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International interdisciplinary Arctic research: Case study of the Russian Arctic biomonitoring mega-grant project

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Review Article

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Abstract

The Arctic region is commonly seen as a territory of international dialogue and cooperation. This perception is largely due to the science diplomacy efforts that are largely being contributed by universities, scientific centres, research teams and individual scholars. This paper discusses the Arctic science diplomacy initiatives proposed by Russia's northernmost federal university. Of particular interest is the case of establishing in the Arctic Zone of the Russian Federation of national biological monitoring network – the initiative supported by the government-funded mega-grant programme. Our analysis suggests that two pillars of science diplomacy – "science for diplomacy" and "diplomacy for science" – can be successfully combined within the framework of one project. Evidence is provided of the pursuit of national interests being not a limiting factor but rather a driver in the process of promoting diplomatic collaborations in science, serving as a third science diplomacy pillar. Significant progress towards ensuring peace and harmony in the Arctic and sustaining international dialogue on science-based responses to global challenges has been achieved through science diplomacy initiatives proposed by Northern (Arctic) Federal University (NArFU). The authors confirm that most effective tools for establishing good neighbourly relations in the Arctic and promoting international cooperation are offered by scientific discussion.

Introduction

The modern concept of science diplomacy appeared rather recently, linking two different spheres of human activity – science and diplomacy. While diplomacy can be roughly defined as the actions undertaken by government bodies in pursuit of national foreign policy, science, as a process devoid of political and ideological bias in its pure form, represents a tool for developing and systematising the objective knowledge and offers a universal language for raising questions as to the nature of things. Science diplomacy is underpinned by a dialectics that is rooted in its foundations.

The first influential attempt to provide the phenomenon of science diplomacy with theoretical grounding is articulated in the seminal report "*New Frontiers in Science Diplomacy: navigating the changing balance of power*" by the American Association for the Advancement of Science and the Royal Society of London (The Royal Society, 2010). This report has as one of its key deliverables the description of the three dimensions of science diplomacy – science in diplomacy, diplomacy for science and science for diplomacy.

Science represents a neutral platform for enabling non-political communications that can use diplomacy to achieve agreements and compromise solutions. Science diplomacy offers an effective tool for addressing global issues such as climate change, terrorism, pandemics and space exploration (Davis & Patman, 2015).

Science diplomacy has secured a solid reputation as an innovative tool capable of mitigating global conflicts and political tensions. Most contemporary researchers of science diplomacy are focusing on its peacekeeping component, referring to scientists' participation in international cooperation as benefitting the efforts to build and strengthen trust and relations between states that are parties to disputes or conflicts (Fedoroff, 2009; Krasnyak, 2018; Turekian & Neureiter, 2012).

Science and education have always played a crucial role in building humanitarian bridges between nations and constitute one of the major discourses in the field of international relations. In explicating the significance of their role for the Arctic Region, we refer to the findings of the recent survey of the body of official documents endorsed by the Arctic states and countries with observer status in the Arctic Council (Heininen, 2020). It has been found that the focus on science is increasingly seen among other overarching priorities of the Arctic development (economy/economic development, environmental protection, international cooperation,

security/sustainability) as a dominant trend and one of the most-quoted indicators (Heininen, 2020). Notably, for the nine Arctic Council observer states science and international cooperation stand as factors essential to their self-identification as Arctic stakeholders. From this perspective, Arctic research and international collaboration, which tend to be driven mostly by global challenges and climate change, have become crucial to the Arctic governance, requiring global action towards joint solutions for better sustainability in the Arctic.

Its nature being collaborative, Arctic science creates networks and opportunities for building bridges for joint initiatives. In the context of promoting science diplomacy in the Arctic, the enduring relationships and interactions between academics and researchers are of particular significance.

Arctic-related studies are being conducted at many universities and research centres worldwide. The University of the Arctic (UArctic), which is the world's largest international cooperative network with a mission to build the knowledge necessary for addressing the local and global challenges of the peoples of the Arctic, consists of more than 200 universities, research centres and other organisations active in education and research in the North. By expanding their research portfolios and promoting transnational networking and access to collaborative infrastructures and resources, UArctic members stay committed to their core mission of fostering the Arctic knowledge transfer. In this respect, science diplomacy and its constituents – networking, cross-border communication, shared use of databases and infrastructures, capacity building and academic mobility – are gaining ground in Arctic universities' international policies.

This paper presents a concrete empirical context showing science diplomacy in action. The authors analyse the case of a Russian university, the Northern Arctic Federal University (NArFU) and its diverse international engagements through the lens of science diplomacy and, broadly, from the perspectives of "science of diplomacy", "diplomacy for science" and commitment to international research partnerships (Gast, 2021).

In 2016, NArFU launched a project to develop methodological framework for the Russian Arctic national biomonitoring network. Ambitious as it sounded, the idea was supported by the Russian Government and its mega-grant programme (Mega-Grants, 2021), the latter seeking to create advanced research laboratories in a diverse range of scientific fields by attracting, among others, the world's leading scientists. The project's start in January 2017 was followed by signing, in May in Fairbanks, USA, of the Agreement on Enhancing International Arctic Scientific Cooperation (Agreement, 2017), which is seen by many as obviously one of the landmark achievements of the international dialogue (Berkman, Kullerud, Pope, Vylegzhanin, & Young, 2017) and Arctic science diplomacy. Now, four years later, as the said scientific mega-grant project is approaching its final stage, the Agreement is gaining even greater force.

Under the leadership of the Arctic Council Working Groups and Experts Groups, more than 125 international projects that deal with monitoring and assessing the effects of climate change are currently formulating relevant recommendations and sharing key research findings.

