CONSERVATION SUMMARY

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The chapters in this Ecological Atlas collectively tell a story relating the physical, biological, ecological, and human use patterns of the Bering, Chukchi, and Beaufort Seas. The three seas comprise an Arctic marine ecosystem characterized by both dynamic and enduring features, which together support high productivity and globally important wildlife populations. At the same time, the region is experiencing and anticipating imminent changes from climate warming and development. The significance of this region lies not only in its productivity and what the ocean provides for the people who live here and elsewhere, but also in the impact the Arctic has on global systems. We are learning more and more that the Arctic affects global weather patterns, temperatures, ocean circulation patterns, and is increasingly influencing global trade, energy extraction, and tourism.

A key feature of these three seas is the extraordinary productivity and impressive abundance of wildlife. As illustrated in Chapter 2 (Physical Setting), this marine ecosystem is highly dynamic in nature—driven by an ever-shifting ice edge and the productivity that blooms along this moving feature; strong currents and winds that move water masses and pelagic resources; and the fish, birds, and mammals that follow the advancing and retreating ice. We learn in Chapter 5 (Birds) that some 87% of US seabirds flock to the Bering Sea to nest (US Fish and Wildlife Service 2008). For instance, the Diomede Islands in the Bering Strait make up one of the largest seabird colonies in the world, estimated at over 5.5 million birds (Seabird Information Network 2011). Chapter 4 (Fishes) details many fish species, and explains that the Bering Sea provides about half of US fisheries production by weight and boasts the largest sockeye salmon (*Oncorhynchus nerka*) fishery in the world (Overland and Stabeno 2004, McDowell Group 2015). By measure of primary productivity, the southern Chukchi Sea is one of the most productive marine systems in the world (Springer and McRoy 1993); primary productivity is mapped out in Chapter 3 (Biological Setting). Barrow Canyon, where the Beaufort and Chukchi Seas meet, attracts high densities of many species of marine mammals and birds, and is particularly renowned for the large groups of bowhead whales (*Balaena mysticetus*) that frequent the area to feed on the proliferation of krill (Citta et al. 2015), described in Chapter 6 (Mammals). Wrangel Island has one of the highest densities of polar bear (*Ursus maritimus*) dens and Pacific walrus (*Odobenus rosmarus divergens*) haulouts in the world, designating it a World Heritage Site (UNESCO World Heritage Convention 2004, Rode et al. 2015), as described under Conservation Areas in Chapter 7 (Human Uses). These and countless other impressive environmental phenomena make the Pacific Arctic a globally significant region for many species of fish, birds, marine mammals, and the food web they rely on.

Looking from shore out into places such as Norton Bay, Kotzebue Sound, or Barrow Canyon, one sees dynamic ice and wildlife patterns shifting daily. Yet viewing this system over a longer time period—weeks to months to years—reveals patterns of stability. One begins to see that certain areas consistently provide productive foraging, abundant wildlife, and subsistence opportunities; areas of recurring productivity shift and cycle, yet tend to persist. Continuing to watch for many years uncovers a grander weather and climate cycle, the Pacific Decadal Oscillation, which intermittently delivers warmer or cooler decades, affecting the distribution of fish, birds, and mammals. Looking out even further in time, observation on the scale of multiple decades allows one to realize that beneath this intricate dynamism lies a trend of intense climate warming, which is shifting the very foundations of this ever-changing seascape, making it difficult to quantify what is normal and what is new.

A CHANGING CLIMATE

Currently, the Arctic climate is changing rapidly due to global warming. This change shows itself in the increasingly thin sea ice, the open-water season arriving far earlier and lasting longer, rescheduled hunting trips due to enduring storms, more frequent winter warm spells, and the forced relocations of villages away from the coast due to seawater inundation. Talk to the people of the Arctic coast, and it is in their stories comparing the past to the present. Climate change is the new normal, a daily reality to work with. In a place that characteristically experiences great shifts and changes, the people, wildlife, and ecosystems are resilient and adaptive. But it remains to be seen how far the pendulum can swing before the new normal is too far from the old normal, and systems—both ecological and social—break down.

