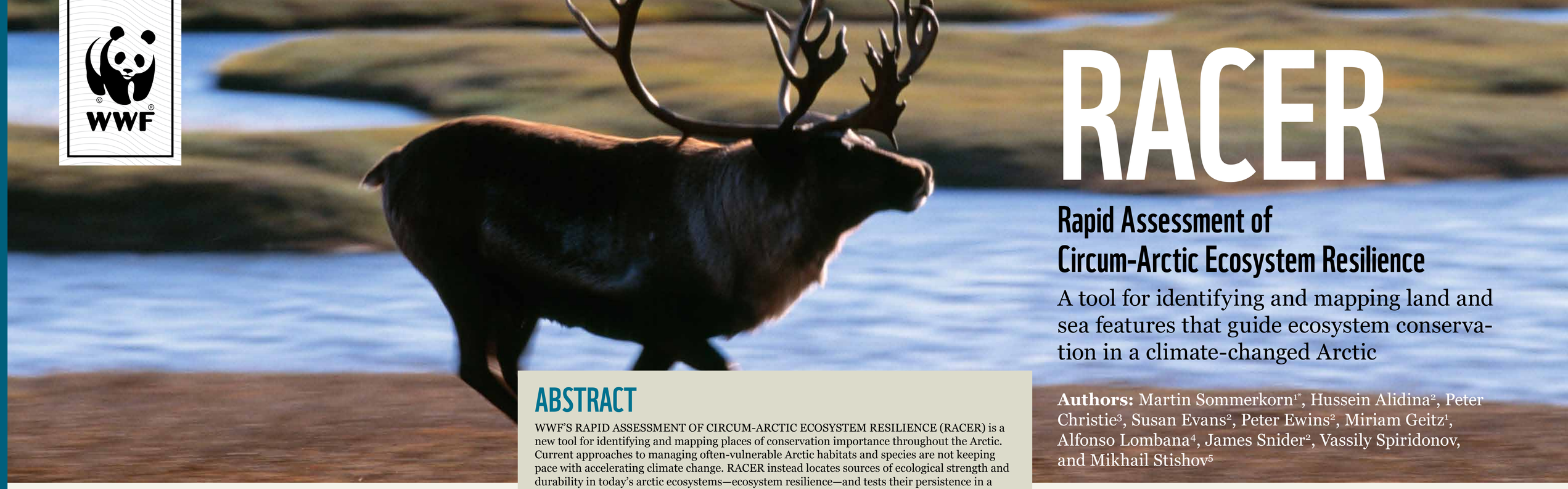

RACER

Rapid Assessment of Circum-Arctic Ecosystem Resilience

A tool for identifying and mapping land and sea features that guide ecosystem conservation in a climate-changed Arctic

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ABSTRACT

WWF'S RAPID ASSESSMENT OF CIRCUM-ARCTIC ECOSYSTEM RESILIENCE (RACER) is a new tool for identifying and mapping places of conservation importance throughout the Arctic. Current approaches to managing often-vulnerable Arctic habitats and species are not keeping pace with accelerating climate change. RACER instead locates sources of ecological strength and durability in today's arctic ecosystems—ecosystem resilience—and tests their persistence in a climate-altered future. Focusing conservation attention on these enduring sources of resilience is important for the continued functioning of arctic ecosystems, including the ecological services people receive from them.

The RACER method has two parts. The first part maps the current location of land or sea features (such as mountains, wetlands, polynyas, river deltas, etc.) that are home to exceptional growth of vegetation and animals (productivity) and varieties of living things and habitats (diversity). These key features are especially productive and diverse because the characteristics that make them up (e.g., the terrain of mountains or the outflow at river mouths) act as drivers of ecological vitality. The exceptional vitality of these places (that is, their above average productivity and diversity) means the key features are sources of resilience for the ecosystems and ecosystem services of the wider regions (ecoregions) in which the key features are found. The second part of RACER tests whether these key features will continue as sources of region-wide resilience despite predicted climate-related changes to temperature, rain and snowfall, sea ice, and other environmental factors important to living systems. The relationship between these changing climate variables and the drivers of ecological vitality (that depend on these variables) provides the foundation for RACER's forecasts of ecosystem resilience to 2100.

The RACER method

The RACER method is an innovative ecosystem-based method that finds and evaluates the local sources of ecological vitality that confer the functioning of the larger-scale ecoregion now—and assesses how well they are expected to function into the climate-affected future (Fig. 2). The relationship between the large regional ecosystems—ecoregions—and the most productive and ecologically diverse features they contain is central to the RACER method.

RACER assessments test ecosystem resilience for entire ecoregions. This allows RACER to make conclusions that are relevant to planning and management in regions that are representative of ecological communities, biodiversity, and natural values and services across the circumpolar Arctic.

