Source: : http://www.fws.gov/home/climatechange/stories505050.html

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| **State** | [50. Alaska](http://www.fws.gov/news/blog/index.cfm/2011/6/30/Alaska-Across-the-Wildest-State-Climate-Change-Threatens-Many-Species-and-Habitats) |
| **Wildlife** | * polar bear (was listed as threatened under the Endangered Species Act in 2008 largely because of its dependence on Arctic sea ice) //
* emperor goose nesting island is exposed by pond drying tied to climate change // Arctic also provides breeding grounds for more than 100 species of birds, including species that breed nowhere else on the continent. Among these are species listed under the Endangered Species Act, such as Steller’s eiders and spectacled eiders, and candidate species such as yellow-billed loon and Kittlitz’s murrelets //
* (and associated losses due to) extent of spruce bark beetle infestation on the Kenai Peninsula //
* Climate change is already making subsistence hunting less dependable in some areas as habitats change and game species move. The northward expansion of beavers, for example, has blocked many traditional salmon-spawning streams, complains Inupiaq Elder Christina Westlake
 |
| **Ecosystem** | Climate change effects documented in the Arctic include rapidly eroding shorelines, melting permafrost (the normally frozen subsurface of two-thirds of the state), loss of Arctic sea ice and increased shrub growth at high latitudes. On the Kenai Peninsula alone, researchers have documented rising tree line, drying wetlands, glacial breakup, shrub encroachment into peat lands, and a change in wildfire patterns — all as a result of climate change. |
| **FWS Response** | Researchers are also unsure if other climate change impacts — including erosion, flooding, salinization, melting permafrost, and sea level rise — could degrade nesting habitat and brood-rearing ponds.  The Service is monitoring pond salinity to establish a baseline and gather trend data for future analyses. |
| **Notes** | During the last half-century, Alaska has seen some of the most rapid warming on earth, with temperatures rising 1 to almost 4 degrees Fahrenheit across its climate regions and ecosystems. By the year 2100, the average annual temperature of Alaska’s North Slope is projected to rise another 10 degrees Fahrenheit. // One big difference between Alaska and the Lower 48 is that here we’re dealing with impacts that have already occurred, not just forecasts of change,” says John Morton, Supervisory Fish and Wildlife Biologist at Alaska’s Kenai National Wildlife Refuge. “And because Alaska hasn’t undergone widespread landscape change from non-climate stressors such as agriculture and development, the impacts of climate change aren’t masked as they are elsewhere.” |

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| **State** | [49. Pennsylvania](http://www.fws.gov/news/blog/index.cfm/2011/6/29/Pennsylvania-Climate-Change-Brings-Uncertain-Future-for-Bog-Turtle) |
| **Wildlife** | * (bog tutles) bog turtles require a specific spring-fed wetland habitat that maintains a fairly consistent water level throughout the year. The turtles nest on hummocks that sit just a few inches above the water, so if climate change results in unusually high flood events in the summer months, nests will certainly be lost. On the other hand, if climate change causes the water level to drop below the surface, then turtles would lose the shallow water and mucky substrate upon which they depend for foraging, cover and hibernation. // another unknown for the northern population of bog turtles is how climate change might affect nesting, or more specifically, “degree days”—the length of time in which a certain temperature is reached to successfully incubate the turtle eggs. Colder summers in the northeast have seen failure of nests, so a longer growing season could potentially increase their nest success.
 |
| **Ecosystem** | warming has resulted in other changes that could affect turtle habitat, such as more frequent very hot days, a longer growing season, changes in precipitation patterns and hydrology //“We do have some concerns because the species is impacted by small changes in temperature, and its habitat is driven by freshwater springs,” Horne says. “The bog turtle relies on open habitat for nesting purposes and springs for clean water, as well as springs with a constant temperature for hibernation.” Any changes in climate associated with springs and nesting could potentially affect the turtle. // climate change could exacerbate impacts to bog turtle habitat by “altering hydrological cycles,” which would either cause the turtle’s habitat to flood or dry out. // Scientists also have linked warming climate to the spread of certain invasive species in the region, such as purple loosestrife, which could decrease water levels. |
| **FWS Response** | the refuge is working with partners, such as The Nature Conservancy, the Pocono Heritage Land Trust, and local townships to get baseline information on turtle populations so they can gauge future changes in behavior. While the effects of climate change on the bog turtle are uncertain, he says even a slight change in temperature would be enough to affect the species. //“We won't know the effects of climate change on bog turtle habitat until we see what it brings,” Whitlock says. “In the meantime, we need to better understand the ecological relationship between the bog turtle's habitat and its hydrology, as well as concentrate on protecting these landscape features from the more immediate threats of development and invasive species.” |
| **Notes** | In October 2010, the U.S. Fish and Wildlife Service established the Cherry Valley National Wildlife Refuge in northeastern Pennsylvania, in part, to protect the federally threatened bog turtle. Climate change, however, could amplify existing threats to the turtle’s fragile habitat. // the first parcel acquired for Cherry Valley National Wildlife Refuge’s provided “promising wetlands in terms of bog turtle management.” |

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| **State** | 48. Colorado |
| **Wildlife** | * Conservation of high altitude wetlands and forested ecosystems can provide direct and indirect benefits to wildlife like the threatened Canada lynx // conservation of high altitude wetlands and forested ecosystems provides both direct and indirect benefits to many wildlife and plant species that are dependent on these ecosystems.   “For example, conserving forested habitat within and around ski resorts provides habitat connectivity and habitat for the food base for the federally threatened Canada lynx,”
* Likewise, federally endangered fish such as the Colorado pikeminnow and razorback sucker benefit from efforts to retain snow at high altitudes to provide more natural hydrologic regimes (changing rates of flow and levels and volumes of water) in the Colorado, Gunnison and Yampa Rivers. Pfister says natural hydrologic regimes with high spring snow melt runoff provide the spawning and rearing habitat requirements of the endangered fish and their young.
 |
| **Ecosystem** | Diminishing snowpack in Colorado and the Rocky Mountains due to warming temperatures // The warming and snowpack decline are projected to worsen through the 21st century, foreshadowing a strain on water supplies // |
| **FWS Response** | (restores not FWS) can work to protect the resources on which they will become even more reliant—water and forest cover. Because snowmaking requires a reliable source of water to pump through cannons over the slopes to make snow, ski areas can prepare for climate change by [restoring wetlands and floodplains to store water](http://blog.nature.org/2009/12/climate-change-adaptation-flood-floodplain-jeff-opperman-nature-conservancy/). Forests also act as windbreaks and shade against the sun and reduce erosion into water sources. // “Protecting upland forests and better water management can support snow sports and provide year-round benefits to millions of people,” |
| **Notes** | Western resorts are expected to face a range of climate-related challenges: outbreaks of pests like the [mountain pine beetle](http://www.fws.gov/news/blog/index.cfm/Wyoming) are already reducing tree cover and increasing vulnerability to fire. Extreme events such as wet avalanches and heavy rains during the ski season, as well as drought,are likely to become more common in a warming climate |

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| **State** | 47. Iowa |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | (focus on C-seq\_ |
| **Notes** |  |

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| **State** | 46. New York |
| **Wildlife** | * Perhaps the species most at risk from continued loss of hemlock forests is the brook trout, New York’s state fish. Brook trout rely on cold water refuges in streams and lakes for their survival. Hemlock forests provide shade needed to maintain lower water temperatures. Brook trout will become increasingly vulnerable as water and air temperatures rise. // “When you take hemlock out of a hemlock stand, the first thing happens is more sunlight hits the ground,” said Denham. “Because of that you get warmer stream temperatures, warmer soil temperatures and more direct sunlight on the forest floor.” In the lower Hudson Valley, this has led to an increase in the number of invasive plants that normally can’t live in the cooler, shady conditions found under a healthy hemlock overstory.
 |
| **Ecosystem** | Hemlock forests provide unique habitat for wildlife. Their shade helps keep soil and water temperatures cool and provide microclimates in which many plants and animals thrive. |
| **FWS Response** |  |
| **Notes** | In New York, climate change may make it easier for an invasive species to continue its spread to hemlock forests further to the north.  |

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| **State** | 45. Arkansas |
| **Wildlife** | * Warmer winters equated to more ducks in states like Minnesota, Illinois, Iowa and Ohio, and fewer ducks in Arkansas, Alabama, Louisiana, Mississippi and Tennessee.
* For dabbler ducks -- those that eat food just below the surface of a pond or wetland -- the climate variables showed a 96 percent probability of explaining the changes in duck abundance in various locations along the flyway. For mallard ducks, the most popular species among hunters, the probability was 99 percent.
* Ducks Unlimited, Humburg expressed concern that warmer and drier conditions in Arkansas and other Mississippi Alluvial Valley states could lead to lower stream flows and groundwater levels, negatively impacting wetlands and waterfowl.
 |
| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** | A 2005 newspaper article gave Dr. James Bednarz the idea to look for a possible link between climate change and duck migration. But the hypothesis presented an interesting research project. After diving into 50 years worth of duck data, Bednarz, a professor of Wildlife Ecology at Arkansas State University in Jonesboro, says he’s now convinced climate change -- including warmer temperatures, more ice-free days and changes in precipitation -- is causing fewer ducks to migrate south for the winter. |