Relying on their experience of managing a mega-grant Arctic research project, the authors showcase their practice of building international interdisciplinary cooperation in the field of Arctic research.

Materials and methods

For the purpose of this paper, we performed a context analysis of documents governing Russia's national and international policies in the field of science diplomacy. We were looking to find the State's position on the role of science diplomacy and science diplomats in its political agenda. Our search involved reading the official webpages of the President of the Russian Federation, the Government and the Ministry of Foreign Affairs. The search keywords (Russian and English) included 'science diplomacy', 'Arctic diplomacy' and 'Arctic science diplomacy' and did not yield any useful results – an indication that there has so far been no comments or statements from the official sources. At the same time, our survey of the policy documents governing Russia's agendas for Arctic development, science and technology has shown that while avoiding the use of that terminology, some of these documents do mention international scientific dialogue and cooperation as a goal to pursue, referring to government's mega-grant programme as intending to stimulate emergence of international scientific partnerships and promote science diplomacy.

With due regard to the scale of science diplomacy as proposed in 2010, our analysis of the NArFU's mega-grant project on Arctic biomonitoring uses the so-called technical (instrumentalist) approach (Antjushina, 2013; Harlamp'eva, 2017) and the approach that views science diplomacy as a type of public diplomacy (Lebedeva, 2017; Melissen, 2005). While the former approach reduces the core purpose of science diplomacy to that of fostering the apolitical settings required for maintaining international relations and solving global problems, the latter approach allows us to consider the NArFU's mega-grant project on Arctic biomonitoring as a tool for enhancing Russia's image as an internationally attractive scientific partner. Not exclusive of the elements of instrumentalism (Nye, 2004), this latter approach underlines the role of "soft power" as a constructive mechanism in the pursuit by nations of their own goals while establishing working relations with key Arctic policy actors.

The following qualitative methods were used in analysing international research collaboration and science diplomacy in the Arctic, namely: method of theoretical analysis, content analysis, participant observation and descriptive method for characterisation of best practices, structure and modelling method, doctrinal approach and interdisciplinary approach. We analysed the Russian policy on scientific research in the Arctic zone of the Russian Federation. We evaluated the official websites of the Russian state authorities. And, finally, to a large extent, the authors of this study relied on their own experience in conducting scientific research and management, international collaboration in the Arctic.

We start with description of the University's initiatives in the sphere of international cooperation and collaboration. We then focus on analyses of the NArFU's mega-grant project on Arctic biomonitoring in terms of promoting and implementing science diplomacy. We do this analysis by discussing the effectiveness of implementation of seven tasks, which are set by the Russian Government to the whole mega-grant programme. In the end, we make concluding remarks.

NArFU as an actor and contributor to science diplomacy

Located in Arkhangelsk, M.V. Lomonosov Northern (Arctic) Federal University (NArFU) is the Russian Arctic Zone's largest

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provider of research and education, offering 360+ degree programmes and boasting an enrolment of 17,000+ including international students from the Arctic and non-Arctic states. Missioned by the Russian Government to deliver research expertise and to be a source of qualified human resources for the industries operating in the Russian Arctic and the North, this university cooperates with businesses and society and has partners abroad. NArFU's distinctive identity builds on its being an Arctic-oriented university that pursues research in four major fields: natural resources management; Arctic ecosystems and climate change; materials and technologies for application in the Arctic; digitalisation, human dimension and life quality in the North.

NArFU views international cooperation as a significant resource for achieving its tasks and integration into global academic system. With 160+ partners worldwide – universities, research institutes, international organisations and businesses – the university offers international programmes and mobility opportunities for students and staff, hosting 40+ visiting professors from abroad and about 100 international events per pear. NArFU operates international centres of excellence and is a party to 70+ large international projects (Kalinina & Zarubina, 2015).

NArFU's diverse range of international activities provides the institutional framework and opportunities for researcher interactions through sustainable channels of communication. Academic mobility is seen as a tool for increasing the interest and motivation to form collaborative partnerships. Over the last five years, courses and internships at the leading Arctic-focused universities and research centres in Norway, Finland, Sweden, USA, Iceland, Canada, Germany, Great Britain, China, South Korea, among others, have been undertaken by a total of more than 3,000 graduates and faculty staff members. NArFU boasts an excellent track-record in international fund-raising and multilateral research within Horizon-2020, Erasmus+, Kolarctic CBC, Nordic Council of Ministers programmes, to name a few (partnering 70+ projects every year). It acts as Lead Partner in the majority of the Kolarctic-funded projects that involve organisations across the Barents Region (Zarubina, Popkova, & Kudryashova, 2021). Activities such as workshops and schools for early-career Arctic researchers – and among them International PhD School "Russia in the Arctic Dialogue: Local and Global Context", dedicated to Arctic science diplomacy and international cooperation – are held on a regular basis. One more noteworthy project is The Arctic Floating University. First launched in 2021, this research expedition to the Arctic seas has been contributed to by 600+ researchers, including early-career scientists, from 100+ partner institutions in sixteen countries (Avdonina, Kudryashova, & Zaikov, 2019).

In the context of its internationalisation policy, NArFU seeks to promote partnerships enabling professor and early-career researcher exchange, joint projects, expeditions, co-authorship, co-supervision of postgraduate internships and joint actions to address the issues facing the Arctic communities. These engagements, where human interactions are obviously a central and most valuable asset (especially when it comes to Arctic-focused projects and constraints such as remoteness and harsh climate), help to build long-standing webs of researcher relations and to train next generations of science diplomats, contributing to mutual trust and reciprocity that science diplomacy relies on.

