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Nunavut General Monitoring Plan
Nunavunmi Tamainni Takuurivangnikkut Parnaiyautaanni
Plan de surveillance générale du Nunavut

NGMP Monitoring Blueprint Compendium

2013

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INTRODUCTION

The *2013 Nunavut General Monitoring Plan (NGMP) Monitoring Blueprint Compendium* serves to provide insight into the current NGMP knowledge and information base, as well as guide further data collection, analysis and reporting activities among NGMP partners. To support coordinated and meaningful investments in Nunavut general monitoring, partners planning on submitting a monitoring project proposal to NGMP are required to refer to this compendium in addition to the *2013 NGMP Guidelines for Proposal Submission*.

The NGMP blueprints for Valued Ecosystemic Components (VEC) and Valued Socio-economic Components (VSEC) in Nunavut are based on current *NGMP Summary of Knowledge (SoK)* reports. The blueprints provide current information on individual Valued Components (VC) and identify Nunavut general monitoring objectives, needs and requirements for each VC. Working together to address these knowledge gaps is central to enhancing our understanding of the changes we are observing to Nunavut's ecosystemic and socio-economic environment. Understanding these changes, in turn, will support enhanced management and decision-making processes in Nunavut.

The information contained in these blueprints and the SoK's is based on broad data collection and analysis activities of the NGMP. These activities are ongoing through NGMP; however, we encourage partners to share their observations in an effort to ensure the blueprints are accurate and up- to-date and reflect changes in current and relevant knowledge.

Please contact NGMP for further information about the blueprints or SoK's, or to identify specific information NGMP may wish to include in the SoK's. NGMP can be contacted by phone at: (867) 975-4654, fax at: (867) 975-4736, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca.

1.0 FRESHWATER

1.1 NGMP MONITORING BLUEPRINT (2013) – SURFACE WATER AND SEDIMENT QUALITY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to surface water and sediment quality, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Surface water and sediment encompasses the physical and chemical state of the rivers and lakes of Nunavut. Water quality varies geographically and seasonally. Sediment quality varies geographically and to a lesser degree seasonally. Water and sediment quality are affected by many factors, both natural and anthropogenic sources.

Lakes and rivers are major features of Northern Canada, and vital resources that provide many essential services including habitats for aquatic wildlife, drinking water supplies for northern residents, and water for economic activities.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Water quality monitoring in Nunavut can be expressed by two categories: Project monitoring (which encompasses local study areas), and general monitoring (which encompasses more broad monitoring initiatives). Specific entities that collect information include: the Fresh Water Quality Monitoring Program, the Kivalliq Region Monitoring Program, the Northern Water Research Studies Program, the Northern Contaminants Program, the Arctic Monitoring and Assessment Program, ArcticNet, and the Nunavut Drinking Water Quality Database.

STATE OF KNOWLEDGE

Northern regions in Canada are not exposed to the same pressures from human settlements and manufacturing and agricultural industries as southern Canada. These circumstances have a positive effect on water quality, which is generally good in the northern areas. The status of freshwater quality was deemed good for more than half (53%) of the northern sites sampled for the 'Canadian Environmental Sustainability Indicators' study, fair for 31%, excellent for 3%, and marginal for 14% of the studied sites.

TREND(S)

In general, studies have concluded that water quality has not degraded in Nunavut over the time periods studied. However, studies are not abundant and some water quality issues could be masked by the lack of data.

PRESSURES

Water quality in northern watersheds is at risk from the long-range transport of pollutants and from primary resource industries, such as mining and exploration, oil and gas development, and hydro development. These pressures are expected to increase in Nunavut.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Currently, the physical-chemical parameters monitored through the Freshwater Water Quality Program include: temperature, pH, alkalinity, major ions, nutrients, and metals. For individual development projects there is normally a need to expand the list of parameters to reflect local requirements and the nature of the development.

Standard sampling and analysis protocols are used by government and industry in Nunavut, which includes manually sampling water and sediments. The manual 'Northern Waters: A guide to designing and conducting water quality monitoring in Northern Canada' makes a series of recommendations for water quality sampling in northern regions.

THRESHOLDS

The applicable thresholds for water and sediment quality are numerous, and are guided in Canada by the Canadian Water Quality Guidelines for the Protection of Aquatic Life, the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, and the Guidelines for Canadian Drinking Water Quality. The federal Fisheries Act Metal Mining Effluent Regulations (MMER) specifies parameter limits for mine effluents.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of surface water and sediment quality:

- What are the trends in water and sediment quality?
- Which are the most frequent pollutants/factors affecting water quality?
- What is the sensitivity of rivers and lakes to changes in water quality? Which and where are the potentially most sensitive water bodies?
- Is the water quality of drinking supplies to Nunavut communities being adequately monitored?
- To what extent are Nunavummiut who are out on the land, utilizing local untreated water supplies, at risk of contaminants?
- How do development projects affect water quality on a local and regional scale?

NGMP has identified the following monitoring needs to enhance understanding of surface water and sediment quality:

- Installing automated water quality sensors in areas of current monitoring programs,
- Monitoring water level decline in specific lakes and rivers and assess changes in water availability,
- Monitoring to detect and monitor climate change impacts.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on surface water and sediment quality. To access this report or for further information on NGMP's current knowledge base regarding surface water and sediment quality, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

1.2 NGMP MONITORING BLUEPRINT (2013) – HYDROLOGY AND WATER QUANTITY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to hydrology and water quantity, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Hydrology and water quantity as a VEC refers to the distribution (spatial and temporal) and the amount or stock (flows and water levels) of surface water resources (rivers, streams and lakes) occurring in Nunavut. These ecosystem components are monitored through a network of hydrometric stations that collect stream-flow and water level data.

The spatial and temporal distribution and the amount of water available in freshwater ecosystems are key components that contribute and determine many essential services, including the support of aquatic wildlife, drinking water supplies for northern residents, and water for industrial activities.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Water monitoring in Nunavut is broken down into two categories: project monitoring (project specific within a local study area), and general monitoring (addresses information on the long-term state and health of freshwater ecosystems in the Nunavut territory). Two bodies that collect information on water in Nunavut are the National Hydrometric Program, and the Canadian Heritage Rivers System.

STATE OF KNOWLEDGE

In terms of the quantitative status of water resources in Nunavut, it should be noted that the analysis and interpretation of collected water data are the weakest components in the hydrological monitoring activity taking place. However, there is information available from individual stations through the Hydrometric Monitoring Program.

Although data are sparse throughout much of Nunavut, available studies indicate that warmer temperatures are causing earlier spring freshets in mainland Nunavut, and melting permafrost is causing lower river levels and changing streamside vegetation.

The main pressures on hydrology in Nunavut are an increase in mining and oil and gas projects, navigation and hydro power, fisheries, and tourism development. Although baseline water demand is low in comparison to water resources due to abundance of water resources, industrial pressures are expected to pose pressures on the VEC.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

The general indicators currently used in Nunavut are water levels and stream flows, while the project indicators are channel depth and flow velocity. Another potential indicator is “ice phenology”.

At each hydrometric station, water level data are recorded continuously, either on graph paper using a mechanical (analogue) recorder, or in digital form using an electronic recorder, or "data logger". The determination of the rate of flow, or discharge, of a river requires several measurements of water depth and velocity across the river to yield the average discharge.

THRESHOLDS

The Department of Fisheries and Oceans issued a protocol for winter water withdrawal from ice-covered water bodies applicable in the Northwest Territories and Nunavut. It establishes that the total water withdrawal from a single water body is not to exceed 10% of the available water volume.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of hydrology and water quantity:

- What trends / changes are occurring in stream flows and water levels?
- What trends / changes are occurring in the hydrograph in relation to climate change?
- What changes are needed regionally in Nunavut in order to better direct efforts and meet the needs of Nunavummiut, communities and development interests?

NGMP has identified the following monitoring needs to enhance understanding of hydrology and water quantity:

- Couple hydrometric data with other monitoring indicators, such as meteorological variables;
- Measuring water level decline in specific lakes and rivers and assessing changes in water availability;
- Collection at project-specific monitoring sites of stream flows data be continued at all sites in an effort to better quantify hydrologic variability in the region;
- Discharge measurements should continue to be collected at new stations in order to strengthen their rating curves.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on hydrology and water quantity. To access this report or for further information on NGMP's current knowledge base regarding hydrology and water quantity, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

1.3 NGMP MONITORING BLUEPRINT (2013) – GROUNDWATER

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to groundwater, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Geological characteristics in Nunavut significantly limit the flow of groundwater. It can be found locally in areas where fractured rocks and glacial debris provide material that can store and release groundwater or in areas where the seasonal development of a thawed 'active layer' above the permafrost can provide permeable pathways for the subsurface movement of water.

Groundwater is a component of the total freshwater resource. It supports freshwater and terrestrial VECs by discharging into streams, wetlands and lakes. Therefore, it plays a determinant role in the hydrology of northern regions.

STUDIES / PROGRAMS THAT GATHER INFORMATION

A literature review revealed no specific research programs for groundwater in Nunavut at the territorial level. Monitoring activity is limited to project-specific initiatives, mainly for mining projects, where groundwater monitoring is generally required as part of the water licensing process.

STATE OF KNOWLEDGE

In Nunavut, groundwater is largely used for industrial (mining developments) uses and it is estimated that approximately 1% of the population in Northwest Territories and Nunavut depend on groundwater for domestic purposes. For the total of Canada, it is almost one third (26%) of the population who rely on groundwater.

TREND(S)

A literature review revealed no trends in Nunavut's groundwater resources, as expected, due to the general lack of available data. However, on a larger Arctic scale and in the context of climate change, it has been estimated that groundwater regimes will change as a consequence of increasing permafrost temperatures resulting the development of large unfrozen near-surface aquifers with groundwater flow throughout the year, more active recharge and discharge of aquifers, and an increase in groundwater flow that would affect the base flow volumes and chemistry of many rivers in northern locations.

PRESSURES

The pressures on groundwater in Nunavut will likely originate from increasing exploration and development of mining and oil and gas projects, and their associated infrastructure, which is predicted for the whole northern region. There are risks of contamination both during the operation and post-operation phases. Currently, hydrocarbons are reported as the most common pollutant in contaminated sites in Nunavut.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

A literature review revealed no established indicators for groundwater. However, should there be monitoring programs developed, the most commonly used indicators of groundwater health are groundwater quality and quantity.

If the overall purpose of the monitoring program is to gather general information about groundwater resources in a region, wells should be located in uniform areas with respect to hydrogeology and land use. If the aim of the program is to collect data for early warning of groundwater impacts from mining developments, the wells should be located immediately downward following the hydraulic gradient from the hazard.

THRESHOLDS

A literature review indicated that no groundwater quantity thresholds are currently used in Nunavut. In terms of groundwater quality, and when used for domestic purposes, the thresholds established for a number of components in the 'Guidelines for Canadian Drinking Water Quality' would be applicable.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of groundwater:

- What is the regional distribution of groundwater resources?
- What are the trends in terms of quantity and quality of groundwater resources?
- For which watersheds does groundwater represent a significant contribution to the water balance and what is the estimation of that contribution?
- What and where are the freshwater ecosystems (ponds, wetlands, lakes etc.) highly dependent on groundwater?
- What communities use groundwater for domestic purposes; what is the quality of this water; and what are the extraction rates?
- What is the relation between active layer depth and groundwater flow/occurrence?

NGMP has identified the following monitoring needs to enhance understanding of groundwater:

- Groundwater data is generally needed in the vicinity of development projects (e.g., mining, oil and gas);
- Integrating the monitoring of groundwater resources with surface water and permafrost monitoring would generate valuable information for the planning process.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on groundwater. To access this report or for further information on NGMP's current knowledge base regarding groundwater, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

2.0 FRESHWATER INVERTEBRATES

2.1 NGMP MONITORING BLUEPRINT (2013) – PHYTOPLANKTON, ZOOPLANKTON, AND BENTHIC INVERTEBRATES

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to phytoplankton, zooplankton and benthic invertebrates, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Benthic macroinvertebrates, as well as phytoplankton and zooplankton, are common inhabitants of lakes and streams where they are important in moving energy through food webs.

Fish, birds and other fauna in Nunavut are dependent on the food base provided by the healthy primary production of phytoplankton and zooplankton and secondary production of macroinvertebrates. Climate change is expected to significantly impact invertebrate abundance in Nunavut, which could have repercussions into marine and terrestrial food webs.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Some examples of studies that gather knowledge are: the Swedish "Tundra Northwest Expedition" which completed lake sampling in 1999, the Canadian Aquatic Biomonitoring Network (CABIN), the Nunavut Research Institute, and various project specific Impact Assessment studies.

STATE OF KNOWLEDGE

Climate warming is likely to result in reduced duration of ice-cover, warmer water temperatures, and increased nutrient supplies from the more bio-geochemically active catchments, which in turn may cause greater planktonic production in the future.

Resource extraction is one of the main pressures on Arctic invertebrates, especially mining operations whose tailings ponds are expected to negatively impact freshwater systems that they are attached to. Other pressures include climate change and ultraviolet radiation.

Indicators for phytoplankton, zooplankton, and benthic invertebrates include: abundance, diversity, biomass, and community structure. Other metrics are also useful such as pollutants and biological integrity. Zooplankton, phytoplankton and benthic invertebrates are regularly sampled as part of mining development Impact Assessments in Nunavut. Methods for collection of freshwater

phytoplankton/zooplankton and macro-invertebrate samples are well established and not overly intensive. Sampling for these taxa can be easily integrated into monitoring programs for other freshwater components (e.g. fish or water quality).

THRESHOLDS

A literature review of phytoplankton, zooplankton and benthic invertebrates revealed that there are no solid thresholds currently established by which to evaluate monitoring data. CABIN uses a Reference Condition Approach (RCA) to compare the observed benthic invertebrate community structure to a regional reference condition defined by reference sites.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of phytoplankton, zooplankton and benthic invertebrates:

- What is the relationship between invertebrates and productivity in Nunavut's freshwater systems?
- How will species abundance and community structure change over time?

NGMP has identified the following monitoring needs to enhance understanding of phytoplankton, zooplankton and benthic invertebrates:

- Baseline collection of diversity and production data for phytoplankton, zooplankton and benthic macroinvertebrates. This data could then be used as reference benchmarks in areas that are likely to undergo localized anthropogenic disturbance and climate change.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on phytoplankton, zooplankton and benthic invertebrates. To access this report or for further information on NGMP's current knowledge base regarding phytoplankton, zooplankton and benthic invertebrates, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

3.0 MARINE COASTAL AND OFFSHORE ENVIRONMENT

3.1 NGMP MONITORING BLUEPRINT (2013) – MARINE WATER QUALITY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to marine water quality, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

An understanding of marine water quality in Nunavut is important in order to understand potential linkages between development projects and the marine environment. In addition, the population of Nunavut is growing, making municipal wastewater a potential issue for marine water quality.

Marine water quality is a VEC because it supports a healthy and productive marine ecosystem, supports the production of marine food species that are important to Nunavummiut, and can be an indicator of ocean circulations and long range transport of contaminants.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Various bodies gather information about marine water quality in Nunavut including: the Northern Contaminants Program, municipalities in support of their water licenses, development projects in support of their applications, various bodies in compliance with the Fisheries Act, and various research initiatives.

STATE OF KNOWLEDGE

Contaminants enter the Arctic via long-range transport by marine currents, air currents, freshwater runoff from land and migratory biota. Additional point sources may come from DEW line sites, local communities, shipping tracks and potential oil spills and natural gas leaks.

TREND(S)

Current knowledge suggest that trend monitoring for contaminants in Nunavut is focused more on detecting trends in biological uptake than on trends in water quality.

PRESSURES

Pressures on marine water quality include: long range transport of contaminants, spills of hydrocarbons and other hazardous materials from marine transportation, and point source contamination from municipalities, marine port construction, mining and oil and gas.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators for the health of marine water quality as a VEC include: temperature, pH, conductivity, turbidity/colour, dissolved oxygen, total suspended solids, total/dissolved organic carbon, major ions, nutrients, total/dissolved metals, bacteria, and organic contaminants.

Sample collection, handling and analysis protocols are standard for routine baseline data collection and monitoring programs associated with development projects. Studies carried out by research organizations can be less routine in their protocols, since many studies appear to incorporate a methodological research and development component.

THRESHOLDS

There are thresholds for marine water quality established by the Canadian Council of Ministers of the Environment publication "Water Quality Guidelines for the Protection of Aquatic Life", the federal Fisheries Act, and requirements under a Water License.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of marine water quality:

- What are the baseline concentrations for key parameters and contaminants in marine waters on a broad scale?
- What are the baseline concentrations for key parameters and contaminants in marine waters in relation to development projects?
- What is the zone of influence in marine water from future developments and communities?
- Have marine waters changed as a result of a given development project(s)? If so, how?
- How are marine waters changing as a result of climate change?

NGMP has identified the following monitoring needs to enhance understanding of marine water quality:

- Identifying pathways of contaminants on a global scale and how they accumulate in the Arctic,
- Continued monitoring of Persistent Organic Pollutants (POPs) and the role of sea ice in moving contaminants from one part of the environment to another.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),

- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on marine water quality. To access this report or for further information on NGMP's current knowledge base regarding marine water quality, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

3.2 NGMP MONITORING BLUEPRINT (2013) – MARINE SEDIMENT

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to marine sediment, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Marine sediment is an integrator and indicator of environmental conditions in the marine environment and can reflect effects from the terrestrial and atmospheric environments.

Marine sediments provide substrate for the benthic community, which influences the food chain all the way up to organisms that Nunavummiut consume. Marine sediments can also be a repository for contaminants, and must be monitored in the development area for major industrial projects.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Marine sediment information is gathered by research programs, both government and academic, as well as by proponents of development projects. Development projects that have collected marine sediment information in association with proposed marine terminals include: Mary River; High Lake; and Bathurst Inlet Port and Road.

STATE OF KNOWLEDGE

The circulation and subsequent melting of sea ice allows contaminants to be redistributed to deep ocean sediments. Although limited studies have been performed on marine sediments in the Arctic, some examples of their results are: an increase in flux of organic carbon to the Arctic Ocean seafloor, high levels of both DDT and PCBs being reported from eastern Hudson Bay relative to other Arctic locations, and high levels of arsenic being found in Hudson Bay.

TREND(S)

A literature review on marine sediments revealed no broad-scale trend information for marine sediments across Nunavut; however local data from development projects has demonstrated that contaminants can accumulate in marine sediments close to the development sites.

PRESSURES

Pressures on the morphology and distribution of sediments in Nunavut arise from ice scouring, glaciers, winds, waves, and currents. Contaminant pressures on marine sediments arise from industrial developments, waste disposal facilities, and contaminated sites.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of the health of marine sediments as a VEC include: particle size, organic carbon, inorganic carbon, trace metals, petroleum residues, and organic contaminants.

Marine studies carried out by proponents generally use standard protocols. Studies carried out by research organizations can be less routine in their protocols, since many studies appear to incorporate a methodological development component.

THRESHOLDS

There are thresholds for marine sediments set by the Canadian Environmental Protection Act and the Canadian Committee of Ministers of the Environment publication, "Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (Summary Tables)".

