Achieving Synergy in the Russian Arctic: a Programme-Objective Approach

N I Didenko¹ and A Sheykina²
¹Peter the Great St. Petersburg Polytechnic University, Polytechnicheskaya, 29, 195251, St. Petersburg, Russian Federation
²University of Regensburg, Universitätsstraße 31, 93053 Regensburg, Germany
¹E-mail corresponding author: didenko.nikolay@mail.ru

Abstract. The sustainable development of Russian Arctic requires new approaches to the planning and organisation of government initiatives. In this article, we discuss the Arctic region in terms of a system of interconnected elements (subareas), each having its specific development goals and features. The subareas of the Russian Arctic are classified into 7 types according their characteristics. A synergistic basis for sustainable development is formed by the combination of subareas’ development goals into a comprehensive programme using a programme-objective method. A development programme for the Arctic subareas based on a tree structure is advanced and possible development goals identified. It is concluded that a synergistic effect can be created by connecting Arctic subareas with each other in order to facilitate mutually beneficial interaction. A classification of the Arctic region according to its analytical decomposition in accordance with its specific functions and features is proposed.

Keywords: Arctic regions, sustainable development, Russian Arctic, Arctic subareas

1. Introduction
In the present global context, issues associated with the development of the Arctic region are becoming increasingly important. In particular, shrinking polar ice has resulted in accessible shipping routes and the increased availability of large quantities of natural resources. Among other circumpolar countries, Russia understands the significance of Arctic projects at the same time as thoroughly considering risks associated with climate change and the intensification of human activities in region. The primary goals of the Arctic policy declared by the state include the well-balanced, sustainable, comprehensive development of the Russian Arctic, leading for the common good of its people, the efficient exploration of resources, win-win international cooperation and national security.

Considering the abovementioned strategic priorities, it is important to design a coherent development programme for all the federal Arctic subjects in order to ensure collaboration between them. At present, each of the Russian Arctic regions (i.e. Murmansk Oblast, Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Chukotka Autonomous Okrug, parts of Arkhangelsk Oblast, Komi Republic and Krasnoyarsk Krai) has separate development programmes, resulting in difficulties in terms of cooperation. Here, it should be emphasised that some of the state social and economic initiatives overlap, intersect and supplement each other. The main problem, then, consists in
developing connections between Arctic subjects and federal authorities in order to ensure clear and accurate management of Arctic projects, avoiding excessive bureaucracy, reducing administrative costs, ensuring effective monitoring and, above all, achieving synergistic effects.

The primary aim of this article is thus to present the Russian Arctic not as a single complex object bounded by an administrative framework but rather in functional terms as a system of subareas. Subareas (in this case, Arctic subareas) are considered as a part of the Arctic having special attributes (characteristics), functions and development goals. Types of subareas and their basic features are described in the following parts of the article. At the same time, it is stressed that it is in the combination of development programmes linked to specific subareas that a synergistic effect necessary to ensure the harmonised and sustainable development of Russian Arctic is most likely to be achieved.

Before proceeding to the description of methods used in this study, we shall define what is meant by a synergistic effect in the context of Arctic development. Synergy is generally assumed to arise from the interaction between several agents such that the combined effect of such interaction is greater than the sum of their individual effects [1], [2]. Thus, for example, a synergistic effect may appear as a result of integration (combination and cooperation) of Arctic subareas, which is possible due to the implementation of comprehensive development programme. The synergistic effect of subarea cooperation as result of a comprehensive development programme can present itself in different spheres, as discussed below in the Results section.

The object of analysis is the Russian Arctic, while the subject of analysis is the system of Arctic subareas. The aim of the study is to develop a mechanism for obtaining the necessary synergies to ensure the coordinated and sustainable development of the Russian Arctic.

2. Methods

Approaches used in this study can be combined into two main groups according to the core issue. In the first place, our aim is to analyse how and where a synergistic effect arises; in other words, it is necessary to observe the formations which produce such effect. This brings us to the necessity of implementing a network approach. The implication here is that, in order to generate a synergistic effect of mutually beneficial interaction, Arctic subareas should be linked with each other.

The relevance of networking is widely discussed in the literature. It is generally understood that networking comprises an important tool for ensuring regional economic growth [3], [4], [5]. Positive effects due to network interactions can be considered in synergistic terms.

