

# Resources

## INSIDE RESOURCES

Literature Cited

Supporting Materials

Glossary

Acronyms

Scientific Names

Team Members

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## Appendix A: Supporting Materials

Below are supporting materials for the National Fish, Wildlife and Plants Climate Adaptation *Strategy* (hereafter *Strategy*). The supporting materials are made available to increase understanding of the development of the *Strategy* and to provide more detailed information about subjects mentioned in the *Strategy*. Each of these materials is available online on the *Strategy's* web site: [www.wildlifeadaptationstrategy.gov](http://www.wildlifeadaptationstrategy.gov), or via the links listed in this appendix.

### Ecosystem-Specific Background Papers

These ecosystem-specific background papers were developed by the Technical Teams (see Appendix E for a listing of the Technical Teams and their members) as source material for the *Strategy* detailing the impacts of climate change on specific ecosystems as well as adaptation strategies and actions for those systems. They are not formal appendices to the *Strategy* and have not been, nor will they be updated or revised based on either the agency or public reviews of the *Strategy*. These papers have been edited by the Management Team for length, style, and content, and the Management Team accepts responsibility for any omissions or errors. Please follow the links to access detailed information regarding climate change adaptation for specific ecosystems.

#### Forest Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Forest\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Forest_Ecosystems_Paper.pdf)

#### Shrubland Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Shrubland\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Shrubland_Ecosystems_Paper.pdf)

#### Grassland Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Grassland\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Grassland_Ecosystems_Paper.pdf)

#### Desert Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Desert\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Desert_Ecosystems_Paper.pdf)

#### Arctic Tundra Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Tundra\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Tundra_Ecosystems_Paper.pdf)

#### Inland Water Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Inland\\_Water\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Inland_Water_Ecosystems_Paper.pdf)

#### Coastal Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Coastal\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Coastal_Ecosystems_Paper.pdf)

### Marine Water Ecosystems

[www.wildlifeadaptationstrategy.gov/pdf/Marine\\_Ecosystems\\_Paper.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/Marine_Ecosystems_Paper.pdf)

### Legislation

[www.wildlifeadaptationstrategy.gov/pdf/2010\\_Legislative\\_Language\\_for\\_Adaptation\\_Strategy.pdf](http://www.wildlifeadaptationstrategy.gov/pdf/2010_Legislative_Language_for_Adaptation_Strategy.pdf)

### Related Resources, Reports, and Materials

#### Adaptive Management: The U.S. Department of Interior Technical Guide

[www.doi.gov/initiatives/AdaptiveManagement/documents.html](http://www.doi.gov/initiatives/AdaptiveManagement/documents.html)

The Technical Guide presents adaptive management as a tool to help bureaus make better decisions in the context of uncertain or incomplete information.

#### America's Climate Choices

[nas-sites.org/americasclimatechoices](http://nas-sites.org/americasclimatechoices)

The National Research Council of the National Academies is conducting a series of coordinated activities designed to advance the U.S. response to climate change.

#### Animal and Plant Health Inspection Service (APHIS): National Wildlife Research Center (NWRC)

[www.aphis.usda.gov/wildlife\\_damage/nwrc](http://www.aphis.usda.gov/wildlife_damage/nwrc)

The APHIS's NWRC can work with conservation and land and resource management agencies and organizations to address invasive species damage management.

#### Climate Adaptation Knowledge Exchange (CAKE)

[www.cakex.org](http://www.cakex.org)

CAKE is a joint project of Island Press and EcoAdapt. It is aimed at building a shared knowledge base for managing natural systems in the face of rapid climate change, and includes a large database of adaptation case studies, reports, and tools, as well as links to federal, state, and local adaptation plans.

#### Climate Change Tree and Bird Atlases

[www.nrs.fs.fed.us/atlas](http://www.nrs.fs.fed.us/atlas)

The tree and bird atlases examine current distributions and modeled future-climate habitats for 134 individual tree species and the distribution of 150 bird species by geographic area.

#### Climate Change Resource Center (CCRC)

[www.fs.fed.us/ccrc/](http://www.fs.fed.us/ccrc/)

CCRC is a reference Web site for resource managers and decision makers who need information and tools to address climate change in planning and project implementation.

