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A dynamic ocean management proposal for the Bering Strait region

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ABSTRACT

Global climate change is raising Arctic temperatures, warming ocean waters, and melting sea ice at unprecedented rates, creating new opportunities for industry and development and new risks. As industries and local communities become increasingly active in newly accessible Arctic waters, a robust and dynamic regulatory regime is needed to reduce safety and environmental risks and balance competing needs of multiple resource user groups, all while continually adapting to rapidly changing environmental, economic, and social conditions. Such governance is particularly necessary in the narrow Bering Strait, where humans and animals compete for space while transiting between Pacific and Arctic Oceans, and where traditional subsistence uses overlap with emerging industries. Dynamic ocean management, a system of resource management that incorporates real-time data to implement spatially and temporally targeted management responses, offers guidance on the benefits and drawbacks of dynamic regulation and best practices for implementation in the Bering Strait. Examples of successful dynamic management regimes exist and are reviewed and used to illustrate benefits and challenges of dynamic multi-resource management in the Bering Strait region. Dynamic regulation has the potential to improve efficiency in achieving economic and environmental outcomes, although substantial stakeholder engagement may be required to identify precise goals and weigh trade-offs. Significant investment in data collection, analysis, and distribution may also be necessary. However, writing incident-based regulations and management thresholds to create incentives for government and private sector action should enable the Bering Strait region to develop a robust governance system able to adapt to the region's on-going changes.

1. Introduction

Global climate change is causing rapid environmental, economic, and social change in the Arctic [1–4]. Arctic air temperatures are rising at twice the global rate [5]. Ocean waters are warming, and sea ice is disappearing at unprecedented rates [6–9], such that ice-free summers are projected as early as 2030 [8], an event once thought impossible in this century. Such environmental changes affect the range, distribution, and health of native and migratory marine species in the region [10–13], with consequences for local and traditional hunting practices [3,14]. Decreased seasonal ice cover is expected to drive commercial activity, including shipping, resource extraction, and tourism [2,15–17]. Increased commercial activity both has the potential to contribute to regional economic development and to increase risks to human safety [18], marine species and ecosystem health [14,19]. The probability and consequences of these risks are exacerbated by the confined geographic space, dynamic conditions, and numerous stakeholders at play in the Bering Strait region, the sole passage between Arctic and Pacific Oceans.

Balancing goals of economic development with ecosystem protection in an inclusive and proactive manner requires a governance system that is multi-disciplinary, collaborative, and precautionary [20]. As the Arctic has not yet experienced the explosive growth in development that is projected over the coming decades, stakeholders in the region have the unusual opportunity to proactively establish a dynamic governance system to prevent harm rather than responding once a disaster occurs. Indeed, efforts to govern the multiple uses and stakeholder groups in the Bering Strait region are emerging [2,21–25] but preliminary efforts are often ad hoc and have been plagued by long, slow bureaucratic processes that leave a gap between the regulations on paper and the rapidly changing conditions on the ground. Among the governance options which have been proposed are traditional marine governance approaches, including traffic separation schemes (TSS) and marine protected areas (MPA) [21]. Although successful in more stable environments, such geographically and temporally static approaches may quickly become ill-placed and

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ineffective in a region of such rapid change unless paired with more dynamic management techniques.

Throughout this article, the phrase 'Bering Strait region' is used to encompass not only the narrow Bering Strait itself, defined as the channel between the easternmost tip of Russia and westernmost tip of Alaska, U.S., but also the surrounding waterways extending to the Chukchi Sea in the north and the Bering Sea in the south (see [Fig. 1]). Waters in the Bering Strait region fall variously under U.S., Russian, or international jurisdiction, as discussed in Section 2.1. Other publications have addressed the potential for U.S. action to reach all Bering Strait waters, whether domestic or international [26], but, unless otherwise specified, proposals herein are framed primarily to address waters and activities under U.S. jurisdiction that the U.S. could implement unilaterally. Any governance system in the region must take Arctic geopolitics into account [27], and international pressures could affect the ability of the U.S. to implement even unilateral efforts. However, to date, Arctic states have shown a high degree of cooperation and coordination, and stable, protected, well-governed commerce in the region appears to be in everyone's interest, making a unilateral management approach for U.S. waters activities feasible..

The following sections briefly review the changes occurring in the Bering Strait region, discuss the theoretical benefits of dynamic ocean management, and illustrate how a dynamic system might be structured and applied in the Bering Strait.

2. Growing challenges in the Bering Strait

Rapid change in the Arctic environment creates unpredictability and raises potential for conflict among stakeholders and resource users. Bookending the Bering Strait, the shallow shelves of the Chukchi and Bering Seas are among the most productive marine ecosystems in the world [28,29]. The region is home to an exceptional range of endemic fish and seabird species (an estimated 80% of the U.S. seabird population), whales (e.g., beluga, bowhead, fin, gray, humpback, killer, sei and minke), pinnipeds, and polar bears [1,11,30,31]. With its narrowest point only 81 km across and a maximum depth of 50 m, the Bering Strait is a "bottleneck" for marine species migrations, commercial traffic, and subsistence harvesting activities transiting between the Pacific and Arctic Oceans [32,33]. In addition to full-time resident species, large numbers of predators migrate poleward to access the intense seasonal production on the Chukchi and Bering shelves [11,30,31]. Local indigenous cultures, including Aleut, Inupiat, and Yupik, likewise depend on the highly productive oceans for subsistence hunting and fishing, an integral component of survival, tradition and culture [3,14,34]. In a recent study, approximately 80% of all subpopulations and subspecies of Arctic marine mammals are regularly and legally harvested for subsistence [30].

