

Research Needs Survey

Yukon Community Survey Results

**CANADIAN CLIMATE IMPACTS AND ADAPTATION
RESEARCH NETWORK
*NORTH REGION***

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Prepared by
Claire Eamer
C-CIARN North (Yukon) Coordinator
Northern Climate ExChange
Northern Research Institute, Yukon College
Box 2799, 500 College Drive
Whitehorse, Yukon, Canada Y1A 5K4

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Introduction

Background

The Yukon Community Survey is a component of the C-CIARN North Research Needs Survey, an initiative of the North Region of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN North). The larger initiative involves an online survey that solicited information from a broad geographical base, community-based surveys in each of the three northern territories, a literature review of existing expressions of research needs, and a number of other approaches such as topic-focused online workshops. The purpose of the project is to help develop a broad sense of the research needed to understand and adapt to climate change impacts in Canada's North.

The Online Survey and the community-based surveys are based on the Northern Climate ExChange Gap Analysis Project, which reviewed the current state of knowledge regarding climate change in 16 natural and human systems in the North. For purposes of assessment, each system was subdivided into a number of aspects. For each aspect, the Gap Analysis Project assessed the state of baseline knowledge (both knowledge of the system before climate change and knowledge about the fundamental mechanisms operating in the system) and the state of knowledge about several different impacts (temperature change, precipitation change, other and indirect impacts) of climate change. Recognizing that a knowledge gap is not necessarily an important knowledge need, C-CIARN North then undertook the next step – to ask where, in light of the current state of knowledge, it is most important to focus research time and resources in the near future.

Please note that the NCE Gap Analysis Project Summary Report, along with a CD containing component reports, is available from the Northern Climate ExChange, Northern Research Institute, Yukon College, P.O. Box 2799, 500 College Drive, Whitehorse, Yukon, Y1A 5K4. All components are also available online at yukon.taiga.net/knowledge/gap.html.

Also available are the following:

- Research Needs Survey: Online Survey Results – report
- Research Needs Survey: Literature Review: Previously Identified Research Needs – report and online database.

All materials are available on the Internet at yukon.taiga.net/knowledge/research.html. The two reports are also available in print from the Northern Climate ExChange, Northern Research Institute, Yukon College, P.O. Box 2799, 500 College Drive, Whitehorse, Yukon, Y1A 5K4.

The Yukon Community Survey

The Yukon Community Survey was administered during the first quarter of 2004. Its goal was to sample the thinking of Yukoners about the kind of research required to help them understand and adapt to the impacts of a changing climate on the territory. The survey was delivered through the Internet, e-mail, fax,

and as a hard-copy hand-out. A total of 38 people responded to indicate interest in the survey. Of these, 25 provided substantive responses. In the remainder of this report, all discussion of Yukon Community Survey respondents refers to the 25 substantive responses only.

In the Yukon Community Survey, participants were provided with a brief explanation of the nature of each system and some of the possible impacts of climate change associated with the system. They were then asked the following questions: “If researchers and community people were to study the impacts of climate change on the system, what specific topics would you like them to study? Why are these research topics important?”

The Yukon Community Survey was less complex than the Online Survey, which asked respondents to evaluate the importance of different kinds of knowledge and particular issues related to climate change. However, Online Survey respondents were also asked to suggest other topics for research within each system – a close approximation of the questions asked in the Yukon Community Survey. The additional topics suggested by Yukon-based Online Survey respondents have been incorporated into the system results of this report.

Respondents by Location

Of the 25 substantive responses to the Yukon Community Survey, 20 listed Whitehorse addresses, 4 listed Yukon addresses outside Whitehorse, and 1 respondent listed an out-of-territory address. While these numbers appear to indicate an overwhelmingly Whitehorse-oriented response, a look at the affiliations of the respondents paints a slightly different picture. Of the 20 Whitehorse-based respondents, more than half represent organizations, governments, or agencies with interests covering most or all of the territory. The preponderance of Whitehorse addresses, therefore, is more indicative of the centralized administration of the Yukon than of geographical limitation in the responses.

Table 1: Respondent Location

<i>Survey</i>	<i>Whitehorse</i>	<i>Yukon, Outside Whitehorse</i>	<i>Other</i>	<i>Total</i>
Yukon Community Survey	20*	4	1	25
Online Survey (All Yukon Respondents)	29	2	1	32
Total	49	6	2	57**

* *Of respondents with Whitehorse addresses, more than half represent organizations or government departments/agencies with interests or jurisdictions outside the Whitehorse area.*

** *Includes one individual who responded to both surveys. In reported results and analysis of response by system, both responses are merged under the Yukon Community Survey category.*

Respondents by Category

Survey respondents were asked to identify themselves by category and encouraged to list as many categories as they felt described their interest in climate change research. Some respondents identified up to four or five categories that fitted their roles and interests. As a consequence, the numbers in Table 2 and Figure 1 represent some duplication.

Respondents to the Online Survey were also asked to identify themselves by category. Although there is some variation in the category lists, a comparison of self-identification by respondents to the Yukon

Community Survey and by Yukon respondents to the Online Survey indicates that the two exercises tapped into somewhat different sectors:

- Of the 28 Yukon respondents to the Online Survey, by far the largest group (68%) identified themselves as employees of federal or territorial government departments and agencies. The next largest group (21%) identified themselves as researchers.
- In contrast, 72% of the 25 Yukon Community Survey respondents identified themselves as individuals and 44% as northern residents.

Without overstating the conclusions to be drawn from such small numbers, the bulk of respondents to the Online Survey appear to have considered that they were responding in their professional capacities, while a substantial portion of respondents to the Yukon Community Survey spoke out of their experience as individuals living in northern Canada.

Table 2: Respondent Category

<i>Yukon Community Survey</i> (Total = 25)		<i>Online Survey</i> (Yukon Respondents) (Total = 28)	
Category	#	Category	#
Northern resident	18	Fed/Terr/Prov government	19
Individual	11	Researcher	6
Resource user	8	Individual	4
Private sector	6	Municipal government	3
Non-government organization	4	Non-government organization	2
Territorial government	4	Private sector	2
Aboriginal government	3	Aboriginal government	1*
Municipal government	2	Academic	1
Co-management agency	1	Environmental Educator	1
Federal government	1	Researcher and stakeholder	1
Youth	1		