**Climate Forest Vegetation Simulator Projection**

[forest.moscowfsi.wsu.edu/climate/species/index.php](http://forest.moscowfsi.wsu.edu/climate/species/index.php)

Climate-FVS is a modification to the Forest Vegetation Simulator, a stand dynamics model generally used to support forest planning, project analysis, and silvicultural prescription preparation.

**Climate Science Centers (CSCs)**

[nccwsc.usgs.gov/csc.shtml](http://nccwsc.usgs.gov/csc.shtml)

Regional CSCs will provide scientific information, tools, and techniques that land, water, wildlife, and cultural resource managers can apply to anticipate, monitor, and adapt to climate and ecologically-driven responses at regional-to-local scales.

**U.S. Environmental Protection Agency (EPA)**

[www.epa.gov/climatechange/](http://www.epa.gov/climatechange/)

The EPA provides a good overview of climate adaptation and links to related resources and materials.

**Forecasts of Climate-Associated Shifts in Tree Species (ForeCASTS)**

[www.forestthreats.org/tools/ForeCASTS](http://www.forestthreats.org/tools/ForeCASTS)

The maps, known as ForeCASTS depict future suitable habitat ranges for North American tree species within the United States as well as across the globe. It uses projections of future climate in combination with the concept of fine-scale ecoregions and can ultimately be used to assess the risk to genetic integrity of North American forest tree populations.

**Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers**

[www.nrs.fs.fed.us/pubs/40543](http://www.nrs.fs.fed.us/pubs/40543)

This document provides a collection of resources designed to help forest managers incorporate climate change considerations into management and devise adaptation tactics. It was developed in northern Wisconsin as part of the Northwoods Climate Change Response Framework project and contains information from assessments, partnership efforts, workshops, and collaborative work between scientists and managers.

**ForGRAS (Forest Genetic Risk Assessment System)**

[www.forestthreats.org/current-projects/project-summaries/genetic-risk-assessment-system](http://www.forestthreats.org/current-projects/project-summaries/genetic-risk-assessment-system)

This assessment framework serves as a tool for planning management activities and conservation efforts, for evaluating species' genetic resources, and for detecting vulnerabilities. It has the advantage of accounting for multiple threats that may result in the most severe genetic impacts.

**Integrated Climate and Land Use Scenarios (ICLUS)**

[www.epa.gov/ncea/global/iclus](http://www.epa.gov/ncea/global/iclus)

The EPA is developing scenarios broadly consistent with global-scale, peer-reviewed storylines of population growth and economic development, which are used by climate change modelers to develop projections of future climate.

**Interagency Climate Change Adaptation Task Force (ICCATF)**

[www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation](http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation)

The Council on Environmental Quality is co-chairing the ICCATF which is comprised of over 200 federal agency staff.

**Intergovernmental Panel on Climate Change (IPCC)**

[www.ipcc.ch](http://www.ipcc.ch)

The IPCC is the definitive scientific intergovernmental body tasked with reviewing and assessing the most recent scientific, technical, and socio-economic information produced worldwide relevant to the understanding of climate change. Work on the Fifth Assessment Report is currently underway.

**Landscape Conservation Cooperatives (LCCs)**

[www.fws.gov/science/shc/lcc.html](http://www.fws.gov/science/shc/lcc.html)

LCCs are self-directed, applied conservation science partnerships that will support conservation at landscape scales.

**MC1 Dynamic Global Vegetation Model**

[databasin.org/climate-center/features/mc1-dynamic-global-vegetation-model](http://databasin.org/climate-center/features/mc1-dynamic-global-vegetation-model)

MC1 is a widely used dynamic global vegetation model (DGVM) that has been used to simulate potential vegetation shifts in California and Alaska, all of North America, and over the entire globe under various climate change scenarios.

**National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate**

[www.whitehouse.gov/sites/default/files/microsites/ceq/2011\\_national\\_action\\_plan.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ceq/2011_national_action_plan.pdf)

The Freshwater Action Plan recommends federal agency actions to aid freshwater resource managers in managing and protecting the nation's water resources.

