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Climatepolitik

BY

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APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

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ABSTRACT

This thesis examines the potential winners of climate change and how the United States should react to the coming changes. It examines the potentiality present in Canada and Russia, and how these two nations are set to benefit from relative gains as the climate changes.



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Introduction

Then God said: Let us make human beings in our image, after our likeness. Let them have dominion over the fish of the sea, the birds of the air, the tame animals, all the wild animals, and all the creatures that crawl on the earth.

- Genesis 1:26

Preface

The world changed in the year 2200 B.C. This change was neither predicted by prophets nor foreseen by soothsayers. Although, according to the book of Genesis, Joseph had interpreted Pharaoh's dream and was able to warn him to store grain during the seven years of plenty to mitigate the looming years of famine.¹

Contrary to climate change naysayers, there is a lot of evidence to support the notion that weather patterns changed significantly in the Maghreb.² The Assyrian nation crumbled, the Egyptian empire disintegrated, and the course was set for Northern European dominance. While the exact cause of the change is not known, geo-climatologists speculate a change to the Gulf Stream's meridional flow triggered precipitation changes across the region. Drought across Ethiopia would have had cascading effects down the Nile resulting in the absence of

¹ Genesis Ch41, *The New American Bible, Revised Edition (NABRE)*, March 9, 2011, <http://www.usccb.org/bible/genesis/41>, 25JAN2012

² In Arabic, the Maghreb means "where and when the sun sets." The region, which includes Algeria, Libya, Morocco, and Tunisia, is part of both Africa and the Arab world, and it enjoys a special relationship with Europe, thanks to geographical proximity, colonial history, and economic ties. The Maghreb is where the Arab world's recent dramatic political upheaval first began (Tunisia) and where it has reached its most violent climax (Libya). Layachi, Azzedine, "Meanwhile in the Maghreb: Have Algeria and Morocco Avoided North Africa's Unrest?", March 31, 2011, <http://www.foreignaffairs.com/Articles/67691/azzedine-layachi/meanwhile-in-the-maghreb>, 25Jan2012

yearly flooding. For a society so tied to the ebb and flow of the river and its interaction with the Nile delta, the consequences would have been catastrophic.

The argument advanced here is this: climate change is real, it poses serious challenges for us, and we are not prepared for it. The thesis of this paper is that while there will certainly be losers in the coming climate change lottery, there will also be winners – albeit relative. Climate change will likely bring various benefits to developed nations in temperate areas (i.e. fewer cold weather related deaths, increased crop yield from longer growing seasons, increased arable land, access to natural resources, and an ice-free Arctic).³ While this is expected to be offset by the negative impacts of rising temperatures in developing nations, the fact remains that there will be relative gains in specific countries.⁴ It is those nations that the United States ought to be most concerned from a national security perspective.

Technologically, we are able to measure weather and temperature changes. We can track Arctic ice cover and glacial movements from

³ Arable land is that land which is open to agriculture. Not all arable land is of equal value. Some lands are much more productive than others, and some improper agricultural practices cause once fertile land to become infertile. It is not the assumption of this thesis that as the climate warms all land will become arable. It is unknown how the tundra may serve as a basis for grasslands or agriculture. Further study is required to ascertain the potential of tundra. What is known is that it is possible for once infertile lands to become even marginally fertile. The Aran Islands on the west coast of Ireland, were once considered too rocky to farm. The residents, however, covered the islands with a layer of ocean sand and seaweed and today use the land to produce crops. World hunger will not be solved overnight as the tundra is magically turned into farms. The point is that there is potential for increases to the amount of land under cultivation. How nations choose to take advantage of that land, and make political choice regarding zoning and agriculture policy is a variable outside of the scope of specific consideration of this thesis.

<http://www.gsi.ie/Programmes/Groundwater/Karst+Booklet/Agriculture.htm>, 16May2012

⁴ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p12.

satellites, and we have sophisticated computer modeling which forecasts how likely a significant shift is to occur. Yet, we may be worse off than the Pharaoh. He only had a slave who interpreted dreams to rely on – yet was able to mitigate the famine. We have supercomputers, pundits, and academic experts and cannot seem to agree on the causes of climate change much less the steps necessary to arrest, adapt, or ameliorate that change.⁵ Nature gets a vote – much as the enemy does when it comes to one's military plans. Natural disasters, extreme environmental events and yes, even radical climate change happens. It has happened throughout history. It will likely continue to happen. Most peoples have not been fortunate enough to see the change coming and were thus unprepared for the effects. Given our current technology, we have the ability to see change coming, and to react in time to make a difference. Pharaoh's prudent planning enabled Egypt to survive the famine. America should also harness its academic expertise, technological prowess, and military might to set the conditions for maintaining security in an uncertain future.

The Contextual Frame

In 79 A.D. Mt. Vesuvius erupted ending the ambitions of the citizens of the fair city of Pompeii. Had they known the eruption was coming, they might have evacuated a safe distance and either returned once the calamity passed, or relocated to a less volcanically active area. While this was a natural disaster, and not the event of climate change, it nonetheless represents nature's vote in relation to human endeavors.

On Sunday, 26 December 2004, a devastating Tsunami struck Indonesia and thirteen other countries. It killed over 230,000 people,

⁵ At least not in the United States.

and deluged coastal regions with waves as high as 30 meters. It was one of the deadliest natural disasters in recorded history. Coastal vulnerability will only increase with rising sea levels – and the sea level has been rising. “Measurements show that the 20th-century rate of global average sea-level rise is about 2 millimeters (mm) per year, and the rate of sea-level rise since 1993 has been measured to be about 3 mm per year.”⁶ All indications are that this trend will continue and as the oceans warm and expand, the polar ice cap will continue to melt. The increases in sea levels will push the destruction further inland, overpowering dikes, levees, and sea walls while countering other construction and adaptation that have been implemented thus far.

In 2010, Eyjafjallajökull erupted in Iceland and clogged air traffic for months. The volcanic cloud also caused some cooling of temperatures and exacerbated health risks for those in its path. Most significantly, the disruption affected materiel flow into Iraq and Afghanistan.

In the latest example (as of the research for this paper), a devastating Tsunami struck the coast of Japan in March of 2011. The damage crippled the Fukushima nuclear power plant and has caused widespread contamination. Debris from the tsunami is starting to come ashore in the western United States and Canada. Some of the debris may be radioactively contaminated.

Granted, it is impossible to plan for every contingency – but there are some so potentially catastrophic that prudent planning is a prerequisite for any military professional. Hurricanes happen, volcanoes erupt, earthquakes occur, and tsunamis strike. These events should all be included in Combatant Commander’s “Black Swan” evaluations and

⁶ *National Security Implications of Climate Change For U.S. Naval Forces: Letter Report*. Washington, DC: The National Academies Press, 2010.
http://www.nap.edu/openbook.php?record_id=12897&page=7 , 20Feb2012

OPLANs.⁷ Climate change is no different in scale of effect. The only difference is in the timeline. The previous events were all relatively sudden. Climate change takes a much longer time – sometimes decades to fully materialize. Yet, failing to plan and take proper actions now can have similarly devastating effects in the future. And some of the decisions need to be made now given the long lead times for effective implementation of the solutions.

The lesson here is that nature - whether by normal variances or anthropogenic catastrophe - strikes at inopportune moments and can wreak economic, biological and human calamity. The point we need to understand is that we can plan for such events and ensure our nation is postured to ensure its security in these natural threat environments. Our national security plans must consider nature as part of the Intelligence Preparation of the Environment (IPOE).⁸

Preparation is important and is often the crucial difference in survival. Yet, while mitigating the bad is important, so is posturing to take advantage of the opportunities. From a United Nations' perspective, the majority of focus has been on disasters, Diasporas, and the dilemmas of a world wrought with climate catastrophe. There will clearly be losers as the climate changes – that is not in dispute. Yet, there are potential gains as well for those nations postured to take advantage of the coming changes.

⁷ The concept of the “Black Swan” is explored in Nassim Nicholas Taleb, *The Black Swan: the Impact of the Highly Improbable*. New York: Random House, 2007.

⁸ IPOE is the term used by the military to understand its environment. The term originated in military intelligence as a way to understand all of the factors affecting military operations. I am suggesting that the military needs to include natural disasters, environmental catastrophes and climate change within the rubric of IPOE. The additional factors should drive military planning and operational considerations at the National Security Council and at the Combatant Command level in OPLAN development.

In Charles Dickens' "A Christmas Carol", Ebenezer Scrooge was afforded a look at the future. The ghost of "Christmas Yet to Come" showed him a likely path if he did not mend his ways and soften his heart. Here too we are afforded a glimpse of a possible future world – we can dismiss it - as science fiction, fanciful fable, or fairy tale - or seek sensible solutions; thereby, mitigating worst case scenarios. These base assumptions and prudent predictions should chart our course while we navigate the nuances of *Climatepolitik*.

So what is offered here?

This thesis analyzes the following question: what are the national security considerations for the United States as it enters the age of climate change? It projects how climate change affects a nation's *power potentiality* by examining the changes that a nation is likely to incur in relation to its agricultural production, access to natural resources and energy reserves, and ability to access global trade routes vis-à-vis the Arctic ocean. Historical work by Azar Gat suggests that the best measure of a great power's military strength is provided by the product of a nation's GDP with the square or third root of its GDP per capita. Income and military power are closely tied. In an anarchic world order, self-defense is crucial for protecting one's vital interests. Nations which possess either the means to support a potent arsenal or the potential to procure one, occupy advantageous positions in the world order.

Potentiality is the sum of those assets currently untapped by a nation, which lay dormant until either domestic will, or changing climactic conditions align to allow exploitation. A country's *potentiality* lies in its abundance of natural resources and its ability to access,

exploit, and export those resources in terms of international influence, economic wealth, and military power.⁹

This paper will examine the effects of climate change on Russia and Canada and assess the likely impacts these changes will might cause on their security posture vis-à-vis the United States. These countries were chosen for several reasons. Canada and Russia are the largest Arctic Nations in terms of landmass, and have both been the most active in Arctic exploration and exploitation. Canada and Russia were also on opposite sides during the Cold War and frequently interacted (although from an adversarial perspective) across the frozen Arctic. Additionally, Canada has recently been our most dependable neighbor and with it we share the longest continuously unguarded border in the world.¹⁰ We have had excellent relations with Canada since 1812 (the last time we tried and failed to invade them). While Canada and the United States are likely to continue cooperation in the near-term, as national interests diverge and competition over resources intensifies, the once solid bonds between them may become brittle or corrode.

Russia was chosen because as a nuclear-armed northern latitude nation, sitting atop vast mineral wealth without upward demographic pressure – it seems specifically set to reap a relative gain in a warming world. Russian ports and access to open Arctic exploration, exploitation, and egress may position Russia as a sea-faring nation wielding the global power of which Mahan would envy. Russia has also been a rival with the U.S. in the Cold War, and a spoiler in the Security Council, thwarting U.S. actions. Russia is also decidedly “nervous” about U.S. efforts to

⁹ Often referred to as D.I.M.E. – Diplomatic, Informational, Military, and Economic. These terms are used as measures/levers of hard and soft power a state can wield. For a larger discussion on these topics see Joseph S. Nye, *The Future of Power*. New York: PublicAffairs, 2011

¹⁰ <http://members.shaw.ca/kcic1/canworld.html>, 19March2012

build an integrated missile defense system across Eastern Europe. From a security perspective, it also remains the only existential threat to the United States. In fact, Russian President Vladimir Putin recently called for a significant expansion and re-tooling of the Russia military to defend against enemies; building “more than 400 modern intercontinental ballistic missiles”, ... 28 submarines armed with nuclear missiles, ... more than 50 military surface vessels, and more than 600 modern warplanes, as well as a broad deployment of the new S-400 anti-aircraft system and Vityaz antimissile system”. Putin has also promised an “effective and asymmetrical” response to the anti-ballistic missile system being erected by the US in various European countries.¹¹

Methodology

Research will be conducted into the likely effects that a change in climate brings to the Arctic. I will explore how changing weather patterns, warming temperatures, and the melting Arctic ice cap, affects agriculture, access to mineral and energy resources, trade routes which increases a nation’s *potentiality*. This data will be examined with consideration given to the latest RAND study on demographic predictions.¹² The focus will be on Canada and Russia, and the security issues raised regarding these two nations with the United States. The

¹¹ Bruce Pannier, “Putin Proposes Vast Rearmament, Military Reform”, February 20, 2012, Radio Free Europe, Radio Liberty, http://www.rferl.org/content/putin_military_russia_rearmament_reform/24489479.html, and Agence France-Presse, “Putin Outlines Push for Stronger Military”, Feb. 20, 2012, <http://www.defensenews.com/Article/20120220/DEFREG01/302200005/Putin-Outlines-Push-Stronger-Military>, accessed 03May2012 and “Russia's military threatens pre-emptive strike if NATO goes ahead with missile plan”, 03May12, <http://www.foxnews.com/world/2012/05/03/russian-military-ups-ante-on-missile-defense/#ixzz1tuhPNtYZ><http://www.foxnews.com/world/2012/05/03/russian-military-ups-ante-on-missile-defense/>, accessed 04May12

¹² “The RAND (Research AND Development) corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.” <http://www.rand.org/>

purpose of keeping the focus on these three nations is their relative importance to the Arctic Dialog.¹³

When coupled with likely economic consequences, I will make projections as to implications for American national security. Focus will not be on causes of climate change, as these are politically charged and would likely only distract from the research and thesis of this paper.¹⁴ It may in fact be beyond our ability to affect even if we wished to do so. Yet, with the coming change, and a growing consensus among scientists about the likely effects on our ecosystem, we can draw some inferences regarding a way forward. Will Kantian ideals prevail as we work together on lifeboat earth? Or will a hybrid Hobbesian/MacKinderesque world – a Dr. Dolman-like view of key strategic points on earth which must be controlled or contested by a benevolent liberal democracy—prevail? In other words, instead of a space-race to the libration points, we might have a polar race towards Mahanian choke points.¹⁵

I have focused on the security realities of a changing world given underlying changes to basic resources and trade routes. I accept that the climate is changing.¹⁶ It has changed over earth's history. I have

¹³ There are in fact eight nations considered to be Arctic: Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States. This thesis is merely an initial block of research and writing which the author intends to parley into a doctoral level dissertation on the effects across ALL relevant Arctic nations.

¹⁴ I have specifically chosen the word climate change to discuss my thesis as opposed to the term “global warming”. Global warming is a politically charged word leading one to the “red herring” of the causes of said warming and the responsibility of nations to address those issues. While those issues are certainly important, and there is much debate over ultimate levels of warming, sea salinity, carbon dioxide and methane parts per million (ppm) – much is outside the purview of this paper.

¹⁵ The libration points, also called the equilibrium or Lagrangian points, are solutions to the equations of motion for the spacecraft such that the x, y, and z positions and x, y, and z velocities are all 0. So to compute the location of these points, one must solve the equations of motion under these special conditions. When solving, one finds that there are 5 solutions to these equations.

<http://www.geom.uiuc.edu/~megraw/MATH1/lib.html>, 21Feb2012. Also see PowerPoint presentation from the space class SAASS 667.

