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Ruptures in Existence –Openings for the Future

The Need for a Different Resource Landscape

ABSTRACT Taking the once seemingly constant yet constantly moving Arctic sea ice as inspiration, this article reflects on how individuals and societies can navigate the ruptures in our expectations about a predictable future caused by climate change. With insights from scientific assessments of adaptation and resilience in the Arctic, it describes various facets of a resource landscape for addressing the challenges brought by the new reality of a warmer and more unpredictable world. In focus is the central role of people, including their learning processes and ability to cooperate. It furthermore emphasizes that futures and values are the outcome of social processes, not predetermined, and thus in the hands of those who engage in shaping them.

KEYWORDS Arctic, resilience, adaptation, transformation, resources, futures

Sea ice is moving all the time.¹ It is inherently changeable. Sometimes the interaction of winter cold, ocean currents, and winds makes the ice impenetrable. Sun, heat, and wind can cause it to rupture. Marine life thrives in the interplay between the melting ice, the flow of nutrients, and the light that penetrates the open water. In the Arctic, this interaction between ice and light has created good conditions for the hunting-based culture of the Inuit and for rich commercial fishing which provides a global market with the food resources. In the increasingly warmer world that we are moving towards, completely new patterns are being created. More ruptures are formed—unexpected cracks that directly affect the lives of people living in the Arctic, and in the long run also have global consequences. The amount of ice is steadily decreasing, no longer just because of natural variations from year to year or the whims of the weather, which have always been part of life in the polar regions (Fig. 1). The shrinking ice today reflects a fundamental shift in which a whole new landscape is emerging—a landscape in which nature’s physical expressions are changing as a consequence of ever-increasing levels of greenhouse gases in the earth’s atmosphere (AMAP 2017*d*; IPCC 2018; Meredith *et al.* In press).

The long-term effects are difficult to predict. Awareness is slowly sinking in that the relationship between the seas and humans in the Arctic is being fundamentally reshaped. It is not only about the ice and the sea or about wildlife—with polar bears becoming an iconic symbol of the changes (Breum 2018). At the local level, the shifting conditions

