Deadly Waters

How Rising Seas Threaten 233 Endangered Species

CENTER *for*
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INTRODUCTION

Sea levels worldwide are rising as warming temperatures melt ice and expand ocean water. Average global sea levels could rise as much as 6.5 feet by 2100. These rising waters pose a widely acknowledged danger to America's coastal cities; but sea-level rise also threatens our nation's biodiversity.

The United States is home to 1,383 federally protected threatened and endangered species, many of which depend on coastal and island habitats for survival. As greenhouse gas pollution builds up in the atmosphere, rising oceans and increasingly dangerous storm surges will threaten already endangered animals that inhabit coastal wetlands, beaches and other vulnerable ecosystems.

FINDINGS

To determine which species are most at risk from sea-level rise, scientists with the Center for Biological Diversity analyzed data from the U.S. Fish and Wildlife Service, National Marine Fisheries Service and scientific literature. Our analysis finds that 17 percent — one in six — of the nation's threatened and endangered species are at risk from rising sea levels.

Left unchecked, rising seas driven by climate change threaten 233 federally protected species in 23 coastal states.

This report highlights five of the most threatened species.

Five of the Species Most Threatened by Sea-level Rise

SPECIES AT RISK	CURRENT POPULATION	KEY FACT
1. Key deer	Approximately 800 deer	About 86 percent of islands occupied by the Key deer are less than 3 feet above sea level.
2. Loggerhead sea turtle	Approximately 17,000 females nesting each year in the United States	At Archie Carr National Wildlife Refuge in Florida, 42 percent of current loggerhead nesting beaches are expected to disappear with just 1.5 feet of sea-level rise.
3. Delmarva Peninsula fox squirrel	20,000 to 38,000 squirrels	Half of the fox squirrels' habitat would be inundated by 6 feet of sea-level rise, which could occur in this century.
4. Western snowy plover	2,500 adults	A third of the West Coast beach habitat areas used by the plovers are less than 3 feet above sea level, and almost half are below 6 feet.
5. Hawaiian monk seal	About 1,000 seals	Sea-level rise poses a serious threat to monk seals' pupping beaches; one key breeding island has already disappeared.

METHOD

The Center compiled a list of all terrestrial and marine endangered and threatened species occurring in the United States as of August 2013 using the U.S. Fish and Wildlife Service's Environmental Conservation Online System (ecos.fws.gov) and the National Marine Fisheries Services' endangered species page (www.nmfs.noaa.gov/pr/species/esa/). Listed species include listed subspecies, distinct population segments (DPSs) and evolutionarily significant units (ESUs). Coastally distributed species were identified based on the occurrence maps provided by the Fish and Wildlife Service and the Fisheries Service. For each coastal species, we reviewed the ecology, distribution and threats in the most recent five-year review, or if not available, the recovery plan, critical habitat designation or published studies.

Species were ranked as at-risk from sea-level rise if all or a portion of their current occupied habitat was in low-lying, nearshore coastal ecosystems vulnerable to inundation, erosion or saltwater intrusion (such as beaches, marshes and salt-intolerant coastal forests) and/or if sea-level rise was identified as a threat to the species by the Fish and Wildlife Service or Fisheries Service or in published studies.

DETAILED ANALYSIS

Seas rising higher and faster

Sea levels worldwide are rising as warming temperatures melt ice sheets and glaciers and expand ocean water. Sea level rose 8 inches during the past century, and the rate of sea-level rise is accelerating as the world warms.[1] Globally, an average of 3 to 4 feet of sea-level rise is expected in this century[2] — five to six times what we have experienced so far — and a 6.5-foot rise by 2100 is possible.[3]

Some regions will be particularly hard-hit. In the United States, sea levels from North Carolina to Boston are rising 3 to 4 times faster than the global average.[4] The effects of sea-level rise will be long-lived: Scientists estimate that we lock in 8 feet of sea-level rise over the long term for every degree Celsius (1.8 degrees Fahrenheit) of warming.[5]

Adding to this threat, flooding from rising seas will worsen as climate change increases the destructive power of Atlantic hurricanes and storm surges — the enormous walls of water — they push onto the coast.[6] The risk of extreme storm surges — like the one that inundated Atlantic City during Hurricane Sandy — has already doubled as the planet warms, and these events could become 10 times more frequent in the coming decades.[7]

Imperiled wildlife at risk

The United States is home to 1,383 threatened and endangered species, many of which depend on coastal and island habitats for survival. Our analysis finds that sea-level rise threatens 17 percent — one in six — of the nation's imperiled animals and plants. (A full list of these 233 species is provided in the Appendix at www.biologicaldiversity.org/campaigns/sea-level_rise/appendix.html.) The most vulnerable groups are flowering plants, which represent a third of all at-risk species, followed by anadromous fishes, birds, mammals, reptiles and freshwater mussels.

These species will be harmed as their habitat areas are submerged and eroded by rising seas.[8] Saltwater intrusion also contaminates groundwater[9] and causes the die-off and conversion of plant communities. In many parts of the coast, salt marshes and coastal forests already are disappearing rapidly,[10] and salt marshes across the coastal United States are expected to decline by 25 to 40 percent in this century.[11]

Faced with rising seas, coastal wildlife and their habitats will need to move inland to survive. However, because 39 percent of the U.S. population lives in coastal counties,[12] much coastal habitat has already been lost to development, leaving species with few places to move. Without help, many species are at risk of being squeezed between rising seas and shoreline development.[13]

Finding solutions

Quick action by local, state and federal policymakers could help save endangered species threatened by sea-level rise. We recommend three key actions:

1. Cut greenhouse pollution quickly: Deep and rapid cuts in greenhouse gas emissions are critical for preventing the worst impacts of sea-level rise.[14] Achieving emissions reductions that keep warming below two degrees Celsius (3.6 degrees Fahrenheit) can decrease future sea-level rise by 31 to 56 percent by 2100 and 71 to 80 percent by 2300, compared to the rise expected under our current emissions trajectory.[15]