Economists widely agree that networks (for example, business clusters) improve business productivity, increase innovative capacities, boost national competitiveness and lead to the creation of new firms [2], [6]. As such, networks embedded in local social systems attract specialised services in regions [7], favour knowledge creation and innovation, imply lower transaction and adjustment costs, promote the development of new competencies [8],[9] provide access to international markets, create knowledge [10],[11] and foster learning and knowledge exchange [12-16].

For this reason, particular attention should be paid to successful cluster and network initiatives in different countries as part of their economic and industrial policy. Case studies of cluster policies and international experience of regional development [3],[7],[17],[18],[19] should be considered in the planning and management of the Arctic project.

Although much has been said and written about the form and function of business networks (e.g. clusters, industrial districts, etc.), which are considered as triggers – or drivers – of economic growth, the question of how to build linkages between regional actors still remains unclear. When the focus is placed on a more general or macro (e.g. state) level, however, the network effect can be seen not only in linkages between business actors, but also between more complicated systems such as Arctic subareas. Here, the core idea here remains the same as in traditional cluster and business network theories – synergies form through linkages – but attention is shifted to the higher level of aggregation to consider subareas as network elements.

This brings us to the second issue of how to build linkages between Arctic subareas in order to create a comprehensive development programme for Arctic regions taking different subarea types into
consideration. In this connection, we will turn to programme-objective method of planning and organisation.

The programme-objective approach uses tools and methods of graph theory in a tree-based structure to illustrate the decomposition of a major goal (see Results section). In other words, a general goal is first defined and then broken down to several mid-level goals and tasks.

The result of the implementation of a programme-objective approach takes the form of a targeted programme. According to Russian legislation (see Russian Government Decree N594 26.06.1995), a federal targeted programme:

1) is used as a tool to solve comprehensive state problems (social, economic, cultural development of the Russian Federation);
2) comprises a well-defined complex of social, economic, R&D, administrative and other measures, activities and actions;
3) must have a timeframe and a list of matched actors and executives;
4) contains a task list.

In general, federal targeted programmes, which are widely used by Russian government to address state issues, have a focused, task-oriented nature. In our study, we implement a programme-objective approach to generate a specific Arctic development programme to be used in combination with the abovementioned subarea concept. From our point of view, a targeted programme can be used as an instrument to create connections between subareas and construct an Arctic networking model.

3. Results

Seven Arctic subarea types are distinguished. This classification represents our own opinion on the possible analytical decomposition of Arctic region according its specific functions and features.

1) Basic towns – urban areas having various infrastructure, buildings & constructions and a population at least 1000 people. Basic towns serve as production and transportation nodes, sites of local administration, business, culture and education. They present the main points of Arctic development and centres of attraction for business and population. E.g.: Norilsk, Pevek, Murmansk, Tiksi, etc.

2) Fly-in, fly-out portable settlements. Such settlements are useful for development and research needs: severe Arctic conditions often make it difficult or ineffective to build a permanent infrastructure. Typically, these settlements are located near mineral and fossil fuels fields and extraction facilities. This subarea type is project-focused and often has more or less homogeneous professional worker structure (e.g. oil & gas specialists). E.g.: Settlement near Shtokman field and Teriberka rural area.

3) Mineral and fossil fuels fields. These subareas include not only the mineral deposits or other fields, but also all the associated extraction facilities and constructions. E.g.: Kupol, Norilsk 1, Mayskoe.

4) Recreation areas and tourist attractions. These territories include such places of cultural, ecological and tourist interest as wildlife reservations, parks, conservation areas, places for ecotourism and other tourist attractions. These subareas function not only as tourist attractions but also serve for environment protection and wildlife conservation. E.g.: national park Beringia (Chukotka).

5) Fishing and reindeer farming areas. These subareas are formed by aquatic resources and reindeer livestock, as well as fishing and farming facilities and constructions. E.g.: Murmansk Oblast fisheries, Yamalo-Nenets reindeer farms.

6) The Northern Sea Route (NSR), which comprises a shipping lane located within the Russian Exclusive Economic Zone (EEZ), runs along the Arctic coast. Although, according to Russian Federal Law N132, the NSR runs from the Kara Sea to the Bering Strait, we propose to additionally include the Barents Sea in this subarea. This subarea also contains all Arctic port, shipping, maritime, navigation and customs facilities.