From the "science for diplomacy" perspective, NArFU's role in circumpolar partnerships and networks has been increasing steadily since 2010, when NArFU was assigned the status of a federal university, and so has its role as a North-based implementor of international education and R&D policies (Kalinina & Zarubina, 2015).

The Barents academic cooperation that started as early as the 1990s has been invaluable in building bridges and forming trust-based relationships between universities, public authorities, diplomats, business and societies in the European North. These enduring relationships provided the foundation for research collaboration and science diplomacy in the "bigger Arctic" (Zaikov et al., 2022).

The opening at NArFU in 2011 of the UArctic Research Office marked a new stage in NArFU's effort to promote international collaborations in the circumpolar world. Currently partnering an impressive number of the UArctic projects and programmes, NArFU is a member of the UArctic steering bodies, contributing to as many as fourteen thematic networks with agendas as diverse as health and well-being, small and medium entrepreneurship, Arctic tourism, natural disasters and teacher training and leading the "Working in the Arctic" thematic network.

In 2015, NArFU, together with Aalto University (Finland) and St. Petersburg State University of Economics (Russia), were appointed coordinators of the Northern Dimension Institute (NDI). A joint policy of four equal partners (the EU, the Russian Federation, Norway and Iceland), the Northern Dimension (ND) provides a platform for practical cooperation via its thematic partnerships on environment, transport and logistics, culture, public health and social well-being. The ND policy aims at enhancing regional cooperation within its area through science diplomacy and capacity building to achieve informed political decision-making in five priority areas: climate change impact in the Arctic; emerging transport and logistics routes between Europe and Asia; energy efficiency; health and well-being; and culture (The Northern Dimension, 2022).

Since 2019, NArFU has been performing the duties of Co-Lead in project *Arctic Foods Innovation Cluster*, a collaborative effort of the University of Saskatchewan (Canada), Finnish and Icelandic universities, and the Arctic Council Sustainable Development Working Group (SDWG, 2022).

As can be seen from the above, NArFU has established a diverse network of collaborative partnerships that enables it to share Arctic knowledge across borders and generations and engage different actors in dealing with research and international policy issues. The role of northern universities as "expert hubs" and contributors to political decision-making cannot be overestimated. Networking and scientific partnerships are key to successful management of Arctic challenges and achieving shared goals, serving as essential elements of science diplomacy and enabling scientists to foster Arctic knowledge transfer.

Considering the complexity of Arctic research tasks, northern universities use networking as a capacity building tool. By pooling resources for international research, they strengthen regional integration in a process that leads to jointly set Arctic research agendas and is of great benefit to all the parties involved.

Another important line of collaborative activities contributing to NArFU's internationally recognised reputation as an Arctic science diplomacy promoter relates to hosting high-level Arctic-related events. NArFU has repeatedly confirmed its status as a venue for political fora, research conferences, seminars, R&D projects and related arrangements intended to facilitate cooperation in the Arctic and beyond. Among the most prominent conferences is International Forum "Arctic: The Territory of Dialogue", which is probably Russia's largest venue for

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government bodies, diplomats, international organisations, researchers and business communities to discuss and exchange views on Arctic sustainability (International Arctic Forum, 2022) and which NArFU hosted twice (in 2011 and 2017); 7th UArctic Rectors' Forum (2013); 3rd Northern Dimension Parliamentary Forum (2013); International Meeting of High-Level Representatives of the Arctic Council Member States, Arctic Council Observer Countries and International Academic Community (2015 and 2016); The First Korea-Russia Workshop on Arctic Research (2017). In 2019, NArFU hosted the Arctic Science Summit Week, initiated by the International Arctic Science Committee and attended by researchers from 29 countries. The June of 2021 saw NArFU hosting the X International Congress of International Arctic Social Sciences Association (ICASSA), one more significant event facilitating the dialogue on Arctic development challenges and the spread of scientists' diplomatic power.

NArFU's megaproject

In April 2010, the Russian Government adopted Resolution No.220 (known also as the Mega-Grants Resolution), aimed at providing financial support to science-driven innovations. Speaking before the Government of the Russian Federation on 20 October 2016, Prime Minister Dmitry Medvedev noted (Government Meeting, 2016):

> '. . . *started in 2010, the Mega-Grant Programme sees its mission as making the Russian universities and research facilities more attractive to researchers from across the world. This is, indeed, a very ambitious programme and it has an impressive budget – RUB 28 billion until 2020. The programme awards grants to applicants who are willing to benefit their homeland, Russia, with research endeavours as part of research teams.*"

Designed to increase the research cooperation among Russian universities, educators, the world's leading scientists and providers of innovation research (Mega-Grants, 2021), the mega-grant programme is one of the Russian Government's largest projects to promote internationalisation in science and science diplomacy.

Mega-grants are awarded on a competitive basis. Eligible for them are those Russian schools and research centres that have among their project development teams a well-known scientist with expertise to lead research on chosen topics. Project topics can pertain to any field of the scientific knowledge (social sciences, humanities, live sciences, engineering, etc.) but should necessarily be in line with the Russian Federation's development goals and the global scientific agendas. The programme led to the emergence, by 2020, of 315 laboratories at 133 research and training organisations in Russia. These laboratories are led by both Russian and international researchers, including expatriate Russian scientists. The mega-grant projects have been contributed by scientists from 36 countries (Mega-Grants, 2021). Although the mega-grant programme does not have a distinct Arctic focus, a minimum of three of the newly established laboratories specialise on Arctic research and few more engage in studies that are linked to Russia's northern areas.

