

Natural Systems Technical Working Group
Draft Adaptation Options for AAG Consideration – February 6, 2009

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NS-1 Incorporate Climate Change into Commercial Fisheries Management and Assist Fishing Communities and Users in Adaptation.

Recommended Adaptation Option

The State of Alaska should take into account climate change impacts when developing commercial fisheries policy and management options. The State should develop a program to assist the commercial fishing industry, including the communities and user groups reliant on the industry, in adapting to the impacts from climate change.

Option Description

Recent scientific evidence indicates the seas around Alaska are responding to warming trends in the last few decades in ways that may substantially influence circulation patterns, food webs and productivity

regimes. Some of these changes could have major impacts on Alaska's bountiful commercial fisheries with potentially different consequences in the Gulf of Alaska, the Bering Sea and the Arctic Ocean. These impacts include:

- Changes in fish distribution and catch composition;
- The northern migration of species such as pollock (in some cases outside of U.S. waters);
- Movement of some fish farther away from on-shore processors, harbors, and communities, requiring further travel;
- The transient appearance of new species such as tuna; and
- Declines in the Bering Sea in the catch of crab, shrimp, and in some locations, halibut, with a corresponding increase in some species such as cod.

No one really knows the cause or significance of these changes nor those projected for the future such as the opening up of the northern Bering Sea and Arctic Ocean to the possibility of commercial fishing; increasing abundance of new species; need for new gear; continued declines in benthic species; and potentially more dangerous fishing conditions due to greater storms, less weather predictability, and the need to travel greater distances. Nor do we know the potential economic impacts on businesses, fishing-reliant communities, and individual Alaskans, some of which may be positive, others negative.

Although Alaska's system of abundance-based management is designed to be broadly responsive to changing species distributions and abundance, climate change impacts and other unpredictable environmental impacts are not explicitly considered in current Alaska fishery policies and management plans and practices, likely due to their uncertainty and complexity. This option would enable the state of Alaska to consider climate change impacts on species abundance and distribution when developing commercial fisheries policy and management plans, including adopting a precautionary approach to the opening and management of new commercial fisheries, and taking climate change into account when considering the rationalization of various commercial fisheries. The State could also urge NOAA Fisheries and the North Pacific Fishery Management Council to consider climate change impacts when making decisions affecting federally-managed fisheries. The proposed 10-year moratorium on commercial fishing in the Arctic EEZ is one example. Because environmental impacts on commercial fisheries can be extremely difficult to predict, the success of these options would be greatly enhanced with a robust system of monitoring and stock assessment.

Most fisheries-reliant communities do not have sufficient information to respond to these potential changes. They don't know how imminent those changes might be, and if they are of sufficient significance to warrant infrastructure development such as retooling of fish processing plants, the development of new harbors and industry support facilities. This option would enable state officials to develop a program to provide information about current and projected changes in commercial fishing due to climate change, and work with communities and the commercial fishing industry to develop the capacity and the infrastructure needed to adapt to those changes. The challenge will be in providing information about extremely uncertain impacts due to mechanisms we do not fully understand. A robust monitoring program covering both physical and chemical ocean conditions and biological populations would however, allow us to document the important changes in ocean conditions and fish abundance and distribution that could be a by-product of climate change. As such, we could respond, even without full understanding.

Without this option, fishing-reliant communities and the commercial fishing industry, and fishermen themselves will continue to be uncertain about how to respond to current and projected environmental changes that will affect their industry. Although fishing has always been an uncertain endeavor and history shows tremendous fluctuations in stock abundance, particularly for salmon, the changes we potentially face under various projected climate change scenarios are beyond the scale of what has been experienced in the past.

In addition, fisheries policies and management actions may be either overly cautious, or not sufficiently cautious in taking these changing conditions into account, and could result in severe over or under-fishing, either an economic loss to Alaskans. Adapting to these changes will require a significant partnership among state agencies, local communities, and industry.

Option Design

Structure/design: The option is divided into four major components that meet short-term, intermediate, and long-term needs.

1. The first is a review of commercial fishing related statutes, policies, management actions, and programs to determine if and how climate change considerations might be included in these. This could begin immediately, and be completed within a year, with possible changes to state laws and regulations requiring additional time. It could be implemented by state agencies including the Alaska Departments of Fish and Game, Law, Environmental Conservation, Natural Resources, Commerce, Community and Economic Development. Another approach would be to appoint an independent commission that would include climate change experts, stakeholders, and agency representatives.
2. The second is a comprehensive analysis of existing fish species and stock monitoring programs to determine their effectiveness and assess how better information could facilitate meaningful responses to likely changes brought on by climate change. A panel made up of agency scientists and independent scientific experts would be valuable in providing this analysis.
3. The third component is development of a centralized source of information (such as the Center for Climate-Change Solutions that is proposed as a separate option) regarding climate projections on the commercial fishing-dependent environment, adaptations tools, technical assistance, and support for communities and businesses to enhance their capacity to plan for and adapt to climate change. Providing this central portal for information would require state funding and implementation, but could begin with a simple web portal to provide access to the most current, reliable information about climate change and associated impacts. This would require significant collaboration and coordination among all the various state, federal, municipal agencies and other organizations including the university that are currently providing various pieces of this information. It would also require some methodology for determining the accuracy and reliability of information.
4. The fourth component is a long-term strategy to work with fishing-reliant communities and businesses to identify the needs for modified or new infrastructure to meet the changing needs of the industry, including possible construction, loans, etc. These actions would depend on how short- or long-term projected changes occur and would need involvement of communities, fishing businesses, climate change scientists, and state and federal agencies.

Participants/Parties involved: Described above.

Evaluation: To be completed.