7) Civil protection sites (safety & security infrastructure areas) – system of civil protection and relevant infrastructure form this subarea (military complexes, bases, training grounds, military and civilian satellites, rescue stations and services, etc.).
It is important to emphasise that the mentioned subareas are not contained within the borders of a single Arctic region; rather, subareas represent a cross-border (in terms of regional, internal borders) formation. Subareas also can include facilities and members from different territories (an obvious example is the Northern Sea Route, which runs all along the Arctic coast).

We also note that difficulties of cooperation between local authorities leading to failed attempts to coordinate between different regional development initiatives can hinder the successful realisation of the Arctic project. In such circumstances, it is possible that a functional, subarea approach could be more effectively used to analyse the development of Russian Arctic territories than administrative frameworks.

It is understood that the attempt to form a unified comprehensive development programme in place of multiplying and intersecting initiatives may be seen as an oversimplification. However, at the same time, concentrating resources on a unified general aim can permit the design of clear state coordination and management tools, allowing greater effectiveness to be achieved through an efficient control mechanism.

In order to achieve synergies, the above subareas should be linked through comprehensive targeted programme. This programme should be formed on the basis of the connectivity of specific goals (each subarea type has its own development goals according to its features and functions; see Figure 1 below for a general view and Figure 2 for a detailed description of the 2nd and 3rd level goals of the comprehensive development programme of the Arctic subareas).

**Figure 1.** Tree-based structure of the Arctic subareas’ comprehensive development programme (targeted programme).

Before proceeding to the concept of goal decomposition, we should emphasise that in this article we present only the concept of such a programme, its main idea and core tree-based structure. In other words, we describe the fundamental basis of the proposed comprehensive development programme of the Arctic subareas (considered in terms of a targeted programme). However, we emphasise that this
programme is only a theoretical, analytical example of a proposed tool for the creation of synergy in the Russian Arctic.

| Subarea | Element | 1st level goal | 2nd level goal | 3rd level goal |
|---------|---------|----------------|----------------|----------------|
| Basic towns | infrastructure (ecology) | To increase synergies in socio-economic development of towns by 5% in the year T | To create X infrastructure buildings & constructions by the year T | To create X infrastructure buildings & constructions by the year T |
| | environment | | | |
| | living conditions; | | | |
| | education; | | | |
| | business environment; | | | |
| Fly-in fly-out portable settlements | labor force; | | | |
| | infrastructure; | | | |
| | living conditions; | | | |
| | mining; | | | |
| | machinery and equipment; | | | |
| | environment; | | | |
| Mineral and fossil fuels | | | | |
| | new mineral and oil deposits; | | | |
| | extraction volume; | | | |
| | investments; | | | |
| | machinery and equipment; | | | |
| | environment (ecology); | | | |
| Recreation areas and tourist attractions | environment (ecology); | | | |
| | infrastructure; | | | |
| | tourism; | | | |
| Fishing and reindeer farming areas | | | | |
| | new fishing & reindeer farming areas; | | | |
| | marine catch volume & reindeer livestock; | | | |
| | investments; | | | |
| | machinery and equipment; | | | |
| | environment (ecology); | | | |
| The Northern Sea Route | infrastructure; | | | |
| | icebreakers assistance; | | | |
| | environment (ecology); | | | |
| | machinery and equipment; | | | |
| Civil protection sites (uninhabited areas) | machinery and equipment; | | | |
| | shipping security; | | | |
| | environmental security; | | | |
| | defense, safety & security; | | | |

Figure 2. 2nd and 3rd level goals of the comprehensive development programme of the Russian Arctic subareas.

We will now briefly consider the principle of goal decomposition connected with a tree-based approach (as illustrated in Figure 1). Since our fundamental goal is to organise the programme-objective management of the development of the Russian Arctic using the comprehensive development programme to achieve synergy, the next steps will be:

1) to decompose this 1st level goal to subarea-level (2nd) aims according to subarea type;
2) to further decompose 2nd level goals according to the elements of development programme for each subarea (see Figure 2).
3) It should be noted that elements determining 3rd level goals are derived from specific subarea functions and features.

Due to the nature of the proposed approach, a separate development programme should be designed for each of the Arctic subarea types. In other words, 2nd level goals represent the main goals for each subarea programme. These seven programmes (or subprogrammes) are united into unified comprehensive Arctic subarea development programme, i.e. a targeted programme (see Figure 1). An integrated public administration approach is implemented in order to realise this comprehensive development programme, i.e. a single mechanism of coordinated work according to the united subprogrammes of the seven Russian Arctic subareas.