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| **State** | 44. Kansas |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | (focus on GoZero replanting on NWR) |
| **Notes** |  |

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| **State** | 43. Rhode Island |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | (focus on solar power on NWR) |
| **Notes** |  |

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| **State** | 42. North Dakota |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** | Each April and May, in a rite of spring, American white pelicans begin arriving in their Northern Plains breeding grounds from the Gulf of Mexico.  But for the last several decades, something has put the large birds ahead of schedule.  That something, researchers believe, is warming tied to climate change — the same change that’s recently brought egrets, ibis and herons to nest on the refuge, well north of their long-time nesting areas. // The early birds are paying for their two-week head start with more chick deaths from severe spring storms.  For the pelicans, this setback comes on top of other major stressors, most notably West Nile Virus. If — and how — the pelicans will adapt is unclear. // As many as 35,000 white pelicans nest on Chase Lake’s remote wilderness islands. That’s up from 50 in 1908, when Teddy Roosevelt established the refuge to protect the species from being hunted to extinction. Despite the colony’s rebound, the great-winged birds are still considered vulnerable because they have so few breeding areas. |

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| **State** | 41. New Hampshire |
| **Wildlife** | * (moose) Unfortunately, climate change is likely to intensify this threat to moose. “There’s almost no question that warming trends are going to be good for ticks, which in turn will be bad for moose,” says Kristine Rines, moose project leader for the New Hampshire Fish and Game Department. // Winter ticks aren’t like the typical ticks that people come into contact with. In autumn, larval-stage ticks climb up vegetation in large groups and “quest” – or look for a passing animal to hop on to. // After attaching to a moose, the ticks feed and then nap until late winter or early spring when they begin to feed again. // According to Rines, “Not only do the ticks remove a large portion of the blood supply of the moose, but the moose’s ability to rest at this time of year and the physiological stress of reduced blood volume lead to a compromised immune system. This combination leaves the moose open to an array of other infections.”
 |
| **Ecosystem** | Climate change magnifies the tick problem in a couple of ways. If there’s no snow on the ground in March or April, engorged female ticks that fall off moose survive to lay their eggs in June. That produces a larger tick population in the fall when they are ready to quest again. Warmer temperatures and less snow in the fall means the ticks can continue questing for a longer period of time, infecting moose at a higher rate. |
| **FWS Response** |  |
| **Notes** | Tick infestations can drain the blood supply of moose and can lead to malnutrition and death. In a year with average weather conditions, a moose will probably carry 30,000 ticks by late fall. In years with a late first snow fall, a moose could carry 160,000 ticks // The creatures posing the threat are winter ticks – Dermacentor albipictus. A New Hampshire Fish and Game Department study that began in 2001 collared and tracked moose and found winter ticks accounted for 41 percent of all moose deaths in the state over a five-year period. That was nearly the same percentage of collared moose killed by hunting and moose-vehicle collisions combined. Virtually all the calf deaths during the study were due to winter ticks.// New Hampshire Fish and Game Department researchers will spend the next several years studying the best way to accurately determine the numbers of ticks on moose and how that relates to mortality rates, as well as the changing climate. |

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| **State** | 40. Illinois |
| **Wildlife** | (focus on green infrastructure & urban issues/Chicago) |
| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** | partners factor climate change into their planning and management efforts.  The plan includes strategies for reducing climate change impacts through land conservation; adapting conservation plans to a rapidly changing climate, and engaging partners by instituting educational “climate clinics” to ensure they are climate ready, no matter what their role is in conservation.  |

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| **State** | 39. New Jersey |
| **Wildlife** | * Forsythe Refuge mainly consists of tidal salt meadow and marsh. Tens of thousands of migrating shorebirds, wading birds, ducks and geese use the refuge in the spring and fall to rest and eat the rich food resources. Other birds remain through the summer to nest and raise their young
* Nesting habitats for [American oystercatcher](http://www.allaboutbirds.org/guide/american_oystercatcher/id) and [piping plover](http://www.allaboutbirds.org/guide/piping_plover/id), as well as stopover habitat for [red knot](http://www.allaboutbirds.org/guide/red_knot/id) during its lengthy fall migration are particularly vulnerable.
 |
| **Ecosystem** | Potential risks include sea level rise inundating habitats, storms destroying beaches and dunes, erosion of tidal creek banks, ocean acidification affecting invertebrates that birds feed on, and heavy rainfall causing greater runoff of pollutants into tidal flats. //  |
| **FWS Response** | [Edwin. B. Forsythe National Wildlife Refuge](http://www.fws.gov/northeast/forsythe/) in Oceanville, New Jersey, is among the first wildlife refuges in the country to complete the [Climate Change Vulnerability Assessment for Shorebird Habitat,](http://www.whsrn.org/tools/climate-change-tool) which not only measures how vulnerable a habitat is to the effects of climate change, but also enables managers to consider how to sustain such habitats.  The assessment looks at a range of stressors, including sea level rise, increased frequency and intensity of storms, and changes in precipitation and temperature.   // Plans are underway to reduce some natural stressors as well. The U.S. Fish and Wildlife Service is committed to undertaking several projects to increase the resilience of the most vulnerable habitats.  The refuge will work this summer on controlling Asian sand sedge, a non-native plant that invades beaches and dunes to such an extent that beach-nesting birds can no longer use them. |
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| **State** | 38. Alabama |
| **Wildlife** | * Diamondback terrapins were once abundant on Dauphin Island, Alabama.  Now, they need state protection in order to survive
* More than 113 of Alabama’s species are now listed as threatened or endangered, including some 61 freshwater mussels, 10 reptiles, and 21 plants. With so many imperiled species in their care, U.S. Fish and Wildlife Service biologists take climate change seriously.  That’s because slight changes in climate can affect the survival of a species.
 |
| **Ecosystem** | “Small environmental changes can have big effects in a relatively short period of time, particularly when you are considering such powerful ecosystem drivers as temperature and moisture,” explained Dan Everson, Deputy Field Supervisor for the Service’s Alabama Field Office.  “Many of the plant communities we have come to know and love on the Gulf coast are responsive to relatively subtle changes in moisture.  Because of the flatness of the coastal plain, a few extra inches of ground water, a few extra floods, a slight change in elevation of the tides, or even a few extra inches of rain per year may determine whether our children will continue to admire a slash pine woodland with an understory of pitcher plants and toothache grass, or find themselves instead tripping over cypress knees and palmetto crowns in a tupelo swamp.” |
| **FWS Response** |  |
| **Notes** |  |

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| **State** | 37. Washington |
| **Wildlife** | (focus on habitat restoration) – only reference to Pacific Salmon |
| **Ecosystem** |  |
| **FWS Response** | River delta restoration projects are considered crucial to provide increased resiliency to large estuary systems – a key tool for adaptation in the face of climate change and related impacts of sea level rise. The Nisqually estuary in Washington State is a shining example. // Restoration of the Nisqually estuary helps promote system resiliency to climate change effects such as:* Increased winter storms, rainfall, and flooding
* Loss of forest cover due to increases in insect infestations and fire
* Rise in sea level resulting in loss of shoreline areas
* Loss of habitats and biodiversity
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| **Notes** |  |