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of marine sediment:

- What are the baseline concentrations for key contaminants in marine sediments, on broad scale?
- What is the zone of influence in marine sediments from future developments?
- How are marine sediments changing as a result of climate change?

NGMP has identified the following monitoring needs to enhance understanding of marine sediment:

- Confirm standard protocols for study design, sample collection, sample handling and analysis for baseline data collection and monitoring carried out by proponents.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on marine sediments. To access this report or for further information on NGMP's current knowledge base regarding marine sediments, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

3.3 NGMP Monitoring Blueprint (2013) – Coastal Processes and Seabed

Objective

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to Coastal Processes and Seabed, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

Background

Seabed relief such as steep gradients can cause upwelling leading to polynyas and areas of increased biological productivity. Coastal and seabed geology and relief also create habitat structure which, along with oceanographic conditions, defines the biological community and productivity.

Coastal processes and seabed constitute a VEC because they define the physical, and to a large degree the biological, characteristics of the coastline; and seabed characteristics provide indicators of faults, ice scouring, hydrocarbons and biological activity and hotspots.

Studies / Programs that Gather Information

The Canadian Hydrographic Service (CHS), the Geological Survey of Canada (GSC) and the ArcticNet National Centres of Excellence (NCE) program have been mapping in the Arctic for many years and have amassed considerable amounts of data.

State of Knowledge

A literature review revealed that very little Nunavut-wide data is available. In general, river discharge to the Arctic Ocean decreased by about 10% for the period 1964 to 2003, inflow to Hudson Bay declined by 13% between 1964 and 1994, likely in response to the terrestrial effects of the Arctic Oscillation on atmospheric circulation. Also, climate change may increase rates of erosion, beach migration and extreme flooding events by impacting storm frequency, sea-level rise, permafrost properties, and sea-ice characteristics.

Trend(s)

An important trend relating to this VEC appears to be climate change, which can alter river discharge rates and increase erosion, as well as storm frequency, sea-level rise, permafrost properties, and sea-ice characteristics.

Pressures

The main pressures on coastal processes and seabed are climate change, which can cause changes in river discharge and calving of icebergs, and industrial development such as oil and gas exploration.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Possible indicators for the health of coastal processes and seabed include: bathymetry, presence and amount of benthic biota in the intertidal and sub-tidal zones, presence/frequency and location of ice and iceberg scour troughs, sea level, and the location/extent and rate of coastal permafrost degradation and erosion.

Seabed and coastal studies carried out by proponents generally use standard protocols. Studies carried out by research organizations can be less routine in their protocols, since many studies incorporate a methodological development component. Data collection using sonar and sample collection, handling and analysis protocols are broadly similar, but tend to be specific to the party carrying out a given study.

THRESHOLDS

Loss of permafrost (by coastal erosion) is an important threshold, particularly in relation to Nunavut communities and development works.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of Coastal Processes and Seabed:

- What are the impacts of developments that require dredging of seabed substrates?
- Will coastal erosion due to permafrost degradation become a more serious problem in Nunavut?
- Do seabed processes such as mass slumping along steep fjords walls have the potential to damage structures through generated waves?

NGMP has identified the following monitoring needs to enhance understanding of Coastal Processes and Seabed:

- Seabed mapping data for the Canadian Arctic,
- Accumulation of contaminants,
- Relationship between changes in sea ice regimes and changes in seabed,
- Benthic sampling should be integrated with geological information at seep sites and other features of interest, and
- Seismic data should be used to better understand the behaviour of marine fluids.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on coastal processes and seabed. To access this report or for further information on NGMP's current knowledge base regarding coastal processes and seabed, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

3.4 NGMP MONITORING BLUEPRINT (2013) – BATHYMETRY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to bathymetry, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Bathymetry is an important feature of the marine environment. Bathymetry is for the most part stable and unchanging in relation to development. The exception would be site specific instances where dredging and/or blasting may be required to remove obstacles to marine navigation.

Bathymetry is a VEC because it defines accessibility for marine shipping, affects the safety of navigation, plays an important role in defining oceanographic regimes, and plays an important role in defining the distribution of marine biological resources.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The Canadian Hydrographic Service (CHS) of Fisheries and Oceans Canada (DFO) has responsibility for mapping the bathymetry of Canadian waters. CHS uses the latest technology to collect high-resolution data on the depth, shape and structure of Canada's oceans, lakes and rivers.

STATE OF KNOWLEDGE

Modern marine charts that provide bathymetric information are compiled from accurate hydrographic surveys; despite this there is a lack of adequate charts for the Arctic. Various nations, including Canada, are carrying our charting activities in the Arctic in anticipation of ice free conditions in the future.

TREND(S)

There is likely to be an increased requirement for bathymetric data in Nunavut. There may be a trend towards increased use of autonomous underwater vehicles (AUVs) for conducting hydrographic surveys in the Canadian Arctic.

PRESSURES

Changes in the ice regime are likely to lead to increased shipping activity and increased development. These are likely to cause an increased requirement for bathymetric data in Nunavut.

Indicators and Protocols for Future VEC Data Collection

One possible indicator in relation to the health of bathymetry includes the number of hydrographic surveys conducted and charts produced to modern navigational standards.

Bathymetric data must be collected in accordance with CHS requirements and standards of the International Hydrographic Organization.

Thresholds

A literature review revealed no thresholds for bathymetry.

NGMP Monitoring Needs

NGMP has identified the following key questions for future monitoring of bathymetry:

- For new development projects, is the available bathymetric information sufficient to ensure safe navigation?
- To what degree is bathymetry affecting sea ice regime and distribution of marine biological resources?

NGMP has identified the following monitoring needs to enhance understanding of bathymetry:

- Within Canada, a high proportion of Arctic waters are inadequately surveyed or covered by frontier surveys only. The Canadian Hydrographic Service reports that 10 percent of the Canadian Arctic has been surveyed to modern standards. Coverage is often minimal and collected using rudimentary equipment and methods.
- More bathymetric surveying is needed.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on bathymetry. To access this report or for further information on NGMP's current knowledge base regarding bathymetry, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

3.5 NGMP MONITORING BLUEPRINT (2013) – POLYNYAS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to polynyas, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Areas within the sea ice that do not freeze over in the winter are referred to as “sarvait” or “aukkarniit” by local experts (depending on local dialects), and as polynyas by sea ice researchers. These areas are described locally as being kept open by strong currents, which keeps the water and ice moving around so that it does not have a chance to freeze.

Polynyas represent hotspots of productivity and diversity relative to other ice covered areas in Arctic marine ecosystems because they allow light into the surface of the sea which produces microbial blooms, the basis of the marine food chain. They can also be important hunting areas because marine mammals frequent them.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Noetix Research Inc. provides a web based reporting service based on Radarsat-2 images and is supported by the Canadian Space Agency; European Space Agency; and Canadian Ice Service/Environment Canada. DFO also operates various programs which provide information on Polynyas in conjunction with Canadian universities and the Government of Nunavut. Natural Sciences and Engineering Research Council of Canada (NSERC) brings together Canadian and international expertise in Arctic oceanography to conduct the International North Water Polynya Study. Acadia University is currently exploring the relationships between biodiversity, climate change and contaminants in small polynyas.

STATE OF KNOWLEDGE

The Noetix Research Inc. service provides an almost daily report of floe edges in the Arctic. The majority of data on Polynyas is collected for the purposes of marine navigation safety however more research is coming out about the ecological values. An example of an important polynya is the North Water Polynya which may be the most productive ecosystem north of the Arctic Circle and has been an important resource for the Inuit for at least 5000 years.

TREND(S)

The greatest recent increase in Canadian Arctic primary production has been observed in the Beaufort Sea, Lancaster Sound, Foxe Basin and Baffin Bay/Davis Strait, most of which are associated with

recurring polynyas. The response of polynyas to climate change is predicted to be complex, with some polynyas disappearing and new ones being generated in new locations.

PRESSURES

Climate change is the most important pressure on polynyas. Polynyas are also at risk of accumulating an increased contaminant load due to the circulation and subsequent melting of sea ice.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of the health of polynyas include: location, duration, changes to existing polynyas and creation of new ones, the impacts from shipping traffic, sea surface temperature (SST), wind forcing, and primary productivity.

A literature review of polynyas revealed that remote sensing is the only existing protocol for data collection. Acadia University is currently developing environmental sampling protocols for two small polynyas in the Canadian High Arctic that can be used for other locations elsewhere in Nunavut.

THRESHOLDS

Thresholds for polynyas are: presence or absence, proximity to Inuit communities, and ice safety in the area surrounding polynyas.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of polynyas:

- Are polynyas changing in terms of location, duration?
- Are important polynyas closing? What are the implications for wildlife dependent upon them?
- What are the ice conditions surrounding and in polynyas?
- Is ship traffic traversing polynyas or their vicinity?
- What is the Inuit traditional knowledge of polynyas?
- How are Inuit adapting to polynya changes?

NGMP has identified the following monitoring needs to enhance understanding of polynyas:

- Data collection on contaminant loading ,
- Monitor vessel traffic at times of year when ice is present, and ice breaking, in proximity to polynyas,
- Continue monitoring ice around polynyas and to make the information available to Inuit hunters.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,

- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on polynyas. To access this report or for further information on NGMP's current knowledge base regarding polynyas, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

4.0 MARINE INVERTEBRATES

4.1 NGMP MONITORING BLUEPRINT (2013) – MARINE INVERTEBRATES AND HARVESTED SPECIES

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to marine invertebrates and harvested species, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Harvested species of invertebrates can be broken down into commercially harvested (i.e. shrimp and clams), and subsistence (i.e. blue mussels) harvested species. This VEC also includes other marine invertebrates that are not consumed or sold, but are still valuable components for their intrinsic ecological value.

Marine invertebrates are a VEC due to their value as a commercially harvested species, which translates to monetary value for Nunavummiut and a means of subsistence (country food). Marine invertebrates are also an intrinsic part of the ecosystems in which they inhabit.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The Department of Fisheries and Oceans (DFO) has completed multiple surveys in recent years such as the Multi Species Survey, and a joint venture with the Northern Shrimp Research Foundation. Population status is evaluated within the DFO Precautionary Approach framework.

STATE OF KNOWLEDGE

Shrimp are the best understood invertebrate in Nunavut waters. The landed value for shrimp in Nunavut was approximately $2.9 million in 2005, however shrimp recruitment is uncertain. The impacts of marine invertebrate harvests on the target species, their habitats, and other species that eat them or use the affected habitat would benefit from further study.

TREND(S)

A literature review of marine invertebrates and harvested species revealed that shrimp were the only species with trend information in this VEC. Shrimp catches have increased steadily from the 1980s until the late 1990s, and since then they have remained steady at approximately 5000-6000 metric tonnes per year. The mean size at sex change (shrimp are hermaphrodites) declined since 1995. Warmer ocean temperatures are known to change the distribution of shrimp populations, as they prefer colder waters.

PRESSURES

Climate change and its implications for oceanographic regimes have the potential to become a pressure for all marine invertebrates. The main pressure on shrimp populations is commercially fishing pressure which is monitored and managed by DFO, and the same applies to all other harvested invertebrate species.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Some indicators of marine invertebrates as a VEC include: abundance and distribution, catch per unit effort, size, and growth rate, abundance, and community structure.

Standard sampling protocols are set by the DFO, and include observations on commercial fishing operations as well as destructive sampling. Protocols for non-harvested species are established by academic studies.

THRESHOLDS

Thresholds for harvested species are established and re-adjusted based on regular data from the fishery and research surveys undertaken by DFO, and are expressed as Total Allowable Harvests (TAH). For non-harvested species, thresholds may be established on a project or location specific basis to respond to the relevant pressures/sensitivities. Thresholds may be reflected in regulatory approvals.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of marine invertebrates and harvested species:

- What are the size and distribution of populations?
- What is the level of fishing effort and distribution?
- What are the effects of changes in ocean temperatures as a result of climate change?
- What are the effects from development projects?

NGMP has identified the following monitoring needs to enhance understanding of marine invertebrates and harvested species:

- Data collection of benthic ecosystems and changes in benthic ecosystems with projected ice retreat,
- Potential effects from individual development projects and project specific monitoring.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,

- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on marine invertebrates and harvested species. To access this report or for further information on NGMP's current knowledge base regarding marine invertebrates and harvested species, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

5.0 AVIAN WILDLIFE

5.1 NGMP MONITORING BLUEPRINT (2013) – AVIAN WILDLIFE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to avian wildlife, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Most avifaunal species in Nunavut are migratory and travel several thousands of kilometres to and from the wintering grounds each year. However, a few avian species are resident in Nunavut. Key Nunavut avian species include breeding birds, shorebirds, passerines, waterfowl and water birds, swans, geese and ducks, sea ducks, raptors, seabirds and birds listed as species at risk.

The avian species present in Nunavut are of importance for Inuit subsistence use, are ecologically sensitive, have special status (e.g., special concern, threatened, endangered) at territorial, federal and/or international levels, or are a part of an ongoing environmental assessment/biomonitoring associated with one or more development projects in Nunavut.

STUDIES / PROGRAMS THAT GATHER INFORMATION

There are several research projects and monitoring programs currently gathering information on avian wildlife including those undertaken by the Canadian Wildlife Service, Canadian Circumpolar Institute (e.g. the Nunavut Raptor Study), and universities (e.g. Carleton University and Acadia University). Databases such as the Polar Data Catalogue and the Arctic Shorebird Demographic Network are other tools used in Nunavut for gathering information. Baseline studies involved with Environmental Impact Assessments and the ArcticWolves initiative provide further information on key avian species.

STATE OF KNOWLEDGE

The breeding studies that are conducted in Nunavut are generally limited in scale, and thus most often represent only a small portion of the total population. Population size and trends are therefore difficult to estimate and may be biased by the scale of study or monitoring. Regardless, the Canadian Arctic is known to contribute significantly to the global population of many species. Baseline surveys such as those performed in Environmental Impact Assessments provide information with regard to the number of species and relative abundance among taxonomic groups. Birdlife International has identified 44 locations in Nunavut as Important Bird Areas (IBA).

TREND(S)

A literature review revealed that trends for species breeding in the Canadian Arctic appear to be generally stable or decreasing. Many recent studies have focused on the effects of weather on reproductive success, survival and breeding abundance. In general, it appears that an increase in average temperature can lead to earlier spring thaw and can advance lay dates, increase clutch size and improve survival of young. Under these conditions, population trends may increase for some species (e.g. Ptarmigan and Snow Geese) and decrease for other species that rely on pack ice and floe edges (e.g. marine birds). Trends in abundance, distribution, reproductive success and survival of terrestrial avifauna are strongly reliant on primary production, arthropods and/or small mammal availability

PRESSURES

The consequences of climate change will likely be the greatest pressure faced by avian species that are resident species or breeding species in Nunavut. In addition, increasing levels of human activities in the north are likely to inevitably increase and intensify pressures on Nunavut's avifaunal wildlife.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Possible impacts of anthropogenic stressors can be explained by such indicators as avian biology (e.g. heavy metal concentrations) and avian habitat (e.g. sea ice quantity).

There are several avian monitoring protocols including those for goose monitoring, avian predator monitoring, and shorebird monitoring.

THRESHOLDS

A literature review revealed no species-specific thresholds for Arctic Avifauna. Avian biological indicator thresholds include productivity values, selenium concentrations in bird's eggs, and egg shell thinning in Peregrine Falcons relative to DDT use.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of avian wildlife:

- Using long-term monitoring and intensive local studies, what are the best indicators that should be monitored for a given species/ecological community/ecosystem?
- Can long-term monitoring detect future changes in bird populations (e.g. timing of breeding, abundance, distribution)?
- Can long-term monitoring explain the mechanisms underlying future changes in bird populations (e.g. timing of breeding, abundance, distribution)?
- What are the key off-shore areas used by migrants and residents during the breeding season, and how do these overlap with shipping routes, industrial development and changing phenology and proportions of sea ice and Open Ocean?
- What are the key off shore areas used by residents during the winter, and how do these overlap with shipping routes, industrial development and changing phenology and proportions of sea ice and Open Ocean?

- What are the emerging contaminants, and are they harmful?

NGMP has identified the following monitoring needs to enhance understanding of avian wildlife:

- In general, monitoring of avian wildlife should be conducted within the context of overall ecosystemic monitoring:
    - monitoring studies that have long term data and study guilds at multiple locations across Nunavut,
    - improving community based monitoring to expand the geographical and seasonal scope of monitoring, and
    - focus on baseline biomonitoring efforts during the pre-development phase of projects.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on avian wildlife. To access this report or for further information on NGMP's current knowledge base regarding avian wildlife, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

6.0 LANDFORMS AND SOILS

6.1 NGMP MONITORING BLUEPRINT (2013) – LANDFORMS AND SOILS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to landforms and soils, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Landforms, along with soils and geology, play a defining role in the ecosystem of Nunavut. Landforms in Nunavut include: rolling terrain of the Canadian Shield, post-glacial features of eskers and moraines, shorelines of the marine environment, lakes and rivers, wide valleys, mountains and hills, steep-walled canyons, cliffs, and glaciers.

Nunavut's exquisite geography forms the basis for the terrestrial ecosystem and defines the hydrologic regime and vegetation growth. The landforms represent notable and valuable indicators of place, and represent present and potentially future attractions valuable to the tourist industry.

STUDIES / PROGRAMS THAT GATHER INFORMATION

A great deal of the collection of landform and soils information is done in support of research projects undertaken by the Geological Survey of Canada, and academia. Also, landform information is collected as part of every environmental assessment conducted for submission to the Nunavut Impact Review Board (NIRB).

STATE OF KNOWLEDGE

Knowledge related to landforms and soils tends to be focused on specific features or areas in individual localized studies and research topics. Part of Nunavut is included in the Canadian Shield, which is comprised of old rocks containing valuable minerals and other resources such as gold, silver, base metals, rare earths, uranium, and diamonds. Glaciers and eskers (the remnants of old glacial rivers) are other examples of commonly found landforms in Nunavut.

From a broad perspective, trends include: scouring and deposition by glaciers, glacier retreat, continued frost shattering, and erosion. Trends with respect to landforms and soils for development projects include: stripping, excavation, leveling, changes in soil quality from acidification, disposal of tailings and other waste, hydrocarbon spills, erosion, and change in the thermal regime.

Some key pressures to landforms and soils in Nunavut are the effects of resource development, community development, and climate change.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

A literature review did not reveal well developed indicators in relation to the health of landforms and soils; however two that were identified are depth of permafrost and spatial extent of landforms and soils.

Protocols for data collection for development projects include surface mapping, drilling, and laboratory testing of samples, excavation of shallow test pits, geophysical surveys, and aerial surveys.

