

## Developing Indicators of Social-Ecological Resilience

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### Monitoring and observing Arctic change

In order to monitor and better understand developments in the Arctic, scientists have deployed a wide array of scientific tools, including sensors, satellite monitoring, and painstaking on-site data collection to measure and track changes in physical (AMAP), ecological (PAME, CAFF), and social parameters (ASI, AHD12). While some important data can be collected by sensors (primarily biophysical parameters) in what amounts to real time, research on Arctic communities and the ecosystems upon which people depend tend to involve data collection methods that are comparatively slow to carry out, and which for a variety of reasons including methodologies and scarcity of data availability, provide an incomplete picture.

In addition, research on Arctic communities is often case study based, with the consequence that the tracking and analysis of social developments lags far behind the developments themselves. Moreover, research tends to investigate changes in biophysical and social systems as separate entities, even though these coupled social-ecological systems co-evolve (Gual and Costanza ref) - i.e. they evolve in concert with one another. In a period of rapid change, knowledge of changing social conditions and the ecosystems communities are tightly linked to often develops too slowly to identify critical thresholds while there is still time to respond. This presents serious challenges for community leaders and other policymakers who seek to base policy decisions on the best and most up-to-date knowledge available.

We see an important opportunity to tackle this lack of data and at the same time strengthen understanding of the links and interactions between social and ecological systems. Residents of the Arctic have traditionally been keen observers of variations in the physical and social environment. Our contention is that the communities across the Arctic monitor and are cognizant of small changes in the social and physical environment around them as they occur—often before they can be properly measured and interpreted by more conventional scientific means. By engaging in assessing key properties of the social-ecological system in a process of co-production, it will be possible to strengthen monitoring and the capacity to respond to change. Developing an indicator framework based on a social-ecological resilience approach can help support the assessment and monitoring of the complex interactions of social-ecological systems.

## What do we mean by resilience?

In the context of operationalising resilience as a tool to develop knowledge tools for responding to and shaping change, the working definition of resilience employed here is:

*the capacity to learn, share and use knowledge of systems functions and feedbacks, empowering communities to consciously and effectively engage in shaping adaptive or transformative social-ecological change – whether in response to disturbances, to strengthen a desired set of functions, to stave off unwanted changes, or in pursuit of a more desirable set of arrangements.”*

This definition takes the subject social-ecological system as its starting point and makes agency fundamental. Agency is exercised by the communities (at whatever scale) that define the social-ecological system, making use of social and ecological systems-related learning & knowledge as an explicit element of “adaptive and/or transformative capacity”.

## What “ingredients” contribute to resilience?

Key capacities that facilitate effective adaptation to disturbances – or support transformational change where needed – have been identified based on a large body of empirical research. Among these, we have identified five key practical dimensions of resilience that are particularly important. The first two of these are cross-cutting, meaning that they enhance resilience as a component part of other “ingredients”. The latter three characteristics provide the basis for useful indicators of social-ecological resilience.

### ***Cross-cutting ingredients:***

***Assuming change*** has the benefit of accepting uncertainty and surprise as part of reality and leaves a community better prepared to steer itself through changing conditions. Crisis and change may be approached as an opportunity for pursuing developmental goals. Most importantly, expecting change leads to different kinds of choices than does an expectation that constancy will be the norm.

***Diversity*** is important because it broadens the range of effective response paths. Diversity can be seen as a form of insurance - when disturbance or changing conditions lead to the failure of one kind of response, other mechanisms are available to carry out a given function or set of essential functions. Beyond that diversity provides the foundations for creative problem solving by maintaining a stock of elements that can be combined in novel ways in response to change– this function applies to both social and ecosystem aspects of the system. Biodiversity also enhances the resilience of ecosystem states to secure the production of desired sets of ecosystem services and for social-ecological adaptation and transformation.

### ***Indicator categories for social-ecological resilience:***

**Livelihoods that provide for material and spiritual well-being** emphasize human needs, capacity for goal oriented action, and also introduce broader issues of values, human rights and competing interests (Tanner, 2014). The material well-being aspect of livelihoods, which entails food, shelter, other material needs is essential to resilience, and poverty undermines basic capacity to respond to disturbance and to changing conditions. The concept of “livelihoods” also includes non-material benefits derived from livelihoods activities such as social contact, ability to pursue meaningful goals and contact with nature. Mixed livelihoods (combined market and non-market means of securing material and non-material needs) are a common and important feature of life in many Arctic communities. Livelihoods provides a framework for wider value sets linked to well-being that inform desired/desirable future states /trajectories of social-ecological systems.

**Knowledge and capacity to learn** to add to and modify existing knowledge is the key means by which community choices can be directed to enable effective responses to disturbances and challenges. Knowledge of cause and effect relationships between communities and ecosystems make it possible to consciously choose between competing priorities and at least some of the trade-offs embedded in those choices. The important precursor for knowledge is the capacity to learn, modify, or replace knowledge – this is an inherently social, even political process.

**Capacity for self-organization** is essential for the effective exercise of agency. It encompasses the multiple factors that contribute to a community's capacity for collective action, define the nature and cause(s) of challenges, and come to some measure of agreement on suitable responses. This capacity is also influenced by factors outside the community, including legal rights or norms that affect how collective efforts may be organized, or define ownership or authority over certain resources or activities.

## **Toward indicators of social-ecological resilience**

In order to operationalize the above dimensions of resilience we are engaging in a scoping effort to identify first how they can be assessed, and second, how strengthening particular ingredients of resilience can support adaptation to change - and to as yet undetermined and/or unknown disturbances. Drawing on analyses of a large body of empirical research we have identified three key ingredients for which indicators could be identified: livelihoods, knowledge and self-organization (see above). Within each of these ingredients, or categories of ingredients, the two cross-cutting dimensions are applied: assuming change and fostering diversity.

Significant work has been done in an effort to develop sustainability indicators, including, for example, indicators of human well-being in the Arctic (i.e. Arctic Human Development Report II and Arctic Social Indicators II). Nevertheless, the development of indicators of social-ecological resilience, which remains in its early stages, is especially important in the

context of planning adaptation actions for a future that is expected to carry with it major and sometimes disruptive change.

Two important issues arise in a process of developing the three sets of social-ecological resilience indicators described above. The first is that while the way in which they are defined and assessed is likely to vary somewhat dependent on local context, the indicators should be translatable into more general, comparable measures. The second is that due to the nature of these indicators, co-production through a participatory process can be expected to produce not only a more informed, nuanced, and well-grounded assessment, but also contribute to the community-based capacity for effective engagement in an on-going process of assessment.