9 Oceans and Marine Resources

Coral reefs in the U.S. Virgin Islands

Key Message 1

Ocean Ecosystems

The Nation's valuable ocean ecosystems are being disrupted by increasing global temperatures through the loss of iconic and highly valued habitats and changes in species composition and food web structure. Ecosystem disruption will intensify as ocean warming, acidification, deoxygenation, and other aspects of climate change increase. In the absence of significant reductions in carbon emissions, transformative impacts on ocean ecosystems cannot be avoided.

Key Message 2

Marine Fisheries

Marine fisheries and fishing communities are at high risk from climate-driven changes in the distribution, timing, and productivity of fishery-related species. Ocean warming, acidification, and deoxygenation are projected to increase these changes in fishery-related species, reduce catches in some areas, and challenge effective management of marine fisheries and protected species. Fisheries management that incorporates climate knowledge can help reduce impacts, promote resilience, and increase the value of marine resources in the face of changing ocean conditions.

Key Message 3

Extreme Events

Marine ecosystems and the coastal communities that depend on them are at risk of significant impacts from extreme events with combinations of very high temperatures, very low oxygen levels, or very acidified conditions. These unusual events are projected to become more common and more severe in the future, and they expose vulnerabilities that can motivate change, including technological innovations to detect, forecast, and mitigate adverse conditions.

Executive Summary

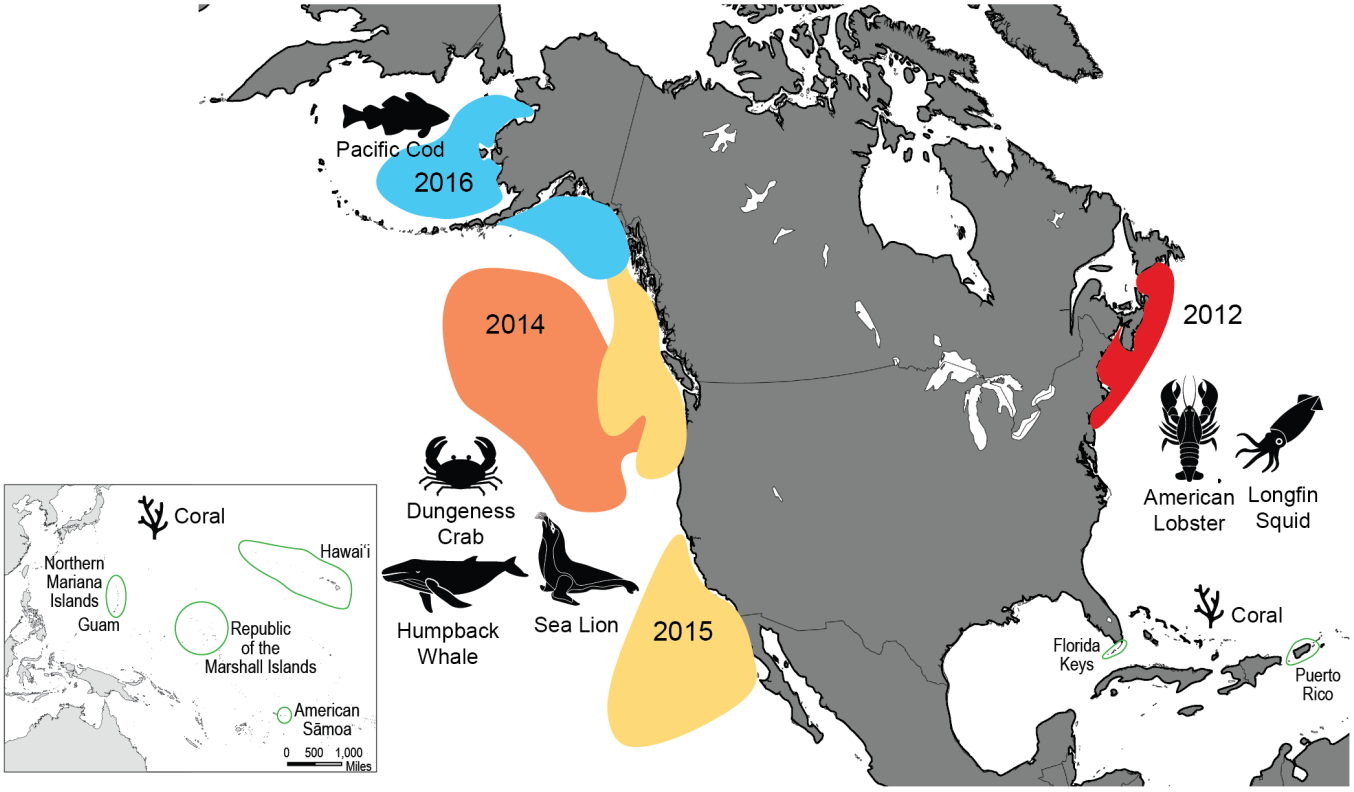
Americans rely on ocean ecosystems for food, jobs, recreation, energy, and other vital services. Increased atmospheric carbon dioxide levels change ocean conditions through three main factors: warming seas, ocean acidification, and deoxygenation. These factors are transforming ocean ecosystems, and these transformations are already impacting the U.S. economy and coastal communities, cultures, and businesses.