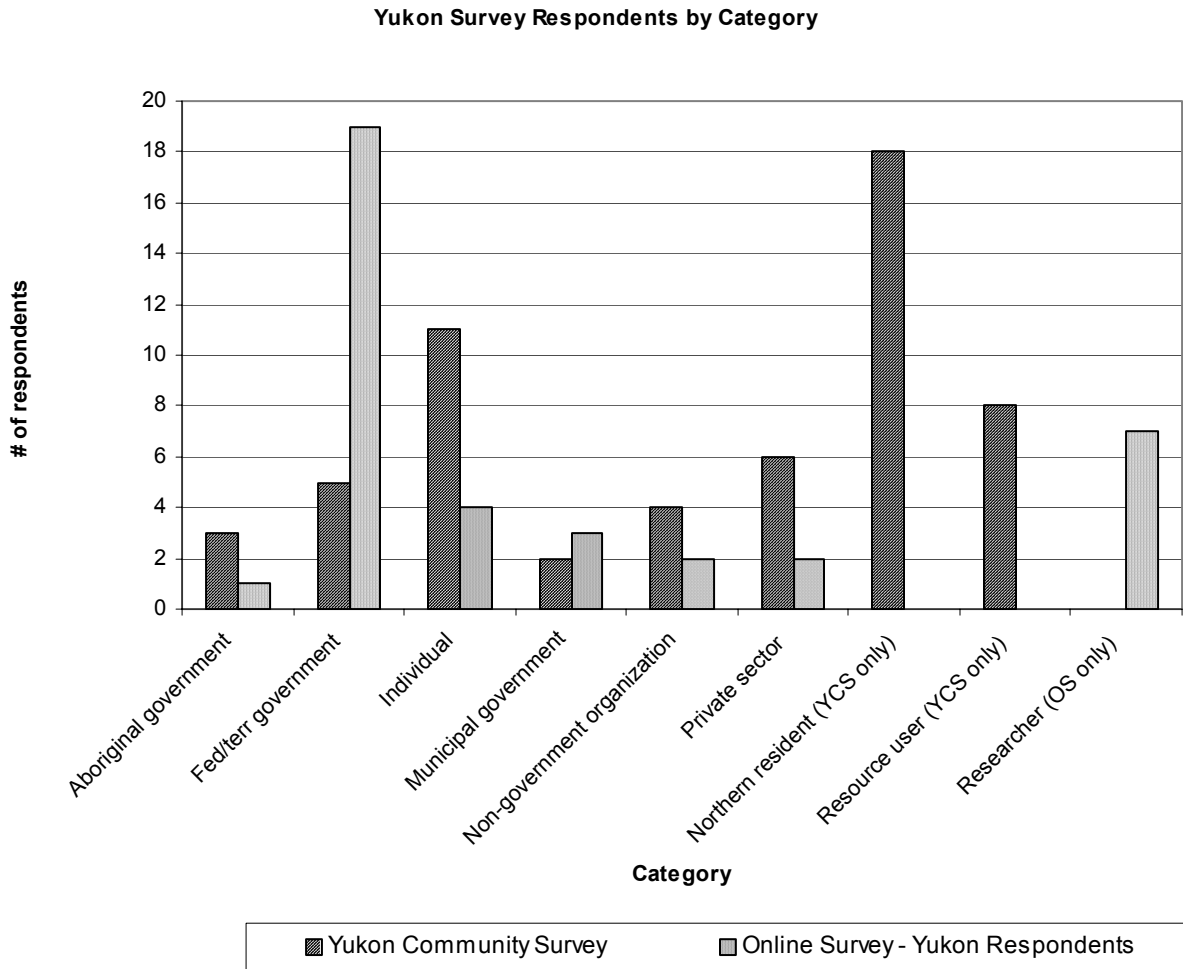
**Non-Yukon First Nation government*

A comparison of the two groups of respondents reveals some other differences:

- Representatives of three Yukon First Nation governments responded to the Yukon Community Survey; the only First Nation government represented in the Online Survey is based outside the Yukon.
- 24% of respondents to the Yukon Community Survey identified themselves as belonging to the private sector, compared to 7% of Online Survey respondents.
- Although the numbers are small, more respondents to the Yukon Community Survey identified themselves as members of non-government organizations than did respondents to the Online Survey.

Figure 1, following, provides a direct comparison of the major categories self-identified by respondents, as well as levels of identification for three categories that appear in only the Yukon Community Survey (YCS) or the Online Survey (OS).

Figure 1



With the caveat that the numbers of respondents in both surveys are small, the Yukon Community Survey appears to have captured a somewhat different audience than the one captured by the Online Survey. The Yukon component of the Online Survey was dominated by government managers and academic researchers, as was the Online Survey as a whole. Participants in the Yukon Community Survey, on the other hand, were overwhelmingly concerned with climate change in their capacity as individual residents of the Yukon, often with specific local responsibilities related to land and environmental management.

Respondent Interests by System

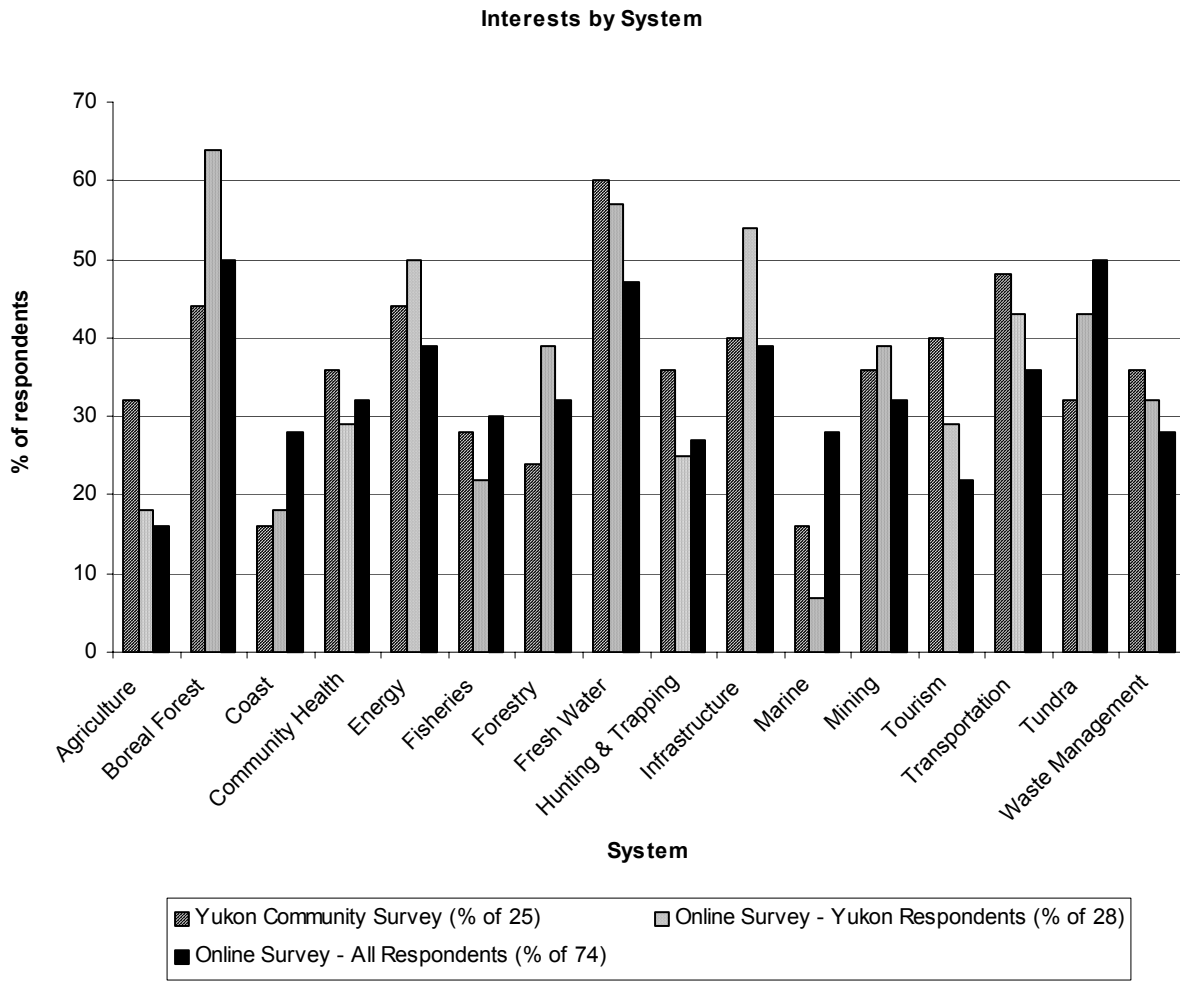
Participants were asked to identify which of the 16 natural and human systems interest them. Responses varied widely, from most or all systems to only one or two. The natural systems of greatest interest to both Yukon Community Survey respondents and Yukon respondents to the Online Survey were the Boreal Forest and Fresh Water systems – an understandable focus in a territory geographically dominated by the two systems. Of the human systems, Energy, Infrastructure, and Transportation attracted strong interest from both groups. Yukon Community Survey respondents showed a somewhat stronger interest in Tourism and Agriculture than Yukon respondents to the Online Survey. In both surveys, the lowest level of interest was in the Coast and Marine systems, reflecting the Yukon’s limited and remote ocean access.

