



From Impacts to Adaptation:
Canada in a Changing Climate 2007
Chapter 3 - Northern Canada

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Photo D Vaughan

Context of Chapter 3 – Northern Canada

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Context of NRCan Report – Chapter 3

- IPCC Third Assessment Report



- Arctic Climate Impact Assessment



- International Polar Year



- IPCC Fourth Assessment Report



- NRCan Regional Experts Meetings

Chapter 3 – Northern Canada (Yukon, NWT, Nunavut)



Figure 1.1. Communities and political boundaries of the Canadian North. The Territorial North includes nearly 100 communities spread across almost 60% of Canada's landmass (from Furgal et al., 2003).

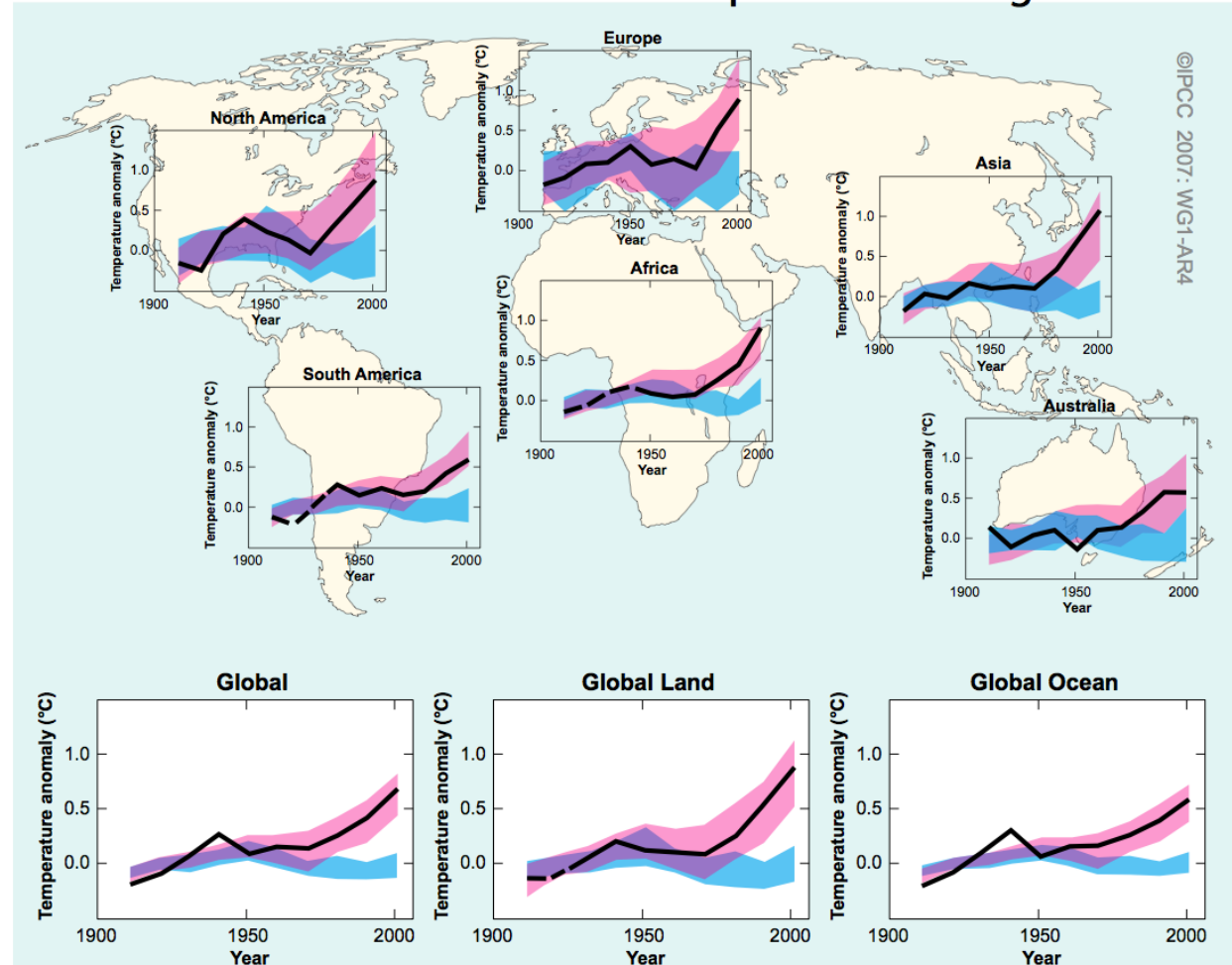
Conclusions from
ACIA and IPCC Fourth Assessment