Arctic Sea Ice Age

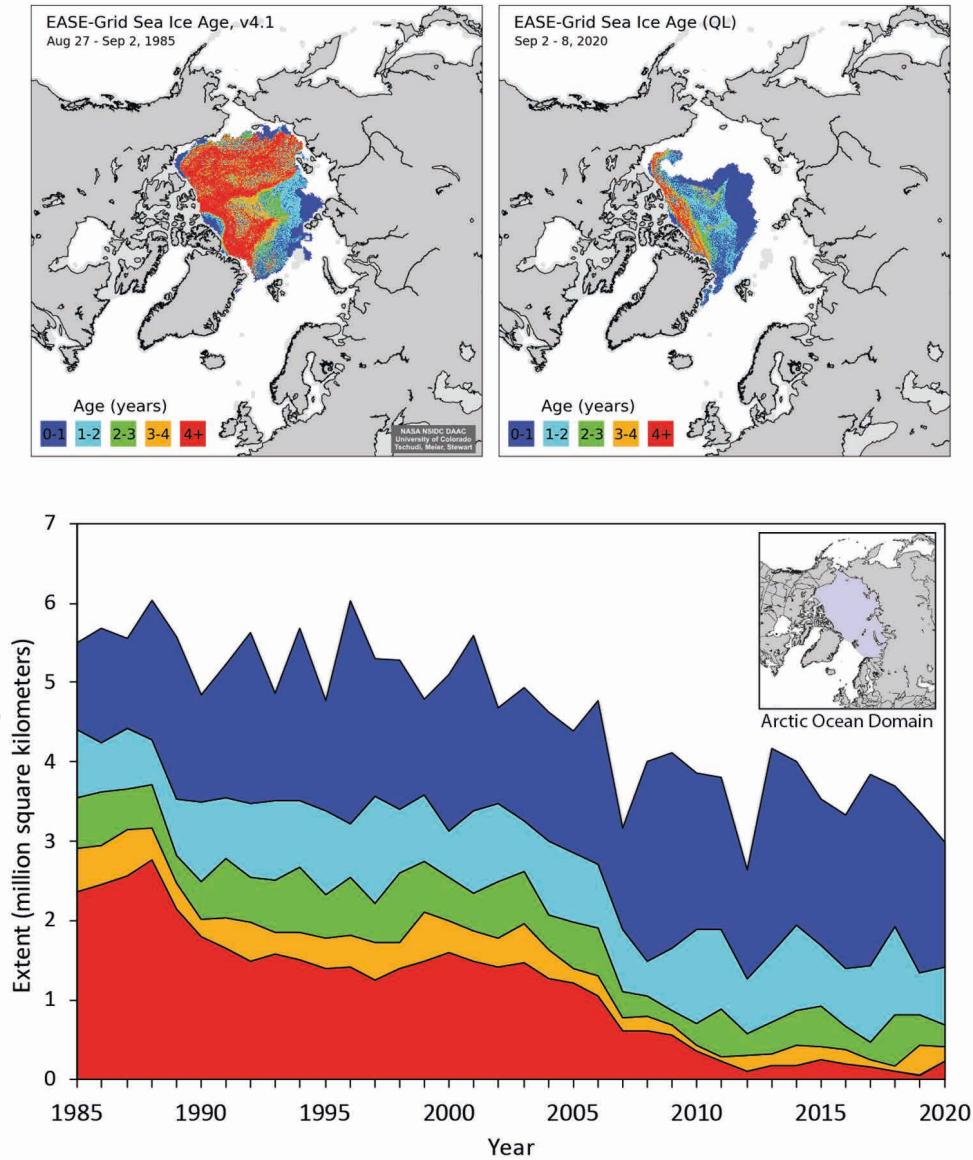


Fig. 1. The extent of the Arctic ice is decreasing by almost 13 per cent per decade. In addition to decreasing areas of sea ice, there is a loss of the older thick ice. Graphics: W. Meier, National Snow and Ice Data Center and M. Tschudi *et al.* (retrieved from <http://nsidc.org/arcticseaicenews/2020/10/>; 28 Dec. 2020).

also affect the ability of Arctic coastal peoples to make a living. When there is less sea ice there are also changes to the weather and climate far inland, which in turn reduces the opportunities for reindeer to find grazing and thus also has an impact on reindeer herders (Forbes *et al.* 2016). In international politics, several countries are now actively monitoring and asserting their national interests in the new seascape that emerges as the ice melts (Dodds & Nuttall 2016; Nilsson & Christensen 2019). Climate scientists, using satellites to follow the extent of the ice and constructing computer models, have long studied the role of sea ice in the global climate (Nilsson & Döscher 2013; Wormbs

et al. 2017). Nevertheless, for every year the sea ice seems to bring new surprises. Neither the local population nor shipping can rely any longer on past experience. Anyone who is dependent on the ice must be prepared for surprises that go beyond human experience and today's knowledge. Since the Arctic ice affects the global climate, this is ultimately a concern for people anywhere in the world.

Research on *Resilience*

Not being able to rely on past experience of weather and nature is a realization that has begun to make an imprint on people's lives all over the world. The ability to deal with change is sometimes called *resilience* and also discussed in the context of societies' ability to adapt to climate change, as elaborated in several reports from the Arctic Council (AMAP 2017a; AMAP 2017b; AMAP 2017c; Arctic Council 2016). This research is about understanding and navigating the dynamics of climate change and its pervasive consequences. Regardless of where we live, the challenge concerns how various processes of change are interlocked, how they make it difficult to plan for the future, and how we—individually and collectively—must nevertheless be able to build a foundation that ensures that new ruptures become openings instead of abysses.

Over the past 10,000 years, a relatively stable climate has created the basic conditions for how people today live their lives in relation to nature and to other people. Now conditions are changing, and the future that is being renegotiated also raises questions about the norms established in different circumstances. How are we to manage the interplay between the conditions shaped by new landscapes and by the interpersonal relationships and institutions that govern our societies? Society's dynamics can be much more sluggish than the ice, not least when it comes to worldviews and power relations. Slow social change can sometimes give a sense of security; we know what to expect and we have a foundation to stand on when a storm comes. The question is whether today's institutions can withstand the power of the new storms that await us, whether the norms and expectations that have facilitated interaction under other conditions, between individuals and between countries, can still fulfil their function, or whether we too must start thinking in new ways. The Arctic Council has played a key role since the 1990s in peaceful cooperation between countries in the Arctic region, but in recent years the discussions have been increasingly affected by the same political tensions and disagreements between national interests that are seen in other parts of the world. Consensus can no longer be taken for granted (Gulliksen Tømmerbakke & Breum 2019). In research on international relations, the interest in cooperation, which emerged in the 1990s, is being replaced by an increasingly clear focus on geopolitics and conflicting interests (Dodds & Nuttall 2016; Nilsson & Christensen 2019; Poelzer & Wilson 2014; Tamnes & Offerdal [eds.] 2016; Wegge & Keil 2018).