¹⁶ “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow

relied heavily on climate change data from the Intergovernmental Panel on Climate Change (IPCC), which is the foremost entity for climate change assessment, and remains a central source of raw data about temperature changes and peer reviewed articles. The IPCC was created by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in order to provide the world community with the most salient, independent, and peer-reviewed data on current climate change information and its likely impacts on the global environment, ecosystems, and socio-economic perturbations. As such it is the leading international body for the assessment of climate change.¹⁷ The UN General Assembly has since endorsed the establishment of the IPCC by WMO and UNEP. The IPCC does not by itself conduct any research on climate change. “It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change.”¹⁸ Contributing scientists the world over provide work on a voluntary basis. Membership in the IPCC is open to all member countries of the United Nations (UN) and WMO and the IPCC currently boasts 195 member countries.¹⁹ This thesis relies heavily on the data presented by the IPCC as that data forms the basis for assumptions, logical leaps, predictions, and recommendations.²⁰ In addition to relying on the data in the report, I have also attended two Environmental Conferences – one at Maxwell

and ice, and rising global average sea level.” ,
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmssp-direct-observations.html, 03May2012

¹⁷ <http://www.ipcc.ch/organization/organization.shtml>, 27March2012

¹⁸ <http://www.ipcc.ch/organization/organization.shtml>, 27March2012

¹⁹ <http://www.ipcc.ch/organization/organization.shtml>, 27March2012

²⁰ The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters. Thousands of scientists from all over the world contribute to the work of the IPCC on a voluntary basis. Review is an essential part of the IPCC process, to ensure an objective and complete assessment of current information. IPCC aims to reflect a range of views and expertise.
<http://www.ipcc.ch/organization/organization.shtml>, 21Feb2012

AFB, hosted by the Minerva Chair, and one at the University of Kansas(KU), hosted jointly by KU and Fort Leavenworth.

Why Climate Change?

While studying and reading about climate change in the news I became fascinated by all of the writing on its impact on equatorial states: rising seas; desertification; famine; pestilence; and mass migrations. All of these factors, it is posited, will lead to weak and failing states and security dilemmas for the United States. This assumes that weak and failing states lead to security threats, and that those catastrophes will lead to mass migrations which will destabilize states and lead to dire economic and security consequences. I had been sucked into this shibboleth as well.²¹ But what if all of it was wrong? What if these fears were exaggerated or based on false assumptions? Then the direction of National Security and Military Policy could be placed on an imprudent course. So I started asking seeking answers about weak and failing states, about war, about climate change and the dynamics of international relations.

If Canada and Russia gain new rainfall patterns, lengthened growing seasons, increased arable land acreage, and easier access to additional natural resources, might they gain relative position to other current powers? The relevance of this topic is to the National Security

²¹ I am not convinced that weak and failing states are the national security threats they were purported to be in the aftermath of 9/11. This conclusion pushed me further along the line of considering truly existential threats to the security of the nation. Weak and failing states as a harbinger of global instability would be the topic of another paper – and perhaps another Master’s degree. See also B. Chance Saltzman, “Liberty and justice for all : the democracy project and the global war on terrorism”, http://catalog.au.af.mil/cgi-bin/Pwebrecon.cgi?v1=2&ti=1,2&Search%5FArg=saltzman&Search%5FCode=NAME%5F&CNT=20&PID=kZ5tVBD-h_AuEEf3WeUb9uE0VT&SEQ=20120508104806&SID=1,08May2012

Posture of the United States in relation to future global realities. Interestingly, the strategic nature of the Arctic is not new. Late in World War II, Colonel Allen of the Army Air Corps gave specific guidance to a planning session working on post-war plans for the future Air Force.

There are only three big power areas – one is the United States – the other is Central and Eastern Europe and the other is the China-India area. On a Polar projection these areas form a triangle and in the world of the future, I believe that a great deal of air commerce will be directed between the corners of this triangle.

Another thing that should be considered... is the pattern of the ocean trade lines because even in the era of air power the bulk of commerce will move by the ocean trade lines... We must not only protect those lines but control them.²²

His words seem as true today as they did over a half-century ago. Not much in our conventional wisdom regarding our collective security thinking has changed in the past 60 years. With our drawdown of forces in the Middle East, our focus has pivoted toward Asia (China specifically) and become enamored with Anti-access/area denial (A2AD) tactics and Marine Corps bases in Australia.²³ Yet, with the opening of the Arctic to ocean travel, the growing access to mineral and energy wealth for Arctic Nations, and the ensuing frictions – the U.S. should perhaps pay closer attention to the avenues of approach from the North.²⁴

What lies ahead?

The thesis is organized as follows.

²² Perry McCoy Smith, *The Air Force Plans For Peace: 1943-1945* (Washington, DC: Ross & Perry, Inc., 2002), page 56-7.

²³ <http://www.cfr.org/united-states/pentagon-pivots-asia/p26979>, 26March2012

²⁴ At least for the summer part of the year.

Chapter 1 provides a brief history, background and summary of Arctic issues, which are presented and provide the basis for the ensuing discussion and exploration of the subsequent chapters. This chapter both bounds and frames the problem of climate change as it affects the Arctic. The Arctic is the bellwether of global health and as such provides the lens through which the examination of future potential occurs.

Chapter 2 analyzes Russia and how climate change projections affect their agriculture, access to natural resources, energy reserves, port access, and how these changes interrelate with demographic issues to shape their ability to project military power. It examines Russia's current military ability in the Arctic and its possible military posture toward the Arctic for the next 25 years.

Chapter 3 analyzes Canada and how climate change projections affect their agriculture, access to natural resources, energy reserves, port access, and how these changes interrelate with demographic issues to shape their ability to project military power. It examines Canada's current military ability in the Arctic and its possible military posture toward the Arctic for the next 25 years.

Chapter 4 takes the conclusions of the previous two chapters and provides a summation of the key issues involved for the United States' security response to the most likely and most dangerous scenarios. It presents recommendations for research investment, and policy and doctrine recommendations at the strategic, operational and tactical levels. These changes are needed to meet emergent threats and present requirements necessary to retain the relative hegemony of the United States through 2040 and America's ability to intervene overseas when

required or desired.²⁵ It also identifies areas requiring additional research and monitoring.



²⁵ The idea for this framework analysis is directly lifted from the ideas presented in the publication: Libicki Martin C., Shatz Howard J., Taylor Julie E., "Global Demographic Change and Its Implications for Military Power", 2011, The Rand Corporation, http://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1091.pdf, 24JAN2012, p 5

Chapter 1

The Arctic

The Arctic is a vast, ice-covered ocean, surrounded by tree-less, frozen ground, that teems with life, including organisms living in the ice, fish and marine mammals, birds, land animals and human societies. - NOAA

The siren song of the Arctic has captured our collective imagination since the eighteenth century. The first intrepid explorers, once they realized that the new world was not part of Asia, repeatedly sought an avenue through to the Pacific. They braved the extremely harsh conditions north of Hudson's Bay, shaking off repeated failures in the quest – the holy grail of European mariners – the Northwest Passage. “Lured by the promise of fame and riches, men endured paralyzing cold, malnutrition, and terrifying storms”, in an attempt to discover this mysterious “mariner's philosopher's stone”. Grippled by greed, “sailors and speculators” often met their demise in search of the gateway to the Orient.²⁶

In the summer of 2007 – two centuries after their quest began – the passage was finally opened and the real race to the Arctic began. There are, in fact, two passages currently available during the summer months – the Northwest Passage across northern Canada and the Northeast Passage across northern Russia. Both routes cut substantial distance from Pacific Ports to the European Union States and the Eastern ports of the United States - 6500km from Shanghai to Stockholm.

²⁶ http://books.google.com/books/about/Voyages_of_delusion.html?id=-m-odt0LgSoC, 27March2012

As the icebergs decrease in the coming years, it could become a commercially profitable route, because it reduces the maritime journey between East Asia and Western Europe from about thirteen thousand miles through the Suez Canal to eight thousand miles, cutting transit time by ten to fifteen days. Russian and German oil tankers are already beginning to ply those waters in the summer months. Approximately 150,000 tons of oil, 400,000 tons of gas condensate, and 600,000 tons of iron ore were shipped via the NSR in 2011.²⁷

In addition to commercial shipping, commercial fishing too may parlay an advantage from more open waters in the Arctic. As waters warm and fish move north, the Arctic Circle could also play host to fruitful fishing locations for other seafaring nations. It seems logical that those nations well poised to take advantage of Arctic offerings will gain relative to others as the earth's climate changes. As the Arctic warms and fish migrate north, so too will the fishermen. The United States must have a mechanism for protecting its vital economic interests in this region. American fisheries account "for \$30 billion domestically, \$12 billion in exports and more than 100,000 jobs."²⁸ World fisheries are already in danger from over fishing. If something like this were to occur in the Arctic, significant economic reverberations could be felt throughout the economy.

The Arctic is also estimated to be flush with untapped natural resources and energy reserves. Russia and Canada are pushing their claims into the Arctic and laying the international institutional

²⁷Captain Melissa Bert, USCG, A Strategy to Advance the Arctic Economy Policy Innovation Memorandum No. 14, Author: Military Fellow, U.S. Coast Guard, Council on Foreign Relations,

http://www.cfr.org/Arctic/strategy-advance-Arctic-economy/p27258?cid=rss-fullfeed-a_strategy_to_advance_the_arct-021612&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+cfr_main+%28CFR.org+-+Main+Site+Feed%29&utm_content=Google+Reader,

²⁸ Melissa Bert, "Look North, America" Published: September 27, 2011

http://www.nytimes.com/2011/09/28/opinion/28iht-edbert28.html?_r=1, 20Feb2012

framework for ensuring their success within the United Nations. The United States, by not being a party to The United Nations Convention on the Law of the Seas (UNCLOS) makes it difficult to muster any leadership in the Arctic Circle club – this despite its *de facto* membership in the Arctic Council.²⁹

The remainder of this chapter will define what is meant by the Arctic and several key terms of reference for understanding the discussion in the remainder of this paper. It will also detail the key facts bearing on the issue of climate change and provide the background required for understanding later discussions.

An Arctic Rorschach Test

Unfortunately, much of our conventional wisdom is still focused on longitudinal approaches to the east and west coast. Some of this thinking might be driven by how the United States was settled, some by

²⁹ UNCLOS is derisively referred to as the Law Of the Sea Treaty (LOST) by its detractors and naysayers. National Research Council. *National Security Implications of Climate Change For U.S. Naval Forces: Letter Report*. Washington, DC: The National Academies Press, 2010. http://www.nap.edu/openbook.php?record_id=12897&page=14 , 20Feb2012; “UNCLOS comprises 320 Articles and 9 annexes governing all aspects of ocean space, including marine scientific research, commercial activities, the permissible breadth of the territorial sea (the part of the ocean nearest the shore, over which the coastal state enjoys sovereignty), and the settlement of disputes relating to ocean matters. A full profile of the UNCLOS, its origin, and its original issues is provided in a publicly available report, *Law of the Sea: The End Game*, Intelligence Community Assessment, published by the National Intelligence Council in 1996. The report is available at http://www.dni.gov/nic/special_endgame.html. Accessed November 23, 2009

” National Research Council. *National Security Implications of Climate Change For U.S. Naval Forces: Letter Report*. Washington, DC: The National Academies Press, 2010. http://www.nap.edu/openbook.php?record_id=12897&page=14 , 20Feb2012; **Arctic Council** – “The Arctic Council is a high-level intergovernmental forum, with all Arctic countries, Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America as members, and with the indigenous peoples of the Arctic participating in its work on a permanent basis. The Arctic Council and its specialized working groups build policies based upon the work of Governments, indigenous people, subregional actors, parliamentarians, nongovernmental organizations and international organizations.” Only six of these nations border the Arctic Ocean (Sweden and Finland do not have coastal boundaries with the Arctic Ocean).

how our wars have been fought, and some by how we follow the celestial orbits. Yet, some of this thinking is likely due to the preponderance of maps we use in our educational and commercial systems. We tend to favor a Mercator projection of the globe, which skews our understanding of time and distance factors between nations. This projection also distorts the relative size of nations and maximizes the scope of the northern over the southern hemispheres. This map has its uses – it is very helpful with longitudinal problems – but it also has its limitations. In the case of the Arctic, the latitudinal shortcomings of the Mercator become a hindrance. When struggling with a problem or a puzzle, it is often beneficial to examine it from a different angle. In this case, a different map is in order.

The Lambert projection (as an example) provides a truer scale of the distance between Russia and Canada across the North Pole. Using this map brings a different urgency when contemplating Russian moves to expand claims in the Arctic Ocean. The tyranny of distance has new meaning when one juxtaposes the significant savings accrued by the circumpolar route from Asia to Europe. Russia seems to have recognized the significance of the Arctic and has taken proactive steps to secure their claims, access, and exploitation ability for the region. For its part, Canada too has been working steadily to secure its access and rights to the region apart from its cooperation with the United States on a host of other issues.

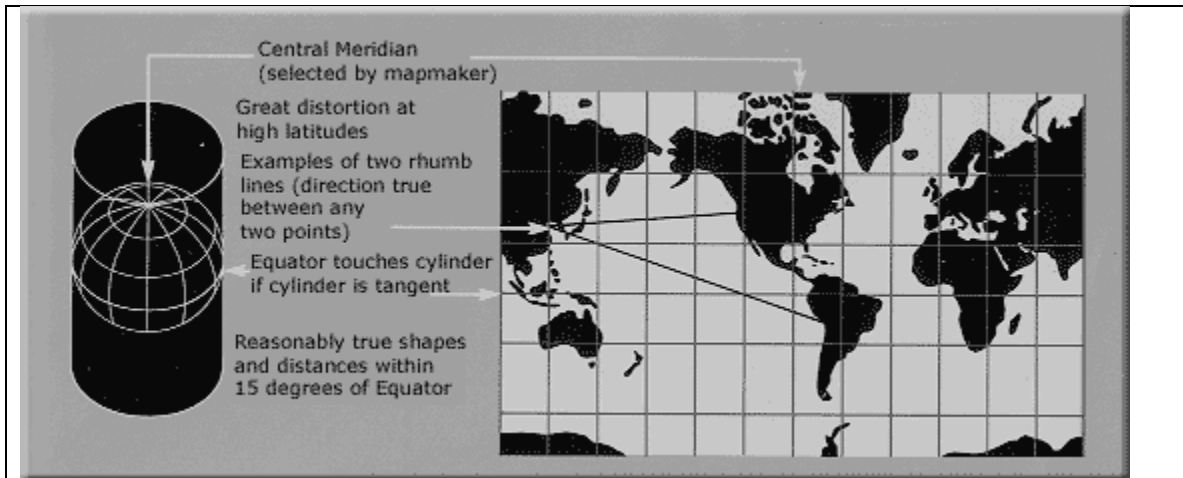


Figure 1 - Mercator Map Projection

<http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html>, 27March2012

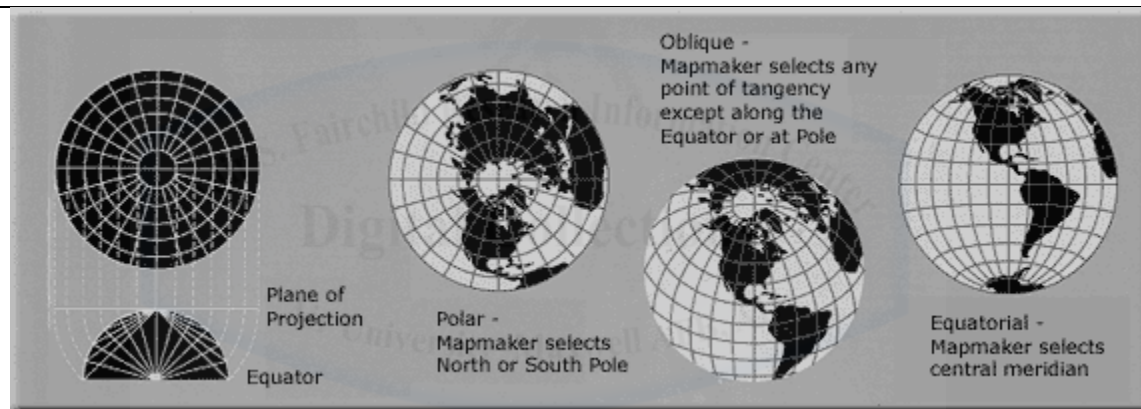


Figure 2 - Lambert Map Projection

<http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html>, 27March2012

Understanding the Arctic

For the purposes of this paper, the Arctic boundary is “All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian

chain.”³⁰ (See figure 1) Iceland is not part of the Arctic boundary – yet it is a member of the Arctic Council. Additionally, the area south of the Bering Strait is also not part of the Arctic Circle, yet is included in the geographic area of the Arctic boundary. This is the difficulty with somewhat arbitrary nation-state boundaries. Iceland is included in the council since it sits at the doorstep of the Arctic, and simultaneously straddles a strategic choke point. During the Cold War the United States invested heavily in Iceland seeking to prevent the Soviet Union from launching its North Fleet into the Atlantic. Given the thaw in the Arctic and the chilling in relations between the two former superpowers, Iceland once again is strategically poised for a geographic point of influence.

