretariat, while retaining appropriate data ownership rights.

The data products of the pilot phase of BSSN can be divided into the following categories. The rights of outside agencies and individuals to access these products will vary and are discussed in relation to each category:

1. Overall Data Summary – This "summary of summaries" consists of the Survey Results Summary shown in Section 6.2 This summary will be widely distributed and has already been presented in various international forums, such as the Arctic Council. Access to this summary has no restrictions.

2. Community Data Summaries – These summaries are for data specific to each community (Section 6.3.) and as such contain more information about the communities themselves. For this reason each community was requested to review its data report prior to freely disseminating these summaries. As of July 2010 the community data summaries have been reviewed and approved for release to the public by all BSSN pilot phase communities.
3. Project Databases – The databases of information entered into the SPSS and Nvivo software programs, as well as these databases converted into CSV (Comma Separated Values) format, will be made available only upon formal request and review by the BSSN Steering Committee. This request will consist of identification of the individual or agency making the request, a synopsis of the project that data will be used for, an explanation of how BSSN data will be used, and a description of what data products are expected to be produced. The request will be forwarded to all community representatives of the BSSN Steering Committee whose data will potentially be used and only upon review from each community will the databases be released for use. Requests can be sent to aia@alaska.net and BSSN staff will facilitate the process.
4. Survey Forms – Paper and electronic versions of the individual survey forms in Microsoft Word, PDF, or RTF (Rich Text) format will be available after a formal request using the procedure outlined above. However, any documents which associate the name of an individual with a particular survey will not be made available at any time.

All data products mentioned above are hosted at the offices of the BSSN Secretariat co-located with the Aleut International Association in Anchorage, Alaska, and are available at www.bssn.net. This storage consists of back-ups on multiple servers, including offsite servers, in the case of electronic data, and secure storage in the case of paper forms. This storage of data will continue for the life of the project and beyond for the foreseeable future. In addition, discussions are currently underway with data management initiatives, such as Exchange for Local Observations and Knowledge of the Arctic (ELOKA) and Cooperative Arctic Data and Information Service (CADIS) for long term hosting/preservation of BSSN electronic data. However, any requests for access to data hosted at ELOKA or CADIS will be made through and will be subject to the same protocols as the data hosted at the BSSN offices. When BSSN member communities develop capacities to host their data sets the current arrangement can be converted to a distributed network.

To make BSSN data discoverable metadata records are being submitted to the following:

- ELOKA
- CADIS
- International Polar Year Data and Information Service (IPYDIS)

These metadata records will link with freely available data stored at www.bssn.net, ELOKA, CADIS and to the protocols for the request of other data.

BSSN is committed to making its data available in formats which provide the greatest benefit to the largest number of users. Towards this end BSSN will remain open to new technologies, such as open source formats, and will provide them as they are developed and where applicable to the data produced by BSSN.

Survey Manager Maryann Smith & Togiak CRA Olia Sutton

3.2.5. Communication Plan

Project communication operates on many levels simultaneously, both external and internal.

Internal communication

With a project as geographically far reaching as BSSN it is essential that project staff in the communities have close communication with the BSSN Secretariat and with their counterparts in other locations. This allows the Community Research Assistants to share successes, discuss problems, and realize that they are part of an international team. This close communication is facilitated by modern electronic communication methods such as, email and Skype, as well as monthly teleconferences between village staff and BSSN personnel in Anchorage. The teleconferences are held separately for Alaskan and Russian village staff to avoid difficulties related to interpreting. Teleconferences notes are then translated into English and Russian and circulated to all BSSN team members.

As has been previously stated, an important principal of BSSN is that participating communities are kept informed about project activities and progress. This is brought about by maintaining close communication with tribal and community organizations that had begun before the project started and continues today and into the foreseeable future. Trips to each community are planned to coincide with meetings of tribal or village administrations whenever possible. This provides opportunities for presentations and progress reports. Each BSSN village has received multiple project updates presented during community meetings. BSSN has also produced printed brochures designed for distribution in the communities in an effort to reach as many residents as possible.

External communication

Informing the international scientific community at large about the network is also important, and a number of presentations about the project have been made at numerous forums including the following:

- Arctic Council Meeting, Selfoss, Iceland, May 2004
- Arctic Council Meeting, Syktyvkar, Russia, April 2006
- Arctic Observing Network (AON), Boulder, CO USA, March 2007
- Arctic Observing Network (AON) Meeting, New York, NY, USA, March 2008
- Berengia Days, Anadyr, Russia, September 2007
- PAME I, St. Johns, Newfoundland, Canada, June 2008
- SCAR/IASC Open Science Conference, St Petersburg, Russia, July 2008
- CAFF, Akureiri, Iceland, September 2009
- AON PI Meeting, Boulder, CO USA, November 2009
- Arctic Council Meeting, Copenhagen, Denmark, November 2009
- Oslo IPY Science Conference, Oslo, Norway, June 2010

3.2.6. Survey administration

Each participating community had an opportunity to review the questionnaires and provide feedback. Village governing bodies – Tribal Councils in Alaska and local Administrations in Russia – gave their approval prior to the beginning of interviews.

The survey targeted experienced harvesters. Respondents were offered compensation for their time, the amount of which is decided by each community. Each interview took about an hour.

Survey interviews took place before and after a harvesting event or fishing season. Trained Community Research Assistants administered individual interviews at a location and time convenient for respondents. Most respondents preferred to be interviewed in an office or other neutral environment. Interviews were recorded (with respondent's approval) using digital voice recorders, while Community Research Assistants recorded answers in writing.

The project languages are English and Russian. Indigenous languages speakers are accommodated through bilingual Community Research Assistants. Four out of six BSSN villages have people speaking indigenous languages on a daily basis.

3.2.7. Data processing

The Bering Sea Sub-Network Survey Manager oversees the organization of the survey data coming in from the participating villages and prepares them for analysis. Because the surveys contain both closed and open-ended questions, the data are managed using research software designed to handle both quantitative and qualitative information.

Community Research Assistants enter written responses into electronic survey forms which are sent, along with the electronic voice recording files, to the BSSN Secretariat office in Anchorage, Alaska. Hard-copy survey originals are mailed to the BSSN office for secure storage. A BSSN Survey Manager receives all survey materials, and then enters all information into an electronic database and files in a secure cabinet.

The answers to the closed-ended and multiple choice questions are entered into an SPSS 16 database, a statistical package widely used in the social sciences and business for managing quantitative data. For the analysis and coding of open-ended questions, the popular qualitative research software NVivo 8 is utilized. Respondents' open-ended answers are coded by using a version of the Delphi method. Drawing on the expertise of the project principles, the knowledge of other researchers involved in the project, and the input of outside experts on socio-environmental research, BSSN has developed a protocol for how to categorize and code the qualitative information contained in the surveys. In this work, particular attention is paid to instances in which the respondents' answers yield information about socio-cultural phenomena such as:

- Expectations about what should exist in the natural environment
- The populations' ability to adapt to changing harvesting conditions and develop flexible responses
- Individuals' sensitivity to climate shifts and general perceptions about environmental conditions
- The sources of information that people rely on – for instance, personal observations, radio and television news, community elders – for their knowledge of environmental conditions
- The impact of economy – for example, rising fuel prices – on harvesters' ability to reach the locations where they hunt or fish.

3.2.8. Reporting to the Communities

At the conclusion of the field work, all questionnaires are compiled for analysis. The resulting data are both qualitative (narratives) and quantitative including graphs and charts. The reports provide detailed data summaries by the community. The results are presented to the community governing bodies. In Alaska, presentations are made at the Tribal Council meetings, in Russia reports are delivered to the Heads of local Administrations.

BSSN team realize that delivering a report on the study results to the communities involves more than mailing a paper copy or making a Power Point presentation. It is crucial to be able to demonstrate how the results can be applied to decision making and problem solving at a community level. In the pilot phase of BSSN, the limited time frame prevented the team from developing a strategy for communicating the results to the communities, but this strategy will be devised in the second phase of BSSN. Collaboration with village authorities is essential because the researchers need a clear understanding of issues and concerns that locally, to make proper recommendations. A successful collaboration necessitates a deep mutual trust. BSSN is a relatively long-term project (seven years for two phases) and is in a good position to achieve this level of trust.

Gambell CRA Antonia Penayah conducts an interview

4. Lessons Learned

The pilot phase is intended to test the BSSN concept and the methods employed. In regards to the overall concept of the network, there is no doubt that the concept has proved itself:

- A systematic collection of local observations can be organized across national borders, diverse cultures, and across a large geographical area.
- Perceptions of local residents provide an accurate reflection of status and changes occurring in the social and natural environment and can be correlated with other types of data.
- Sociological methods of survey utilized to gather local observations enable data aggregation and analysis.

As expected, a number of changes in the project administration and execution have been recommended by the BSSN team after the completion of the pilot phase. These recommendations are discussed below, along with the project accomplishments.