With a warmer Arctic, ecological impacts will be widespread, and while some are already occurring or are reasonably foreseeable, many others are difficult or impossible to predict (Arctic Climate Impact Assessment 2004). Reduction in sea ice cover is a major change to the Arctic as it functions today. Aside from the Aleutian Islands and the Aleutian Basin, the Bering, Chukchi, and Beaufort Seas are seasonally ice-covered. Sea ice shapes the functioning of this ecosystem throughout the food chain and across all species and is greatly affected by changes in climate. The ice influences the timing, extent, and abundance of primary productivity, which in turn influences the distribution and abundance of zooplankton and fish, and in turn the distribution and concentration of upper trophic species (Sigler et al. 2011). To some species, sea ice is a necessary platform for hunting, resting, and breeding. For others, openings in the ice provide foraging opportunities and breathing holes. Other species encounter the ice as an obstacle or barrier to movement. Loss of sea ice drives ecological changes from the base of the food chain to higher trophic levels (Grebmeier et al. 2006). Forage resources may decrease, increase, redistribute to new areas, or become available at different times. Scientists have predicted that the Arctic Ocean will be nearly ice-free in summer by the 2030s (Wang and Overland 2009, 2012).

By virtue of their adaptations for living in this harsh and dynamic region, Arctic species are incredibly resilient. Yet even these hardy species are already experiencing the pressure from changing climate and habitat. In this fundamentally different Arctic marine future, there will be climate winners and losers. Some species will increase in abundance; others may become threatened or even extirpated. Species will see their habitat expand, shift, shrink, or possibly disappear; some will adapt in place, others will migrate. Certain enduring features in the Arctic will continue to provide vital habitat areas to Arctic wildlife species. By making sure to protect those key places, managers can give fish and wildlife a better chance to persist and adapt as the region undergoes unprecedented change.

PRESSURE POINTS

Climate change is at the forefront of the threats to the Arctic, but it is certainly not alone. Sea ice has acted as a barrier to year-round shipping and vessel traffic pressure. Retreating ice brings greater access and increased vessel traffic, which comes with associated risks: shipwrecks, chemical spills or leaks, and ship strikes and noise disturbance to wildlife.

The Arctic is also vulnerable to the effects of hydrocarbon extraction and transportation. The petroleum products extracted from the Arctic are at least partly traceable to the very carbon emissions indirectly causing such profound changes to climate and sea ice. But the direct impacts of seeking, extracting, and transporting petroleum products in the Arctic marine environment can also cause severe impacts to surrounding habitat and wildlife. The associated activities of constructing infrastructure, moving people and materials to and from job sites, and providing for the transportation of products in pipelines or barges, all add up to substantial activity in a remote region of the world. The wells, rigs, pipelines, roads, airports, power plants, rig platforms, and artificial islands can have an impact on nearby seabirds and marine mammals. Even with comprehensive planning for mitigating a spill event, drilling in the Arctic is inherently risky, the stakes are high, and response is very challenging.

In addition to biological value for the wildlife that inhabit the Bering, Chukchi, and Beaufort Seas, this region is a place with many human values, both contemporary and ancient. Indigenous communities are facing challenges to food security and their traditional ways of life, and stand to be most immediately and directly affected by the changing climate. Researchers and scientists have an interest in surveying the environment, and the knowledge they gain plays an important role in understanding the ecosystem and contributing to sound management decisions. Industry also has a financial stake in what occurs in the Arctic, whether drilling for oil or seeking safer shipping routes. Finally, the Arctic also is a region of enormous personal significance even for those who may never visit, or personally see a polar bear or sea ice. All of these voices merit attention and consideration. Sustainable management of this region should consider various perspectives, and integrate information across disciplines and geographies to implement sustainable actions that account for cumulative effects.

KEY CONSERVATION THEMES AND MANAGEMENT IMPLICATIONS

This Ecological Atlas represents a data-rich foundation upon which to understand the complex dynamics of the Arctic marine ecosystem and the social, cultural, and economic relationships that depend upon it. Through the study of physical influences, species natural history, and human uses, we begin to see the spatial patterns that point to special places in the Arctic Ocean—Unimak Pass, Bering Strait, Barrow Canyon, Wrangel Island, and MacKenzie Bay, to name a few. We also have learned key lessons from considering this compilation of data holistically.