THRESHOLDS

A literature review revealed no well-defined or accepted thresholds for landforms and soil as a VEC for the Canadian Arctic. As an example for industrial development, the following thresholds were developed for determining a significant impact: greater than 30% loss of any landform and associated soils, greater than 15% loss of the surface occupied by any permafrost-sensitive landforms, and greater than 15% loss of any uncommon and valued landform.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of landforms and soils:

- What are the location, nature and extent of changes in landforms?
- What are the location, nature and extent of changes in soil quality?
- Will the landforms and soils recover from changes due to communities and/or development projects, and at what rate?
- What are the individual and cumulative footprints of development projects in relation to key landform and soil features?
- What is the extent and rate of change (loss) of key glaciers?
- What are the overall proportions of changes, diminished quality or losses in key landforms such as eskers, cliffs, river floodplains, falls, etc., particularly in relation to development projects and communities?

NGMP has identified the following monitoring needs to enhance understanding of landforms and soils:

- Identify and map landforms, soils and potential geohazards for individual projects (e.g., permafrost, landslides, eskers, cliffs, river floodplains, etc.),
- Track the site specific and cumulative changes in landforms and soils in relation to development projects and communities,
- Identify/monitor changes in landforms and soils in relation to climate change.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,

- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on landforms and soils. To access this report or for further information on NGMP's current knowledge base regarding landforms and soils, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

7.0 FRESHWATER FISH

7.1 NGMP MONITORING BLUEPRINT (2013) – FRESHWATER FISH

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to freshwater fish, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

There are approximately 20-22 fish species thought to occur in Nunavut's freshwaters across riverine and lacustrine environments including lake cisco, Arctic cisco, lake whitefish, broad whitefish, least cisco, kokanee or sockeye salmon, Chinook salmon, round whitefish, Arctic Char, lake trout, Arctic grayling, pond smelt, northern pike, lake chub, longnose sucker, white sucker, burbot, threespine stickleback, ninespine stickleback, trout-perch, slimy sculpin, and spoonhead sculpin.

Freshwater fish are important on a commercial basis (e.g. Arctic Char harvests) and important to the Inuit culture in Nunavut. Freshwater fish are also important for tourism with respect to sport fishing, important as a food source and are an important component of the food chain. Freshwater fish can also be useful indicators of the shorter term localized impacts of land development, as well as long term changes in the environment (e.g. climate change).

STUDIES / PROGRAMS THAT GATHER INFORMATION

DFO gathers information on fish populations in Nunavut as part of its mandate to manage fisheries. Other current freshwater fish monitoring projects include: establishing a long-term, river-based monitoring system for Arctic Char in the Cambridge Bay area; development and implementation of a community-based fishery monitoring program and adaptive co-management plan for Arctic Char in Baffin Region; and development of an Aquatic Monitoring Program to allow community members to gather data on and monitor water quality, aquatic invertebrate species, and fish populations and harvests near Igloolik, Kugluktuk, and Coral Harbour.

STATE OF KNOWLEDGE

Regional watershed analysis undertaken across all of Canada's provinces and territories indicated that Nunavut had the lowest freshwater fish species richness in the country and the lowest score for a derived Environmental Index.

TREND(S)

A literature review revealed that status and trends information for freshwater fish in the Arctic is generally lacking. However, decreasing populations of Arctic Char have been identified near some communities where over-fishing, perhaps combined with habitat changes, has resulted in population collapse.

PRESSURES

Increasing levels of human activities in the north are likely to increase and intensify pressures on Nunavut's freshwater resources. Climate change effects such as rapid temperature increases could cause local extirpation from thermal stress, a northward shift in geographic range, and genetic change. Some freshwater fish species that exhibit wide thermal tolerances could conceivably benefit from temperature increases, and colonize new areas.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Biological and habit related indicators provide a measure of the condition of freshwater fish and provide insight into the possible impacts of anthropogenic stressors. These indicators include: metal concentrations in fish tissues; contaminant load; biochemical stress indicators; abundance; direct fish mortality; reproductive rate; sedimentation; water withdrawals; altered habitat areas; fish passage; water quality and water temperature; and change in food web structure.

The five-year exploratory fisheries protocol currently used by Fisheries and Oceans Canada (DFO) Central and Arctic Region's Fisheries and Aquaculture Management (FAM) sector was established as a test fishery program to evaluate the commercial feasibility of anadromous Arctic Char stocks. The exploratory fishery protocol requires updating given the variety of species now under exploratory license and the three-stage New Emerging Fisheries Policy.

THRESHOLDS

Biological thresholds include metal concentration thresholds based on CCME guidelines for the protection of aquatic life. Habitat related thresholds include habitat alteration thresholds, exceedance of DFO protocols pertaining to water withdrawal rates, and information on the effect of suspended sediments.

NGMP MONITORING NEEDS

Application of an ecosystem approach to the study of freshwater fish will be particularly important in Nunavut and Canada's northern areas where ecosystems are especially sensitive to disturbance, and subject to significant modification as a result of climate change. NGMP has identified the following key questions for future monitoring of freshwater fish:

- Are there any significant changes in population metrics (abundance/production) of key freshwater fish species and/or in the distribution of species?
- What are the contaminant loadings in freshwater fish being harvested for subsistence?
- Are there changes occurring in harvest of key freshwater fish species?

- Are changes occurring in the distribution of sensitive freshwater fish species (e.g. in response to possible climate change)?
- What are the environmental impacts of shipping traffic, particularly those with high risk cargoes (e.g. petroleum products) that may impact freshwater river systems, or migratory stocks of fish?

NGMP has identified the following monitoring needs to enhance understanding of freshwater fish:

- Baseline biodiversity data establishment (as reference benchmarks) for areas that are likely to undergo anthropogenic disturbance (e.g. access roads, mining, new shipping activity, ecotourism),
- Baseline inventory, distribution and population metrics such as abundance and production,
- Long term monitoring of freshwater fish populations and their habitats in Nunavut,
- Contaminant loads, and
- Evaluating anthropogenic (e.g. climate change) impacts on fish vs. the influences of natural variation in environmental conditions.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on freshwater fish. To access this report or for further information on NGMP's current knowledge base regarding freshwater fish, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

8.0 SNOW AND ICE

8.1 NGMP MONITORING BLUEPRINT (2013) – SNOW

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to snow, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Snow is a defining characteristic of the Nunavut environment and is integral to Inuit culture. Inuit have traditionally travelled over snow covered terrain and used snow for building Igloo shelters. Vegetation is protected by snow and receives moisture from snowmelt. Wildlife in Nunavut utilizes snow for shelter and deep snow can adversely affect access to food for wildlife (e.g. muskox, arctic hare).

Snow is a VEC because it creates the possibility for transportation through snowmobiles or traditional modes of transportation by dog sled, enables subsistence harvesting of country foods, plays a role in eco-tourism, contributes water to the hydrologic regime, and plays a major role in the climate system. Snow is of critical importance to the function of the existing Arctic ecosystem, including: vegetation; terrestrial wildlife; and marine wildlife, by providing shelter and a source of freshwater.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Remote sensing data (satellite imagery) on the cryospheric (snow or ice covered) portion of Canada is collected daily at the 25m resolution for the World Meteorological Organization (WMO) Global Climate Observing System (GCOS). Data are also collected by the Canadian Cryospheric Information Network and Environment Canada. In addition, baseline conditions are collected by various Environmental Impact Assessments for major projects.

STATE OF KNOWLEDGE

Despite its importance, systematic measurements of tundra snow cover across Canada are limited by a sparse conventional observing network that has a strong coastal bias. Measurements of wind-blown snow are difficult to acquire. Models have been developed to estimate wind-blown snow events from wind speed and snowfall data. Unfortunately, accurate arctic snowfall measurements have proven nearly impossible to achieve.

TREND(S)

Northern Hemisphere spring snow cover extent has undergone significant reductions over the past approximately 90 years, and that the rate of decrease has accelerated over the past 40 years. The frequency of freezing precipitation has increased almost everywhere across the Canadian Arctic since 1953. On the contrary, the frequency of blowing snow occurrence has decreased significantly in the Canadian Arctic. The decline is most significant in spring.

PRESSURES

Climate change is a major pressure on snow as a VEC in Nunavut.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of the health of snow as a VEC include: amount of snowfall, spatial and seasonal distribution of snowfall, frequency of blowing snow, relationship to frequency of freezing precipitation events, and snow cover duration.

The two main methods of snow data collection are satellite imagery (remote sensing) and manual sampling of snow (surface based).

THRESHOLDS

A literature review revealed no specific thresholds for snow; however snow depth can be a threshold for other VECs. For instance, the impact of varying snow depth on overwinter food supplies may be highly significant to hare populations at or near cyclic peaks.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of snow:

- What is the snowfall deposition, by month, and is it changing?
- What is the snow cover extent, and is it changing?
- What is the snow depth?
- What is the frequency and extent of blowing snow?
- What is the snow water equivalency?
- What is the snow density?

NGMP has identified the following monitoring needs to enhance understanding of snow:

- Proponents should monitor snow cover regime in areas of development projects,
- Monitor blowing snow in relation to air and road transportation.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,

- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on snow. To access this report or for further information on NGMP's current knowledge base regarding snow, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

8.2 NGMP MONITORING BLUEPRINT (2013) – PERMAFROST

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to permafrost, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Permafrost is soil, rock or sediment that remains at or below 0°C for two or more consecutive years. The vast majority of the Arctic landscape consists of discontinuous or continuous permafrost (>50% permafrost).

Thawing permafrost can lead to terrain instability. This process is amplified by the loss of sea ice, making it easier for water to scour the coastline. Recent thawing of permafrost has led to the draining of wetlands resulting in the loss of habitat in some areas and impeded drainage in others. These hydrological changes, as well as thaw slumping, have affected the biodiversity and ecosystem processes on land and in freshwater habitats. Permafrost regions host a large amount of greenhouse gasses including carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) which may be released upon melting.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Permafrost monitoring sites are located in Pangnirtung, Clyde River, Igloolik, Pond Inlet, Arctic Bay, Resolute, Repulse Bay, Kugaaruk, Gjoa Haven and Taloyoak. Permafrost investigation and monitoring also occurs at existing and proposed mine sites. During the international polar year (IPY), a map and accompanying database of permafrost temperatures across the Canadian North was developed from data collected between 2007 and 2009 at over 100 monitoring sites.

STATE OF KNOWLEDGE

When the IPY site trends are combined with other monitoring locations across the Polar Regions, a pattern emerges. Temperature increases are generally smaller in warmer ice-rich permafrost at temperatures close to 0°C due to latent heat affects associated with phase changes (thawing and freezing). Also temperature trends observed in the eastern and high Canadian Arctic are similar to those in Nordic regions (particularly Svalbard), which show more recent temperature increases. A comparison between ground temperatures at northern Canadian sites and air temperatures for the same region reveals that increased winter air temperatures are largely responsible for the observed increases in temperature.

TREND(S)

A literature review revealed an overall degradation of coastal permafrost. Permafrost temperatures increased in Alaska and decreased in Eastern Arctic; however permafrost temperatures have been reported as increasing at CFS Alert, Iqaluit and northern Quebec. Increased seasonal thaw depth has been reported at Baker Lake. Decreased surface water levels due to permafrost melting have also been reported.

PRESSURES

Global warming is expected to be greatest over high latitudes and permafrost areas will be among the regions most heavily affected. Predicted increases in mean annual air temperature of several degrees in northern latitudes will lead to thawing and destabilization of perennially frozen ground.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of permafrost viability include the following: thickness of the active layer; permafrost extent and depth; permafrost temperature; thaw subsidence; presence of thermokarst; and development of talik.

The Geological Survey of Canada directed monitoring in communities utilizes thermistors to depth of 15 m. Temperature data is collected every 8 hours and maintained in a data base for distribution. Thermistors are also installed at mines.

THRESHOLDS

For the High Lake Project, the threshold cited in the EIS that is relevant to permafrost is: >15% loss of the surface occupied by any permafrost sensitive landforms.

NGMP MONITORING NEEDS

NGMP has identified the following key question as a focus for future monitoring of permafrost:

- What is an effective monitoring strategy for the detection of the terrestrial climate change signal and for the assessment of its lag and attenuation, as well as indications of the spatial variability of change across the Arctic?

NGMP has identified the following monitoring needs to enhance understanding of permafrost:

- Understanding whether the Arctic will be a net source or sink for carbon,
- Monitoring permafrost degradation at development projects on an ongoing basis as part of project planning, mitigation, and adaptive management,
- Monitoring permafrost in communities as part of climate change action plans.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,

- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on permafrost. To access this report or for further information on NGMP's current knowledge base regarding permafrost, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

8.3 NGMP MONITORING BLUEPRINT (2013) – SEA ICE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to sea ice, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Arctic sea ice has thinned and the area of ice cover remaining at the end of summer has decreased, particularly over the past ten years. Since satellite monitoring began in 1979, the lowest sea ice extent on record is the summer of 2012 followed by 2007. The reduction in sea ice area is faster than previously predicted by the Intergovernmental Panel on Climate Change (IPCC) models. Current predictions call for ice-free conditions over most of the Arctic basin by mid-century or earlier.

Sea ice is fundamental to Inuit culture and provides critical transportation routes and access to hunting and fishing opportunities. Sea ice is a unique habitat that is home to a wide range of Arctic species and supports the movement of wildlife between islands and the mainland, particularly Victoria Island and West Kitikmeot. Sea ice also plays a key role in arctic climate impacting albedo, atmospheric-ocean exchanges and ocean circulation.

STUDIES / PROGRAMS THAT GATHER INFORMATION

There are several agencies reporting on sea ice conditions, including: Noetix Research Inc. which provides a Floe Edge reporting service; the Canadian Ice Service (CIS) which provides up-to-date information, analyses and warnings about ice conditions, and an annual Arctic Ice Atlas; and the Inuit Sea Ice Use and Occupancy Project which aims to further document and map local sea ice expertise.

STATE OF KNOWLEDGE

Sea ice data has been collected from satellite imagery since 1979 and Inuit Knowledge has also contributed to the current state of knowledge on sea ice. In the Inuit Siku (sea ice) Atlas, geographically specific descriptions, particularly in relation to Cape Dorset, Clyde River, Igloolik and Pangnirtung, are provided for phenomena such as: the floe edge (sinaaq); tidal cracks; polynyas (sarvait or aukkarniit); early ice melt areas; pressure ridges (ivujuq); reefs; travel routes; and camps.

TREND(S)

Arctic sea ice cover has changed extensively over the last ten years. Multi-year sea ice (MYI, sea ice that survives more than one year) has been steadily replaced by seasonal first-year ice. In all regions, extent and area change is greatest in the summer and non-existent or minimal during the winter. In the Arctic, the melt season duration increased by about two weeks per decade from 1979 to 2005. Recent trends in

Arctic sea-ice extent, thickness and duration are not uniform and have considerable regional variability. Thinner sea ice may make accessing breathing holes easier for whales and seals. However, the unexpected movement and deformation (i.e. thick ridges) of thin ice may trap whales. Increasing sea-ice variability and deformation may also create serious problems for ice-obligate species such as the Hudson Bay eider, ringed seal and polar bear. Thinner and less abundant sea ice make it more difficult and dangerous to travel on the ice and hunt seals.

PRESSURES

The main pressure on sea ice is climate change. Another pressure on sea ice is transits by vessels, which leave ship tracks that result in open water for a period of time before freezing.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

The following are indicators relevant to monitoring sea ice: extent of ice cover; ice thickness; duration of melt time; location of polynyas; and location of the floe edge.

Monitoring sea ice cover is currently carried out using real time satellite imagery. Monitoring using Inuit knowledge in combination with satellite imagery is considered very useful for communities.

THRESHOLDS

Thresholds in relation to sea ice include: quality and thickness of the sea ice to allow safe travel by hunters; change in location of the floe edge; changes in the quality of the ice that effect or compromise wildlife migration routes; and area of landfast ice disrupted by vessel transit.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of sea ice:

- Where, and to what extent, is the location of the floe edge changing?
- Where, and to what extent, is ice thickness changing?
- Where, and to what extent, is coverage changing?
- Are polynyas changing in terms of location, duration?
- Is sea ice coverage shifting in the direction of broken ice which is potentially harmful to marine mammals and hunting?
- To what degree is the extent and distribution of sea ice affecting:
    - Inuit hunting and fishing activities?
    - the safety of travel on the ice?
    - marine transportation, including the sea lift?
    - shipping of mineral products from Nunavut mines and oil and gas production facilities?
    - oil and gas seismic and offshore exploration activities?
    - the placement and design of community and industrial harbour facilities?

NGMP has identified the following monitoring needs to enhance understanding of sea ice:

- Monitor pollutants in sea ice, specifically Persistent Organic Pollutants (POPs) in seawater,

- Collect quantitative data including spatial and temporal extent of sea ice, distribution of sea ice, sea ice thickness, and extent to which it is broken,
- Determine changes in travel, hunting and fishing practices caused by sea ice changes.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on sea ice. To access this report or for further information on NGMP's current knowledge base regarding sea ice, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

8.4 NGMP MONITORING BLUEPRINT (2013) – LAKE ICE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to lake ice, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Freshwater ice plays an important role in physical, geochemical and biological processes in cold regions lakes. The formation and breakup of ice are, therefore, important seasonal events in mid- to high-latitude cold regions.

Lake ice is a VEC because it provides a surface for transportation (snowmobile, dog sled, trucking, and aircraft), provides a surface for animal movement, and is an important indicator of climate change.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Traditional Knowledge studies provide much of the basis for the understanding of historic ice conditions in Nunavut. Various other bodies gather information such as the Nunavut Arctic College, the Canadian Ice Service (CIS), as well as individual development projects.

STATE OF KNOWLEDGE

Despite recognizing the importance of lake ice monitoring, databases of lake ice freeze-up, break-up, and ice thickness observations have dramatically declined from 1980 to the present. Data are gathered primarily through remote sensing, using satellite imagery. Current knowledge about lake ice in Nunavut is generally gathered in support of use of the land by Inuit and in support of winter roads, airstrips and water withdrawals.

TREND(S)

Analysis of modeling results indicates that future warming associated with climate change may result in an overall increase in lake-water temperature, with break up occurring earlier and freeze up occurring later than usual.

PRESSURES

The greatest pressure on lake ice freeze-up, break-up and thickness appears to stem from climate change. Individual development projects can have impacts on lake ice at the local scale.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of lake ice health include ice thickness, cover, freeze up and breakup dates, colour, and condition.

Synthetic aperture radar (SAR) is used to monitor lake ice remotely, supplemented by ground-truthing. For the winter roads, ground penetrating radar (GPR) technology is used for ice and bathymetry measurements.

THRESHOLDS

Thresholds for lake ice include: the 0^{o} threshold for water to freeze, the thickness of ice required to support vehicles (70cm for light loads), and withdrawal volume should be less than 10% of the available water volume beneath 2 m of ice (for development projects and municipalities).

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of lake ice:

- What are the changes that are occurring in freeze-up (ice-on) and break-up (ice-off)?
- What changes are occurring in ice thickness?
- Is the ice on lakes capable of supporting truck traffic and the landing of heavy aircraft?
- Is the use of lake ice by wildlife changing?
- Is the use of lake ice by Inuit hunters changing, and what are the costs of such changes?