Research and Data Needs:

1. Research what other countries, U.S. federal agencies and other states are doing to incorporate climate change considerations into commercial fishing policies and management. Assess what is appropriate to Alaska conditions. **High Priority for near-term.**
2. Some research needs to occur to synthesize current information about climate change impacts on Alaska's commercial fisheries and assess its reliability and degree of uncertainty. **Lower priority.**

3. The larger piece is a comprehensive long-term monitoring program, including physical and biological components, to inform the commercial fishing community about ecosystem changes. This includes a robust program for monitoring species abundance and distribution. Associated with this is the need for monitoring of human activities, their potential effects on the ecosystem, and monitoring of community and industry socioeconomic data to track trends. Improved monitoring would provide policy and decision makers greater confidence when allocating resources and managing fisheries, by distinguishing human-caused changes due to global warming from natural variability. **High priority.**
4. Possible research is needed on new infrastructure to meeting engineering requirements of a changing climate. **Lower priority.**

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the highest ranked option with no minority views. It ranked high for all criteria, particularly significance, effectiveness and cost considerations. The TWG is in concurrence about the ranking of this option.

NS-2 Review and Modify Alaska's Wildland Fire Policies and Programs

Recommended Adaptation Option

The State will thoroughly review, and modify as appropriate, Alaska's wildland fire policy and programs to address potential climate-induced increases in wildland fire frequency, size and geographic location.

Option Description

Wildland fires occur commonly throughout much of Alaska and have a wide range of effects on social, health, economic and biological conditions.

This option would address these concerns via a variety of actions that range from changes to current policy, increased planning and education at the community and individual homeowner levels and increased active management of high-risk fuel types.

There are several goals that this option proposes to address:

- Especially in tundra ecosystems, keep large amounts of organic material stored in place and prevent emissions of greenhouse gases (GHGs) by excluding or minimizing the severity of wildland fire in this ecosystem

- Reduce risks to human health (respiratory) and to human improvements
- Utilize woody material removed from fuels management activities in bioenergy applications to offset fossil fuel used in home and community heating applications
- Maintain a healthy ecosystem that provides habitat for a variety of species, many of which are important to subsistence life styles
- Engage local communities in planning and implementation of fire management in the lands that directly affect them.

These goals will be addressed by actively managing high-risk fuel types via fuel-reduction programs for individual homes and communities via increased education and planning efforts. These plans are called Community Wildfire Protection Plans (CWPP), while the individual outreach would be via an education program called Firewise. The interagency community that provides wildfire protection and education services in Alaska already uses these tools, but the programs would be expanded and updated to address changing conditions, perhaps in collaboration with the proposed Alaska Center for Climate-Change Solutions.

Additionally, the Alaska Interagency Wildland Fire Management Plan (AIWMP) would be reviewed for the North Slope portions of the state within the context of a policy discussion on fire in the tundra ecosystem. Currently fire in this ecosystem is a relatively rare event, and most of the region is planned for a “limited” response. In layman’s terms this means no initial attack on fire starts except in very specific circumstances. Some call this the “let burn” policy, but this terminology over-simplifies the option.

Without a discussion and review of the AIWFMP many of the current policies will continue and will not reflect the changing conditions and needs of the ecosystem and the wildlife and humans that depend on it.

Option Design

Sub Option 1: Community Wildfire Protection Plans (CWPP)

Structure/design: Increase the capacity of communities to initiate, complete and implement a CWPP. This program is already well established and has a template for developing a planning effort. Communities will need technical assistance in developing plans and maps that show fuel types and community improvements. This could be accomplished through close collaboration with the proposed Alaska Center for Climate-Change Solutions. Once risk maps are completed, projects for treating hazard fuels can be designed and ranked.

Targets/goals:

- Complete five new plans each year for the next ten years.
- Keep all current plans updated.
- Establish a statewide CWPP coordinator as part of the Division of Forestry or the Alaska Wildland Fire Coordinating Group (AWFCG).

Timing:

- Can begin immediately, but need to increase the number of plans being prepared or updated.
- Within ten years complete 50 new plans and within 20 years have all communities with fire risk completed.
- Results will accrue indefinitely into the future so long as plans are updated and implemented.

Participants/Parties involved: Numerous individual communities and federal and state agencies involved in wildland fire management activities and national, state and local governments. Specific agencies would include: State of Alaska, DNR, Division of Forestry, ADF&G, Wildlife Conservation, Habitat Divisions, Bureau of Land Management, Alaska Fire Service, U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service, the proposed Alaska Center for Climate-Change Solutions.

Evaluation: Periodic review of the CWPP's would be required to determine if community goals and projects are being implemented on the ground. Reviews should be made at the community level annually and a more comprehensive update made every five years if conditions warrant.

Research and Data Needs: There are no specific research needs for this sub option but, as noted in the design section, there would be needs for data in the form of vegetation (fuel) maps that are usually compiled from satellite imagery. Ortho rectified imagery would show human improvements and vegetation and a base map is needed for the state. Currently only portions of the state have this information available. In addition, fine-scale projections of future fire regime, prepared by SNAP at the University of Alaska, would benefit communities in preparing their Community Wildfire Protection Plans.

Sub Option 2: Policy Change to the Alaska Interagency Wildland Fire Management Plan

Structure/design: Reviews of the Alaska Interagency Wildland Fire Management Plan (AIWFMP) are part of the current process provided for in the plan; they can occur on an annual basis. The interagency community that oversees the plan would need to engage communities, landowners, and managers in a formal review process of the protection levels for their lands. A discussion on the merits of higher protection levels for areas of the tundra ecosystem would be undertaken as part of the annual review. It may be necessary to update sections of the plan to better reflect climate-change issues and concerns as they relate to wildland fire and its management in the state.

Targets/goals:

- Complete plan review for tundra ecosystems within two years to identify resources at risk (including air quality in communities) and appropriate responses of fire suppression.
- Identify components of a CWPP (see sub-option 1) appropriate to communities in tundra-dominated ecosystems.
- Update plan to reflect climate-change issues and strategies as they relate to management of wildland fires
- Reduce or avoid GHG emissions from tundra fires (set a tonnage goal?) Plan and document these effects in ways that allow the State to claim carbon credits in the context of whatever national carbon-trading legislation is developed.

Timing:

- Begin plan review in 2009 and have any modified protection levels in place for the 2011 fire season.
- Results will accrue over time, depending on the level of success of the increased protection policy.