Global Temperature Trends

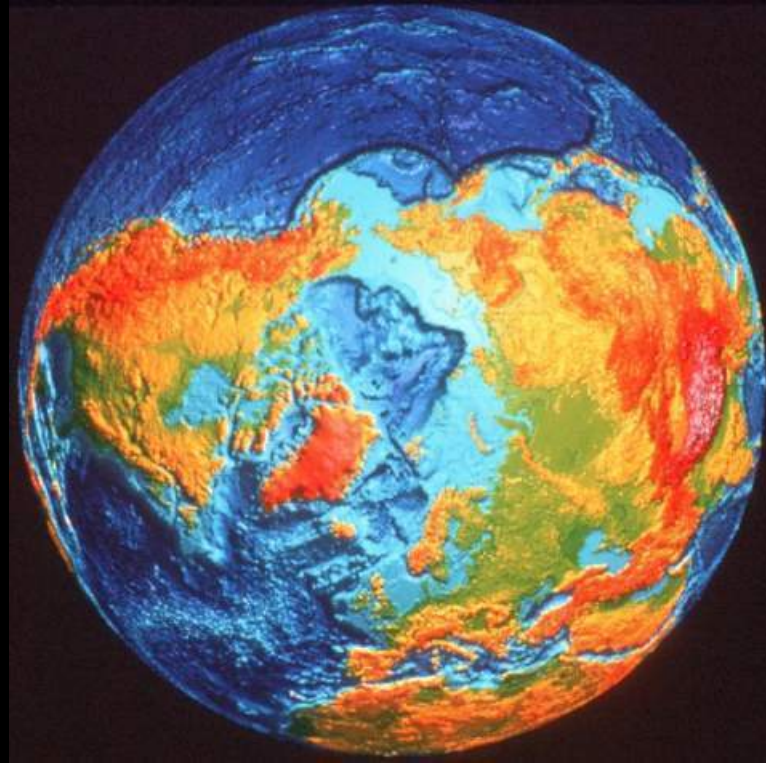
- It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent except Antarctica

IPCC WGI

Global and Continental Temperature Change



Arctic Temperature Trends



- **Average Arctic temperatures increased at almost twice the global average rate in the past 100 years.** Arctic temperatures have high decadal variability, and a warm period was also observed from 1925 to 1945.

Sea Ice Trends

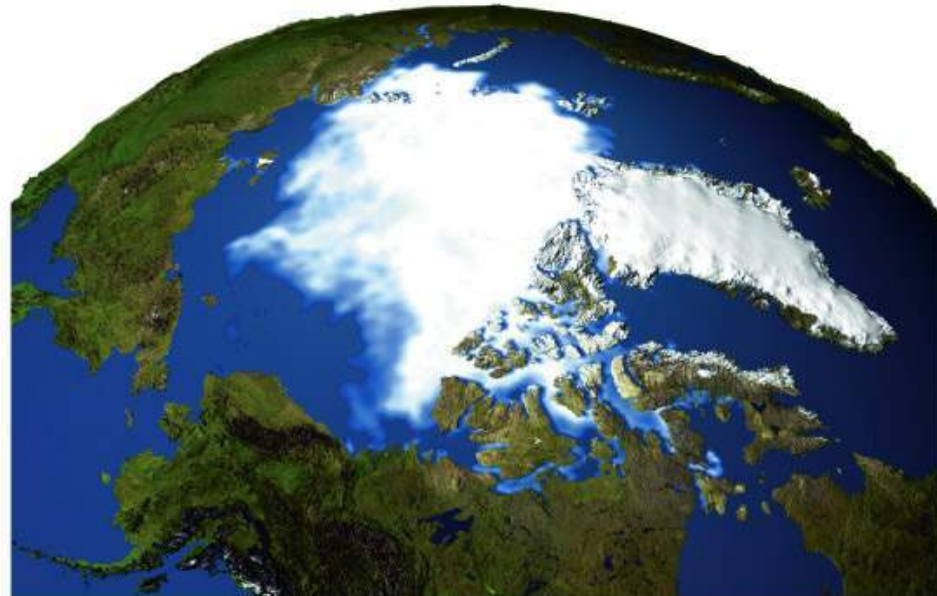
- Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 [...] % per decade, with larger decreases in summer of 7.4 [...] % per decade. These values are consistent with those reported in the TAR.