NGMP has identified the following monitoring needs to enhance understanding of lake ice:

- High quality in situ measurements of ice thickness and on-ice snow depth of a limited number of sites for evaluation of satellite data,
- Increased remote sensing.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on lake ice. To access this report or for further information on NGMP's current knowledge base regarding lake ice, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

9.0 MARINE FISH

9.1 NGMP MONITORING BLUEPRINT (2013) – MARINE FISH

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to marine fish, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

There are 189 marine fish species in the Arctic of which 182 are found in Nunavut marine waters. The list of marine fish includes starry flounder, Arctic cod, Greenland cod, capelin, Arctic skate, thorny skate, spotted wolffish, northern wolffish, Atlantic wolffish, roughhead grenadier, fourhorn sculpin, and saffron cod.

Many marine fish are important to Nunavut for their contribution to subsistence gathering. Furthermore, many of the species are important food sources for other VECs such as marine mammals and sea birds.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Department of Fisheries and Oceans conducts multi-species surveys in Baffin Bay, Davis Strait and Hudson Strait that gather information to help manage Greenland halibut and shrimp fisheries, and collects incidental data on other species. DFO also collects and maintains catch statistics for both directed and by-catch species, from fishing logbooks and onboard observer records. Other studies are limited, but include baseline studies for industrial development and sea bird surveys.

STATE OF KNOWLEDGE

For many non-harvested species, there is little knowledge of population size, distribution and biology in Nunavut. Marine fish species that are caught as by-catch in the Greenland halibut and shrimp fisheries include: Arctic skate; thorny skate; spotted, northern and Atlantic wolffish; and roughhead and roundnose grenadier. The by-catch is recorded and reported.

TREND(S)

A recent literature review revealed limited studies or programs that gather information on species that are not subject to active fisheries management. Therefore, trend information is not commonly found in literature for the aforementioned species.

PRESSURES

By-catch in the Greenland halibut and shrimp fisheries constitutes a pressure on some species included in the VEC list. Other pressures include industrial development, changes in water quality (e.g. spills) and changes in river outflow (e.g. hydro-electric development).

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

The key indicators of marine fish health include: population level of the species, distribution of the species, and level of catch in commercial fisheries, as either directed or by-catch.

Multi-species surveys for fisheries monitoring purposes are carried out in accordance with standard fisheries scientific protocols and it is expected this would continue in the future. Hydroacoustic detection and ocean tracking with acoustic tags that also collect data on depth and temperature are approaches that have been applied recently and may become more important in the future.

THRESHOLDS

Many Nunavut marine fish species appear to be studied on a limited basis and therefore, population level thresholds have not been established. However, thresholds may tend to focus on fish habitat and would likely include maintenance of water quality in accordance with a water license, and adhering to DFO's regulations included in the Policy for the Management of Fish Habitat.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of marine fish:

- Are harvesting activities (for directed and by-catch species) depleting the populations such that the fisheries or populations are not sustainable or at risk?
- What physical changes are occurring in fish habitat? Is fish habitat compensation required?
- Is the distribution of fish populations changing?
- Are there changes in water quality that could impact fish populations?
- Are there contaminant inputs that could be deleterious to fish or have the potential to be taken up by fish, rendering them not suitable for human consumption?

NGMP has identified the following monitoring needs to enhance understanding of marine fish:

- Quantitative population data,
- Distribution of marine fish species in Nunavut,
- Habitat of marine fish species.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),

- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on marine fish. To access this report or for further information on NGMP's current knowledge base regarding marine fish, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

9.2 NGMP MONITORING BLUEPRINT (2013) – GREENLAND HALIBUT

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to Greenland halibut, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Greenland halibut (*Reinhardtius hippoglossoides*), or turbot as they are commonly known, have been recorded as far north as Baffin Bay. The Greenland halibut fishery is comprised of an offshore fishery in Baffin Bay and Davis Strait, conducted in the summer by offshore trawlers and gillnetters with crews that increasingly include Nunavummiut, and an inshore fishery in Cumberland Sound conducted by Nunavummiut through the ice using longline gear.

Greenland halibut is a valued commercial fish species that along with northern shrimp comprises the main species of marine commercial fisheries in Nunavut. Greenland halibut is also a prey species of the narwhal.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Department of Fisheries and Oceans Canada (DFO) monitor Greenland halibut stock status and conducts research to support fisheries management decisions on allowable harvest. Nunavut Wildlife Management Board is the main instrument of wildlife management and makes decisions on fisheries within the Nunavut Settlement Area (inshore) and makes recommendations on fisheries outside Nunavut Settlement Area (offshore).

STATE OF KNOWLEDGE

Despite the commercial importance of the Greenland halibut to indigenous communities, stocks in the eastern Canadian Arctic have been relatively unstudied to date, in part because of the remoteness characterizing the fisheries.

TREND(S)

A literature review revealed that in Cumberland Sound, very little is known about the Greenland halibut population, its movements and its ecological role in the Cumberland Sound ecosystem.

PRESSURES

Commercial fishing is the main pressure on Greenland halibut within Nunavut. Narwhals also target Greenland halibut as a food source.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

There are several indicators including stock size and distribution, fisheries landings, growth rate, fecundity, catch per unit effort, total allowable catch, and economic and employment indicators.

Fisheries monitoring is carried out in accordance with standard fisheries scientific protocols and it is expected that this will continue in the future. A five year study was initiated in 2010 to understand the seasonal and annual movements of Greenland halibut in Cumberland Sound. Fish are being tracked with acoustic tags that also collect data on depth and temperature.

THRESHOLDS

Greenland halibut indicator thresholds include catch per unit effort and total allowable catch.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of Greenland halibut:

- What are the stock sizes and distributions?
- What are the fisheries landings, fishing effort, catch per unit effort, and identity of the fishing company (offshore) or fisher (inshore)?
- What are the growth and fecundity rates?
- Are there economic and employment indicators?

NGMP has identified the following monitoring needs to enhance understanding of Greenland halibut:

- Understanding the relationship between commercial harvesting in Baffin Bay and Davis Strait and broader harvesting in other areas,;
- Population recovery rates and sustainability in the Arctic; and effects of climate change on Greenland halibut stocks, distribution and productivity;
- Understanding the role of Greenland halibut in the larger ocean ecosystem.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on Greenland halibut. To access this report or for further information on NGMP's current knowledge base regarding Greenland halibut, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.0 MARINE MAMMALS

10.1 NGMP MONITORING BLUEPRINT (2013) – SEALS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to seals, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Nunavut has several species of seal found throughout the territory, including ringed seals, bearded seals, harp seals, harbor seals, and hooded seals.

Seals are fundamental to Inuit culture and are harvested annually for subsistence and commercial use. Seals are important prey for marine carnivores with ringed seal being a keystone species.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The Nunavut Wildlife Management Board monitors all seal catch numbers. Fisheries and Oceans Canada conducts surveys to estimate seal population abundance and distribution.

STATE OF KNOWLEDGE

There are estimated to be 1.5 to 2 million ringed seals throughout Nunavut, with the Inuit harvest at about 30,000, well below the sustainable yield level and historical harvest levels. Surveys may indicate a decline in numbers of ringed seals in western Hudson Bay for a variety of biological reasons. It is estimated that tens of thousands of bearded seals occupy Nunavut waters. Almost all communities (27 out of 28) in Nunavut hunt the bearded seal. Hooded seals range from the Gulf of St. Lawrence to Davis Strait in winter and most migrate to eastern Greenland in spring. It is not known how many harbour seals inhabit Nunavut waters. Although they occupy a broad range in Nunavut, they are only found in small numbers throughout that range.

TREND(S)

Reported seal density survey results vary from 0.19 to 1.47 seals per square kilometer depending on year. These results are difficult to interpret, partly because they depend on the number of visible seals on the ice surface. Scientists think there may be a ten-year cycle of seal populations due to environmental factors, including the effect of climate change.

PRESSURES

Hunting pressures by Inuit exist but are decreasing. Predators also hunt seals. Habitat is important, particularly for birth lairs, and will be affected by climate warming. Disease levels are stable over time. Contaminant levels are stable, although perfluorinated carboxylates are increasing.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of seal population health include: body condition and reproductive status; disease and contaminant loads; pregnancy rate; reproductive rate; stock size and range; harvest, including percent of pups; prey quantity and quality; and quality, temporal and spatial extent of sea ice.

Strip transect aerial surveys have been use to count ringed seals. Aboriginal Affairs and Northern Development Canada (AANDC) provides information on the extensive work being done on the development and application of protocols for monitoring contaminants through the Northern Contaminants Program.

THRESHOLDS

A literature review revealed no thresholds in relation to seal populations. Some thresholds could be considered relating to seal distribution and access to harvesting, in relation to climate change.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of seals:

- Are there any significant changes in population levels?
- Are changes occurring in the distribution of seals as a result of changes in the sea ice regime due to climate change and/or vessel traffic?
- Is reproductive success and pup survivability being adversely affected by climate change (e.g. changes in sea ice availability, melting of lairs, changing snowfall patterns, unseasonable rain events) that leaves seals exposed to cold temperatures?
- Are changes (increase/decrease) occurring with respect to contaminant levels in seals?
- Are changes in seal condition occurring?
- Are changes occurring in the subsistence harvest?
- Are changes occurring in harvest statistics and is the harvest sustainable?
- Are changes in seal distribution affecting accessibility for harvesting?

NGMP has identified the following monitoring needs to enhance understanding of seals:

- Changes in sea ice regime, including distribution and timing of ice consolidation and break-up,
- Changes in polar bear and killer whale predation,
- Long-term effects of climate change,
- Contaminant levels and effects in relation to seals.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on seals. To access this report or for further information on NGMP's current knowledge base regarding seals, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.2 NGMP MONITORING BLUEPRINT (2013) – BELUGA WHALE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to beluga whale, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The beluga is a medium sized whale found throughout northern polar waters. Belugas occupy estuaries, continental shelf and slope waters, and deep ocean basins in conditions of open water, loose ice, and heavy pack ice.

Beluga whales are an important part of Inuit culture and are hunted by Inuit for food. Belugas are also a charismatic animal to all Canadians, and a portion of their populations are slated to be listed as Endangered under the federal Species at Risk Act (SARA).

STUDIES / PROGRAMS THAT GATHER INFORMATION

The Department of Fisheries and Oceans (DFO), in conjunction with the Nunavut Wildlife Management Board (NWMB) are responsible for the management of belugas and collect information on them. Aboriginal Affairs and Northern Development Canada (AANDC) also fund research through the Northern Contaminants Program (NCP).

STATE OF KNOWLEDGE

Stocks were last assessed using flyovers in both 2001 and 2004, depending on the population. The "WHB" population was estimated at 57,300 animals and the "EHB" population was estimated at 3,100 animals. 8,400 belugas were estimated for James Bay, and 1,000 for northern Hudson Bay. An additional 7,000 belugas were estimated for the Ontario coast of Hudson Bay, but it is unclear if these belugas were already counted elsewhere.

TREND(S)

The average harvest from all Nunavut communities reporting taking belugas was 577 between the years 2000 and 2006. DFO reports that an additional 100 belugas could be taken without significant population decline.

PRESSURES

Possible pressures on beluga whales include: harvesting, climate change, disease and illness, and contaminants.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Possible indicators of the health of belugas include: stock size and range, harvest data, preferred habitat for different life-stages, kill rate by predators, quality of sea ice, temporal extent of sea ice, spatial extent of sea ice, and contaminant loads in individual whales.

Under the Health of the Oceans Initiative, DFO provides advice in support of the management of Marine Protected Areas (MPAs). This includes identification of indicators, protocols and strategies to be incorporated into MPA monitoring plans.

THRESHOLDS

Total Allowable Harvest (TAH) is expressed as Total Allowable Landed Catch (TALC) by DFO for each stock and then implemented by the NWMB.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of beluga whales:

- What is the population abundance and distribution of beluga whales?
- What is a sustainable harvest rates?
- Where are the beluga whale migration routes?
- What levels of contaminants are belugas exposed to and what are the impacts?
- What are the effects of changes in the ice regime to beluga whales?
- What are the effects of increased killer whale predation on beluga whales?
- What are the effects of increased shipping from noise, ice breaking and disturbance to beluga whales?

NGMP has identified the following monitoring needs to enhance understanding of beluga whales:

- Increased precision and accuracy of stock estimates,
- Repeated surveys and ongoing monitoring,
- Monitoring the effects of increased killer whale presence and predation, and
- Assessing the effects from individual development projects.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on the beluga whale. To access this report or for further information on NGMP's current knowledge base regarding beluga whales, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.3 NGMP MONITORING BLUEPRINT (2013) – BOWHEAD WHALE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to bowhead whale, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The bowhead whale (*Balaena mysticetus*) is a large migratory whale with great cultural and sustenance value. Historic overhunting reduced its population greatly, but recent increases in population size have allowed some harvesting to continue.

The bowhead whale has long been important to Inuit for subsistence and is being revived as an important cultural icon and food source, and is known in the scientific community as a keystone species. In addition, COSEWIC has assessed and designated the two Eastern Arctic bowhead whale populations in the Canadian Eastern Arctic as Threatened.

STUDIES / PROGRAMS THAT GATHER INFORMATION

DFO is responsible for monitoring bowhead whale populations, recommending allowable harvest levels to the Nunavut Wildlife Management Board (NWMB) and preparing a Recovery Strategy under the federal *Species at Risk Act*. DFO has been undertaking surveys and identifying critical habitat for bowhead whales. This has involved tagging and tracking whales using satellite telemetry. The NWMB co-manages the harvest with DFO, along with the Nunavik Marine Region Wildlife Board.

STATE OF KNOWLEDGE

Populations that have been harvested more frequently have more biological information available, such as the Bering-Chukchi-Beaufort whales. Aerial surveys combined with knowledge gained from hunters from a 1981 survey puts the population estimate at approximately 1684 individuals in the Baffin Bay region.

TREND(S)

A literature review revealed that populations are thought to be expanding. COSEWIC changed the 2005 Threatened determination to Special Concern in 2009, based on Inuit knowledge as well as scientific research indicating that populations are increasing. New research indicates that a harvest rate of 18 individuals per year is unlikely to jeopardize population recovery.

PRESSURES

Possible pressures on bowhead whale populations include: toxins (pollution), noise (due to marine traffic), climate change (primarily loss of sea ice affecting prey availability), ship strikes, ice entrapment, entanglement, and predation (from humans and killer whales).

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Existing indicators with respect to bowhead whale population health include: abundance and trend, distribution and range, quality of sea ice, temporal extent of sea ice, spatial extent of sea-ice, ambient and anthropogenic noise levels, vessel traffic, ship strikes, contaminant load, harvest level, population structure, calf production, body condition, mortality rate (predation from killer whales and humans), age/stage structure, seasonal distribution, habitat use.

Existing protocols for bowhead whale data collection include: aerial surveys (summering or wintering areas), photographic mark-recapture surveys, genetic mark-recapture surveys, boat and shore-based surveys, and acoustic surveys. DFO has identified a need for a population re-assessment in the near future. Future monitoring protocols include assessing bowhead whale mortality due to killer whale and human predation.

THRESHOLDS

The current level of harvest in Canada is three bowhead whales per year in the Nunavut Settlement area.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of bowhead whales:

- What is the population abundance and distribution in Nunavut?
- What areas are critical habitats?
- What is the extent and level of killer whale predation?
- What is the effect of Killer Whale predation on bowhead whale distribution?

NGMP has identified the following monitoring needs to enhance understanding of bowhead whales:

- Bowhead whales need to be moved from being considered a data-poor species to a data-rich species, which requires three or more population estimates within ten years and population data on survival and reproduction.
- Some life history characteristics which must be assessed are:
    - calf production,
    - body condition,
    - mortality rate, including level of Killer Whale predation, and
    - age structure.
- Seasonal distribution is also needed to assess critical habitat and guide future surveys.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on the bowhead whale. To access this report or for further information on NGMP's current knowledge base regarding bowhead whales, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.4 NGMP MONITORING BLUEPRINT (2013) – KILLER WHALE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to killer whales, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Killer whales are found in all oceans of the world. In Nunavut, killer whales are infrequently reported in many areas but are reported most often near Repulse Bay and in the Lancaster Sound region. Killer whales are thought to only be present in Nunavut waters during the open water season.

Killer whales are a keystone species and a major predator that may re-shape marine ecosystems through top-down forcing. Killer whales are also a climate change indicator as they exploit new territory as sea ice conditions change.

STUDIES / PROGRAMS THAT GATHER INFORMATION

DFO and the University of Manitoba have been conducting research on killer whale distribution in Nunavut, particularly with respect to increased presence and predation on marine mammals.

STATE OF KNOWLEDGE

Evidence of choke points exists; areas where there is seasonal variation in sea ice presence and affects killer whale distributions in the Arctic. These conditions are expected to change with global change. Killer whales are known to prey on a number of other marine mammals in the high Arctic. Their population in the Arctic is estimated at 25 individuals, and they can travel great distances over the course of seasons.

TREND(S)

Killer whale sightings have increased exponentially in the Hudson Bay region since a significant sea ice choke point in Hudson Strait opened up approximately 50 years ago. Killer whales are now reported in the Hudson Bay region every summer. It was predicted that other choke points are likely to soon open up with continued sea ice melt, producing punctuated predator–prey food web changes across the Arctic.

PRESSURES

The entry of killer whales into Hudson Bay creates a pressure on other marine mammal stocks, particularly beluga whale, narwhal and bowhead whale stocks.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Some indicators of killer whale health include: population size and distribution, quality of sea ice, temporal extent of sea ice, spatial extent of sea ice, and contaminant loads in individuals.

Killer whale data collection is done by satellite tracking, anecdotal evidence, sighting reports, Inuit traditional knowledge, and photographic identification. Combining methods such as sighting reports, photographic identification, acoustic research, and Inuit oral knowledge can significantly improve the understanding of complex processes such as the ecosystem effects of killer whale activity in Hudson Bay and by extension in other areas of Nunavut.

THRESHOLDS

The killer whale is a new predation pressure on marine mammals in Nunavut waters. Thresholds will relate to the extent of increase in the killer whale population and distribution, and its adverse effect on the distribution of key harvested species (i.e. seals, beluga whale, narwhal, walrus etc.).

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of killer whales:

- How do hunting behaviours determine the factors that influence prey choice?
- Does killer whale predation affect populations of beluga, narwhal, and bowhead whales?

NGMP has identified the following monitoring needs to enhance understanding of killer whales:

- Collecting quantitative data about the number of killer whales entering the Arctic,
- Using traditional knowledge as a source of information.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on killer whales. To access this report or for further information on NGMP's current knowledge base regarding killer whales, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.5 NGMP MONITORING BLUEPRINT (2013) – WALRUS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to walruses, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The walrus has a discontinuous circumpolar distribution in the Arctic. Within Nunavut, the Atlantic walrus ranges from Bathurst and Prince of Wales islands to Davis Strait and from James Bay to Kane Basin. Four distinct stocks of Atlantic walrus have been identified in Canada and all reside in Nunavut: South and East Hudson Bay, Hudson Bay—Davis Strait, Foxe Basin and Baffin Bay.