4.1 Survey Design

One of the significant accomplishments of the survey question design, which occurred through extensive discussions between the communities and researchers, is in the reduction of "filtering" by respondents. This can be achieved by focusing on actual events and individual life experiences while extracting information on various physical and natural phenomena. Special attention is paid to avoiding "driving" respondents to any "well-known" facts or media-publicized conclusions. This approach increases objectivity in respect to assessments based on the observations of local residents. Of equal importance is the improvement of data accuracy since questionnaire entries are entered in their original languages, English and Russian.

The pilot phase questionnaire is very long, and interviews were tiring for respondents. It is challenging to structure questions relevant and applicable to all respondents in all locations in all possible situations while accommodating community wishes and research requirements. The pilot phase questionnaire became overcomplicated and confusing, and that led to a high rate of missed questions and other problems with the survey administration. The concept of interviewing harvesters before and after harvesting events proved to be ineffective as hunters and fishermen are very busy, and it is difficult to complete both the pre and post-event questionnaires because of the problems with scheduling for the post-event interview. There were also difficulties with data organization because the questionnaire has two parts, harvest and environmental observations, that would have been better administered separately.

To respond to these issues, the survey instrument has been adjusted and redesigned to include a suite of short questionnaires: Harvest Locations (Baseline data), Seasonal Harvesting (Observations about species harvested in the previous six month), and Environmental Conditions Survey (Observations about the state of physical and natural environment in the last 15 years or more). Each questionnaire has a map where respondents can draw the locations. This information is used for GIS mapping. The new questionnaires are being successfully used in Phase II of BSSN.

4.2 Training

Training and face to face meetings for Community Research Assistants (CRA) are essential. In the pilot phase, the funds, budgeted for travel to the villages, were insufficient. The emphasis was on the use of a BSSN Survey Manual that was written for CRAs. A training session was held at the seminar in Anchorage in 2007, but it was the on-site training in each community that proved to be the most efficient. The training period for community coordinators needs to be extended in order to better equip them to cope independently with the variability inherent in the interviewing and technical questions regarding the documenting process. In Russia, the situation was even more challenging due to logistical issues.

The above issues are being addressed in BSSN Phase II. The budget allows for up to three trips per village per year in Alaska. Survey Manager and Senior Project Coordinator are in daily contact with village staff. The Russia based sub-award manager is trained in the survey methods for on-site training and prompt response to any issues that may arise in the Russian communities. The manager also reviews all completed questionnaires for quality control.

4.3 Communication

Utilizing emerging communication tools is essential for this project. Despite the distances between the Anchorage-based staff and member communities, extensive communications were possible due to the use of digital tools, such as Skype, to supplement scheduled teleconferences where possible. These tools allow real time audio and visual interactions on a daily basis and enable a distributed, coordinated network to function smoothly and acquire systematic data reliably. The use of emergent communication and data acquisition tools can drastically increase the effectiveness of this type of project.

Other challenges encountered by project managers range from the difficulties with retaining staff in remote locations and training new people to unpredictable weather conditions that affect travel and high cost of transportation. Such challenges are not unique to BSSN; they are common for any research projects based in remote arctic regions.

5. Conclusion

The Bering Sea Sub-Network is community-based. At the very core of BSSN is the idea that the participating communities should be involved at every level of planning and development of the network and the BSSN project. A community member in Gambell eloquently summarized why he likes the project: “I like this project because you are not researching us – you are doing research with us”.

5.1 Benefits to Communities

- By employing community members, especially younger people, the project provides modern opportunities to facilitate traditional knowledge transfer.
- In communities where cash earning opportunities are scarce, BSSN provides additional income.
- Community members are afforded an opportunity to learn new skills, such as interviewing techniques, advanced computer skills, GIS mapping that are transferable to other research or employment opportunities leading to the improved individual and collective adaptability.
- Community leaders have a direct access to the project management and can influence how the project is conducted in their communities, as well as consult the research team on the best ways to handle community concerns.

The information garnered by this survey and presented in this report may be a useful tool in the hands of communities as they seek to improve resource management in order to preserve and continue their indigenous way of life. The project data may contribute to local decisions regarding resource management and may enhance communities’ understanding of what is happening in and around the whole of the Bering Sea. The BSSN team will work with communities on identifying the best venues for application of the survey results in everyday local decision making.

As a network, BSSN encourages cultural connections and communication between groups of people who have diverse cultures, but who share similar concerns. As a project, BSSN empowers communities in their resource management endeavors and contributes to their ability to plan for and adapt to environmental and social change.

These data may be useful in helping communities plan for the future, for example they may need to develop several ‘plans of action’ to be able to adapt to the occurring changes. A picture of the impacts of environmental changes on arctic communities is often painted with a broad brush stroke without understanding what is happening at a local level. BSSN data show a range of impacts experienced by local residents in different participating communities. Processes of arctic change are heterogeneous and this heterogeneity is more pronounced at local levels (Jenssen 2006). It is crucially important that mitigation and adaptation plans don’t address the ‘wrong’ issues (i.e., those that communities do not observe or experience). The BSSN data are especially valuable in ensuring this. For example, pilot phase data from BSSN provide insight to the constraints on adaptation: individuals in Alaskan communities are far more mobile than those in Russian communities, through freedom and means (i.e., access to fuel, personal transportation) to move, leading to greater options to respond to change, particularly those affecting local scales. Residents of Kanchalan overwhelmingly were pointing to the changes in the river and some raised concerns about mining activities in the area. As local communities in Russia have fewer opportunities to influence decision making regarding large scale resource exploration, such as mining, than their Alaskan counterparts, their adaptation strategies should be different.

5.2 Benefits to Society

Broader societal benefits of BSSN are in its contribution to the scientific research in the Arctic. A significant contribution of the pilot phase is the development of a model for community-based observing network. While BSSN is not a circumpolar project, the sheer diversity of participants, the range of the collected data and a multidisciplinary approach make this model replicable and potentially applicable in other regions.

BSSN addresses scientific questions of the variations in environmental and socio-economic conditions that have a meaningful impact on everyday life in indigenous communities in the Arctic; the evolution of past and present consequences of change and potential strategies for communities’ capacity to adapt and interactions and feedback between biophysical and social systems.

Climate change and its effects are likely to pose a threat to the food security of subsistence cultures (Ford 2009). However, the most effective way to deal with these changes is not fully understood (Smit et al. 2008). Subsistence harvesters are likely to be observant of environmental changes directly affecting subsistence activity since their ability to secure food is dependent on understanding these conditions. By examining environmental conditions from the perspectives of local residents, it will be possible to better understand what changes most affect subsistence. This will help decision makers focus mitigation efforts in order to better ensure food security. Observed changes in environmental conditions from the pilot phase are numerous and varied (see Figure 7) and show some correlations with western science (Alessa et al 2008)). In this way local knowledge can be calibrated with western science and be used, fo example, as an early warning system for environmental change.

The socio-economic importance of subsistence is clear.

Future leaders of Gambell, Alaska

Across all communities majorities use their harvest for traditional purposes and sharing (see Figure 10). The family’s need for food was a primary driver for the timing of the next trip for all communities but one (see Figure 11). This pattern reconfirms the fact that coastal communities depend on the Bering Sea’s bio resources for providing food to their families. These results clearly point to the importance of biological resources for coastal villages as a matter of food security.

Russian communities stand out as more likely to report catching at least one fish/animal with visible disease (see Figure 12). The most significant observations point to a high rate of disease in red salmon and pacific cod in Nikolskoye, whitefish and chum salmon in Kanchalan, and pink salmon in Tymlat. Reasons for this need further investigation, but participants frequently cited pollutants associated with mining and military activity as the cause.

Climate change will continue to be a significant issue in the Arctic for the foreseeable future, with Bering Sea communities continuing to experience its effects for many decades to come. Climate change is making Arctic waters and resources more accessible. An increase in human activities in the Arctic, driven by the greater accessibility of resources and the emergence of more economical shipping routes, will present new challenges and, hopefully, more opportunities for the Bering Sea coastal communities. BSSN increases a community’s ability to convey their observations and concerns to scientists, policy makers, and the public. It may also help them better prepare and plan for the changes taking place.

In the next five years, BSSN will be expanded to include other communities. The established network may become a springboard for many other research activities in the region, and may provide a model for other regional networks. Developing collaborative relationships with other projects is vital to the future sustainability of BSSN. These partnerships will also increase opportunities for local communities to meet their research needs.

6. Pilot Data Summaries

6.1 Introduction

Sampling was purposeful, and intended to capture frequent harvesters. Peer referral was used by asking Community Research Assistants and Steering Committee members from each community to identify and interview experienced harvesters. These data are not representative and thus, the following summaries do not include tests of statistical significance.

Two surveys were administered, a pre-harvest and a post-harvest. Because of difficulties in the administration of the post-harvest survey only the results from the pre-harvest survey are presented.

