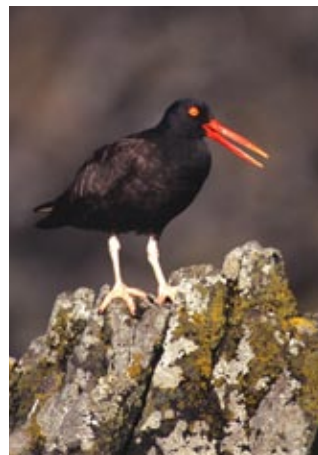


ALASKA DEPARTMENT OF FISH AND GAME

# CLIMATE CHANGE STRATEGY



NOVEMBER 2010



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Photos above, left to right: Clams, Fieldwork at Moraine Creek, Oystercatcher, Moose. All ©ADF&G.



Caribou. © ADF&G.

Scientific and traditional evidence is increasingly showing that climate is changing at unprecedented rates throughout the Arctic. This is evident in warming temperatures, changing precipitation patterns, altered stream flows, loss of sea ice, increased fire regimes, thawing permafrost, altered fishing and hunting availability, and coastal erosion, amongst others.<sup>1</sup> In combination, these effects are beginning to affect Alaska's natural systems and the uses they sustain.<sup>2</sup>

<sup>1</sup> ACIA, 2005. Arctic Climate Impact Assessment. Cambridge University Press, 1042p.

<sup>2</sup> ADEC, 2009. Alaska's Climate Change Strategy: Addressing Impacts in Alaska. Final Report Submitted by the Adaptation Advisory Group to the Alaska Climate Change Sub-cabinet. Anchorage, Alaska (<http://www.climatechange.alaska.gov>)

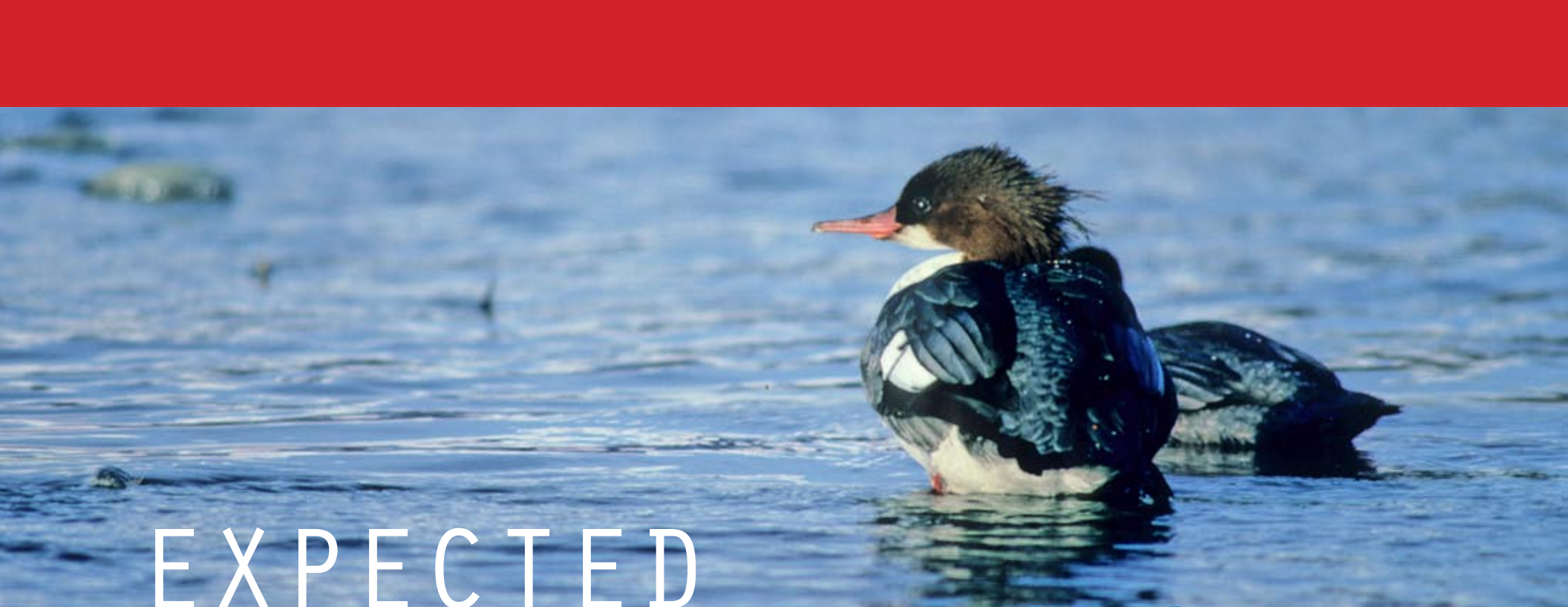
In recognition of these changes, a subcabinet<sup>3</sup> was formed to prepare a comprehensive climate change strategy for Alaska. This strategy focuses on building the state's knowledge of the actual and foreseeable effects of climate warming in Alaska, developing appropriate measures and policies to prepare communities in Alaska for the anticipated effects from climate change, and providing guidance regarding Alaska's participation in regional and national efforts addressing the causes and effects of climate change.