IPCC WGI

Observed sea ice September 1979



Observed sea ice September 2003



Projected Sea Ice Trends

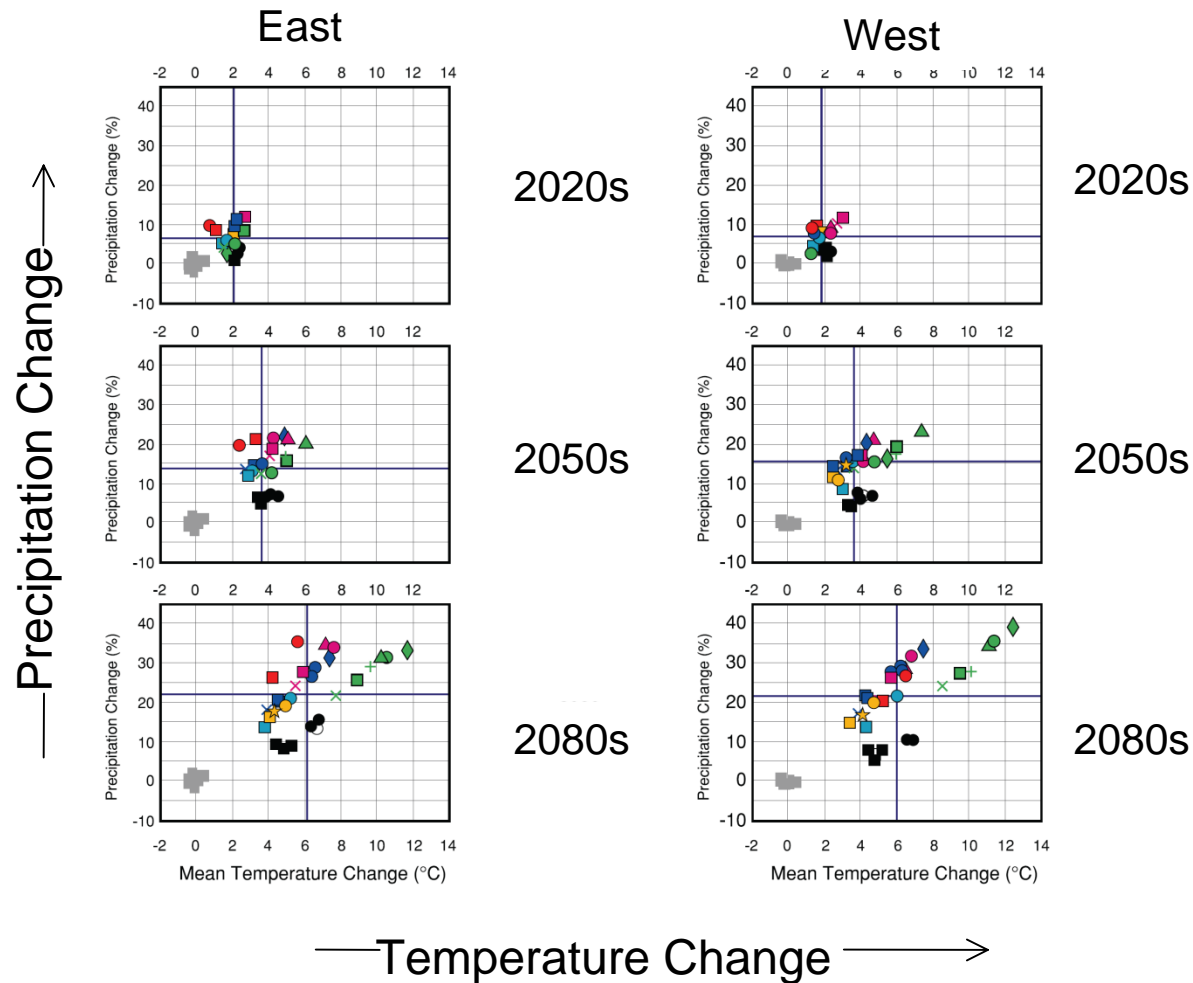
- Sea ice is projected to shrink in the Arctic under all model scenarios. In some projections, Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century

IPCC WGI



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Chapter 3 – Temperature & Precipitation Projections