NArFU landed its mega-grant in the fifth call of the programme (Grant Agreement No.14.Y26.31.0009 dd. 14 March 2017) and was able to set up its Arctic Biomonitoring Laboratory (ABL). Tasked with designing the methodology for monitoring, assessing, predicting and preventing the risks associated with highly toxic pollutants, ABL explores, among others, the pollutants pathways into food chains and the Arctic ecosystems.

As we mentioned earlier, the project idea had its initiative to set up in the Russian Arctic a national biological monitoring system (Sorokina, 2019). Using ABL as a research center, the project continues to study the impact of environmental phenomena on the health of the northern residents, providing biological monitoring data and conducting research on human health, Arctic biota, food pollution risks and much more. This project is a vivid illustration of the "One Health" approach (WHO, 2017). Effort-consuming research, trips to remote Arctic areas, sampling, interacting with the local population and authorities, statistical processing and risk analysis are just some of the tasks before the ABL team. Along with the need to involve specialists from diverse backgrounds, these tasks require the team to interact with outside organisations and officials.

The topic chosen for this project has been a follow-up to initiatives that have been undertaken earlier by national and international research teams in the Arctic States. One such initiative was started by the Arctic Council and has produced a series of scientifically based assessments of the pollution status of the Arctic (Arctic Monitoring and Assessment Program – AMAP). Largely contributed by Canada and Norway, the AMAP initiatives were later joined by Denmark (Greenland) and other Arctic States, resulting in an expanded geography of research. On the international Arctic biomonitoring map, the Russian Arctic had long remained a white spot. This was due to two reasons: (1) the size of Russia's Arctic regions poses a challenge to the goal of developing infrastructure, complicating the deployment of research activities and requiring extensive preparations, etc. and (2) the monitoring system's being too complex in nature, as we described in one of our previous papers (Sorokina, 2019).

With the emergence of AMAP, the regions of the RF Arctic Zone started to be covered by biomonitoring studies. The period between late 1990s and early 2000s was marked by the increase in the collaboration efforts between Russian and international scientists, reflected in a series of joint reports (AMAP, 2004, 2009, 2015, 2016, 2017, 2018). Although not all the Russian research teams chose to continue their biomonitoring studies on a regular basis, those that did, even though on geographically limited areas, have produced outcomes that could be integrated with international biomonitoring data systems. Gradually, the picture started to take shape, making it possible to identify the health effects of Arctic contaminants (persistent organic and inorganic pollutants), deficiencies of essential elements and other habitat-related factors influencing the Arctic population. NArFU's project made it possible to bring the Russian Arctic biomonitoring studies to a new level in terms of consistency, alignment with provisions of the AMAP protocol and the need for cohort studies in the areas previously explored by the AMAP and other research teams. Inspired by the international research agenda and its team's desire to explore the topic that had long remained understudied at national level, NArFU and its project have contributed to Russia's involvement in international research collaboration. This is what we know as "science for diplomacy" (The Royal Society, 2010). Not only does it facilitate international collaboration, its helps the Arctic States to achieve a unified research agenda for the Arctic.

Our study of the Arctic biomonitoring initiative and its role from the perspective of the Arctic science diplomacy involved the analysis of NArFU's project performance for consistency with seven tasks outlined by the Russian Government for its mega-grant programme (Mega-Grants, 2021). These seven tasks are:

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1. Involving renowned scientists, including expatriate Russian scientists, in the research conducted by the Russian universities, scientific organisations and centres of excellence.
2. Creating internationally competitive research laboratories.
3. Achieving world-class research performance.
4. Creating faculty development opportunities and incentive programmes for researchers.
5. Encouraging young people to pursue research and careers in education and high technologies.
6. Establishing strong connections between world's leading schools and Russian universities, research organisations and member institutions of the Russian Academy of Sciences.
7. Transferring promising research-based developments to national and global economies.

Although science diplomacy goals are not what these tasks seek in the first place, our research has shown that their fulfilment implies, in one way or the other, bringing science into diplomacy and diplomacy into science.

Task 1. Involving renowned scientists, including expatriate Russian scientists, in the research conducted by the Russian universities, scientific organisations and centres of excellence. While interpretations of the notions such as fame and global recognition tend to be largely subjective, those implying quantifiable indicators – publications in peer-reviewed journals, research leadership experience, membership in scientific communities, titles, awards, etc. – inspire better confidence. One useful metric that measures author's productivity (and is therefore commonly used by Russian research communities) is h-index (Hirsch, 2005). Important as it is, h-index is however not the only criterion which is considered by decision-makers in the first place.

NArFU's project has been lucky to have Yngvar Thomassen, a distinguished non-Russian scientist with h-index of 42 (Scopus, 2022). Even though Task 1 implies it would have been acceptable to have the project led by an expatriate Russian scientist, involvement of compatriots is not regarded as a preferred way of establishing international collaborations from the science diplomacy perspective. While scientific diplomacy is not what mega-grant programme pursues in the first place, it is viewed by the Russian Government as leading to improved quality of research results in Russia. Therefore, when deciding on the award of a grant, the programme's Grant Board looks at the proposed lead scientist's scientific merits, not nationality. There is one more goal the mega-grant programme is expected to contribute to – to stop the brain drain which had first affected Russia after the collapse of the USSR.

In order to ensure lead scientist's involvement in the routine operations of the research team, the grant contract stipulates the obligation to be present personally and be provide guidance during the minimum of 120 calendar days – a stipulation which is regularly monitored by the grant giver throughout the year and which is still regarded as controversial. The idea is to avoid a technical, uncreative approach to research leadership. Indeed, many scientific leaders, after they have experienced a new environment and got accustomed to its standards (one example being the notorious Russian red tape), become able to effectively respond to processes affecting the success of projects they are responsible for. On the other hand, not every scientist can objectively afford staying in a foreign country for such a long time (Professor Thomassen was able to fulfil this obligation in 2017, 2018 and 2019), for which reason many worthy candidates fall out of the competition. In 2020, when the pandemic made it even more difficult to meet this obligation, the ABL was forced to move the supervision of its project online (2–4 online sessions weekly). Although the online/mixed format proved to be effective, traditional face-to-face interactions will always be the preferred mode.