Table 3: Respondent Interests

<i>Yukon Community Survey</i> (Total = 25)		<i>Online Survey</i> (Yukon Respondents) (Total = 28)	
System	#	System	#
Boreal Forest	17	Boreal Forest	18
Fresh Water	15	Fresh Water	16
Transportation	12	Infrastructure	15
Energy	11	Energy	14
Tourism	11	Transportation	12
Infrastructure	10	Tundra	12
Community Health	9	Forestry	11
Hunting & Trapping	9	Mining	11
Mining	9	Waste Management	9
Tundra	9	Community Health	8
Waste Management	9	Tourism	8
Agriculture	8	Fisheries	7
Fisheries	7	Hunting & Trapping	7
Forestry	6	Agriculture	5
Coast	4	Coast	5
Marine	4	Marine	2

Figure 2, following, presents a comparison of the level of interest in the various systems shown by Yukon Community Survey respondents, Yukon respondents to the Online Survey, and all Online Survey respondents. The interest level is shown as a percentage of the total number of substantive responses to each survey.

Figure 2



Examined in this light, respondents to the Yukon Community Survey show a stronger interest than the other two groups in:

- Agriculture and Tourism – both systems of significance to the Yukon economy;
- Hunting and Trapping – an important component of the traditional economy and culture;
- Community Health – of relevance to both traditional societies and the broader Yukon society; and
- Fresh Water, Waste Management, Transportation – all systems with particular relevance to the quality of life in Yukon communities.

Responses by System

Not all survey respondents who expressed an interest in a system went on to fill out the survey sheet for that system. Table 4 shows the actual response by system, both for the Yukon Community Survey and for Yukon respondents to the Online Survey.

Table 4: Responses by System

<i>Yukon Community Survey</i> (Total = 25)		<i>Online Survey</i> (Yukon Respondents) (Total = 28)	
System	#	System	#
Boreal Forest	11	Boreal Forest	17
Fresh Water	10	Infrastructure	12
Community Health	7	Fresh Water	10
Energy	7	Transportation	10
Hunting & Trapping	7	Energy	6
Transportation	7	Forestry	6
Tundra	7	Mining	6
Fisheries	6	Waste Management	6
Agriculture	5	Agriculture	5
Infrastructure	5	Tourism	5
Mining	5	Tundra	5
Tourism	5	Fisheries	4
Waste Management	5	Community Health	3
Forestry	4	Coast	1
Coast	2	Hunting & Trapping	1
Marine	2	Marine	1

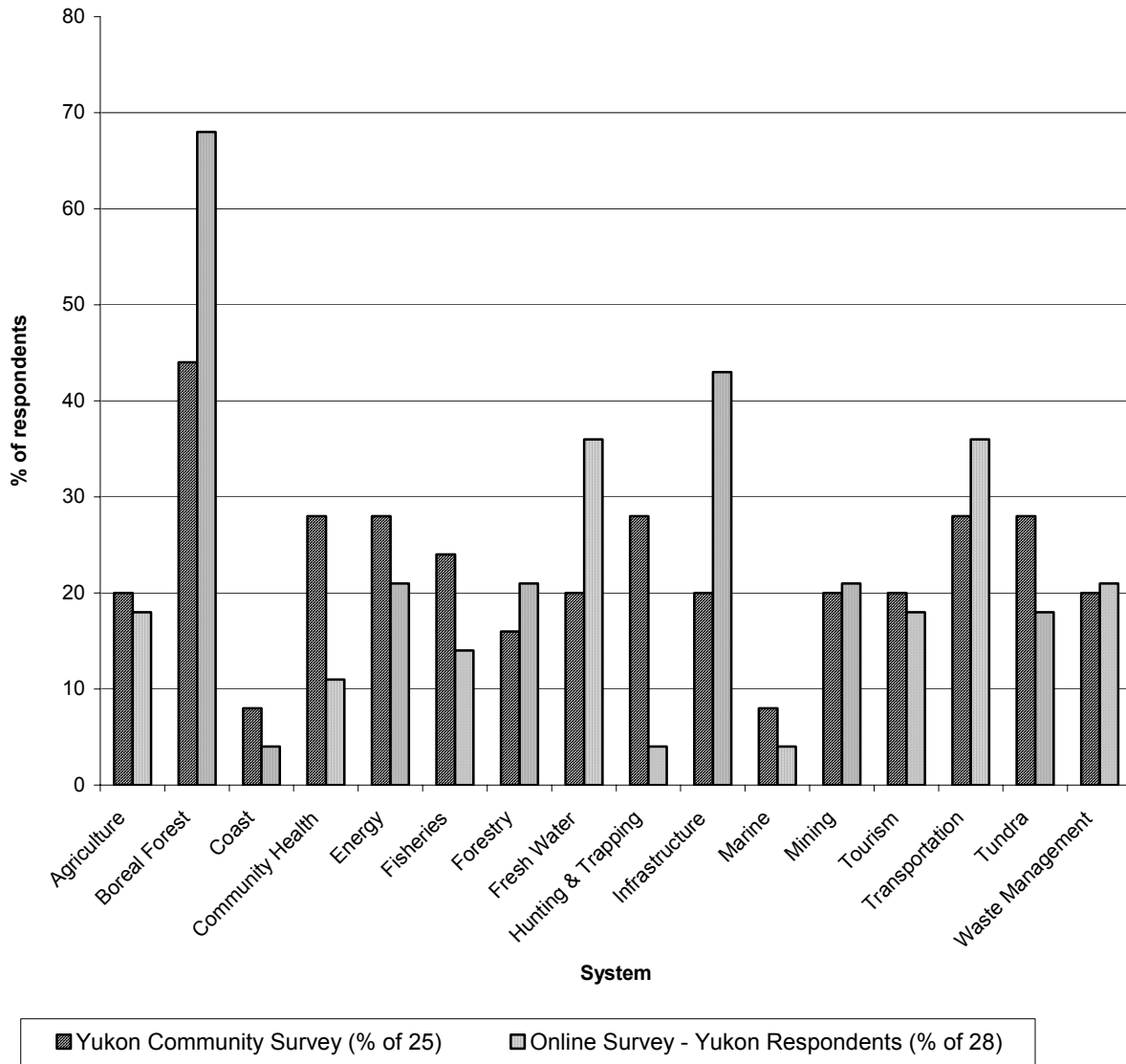
Figure 3, following, shows more clearly the areas in which the Yukon Community Survey elicited a particularly strong response. The response for each system is shown as a percentage of total respondents to each survey.

The most striking difference between the two surveys is the response under the Hunting and Trapping system. Although 7 Yukon respondents to the Online Survey expressed an interest in Hunting and Trapping, only 1 actually filled out that portion of the survey. In contrast, 9 respondents to the Yukon Community Survey expressed interest in the system and 7 of those filled out the relevant survey sheet. Participants in the Yukon Community Survey also showed particularly strong response rates under the Community Health and Fisheries systems. These elevated response rates are likely reflective of the number of Yukon Community Survey respondents directly engaged in or interested in the traditional economy and culture.

Yukon participants in the Online Survey, on the other hand, responded strongly to questions under two natural systems, Boreal Forest and Fresh Water, and two human systems, Infrastructure and Transportation. This balance is in keeping with the high participation in the survey by federal and territorial government employees, many of whom are resource or infrastructure managers.