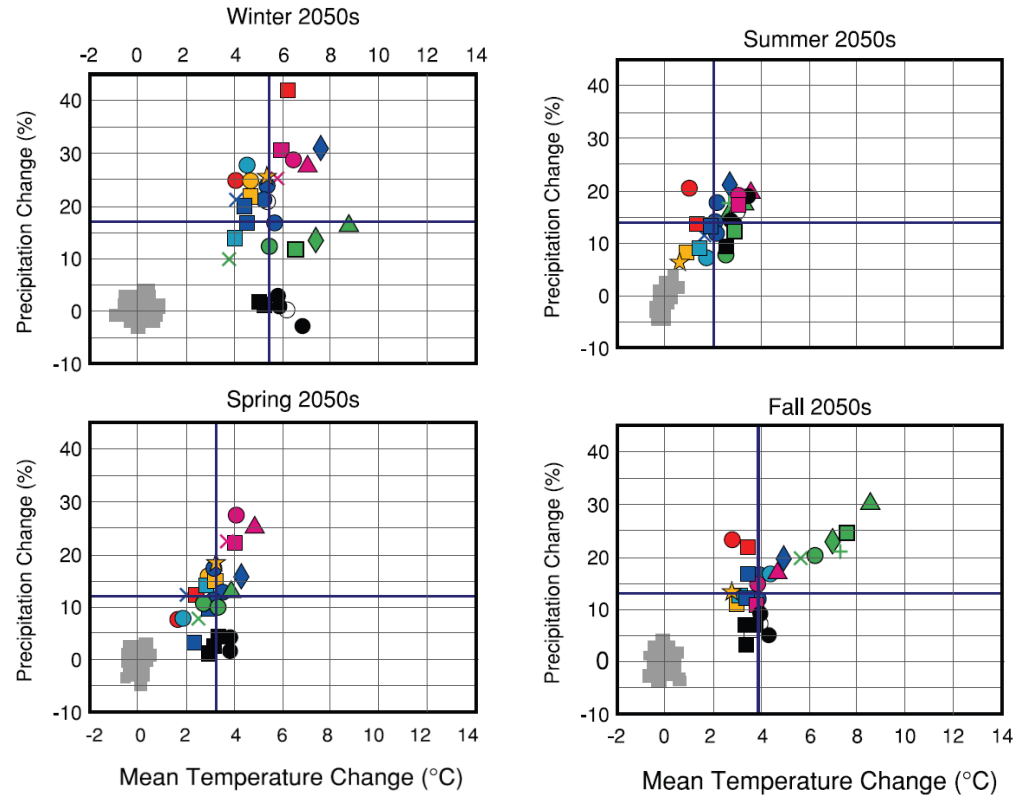
2080

- A predominantly warmer and wetter future is projected throughout the North
- Median temperature change of +6°C (ranging from +3.5°C - +12°C)
- Median precipitation change of +22% (ranging from +5% - +40%)

Chapter 3 – Temperature & Precipitation Projections

East

Precipitation Change



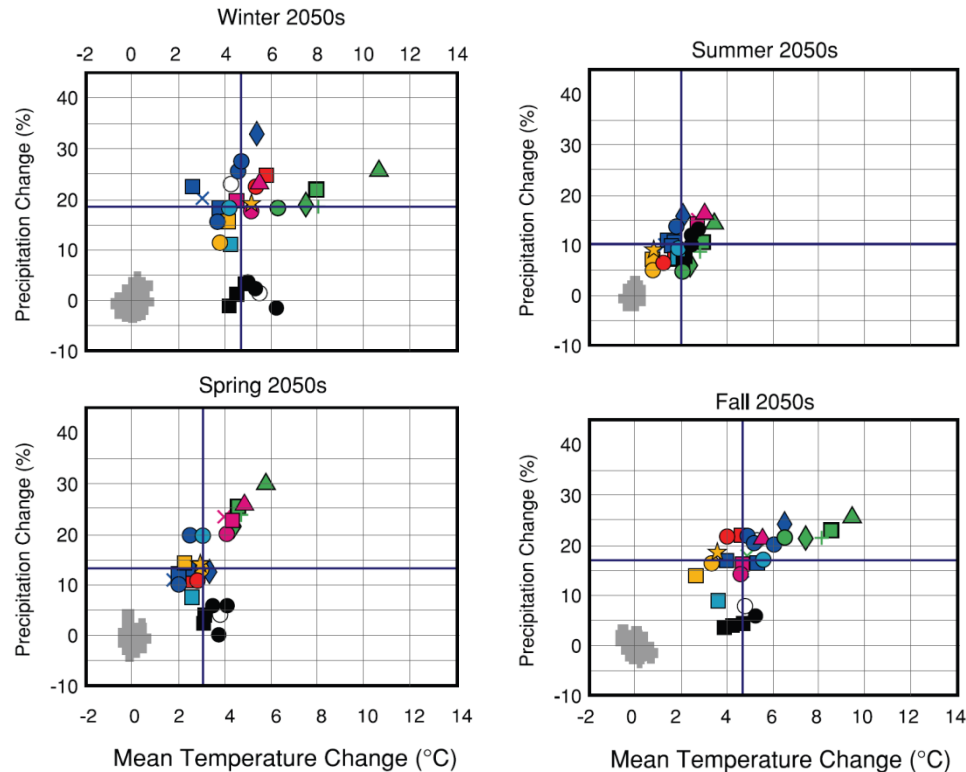
Temperature Change

- Warming will be more significant in winter and fall months
- Eastern winter temperature projections are slightly warmer than West
- Range of precipitation increases (0% to 40 %) during winter months