As part of this effort, each state agency has been asked to identify how a changing climate may affect its ability to meet its mission. The mission of the Alaska Department of Fish and Game (ADF&G) is "to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle." Because a changing climate is anticipated to affect the sustainability of Alaska's fish and wildlife resources and their uses, it is of interest to the department to assess the likely effects of climate change on fish and wildlife and their uses and to develop adaptation strategies to address these effects.

<sup>3</sup> Information on the Sub-cabinet can be found by visiting <http://www.climatechange.alaska.gov/>.

# CONTENTS

EXPECTED CLIMATE IMPACTS	2
EXAMPLES OF CLIMATE IMPACTS	6
NEEDED RESEARCH	10
ADF&G STRATEGY FOR ADDRESSING CLIMATE CHANGE	14



# EXPECTED CLIMATE IMPACTS

Common Merganser. ©ADF&G.  
Photo by John Hyde.

A changing climate is beginning to alter the landscape, both physically and biologically. These changes will likely affect fish and wildlife these landscapes support. They will also affect the uses these resources support. Key physical changes that are expected to occur on landscapes include:

## **Altered hydrologic conditions**

Based on temperature and precipitation projections of climate change in Alaska<sup>1</sup>, significant and continued changes in freshwater quantity and quality are expected throughout Alaska. These changes will likely alter hydrologic conditions across Alaska, affecting Alaska's numer-

ous aquatic environments including wetlands, rivers, and lakes—particularly shallow water lakes maintained by permafrost. These alterations will differentially affect aquatic habitats, their dependent species and the uses they support. For example, the distribution of freshwater fishery resources throughout Alaska may be altered (e.g., a shift to fish species tolerant of warmer waters). Altered hydrologic conditions could also affect the productivity of wetlands for various wildlife and the migratory birds seasonally dependent upon them.

## **Altered fire regimes**

As precipitation and temperature patterns change, fire regimes in Alaska's terrestrial habitats are changing both in frequency and areas

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<sup>1</sup> University of Alaska-SNAP. 2008.

burned. This is affecting ecosystems and the terrestrial species they support, with some species benefiting and others suffering. Species such as moose may benefit in some areas experiencing increased fire regimes whereas species dependent upon old growth forest (e.g., woodpeckers) may suffer.

### Altered sea ice conditions

As temperatures warm in the Arctic, sea ice conditions are changing. This has the potential of affecting species dependent upon sea ice for all or a part of their lives as well as the subsistence uses these species support. For example, distribution of seal species may change as a result of altered sea ice conditions affecting subsistence users of these species (e.g., earlier breakups may alter traditional subsistence hunting patterns). Migrations and trophic ecology of juvenile salmonids transitioning from a freshwater environment to a marine environment may also be affected by altered timing of ice accumulation and retreat in near shore environments.

### Ocean acidification

Increasing atmospheric CO<sub>2</sub> concentrations may result in increased acidification of Alaska's coastal waters. However, it is unknown at what rate such acidification will occur and at what acidity levels effects to species will occur. As ocean acidity increases, marine food webs may be altered, potentially affecting commercially targeted fish and other marine dependent species.

These and other physical changes are expected to affect fish and wildlife in a variety of ways, including:

### Changing species distributions, abundances, and phenologies

As landscapes and their ecosystems change, species distributions and abundances are also likely to change. For example, there may be shifts of marine species assemblages as waters warm (e.g., a northward shift in pollock). An asynchrony between breeding phenology of migratory bird species and their invertebrate food sources is also possible.

Seiner in Southeast Alaska. ©ADF&G. Photo by Marianne McNair.