2. Protect natural buffers: Coastal ecosystems naturally protect our shorelines from sea-level rise by absorbing storm surge and slowing erosion. Protecting and restoring living shorelines —including marshes, seagrass beds, kelp forests, coral reefs and oyster reefs — will buffer the coast from sea-level rise and also provide essential habitat for wildlife, as well as sequestering carbon and filtering pollutants.[16] If existing coastal habitats in the United States remain intact, exposure to sea-level rise hazards could be reduced by half.[17]

3. Make room for species to move inland: Proactively protecting coastal habitat areas is essential to helping wildlife and their habitats move inland in response to sea-level rise, preventing them from being squeezed out between rising waters and coastal development.

Hawaiian monk seals and green sea turtles at French Frigate Shoals, Hawaii, Monica Bond under permit from NMFS

1. KEY DEER (South Florida)

Key Deer, *Odocoileus virginianus clavium*, Wikimedia Commons/IanareSevi

The Key deer is the smallest subspecies of white-tailed deer, about the size of a German shepherd, and is found only on the islands of the Florida Keys. Three-quarters of the world's key deer live on just two islands: Big Pine Key and No Name Key. They are strong swimmers, moving seasonally between the islands to find fresh water.

Hunting and habitat loss caused the Key deer to decline to about 50 animals by the 1920s. However, an editorial cartoonist, a Boy Scout and a gun-toting refuge manager helped save the deer from extinction. In the 1930s, Pulitzer prizing-winning cartoonist "Ding" Darling publicized the hunting of the Key deer in a political cartoon that drew an enormous public outcry, leading to a state hunting ban. In 1947, 11-year-old Glenn Allen, a Boy Scout in Miami, wrote a letter asking President Truman to establish a national wildlife refuge to save the Key deer, sparking a letter-writing campaign that resulted in the establishment of two refuges. Decades of dedicated enforcement of the hunting ban by gun-toting refuge manager Jack C. Watson — the John Wayne of the Keys — helped to increase the population to 400 by the late 1960s. The Key deer was listed as an endangered species in 1967, and there are probably more than 800 today.[18]

Although car collisions are the biggest cause of deer deaths today, sea-level rise is a rapidly escalating threat. About 86 percent of the land area of the islands occupied by the Key deer is less than 3 feet above sea level.[19] The Key deer's pine rockland habitat has already been reduced by rising seas, and up to 96 percent of Big Pine Key's pine forest and hardwood hammocks could be inundated by 2100.[20] Sea-level rise will also eliminate many Key deer watering holes.