Participants/Parties involved: Individual land owners and managers on the north slope and the fire suppression agencies, mainly the Alaska Fire Service (AFS), Alaska Wildland Fire Coordination Group and the Division of Forestry. In addition, local government and researchers at the University of Alaska

and other institutions and agencies should be involved in discussing the nature and feasibility of potential policy changes.

Evaluation: There should be monitoring of fire occurrence and burn intensity, on an as-needed basis, to determine if objectives and goals of the policy change are being met. Agency or university researchers could do this monitoring. Concurrent monitoring of lightning strikes and climate trends would allow inference on whether there is an increasing trend in potential area burned in tundra on the North Slope.

Research and Data Needs:

- Further work on burn intensity mapping and quantification of GHG emissions from recent fires should be completed. Some work has been initiated. Studies should look at both the long- and short-term emissions from fire in tundra and changes in the dynamics of permafrost response in boreal forest and tundra. Research on the relative contribution of GHG emissions from tundra ecosystems that are independent of fire is also needed to put fire release of GHGs in context (e.g., release of methane CH₄ from melting permafrost; it has >20 times the effect on climate warming than release of CO₂).
- Evaluate mitigation strategies for communities in tundra-dominated ecosystems to create fuel breaks at the wildland interface (e.g., gravel perimeter road around community) to reduce risk of wildland fire spreading among structures, as well as spread of fire from communities into wildlands (e.g., escaped trash fires at dumps).
- Additional research should be conducted on the impacts of fire on winter caribou range and changes in vegetation patterns and succession caused by fire.
- Modeling work to help quantify what would happen under an increased fire protection strategy scenario and the current management action. (This could help quantify the third goal bullet above). Modeling is also needed to assess future fire dynamics under a suite of potential future climate scenarios. SNAP, at the University of Alaska, has these modeling capabilities.

Sub Option 3: Develop a comprehensive fuels management program to treat high-risk areas to minimize negative impacts of wildland fire on humans and to increase beneficial aspects, especially wildlife habitat.

Structure/design: Examine strategic applications of wildland fire use or mechanical fuel treatments to break up extensive areas of fire-prone black spruce forests, in part by creating fuel breaks of less flammable early succession post-fire vegetation that connects to other natural fuel breaks such as wetlands.

Targets/goals:

- Work in conjunction with CWPP's at the community level to identify fuel-reduction projects.
- Reduce GHG emissions and lessen health impacts from wildland fire events.
- In fire-dependent ecosystems, allow wildland fire to continue to play an important role in maintaining healthy ecosystems, while meeting the needs of communities that utilize these ecosystems
- Utilize woody fuels from hazard fuel treatment, if feasible, in wood biomass applications

Timing:

- Fund and implement fuel reduction projects identified in current CWPP's, 2009 forward.

- Take advantage of wildland fire starts to remove hazard fuels during late fire season or during other strategic times during the fire season. Variable time frame depending on fire season activity, but utilize strategy during each fire season.

Participants/Parties involved: Primarily the wildland fire suppression agencies in the state: Division of Forestry, Alaska Fire Service and the U.S. Forest Service. These agencies would need to work with communities, land managers, Alaska Native Corporations and other entities to fully implement this option.

Evaluation: Utilize a statewide Fire Plan Coordinator to develop metrics to track and monitor the accomplishments of the stated strategies. Acres treated by both fire use and mechanical methods on an annual basis could be one metric. Acres of fuel types in a condition class above normal to gauge level of risk and thus risk reduction by these treatments.

Establish baseline conditions across geographic regions and track via modeling expected outcomes under different treatment scenarios.

Research and Data Needs:

- Determine if mechanical fuel treatments are achieving the desired condition class change in the fuel type.
- Conduct further assessments of harvesting systems to economically produce wood biomass fuels for use in space heating applications. (See related item NS-7)

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the second-highest ranked option with no minority views. The option ranked particularly high in terms of feasibility, timing and adaptive capacity. The TWG is in concurrence about the ranking of this option.

NS-3 Manage Climate Change Impacts on Watersheds and In-stream Flow

Recommended Adaptation Option

The State of Alaska will establish policies that manage the impact of a warming climate on the diverse needs for freshwater in Alaska. The broad range of needs include those of communities, industries, transportation, and ecosystems. It is proposed that the new policies fit within the context of existing policies that balance the potentially competing uses of water.

Option Description

This option is designed to ensure effective management of fresh water for Alaska’s users, including, but not limited to, communities, industries, and ecosystems, in the face of a warming climate. Climate-change projections suggest that surface water abundance could more variable and might decrease if evaporation and plant water use increase more than precipitation. In addition, as permafrost degrades, soil becomes increasingly permeable to water. This could cause perched lakes and other surface water sources to disappear for much of the year. These lakes and streams constitute a source of freshwater for many Alaskan communities. In many cases, communities may not find a groundwater source to replace lost surface water. With less permafrost, rivers will have lower peak flows, possibly limiting navigation of rivers that require high flows for boat travel. This policy will:

- Provide means by which the state can incorporate water use feasibility assessments and climate scenarios into its water management policies. The state’s present system for use and protection of the freshwater system does not address the potential impacts of a warming climate.
- Streamline the adjudication process for applications related to all water uses, including community and industrial water supplies and reservation of in-stream flow for fish to provide flexibility to adapt to climate change.

This policy is necessary because many Alaskans are already threatened with inadequate water supply and sufficient in-stream flow to meet their needs. In addition, declines in in-stream flow and warmer temperatures change threaten healthy fish habitat. It is critical that the policy enable the state’s water managers to develop effective strategies for water management in what could be a significantly altered future environment.

Option Design

Structure/design: The policy will define the process by which the state incorporates climate change into its existing water policies, such as assignment of water rights, discharge requirements, and ecosystem management. The departmental infrastructure to execute such a policy already exists within the Departments of Environmental Conservation, Fish and Game, and Natural Resources. Incorporating climate-change considerations in water management is critical to the sustainability of Alaska’s communities, industries, and ecosystems.

Targets/goals: The goal is to provide effective management of Alaska’s water supplies.

Timing: Immediate initiation of background research, with subsequent (within five years) definition of water needs and priorities for regions with greatest potential water shortages.