European green crab with eggs. Photo by Linda Shaw, NOAA Fisheries.

### **Invasive species**

Invasive species may become established as a result of more favorable environmental conditions resulting from a changing climate. This has the potential to negatively affect native and endemic species. For example, invasion of green crabs could affect native crab species.

These physical and biological changes will lead to certain human responses. For example:

#### **Impacts on existing harvest opportunities**

As fish and wildlife populations respond to changing climate conditions, subsistence, personal use, commercial, and sport harvest opportunities will be affected. For example, later falls may require shifts in hunting seasons. In other cases, shifts in distribution or abundance will occur that will affect harvest opportunity. This will require review and adjustment of regulatory structures by the Alaska boards of Fisheries and Game and other regulatory bodies such as the North Pacific Fishery Management Council and the Federal Subsistence Board.

#### **Impacts on existing regulatory structures**

Many environmental laws, regulations and policies on the federal, state, and local levels were developed before the signs of a rapidly changing climate were predicted and observed. The challenge for



Brace of birds in Southcentral Alaska. © Ken Marsh.

environmental and resource management agencies will be to manage for healthy, productive ecosystems in a future made less certain due to a changing climate. This will necessitate possible changes to their institutional, legal and policy frameworks to respond quickly enough to sustain the natural resources they manage for the “public trust.” For example, resource managers in Alaska may need to revise Alaska policies relative to wildland fire management in light of the effects of climate change. There is also a need to conduct a review of key statutes and laws and their enabling regulations and policies applicable to the management of fish and wildlife resources and report on changes that may be needed to manage these resources and meet agency missions in the context of climate change.

#### **Impacts of development of “clean” energy alternatives**

Alaska is in the process of developing mitigation strategies that rely on “clean” energy sources to reduce carbon footprints. While these

“clean” energy sources lessen carbon emissions, they have other effects, some of which may negatively affect fish and wildlife and their uses. For example, wind energy may prove to be a key mitigation tool towards reducing carbon emissions, however increased development of this energy source has been shown to have negative effects on fish and wildlife (e.g., bird strikes associated with wind turbines) and their uses. It will be critical to assure that “clean” energy development is done in a manner that minimizes effects to fish and wildlife and their uses.



## New opportunities presented by climate change

While a changing climate will potentially negatively affect fish and wildlife and their uses, others may result in new opportunities. For example, new commercial fishing opportunities may open in the Arctic as sea ice retreats. Failure to identify and assess such opportunities will result in lost economic opportunity. Because such opportunities are new, there is very little information available to develop them in a responsible manner. Responsible development will require assessment, planning and monitoring, and public involvement.



Above: Bristol Bay fishery. Courtesy of the Alaska Seafood Marketing Institute.  
Left: Scooping drinking water from a stream. ©ADF&G. Photo by John Hyde.



# EXAMPLES OF CLIMATE IMPACTS

## Possible impacts to fish and their uses

- Distribution (e.g., northward movement of stocks into the northern Bering Sea and southern Chukchi Sea) and run timing (e.g., earlier as a result of earlier springs) of targeted fish may shift, likely affecting existing regulation and management of fisheries.
- Increases in predatory fish (e.g., arrowtooth flounder, mackerels) may affect production of targeted fish (other groundfish and salmon) likely affecting existing regulation and management of fisheries.
- Ocean acidification may disrupt marine ecosystems (e.g., shell formation in crab, shrimp, and other shellfish) potentially impacting shellfish fisheries. Ocean acidification could also affect zooplankton development, thereby affecting survival of fish species dependent upon zooplankton (e.g., sockeye salmon).
- Changes in stream flows and water quality may alter freshwater-dependent species (e.g., salmon and trout). Instream flow reservations may need to be re-evaluated.

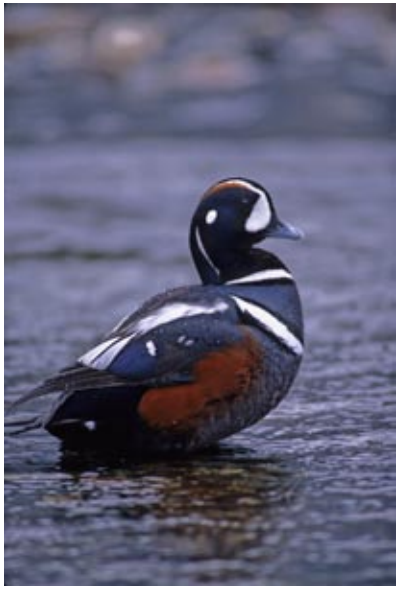
Above: Glacier melt. ©ADF&G. Photo by Amy Carroll.