The intensified effects of anthropogenic climate change in the Artic, coined 'polar amplification', have prompted rapid change in the region. Most visible has been a dramatic decline in the extent, volume and duration of Arctic Ocean sea ice over the past few decades [6–9]. Loss of sea ice not only affects the behavior and health of ice-dependent marine species [10,13,35] but also entire ecosystems from the bottom of the ocean floor to the coasts [36]. One of many potential changes expected is a northward migration of temperate marine species [12]. Migratory whales, including gray and killer whales, have already shifted their primary foraging grounds to waters farther north and lengthened their residence times in the Arctic, likely increasing competitive stress on endemic Arctic species that are restricted in their ability to relocate [10,37]. Likewise, many commercially fished species (e.g., walleye pollock, pink salmon, snow crab, Pacific cod, and Bering flounder) have been observed farther north than their typical range [1,38,39].

Increasing open water extent and duration also unlocks previously inaccessible natural resources and transportation routes. As sea ice continues to disappear, the region is expected to experience an increase in cargo shipping [2,26,40–42], oil and gas development [14–16,43], tourism and cruise ships [17,23,44], and scientific research activity. Warming temperatures and thawing permafrost may also change shore-based natural resource extraction and tourism and affect infrastructure, altering the pattern of shipping required to transport goods and supplies to coastal communities [45,46]. Trans-Arctic shipping, connecting Asian and European markets via shorter northern routes such as the Northern Sea Route or Northwest Passage, has been described as an attractive economic prospect, [2,47,48] but, to date, the presence of even small amounts of sea ice and lack of regional navigational, communication, and support infrastructure have limited the number of ships willing to undertake the voyage [49]. However, as ice continues to retreat and infrastructure is developed, vessel traffic is projected to continue to increase. Nome, Alaska, which received only 35 dockings in the 1990 s, had more than 730 in 2015 [50] and is proposing to build a deep-water port to accommodate larger deep-draft vessels [51,52]. Much of the short-term increase in vessel traffic is expected to be destinational shipping, servicing local communities and industries [2,42], but similar governance and management approaches will be needed to address this short-term increase as to support future anticipated trans-Arctic traffic.

While increased activity will contribute to economic development, it also poses significant risks. The Arctic Ocean is a harsh climate; navigating in shifting sea ice, high winds, rough seas, and limited daylight makes marine travel risky and the likelihood of an accident extremely high. Northern Alaskan waters are not well-charted [53] and global positioning systems (GPS) [54] and communications are limited at high latitudes [55]. New pilots and captains foraying into Arctic waters are reportedly less experienced in polar operations [56], a safety concern given that lack of experience is a known contributor to maritime accidents [18]. Moreover, as summer sea ice continues to decline, ice conditions are likely to become more variable and unpredictable, increasing risk in an already risky operating environment and requiring improved monitoring and communication systems [2]. As shipping rates increase, the risk of ecological damage also grows, both through dangers of daily operations (such as pollution discharge [13,19,57], noise [58,59], whale strikes [60,61], or the use of bunker fuel [62,63]) and through the increased potential of an accident or oil spill [43]. Should an accident occur in the Bering Strait or along Alaska's North Slope, which many analysts consider a matter of 'when' not 'if', the nearest Coast Guard station is roughly 1000 miles away [43,64], complicating a potential response. Even with an increasing presence of Coast Guard patrols through Alaskan waters, the infrastructure and technical capacity to clean a spill or respond to an accident remains limited [2,43,64,65]. In short, any accident in the Arctic would be a disaster to both local communities and the marine ecosystem, and with the unpredictability of climate change and rapidly changing ice conditions, the risks only grow more severe.

2.1. Emerging Bering Strait governance

Despite known safety and environmental risks, there are, to date, no regulations or vessel traffic separation schemes (shipping lanes) to guide vessels through the treacherous waters of the Bering Strait or to aid in avoiding sensitive ecosystems or subsistence hunting grounds [20,21,24]. This is, in part, due to the geopolitics of the region [66]. Shipping in international waters is governed largely by the United Nations Convention on the Law of the Sea (UNCLOS). Despite not being a party, the United States adheres to most UNCLOS provisions. Under UNCLOS, the Bering Strait, as a recognized international strait in both U.S. and Russian waters, is subject to provisions that ensure all nations have relatively free access to transit the strait [24,26]. As a coastal state bordering the strait, the United States may take unilateral action to recommend voluntary measures for all vessels or to enforce mandatory measures for vessels under U.S. domestic jurisdiction (such as those flagged in the United States) and those with a U.S. destination