Frequently, management agencies do not have the dedicated staff or funding to pull together a transboundary resource like this one, or the jurisdiction to engage in data gathering or planning beyond their respective missions. However, a holistic perspective is vital to understanding the larger context of decisions and to assessing cumulative effects. Over the past four decades, Audubon Alaska, with many partners, has promoted the conservation of bird, mammal, and fish populations in and around Alaska for present and future generations. Through this latest Ecological Atlas, we have worked to examine ecological patterns, share interdisciplinary knowledge, inform sustainable management of natural resources, and inspire an appreciation for this spectacular place. While we created this Ecological Atlas with the assistance of many people, most prominently our collaborators at Oceana, as well as the many agencies, organizations, and individuals who contributed data, expertise, and review, we recognize that our partners represent diverse backgrounds and may interpret data presented in the atlas differently. We offer the following observations and recommendations for managing the Bering, Chukchi, and Beaufort Seas. However, we emphasize that the following key themes and recommendations presented below reflect Audubon Alaska's background, experience, and viewpoints. They do not necessarily represent the views of any of the other authors, editors, data stewards, reviewers, or agencies who contributed to this effort.

CONNECTING THE NINE CONSERVATION AND MANAGEMENT THEMES

1. The Bering, Chukchi, and Beaufort Seas region is a major hotspot of productivity.
2. This ecosystem is dynamic and highly seasonal, and especially driven by sea ice.
3. Certain enduring features consistently contribute to ecosystem function and resiliency.
4. The areas critical to ecosystem function are interconnected.
5. Climate change is shifting sea ice patterns and species ranges, and requires adaptation to a new normal condition.
6. There is intensifying development interest in the Arctic, requiring a better understanding of cumulative impacts at regional scales.
7. Among what we currently know, there are a number of outstanding data gaps and uncertainties.
8. The synthesizing, publishing, and sharing of spatial data greatly enhances understanding and decision-making abilities.
9. Managers should integrate the best available data across disciplines and broad geographic and temporal scales to assess cumulative effects and implement sustainable actions.

1

PRODUCTIVITY

The Bering, Chukchi, and Beaufort Seas region is a major hotspot of productivity.

CONSERVATION THEME	PRODUCTIVITY	MANAGEMENT IMPLICATIONS
This ecosystem has a great richness and abundance of species that live here year-round, or travel great distances to feed here during the summer months. This is one of the most productive areas in the world for phytoplankton, zooplankton, invertebrates, fish, birds, and mammals.		Management of this region should recognize and protect this productivity and preserve the significant global value to wildlife. Resource use and development decisions should incorporate and integrate the stewardship responsibility for migratory species that belong to multiple nations at different times of year.
Example: Globally, seabird numbers are thought to be in steep decline, down 70% since 1950 among the world's monitored populations (Paleczny et al. 2015). The US, and particularly Alaska, supports the largest number of breeding seabird species of any nation, as well as the second-highest number of endemic breeding seabird species, and the third-highest number of species of conservation concern (Croxall et al. 2012).		**Example:** Having a significant proportion of the world's seabird abundance and diversity, Alaska bears a great responsibility for the stewardship of seabird habitat and populations. Concentration areas for marine birds should be thoughtfully managed, especially in Important Bird Areas. Conserving only 27 of the 865 bird colonies in this region protects three-quarters of all colonial nesting seabirds in the project area—about 25 million individuals (Table 5.1-1). Those sites, of which many are already incorporated into the Alaska Maritime National Wildlife Refuge (Maps 5.1 and 7.10), deserve the highest possible protection from harm.

2

DYNAMISM

This ecosystem is dynamic and highly seasonal, and especially driven by sea ice.

DYNAMISM

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
The seasonally advancing or retreating ice edge influences the timing, extent, and abundance of primary productivity, which in turn influences the abundance of zooplankton and fish, and the distribution and concentration of upper trophic species.	The dynamic, shifting nature of sea ice means that the location of Arctic marine species' habitat constantly shifts as the sea-ice margin advances and retreats over the course of a year. Static management boundaries are not ideal; creative new conservation approaches should be considered.
Example: For polar bears (*Ursus maritimus*), sea ice is a necessary platform for many life functions, which may include travel, foraging, resting, breeding, and denning (Summary 6.1). These bears have evolved to live on this shifting habitat and to thrive on food resources (mainly seals) that also live among the drifting pack ice.	**Example:** The US Fish and Wildlife Service designated critical habitat for polar bears effective in 2011 (Figure 6.1-3). This designation included various components of habitat, including sea-ice habitat, which encompassed much of the US portion of the marine ecosystem because the location of this habitat is constantly shifting. The designation has been contentious, in part because of the all-encompassing spatial extent of critical habitat.

3

ENDURING FEATURES

Certain enduring features consistently contribute to ecosystem function and resiliency.