When the future opens in unexpected directions, different actors search for and assert their positions, not least by formulating visions of the future. The Arctic has often served as a projection surface for hopes of lucrative opportunities, and now the newly opened sea once again appears attractive for commercial activities (Wormbs [ed.] 2018). The narratives in these visions serve to shape the Arctic resource landscape of the future. Such narratives can also affect what we pay attention to and value (Avango *et al.* 2013; Bridge 2009). Judging by news coverage in both English-language and Russian media, oil and gas under the continental shelf are among the most important assets in the Arctic (Nilsson & Christensen 2019). Climate scientists talk instead about the ability of ice to reflect solar energy and cool the earth as a planetary resource that we are on the verge of losing. For others again, not least tourists who make a kind of pilgrimages to the

north, the value of the Arctic environment often lies in the beauty of the landscape and perhaps in the possibility of encountering some iconic animals. After following research on pollution, climate change and human conditions in the Arctic for a couple of decades, first as a science journalist and later as a social scientist with an interest in Arctic politics, visions of the future, and climate adaptation, I have begun to think about resources in a different way. The most important resource in a rapidly changing landscape is people's ability to work together to create the conditions for dealing with surprises and coping with a future that is difficult to predict.

The Complexity of Change

The changes in the Arctic are rapid and taking place significantly faster than scientists envisaged just a few years ago (AMAP 2017*d*). In addition to a warmer climate and new weather patterns, the Arctic is facing pressure from a number of other changes, where historic development and long-term processes interact with the new dynamics (Hovelsrud & Amundsen 2017). Large-scale resource extraction has a long history in parts of the Arctic, as described in more detail in Dag Avango's contribution to this special issue. With rising global demand for raw materials, there is increasing pressure to open new mines and drill for oil in new areas. New infrastructure in the form of railways, roads, ports, and fibre cable reduces distances between the Arctic and the rest of the world. A historical example of the potentially transformative role of new infrastructure is the railway between the mines in Kiruna and Malmberget with the ports of Narvik and Luleå. This new connection opened parts of Arctic Sweden to industrial development, leading to shifts in regional economic structures, demography, and livelihoods, in addition to the impacts on the landscape. Today there are discussions about a railway linking Finland to the port of Kirkenes on the Norwegian-Russian border, thus connecting Europe with the Arctic Ocean (Arctic Corridor n.d.). The Arctic is becoming increasingly accessible. In recent years, tourism has grown at a record pace, although this growth shows an uneven geographical distribution. Iceland has become one of the major tourist magnets, where tourism in 2018 accounted for over 40 per cent of the export value, thereby contributing more to the economy than fisheries and manufacturing (Óladóttir 2018). The booming tourism has also sparked debate. Environmental organizations have stressed the need for regulations to protect sensitive nature, and Sami voices emphasize that tourism must not be allowed to grow at the expense of their livelihood and their rights. Researchers have also begun to draw attention to the negative sides of mass tourism (see, for example, Hale 2018). Whereas tourism used to be described as an alternative to mining and heavy industry, bringing economic growth and jobs, voices are now being raised that question the long-term sustainability of tourism (Mullis 2017; Saarinen & Varnajot 2019). The COVID-19 pandemic has also shown the vulnerability of the Arctic tourism industry and the local economies that rely on it.

The Arctic has also become part of world politics. Twenty years ago, few would have predicted that China would have interests in the Arctic. Today this is taken for granted, and countries even further south in Asia are looking to the north. In the Arctic Council the number of states with observer status has grown.² During the Cold War the Arctic, as Kirsten Hastrup describes in her contribution, was an arena for the arms race, and although leading political actors today take pains to emphasize the consensus for peace and cooperation in the region, military rearmament is plain to be seen (Wezeman 2016).

Computer models simulating future climate can provide an overall picture of changes in temperature, precipitation, and the extent of the ice in a hundred-year perspective.³ In practice, however, it is difficult to imagine what the world will look like in as short a time as a few decades, because the changes also concern society, globally as well as locally. The unpredictability becomes apparent when you look back in time, with major political upheavals in recent years, and with COVID-19 pandemic, but also when we as scientists, in dialogue with local actors in the Arctic, have tried to create scenarios about how the future might turn out. A few years ago, in workshops conducted for the research project Mistra Arctic Sustainable Development and an assessment of adaptation action in the Arctic, we asked local and regional actors in the Nordic Arctic about what changes they see as most important from a local perspective and what changes they perceive as the most difficult to predict (Nilsson *et al.* 2017; AMAP 2017b). Responses varied depending on the local economy and geography, but there were some recurrent themes. One example concerns who will desire to live in rural areas and small towns in the future; whether there can be vibrant local communities when young people move to cities in search of education and work. Another recurring theme concerns the dependence on local natural resources, both the availability of these in the future and the question of whether there will be a market where they can be sold. A third theme concerns the local community's ability to have a voice in political decisions that govern the conditions for the development of the area.