The pre-harvest survey consisted of two portions, one focused on aspects of a specific harvest event, the other focused on observed environmental changes. A respondent could fill out the harvest section of the survey more than once for each species he/she harvested. The environmental portion could only be filled out once, thus there are different sample sizes for each subject. Due to the nature of the project, and community-based research in general, some data were unusable and some surveys had missing answers. Quantitative and qualitative methods were employed which may also result in different sample sizes for specific responses. An explanation is provided for each circumstance that varies from the sample sizes presented below (see Table 1).

Different parameters are sometimes presented for different communities. This is a result of different species harvested (i.e. non-fish harvesting communities were not asked about the timing of fish runs) and different trends in the data. Predominant trends are presented. Complete data will be made available upon request.
These data summaries are synopses of the survey results. They are not interpretative analyses and thus do not contain conclusions or make generalizations about the meaning of the results.

Average age for participants from all communities was 45 (see Table 2) and participants were predominately male (see Table 3).

6.2 Survey Results Summaries

6.2.1 The Sample

The BSSN community in this survey is represented by 246 people. Different age groups are represented (see Table 2). The gender of participants is balanced with 65.3 percent male and 34.7 percent female (see Table 3). Harvested species are summarized in Table 4 for each community. The majority have lived in the area for more than 30 years (70.5 %). 42.5 percent have also harvested in the same area for more than 30 years. Thus the majority of participants have accumulated several decades of observations of the local environment.

Ice fishing near Tymlat, Russian Federation

Table 1. Sample sizes from each community for two different portions of the survey

Village	Overall sample	Harvest	Environmental	% of overall sample with 11 years or more harvesting experience
Gambell	49	42	49	94%
Kanchalan	43	47	43	82%
Nikolskoye	29	61	29	90%
Sand Point	18	19	18	78%
Togiak	69	70	69	89%
Tymlat	38	48	38	80%
Total Sample	246	287	246	86%

Table 2. Age of Participants from each community

Villages	Gambell	Kanchalan	Nikolskoye	Sand Point	Togiak	Tymlat	All villages
18-25	5 (10%)	1 (2%)	0 (0%)	5(28%)	5 (7%)	1 (2%)	17 (8%)
26-35	8 (16%)	2 (5%)	5 (17%)	5 (28%)	17 (25%)	11 (29%)	48 (20%)
36-45	16 (33%)	18 (42%)	6 (21%)	2 (11%)	18 (26%)	13 (34%)	73 (28%)
46-55	14 (29%)	14 (33%)	8 (28%)	5 (28%)	12 (17%)	4 (11%)	57 (24%)
56-65	5 (10%)	7 (16%)	4 (14%)	1 (6%)	15 (22%)	5 (13%)	37 (14%)
Over 65	1 (2%)	1 (2%)	6 (21%)	0 (0%)	2 (3%)	4 (11%)	14 (7%)
Total	49 (100%)	43 (100%)	29 (100%)	18 (100%)	69 (100%)	38 (100%)	246 (101%)*
Average Age	46	48	51	37	43	45	45

*due to rounding

Table 3. Gender of participants

Villages Gender	Gambell	Kanchalan	Nikolskoye	Sand Point	Togiak	Tymlat	All villages
M	71%	72%	79%	61%	57%	52%	65%
F	29%	28%	21%	39%	43%	48%	35%

Table 4. Composition of sampled harvests

Species caught:	Gambell	Kanchalan	Nikolskoye	Sand Point	Togiak	Tymlat
Bowhead Whale (Balaena mysticeti)	✓					
Walrus (Odobenus rosmarus),Seal (Phocidae& Otariidae)	✓				✓	
Emperor Geese (Chen canagica)	✓					
Shee Fish (Stenodus leucichthys)	✓					
Salmon unspecified (Oncorhynchus)	✓			✓	✓	
Silver Salmon (Oncorhynchus Kisutch)			✓			✓
Red Salmon (Oncorhynchus nerka)			✓	✓		
Pink Salmon (Oncorhynchus gorbuscha)			✓			✓
Chum Salmon (Oncorhynchus keta)		✓				✓
Arctic Char (Salvelinus alpinus)			✓			
Pacific Cod (Gadus macrocephalus)			✓	✓		
Halibut (Hippoglossus pleuronectidae)			✓	✓		
Plaice (Pleuronectes quadrituberculatus)			✓			
Atka Mackerel (Pleurogrammus monopterygius)			✓			
Smelt (Thaleichthys pacificus)					✓	✓
Broad Whitefish (Coregonus nasus)		✓				
Arctic Grayling (Thymallus arcticus)		✓				
Trout (Salmoninae)					✓	
Pike (Esox Lucius)					✓	
Crab (Decapoda)	✓					
Shellfish (Mollusca)				✓		
Other	✓				✓	✓

6.2.2 Survey Results for all communities

A. Changing Environmental Conditions

Environmental and climatic changes in the Bering Sea can have direct impacts on major food webs that result in disturbances for subsistence dependent communities (Grebmeier, 2006). By examining environmental changes from the perspective of residents we can gather clues about local changes that may indirectly affect subsistence through changes in the food web and examine changes directly impacting subsistence activity. Changes directly impacting subsistence may include an increase in storm frequency that restricts travel, or thinner ice that results in difficulties butchering whale. These changes are likely to be understood at an intuitive level by the harvester who relies on certain conditions to obtain food.

Figure 6 displays the percent of participants that noticed some change in environmental conditions across all communities. Some trends are apparent. Respondents in Gambell noticed more environmental changes than any other community . A large majority (84%) noticed some change in ice condition. Residents may be especially aware of changing ice conditions due to the ice-dependant nature of the harvest. Hunting for seal, walrus and whale is directly affected by sea ice. Satellite data from the National Snow and Ice Data Center confirm sea ice has changed drastically in the past 50 years (Fetterer et al. 2009, NSIDS)(see Figure 7).

Figure 8 presents trends in air temperature change from the ACIA and BSSN communities. When percentages of all environmental observations among communities are compared to trends in ambient temperature change, some correlations are evident. In Gambell the highest average percentage noticed changes (50%) and relative to other sites Gambell showed the greatest change in air temperature (Figure 8. Observed surface air temperature changes: 1954-2003). The average percent of people noticing change in Togiak and Kanchalan were both 44%, followed by Sand Point (33%), Nikolskoye (25%) and Tymlat (20%). Interestingly Tymlat observed the fewest changes in environmental conditions and real data confirms that Tymlat is not experiencing a change in air temperature.

The previous two examples represent the calibration of local knowledge with Western scientific data. Although sample size was small, there were significant, positive correlations observed in the pilot phase, and these trends need further examination.