Climate change

Since the term “climate change” appears throughout the thesis, it is important to be clear of its meaning. According to the IPCC “climate change” refers to any change in the climate which occurs over time and is due to either natural variability or human activity. “This usage differs from that in the Framework Convention on Climate Change, where *climate change* refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed

³⁰ **Arctic Circle** – “The most common and basic definition of the Arctic defines the region as the land and sea area north of the Arctic Circle (a circle of latitude at about 66.34° North). For surface locations within this zone, the sun is generally above the horizon for 24 continuous hours at least once per year (at the summer solstice) and below the horizon for 24 continuous hours at least once per year (at the winter solstice). The Arctic Circle definition includes the northernmost third or so of Alaska, as well as the Chukchi Sea, which separates that part of Alaska from Russia, and U.S. territorial and Exclusive Economic Zone (EEZ) waters north of Alaska. It does not include the lower two-thirds or so of Alaska or the Bering Sea, which separates that lower part of the state from Russia.” <http://www.fas.org/sgp/crs/misc/R41153.pdf>, 22March2012 and http://www.Arctic.gov/maps/ARPA_Polar.pdf, 27March2012

over comparable time periods.”³¹ This is an important distinction – especially for the purpose of this paper. The base assumption is that climate change is occurring (and has occurred in the past). The key is the recognition of the reality of the change and the process of seeking to mitigate, adapt, and react to those environmental changes. It is not necessarily the process of seeking to solve the root causes of the change, whether or not they are anthropomorphic.

For example, the 20th-century rate of global average sea-level rise is about 2 millimeters (mm) per year, and the rate of sea-level rise since 1993 has been measured to be about 3 mm per year.³² The results might be more frequent coastal flooding, more intense typhoons and hurricanes, and more frequent necessity for the military to support humanitarian relief operations. These operations might strain “military transportation resources and the supporting force structures.”³³ When viewed through the lens of national security, these changes might stress nations and “generate geopolitical instability in already-vulnerable regions.”³⁴ The challenges in adapting to this change and the risks involved in a worst case scenario are separate from the challenges confronting those confronting causal issues. One can take prudent action to mitigate observed changes without getting bogged down in the politics of who or what is at fault for those changes. It is vital to understand how the data collected is interpreted to arrive at our assumptions.

³¹ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p6

³² National Research Council. *National Security Implications of Climate Change For U.S. Naval Forces: Letter Report*. Washington, DC: The National Academies Press, 2010. http://www.nap.edu/openbook.php?record_id=12897&page=7 , 20Feb2012

³³ *Ibid*

³⁴

http://www.nap.edu/openbook.php?record_id=12897&page=4#p2001ae008960004004 , 08May2012

Our predictions about these measurements are only as good as the accuracy of our measurements, and the veracity of our assumptions on those things we are not able to accurately ascertain. The confidence in our findings is what allows us to make educated guesses about future trends. *Confidence* is a factor assigned by IPCC authors, who according to their expert judgment and broad reading of the literature have assigned a confidence level to the major statements in their report. The degree of confidence in the statements throughout this paper follows the same meaning.

<i>Very high</i> confidence	At least 9 out of 10 chance of being correct
<i>High</i> confidence	About 8 out of 10 chance
<i>Medium</i> confidence	About 5 out of 10 chance
<i>Low</i> confidence	About 2 out of 10 chance
<i>Very low</i> confidence	Less than a 1 out of 10 chance

Similarly, *likelihood* is an assessment of probability of a precise outcome either having previously occurred or to be expected in the future. This estimation is also based on expert views and sound, quantitative analysis. I will use the same definitions as the IPCC.

<i>Virtually certain</i>	>99% probability of occurrence
<i>Very likely</i>	90 to 99% probability

<i>Likely</i>	66 to 90% probability
<i>About as likely as not</i>	33 to 66% probability
<i>Unlikely</i>	10 to 33% probability
<i>Very unlikely</i>	1 to 10% probability
<i>Exceptionally unlikely</i>	<1% probability

Potentiality – Azar Gat suggests that the best measure of a great power’s military power is provided by the product of a nation’s GDP with the square or third root of its GDP per capita. Income and military power are closely tied. Potentiality is currently untapped by a nation, and lies dormant until either domestic will, or changing climactic conditions align to allow exploitation. A country’s *potentiality* lies in its abundance of natural resources and its ability to access, exploit, and export those resources in terms of international influence, economic wealth, and military power.³⁵ These assets can be viewed as potential energy.³⁶ The classical physics definition of potential energy is the inherent energy stored by virtue of an object’s position. A common example would be a hunter’s bow. When the bow is in its normal position - equilibrium – it has no potential energy. Yet, when pulled taut has potential energy that becomes kinetic when the bow is released from its “cocked” position. A similar analogy and terminology can be applied to nation-states and their natural resources. They have potential energy stored in their mineral

³⁵ Often referred to as D.I.M.E. – Diplomatic, Informational, Military, and Economic. These terms are used as measures/levers of hard and soft power a state can wield. For a larger discussion on these topics see Joseph S. Nye, *The Future of Power*. New York: PublicAffairs, 2011

³⁶ <http://www.physicsclassroom.com/class/energy/u5l1b.cfm>, 3Mar12

resources, arable land, demographics, infrastructure, etc. Their exploitation of these resources releases this energy in a kinetic manner with diplomatic capital, informational advantages, military capability and economic output. This concept is crucial to understanding the implications of climate change and a country's natural borders. In an attempt to quantify this potentiality, I have developed the following equation to capture a nation's relative potentiality and its likely ability to take advantage of the changing climate. Heuristically, we can think of potentiality(P) as the sum of population(p) + mineral resources(mr) + agriculture(ag) + energy reserves(er) + ocean access(oa) or $P = \{p+mr+ag+er+oa\}$. Similarly, we can think of a nation's ability to project Power as *the sum of diplomacy, information capacity, military power and economic power* or $D+I+M+E$.

Facts bearing on the Problem

The Arctic is in the greatest state of flux with climate change, and concomitantly has a significant impact on the countries examined in this report. Thomas Homer-Dixon posits that the melting Arctic Ice could be causing perturbations to the meridional Jetstream flows, thus causing wildly ranging temperature fluctuations; resulting in colder weather in the south and warmer weather in the north.³⁷ There is anecdotal evidence from these last few winters which supports his hypothesis. These changes could impact the growing seasons, arable land, and rainfall patterns for all three nations under examination here. Yet, while these bring opportunities for greater national wealth, significant changes to rainfall patterns exacerbate the cycle of flood and drought, which must

³⁷ Thomas Homer-Dixon, "And Now the Weather: Nasty and Brutish", Toronto Globe and Mail, December 31st, 2010, <http://www.homerdixon.com/2010/12/31/and-now-the-weather-nasty-and-brutish/>, 20Feb2012

be mitigated through smart land-use practices and the prudent use of dams, levees, dikes and other flood control measures.

We are in the midst of the largest carbon reverse-sequestration in earth's history. Fossil fuels are sequestered carbon. There was a period of time in earth's history when carbon dioxide was plentiful and plants thrived. In fact, there is evidence that plants adapt to a high carbon environment by using less moisture. They are actually more efficient in such an environment.³⁸ Over millennia, plants thrived so quickly that there was an inability of bacteria to decompose the material. In this way, the carbon was sequestered and became the oil, coal, and gas deposits we exploit today to fuel our global economy. It is possible that we will witness something similar in the northern latitudes as carbon and temperatures increase.

Regarding carbon, "the best estimate is that 1,000 gigatonnes of carbon emissions leads to about 1.75°C (3.15°F) increase in global average temperature. Cumulative carbon emissions to date (2010) are about 500 gigatonnes, and the rate of global emissions is increasing."³⁹ Based on current understanding, this warming is expected to be nearly irreversible for more than 1,000 years without a method of sequestration or mitigation. As the tundra warms tons of methane and carbon effective sequestered in the permafrost may be released.

Permafrost – soil that is perennially frozen – is particularly vulnerable to climate change. It currently covers 18% of the Northern Hemisphere.⁴⁰ In areas of both the Arctic and the subarctic, the depth of

³⁸ According to Wade Wall, a plant expert (doctorate in biology) who works for the Army Corps of Engineers.

³⁹ *Climate Stabilization Targets: Emissions, Concentrations, and Impacts Over Decades to Millennia*, National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

Photo credits: p.5 (*second from top*), 2011 The National Academy of Sciences

⁴⁰ www.nasa.gov, "A Tour of the Cryosphere" DVD, 28APR12

the permafrost varies according to the average annual temperature, and the amount of snow cover which acts as an insulator. The top layer of soil which goes through a thaw/freeze cycle with the seasons varies from 30 to 100cm. The layer of soil which remains frozen year-round varies anywhere from a few to over several hundred. "Permafrost gets colder and thicker northward. Within the northern foothills of the Brooks Range permafrost is already -2 to -5°C cold and about 200 meters thick. On the Alaskan Arctic Plain, permafrost could be as cold as -9 to -11°C cold and up to 650 meters thick."⁴¹

It has been noted that the depth of thawing has been increasing as the average annual temperatures increase across the Arctic region. Permafrost is yet another measurable issue of concern which leads many scientists to call the Arctic the "barometer" of global climate change implications. There are four significant factors related to the thawing of the permafrost: "*hydrology, ecosystems, infrastructure, and carbon cycle*."⁴²

The top layers of permafrost contain significant amounts of ice. As the permafrost melts to greater depths, the melting of the ice-rich soil causes significant disruptions to the amounts of groundwater present. Areas may become oversaturated producing a condition known as "wet thermokarst", which could lead to trees dying. In areas that already possess good drainage, a condition known as "dry thermokarst" could occur. Both of these conditions will likely lead to changes to groundwater absorption and surface runoff, which in turn might produce cascading effects downstream. Heavier precipitation events may lead to more flooding in areas with already saturated ground, while the converse may happen in other areas where less runoff occurs; causing lower river and stream levels. These hydrology changes may then affect various

⁴¹ http://www.Arctic.noaa.gov/essay_romanovsky.html, 26March2012

⁴² Ibid

ecosystems with the impact on contamination levels from runoff, and various species adapted to determined water levels – too much water can be just as damaging as too little water to delicately balanced ecosystems.

The deeper thawing of permafrost causes significant damage to infrastructures. The ground becomes unstable causing sink-holes, and potentially catastrophic erosion events. The unstable ground also undermines the integrity of buildings, roads, pipelines, airfields, and railroads. This disruption may lead to the abandonment of the structures if significant funds are not available for their continual maintenance and repair needs.

Finally, permafrost holds vast quantities of carbon and methane that were previously sequestered.⁴³ The current conditions prevent (or significantly slow) the decay of matter. Microbes do not function very efficiently in the cold weather either. This delays the release of carbon and methane into the atmosphere, since the permafrost is rich in organic matter. Warming will likely cause an acceleration of the decay process, causing significant increases to the amount of carbon and methane released into the atmosphere.⁴⁴ Both of these gases have been identified as likely contributors to climate change. If so, warming permafrost may lead to a positive feedback cycle where the very warming leads to more gases released, which leads to more warming – not an easy cycle to break.⁴⁵

⁴³ Zech, R., Huang, Y., Zech, M., Tarozo, R., and Zech, W.: High carbon sequestration in Siberian permafrost loess-paleosols during glacials, *Clim. Past*, 7, 501-509, doi:10.5194/cp-7-501-2011, <http://www.clim-past.net/7/501/2011/cp-7-501-2011.html>, 03May2012

⁴⁴ http://www.Arctic.noaa.gov/essay_romanovsky.html, 26March2012

⁴⁵ In a positive feedback cycle. A positive feedback cycle is a process in which the effects of a minor disruption within a system cause a massive disturbance. “*A produces more of B which in turn produces more of A*”. A negative feedback system is one in which the opposite holds true – minor disruptions reduce exhibited effects. “Examples of positive feedback subsystems in climatology include: A warmer atmosphere will melt

Current rainfall patterns may also change as a result of warming temperatures – creating risk and opportunities in agriculture. The greatest temperature and rainfall increases are likely to happen in the northern hemisphere and specifically in the Arctic. These changes create opportunities for forward-looking nations to take advantage of and leverage to their respective gains. These changes also create obstacles for the ill-prepared and backward looking which may at some point become insurmountable when attempting to maintain the status quo.

Conclusion

The Arctic is a strategically important area of the globe, and the United States must be ready for a plan to engage in this area of the world. The opening of the Arctic to summer shipping is but the first step in the new frontier of exploration, exploitation, and environmental mitigation. The United States must be ready to engage with this new reality and be ready to successfully exploit the new opportunities presenting themselves on a near-daily basis. “Russia has been working hard to make this route a viable option for shippers, building search and rescue stations to drive down the cost of insurance for shippers, and make the route a viable alternative to the Panama Canal.”⁴⁶

An open Arctic is a new reality we must accept. Just because we choose not to engage in that domain does not mean that all players will stay out. Additionally, the Arctic and the Antarctic are not synonymous.

ice and this changes the albedo which further warms the atmosphere. Methane hydrates can be unstable so that a warming ocean could release more methane, which is also a greenhouse gas.” http://en.wikipedia.org/wiki/Positive_feedback, 27March2012

⁴⁶ Carey Restino, “Coast Guard lays out plans to monitor Arctic Alaska oil drilling, ship traffic”, The Arctic Sounder, Mar 24, 2012 <http://www.alaskadispatch.com/Arcticle/coast-guard-lays-out-plans-monitor-Arctic-alaska-oil-drilling-ship-traffic>, 27March2012

It is a much different climate and a much different pursuit by UN member nations. In short, climate change must be accepted and must be thought of in terms of national security.