ENDURING FEATURES

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
As evidenced throughout this atlas, wildlife abounds across the Bering, Chukchi, and Beaufort Seas. Certain areas have additional ecological significance due to underlying bathymetry and the biological and physical processes that drive productivity, supporting a high density or diversity of wildlife.	The high biological values of this region warrant consideration for enhanced conservation measures. Responsible agencies should identify ecological hotspots that are key to ecosystem functioning today, as well as project which areas exhibit resiliency and will continue to be important in the future (e.g. Christie and Sommerkorn 2012). Governments should protect those key areas from harm, in the form of conservation areas and/or by instituting best management practices that protect the resources at stake.
Example: The Nushagak and Kvichak River systems, and their marine counterpart, Bristol Bay, are a global hotspot of productivity for salmon (Map 4.7). These anadromous fish facilitate an immense terrestrial-marine nutrient exchange that is a foundational building block of the regional ecology (Summary 4.7). This region fuels the largest sockeye salmon fishery in the world, and provides $1.5 billion dollars annually to the US economy (Knapp et al. 2013).	**Example:** Conservation organizations, fishermen, tribal entities, and government agencies identified Bristol Bay as an area of critical ecological importance to Alaska's commercial salmon fisheries. In 2014, the North Aleutian Basin, which includes Bristol Bay, was withdrawn from oil and gas leasing by then President Obama to safeguard its unique biological values (Map 7.3).

4

INTERCONNECTION

The areas critical to ecosystem function are interconnected.

INTERCONNECTEDNESS

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
Components of the marine ecosystem—from water masses and nutrients, phytoplankton and fishes, to birds and mammals—travel among these three seas. Even the terrestrial and marine environments are linked by physical processes such as freshwater runoff and by wildlife such as anadromous fish and birds. Upper-trophic-level species such as birds, marine mammals, and people rely on productivity of lower trophic levels such as zooplankton, benthic biomass, and fish.	Because of the connectivity inherent in the Arctic marine ecosystem, even localized impacts can resonate across a much broader area. Management decisions should consider connectivity and cumulative effects among key sites and at regional scales. Migratory birds, for example, travel long distances to and from other continents, and reduced breeding success in the Arctic would affect species abundance throughout their range.
Example: Migratory birds such as the Spectacled Eider (*Somateria fischeri*) utilize a series of seasonally important habitats. The entire global population overwinters in a recurrent polynya south of St. Lawrence Island before dispersing across discrete breeding locations on the North Slope of Alaska, Siberia, and the Yukon-Kuskokwim Delta (Map 5.4.2). Nutrients acquired during foraging near the Bering shelf break are redistributed to terrestrial nesting sites and marine staging areas, linking the Bering Sea with coastal wetlands, the Chukchi Sea, and Russian waters.	**Example:** The US Fish and Wildlife Service designated critical habitat for the Spectacled Eider based not only on the heavily concentrated wintering area, but also breeding areas in the Yukon-Kuskokwim Delta and molting areas in Ledyard Bay and in Norton Sound (Map 5.4.2). Aligning protections across a broader geography, as the US Fish and Wildlife Service has done with Spectacled Eider critical habitat, highlights the biological connections among distant sites.

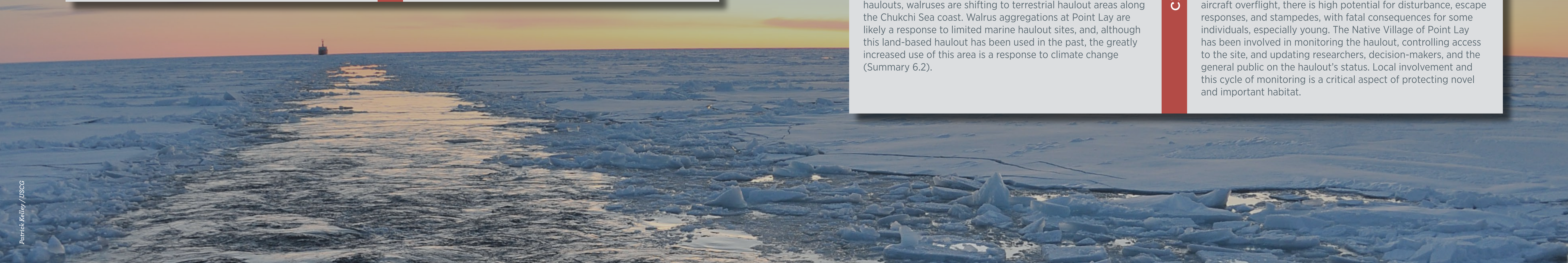
5

CLIMATE CHANGE

Climate change is shifting sea ice patterns and species ranges, and requires adaptation to a new normal condition.