- Access by anglers to water bodies may change due to changes in flow regimes.
- Invasive species are expected to expand their ranges (e.g., orange hawkweed) or newly arriving invasive species may become established (e.g., green crabs) necessitating increased monitoring and control or eradication efforts.
- Requests for stocking of nonnative fishes that are better adapted to warmer water temperatures (e.g., walleye) will need to be considered and policy decisions made regarding these requests.
- New or modified assessment methodologies that are more adaptable and robust will be needed to assess the compounding effects of climate change on resource management.
- Economic losses to local coastal communities may occur as traditional target stocks change in their relative abundance and location (e.g., northwestward movement of Bering Sea pollock). This could result in a drop in fish tax revenues to coastal communities as well as income to fishers and CDQ groups. While some new economic opportunities may arise, there will likely be a time lag prior to being able to capitalize on them.
- Adjustments to outreach, education, and involvement programs will need to be made to inform and educate the public about changes in fish and fisheries due to climate change.

**Expected impacts to wildlife and its uses**

- Changes in wildlife production, distribution, and behavior will likely affect existing management plans and harvest regulations.
- Increased occurrence and intensity of wildfire will likely affect wildlife, both in positive and negative manners, thereby affecting existing management plans and harvest regulations.



Changes in sea level, increases in storm intensity and frequency, and erosion could result in multiple effects:

- Coastal dependent species (e.g., Pacific brant, emperor geese and spectacled eiders) may lose important habitats.
- Low-lying coastal staging areas that support millions of shorebirds, geese and ducks during spring and fall staging could degrade.

Male harlequin. ©ADF&G. Photo by John Hyde.



The Arctic Sea, a Coastal Village Cooperative vessel. ©Herman Savikko.



Shovelers taking flight. ©ADF&G. Photo by John Hyde.



Juvenile salmon. ©ADF&G.

- Changes in marine productivity could negatively affect food webs important to bird species (e.g., clam beds used in winter by spectacled eiders).
- Changes in climate could warm interior Alaska river basins thereby negatively affecting dependent species (e.g., changed vegetation may affect moose and altered wetlands may affect waterfowl).
- Changing coastal ocean and seasonal ice conditions could affect some ice-dependent marine mammals.
- Changes to general climate patterns could affect nesting birds and their phenology.
- Hunter's access to trails may be affected by flow regimes.
- New population survey and monitoring strategies may need to be developed including research into new techniques and methodologies.
- Climate change outreach and education will need to be expanded to include additional target audiences and subjects.

Juvenile moose. ©ADF&G. Photo by John Hyde.





Susan Georgette, Division of Subsistence employee at the time of this photo, in a fish camp near Selawik on the Upper Kobuk River as part of a study on whitefish traditional ecological knowledge. ©ADF&G. Photo by Susan Georgette.

**Expected impacts to subsistence use opportunities**

Adaptation in subsistence practices and reliance is expected to change. Changing climate conditions may affect populations of wildlife and stocks of fish upon which subsistence users have customarily relied. Some examples follow.

- Changes in terrestrial conditions may influence availability of wildlife and fish species to harvest, as well as access to harvests.
- Changes in the seasonality of events such as river freeze up and break-up may affect subsistence users’ opportunities for customary and traditional uses of fish and wildlife.
- Range extensions of more temperate plants and animals may affect subsistence resources and resulting harvests.

- Rural cultures and lifestyles may be threatened due to changes in subsistence opportunities.

Aerial view of the Branch River. ©ADF&G. Photo by John H. Clark.





Fieldwork on the Branch River. ©ADF&G. Photo by John H. Clark.