Chapter 3 – Temperature & Precipitation Projections

West

Precipitation Change

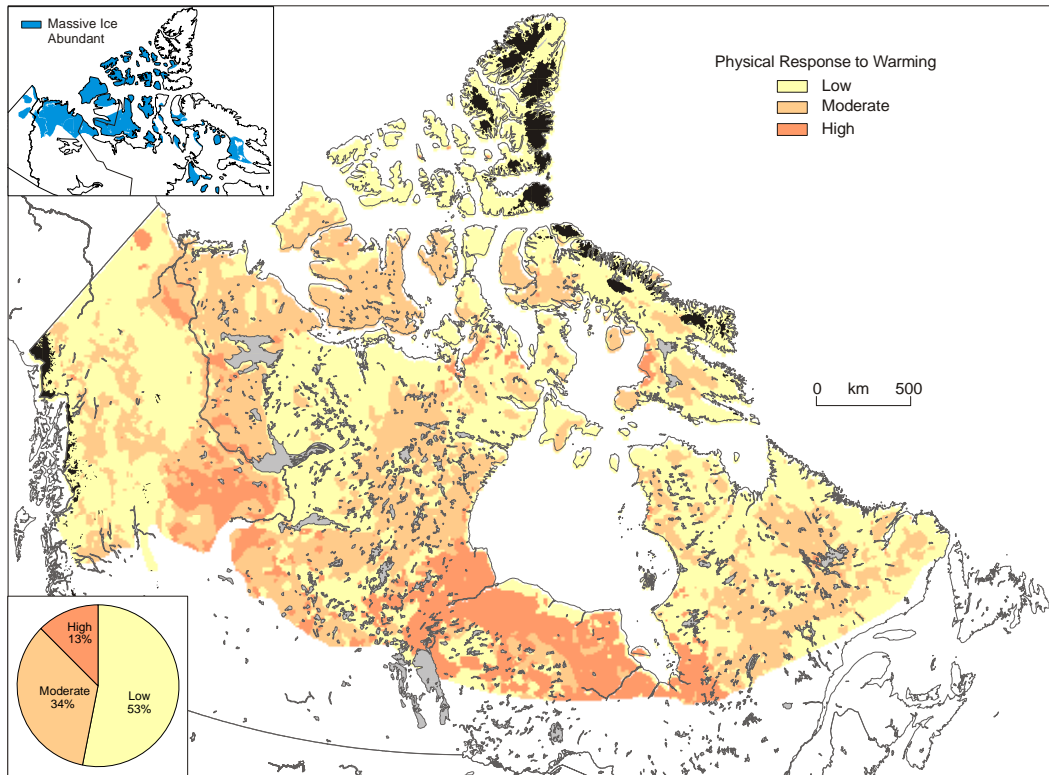


Temperature Change

- Greatest temperature changes will occur at higher latitudes; particularly in the extreme northwest
- Greatest annual precipitation increases over more northerly regions
- High degree of variability stresses need for consideration of range of 'potential futures'

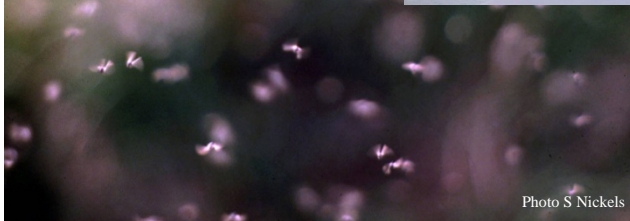
Key Findings from Chapter 3: Northern Canada

Chapter 3 – Key Findings



- Climate-induced changes in the cryosphere (permafrost, sea ice, lake ice and snow) will have large implications for infrastructure maintenance and design
- Increase in active layer depth (0-50%) projected to be greatest in the Yukon

Chapter 3 – Key Findings



- There will be consequences for biodiversity shifts and in ranges and distribution of many species with impacts on availability, accessibility and quality of resources upon which human populations rely