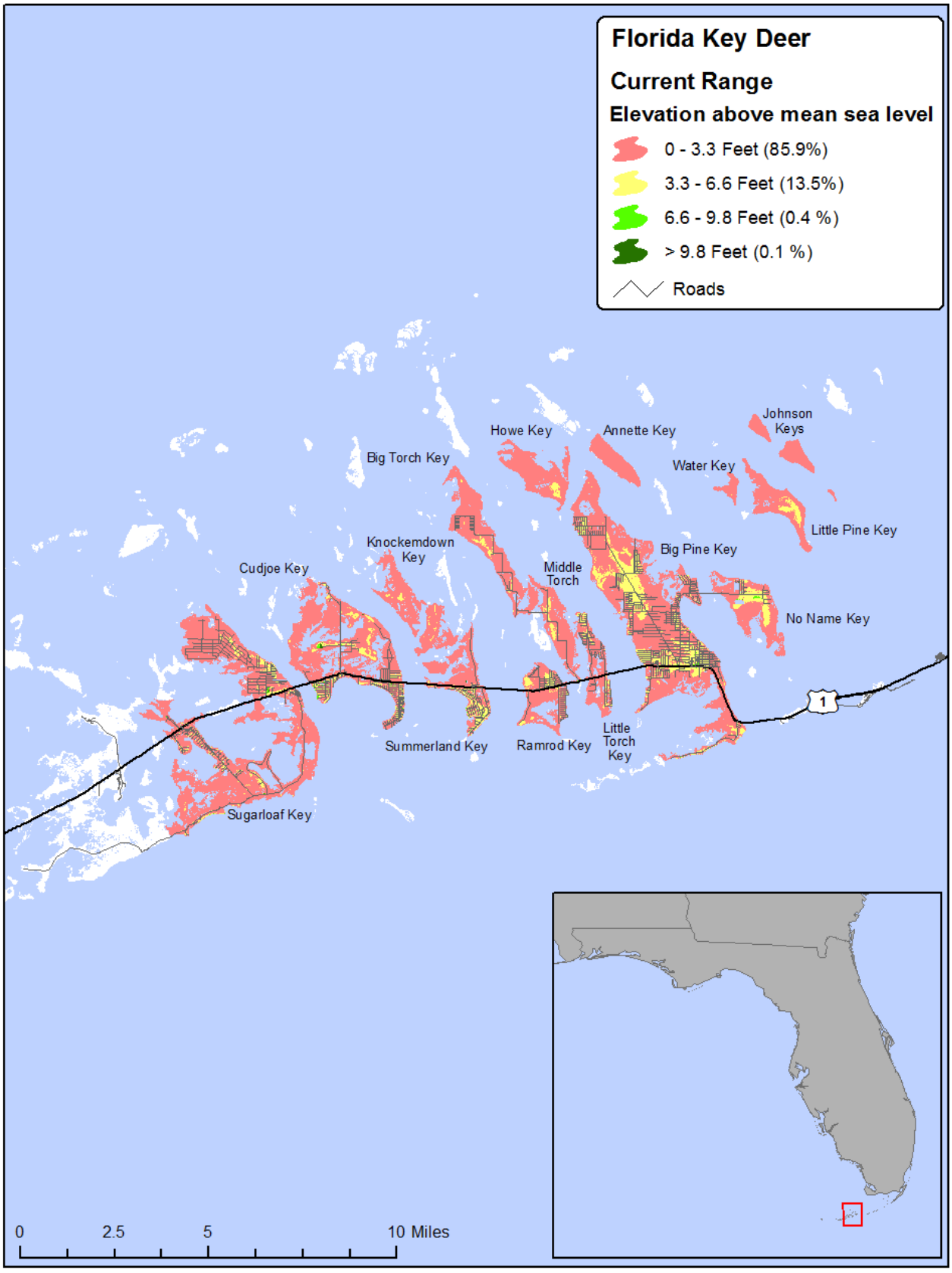
Sea-level rise in South Florida

Florida's low-lying coasts and islands, flat topography and porous limestone geology make it particularly vulnerable to inundation and saltwater contamination of groundwater.

In South Florida, with just 3 feet of sea-level rise, major coastal cities such as Miami will suffer severe damage,[21] and much of the majestic Everglades wetlands and Florida Keys could disappear.[22] The Everglades — the "river of grass" covering the lower third of the state that is home to numerous endangered species including Florida panthers and Cape Sable seaside sparrows — is rapidly losing marshes and coastal forests.[23] In the Florida Keys, where much of the land is below 6 feet in elevation,[24] endangered species are already suffering major impacts. The endangered Lower Keys marsh rabbit has lost almost half of its habitat because of sea-level rise,[25] and the key tree cactus is dying off as the soil becomes too salty.[26]

Florida wildlife at risk

Florida is home to 120 endangered species — more than half (58 percent) are at risk from sea-level rise. In the Florida Keys alone, sea-level rise threatens more than 20 endangered species, including the West Indian manatee, elkhorn and staghorn corals, five nesting sea turtles, and nine endangered species unique to these islands, from the Miami blue butterfly to the Key Largo cotton mouse.



2. LOGGERHEAD SEA TURTLE
(Southeast)

Loggerhead turtle, *Caretta caretta*, Donna Dewhurst / USFWS

Loggerheads ply the temperate and tropical waters of three major oceans — the Atlantic, Pacific and Indian. They make some of the longest known journeys of any sea turtle species. In the North Pacific, they migrate more than 7,500 miles between nesting beaches in Japan and feeding grounds off the coast of Mexico. In the Atlantic most loggerheads congregate on the beaches of the southeastern United States, from Virginia to Alabama, to lay their eggs, with 87 percent of all nesting occurring on the east coast of Florida.[27]

Loggerheads have declined dramatically, primarily due to entanglement and drowning in the fishing gear. At sea, longline fishing vessels targeting swordfish and tuna collectively deploy lines with millions of baited hooks that catch and kill thousands of sea turtles. Gillnets and trawls likewise entangle and drown many turtles.[28]

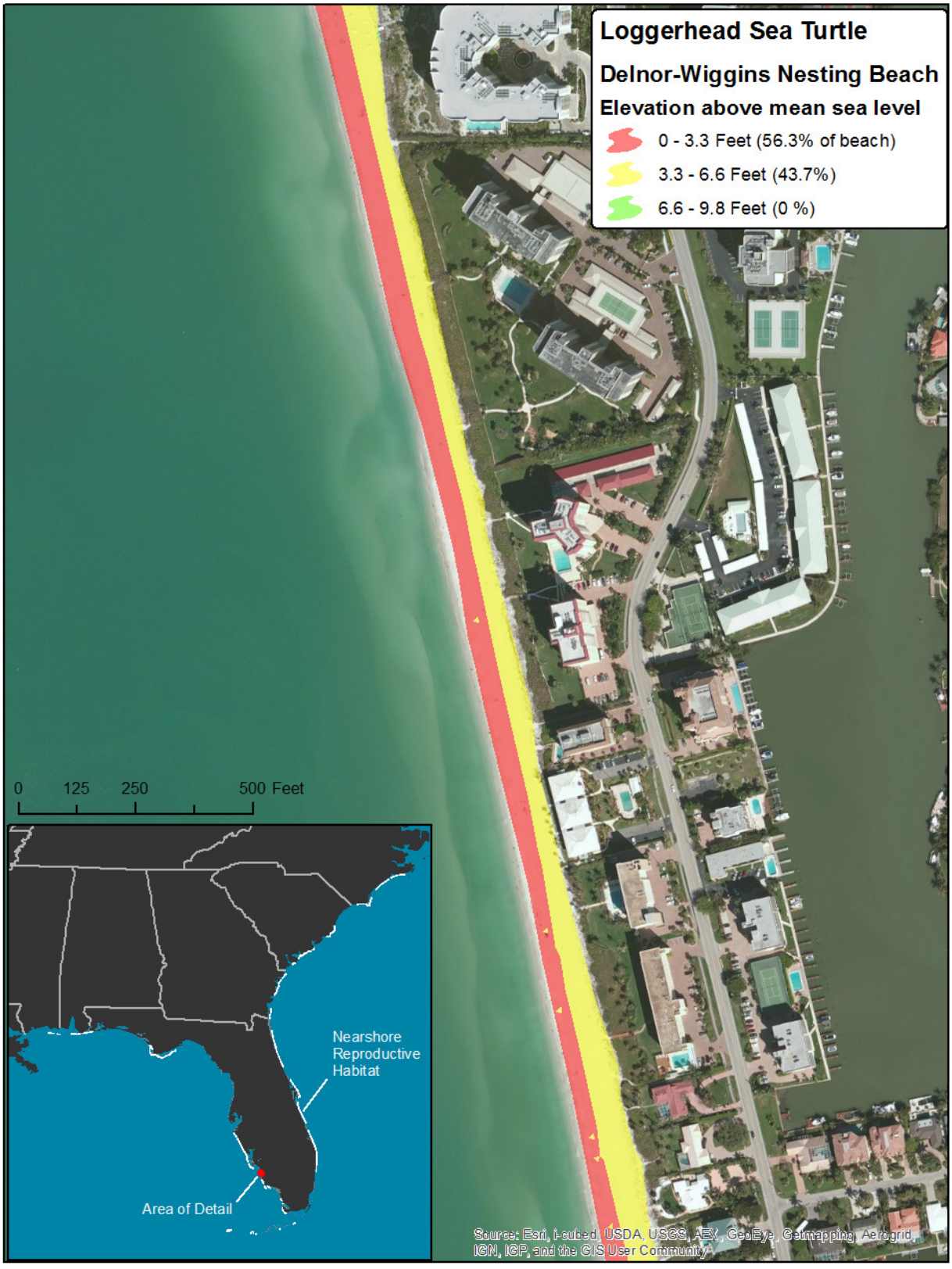
Today, sea-level rise poses a serious threat to the loggerheads' nesting beaches. At Archie Carr National Wildlife Refuge in Florida, which supports North America's densest nesting beaches, 42 percent of the current nesting beaches are expected to disappear with just 1.5 feet of sea-level rise.[29] As the beaches shrink, crowding will increase the likelihood that female turtles inadvertently dig up other nests, as well as the rate of nest infections and predation.[30] Beachfront development and seawalls in many areas of the coast will prevent beaches and nesting turtles from moving inland. Seawalls create more beach erosion and increase the chance that nests are washed away by storms.[31]