# NEEDED RESEARCH

While many of these effects can be projected, it is critical to implement a robust and adaptive research program to assess and monitor the affects of a changing climate on Alaska’s fish and wildlife resources and the uses they sustain. The Governor’s Climate Change Subcabinet established a Research Needs Work Group<sup>1</sup> to identify research needs to implement identified adaptation and mitigation climate change strategies. These needs, which are applicable to fish and wildlife, include:

<sup>1</sup> Information on the Research Needs Work Group and its final report can be found by visiting <http://www.climatechange.alaska.gov/>

### **Improved downscaled (local) climate models**

The ability to effectively implement policy recommendations is largely dependent upon being able to act at local levels. This necessitates being able to predict the effects of a changing climate locally. Programs like Scenario Network for Alaska Planning need to be expanded to include more variables and greater specificity, as well as the variety of Alaska ecosystems (ocean, coastal, terrestrial) and the needs of natural system services (e.g. wildlife, fisheries, subsistence, economic, etc.).

## Need for baseline environmental research and monitoring

The success and accuracy of downscaled models is largely dependent upon the quantity and quality of data available. There is an urgent need to collect baseline environmental research and monitoring data. This includes developing a robust baseline monitoring program of a variety of physical, chemical, biological and socioeconomic variables that takes into account seasonal, annual, and decade-long variability. It also includes implementing a well-developed research program that includes process studies and applications. Monitoring of subsistence harvests at the community level will be required to assess harvesting adaptations to changing conditions and flux in available fish and wildlife resources to harvest.

## Improved baseline mapping

The ability to predict landscape-level changes due to climate change is dependent upon being able to define the status quo. Unfortunately, few baseline maps of key environmental variables are available for Alaska. Improved baseline mapping and associated data collection is a critical need.



Evaluating sockeye salmon eggs from Moraine Creek.  
©ADF&G.  
Photo by John H. Clark.

John Hilsinger and Katie Sechrist doing genetic sampling on Skwentna River sockeye salmon. ©ADF&G.  
Photo by Nick Decovich





### Improved research infrastructure

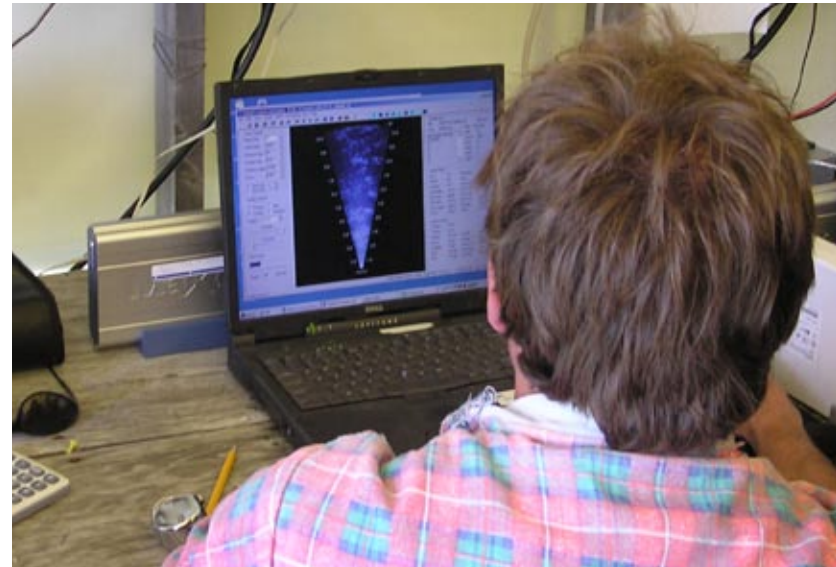
Our ability to collect data is largely dependent upon our ability to improve our research infrastructure (e.g. computers, radars, ships, satellites, personnel, etc). This includes research as well as baseline data collection and monitoring.

### Improved data integration and sharing

To assure there is not duplication of efforts it is imperative to coordinate data integration and sharing between agencies. This will ensure the success of various interdisciplinary efforts that will be needed to address climate change issues. Other key elements include data management, interoperability, access and archiving.

Left: Fieldwork on the Upper Talerik River. ©ADF&G.

Below: Counting fish using sonar. ©ADF&D. Photos by John H. Clark.





Inserting esophageal tag into McNeil chum. ©ADF&G. Photo by Ted Otis.

### **Adaptable legal and policy frameworks**

Many laws, regulations and policies on the federal, state, and local levels were developed for a static environment where climate change was not recognized. The challenge for government leaders and businesses will be to adapt to a future made less certain due to a more rapidly changing climate. This will necessitate an evaluation of existing laws, regulations and policies and possible changes to institutional, legal and policy frameworks in an adaptive manner.

A bear track, like this one near the Chena River, offers a look at one of the signs of wildlife. ©ADF&G. Photo by Riley Woodford.