As we have indicated, third-level goals are connected with fundamental elements of Arctic subareas. In Figure 2, we have generally described principal aims that can be defined for each Arctic subarea; however, we note that this shortlist can be extended. Additionally, for government purposes it is important to evaluate the exact value of X% and determine the deadline (year T) for each aim.

We now move to the last level of the tree-structured comprehensive programme formed by the complex of targeted measures, actions and events. The list of the main actions and measures will not be described here; however, we emphasise that the successful fulfilment of these events leads to the achievement of the third-level goals, which, in turn, results in the accomplishment of second-level aims. In Figure 1, although the 4th level actions are not connected by arrows with the 3rd level goals for ease of comprehension, they are logically linked with them.

It has been emphasised that the comprehensive development programme of the Arctic subareas should unite seven subareas’ development goals to serve as a basis for synergy. We have considered the Arctic region in terms of as a complex of subareas each having its features and different development goals. The development goals of the subareas (2nd level goals in the tree-based comprehensive development programme, see Figure 1) form a basis of development subprogrammes. These subprogrammes should not be presented as isolated incentives, since, in this case, the concept of synergy would be affected; on the contrary, it is the common implementation mechanism, coordinated management and interconnected complex of actions and events that comprise the 4th level of the programme that should be the drivers of synergy. To put our description in another form, the comprehensive development programme should be based on the principle of differentiation of the subarea types and assignment of specific development goals according to their functions (features).

4. Discussion

All the above-mentioned goals have been defined according to the key development priorities of the Russian Arctic as stated in Russian Strategy of the Development of the Arctic Zone and the Provision of National Security until 2020 (adopted by the President of the Russian Federation on February 8, 2013, No. Pr-232):

1) comprehensive socio-economic development of the Russian Arctic;
2) science and technology development;
3) creation of modern telecommunications;
4) environmental security & protection;
5) international cooperation in Arctic;
6) provision of national defence, security & safety.

We accept that the point about international cooperation has not been represented in the concept of targeted programme (referred to as the comprehensive development programme of the Arctic subareas) described above. The main reason for this is the focus placed on internal, regional development; as such, international cooperation is considered to have a positive impact on almost all of the subareas’ development goals [20],[21],[22],[23]. Similarly, effective and competitive science and technology should underlie in every aspect of subareas’ development. In other words, these two priorities are not segregated into individual goals, since it is assumed that these points should be considered as fundamental for government initiatives in Arctic.

Another important principle of the proposed approach can be defined in terms of the fundamental role of basic towns in the Arctic development project. Basic towns (such as Anadyr, Norilsk, Pevek, Severomorsk, etc) become the cores, drivers and engines of local socioeconomic growth, as well as
serving as points of attraction for the labour force, foreign and national investments, business, tourists, etc. [24],[25] Port towns and cities should be transformed into competitive transportation hubs [26],[27],[28] closely linked with a system of oil & gas shipping and stocking, as well as providing a variety of services. Basic towns additionally represent centres of culture and education [29],[30], preparing well-qualified Arctic specialists for the needs of local development.

One more point to be discussed is the theoretical example of synergistic effects that can appear due to subarea interconnection. As has been already stated, synergies can be generated on the basis of comprehensive development programme that serve to connect subareas goals and resources [31],[32].

Synergistic effects can be classified according to the sources of their generation, e.g.:
1) Synergistic effect in industry as result of common industrial infrastructure of subareas (can show itself as cost reduction and increase in revenues);
2) Synergistic effect in transportation as result of common transport infrastructure (consequently enabling cost reductions);
3) Synergistic effect in finance (common financing sources and their differentiation);
4) Synergistic effect in science and innovations (generation of common and interconnected scientific community, facilitation of knowledge exchange, fostering of innovation implementation);
5) Synergistic effect in human resources (creation of Arctic competence and education centres providing specialists for all Arctic region).

The development of the Russian Arctic is undoubtedly a strategic and ambitious project that requires cooperation and coordination between all administrative initiatives. Obviously, almost every human activity in Arctic is hampered by extreme weather conditions; moreover, the consequences of climate change in the context of a fragile environment requires a cautious and balanced Arctic policy. In this situation, it is necessary to operate in a coherent manner; therefore, government measures and actions should be linked into a unified system in order to achieve regional growth and sustainable development.