Figure 6. Observed environmental changes among all BSSN communities

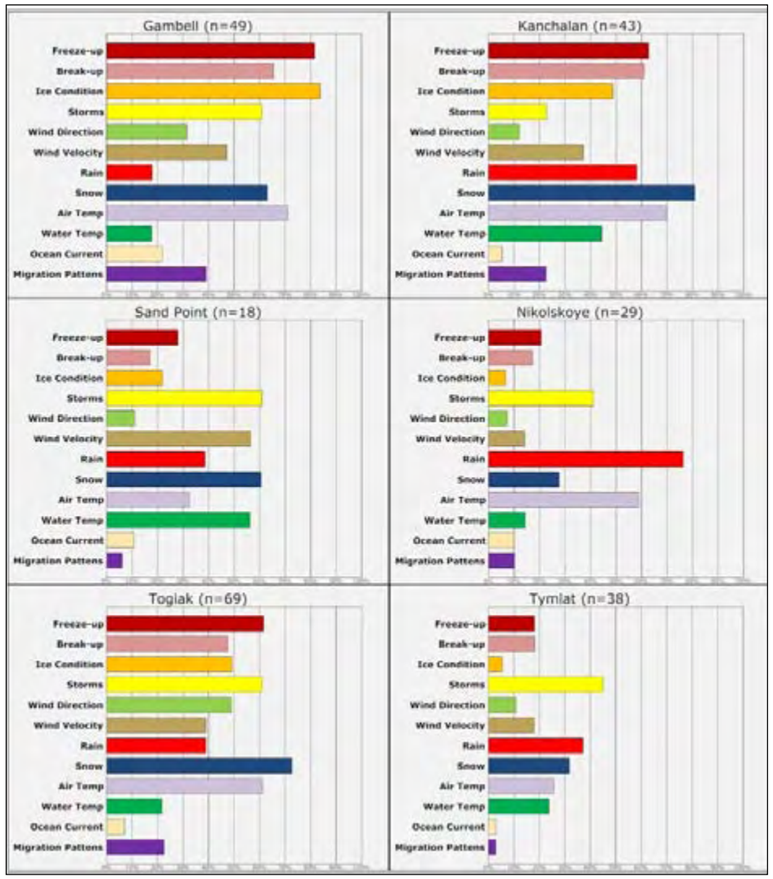


Figure 7. Trends in sea ice extent

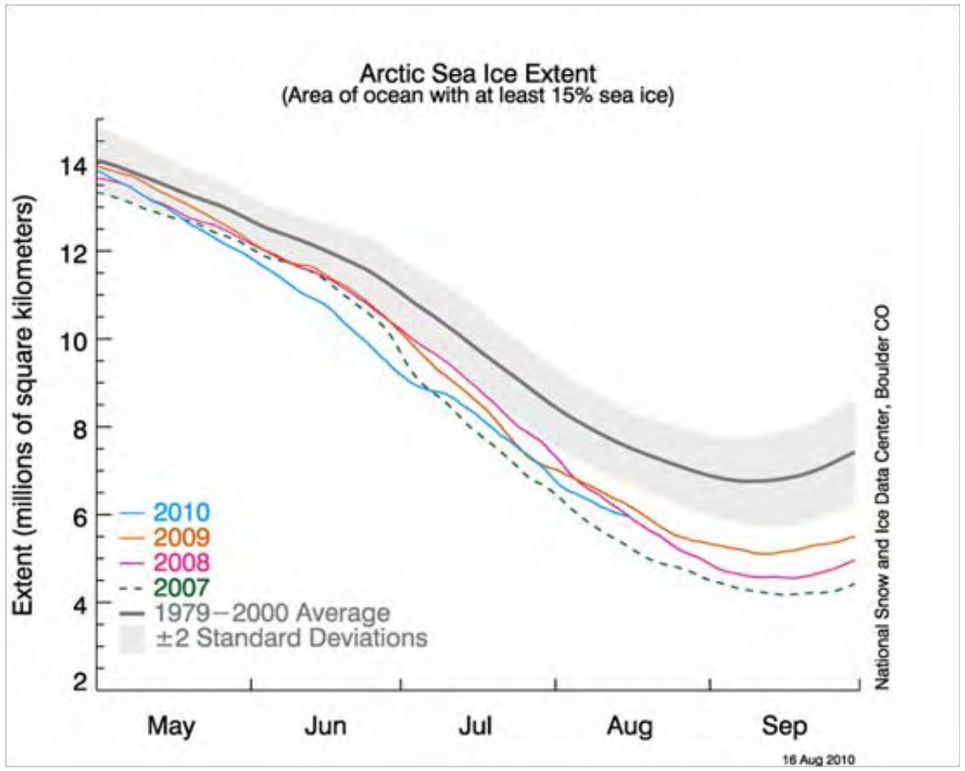
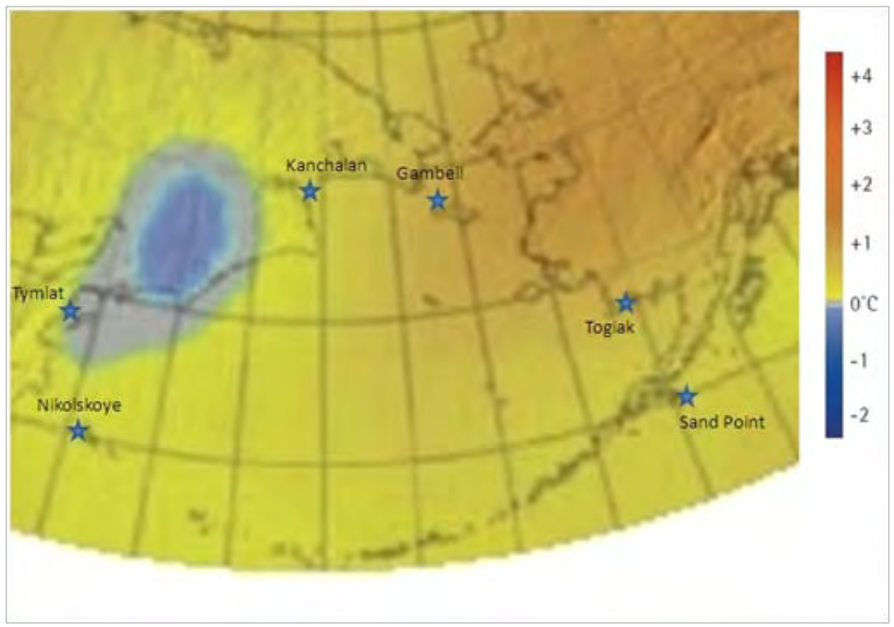


Figure 8. Observed surface air temperature changes: 1954-2003 (Annual degrees celcius) with BSSN communities, from ACIA 2004, Clifford Grabhorn



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- Faroese Museum of Natural History, Tórshavn, Faroe Islands (Kingdom of Denmark)
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- The Ministry of Domestic Affairs, Nature and Environment, Greenland
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- United States Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska

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- Aleut International Association (AIA)
- Arctic Athabaskan Council (AAC)
- Gwich'in Council International (GCI)
- Inuit Circumpolar Conference - (ICC) Greenland, Alaska and Canada
- Russian Indigenous Peoples of the North (RAIPON)
- Saami Council

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The **Bering Sea Sub-Network: International Community-Based Environmental Observation Alliance for the Arctic Observing Network**, known as BSSN, is a 2008–09 International Polar Year project implemented by the Aleut International Association in collaboration with the University of Alaska, United Nations Environment Programme/GRID-Arendal and Alaska Native Science Commission under the auspices of the Conservation of Arctic Flora and Fauna working group of the Arctic Council. BSSN is funded by the United States National Science Foundation under the Cooperative Agreement ARC – 0634079. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF)

Bering Sea Sub-Network
Pilot Phase
Final Report

Victoria Gofman & Maryann Smith

1. Executive Summary

1.1 Background

The Bering Sea Sub-Network: International Community-Based Environmental Observation Alliance for the Arctic Observing Network, known as BSSN, is a 2008-09 International Polar Year project implemented by the Aleut International Association in collaboration with the University of Alaska, United Nations Environment Programme – Global Resource Databank Arendal and the Alaska Native Science Commission under the auspices of the Conservation of Arctic Flora and Fauna working group of the Arctic Council . BSSN is funded by the United States National Science Foundation under the Cooperative Agreement ARC – 0634079 and 0856774. The project began as a pilot in 2007 (Phase I) and received an award for a five-year continuation in 2009 (Phase II).

This report provides an overview of the BSSN concept, its history, and the pilot project results. It informs the broader community of scientists, governments, and Arctic residents about the project's findings and shares the lessons learned.

1.2 Project History

The first concept of a community-based monitoring network developed by the Aleut International Association in 2003-2004 was in response to the findings of the Arctic Climate Impact Assessment (ACIA), 2004, an Arctic Council report highlighting environmental changes occurring as a result of climate change. A key ACIA recommendation for future Arctic research was the improvement of long-term monitoring, extending it to year-round data collection and expanding it spatially (Hassol 2004, p. 122).

ACIA was also one of the first significant scientific reports that included observations of local and indigenous peoples, as case studies, to support and enhance scientific findings and to understand the impacts of climate change on a more personal level (Huntington and Fox 2005). A striking convergence of community-based observations with scientific data helped validate local observations and elevated them from "anecdotal evidence", a term commonly applied to identify such information in scientific research, to indispensable building blocks of a holistic understanding of the Arctic environment (Gofman 2009, 2010). However, case studies can only convey personal perspectives. They may provide the basis for discussion and scientific inquiry, but they do not provide aggregate statistics or general trends (Huntington and Fox 2005). The BSSN pilot was designed to test methods that could produce aggregated statistics and general trends.

This work led to an increased interest in local knowledge and community-based monitoring that was amplified even more during the International Polar Year 2007-2008. The Aleut International Association recognized this tremendous opportunity and developed a concept that evolved into the Bering Sea Sub-Network: International Community-Based Environmental Observation Alliance, which IPY 2007-2008 Joint Committee endorsed, along with several other innovative projects in this field, and the U.S. National Science Foundations funded in 2007. The Arctic Council also welcomed BSSN, and it was included in the project portfolio of the Conservation of Flora and Fauna working group.

Coastal villages representing six indigenous cultures: three in the Russian Federation (Kanchalan — Chukchi, Tymlat — Koryak, and Nikolskoye – Western Aleut/Unangas) and three in the United States (Gambell – St. Laurence Island Yupik, Togiak — Central Yup'ik, and Sand Point— Eastern Aleut/Unangan) formed the network.

All villages, except Tymlat, have seen a substantial interest from the research community in the recent years (See Appendix 2,), which suggests that scientists have a growing concern over the changes occuring in the environment thus posing risks to areas of cultural significance and rich biodiversity (Grebmeier, 2006). Improving the understanding of the processes occurring in this region is crucial to sustainable resource stewardship and the wellbeing of local communities (ARCUS 2008).

1.3 BSSN Purpose

The overall goal of the Bering Sea Sub Network (BSSN) is to advance knowledge of the environmental changes that are of significance to understanding pan-arctic processes thereby enabling scientists, arctic communities and governments to predict, plan and respond to these changes. This may also help to enhance community resilience under conditions of rapid environmental and social change (Alessa et al 2007).