**National Ocean Policy**

[www.whitehouse.gov/administration/eop/oceans/policy](http://www.whitehouse.gov/administration/eop/oceans/policy)

In July of 2010, Executive Order 13547 established a National Ocean Policy and tasked the interagency National Ocean Council with developing this strategic action plan.

**National Road Map for Responding to Climate Change**

[www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf](http://www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf)

The National Road Map for Responding to Climate Change was developed by the U.S. Forest Service to achieve the goal of all National Forests being in compliance with a climate adaptation and mitigation strategy. The Roadmap integrates land management, outreach, and sustainable operations accounting. It focuses on three kinds of activities: assessing current risks, vulnerabilities, policies, and gaps in knowledge; engaging partners in seeking solutions and learning from as well as educating the public and employees on climate change issues; and managing for resilience, in ecosystems as well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.

**Plant Protection Act (PPA)**

[www.aphis.usda.gov/brs/pdf/PlantProtAct2000.pdf](http://www.aphis.usda.gov/brs/pdf/PlantProtAct2000.pdf)

The PPA consolidates all or part of 10 existing U.S. Department of Agriculture plant health laws into one comprehensive law, including the authority to regulate plants, plant products, certain biological control organisms, noxious weeds, and plant pests.

**Responding to Climate Change in National Forests: A Guidebook for Developing Adaptation Options**

[www.fs.fed.us/pnw/pubs/pnw\\_gtr855.pdf](http://www.fs.fed.us/pnw/pubs/pnw_gtr855.pdf)

This guidebook created by the U.S. Forest Service contains science-based principles, processes, and tools necessary to assist with developing adaptation options for national forest lands.

**Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change**

[www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf](http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf)

The U.S. Fish and Wildlife Service climate change strategy, titled "Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change," establishes a basic framework within which the Service will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants and habitats in the face of accelerating climate change.

**Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment**

[www.habitat.noaa.gov/pdf/scanning\\_the\\_conservation\\_horizon.pdf](http://www.habitat.noaa.gov/pdf/scanning_the_conservation_horizon.pdf)

This guidance document is a product of an expert workgroup on climate change vulnerability assessment convened by the National Wildlife Federation in collaboration with the U.S. Fish and Wildlife Service.

### The seed selection tool (SST)

[sst.forestry.oregonstate.edu](http://sst.forestry.oregonstate.edu)

The seedlot selection tool (SST) is a GIS mapping program designed to help forest managers match seedlots with planting sites based on climatic information.

### Template for Assessing Climate Change Impacts and Management Options (TACCIMO)

[www.forestthreats.org/tools/taccimo/intro](http://www.forestthreats.org/tools/taccimo/intro)

A web-based tool that provides land owners, managers, and planners with the most current climate change science available. Developed by EFETAC researchers in partnership with USDA Forest Service Southern Regional Planning, Land and Resource Management; Southern Regional Cooperative Forestry; and Western Wildland Environmental Threat Assessment Center, the TACCIMO tool compiles climate change projections, literature-based impacts and management options, and Forest Service land and resource management plans in an online database.

### U.S. Global Change Research Program (USGCRP)

[www.globalchange.gov](http://www.globalchange.gov)

The USGCRP coordinates and integrates federal research on changes in the global environment and their implications for society.

### Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans

[www.fishwildlife.org/files/AFWA-Voluntary-Guidance-Incorporating-Climate-Change\\_SWAP.pdf](http://www.fishwildlife.org/files/AFWA-Voluntary-Guidance-Incorporating-Climate-Change_SWAP.pdf)

This document, which was produced by the Climate Change Wildlife Action Plan Work Group which was created as a joint work group by the Association of Fish and Wildlife Agencies Climate Change and Teaming with Wildlife Committees, provides voluntary guidance for state fish and wildlife agencies wanting to better incorporate the impacts of climate change on wildlife and their habitats into Wildlife Action Plans.



USFWS/GEORGE GENTRY

## Appendix B: Glossary

**Adaptation (Climate Change):** adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

**Adaptation (Biological):** the process or the product of natural selection that changes an organism's behavior, physiological function, or anatomical structure, so that it is better suited to its environment.