The picture that emerged from these conversations allows us to see climate change in a wider societal perspective. We know, thanks to solid research, that the climate will change in coming decades, but both individuals and communities still face a situation where it is impossible to predict exactly which effects these changes will have on weather, landscapes, and society. The challenges that we—and the generations after us—will face are shaped in complex interactions that affect both the impact of the climate on individual people's choices and how the consequences of different political currents are translated into action. No one knows for sure what resources will be needed to ensure a good life in the future.

The media debate about Arctic resources is, as we have seen, mostly about oil and gas or about various minerals that can be extracted from the earth's crust—finite natural resources that have played and still play a key role in today's material welfare. The rich fisheries are also sometimes mentioned, either as a key resource locally for many coastal communities or as a factor in the national economy of Greenland, Iceland, and Norway. In some parts of the Arctic, forests are an important asset. Another feature of the Arctic that has attracted investment and economic interests is the supply of flowing water and wind, energy that can be captured by hydroelectric power stations and wind turbines.

Although food, energy, and materials for buildings and infrastructure are crucial for ensuring a good life, the resource landscape of the future may ultimately concern a completely different kind of resource: people's ability and willingness to work together and to learn new things. People themselves are a key resource. The rapid changes that have begun to appear as the earth becomes warmer make great demands of the ability of individuals, groups, and entire societies to *solve problems together*. Apart from the fact that we need to find ways that lead away from the fossil dependence that causes climate change, we will have to *adapt* to the effects of climate change that are already inevitable. In addition to this, there is the increasing unpredictability of how a warmer climate will affect us in everyday life. The situation requires us to tackle new questions: What are we going to plan for? What is most important in our lives? Whether it is the Arctic or

some other part of the world, the question of resources becomes much broader than just a matter of raw materials and energy: What resources do we need to *create* to cope with the challenges that an unpredictable future might bring?

Figs. 2–3. Humans and their ability to make the world comprehensible, and to solve problems along with others, are a key resource in a changing world. In the exhibit “The Arctic—While the Ice Is Melting” at Nordiska museet in Stockholm, the original graphic from the Arctic Resilience Report was used as inspiration for a woven installation, where the mere act of weaving further emphasizes the dynamic nature of adaptive capacity.

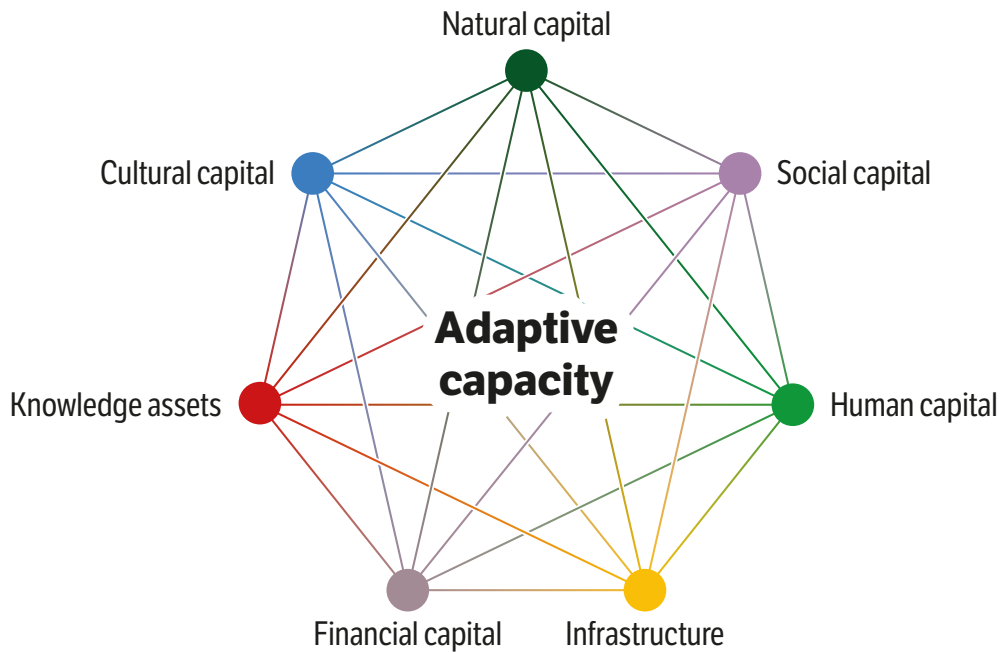


Fig. 2. Graphic: Hugo Ahlenius, Nordpil, reproduced from Arctic Resilience Report (Arctic Council 2016).