Step 1

The first part of the RACER method identifies and maps the current location of mountains, river deltas, ocean polynyas, and other land or sea features significant for the functioning of ecosystems across arctic regions. RACER identifies key features from their above-average levels of biological productivity and diversity—the two main engines of ecosystem functioning (see Fig. 1.3). Productivity and diversity are driven by the physical and ecological characteristics that make up features on the landscape or in the sea.

The RACER method recognizes key features from among the many features in each arctic ecoregion by looking for places where productivity or diversity (or both) are above the region-wide average.

To detect and map places where the ecosystem engines of productivity and diversity are working well, RACER gathers and analyses information from three general sources: remote sensing data; reviews of ecoregion-relevant literature (such as scientific publications or harvest records of Indigenous peoples); and evaluations of the information by scientific and local experts familiar with the regional ecology.

Step 2

The second part of the RACER method looks ahead to anticipate whether arctic ecosystems with a capacity for resilience today will continue to exhibit the same ecological fortitude in a future altered by climate change.

RACER assesses the impacts of climate change using the drivers of productivity and diversity as measuring sticks. The drivers relevant to RACER's assessment come together in unique ways at the sites of key features to generate locally exceptional ecological vitality. These high-performing combinations of drivers are the result of the physical and ecological characteristics that make up the key features. Although the same ecological drivers are at work across the entire ecoregion, RACER's assessment is concerned only with their performance (now and into the future) at the places of locally exceptional productivity and diversity that helps to confer region-wide resilience.

The novelty of the RACER method is the use of ecological-relevant drivers as a quantitative link between climate change and the continued functioning of regional arctic ecosystems. This link—missing from many other methods attempting to forecast climate-related ecological change—takes advantage of the close relationship between the ecological drivers of productivity and diversity and the climate-affected environmental variables for which forecasts are available.

RACER uses the best-available forecasts of change to climate-related environmental variables provided by Global Circulation Models (GCMs).

Forecasts of change to environmental variables allow RACER to evaluate changes (in direction and degree) to related ecological drivers in the region.

Using drivers as the link, RACER is able to use the forecast information from the GCMs to assess whether key features are likely to continue as local sources of region-wide ecosystem resilience in a changed climate. Experts who live or conduct research in the region play a pivotal role in evaluating how forecasted climate changes to the region-wide environment can affect the drivers of productivity and diversity at key features and alter the likelihood these key features will remain as local sources for regional ecosystem resilience.

CONCLUSION

By mapping key features and evaluating their likely persistence in our future climate, RACER focuses conservation and management attention on the importance of minimizing environmental disturbance to places that are—and will be for the remainder of this century—sources of ecosystem resilience in the Arctic. In particular, RACER's ecosystem-based method equips resource managers and conservationists with new targets and leverage points for their efforts—managing not just from a species and habitats perspective, but including the combinations of geographical, climatic, and ecological characteristics, or drivers, that are behind ecosystem functioning in the Far North. Identifying the sources of resilience in arctic ecosystems and safeguarding and nurturing them may be the best hope for survival of the Arctic's unique identity—including its habitats, plants, animals and the ecological services that northern peoples and cultures depend upon.

Figure 2 RACER analytical framework

PART 1: Mapping Resilience

Step 1. MAP PLACES OF EXCEPTIONAL PRODUCTIVITY AND DIVERSITY
Uses literature and remote sensing analysis to identify places with exceptional productivity and diversity within each ecoregion.

Step 2. IDENTIFY KEY FEATURES
Describes the unique combinations of drivers considered responsible for the exceptional local-scale productivity and diversity (above).
Identifies these driver combinations as "features" that confer ecoregion-wide resilience and shows these features on a map.

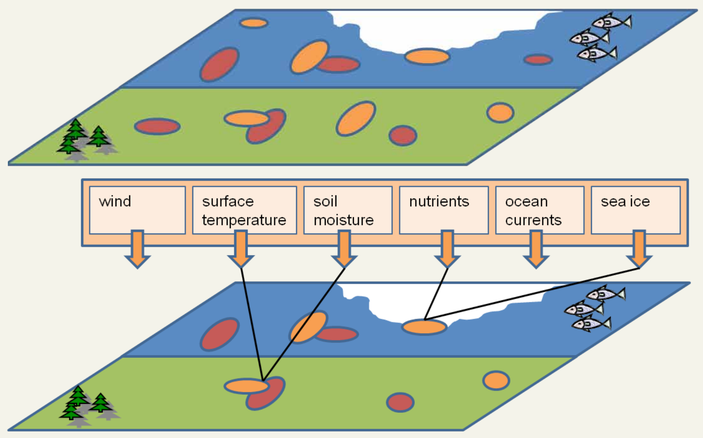
PART 2:Assessing Persistence

Step 1. ASSESS THE IMPACT OF CLIMATE CHANGE ON THE ECOREGION
Identifies the GCM variables that are relevant to the ecoregion and describes the GCM-projected change of these variables through to 2100.