Task 2. Creating internationally competitive research laboratories. In addition to conducting scientific research, mega-grant projects are tasked with creating world-class laboratories. Although the official definitions of "world-class laboratory" is found nowhere in the documents, it follows from the general descriptions of the transformations that are being experienced by Russian science that world-class laboratories are two-component structures: (i) infrastructure component and (ii) intellectual component. The infrastructure component involves equipping the laboratories with science-intensive technologies that meet high standards. In Russia, the issues of upgrading research facilities' infrastructures are addressed through competitive funding schemes, assigning a facility the status of federally funded research organisation, and programmes such as Russian Academic Excellence Project 5-100 (Project 5-100, 2021) and the newly launched Priority 2030 (Prority 2030, 2021), among others. Aimed at accelerating research developments within grant-winning universities, these government-funded programmes finance infrastructure renewal and development strategies, allowing their beneficiaries to decide on distribution of the funds among their departments and research teams, for which internal competitions can occur. Mega-grants are designed to solve concrete research problems by establishing, within the winning research facilities, modern laboratories and thus sparing their research teams from having to compete for resources. The intellectual component of world-class labs involves professional competencies available to the research team. Conducive to competency development are Tasks 1, 4 and 5. Task 2 relates more to infrastructure component.

The ABL was established at NArFU in the early 2017 and it took time, longer than expected, to turn it into a full-fledged facility for processing of biological samples and conducting quantitative chemical analyses and collective projects. Biological monitoring involves systematic observations of biota and human health, as well as stages such as planning, task prioritisation and selection of object-specific criteria and quantifiable indicators. It is only obvious that a project as large as this cannot be limited to only one domain, for example public health or analytical chemistry. An essential part of biomonitoring projects is the sampling trips to remote areas and communication with the local people. Samples must be properly packaged, labelled, stored and transported for further processing in the lab. The tasks of analysing health risks to the Arctic population involve experts with background in public health, ecology, chemistry, biology, biotechnology, law, geography and many other fields. This interdisciplinary approach requires diverse equipment and consumables to meet its team's ambitious goals.

For the purpose of its research projects, the laboratory is equipped with technologies allowing rapid sample preparation and accurate measurements. Other purchases include expedition equipment for field trips in extreme Arctic conditions and research supplies including chemicals – the standard sets of equipment and consumables that can be found in many laboratories across the globe. But, there is one thing that sets ABL apart from other labs: all units of equipment, including the technologies for sample preparation and quantitative chemical analysis, can be assembled here, rendering ABL absolutely independent from third-party organisations in carrying out its monitoring operations in the Russian Arctic.

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However, access to equipment and consumables per se does not guarantee being "the world's leading". The lab should be able to demonstrate that its equipment operates according to international standards. ABL has been successfully accredited by the National System of Accreditation of Testing Laboratories and found competent in providing high-quality tests and analyses (confirmation of competence last issued in 2019). However, there are two more criteria to meet in order to be called a high-performing lab. The first is published research – a measure allowing the estimation of the international significance of studies and the results obtained. The laboratory team have so far published ten papers in highly ranked journals (Publications, 2021), which is a good result given the young age of the laboratory – four years. The other indicator is involvement in external quality control programmes such as interlaboratory comparisons (Interlaboratory, 2021) and proficiency testing programmes (Haines, Saravanabhavan, Werry, & Khoury, 2017). ABL participates in the qualification tests held annually within the framework of the national interlaboratory comparison tests, successfully passing the tests with the laboratories of the National Institute of Public Health (Norway). There is a plan to expand interlaboratory cooperation and to be involved in the AMAP quality assessment programme for persistent organic pollutants (POPs) in human samples (AMAP, 2009), a "gold standard" of the quality control for Arctic research projects.

Task 3. Achieving world-class research performance. The results and deliverables of this ambitious project to set up the national biomonitoring system can be grouped into at least three categories.

Results in category one involve gap filling on the international biomonitoring map data. The research team undertook about 30 expeditions to multiple destinations in the Russian Arctic (Nenets Autonomous Okrug, Chukotka Autonomous Okrug, Murmansk Region, Krasnoyarsk Krai, Republic of Sakha (Yakutia) and Yamalo-Nenets Autonomous Okrug). Work did not stop even during the global pandemic of 2020. The team gathered about one thousand samples of fish and one hundred samples of migratory birds – the common foods of Arctic residents. Sampling covered even whales. Blood samples numbered approximately 500 and urine samples 100. Work is underway in parallel to conduct quantitative chemical analyses (concentration measurement, nutrient deficiency analysis). The team are actively exploring previous research and published data to facilitate interpretation of the test results. They even built a mobile lab facility for testing sea water and air samples during field trips. Work is in full swing and will continue at a fast pace in the years to come.

The second category of projects results deals with building the institutional frameworks for the national Russian Arctic biological monitoring system. In place are the research protocols and methodological guidelines. The laboratory staff have developed guidelines for awareness raising campaigns to inform the public authorities, local governments and the population about health risks and pollution transfer pathways, as well as to advise the public and authorities on health protection measures if toxic pollutants levels in the Arctic ecosystems and food chains should start to be a major threat. One dedicated sub-project is designed to create a system for early detection, monitoring and assessment of pollutants spreading risks.