CLIMATE CHANGE

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
Experts predict that climate change will have major effects on physical, ecological, social, and economic systems around the world over the next century. Climate is a fundamental aspect of the ecology and natural history of species, and ecological impacts will be widespread. Some impacts—such as loss of sea ice and a shift from a benthic-driven to pelagic-driven food web—are already occurring or reasonably foreseeable (Grebmeier et al. 2006). However, many other impacts are difficult or impossible to predict, such as whether ice-obligate species will redistribute, develop novel behaviors to continue to persist, or simply become extirpated.	Climate change is a reality in Arctic Alaska and requires agencies to acknowledge Arctic warming and shifting patterns, and to conduct studies, anticipate impacts, and fund mitigation efforts. In particular, adaptive management based on an iterative process of planning, implementation, monitoring, and adaptation is of paramount importance to effectively respond to uncertain changes. Beyond the scope of this Ecological Atlas, but most importantly, governments should set limits on carbon emissions and reduce greenhouse gases to abate further damage to the Arctic ecosystem and coastal communities.
Example: In the absence of ice floes traditionally used as haulouts, walruses are shifting to terrestrial haulout areas along the Chukchi Sea coast. Walrus aggregations at Point Lay are likely a response to limited marine haulout sites, and, although this land-based haulout has been used in the past, the greatly increased use of this area is a response to climate change (Summary 6.2).	**Example:** Because hauled out walrus are highly responsive to aircraft overflight, there is high potential for disturbance, escape responses, and stampedes, with fatal consequences for some individuals, especially young. The Native Village of Point Lay has been involved in monitoring the haulout, controlling access to the site, and updating researchers, decision-makers, and the general public on the haulout's status. Local involvement and this cycle of monitoring is a critical aspect of protecting novel and important habitat.



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6

DEVELOPMENT INTEREST

There is intensifying development interest in the Arctic, requiring a better understanding of cumulative impacts at regional scales.

DEVELOPMENT INTEREST

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
There is interest in using the Arctic for many different activities including for natural resource extraction, shipping, and tourism. Main pressure points on the ecosystem include fishing, vessel traffic, energy extraction, and climate change, each of which poses a variety of threats.	Agencies should work together domestically and internationally to adequately understand, plan for, and address major threats and cumulative impacts of development at regional scales.
Example: Vessel traffic and offshore hydrocarbon extraction pose risks of oil spills, ship strikes, noise-based disturbance, discharges and emissions, and aquatic invasions (Summaries 7.3 and 7.5). In particular, a large oil spill like *Deepwater Horizon* or *Exxon Valdez* could be catastrophic to some wildlife species or populations, and may greatly impact food security for nearby communities. Due in part to the long distance from the nearest response station, the US is not adequately prepared to respond to a major oil spill in ice-covered Arctic and subarctic waters.	**Example:** Especially in newly seasonally ice-free areas, the US Coast Guard and other similar agencies should establish vessel traffic routing, speed restrictions, Areas to be Avoided, and other measures to mitigate negative effects of increasing shipping and be prepared for accidents and spills (Map 7.5.3m). Prior to permitting offshore oil and gas production, the US and other nations should develop adequate response capabilities (Figure 7.5-1).

7

DATA GAPS

Among what we currently know, there are a number of outstanding data gaps and uncertainties.

DATA GAPS

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
The Arctic is very much a region still being discovered. Despite technological advances, there are significant hurdles to a comprehensive understanding of Arctic ecology, including limited baseline data, short field seasons, challenging international coordination, and a combination of broad species ranges and logistically, financially, or physically inaccessible locations. Areas such as the Aleutian Basin and Canada Basin are little studied, often leaving gaps in species distribution that may or may not reflect actual lack of use. Data gaps similarly preclude precise species population estimates, a foundation of sustainable management. Climate change introduces significant uncertainty in how population dynamics and distributions will respond in the years and decades ahead.	Data gathering and monitoring are the foundation for informed management decisions. Sufficient funding is essential for agencies to continue to conduct science, and provide long-term datasets to develop our knowledge and aid management decisions. The US, Russia, and Canada should increase international cooperation regarding species management and conservation. More complete documentation of traditional knowledge through the use of appropriate social science methods in cooperation with communities would fill data gaps and improve knowledge. Furthermore, when data gaps or scientific uncertainty exist, management decisions should be informed by the precautionary principle that a new action with the potential for causing harm bears the burden of proof, and a protective action can be taken given plausible but uncertain risks.
Example: Successful management of fisheries in the Chukchi and Beaufort Seas relies on balancing somewhat limited scientific understanding with the varying perspectives of numerous user groups and political entities. As fish ranges expand due to climate change, economically viable commercial fishing may become possible in the Arctic Ocean. However, the absence of definitive stock estimates and other key biological data make it challenging to define sustainable catch limits, harvest timing and duration, and acceptable catch methods (Summary 7.7).	**Example:** Both the US and international communities have taken proactive steps toward sustainable management of emerging Arctic fisheries. The Arctic Fishery Management Plan, implemented in 2009, closed the US Arctic to commercial fishing (Map 7.7). This decision was reaffirmed by a landmark international agreement from the five Arctic-bounding nations passed in July 2015 banning commercial fishing until a more complete scientific understanding is gained. Together, these agreements preclude ecologically damaging harvest practices and protect novel fish populations until research demonstrates that these stocks can support sustainable commercial fishing.