Fig. 3. Model installed in exhibition by Johanna Thelander. Photo: Karolina Kristensson, Nordiska museet 2019.

The Resource Landscape of the Future

Climate change has led to a growing interest in questions about the ability of societies to adapt. Assembled insights and results of research on climate adaptation and resilience in the Arctic indicate some decisive factors to prevent new conditions and surprises from leading to crisis (Kofinas *et al.* 2013; Nilsson *et al.* 2016). Taken together, they outline what I have chosen to call *the resource landscape of the future*. It is a multifaceted landscape. To clarify that it is a whole consisting of parts which must interact in order to strengthen our ability to deal with a rapidly changing world, they can also be described as the facets of a prism. Just as today's landscape has been shaped by decisions and actions in the past, so the decisions taken now and in the immediate future will in turn affect the resource landscape of future generations. This urges us to assume responsibility, both individually and collectively, so that resources are not eroded but actively strengthened. The resources of this landscape are illustrated in Fig. 2 and described in more detail below.

Humans are often portrayed as a threat to nature, and the climate change that the earth is now undergoing is undeniably the result of how people have chosen to live their lives. Kyrre Kverndokk's contribution discusses in greater detail how a growing awareness of this is expressed, among other things, in the increasingly common designation of our era as the *Anthropocene*. At the same time, I would argue that the individual person and people together are also the single most important resource to meet the new challenges we face. People possess knowledge, skills, and life experience. Representatives of companies and states sometimes talk about investing in human capital as a way to boost growth, but there are also traditions that emphasize the central role of humankind as the steward of a legacy to be passed on to future generations. This outlook, underpinned with ethical rather than economic arguments, has, for example, been highlighted in Arctic research into biodiversity (Chapin *et al.* 2015).

As mentioned earlier, polar bears have long dominated the image of the Arctic. Is this an expression of an ideal picture of the Arctic as a huge nature reserve without humans? Yet, people have lived in different parts of the Arctic for several thousand years, and they still do. The societies and survival strategies that Kirsten Hastrup writes about in her contribution on life with the ice in Greenland provide examples of both change and continuity. In recent years, the rights of Arctic indigenous peoples have been given ever stronger protection in international law (Bankes & Koivurova 2014). The experiences and specific knowledge of Arctic peoples concerning the environment and living conditions have also gained increasing attention and are held up as vital also outside of the immediate context. Local observations of what is happening in the north are essential if the rest of the world is to understand what climate change can mean for humans and nature.

Collaboration is based on a great many interwoven and overlapping social networks. Who can extend a hand when you are in need? Who has knowledge to share with others? Who can give meaning to life and generate inspiration to find new ways when old habits are no longer fit for purpose? At least as important as the links between individuals are the societal processes that create common expectations and norms, even when we disagree on individual issues. These structures have been built over time to create trust in the community even when not everyone knows each other. We are all part of political systems at local, national, or international level, and these are often based on trust in democratic processes. When this trust is undermined, it becomes more difficult to cooperate and make decisions that take everyone's wellbeing into account, including future generations, and that do not just bring short-term benefit for some individuals.

Today's major political challenges stem from the fact that in matters large and small, from planetary to local or individual, there are often clashes when it comes to long-term risks and benefits versus immediate interests. Many of the changes that characterize today's societies around the world derive from systems that are global. The earth's climate is an example, but there are also the markets for raw materials and money. At the same time, it is often easier to create trust in small-scale, local contexts or within national borders, where shared interests are more obvious and where fundamental values have in many cases been shaped by a common past. Effective cooperation to meet changes and surprises will require us to simultaneously consider the global and the local, the individual and society. Otherwise, there is a risk that both politicians and individuals will make decisions on erroneous grounds.

Knowledge is another central resource. It often refers to facts about the world as we understand it today. But the world is constantly changing, which means that some knowledge quickly becomes outdated. Old textbooks or scientific articles about sea ice in the Arctic could easily be misleading, not because there was anything wrong with the texts when they were written but because the world has changed so quickly. Instead of viewing knowledge as static, it is therefore more useful to see both knowledge-making and learning as social processes. Such processes, together with our experiences, also shape what we regard as facts. In a changing world, the demands on our ability to quickly perceive and analyse the surrounding world increase, as do the importance of social contexts where proven experience can meet new insights and where it is possible to listen and learn from others. A society's ability to adapt to change may depend on the existence of forums where people with different types of knowledge can meet: the knowledge accumulated in different scientific disciplines, experience-based and local knowledge of the specific conditions that prevail in a particular place, and the knowledge possessed by those who practise a particular activity.