Sea-level rise in the Southeast

Many areas of the Gulf of Mexico and Southeast Atlantic coasts have experienced significantly higher rates of relative sea-level rise than the global average during the past 50 years.[32] Large regions of Florida and Louisiana have elevations at or below 3 to 6 feet, making these areas particularly vulnerable to sea-level rise.[33] Louisiana has already lost about one-third of its coastal plain in the past century,[34] and much of the Mississippi Delta is projected to be lost with sea-level rise.[35]

Southeast wildlife at risk

Many endangered species rely on the tidal wetlands, beaches and coastal forests of the Gulf of Mexico coast, putting them at risk of sea-level rise — among them the Attwater's prairie chicken, Alabama beach mouse, Louisiana black bear and Alabama red-bellied turtle. Highly imperiled freshwater mussels such as the fat threeridge and purple bankclimber are threatened as coastal streams and rivers become more saline.



3. DELMARVA PENINSULA FOX SQUIRREL

(East Coast)

Delmarva Peninsula Fox Squirrel, *Sciurus niger cinereus*, Chincoteague NWR, VA, Flickr Creative Commons / Larry Meade

The Delmarva Peninsula fox squirrel is the largest variety of tree squirrel in North America, with about half its length taken up by its long, exceedingly fluffy tail. Unlike the chattering, scampering gray squirrel, it is quiet, shy and not quite agile enough to jump from tree to tree. It relies on mature pine and hardwood forests, where it eats nuts and seeds.

Historically the fox squirrel occurred in five states along the eastern seaboard. But logging, farming and development reduced the squirrels' habitat to about 10 percent of its historic extent, and the squirrel was isolated to small regions of the Delmarva Peninsula in Maryland by the time it was listed as endangered in 1967. Due to recovery efforts under the Endangered Species Act, it may now number 20,000 to 38,000 squirrels.[36]

The Delmarva Peninsula fox squirrel is at high risk from sea-level rise since most of its current habitat lies along the coastline of the Chesapeake Bay — a region undergoing rapid sea-level rise and habitat loss. Sea levels in Chesapeake Bay are rising 2 to 3 times faster than the global average, and parts of the Bay have experienced more than a foot of sea-level rise in the past century.[37]. Six feet of sea-level rise, which could occur in this century, would inundate half of the currently occupied fox squirrel habitat.[38] Given the squirrel's specific habitat needs and the limited available habitat due to current and past logging and development, this large loss of habitat poses a serious threat.