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| **State** | 36. Michigan |
| **Wildlife** | (focus – more on potential exposure to contaminants)  |
| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** | More than a half century of research has shown that bald eagles along Michigan’s shorelines and rivers are gradually beginning to nest earlier each season -- a potential indication of this iconic species’ response to changes in climate in the upper Midwest. // More recently, Dave Best, fish and wildlife biologist at the U.S. Fish and Wildlife Service’s (Service) [East Lansing Ecological Services Field Office](http://www.fws.gov/midwest/EastLansing/), and Bill Bowerman, from the [University of Maryland](http://www.enst.umd.edu/), have been studying bald eagles as indicators of water quality in the Great Lakes watershed of Michigan.  The two have seen a trend in coastal bald eagle nesting patterns that may point to the effects of the changing climate.  // Their research has determined that from 1988 to 2006, eagles nesting along the Great Lakes shorelines in Michigan initiated egg laying an average of 0.7 days earlier each year, and those nesting along Great Lakes tributaries began 0.9 days earlier. These are the highest such rates recorded to date.  Analysis of data from eagles inhabiting Michigan’s interior did not show significant changes in nesting behavior. // The Great Lakes tend to moderate the climate along Michigan’s shoreline and rivers; with less snow and ice cover, temperatures have a tendency to stay warmer. However, interior portions of Michigan are less buffered from pronounced changes in temperature, which may contribute to the insignificant changes in nesting dates for birds in Michigan’s interior.  // What does earlier nesting mean for the bald eagle?  “We believe that the reduced duration and extent of ice cover on the Great Lakes due to climate change has led to earlier access to foraging areas along the lakes, which has triggered earlier initiation of egg laying by nesting eagles,” Best said. “Earlier nesting has not yet resulted in any change in productivity, suggesting that the eagles have adjusted to climate change so far.” // Still, biologists are thinking about all of the ways climate change may impact eagles and similar raptors.  Less ice cover earlier in the year may mean birds have easier and longer access to foraging opportunities.  Longer feeding times increase the chances for contamination in birds. “Although contamination has decreased, there’s still a lot out there in biota and sediment,” Best said. "This is something we will need to monitor and evaluate any potential impacts." |

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| **State** | 35. Virginia |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | ( focus on use of technology – LIDAR and SLAMM modeling – impacts of SLR)  |
| **Notes** | “Comparing older maps of the refuge and the town of Chincoteague with newer maps tells a distinct story,” said Lou Hinds, Chincoteague refuge manager. “The land mass is shrinking and sea level rise is the main culprit.” |

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| **State** | 34. Hawaii |
| **Wildlife** | (focus on PICC partnership and study)  |
| **Ecosystem** | Tropical coral reefs are among the world’s most diverse ecosystems, harboring thousands of species in a complex community built by living corals. But in the Hawaiian and Pacific Islands, as elsewhere, these ecosystems are declining because of human impacts, including climate change. |
| **FWS Response** | In the Pacific, where the Service manages more than one million acres of coral reef habitat in 11 refuges, including the [Hawaiian Islands National Wildlife Refuge](http://www.fws.gov/hawaiianislands/), Service scientists are seeking ways to reduce coral vulnerability. //“We are looking for management actions that can give coral reefs a fighting chance in our changing climate,” explains Susan White, who manages coral reefs within the PICCC area as project leader for the [Pacific Reefs National Wildlife Refuge Complex](http://www.fws.gov/pacificremoteislandsmarinemonument). “We can’t afford the death of these vital ecosystems.” |
| **Notes** | A tropical Pacific coral reef at Palmyra Atoll National Wildlife Refuge in the Pacific abounds with fish. Ocean warming and acidification, tied to climate change, are taking a toll on coral reefs |

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| **State** | 33. Georgia |
| **Wildlife** | * gopher tortoise is walking through grasses found in the longleaf ecosystem
* Additionally, nearly 900 plant species occur only in the longleaf forests. It’s counter-intuitive, but the monoculture of a forest dominated by longleaf pines leads to rich biodiversity of animals and plants that depend on its ecosystem. The secret is fire.
* gray tree frog and many other amphibians depend on the longleaf ecosystem for survival.
* Georgia’s conservation priorities include more than 20 animal and 56 plant species associated with the longleaf ecosystem, such as the bobwhite quail, a ground-dwelling bird that is Georgia’s official State Gamebird due to its popularity among small-game hunters.
 |
| **Ecosystem** | (focus on longleaf pine restoration) |
| **FWS Response** | In 2009, the Service and other federal agencies joined states, universities and non-profit partners to launch America’s Longleaf Restoration Initiative. The goal is to expand the longleaf pine forest from about 3.5 million acres today, to 8 million acres by 2024. // Millions of dollars in federal grants have been distributed to plant longleaf, remove invasive species, thin trees and prescribe fire. For example, the Service’s Partners for Fish and Wildlife Program last year spent about $1.2 million across the Southeast to provide longleaf pine technical assistance and habitat improvement on private lands. //  |
| **Notes** | Longleaf pine forests need fire. Fires remove competing woody vegetation and release nutrients, allowing the rich diversity of plant and animal species found in longleaf ecosystems to thrive.  As temperatures rise in a changing climate, wildfires are expected to increase, making the longleaf pine a good bet for the future. //  |

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| **State** | 32. Utah |
| **Wildlife** |  |
| **Ecosystem** | [Climate change](http://pubs.usgs.gov/fs/2010/3123/) could have significant impacts to the basin’s aquatic ecosystem.  Impacts may include: * Higher water temperatures from increased air temperature;
* Changes in the timing of peak flows from an earlier snowmelt; and
* Potentially lower runoff peaks because of reduced snow packs.

current scaled-down models suggest the northern part of the basin may get wetter and the southern portion drier. “But that moisture could come in the form of more spring rains and less winter snow. |
| **FWS Response** | “During times of shortages, whether due to drought or climate change, flows for endangered fish receive the same protection as water deliveries to agriculture, municipalities and industries,” he says. //“Partners in the Upper Colorado and San Juan River Recovery Programs have made important strides toward recovery of the endangered Colorado River fishes,” she says. “But climate change can be expected to bring new challenges to these recovery efforts.  And it’s the strong working relationships formed in these Recovery Programs that will provide the platform for addressing the effects of changing river flow and temperature anticipated with climate change.”  |
| **Notes** | In the face of a warming climate and persistent drought, people and wildlife along the Colorado River and its tributaries in Utah, Colorado, New Mexico and Wyoming are benefiting from cooperative efforts to recover four species of endangered fishes while effectively managing water for human uses and hydroelectric power generation. //partnerships are recovering endangered Colorado pikeminnow and razorback sucker while water development proceeds in accordance with federal and state laws and interstate compacts. The Upper Colorado Program is also working to recover humpback chub and bonytail. //When the endangered fish recovery programs were established, says Upper Colorado Program Assistant Director Angela Kantola, chronic drought conditions in the west raised concerns that altered river flows might result in completely dry river sections in some years. |

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| **State** | 31. Maryland |
| **Wildlife** |  |
| **Ecosystem** | There are many reasons why the marshes have been disappearing. Nature has had a hand, including erosion from wind and waves, more frequent powerful storm surges, land subsidence and – now we know-- sea level rise // The bay’s coastline also faces the prospect of rising sea levels due to climate change, which might transform both coastal and inland habitats. Moreover, some local areas, like [Blackwater National Wildlife Refuge](http://www.fws.gov/blackwater/), are experiencing land subsidence – the slow sinking of coastal land thought to be related to the geological history of the area. // |
| **FWS Response** | The simple act of planting trees creates wooded areas or corridors for animals to roam as the marshes continue to shrink. Blackwater Refuge has lost about 5,000 acres of marshland since the 1940s. Moreover, tree-planting also fights a central cause of climate change: the build-up of greenhouse gases. |
| **Notes** | More than 5,000 acres of wetlands have been lost within the Blackwater National Wildlife Refuge boundary since the late 1930s // |

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| **State** | 30. South Dakota |
| **Wildlife** |  |
| **Ecosystem** | “Wetlands are at risk from a number of factors and climate change may present an added challenge for wetland persistence,” said Cami Dixon, zone biologist for North and South Dakota.  “By understanding the potential impacts of climate change at finer resolutions we can develop strategies to foster resiliency and sustain wetlands. |
| **FWS Response** |  |
| **Notes** | rich habitat of North America’s wetlands – habitat that may be affected by climate change. // The Prairie Pothole Region (PPR) - named for its many glacial depressions, commonly referred to as potholes - is seasonally home to many wetland bird species.  The region is often referred to as North America’s “duck factory” because the potholes support more than 50 percent of the continent’s breeding waterfowl. South Dakota contains a large portion of the remaining wetlands in the PPR, which contribute significantly to annual production of wetland birds, including migratory waterfowl. // The once plentiful prairie wetlands declined in number. // The National Wildlife Refuge System includes nearly 7,000 WPAs – many of them in the PPR -- that preserve vital wetlands and grasslands for countless nesting waterfowl and other wildlife. |

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| **State** | 29. Tennessee |
| **Wildlife** | * Adult Brook Trout. These fish, known for their distinct coloring, face fragmented populations, habitat loss, invasive species, degraded streams, longer droughts, more intense wet periods, and temperature changes
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| **Ecosystem** |  |
| **FWS Response** | Preventing this scenario is precisely why a growing number of partners are collaborating through the Eastern Brook Trout Joint Venture to determine how accelerating climate change and other challenges will impact Southern Appalachian brook trout populations in Tennessee and other states, and what biologists can do to protect the iconic fish. // In collaboration with many conservation organizations, the U.S. Fish and Wildlife Service developed and released an ambitious strategy for responding to accelerating climate change and addressing its impact on critters like brook trout. The Service and joint venture are working on a climate change monitoring program, targeting 400 sites aimed at taking a closer look at how air and water temperatures impact brook trout. |
| **Notes** |  |