This project created a structured framework that provides the means for the systematic collection of information about the environmental and socioeconomic conditions based on the perceptions of local residents. The network also provides for the efficient management of data gathered from community-based observations.

The pilot phase demonstrated that such an international network of indigenous communities can be organized and can produce usable data sets based on local observations.

1.4 Brief outline of project activities

While the grant period began in 2007, the initial project activities took place in 2005 and 2006. Two international workshops were organized in Anchorage for representatives of several Bering Sea communities with the purpose of identifying potential project goals (2005), the scope of work and participating communities (2006). This pre-grant time work was particularly valuable because it provided a venue for communities to express their opinions on what should be monitored and where. In addition, early community involvement in the project led to stronger connections and mutual respect between researchers and the residents of the villages.

The first project year (June 2007 – May 2008) involved extensive travel to the participating villages and included meetings with individuals and communities involved in BSSN, efforts to establish and formalize international partnerships, and the development of the survey instrument that was designed utilizing sociological methods, drawing in particular on cognitive interviewing techniques. The BSSN team developed a uniform protocol for interviewing residents in all participating villages about their observations of environmental conditions and marine resources vital for subsistence. Local residents were hired to conduct interviews and were trained in the interviewing methods and techniques.

In the second project year (June 2008 – August 2009), the expanded BSSN team, which grew to nearly 20 researchers, coordinators, and assistants, was busy interviewing hunters and fishermen and processing the collected data. Despite extensive preparation activities, not all nuances of working in remote villages could have been predicted, and a fair amount of troubleshooting was required. In some villages, additional training of newly hired research assistants was arranged, in others – project management needed adjustments. These issues were successfully resolved thanks to extensive support from BSSN villages' leaders and local partners.

1.5 Project Data

Over 600 interviews were conducted in six villages. Approximately 300 hunters and fishermen participated. This information was organized in two data sets using broadly available software: NVivo 8 for the qualitative data and SPSS 16 for the quantitative data. Both data bases are stored at the BSSN Secretariat co-located with the Aleut International Association office in Anchorage and are available at www.bssn.net for other users.

The BSSN research team and community representatives discussed data ownership issues at length. While it is possible to have a distributed database with individual community data stored at the villages, it was recognized that most of them do not have capacities to maintain such data bases. Until such capacities are developed, the BSSN communities agreed to keep all project data at a centralized place, the BSSN Secretariat, while preserving appropriate data ownership rights.

These pilot data are not statistically representative of the participating communities and should be approached with caution when attempting to draw conclusions or to interpret meaning, and while this may be considered a limitation of their use, these findings do point to some compelling trends that need to be investigated further in Phase II of this project and other research.

The BSSN research team recognizes the challenges of assuring reliability and credibility of the data based solely on human observations that are inherently subjective and biased (Shiffman et al 1997). This should not preclude from using the wealth of collective memory of humans in the Arctic that holds information about past environmental conditions that extends beyond the knowledge acquired by science in recent decades. By using a combination of survey methods, such as cognitive interviewing techniques, standard semi-structured questionaries, and increasing sample sizes, it is possible to successfully extrapolate objective information from what people can remember and recall. Local resi-

1. The Arctic Council (AC) is an international, intergovernmental circumpolar organization with eight member states (Canada, Denmark, Finland, Iceland, Norway, Russian Federation, Sweden, and the United States) and six Indigenous Peoples' organizations, which are known as Permanent Participants (The Aleut International Association (AIA), The Athabaskan Arctic Council (AAC), the Gwich'in Council International (GCI), the Inuit Circumpolar Council (ICC),the Russian Association of Indigenous Peoples of the North (RAIPON), and the Saami Council (SC). The Arctic Council provides a mechanism to address common concerns and challenges faced by Arctic residents through scientific research, program implementation, and the development of policy recommendations.

dents observing their environment on a regular basis are capable of detecting events indicating that the system is operating unusually (Dasgupta and Attoch-Okine 1997).

1.6 Summary of selected survey results

Although the analyzed sample size is not sufficient to be called representative, it is larger than many similar social science studies in which only a few residents have been interviewed. The research in BSSN pilot yielded compelling findings. The BSSN community in this survey is represented by 246 people, the gender of participants is balanced with over 65 percent male and almost 35 percent female. The majority has lived in the area for more than 30 years (over 70%). Over 42 percent have also harvested in the same area for more than 30 years. Thus the majority of participants have accumulated several decades of observations of the local environment and harvests.

The survey section about the environment asks questions about observations of meteorological, geophysical, and oceanographic conditions. In respect to important subsistence species, the survey captures information on a number of them, such as bowhead whale (Balaena mysticeti), walrus (Odobenus rosmarus), seal (families Phocidae & Otariidae), emperor geese (Chen canagica), silver salmon (Oncorhynchus Kisutch), red salmon (Oncorhynchus nerka), pink salmon (Oncorhynchus gorbuscha), arctic char (Salvelinus alpinus), pacific cod (Gadus macrocephalus), halibut (Hippoglossus pleuronectidae), plaice (Pleuronectes quadrituberculatus), Atka mackerel, (Pleurogrammus monopterygius), smelt (Thaleichthys pacificus), broad whitefish (Coregonus nasus), arctic grayling (Thymallus arcticus), trout (family Salmoninae), and pike (Esox Lucius).

These species are essential for subsistence in many Bering Sea villages. Some are indicators of the status and trends of ecosystem change , *e.g.*, harbor seal, fur seal, and bearded seal, (Hare and Mantua 2000; Livingstone et al 2005). Many of them, such as pink salmon, are also important commercial species. An increasing competition for such species, coupled with environmental changes, may have a negative impact on communities that depend on the marine biological resources for their well being and survival. The study participants showed a serious concern for the health of the sea and the fish, and they shared their observations in considerable detail. One person concludes, “The sea is sick, and the fish are sick, too”, stressing the interrelation between habitat and species.

The survey instrument consists of two questionnaires that contain close-ended, open-ended and multiple-choice questions and that allows ample room for additional comments. These comments add specific context for statistics that may improve understanding and visualization of the gathered data by researchers and potential user. The voices of local hunters and fishermen add a human dimension to the results of the survey.

1.7 Observed Trends

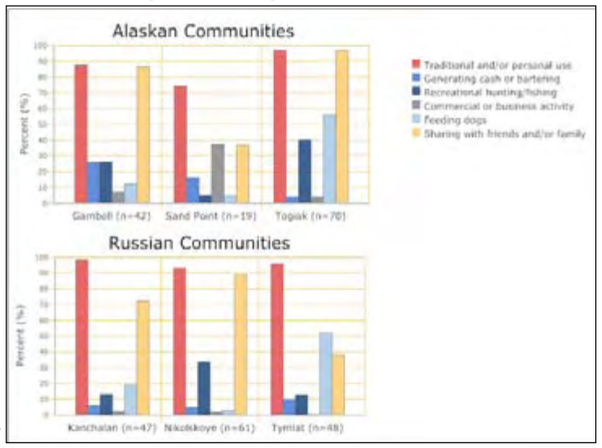
Socio-economic importance of fishing and hunting for the wellbeing of residents

The pattern of harvest use is very uniform in all communities (See Figure 1.) Traditional and personal uses, including sharing, are the primary use in all communities. This pattern reconfirms the fact that coastal communities depend on the Bering Sea’s bio resources for providing food to their families. The results clearly point to the importance of biological resources for coastal villages as a matter of food security.

Changes observed in environmental conditions

The survey participants shared their observations about the status and changes in environmental, seasonal, and meteorological conditions (See Figure 2), the so called

Figure 1. Socio-economic importance of fishing and hunting for wellbeing of residents.

