



Original research article

Identification of development areas in a warming Arctic with respect to natural resources, transportation, protected areas, and geography



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ARTICLE INFO

Article history:

Received 10 September 2015

Received in revised form 8 October 2016

Accepted 16 November 2016

Available online 17 November 2016

Keywords:

Global warming

Natural resources

Long-range planning

Shipping routes

Overlay maps

High north

ABSTRACT

Global warming will cause changes in the Arctic and the sub-Arctic in the 21st century. This paper presents maps of natural resources, transportation, protected areas, and geography in the Arctic. The overlay method is used to study where resources and limiting factors overlap to identify development areas that might open up with a warming climate. The novelty of this study lies in the new overlay maps and their interpretation in combination with megapatterns in spatial trends to reveal areas that are likely to develop in the Arctic in the future (around the year 2100) given a warming climate. The analysis is intended to help strategic long-range planning and policy making on large geographic scales in order to prepare for growing development pressures.

The results show the Barents Sea region has the most growth potential, followed by the Beaufort Sea and Kara Sea. The Barents Sea draws activities due to abundant natural resources, location in relation to the Northern Sea Route, geographical conditions, and existing infrastructure. The other areas have more limiting factors. Within the North Atlantic, the east and west Coasts of Greenland have the most opportunities, especially in terms of oil/gas extraction and future fishing grounds, but they are vulnerable to ecological change and pollution.

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1. Introduction

Climate change has caused the Arctic to become a focal point for future developments on a global scale (ACIA, 2005). The warming climate is opening opportunities that were previously unavailable or too expensive to exploit (Lindholt, 2006). There is uncertainty about development in the Arctic in terms of international rights and many countries are staking claims to the international areas in the Arctic Ocean (IBRU, 2013). Many countries that are not adjacent to the Arctic Ocean have expressed interest in participating in projects in the region (Arctic Council, 2014). A great deal of work and research is being done regarding the Arctic in fields such as ecology, environmental protection, anthropology, resource utilization, sea ice, and Arctic shipping (ACIA, 2005; Arctic Council, 2011; Arctic Portal, 2014). Most studies on the Arctic have focused on specific

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aspects, for example, vegetation (CAFF, 2012), the rights of indigenous people (Nuttall, 2005), and oil and gas reserves (USGS, 2008). However, there is a lack of a comprehensive, overall view of how the area might develop.

The Arctic Region is most commonly defined as the area that lies north of 66° 33'N (NSIDC, 2013), although other definitions are sometimes used such as the area where the mean temperature in July is under 10 °C (NSIDC, 2013), or the area defined by the tundra belt (NSIDC, 2013).

Eight countries have land within the Arctic, that is, bounded by 66°33'N: Canada, Russia, Greenland (Denmark), the United States, Norway, Sweden, Finland and Iceland, as shown in Fig. 1. The Arctic Council is a joint governmental project of these eight Arctic countries (Arctic Council, 2011). Each of the countries, except Finland and Sweden, has control of a 200 nautical mile Exclusive Economic Zone (EEZ) that stretches from the coast into the Arctic Ocean (OECD, 2003). The areas that lie outside the EEZs are defined as international waters. However, some of the Arctic countries have made claims to the ocean floor outside their EEZ based on the sector principle and their long history of activity in the area (IBRU, 2013). There are three major international sea zones in the Arctic. Disputes have risen among the countries about zones that lie on the borders of their EEZs (IBRU, 2013). In summary, territorial disagreements in the Arctic are primarily claims to international waters or boundary issues.

One of the main issues regarding the Arctic is climate change. Although the warming climate is a global issue, the Arctic is more vulnerable to warming because of the long summer days and diminished reflection of solar rays as the area covered by ice decreases (ACIA, 2005). The warming weather and melting sea ice threatens the Arctic ecosystem and simultaneously unleashes opportunities and generates new threats (ACIA, 2005). Nations are now looking at new navigation routes and possibilities in oil and gas extraction in areas that were previously out of reach or too expensive for harvesting (Lindholt, 2006).

ACIA 2005 predicts the temperature in the Arctic will rise on the average by 4–7 °C by 2100. The fifth IPCC assessment report reiterates a conclusion reached in the previous reports that climate change due to human activities will have a huge impact globally in the 21st century (IPCC, 2013). In summary, the IPCC report predicts the following for the Northern Hemisphere (high and low values depend on climate model and are for the end of the 21st century):

- The Arctic will warm more rapidly than the global average, which is expected to be 0.3 °C–4.8 °C.
- The reduction of the yearly minimum (in September) Arctic sea ice extent will be 43%–94%; the reduction of the yearly maximum (in February) sea ice extent will be 8%–34%.
- The spring snow cover is predicted to diminish by 7%–25%.
- The surface of permafrost is predicted to diminish by 37%–81%.

Legend

- North Pole
- EEZ
- The Arctic Circle
- Canada
- Denmark
- Finland
- Iceland
- Norway
- Russia
- Sweden
- United States of America
- Ocean



Fig. 1. The Arctic and exclusive economic zones (EEZ) of the bordering nations.

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