The opportunity to gain knowledge of what is happening in the Arctic has never been greater than today. Since political cooperation began in the Arctic in the 1990s, first on environmental issues and research and then through the establishment of the Arctic Council in 1996, countless scientific reports have been published, the findings of which are often summarized and spread in popular form to a larger audience. During the International Polar Year 2007/2008, major investments were made both in basic new research with scientific fieldwork and in reaching out more with results and interpretations. Some of the initiatives taken during the Polar Year have become a permanent part of the information flow. For example, those interested in sea ice can get new reports every month and also follow how scientists reason about the results.⁴ In addition, more is reported about the Arctic in the media, whose interest in the region has increased after the sea ice began to disappear at an accelerating pace (Christensen 2013). In Swedish newspapers too, Arctic matters have gained more space in recent years when the rapid melting of the ice has become apparent (Christensen 2013). Experiences from the Arctic also appear in film and music, and on a large scale through Nordiska museet's exhibition "The Arctic—While the Ice Is Melting." The great challenge for those who are interested is rather to sift the information and critically evaluate it: Why do some images and narratives get a lot of space? What knowledge or experience is *not* visible in the news flow or in the range of culture on offer?

Culture is not always mentioned in the academic discussion of what creates the conditions for climate adaptation, but in the conversation about the future of the Arctic it has been highlighted as a central factor, with the focus on indigenous peoples' experience-based knowledge and views of the relationship between humans and nature

(Kofinas *et al.* 2013). Misguided attempts during the colonization of the Arctic to shape all people according to the norms of the colonizing society damaged processes related to sharing traditional and local knowledge across generations. This applies not least to the reservoir of experience that was integrated in the linguistic diversity. But there are also positive trends in cultural and linguistic renewal (Schweitzer *et al.* 2014). Moreover, in the past decade, more and more knowledge processes have started to make room for dialogue between science and indigenous peoples' knowledge and culture, not least concerning climate change.⁵ The short documentary films shown in Nordiska museet's exhibition include additional projects based on collaboration between scientists and people with expert local knowledge: from north western Greenland where anthropologists, biologists, and local hunters worked together exploring new waterways and other effects of warming (Andersen *et al.* 2017), and the collaboration on measuring glaciers and studying warming that is being developed between reindeer herders in the Laevas Sami community and climate research at Stockholm University's research station Tarfala (Rosqvist 2020: 186–187; Inga 2020: 194–196).

Culture in its diverse forms also plays a central role as a tool for existential and ethical problems. We are all faced with questions where knowledge in a narrow sense is not sufficient to provide us with a basis for decisions: What is valuable for a good life? How should we prioritize when it is not possible to satisfy all desires and needs? What does nature mean to people and communities?

Nature in the form of the physical attributes of landscapes and ecosystems with their diversity of organisms plays a key role in producing food and materials, but also in regulating the climate, ensuring the availability of clean water and in many cases for recreation and for people's identity. In the discussion of human dependence on ecological processes, concepts such as ecosystem services and natural capital occur. There have also been attempts to estimate the economic value of ecological processes, although not everything can be measured in money (Kumar [ed.] 2012; for examples from the Arctic of applications and critique, see CAFF 2015). An environmental economist has calculated that the overall global climate benefit of the ability of sea ice to reflect solar energy and of the Arctic soil to absorb the climate gas methane is ten times greater than all the oil and gas in the region (O'Garra 2017).

Estimates of economic values are based on how a resource is valued on the market (how much someone is willing to pay), sometimes affected by guidelines that have been decided by political assemblies. An example of the latter is that the EU has created a market for carbon dioxide emissions to stimulate a reduction. But the economic value that is ascribed to various resources is not given by any laws of nature; it depends on priorities and choices in a social context as well as on who has the opportunity to make their voice heard in the market and in politics. Economic value can therefore be a dubious measure of the overall benefit to society, not least when we have to think ahead in time and also take into account the welfare and priorities of future generations, which we can only guess at today. Moreover, calculations of the value of ecosystem services do not capture values other than purely economic ones. Despite their shortcomings, calculations of ecosystem services and their values can be important for revealing matters that are otherwise easily overlooked. Perhaps the strength of concepts such as *natural capital* and *ecosystem services* is primarily rhetorical, in that they use a language that tends to have a greater political impact than references to spiritual, emotional, and ethical values. These concepts also draw attention to the fact that many basic human needs are entirely dependent on processes in landscapes and ecosystems. Today, many

of the roles that nature plays for people's well-being are being eroded. This happens when we pollute land and water so that they can no longer help to provide us with food. It happens when chemicals kill the bees that pollinate fields, berry bushes and fruit trees. And it happens when a warmer world creates an Arctic that can no longer play the role of earth's refrigerator.