Step 2. ESTIMATE HOW DRIVERS OF EXCEPTIONAL PRODUCTIVITY AND DIVERSITY OF KEY FEATURES ARE AFFECTED BY CLIMATE CHANGE
Estimates how projected changes in GCM variables affect the ecoregion-scale drivers and interpret their impact on the drivers of the exceptional productivity and diversity at the scale of key features.

Step 3. ASSESS THE PERSISTENCE OF THE CAPACITY OF KEY FEATURES TO CONFER RESILIENCE ON THE ECOREGION AFFECTED BY CLIMATE CHANGE
Assesses the likely persistence of a key feature's continued ability to confer resilience by interpreting whether feature-scale drivers will continue to support exceptional productivity and diversity for identified key features.

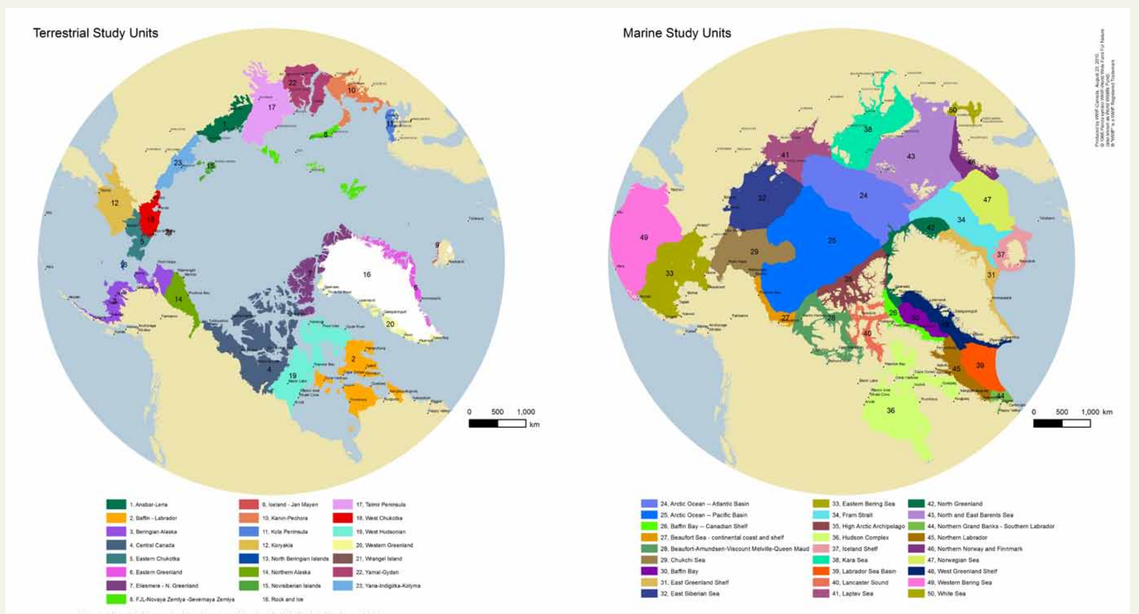
Figure 3 The connection between drivers, key features, exceptional productivity and diversity.



TOP: The descriptive view
Places of above-average productivity and diversity on the land and in the sea

BOTTOM: The functional view
The unique local combination of drivers of productivity and diversity comprise the key features of the region

Figure 1 RACER Study units



LEFT: ADAPTED FROM THE CIRCUMPOLAR ARCTIC VEGETATION MAPPING (CAVM), FLORISTIC PROVINCES (2003), WWF TERRESTRIAL ECOREGIONS (2007), IVACHENKO LANDSCAPE DIVISIONS (1980) AND ALEXANDROVA VEGETATION ZONES (1970)
RIGHT: ADAPTED FROM THE MARINE ECOREGIONS OF THE WORLD (MEOW) 2007

50 diverse ecoregions

Fifty representative ecological regions, or ecoregions (Fig 1; Spalding et al. 2007, CAVM Team 2003), are found within the boundaries of the circumpolar Arctic (as defined by the CAFF working group of the Arctic Council). These ecoregions are home to diverse biological communities and unique arrays of creatures, plants, and sea life superbly adapted to harsh conditions, dramatic seasonal shifts, and months of dark cold. With these adaptations also comes the high genetic diversity that characterizes arctic life (CAFF 2007).

The cultural significance of the Arctic is also far-reaching. Rich, regionally distinctive cultures and communities are intimately connected to the land, water, and ice. Today, many traditional ways of life continue alongside modern economic activities. But the fate of their traditions is tied in large part to the survival of the wildlife and ecosystems that continue to sustain them. While there may be changes in species, the purpose of promoting ecosystem resilience is that the ecosystem functions will continue, and can continue to sustain life.

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Further Information

The RACER method has been compiled in a handbook aimed at policy makers and natural resource managers and planners. To download the RACER handbook and to obtain more details on the background of the method, please visit www.panda.org/arctic/racer .

Photo: Staffan Widstrand / WWF

Sources

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Footnotes

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