Evaluation: The success of this policy will be evaluated by the extent to which communities, industries, and ecosystems meet their water requirements over a range of years characterized by different water availabilities.

Participants/Parties involved: ADFG, ADNR, ADEC

Research and Data Needs:

- Gather data on hydrologic parameters throughout the state to establish baselines, so the effects of climate change on these parameters (e.g., precipitation, snowpack, and streamflow) can be evaluated.
- Scenarios should be developed to better understand the broad range of impacts of climate change on freshwater in Alaska.
- Identify areas where future water needs are likely to be insufficient, using assessment tools such as the Arctic Water Resources Vulnerability Index (AWRVI), and review appropriateness of long-term water management strategies for these regions.

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the ranked third with no minority views. The option ranked highest in terms of significance, benefits and timing. The TWG is in concurrence about the ranking of this option.

NS-4 Reduce Introduction and Spread of Invasive Species**Recommended Adaptation Option**

The State of Alaska will expand efforts to become an active partner in addressing the problem of invasive species in the state. The involvement of several state agencies is critical to controlling the introduction and spread of invasive species, yet to date their participation has been modest. Support substantial involvement of the Departments of Transportation and Public Facilities, Natural Resources, Environmental Conservation and Fish and Game.

Option Description

The combination of changing climate and increasing globalization has dramatically increased the rate of introductions of non-native, invasive species to Alaska. Invasive species threaten every Alaskan ecosystem, from near-shore marine environments to arctic tundra. Invasions by non-native species have the potential to damage important economic sectors such as fisheries and forestry, as well as to alter fire cycles and subsistence opportunities. Alaska still has the opportunity to prevent problems caused by invasive species. If allowed to become widespread, invasive species can cause gradual and irreversible degradation of entire ecosystems, with substantial negative impact to local economies. Once invasive species become widespread, the possibility and economic feasibility of controlling them declines dramatically.

This option would take advantage of the opportunity that still exists to prevent the spread of invasive species to large areas of the state. Limited state funds would be far more effectively spent on prevention than on control.

There are several goals for this option:

- **Support the creation of an Alaska Invasive Species Council.**¹ State representatives to the Council will include ADF&G, DNR, DEC, DOT/PF, and University of Alaska. The Council will review the current funding mechanisms and levels for state agencies to manage noxious weeds and aquatic nuisance species on the lands and waters under their authority. The Council will establish criteria for the prioritization of invasive species response actions, and prepare an annual report to the governor and to the relevant policy committees of the Senate and House of Representatives.
- **Develop modern and comprehensive noxious weed regulations.**
- **Encourage Alaskan agricultural producers, greenhouses and nurseries to enter the native-plants-as-revegetation-materials market.**
- **Work with Canada through appropriate diplomatic channels** to encourage the control and eradication of a variety of weeds, insects, aquatic nuisance species, and marine invasive species (e.g. spotted knapweed, *Spartina*, green crab) in British Columbia, the Yukon, and NWT to reduce their spread towards Alaska.
- **Work with shellfish mariculture industry** on education and best management practices to prevent, identify and control non-native organisms that arrive with shellfish stock.
- **Evaluate ballast water treatment technologies now available.**
- **Evaluate the impact of hull fouling on the spread of invasive marine organisms to Alaskan waters.**

This option would contribute to and build on work underway by the statewide Alaska Committee on Noxious and Invasive Plant Management (CNIPM) and by the Alaska Invasive Species Working Group (AISWG).

Option Design

Structure/design: This option allows the State to join forces with already-established federal (USFS, NPS, USF&WS) and public sector programs (Cooperative Weed Management Areas, Watershed Partnerships, CNIPM, AISWG) to coordinate a cross-land-ownership program on invasive species in Alaska. This proposal includes tasks that can be implemented at both small and large scales.

Currently, invasive plant propagules are being spread unintentionally in gravel and fill material used in construction projects statewide. Yet most of the state's material sales sites (gravel pits) remain, at this point, weed-free. A gravel pit certification program would be a simple means of documenting and

¹ The proposed Alaska Invasive Species Council must not be confused with the existing Alaska Invasive Species Working Group (AISWG), or the Alaska Committee for Noxious and Invasive Plant Management (CNIPM). AISWG and CNIPM are voluntary, ad-hoc groups made up of members of the public, the private sector, and municipal, state and federal government. In contrast, the Alaska Invasive Species Council is proposed in House Bill 12, introduced to the Alaska Legislature on January 9, 2009. If this bill is enacted, it will formalize and codify involvement of the State of Alaska on invasive species issues, including the control of and response to invasive species in the context of climate change. Council members would include the Commissioners of Fish and Game, Natural Resources, Environmental Conservation, Transportation and Public Facilities, Health and Social Services (or their designees). The purpose of the Council is to plan and coordinate efforts that address the threats posed to the state and its residents by invasive species. The Council will work to foster cooperation, communication, and coordinated approaches that support federal, state, local, and regional initiatives relating to the control of harmful invasive species.

maintaining weed-free status for state-owned pits. The next step would be to encourage that gravel used by AK DOT/PF and in other state construction projects come from certified pits only.

Routine road maintenance operations of the Department of Transportation and Public Facilities also spread invasive plant propagules, rapidly and unnecessarily increasing the distribution of those species. Simple changes in the timing, methods and equipment used in these activities would eliminate this acceleration of spread.

At present, the only plant/agricultural materials entering the state that are inspected in any way are potatoes and tomatoes. Nursery starts are being shipped into Alaska from outside the state with a wide variety of noxious weed contaminants. Western tent caterpillars are routinely found pupating on ornamental trees and shrubs brought to Alaska from the lower 48. In 2007, a 747-cargo plane of Christmas trees from Oregon was flown directly to Alaska after being rejected for off-loading in Honolulu by the Hawaii Division of Agriculture. The shipment was infested with a variety of species of insects and contaminated with soil, which was then distributed around Anchorage when the plane was off-loaded with no inspection whatsoever. As the climate warms, such introductions will increasingly lead to new established populations. For some species, the consequences for Alaskan ecosystems are potentially devastating. An inspection program is needed that would include all nursery materials and Christmas trees entering the state as well as wood shipping containers, pallets and wood products for exotic wood borers.