Figure 3

Responses by System (% of respondents)



Report Structure and Approach

The survey was based on the NCE Gap Analysis Project, which looked at the state of knowledge in 16 different natural and human systems. See the Matrix Maker, yukon.taiga.net/matrix/, for detailed results.

In the Yukon Community Survey, participants were given a brief description of each system and a couple of examples of the kinds of impacts climate change might have on the system. The examples were kept deliberately brief and undetailed in the hope of stimulating thought without unduly influencing responses.

Respondents were asked the same question under each system:

If researchers and community people were to study the impacts of climate change on the system, what specific topics would you like them to study? Why are these research topics important?

For ease of reading, each suggested research topic and the reason for its importance has been merged into a single entry in this report.

Survey responses for each of the 16 systems are set out separately in the following pages. Each section begins with the system description provided in the original Yukon Community Survey and with the number of people who responded within that system. The responses include both the 25 substantive responses to the Yukon Community Survey and responses from 9 Yukon participants in the Online Survey who submitted ideas under the “Other Issues” category in that survey (a close approximation of the Yukon Community Survey approach). The responses of the one participant who took part in both surveys have been merged under the Yukon Community Survey responses. Therefore, the total possible number of responses per system is 33.

Responses have been edited for clarity and consistency of diction but otherwise appear as the respondents submitted them. In each system, the responses are grouped by topic and, where appropriate, by time frame (i.e., immediate concern or future concern) or scope of impact (i.e., impacts on natural components of system or impacts on human component of system). In addition, each system report includes a set of responses related to the tools, resources, and information required to plan for adaptation to climate change. It should be noted that none of these groupings were set out or implied in the original survey questions.

1. The Boreal System

The boreal system is the area within range of the boreal forest. That currently includes much of the Yukon and the southwestern Northwest Territories. Climate change could affect how far north the boreal forest extends, what mix of trees grows in it, and what birds, animals, and insects inhabit it. Changing conditions could also increase the number of forest fires and allow forest pests and diseases to move further north.

Number of respondents: 15

Research Topics	
Nature and vulnerability of boreal system	
Geophysical systems	Evapotranspiration rates: Have a fundamental influence on amount of water available to streamflow and lake-level regimes, both in respect of surface run-off and as recharge to aquifers. Discharge from aquifers provides summer base flows and related thermal buffering and winter flows.
	Oceanic temperature oscillations may occur more frequently or cease to occur with climate change. What impact will this have on our climate, marine, fresh water and terrestrial habitats and the species dependent on them?
	The distribution of permafrost in mountainous and hilly terrain.
Vegetation	Climate change as it is related to pests, like the leaf miner, spruce bark beetle, the fungus on spruce trees, etc.: A warmer climate could open the door to migration of pests further north, possibly killing vast areas of forests.
	Vegetation in mountainous regions: I have personally seen stands of balsam trees dead and dying in the Glenlyon Range and large patches of dead bearberry and other plants.
	Treeline movement, forest composition: Ecosystem health, productivity.
	It would be nice to study the advance of spruce, pine, alpine fir, tamarack, and poplar, species of tree moving northward: See how global warming and its impacts increase or decrease the advance of tree species northward.
	How does the changing climate affect the trees in their competition with each other and their possible adaptation to the northern climate? We may possibly have competition occurring within the native species, with climate change. Also, where are all the ornamental trees? Are they populating native species' habitat?
	Migrating treeline, both northwards and upwards (i.e., alpine): Diminishes particular ecosystems, e.g. tundra ecosystems. Introduces new plant and animal species in areas, perhaps displacing others.
Birds and wildlife	Changes in abundance, movement, and range of species
	Bird migration and habitat: We know little about boreal forest birds and ecosystem dynamics, implications for changes in migration patterns.
	How birds and animals would be affected: I would not like that the Yukon birds and animals that live here now become endangered.
	Ecological implications of reduced ground squirrel populations due to variation in winter temperature and precipitation – especially for grizzly bears: Widespread declines in ground squirrels in the southwest Yukon were observed in 2000 and 2001, after winters with unusually mild temperatures and precipitation. Grizzly bears, it has been suggested, have also declined locally at the same time, and that decline has been speculatively related to reduced ground squirrel availability.
	My concerns revolve around the unique Fannin sheep that live in and around Faro and the mine site now being “maintained” just north of town: Both of these potentially will be/are being impacted by the changing climate we are experiencing in Faro and around the North.

Impacts of climate change on the human component of the system	
Economic use of system	Tree growth under different precipitation/temperature regimes: This could change the viability of a forestry industry and is important in addressing sustainability. E.g. – Is global warming going to result in less precipitation, which seems to be the limiting factor?
	Spruce bark beetle infestations are becoming more frequent in appearance: The weather doesn't get cold long enough to hamper spruce bark beetle infestations, leading to the loss of merchantable timber.
	Effects of climate change on trails and routes: Recreational activities may be affecting plant and animal ecosystems more severely than would be the case if the systems were stable.
	Changes in human access and the effects on wildlife
	Changes in wildlife resiliency to human disturbance due to climate change.
Public safety	Forest fires are an interest to me: They can easily get out of control.
	Changes in the water cycle affect the magnitude and frequency of freshet/precipitation/flood events. These in turn affect infrastructure with severe potential damage. Proper predictions on frequency and magnitude of these hydrological events in light of climate change need to be conducted.
Traditional use	Plant life: Plants are very important for First Nation people, because of the medicinal value each has. If these are destroyed we will no longer have our medicines to heal ourselves.
	Vegetation communities: Plants and berries are harvested as part of traditional diet and lifestyle. Wildlife rely on certain food sources.
Adaptation: tools, resources, information required	
Tools	Create ways to project scenarios of climate change for areas of 5,000 to 10,000 sq km, so that we can engage communities in discussions of change: Finer-scale modeling is essential. The general model predictions are too vague to allow discussion of impacts.
	Weather – update Wahl's <i>Climate of Yukon</i> report and make data accessible in real time: Atmospheric Environment Service weather long-term studies are not being done; data are hard to find and not accessible. <i>Climate of Yukon</i> is an excellent reference text for a broad range of users.
Resources	The allocation of funds designated for climate change research – who is making these decisions, who is benefiting, how well national and regional goals are being met: People are really angry and this is hampering progress. The Natural Resources Canada funding calls are not relevant to their needs and desires.
Information	Impacts of climate change on land management decisions.
	Optimal designs for forests at a landscape level, that will provide the ecological services needed as the climate changes: The regional forest planning paradigm is still where to get the AAC [Annual Allowable Cut] with the least damage. More enlightened design work is needed, led by boreal system specialists rather than industrial foresters.
	Impacts of climate change on First Nation economies.
	The effect of climate/global change on the subsistence strategies of aboriginal people in the boreal forest: First Nations may want to adapt their subsistence methods to a changed boreal forest.

2. The Fresh Water System

The fresh water system includes lakes, rivers, wetlands, and glaciers – and the life forms (for example, plants, insects, fish, and other animals) that are associated with them.

Climate change could affect the fresh water system in many ways. Water levels, movement, and water quality may change. Glaciers may melt faster. Freshwater plants, insects, and fish may be affected.