Chapter 3 – Key Findings

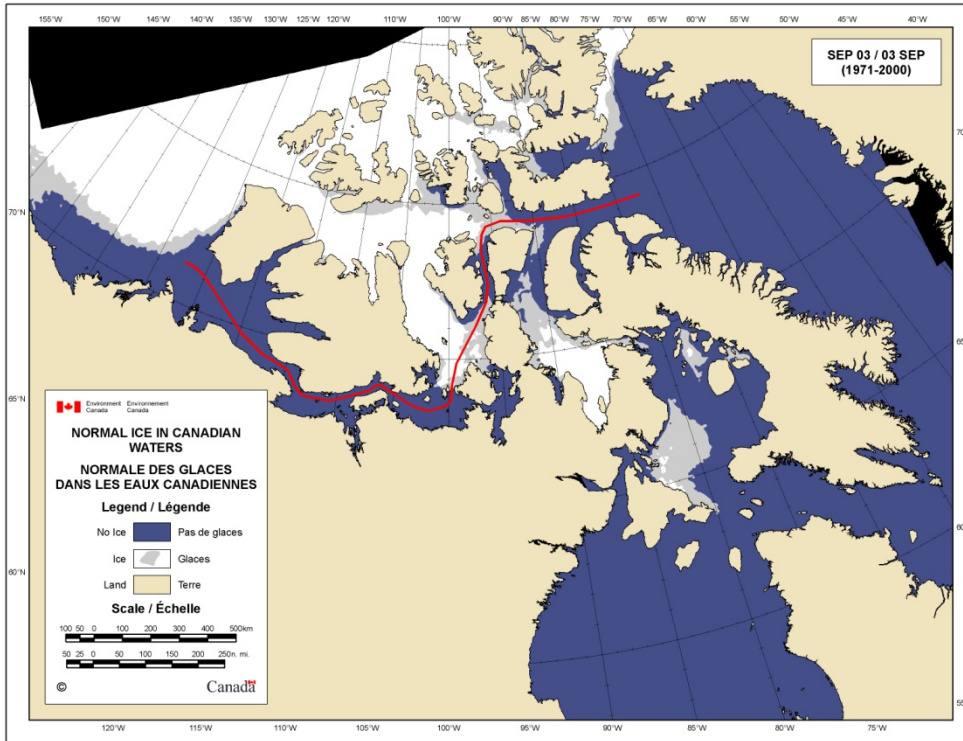


Figure 4.5.1: Typical route for the Northwest Passage, on charted median ice concentration (1971-2000) for September 3.

- Increased navigability of Arctic marine waters and expansion of land- and fresh water-based transportation networks will lead to a less ‘remote’ northern Canada, bringing both opportunities for growth in a range of economic sectors, and challenges associated with culture, security and the environment

Chapter 3 – Key Findings

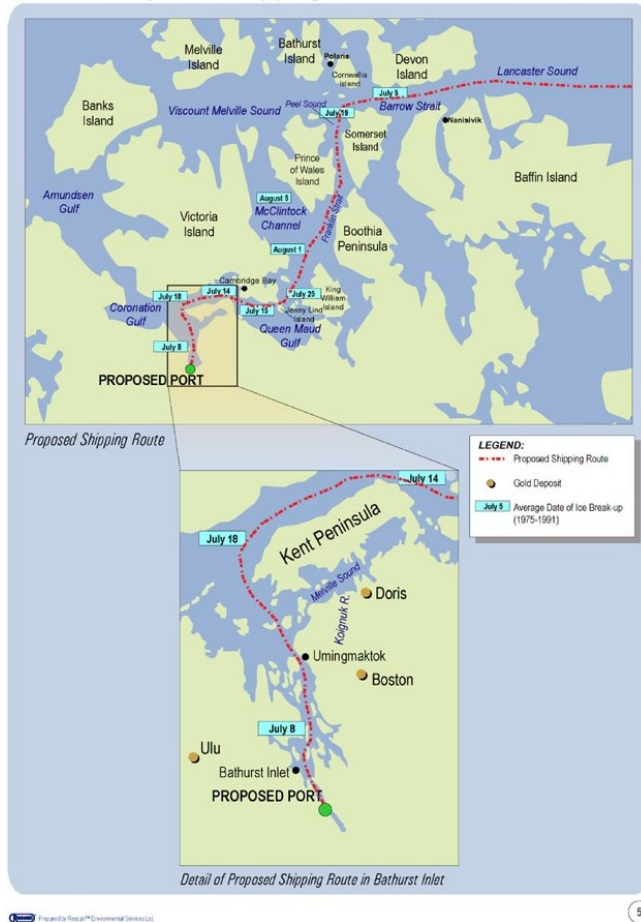
- While maintaining and protecting aspects of traditional and subsistence ways of life in many Arctic Aboriginal communities may become more difficult in a changing climate, some new opportunities will also be presented