**Adaptive Capacity:** the ability of a species to become adapted (i.e., to be able to live and reproduce) to a certain range of environmental conditions as a result of genetic and phenotypic responses.

**Anthropogenic:** of, relating to, or resulting from the influence of human beings on nature.

**Biodiversity:** the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, among species, and of ecosystems.

**Bycatch:** unwanted marine creatures that are caught in the nets while fishing for another species

**Carbon Sequestration:** the long-term storage of carbon dioxide or other forms of carbon. It has been proposed as a way to slow the atmospheric and marine accumulation of the greenhouse gas, which is released by burning fossil fuels.

**Clean Water Act:** the primary federal law in the United States governing water pollution. The Act established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human sports and recreation by 1983.

**Climate Change:** a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions or the distribution of events around that average (e.g., more or fewer extreme weather events). Climate change may be limited to a specific region or may occur across the whole Earth.

**Climate Models:** quantitative methods to simulate the interactions of the atmosphere, oceans, land surface, and ice. They are used for a variety of purposes from study of the dynamics of the climate system to projections of future climate.

**Coastal Zone Management Act:** an Act of Congress passed in 1972 to encourage coastal states to develop and implement coastal zone management plans. This act was established as national policy to preserve, protect, develop, and where possible, restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations.

**Conservation:** preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife.

**Conservation Partners:** entities working toward the conservation of fish, wildlife, and other natural resources, which includes local governments, non-government organizations, charitable foundations, academic institutions, industries, private landowners, and other interested individuals.

**Downscaling:** refers to techniques that take output from global climate models and add information at smaller scales. Downscaling methods are used to obtain local-scale surface weather from global or regional-scale models.

**Ecosystem:** a biological environment consisting of all the organisms living in a particular area, as well as all the nonliving (abiotic), physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight.

**Ecosystem Function:** the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of the ecosystem, such as decomposition, nutrient cycling, pollination, and seed dispersal.

**Ecosystem Process:** A natural phenomenon in an ecosystem that leads toward a particular result.

**Ecosystem Services:** the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services such as the regulation of climate, floods, disease, wastes, and water quality; cultural services such as recreation, aesthetic enjoyment, identity, and spiritual fulfillment; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

**Endangered Species Act (ESA):** environmental law signed on December 28, 1973, that provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA replaced the Endangered Species Conservation Act of 1969. It has been amended several times.

**Eutrophication:** the movement of a body of water's trophic status in the direction of increasing biomass, by the addition of artificial or natural substances, such as nitrates and phosphates, through fertilizers or sewage, to an aquatic system.

**Evapotranspiration:** describes the sum of evaporation and plant transpiration from the Earth's land surface to atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapor through its leaves.

**Exclusive Economic Zone:** a zone of an ocean or sea over which a state has special rights over the exploration and use of marine resources, including production of energy from water and wind. It stretches from the seaward edge of the state's territorial sea out to 200 nautical miles from its coast.

**Extreme Events:** includes weather phenomena that are at the extremes of the historical distribution, especially severe or unseasonal weather such as heat waves, drought, floods, storms, and wildfires.

**Farm Bill:** colloquial name for the primary agricultural and food policy tool of the federal government. The comprehensive omnibus bill is passed every five years or so by the United States Congress and deals with both agriculture and all other affairs under the purview of the U.S. Department of Agriculture. The formal title of each bill varies, but the current version is known as the Food, Conservation, and Energy Act of 2008.

**Geomorphological Change:** changes observed in landforms and the processes that shape them. The study of geomorphological change can be used to understand landform history and dynamics, and to predict future changes through a combination of field observations, physical experiments, and numerical modeling.

**Globalization:** refers to the increasingly global relationships of culture, people, and economic activity.

**Greenhouse Gas:** a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

**Habitat:** an ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism. It is the natural environment in which an organism lives, or the physical environment that surrounds (influences and is utilized by) a population.

**Habitat Degradation:** the process in which natural habitat is rendered functionally unable to support the species present. In this process, the organisms that previously used the site are displaced or destroyed, reducing biodiversity.