While climate-driven ecosystem changes are pervasive in the ocean, the most apparent impacts are occurring in tropical and polar ecosystems, where ocean warming is causing the loss of two vulnerable habitats: coral reef and sea ice ecosystems. The extent of sea ice in the Arctic is decreasing, which represents a direct loss of important habitat for animals like polar bears and ringed seals that use it for hunting, shelter, migration, and reproduction, causing their abundances to decline (Ch. 26: Alaska, KM 1). Warming has led to mass bleaching and/or outbreaks of coral diseases off the coastlines of Puerto Rico, the U.S. Virgin Islands, Florida, Hawai'i, and the U.S.-Affiliated Pacific Islands (Ch. 20: U.S. Caribbean, KM 2; Ch. 27: Hawai'i & Pacific Islands, KM 4) that threaten reef ecosystems and the people who depend on them. The loss of the recreational benefits alone from coral reefs in the United States is expected to reach $140 billion (discounted at 3% in 2015 dollars) by 2100. Reducing greenhouse gas emissions (for example, under RCP4.5) (see the Scenario Products section of App. 3 for more on scenarios) could reduce these cumulative losses by as much as $5.4 billion but will not avoid many ecological and economic impacts.

Ocean warming, acidification, and deoxygenation are leading to changes in productivity, recruitment, survivorship, and, in some cases, active movements of species to track their preferred temperature conditions, with most moving northward or into deeper water with warming oceans. These changes are impacting the distribution and availability of many commercially and recreationally valuable fish and invertebrates. The effects of ocean warming, acidification, and deoxygenation on marine species will interact with fishery management decisions, from seasonal and spatial closures to annual quota setting, allocations, and fish stock rebuilding plans. Accounting for these factors is the cornerstone of climate-ready fishery management. Even without directly accounting for climate effects, precautionary fishery management and better incentives can increase economic benefits and improve resilience.

Short-term changes in weather or ocean circulation can combine with long-term climate trends to produce periods of very unusual ocean conditions that can have significant impacts on coastal communities. Two such events have been particularly well documented: the 2012 marine heat wave in the northwestern Atlantic Ocean and the sequence of warm ocean events between 2014 and 2016 in the northeastern Pacific Ocean, including a large, persistent area of very warm water referred to as the Blob. Ecosystems within these regions experienced very warm conditions (more than 3.6°F [2°C] above the normal range) that persisted for several months or more. Extreme events in the oceans other than those related to temperature, including ocean acidification and low-oxygen events, can lead to significant disruptions to ecosystems and people, but they can also motivate preparedness and adaptation.

Extreme Events in U.S. Waters Since 2012



The 2012 North Atlantic heat wave was concentrated in the Gulf of Maine; however, shorter periods with very warm temperatures extended from Cape Hatteras to Iceland during the summer of 2012. American lobster and longfin squid and their associated fisheries were impacted by the event.[1] The North Pacific event began in 2014[2] and extended toward the shore in 2015[3,4] and into the Gulf of Alaska in 2016,[5,6] leading to a large bloom of toxic algae that impacted the Dungeness crab fishery and contributed directly and indirectly to deaths of sea lions and humpback whales. U.S. coral reefs that experienced moderate to severe bleaching during the 2015–2016 global mass bleaching event[7] are indicated by coral icons. *From Figure 9.3 (Source: Gulf of Maine Research Institute).*