Chapter 2

Russia

*From Russia with love I fly to you
Much wiser since my goodbye to you
I've traveled the world to learn
I must return from Russia with love*

Overview

This chapter analyzes the Russian Federation and how climate change might affect arable land, access to natural resources, energy reserves, port access, and how these changes might be related to demographic issues that shape their ability to project military power. It also investigates how a warming climate may affect Russia's geopolitical landscape. Warmer weather could be the herald of opportunity or the harbinger of challenge for the great Eurasian nation. Increased global temperatures may bring changes to traditional weather patterns – some innocuous and some severe. Lengthening growing seasons and precipitation changes may bring about increased agricultural yields, forest management issues, and increased access to mineral resources. Additionally, geography, current and projected climate, history, and demographics juxtaposed with the likely impacts of climate change will further highlight the potential gains made by Russia with a warming climate.

Yet, even if Russia succeeds in harnessing these opportunities, the increased economic production might strain Russia's already underfunded and ill-maintained transportation infrastructure, and the changing global geopolitical dynamics may threaten its security. Increased immigration, declining birthrates, and decreases in life

expectancy increase the complexity of this analysis. While there are no simple solutions, nor easy predictions about Russia's future, it certainly has the potentiality to ascend once again.

History

The Russian experience was forged in the furnace of war, invasion and occupation. Near continuous external threats have molded perceptions and ingrained a preoccupation with especially western territorial threats. Modern Russia has its roots in the Principality of Muscovy, fashioned in the 12th century after over 200 years of Mongol domination during the 13th-15th centuries. From this inauspicious beginning, it was steadily able to conquer and integrate the contiguous principalities. A new Romanov Dynasty under Peter I, who ruled from 1682-1725, continued this policy of conquer and integration by absorbing the neighboring principalities, from across the Siberia highlands to the Pacific. After securing the western lands to the Pacific, he continued his consolidation and extended Russia's territory to the Baltic Sea. The new country was subsequently renamed the Russian Empire. During the 19th century, Russian territorial aspirations in Europe and Asia led to the international intrigue known as the "Great Game" which is known in Russia as "Турниры теней" or the "Tournament of Shadows". These were the terms for the supremacy struggles in Central Asia resulting in strategic rivalry and continual conflict between the British and Russian Empires. Romanov dynastic power peaked and then rapidly descended with its defeat in the Russo-Japanese War of 1904-05. Loss in the war contributed to the Revolution of 1905, resulting in the formation of a parliament and other reforms. Repeated demoralizing losses by the Russian Army in World War I predicated pervasive rioting in the major Russian cities and led to the

overthrow of the czar in 1917. This crisis and the ensuing civil war led to intervention by the United States. During the Russian Revolution, on 13 August 1918, the 31st Infantry moved from Manila's tropics to the bitter cold of Siberia. Its mission - to prevent the looting of allied war material left on Vladivostok's docks. The regiment was broken into various detachments and used to guard the Trans-Siberian railway, as well as 130 km of a branch line leading to the Suchan mines. For the next 2 years, the 31st and its sister, the 27th Infantry Regiment, fought off bands of Red revolutionaries and White counter-revolutionaries that were plundering the Siberian countryside. They also dissuaded their 40,000 Japanese "allies" from taking control of Russian territory.⁴⁷

The Communists under Vladimir Lenin were ultimately successful, however. Josef Stalin succeeded Lenin, and after defeating the Germans during World War II, instituted a brutal rule of repression until his death in 1953. The decades following were punctuated by proxy wars, the arms race, and the threat of nuclear Armageddon. The Soviet economy and society stagnated – its command economy unable to compete with western capitalism. General Secretary Mikhail Gorbachev came to power in 1985, and sought to reform the USSR from within. He extricated Russia from Afghanistan (after 10 years of a devastating and embarrassing loss to the mujahedeen), introduced glasnost (openness) and perestroika (restructuring). His initiatives, while bold, innovative, and generally democratic in nature, ran out of control leading to the

⁴⁷ During the Siberian deployment, 30 soldiers of the 31st INF were killed and some 60 troops were wounded in action. In addition, a large number of troops lost limbs due to frostbite. During this deployment, the regiment recommended one Medal of Honor and 15 Distinguished Service Crosses. For its Service in Siberia, the 31st Infantry became known as "the Polar Bear regiment", adopting a silver polar bear as its insignia. Pro Patria!!! [http://en.wikipedia.org/wiki/31st_Infantry_Regiment_\(United_States\)](http://en.wikipedia.org/wiki/31st_Infantry_Regiment_(United_States)), 13Feb2012

unlikely demise of the Soviet Union.⁴⁸ Since then, Russia has vacillated between the desire for democracy and the desire for strong central government. Vladimir Putin has once again been elected President – after a brief stint as prime minister – much to the chagrin of the international community and many reformists inside of Russia. During the past two decades, Russia has severely disabled a Chechen rebel movement, “condoned” nationalistic cyber-attacks on Estonia, invaded Georgia, used its pipeline as an economic lever on the Ukraine and thwarted UN actions with Syria. Despite the most hopeful predictions – it is not yet “the end of history.”⁴⁹ With Russia potentially winning the climatic lottery – it may just be the beginning.

Geography⁵⁰

The Russian landscape is decorated with a disparate collection of terrain. In the east lies fertile farmland, west of the Ural Mountains lays a broad plain with low rolling hills. Steppes dominate the southern borders. Its southern region consists of uplands and mountains stark in relief and inaccessible to all but the heartiest of pioneers. And in Siberia it has vast coniferous of forest and tundra. For the purposes of this thesis, Russia, west of the Urals, is considered part of Europe bordering the Arctic Ocean, extending from Europe (the portion west of the Urals) to the North Pacific Ocean.⁵¹ Russia is the largest country in the world,

⁴⁸ “Nine Days that changed the World”, DVD, Citizens United, and <https://www.cia.gov/library/publications/the-world-factbook/geos/rs.html>, 03Mar2012

⁴⁹ Francis Fukuyama, *The End of History and the Last Man* (New York: Free Press, 1992),

⁵⁰ All facts for this chapter are derived from the CIA World Factbook, <https://www.cia.gov/library/publications/the-world-factbook/geos/rs.html>, 20Feb2012

⁵¹ In many geography texts Russia is considered part of Asia. Others merge Russia and Europe and have a “Eurasian” Continent. A “Eurasian” context fits much better with MacKinder’s Pivot Point thesis. The IPCC groups Russia as part of Europe, and

comprised of just over 17 million square kilometers⁵². It encompasses 11 time zones and its landmass extends across almost one-half of the globe. “In fact, by jet from Moscow, it takes about 8 hours to reach Vladivostok on its Pacific Ocean coast.”⁵³ A trip on the Trans-Siberian Railroad would take at least four days from one end of the country to another. Russia boasts over 1,000 major cities - 16 having surpassing one million in population. Its largest cities are Moscow, St. Petersburg, Nizhny Novgorod, Novosibirsk and Yekaterinburg.

Its next largest competitors follow neatly along with the case studies in this thesis and are Canada with 9,984,670 sq. km and the United States with 9,826,675 sq. km. It is not just the sheer size of Russia that matters. The Sahara desert for instance is 9,400,000 sq. km – or almost the size of China.⁵⁴ Yet, that famous African desert, with its dearth of natural resources, offers little in economic prosperity to the countries which claim it as part of their sovereign territory.⁵⁵ It is the abundance of resources possessed by Russia that make it so ripe for development. By this definition, Russia possesses tremendous potential gains from a warming climate, given projected near-term temperature increases and changing rainfall patterns.

By comparison then, the Russian landmass is approximately 1.8 times the size of the United States. The Russian country is just over

therefore to maintain consistency, I will maintain that grouping throughout the paper. IPCC, 2007: *Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group II To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK. p3

For a different discussion on the true place of Russia in the world see Samuel Huntington's, "A Clash of Civilizations".

⁵² According to our post-Westphalian, UN enshrined, nation-state system. For those of you still using the English system that equates to just over 6.6 million square miles.

⁵³ <http://www.worldatlas.com/webimage/countrys/asia/ru.htm>, 27March2012

⁵⁴ <http://en.wikipedia.org/wiki/Sahara>, 23Feb2012

⁵⁵ Besides perhaps solar power – which is not yet economically viable to transport the electricity derived from solar power over long distances.

95% land and 4% water. It shares a variety of borders with Azerbaijan, Belarus, China, Estonia, Finland, Georgia, Kazakhstan, North Korea, Latvia, Lithuania, Mongolia, Norway, Poland, and the Ukraine. In all, it has 20,241.5 km of land borders, and 37,653 km of coastline. That is an incredible amount of border requiring defense.⁵⁶ The United States has enough trouble maintaining its territorial integrity along the relatively measly 3,141 km it shares with Mexico. By comparison, Canada borders only the United States on land with 8,893 km (including 2,477 km with Alaska). Russia claims 12 nm of territorial sea, 24 nm of a continuous zone and 200nm of an economic exclusion zone. Russia claims these distances from its continental shelf from a 200m depth or to the *depth of exploitation*.⁵⁷



⁵⁶ border countries: Azerbaijan 284 km, Belarus 959 km, China (southeast) 3,605 km, China (south) 40 km, Estonia 290 km, Finland 1,313 km, Georgia 723 km, Kazakhstan 6,846 km, North Korea 17.5 km, Latvia 292 km, Lithuania (Kaliningrad Oblast) 227 km, Mongolia 3,441 km, Norway 196 km, Poland (Kaliningrad Oblast) 432 km, Ukraine 1,576 km.

⁵⁷ This concept, before the melting of the Arctic sea ice, made little impact across the frozen expanse of the north. However, given the fact that now Russia, Denmark, Canada, Norway, and the United States have all laid claims to certain mineral deposits in the Arctic, Russia's claim of exclusion becomes problematic, and provocative.

Current Climate



Figure 3 – Russian snow cover during winter. A MODIS-derived image displaying global snow cover over northern Eurasia during the winter of 2001-02. Image courtesy of NASA/Goddard Space Flight Center Scientific Visualization Studio. https://www.cia.gov/library/publications/the-world-factbook/photo_gallery/xx/photo_gallery_B1_xx_7.html, 20Feb2012

The photo in figure 3 above shows the typical winter associated with the ‘Russian winter.’ This idea has been ensconced in our collective conscience with the stories Charles XII of Sweden, Napoleon Bonaparte, and Adolf Hitler’s humiliating defeats at the hands of Russia’s “General Winter”. In each instance, the tactic of trading land for time, following a scorched earth policy, and relying on the natural harshness of the winter enabled inferior Russia Armies to defeat supposedly superior generals and better trained armies. Peter the Great executed this maneuver in 1707. The winter cooperated as the most brutal of the 18th century – to the point that the salt water port of Venice froze.⁵⁸ If only those three

⁵⁸ http://en.wikipedia.org/wiki/Russian_Winter, 04Mar12

“brilliant” European generals had not underestimated the character of the Russian people, their willingness to sacrifice everything instead of facing defeat, and the harsh extremes of Russian weather.

This may not prove to be true in the future. The average annual temperature in Moscow has increased by a little over 1.5 degree C over the past two decades. The photo of snow cover was taken in 2001-2002 and does not fit with the changes which have occurred in just the last decade with regards to climate change in the northern hemisphere. While Russia can still rely on the character of its people, and their willingness to sacrifice for survival – it may no longer count on the assistance of climatic extremes to delay, defeat, and destroy its enemies. “By the end of the century, annually averaged Arctic sea-ice extent is projected to show a reduction of 22 to 33%” and the ice sheets from the Arctic glaciers and the Greenland ice sheet will have significant reductions in thickness and extent.⁵⁹

The current climate ranges from the steppes in the south through humid continental areas in much of European Russia. There is a subarctic region in Siberia, with a tundra climate in the polar north. Russian winters vary from cool along the Black Sea to frigid throughout Siberia. Conversely, summers diverge from the warmer south along the steppes region to the cooler north on the Arctic coast.

Projected Climate

This warming trend is projected to continue and with it substantial changes in precipitation patterns. There are some factors that could

⁵⁹ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p51-53

produce serious ramifications. One of these is disruption of the meridional overturning circulation (MOC), which “is a system of surface and deep currents encompassing all ocean basins. It transports large amounts of water, heat, salt, carbon, nutrients and other substances around the globe, and connects the ocean surface and atmosphere with the huge reservoir of the deep sea. As such, it is of critical importance to the global climate system.”⁶⁰ A sudden shutdown of the MOC – while a low probability – would probably severely impact western European coastal areas. A change in the MOC is one of the explanations for the sudden climate change experienced across the Fertile Crescent in 2200 B.C. Since the circulation of the MOC brings more temperate winters to the Western European Coast, and facilitates current rainfall patterns, a change in this ocean current would reduce crop production, increase cold-weather deaths, disrupt winter transport with more freezing and disparate sea ice formation – likely causing a shift in the economic center of gravity from Northern to Southern Europe.⁶¹ A change in the MOC might cause a reverse migration issue. So, while these predictions are based on the current best available science – they are not absolute. All indications point to the fact that the climate is changing, and will impact all ecosystems. Nations must be ready for that reality and prudently plan for the fact that changes are coming. If nothing else, it would seem foolish not to prepare. Thomas Homer Dixon writes about the changes to the Jetstream, which is also a meridional circulation.⁶² He posits that a

⁶⁰ http://mgg.coas.oregonstate.edu/~andreas/pdf/S/schmittner07agu_intro.pdf , 04Mar2012

⁶¹ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

⁶² Thomas Homer-Dixon holds the CIGI Chair of Global Systems at the Balsillie School of International Affairs in Waterloo, Canada. At the University of Waterloo, he is Director of the Waterloo Institute for Complexity and Innovation and Professor in the School of Environment, Enterprise, and Development in the Faculty of Environment, with a cross-appointment to the Political Science Department in the Faculty of Arts. He

change in the Jetstream across North America would have devastating effects as the cold Arctic air is pushed south into America, and warmer air is pulled up into Canada. Precipitation changes would lead to ruined crops and forests prone to fire. The lack of deep winter freezes might lead to insect infestations and other damaging vectors.

Part of the irony of “global warming” is that the changes to air pressure in the polar region, caused by warmer waters in the summer, can cause significant disruptions to the jet stream, which ironically cause *colder* winters in the northern hemisphere. Some of this evidence might explain the “freakish” winter weather experienced by America these past few years. Again, while there will undoubtedly be benefits to increased temperatures – there will also be fluctuations at the extremes whereby some of the “averages” that are improved are episodic and concentrated.