**Habitat Fragmentation:** describes the emergence of discontinuities in an organism's preferred habitat, causing population fragmentation. Habitat fragmentation can be caused by geological processes that slowly alter the layout of the physical environment or by human activity such as land conversion and road building.

**Harmful Algal Blooms:** a rapid increase or accumulation in the population of algae in an aquatic system forming visible patches that may harm the health of the environment, plants, or animals. They can deplete the oxygen and block the sunlight that other organisms need to live, and some algae blooms release toxins that are dangerous to animals and humans.

**Hydrology:** the movement, distribution, and quality of water, including the hydrologic cycle, water resources, and environmental watershed sustainability.

**Hypoxia:** a phenomenon that occurs in aquatic environments as dissolved oxygen becomes reduced in concentration to a point where it becomes detrimental to aquatic organisms living in the system.

**Invasive Species:** non-indigenous species of plants or animals that adversely affect the economy, environment, and/or ecology of the habitats and bioregions they invade.

**Keystone Species:** a species that has a disproportionately large effect on its environment relative to its abundance. Such species play a critical role in maintaining the structure of an ecological community, affecting many other organisms in an ecosystem and helping to determine the types and numbers of various other species in the community.

**Maladaptation:** an adaptation that, although reasonable at the time, becomes less and less suitable and more of a problem or hindrance as time goes on. It is possible for an adaptation to be poorly selected or become less appropriate or even become, on balance, more of a dysfunction than a positive adaptation over time.

**Mitigation:** in the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases.

**Natural Disturbance Regimes:** the pattern and dynamics of disturbance events (e.g., fires, floods, landslides, etc.) that mold the structure and species composition of an ecosystem.

**Natural Resources:** materials and components that can be found within the environment. A natural resource may exist as a separate entity, such as fresh water and air, as well as a living organism, such as a fish, or it may exist in an alternate form which must be processed to obtain the resource, such as metal ores, oil, and most forms of energy.

**Non-climate Stressors:** in the context of climate adaptation, non-climate stressors refer to those current or future pressures and impacts threatening species and natural systems that do not stem from climate change, such as habitat fragmentation, invasive species, pollution and contamination, disease, and over exploitation.

**Nonpoint Source Pollution:** refers to both water and air pollution from diffuse sources. Nonpoint source water pollution affects a waterbody from sources such as polluted runoff from agriculture areas draining into a river or wind-borne debris blowing out to sea. Nonpoint source air pollution affects air quality from sources such as smokestacks or car tailpipes. Although these pollutants have originated from a point source, the long-range transport ability and multiple sources of the pollutant make it a nonpoint source of pollution.

**Ocean Acidification:** the ongoing decrease in the pH and increase in acidity of the Earth's oceans, caused by the uptake of carbon dioxide from the atmosphere.

**Permafrost:** soil at or below the freezing point of water (0 °C or 32 °F) for two or more years.

**Phenology:** the study of periodic plant and animal life cycle events and how these are influenced by seasonal and inter-annual variations in climate.

**Resilience:** (Current Ecological Usage) - the capacity of an ecosystem to return to its original state following a perturbation, including maintaining its essential characteristics of taxonomic composition, structure, ecosystem functions, and process rates. (Emerging Climate Change Usage)—In the emerging context of climate change, resilience might best be thought of as the ability of an ecosystem to recover from or adjust easily to change, measured more in terms of overall ecosystem structure, function, and rates and less in terms of taxonomic composition. A grassland that remains a grassland in the face of climate change could be thought of as resilient, even if its species composition is substantially altered. On the other hand, a grassland that becomes a forest in the face of climate change was not resilient: it has transformed into a new system.

**Resistance:** the capacity of the ecosystem to absorb disturbances and remain largely unchanged.

**Restoration:** (Current Ecological Usage) - the process of repairing damage to the diversity and dynamics of indigenous ecosystems, which can include promoting or mimicking natural disturbance regimes; managing issues like in-stream flows, water withdrawals, and stormwater run-off; and addressing poorly-sited infrastructure. (Emerging Climate Change Usage) - In the emerging context of climate change, restoration might best be thought of as focusing on repairing damage to such structural or functional aspects of the ecosystem as listed above, as opposed to attempting to restore the original species composition of an ecosystem.