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| **State** | 28. Oklahoma |
| **Wildlife** | * Several rare and distinctively-named creatures depend for survival on the cool, mountain-fed Little and Kiamichi River Basins in southeastern Oklahoma and southwestern Arkansas. At [Little River National Wildlife Refuge](http://southwest.fws.gov/refuges/oklahoma/litlriv.html) and surrounding areas, the Ouachita rock pocketbook — a freshwater mussel — filters the water alongside two other endangered mussels, the scaleshell and winged mapleleaf. A small federally threatened fish called the leopard darter also hides in these upland streams.
 |
| **Ecosystem** |  |
| **FWS Response** | Research has shown that higher stream temperatures impair species’ feeding, growth and reproduction. Biologists worry that changes to these important biological processes may lead to a general decline in the condition of these rare species, leaving them more vulnerable to competition from other creatures that share their food, habitat and spawning areas. // Working with other state and federal agencies at the [Tishomingo National Fish Hatchery](http://www.fws.gov/southwest/fisheries/tishomingo.html) and [Ecological Services Field Office](http://www.fws.gov/southwest/es/oklahoma/) in Oklahoma, the Service is nearing completion of the first phase of a three-part study. Lab scientists have measured the tolerance of common Oklahoma mussel and fish species to changes in water temperature. Once data analysis is complete, they will prepare a preliminary report to guide the next study phases. // Phase two will study the temperature tolerance of species similar to the federally listed species in their distribution and use of resources. Studying more-abundant “surrogate” species ensures that enough live specimens can be captured without harming the rare species.  // The last phase of the study will involve leopard darters only. Leopard darter populations fluctuate considerably from year to year. During a year when population numbers are well above average, researchers will collect a small sample for thermal tolerance research. The collected fish will then be used for further research or educational purposes.  This phase of the study will let researchers compare the thermal tolerance of leopard darters to that of species that share their resources (determined in phase two) to determine if competition for shared resources could be a future threat. Once the potential effects of higher stream temperatures on these rare species are better understood, scientists will be better equipped to gear recovery actions to projected climate change impacts. |
| **Notes** | A researcher displays juvenile freshwater fat mucket mussels that will be used as stand-ins for rarer species in studies on water temperature tolerance. Study data will help researchers assess how vulnerable rare Oklahoma aquatic species will be to potential warming tied to climate change // And now, biologists speculate the fish and mussels could face another potential stressor: rising stream temperatures resulting from climate change, if projections by an [intergovernmental panel](http://www.ipcc.ch/) prove accurate. //  |

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| **State** | 27. Connecticut |
| **Wildlife** | * The [roseate tern](http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B07O) is a federally endangered seabird whose favored nesting areas are found on rocky offshore islands and barrier beaches along the north Atlantic coast of the U.S. Unfortunately, the tern is losing some of its prime seacoast habitat. The land is disappearing due to erosion that may be made worse by climate change. Increasing atmospheric temperatures are linked to rising seas and more intense storms, which eat away at the shore. // Falkner Island is a unit of the [Stewart B. McKinney National Wildlife Refuge](http://www.fws.gov/northeast/mckinney/) in Connecticut. Refuge Manager Rick Potvin estimates that the island is losing about 300 to 400 square feet of land each year due to erosion. He predicts that in the next few years the north spit nesting area will revert to tidal zone and will become unsuitable habitat for breeding terns.
 |
| **Ecosystem** |  |
| **FWS Response** | “On Falkner Island, we are adapting habitat to more closely resemble the terns’ preferred nesting areas on the north spit,” said Potvin. “Last year we watched the birds and identified the best sites on the island for the project. This year we’ll install bird nesting structures, sand, gravel, and cobble at these locations to provide attractive new nesting habitat on the refuge for the terns.” |
| **Notes** | Falkner Island, home to the only roseate tern nesting colony in Connecticut // [Falkner Island](http://ct.audubon.org/IBA_FIU_McKinnyNWR.html), off the Connecticut coast in Long Island Sound, is home each spring to 40 to 50 pairs of nesting roseate terns – the only colony remaining in the state. Most of the terns nest on the north spit of the island, a sand and cobble environment.  |

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| **State** | 26. Florida |
| **Wildlife** | climate change expected to be as dramatic as in Florida. The signs are already here. * In the Florida Keys, just a half-foot rise in sea level over the last 100 years reduced the pine rockland forest on one island by two-thirds. The globally imperiled habitat is home to many plants and animals that exist nowhere else, including the endangered Key deer, a smaller cousin of the white-tailed deer.
* Along the coasts, beaches are eroding from a combination of sea-level rise and storms, reducing the sea turtles’ nesting habitat.
* Fifty years ago, [sooty terns](http://www.nwf.org/News-and-Magazines/National-Wildlife/Birds/Archives/2008/Sooty-Tern-Migration.aspx) would arrive in April on Bush Key in the Dry Tortugas National Park, the largest U.S. nesting colony for the seabird. Now they arrive starting in late January.
* All those factors – sea-level rise, warmer temperatures, development and conservation funding – will determine where south Florida’s 67 threatened and endangered species are able to live in the future.
 |
| **Ecosystem** | Florida’s low elevation makes it especially susceptible to sea-level rise, and its fragile ecosystems are sensitive to changes in temperature and precipitation. Climate change is also expected to compound multiple threats already facing south Florida’s wildlife and habitat: habitat loss, droughts and competition with exotic species. |
| **FWS Response** | A Key deer walked through an area that had been intentionally burned the day before on the National Key Deer Wildlife Refuge on Big Pine Key in Florida. Prescribed burns are critical tools in maintaining the pine rockland forest, a fire-dependent habitat that is home to several endemic species including the big pine partridge pea and the Florida leafwing butterfly. As temperatures rise and droughts lengthen, it become more difficult to use prescribed burning as a management tool. // (also introduces the MIT modeling tool for the everglades) |
| **Notes** | Florida is a unique ecosystem where subtropical wildlife and habitats mix with their cooler-counterparts. Where else could one find an endangered Key deer eating a red mangrove? Accelerating climate change is expected to throw off the delicate balance //  |

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| **State** | 25. Oregon |
| **Wildlife** |  |
| **Ecosystem** | Estuaries all along the West Coast have been greatly affected during the past 100 years by diking, draining and conversion to agriculture or development, says Roy Lowe, refuge manager for the [Oregon Coast National Wildlife Refuge Complex](http://www.fws.gov/oregoncoast/). This activity eliminated vast tidal marshes and swamps. For instance, the Coquille River estuary, where Bandon Marsh National Wildlife Refuge is located, has suffered a 95 percent loss of the tidal marsh and 93 percent loss of forested wetlands. Lowe says these habitats directly support juvenile salmon and steelhead, waterfowl, wading birds and many other species. //  |
| **FWS Response** | (focus on FWS support of NWF report) |
| **Notes** | A long-billed curlew. The Service is working with the National Wildlife Federation and state and federal partners to assess climate change impacts in marine and coastal environments in Oregon and the North Pacific region. The information will help resource managers take action to safeguard species and habitats in the region // |

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| **State** | 24. Nevada |
| **Wildlife** | * [Devils Hole pupfish.](http://www.fws.gov/endangered/about/ep-18.html) This iridescent blue inch-long fish makes its home in the 93 degree waters of Devils Hole, which is located within Ash Meadows National Wildlife Refuge near the California/Nevada border. The Devils Hole pupfish is found nowhere else in the world. // “The majority of climate models indicate that the desert Southwest is headed for a hotter, drier future,” says Rick Kearney, the assistant regional director for Science Applications in the Service’s Pacific Southwest Region. “The increased frequency and duration of droughts we expect will almost certainly impact the aquifer that supports Ash Meadows.” // The endangered Devils Hole pupfish’s sole natural habitat is [Devils Hole](http://www.nps.gov/deva/naturescience/devils-hole.htm), a water-filled abyss on National Park Service land within the refuge. The fish spawn on a rock shelf near the surface and are vulnerable to water-level shifts.
 |
| **Ecosystem** | [Ash Meadows National Wildlife Refuge](http://www.fws.gov/desertcomplex/ashmeadows/) is an anomaly: an oasis of spring-fed wetlands in the Mojave Desert. Even more unusual are the plants and animals that have evolved there. Scientists have found 26 species that they believe exist only on or near the refuge. // “Ash Meadows is really about water, from the fish to the endemic plants,” said refuge manager Sharon McKelvey, who said that a drop in groundwater levels would imperil the refuge’s rare and endangered species. Among Ash Meadows Refuge’s endemic species are at least 10 freshwater snail species, aquatic beetles and a variety of listed native fish – all dependent on warm springs from a deep aquifer. // |
| **FWS Response** |  |
| **Notes** | When the Bureau of Land Management notified the U.S. Fish and Wildlife Service (Service) in early 2009 about a right-of-way application to install a solar array on BLM land 10 miles from the refuge, FWS and National Park Service staff considered how the project might affect the refuge and its resources. Most concerning was a proposed wet cooling system that would consume 4,500 acre-feet of water per year – water to be obtained via pumping from a deep-water wells. (An acre-foot is the amount of water required to fill a one-acre area to the depth of one foot.) // |