### **Education and Outreach**

Our ability to implement policy changes is largely affected by public perception and understanding. There is a critical need to develop and implement an education and outreach program aimed at improving public understanding of climate change and its affects, as well as the need to address them.





# ADF&G STRATEGY FOR CLIMATE CHANGE

It is important that the department have a strategy defined to guide its response to climate change. The principles and strategies that follow are adapted from recommendations of the Association of Fish and Wildlife Agencies Climate Change Committee which the department helped to prepare. The key initial actions are specific actions the department will implement over the next four years.

## **Management principles**

- Healthy and robust ecosystems are necessary to support fish and wildlife and their uses and conservation.
- Ecosystems in transition will present management challenges commensurate with the rate and extent of climate change.

Above: Photo courtesy of the Alaska Seafood Marketing Institute.



- Some fish and wildlife populations will decline, while others will increase or adapt under changing climate conditions.
- Long-term management objectives and implementation options will be influenced by changes in land use and changes in species compositions, distributions, and interactions with humans.
- Short-term and transitional management strategies will play an important role in species health and conservation.
- Effective partnerships and collaborations at state, regional, national, and international levels will be needed to address climate change challenges.

### Key strategies

- Identify the observed, likely, and potential effects of climate change on fish and wildlife, their habitats, and their uses.
- Conduct vulnerability assessments (including threat assessments) that consider the ecological, economic, and sociopolitical ramifications of climate change effects on fish and wildlife and their uses.
- Implement adaptive research and monitoring to assess the effects of climate change on fish and wildlife and their uses.
- Incorporate climate change considerations into fish and wildlife management plans (including fish habitat action plans), local area management plans, migratory waterfowl plans, species conservation plans, state wildlife action plans, and others.
- Adaptively manage fish and wildlife and their habitats in light of their vulnerability.
- Identify and address statutory changes needed at federal, state and local levels to effectively address and manage climate change effects on fish and wildlife.
- Determine budget needs to respond to climate change effects and allocate funding to implement first order priorities.

- Identify and actively pursue new sources of funding to effectively respond to climate change issues.
- Identify or develop regional partnerships to address common climate change goals and strategies.
- Develop effective communication systems and outreach efforts for state agencies, researchers, policy makers, planners, natural resource managers, and stakeholders to enhance collaborative efforts.

### Key initial actions

- Continue to fill information gaps on Alaska's species of greatest conservation concern, potentially avoiding future listings under the state and federal endangered species acts as outlined in Alaska's Wildlife Conservation Strategy (<http://www.sf.adfg.state.ak.us/statewide/ngplan/>).

Bristol Bay setnetters. ©ADF&G. Photo by John H.Clark.



- Continue to fill information gaps related to climate change on Alaska's hunted and fished species and update their management plans in cooperation with the Alaska boards of Fisheries and Game and other federal management boards, including the Federal Subsistence Board and the North Pacific Fishery Management Council.
- Continue to participate on the Governor's Climate Change subcabinet and implement its recommendations and strategies.
- Work with the University of Alaska's SNAP program to develop scaled down climate change scenarios.
- Look for opportunities to become engaged in partner assessments of climate change effects on ecosystems in all regions of Alaska.
- Establish partnerships with federal agencies. Specifically, continue to participate on the Alaska Climate Change Executive Round Table, partner with the USFWS on the development of Landscape Conservation Cooperatives, the USGS on the development of the Alaska Climate Science Center, with NOAA on the development of the Alaska Regional Climate Center, the North Pacific Research Board, and the North Slope Science Initiative.
- Continue to work with the Alaska Ocean Observatory System to assess ocean acidification and marine ecosystem change.
- Develop regulations and guidelines for importation of exotic species into Alaska in light of predicted climate changes.
- Designate dedicated staff for the department and each division to engage in climate change workshops and discussions, to build program capacity by identifying funding and other resources to meet program needs. Identify resources needed to support this effort.
- Design and implement streamlined and affordable monitoring programs that inform management decisions under a changing climate.
- Increase public outreach and involvement to improve understanding of the effects of climate change to Alaska's fish and wildlife since the potential for controversy associated with climate change could be high, and there may not be agreement on messages or approaches.

King crab. ©ADF&G. Photo by Jim Craig.







Photos above, left to right: Sea urchin, Spawning colors, Steller sea lions, Dungeness crab. All ©ADF&G.