Precipitation might have an immediate impact due to the change in temperatures and meridional circulation. “By mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water-stressed areas”.⁶³ Conversely, there will also be an increase in drought affected areas and heavy precipitation events. The extremes will grow more so. Russia may be blessed with longer growing seasons, access to increased rainfall patterns, and the possibility of increased access to arable land. Yet, its steppes might

writes extensively on the issues surrounding climate change and mitigation and adaptation. <http://www.homerdixon.com/wp-content/uploads/2009/09/Homer-Dixon-Biography-Jan-2012.pdf>, 04Mar12

⁶³ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

become drier; its rivers flooding more frequently and severely. Water management might become a trickier issue.⁶⁴

Other potential benefits of climate change “will reduce excess winter mortality, primarily through a reduction in cardiovascular and respiratory deaths and in injuries” but will likely be offset by an increase in heat related deaths during the summer months.⁶⁵ This is especially problematic for Russia whose average life expectancy for males is 59 years. Additional problems with Arctic warming include “increased vulnerability to pests and diseases in wildlife, such as tick-borne encephalitis, which can be transmitted to humans” and increased destruction of permafrost all of which “threaten community, public health and industrial infrastructure and water supply.”⁶⁶ The forested area is likely to increase in the north with a redistribution of tree species and an increase in the mountain tree line elevation. Yet, the warmer weather, coupled with increased episodic precipitation may also lead to more large-scale forest fires (like the ones recently witnessed) and outbreaks of tree-killing insects, triggered by the warmer weather. In the Arctic, the initial thawing of the permafrost will alter natural drainage systems, in some cases changing the habitat from one in which animals thrive to one dominated by aquatic species. These changes to surface drainage systems will also alter groundwater systems and likely increase coastal erosion. The permafrost in the Northern Hemisphere is projected to decrease by 20 to 35% by 2050.⁶⁷ This depth of the seasonal thawing is also expected to increase by 15 to 25% in most areas by 2050, which will lead to difficulties in existing and planned infrastructure with frost-heave issues and increased substrata instability. This impacts buildings,

⁶⁴ National Security and the Threat of Climate Change, <http://www.cna.org/sites/default/files/National%20Security%20and%20the%20Threat%20of%20Climate%20Change%20-%20Print.pdf>, 03May2012

⁶⁵ Ibid

⁶⁶ Ibid

⁶⁷ Ibid

roads, railways, port structures and airfields. This will be a major consideration as Russia adapts to its changing climate and economic opportunities drive exploitation of previously inaccessible resources.

In both Polar Regions, climate change may also lead to an impact on other species. There might be major impacts for predators such as seals and polar bears as their habitat for migratory birds and mammals decreases in habitat. “By the end of the century, 10 to 50% of Arctic tundra will be replaced by forest, and around 15 to 25% of polar desert will be replaced by tundra.”⁶⁸ Additionally, warming water temperatures can affect those aquatic species that prefer cold water – likely impacting the availability of fish sources for food. “Reductions in lake and river ice cover are expected in both polar regions. These will affect lake thermal structures, the quality/quantity of under-ice habitats and, in the Arctic, the timing and severity of ice jamming and related flooding.”⁶⁹ These events will lead to increased difficulty in forest and tundra land management issues and their concomitant resource allocation and associated cost issues. As with other climatic changes, there are costs and benefits associated with adapting to the new reality.

The warming temperatures and melting ice result in a now open sea transit lane across the North Pole. The difference in distance is astounding in the impact it has on sea travel. While the most immediate impact is on the Far East and their access to European commercial markets, to the one who can control the northern route belongs much in the way of gain. In the case of China, it is estimated that nearly 50% of its gross domestic product (GDP) is dependent on shipping. “The Northern Sea Route—which runs along the north coast of Russia trip from Shanghai to Hamburg via from the Bering Strait in the east to Novaya Zemlya in the west—is 6400 kilo-metres (sic) shorter than the

⁶⁸ Ibid

⁶⁹ Ibid

route via the Strait of Malacca and the Suez Canal.”⁷⁰ Concomitantly, the current route via the Gulf of Aden, transiting the Suez Canal has become fraught with peril due to increased piracy. The cost of insurance for ships travelling this route has increased more than tenfold in the 18 months between September 2008 and March 2009.⁷¹ The most noteworthy points for Russia are the now ice free northern ports and the now strategically vital “choke-point” on the seas – the Bering Strait – a new point of possible friction with the United States and Canada.

Agriculture

“By 2050, crops are expected to show a northward expansion in area. The greatest increases in climate-related crop yields are expected in northern Europe (e.g., wheat: +2 to +9% by 2020, +8 to +25% by 2050, +10 to +30% by 2080)”.⁷² Russia is expected to have a 10-14% increase in arable land area due to agricultural expansion.⁷³ The potential is incredible. Russia, if it manages its agricultural potential properly, will become a net exporter of grain. This puts it in a position of incredible leverage as food outputs from China, India, and Africa are likely to plummet given the effects climate change will have on their respective areas couples with their demographic pressures. Additionally, Southern

⁷⁰ Linda Jakobson, “China Prepares For An Ice-Free Arctic”, Stockholm International Peace Research Institute (SIPRI) *Insights on Peace and Security*, No. 2010/2, March 2010, <http://books.sipri.org/files/insight/SIPRIInsight1002.pdf>, 03Mar2012

⁷¹ Ibid

⁷² IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p51-53

⁷³ Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, 2007: Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., p505, <http://www.ipcc-wg3.de/publications/assessment-reports/ar4/.files-ar4/Chapter08.pdf>, 15Feb2012

Europe is likely to see decreased capacity for food production which will also tighten the trade bonds between the European Union and Russia. Proximity to market gives Russia a trading edge vis-à-vis the United States and Canada as Europe also becomes hungrier. This closer collaboration presents an opportunity to “balance” the power of the United States. Excess food production, coupled with faster access to far eastern ports puts Russia in a very advantageous position agriculturally.

Natural Resources – Energy, Minerals, People

Russia is the largest natural gas exporter in the world, and second largest oil producer and exporter in the world. These resource rich commodities have handcuffed Russia with a boom bust cycle based on the global economic cycles. Yet, this position has not been without its benefits. In 2009, Russia cut off the gas supply to the Ukraine over disputes contract disputes.⁷⁴ The Ukraine had also been at odds with Russia over the erstwhile satellite’s attempt to join the NATO alliance. Europe received one-fifth of its gas from Russia and concerns about Russia’s reliability as a gas supplier were rampant. However, the ability of Russia to flex its economical muscles allowed it to gain a position of strength from which to further negotiate.

Since Russia’s main trading partner is Europe, the net energy exports have provided Russia with the ability to run a trade surplus.⁷⁵ Russia does not have a well-developed manufacturing base, however, and therefore has a trade deficit with manufactured goods. Russia possesses tremendous raw materials – access to which will only increase with climate change, yet is currently unable to utilize those resources

⁷⁴ <http://www.reuters.com/Article/2009/01/01/us-russia-ukraine-gas-idUSTRE4BN32B20090101>, 27March2012

⁷⁵ http://www.wto.org/english/res_e/statis_e/its2011_e/its11_highlights1_e.pdf, 19March2012

domestically.⁷⁶ If Russia is to capitalize on its increasing resource base, it must find a way to develop its industrial base as well. The largest trading nations – China, U.S., and Germany – also benefit from close intra-regional trading ties. 65% of the European Union's trade is within the European Union. Only 19.5% of the Russian Federation's trade is internal to the Commonwealth of Independent States (CIS).⁷⁷ Yet, with increased access to the Arctic and a growing demand for energy from China and India – Russia sits atop tremendous potential to influence the world energy market.

Russia also has access to forests for wood and paper product production and untapped other mineral resources which were previously inaccessible due to the harsh climate. The challenge for Russia will be to access its mineral wealth without polluting its environment. Russia faces severe air, water, soil and radioactive pollution issues. During the Soviet era, little to no attention was paid to pollutants, oil spills, deforestation, and poor agricultural management issues. Remember it took the Soviets days to acknowledge Chernobyl.⁷⁸ Additionally, “twenty nuclear reactors, most with their fuel rods still inside, were dumped from nuclear submarines and an icebreaker into the Arctic Ocean north of Russia.”⁷⁹ Russians already have more health related issues than the other developed countries, and with its falling demographics it cannot afford to risk its human capital.

⁷⁶

<http://stat.wto.org/CountryProfile/WSDBCountryPFView.aspx?Language=E&Country=CA,CN,RU,US>, 19March2012

⁷⁷ http://www.wto.org/english/res_e/statis_e/its2011_e/its11_highlights1_e.pdf, 19March2012

⁷⁸ The accident occurred on 26APR1986 and was not announced by the Soviet Union until 28APR1986. The announcement was not made until after Sweden, Finland and Denmark announced abnormally high levels of radioactivity.

<http://www.nytimes.com/learning/general/onthisday/big/0426.html#article>, 09May2012

⁷⁹ <http://countrystudies.us/russia/25.htm>, 27March2012

Security



Figure 4 - The Bering Strait

<http://www.worldatlas.com/aatlas/infopage/beringphoto.htm>, 3Mar2012

The Bering Strait, named for the Danish-born Russian mariner Vitus Bering, is located just south of the Arctic Circle where the easternmost point of the Asian continent and the westernmost point of the North American continent come to within 85 km of each other. With a water depth of only 30-50 meters, this narrow passage creates, much like the straits of Gibraltar in the Mediterranean, or the Bosphorus straits in Turkey, an ability to control shipping. Bering was the first to spot the Alaskan mainland while on an exploration expedition during the mid-18th

century. While originally a Russia possession, Alaska was sold to the United States in 1867 for 7.2 million dollars.⁸⁰

The official boundary between the United States and Russia lies between the Big and Little Diomed islands at that exact point in the middle of the strait. In the last few decades some groups have discussed the construction of either a bridge or a tunnel connecting Russia and Alaska. While cost and weather have been the biggest hindrances, the connection may yet become a reality as human mobility and migration affect the northern latitudes. “The United States and Russia in 1990 signed an agreement regarding a disputed area of the Bering Sea; the U.S. Senate ratified the pact the following year, but the Russian *Duma* has yet to approve the accord.”⁸¹

Russia has a significant amount to gain in the Arctic and has an impressive plan to gain and maintain those resources. Russia has the largest icebreaker fleet in the world boasting a total of 20 ships, of which seven are nuclear powered. Nonetheless, many of these ships are reaching the end of their service lives, which will result in significantly reduced icebreaking capability by 2020. Russia has been investing in new icebreaker technology and partnering with its private sector to employ the latest in ice breaking technology: double-acting tankers and cargo vessels. These vessels are able to cruise bow-first in open water, taking advantage of fluid dynamics for efficiency. They are also able to operate “stern-first in ice conditions using its reinforced icebreaking aft hull.”⁸² Sovcomflot, the state-owned shipping company, brought its fleet

⁸⁰ “Seward’s Folly” as it came to be known was scoffed at by political opposition in the United States. The purchase – at the bargain price of 2.7 cents per acre – has since been hailed as prescient. This is especially so from the perspective of the United States who now has the ability to contest the straits. This has only increased in strategic importance as the Arctic has begun to open to seasonal and eventual year-round transit. <http://www.u-s-history.com/pages/h230.html>, 04Mar2012

⁸¹ <http://www.fas.org/sgp/crs/misc/R41153.pdf>, 22March2012

⁸² Reginald R. Smith, “*The Arctic: A New Partnership Paradigm or the Next “Cold War”?*”, <http://www.ndu.edu/press/Arctic-new-cold-war.html>, 22March2012

up to three with its newest vessel commissioned in 2010. Each ship has a 70,000-ton capacity. The added benefit to these vessels is that they can transit the Arctic waters solo – they do not need an additional icebreaker escort – saving tremendous shipping costs and boosting profitability. Russia is planning on building diesel-electric icebreakers to replace its aging fleet of Soviet-era nuclear-powered ones. In comparison, the United States currently has one active medium icebreaker, and two heavy icebreakers – both of which have been mothballed.⁸³ The Russian Federation has planned maritime upgrades and coordinated these with port and other infrastructure support upgrades in a comprehensive Transport Strategy out to 2030. This includes both new construction and upgrades to existing Arctic ports and both ocean inland waterways. Russia is also planning regulations for the transit of the Northwest Passage and North Sea Route requiring “for all ships to provide advance notice of passage and apply for guidance through the route; implied here is also the payment of a fee for services rendered, a sea-based toll way of sorts.”⁸⁴ An open Arctic Ocean will likely lead to significant increases in trans-oceanic traffic through the Bering Strait. This narrow passage will create a bottleneck condition similar to what is seen in the other strategic chokepoints around the globe. Traffic management, search and rescue, environmental catastrophe mitigation, and the entire sundry other tasks associated with seafaring will increase in frequency and complexity. Tolls, tariffs, and port fees could add significant money to state coffers. Given Russia’s forward leaning posture on Arctic preparation, they may be well ahead of the United States in capturing the economic benefits associated with the strategic changes inherent in increased Arctic commerce. The thousands of miles of ungarded coastline could lead to increased transnational criminal

⁸³ Incidentally, China also has one icebreaking vessel – which just shows the impotence of U.S. Arctic action.

⁸⁴ Reginald R. Smith, “*The Arctic: A New Partnership Paradigm or the Next "Cold War"?*”, <http://www.ndu.edu/press/Arctic-new-cold-war.html>, 22March2012

organizations operating in the area: trafficking humans, counterfeit products, drugs, and weapons. The increase in access – while beneficial to business – is also difficult on the downside for those charged with local law enforcement. The Russian navy, if recapitalized, may be in an advantageous solution to shepherd ships in both the Bering and Chukoi seas – leaving the U.S. Navy and Coast Guard to sit on the sidelines.

Conclusion

This chapter has examined Russia and the opportunities and challenges it faces in a world of uncertain climate change. In many ways, it is a story of ‘ifs’ and ‘maybes’ but given Russia’s size and latent potentiality for growth, those ‘ifs’ and ‘maybe’s should be taken seriously. If nothing else, Russia is well situated to take advantage of the coming changes should they break in their favor. It is worth remembering that in 1985 no one thought that the cold war would end. That it ended peacefully just four years later says a lot about the timing, tempo, and character of large, cataclysmic change. When thinking about climate change and its potential impact on geo-politics, one loses sight of that at their peril.

Chapter 3

Canada

We stand on guard for thee.

Overview

This chapter analyzes Canada and how climate change might affect its arable land, access to natural resources, energy reserves, and port access. Additionally, I attempt to relate changes interrelate with demographic issues in order to illustrate how these shape Canada's ability to project military power. Increased global temperatures may bring changes to traditional weather patterns – some harmless and some hellacious. Lengthening growing seasons and precipitation changes may bring about increased agricultural yields, intensify forest management issues, and increase access to mineral resources.

Yet, even if Canada succeeds in harnessing these opportunities, the increased economic production might strain Canada's relationship with the United States, or cause internal turmoil and fractures along ethnic fault lines. Given Canada's beneficial geography, current and projected climate, history, and demographics the likely impacts of climate change may increase Canadian potential power or the added national agricultural and mineral fertility may make a tempting target for the unscrupulous or opportunistic.

History

Anthropologists estimate that the earliest residents of what is now Canada arrived as early as 28000 BC; crossing a land-bridge over the Bering Strait which connected the North American and Eurasian land masses. The lower ocean levels of the time – possibly during an ice-age – facilitated the crossing. There is historic evidence for the extreme fluctuation of sea levels since the land bridge is now underwater. The usurpation of the locals began in 1000 AD when the Norsemen - the first modern European settlers – arrived and erected temporary settlements on the northern portion of Newfoundland. The likes of Leif Erikson did not stay, however, and the course of Canadian history did not permanently change until the slow trickle of European explorers began arriving in 1497. John Cabot's expedition that year claimed the territory for King Henry VII of England. While a scant 37 years later (lightning quick in historical time), Jacques Cartier landed in what is currently Quebec. He claimed the territory for France, creating the settlements which would later mature into Montreal and Quebec City. That foundational fault line between the British and French colonies set up a show-down which played out well into the 20th Century with the Quebec secessionist movement.

The Hudson's Bay Company - which still exists today and operates as a chain of department stores--was founded in 1670 and is Canada's oldest business enterprise. Britain's roots run deep and from this point forward she gradually takes governmental control of Canada. The victory of British forces at the Plains of Abraham outside Quebec City in 1759, eradicate the last vestiges of France's North American Empire. The treaty of Paris in 1763 formally transitions the rule of Canada to the British.