5. Conclusion

In our study we consider Russian Arctic as a specific area composed of different subareas interacting with each other. For the purposes of generating synergies, this interaction can be fostered and targeted with government initiatives. Here we come to our conclusions:

− An Arctic subarea comprises a part of the Arctic region that has special attributes (characteristics), functions and development goals. Thus, Arctic subareas do not correspond with the federal subjects of the Russian Arctic (Murmansk Oblast, Nenets Autonomous Okrug, etc.).
− We distinguish 7 types of Arctic subareas: basic towns, fly-in fly-out portable settlements, mineral and fossil fuels fields, recreation areas and tourist attractions, fishing and reindeer farming areas, the Northern Sea Route (NSR), civil protection sites (safety & security infrastructure areas). Each subarea type has its own features, functions and development goals.
− Arctic subareas can be considered as separate elements of the Russian Arctic system; however, their interconnection and cooperation through a unified common comprehensive development programme form the basis for synergy.
− The subarea approach can be used to overcome administrative barriers when implementing different regional initiatives (due to the strategic significance of Arctic regions and complexity of Arctic project, although local authorities can realise specific events and actions, the programme management and organisation, including monitoring and planning, should be carried out at the federal level).

We propose a concept of the Russian Arctic comprehensive development programme (targeted programme for Arctic subareas) that has a tree-based structure.
− Development goals of Arctic subareas can be transformed into subprogrammes and connected into a general comprehensive development programme.
− The comprehensive development programme should be based on the principle of the differentiation of subarea types and the assignment of development goals according to their specific functions (features).
In the context of the comprehensive development programme, the connection of subarea goals and subprogrammes should foster synergy through a unified approach to planning, management and monitoring.

Although it is yet to be seen whether the outlined approach would be superior to the existing approach based on various federal targeted programmes and local initiatives, the subarea approach to analysing the Russian Arctic as a unified, coherent system provides a potentially useful viewpoint from which to consider development approaches.

6. Acknowledgments
The paper is based on research carried out with the financial support of the grant of the Russian Foundation for Basic Research (RFBR, Project No. 19-29-07131 "Modelling and measurement of human capital and its forms in the context of economy digitalization: resources, flows, institutions«). University of Tyumen.

References
[1] Ansoff H I Corporate strategy 1965 (New York: McGraw-Hill)
[2] Porter M E 1985 Competitive advantage: Creating and sustaining superior performance (New York: The Free Press)
[3] Callaghan B A O and Lenihan H 2008 Entrep Reg. Dev. 20 pp 561–580
[4] Huggins R and Thompson P 2013 A network-based view of regional growth J. Econ. Geogr. 14 pp 511–545
[5] Didenko N I, Kulik S V, Kikkas X N and Kudriavtceva R E A 2018 Models of the impact the global crisis has on the world economy Int. Multidisciplinary Scientific GeoConf. Surveying Geology and Mining Ecology Management 18(5.3) pp 585-592
[6] Porter M E 1998 On competition (Boston: Harvard Business School Press)
[7] Rosenfeld S A 1997 Bringing business clusters into the mainstream of economic development Eur. Plan. Stud. 5 pp 3–23
[8] Cappellin R and Wink R 2009 International knowledge and innovation networks: knowledge creation and innovation in medium-technology clusters (Cheltenham: Edward Elgar Publishing)
[9] Afonichkina E A and Afonichkin A I 2018 Synergies of the Economic Development of the Arctic Cluster System IOP Conf. Series: Earth and Environmental Science (Institute of Phys. Publishing Press) 180(1) 012011
[10] Ketels C H M and Memedovic O 2008 From clusters to cluster-based economic development Int. J. of Technological Learning Innovation and Development 1(3) p 375
[11] Didenko N I, Skripnuk D F, Mirolyubova O V, Sevashkin V and Samylovskaya E 2018 System of econometric equations of the world market of natural gas Int. Conf. on Information Networking pp 217-222
[12] Dore R 1983 Goodwill and the spirit of market capitalism Brit. J. Sociol. 34 pp 459–482
[13] Hamel G 1991 Competition for competence and interpartner learning within international strategic alliances Strategic Management J. 12 pp 83–103
[14] Podolny J. M and Page K L 1998 Network forms of organisation Annual Review of Sociology 24(1) pp 57–76
[15] Powell W 1990 Neither market nor hierarchy: network forms of organisation Res. Organ. Behav. 12 pp 295–336
[16] Uzzi B 1996 The sources and consequences of embeddedness for the economic performance of organisation: the network effect Am. Sociol. Rev. 61 p 674
[17] Andersson S, Evers N and Griot C 2013 Local and International Networks in Small Firm Internationalisation: Cases from the Rhône-Alpes Medical Technology Regional Cluster Entrepreneurship and Regional Development 25 pp 867–888
[18] Ketels C, Lindqvist G and Sölvell Ö 2013 The Cluster Initiative Greenbook 2.0 (Stockholm: Ivory Tower Publishers)