The University of Alaska Fairbanks has begun to develop a management plan for the significant invasive plant infestations on the UAF campus. UAF facilities services and the UAF administration should be recognized for their commitment to this effort; it should be expanded to address similar issues at the Palmer Experiment Station. The next step would be to use these projects as a starting point from which to address and manage invasive plant infestations around all state-owned administrative sites, buildings, storage areas, parking lots and other public facilities.

Plant species now recognized as invasive are still being used for revegetation projects around the state, in part because commercial sources of native plant seed or starts are extremely limited. Demand for native plant revegetation materials far outstrips supply. The state could initiate a small-grants program to encourage Alaskan agricultural producers, greenhouses and nurseries to enter the native-plants-as-revegetation-materials market. A next step would be to require that construction projects on state land revegetate with native species.

The state should work with and encourage the shipping industry to adopt any of the many treatment technologies now available to reduce the impact of ballast water in Alaska offshore environments. Ballast water coming into Alaska must be tested to gauge the range and types of organisms present. Ballast water may have the ability to transfer pathogens - such as a possible *Vibrio* outbreak, and may have implications to the health of the shellfish industry and human health. The state should consider regulation such as that for Washington and Oregon to protect Alaskan waters from ballast water release.

The state of Alaska should work to develop educational outreach materials and best management practices to prevent, identify and control non-native organisms that arrive with shellfish stock. Work with the shellfish mariculture industry to educate about and monitor for green crab occurrence in State.

The state should actively support the outcomes of a NMFS-funded *Spartina* response plan.

The state should determine if action should be taken to address hull fouling as a vector to Alaska. This would involve evaluating the results of research funded by Prince William Sound Regional Citizen's Advisory Council (PWSRCAC) for possible follow up on additional research, education, or best management practices.

Targets/goals:

- Establish the Alaska Invasive Species Council.

- Re-fill the integrated vegetation management position at the Alaska DOT/PF (position has been vacant since 1/08).
- Establish a dedicated plant/wood products quarantine inspector *with regulatory authority*.
- Develop a program to encourage Alaskan agricultural producers, greenhouses and nurseries to enter the native-plants-as-revegetation-materials market.
- Develop a best management practices document for the construction industry to avoid spreading invasive plant propagules in fill material.
- Evaluate ballast water technologies now available.
- Support the outcomes of the NMFS-funded *Spartina* response plan.

Timing:

- The groundwork for many of the targets/goals described above has already been laid. In some cases the only ingredient missing is committed State of Alaska involvement. Thus, many of these goals can be accomplished quickly, within two to three years.
- A gravel pit certification program can be established for state-owned materials sales sites within five years.
- Results will be both short and long-term.

Participants/Parties involved: There are a wide variety of entities that can participate in these efforts, including public and private organizations with broad expertise in the areas discussed. A partial list would include: AK DNR, AK DOT/PF, AK DEC, ADF&G, Alaska Committee for Noxious and Invasive Plant Management, Alaska Invasive Species Working Group, Alaska Cooperative Extension Service, Association of Alaska Conservation Districts, U.S. Forest Service, State and Private Forestry, National Oceanic and Atmospheric Administration, US Fish and Wildlife Service, USDI National Park Service, USDI Bureau of Land Management, USDA Agricultural Research Service, Juneau Watershed Partnership, Anchorage Cooperative Weed Management Area, Alaska Center for Coastal Studies, and Prince William Sound Regional Citizen’s Advisory Council.

Evaluation: The body charged with monitoring these efforts would be the newly formed Alaska Invasive Species Council.

Research and Data Needs: Research is needed on a variety of topics associated with invasive species in Alaska, including:

- Commercial production of native plant materials for revegetation projects;
- Appropriateness of existing ballast water technologies for Alaska;
- Spread and distribution of *Spartina*, green crab and tunicates in Alaskan coastal waters; and
- Effectiveness of new road maintenance equipment, schedules and methods in reducing the spread of invasive plant propagules.

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was ranked fourth, with no minority views. It ranked highest in terms of significance, timing and feasibility. The TWG is in concurrence about the ranking of this option.

NS-5 Review State Regulatory Process for Wildlife Harvest to Assure Timely Adaptation.

Recommended Adaptation Option

The State of Alaska should conduct a comprehensive review of laws, regulations, and policies on sustainable harvest of wildlife in Alaska and recommend changes that allow for more timely, coordinated, and effective adjustment of state and federal hunting regulations to allow hunters to adapt to effects of climate change.

Option Description

The rate of climate change in recent years is perceived to be disrupting historic patterns of movement and behavior by game animals (e.g., large forest fires, warm periods during rut) and transportation options for hunters during hunting seasons (e.g., low water depth in rivers, formation of ice adequate for safe travel). There is concern by some hunters that the regulatory process for changing hunting seasons is too slow for timely adaptation to changing conditions, resulting in lower hunting success (proportion of people who harvest an animal compared to the number who attempt to harvest an animal).

This adaptation option recommends a review of the structure and frequency of the State regulatory process in terms of how seasons for sustainable wildlife harvest can allow flexibility for adaptation in a timely fashion and appropriate geographic scale to changes in hunting success caused by climate.

Hunting seasons restricted to inopportune periods may hinder harvest success of wild game as a food source, complicate care of meat in the field, force unsafe travel, or encourage illegal hunting during closed periods, especially where subsistence harvest is critical in remote communities. Requests to shift hunting seasons are occurring more frequently in certain regions (e.g., September moose hunts in western Interior), which increases workload and decreases efficiency for regulatory authorities and local advisory groups. Some rural residents perceive a lack of concern by management agencies and regulatory authorities, which will hinder the cooperation necessary for effective harvest management and wildlife conservation in remote areas.