Fortunately, there are also measures that can contribute to well-functioning ecosystems and where the role of humans as *stewards* becomes central. In a rapidly changing world, however, that role is far from simple. It requires long-term planning in a situation of uncertainty about the conditions that may prevail, even in the near future. Resilience research often highlights diversity in biology, culture, and knowledge as means to secure the broad resource base that is particularly important when the surrounding world changes. In the short term, preserving such diversity can be perceived as a cost or a restriction, for example when policy decisions protect certain areas from development (see for example Carson & Sommerkorn 2017). Given that the findings and messages of climate research show that a radical societal transition is needed to limit the earth's warming, many people believe that we are in a situation where national and individual interests sometimes need to be set aside in favour of joint responsibility. Basically, it is a question of what risks we want to take and at what price. At the same time, we need an open discussion about who should make decisions and how they should be made. To what extent are those exposed to the greatest risks also included in the decision making? The difficult questions require not only knowledge of the systems to be managed, but also open conversations about priorities, fairness, and objectives. It concerns the perspectives that need to be included in conversations about how nature and society interact in what are sometimes referred to as *social-ecological systems* (Sommerkorn *et al.* 2013). Climate research has in recent years become increasingly multidisciplinary, with strong elements of social sciences and humanities, and played a part in putting issues like these on the agenda (Berkes *et al.* 2003).

To a large extent, today's social-ecological systems also involve the *infrastructure* that helps provide people with food, water, energy, and opportunities to communicate with the surrounding world. The role of the infrastructure comprises the technical hardware in the form of bridges, roads, railways, fibre cables, and water pipes, but also the social structures required for this technology to function, as well as laws and structures for ownership and management. In this broader sense, the infrastructure often goes hand in hand with the public institutions that make decisions on behalf of everybody. Investments in infrastructure are often expensive, which is why the infrastructure is often substandard in sparsely populated parts of the world, as in the Arctic, where the investments are also rendered more expensive by large distances and demanding natural and climatic conditions. Infrastructure expansions have often been justified by industrial interests in Arctic natural resources and driven by economic forces. In Sweden, for example, the development of the railway in the north went hand in hand with the mining industry (Sörlin 1988). In Russia, Alaska, and Canada, the need to transport fossil resources to southern markets has played an important role. Now there is increasing investment in infrastructure to facilitate shipping and to link northern areas to the Internet as well.

The relationship of infrastructure to a changed climate is complex. If communication between people and the transport of goods is facilitated in areas with great distances, this can contribute to a greater ability to cope with change and surprises. At the same time, insensitive infrastructure placement can harm existing ecosystems and reduce freedom of movement for humans and animals, which can instead erode the capacity for

adaptation. For example, the Sami and their reindeer need migration routes and pastures, but this has often conflicted with new infrastructure projects, from the construction of hydroelectric power stations in the first half of the century to today's need for wind power and new roads for mining transports.

The infrastructure itself is sensitive to climate change and has often been dimensioned according to historical climate conditions. Even if one builds with a margin for occasional extreme events, there is a high risk that weather events that are now perceived as exceptional will become more common in a warmer world. Examples include torrential rain undermining roads and railways, heatwaves that are too extreme for cooling systems in hospitals and industry, or large amounts of snow which must be handled with inadequate resources. In areas with melting permafrost, the challenges are even greater, since land that was previously frozen all the year round is now thawing to ever greater depths and therefore no longer provides a firm foundation for buildings, roads, and railways (Hjort *et al.* 2018).

Financial capital is a prerequisite for making the necessary investments, whether in infrastructure, knowledge, or new collaborations. The availability of money in the bank or the possibility of borrowing is central both for adaptation and for renewal. In the Arctic, financial muscle has often been linked to industry and investment has therefore followed the needs and priorities of industry. One issue for local communities facing new industrial establishments is the extent to which local people and municipal politicians can participate in steering investments. It is becoming more and more common to see agreements in which companies which over and above their other priorities make deals to finance investments that can help develop the local community in order to secure social acceptance for industrial development. A broader question concerns who is to pay for investments that do not yield any financial returns, at least not in the short term, but which can be crucial to people's livelihood and quality of life. How do we ensure that today's financial investment contributes to long-term sustainability, according to the UN's Sustainable Development Goals, rather than only stressing economic returns? At the same time, global sustainability objectives need to be translated and supplemented so that they become relevant in every unique local situation.