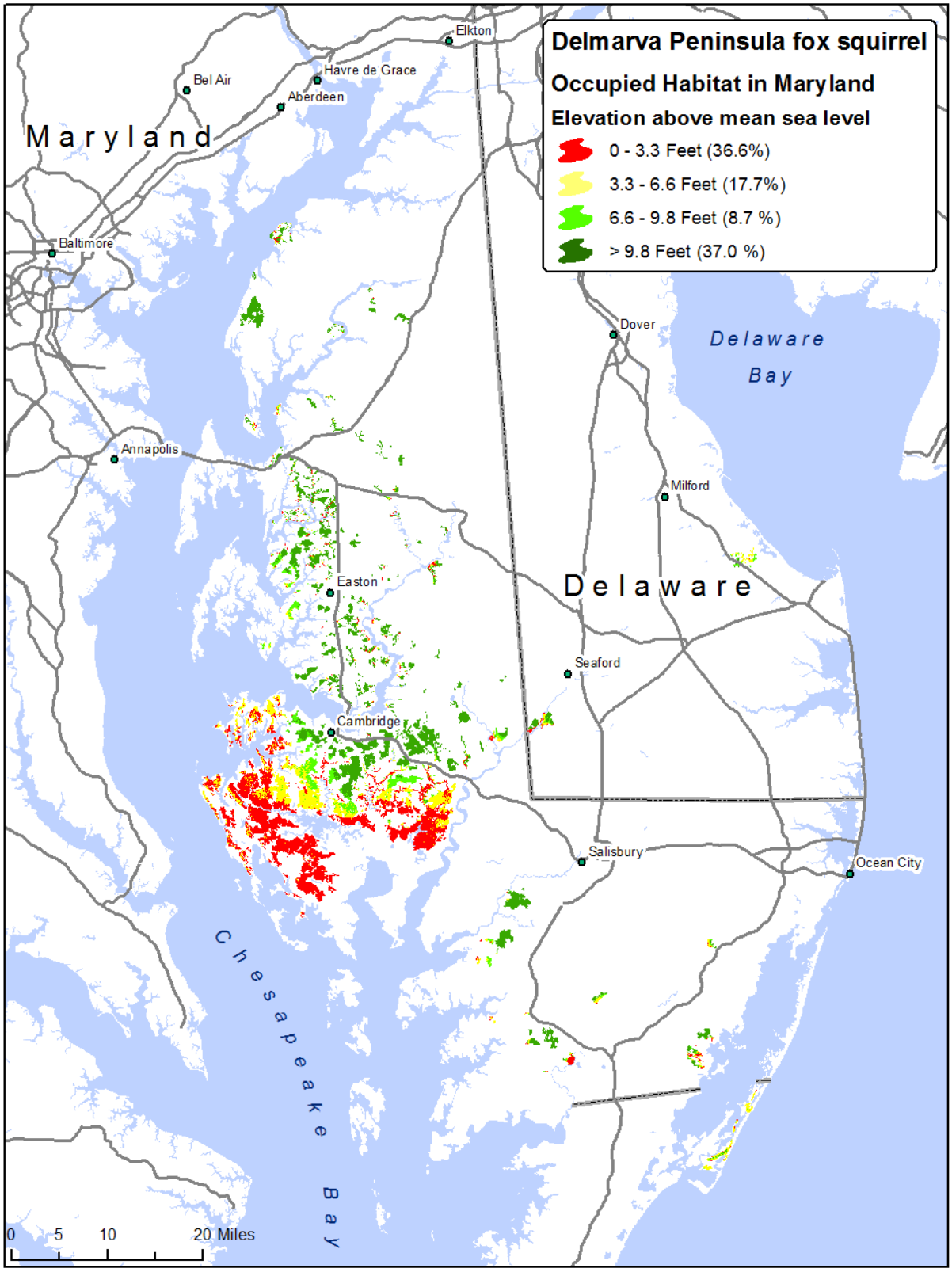
Sea-level rise on the East Coast

The East Coast from Boston to Cape Hatteras, N.C., is a hotspot for sea-level rise. Sea levels along this 620-mile stretch are rising 3 to 4 times faster than average and could increase by a foot more than the global average by 2100.[39] As a result, major U.S. cities — from Baltimore to New York to Boston — are at increased risk of flooding and storm surges, as are coastal wetlands and beaches. The dramatic

acceleration in sea-level rise is thought to be triggered by the slowing of the Gulf Stream due to the melting of the Greenland ice sheet.[40]

East Coast wildlife at risk

Endangered East Coast wildlife threatened by sea-level rise include the roseate tern, piping plover, red wolf, eastern indigo snake, Northeastern beach tiger beetle, puritan tiger beetle, sensitive joint-vetch and seabeach amaranth.



4. WESTERN SNOWY PLOVER
(West Coast)

Western Snowy Plover, *Charadrius alexandrinus nivosus*, Sidney Maddock

Ornamented in buff and pale feathers, the western snowy plover blends into the sand dunes it inhabits along the West Coast's sandy beaches. Plovers lay their tiny camouflaged eggs in small depressions in the sand — sometimes in human footprints — often lining their nests with bits of shell and pebbles, making them difficult to spot.

Plovers declined steeply in numbers due to beachfront development and increasing human beach activity, which often scares plovers away from their nests, leaving chicks and eggs vulnerable to predators and the elements. Fortunately, since the species was protected under the Endangered Species Act in 1993, nest-site destruction and harassment has been reduced. The bird's once-decimated population has increased by more than 50 percent.[41]

Because plovers depend on sandy beaches, they are at high risk from sea-level rise and increasing storm surge that will inundate and erode their nesting and feeding grounds. Along the West Coast, a third of the beach habitat areas used by the plover are less than 3 feet above sea level and almost half are below 6 feet.[42] In many areas, coastal development will make it more difficult for beaches — and plovers — to move inland as the ocean rises.

