IMPACT

Coastal Issues

"The non-market value of coastal recreation in California alone exceeds $30 billion annually, [this no-cost benefit] would be impossible to replicate with human-engineered solutions."

Increases in the rate of sea-level rise and warmer ocean temperatures, in conjunction with waves, tides, and storms, combine to reshape the coastline and modify coastal ecosystems. Photo Courtesy of David Revell.

Key Messages

1

The future severity of coastal erosion, flooding, inundation, and other hazards will increase due to sea-level rise and continued coastal development. Increased intensity or frequency of storms will add to projected impacts.

2

Ocean warming affects a range of ecosystem processes, from changes in species distribution to reduced oxygen content and sea-level rise. However, scientists cannot yet predict how these changes will impact ecosystems, fisheries, and coastal communities.

3

While many coastal communities have begun to prepare for climate-change impacts and minimize the severity of now-unavoidable consequences, the development and implementation of adaptive policies are still insufficient compared with the magnitude of the expected harm.

The ninth chapter of the *Assessment of Climate Change in the Southwest United States* examines climate-change threats to coastal ecosystems, as well as available management and adaptation options. The chapter evaluates key climate-induced impacts, including sea-level rise, erosion, storm surges, and oceanographic factors such as nutrient upwelling, acidification, and oxygen-depleted zones. "Coastal Issues" also describes interactions between projected climate changes and existing vulnerabilities.

For more information about *Assessment of Climate Change in the Southwest United States*, see: www.swcarr.arizona.edu, www.cakex.org, www.islandpress.org/NCAreports.
This fact sheet developed by Institute of the Environment, University of Arizona.

Sea-Level Rise

Sea level along the coast of California has risen gradually over the past century (by about 8 inches [20 cm]). The combination of elevated sea levels, high tides, and storm waves has the potential to erode shorelines and impact infrastructure and habitat. Moreover, the effects of less severe storms will be magnified by progressively higher sea levels—as a result, coastal communities can expect more severe losses from these events.

Threats to Wetlands

As climate and ocean chemistry change, scientists anticipate significant alterations in the composition, structure, and function of coastal ecosystems. As sea levels rise, tidal wetlands and beaches accrete vertically, become inundated, and/or "migrate" landward. The loss of coastal wetlands causes the loss of the numerous benefits they provide, including flood protection, water treatment, recreation, carbon sequestration, biodiversity, and wildlife habitat.

Ocean Acidification

The ocean has become significantly more acidic than during the preindustrial age, due to the absorption of atmospheric CO_2. More acidic seas will alter marine ecosystems in the following ways:

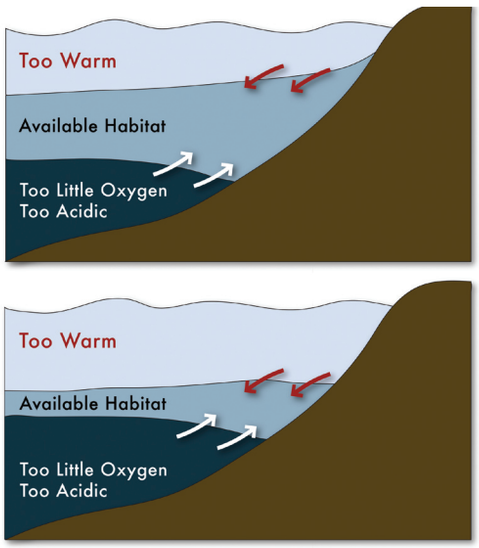
- There will be ecological winners and losers as species respond differently to a changing environment.
- Areas of coastal upwelling and increased nutrient runoff will be the most affected.
- Marine food webs are shifting in the already acidified ocean.

Higher CO_2 hinders the development of shells and other hard parts in mollusks, corals, and other marine animals. These changes are already having direct economic effects: increased acidification has severely harmed several years of hatchery-bred oyster larvae, sending reverberations throughout the industry.

Key regional airports, and associated economic activity, are vulnerable to impacts of sea-level rise.

A Warming Ocean

Warming atmospheric temperatures have already led to an increase in surface-water temperatures and a decrease in the oxygen content of deeper waters. Species adapted to warmer waters may be able to expand their native ranges and migrate into ("invade") new regions, preying on species of commercial importance. In addition, warmer waters lead to habitat loss for species that are adapted to very specific temperature ranges. As waters warm, they also become less able to hold oxygen. Hypoxic events—dangerously low oxygen levels that can lead to widespread die-offs of fish or other organisms—will increase as the warming of surface waters increases.



Climate-related changes to the ocean can reduce available habitat for economically important marine species.

Policy Planning

Coastal managers have several adaptation options that typically fall into three categories:

1. Structural protection measures such as seawalls and revetments (hardened surfaces that protect embankments) as well as beach replenishment have frequently been the preferred option for local governments trying to protect public shorelines and adjacent coastal properties (which are part of the property and commercial tax base) and enhance opportunities for coastal tourism.

2. Adjustments to building codes (such as requirements for flood-prone basements) or modifications to standards for development and coastal construction (such as setbacks for building from the shoreline, or stormwater retention and treatment).

3. Measures for reducing long-term exposure to the risks associated with climate change and coastal hazards. Such measures might take the form of planned retreat from the shoreline, but might also include the restoration of dunes and wetlands. Ecosystem-based adaptation provides social, economic, and environmental benefits, both directly through the preservation of innately valuable biological resources and indirectly through the protection of services that these resources provide.

Information from: Caldwell, M. R., E. H. Hartge, L. C. Ewing, G. Griggs, R. P. Kelly, S. C. Moser, S. G. Newkirk, R. A. Smyth, and C. B. Woodson. 2013. "Coastal Issues." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 168–196. A report by the Southwest Climate Alliance. Washington, DC: Island Press.