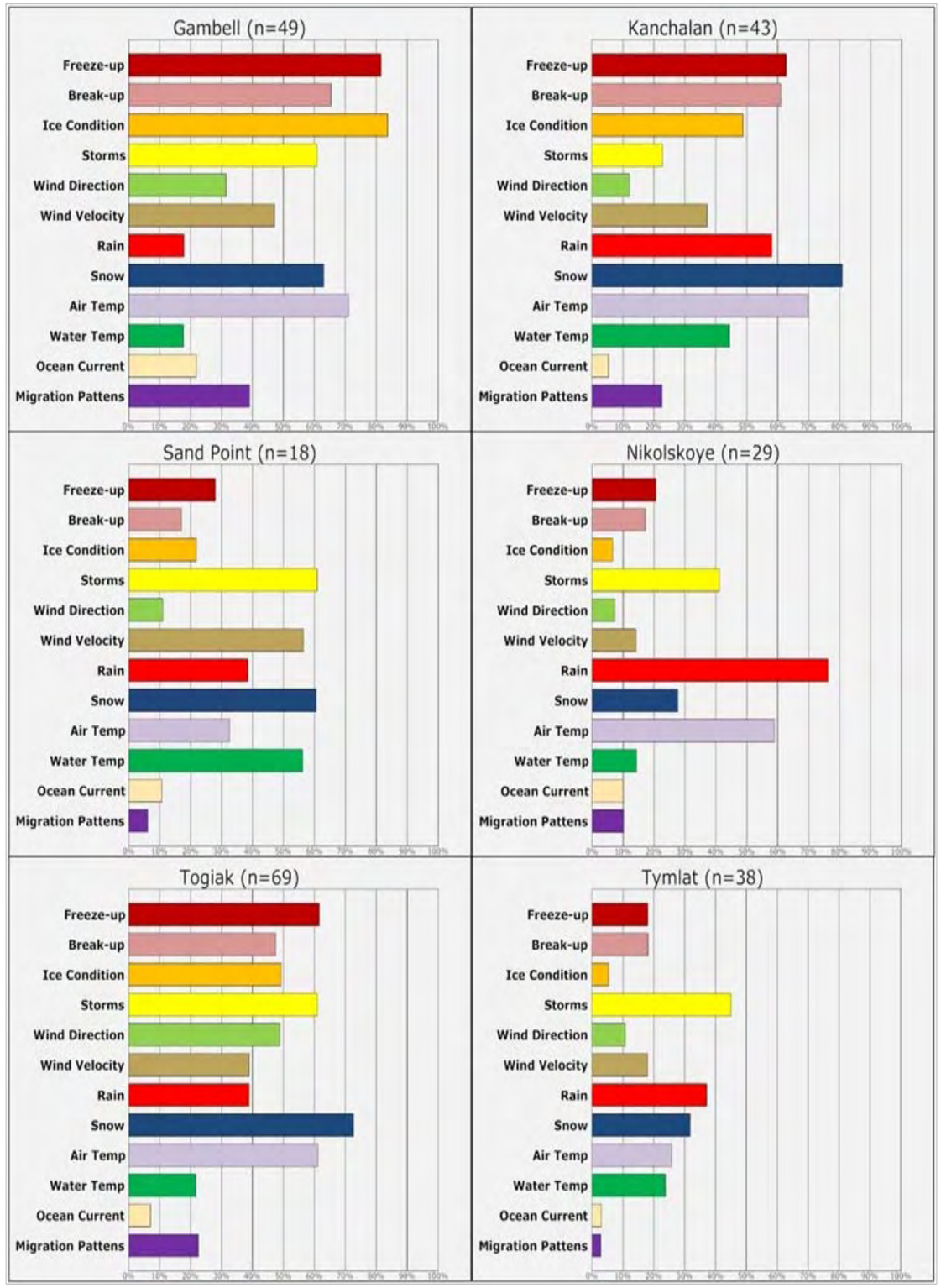


“markers of climate change”. Based on the limited pilot data, no clear trends showing consistent change of any parameter could be identified, but there appeared to be

a trend towards increasing variability in response. There was also a clear difference in the frequency of changes observed in the sea-ice dependent communities, such as Gambell, in comparison with non-ice dependent communities, such as Tymlat. The perceptions of local residents reflected in their comments provided during the interview support this statement. A Gambell resident, for example, points out that “There is less ice each year and it is getting thinner. It comes very late, and goes really early in the spring. Weather conditions have changed too. We used to have northerly winds. Now, in that season, we get more southerly wind. The wind is stronger and changes all the time. I’ve never seen this before in my life.”

Conditions of harvested species

Figure 2. Observed changes in environmental conditions.



A summary of the significant observations with respect to animal conditions and harvests shows that the Russian communities report high incidences of disease in fish (See Figure 3). The most significant observations point to a high rate of disease in red salmon and pacific cod in Nikolskoye, whitefish and chum salmon in Kanchalan, and pink salmon in Tymlat.

The reported conditions are evidence of fish hit by sludge ice, and common occurrences of sores, ulcers, spots, worm infestations and unusually small fish with abnormal reproductive organs.

The Alaskan participating communities highlight the changes in abundance of harvested species and sightings of rare or new species. In Gambell, hunters report observing the decline of seal and walrus harvests, as well as marine mammals being farther out. The appearance of white king salmon is also noted. In Sand Point, fishermen see more whales and even the mating of humpback whales. Togiak residents report fewer trout, smelt and ptarmigan.

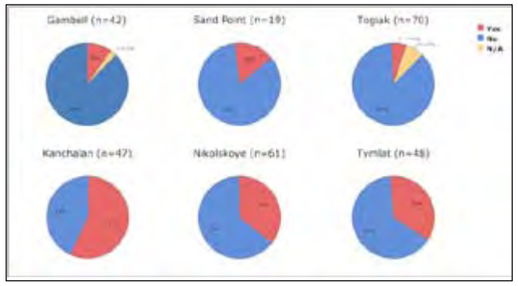


Figure 3. Percentage of respondents stating the previous harvest contained any fish or animal with visible disease

1.8 Conclusion

The Bering Sea Sub Network is intended as a mechanism for gathering data. While documenting status and change is a crucial task in its own right, it is necessary that potential users apply the data in further research and resource management. BSSN is community-based, and it strives to serve the member-communities by providing them with additional tools to undertake much needed planning for adaptation to life in a changing social and natural environment.

As a network, BSSN encourages cultural connections between groups of people who have diverse cultures, but share similar concerns. It builds a sense of collective stewardship of the common region. “It does not matter if we’re Russian or American; we are part of a family that lives off the same resource, and we simply have to cooperate,” said Svetlana Petrosyan, BSSN Community Research Assistant (CRA) from Tymlat.

It would be challenging to find better words to express what BSSN means to the communities than what BSSN Community Research Assistants say about the project. Below are key points that BSSN CRAs made at the workshop concluding the pilot phase of BSSN in August of 2009 in Anchorage, Alaska, U.S.

Capturing traditional knowledge from Elders

Esther Fayer, CRA and BSSN Steering Committee Member from Togiak, talks about the elder whose photo was taken during the interview, “We just lost him this past spring. He went out hunting with his son, and his son’s snow machine made it across the river but the old man did not and went through the ice, he has not been found to this day. He was an elder, and he understood the ice, but things are changing, and he was lost. That was hard for me, but that is our everyday life.” Capturing traditional knowledge during the BSSN interview with that Elder now takes on a momentous meaning.

Ester Fayer & Olia Sutton Interview Togiak Elder George Smith Sr

Her colleague in Togiak, Olia Sutton, continues, “Our elders were hesitant at first, they wondered why we were doing this [interviewing] and they held back. It is hard for elders to open up, but when they understood what we were trying to do and that we wanted to know about changes in the climate and environment, they would get interested, sometimes the interviews would go on for more than an hour. It is a two-way street for me: I learn from them and they learn from me. My grandma taught me, and the interviewee teaches me something new. “ Svetlana Petrosyan, CRA, Tymlat, was surprised to learn so much during her interviews: “I find it amazing that I’ve learned some things I never knew before, like how to fish in the dark, you cannot see the line, but you can feel it!”

Using indigenous languages

Most of the interviews in Togiak and many in Gambell, Alaska, U.S., were conducted in their native tongues, Central Yup’ik and St. Laurence Island Yupik. This presents both challenges and opportunities. Antonia Penayah, CRA from Gambell, draws attention to the importance of accurate translation. She says, “Another factor we have to deal with is translations, in my language it is easy to get lost, some words have a dual meaning, and some do not have any English meaning.” Olia Sutton who is a strong supporter of using indigenous languages, gives another excellent reason why it is essential: “I like to interview in my Yup’ik language because then it comes from my heart.”

Identifying problems that require rapid response

Olga Gerasimova, Ph.D., a Russian biologist who led the study in Chukotka, notes that “Many people are noticing that the ice is breaking earlier and developing later, and people have noticed lower levels in the rivers and lakes along with more weeds or water plants in the river. Also, the water is more turbid and some fishermen are saying that the main channel is changing. All of that is leading to a change in the fish species observed: there are more pike and sometimes the chum salmon do not come at all. The most troubling development is that a lot of fish that go up the rivers to feed in the lakes cannot leave the lakes because the water level is too low. When the winter comes they die. Also there have been a lot if diseased fish observed, some people say this is because of the mining which is taking place up the river.” As a biologist, Olga would like to see local government taking immediate actions, such as taking water samples, to address these problems: “In a way, it was really hard to interview people because I wanted to take action right away and try to find solutions to these problems and even thought about taking samples of water and fish.”

Bringing people from different communities together to learn from each other

Iver Campbell, CRA and BSSN Steering Committee Member from Gambell, is especially grateful about the opportunities that the project provides for learning about what other communities observe: “I think this project is very important because it allows us to be in touch with other partner communities, even the ones in Russia.” Arlene Gundersen, BSSN Steering Committee Member from Sand Point, says: “For us, observations begin at home. People who go out hunting and fishing have the knowledge to understand the conditions at any given time, and so we learn about changes in the environment from the people who are out in it. I’ve learned like this from my father, like about passes where boats used to be able to go through, but cannot any more. Getting people together to talk about these things is an excellent way to record the knowledge of the community and finding about things that are happening can lead to action.