The walrus is harvested by Inuit on a subsistence basis and have traditionally provided important staples in the subsistence economy of the eastern Canadian Arctic and Greenland Inuit. The hunt and sharing of its proceeds continue to be of great social and cultural significance and the meat is consumed and considered an important source of protein. Additionally, the walrus is a species of special concern as designated by COSEWIC, and is also a keystone species in its ecosystem.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The walrus hunt is regulated under the Fisheries Act. Walrus hunts in Nunavut are co-managed by the Nunavut Wildlife Management Board with scientific advice and support from the Department of Fisheries and Oceans (DFO), which manages the walrus in other jurisdictions in cooperation with other agencies. Mercury and halogenated organic compounds are being monitored in walruses through research conducted under the AANDC Northern Contaminants Program.

STATE OF KNOWLEDGE

Many (18 out of 28) communities in Nunavut harvest walruses. Opportunistic counts suggested there were 270+ animals in the late 1990s in the South and East Hudson Bay area. The most recent survey (August 1990) counted 1376 animals in the Coats Island–Southampton Island area, and 461 in the Nottingham Island-Salisbury Island area. An aerial survey in 1999 of Baffin Bay, combined with best guesses for areas not counted, suggest the population may have numbered about 1500 animals.

TREND(S)

Walruses appear to be recovering from historical exploitation. Walrus populations are generally identified as stable or increasing in numbers.

PRESSURES

Atlantic walrus populations in Canada may be limited or threatened by hunting activities, noise disturbance, and industrial activities. Their narrow ecological niche and restricted seasonal distribution make walruses relatively easy to hunt and vulnerable to environmental changes. Hunting is the cause of most known mortality among Atlantic walruses. It probably poses the most consistent limiting factor and threat to populations in Canada.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

The indicators of walrus population health are: body condition and reproductive status, disease and contaminant loads of individuals, reproductive rate, stock size and range, harvest statistics, and quality of sea ice, temporal extent of sea ice, and spatial extent of sea ice.

Walruses are monitored through aerial surveys that concentrate on haul-outs on land or ice where walrus gather to socialize and rest. Aerial surveys have improved the knowledge of abundance, but have their limits. Walruses cannot be counted when they are under water and surveys of haul-outs do not provide information on migration.

THRESHOLDS

As of 2006, four settlements in the Canadian Arctic had annual community quotas: Coral Harbour 60, Sanikiluaq 10, Arctic Bay 10, and Clyde River 20. Elsewhere, Inuit and other aboriginal peoples of Canada can harvest up to four walruses per year without a license; non-aboriginals require a license.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of walruses:

- What are the abundance and distribution sizes?
- What are the harvest rates, including harvest rates in Greenland affecting overlapping stocks?
- What are their migration routes and habitat?
- What levels of contaminants are present?
- Are there effects of changes in the ice regime?
- What are the impacts to the population due to commercial shipping?

NGMP has identified the following monitoring needs to enhance understanding of walruses:

- Estimates of the walrus populations and removals to ensure that declines in recorded harvests do not signal population depletion,
- Data on total harvest rates,
- Document areas where walrus are found to haul-out in large numbers to aid in land and marine based conservation for this species.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,

- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on walruses. To access this report or for further information on NGMP's current knowledge base regarding walruses, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

10.6 NGMP MONITORING BLUEPRINT (2013) – NARWHALS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to narwhals, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Narwhals occur year-round north of 60° in the eastern Canadian High Arctic and in waters around West Greenland. The narwhal is the most specialized Arctic cetacean and the most restricted in distribution. In summer, narwhals spend approximately two months in High-Arctic ice-free shallow bays and fjords and overwinter in offshore, deep, ice-covered habitats along the continental slope. These seasonal distributions are connected by extensive annual migrations (>1000 km) that last approximately two months.

The narwhal is used as a food source for Inuit, from which tusks are opportunistically harvested. Narwhals are also an important cultural component for Inuit and are a charismatic species valued by Nunavummiut and Canadians at large.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Fisheries and Oceans Canada (DFO) conducts surveys of narwhal populations in support of harvest management decisions for the Nunavut Wildlife Management Board (NWMB). The World Wildlife Fund (WWF) reported that it was supporting a new project to track narwhals using attached satellite tracking devices.

STATE OF KNOWLEDGE:

Two stocks of narwhals were previously identified in Nunavut waters: the High Arctic stock and the Northern Hudson Bay stock. Some studies have identified possible differences within the above populations, but these studies are in their infancy and need to be expanded upon greatly. Traditional knowledge is considered an important input for seasonal occurrences.

TREND(S)

All narwhal population trends are considered to be possibly in decline or unknown. The narwhal is listed as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is Under Consideration under the Species at Risk Act (SARA).

PRESSURES

Increasing killer whale predation is an emerging pressure, as sea ice conditions become more conducive to killer whales migrating into narwhal habitat. The narwhal does not appear to adapt its behaviour to stressors such as hunting, indicating that it could be quite sensitive to changes in habitat or prey availability.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of the health of narwhal populations include: stock size and range, seasonal distribution and movement, harvest data, preferred habitat for different life stages, kill rate by predators, quality, timing and spatial extent of sea ice, and contaminant loads in individual narwhals.

DFO has been working to develop a decision tool to help co-managers decide on the allocation of total allowable landed catch (TALC) of Baffin Bay narwhal stocks given that multiple communities may harvest from the same summering stocks. Aboriginal Affairs and Northern Development Canada (AANDC) provides information on the extensive work being done on the development and application of protocols for monitoring contaminants which includes present and future work on narwhals.

THRESHOLDS

A literature review on narwhals revealed that the only available threshold for the narwhal is TALC, which is set by DFO at a rate that allows for sustainable harvest. TALCs are determined from both Inuit Traditional Knowledge and scientific-based knowledge. DFO consults and works with communities and stake holders throughout the process of defining the allowable catch.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of narwhals:

- Understanding abundance and distribution;
- Determining sustainable harvest rates;
- Identifying migration routes;
- Identifying levels of contaminants;
- Effects of changes in the ice regime;
- Effects of increased killer whale predation;
- Effects from the turbot fishery;
- Effects of increased shipping from noise, ice breaking and disturbance.

NGMP has identified the following monitoring needs to enhance understanding of narwhals:

- Effects of increased killer whale presence on distribution and behaviour of narwhals,
- Increased quantitative population data,
- Migration information.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on narwhals. To access this report or for further information on NGMP's current knowledge base regarding narwhals, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.0  TERRESTRIAL WILDLIFE

11.1 NGMP MONITORING BLUEPRINT (2013) – CARIBOU

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to caribou, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

There are at least 23 herds of caribou in Nunavut ranging in size from several hundred Peary caribou roaming across the islands of the High Arctic to the tens or hundreds of thousands of caribou which migrate across the tundra and taiga of mainland Nunavut. Of concern is the lack of detailed knowledge of the population sizes and the impacts of human activities on caribou.

Caribou is a keystone species and provides food and socio-cultural activities for Nunavummiut. The monetary value of caribou in Nunavut is estimated at $17 million. To Nunavummiut, caribou have an intrinsic value that far exceeds any other valuation.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Within Nunavut, responsibility for managing caribou, and therefore information gathering, is shared across several levels of government, Inuit organizations, land and resource boards established under the Nunavut Land Claims Agreement (NLCA), and wildlife co-management organizations such as the Regional Wildlife Organizations (RWO's) and Hunters' and Trappers' Organizations (HTO's).

STATE OF KNOWLEDGE

Barren ground caribou are found throughout the mainland in the Kivalliq and Kitikmeot regions and most of Baffin, Victoria and Southampton islands, as well as several smaller islands in the northern and eastern Foxe Basin. Peary caribou are listed in Part 2 of the Species at Risk Act as endangered, and Dolphin Union Caribou herd are Special Concern. The Barren-Ground Caribou (*Rangifer tarandus groenlandicus*) is listed in Part 4 of the Species at Risk Act as Special Concern.

TREND(S)

Both Inuit traditional knowledge and scientific evidence agree that caribou herds go through long cycles of abundance and scarcity in response to environmental factors. These are natural cycles that have occurred for millennia, and are thought to be linked to the effect of climate and caribou populations on

forage species. Currently, evidence suggests that many of the herds in Nunavut are declining with herd sizes considerably lower than those recorded in previous decades.

PRESSURES

The main pressures on caribou are habitat loss, degradation, and fragmentation, as well as predation and disease. The mechanisms of the current declines in many of the herds in Nunavut are not well understood but there is concern that human activities could be contributing to this change.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of caribou health as a VEC in Nunavut include: population size and trends, caribou harvest levels, calf/cow ratio, habitat availability, migratory connectivity and the presence of barriers to movement, and availability of forage.

The Government of Nunavut (GN) recommends for future data collection that: research and monitoring activities are based on validated methods; that new or alternative tools for caribou monitoring and management, including methods consistent with Inuit values, are implemented; that data are readily available; and that industry is included in research. Furthermore, the incorporation of satellite tracking into study designs is considered the only way to understand caribou population ecology without influencing their behavior.

THRESHOLDS

Total Allowable Harvest (TAH) levels are established by GN DOE to manage harvesting in a manner that provides for the sustainability of populations, and is an example of a threshold for caribou.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of caribou:

- What are the population sizes and trends?
- What is a sustainable caribou harvest rate?
- What is the calf/cow ratio?
- What is the availability of habitat?
- What is the migratory connectivity and the presence of barriers to movement?
- What are the impacts to caribou from development projects?

NGMP has identified the following monitoring needs to enhance understanding of caribou:

- Current and future changes in the size and productivity of some caribou herds especially the factors responsible for those changes,
- The distribution of sensitive habitats,
- Migratory patterns,
- The types and quantity of habitat needed to support viable herds, and
- The extent to which development and other land uses affect caribou

- management of development activities in sensitive caribou habitats such as calving grounds and post calving areas requires special attention.

It has been particularly noted that IQ/Traditional Knowledge studies have provided highly useful information with respect to caribou.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on caribou. To access this report or for further information on NGMP's current knowledge base regarding caribou, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.2 NGMP MONITORING BLUEPRINT (2013) – MUSKOX

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to muskox, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Muskox are present on most of the Nunavut mainland except northeastern and western areas, and on most Arctic islands except Baffin and Southampton Islands. Muskox are an emblematic figure of the Arctic. It has been able to survive the toughest arctic conditions and has been a key species for the survival of carnivores, local inhabitants and foreign expeditions, and a key component of the ecosystem.

Muskox are a VEC because they provide subsistence for Nunavummiut, are harvested commercially, are a keystone species consumed by carnivores, and also are harvested by sports hunters using Inuit guides.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The Government of Nunavut as well as various academic research projects gathers information on Muskox in Nunavut.

STATE OF KNOWLEDGE

There are approximately 50,000 Muskox in the Kitikmeot region of Nunavut. Approximately 4% of them are harvested annually, divided amongst subsistence, commercial, and sport hunts. In the Kivalliq region, there are approximately 20,000 Muskox. The High Arctic Islands population is approximately 17,500.

TREND(S)

Since the major decline in muskoxen populations over the Arctic and subarctic during the 1800s and early 1900s, and the subsequent protection of the species (1917), muskoxen populations have recovered in most of their Canadian range and are progressively re-colonizing the eastern and southern parts of their historic range.

PRESSURES

Harvesting, disease, harsh environmental conditions, lack of forage, and habitat loss are all pressures on the Muskox population.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of the health of Muskox include: population numbers, population distribution, harvest level, monetary value of harvest, proportion of calves, pregnancy rates, movements and distribution, habitat availability, predation, body weight/fat, levels of contaminants, and availability of forage.

Existing data collection of Muskox consists of fixed-width line transect surveys and information obtained through harvesting activities.

THRESHOLDS

Total Allowable Harvest (TAH) levels are established by Government of Nunavut Department of Environment (GN DOE) to manage harvesting in a manner that provides for the sustainability of populations.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of muskox:

- What are the effects of various developments on muskox use of habitat?
- What is a sustainable harvest rate?

NGMP has identified the following monitoring needs to enhance understanding of muskox:

- Implementing routine monitoring in the Arctic Archipelago and areas with smaller populations to evaluate trends in abundance,
- Refining total allowable harvest needs on an ongoing basis,
- Understanding potential effects from individual development projects.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on muskox. To access this report or for further information on NGMP's current knowledge base regarding muskox, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.3 NGMP MONITORING BLUEPRINT (2013) – WOLVERINE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to wolverines, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The wolverine is the largest member of the family Mustelidae (weasels). The species has a circumpolar distribution, inhabiting northern boreal forest, taiga, and tundra habitats in North America and Eurasia.

Wolverines are ranked as vulnerable worldwide and are valued both culturally and as a food/pelt source by Nunavummiut. Wolverines are also considered good indicators of ecosystem health, since they depend on large, connected and intact ecosystems. They are vulnerable to impacts from habitat fragmentation, overharvest, disturbance, and declining ungulate populations.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Various bodies have collected or do collect information on wolverines in Nunavut including individual development projects and government. The Nunavut Department of Environment website identified current research project involving wolverine hair snagging and carcass collection projects, and a wolverine landscape use study. The University of Quebec at Rimouski is also monitoring wolverines as part of a monitoring program of large terrestrial carnivores in Nunavut.

STATE OF KNOWLEDGE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has listed the western population of wolverine, which includes Nunavut, as “Special Concern”. Little is known about wolverine population structure in Nunavut; however wolverines are estimated to number 2000 to 2500.

TREND(S)

Wolverine numbers are believed to be stable to slightly increasing in Nunavut.

PRESSURES

Harvesting is the most significant pressure on wolverines in Nunavut. Wolverines are sensitive to over harvesting, as they have a very low intrinsic rate of increase. Additional pressures on wolverines include accidental mortality (i.e. snowmobile collisions) and development projects.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of the health of wolverines include: population size/distribution, reproductive success, habitat loss or fragmentation, wolverine harvest levels, proportion of females in the total harvest, and prey species population size and distribution.

There is some research-level monitoring using mark-recapture techniques near Kugluktuk. Harvest records, including locations and carcass samples, are collected in the Kitikmeot region. In Ontario, the Ministry of Natural Resources (OMNR) has tested several methods for detecting wolverines at different spatial scales, including aerial track surveys, interviews with local trappers, hair snares, remote cameras, live-trapping, and radio telemetry.

THRESHOLDS

A literature review revealed limited information on thresholds in relation to wolverines in Nunavut. In the core management area of Nunavut, where wolverines are abundant, the total number that can be harvested each year is 200. In areas where they are not abundant but appear regularly, the total annual harvest number is 65. In all other areas, there is no season for wolverine.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of wolverines:

- Are there any significant changes in wolverine population levels?
- Are changes occurring in wolverine distribution?
- Are there any significant changes in juvenile survival?
- Are there any changes in the level of the harvest?
- Are there any significant changes in the sex ratio of the harvest?

NGMP has identified the following monitoring needs to enhance understanding of wolverines:

- Quantitative population data and baseline wildlife habitat information,
- Determine what communities use the species,
- Post-project monitoring at all development projects,
- Combining wildlife resource data with traditional knowledge.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on wolverines. To access this report or for further information on NGMP's current knowledge base regarding wolverines, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.4 NGMP MONITORING BLUEPRINT (2013) – POLAR BEARS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to polar bears, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Polar bears are found throughout Nunavut and range from the northern end of Ellesmere Island south to the Belcher Islands. There are 19 polar bear populations in the world. Of these, 13 are found in Canada and 12 are in Nunavut.

Polar bears are important to the Arctic ecosystem because they are a top predator. They also have significant cultural and economic importance to Inuit and are hunted by almost all communities in Nunavut.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Various bodies collect information on polar bears including the Government of Nunavut (GN), the Northern Contaminants Program, the World Wildlife Fund, Aboriginal Affairs and Northern Development Canada, and various academic researchers.

STATE OF KNOWLEDGE

Polar bears are protected under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and are classified under the International Union for Conservation of Nature (IUCN) as Lower Risk: Conservation Dependent. The total population numbers for all sub-populations in Nunavut were reported in 1998 to be 12,130.

TREND(S)

Annual survival rates of polar bears in Davis Strait have increased since the 1970's when annual survival was only 85%. Currently an adult female has a 91% chance of surviving every year. Polar bears in western Hudson Bay have exhibited a shift in diet towards fewer bearded seals and more harbour and harp seals. This has resulted in increased exposure to some contaminants.

PRESSURES

Pressures on polar bears include climate change, decline in habitat, decline in permafrost-based denning habitat, increases in shipping traffic, harvesting, and contaminants affecting health of polar bears and health of people-eating polar bears.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of polar bear population health include: population size and trend, distribution, birth rate, death rate, harvest level, reproductive rate, age structure, frequency and location of bear-human encounters, contaminant levels, seal population levels and locations, sea ice extent, distribution, composition, and timing of freeze-up and thaw.

Harvest data and samples are recommended for circumpolar monitoring programs. Other data collection methods include hair/DNA studies, tagging, and aerial observation.

THRESHOLDS

A threshold for polar bear populations is the harvest rate. A 2:1 ratio of males to females is thought to promote a sustainable harvest by not compromising the reproductive capacity of the population. A global harvest rate of 3-4% of the total population of 20,000-25,000 individuals is the current rate.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of polar bears:

- How adaptable are polar bears?
- What are the impacts of resource developments?

NGMP has identified the following monitoring needs to enhance understanding of polar bears:

- Data on illegal harvest rates,
- Data on changes to habitat,
- Early indicators of the effects of habitat loss due to climate change,
- Size of polar bear subpopulations, and
- Identifying which measures to best represent reproductive output and survival.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on polar bears. To access this report or for further information on NGMP's current knowledge base regarding polar bears, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.5 NGMP MONITORING BLUEPRINT (2013) – GRIZZLY BEAR

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to the grizzly bear, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Grizzly bears are members of the family Ursidae, and occur in Canada, the USA and at least 42 Eurasian countries. In Canada, grizzlies can be found in parts of Alberta, British Columbia, Yukon, the Northwest Territories, and Nunavut. In Nunavut, barren ground grizzly bears occur throughout the Kivalliq region and in large portions of the Kitikmeot and Baffin regions.

Grizzly bears are considered indicator species, meaning that they are sensitive to minute changes in their ecosystems. Grizzly bears are also highly regarded culturally by all Canadians as typical of our wilderness. In addition, grizzly bears are harvested by Nunavummiut and provide food, pelts, and ornaments.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Some examples of grizzly bear studies are: Kitikmeot Region Grizzly Bear and Wolverine Hair Snagging Project, Kitikmeot Grizzly Bear Diet Study, Kitikmeot Grizzly Bear Stress Study, Kitikmeot Grizzly Bear and Wolverine Landscape Use, Kitikmeot Grizzly Bear/Human Conflict Study, Kitikmeot Furbearer Disease Monitoring, and Grizzly Bear Harvest Monitoring. The University of Quebec at Rimouski is also monitoring grizzly bears as part of a monitoring program of large terrestrial carnivores in Nunavut.

STATE OF KNOWLEDGE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has listed the northwestern population of grizzly bear, which includes Nunavut, as being of “Special Concern”. The number of grizzlies in Nunavut is unknown, but according to COSEWIC is believed to have been relatively stable since 1990 at between 800 and 2000 animals.