Option Design

Structure/design: Unlike some commercial and subsistence fisheries, presently there are no options for in-season extension of wildlife hunts or the ability to increase bag limits where appropriate at the discretion of the local manager. Emergency closure of a season does occur on some registration hunts when a general harvest quota is reached; this encourages strong competition to hunt early, when meat care may be difficult. A policy option to avoid hunting in warm weather could be addressed by a working group focused on a community or small region as a test case to develop a proposal to the Board of Game.

The charge would be to design a hunting season and harvest quota system that is flexible and informed by knowledge of local conditions to allow season extension if short-term weather hindered harvest during a general season (no restriction on access by non-local hunters) and the harvest quota for the community/region is not met. Communication and close cooperation between managers and hunters to ensure timely harvest reporting would be critical in low animal populations to avoid overharvest with this approach.

Targets/Goals: One goal would be a reduction in the number of proposals to the Board of Game and Federal Subsistence Board that request shift hunting season dates later because of trends in warmer conditions during fall and early winter hunts. A second goal would be hunting at times when travel is safe and meat can be preserved in good condition.

Timing: A working group could provide input through the local Fish and Game Advisory Committee (state) and Regional Advisory Council (federal). Initial recommendations for changes in regulations could be completed within one year. The Alaska Board of Game and Federal Subsistence Board each convene annually but address regional issues (e.g., Southeast, Southcentral, Interior, Western/Arctic in state system) for wildlife on a 2-year cycle. Thus, the entire process to put a new (flexible) regulation in place in a particular region may take up to 3 years.

Participants/Parties involved: Hunters, state and federal wildlife managers, Alaska Board of Game/Local Advisory Committees, Federal Subsistence Board/Regional Advisory Councils, and tribal organizations (e.g., Association of Village Council Presidents).

Evaluation: Effectiveness would be gauged as fewer proposals to shift seasons or create additional hunting seasons, community harvest needs being met (subsistence harvest monitoring), and a sustainable harvest that does not cause wildlife population declines (population monitoring, harvest reporting).

Research and Data Needs:

- Literature review about effects of temperature on rut timing and the potential effect of allowing moose hunting during the rut on productivity of moose. The most common request to date has been to shift moose hunting seasons later in autumn when weather is cooler (change to warmer weather in early September for parts of the Interior was documented by National Weather Service on request of Alaska Department of Fish and Game in 2008). Managers are concerned that shifting a hunt into the rut period (when bulls are preoccupied with breeding) can increase hunting success, which could be a problem in low-density populations or those with a low bull:cow ratio. Research on rutting behavior would require long-term observational studies, which would be challenging in boreal forest.
- Effect of temperature and rainfall patterns on river level for motor-boat access in autumn and the effect of temperature patterns on ice formation for winter travel on both freshwater ice and sea ice. The travel relationships are complex, encompassing both natural sciences (climate, hydrology) and human behavior.

Implementation Mechanisms

Collaborative efforts to resolve hunting issues or conflicts do occur outside of the regulatory process, often with the intent to produce a proposal to the regulatory process. Progress would occur by choosing a test case area of state where weather during hunting season has been a problem, asking for participants (one representative from each group noted in previous section), setting goals and a timeline for a proposal, and providing the group with the resources for meetings to occur. A local test case in the Bush where good cooperation already exists is advisable before attempting a more complex process on the road system or a process that is regional or statewide in scope.

No action by the Legislature would be required. Hunting regulations are set for all lands statewide by the Alaska Board of Game and apply for all hunts on state and private lands (including Alaska Native allotments and Native corporation lands). The Federal Subsistence Board may separately set hunting regulations on some federal lands to ensure subsistence needs of federally-qualified rural residents are met, which may result in a priority for rural residents at times when sustainable harvest is less than demand by all hunters.

There would need to be a mechanism for resolution of state and federal harvest management in times of perceived game shortage in rural areas, when a subsistence priority could be given to rural residents on federal lands (see Feasibility section below).

Related Policies/Programs and Resources

There are good examples of consensus-based stakeholder groups to address hunting issues (Western Arctic Caribou Working Group) and fishing issues (Yukon River Drainage Fisheries Association).

Travel funding would be required for a working group to convene 2-3 times over several months to one year to draft a proposal (federal partners may be able to assist with funding). Depending on the schedule, additional travel funding may be needed for the rural Fish and Game Advisory Committee because some committees have funding only for one meeting per year. The working group would submit a proposal to the Board of Game at the next available cycle.

If the Board of Game adopted a quota system, it may require extra resources for Fish and Game staff to travel to communities that do not have a license vendor so hunting licenses and harvest reporting information can be issued to hunters. Timely reporting would require hunters to provide Fish and Game with harvest data by phone or email within a short period after harvest (e.g., 3 days) so a manager could estimate shortly before a season ending date if an extension is advisable.

Feasibility

The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) required a subsistence hunting and fishing preference for rural residents of Alaska on federal lands, which compose 60% of the state. In the 1989 McDowell decision, the Alaska Supreme Court upheld the common use clause in the Alaska Constitution that provides for access to game by all Alaska residents, thus putting State game management in non-compliance with federal law. Since 1990, dual regulations for hunting and fishing have existed on most federal lands in Alaska (determined by Title VIII of ANILCA).

Feasibility: A single regulatory system for hunts on federal lands would require amending provisions for priority harvest allocation in the Alaska Constitution, ANILCA, or both. Resolving the legal differences between state and federal regulation of hunting and fishing on federal lands in rural Alaska has been a contentious issue for decades and is highly unlikely to occur in the near future. However, a State regulation allowing manager discretion to extend season length for harvest up to a sustainable quota that meets subsistence harvest needs for a rural community or communities would eliminate the need for additional hunts on federal lands. Regulations that are simpler, apply to all land ownership, and are consistent over time are more likely to be understood and embraced.