[19] OECD 2001 Innovative clusters: drivers of national innovation systems Enterprise, industry and services (OECD Publishing) p 420

[20] Didenko N I, Skripnuk D F and Mirolyubova O 2017 Modeling the changes in global temperature due to pollution Int. Multidisciplinary Scientific GeoConf. Surveying Geology and Mining Ecology Management 17(53) pp 577-586

[21] Konakhina N A 2018 Evaluation of Russian Arctic Foreign Trade Activity IOP Conf. Series: Earth and Environmental Science (Institute of Phys. Publishing Press) 180(1) 012018

[22] Gazisulina A Y, Mirolyubova O V, Konakhina N A, Grigorieva A A and Danilova S Y 2018 Problems of forming requirements to training of specialists for industrial and economic complex Int. Conf. on Reliability, Infocom Technologies and Optimisation: Trends and Future Directions (Amity Univ. Uttar Pradesh Noida INDIA/Publisher: IEEE) pp 196-198

[23] Silkina G 2019 From analogue to digital tools of business control: Succession and transformation IOP Conf. Series: Materials Science and Engineering 497(1) 012018

[24] Klochkov Y, Klochkova E, Kiyatkina E, Skripnuk D and Aydarov D 2018 Development of methods for business modeling Int. Conf. on Infocom Technologies and Unmanned Systems: Trends and Future Directions pp 366-369

[25] Popkova A, Kostko N and Skripnuk D 2017 The quality of social space mapping: The case of Tyumen, Russia Int. Multidisciplinary Scientific GeoConf. Surveying Geology and Mining Ecology Management 17(23) pp 753-760

[26] Skripnuk D, Kikkas K N, Safonova A S and Volodarskaya E B 2019 Comparison of international transport corridors in the Arctic based on the autoregressive distributed lag model IOP Conf. Series: Earth and Environmental Science (Institute of Phys. Publishing Press) 302(1) 01209

[27] Kikkas K 2018 Territorial-sectoral modelling of the automotive industry in the Russian Federation IOP Conf. Series: Earth and Environmental Science (Institute of Phys. Publishing Press) 180(1) 012015

[28] Kikkas K N, Cherenkov V I, Berezovskaya I P and Anosova N E 2019 The application of the ARCH model for the assessment of transport routes in Northern Europe and Southeast Asia IOP Conf. Series: Earth and Environmental Science (Institute of Phys. Publishing Press) 302(1) 012100

[29] Kireev K V, Ermakov V V, Kikkas K, Gasyuk D P and Rodionova U 2018 Mathematical modeling of Arc extinction process in devices with liquid-metal contact Int. Conf. on Infocom Technologies and Unmanned Systems: Trends and Future Directions (Amity Univ. Dubai U ARAB EMIRATES/Publisher: IEEE) pp 273-277

[30] Pogodaeva T V, Zhaparova D V, Rudenko D Y and Skripnuk D F 2015 Innovations and socio-economic development: Problems of the natural resources intensive Use regions Mediterranean J. of Social Sciences 6(1) pp 129-135

[31] Rudenko D and Skripnuk D 2016 Environmental Kuznets curve: The case of arctic Russian regions Int. Multidisciplinary Scientific GeoConf. Surveying Geology and Mining Ecology Management 3 pp 209-216

[32] Tallman R F, Roux M J and Fisk A 2012 Management of ecosystem effects, potential and realised, in emerging arctic fisheries in South Baffin Island (In: G H Kruse, H I Browman K L Cochrane, D Evans, G S Jamieson, P A Livingston, D Woodyby and C I Zhang (eds.), Global Progress in Ecosystem-Based Fisheries Management /Alaska Sea Grant Univ. of Alaska Fairbanks)