Raising awareness about the value of traditional ways of life

Revitalization of traditional ways of life is crucial for improving stewardship of the environment. Svetlana Petrosyan emphasizes this idea in her comments: “This project is very interesting, but also very difficult because you cannot expect people to provide answers immediately. You have to be patient and establish trust. Now people in the village like the project, and they want to know how to deal with our government to help preserve our traditional ways of life. Most respondents have similar values to share: live in agreement with your environment; do not take more than you need from the land. Despite the difficult economy in Russia, especially in our region, people still want to live in the traditional ways.”

Documenting the importance of the marine biological resources for food security of the coastal communities

Having access to sufficient subsistence resources is vital for all communities, but some depend on them to a greater degree than others. Iver Campbell reminds that “Jobs are very scarce in Gambell, and so we mostly hunt for marine mammals, with a little bit of fishing. When most city people go grocery shopping they get a week’s worth of food, but when we are subsistence hunting we’re trying to get food for a whole year.”

Witnessing change: providing valuable observations about the environment

The need to document observations about the environment was one of the drivers for the development of BSSN. The gathered information shows a detailed account of what people are witnessing. Not all communities appear to be experiencing the same rate of change. Gambell is one place where rapid change is occurring. Iver Campbell describes what people observe there: “Now we’ve been noticing things like the winds changing, we used to have consistent winds from the North or Northeast, but now we get South winds all the time. In Gambell, even when our elders are not harvesters anymore they still play in a big role in hunting. They observe the weather and ice, so if there is a storm coming or the ice is changing they can call the hunters on the radio and tell them. We also have travelers who talk about the changes they see around the island. For instance, people have told me about new plants they’ve observed for the first time recently. There are so many things on our island that we can use to observe changes, like the way the birds fly to a different place before the weather changes. We are witnessing global changes now. Maybe we cannot stop it, but maybe we can slow it down, and interviewing people helps us to learn about these

changes in the environment."

Antonia Penayah is also concerned about the changes: "Talking to our hunters and elders has made me realize that we live on the edge every day and people want to talk about what they've seen so we're finding out lots of information about hunting and weather changes. I do not know if we can stop these changes that are happening in the environment, but maybe what we're doing can make a difference."

It is likely that climate change will result in both risk and opportunity for Arctic residents. Potential risks include a reduction in summer sea ice that might threaten several ice-dependent species, including seals and walrus, not to mention the humans that depend upon them. Opportunities include better access to marine resources, potential opening of the Arctic for year-round shipping, and shifts in populations of species that could present new economic opportunities. (ACIA, 2004, AMSA 2009). This new paradigm requires arctic communities to have the means to communicate their knowledge and concerns to scientists, policy makers, and the public. BSSN provides such an opportunity, and this may increase a community's ability to prepare and plan for the occurring and future changes, thus leading to better adaptability and resilience. BSSN is not a circumpolar project, but the sheer diversity of participants, the range of the collected data, and a multidisciplinary approach make this model replicable and potentially useful in other regions. While many other studies in the region used similar methods (See Appendix 2), the model designed for BSSN may present a better opportunity for creating a systematic observatory and generating new knowledge. This assumption will have to be proven in the upcoming project years.

In the next five years, BSSN will be expanded to include other communities. The established network may become a springboard for many other research activities in the region and may provide a framework for other regional networks. Developing collaborative relationships with other initiatives will be critical to the future sustainability of BSSN. By creating an organized community-based monitoring network, BSSN will ultimately serve as a valuable partner in the international effort to expand integrated observations in the Arctic.

Gathering dried fish near Tymlat, Russian Federation

2. Introduction

2.1 Background

Indigenous peoples around the Bering Sea region have come together for a project that monitors environmental changes in the region. The Bering Sea Sub-Network (BSSN) provides a mechanism for remote indigenous villages to communicate their observations from their own perspective – a viewpoint that is based on their knowledge and a keen understanding of the local environment – in order to improve management of Bering Sea resources. In addition, BSSN improves our understanding of the social, cultural, and economic impacts of environmental changes on these communities. The project assesses large-scale environmental change and its impact.

The Bering Sea is one of the most productive seas in the world and is of economic importance to both the United States and Russia, but this vast marine ecosystem is experiencing widespread environmental changes – changes that alarm scientists and coastal residents alike. Declines in sea ice extent, the northward movement of southern species, alterations in the distribution and abundance of fish and marine mammals, modified weather patterns, and a myriad of changes to Arctic ecosystems present serious challenges for indigenous peoples.

The health, economic well-being, and ways of life of the indigenous and non-indigenous peoples around the Bering Sea are all inextricably linked to the sea itself and to the natural resources it provides. The socioeconomic development of coastal villages around the Bering Sea depends on maintaining ecologically sustainable conditions in the region.

In 2003, the Aleut International Association (AIA) began exploring the possibility of a network for community-based monitoring in the Arctic. The BSSN concept emerged as a response to the findings of the Arctic Climate Impacts Assessment (ACIA), a report released by the Arctic Council in 2004, which demonstrated a clear need for large-scale networks to record local observations of environmental change. ACIA was also one of the first significant scientific reports that included observations of local and indigenous peoples, as case studies, to support and enhance scientific findings and to give a human face to some of the impacts of climate change (Huntington and Fox 2005). A striking convergence of community-based observations with scientific data helped validate local observations and elevated them from "anecdotal evidence", a term commonly applied to identifying such information in scientific research, to indispensable building blocks of a holistic understanding of the Arctic environment (Gofman 2009, 2010). However, case studies can only convey personal perspectives. They may provide the basis for discussion and scientific inquiry, but they do not provide aggregate statistics or general trends (Huntington and Fox 2005). The BSSN pilot was designed to test methods that could produce aggregate statistics and general trends.

The recognition of the validity of local observations that was coupled with the need for on-going monitoring created an excellent opportunity for a surge in interest in various forms of community-based monitoring. The opportunity was amplified by the International Polar Year (IPY) 2007-2008. The Aleut International Association was among the first applicants from the social and human studies field that responded to the call for IPY 2007-2008 projects in winter 2004 and had submitted its concept for an IPY 2007-2008 activity under the name "International Network of Arctic Indigenous Community-Based Environmental Monitoring & Information Stations" to the ICSU Planning Group. That concept was included in the 'Initial Outline Science Plan' for IPY 2007-2008 in April 2004 and was received with keen interest. Over the next two years, numerous discussions at workshops, meetings with stakeholders, and consultations with scientists helped refine the concept. That work led to the development of the full proposal, entitled the Bering Sea Sub-Network: International Community-Based Environmental Observation Alliance (BSSN, IPY #247) that became an endorsed IPY 2007-2008 project and was subsequently funded by the U.S. National Science Foundation (NSF) under the Arctic Observing Network (AON) funding initiative.

BSSN became one of the projects in a small group of innovative IPY activities involving indigenous and local residents in Arctic research. It set sail in uncharted waters of community based monitoring along such projects as EALAT (IPY project # 399), MODIL-NAO (IPY project # 47), SIKU (IPY project # 47), and others (See Appendix 2). These projects are science initiatives, and as such, are required to follow clear milestones, guidelines, and established criteria for assessment. The challenge is that none of these are clearly defined for the field commonly called "community-base monitoring". All projects contribute to local capacity building, resident training, and community empowerment in addressing adaptation to environmental and subsequent socio-economic changes, but the scientific contribution of such projects is more elusive and will require time to evolve.

BSSN has emerged as an observing network that connects people bound by a common geographic area who share similar traditions, values, and ideals. It is devised to gather and record observations regarding Bering Sea marine resources and environmental changes in and around the Bering Sea. It began from six coastal villages representing six indigenous cultures: three in the Russian Federation (Kanchalan — Chukchi, Tymlat — Koryak, and Nikolskoye – Western Aleut/Unangas) and three in the United Stated (Gambell – St. Laurence Island Yupik, Togiak — Central Yup'ik, and Sand Point—

Figure 4. Pilot phase communities

Eastern Aleut/Unangan). Several other Alaskan villages will be able to join the network during Phase II that runs from 2009 to 2014.

2.2 BSSN member communities

BSSN communities span across the Bering Sea and extend into the upper reaches of the North Pacific.

Gambell

The village of Gambell is located on the northwest cape of Saint Lawrence Island, at the base of Sevuokuk Mountain. At 58 km (36 miles) from the Chukchi Peninsula in the Russian Far East, this island is nearer to Russia than it is to mainland Alaska. Saint Lawrence Island is about 145 km (90 miles) long and 13–36 km (8–22 miles) wide, and is thought to be a remnant of the Bering Land Bridge.

Village facts:
- The population is about 649 (2002 Census), more than 95% Yup'ik (621)
- Residents speak St. Lawrence Island Yupik
- The self-governing authority is the Native Village of Gambell
- Access is by plane and by boat
- The traditional harvest includes bowhead and gray whale, seals, walrus, geese and other birds, and a small amount of fish.
- St. Lawrence Island has no trees, only the woody Arctic Willow which grow no taller than 30 cm (1 foot) high.
- Sivuqaq is the Yupik name for St. Lawrence Island and for Gambell

Kanchalan

Kanchalan is located 70 kilometers (45 miles) northwest of the regional capital, Anadyr, in Russia's Far East on the Kanchalan River. The village is in the Chukotsk Autonomous Region of the Russian Federation.