Number of respondents: 10

Research Topics	
Nature and vulnerability of the fresh water system	
Geophysical systems	Low lake levels: Lakes, rivers and streams are becoming low and drying up in some areas. Each fall the watershed backs up with water, and slowly it is becoming lower; not as much run-off as there used to be.
	Not as much precipitation in all seasons: The wind never used to blow when it was really cold out, minus 35-40 Celsius. Watersheds are not getting enough rain and snow, as our glacial patches are melting at an alarming rate.
Plants and animals in system	How the wildlife – animal and plant life – would be affected [by changes in] in our waters: The Yukon has such interesting animal life and such beautiful plant life, that it would be a shame to destroy it.
	Partitioning the sources of climate variability (marine, terrestrial, riparian/lacustrine) that may influence salmon runs: Salmon are not only an important resource for Yukoners, but also have been documented elsewhere to be an important source of marine nutrients which are imported into terrestrial ecosystems. To date in the Yukon, salmon have not been managed to account for those non-human needs, and climate change may make such a process more difficult.
	The ecological implications for terrestrial and freshwater ecosystems of changing salmon availability (due to climate change and other factors): See note above re salmon.
	Quantity and mechanisms of past and present transfer and uptake of marine nutrients (i.e., salmon eaten by various species including man, and salmon carcasses) into other ecosystems (lakes, streams, riparian forests): See note above re salmon.
Impacts of climate change on the human components of the system	
Water quality and quantity	Water volume: Sustainability.
	Fresh water: Even in the Yukon we are faced with pollution of our fresh water. When this is all gone, so are we. Our water is our replenisher.
	Impact on aquifers: Affects water levels, municipal water supply, wells. Impact on costs.
	Water temperatures: Affects fish growth, cost of municipal water supply.
	Fresh water for drinking: Changes in the fresh water regime may affect the quality and availability of drinking water.
Public health and safety	Water levels and flooding and glacial melting: Effect on riparian systems and human river-front habitation.
	Freeze-up and break-up times: Ice on rivers and lakes is used for travel corridors; inadequate ice depth means danger.
	What pollution is in our water system? e.g., from mining, industry, agriculture. This affects the health of humans and animals.
Traditional use	Fish habitat in lakes and rivers: Fish are an important part of traditional lifestyle and diet. Their availability is important to Ta'an Kwach'an Council citizens.

Adaptation: tools, resources, information required	
Tools	Proper, accurate inventory of lakes and river hydrographic conditions needed; not enough hydrometric stations: Warmer winters mean more snow, more run-off, changing flood peaks.
	Portable/mobile technology for the treatment of water, powered by alternate energy: Community health [impacts].
Information	How much is our water at risk from being sold? I feel strongly that we need to ensure we don't go down this path.
	How do you differentiate a climate-change-related impact on water quality from a non-climate-change-related one? Drawing a line and saying "this is a climate change impact" and "this isn't" could be very difficult. There are many factors impacting our fresh water. Water quality is very important, and fear surrounding deteriorating water quality has been a hot topic in the last few years. Contamination seems to be the usual problem.

3. Tundra System

Tundra – or barren land – is located north of the treeline and extends all across the Canadian North. The animals (for example, caribou, muskox, and wolves) and plants that live on the tundra, as well as the other features of the tundra such as glaciers, permafrost, and the land itself, may be affected by climate change.

Number of respondents: 8

Research Topics	
Nature and vulnerability of the tundra system	
Ecosystem	Inadequate knowledge of base vegetation conditions: Range extensions, impacts on quantity/quality and type of vegetation present.
	Vegetation communities: Rare species of tundra plants may be at risk from changing conditions, migrating treeline, etc.
	Snow depth in tundra areas: Food sources for caribou become difficult to access.
	Melting/freezing regime in tundra areas: Food sources for caribou become difficult to access.
	Weather changes' effects on wildlife migration, warmer weather, more insects and more problems for wildlife: Physiological changes in wildlife and behaviour.
	Food-chain relationships for all species will change.
	How the tundra is best suited for certain animals: Here also the tundra plays a very important part in the lives of animals, so let's preserve it the best we can.
Impacts on species	Effect of climate change on parasites of northern ungulates: It was an aspect of my MSc thesis and I am hoping to look at this with regards to a newly-found parasite of caribou and muskoxen for my PhD. But we currently do not know what the actual parasitic populations are for these animals or others. Complicating this is the possibility of changing host populations, with animals such as whitetail deer moving further northward and with game farming. Also tied in with parasites and climate change is the threat of emerging diseases under the new climate conditions. Is there a possibility of uncoupling of lifecycles of parasite and host such that the organism with the shorter lifespan is able to match shifts in climate whereas the larger, longer-lived organism cannot change/adapt as quickly and suffers as a consequence?
	Ecological implications of reduced ground squirrel populations due to variation in winter temperature and precipitation – especially for grizzly bears: Widespread declines in ground squirrels in the southwest Yukon were observed in 2000 and 2001, after winters with unusually mild temperatures and precipitation. Grizzly bears have also been suggested to have declined locally at the same time, and that decline has been speculated to be related to reduced ground squirrel availability.
	Individual and population-level responses of hibernating mammal populations (lagomorphs, rodents, bears) to climate variation, especially winter temperature and precipitation: These animals may be vulnerable (though not necessarily to the same degree or in the same ways) to climatic changes that affect the condition or suitability of their dens/hibernaculae, reducing their over-winter survival. Reduced over-winter survival of denning grizzly bears is also a possible alternative explanation for a suggested recent local decline in grizzlies in the southwest Yukon.
Impacts of climate change on the human components of the system	
Economic use of system	Alpine tundra close to settled areas and trails may be affected by climate change: Recreational activities, mainly hiking, may be impacting the stressed ecosystems and causing more rapid breakdown.
	Permafrost degradation: Implications for road/infrastructure construction.
	Permafrost melting: Construction and maintenance of remote facilities are difficult when permafrost depths are changing and are unpredictable.

Traditional use	Changes in mammal movements due to heavier snow pack and other results of climate change in the North.
Adaptation: tools, resources, information required	
Tools	We cannot know all and never will. Therefore a risk assessment approach, which looks at collective consequences of climate change across ecosystems, may be worth exploring.

4. Coast System

The coast system includes all the land, plants, birds, and wildlife in the ocean shoreline area (between the high and low tide marks) and on the mainland area bordering the ocean shoreline.

Climate change may affect the plant and animal life of the coast system, as well as land and sea features like permafrost and sea ice. Climate change impacts like melting permafrost, reduced sea ice leading to more and bigger storm waves, and shoreline erosion could affect coastal communities and structures.

Number of respondents: 3

Research Topics	
Nature and vulnerability of coastal system	
Geophysical systems	Coastal wind and how far it is carried inland for extended periods: In the Carcross area, we experience high wind from the south. This wind regulates our weather systems, and we experience a warmer climate for extended periods
	The weather changes and how it would affect us living here: Our weather patterns seem to be changing drastically these days. If we can do anything to have the weather more predictable, I'm for it.
Ecosystem	Can't separate coast from ocean: Each will affect the other. For example, more open water can increase storms, eroding more shoreline. More shoreline erosion can create new beaches/spits that are attractive to shorebirds. Warmer waters may increase marine mammal activity.
Impacts of climate change on the human components of the system	
Public safety	Erosion and flooding of shoreline communities: Some people in the North live in low-lying coastal areas and therefore are at risk of major destruction and life/economic/land loss.

5. Marine System

Marine systems of importance to the North include the Beaufort Sea, the Arctic Ocean, Hudson Bay, and the western reaches of the North Atlantic.

Climate change may affect many parts of northern marine systems in many ways. Sea ice, ocean currents, tidal patterns, and storm impacts may change. Marine plant life, fish, and marine mammals like seals and whales may be affected.

Number of respondents: 2

Research Topics	
Nature and vulnerability of coastal system	
Geophysical systems	The possible oceanographic changes in the northeast Pacific induced by global change: Affects regional climate.
Ecosystem	Weather impacts and extinction of certain animals who live in this area: I would like a climate that was more moderate, if this is possible. I am concerned about animals of this area becoming endangered.
Impacts of climate change on the human components of the system	
Traditional use	Effects of sea ice changes on seal species and whale species: Part of the marine ecosystem; part of traditional diet, lifestyle, and economy.
	Anadromous fish species and climate change: Salmon, for example, is an import part of traditional lifestyle and diet.