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| **State** | 23. Indiana |
| **Wildlife** | * Midwest bat populations already faced serious threats, such as the loss of habitat to development, when they were struck four years ago by a deadly disease known as white-nose syndrome. The disease is still killing bats, the endangered Indiana bat among them. How climate change will affect the situation is unclear. But just as in the case of Kentucky bats — described in a story May 11 — scientists fear climate change could add to stressors on the imperiled species. //
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| **Ecosystem** |  |
| **FWS Response** | The U.S. Fish and Wildlife Service is revising its Indiana Bat Recovery Plan, first drafted in 1983, to acknowledge that concern. “We know that temperature is very important to survival of our insectivorous bats that hibernate in caves, including Indiana bats,” says Lori Pruitt, lead Service biologist for the species. “During winter, only a small proportion of caves provide the right conditions for hibernating Indiana bats because these bats have very specific temperature requirements during hibernation. Surface temperature is directly related to cave temperature, so climate change will inevitably affect the suitability of hibernacula.” // |
| **Notes** | Climate change models for the little brown bat, a closely related species, suggest warming will push its range north in the next 80 years. A similar range shift for the Indiana bat could reduce the bats’ access to the large, complex cave systems on which they depend; such caves are rare north of the bats’ current range. Indiana bats have also been known to colonize abandoned mines. Scientists speculate that in response to climate change the bats might colonize more mines north of the current range — if the climate inside the mines adequately mimics the cave environments to which the bats have adapted over millions of years. // Climate change could also affect whether bats go hungry. Indiana bats are prodigious insect-eaters. During their six months of winter hibernation, they live solely on their fat reserves. When they emerge in spring, with their fat reserves depleted, their survival depends on the availability of insects. If climate change reduces the number of insects then at hand, scientists theorize, bats may be hard pressed to find enough food at this critical time. // Female Indiana bats may be particularly vulnerable when they emerge from hibernation pregnant and migrate to their summer maternity areas. There, they must eat more to support pregnancy and produce milk for their pups. If pup production doesn’t coincide with sufficient insect availability, experts worry reproductive success could decline. Indiana bats produce only one pup per year, so bat populations are slow to recover if reproduction drops. // Climate change could also disrupt bat mating and migration, biologists speculate, by altering the seasonal cues that trigger these behaviors. //  |

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| **State** | 22. Vermont |
| **Wildlife** | * Bicknell’s thrush nest in mountain-top evergreen forests in Vermont, areas that are shrinking due to global warming. // Bicknell’s thrush has one of the most restricted breeding ranges of any North American bird, nesting primarily in stunted spruce-fir forests found at or near the highest elevations of mountains in Vermont and other New England states. These mountain tops are like a chain of islands separated by a sea of habitat that is unsuitable for this species. // As the climate warms and precipitation patterns change, deciduous trees – those that shed their leaves in the fall – are likely to become more prevalent in higher elevations, shrinking the size of the mountain-top evergreen conifer forests that are home to the [Bicknell's thrush](http://www.allaboutbirds.org/guide/Bicknells_Thrush/lifehistory). // This is just one of many challenges that climate change poses for the rare bird. // Another potential threat is a mismatch between the arrival time in spring of Bicknell’s thrush and other birds, which is regulated by day length, and the abundance of insect prey, linked to temperature. If the peak food supply for birds comes earlier due to warmer spring temperatures, late arriving birds may lay fewer eggs and produce offspring that have less chance of reaching adulthood.
* The red squirrel, which also lives in the mountain-top forests, also presents a danger. The squirrels feed mainly on spruce and fir cones, but will also raid the nests of Bicknell’s thrush to feed on eggs and young birds. // The red squirrel population is cyclical and tied to the availability of cones. Conifer trees typically produce robust cone crops every other year, and the red squirrel population rises and falls accordingly. Some predict that climate change will result in more frequent cone crops in balsam fir, even as conifer forests diminish due to climate change. That could mean an increase in the red squirrel population and a subsequent increase in the threat to Bicknell’s thrush.
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| **Ecosystem** |  |
| **FWS Response** |  |
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| **State** | 21. Texas |
| **Wildlife** | * Even though a record-breaking 281 whooping cranes wintered this past season at [Aransas National Wildlife Refuge](http://www.fws.gov/southwest/refuges/texas/aransas/) on the Gulf Coast of Texas, climate change is a major concern for the charismatic endangered species. // The primary threat to the cranes’ survival, according to Aransas Refuge manager Dan Alonso, is rapidly disappearing coastal habitat. Most of the habitat is being devoured by burgeoning real estate development along the Gulf of Mexico, but climate change is exacerbating the problem. A secondary concern related to climate change is the prospect of prolonged drought, which would reduce the flow of freshwater and leave marsh habitat unacceptably saline for cranes. // “The major climate change impacts are sea-level rise and loss of habitat, and black mangrove encroachment from the south,” says Alonso. // Sea-level rise results in saltwater intrusion into brackish marsh, erosion of coastal marsh and simple inundation, Alonso says. “The areas are now deeper than they were before. The bird is only so tall. It’s a wading bird, not a diving bird.” // Whooping cranes – which are five feet tall and have a seven-foot wingspan – thrive on open tidal marsh where they can forage for razor clams, minnows, lizards, snakes and, especially, blue crabs. They dislike thick cover. “They don’t fly into trees or densely wooded areas,” Alonso says, “because it doesn’t afford them the opportunity to elude predators” – primarily coyotes and bobcats. So, the climate-related proliferation of black mangroves makes what once was prime habitat undesirable to the cranes. A proposal by University of Texas researchers to study and document the extent and the effect of black mangrove encroachment on Gulf Coast habitat and its wildlife – including cranes – is pending approval.
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| **Ecosystem** |  |
| **FWS Response** |  |
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| **State** | 20. Mississippi |
| **Wildlife** | * The Grand Bay National Estuarine Research Reserve is researching the diamondback terrapin turtle, whose habitat is likely to be inundated as the sea rises // It’s the home of the [Mississippi diamondback terrapin](http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C063), a feisty little water turtle that is slowly disappearing thanks to over-harvesting and habitat loss. The U.S. Fish and Wildlife Service has listed the terrapin as a species of concern, a sort of watch list for species in decline. // These smallish turtles are special in several ways. They are the only turtle species adapted to live in brackish waters, which are a mix of freshwater and sea water. // The turtles, which can live up to 40 years or more, have been slow to recover. In addition, the turtles have faced habitat loss due to erosion. That’s likely to worsen as the changing climate leads to accelerated sea level rise. // The terrapin’s current home will likely be submerged, though their estuaries could migrate inland if not blocked by development. Another possible impact to the terrapin is warming temperatures. Terrapin sex determination depends on the temperature of the eggs. When the weather is warmer, more females hatch. When it’s cooler, males dominate.
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| **Ecosystem** | The 10,216-acre Grand Bay National Wildlife Refuge is under threat from the very thing that gives it life – the Gulf of Mexico and its changing sea levels. // Salinity is likely to increase in tidal rivers like this one in the Grand Bay National Wildlife Refuge. |
| **FWS Response** | Service biologists are now turning their attention to a new threat to the terrapin: climate change. The most imminent impact is sea level rise and the possibility that the turtle’s habitat will one day be under water. |
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| **State** | 19. Wyoming |
| **Wildlife** | * Lodgepole pine forests dominate the forested ecosystems of western North America and can provide breeding and foraging habitat for many coniferous wildlife species, including song birds, woodpeckers and red squirrels.
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| **Ecosystem** | The U.S. Forest Service estimates that by 2012, the majority of lodgepole pines in northern Colorado and southern Wyoming will be killed by the beetle. Currently, there are [four million acres](http://www.fs.usda.gov/wps/portal/fsinternet/%21ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gjAwhwtDDw9_AI8zPwhQoY6BdkOyoCAPkATlA%21/?ss=110299&navtype=BROWSEBYSUBJECT&cid=FSE_003853&navid=091000000000000&pnavid=null&position=BROWSEBYSUBJECT&ttype=main&pname=Rocky%25) of lodgepole pine trees on Forest Service land affected by mountain pine beetle infestation. Extensive beetle kill has resulted in ecosystem-wide impacts such as increased potential for wildfires and some loss of other tree species such as Douglas fir. //  |
| **FWS Response** | The lodgepole pines are not the only trees favored by the mountain pine beetle. The Fish and Wildlife Service is currently working on a listing determination for the entire range of whitebark pine, another western pine tree species heavily impacted by the insects. // The Service anticipates completing its review, which will determine whether the whitebark pine will become a candidate for ESA listing, in mid-July, Nicholas said.  |
| **Notes** | Triggered by a “perfect storm” of extended droughts, warm winters, and old, dense forests, mountain pine beetle populations have exploded across a landscape of lodgepole pine trees throughout Colorado and southeastern Wyoming. // Triggered by a “perfect storm” of extended droughts, warm winters, and old, dense forests, mountain pine beetle populations have exploded across a landscape of lodgepole pine trees throughout Colorado and southeastern Wyoming. // |