Village facts:
- The population is about 635 (2004, source: regional government), more than 90% Chukchi
- The Russian name "Chukchi", which is also the language, comes from the Chukchi word "chauchu" which means, "rich in reindeer"
- The community has a locally elected administrator and is part of the Chukotka Autonomous Okrug
- There are three travel options, helicopter, boat or by caterpillar all-terrain vehicle
- Traditional harvest includes reindeer, fish, birds, marine mammals, berries and mushrooms
- Chukotka's landscape is primarily tundra with some low mountains

Nikolskoye

The village of Nikolskoye is located in the Kamchatsky Region of the Russian Federation on Bering Island. Bering Island, at 90 kilometers (56 miles) long and 24 kilometers (15 miles) wide, is the largest of the Commander Islands and is located to the east of the Kamchatka Peninsula in the Bering Sea.

Village facts:
- The population is about 667 (2008, source: regional government), 300 of them Aleut
- The native language is Western Aleut/Unangas but only a few speakers are left
- Nikolskoye village is the administrative center and the district's only settlement
- Access is by weekly flights between Petropavlovsk-Kamchatsky and Nikolskoye and by boat
- Traditional harvest includes fish, salmon caviar, fur seal, birds and eggs, marine invertebrates, seaweed, and mushrooms
- Aleuts were relocated to the Commander Islands from Atka and Attu in Alaska by the Russian-American Company in the early 19th century to hunt fur seals.
- Nikolskoye has a kindergarten, a school, a district hospital, and a cultural center

Sand Point

Sand Point is located on the northwest coast of Popof Island. Popof Island is in the Shumagin Island group located south of the Alaska Peninsula and is near the entrance to the Bering Sea. The island is 16 km (10 miles) long, and is 8 km (5 miles) wide.
Village facts:
- The population is around 952 (2002 Census), about half of which are Aleut (403).
- The native language is Eastern Aleut/Unangan but there are no fluent speakers left in Sand Point
- Sand Point has an elected city government and is home to 3 tribal organizations, Pauloff Harbor Tribe, Qagan Tayagungin Tribe, and Unga Tribe.
- Access is by air and by boat
- Traditional harvest includes fish, marine mammals, terrestrial mammals, marine invertebrates, birds and eggs, edible plants.
- Qagun Tayagungin is the Aleut name for Sand Point.
- Sand Point has one of the largest commercial fishing fleets in the Aleutians.

Togiak

Togiak is located 67 miles west of Dillingham at the head of Togiak Bay, and is in the Togiak National Wildlife Refuge- gateway to Walrus Island Game Sanctuary.
Village facts:
- The population is around 809 (2002 Census), more than 86% Central Yup'ik (698).
- The predominant language spoken is Central Yup'ik
- Togiak has an elected city government as well as a Tribal Traditional Council
- Access is primarily by air.
- Traditional harvest includes salmon, herring, herring roe, seal, sea lion, walrus and whale.
- 48 marine and terrestrial mammal species and more than 150,000 caribou from two herds inhabit the Togiak Refuge.

Tymlat

Tymlat is located in the Russian Far East on the Tymlat River that flows into the Bering Sea. The village is in the Koryak Autonomous Okrug in the Karaginskiy District of the Kamchatka Region of the Russian Federation.
Village facts:
- Tymlat's population is around 874 (2008, source: regional government), about 70% Koryak
- The native language is Koryak with very few speakers left
- The local government consists of an elected village administrator who oversees small staff.
- Access is by air or boat; in the winter the village can also be accessed by dogsled.
- Traditional harvest includes salmon, navaga - a member of the cod family, herring, caviar, reindeer, marine mammals
- Kamchatka's climate ranges from temperate to subarctic

Fishing on Bering Island, Russian Federartion

2.3 Research Team

The BSSN research team is comprised of more than 20 people, representing academia, non-profit organizations, and local communities. This collaboration made BSSN a reality.

Principals

Victoria Gofman
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Ms. Gofman is the Executive Director of the Aleut International Association (AIA). In addition to her administrative responsibilities, she leads the development of research projects and AIA's representation in the Arctic Council, where AIA is a permanent participant. Over the years, she has contributed to the major Arctic Council reports, such as the Arctic Climate Impact Assessment (2004), the Arctic Human Development Report (2004), and the Arctic Marine Shipping Assessment (2009). She is actively involved in the conceptual development of the community-based monitoring in the Arctic under the auspices of the Arctic Council working groups. Her work in the Conservation of Arctic Flora and Fauna working group lead to the development of the Community-Based Monitoring Hand Book: Lessons from the Arctic and beyond, which is currently in print. She was a strong supporter of the inclusion of human dimensions and especially indigenous peoples in the International Polar Year (2007-08). She holds a Master's Degree in Education and Linguistics from the Pedagogical University of Khabarovsk, Russia.

Patricia Cochran
Alaska Native Science Commission, Anchorage, U.S. (Co-Principle Investigator)
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Ms.Cochran was born and raised in traditional Inupiat ways in Nome, Alaska. She served as Chair of the Inuit Circumpolar Council, and she also served as Chair of the Indigenous Peoples' Secretariat to the Arctic Council. Ms. Cochran is the Executive Director of the Alaska Native Science Commission, a non-profit organization created to bring together research and science in partnership with Alaska Native communities.
Ms. Cochran has served earlier as Principal Investigator or Co-Principal Investigator on numerous projects throughout the Arctic, including the Survey of Living Conditions in the Arctic, the Traditional Knowledge and Contaminants Project, the Traditional Lifeways and Subsistence Project, and the Indigenous Knowledge Systems Research Colloquium. She has also served in numerous other positions in various boards and institutions around the Arctic.

Lilian Na'ia Alessa
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Dr. Alessa is a Professor of Biological Sciences at the University of Alaska Anchorage. She heads the Resilience and Adaptive Management Group at UAA, and has served on the board of the Arctic Research Consortium of the United States. She currently conducts extensive research on human adaptation to climate change, funded by the National Science Foundation, including International Polar Year projects such as the Indigenous Arctic Observing Network. Canadian-born and raised, Alessa holds a Ph.D. in cell biology from the University of British Columbia and has extensive training in cognitive psychology. Her studies of cellular organization greatly inform her current approaches to social ecological complexity. Her expertise is in the conceptual development and application of complex systems thinking, and development of research strategies.

Joan Eamer
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Ms. Joan Eamer, editor of the Global Outlook for Ice and Snow, was the manager of the Polar Programme at UNEP/GRID-Arendal in Norway. She has an MSc degree in zoology from the University of British Columbia, Canada. Prior to joining UNEP/GRID-Arendal in 2005 she worked as a scientist and a program manager in northern Canada for industry and government. Her experience includes work on Arctic climate change science, environmental impact assessment, natural resource management, state of the environment reporting, and development of ecological and community-based monitoring and research networks in Canada's Arctic.

Senior Research Staff

Andrew (Anaru) Kliskey
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Dr. Andrew (Anaru) Kliskey comes from Aotearoa / New Zealand. He is trained as a land surveyor (BSurv), resource planner (MRRP), and gained a PhD degree in geography that integrated geographic information systems, behavioral geography, and resource management. He was a postdoctoral researcher at the University of British Columbia, BC and at the Arctic Institute of North America's Kluane Lake Field Station in Yukon Territory, Canada. He is currently Associate Professor in Biology and Geography & Environmental Studies and co-leader of the Resilience and Adaptive Management (RAM) Group at the University of Alaska Anchorage. Dr. Kliskey has spent the last five years working with people in Inupiat communities in Northwestern Alaska to understand their perception of environmental change. Dr. Kliskey's expertise is in the application and integration of questionnaire surveys, in-person interviews, GIS, and agent based modeling.

Maryann Smith
BSSN Survey Manager
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Ms. Smith was born and raised in Anchorage, Alaska and holds a Master's Degree in Environmental Science from Alaska Pacific University. In the past she has done qualitative research on perceptions of wilderness, and mapping of recreational use and sensitive marine wildlife overlap.

Uliana Fleener
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Ms. Fleener was born and raised in Russia. She holds a Bachelor's degree in Linguistics and International Communication from Chelyabinsk Institute of Economics and Law. In the past she worked closely with Language Interpreter Center, Alaska Immigration Justice Project as an interpreter and translator.

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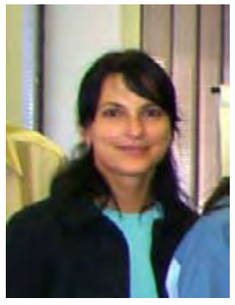

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2.4. Project milestones

The table below summarizes the main project tasks and their progress