6. Agriculture

At present, agriculture is most important to the southern and central Yukon. In most other parts of the North, conventional agricultural production is limited by both climate and soil conditions. However, changing conditions and introduction of new crop and livestock species might expand the North's agricultural potential.

Number of respondents: 6

Research Topics	
Impacts of climate change on current industry practices and environment	
Crop production	Northward movement of agricultural pests and diseases and of weed species: If weather becomes drier, soil salinity due to increased irrigation may become even more of a problem than it is now.
Livestock production	Does climate change facilitate new emerging diseases? If we choose to have livestock, including game farming, we stand the chance of collapsing our wildlife populations. Point in case: we no longer have the original wild stock of our present-day domestic animals. Without having a good understanding of the current parasite populations and diseases across our wildlife, we would be foolish to introduce livestock capable of spreading pathogens to our wildlife. Coupled with a host population of transplanted livestock serving as a reservoir of pathogens, a warming trend of a few degrees C could propel a seemingly innocuous subclinical condition in the normal host to an emerging disease or promote a jump to a different species, say a wild animal host, without any evolved evasion strategies. A current example of this sort of jump between species is the Avian Flu in Asia which is harboured by wild ducks, hard on chickens, and lethal for humans. That specific example does not have a factor of climate change as far as I know, but that does not mean that climate change could not increase the survival of an intermediate host such as an insect or mollusc and have the same amplifying effect for easing a jump to a new host species.
	Interchange of diseases between domestic animals and wildlife.
Impacts of climate change on future of industry	
Impact of warming	Soil temperatures: May allow a longer growing season, new crop production, new disease problems.
	The increased ability of soil to incorporate organic matter, which would lead to greater potential for green manuring.
	Effect of warming on number of frost-free days and average daily temperatures: Viability of different crops in the North – e.g., wheat and other grains, tubers, market garden plants.
Adaptation: tools, resources, information required	
Information	Feasibility of more community-based agriculture/horticulture in each Yukon community: Food sustainability.
	Increasing land allocations in spot-land, agricultural, and lot enlargements: In the North, Carcross region, we are seeing more agricultural land allocated to the public. What effects does this have on the surrounding wildlife and habitat? Increasing land allocations, with the introduction of fences, take up more natural wildlife habitat.
	Reclaimed gravel pits: After a pit has been decommissioned and undergone reclamation measures, how long does it take for the natural habitat to come back? – i.e., lichens, caribou moss that the Southern Lakes Caribou Herd depends upon.
	Road right-of-ways are being seeded with a mix of grasses and sedges that promote unnatural wildlife feeding areas: How much wildlife is being lost due to areas that have foreign, introduced species of food?

7. Mining

Mining for gems and precious and base metals is an important economic activity throughout the North. Climate change may make it more difficult for mining companies to access mine sites and minerals, and climate change impacts (such as more melting of permafrost) may worsen the impacts of mining on the environment.

Number of respondents: 6

Research Topics	
Impacts of climate change on current industry practices and environment	
Permafrost impacts	Examine existing tailings and permafrost, and determine whether permafrost melting results in instability of tailings piles and retaining dams, especially at abandoned mines: Melting of permafrost could result in increased effluents from tailings, etc. getting into ground and surface water.
	Melting permafrost relation to increased slope failures, etc.: May be opportunities for placer mining to produce more stable slopes.
	Stability of mine tailings and holding ponds, etc. in a changing climate: Potential for contamination of natural systems when land becomes unstable.
Impacts of climate change on future of industry	
	Climate change may make it more difficult to access mineral deposits and complicate mining processes including reclamation, thus increasing costs, but it won't change the business of mining.
Adaptation: tools, resources, information required	
Tools	Effect of oil development on tundra ungulates: This question has been addressed for the Central Arctic caribou herd. It is doubtful that we will be able to spend the time to study this with the Porcupine Caribou and muskoxen in ANWR/North Yukon. What may need to be addressed is what might happen or affect these animals with both oil development and climate change. Dr. Gary Kofinas (UAF) has put together a number of scenarios addressing these questions. Good research questions could be derived from that scenario-generating exercise.
Information	How much mining activity takes away wildlife habitat: In each First Nation's traditional territory, how much land is used or has been used to mine, placer or hard rock? When these activities are carried out, wildlife habitat is lost, wildlife is forced to avoid or go around loud mining initiatives. On the grander scale, how have these areas been studied to look at these concerns?
	How may past mining initiatives have taken a toll on fish populations that have undergone unmeasured deleterious substances introduced into their habitat? Important to find and measure old mine sites, compare fish harvesting practices, more or less fish [change in population], before or after mining activities have come and gone.
	Do permafrost melt/settleable solids affect fish habitat? Is there a correlation? Does fish habitat occur where there is direct permafrost exposure?
	Can mining ever be an industry in the Yukon again? I am concerned about the economic status of the Yukon. I have lived here for about 36 years and have seen many changes.

8. Tourism

Tourism is an important part of the economy throughout the North. Climate change could affect the location of areas best suited for tourism and recreation, the amount of wilderness and wildlife available for recreational uses, and the best times of year for tourism. It could also affect particular sectors like winter adventure tourism.

Number of respondents: 5

Research Topics	
Impacts of climate change on current industry practices and environment	
Wildlife viewing	Impact on large mammal populations: Wildlife viewing is very important and lack thereof is currently the greatest disappointment for tourists.
Aurora viewing	Winter cloud cover: Aurora viewing is becoming more important; we need to know how viable it will continue to be.
General tourism	Unpredictable weather and impacts on tourism: Tourism economy relies on certain components to be present (e.g., nice weather, enough snow, low precipitation, etc.).
Adaptation: tools, resources, information required	
Tools	Model changes in visitation rates to northern wilderness areas due to milder winters.
Information	Is private enterprise increasing or decreasing with population numbers in tourism? Is this related to the Yukon's warmer climate? Find out the statistics of increased tourism due to the warmer climate. We know it has increased, but how much?
	Will winters get warmer, colder, more or less snow? Snowmobiling alone is a \$6.9 million industry in Yukon (2001).
	How can we best promote the Yukon? I do want to share the beauty of the Yukon with many people as long as they are environmentally friendly.

9. Fisheries

Fisheries are important throughout the North – for commercial harvesting, as a tourist attraction, as a recreational resource, and as part of traditional foods. Climate change may affect where fish are located, the types of fish in the North, and how quickly fish individuals and populations grow. Fish habitat and food resources may also be affected.

Number of respondents: 7

Research Topics	
Impacts of climate change on current industry practices and environment	
Fish populations	The kinds of fish that we have in the Yukon becoming extinct: I am proud that our lakes and rivers flourish with many kinds of fish to offer all types of activities.
	The response of migratory fish to changes in ocean currents and river temperatures: To understand if fish are undergoing extinction or migration in the Pacific Northwest.
	Effect of climate change on salmon.
Impacts of climate change on future of industry	
Habitat and disease	We may see new diseases and parasites over time, while other climate change problems, such as increased sedimentation, could change river and stream flow characteristics.
	Fish habitat related to temperature of water and pollution: Healthy habitat equals a healthy fish population.
Adaptation: tools, resources, information required	
Information	With increased tourism numbers each year, how many tourists buy a permit to catch Yukon fish species? Important to find out how much fish populations are being harvested, with increasing tourism.
	Harvesting routes for salmon: We need more places to go salmon fishing. Once the salmon can't spawn here, we will lose them.