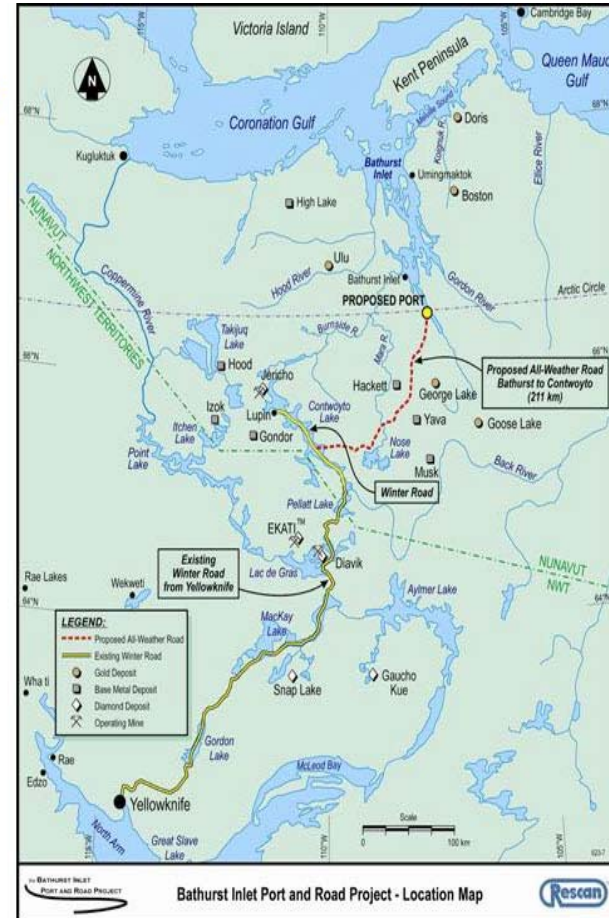
Themes and Case studies

Chapter 3 – Case Study – Mining and Transportation

Proposed Shipping Route and Ice Data



Kivik Corporation
"NUNUT" 40444



- Decreased ice cover and extent presents new opportunities for marine transport and planned resource development

Chapter 3 – Case Study – Northwest Passage

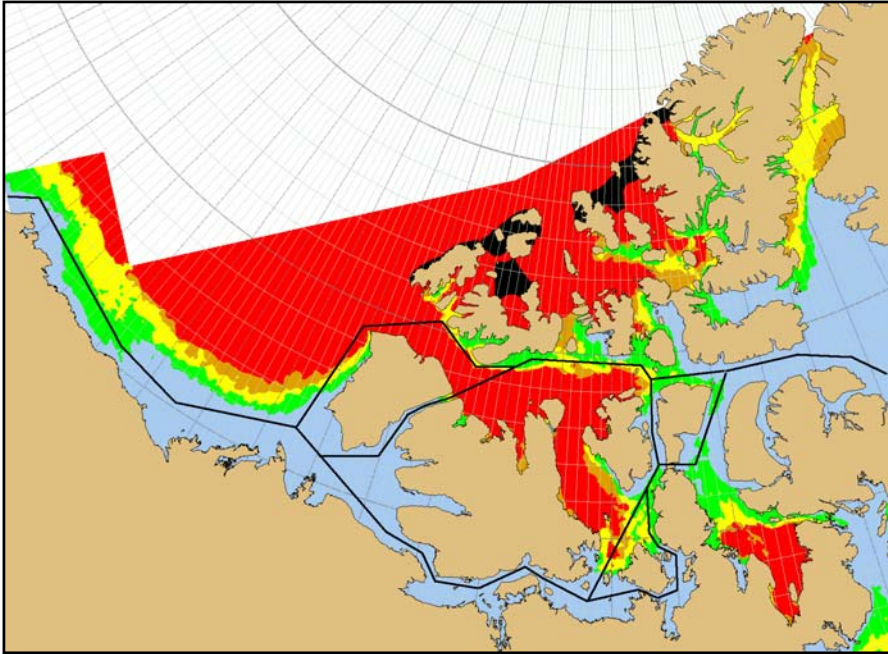


Figure 4.5.1: Typical routes for the Northwest Passage, superimposed on charted median ice concentration (1971-2000) for September 3. Colour indicates ice concentration in tenths: Blue 0-1, Green 1-3, Yellow 4-6, Brown 7-8, Red 9-9+, Black 10.

- Increased pressure to protect Canadian position on NWP
- Enhanced traffic through the NWP is likely to lead to issues such as : spread of new and exotic diseases and, increased risks of environmental damage and pollution, threats to traditional ways of life, opening of opportunities for economic development

Chapter 3 – Case Study – Forest Management

Biophysical impact	Socioeconomic impacts
Changes in forest productivity	Changes in timber supply and rent value
Increased atmospheric greenhouse gases	Introduction of carbon credit-permit mitigation policies that create a carbon sequestration market
Increased disturbances	Loss of forest stock and non-market goods
Northward shift of ecozones	Change in land values and land-use options
Change in climate and ecosystems	Economic restructuring leading to social and individual stresses
Ecosystem and specialist species changes	Changes in non-market values
Ecosystem changes	Dislocation of parks and natural areas, increased land-use conflicts



Table 10. Examples of the impacts of climate change on the northern forest sector (modified from Lemmen and Warren, 2004)

- Many projected impacts already visible (e.g. Temperature and precipitation patterns, spruce bark beetle outbreaks, loss of merchantable timber)
- Such disturbances are likely to continue
- Northern forest managers are adapting and proactive adaptation will continue to be required

