Guidelines for Designing MPA Networks to Promote Resilience of Arctic Marine Ecosystems in a Changing Climate

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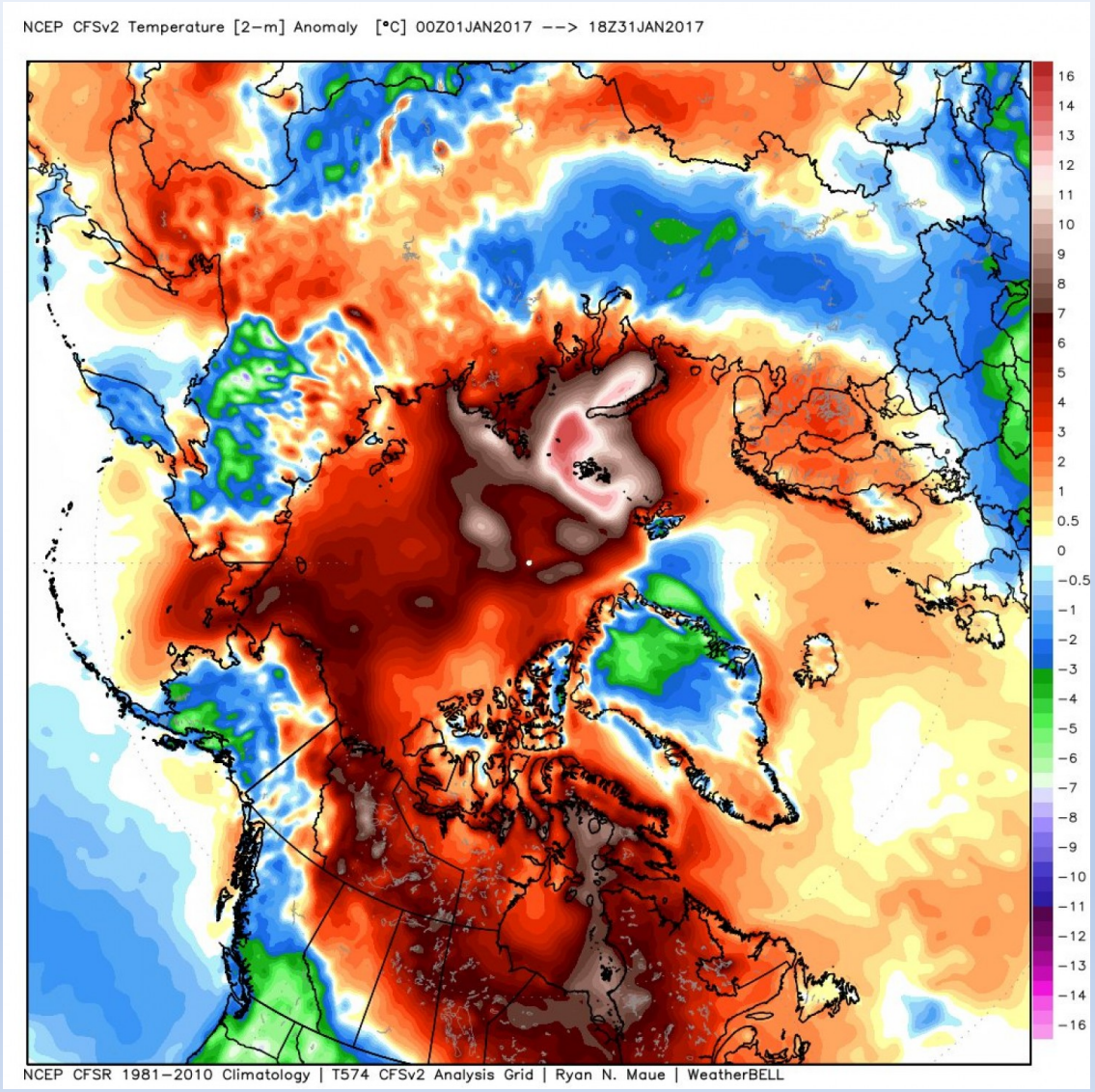