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| **State** | 18. Minnesota |
| **Wildlife** | * Minnesota’s iconic moose might be the seven-foot-tall, 1,000 pound version of the canary in the coal mine. The large antlered animal appears on the verge of being pushed out of its southernmost historic range by climate change and other stressors. // Biologists at [Agassiz National Wildlife Refuge](http://midwest.fws.gov/agassiz) and the [Minnesota Department of Natural Resources](http://www.dnr.state.mn.us/index.html) say rising temperatures are at least partly to blame for a sharp drop in moose numbers in northwest Minnesota since the early 1990s.  Warming appears to make moose more susceptible to deer-borne parasites and ticks, which often lead to malnutrition and death. // According to aerial winter surveys conducted by the state, northwestern Minnesota’s moose population has dropped from a high of about 4,000 in the early 1980s to fewer than 100 in 2007.  Agassiz Refuge used to boast more than 430 moose; now, it has fewer than 50.  // Average winter temperatures near Agassiz Refuge have risen by about 12 degrees Fahrenheit over the last 41 years; summer temperatures have increased by about four degrees. Moose calf counts declined the year after higher mean temperatures were recorded. // Moose expend added energy when temperatures in March (two months before calving) exceed 23 degrees and temperatures in September breeding season exceed 57 degrees. Since 1984, temperatures have passed those thresholds more times than they did in the previous 24 years.  // Climate change has contributed to the sharp drop in moose numbers in in northwestern Minnesota, say scientists. // In addition to capturing and studying wild moose, researchers consult studies of cattle, mooses’ closest domestic counterparts. Like moose, cattle are ruminants — mammals that pre-digest food in the first part of their four-section stomach. Studies show that “cattle exposed to higher temperatures have an impaired immune system,” says Mark Lenarz, who leads forest wildlife research for the Minnesota Department of Natural Resources. If moose react the same way, he says, “higher temperature would make them more vulnerable to diseases and parasites.” // Heat-stressed moose are more apt to become malnourished and have lower reproductive rates. Scientists speculate that reproductive rates may also be impaired by copper deficiency, exacerbated by increased particulate absorption in soil and vegetation.  The problems of heat stress and malnutrition compound one another.
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| **Ecosystem** |  |
| **FWS Response** |  |
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| **State** | 17. Maine |
| **Wildlife** | * Canada lynx are uniquely suited for the rigors of life in snowy northern Maine. // If snow cover decreases in Maine, the lynx may lose its competitive advantage over other predators // While the historic range of [Canada lynx](http://www.nwf.org/Wildlife/Wildlife-Library/Mammals/Canada-Lynx.aspx) used to extend throughout much of the northern United States and the Rockies, today the cat is confined to handful of northern states. Northern Maine currently supports the only viable lynx population in the United States east of the Mississippi River. // The U.S. Fish and Wildlife Service officially listed Canada lynx as a threatened species in 13 states in 2000. As a federally threatened species whose range has already been greatly diminished, this rare wildcat faces a grave threat in climate change. // “Lynx are uniquely sensitive to climate change based on their physical attributes,” said Chris Hoving, Endangered Species Coordinator for the Michigan Department of Natural Resources and Environment. “Their preferred habitat requires at least 2.7 meters of average annual snowfall. If snowfall decreases, there may be almost no suitable habitat in Maine, where the only verifiable lynx population on the East Coast exists.” // Just as the success of the Canada lynx is tied to snow depth, it is also tied to the animal’s primary food source - snowshoe hare. The Canada lynx is so effective at hunting the widely available snowshoe hare that it has little need to hunt anything else. But as temperatures rise and snowfall drops, bobcats, fishers and other predators may adapt better to the climate changes and availability of other prey, out-competing the Canada lynx in northern Maine.
 |
| **Ecosystem** |  |
| **FWS Response** | State and federal conservation agencies are developing strategies to maintain Maine’s lynx population. Part of that includes providing ample habitat for the snowshoe hare. // As the hare goes, so goes the lynx,” said Organ. “Providing guidance to land managers – within the context of larger biodiversity concerns – is critical to the success of lynx and all species.” “Managed forests respond less severely to climate change than unmanaged,” said Hoving. “Through management, we can reduce the forest’s rate of change and soften the blow of climate change to a variety of species.” |
| **Notes** |  |

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| **State** | 16. West Virginia |
| **Wildlife** |  |
| **Ecosystem** | (focus on Cerulean warblers) n/a |
| **FWS Response** |  |
| **Notes** |  |

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| **State** | 15. Nebraska |
| **Wildlife** | * Building resilience into the system will in turn ensure that even in drier, warmer climates, wetlands will have some level of function to support the millions of birds that depend on this region every spring, providing connectivity between the birds’ wintering and breeding grounds.
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| **Ecosystem** |  |
| **FWS Response** | Last year, a watershed initiative was developed to remove concentration pits, plug surface drainages and recontour waterways, all of which will improve hydrologic function of the watersheds that fill Rainwater Basin wetlands.  These actions will enable hydrologic function and increase resilience of these wetlands to climate change.  |
| **Notes** | During spring migration, as shorebirds, waterfowl and waterbirds make their way from wintering habitats to their northern breeding grounds, the broad Central flyway migratory corridors constrict in central Nebraska, funneling millions of birds through the state’s Rainwater Basin Wetland Complex. // Rainwater Basin wetlands are shallow playa wetlands that fill each spring with snowmelt.  The flooded wetlands provide critical foraging habitat for millions of waterfowl and shorebirds annually.  While in the Rainwater Basin, birds acquire significant energy and nutrient reserves that they will need to continue migration and initiate nesting.  // Current climate models project increases in temperature and winter precipitation and decreases in summer precipitation for this region during the next century.  Both maximum and minimum temperatures are projected to rise, with minimum temperatures showing the greatest increases.  It is also expected that a higher percentage of precipitation will come during major storm events. // Based on the preliminary results of climate-based habitat [assessments](http://krex.k-state.edu/dspace/bitstream/2097/4116/3/RexRobichaux2010.pdf), this could be catastrophic for Rainwater Basin wetlands.  Current results suggest a strong relationship between flooded wetland habitat during spring migration and cold season (October – February) temperature, precipitation, and annual snow storage.  Higher winter temperatures would reduce snow storage, increase evaporation, and ultimately reduce surface runoff that fills these wetlands just prior to migration. |

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| **State** | 14. Kentucky |
| **Wildlife** | * Bats typically have specific roost requirements, especially during winter hibernation. For certain species that hibernate in Kentucky — such as the federally endangered Indiana bat (Myotis sodalis), gray bat (Myotis grisescens), and Virginia big-eared bat (Corynorhinus townsendii virginianus) — only a small number of caves within each species’ geographic range meet these requirements. // Scientists worry that longer or hotter summers may warm cave interiors so that they no longer meet some bats’ hibernation needs. Alternatively, warming might improve the picture by shortening the duration of bat hibernation or triggering the mid-winter emergence of insects for bats to feed on, scientists speculate.
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| **Ecosystem** |  |
| **FWS Response** |  |
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| **State** | 13. Ohio |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | (focus on kids CC education) |
| **Notes** |  |

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| **State** | 12. New Mexico |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** | (focus on renewable energy) |

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| **State** | 11. Wisconsin |
| **Wildlife** |  |
| **Ecosystem** | According to a comprehensive state report, Wisconsin's Changing Climate: Impacts and Adaptation, climate change models predict a shift to increased moisture and temperature in the decades ahead. By the middle of the century, statewide annual average temperatures are likely to warm by 6-7 degrees Fahrenheit. These changing conditions favor invasive plant and tree species over native prairie. // |
| **FWS Response** | (focus on biomass) |
| **Notes** |  |