10. Forestry

Forestry is currently a significant industry in the parts of the southern Yukon and Northwest Territories. Climate change might have an effect on both the health of northern forests and their extent. The kind and quality of trees might be affected by climate change. The kind and severity of insect pest infestations and tree disease might change. Natural disturbances like forest fires and flooding might become more frequent.

Number of respondents: 5

Research Topics	
Impacts of climate change on current industry practices and environment	
Change in seasons	With earlier warmer weather in February, March, how much forestry harvesting can be done in a way that causes less environmental damage to the forest floor? When the warmer weather hits, forestry practices are still going ahead as in the past, and forest floor damage causing erosion is highly possible.
Wildfire	Increased frequency of forest fires: Safety of community; destruction of habitat (out of proportion to “normal” fire cycles).
Impacts of climate change on future of industry	
Change in seasons	How much has our growing season increased from year to year? Find out or possibly project longer growing seasons for Yukon wild forests.
Adaptation: tools, resources, information required	
Tools	How to preserve our forests to the best of our ability: Forestry could be an industry in the Yukon with the proper guidelines.
Information	The aerosol feedback mechanism of wild-land fire smoke on the macroclimate of Yukon: To help clarify the possible future scenarios for the Pacific Northwest.
	Climate changes in the North may result in changes in snow cover: Reduced snow cover would reduce the albedo effect and positively feed increased temperature, thereby accelerating the impacts of climate change.

11. Hunting and Trapping

Hunting and trapping have provided northerners with food, clothing, and a sense of identity for thousands of years. Climate change may affect hunting and trapping by affecting the numbers, location, migration patterns, behaviour, and health of wildlife, and by affecting hunters' ability to travel and find game.

Number of respondents: 8

Research Topics	
Impacts of climate change on current industry practices and environment	
Trapping	Trapping furs: All the warm winter weather that we have been getting is really taking a toll on our quality of fur. Are they quality furs now or not?
	How much the fur market has dropped due to insufficient fur numbers being harvested: When the weather is warm, the animals have a harder time producing a good coat of merchantable fur.
	How many active trappers actually still go out to trap? The market being in a slump, not many trappers are going out. If they don't trap in a certain amount of time, actually they may lose their traplines.
Hunting	Due to the longer fall season, animals take longer to rut or don't rut until later than expected: I've noticed bull moose rut 2-3 weeks into October, when the last two weeks in September are thought to be late ruts.
Impacts of climate change on future of industry	
Traditional economy	Warmer winters and effect on hunting and trapping activities (e.g., ability to get out there): Trapping/hunting is part of traditional lifestyle, diet, and economies.
	Warmer winters and effect on fur-bearers: Harvesting of fur-bearers is part of traditional economy.
Hunting	In the Yukon, mountain goats are only found in our wetter regions, and/or may be quite closely associated with late-melting snow patches. If the snow patches were to disappear, the vegetation may change and no longer be lush enough to support the relatively sedentary goat populations.
Adaptation: tools, resources, information required	
Tools	Warmer autumns (late snow) can make sheep more vulnerable to hunting as they move to winter range and rutting areas. May require refinement of hunting regulations.
	Hunting and trapping with reasonable guidelines: I have family members who do enjoy hunting for the food and the sport of the chase. I do not. I think there is a place for hunting and trapping in the Yukon.
	Practical systems that hear and relay the observations of abnormal events experienced by hunters and trappers. The comparisons to normal will be part of this: Systems now available rely on patrols or annual interviews that are expensive and subject to recall error. A more immediate system is needed, probably with some small financial incentive to report and to relay the information.
Resources	Norms in current harvesting behaviour and strategies need to be described, particularly aboriginal hunting. The norms need to be described in terms of underlying values: To allow analysis of how vulnerable these are to patterns in climate change. They have changed a lot in the past 20 years with better, cheaper, off-road vehicles.
Information	Projected wildlife uses of lands zoned as having higher agricultural potential as the climate changes: As soon as some threshold is passed where the degree days will allow cereal crops to mature most years, there will be substantial pressure to farm these lands.
	The potential extinction/migration of regional animal populations: To help First Nations plan for adaptation to a changed climate.

	<p>How land users (particularly, but not exclusively, First Nations) adapt to changing distribution and abundance of hunted and trapped species: Knowing about and understanding successful adaptation strategies may not only directly benefit other land users, but may also provide new approaches for resource management policies.</p>
	<p>How land users (particularly, but not exclusively, First Nations) adapt to changing and increasingly unpredictable environmental conditions: Knowing about and understanding successful adaptation strategies may not only directly benefit other land users, but may also provide new approaches for resource management policies.</p>
	<p>Trappers and hunters are on the land on a regular basis. They often are the first to notice changes in the animal population. What effects of climate change are evident to them, and when did they start noticing changes? Trapping and hunting are important to Yukoners, especially those in small communities. Changes in the animal populations will impact this way of life.</p>

12. Community Health

Climate change may affect the health of northerners and northern communities in a variety of ways. Air and water quality in communities may change. Local lifestyle patterns and country foods could be affected. Even the availability of jobs can be affected by changing climate.

Number of respondents: 7

Research Topics	
Current concerns	
Contaminants	Cancer: With so many people being diagnosed with cancer (any kind), it should really make us all think about where it is coming from. When Chernobyl blew up, I am sure we must have gotten some particles here in the Yukon. If we could get the dust storm from the great deserts overseas, then I am sure we got some radiation particles from Chernobyl.
	The long-range transport of radio nuclides from Eurasia to the Pacific Northwest: Community health.
	Doing whatever it takes to make our air and water as pollution-free as possible: I am promoting not starting smoking with the elementary students that I teach at my school. Also, I am trying to raise the awareness of people around me about idling of vehicles and second-hand smoke.
General health concerns	'Flus and colds: In the past 6-7 years, colds and 'flus are more evident, and everyone gets sick for longer periods of time.
	Availability of traditional food sources: Health of community.
	Protection of drinking water sources: Health and safety of community.
Adaptation: tools, resources, information required	
Information	Mosquito and biting-fly borne diseases: For example, as the average temperature increases the possibility of mosquitoes carrying Plasmodium spp. pathogens increases. The Yukon does have Anopheles sp. mosquitoes (I have conducted mosquito control in the Dawson region for 10 years and on occasion find Anopheles) and if they are able to survive the winter as some of our other mosquitoes do, the ability to harbour malaria is facilitated.

13. Energy

Communities throughout the North depend on fossil fuels like gasoline, oil, diesel, and propane for heating, electricity, and transportation. Alternative energy systems, such as wind and solar power and hydroelectricity, are also used as energy sources in many areas of the North.

Climate change may affect availability and cost of Northern energy resources – for example, melting permafrost might affect gas pipelines and a shorter winter road season could affect fuel prices.