Constraints: Participating hunters will have to be convinced of the value of harvest reporting as a benefit to meeting their subsistence needs because law enforcement alone is unlikely to be an effective means of change. Some people prefer cow moose (often more fat than bulls) or hunting in winter (additional season), when options exist for overland travel by snow machine and easier meat care. Some requests to adjust timing of harvest seasons may occur in areas where harvest is already managed to the sustainable limit (e.g., harvest in warm weather is more difficult but the quota is already being met). In that instance, shifting a State moose hunting season open to all residents and possibly even non-residents from early September to late September or early October (during the active rut, when bull moose are more vulnerable) may increase harvest success to beyond sustainable yield. Allowing a winter hunt for bulls on

federal lands (particularly after bulls have begun to drop their antlers) may increase the harvest of cows. This is a particular problem in low-density moose populations, which are common in predation-limited systems of the boreal forest in rural Alaska. Coordination of state seasons and federal subsistence seasons is critical to prevent overharvest, particularly of cow moose during winter hunts.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

This option was the ranked fifth, with no minority views. It ranked high for its high potential significance and low cost. The TWG is in concurrence about the ranking of this option. At the suggestion of the AAG, the TWG member who had taken the lead on this option considered combining it with option NS-6, but felt that the options were substantially different and that keeping them separate would be clearer.

NS-6 Prepare for Adaptive Management for Fish and Wildlife

Recommended Adaptation Option

The State of Alaska should coordinate efforts to monitor species or stock abundance changes, evaluate the risk of species loss or decreased genetic diversity, and ensure that information and tools are in place for adaptive management of fish and wildlife to be implemented where feasible and warranted.

Option Description

Changing climate is expected to continue influencing the distribution and possibly the quality of habitat for fish and wildlife in Alaska, which may cause declines in some native species and increases in other species. Important distributional changes in stocks may occur for some marine and freshwater fish species.

This option recommends that the State coordinate efforts to monitor species or stock abundance changes, evaluate the risk of species loss or decreased genetic diversity, and ensure that information and tools are in place for adaptive management to be implemented where feasible and warranted. Improved coordination leverages efforts and funding to document changes in a timely fashion for adaptive management, which might include changes in harvest patterns or steps to restore populations if adequate habitat remains.

Decline or change in distribution of harvested species or stocks has implications for provisioning of food, particularly for remote communities as the cost of transportation fuel increases. Climate change may also threaten populations of non-game species, leading to potential biodiversity loss or restrictions on uses of lands for some purposes. Indirectly, change in location of major vegetation types has implications for wildland fire regime, which is the primary agent of habitat enhancement for game in boreal forest. Loss or increasing fragmentation of rare habitats (e.g., alpine in Yukon Tanana uplands) may warrant translocation of individuals from endemic species (e.g., Alaska marmot) to maintain genetic diversity among remaining populations. Changes in near shore marine circulation patterns may alter food webs or migratory pathways for fish, and changes in freshwater flow and temperature regimes may impact salmon spawning habitat and juvenile survival.

Option Design

Structure/design: This option would provide a common structure for cataloguing and disseminating information on species status and distribution.

Targets/goals: Quantitative targets or goals would need to be developed by participants once a review of the existing efforts is assembled in a single framework. Existing escapement goals for salmon species and stocks can be used to evaluate potential impacts of climate change on abundance and distribution.

Timing: Various levels of collaboration on monitoring biological diversity for scientific and conservation purposes has occurred in the past. A single meeting of a comprehensive participant group should be able to catalog efforts across species, aquatic and terrestrial ecosystems, and jurisdictions to identify gaps and potential for collaboration.

Participants/Parties involved: State and federal management agencies, University of Alaska campuses, tribal organizations, non-government organizations, citizen science efforts, and private business (e.g., oil companies).

Evaluation: The success of this policy will be evaluated by the increased efficiency in obtaining information about species abundance and distribution at a single source, particularly as large development projects are undertaken (e.g., oil or gas pipelines, railroads, roads for resource extraction) that require comprehensive environmental studies.

Research and Data Needs: Once a review of the existing efforts has occurred, participants could identify gaps in knowledge, prioritize inventory and monitoring needs, and suggest protocols.

Implementation Mechanisms

Several efforts to coordinate monitoring have already occurred in the last few years (see Related Policies/Programs/Actions below).

A coordinator position to link extant monitoring programs into an archival network for data exchange is more likely to receive professional buy-in from scientists than a top-down authority. The coordinator could be housed in a government agency that already has a substantial data archive. Alternatively, it could be located in a neutral organization such as the University of Alaska that has secure base funding (office space, internet data server, and technical specialists) and seeks operational/maintenance funding from conservation foundations and various agency members that contribute data on species status.

A membership charter for the network should be established to document responsibility of contributors (e.g., free access to data, providing metadata on sources of information, funding for upkeep of host website, etc.)

Related Policies/Programs and Resources

Related Policies and Programs: Efforts to inventory and monitor the status of species and their environments already exist in many forms and organizations, but they are not sufficiently coordinated. Harvested species are monitored by ADF&G. Non-game vertebrates, invertebrate animals, and plants are monitored through several groups or efforts, such as the High Latitude Ecological Observatory (part of national NGO), regional inventory and monitoring networks (National Park Service), the Comprehensive Wildlife Conservation Strategy (ADF&G), and the Alaska Natural Heritage Program (University of Alaska-Anchorage). Presently efforts are underway with respect to forecasting the effects of climate change on freshwater, marine and terrestrial species and ecosystems (see NS TWG Catalog, December 2008, Section I).

Available Resources: State and federal agencies have numerous monitoring programs in place that can contribute to this coordinated effort. Results of the gap analysis developed through implementation of this option can identify the need for new monitoring efforts. Indigenous knowledge may be highly useful to sampling design. Potential for citizen science involvement is high for some monitoring tasks and would leverage labor across our vast geography, although training and testing of observers will be necessary for some species or purposes.

Feasibility

Feasibility: The Alaska Department of Fish and Game and the University of Alaska can play a lead role for the state in coordinating a broad partnership. The financial resources required to host and maintain an Internet database could be estimated during the review of existing data sets and where gaps in data exist.

Constraints: There will be a start-up period of perhaps one year before all the various entities and information sources are coordinated to fully identify data gaps and make existing data available in a consistent structure. Some data may be proprietary (e.g., private industry reports), and some will require filtering for posting on a public database (e.g., reduced geographic resolution for species listed as threatened or endangered). The funding required for sampling of geographic gaps may be substantial, and the time delay until a “useful” product exists depends on the desired resolution or intended uses of the data.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the ranked sixth, with no minority views. It ranked highest for its potential significance. The TWG is in concurrence about the ranking of this option. At the request of the AAG, the TWG member who had taken the lead on this option considered combining it with option NS-5, but felt that the options were substantially different and that keeping them separate would be clearer.