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| **State** | 10. North Carolina |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | What can we do about climate change? // Artificial oyster reefs parallel to the shoreline is a natural way to slow the rate of erosion by catching wave energy.  // One thing we can do is prepare for it, by working with Mother Nature. At the [Alligator River National Wildlife Refuge](http://www.fws.gov/alligatorriver/) in North Carolina, where rising seas are eroding the shoreline, the U.S. Fish and Wildlife Service and [The Nature Conservancy](http://www.nature.org/) are giving the Albemarle Peninsula a fighting chance. // Starting with a $1 million grant from [Duke Energy](http://www.duke-energy.com/north-carolina.asp), the partners have constructed artificial oyster reefs along the shoreline, planted salt- and flood-tolerant trees and vegetation, and restored freshwater wetlands. The goal is to give the land and its species, such as forest-dependent birds and black bears, time to adapt to sea level rise, increased salinity and other climate change impacts.Here’s how the Climate [Adaptation](http://www.fws.gov/home/climatechange/adaptation.html) Project is preparing the refuge for accelerating climate impacts:* The artificial reefs, made of limestone rock and oyster shells, are already attracting oysters. They provide a natural buffer to shield the tidal marsh from crashing waves. The result should be reduced erosion and a more stable shoreline.
* As the sea creeps inland at the rate of about 25 feet a year, the coastal forest is dying and changing to salt marsh. The refuge’s newest saplings include native black gum and bald cypress. Both species can handle a little salty water. On land expected to be submerged in the near future, the partners are planting brackish marsh vegetation to ease the transition.

Freshwater wetlands that had been drained for mining and farming are being restored. Returning the natural balance to the water table will reduce saltwater intrusion, which is causing the soil to erode more quickly and is killing off salt-intolerant trees in the pocosin forest. Partners are also plugging manmade ditches that were pulling the sea farther inland. |
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| **State** | 09. Montana |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | Biologists in Montana and other Rocky Mountain states are looking for ways to identify and maintain connected areas that can help wildlife adjust to changes in climate. // A project supported by the Great Northern Landscape Conservation Cooperative aims to identify landscape-scale movement opportunities for the grizzly bear and other wildlife species in Montana and Idaho, and adjacent cross-border areas of British Columbia and Alberta. // Biologists recognize that the changing climate and other environmental stressors may alter the distribution of foods and ranges within ecosystems -- resulting in significant changes in distribution of species on the landscape and making enabling wildlife to move freely and safely even more important.  This project will provide information biologists need to maintain connectivity between important habitats. // The project provides the scientific foundation for efforts to increase long-term viability of wildlife by increasing opportunities for movement through low-elevation areas and across highways in northwestern Montana and northern Idaho. Successful dispersal of species is important for genetic viability and demographic connectivity, both of which increase species resilience to threats such as climate change, expanded human development, and increasing highway traffic volume and speeds. |
| **Notes** |  |

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| **State** | 08. Delaware |
| **Wildlife** | * A red knot tagged for research rests and refuels in Mispillion Harbor, Delaware. Climate changes such as sea-level rise and increasing storm intensity are adding challenges to red knot survival. // That’s when red knots, birds the size of a coffee mug, stake their future on the eggs laid by tens of thousands of horseshoe crabs. Without enough crab eggs to fuel them, the long-distance fliers may not survive their 10,000-mile spring trek from the southern tip of South America to their Arctic breeding grounds. // In recent years, the red knots’ bet on the crab eggs has been more of a crapshoot. First, the over-harvesting of horseshoe crabs for bait caused an egg shortage. Now, scientists also point to a wild card. // “The peak of horseshoe crabs spawning in Delaware Bay has not always been aligned with the migration of the red knots,” said Gregory Breese, the U.S. Fish and Wildlife Service’s project leader for the Delaware Bay Estuary Project. “That could be related to climate change.” // Changing water temperatures in Delaware Bay and more frequent and intense storms appear to be disrupting the synchronization between the spawning of the crabs and the arrival of the red knots. When waters warm, the crabs lay their eggs earlier, and other creatures may beat red knots to the feast. // Other climate-related influences are also likely affecting crabs and red knots. Rising sea levels have eroded beach and shrunken crab spawning areas. Red knots spend most of their time in regions of the world already experiencing effects from climate change. When Arctic snow cover is less than average during their summer breeding season, models suggest that red knot survival rates drop, Breese said. In the winter, red knots are arriving one week later than they did a decade ago in Tierra del Fuego, an archipelago on the tip of South America. // Rufa numbers have held steady since 2003, said Kalasz. The bird is a candidate for federal protection under the Endangered Species Act.
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| **Ecosystem** |  |
| **FWS Response** |  |
| **Notes** |  |

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| **State** | 07. Arizona |
| **Wildlife** | * Pollinators are critical to maintaining diverse, healthy ecosystems. The Service is entrusted to protect at-risk pollinators, such as hummingbirds and pollinators on national wildlife refuges – and threatened or endangered species that rely on animal pollination.  More than 75 percent of flowering plants, which provide fruits, seeds nuts, and nectar for wildlife, depend on pollinators.  Recent studies indicate some pollinators are already being impacted by climate change. // Launched in summer 2009, the northern Arizona study is looking at bees and other pollinating insects across elevations, from 5,000 feet in the desert grasslands to almost 9,000 feet in the mixed conifer and aspen forests of the San Francisco Peaks.  Piñon pines have already experienced die-offs after being weakened by drought and therefore becoming susceptible to insect pests.
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| **Ecosystem** |  |
| **FWS Response** | The U.S. Fish and Wildlife Service’s Arizona Ecological Services Field Office is addressing those research questions as it works at five sites with the Merriam-Powell Center for Environmental Research Center at Northern Arizona University to compile the first-ever baseline about the diversity and behavior of pollinating insects at varied elevations in northern Arizona.  |
| **Notes** | But what happens when the piñon and Ponderosa pines and aspens of northern Arizona -- vegetation pollinators call home -- move up the mountain as precipitation patterns change due to climate change?  // Some pollinators rely on specific plants.  But can they use a broader spectrum of plants?  Can they live at higher elevations to get to the plants they need? And what if they can’t?  |

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| **State** | 06. California |
| **Wildlife** | * A Northern Pintail. This dabbling duck can be found in much of the Northern Hemisphere, including the San Joaquin Bay-Delta, although in considerably lower numbers than in the past.
* But the Bay-Delta is in the throes of a well-chronicled crisis. Four recent years of below average precipitation have hammered this fragile ecosystem, contributing to the puzzling decline of the Delta fishery and the collapse of California's salmon fishing industry. The combination of decreased water supplies (from the drought), and seasonal water restrictions to protect the threatened delta smelt, endangered Chinook salmon and other species, has created a volatile political situation
* The Service’s Bay-Delta Fish and Wildlife Office, in Sacramento, California, is involved in examining the near-and long-term effects of climate change on Bay-Delta species through several planning efforts. The Service in 2008 established criteria for managing water flows through the Delta and issued a biological opinion that determined the effects of operating the state and federal water projects were putting the delta smelt at risk of extinction.  Climate change research and projections were a key element of that biological opinion.
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| **Ecosystem** | As federal, state and local experts continue to examine the factors contributing to the recent decline of California’s Bay-Delta ecosystem, the effects of climate change have surged to the forefront of study // The Delta and its watersheds also support several threatened and endangered species, and a popular recreational and commercial fishing industry //Total precipitation and temperature changes are two obvious factors linked to climate change, Cox said. Those changes can affect the timing of snowpack release into the Delta, which has the potential to affect fish migration patterns or other conditions which cue the behavior of fish and wildlife species. // “We’ve already seen shifts of snowpack melting earlier and shifts of temperature, both of which change the timing of water moving through the rivers and into the Delta,” Cox said. “It’s not just the amount of water that’s important; it’s when the water comes. Both of those factors can have a profound impact on fish habitat.” |
| **FWS Response** | Climate change, barely mentioned a decade ago, is now considered a major factor in the Delta planning picture. The rise in sea level, temperature, and changes in the timing of rainfall and snowmelt– all considered effects of climate change – are altering the landscape. //  |
| **Notes** |  |