Number of respondents: 9

Research Topics	
Current concerns	
Costs	Home heating: The cost of all our fuel is outrageous. Because we live in the North we have to pay. Government should give us grants that don't need to be paid back to use different energy sources.
	Fossil fuels not being available in the future, the cost of electricity in the Yukon: I am a homeowner and find the electrical bills very high. I also believe that someday our fossil fuels may no longer be available.
Environmental impact	The entire Southern Lakes should be looked at when doing an environmental assessment of the Whitehorse power-generating station: The more recent impact study and assessment on the Whitehorse dam was only done on the Marsh Lake (northward) lake system, not taking in the entire Southern Lakes system.
	Loss of forest ecosystem services from the clearing of land for linear energy development.
Global impact	Fossil fuel exploration and exportation in the North is contributing to Canada's greenhouse gas emissions – but what are the quantities?
Adaptation: tools, resources, information required	
Tools	Compile a database with mean ground temperatures at various locations throughout the Yukon: Ground-source heat pumps are a viable alternative energy system that reduces our dependence on fossil fuels. In order to size equipment and design the ground loops, detailed information is required, including mean ground temperatures and annual ground temperature amplitude. Currently, this information is lacking and designers have to rely on NASA data, which is based on satellite photos and is ultra-conservative. This lack of information results in calculations or models that show poor performance of the heat pumps.
Resources	Feasibility of fossil fuel continuation: Help communities design for renewable energy sources now. Help them with bottom line on current projects.
Information	Viability of wind power in small communities or for individuals living in isolated situations where shipping fuel in is difficult. Is wind a cost-effective solution? Dependence on fossil fuels must decrease.
	Viability of solar power for anyone, including people living on the grid. Can solar power make a significant difference in home heating costs? Dependence on fossil fuels must decrease.
	What is the viability of earth-bermed homes in the Yukon? Can government adapt to recognizing that this is an energy-saving way to live? Dependence on fossil fuels must decrease.
	Portable generation of electricity from alternative fuels: To be able to utilize technology in remote locations.
	Feasibility of localized energy sources: Reduce reliance on larger (outside) systems.
	Climate change could possibly cause huge amounts of methane to release from permafrost areas of the North. What are the amounts? When will it happen?

14. Infrastructure

Impacts of climate change may reduce land stability, cause increased water levels and erosion, and increase the number of winter thaws. These changes could in turn affect buildings, roads, airports, sewer and water systems, pipelines, power plants, and other infrastructure in northern communities.

Number of respondents: 5

Research Topics	
Current concerns	
Built environment	Analysis of current practice costs versus sustainable practices: Help communities make good decisions re new buildings where improved efficiency and performance actually benefit in many more ways
	Buildings and their associated infrastructure (pipes, electrical, sewage, water, etc.) need to be developed with awareness of climate change: Northern residents need healthy and safe homes.
	Dawson City's recreation centre – what happened to the foundation?
Communications	Infrastructure: Continued deployment and development of information technologies requires a core network of modern telecommunications facilities. These facilities must be accommodated in an practicable and sustainable manner.
Adaptation: tools, resources, information required	
Tools	Monitor the mean ground temperature at various locations throughout the North: Determine whether the ground temperature is increasing due to climate change. Increasing ground temperature could lead to infrastructure failure in temperature-sensitive structures.
Information	Snow pack changes: We build and maintain a trail system for snow machines, dog sleds, skiers.
	Climate change impacts on soil: We build and maintain the Trans Canada Trail in Yukon. Will the effects of summertime users such as horses, bikers, atvs, and people afoot increase or decrease with climate change?
	Permafrost degradation: Effect on infrastructure design.
	Higher temperatures, increased run-off: Effect on infrastructure design.

15. Transportation

Northern transportation systems include transportation routes (community roads, sea ice, winter ice roads, ice bridges, ferry crossings, marine shipping routes, and highways) and transportation modes such as cars, snowmobiles, all-terrain vehicles, boats, and airplanes. Northern transportation systems are sensitive to climate and weather, and may be affected in many ways by climate change.

Number of respondents: 8

Research Topics	
Current concerns	
Greenhouse gas emissions	Active transportation: People commuting to work by bike or on foot, roller blades, etc. increases personal well-being, health, and wellness. It protects the environment from pollution and gives people a greater appreciation for our environment.
	Civic transportation modes: Planning for climate change, I think, should include a concentrated effort to get Whitehorse residents out of their private vehicles – walking, cycling, skiing to work, or riding a bus.
	We should have emission testing done on all vehicles that are over a certain age: There are a lot of vehicles running around, burning lots of oil and running very poorly.
	Making people aware, when you leave your engine running during extreme temperatures, how much your individual vehicle can contribute to ozone depletion and greenhouse gases: I believe it is important to have everyone aware that it takes everyone to work on not contributing to the greenhouse effect.
Vulnerability	Community design to reduce need for transportation of commodities: If transportation will be uncertain, then show how we can reduce our need for it
	Sustainability of current transportation system within the context of a changing climate: Northerners rely almost exclusively on transportation for food, supplies, material, etc..
	How to keep all our transportation routes open year-round: We are quite isolated and at a distance from the bigger centres, so it is wise to be concerned about how climate change could affect transportation.
	Feasibility of winter ice roads: Transportation of necessary materials and supplies for community development.
Maintenance	Longer spring and fall seasons may cause greater frequency of freeze-thaw cycles. This would lead to more ice on the highways, greater costs for highway maintenance, and more dangerous driving conditions.
	Impact of warming/cooling on safety of northern roads: People travel a lot in the North – for work, food, and visiting. They therefore need this to be a safe activity.
Adaptation: tools, resources, information required	
Tools	Computer-aided modeling of regional transportation systems: To identify faulty paradigms based on the assumption of unlimited oil and gas.
	Aspect-controlled permafrost: Very little is understood about hill-slope permafrost. In southern and central Yukon in the sporadic-to-discontinuous permafrost zone, the existence of permafrost is often governed by the aspect of a slope: i.e., north-facing slopes have permafrost whereas south-facing slopes have none. It is likely that much of this permafrost should be considered “warm” permafrost and therefore susceptible to melting. Melting will thus destabilize slopes. Future development in the territory, whether it be pipelines or mine access roads, needs to be aware of permafrost conditions of this nature. A research suggestion would be to establish borehole monitoring stations in southern Yukon, similar to the Mayo research, to assess the current temperatures and future trends.

Information	What do road-builders need to know to adapt successfully to climate change? Is the industry prepared to adapt? What do the governments who make the decisions need to know in order to make the right choices? The Yukon is falling behind in maintaining its road infrastructure, despite the best efforts of the people who actually do the work. Costs are increasing, and it's becoming more and more difficult to keep up the maintenance.
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16. Waste Management

The waste management system in the North includes things like tailings ponds, sewage lagoons, and garbage dumps. Climate change may affect the way human and industrial wastes in northern communities can be stored and the way wastes can be treated or transported. Climate change may also affect the way contaminants move through the environment, where the contaminants end up, and how long they remain.

Number of respondents: 5

Research Topics	
Current concerns	
Sewage	Is secondary sewage treatment necessary in Dawson City? Is there a possibility that screening the effluent and diluting it in the river (permitting microorganisms to break it down there rather than in big tanks) is a reasonably effective way to treat the sewage? The cost of secondary sewage treatment (construction and O&M) is extremely large. Not only is Dawson faced with this but other communities as well (Carmacks, Mayo - which has a lagoon but it completely drains rather than forming the lagoon), so the overall cost of building plants ultimately falls on YTG (which maintains that they can't even afford Dawson's system). Obviously we need another approach and perhaps we should seriously put aside our initial Freudian response to "poo in the river" and investigate, sans emotional response, this question.
	Which is more harmful - one family living off the grid with an outhouse or composting toilet, or one more family moving into a city to be part of the flush-it-all sewage system?
Industrial	Tailings ponds: There must be thousands of tailings ponds that we don't know about – because when I was a kid, people and companies dumped whatever wherever.
General	Garbage dumps, contaminants, recycling initiatives are all concerns of mine: I am a strong believer in not polluting and contaminating our planet earth any more than we already have. The more we do this, the more it will help in the long run.
Adaptation: tools, resources, information required	
Information	The use of waste in the generation of energy, the growth of food, and the treatment of water on micro- and macro-scales: To diversify present options.
	Possibility of leaching and contamination from land instability: Contamination of land, water, wildlife – all key components of northern lifestyles.