8

DATA SYNTHESIS

The synthesizing, publishing, and sharing of spatial data greatly enhances understanding and decision-making abilities.

DATA SYNTHESIS

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
Ecological data are inherently spatial. Environmental processes are tied to places—the physical features, climate, and interactions that set the biological stage. Maps make such data visually accessible, bringing ideas together to help people understand spatial context, patterns, and relationships. The process of bringing together ecological data across broad scales also identifies data quality and data gaps and the need for greater knowledge.	Ecosystem-based management requires synthesizing spatial data across larger regions to understand the ecological patterns and broader context. Natural resource management requires decisions about where activities will take place and what may be affected. Agencies should continue and also enhance a culture of data synthesis, publishing, sharing, and cross-disciplinary collaboration to promote understanding and sustainable management.
Example: The Aerial Survey of Arctic Marine Mammals (ASAMM) documents the distribution and relative abundance of whales and other marine mammals. Formerly focused on surveying the fall migration of bowhead whales (Map 6.7d) in the Beaufort Sea, ASAMM dates back to 1979 with expanded species, geographic, and temporal coverage in more recent years (National Oceanic and Atmospheric Administration 2015). The survey serves as a baseline for pre-development conditions and for studying trends in distribution and abundance over time.	**Example:** ASAMM is a National Oceanic and Atmospheric Administration (NOAA) and Bureau of Ocean Energy Management (BOEM) cooperative effort. The survey occurs annually during the summer and fall in the Chukchi and Beaufort Seas in areas of potential energy exploration, development, and production. NOAA and BOEM compile, analyze, and report data annually, and make those data easily available. ASAMM has provided much-needed data to planning processes related to offshore energy development.

9

INTEGRATED ASSESSMENT

Managers should integrate the best available data across disciplines and broad geographic and temporal scales to assess cumulative effects and implement sustainable actions.

INTEGRATED ASSESSMENT

CONSERVATION THEME	MANAGEMENT IMPLICATIONS
Synthesizing data across time and space reveals important patterns, and cross-disciplinary study lends useful connections. Integrated assessment succeeds by comprehensively evaluating actions across disciplines, stakeholder groups, and broad geographic and temporal scales. With this information, managers are better equipped to make sound decisions and succeed at long-term conservation goals.	Decision-makers need to comprehensively assess the cumulative effects of decisions—changes to the environment that are caused by an action in combination with other past, present and future human actions. To this end, agencies should collaborate more seamlessly across missions and jurisdictions, and continue to work with tribes on co-management. An understanding of cumulative effects should be applied to design mitigation, monitoring, and adaptation strategies and ultimately to implement sustainable actions.
Example: The Arctic Council's 2009 Arctic Marine Shipping Assessment (AMSA) brought together people and knowledge from various disciplines to holistically assess the future of Arctic vessel traffic. AMSA reported on the last few hundred years of shipping history as well as changing conditions (e.g. sea ice) looking 15 years ahead. The effort covered the circumpolar Arctic, while including regional and local perspectives. The report focused on geography, history, governance, current uses, future scenarios, human dimensions, environmental impacts, and infrastructure.	**Example:** AMSA resulted in recommendations for enhancing marine safety, protecting Arctic people and the environment, and building Arctic marine infrastructure. The report recommended identification of areas of heightened ecological and cultural significance, and found that the release of oil into the Arctic marine environment is the most significant threat from Arctic shipping.

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ECOLOGICAL ATLAS OF THE BERING, CHUKCHI, AND BEAUFORT SEAS