**Risk Assessment:** the determination of quantitative or qualitative value of risk related to a concrete situation and a recognized threat such as climate change.

**Sea Level Rise:** As water warms, it expands, and the ocean surface rises. The melting of inland glaciers and continental ice sheets, including those in Greenland and Antarctica, causes additional sea level rise. Sea level change is highly variable regionally. It depends on the relative increase in water levels as well as local land elevation changes caused by subsidence or uplift, and local rates of sediment accumulation. Relative sea level rise refers to a local increase in the level of the ocean due to the interaction of these factors.

**Sentinel Site:** A location that is selected to represent a certain, preferably large, class of ecosystems for intensive monitoring.

**Socioeconomics:** a word used to identify the importance of factors other than biology in natural resource management decisions. For example, if management results in more fishing income, it is important to know how the income is distributed between small and large boats or part-time and full-time fishermen.

**Stakeholders:** a person, group, organization, or system that affects or can be affected by an organization's actions.

**Stratification:** in relation to water, stratification occurs when water masses with different properties (salinity, oxygenation, density, temperature) form layers that act as barriers to water mixing. These layers are normally arranged according to density, with the least dense water masses sitting above the more dense layers.

**Vulnerability Assessment:** a tool used in adaptation planning for informing the development and implementation of resource management practices.



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## Appendix C: Acronyms

<b>ACIA</b>	Arctic Climate Impact Assessment	<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>AFWA</b>	Association of Fish and Wildlife Agencies	<b>ICCATF</b>	Interagency Climate Change Adaptation Task Force
<b>AMSA</b>	Arctic Marine Shipping Assessment	<b>JVs</b>	Migratory bird and other Joint Ventures
<b>ASCE</b>	American Society of Civil Engineers	<b>LCC</b>	Landscape Conservation Cooperative
<b>AZ CCAG</b>	Arizona Climate Change Advisory Group	<b>NC NERR</b>	North Carolina National Estuarine Research Reserve
<b>CADFG</b>	California Department of Fish and Game	<b>NCA</b>	National Climate Assessment
<b>CAKE</b>	Climate Adaptation Knowledge Exchange	<b>NERRS</b>	National Estuarine Research Reserve System
<b>CEC</b>	Commission for Environmental Cooperation	<b>NFHAP</b>	National Fish Habitat Action Plan
<b>CEQ</b>	Council on Environmental Quality	<b>NMFS</b>	National Marine Fisheries Service
<b>CO<sub>2</sub></b>	Carbon Dioxide	<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>CSCs</b>	Climate Science Centers	<b>NOC</b>	National Ocean Council
<b>CCSP</b>	U.S. Climate Change Science Program	<b>NOP</b>	National Ocean Policy
<b>DDT</b>	Dichlorodiphenyltrichloroethane	<b>NRC</b>	National Research Council
<b>DOC</b>	Department of Commerce	<b>NRCS</b>	National Resource Conservation Service
<b>DOI</b>	Department of the Interior	<b>NSF</b>	National Science Foundation
<b>ECA</b>	Economics of Climate Adaptation Working Group	<b>PCB</b>	Polychlorinated biphenyls
<b>ESA</b>	Endangered Species Act	<b>PCSGA</b>	Pacific Coast Shellfish Growers Association
<b>F</b>	Fahrenheit	<b>REDD</b>	Reducing Emissions from Deforestation and Forest Degradation
<b>FAO</b>	Food and Agriculture Organization of the United Nations	<b>RISAs</b>	Regional Integrated Sciences and Assessments
<b>FWS</b>	U.S. Fish and Wildlife Service	<b>RMRS</b>	U.S. Forest Service: Rocky Mountain Research Station
<b>GAO</b>	General Accountability Office	<b>SNAP</b>	Scenarios Network for Alaska Planning
<b>GHG/GHG<sub>s</sub></b>	Greenhouse Gas/Gasses	<b>TEK</b>	Traditional Ecological Knowledge
<b>HABs</b>	Harmful Algal Blooms	<b>USDA</b>	United States Department of Agriculture
		<b>USGCRP</b>	United States Global Change Research Program
		<b>USGS</b>	United States Geological Survey
		<b>WICCI</b>	Wisconsin's Changing Climate: Impacts and Adaptation