TREND(S)

A literature review revealed that the number of grizzlies in Nunavut is unknown, but is believed to have been relatively stable since 1990. The most comprehensive data comes from west Kitikmeot and Slave Geological province where the population is believed to be stable or slightly increasing. In a traditional

knowledge survey of the people of Kugluktuk and Baker Lake, respondents stated that the grizzly bear population in Nunavut has been increasing over the past five decades.

PRESSURES

Harvesting is one of the main pressures on grizzly bear populations. Development projects and increased human encroachment on habitat, such as road building, can negatively impact grizzly bear populations.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators for the grizzly bear are population size, reproductive rates, habitat quality, number harvested, proportion of females in the harvest, levels of human activity in areas of bear concentration, and caribou population size and distribution.

Protocols for VEC data collection include satellite and VHF radio-telemetry programs, collection and analysis of grizzly bear scats, habitat suitability and effectiveness modeling, mandatory reporting of harvests, Population Viability Analysis (PVA), and hair snagging studies.

THRESHOLDS

The total allowable annual harvest (TAH) of grizzly bears in Nunavut has been set at eight bears for the Kugluktuk area, six bears for Bathurst Inlet, and six bears for Kivalliq and east Kitikmeot. In all other areas of Nunavut, which are considered to be colonizing areas, the total allowable harvest for grizzly bears is zero.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of grizzly bears:

- What trends are detectable in grizzly bear population levels?
- Are changes occurring in grizzly bear distribution?
- Are there any significant changes in grizzly bear reproductive success?
- Are changes occurring in the frequency of grizzly bear encounters with humans?
- Are there any significant changes in human-caused mortality (i.e. harvests of all kinds plus other forms of anthropogenic mortality)?
- Are there any significant changes in the sex ratio of the harvest?

NGMP has identified the following monitoring needs to enhance understanding of grizzly bears:

- Address gaps on species utilized by communities, followed by habitat which may be affected through pending industry activity,
- Identify known denning areas, determine values associates with grizzly bears, and to clarify population and harvest objectives,
- Long-term population and habitat monitoring studies are important to provide a basis for evaluating the effectiveness of land use plans.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on grizzly bears. To access this report or for further information on NGMP's current knowledge base regarding grizzly bears, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.6 NGMP MONITORING BLUEPRINT (2013) – WOLVES

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to wolves, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Wolves are members of the family Canidae, which includes foxes and dogs. Tundra and high arctic wolves are found throughout Nunavut, and have lived on the mainland barren-ground tundra and the arctic islands for thousands of years.

Wolves are a Valued Ecosystemic component because they have been designated as "Sensitive" by the Nunavut Wild Species 2000 report. They are important to the culture and economy of northern peoples, as a pelt source, and play an integral role in the Arctic food web as top predators.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Proponents of development projects collect baseline information on wolves as part of studies supporting environmental impact assessments. Mandatory reporting of harvesting exists in Nunavut. Some studies that have gathered knowledge about wolves in Nunavut include traditional knowledge studies such as the West Kitikmeot/Slave Study, the Nunavut Wildlife Harvest Study, the Northern Contaminants Program, and the Northern Ecosystem Initiative. The University of Quebec at Rimouski is also monitoring wolves as part of a monitoring program of large terrestrial carnivores in Nunavut

STATE OF KNOWLEDGE

There are no known continuous programs to determine or estimate carnivore populations in Nunavut. Foxes and wolves are not managed or studied in Nunavut. For individual development projects, there is variability in the density of wolf populations in the study areas. The ArcticWOLVES project is a comprehensive database of most of the information collected at the Canadian sites during the International Polar Year program and, in some cases, during previous years as well. This database includes data on the abundance, distribution, reproduction and ecology of a large number of Arctic wildlife species that will be useful for future studies.

TREND(S)

The population of tundra/timber wolves is believed to be large. The International Wolf Centre has published an estimate for Nunavut of 5000 arctic wolves, and the population is characterized as stable.

PRESSURES

The primary threats to wolves include persecution by humans, disruption of caribou distribution and migratory patterns, disturbance of denning sites, overharvesting, and disease.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of the health of wolves include food availability, habitat quality, population size and pup survival, and number harvested.

Radio telemetry is a popular method for monitoring large terrestrial mammals, including wolves. In a worldwide review and assessment of current surveying methods, territory mapping using radio telemetry was the most common method used.

THRESHOLDS

A literature review revealed no information regarding thresholds for food availability, habitat quality, population size, or pup survival indicators in Nunavut. There is an open season on wolves in Nunavut, except when denning or with pups. There is no total allowable harvest limit for wolves.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of wolves:

- Once baseline data is available, are there significant changes in wolf population levels?
- Are changes occurring in wolf distribution?
- Are there trends in the wolf harvests?
- Are there trends in other anthropogenic wolf mortality?
- What are the cumulative effects of oil and gas exploration, pipeline construction, mining activities, and other forms of development on wolves?

NGMP has identified the following monitoring needs to enhance understanding of wolves:

- Baseline population data and an inventory database of wolf populations in Nunavut,
- Identify known denning areas and to clarify population and harvest objectives,
- Combine scientific data with Inuit Qaujimajatuqangit (traditional knowledge),
- Long-term population and habitat monitoring studies in order to provide a basis for evaluating the effectiveness of land use plans.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,

- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on wolves. To access this report or for further information on NGMP's current knowledge base regarding wolves, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.7 NGMP MONITORING BLUEPRINT (2013) – FOXES

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to foxes, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The Arctic fox is a member of the family Canidae, which includes wolves, dogs and other foxes. The species inhabits mainly Arctic and alpine tundra, coastal areas and some forested areas in the southern portion of their range. The Arctic fox has a circumpolar distribution, ranging from northern Greenland to the southern tip of Hudson Bay, Canada.

Arctic foxes are valued for their pelts. Trapping is an important subsistence activity in Nunavut, and pelts are a valuable source of income for many northern residents. The Arctic fox is also a keystone species in the tundra ecosystem.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Various impact assessments collect information as well as other sources such as the Nunavut Wildlife Harvest Study, a TEK study by the Naonayaotit Traditional Knowledge Project, and the Northern Contaminants Program, among others.

STATE OF KNOWLEDGE

A literature review revealed that current arctic fox population information in Nunavut is limited; the species is neither managed nor studied in the territory. The world population of Arctic foxes is on the order of several hundred thousand animals. Although only a few populations have been studied directly, population status is believed to be good in most areas.

TREND(S)

Trends in fox populations in the Arctic appear to be poorly understood but are known to track lemming populations closely.

PRESSURES

Development projects have the potential to displace Arctic foxes, disturb food sources such as lemmings, and destroy denning sites. Harvesting of fox for their pelts is another pressure on populations.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of Arctic fox population health include food availability, presence of disease such as rabies, and number of foxes harvested.

Long-distance gene flow in Arctic foxes precludes identification of particular movement corridors or directional migrations, so regional ear-tagging and radio-collaring studies may be more effective at answering these questions.

THRESHOLDS

The status of the Arctic fox in Nunavut is currently listed as "Secure" by the National General Status Working Group, and no specific thresholds for Arctic foxes have been established.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of foxes:

- Are red fox populations encroaching on Arctic fox populations?
- What are the litter sizes of Arctic foxes?
- What is the extent of sea-ice that the Arctic fox uses for movement in winter?
- Is there potential for Climate change to affect Arctic fox denning habitat?

NGMP has identified the following monitoring needs to enhance understanding of foxes:

- Quantitative population data,
- Movement data,
- Post-project monitoring at all development projects which enables verification of assessment conclusions, identification of unanticipated impacts, fine-tuning and refinement of mitigation measures as needed, and documentation of significant impacts on abundance and distribution of wildlife populations, including Arctic fox.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on foxes. To access this report or for further information on NGMP's current knowledge base regarding foxes, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.8 NGMP MONITORING BLUEPRINT (2013) – RABBIT/HARE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to the Arctic hare, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The Arctic hare is a member of the order Lagomorpha. It is the most northern, and among the largest, of the hare species. It is widely distributed in northern Canada and Greenland, and can be found throughout Nunavut.

Arctic hares are a food source for many tundra predators, and provide food and clothing to Nunavummiut who harvest them.

STUDIES / PROGRAMS THAT GATHER INFORMATION

A literature review of Arctic hares revealed no specific research programs being conducted in Nunavut. This may be due to constraints on resources, combined with low harvest levels, which make it a low priority species. Proponents of development projects collect baseline information on Arctic hares as part of monitoring studies supporting environmental impact assessments.

STATE OF KNOWLEDGE

The Wild Species 2005 report lists Arctic hare in Nunavut as “Secure”, the International Union for Conservation of Nature (IUCN) Red List of Threatened Species lists Arctic hare as “Least Concern”, and the population trend is “Unknown” but it is thought to be stable and healthy. Sporadic freeze-thaw events are increasing, and these may affect the availability of vegetation for a variety of browsing and grazing animals, including Arctic hare.

TREND(S)

Population trend information for the Arctic hare is limited but thought to be stable and healthy.

PRESSURES

Predation is the main pressure on Arctic hare populations, as well as human harvesting. Illness may be an issue when population pressures are high, and climate change may negatively influence their ability to move around due to shifting ice regimes.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of the health of Arctic hares include: population size and distribution, population sizes of key predator species, reproductive success, harvest levels, and timing of freeze-up and ice out.

NGMP identified no data collection protocols for the Arctic hare in Nunavut. In the Northwest Territories, snowshoe hare abundance is measured using long-term (10 year) pellet (scat) count surveys.

THRESHOLDS

A literature review revealed no established thresholds for the Arctic hare, but harvest levels are thought to be well below the critical level.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of Arctic hares:

- What are the changes in populations of the Arctic hare?
- What are the changes in distribution of the Arctic hare?
- What are the trends in harvesting the Arctic hare?
- What changes could climate change bring about in the Arctic hare?

NGMP has identified the following monitoring needs to enhance understanding of Arctic hares:

- Post-project monitoring at all development projects,
- Quantitative data focusing on arctic hare population biology and population trends.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on Arctic hares. To access this report or for further information on NGMP's current knowledge base regarding Arctic hares, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

11.9 NGMP MONITORING BLUEPRINT (2013) – ARCTIC GROUND SQUIRREL AND MUSKRAT

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to Arctic ground squirrels and muskrats, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The Arctic ground squirrel is the largest of all the ground squirrels, and also the one with the most northern distribution. The muskrat, a medium-sized rodent, is highly aquatic and largely limited to areas south of the tree line.

As a group, small mammals such as ground squirrels and muskrats constitute a very important component of the arctic ecosystem because they are a food source for many tundra predators, are indicators of ecosystem health, and provide food and pelts to Nunavummiut.

STUDIES / PROGRAMS THAT GATHER INFORMATION

A literature review revealed no monitoring programs in relation to Arctic ground squirrel or muskrat populations due to constraints on resources combined with low harvest levels, which make them low priority species. The Northern Contaminants Program (NCP) collects data on muskrats to measure contaminant loads.

STATE OF KNOWLEDGE

There is limited published population information on ground squirrels, but anecdotal evidence states that they are common in Nunavut. According to the Nunavut Wild Species 2000 report, the status of the Arctic ground squirrel is secure. Sporadic freeze-thaw events are increasing, and these may affect the availability of vegetation for a variety of browsing and grazing animals, including ground squirrels and other small mammals. In the Northwest and Yukon territories, levels of PCBs, DDT, chlordane and other persistent organic pollutants in muskrats range from very low to undetectable.

TREND(S)

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species lists the ground squirrel population trend as “Unknown”, and the muskrat population trend as “Stable”. There are reports that the range of ground squirrel may be changing.

PRESSURES

Pressures on Arctic ground squirrels include climate change, harvesting, predation, and the mortality of young animals in new dens that either flood or are penetrated by permafrost. The largest pressure on muskrat populations is harvesting. Muskrats are intensively trapped for their pelts, which are of increasing economic value around the world.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of the health of Arctic ground squirrels and muskrats include: population size and distribution, population sizes of key predator species, reproductive success, harvest levels, and climate change.

A literature review indicated that there is no ground squirrel monitoring conducted in Nunavut; however, data collection involves live-trapping, marking individuals, recording calls, and infrared imagery. The most common approaches for estimating muskrat population size are house counts and mark-recapture studies.

THRESHOLDS

A literature review revealed no existing thresholds for Arctic ground squirrels or muskrats, as the populations are thought to be abundant, and the harvesting levels are sustainable.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of Arctic ground squirrels and muskrats:

- Are there any significant changes in ground squirrel or muskrat population levels?
- Are changes occurring in ground squirrel or muskrat distribution?
- What is the trend in the harvest of these species?
- Are changes occurring in the timing of snowmelt and freeze-up?
- What are the cumulative effects of oil and gas exploration, pipeline construction, mining activities, and other forms of development?

NGMP has identified the following monitoring needs to enhance understanding of Arctic ground squirrels and muskrats:

- Long-term population and habitat monitoring studies to provide a basis for evaluating the effectiveness of land use plans,
- Data collection relating to the biology of these species.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),

- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on Arctic ground squirrels and muskrats. To access this report or for further information on NGMP's current knowledge base regarding Arctic ground squirrels and muskrats, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

12.0 GEOLOGY

12.1 NGMP MONITORING BLUEPRINT (2013) – GEOLOGY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to geology, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The geology of Nunavut records almost three-billion years of Earth history, and Nunavut can be subdivided into three main temporal blocks; the Archaean, the Proterozoic and the Phanerozoic. Each era is characterized by a distinctive suite of rocks, tectonic events and resource endowment.

Geology is a VEC because it defines the environment to a large degree, and the way it is used by humans, and provides minerals and materials valued by people.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Bodies that gather information on geology in Nunavut include: The Geological Survey of Canada (GSC), Canada-Nunavut Geoscience Office (CNGO), and Natural Resources Canada, as well as proponents of development projects.

STATE OF KNOWLEDGE

The geological properties of Nunavut have been mapped at a coarse scale. Finer scale data are available at the location of proposed or operational mineral or petroleum developments, as well as research projects supported by the CNGO and GSC. The potential for mineral and petroleum developments is thought to be high in Nunavut.

TREND(S)

Long term trends in geology include glacial rebound and continued ice fracturing and erosion. Shorter term trends include continued mining exploration and development, continued oil and gas exploration, and development.

PRESSURES

Some pressures that are relevant to geology include permafrost degradation and market conditions in relation to mining, oil and gas exploration, and development.

Indicators and Protocols for Future VEC Data Collection

One long term indicator related to geology is elevation above sea-level in relation to post-glacial rebound. Some shorter term indicators are the number and location of exploration permits issued, seismic surveys, exploration wells, new mines, and new production wells.

Data collection related to geology follows standard protocols that include protocols for prospecting, aerial geophysics surveys, diamond drilling for exploration, oil and gas drilling, bulk sampling, mine production.

Thresholds

Thresholds relating to geology can be geo-hazard thresholds including earthquakes, subsidence following hydrocarbon extraction, permafrost degradation and slumping, and gas venting and oil seepage.

NGMP Monitoring Needs

NGMP has identified the following key questions for future monitoring of geology:

- What are the characteristics of mining in Nunavut (i.e. how many projects are proposed, where are they located, the level of exploration interest)?
- What are the effects of mineral exploration, development, operation and abandonment on Nunavummiut, and other VECs?

NGMP has identified the following monitoring needs to enhance understanding of geology:

- More detailed baseline data on geology,
- There is a need to track developments in the mineral exploration and development field, and
- Tracking effects of mineral exploration, development, operation and abandonment on Nunavummiut, and other VECs.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on geology. To access this report or for further information on NGMP's current knowledge base regarding geology, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

13.0 VEGETATION

13.1 NGMP MONITORING BLUEPRINT (2013) – VEGETATION

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to vegetation, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

There are three ecozones in Nunavut: Southern Arctic with few trees, and which is restricted to the mainland; Northern Arctic with stunted sparse vegetation, and which includes a portion of the mainland towards the eastern part of Nunavut and most of the Arctic islands; and the Arctic Cordillera which has little vegetation includes a small portion of the far northern Arctic Islands. There are two relict or endangered plant species and several rare plants in Nunavut.

Plants are the foundation of the food web and therefore, are relied on directly or indirectly by land animals. Some plants are harvested by Nunavummiut. Plants are part of the landscape that attracts tourism.

STUDIES / PROGRAMS THAT GATHER INFORMATION

There have been a few large scale studies of vegetation in Nunavut including a habitat classification covering the Slave Geological Province of the Kitikmeot region and Arctic Change, which surveyed vegetation throughout the circumpolar region. Proponents of development projects collect baseline information on vegetation as part of studies supporting environmental impact assessment.

STATE OF KNOWLEDGE

Vegetation varies a great deal across Nunavut from ecozone to ecozone as well as within ecozones. Landscape features affect the type of vegetation. There is only one known location in Nunavut for the threatened Porsild's bryum, and that is on Northern Ellesmere Island. Felt-leaf willow, listed by COSEWIC as Special Concern, is known to occur in Nunavut only at one location (Pelly Lake), and virtually nothing is known about the population.

TREND(S)

Over the long term, a warmer climate due to climate change will increase plant productivity, but not necessarily across the board. Despite the clear trend for an increase in plant production reported at many Arctic sites, this has not yet translated into increases in herbivore populations at those sites.

Growing season temperatures are warming in Alaska and western Canada, and satellite imagery shows a concurrent greening of the Arctic tundra.

PRESSURES

Pressures are largely development, which is fairly localized and can be mitigated, and climate change which is widespread and will continue for many years.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Key indicators of vegetation health include: litter production, population size of herbivores and change in abundance/location of harvested plant species.

Satellite imagery may be useful for doing large scale vegetation monitoring. Detailed vegetation surveys are much smaller scale, usually using transects or grids. Timing is important for successful surveys. More comprehensive survey methods are needed for rare plants. Long-term sample plots will be needed to track vegetation change.

THRESHOLDS

A literature review of vegetation revealed no information about thresholds in relation to vegetation in Nunavut.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of vegetation:

- What is the vegetation cover/abundance?
- What is the quality of the habitat?
- What changes are occurring in phenology and growth?
- What are the changes in human use/consumption of wild plants/berries?
- What are the impacts of herbivores?
- How do forest fire regimes affect vegetation (in the boreal zone)?
- What shifts, if any, have occurred in the distribution of vegetation?
- Are contaminants present?
- What is the frequency of rare plants?
- What disease and insect outbreaks are occurring?

NGMP has identified the following monitoring needs to enhance understanding of vegetation:

- Collect data to better understand the tundra food web,
- Post-project monitoring at all development projects including: dust deposition rates (and correlation to community composition and plant growth) near-site and far-site; effects on lichen growth and biomass near-site and far-site; and to validate metal concentrations in soils and vegetation, soil pH and potential phyto-toxic symptoms.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on vegetation. To access this report or for further information on NGMP's current knowledge base regarding vegetation, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

14.0 CLIMATE AND WEATHER

14.1 NGMP MONITORING BLUEPRINT (2013) – WEATHER/METEOROLOGY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to weather/meteorology, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The climate of the Canadian Arctic is characterized by long cold winters with temperatures ranging from -18° C in the south to -37° C in the north, and short cool summers with temperatures ranging from 16° C in the south to 6° C in the north. Most of Nunavut is classified as Northern Arctic, Southern Arctic and Arctic Cordillera ecozones, characterized as semi-arid with little precipitation.