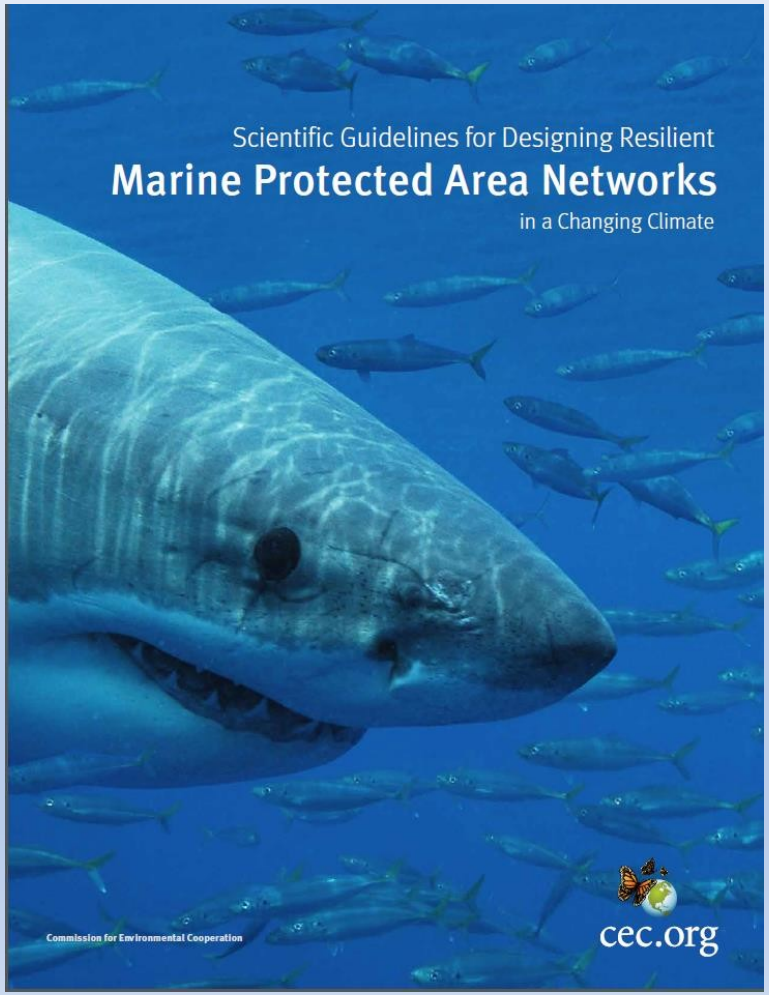
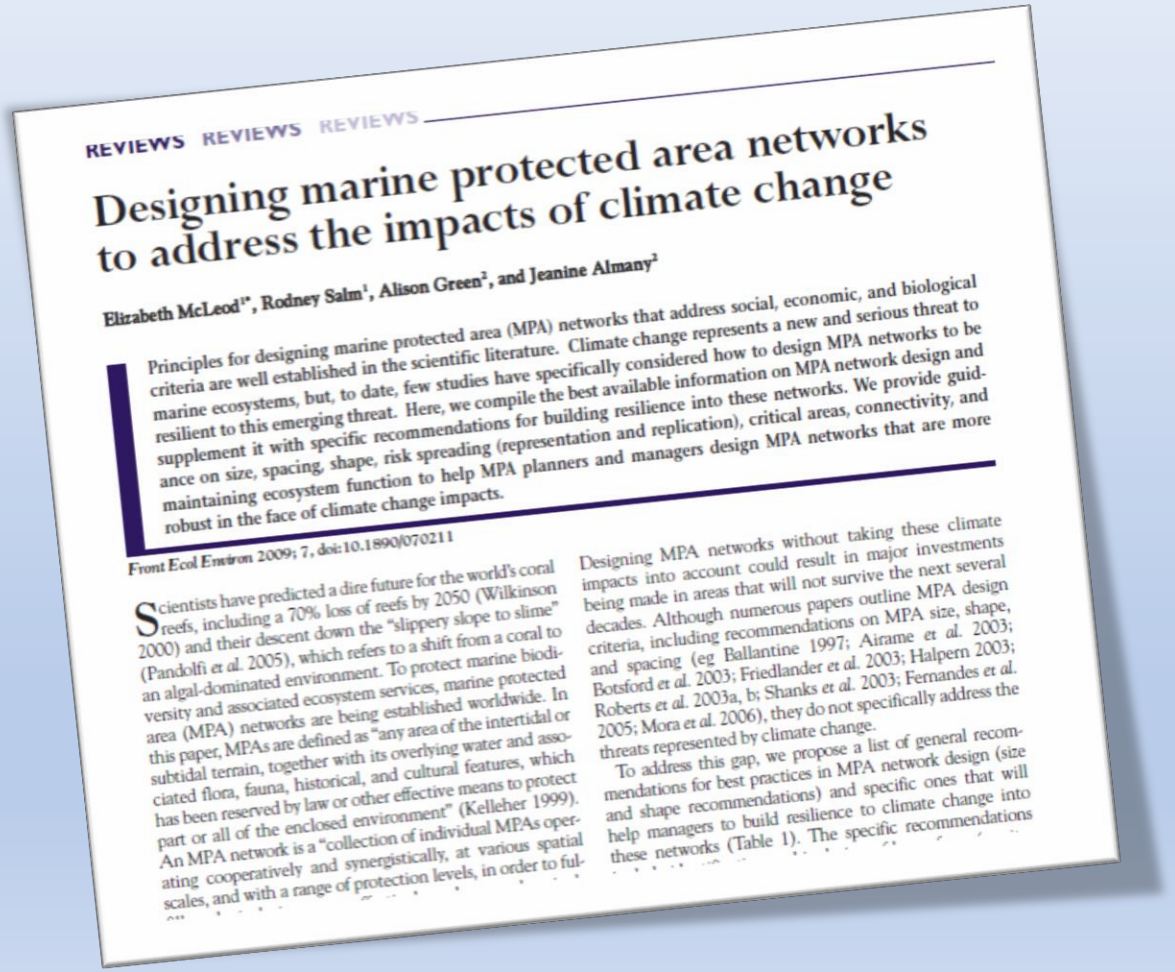
“Beyond the extreme’: Scientists marvel at ‘increasingly non-natural’ Arctic warmth”