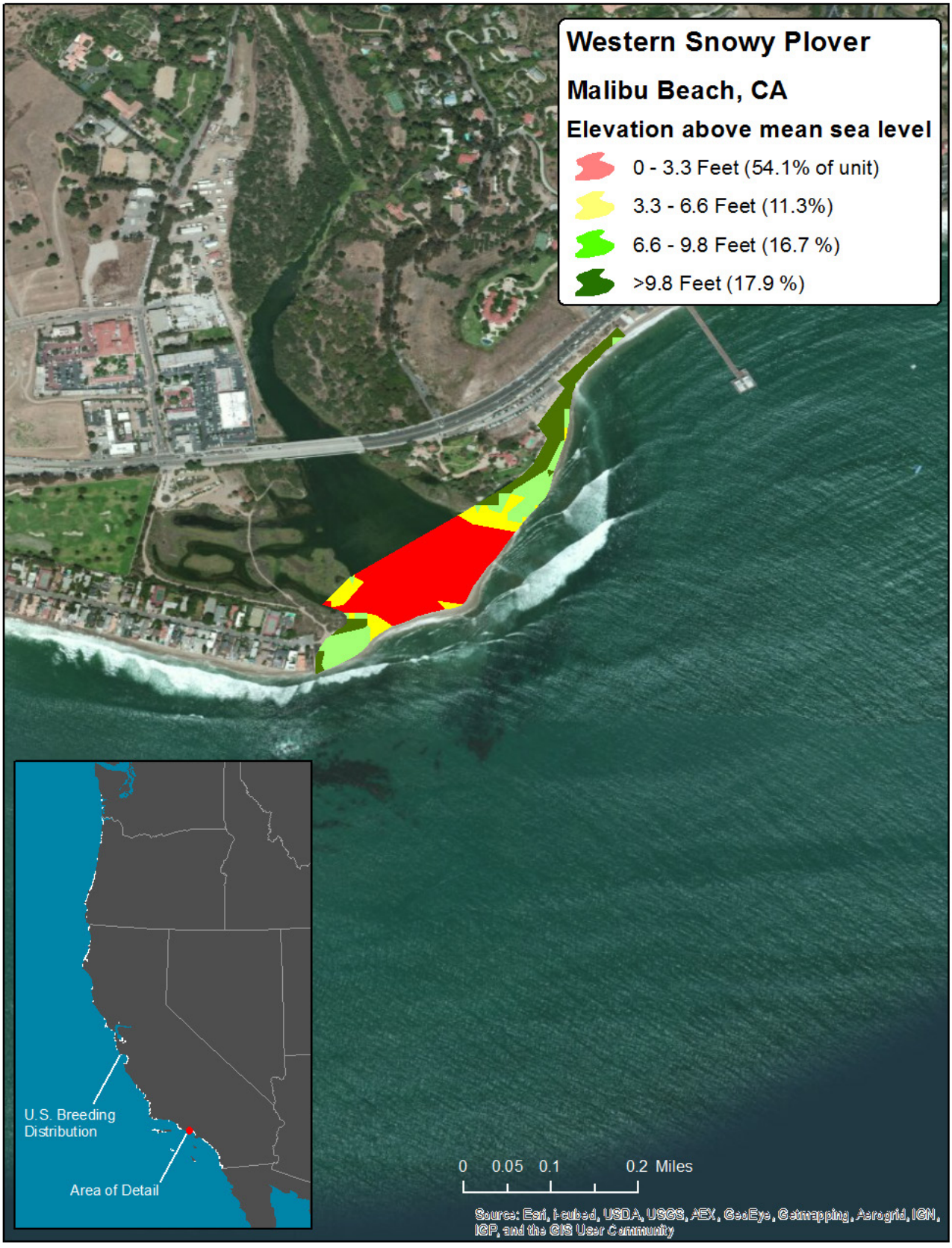
Sea-level rise on the West Coast

Among West Coast states, California will be particularly hard-hit by sea-level rise. Most of the California coast will experience an average of 3 feet, and perhaps more than 5 feet, of sea-level rise within this century, with somewhat less off Washington and Oregon.[43] In an area of coastline stretching from northern California to Washington, a large earthquake could cause sea level to rise suddenly by another 3 to 7 feet.[44] In Alaska, many coasts are eroding due to the combined effects of sea-level rise and sea-ice loss, exposing coasts to more storm surge.[45]

West Coast wildlife at risk

The West Coast from California to Alaska is home to numerous endangered animals and plants at risk from sea-level rise, including the El Segundo blue butterfly, Morro Bay kangaroo rat, western lily, Steller sea lion and polar bear. In the San Francisco Bay and Sacramento-San Joaquin River Delta — the largest

estuary on the West Coast — species such as salt marsh harvest mouse, California clapper rail and Suisun thistle are in jeopardy of being trapped between rising seas and shorefront development. Many of the unique beach and seacliff dwelling plants and animals of the California Channel Islands are also at risk, such as the Santa Barbara Island live-forever and the island night lizard.



5. HAWAIIAN MONK SEAL (Hawaii)

Hawaiian Monk Seal, *Monachus schauinslandi*, USFWS

The Hawaiian monk seal, known to native Hawaiians as *ilio-holo-i-ka-uaua*, or "dog that runs in rough water," is unique to the Hawaiian Islands. It was once spread across the entire Hawaiian chain but today is restricted largely to six small atolls in the Northwestern Hawaiian Islands marine sanctuary. Monk seals need islands for resting, molting, and most importantly, giving birth and nursing their pups. Sandy beaches next to shallow waters give pups access to the ocean while providing protection from large waves and predatory sharks.

Threats — including limited food availability, entanglement in fishing gear, shark predation and disease — have caused dramatic population declines in the last half-century that have left the Hawaiian monk seal one of the world's most imperiled marine mammals. There are only slightly more than 1,000 seals alive today.[46]