During the American revolutionary war, Canada became a refuge for British loyalists, and this concentration of a pro-British population cemented Canadian opposition to the United States during the War of 1812. The U.S. suffered its second military defeat at Canadian hands (the first was during the American Revolution). The treaty of Ghent ended the war in 1814 and in 1818 the 49th parallel became the accepted border in the western territories – a stable border to the present.

The nation of Canada continued to take shape with the selection of Ottawa as the capital in 1856 - followed closely in 1867 with the creation of the Dominion of Canada by the British North America Act. The first provinces were Ontario, Quebec, Nova Scotia and New Brunswick – followed six years later by Manitoba, British Columbia and Prince Edward Island.⁸⁵

The rush to riches and the start of Canada's environmental challenges date to 1897 and the start of the Klondike Gold Rush began near Dawson City, Yukon. Within a year, the population in the region approached 40,000, threatening to cause a famine. The mining and manufacturing boon during the industrial revolution led to massive problems with water, air, and soil pollution – much of it caused by acid rain and the dumping of industrial waste into lakes and rivers. Environmental issues continue to the present in the issues of oil sands mining and the impacts of climate change on Arctic flora and fauna and indigenous cultures. Yet, since World War II, the remarkable development of its mining industry, manufacturing base, and service sectors have changed the nation from a rural-based economy into a primarily urban and industrial based economy. "Canada is the US's

⁸⁵ In 1904-5 Alberta and Saskatchewan enter the Confederation. Newfoundland was the last province to join the Confederation – in 1949. Nunavut became the last territory when is split from the Northwest Territories on April 1, 1999.

largest foreign supplier of energy, including oil, gas, uranium, and electric power.”⁸⁶

The 1960s saw two more milestones in Canada’s development – the introduction of the Maple Leaf on February 15, 1965 and the adoption of English and French as "official" languages in 1969. The 1990s brought similar steps as Canada signed the North American Free Trade Agreement (NAFTA) with Mexico and the U.S. in 1994, and defeated a referendum on Quebec independence in 1995 – by a very narrow margin.⁸⁷ Trade with the United States accounts for over 75% of Canadian exports and affords Canada a substantial trade surplus with the US. “In addition, the country's petroleum sector is rapidly becoming an even larger economic driver with Alberta's oil sands significantly boosting Canada's proven oil reserves, ranking the country third in the world behind Saudia[sic] Arabia and Venezuela”.⁸⁸ Canada which closely resembles the US in its “market-oriented economic system, pattern of production, and affluent living standards” boasts a trillion-dollar economy, affluent culture, and a high-tech industrial society.⁸⁹

Canada is a land of contradictions – independent in spirit and freedom-loving yet still pledging allegiance to the British crown. Its government is simultaneously a parliamentary democracy, a federation, and a constitutional monarchy maintaining itself as a member of the British Commonwealth. It spends only 1.1% of its GDP on defense – enjoying the protection of the United States – yet eschews US hegemony and jealously guards its independence of action. Despite the miniscule military budget, Canadians are deployed world-wide in a variety of peace-keeping, observation and liaison roles. Canadians played an active role

⁸⁶ <https://www.cia.gov/library/publications/the-world-factbook/geos/ca.html>, 20March2012

⁸⁷ <http://www.schoolsincanada.com/Canadian-History-Timeline.cfm>, 20March2012

⁸⁸ <https://www.cia.gov/library/publications/the-world-factbook/geos/ca.html>, 20March2012

⁸⁹ Ibid

in Afghanistan and Kosovo – yet rejected a military role in Iraq much to the chagrin of their erstwhile Enduring Freedom allies.⁹⁰

Geography

Canada is the second largest country in the world by landmass, following closely behind its Arctic neighbor Russia. It “extends across the continent of North America from Newfoundland on the Atlantic coast to British Columbia on the Pacific coast” and despite being slightly larger than the United States, it possess only about a tenth of the population – approximately 35 million people. Yet, despite its vast size, 90% of its population lives within 160km of the U.S. border. The rugged terrain, harsh climate, and geographic isolation keep much of Canada either uninhabited or sparsely populated.

Canada has a total area of 9,984,670 sq. km, although, if only the “land mass” is counted, and not inland water as part of its area, then Canada drops to fourth place in size behind the United States and China. It is the world’s largest country that borders only one other country, sharing 8,893 km (includes 2,477 km with Alaska) with the United States. And despite the two ill-fated military excursions by its southern neighbor, has maintained a historically good relationship with the United States. The two nations share the remarkable distinction of having the longest unfortified border in the world. Canada is comprised of ten provinces (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Quebec, and Saskatchewan) and three territories (Northwest Territories, Nunavut, and Yukon).

⁹⁰ Mark Mackinnon, “*For Canadian, serving in Iraq is a source of pride*”, Friday's Globe and Mail, Mar. 21, 2008, <http://www.theglobeandmail.com/news/world/Article674814.ece>, accessed 21March2012

Canada is divided into eight major land regions: the Pacific Ranges and Lowlands; the Rocky Mountains; the Arctic Islands; the Interior Plains; the Canadian Shield; the Hudson Bay Lowlands; the St. Lawrence Lowlands; and the Appalachian Region. "Canada is bounded on the north by the Arctic Ocean; on the north-east by Baffin Bay and Davis Strait, which separate it from Greenland; on the east by the Atlantic Ocean; on the south by the United States; and on the west by the Pacific Ocean and Alaska".⁹¹ It extends 4600 km north to south from its territorial extremes, and 5500 km from east to west. Its highest point is Mount Logan at 5,959 m and its lowest point is sea-level. The overall character of the landmass is mostly plains with lowlands dominating the southeast and mountains rising in the west. These vast prairies are covered by grassland, although much is now farmed. In the north, evergreen forests "sweeps across Canada from Alaska to the coast of Labrador. Near the Arctic Ocean, the forests gradually give way to tundra that is frozen for more than half the year."⁹²

Current Climate

Canada's current climate varies from temperate in the south to subarctic and Arctic in north. As already mentioned the harsh climate motivates most of the population to live in the southernmost 160km wide belt of the country. There are indigenous peoples scattered throughout the Arctic and subarctic – but these are mainly subsistence living and not part of the main Canadian political and economic engine. These inhabitants only account for 1% of Canadian population.

Many people identify Canada with cold snowy weather, outdoor skating on the frozen river in Ottawa and ice hockey. Its climate

⁹¹ <http://www.fao.org/forestry/country/18310/en/can/>, 20March2012

⁹² Ibid

however, is as sundry as its scenery. Most of the Canadian people enjoy four very distinct seasons – which is a bit misleading since most of the population lives in close proximity to the United States. Summer temperatures can reach as high as 35°C and winter lows can plummet to -25°C. Spring and fall are much more pleasant with moderate temperatures being the norm. Summertime on the Canadian prairie can be hot and dry, while the central regions experience humid conditions and the coastal regions enjoying milder climes. Winters are generally cold with periods of snow, although southern Alberta enjoys the occasional ‘Chinook’, a warm dry wind from the Rocky Mountains that gust through and melts the snow.”⁹³ The winters on the west coast in cities like Vancouver and Victoria and are typically wet and cold – similar in many respects to winters in Seattle.

Potential Climate

The potential climatic changes for Canada are dramatic with some likely changes having a very positive impact, while others create challenges to the status quo. Some areas of Canada experience four distinct seasons – summer, winter, spring, and fall. In those areas, winter typically runs from August through March. This is much too short of a time for any meaningful agriculture. Warming weather will likely shorten the winter and create the conditions for agriculture to take root. In fact, in both Siberia and North America, the northern limit for forestry and agriculture may shift several hundred kilometers by the year 2050. This could provide a boon to Canadian lumber, paper and farming

⁹³ Ibid

industries – but will stress indigenous communities that rely on traditional lifestyles.⁹⁴

Climate change is also likely to increase forest production, but cause a concomitant sensitivity to “drought, storms, insects and other disturbances.”⁹⁵ Arctic warming will likely see 10 to 50% of the Arctic tundra replaced with coniferous forests, while 15 to 25% of the current polar desert is transformed into tundra. These changes may be fairly rapid – estimates have them occurring by the end of the 21st century – further straining the ability of government, industry, and the population to adjust. Changing tundra to forest and desert to tundra appears positive on the surface; yet, the down side is that Canada already fights over 1,000 forest fires per year in its western provinces. The warming weather may exacerbate the number and intensity of those forest fires; creating catastrophes in the genre of forest management, and increasing the fire risk to already isolated and vulnerable communities. The IPCC estimates that the window of high fire risk will increase between 10-30% per annum over current levels. Burn areas are also projected to increase across Canada by 74-118% through the year 2100.⁹⁶ Adding insult to injury, the additional fires will release tons of carbon dioxide into the atmosphere possibly creating a positive feedback loop that then leads to more warming and yet additional increases to fire risk. Furthermore, “projected warming in the western mountains by the mid-21st century is

⁹⁴ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

⁹⁵ Ibid

⁹⁶ Large-scale forest fires and outbreaks of tree-killing insects, which are triggered by warm weather, are characteristic of the boreal forest and some forest tundra areas, and are likely to increase. IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

very likely to cause large decreases in snowpack, earlier snow melt, more winter rain events, increased peak winter flows and flooding, and reduced summer flows.”⁹⁷

Canada already has some of the largest freshwater reserves in the world, and with the coming rainfall pattern changes may receive even more. Projections estimate an annual 10-30% increase in the amount of rainfall across Canada. Harnessing the increase in precipitation may be challenging as it seems unlikely to be evenly distributed throughout the year. Yet, with sufficient planning and prudent land use policy, the water could be used to decrease reliance on irrigation. Canada may even find a way to export freshwater to those nations suffering from drought or clean water shortages. Exporting freshwater could be an economic boon to the Canadian economy.

Increased numbers of severe heat waves, which are characterized by “stagnant, warm air masses and consecutive nights with high minimum temperatures”, are also expected.⁹⁸ While Canadian cities have not typically been subjected to these events, the likelihood that cities like Montreal and Toronto will experience such events is increasing. These cities – while very capable of coping with extreme cold and massive snow events – are ill-equipped to handle heat related issues. Air conditioning is not as prevalent in Northern cities as it is across the southern cities in North America. Heat waves across southern Canada – similar to the ones which occurred across Europe in 2011 – could have deadly effects for the elderly and young children who are most susceptible to heat related injuries. The flip side is that “Arctic warming will reduce excess winter mortality, primarily through a reduction in cardiovascular and respiratory deaths and in injuries.”⁹⁹ So, in the

⁹⁷ Ibid

⁹⁸ Ibid

⁹⁹ Ibid

aggregate to overall climate change related deaths may be offset by the changes to risk during the summer and winter seasonal extremes. A rather macabre method of measuring effects on men and women, but a useful lens through which to contemplate the macro-level initiatives required to respond to various climate change challenges at the national level.

Agriculture

Canada is a net agricultural exporting nation. It currently has a 3.7% share in the global agricultural export market and is a member of the CAIRNs group.¹⁰⁰ Blessed by a small population and fertile farm lands, it annually produces more food than its citizens consume. Longer growing seasons and the opening of more arable land will likely boost food production. Food scarcity in other regions of the world, and burgeoning populations may place Canada in a very enviable position of control of a very precious commodity. Canada makes significant gains as the climate warms and more arable land becomes available and the growing season lengthens. In this respect, Canada could become the new breadbasket for the world, surpassing the United States in food exports.

Canada is currently the second largest producer of rapeseed oil in the world. Rapeseed oil is better known today as canola oil, which is “originally a syncopated form of the abbreviation ‘Can.O., L-A.’ (Canadian Oilseed, Low-Acid).”¹⁰¹ This versatile oil is also used in the manufacture of biodiesel. Advances in biodiesel and modern diesel engines all the use of pure biodiesel or, as is frequently done, “combined with fossil-fuel

¹⁰⁰ <http://cairnsgroup.org/Pages/map/index.aspx>, 22March2012

¹⁰¹ http://en.wikipedia.org/wiki/Brassica_napus, 20March2012

diesel in ratios varying from 2% to 20% biodiesel.”¹⁰² When barrels of crude oil hovered around \$30 a barrel, the cost of producing biodiesel was prohibitive. The cost involved in growing, harvesting, crushing and refined rapeseed oil did not make economic sense. Yet, with the cost of a barrel of light Brent crude now flirting with \$125 the use of rapeseed oil is very attractive.¹⁰³ Rapeseed is the oil of choice for biodiesel throughout much of Europe, attributed to the fact that it produces more oil per hectare than does soy.¹⁰⁴ Rapeseed oil accounts for about 80% of the feedstock in Europe – an attractive factor for Canadian exporters. Even more attractive is the fact that the majority of European cars and trucks run on diesel fuel and an “estimated 66% of total rapeseed oil supply in the European Union was expected to be used for biodiesel production in the 2010-2011 year”.¹⁰⁵ As legal mandates for biodiesel content requirements in Europe go into effect, world production can be expected to trend further upward in the coming years.¹⁰⁶ Incidentally, Canada witnessed a 17% increase from 2002-2008 in the export of rapeseed oil.

Hydroponics is also a promising addition to Canada’s booming agricultural industry. Hydroponics is energy and water intensive, yet may meet increased food needs by mitigating climatic and insect threats to traditional terra-based farming. Currently, the largest cash crop for hydroponics in Canada is marijuana. If the technology can be harnessed to produce tomatoes, turnips, and tulips it has the potential to further increase the relative gains for Canada in a warmer world.¹⁰⁷ Canada is already home to extensive hydropower and fresh water resources – tapping into these requires political, industrial, and financial incentives

¹⁰² Ibid

¹⁰³ <http://www.oil-price.net/>, 21March2012

¹⁰⁴ http://en.wikipedia.org/wiki/Brassica_napus, 20March2012

¹⁰⁵ Ibid

¹⁰⁶ Ibid

¹⁰⁷ Barring of course legalization or de-criminalization issues.

rather than extreme capital outlays. Harnessing these two aspects with greenhouses could mitigate the increase in insects likely to come from a warming climate and the need to clear more forests to make way for additional agricultural land. Traditional farming techniques might be better left to traditional societies and new techniques embraced.

Genetically modified crops (although politically charged) may also play a significant role in overcoming the challenges of climate change. Some crops are already modified to have pesticide as part of their DNA. Some crops are modified to resist temperature extremes and drought conditions. Altering plants is nothing new – grafting has been going on for centuries. The rate and ability to change plants at the cellular level is. Even for those who are philosophically opposed to genetically modified plants, the realities of climate change and the pressures on agriculture may cause them to make a Faustian bargain.

Canada will likely continue to have internal food security – producing more high quality food than its population consumes. Canada has tremendous potential for the expansion of its agricultural base. Even marginal lands can produce food if the cost benefit margins are high enough. Canada has seen a 2.7% increase in its ration of food exports to imports.¹⁰⁸ The potential is there for that number to increase even more. Canada is well poised to take advantage of the moderate changes expected to occur in the early decades of the 21st Century which predict an aggregate increase to yields of rain-fed agriculture by 5 to 20%. Canada also has a surplus of fresh water and even if it expands its irrigated acres will not risk the challenges associated with “crops that are

¹⁰⁸http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Canada_E.pdf, 21March2012

near the warm end of their suitable range or which depend on highly utilised water resources.”¹⁰⁹

Natural Resources

Canada is blessed with numerous natural resources such as “iron ore, nickel, zinc, copper, gold, lead, rare earth elements, molybdenum, potash, diamonds, silver, fish, timber, wildlife, coal, petroleum, natural gas, and hydropower.”¹¹⁰ The likelihood of increased access to these resources may lead to additional development, foreign direct investment, and a more robust GDP. The current boom in the Canadian economy is in the extraction and processing of oil sands, which are expensive to extract and convert into usable industrial and commercial grade oil. Yet, with record high oil prices, and the ongoing volatility and violence in much of the oil producing regions of the world, oil sands have become a lucrative venture – albeit not without their detractors.