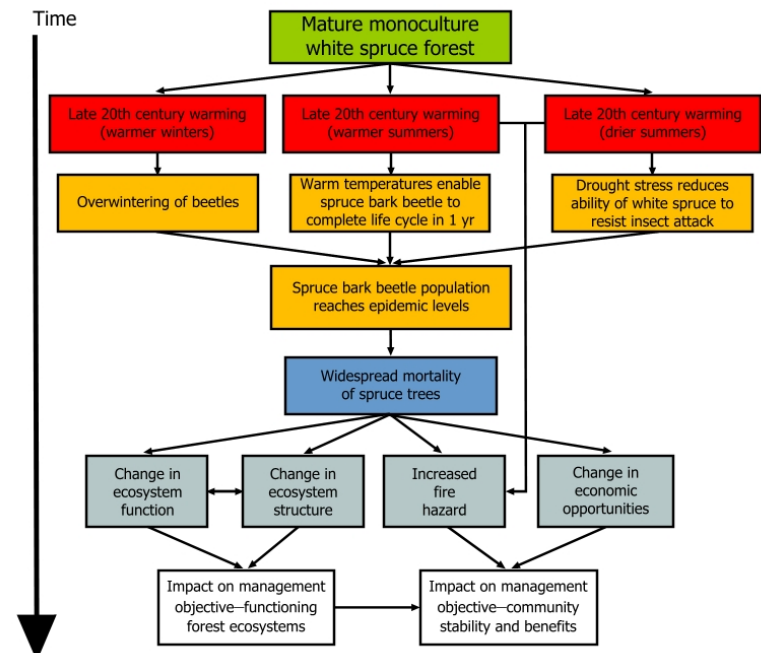


Figure 4.6.2 Influence of climate warming on spruce bark beetle populations in the southwest Yukon (Source Ogden, 2006).

Chapter 3 – Case Study – Fisheries



Figure. Lifting whitefish nets on Great Slave Lake.
Photo courtesy of George Low.



- Projected 50% increase in number of ‘optimal growing season days’ for cold water *spp.*
- In shallow waters, climate changes will stress some *spp.* (e.g. Lake trout) and be beneficial for others (e.g. Lake whitefish)
- Structural shifts in lake ecosystems with introduction of southern *spp.*
- Adaptive management will be required considering cumulative effects including non-climate stresses
- Similar changes will impact access by Aboriginal harvesters and local scale adaptation will be required

Chapter 3 – Theme – Hydroelectric, Oil and Gas

Hydroelectric Development

- Changing climate will affect capacity and operations of current and future facilities
- Increased winter runoff from rainfall and enhanced snowmelt = decline in winter snow storage
- May require expanded reservoir capacities
- Increased need to determine changes in future flow and dangers (river ice-jamming)



Oil and Gas

- Exploration is most likely activity to be impacted
- Thawing permafrost and changes in snow cover necessitate focus on low-impact vehicles and seasonal scheduling of exploration
- Winter and road uncertainty will require flexibility
- Off-shore exploration will be affected by decreased sea-ice cover
- Great attention required on infrastructure stability

Chapter 3 – Theme – Transportation

Freshwater Transport

- Increase in river ice-free season will expand potential period for Mackenzie barge season
- Water levels and river flow regimes will impact these opportunities
- All-season roads could be seen as alternative in face of increasing challenges with river transport

Winter Roads

- Mackenzie River crossing delayed by >3 weeks since 1996
- Reduction in maximum load capacity
- May require flexibility in scheduling or concentration of transport into max ice periods
- Increased difficulties in resupply of communities and industrial sites during winter months



Photo T Prowse

Chapter 3 – Theme – Aboriginal Perspectives



Chuvash National Office/Resource Centre



Photo C Furgal



Photos E Loring



- Aboriginal observations and knowledge are some of the best and only information on impacts and adaptation at local scale
- Significant contribution to understanding of climate change throughout the North and beyond
- Climate change poses a significant threat to many Aboriginal communities in lifestyles, livelihoods and traditions
- Small, more isolated communities, reliant on a smaller variety of resources are particularly vulnerable yet potentially most resilient and adaptive to some impacts because of Traditional Knowledge and skills

Chapter 3 – Theme – Adaptive Capacity



- Traditional Capacities – social, economic and cultural change stress socio-ecological resilience
- Economic Resources – populations which are educated and mobile will be able to take advantage of economic opportunities that may be created
- Information and Technology – Access to both Traditional Knowledge and skills as well as new technologies will enhance the ability to adapt to a changing environment
- Policies and Institutional Capacity – policies should aim at supporting aspects of resilience (e.g. flexibility in management regimes, strengthening the transmission of traditional skills and knowledge, economic support for traditional activities/livelihoods, new skills training and development)
- Mainstreaming Climate Policies - include consideration of climate concerns in existing policy and program areas