Washington Post
Feb 1, 2017



How do we design Arctic MPA Networks to Promote Resilience of Arctic Marine Ecosystems?





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Designing marine protected area networks to address the impacts of climate change

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Principles for designing marine protected area (MPA) networks that address social, economic, and biological criteria are well established in the scientific literature. Climate change represents a new and serious threat to marine ecosystems, but, to date, few studies have specifically considered how to design MPA networks to be resilient to this emerging threat. Here, we compile the best available information on MPA network design and supplement it with specific recommendations for building resilience into these networks. We provide guidance on size, spacing, shape, risk spreading (representation and replication), critical areas, connectivity, and maintaining ecosystem function to help MPA planners and managers design MPA networks that are more robust in the face of climate change impacts.

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Scientists have predicted a dire future for the world's coral reefs, including a 70% loss of reefs by 2050 (Wilkinson 2000) and their descent down the "slippery slope to slime" (Pandolfi *et al.* 2005), which refers to a shift from a coral to an algal-dominated environment. To protect marine biodiversity and associated ecosystem services, marine protected area (MPA) networks are being established worldwide. In this paper, MPAs are defined as "any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" (Kelleher 1999). An MPA network is a "collection of individual MPAs operating cooperatively and synergistically, at various spatial scales, and with a range of protection levels, in order to ful-

Designing MPA networks without taking these climate impacts into account could result in major investments being made in areas that will not survive the next several decades. Although numerous papers outline MPA design criteria, including recommendations on MPA size, shape, and spacing (eg Ballantine 1997; Airame *et al.* 2003; Botsford *et al.* 2003; Friedlander *et al.* 2003; Halpern 2003; Roberts *et al.* 2003a, b; Shanks *et al.* 2003; Fernandes *et al.* 2005; Mora *et al.* 2006), they do not specifically address the threats represented by climate change.

To address this gap, we propose a list of general recommendations for best practices in MPA network design (size and shape recommendations) and specific ones that will help managers to build resilience to climate change into these networks (Table 1). The specific recommendations

Guideline #1: Protect Species and Habitats Crucial to Ecosystem Function or of Conservation and/or Cultural Concern

***Step 1**: Identify species and habitats that are crucial to ecosystem function or of conservation and/or cultural concern, e.g.,* species and habitats that structure ecosystems (e.g., ice, cold water corals), keystone species (e.g., polar cod), or vulnerable species due to declining numbers, restricted distribution, sensitivity to disturbance, etc.

***Step 2**: Identify which of these species and habitats are vulnerable to climate change/ acidification. E*.g., calcifiers, ice dependent species, etc.

Step 3: Determine whether area based measures including MPA networks can help improve resilience of key species and habitats to climate-induced changes.

Step 4: Implement MPA networks to be robust to climate-related changes; e.g., reflect the time scale of expected climate induced changes and provide for regular re-evaluation of boundaries.

Guideline #2: Protect ecological connectivity for a wide range of species

Step 1: Identify ecological connectivity pathways for a diversity of floaters, swimmers and flyers.

Step 2: Identify which linkages and pathways are vulnerable to interruption or alteration due to climate change.

Step 3: Determine whether area based measures including MPA networks can help ameliorate connectivity disruptions due to climate-induced changes.

Step 4: Implement MPA networks to be robust to climate-related changes; e.g., reflect the time scale of expected climate induced changes and provide for regular re-evaluation of boundaries.

Guideline #3: Protect the Full Range of Biodiversity

***Step 1**: Identify biodiversity present in the target biogeographic area (e.g., LME).*

***Step 2**: Assess projected impacts from climate change/acidification.*

Step 3: Determine whether area based measures including MPA networks can help mitigate climate-induced impacts on biodiversity.

Step 4: Implement MPA networks to be robust to climate-related changes; e.g., reflect the time scale of expected climate induced changes and provide for regular re-evaluation of boundaries.

Guideline 4: Incorporate MPA networks into integrated ecosystem-based management approach in the target region