There are several environmental impacts of climate change which affect access to natural resources, while simultaneously challenging Canada’s ability to deal with the negative aspects of climate change. Using the issue of oil sands as a lens to understand these challenges might be helpful. The coming changes require a look toward the future – not the past. Continued investment incentives and decisions based on historical precedence are likely to increase “vulnerability of many sectors to climate change”.¹¹¹ Infrastructure improvement requires foresight to

¹⁰⁹ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

¹¹⁰ <https://www.cia.gov/library/publications/the-world-factbook/geos/ca.html>, 20March2012

¹¹¹ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The

overcome the inherently long lead times for adequate development. Infrastructure investments would benefit from incorporating climate-change information into the decision making schema. And while the need for road and rail lines is crucial for the exploitation of oil sands, the lands upon which those lines of communication would be built are problematic. According to IPCC SRES scenarios, the “northern hemisphere permafrost extent is projected to decrease by 20 to 35% by 2050. The depth of seasonal thawing is likely to increase by 15 to 25% in most areas by 2050 and by 50% or more in northernmost locations”.¹¹² In other words, if nothing in the world changes, the ground beneath the roads will be unstable. The initial permafrost thaw will not only alter drainage systems causing flooding and effluent contamination issues, but also disrupt ecosystems – in some cases replacing terrestrial species with aquatic species and lakes, ponds, and marshy areas are created. These changes may also lead to an increase in coastal erosion. The climatic barriers (i.e. extreme cold and ice) that have thus far acted as a near impenetrable barrier protecting various polar species from competition will be lowered or eliminated. The concomitant, “decreases in habitat (including sea ice) for migratory birds and mammals, with major implications for predators such as seals and polar bears.”¹¹³

The increased temperatures will lead to reductions in lake and river ice cover and in the Arctic, the timing and severity of ice jamming and related flooding may also be affected. The oil sands extraction business faces environmental and ecological vice commercial challenges to its long-term viability. The increasingly unstable permafrost will likely make the current road networks unstable leading to accessibility issues.

Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

¹¹² Ibid

¹¹³ Ibid

The construction issues associated with melting of the permafrost also endanger pipelines – necessitating costly mitigation issues and increased construction costs. The already delicate environmental issues in the Arctic region will be further threatened by the changing watershed realities and the contamination issues surrounding the oil sand sites' effluent. "The overall amount of water used by the oil-sands companies is currently estimated to be just under 200 million cubic metres, including groundwater and surface runoff. That's the equivalent to about 40 percent of the yearly water consumption of the City of Toronto."¹¹⁴

Oil sands are already a "dirty" business – made viable by a relative increase in the cost of traditional oil. The added costs to comply with additional extraction (access) costs and environmental legal requirements may yet make the oil sands cost prohibitive to exploit. Canadian companies, citizens, and the government would do well to consider the implications of climate change prior to blindly following the lure of easy profit.

Security

Despite Canada's relatively small population – it is currently ranked 36th in the world with 34,300,083 - it has played a considerable role on the world stage. In 1956, during the Suez Crisis, Lester B. Pearson (later Nobel Prize recipient) proposed a UN sanctioned peacekeeping force to monitor and enforce the cease-fire. He went on to become Prime Minister of Canada in 1963. Canadians armed forces have served with distinction during WWI, WWII, Korea, Vietnam, and Desert Storm. More recently Canadian units cycled through Kandahar in Afghanistan fighting in the Taliban's heartland.

¹¹⁴ Curtis Gillespie, "Alberts's Oil Sands", Canadian Geographic, June 2008, http://www.canadiangeographic.ca/magazine/jun08/feature_tar_sands4.asp, 22Mar2012

Canadians have been central to NORAD and a stalwart of the defense network protecting North America from the Soviet threat during the cold war. Canada, after all, has a vested interest in protecting its homeland from attack. Any missile or bomber strike was likely to come over the North Pole as this is the shortest distance between the two nations. Currently there are 114 Canadian military members completely integrated into NORAD's headquarters.¹¹⁵ Armed fighters – maintained on alert status – are positioned across both the United States and Canada. They are ready to “intercept and identify suspect aircraft, which allows NORAD to be postured to defend against strategic airborne threats to the United States and Canada.”¹¹⁶ NORAD has provided a collaborative mechanism for the United States and Canada to meet and work through mutual security issues. This forum has been an invaluable part of the partnership between the two nations.¹¹⁷

While this relationship worked effectively to counter the Soviet threat during the Cold War, it may not retain much utility in the future as the changing dynamics across the Arctic unfold. The recent history of close cooperation between the United States and Canada could change into one of competition as their respective national interests diverge. Differences over access to sea lanes, basing, and mineral and energy claims could drive a wedge between the two erstwhile allies. Canada will likely seek to exert nationalist ideals in its Arctic diplomacy, but will not likely shift too far from the United States. Russian rhetoric has been increasingly perceived as provocative.

Since 2007, Russian bombers have flown training missions on a regular basis – some announced and some unannounced – and NORAD

¹¹⁵ <http://www.airforce-magazine.com/SiteCollectionDocuments/Reports/2012/March2012/Day16/031312jacob.pdf>, 21March2012, p2

¹¹⁶ Ibid, p7-8

¹¹⁷ Ibid, p3

has responded. Russia is no longer viewed as an enemy – yet the decidedly provocative moves have caused concern and consternation. The VIGILANT EAGLE exercise in August 2011, was part of the continuing attempt to mitigate misunderstandings and build the bridge to partnership opportunities across the warming Arctic.¹¹⁸ But the fact remains that the actions by Russia can be viewed as provocative and an attempt to flex military muscles as world focus has shifted to the Middle East and toward Asia (i.e. China). The Arctic remains a cold war vestige of contestation, however, the water is now open for free sailing, navigation, and commerce – creating a more complex environment from which nations must defend their sovereignty and protect free trade. The Arctic also has the Bering Strait which can be controlled by Russia and America – this affects Canada as well since it can be held hostage by the two former rival superpowers. Canada could deftly play *Climatepolitik* by pitting the interests of Russia and America against each other. Should Canada choose a balance of power approach to the Arctic, relationship dynamics among the Arctic nations could shift significantly.

The threat of a Russian attack has diminished considerably since the end of the Cold War, yet the airborne threat has not evaporated entirely. New technologies, remotely piloted vehicles (RPVs), and lightweight “drones” have profligated and increased the threat from some of these low cost, commercial off-the-shelf technologies.¹¹⁹ The threat of a low, slow moving aircraft, launched by ship from the Arctic has become more prevalent. Yet, with the opening of the Arctic to seafaring – at least for part of the year – military action is not the only threat. Transnational Criminal Organizations (TCOs) also save time shipping across the north. There will likely be issues with commercial rights, trafficking of illicit

¹¹⁸ Ibid, p9

¹¹⁹ RPVs are the latest name for Unmanned Aerial Vehicles (UAVs). The RPV moniker is meant to ensure an understanding of the significant manpower requirement to operate the vehicles. They are in fact remotely piloted, and not just unmanned. Unmanned implies the lack of humans in the chain of operation.

goods, drugs, and persons. Increased tourism and the risks associated with offshore drilling.

To mitigate emerging threats, Canada and fifteen other stakeholders participate in maintaining a common operating picture of the maritime areas and internal waterway of North America. These other stakeholders also include the U.S. Coast Guard, and other governmental agencies which are vital to maintaining national security and unhindered commercial trade.¹²⁰ In support of these interests, “NORAD, USNORTHCOM, and Canada Command are working toward a Tri-Command Framework for Arctic Cooperation, which synchronizes planning, operations, domain awareness, and information sharing, exercises, and capability development among the commands in the Arctic region.”¹²¹ In recent testimony before the Senate Armed Services Committee, GEN Jacoby, the commander of NORTHCOM testified:

Canada is a trusted partner with whom we share the defense of the continent. The military-to-military relationship between USNORTHCOM and Canada Command is strong, and has progressed to unprecedented levels of cooperation.

Canada and the United States are allies and strategic partners in the security cooperation arena, with USNORTHCOM and Canada Command working together as never before on emerging regional engagements such as the North American Maritime Security Initiative.

Meanwhile, Canada Command is developing a plan for complementary regional engagements along Mexico’s southern border with Guatemala and Belize, supporting the fight against TCOs as well as providing expertise and training to the Mexican military and civil authorities as they transition their legal system to a model better able to prosecute, convict, and incarcerate TCO members.

USNORTHCOM and Canada Command also closely coordinate security cooperation activities with other partner nations, as well

¹²⁰ Ibid, p10

¹²¹ Ibid, p16

as refine a common exercise schedule, to ensure that all activities provide the most value for their cost and that no time is wasted on duplicating efforts.¹²²

At least for now, the rhetoric is one of continued cooperation. Mil-to-mil coordination is an essential building block for greater coordination, yet it is not necessarily the official government policies of either nation. Myriad other interests have a role in how state-to-state relations exist. Energy companies, for example, could have significant differences as oil from the Dakotas competes with oil from Alberta. Pipeline politics also plays a significant role as Canada seeks to export its energy resources, while environmental groups in the United States seek to thwart the perceived pipeline to perdition.

Lest any believe that Canada will meekly accept their fate as America's "little friend", the prediction that "global warming will reduce the ice pack in Canada's northern archipelago sufficiently to permit ships to use the trans-Arctic shipping route known as the Northwest Passage during the summer months" has raised concern over jurisdiction.¹²³ Potentially heavy traffic raises the question of oversight, regulation, surveillance and ultimately control of the Northwest Passage. "Ottawa maintains that such a passage would be an inland waterway, and would therefore be sovereign Canadian territory" under the oversight of Canada.¹²⁴ Other nations disagree, however, and the two economic juggernauts of The United States and the European Union, and others assert that the passage would constitute an international strait between two high seas. The United States and Canada also continue negotiating over a bi-national boundary in the Beaufort Sea – another point of friction.

¹²² Ibid, p22

¹²³ <http://www.fas.org/sgp/crs/misc/R41153.pdf>, 22March2012, p13

¹²⁴ Ibid

Conclusion

Like Russia, Canada's future with respect to climate change sits precariously between 'ifs' and 'maybes'. As one group examining the problem put it, "it is virtually certain that there will be both negative and positive impacts, particularly through changing cryospheric components, on infrastructure and traditional indigenous ways of life."¹²⁵ Across the Arctic, indigenous peoples are, out of necessity, being required to adapt to the realities of climate change. The impacts on their traditional way of life are acting like the proverbial canary in the coal mine – a sentinel of seismic shifts in ecosystems. "In combination with demographic, socio-economic and lifestyle changes, the resilience of indigenous populations is being severely challenged."¹²⁶ By the end of the century, a reduction of 22 to 33% is expected annually in the average Arctic sea-ice coverage with projections ranging up to a complete loss of summer sea ice. "Over the next hundred years there will important reductions in thickness and extent of ice from Arctic glaciers and ice caps, and the Greenland ice sheet, as a direct response to climate warming."¹²⁷ Current political systems are ill-equipped to deal with dangers outside of short-term budgetary cycles. Re-election campaigns and "what have you done for me lately" politics hamper the ability of nations to cope with long-term threats which only deal with probabilities. It is one thing to deal with nuclear Armageddon, it is quite another to motivate the home front to worry about melting sea ice.

¹²⁵ The cryosphere is the frozen stretches of the planet that act as the Earth's thermostat, <http://www.nasa.gov/vision/earth/environment/cryosphere.html>, 21March2012, and IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

¹²⁶ Ibid

¹²⁷ Ibid

Yet these changes bring challenges and opportunities. The warming climate increases Canada's access to oil sands and other natural resources. The longer growing season increases agricultural yields and the amount of arable land. The warming weather keeps her ports ice-free year-round and facilitates trade. All of these factors lead to an increase in Canada's potentiality index. Yet, with a small population and a military the size of only one U.S. Army division, the challenges to providing its own security are daunting. The most likely economic scenario is increased trade and relations between the Russian Federation and Canada as they both gain access to the Arctic and shorter trade routes. Although, with both vying for the energy resource market and both competing for the European market some friction is likely to result. Additionally, the provocative actions of the Russians may foist a skittish push in Canada to more closely militarily align with the United States – offering additional Air, Land, and Sea basing rights in the Arctic.

Digital Collections

Air University—Maxwell AFB, AL

Chapter 4

Recommendations and Conclusions

But we thought we might be in for a period of climate change, of such magnitude that could dwarf other global problems. After carefully interviewing atmospheric scientists, we said that one early indicator would be extremes in local weather conditions around the world: record-breaking high and low temperatures, droughts, storms, unusually mild or harsh winters.

- Peter Schwartz

In the opening scenes of the film entitled “An Inconvenient Truth”, a solitary polar bear swims in the Arctic Ocean – miles from land, ice sheets, food, or safety.¹²⁸ Metaphorically speaking, that scene of the polar bear is what we might face as we wrestle with the potential implications of climate change. The scientific evidence is clear, overwhelming, and indisputable – the climate *is* changing. Regardless of the causal effects, we must take pragmatic steps to exploit emerging opportunities. We must also prepare for the worst case scenarios, the mega-catastrophes, or the “Black Swans”.¹²⁹

Global climate change has profound implications for states. For starters, climate change is truly a global issue—no one state can afford to go it alone in a world of such dramatic shift. Second, while there will be losers in this new world, there might be winners and understanding the differences between the two is a useful first step in thinking about the policy implications of climate change. Lastly, while climate change is

¹²⁸ *An Inconvenient Truth*, 2006, Paramount, November 21, 2006 DVD Release, Rated PG, 100minutes, Color Widescreen, NTSC, Al Gore, Billy West II, Directed by Davis Guggenheim

¹²⁹ Nassim Nicholas Taleb, *The Black Swan* (New York: Random House, 2007)

very much a story of 'ifs' and 'maybes' it is not a fairy-tale; for better or worse the world is getting hotter and it is reasonable to conclude changes will result. Given what we do know about a warmer climate, it is also reasonable to assume that the global economy will become more interdependent as agriculture production becomes more regionalized and the distribution of fresh water becomes more disparate. It is possible to imagine a scenario where the food and water markets are similar to the oil markets today, where certain states enjoy an elevated effect of the global market based on their disproportionate share of proven reserves and the rest of the world's reliance on that commodity.

Also reasonable is the assumption that a warming world will cause a concomitant rise in sea levels which will exacerbate the effects of hurricanes, typhoons, and tsunamis on increasingly populated littoral regions. Add to this an increase in intensity and frequency of storm phenomena and again one can imagine scenarios where governments are overwhelmed and require the assistance of other nations. Even Japan was initially overwhelmed by the effects of the tsunami and required assistance to contain a rapidly deteriorating situation. Now, imagine similar scenarios repeated in frequency across the globe.