Thirdly, research data management leads to publications in the international scientific journals. The mega-grant programme considers publications in Web of Science (WoS) indexed journals an important indicator of effectiveness, and there is a minimum required number of articles that must appear in Q1 and Q2 journals. Of the fourteen articles written and published by the team in WoS indexed journals, seven appeared in Q1 and three in Q2 journals. In 2019, the laboratory held its Arctic Biomonitoring Conference (November 26–27, 2018). Its proceedings were published in English in the IOP Publishing (UK) online journal *IOP Conference Series: Earth and Environmental Science* (also indexed in the WoS database). The laboratory and its project will continue publishing their work to make more data available worldwide.

There are many other considerable results delivered by the project over the five years of its existence. One of them involved in-depth analysis of legal frameworks regulating Arctic monitoring activities in Russia (Sorokina, 2022) and had identified a number of gaps with regard to fish and bird species – the traditional foods of many Russian Arctic residents (Sorokina, 2019). Particular attention was paid to the Russian Federation's obligations under the Stockholm Convention on Persistent Organic Pollutants 2021. The ABL and its research work are an example of the government using science to achieve fulfilment of its international obligations (bottom-up approach), whereas bureaucratic procedures (top-down approach) are still too numerous land may restrain research within the country (Sorokina, 2019). The Arctic fish samples collected during the project were found to contain relatively low contents of persistent inorganic pollutants, including Mercury (Hg) (Sobolev et al., 2019), while POPs were present in greater quantities in many samples. Fish with high lipid content were found to contain higher concentrations of polychlorinated biphenyls (Lakhmanov et al., 2020).

Blood samples of communities subsisting mainly on marine fish showed increasing median arsenic contents. Cadmium (Cd) is found in high concentrations in the blood of smokers and lead (Pb) in that of hunters (Sobolev et al., 2021). As to the concentrations in human blood of POPs (listed in the Stockholm Convention on Persistent Organic Pollutants 2021), there is a tendency for them to decrease in every Arctic State (Varakina et al., 2021, 2022), indicating the effectiveness of international efforts. Another source of adverse health effects is deficiency of essential elements (I, Fe, etc.). Our analysis has shown that trace element deficiencies are suffered by the majority of the Russian Arctic population (Sobolev et al., 2021).

The list of project's scientific results can be continued, but the outcomes presented above are sufficient to illustrate the comprehensive nature of the research being conducted at the laboratory. Arctic biomonitoring is an effort-consuming process involving examination of domestic and international legislation; pollutant concentrations measurements; data correlation; identification of human health threats; gap identification and analysis; research management; and much more. With well-established sources of science-based knowledge, the benefits of international interdisciplinary Arctic research are beyond doubt.

Task 4. Creating faculty development opportunities and incentive programmes for researchers. This task is achieved using two schemes: (1) staff training and development and (2) merit-based financial awards. The project is free to use as much as 60% of its annual grant funding for payroll financing. The funds are used to pay for expeditions, traineeships and scientific trips – they are effective ways for any multinational interdisciplinary team to exchange research results, discuss progress and be able to learn from one another.

The progress towards achieving Task 4 is yet to be evaluated. On the one hand, since personnel development is predominantly about creating access to development, the progress can be said to

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have been quite sufficient, but how can we be sure that the measures undertaken yield sufficient quality? One possible solution would be to turn to our lead scientist and, given his many years of experience in research management and project work, and ask who of his research team members seems to be performing better than the others, but this, too, involves uncertainty and subjectivity. Therefore, the following criteria are used by the Laboratory to measure the performance of its staff: (a) awareness of research topics and ability to communicate laboratory's needs across the university without involving more experienced team members; (b) ability to organise and manage research projects (self-sustained research was started in these past five years by two PhD students with the funding from small grants programmes); (c) ability to prepare manuscripts on research findings for publication in reputable international journals (most of the published articles were prepared by team members themselves under the guidance of lead scientist); (d) invitation to join/have involvement in research projects other than that of the ABL and (e) invitation to join/involvement in the activities of outside research and training organisations. This latter criterion can be the most undesirable for laboratories and may cause discouraging outcomes to some upon completion of the projects, but it is that very yardstick that allows to measurement of recognition of the team by third parties. Cases of highly qualified specialists leaving for another employer are common, and there are cases when mega-grant project team members leave for other countries on invitations from lead scientists. Poaching talents is a bad idea and sounds unethical from the point of view of science diplomacy. The time needed to find a replacement, often to an early-career scientist, can weaken the laboratory's performance and be detrimental to its credibility, authority and attractiveness as a research partner. At the same time, many of research team members benefit their laboratories by achieving the results that lead to an improved reputation and expanded partner networks both domestically and internationally.

Task 5. Encouraging young people to pursue research and careers in education and high technologies. It is stipulated in the contract that research teams must have at least three holders of PhD (postdocs), four PhD students and three master's students and that 50% of them should be under 35 years old. Shortly after winning its mega-grant, NArFU announced a competition to find talented candidates available at its higher schools and research centres. The final choice of candidates to join the project was made by the lead scientist. The laboratory has a staff of seventeen, excluding the lead scientist. Four hold doctoral degrees (one holds membership in the Russian Academy of Sciences as an associate), four PhDs (postdocs), four are PhD students, three are master's students and two are research assistants.

At NArFU ABL, early-career researchers interact with their more experienced peers on a daily basis. The mentoring system uses a scheme that is not like a conventional mentor–mentee relationship. There are tools provided by the mega-grant programme to ensure that early-career researchers receive continuous guidance from the lead scientist. One such tool is the minimum required number of days during which lead scientist is expected to be physically present at the hosting university for face-to-face communication with research team members.