A Web of Resources and Dependencies

Placing emphasis on the potential for adaptation and renewal in the face of an uncertain future conjures up a different picture of the Arctic as a resource landscape than when we talk solely about natural resources. The focus shifts to people's ability, individually and together, to prepare themselves for new circumstances and climate-related surprises. It is important not to stare blindly at one aspect at a time, but to see the facets considered here as part of a whole. To be able to contribute to a general capacity to adopt new challenges, these aspects are mutually dependent: people, cooperation, knowledge, culture, nature, infrastructure, and financial capital. They are not interchangeable entities. As previously discussed, one can calculate the value of specific aspects of nature for human well-being in economic terms, but unlike money, one ecosystem service cannot be freely replaced with another. Nor can people's inventiveness be replaced by a productive ecosystem or a functioning political structure for making shared decisions.

The increasing scientific interest in the interaction between ecological and societal processes from a system perspective has led to a focus on new issues. For example, *resilience* research has highlighted how many separate small changes together can make an entire system sensitive even to an isolated moderate shock (for an overall presentation

of the resilience concept, see Walker & Salt 2006; Folke *et al.* 2010). In the worst case, the shock can cause the whole system to change character and get stuck in a new dynamic, which may not be as favourable to humans. Scientists talk of this in terms of *tipping points*. Today there is a growing awareness that sea ice may disappear completely from the Arctic during the summer months, which in turn may lead to a fundamental change in how the global climate system works (Peterson & Rocha 2016; Wassmann & Lenton 2012). This would also profoundly change the Arctic societies whose everyday life, livelihood, and culture are intimately intertwined with hunting which in turn depends on the ice, or with reindeer herding which is dependent on the availability of lichen and land on which to move. These changes have even been described in terms of threats to the existence and fundamental rights of indigenous peoples (Watt-Cloutier 2015). But climate change will also affect life in larger communities and cities, the conditions for transports across land and sea, and economic activities such as industry and winter tourism.

At the same time, the system perspective has been criticized for being blind to the ability of humans to make decisions and choose direction; the future may seem predetermined and guided throughout by forces beyond people's influence (for a summary of the debate see Carson & Sommerkorn 2016). Yet research based on studies of Arctic communities shows that a society's ability to make decisions locally is crucial for preventing local social-ecological systems from shifting character in an unwanted direction (Huitric *et al.* 2016). But if that foundation—the opportunity to control one's future—is also eroded, perhaps only a little nudge is needed before the undermined ground collapses. Diversity, as discussed in the context of knowledge processes, is another key word in resilience research. Since we cannot know in advance what knowledge, which social networks or natural resources may be decisive for dealing with future challenges, the presence of different perspectives needs to be facilitated and secured.

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Ruptures in the ice are a warning that climate change is creating completely new conditions for life in the Arctic. We are reminded that both nature and societies are in constant motion and that we cannot take the world of today for granted. But new ruptures not only create new conditions but also an opportunity for new openings. Although we know that the earth will grow warmer, we cannot know in detail what challenges people and societies will face even within as short a time as twenty to thirty years, when the children born now have grown up and perhaps have children of their own. On the other hand, it is possible for the vast majority to help strengthen one or more of the characteristics, the facets of the prism sketched here, that together enable communities and ecosystems to cope with rapid changes and surprises.

NOTES

¹ This article is a revised and translated version of the chapter "Sprickor och öppningar. Arktis och framtidens resurser" ['Cracks and openings. The Arctic and the resources of the future'], in Gustafsson Reinius (ed.) (2020), pp. 252–269.

² For a current list of Arctic Council observers, see <https://arctic-council.org/index.php/en/about-us/arctic-council/observers>; access date 28 Dec. 2020.

³ For more information about how models contribute to knowledge about sea ice: <https://nsidc.org/cryosphere/seaice/study/modeling.html>; access date 28 Dec. 2020.

- ⁴ Read more on the website of the National Snow and Ice Data Center: <https://nsidc.org/>; access date 28 Dec. 2020.
- ⁵ See, for example, the project “Exchange of Local Observations and Knowledge of the Arctic;” <http://eloka-arctic.org>; access date 28 Dec. 2020. Another example is the work of the Arctic Council on climate adaptation, as presented in three reports: *Adaptation Actions for a Changing Arctic. Perspectives from the Barents Area*; *Adaptation Actions for a Changing Arctic. Perspectives from the Baffin Bay/Davis Strait Region*; *Adaptation Actions for a Changing Arctic. Perspectives from the Bering-Chukchi-Beaufort Region* (AMAP 2017a; 2017b; 2017c).

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