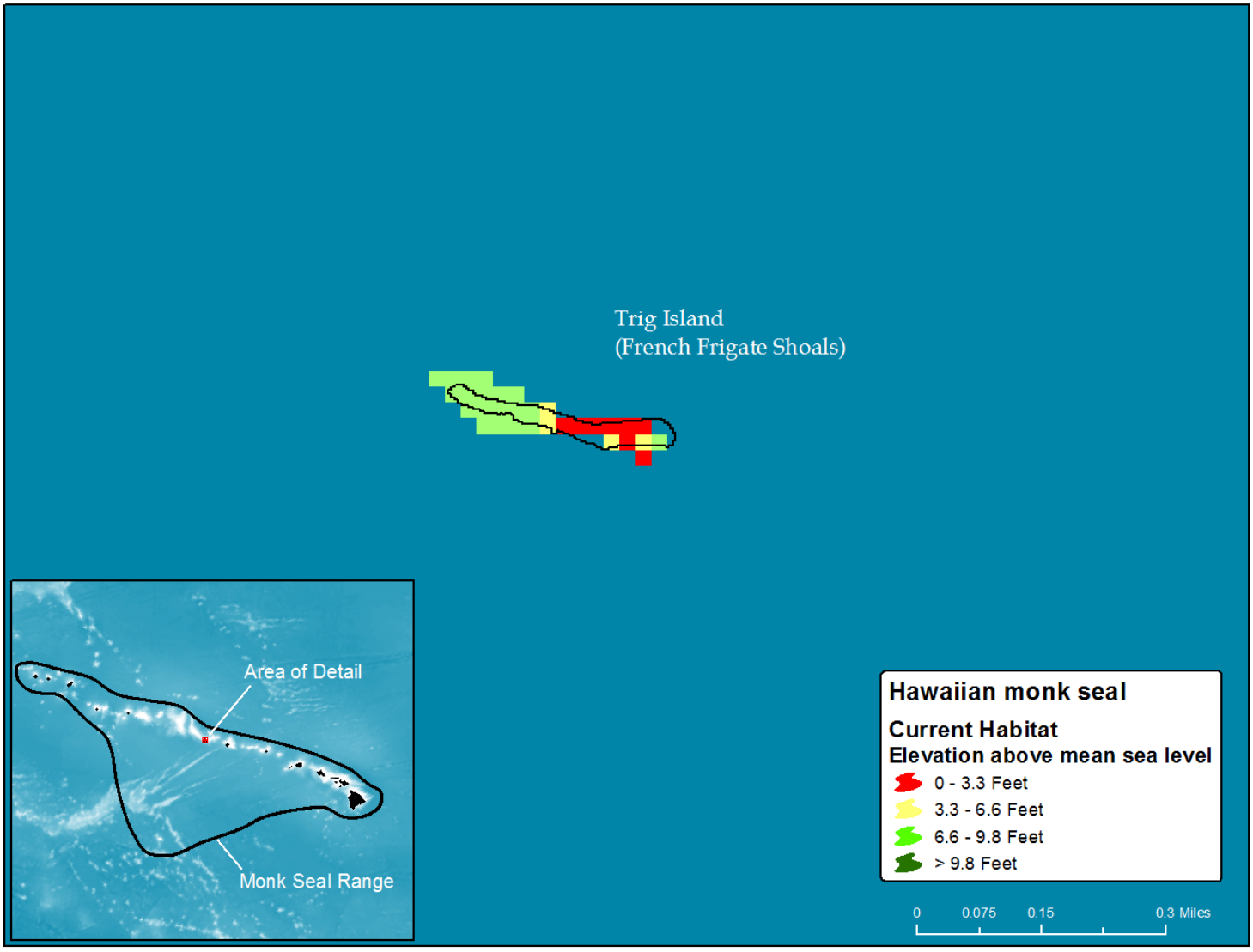
Today sea-level rise poses a serious threat to the monk seals' pupping beaches. Low-lying Whaleskate Island — which once supported one-third of all pupping at French Frigate Shoals atoll — has already disappeared, forcing females to crowd on neighboring islands to rear their pups. The higher seal densities are thought to be attracting more sharks and increasing pup deaths.[47] Sea-level rise will also take a heavy toll on the higher atolls. At Laysan Island, inundation and wave run-up is expected to reduce beach area by three-quarters with 3 feet of sea-level rise and nearly entirely (97 percent) with 6 feet. At Midway Island, beach habitat at Sand, Spit and East islands would be reduced by 66 percent, 100 percent and 84 percent respectively with 3 feet of sea-level rise, with near-entire loss with 6 feet of rise.[48]

Sea-level rise in Hawaii

The low-lying atolls of Northwestern Hawaii are particularly at risk from rising seas. Sea level around these atolls is rising 3 to 4 times faster than around the main Hawaiian Islands.[49] The protective coral reefs fringing these atolls are unlikely to grow quickly enough to keep pace with sea-level rise, allowing larger waves to hit the islands.[50] With less than 3 feet of sea-level rise, French Frigate Shoals is expected to lose 40 to 57 percent of its land area, while Pearl and Hermes Reef will lose 51 to 69 percent, not including increased flooding from waves.[51] The main Hawaiian Islands are also at risk. Hawaii, Maui and Oahu have lost 9 percent of their beaches over the past century, and beach erosion will worsen as sea-level rise accelerates.[52]

Hawaiian wildlife at risk

Endangered species on the low-lying Northwestern Hawaiian Islands facing severe habitat loss include the Laysan duck, short-tailed albatross, Laysan finch and Nihoa finch. On the main islands, endangered species facing threats from habitat inundation and erosion include four endemic Hawaiian waterbirds — the Hawaiian stilt, coot, moorhen and duck —and coastal plants such as the Niihau panic grass and coastal flatsedge.