Climate can be considered an important VEC as it is a fundamental aspect of the natural environment, connecting many other ecosystem as well as socio-economic components. Also, an understanding of weather and climate is important in assessing the effects of a project on ambient air quality in development project areas.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Bodies that gather information on weather in Nunavut include: the National Climate Data and Information Archive (operated by Environment Canada and encompassing data from many weather stations across Canada) and various industry-led meteorological stations.

STATE OF KNOWLEDGE

Various environmental assessments have provided baseline climatic conditions for Nunavut. In addition, the National Climate Data and Information Archive contain extensive climate data that span the entirety of any climate data records that have ever been collected in Nunavut.

TREND(S)

Documented changes experienced in the Arctic to date include significant warming, increased precipitation, changes in sea-ice dynamics, decreased snow cover and sea ice extent, coupled with the continued retreat of glaciers and ice caps, and changes in the occurrence of climatic extremes. Local knowledge from communities in Arctic Bay and Igloolik suggests that weather is becoming increasingly unpredictable with more and more extreme weather events.

Climate change is the single greatest pressure on weather and meteorology in Nunavut. Climate change is expected to drive extensive changes in the range of variability of climatic variables in Nunavut.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Important and common indicators of climate and meteorology in Nunavut include: air temperature, precipitation by type (i.e. rain, snow), wind-blown snow, wind speed and strength, solar measurements, atmospheric moisture, evaporation, relative humidity, and solar radiation.

Data collection consists of measuring climate variables such as temperature, precipitation, and wind speeds at climate stations. Data can then be analyzed qualitatively or entered into models, which can identify trends and help predict future climate conditions.

THRESHOLDS

Beyond the capacity of most governments, climate thresholds are studied on a global scale rather than a national or territorial scale. Although a defined threshold for dangerous global warming has been a contentious debate, many scientists and climate experts propose no more than a 2°C increase in global temperatures over pre-industrial levels. Although the resiliency of ecosystems and zones are different, many parts of the Arctic, Nunavut included, have already exceeded this threshold.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of weather/meteorology:

- What impacts climate change will have on: climate variables (such as temperature, precipitation, and wind speed), the way of life of the Inuit, and extreme weather events?
- What impacts will development projects have on regional climate in Nunavut?

NGMP has identified the following monitoring needs to enhance understanding of weather/meteorology:

- Expand the density and geographic coverage of precipitation and weather monitoring stations in Nunavut,
- Assess what aspects of indigenous life are most at risk from climate change.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on weather/meteorology. To access this report or for further information on NGMP's current knowledge base regarding weather/meteorology, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

15.0 NOISE

15.1 NGMP Monitoring Blueprint (2013) – Atmospheric Noise Levels

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to Atmospheric Noise Levels, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Atmospheric noise can originate from a variety of sources including development projects, municipalities, and Nunavummiut out on the land. Noise can also be generated from aircraft.

NGMP has identified that impacts and changes to atmospheric noise have the potential to:

- impact people in communities;
- have effects on caribou behavior;
- displace wildlife from traditional areas;
- affect the hunting patterns of Nunavummiut; and
- alter/compete with natural atmospheric noises.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Data from noise monitoring programs in communities are currently identified as knowledge gaps. Individual development projects gather information on atmospheric noise including the Mary River, Meadowbank, and High Lake projects.

STATE OF KNOWLEDGE

Noise monitoring data from communities, research projects and lodges/camps are currently identified as knowledge gaps by NGMP. Information exists at specific project locations, but there is no synthesis available for all of Nunavut.

TREND(S)

With respect to all of the sources of atmospheric noise levels, atmospheric noise levels can be expected to increase as the population, tourism industry, and industrial development grow in Nunavut.

PRESSURES

Pressures on atmospheric noise levels include: population growth, industrial growth, and growth of the tourism industry.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Sound levels and 24 hour averages of sound levels are both existing indicators for atmospheric noise levels.

Atmospheric noise levels are most commonly measured in decibels, which are adjusted to approximate human hearing response. Ambient sound levels are measured as a sound level over a period of time.

THRESHOLDS

A literature review revealed no general thresholds for noise levels in Nunavut. Some examples of industrial sound limits are 70 decibels (daytime) and 65 decibels (night), and 40 decibels measured 1.5 kilometres from a facility.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of atmospheric noise levels:

- What are the characteristics of the noise (i.e. level, duration, and whether it is intermittent or not)?
- What effect does the noise have on wildlife?
- What effect does the noise have on Nunavummiut hunting activities?

NGMP has identified the following monitoring needs to enhance understanding of atmospheric noise levels:

- More Nunavut wide data and information regarding atmospheric noise levels is needed.
- More monitoring into developing thresholds for atmospheric sound interactions with humans and animals is needed.
- Ongoing monitoring of atmospheric noise levels (due to industry and a rising population) is needed.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on atmospheric noise levels. To access this report or for further information on

NGMP's current knowledge base regarding atmospheric noise levels, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

15.2 NGMP Monitoring Blueprint (2013) – Marine Noise Levels

Objective

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to marine noise levels, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

Background

Navigation, pile driving, dredging, and seismic surveying all generate underwater noise. Change in ambient sound levels in the marine environment has the potential to directly affect fish, marine mammals and indirectly traditional use.

Inuit have concerns over the effects of noise which may alter the behaviour and distribution of some marine mammals due to certain mammal's sensitivity to noise. Also, noise has been shown to cause mortality and/or avoidance by fish.

Studies / Programs that Gather Information

In the past, military interest in the strategic role of the under-ice environment in the Arctic motivated much of the research on ambient underwater noise. In the Arctic, much of the work has focused on the hydroacoustic environment of the Arctic Ocean.

State of Knowledge

Noise is produced by the interaction of the pack ice and floes with environmental forces such as wind, rate of temperature change, radiation cooling, insolation, and large-scale oceanic currents. Noise is also produced by marine animals. These sources of sound are temporally variable as well as seasonal in nature. Marine mammals are potentially impacted by human activities which generate marine noise.

Trend(s)

There are expectations that shipping in the Canadian Arctic will increase as a result of climate change, changes in the ice regime and increased navigability, development projects and tourism. As shipping increases through the Canadian Arctic, noise can be expected to increase as a result of engine noise, propeller cavitation noise and noise arising from ice-breaking.

PRESSURES

The main pressures on marine noise levels include industrial development and navigation.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of marine noise include presence, location, characteristics (i.e. decibel levels, frequencies, etc.), and duration of anthropogenic noise sources, as well as presence, characteristics and intensity of natural background noise resulting from ice, wind, waves, rain, and marine mammals.

It is likely that Passive Acoustic Monitoring is used for military purposes. Sounds levels are reported in decibels.

THRESHOLDS

DFO recommends minimum mitigation standards for seismic operations in Canadian waters including establishing safety zones of at least 500 metres around the air source, ramp-up procedures for starting up the airguns, shut-downs if marine mammals are within the safety radius during operation, and use of a mitigation gun during periods of line change in low visibility.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of marine noise levels:

- What are the new sources of noise, including location, intensity, increased intensity above background noises, and duration and frequency?
- How close are new noise sources to key biologically sensitive receptors, including marine mammals?
- Are the new sources of noise cumulative with other anthropogenic noise sources?

NGMP has identified the following monitoring needs to enhance understanding of marine noise levels:

- Gather information on ambient noise levels in the Canadian Arctic using defense data and or collecting new data.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,
- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on marine noise levels. To access this report or for further information on

NGMP's current knowledge base regarding marine noise levels, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

16.0 AIR QUALITY

16.1 NGMP MONITORING BLUEPRINT (2013) – GREENHOUSE GAS EMISSIONS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to greenhouse gas emissions, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Monitoring of greenhouse gases (GHGs) in Nunavut is currently conducted by federal and international programs and initiatives. Currently, there are 2 atmospheric observatories in Nunavut which have historically or are at present monitoring GHG concentrations and trends.

With a small population and manufacturing base, total anthropogenic GHG emissions in Nunavut are currently very low. However, global GHG emissions and atmospheric concentrations are of significant concern to Arctic territories due to their particular vulnerability to climate-induced changes in permafrost, sea ice, lake ice and snow.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Programs that gather information include: Canada's National Inventory Report, International Arctic Systems for Observing the Atmosphere (IASOA), and the World Meteorological Organization Global Atmosphere Watch (WMO GAW).

STATE OF KNOWLEDGE

Total GHG emissions in Nunavut are currently very low. According to the most recent National Inventory Report (1990 – 2009), Nunavut generated 0.33 mega tonnes of GHGs in 2009, or 0.2% of Canada's total GHG emissions. Although only a small percentage of Canada's national emissions, this represents an increase of 18.8% over 1999 levels.

TREND(S)

Since Nunavut's creation in 1999, GHG emissions have increased by 18.8 % from 1999 levels. This increase over the long-term has been driven mainly by increases in electricity and heat generation, as well as road and other transportation sectors, coupled with an increasing population. More recently however, over the short-term (2005 – 2009), emissions in Nunavut for each of the key sectors have been declining.

PRESSURES

Although current GHG emission totals for Nunavut are low, given its small population and manufacturing base, planned resource extraction and mining activities in Nunavut can potentially contribute to Nunavut's total GHG emissions through both the burning of fossil fuels and soil disturbance. Growth in and expansion of diesel generation facilities could pose increasing pressures on Nunavut's territorial greenhouse gas emissions.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of GHG emissions are the gases themselves. The major GHGs are: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons , and hydrofluorocarbons.

Nunavut has joined the Climate Registry, a non-profit collaboration between North American states, provinces, and territories aimed at measuring, calculating, and reporting GHGs. Under this registry, the Government of Nunavut (GN) must follow the data collection protocols of the Greenhouse Gas Protocol.

THRESHOLDS

GHG thresholds are studied on a global scale rather than a national or territorial scale. Although a well-defined threshold for global atmospheric GHG concentrations has been difficult to define, many scientists and climate experts propose 350 parts per million (ppm) of CO_2 equivalent as the boundary condition of a safe upper limit for CO_2 in the atmosphere. Recent CO_2 concentrations observed in Alert are 394.55 ppm.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of greenhouse gas emissions:

- How much fuel is consumed in Nunavut annually?
- How will the government of Nunavut calculate and monitor GHG emissions?
- How will economic activities impact emissions?
- How will permafrost disturbance impact GHG emissions in Nunavut?

NGMP has identified the following monitoring needs to enhance understanding of greenhouse gas emissions:

- Ongoing long term studies of the effects of regional warming on the cryosphere, including the feedback mechanism associated with permafrost warming and thaw and GHG emissions.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,

- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on greenhouse gas emissions. To access this report or for further information on NGMP's current knowledge base regarding greenhouse gas emissions, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

16.2 NGMP Monitoring Blueprint (2013) – Other Air Quality Parameters

Objective

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to air quality parameters, to build capacity to better understand the state of this Valued Ecosystemic Component (VEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

Background

Air quality in the far north is most strongly influenced not by Arctic sources but rather by the long range transport of contaminants from more southerly industrial and urban areas in North America and Eurasia. Common contaminants are organochlorides, heavy metals, radionuclides, and hydrocarbon contaminants.

Air quality is an important and valued environmental component particularly as airborne pollutants can impact soil, water and food chain dynamics (through bioaccumulation) via processes of dry deposition, absorption, and/or precipitation. These impacts, in turn, can contribute to sub-optimal human and wildlife health outcomes.

Studies / Programs that Gather Information

Some bodies that gather information are the National Air Pollution Surveillance (NAPS) Network, the National Pollutant Release Inventory (NPRI), the Canadian Air and Precipitation Monitoring Network (CAPMoN), the Northern Contaminants Program (NCP), and the Arctic Monitoring and Assessment Program (AMAP).

State of Knowledge

Baseline air quality in the far north is more typically affected by long range transport than by Arctic sources. Current data regarding ambient air quality parameters in Nunavut is limited.

Trend(s)

A literature review on air pollutants revealed that information related to historical emission trends for key air pollutants for Nunavut is limited.

Pressures

New mines coming on line, an increased number of access roads and vehicles, and increased marine shipping due to both economic activities and melting sea ice opening up more navigational waterways could present new pressures on air quality in Nunavut. Continued emissions from distant areas are also a constant pressure on air quality in Nunavut.

INDICATORS AND PROTOCOLS FOR FUTURE VEC DATA COLLECTION

Indicators of air quality in Nunavut include concentrations of the following substances over averaged intervals: fine particulate matter, total suspended particulate, nitrogen dioxide, sulphur dioxide, and ground level ozone.

Existing protocols include the Ambient Air Monitoring Protocol for PM2.5 and Ozone, and the National Air Pollution Surveillance Network Quality Assurance and Quality Control Guidelines.

THRESHOLDS

In 2011, the Government of Nunavut's Department of Environment published an Environmental Guideline for Ambient Air Quality, establishing numeric standards for common air contaminants found in Nunavut. Ambient air quality standards for Nunavut are consistent with other federal, provincial and territorial standards and have been adopted from Canada-wide Standards approved through the Canadian Council of Ministers of the Environment (CCME) and the Canadian National Ambient Air Quality Objectives.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of air quality parameters:

- How will climate change and variability influence future spatial and temporal distributions of air quality contaminants in the Arctic?
- How will climate change and variability influence long range transportation of criteria air contaminants and heavy metals in the Arctic?
- How will climate change and variability affect the duration and intensity of atmospheric mercury depletion events? Arctic haze?
- What effects will increased industry potentially pose on air contaminants in Nunavut?

NGMP has identified the following monitoring needs to enhance the understanding of air quality parameters:

- Assessing spatial and temporal trends of more contaminants (other than lead, mercury, etc.), particularly heavy metals and Persistent Organic Pollutants (POPs),
- Long-term air monitoring programs,
- Identifying what is being released from specific development projects, projects and works in communities and the affect to air quality.

Any monitoring should explicitly report on the state / health of the VEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VEC to change,

- the resilience of the VEC in the face of change,
- the pressures that the VEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on air quality parameter. To access this report or for further information on NGMP's current knowledge base regarding air quality parameters, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.0 PEOPLE

17.1 NGMP MONITORING BLUEPRINT (2013) – DEMOGRAPHICS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to demographics, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

The statistical characteristics of a population is commonly referred to as "demographics," where birth rates, gender, age, ethnicity, mother tongue, disabilities and employment status, among others can be analyzed to identify trends and patterns within a region. The change in demographics, which are influenced by any number of socio-economic factors, have the potential to cause significant implications on the social and physical fabric of a region, causing considerable shifts in needed services, infrastructure, and other socio-economic indicators. Understanding demographics is an essential policy tool which can be used to help plan for future decisions.

STATE OF KNOWLEDGE

Statistics Canada provides a statistical snapshot of Nunavut every 5 years through their census programs. General demographical trends within Nunavut are evident through this data, and are also supplemented by Government of Nunavut health data.

More detailed qualitative and quantitative data is needed in Nunavut to better understand the trends and patterns of Nunavut's rapidly changing population and make-up. This includes a need for a better understanding of the pattern of mobility and resettlement within Nunavut and to the south.

Opportunities for alignment of existing data collection and demographic analysis systems and for establishment of a framework for integration and coordination of protocols for data exchange between Government of Nunavut Bureau of Statistics, Statistics Canada, NTI, and other agencies should be explored.

NGMP MONITORING NEEDS

NGMP has identified the following key question for future monitoring of demographics:

- Due to the complex nature of the patterns and trends of population change and characteristics in Nunavut, the NGMP sees significant value in studies that assess how different socio-economic factors influence population change and characteristics.

NGMP has identified the following monitoring needs to enhance understanding of demographics:

- Align existing data collection,
- Mobility and resettlement patterns within Nunavut and to other parts of Canada
    - Emphasis on the impact of major development projects

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on demographics. To access this report or for further information on NGMP's current knowledge base regarding demographics, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.2 NGMP Monitoring Blueprint (2013) – Health and Well-Being

Objective

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to health and well-being, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

Background

Good health is an important contributor to the quality of life for all Nunavummiut, a key factor in the enjoyment of their lives and engagement in their community. Health and well-being have a significant impact on the level and quality of individual engagement in everyday social and economic activities. The state of the population's health both affects and is affected by education, housing, income, economic opportunities, and social issues. The health and well-being of Nunavummiut is one of the key priorities of the Government of Nunavut along with the impact of development projects on health and well-being.

While significant improvements in the delivery of health-related services have taken place in Nunavut, the health status of Nunavummiut is significantly below the national average. The average life expectancy in Nunavut is almost 10 years shorter than that of an average Canadian, the number of smokers is nearly double, and infant mortality in Nunavut is almost four times the national average.

State of Knowledge

The Nunavut Bureau of Statistics, Statistics Canada, the Inuit Knowledge Centre and Health Canada are major organizations currently operating and collecting health related data such as life expectancy, number of live births with a low birth weight, rates of infant mortality, number of suicides, number of daily smokers, number of Nunavut residents with diabetes, and information on alcohol consumption and drug use, etc.

Trends in the data reveal that the health and well-being for Nunavummiut is significantly below the national average of Canada for many indicators; and furthermore, some of the major indicators of health seem to be declining.

Factors that influence the state of health and well-being of Nunavummiut are complex and largely not well understood and arise from many socio-economic factors in the territory. To better understand changes happening in the communities in relation to health and well-being, it is suggested that data related to birth weights, life expectancy, diabetes, and tobacco use be collected at community and regional levels.

NGMP Monitoring Needs

NGMP has identified the following key question for future monitoring of health and well-being:

- What will the impacts of development have on different health indicators?

NGMP has identified the following monitoring needs to enhance understanding of health and well-being:

- Increased monitoring of incidence and severity of alcohol and drug abuse,
- Establishing a strong baseline of health information.

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on health and well-being. To access this report or for further information on NGMP's current knowledge base regarding health and well-being, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.3 NGMP MONITORING BLUEPRINT (2013) – FOOD SECURITY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to food security, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Food security encompasses a number of key elements, which include: food accessibility; a nutritionally adequate diet; cultural appropriateness; and stability and sustainability. Food security is a priority of the Government of Nunavut as a VSEC for a number of reasons, including: how important food is to the health and well-being of all Nunavut residents and communities, and how food is inherently linked to the promotion and preservation of traditional activities and skills.

STATE OF KNOWLEDGE

There is growing evidence of malnutrition, unhealthy eating practices and food insecurity in Nunavut, with important implications for the health system in Nunavut. For example, approximately half of Nunavut households reported not having enough to eat due to a lack of money. The Canadian Community Health Survey reported that almost one-third (31.9%) of Nunavut households indicated food quality and/or quantity were compromised, usually due to limited financial resources, compared to only 7.7% nationwide and half of the Aboriginal households with incomes of less than $40,000 obtain most or all of their meat and fish through hunting and fishing.