If reliance on the world's "bread baskets" increases, and collective action in the face of more numerous and destructive natural disasters tests governments world-wide it is reasonable to assume that these facts may drive increased interdependence among states. This could lead to increased cooperation in a more Kantian outlook, or could lead to increased tensions if a more Hobbesian view is adhered to. These approaches to world order may well depend solely on individual state's perceptions of how others either seek to support or exploit each other in the face of these changes. The interconnectedness of the global media

environment and the realities of social media are sure to impact this perception.¹³⁰

In thinking about the implications of climate change the IPCC developed the following conclusions on the Arctic:

- Projected hydrological changes will influence the productivity and distribution of aquatic species, especially fish.
- Warming of freshwaters is likely to lead to reductions in fish stock, especially those that prefer colder waters.
- Severity of Arctic flooding, erosion, drought and destruction of permafrost, threaten community, public health and industrial infrastructure and water supply.
- Changes in the frequency, type and timing of precipitation will increase contaminant capture and increase contaminant loading to Arctic freshwater systems.
- Increased loadings will more than offset the reductions that are expected to accrue from global emissions of contaminants.¹³¹

The IPCC also has significant findings related to agriculture and forestry.

- In mid- to high-latitude regions, moderate warming benefits crop and pasture yields, but even slight warming decreases yields in seasonally dry and low-latitude regions (medium confidence).
- Projected changes in the frequency and severity of extreme climate events have significant consequences for food and

¹³⁰ The nature of how global information affects perceptions of climate change, state reactions and policies may have either an inflammatory or dampening effect on international relations. This is a subject which required further study and reflection, and may be an area of additional research for either a separate study or a more fully fleshed out argument if this thesis is later developed into a dissertation.

¹³¹ Nassim Nicholas Taleb, *The Black Swan* (New York: Random House, 2007)

forestry production, and food insecurity, in addition to impacts of projected mean climate (high confidence).

- Simulations suggest rising relative benefits of adaptation with low to moderate warming (medium confidence), although adaptation stresses water and environmental resources as warming increases (low confidence).
- Smallholder and subsistence farmers, pastoralists and artisanal fisherfolk will suffer complex, localised impacts of climate change (high confidence).
- Globally, commercial forestry productivity rises modestly with climate change in the short and medium term, with large regional variability around the global trend (medium confidence).
- Food and forestry trade is projected to increase in response to climate change, with increased dependence on food imports for most developing countries (medium to low confidence).¹³²

These findings support the notion that some nations will experience relative gains vis-à-vis others. Climate change unequally affects different regions on the planet. The Arctic is projected to warm faster than the rest of the globe, but is more resistant to precipitation fluctuations than the Maghreb and Levant where small changes in rainfall would likely cause widespread devastation given the fragility of the ecosystems.¹³³ The mid to high latitude nations (of which Russia and Canada are the two most prominent) may experience significant gains in agriculture and forestry productivity. Additionally, these increases must be accounted for in an interconnected global economy where developing nations in the equatorial regions require an increase in food imports. These factors place both Canada and Russia in the

¹³² William Easterling et al, "Chapter 5 Food, fibre and forest products", <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter5.pdf>, p274-275, 08May2012

¹³³ While outside the scope of this essay, Israeli agricultural production relies almost exclusively on irrigation, and changes to the availability of water for irrigation could collapse Israeli food production. This is the topic of a separate case study.

potentially advantageous position of producing a high demand commodity, and may afford them increased influence in regions reliant on imported foodstuff.

A Way Ahead

The previous chapters painted a picture about the changing Arctic and the possible relative gains and losses associated with that change. In the final analysis, I will consolidate the data and explore the implications for the United States, and draw conclusions about a way ahead.¹³⁴

Potentiality Index

Based on the data presented in the previous chapters, here is a graphic representation of *potentiality*.¹³⁵

Nation	Population	Mineral Resources	Agriculture	Energy Reserves	Ocean Access	Potentiality
Russia	-	+	+	+	+	+
Canada	0	+	+	+	+	+

Legend: (-) is a negative trend, (0) is a neutral trend, and (+) is a positive trend

¹³⁴ The idea for this framework analysis is inspired from the ideas presented in the publication: Libicki Martin C., Shatz Howard J., Taylor Julie E., "Global Demographic Change and Its Implications for Military Power", 2011, The Rand Corporation, http://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1091.pdf, 24JAN2012, p 5

¹³⁵ Potentiality = {population + mineral resources + agriculture + energy reserves + ocean access

Recall, the purpose of this heuristic device is to suggest levels of potential as defined in terms of latent resources. The key ingredient lacking for both Canada and Russia is population – the easiest variable to manipulate, but also the most complicated. Changes to immigration and naturalization laws, and pro-family government policies both have the potential to rapidly change demographics. For immigration laws, the difficulty in acceptance and integration of those immigrants by the native population is the hard part to overcome.

For Russia, this is a particularly thorny issue. Besides declining birthrates, and premature deaths, by 2050, “Russia’s Muslim population could double to reach 30 percent of the total.”¹³⁶ Russia has not done a good job of integrating minorities. Russia typically boasts many more emigrants than immigrants but a carefully crafted centralized effort could change that. Compounding the population problem are Russia’s health care and environmental issues. Given Russia’s large land mass, vast latent potential resources, and the benefit of being likely to gain from increased temperatures, it is well situated to potentially see sizable relative gains vis-à-vis the rest of the world in the coming century. For Russia, as climate change results in temperature, precipitation, and meridional circulation changes to its ecosystems it must position itself to take advantage of the benefits.

Current demographic trends notwithstanding, Russia is poised to ascend the hegemonic altar once again if it can effectively manage the second chance it seems to have been given by Mother Nature. If it can harness its potentiality and modernize its military, then it seems MacKinder’s thesis of the pivot point has some new life in the new century.

¹³⁶ Libicki Martin C., Shatz Howard J., Taylor Julie E., “Global Demographic Change and Its Implications for Military Power”, 2011, The Rand Corporation, http://www.rand.org/content/dam/rand/pubs/monographs/2011/RAND_MG1091.pdf, 24JAN2012, p xvii

The world's population is increasingly concentrated along the littoral regions – and Canada is no different. Growing population, rising property values and continued investment increase coastal vulnerability. Storm surge, increased coastal storms and rising sea levels all increase the risk. Transportation infrastructure is also at risk, as current port facilities, rail and road networks and low-lying airfields may be inundated and rendered unusable. Clean up costs may also become exorbitant to clear away storm debris. “Any increase in destructiveness of coastal storms is very likely to lead to dramatic increases in losses from severe weather and storm surge, with the losses exacerbated by sea-level rise.”¹³⁷ The impacts of rising sea levels may have a disproportionately greater impact on Canada than on Russia. It is possible that much more of Canada's population and high-value real estate is at risk as sea-levels rise given relative population distribution.

Canadian climate has been largely too inhospitable for larger populations in its interior and northernmost latitudes. With the changes to meridional flow and more temperate weather creeping northward, this could change. Canada shares similar ideals to those espoused by America, yet has had its own difficulties with integration. The Quebec secessionist movement is the prime example. Canadian history is replete with examples of rapid advancement at the cost of environmental degradation. The history of acid rain and water pollution from strip mining has negatively impacted large segments of the Canadian environment. While unlike Russia, Canada has not had any nuclear

¹³⁷ IPCC, 2007: Climate Change 2007: Impacts, Adaptation And Vulnerability. Contribution Of Working Group Ii To The Fourth Assessment Report Of The Intergovernmental Panel On Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. Van Der Linden And C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, p55-57

mishaps, it has had serious environmental issues with the extraction of the oil sands in Alberta.

The Canadian military has a storied history of involvement in the world. Its expeditions have been in fulfillment of treaty obligations and in support of peace keeping and peace enforcement operations. Canada has neither deployed troops in an aggressive manner, nor used its military to enforce territorial disputes. Canada has benefited from the protective umbrella of the United States and the Pax Americana distributed across North America. While not likely in the near term, there remains a possibility of closer Russian and Canadian cooperation. The distance between the two nations across the Arctic is relatively short and both are in ostensible control of the majority of the land within the Arctic Circle. Both nations are in control of the two viable ocean passages across the Arctic and both have a vested interest in encouraging increased traffic, tourism and energy exploration in the region.

Depending on how Canada plays power politics, it is in the realm of the possible that the two Arctic neighbors will seek to balance American hegemony by checking its influence in the Arctic. Canada and Russia could do so without a direct military confrontation with the United States, instead leveraging international institutions to regulate Arctic access and exploitation rights. It is possible that the two nations may collude to confound American influence in the Arctic – especially if America continues to wait on the sidelines without taking the necessary actions required to be a player in the Arctic.

So, what is the United States to do in reaction to Russian and Canadian potentiality?

At the strategic level our recent pivot to Asia might be myopic – a resurgent Russia seems to present grave dangers to our national

security. Historically, China has not been a global peddler of power projection. Even when China was in an advantageous position, it sought greater domestic harmony rather than international dominance.¹³⁸ Should China pursue a similar approach to international relations in the future, an American “Pacific First” focus might prove to be a stumbling block to building Arctic capacity. We are not blessed with unlimited resources, and hard choices must be made regarding priorities and focus. Our national levels of diplomacy, information, military force, and economic development only reach so far, and are not omnipotent. An Arctic first focus must be our security policy.

The Bering Strait is rapidly becoming a strategic choke-point on par with the Straits of Gibraltar, Hormuz, and the Bosphorus. An ad hoc approach to the impending explosion of activity in the Arctic is a recipe for disaster. America should continue to develop enduring ties with Canada and ensure relations are favorable to sharing in Canada’s vast potential mineral and agricultural resources. Canada could greatly gain from this relationship as well – tapping into America’s demographic strength to fuel an economic boon. The United States should also seek close cooperation ties with Russia, simultaneously working through liberal institutions, while maintaining potent military strength - a strength significantly lacking in America’s Arctic ability. American leadership – when it has chosen to lead – has been invaluable to peace and prosperity in the world. Given America’s current military and economic dominance, an abdication of its role in the Arctic would be misinformed. America should show a similar spirit toward Arctic issues as it did to Antarctic discovery, exploration, and treaties codifying international cooperation. America’s diplomatic posture should recognize the importance of the Arctic and seek cooperation from like-minded nations to ensure that our interests are represented. An absence

¹³⁸ Henry Kissinger, *On China*, New York: Penguin Press HC, The, 2011

of American presence in the Arctic dialog will be filled by someone, and if we are not in the kitchen helping to prepare the meal, we lose the ability to complain about the dishes served at the table.

Operationally, America's military approach to the Arctic lies most effectively with NORTHCOM and EUCOM. Homeland defense extends to the North Pole and Russian intent, ability and posture should be EUCOM's main focus. Both combatant commanders should seek bi-lateral and multi-lateral military exercises in the Arctic to refine tactics and research operational needs which they can then pass to the specific services for development. NORTHCOM must include the Coast Guard in these exercises – as both a coastal police force and as a military service. The Arctic paradigm does not fit our other neatly conceived operations in gray and blue waters. The Arctic presents unique challenges to the warfighter, and these must be understood and accounted for in planning and force development.

At the tactical level, all branches should take a cue from the Coast Guard, which has been making adjustments, and just recently hosted a conference on the Arctic at the Coast Guard Academy. They have increased their activity in response to all of the increased traffic through the Bering Sea, but lack the necessary tools to provide a robust presence. The Army should ensure it has an adequately trained and equipped Arctic Brigade – not necessarily stationed in Alaska, but one conditioned to the cold and specifically trained for survival and operations in austere Arctic environs. Additionally, the Army must start exploring operations on the tundra. Permafrost may not support maneuvers by Abrams tanks and Bradley fighting vehicles. Ground lines of communication (GLOCs) will be difficult to maintain and ground maneuver will be difficult during the summer months when the land has thawed. Additionally, the harsh weather will continue to tax the endurance of both Soldier and equipment. Again, an Arctic warm

enough to melt sea ice does not equate with tropical paradise. The Arctic environment will remain cold and inhospitable for the foreseeable future. The change will come from the increased economic traffic – the lure of black bullion. The military must be prepared to defend the global commons to keep commerce flowing.

In this regard, seafaring forces play a pertinent role. Both the Navy and the Coast Guard must plan and coordinate, clearly delineating responsibilities and smartly building important capability. Significant challenges remain in the area of communications and operations in the harsh climate of the Arctic Sea. The Navy must revive some of its Cold War northern latitude operational plans. A whole new sea seems to be opening which will need to be patrolled, defended and explored. The reality of an ‘ice-free’ Arctic does not mean a tropical bathtub at the North Pole. There will still be sea ice, and likely some ice-breaking required. The difference is in the amount required. Air Sea Battle has been a hot topic recently. Unfortunately, the focus on anti-access/area denial missions does not suit the requirements for Arctic operations.

There is almost always an opportunity cost involved in strategic decisions. The choice to pivot to Asia precludes military development of Arctic warfare necessities. If the Navy is concerned with carrier operations off the coast of Taiwan, it is not focused on navigational and ship borne operations in the Arctic. If PACOM is the focus and deploying Marines to Australia is the shiny object at the moment, then closer ties with Iceland are not. There is a limit to our national leaders’ attention and focus – and there is a limit to the skills that our armed forces are capable of honing. The current economic conditions have highlighted these limitations since difficult decisions will be required about the way ahead for military forces.

The Navy and Air Force are closely tied in this respect since both require incredibly long-lead times for research, development and fielding of new weapon systems. While the F-22 is the world's premier penetration aircraft, it might not be suitable for circumpolar patrol operations. In this respect, the Air Force must plan and consider the forces necessary to patrol the northern latitudes, considering the unique operational characteristics. Significant, long-term problems exist with regards to sustained polar operations. GPS does not function well in the Arctic, and so new or additional navigational assets must be deployed. Pilots must also be trained to operate in this area. Air fields or bases must be developed to support operations in the Arctic. This is difficult given the austere conditions which exist in the polar latitudes.

Additionally, freezing conditions wreak havoc with ground support operations required to keep planes maintained and airborne. Freeze/thaw cycles with the permafrost significantly increase the engineering challenges required to build and maintain airfields in the locations required to support patrols and force projection to the North Pole region. Increases in civilian and military traffic necessitate the presence of Arctic airpower, and the need for the Air Force to close the gap created by the melting of the ice. These decisions are not without risk. They require a focus away from another area or effort. The argument here is not that those other areas are not important – it is that with the reality of climate change, the Arctic is *more* important.

Finally, in the area of research and technology, the United States must take the lead in fostering solutions to climate change challenges, and technological breakthroughs to seize opportunities as they arise. The best thing for the United States to do is set the conditions for private enterprise to thrive by supporting those entities involved in renewable resources. There are myriad possibilities. Oil companies and agriculture have long been the beneficiaries of favorable government policy and tax-

structure. Resetting this schema to support new technology could result in similar success for these fields as was seen by the oil and agriculture industries over the past century. Possibilities abound in the areas of solar, wind, and geothermal power. Getting off the oil standard – a goal of every president since Jimmy Carter – would be a critical first step. In a similar way that President Kennedy sent the nation to the moon, the United States could harness American ingenuity to reach this goal. Technologies of desalination, hydroponics, and distributed agriculture (modern victory gardens) could easily meet the national nutritional needs as the “bread basket” of the Midwest morphs as temperatures and precipitation patterns shift. Permafrost engineering solutions, space solutions for the Arctic, naval, air and land forces capable of Arctic operations. Given the long lead times for construction, development, and budgeting the United States needs to act now to secure its future.

Change is coming – the first step, as with most difficulties – is the simple act of acceptance.

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