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| **State** | 05. Idaho |
| **Wildlife** | * The waterways of the Pacific Northwest run deep. They unify the region that includes Idaho, Oregon and Washington by connecting the glaciers of its high volcanoes to its fertile valleys to the Pacific Ocean. Water coursing through streams and rivers is the lifeblood critical to urban and agricultural uses and to the vitality of aquatic ecosystems. Many iconic fish species in Idaho and the region such as salmon, steelhead, Pacific lamprey, bull trout and other native trout species, depend upon cool and plentiful stream flows to survive. But climate change is causing many stream flows to respond differently than they have in the past. // A changing climate is already bringing warmer air temperatures, an increasing proportion of winter precipitation falling as rain, earlier snowmelt and reduced spring snow pack. These changes all manifest in stream flow responses with decreased base flows, rising summer water temperatures, and more frequent winter flooding from rain-on-snow events.
* Bull trout were listed as threatened in June 1998. Critical habitat was designated in 2005. A recovery plan was drafted in 2005 and has not been finalized. In January 2010, the USFWS proposed a revision of critical habitat. // The complex work of conserving and recovering fish populations in the Pacific Northwest has grown substantially more challenging in light of our changing climate – this has become increasingly clear in the last several years with recent scientific assessments and projections,” said Dan Shively, the U.S. Fish and Wildlife Service’s Regional Fish Passage and Habitat Partnerships Coordinator.  “Robust and diverse fish communities require healthy watersheds and habitat; or more simply put, an abundance of cool, clean water.” //
* “Understanding how changing climate is likely to affect stream flow and water temperature decades ahead is paramount when contemplating today’s strategies for investing in both the present and future for healthy aquatic habitats,” he said.  “Our collective interagency and partnership efforts are intended to provide the foundation for supporting self-sustaining populations of salmon, steelhead, trout, Pacific lamprey, and many other native fish species.”
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| **Ecosystem** | In the Pacific Northwest, both elevation and geology have an important influence on stream flow responses – and therefore not all streams are responding to climate change in the same way. Upcoming published research by a team of hydrologists from the Service, NOAA-Fisheries and the U.S. Geological Survey provides greater understanding of how stream flow responses vary. The research builds on a substantive body of work by the University of Washington’s Climate Impacts Group, among others. // The research concluded that groundwater-dominated river systems of the Pacific Northwest, drawing water from deep beneath the surface, are less vulnerable to some climate change impacts and consequently may serve a greater strategic importance for sustaining aquatic ecosystems and the fish populations they support. These river systems, while vulnerable to the effects of changes in snow pack and winter precipitation, may provide cooler water and greater adaptive capacity to serve as refuges for coldwater-loving fish and other species.  |
| **FWS Response** | Working as an interdisciplinary team with members of the Service’s Regional Water Resources Program and with scientists from other agencies and organizations provides critical understanding of climate change and water resources, Shively said. That understanding, in turn, will provide a foundation for broad landscape-scale strategies that will serve as the “blueprint” for conservation of aquatic habitats and fishery resources in the region. |
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| **State** | 04. Louisiana |
| **Wildlife** |  |
| **Ecosystem** |  |
| **FWS Response** | (focus GoZero restoration) |
| **Notes** | “Every day, we hear about the impacts of deforestation in the Amazon or Indonesia,” says T[he Conservation Fund’s](http://www.conservationfund.org/) Louisiana state director Ray Herndon, “but it has happened in the Gulf Coast area, too. Migratory bird populations have lost more than 24 million acres of bottomland hardwood forest habitat over the last century along the Red River and lower Mississippi River valleys. Habitat destruction is more pronounced here than in any other area of the United States.” // Less than 5 million acres of bottomland hardwood forest remains. // the historic bottomland hardwood forests that feed and shelter shorebirds, blackbirds, warblers and other birds.  |

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| **State** | 03. Missouri |
| **Wildlife** | * Above-average fluctuations in rainfall, snowmelt and runoff in the lower Missouri River are complicating U.S. Fish and Wildlife Service efforts to recover endangered pallid sturgeon, one of the continent’s largest freshwater fish.  Unusually low water levels in 2004 and 2006 have been followed by record high levels since 2007, say scientists.  The Service is working with the U.S. Geological Survey (USGS) through the [National Climate Change Wildlife Science Center](http://nccwsc.usgs.gov/) and [Science Support Partnership Program](http://ecosystems.usgs.gov/ssp/index.html) to anticipate how a range of such changes may impact pallid sturgeon recovery efforts throughout the region, encompassing Missouri, Nebraska, Iowa, Kansas and South Dakota. // For sturgeon, some potential changes are double-edged swords.  Higher water temperatures, for example, would raise fish metabolism, spurring growth and reproduction — as long as adequate food is available. If food is scarce, however, fish growth and reproduction would likely slow in warmer water. // High water flow can likewise help or hinder sturgeon recovery.  In spring, high flow benefits the fish, triggering migration and conditioning spawning sites. But in summer, high flow washes fry downstream, reducing survival and recruitment into the adult population.
* The pallid’s feeding habits could be partly accountable. While shovelnose sturgeon feed primarily on silt plankton and small invertebrates, pallid sturgeon depend on larger organisms, such as other fish, for food. Changes to river habitat and water flow have reduced the availability of those organisms, a situation that could be exacerbated by a changing climate. // Commercial roe fishing is also still a threat.  Shovelnose caviar is more sought after, but pallid sturgeon have also been harvested for their eggs. The Service’s recent listing of shovelnose sturgeon as threatened may help protect both species. The listing permits law enforcement actions in portions of the Missouri and Mississippi River basins where pallid and shovelnose sturgeon co-exist.
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| **Ecosystem** |  |
| **FWS Response** |  |
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| **State** | 02. Massachusetts |
| **Wildlife** | * A [study](http://www.esajournals.org/doi/abs/10.1890/07-0068.1) conducted by Abraham J. Miller-Rushing and Richard B. Primack found that climate change is causing many plants to flower much earlier today than they did in the past. The two researchers used Thoreau’s observations, as well as the work of Alfred Hosmer, another naturalist who studied the ecosystem around Concord, as a comparison to their own modern-day observations. Their research concludes that in Concord, plants are now flowering seven days earlier on average than they did in Thoreau’s time. // But not all plants are equally impacted by climate changes. Some species have the ability to track seasonal temperature change and will flower earlier when temperatures are warmer. Other species don’t track temperatures as well, and will continue to flower at the same time every year—regardless of temperature variations. The ones that don’t track temperatures as well are more likely to suffer a decline in numbers; they also tend to be related to one another, so entire plant families are impacted. // Unfortunately, research also suggests that non-native species may be the ones that adapt the best to climate changes. A [study](http://www.plosone.org/article/info%3Adoi/10.1371/journal.pone.0008878) conducted in Thoreau’s woods shows that non-native plant species are far better able to respond to recent climate change by adjusting their flowering time. The researchers discovered that mayweed chamomile (Anthemis cotula L.), which is native to the Mediterranean, shifted its flowering time over the years and now blooms 23 days earlier than it did in 1900.
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| **Ecosystem** |  |
| **FWS Response** | The impact of thriving non-native species can be devastating to the environment. Non-native plants that propagate and become invasive can have tremendous negative impacts—both ecologically and economically.  An estimated 5,000 [alien plants](http://ipm.ifas.ufl.edu/pdf/EconomicCosts_invasives.pdf) exist in the United States, displacing native species. One example is the European purple loosestrife. It has been spreading at a rate of 115,000 ha/year and has been blamed for reducing the biomass of 44 native plants and endangered wildlife, including bog turtles and several species of ducks that depend on the native plants. Loosestrife now occurs in 48 states and costs $45 million per year in control costs and forage losses. |
| **Notes** | [Great Meadows National Wildlife Refuge](http://www.fws.gov/northeast/greatmeadows) is located in Concord, Massachusetts. The area was home to a dedicated naturalist in the mid-1800s. He built himself a house on 14 acres of woods on the bank of [Walden Pond](http://www.mass.gov/dcr/parks/walden/). He dutifully and diligently recorded the flowering times of hundreds of plants as well as the behavior of rabbits, red squirrels, mice, birds and other animals for six years. // |

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| **State** | 1. South Carolina
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| **Wildlife** | * The nearby Cape Island is also important habitat for wildlife. It’s one of the most important nesting areas on the Atlantic Coast for loggerhead sea turtles, a threatened species that may soon be uplisted to endangered. // From 1999 to 2006, the Cape Island beach receded 180 feet. Loggerheads returning to their birthplace to lay their own eggs began digging nests in areas exposed to high tides and groundwater intrusion. Many of their nests were inundated.
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| **Ecosystem** |  |
| **FWS Response** | Raye Nilius, project manager for the South Carolina Low Country National Wildlife Refuge Complex, questions whether in 50 years Cape Romain will be able to provide the habitat that species depend upon today. The refuge’s future existence may depend on conserving land on the mainland now, before spreading urban development takes away that option. |
| **Notes** | A wooden post in the middle of open water at Cape Romain National Wildlife Refuge near Charleston, South Carolina is literally a sign of climate change. // The sign warns visitors to keep their dogs off the refuge. It made sense until 2009, when the sea swallowed the island it sat atop. The narrow island, called Sandy Point, used to be a perfect nesting area for American oystercatchers, Wilson’s Plovers and terns. Just ten years ago, Sandy Point stretched for a mile.  |