## Appendix D: Scientific Names

alpine chipmunk  
 American oystercatcher  
 American robin  
 Arctic fox  
 Asian carp (Bighead carp)  
 Asian carp (Black carp)  
 Asian carp (Grass carp)  
 Asian carp (Silver carp)  
 Atlantic croaker  
 blue crab  
 brook trout  
 brown treesnake  
 buffelgrass  
 California vole  
 caribou  
 cheatgrass  
 Edith's checkerspot butterfly  
 Chinook salmon  
 cisco  
 Coho salmon  
 Cope's gray treefrog  
 diamondback terrapin  
 eastern tiger salamander  
 feral hog  
 greater sage grouse  
 grizzly bear  
 hemlock woolly adelgid  
 horseshoe crab  
 humpback chub  
 kelp  
 Kittiwake  
 kudzu  
 lake trout  
 least tern

*Neotamias alpinus*  
*Haematopus palliatus*  
*Turdus migratorius*  
*Vulpes lagopus*  
*Hypophthalmichthys nobilis*  
*Mylopharyngodon piceus*  
*Ctenopharyngodon idella*  
*Hypophthalmichthys molitrix*  
*Micropogonias undulatus*  
*Callinectes sapidus*  
*Salvelinus fontinalis*  
*Boiga irregularis*  
*Pennisetum ciliare*  
*Microtus californicus*  
*Rangifer tarandus*  
*Bromus tectorum*  
*Euphydryas editha*  
*Oncorhynchus tshawytscha*  
*Coregonus artedii*  
*Oncorhynchus kisutch*  
*Hyla chrysoscelis*  
*Malaclemys terrapin*  
*Ambystoma tigrinum*  
*Sus scrofa*  
*Centrocerus urophasianus*  
*Ursus arctos horribilis*  
*Adelges tsugae*  
*Limulus polyphemus*  
*Gila cypha*  
*Laminariales*  
*Rissa sp.*  
*Pueraria sp.*  
*Salvelinus namaycush*  
*Sterna antillarum*

lesser prairie-chicken  
 lodgepole pine  
 mountain pine beetle  
 muskoxen  
 northern pike  
 Pacific oyster  
 paper birch tree  
 common reed  
 pinyon mouse  
 piping plover  
 poison ivy  
 polar bear  
 Ponderosa pine  
 quagga mussel  
 rainbow trout  
 red fox  
 red knot  
 ring seal  
 Rio Grande cutthroat trout  
 sagebrush  
 Saguaro  
 seabeach amaranth  
 silver hake  
 smallmouth bass  
 southwestern willow flycatcher  
 spruce  
 spruce bark beetle  
 surf clam  
 walleye  
 walrus  
 water hyacinth  
 white spruce  
 white-tailed deer  
 Wilson's plover  
 zebra mussel

*Tympanuchus pallidicinctus*  
*Pinus contorta*  
*Dendroctonus ponderosae*  
*Ovibos moschatus*  
*Esox lucius*  
*Crassostrea gigas*  
*Betula papyrifera*  
*Phragmites sp.*  
*Peromyscus truei*  
*Charadrius melodus*  
*Toxicodendron radicans*  
*Ursus maritimus*  
*Pinus ponderosa*  
*Dreissena rostriformis bugensis*  
*Oncorhynchus mykiss*  
*Vulpes vulpes*  
*Calidris canutus*  
*Pusa hispida*  
*Oncorhynchus clarki virginalis*  
*Artemisia sp.*  
*Carnegiea gigantea*  
*Amaranthus pumilus*  
*Merluccius bilinearis*  
*Micropterus dolomieu*  
*Empidonax traillii extimus*  
*Picea sp.*  
*Ips typographus*  
*Spisula solidissima*  
*Sander vitreus*  
*Odobenus rosmarus*  
*Eichhornia crassipes*  
*Picea glauca*  
*Odocoileus virginianus*  
*Charadrius wilsonia*  
*Dreissena polymorpha*



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