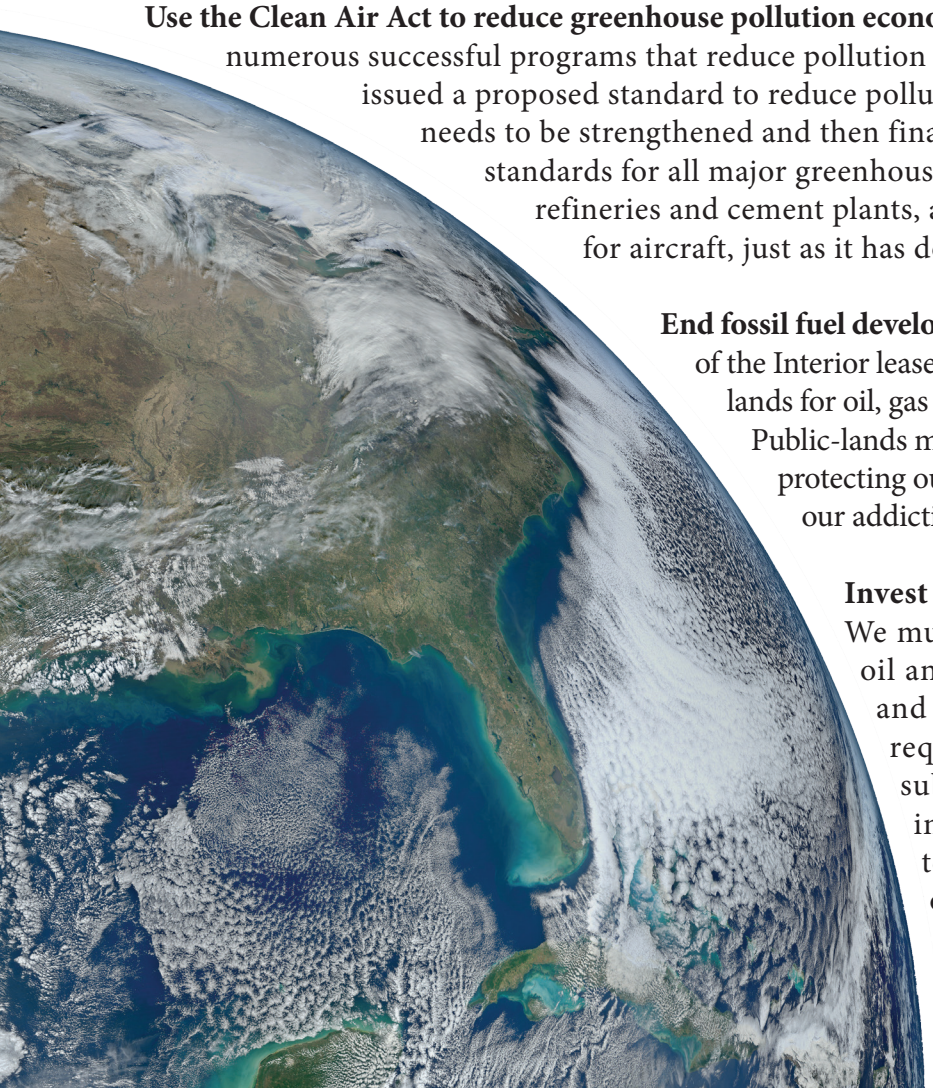
THE WAY FORWARD

As documented in this report, sea-level rise is already having serious impacts on wildlife. Without rapid and bold action to slow climate change, these impacts will only worsen, and many species could lose their habitat altogether. Fortunately we already have powerful tools to make steep reductions in greenhouse gas pollution and help protect wildlife from the sea-level rise, but action is needed at all levels:

Step 1. Cut greenhouse pollution quickly: Deep and rapid cuts in greenhouse gas emissions are essential for preventing the worst impacts of sea-level rise.[53] By reducing greenhouse pollution and limiting temperature rise to less than 2 degrees Celsius (3.6 degrees Fahrenheit), we can decrease future sea-level rise by 31 to 56 percent by 2100 and 71 to 80 percent by 2300, compared to the rise expected under our current emissions trajectory.[54] Achieving stronger reductions recommended by scientists that lower the atmospheric carbon dioxide level to no more than 350 parts per million would have even greater benefits in minimizing sea-level rise risks.[55]

In the United States, we have a variety of powerful tools to make the needed pollution cuts. Here are recommended steps:

Use the Clean Air Act to set a national pollution cap for greenhouse gases: The Clean Air Act requires the EPA to set such a national pollution cap, based solely on science, at the level necessary to protect public health and welfare. A national pollution cap that sets carbon dioxide levels at no more than 350 parts per million would drive pollution reductions under the Act and act as a science-based standard to guide all climate policy.



Use the Clean Air Act to reduce greenhouse pollution economy-wide: The Clean Air Act has numerous successful programs that reduce pollution from specific sources. The EPA has issued a proposed standard to reduce pollution from new power plants, which needs to be strengthened and then finalized. The EPA should also issue strong standards for all major greenhouse polluters, including sources like oil refineries and cement plants, and set greenhouse gas reduction rules for aircraft, just as it has done for passenger cars.

End fossil fuel development on public lands: The Department of the Interior leases out millions of acres of publicly owned lands for oil, gas and coal development, including fracking. Public-lands management should be directed toward protecting our air, water and wildlife — not furthering our addiction to fossil fuel.

Invest in clean, renewable energy generation: We must rapidly transition away from coal, oil and other fossil fuels to truly clean and renewable energy sources. This will require ending massive and ubiquitous subsidies for dirty energy, investing in existing clean energy sources and technology development, and ultimately overcoming the political stranglehold that polluters hold on political systems around the world.

Embrace energy efficiency: The amount of energy we use, and therefore the amount of greenhouse pollution we produce, can be slashed dramatically through simple energy-efficiency improvements in buildings, including improving insulation and upgrading appliances and fixtures, as well as minor lifestyle changes.

Step 2. Protect natural buffers: Coastal ecosystems naturally protect our shorelines from sea-level rise by absorbing storm surge and slowing erosion. Protecting and restoring living shorelines — including marshes, seagrass beds, kelp forests, coral reefs and oyster reefs — will buffer the coast from sea-level rise and also provide essential habitat for wildlife, as well as sequestering carbon and filtering pollutants.[56] If existing coastal habitats in the United States remain intact, exposure to sea-level rise hazards could be reduced by half.[57] Restoration of natural buffers should be prioritized rather than armoring the coast with hard barriers like sea walls that ultimately increase shoreline erosion and loss. The Federal Emergency Management Agency (FEMA) should prevent development in coastal floodplains and flood-prone areas to increase the resilience of the coasts.

Step 3. Make room for species to move inland: While cutting greenhouse gas pollution is ultimately necessary to protect coastal species, we must also implement strong conservation measures that help wildlife better survive the sea-level rise that is already occurring. A top priority is protecting inland coastal habitat to help wildlife and their habitats move landward and prevent them from being squeezed out between rising waters and coastal development. The Department of the Interior should designate important inland areas as critical habitat for threatened and endangered species, which will provide an extra layer of protection by prohibiting federal agencies from taking actions that harm these essential areas.

Hawaiian monk seal and green sea turtle, Derek Lee under permit from NMFS

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