A plethora of pressures continue to shape food security as an ever important priority in Nunavut from a variety of different sources. These pressures include Government policies, plans, programs and funding related to employment and income, community infrastructure, traditionally economy, and transportation costs; major development project planning, management and mitigation of impacts related to support for traditional harvesting activities and access to harvesting areas; and Climate change related to accessing harvesting areas and changes in harvesting quotas and regulations.

The state of food security in Nunavut is currently being monitored by Statistics Canada, Health Canada, through the office of Nutrition Policy and Promotion, and the Inuit Knowledge Centre. Some of the key indicators being monitored are # of households experiencing food insecurity; # of aboriginal status households experiencing food insecurity; cost of Northern food basket; consumption of country food; and percentage of children 0-5 who felt hungry because of lack of money or food.

Literature suggests that indicators related to food security should be tracked at the community level, as each community has its own characteristics and will be affected differently by development.

NGMP Monitoring Needs

NGMP has identified the following key questions for future monitoring of food security:

- What will the impacts of development have on food security?
- What will the impacts of climate change have on food security?

NGMP has identified the following monitoring needs to enhance understanding of food security:

- Regional level:
    - Percentage of households experiencing food insecurity – both the total number and Aboriginal-only households,
    - Food security/insecurity of single-parent families,
    - Percentage of children 0-5 years old who felt hungry because of lack of money or food.
- Community level:
    - Indicators related to country food, as each community has its own characteristics and will be affected differently by major development projects.
- Impact of major development projects on food security and availability of country food,
- Impact of climate change on food security.

Any monitoring should explicitly report on the state / health of the VALUED SOCIO-ECONOMIC COMPONENT (VSEC), also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on food security. To access this report or for further information on NGMP's current knowledge base regarding food security, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.4 NGMP MONITORING BLUEPRINT (2013) – EDUCATION AND TRAINING

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to education and training, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Education and training have long been recognized as critical building blocks of Nunavut society, and it is recognized as one of the key priorities of the Government of Nunavut. They have significant impact on individual and community quality of life—contributing to self-esteem, allowing individuals to provide for their own and their families' needs, and enabling them to engage and contribute to the betterment of their communities.

STATE OF KNOWLEDGE

General knowledge about Nunavut's Education and Training is largely driven by Statistics Canada and the Nunavut Bureau of Statistics. The data is divided by community and region and provides data every 5 years, or on a yearly basis, and report on a variety of indicators that are openly available to the public. Most indicators for formal education and training within the territory appear to be below the Canadian average, whereas in 2001, 9% of Nunavut's population aged 20-34 years had a trades certificate or diploma and only 1.4% of people in Nunavut with Aboriginal identify held a university degree at a bachelor's level or higher.

Over the last decade, indicators of formal education and training appear to be improving, which may be attributed to a number of pressures within the territory. These pressures include the following:

- Government policies, plans, programs and funding related to education infrastructure, communication infrastructure, Territorial education curriculum, promotion of school completion, employment-focused training and language;
- Major development project planning, management and mitigation of impacts related to employment-focused training and employment opportunities; and
- Cultural changes such as increased social recognition of the value of education.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of education and training:

- How can we measure and keep track of non-formal educational attainment in Nunavut?

NGMP has identified the following monitoring needs to enhance understanding of education and training:

- Community level collection of data on the social factors that affect educational attainment should be done for a sample of communities
    - Some quantitative data on social factors (e.g. employment, educational status of parents) may be available from schools and training organizations. Additional qualitative information on social factors could be collected through community-based data collection programs.
- Determination of the impact of major development projects on improving trades education and training, secondary education, and post-secondary education.
- Understanding the linkages between existing territorial legislation (i.e. Nunavut Education Act) and educational outcomes over time.

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on education and training. To access this report or for further information on NGMP's current knowledge base regarding education and training, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.5 NGMP MONITORING BLUEPRINT (2013) – HOUSING

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to housing, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Access to safe and adequate shelter is a fundamental need shared by all residents. Housing has direct and significant impact on the state of other aspects of Nunavut's social and economic environment, including health, education, employment, and the overall well-being of a community. The need for housing is one of the key elements impacted by resource development, requiring monitoring at the project level.

STATE OF KNOWLEDGE

There are several groups that collect information on the housing sector in Nunavut including: the Nunavut Housing Needs Survey, Inuit Knowledge Centre, Nunavut Bureau of Statistics, and Statistics Canada. These organizations keeps track of such indicators as the number of dwellings in Nunavut, the number of privately-owned housing units in Nunavut, the number of rented housing units in Nunavut, the number of households that lived in dwellings that did not meet housing standards, and the average number of people per household.

The state and health of housing in Nunavut is currently impacted by a number of issues including, a critical shortage of housing units available to meet current and future demands (leading to high costs), overcrowding in existing units, and a high percentage of housing units in need of major repairs.

NGMP MONITORING NEEDS

NGMP has identified the following key question for future monitoring of housing:

- What is the impact of major development projects on the availability and quality of housing, and on the patterns of home ownership?

NGMP has identified the following monitoring needs to enhance understanding of housing:

- Collection of data at five year intervals.

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,

- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on housing. To access this report or for further information on NGMP's current knowledge base regarding housing, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

17.6 NGMP MONITORING BLUEPRINT (2013) – CRIME

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to crime, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Crime has been a social challenge facing the Nunavut Territory since its creation in 1999. Reducing the crime rate is one of the priorities of the Government of Nunavut. Crime is closely linked to other social and economic conditions, including poverty, neglect, poor living conditions, unemployment, low literacy rate, drug and alcohol abuse, and physical and sexual abuse.

STUDIES/PROGRAMS THAT GATHER INFORMATION

Most of the Nunavut specific crime data comes from Statistics Canada, with the exception of suicide rates, which are provided by the Office of the Chief Coroner, Department of Justice, Government of Nunavut. Most statistics are collected annually with the exception of the crime data by region and community 1999-2009, which is provided for each community in Nunavut, information is provided at the territorial level (Nunavut). The data is free and accessible to the public.

STATE OF KNOWLEDGE

There is a clear trend, with respect to crime rates in Nunavut. Crime rates are increasing, well above the Canadian average; possibly fuelled by substance abuse, but also possibly influenced by any number of factors including Nunavut's low overall educational attainment, housing factors, high levels of unemployment, rates of violence and suicide, government policies and programs, and major economic developments. The origin of crime and the factors that affect crime rates are extremely complex issues within Nunavut and a better understanding of these will help governments make more effective decisions in dealing with crime.

INDICATORS AND PROTOCOLS FOR FUTURE VSEC DATA COLLECTION

Presently the most reliable data collected on crime indicators are from Statistics Canada and the Nunavut Bureau of Statistics, both of which provide information at the territorial level. There is currently a gap in community and regional level data that will require further analysis of Nunavut Crime Data from Statistics Canada. In some cases, community data will not be available due to small sample size and confidentiality.

NGMP MONITORING NEEDS

NGMP has identified the following key question for future monitoring of crime:

- Due to the complex nature of the origin of crime and ambiguous way crime rates are influenced, the NGMP sees significant potential in new studies that addresses how different socio-economic indicators affect crime rate.

NGMP has identified the following monitoring needs to enhance understanding of crime:

- The current statistical bodies (StatsCan and the Nunavut Bureau of Statistics) that report on crime provide standardized and regular data for monitoring within the territory. However, there is still a need to understand crime at a finer level, at the regional and community level, to help provide a more detailed and clearer picture of crime trends within Nunavut.

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on crime. To access this report or for further information on NGMP's current knowledge base regarding crime, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

18.0 CULTURAL PRACTICES

18.1 NGMP MONITORING BLUEPRINT (2013) – INUIT LANGUAGE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to Inuit language, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Language is the fundamental point of connection between people, the medium through which we communicate ideas, thoughts, and plans. In Nunavut, language is seen as a priority and has been recognized as one by the Government of Nunavut. It is seen as integral to the preservation and promotion of Inuit culture and way of life, essential to Inuit Qaujimajatuqangit, and to traditional activities and skills.

Language is particularly important to Nunavut because it is the only jurisdiction in Canada to formally grant the status of official language to an Indigenous language.

STATE OF KNOWLEDGE

Information on the use of the Inuit Language in Nunavut is gathered by the Nunavut Bureau of Statistics and Statistics Canada. Both Statistics Canada and the Nunavut Bureau of Statistics completed various censuses compiling information about population and languages spoken, including mother-tongue. There are seven dialects/sub-dialects used in Nunavut. The dialect spoken in the largest number of communities is North Baffin, followed by South Baffin.

In general, Inuit language being spoken in the home has decreased in frequency among the population of Nunavut. The percentage of those who identify an Inuit language as their mother tongue has also decreased in recent years. Although the percentage of people speaking an Inuit language has dropped in recent years, the absolute value of people speaking an Inuit language has increased. These trends have resulted in initiatives such as the Inuit Language Protection Act (ILPA) and the Official Languages Act (OLA).

One major pressure on Inuit language is the ongoing loss of elders. Documentation of the Inuit language in its richest form is becoming more difficult as the real repositories of the language in its richest form - the elders - pass away.

Some of the key targets identified by the Government of Nunavut for the protection of the Inuit language include: Inuit having the right to work for the Government of Nunavut in their own language by 2011, municipalities offering services in the Inuit language by 2012, and all school grades having the right to an Inuit language education by 2019.

NGMP Monitoring Needs

NGMP has identified the following key questions and monitoring needs for future monitoring of Inuit language:

- What are the impacts of major development projects on the use of the Inuit language in the workplace?
- To what extent will the Language Acts and their implementation impact the amount and quality of Inuktitut being spoken in Nunavut?

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on Inuit Language. To access this report or for further information on NGMP's current knowledge base regarding Inuit language, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

18.2 NGMP MONITORING BLUEPRINT (2013) – TRADITIONAL ACTIVITIES AND SKILLS

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to traditional activities and skills, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Traditional activities, especially the right to harvest wildlife and to retain access to land for the purpose of harvesting, are important components of the Nunavut Land Claim Agreement and play an important part in preserving the Inuit culture and identity. Traditional activities and skills provide a key contribution to household nutrition, and thus enhance food security. The harvesting of animals, plants and fish has provided sustainable livelihoods for Inuit for millennia and still does to Nunavut residents today. Carving, weaving, storytelling and other arts survive in both their traditional form, and in exciting new areas like film-making that fuse contemporary approaches with traditional practices. Traditional activities, including games such as Inuit wrestling and thumb games, have helped to preserve the Inuit culture and language and reinforce a sense of community identity.

STUDIES / PROGRAMS THAT GATHER INFORMATION

The following studies/programs gather information about traditional activities and skills: Statistics Canada, the Nunavut Wildlife Harvest Study, the Nunavut Wildlife Management Board, and the Inuit Knowledge Centre. Many other research projects also explore traditional activities and skills in Nunavut.

STATE OF KNOWLEDGE

Researchers have noted the difficulty in finding new and recent data on the traditional economic activities in Nunavut. In a number of communities the number of hunters decreased between the period 1996/1997 and 2000/2001, possibly due to major industrial development and the wage economy acting as a pressure on these activities. Inuit Qaujimajatuqangit (IQ) data collection and studies to date have primarily focused on location and types of harvesting, and quite often provide data collected for resource project level Environmental Impact Assessments and regional studies. The Kitikmeot Inuit Traditional Land Use and Occupancy Baseline Data Integration Project aims to convert data recorded in the 1970s into data usable by managers today.

NGMP MONITORING NEEDS

NGMP has identified the following key questions for future monitoring of traditional activities and skills:

- What role does traditional harvesting play in the contemporary mixed economy?

- What is the impact of major development projects on the level of traditional activities?
- What is the impact of major development projects on the level of youth involvement in traditional cultural activities?
- What is the impact of climate change on harvesting activities?

NGMP has identified the following monitoring needs to enhance understanding of traditional activities and skills:

- Collect quantitative data on the state of traditional activities and consolidate or align data collection,
- Analyze the Aboriginal Peoples Survey which was re-done in 2012 and combine with other data.

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on traditional activities and skills. To access this report or for further information on NGMP's current knowledge base regarding traditional activities and skills, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

19.0 ECONOMY

19.1 NGMP MONITORING BLUEPRINT (2013) – ECONOMIC ACTIVITY

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to economic activity, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Nunavut has a mixed economic base with a relatively large public administration sector, traditional land use activities, and a vast potential for mineral development. Economic development is a key priority of the Government of Nunavut as it has a direct impact on employment, as well as other social and economic areas, including food security, education, housing expenditure, crime rates, income, and the overall health and well-being of the community. Participation of Inuit in economic opportunities and the promotion of self-reliance are key objectives of the Nunavut Land Claim Agreement. The economy of Nunavut is characterized by the following:

- **Small scale:** Nunavut's economy is the smallest in Canada.
- **Impact of major projects**: Because of its small size, Nunavut's GDP can alter dramatically as the result of a single major project such as the Meadowbank mine.
- **Unequal growth of GDP within the Territory**: Because of the level of impact from a single major project, the future growth of GDP in the three regions may be unequal.
- **Infrastructure challenges:** One of the key challenges that Nunavut's economy faces is the state of public infrastructure; this is addressed in a separate VSEC paper (see *Municipal Infrastructure*).
- **High cost of doing business**: Because of its remote location and the inadequate state of much of the public infrastructure, the cost of doing business in Nunavut is much higher than in other parts of the country.

STATE OF KNOWLEDGE

Knowledge about Nunavut's economic activity is primarily driven by Statistics Canada and the Nunavut Bureau of Statistics. These governmental bodies keep track of a significant number of economic indicators and report on these statistics annually. In Nunavut, their data shows a quickly growing territorial economy, where Nunavut's GDP (Expenditure Account) grew 140% from $747 million in 1999 when Nunavut was established, to $1.755 billion by 2010. However, classical measurements of the economy may not be the best method to measure the Nunavut economy, where many of our people are not involved in the wage based economy; as well GDP does not take into consideration economic inequality and does not factor environmental impacts into economic decisions.

The Nunavut economy, due to its small size, is highly sensitive to change and it is necessary to monitor how external forces are shaping Nunavut.

NGMP Monitoring Needs

NGMP has identified the following key questions and monitoring needs for future monitoring of economic activity:

- How are external forces (major developments, climate change, immigration) shaping the economy of Nunavut using classical (GDP, cost of living) and non-classical (PPP) methods of measurement?
- What is the economic activity of Nunavut on a regional basis?

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on economic activity. To access this report or for further information on NGMP's current knowledge base regarding economic activity, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

19.2 NGMP MONITORING BLUEPRINT (2013) – EMPLOYMENT

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to employment, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Employment is tied to an individual's sense of well-being and also to the well-being of their dependents. Employment is a VSEC because Inuit employment, especially of youth, is an integral part of the Nunavut Land Claims Agreement and has a direct impact on the overall health and well-being of communities and of the Territory. Increased employment may be negatively correlated with levels of crime and is a key benefit of development projects and a growing economy.

STATE OF KNOWLEDGE

Employment data in Nunavut is collected and available through Statistics Canada and the Nunavut Bureau of Statistics. Data is available territorially, regionally, and locally between the years 2001 and 2011 and is available online. Persons in the labour force have been increasing in Nunavut in recent years, although a lack of long term data prevents any clear trends from being identified.

Indicators for the health of employment as a VSEC are: employment rate, employment rate for people of Aboriginal identity, employment rate for youth (15-24 years old), unemployment rate, unemployment rate for people of Aboriginal identity, unemployment rate for youth (15-24 years old), participation rate, participation rate for people of Aboriginal identity, participation rate for youth (15-24 years old), not in the labour force, not in the labour force for people of Aboriginal identity, not in the labour force for youth (15-24 years old), and source of income.

NGMP MONITORING NEEDS

NGMP has identified the following key questions and monitoring needs for future monitoring of employment:

- What is the impact of major development projects on overall employment, Inuit employment, and employment for youth?
- What is the impact of major development projects on education and skill levels of community workforce?
- What impact are current GN and Federal employment and training plans and policies having on levels of Inuit employment in Government, and what additional measures are required?

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on employment. To access this report or for further information on NGMP's current knowledge base regarding employment, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca

19.3 NGMP MONITORING BLUEPRINT (2013) – MUNICIPAL INFRASTRUCTURE

OBJECTIVE

NGMP is seeking monitoring proposals that address the key questions, data development needs and monitoring gaps identified in this blueprint with respect to municipal infrastructure, to build capacity to better understand the state of this Valued Socio-Economic Component (VSEC), and any changes taking place, as a basis for management and decision-making going forward.

NGMP encourages community based, scientific and other relevant monitoring approaches.

BACKGROUND

Municipal physical infrastructure is the foundation of virtually all programs and services a municipality provides to the residents, businesses and organizations within its jurisdiction. It has a major impact on education, health, and economic activity in a community. Upgrading and the provision of new municipal infrastructure have been identified as priorities by the Government of Nunavut.

STUDIES / PROGRAMS THAT GATHER INFORMATION

Information on municipal infrastructure in Nunavut is gathered by: the Quilliq Energy Corporation, the Government of Nunavut (through various programs), and Aarluk consulting (on behalf of the Government of Nunavut).

STATE OF KNOWLEDGE

The main challenges facing municipal infrastructure in Nunavut arise from the Territory's geographic location and harsh climate, the growing demands placed on infrastructure by a young and rapidly increasing population, and the limited financial resources for investment in upgrading infrastructure at the community level. As of 2008, only Iqaluit had a tax based fund for infrastructure. Much of Nunavut's wastewater treatment is in the form of lagoons. Water and sewage services are provided by trucks in most Nunavut communities. Most municipalities in Nunavut do not monitor effluent quality due to limited resources and capacity, the characteristics of the treatment systems, and logistical issues.

The water infrastructure in most communities needs upgrading and expansion, and in a number of communities is significantly under capacity. Power consumption in Nunavut had gone up consistently since 1999. In almost all communities the current state of the waste-related infrastructure is poor. Internet service in Nunavut is entirely dependent on satellite connectivity due to the geographic location of the communities.

The Government of Nunavut aims to achieve, through municipal infrastructure, the following general targets: affordable housing with safe water and healthy food, sustainable economic development, high level communications infrastructure, and alternative forms of energy.

NGMP Monitoring Needs

NGMP has identified the following key question for future monitoring of municipal infrastructure:

- What is the impact of major development projects on the demand for services from municipal infrastructure?
- What infrastructure would be needed to accommodate projects?
- What is the state of internet service in Nunavut?

Any monitoring should explicitly report on the state / health of the VSEC, also addressing the following, where applicable:

- existing baseline data,
- any changes in the state of the VSEC compared to baseline,
- any trends that can be identified,
- the magnitude, duration and extent of any changes (include definitions),
- the sensitivity of the VSEC to change,
- the resilience of the VSEC in the face of change,
- the pressures that the VSEC is subject to.

The information contained within this blueprint has been summarized from the original NGMP State of Knowledge (SoK) report on municipal infrastructure. To access this report or for further information on NGMP's current knowledge base regarding municipal infrastructure, please contact NGMP by phone at: 867-975-4654, fax at: (867) 975-4736, or by email at: NGMP.PSGN@aandc-aadnc.gc.ca