The COVID-19 pandemic has disrupted many aspects of the laboratory routines and schedules. The communication largely moved online. Weekly online meetings with the lead scientist alternate with small group meetings that take place one or two times a week and, when needed, individual online consultations. The lead scientist has a teaching load of 36 h per year. His lectures cover the best practices of Arctic research, personal experience and are intended for a diverse audience of students. Teaching also takes the form of individual consultations, practical sessions, labwork supervision and interaction with the student cohort not involved in the implementation of the project. In this way, students (including those indifferent majors) are provided training and the research work is aligned with international scientific agendas.

Training effectiveness is achieved also using laboratory's own tools. Senior researchers (PhD holders and postdocs) supervise their younger colleagues, explaining to them in great detail the contents of research tasks, background and results to be achieved. Some tasks require one-to-one consultations. Every month or two there are 2- to 3-day brainstorming sessions, and there are joint staff meetings at the end of every cycle where members report their progress and near-term tasks. Senior team members and their mentees are flexible in scheduling their communication. Questions can be addressed personally or by phone or e-mail. Where a senior scientist is absent from the office and there is an urgent matter, online meetings are held. Through mentorship, early-career researchers can: (a) overcome psychological barriers which are often causes of underperformance; (b) promptly deal with issues arising during the performance of their tasks; (c) get a broader view of a phenomena or issue from their more experienced peers and (d) verify they are on the right track with their research and producing valid results. The mentoring relationships often lead to mentees becoming mentors to newly hired members one or two years after having been mentored.

As junior research team members become more qualified and start their PhD studies, the Laboratory hires replacements. In this sense, its staff is never permanent. Two students chose to write their theses on the topic of the project and currently continue their research at PhD level, and another student has successfully defended his PhD thesis. These changes mean also moving from one role (master's student) to another (PhD student) within the team, requiring the Laboratory to find replacements in order to stay in compliance with the mega-grant programme requirements. At the same time, unfortunately, we have to admit that laboratories face: (1) outflow of young talents from science and (2) outflow of young people to large cities. After four years in operation, ABL has kept the core of its committed members who welcome the opportunities for new research and scientific practices. Mega-grant projects are undoubtedly one of the best practices for motivating younger people to pursue research through: (a) interesting and diverse scientific tasks; (b) the opportunity to be mentored by seasoned professionals; (c) regular training and professional development opportunities; (d) access to international scientific events; (e) publication opportunities and (f) competitive remuneration.

Organisationally, this format of early-career scientist training differs from the traditional Russian model where research is limited to one domain depending on the specialisation of a given university department (e.g. analytical chemistry, biology, philosophy, etc.), allowing little flexibility to student research. Graduate students are assigned supervisors from among the experienced faculty and interact only with them, with little contact, if any, with other members of the faculty or students.

At ABL, we stepped away from monodisciplinarity and introduced the principles of equality and democracy for daily routine tasks. The research team members are encouraged to communicate among themselves. This change implied complete abandonment of the classical Russian model (monodisciplinarity)

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and adoption of a paradigm where a research problem is dealt with by scientists from different research backgrounds: a student majoring in environmental chemistry teams up with a biology major for a research work on Arctic biological monitoring issue. Russian research communities have all resources necessary for adhering to multidisciplinary at their home universities without involving their foreign colleagues – the lack of multidisciplinary approach was somehow overlooked by science diplomacy efforts. The most essential element is the research topic itself. We hold that scientists engaged in Arctic research are simply obliged to be aware of the international Arctic agenda. Involvement of international scientists is a key to success. International scientists stick with this approach as much as we do here. The process of organising research work thus is universal internationally.

Task 6. Establishing strong connections between world's leading schools and Russian universities, research organisations and member institutions of the Russian Academy of Sciences. Arctic biomonitoring is interdisciplinary and requires a cross-cultural approach. As we mentioned earlier, ABL cooperates with specialists from diverse backgrounds and areas of expertise – public health, environmental protection, analytical chemistry, law, geography, economics, mathematics, ichthyology, ornithology, among others – professors at the leading universities in Russia (NArFU, Higher School of Economics, I.I. Mechnikov Northwestern State Medical University, North-Western Center of Hygiene and Public Health, etc.) and abroad (National Institute of Occupational Hygiene in Oslo, UiT the Arctic University of Norway, etc.). The interaction commonly unfolds through competency exchange, consultations, co-authorships, joint scientific events and expeditions.

Alongside with its own research commitments, the ABL is contributing to international academic projects, collaborating, among others, with the UArctic. The staff of ABL are regular contributors to conferences and host sessions within major interdisciplinary events. Among the sessions hosted in 2019 is *Arctic Law: Modern legal regulation, training and research*, held within the frameworks of the Arctic Scientific Summit Week in Arkhangelsk, Russia, and the panel session at the Arctic Circle Assembly 2019 (Reykjavik, Iceland) which discussed the progress of the biomonitoring efforts in the Russian Arctic and presented ABL as a mega-grant project.

NArFU ABL forms part of a joint Russia-Japan Research Laboratory, partnered by Hokkaido University. Its teams will be conducting studies into climate change, the Arctic environment, international cooperation and governance.

The team of ABL has demonstrated excellent performance as a science diplomacy actor and contributor to international cooperation. In 2021, after the drastic deterioration of Russia's relations with the European countries and the USA (Russia Today, 2021), followed by the Russian Ministry of Foreign Affairs announcing a deep crisis in relations with the United Kingdom (RIA, 2021), the team of the ABL was invited to take part in Oxford University Polar Forum series of seminars on the Russian Arctic. This effort as lecturers for the students of the University of Oxford, one of the highest-ranking schools globally, marks an important step towards positioning NArFU as a recognised research provider in the field of Arctic studies.

Earlier in 2018, the UK-Russia Year of Science and Education, the UArctic Research Office at NArFU successfully completed the project *"Development of the UK-Russian Arctic Research and Collaboration Network"* that involved a series of joint seminars at NArFU, the University of Aberdeen and the Scott Polar Research Institute in Cambridge. Those seminars proved fruitful opportunities for exchanges focused on the Arctic research in Russia and UK and joint research interests. This is yet another illustration of Arctic science diplomacy being a "parallel reality" and a medium for promoting, and achieving noticeable progress, in the international cooperation efforts.

Task 7. Transferring promising research-based developments to national and global economies. Creation and staffing of a world-class laboratory is a project in itself (if viewed from the perspective of the project-based approach). A project-based approach is becoming increasingly popular in the science sector. At the same time, project management skills continue to be neglected by many degree programmes, especially in the life sciences. At NArFU ABL, a project-based approach is an operating principle. With scopes of works, deadlines, budgets and performance indicators clearly defined in the mega-grant agreement, the team cooperates with outside customers, facilitating interactions between industries and scientists.

Now a provider of consulting and analytical services, ABL has found a common language with its customers and has completed eight contracts since its establishment. The expertise it offers to the international markets includes competency in complex Arctic monitoring studies; biological and environmental samples laboratory analysis and consulting services. One important commercial project involved ABL in monitoring the effects of oil spill in Norilsk, Krasnoyarsk Krai, Russia in May 2020 (BBC, 2020) and its consequences for indigenous communities.

We mentioned earlier the Stockholm Convention on Persistent Organic Pollutants 2021 and NArFU mega-grant's consistent contribution to its implementation. (Sorokina, 2019). The ABL of NArFU has been Convention's unofficial focal point for collecting and distributing the data on POP levels in the Arctic environment. We hope that this data will be included in the upcoming report for the Global Monitoring Plan under the Convention. This would be another testimony to NArFU ABL mega-grant project being a success story of science diplomacy.

The Arctic biomonitoring initiative, implemented under the government-funded mega-grant programme, has been a solid contribution towards facilitating international research cooperation known as "diplomacy for science", demonstrating "science for diplomacy" and "diplomacy for science" in action.

While science diplomacy is commonly defined as "the use of scientific collaborations among nations to address the common problems facing 21st century humanity and to build constructive international partnerships" (Fedoroff, 2009), we cannot deny the "national interest has always been a key driver in the exercise of science diplomacy" (Ruffini, 2020). This latter statement is what clearly reflected by the mega-grant programme: one its slogans is, "Global Research – For the Benefit of Russia" (Mega-Grants, 2021). This means that NArFU's biomonitoring project is "at the service of national interests" (Ruffini, 2020). Some view this as a negative feature of science diplomacy and a reason for criticism (Ruffini, 2020). However, our position is as follows. Since any scientific research, especially in such remote areas with harsh climatic conditions as the Arctic, is costly and resource-intensive, when using scarce funding (often provided by Arctic States' national funds) the investor interests must come first. This means that science diplomats are advocates of national policies. Science has at its disposal an important tool mitigating international tensions and achieving other significant results in the international political arena. This tool is scientific discussion. As means of mediation, scientific discussion helps to manoeuvre, smooth out sharp corners

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and advocates act as independent actors. This feature of scientific discussion allows scientific conferences, seminars, workshops, researcher interactions and related events to be the venues where peoples can maintain cooperation towards peace and balance in the Arctic. The primary purposes of science diplomacy – and this is the key message of our study – are to balance the national interests of sovereign states and, using as a tool scientific discussion, to achieve adequate internationalisation in science in order to provide solutions to the global challenges facing the humanity.

Conclusion

Arctic universities and individual researchers play a major role in establishing effective international collaborations in the Arctic Region, acting as hubs of expertise to support political decision-making. The experience of science diplomacy in action presented in this paper allows us to conclude that our future generation of scientists is ready to assume roles as science diplomats.

As universities expand their research collaborations, they obtain a broader view of internationalisation strategies, embedding them in their own development agendas. In doing so, they build bridges that help secure understanding among nations (Gast, 2021).

The ABL of NArFU acts a driver of its home university's science diplomacy efforts. When launching its mega-grant programme, the Russian Government had tasked the would-be labs with an ambitious mission: to turn domestic research providers into major players on the global research arena. ABL owes its success in achieving this mission to two factors, one being its stimulating and collaborative environment where research teams and individual researcher feel encouraged to participate in international collaborations, and the other being the sufficient funding from the mega-grant programme, which had led to ABL's engagement in the world-class research projects as equal partner.

The NArFU ABL mega-grant project spanned 2017–2021 (the mega-grant programme is still ongoing). Despite the severe consequences of the recent crisis, researcher interactions have not ceased. While official cooperation with Russian universities remains suspended, the laboratory and its team continue to cooperate with their international peers in the Arctic States on an individual basis. Online meetings with leading scientists are still a regular practice and work on joint biomonitoring is underway. The need to manage the global challenges facing the Arctic and its population calls for joint action. Right now the world needs science for diplomacy more than ever.

The research has been written on the basis of the case studies taken into account in the period of 2017–2021 before the geopolitical situation of 2022. Nevertheless, Russia is still implementing a mega-grant programme. Due to the fact that the contract is concluded with a leading scientist individually without taking into account his/her citizenship and affiliation with other institutions, the mega-grant programme remains an important mechanism for the maintenance and development of international scientific cooperation and science diplomacy.

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