NS-7 Develop Capacity in New Forestry and Wood Biomass Opportunities

Recommended Adaptation Option

The State should invest in economic development and infrastructure to attract and facilitate development of industrial capacity, at appropriate scales, to use insect- or fire-damaged timber and underutilized and new sources of wood biomass.

Option Description

As the changing climate stresses the forests of Alaska, mortality of trees will increase due to insects, fire and tree decline agents. Finding economic and innovative uses for dead, small and underutilized species will help managers confront this forest health crisis and provide for resilient forests more able to withstand rapid change.

This option would invest in developing and deploying new harvesting technology and silvicultural techniques and demonstrate a variety of wood biomass systems to produce heat and power for rural and urban communities.

There are several goals for this option:

- Replace fossil fuels with a renewable, locally produced fuel that is considered carbon-neutral with regard to greenhouse gas (GHGs) emissions
- Create local employment in harvesting, silvicultural work and in operation of energy facilities, especially in rural communities
- Actively manage forestlands for a variety of social, economic and biological benefits

- Demonstrate the feasibility and economics of different bioenergy technologies, from small to larger scale for space heating and electrical needs

This option would build on work initiated by the Wood Energy Task Force in 2002 and continue efforts to complete feasibility studies, engineering, financing and construction of biomass space heating facilities for public buildings. There are several different scales that this can occur at, from individual wood-pellet stoves, solid-wood boilers, and wood-chip boiler systems. The option would also explore the use of wood chips in co-firing applications with coal to produce electricity in large-scale utility settings.

Without investment and demonstration of these types of projects and facilities the technology will be slow to develop and “catch-on” in Alaska. While there has been significant movement toward a variety of alternative energy options, wood biomass consistently ranks near the top in economics and ability to be implemented quickly. By demonstrating different technologies at a variety of scales, communities will be able to choose the best options for their situation. This would include fuel type, quantities available on a sustainable and economic basis, heat-load need, and a variety of other factors. In turn, this will permit forest managers to aggressively address forest health issues and utilize wood that would otherwise increase fire hazard and cause further declines in stand and community resilience.

Option Design

Structure/design: This option has several different facets that work together to achieve the overall result of utilizing dead, small, or underutilized tree species to improve overall forest health and to form the basis of a wood bioenergy industry. This industry can function at several scales and can be as simple as an energy-efficient wood stove in a single-family dwelling, to a large, complex wood-energy plant in an urban community. The important aspect of this proposal is that it can be implemented at both the small and large end of the wood-energy spectrum, with numerous options in between. A community can scale their options to what they are comfortable with.

Currently in the state there are several installations of Garn boilers, they use solid wood, much like a wood stove, but on a larger scale. They are used for space heating needs and can heat public buildings and other small-to-medium-sized buildings. There is a need to demonstrate a wood chip system that is more automated than the Garns and can handle large heat loads, such as an entire high school, hospital, or prison. There are two communities, Delta and Tok, that are considering a project like this, and both have applied to the Alaska Energy Authority (AEA) grant program to secure funds to move ahead with this work.

The next step up would be to look at a co-firing opportunity with an electric utility. In a system like this coal and wood chips would be burned together to produce the steam required to run turbines and generators to make electricity. The University of Alaska is interested in this off-the-shelf technology for a proposed new generating unit at the Fairbanks campus.

All of these options are viable short-term solutions that have been in use in other parts of the nation and world for many years. Our cheap supplies of energy have prevented their evaluation and use in the state, and there is a need demonstrate their reliability, and economics.

In addition, air quality and related health issues have been raised concerning fine particulate matter, called PM-2.5 by the EPA. Recently the community of Fairbanks joined the city of Juneau in being a non-attainment area for the PM-2.5 standard. Wood-burning appliances, especially older wood stoves and some outdoor wood furnaces will not meet this standard. Wood pellet stoves and boilers can meet this standard, and homeowners may need to switch to this type of fuel, if they wish to continue utilizing wood fuels. There is a need to manufacture wood pellets in Alaska, and at least one company has taken steps to do so, but there is much work to do on the harvesting and transportation side to ensure pellets can be produced economically.

Why is all this so important for helping with climate change. Whenever wood is burned it offsets a fossil fuel, like oil, coal or natural gas. Wood also produces CO₂ when combusted, but new trees are taking the harvested trees place in the forest. These young trees sequester carbon and thus are considered carbon-neutral from a GHG perspective. Additionally, if the U.S. or the state adopts a cap-and-trade program for GHGs, the fuel offsets mentioned above can be sold as carbon credits in carbon exchange markets such as the Chicago Climate Exchange (CCX).

Targets/goals:

- Construct a wood chip boiler installation at a public school or similar facility and have it operational by 2010
- Complete feasibility studies for five communities interested in wood-energy projects annually for each of the next ten years
- Develop and demonstrate harvesting and transportation systems using currently available equipment for wood energy facilities. Demonstrate one road system and one rural harvesting system
- Establish a wood-energy coordinator position in the Division of Forestry to provide technical assistance to communities and AEA to determine sustainability of wood supplies for wood energy projects

Timing:

- Build on projects already initiated; this would enable rapid deployment of wood energy systems beginning in 2009. Additional projects can be brought on line as fast as feasibility studies, engineering, financing and construction can be accomplished.
- Over the next ten years numerous projects can move forward in both urban and rural communities
- Results will be both short- and long-term and can be expected to continue through the design life of the facility

Participants/Parties involved: There are a number of entities that can participate in this effort, ranging from public and private organizations with expertise in the areas discussed. A partial list would include: Alaska Energy Authority, Wood Energy Task Force, Division of Forestry, U.S. Forest Service State and Private Forestry, Department of Energy, U.S. Forest Service Forest Products Lab, Tanana Chiefs Conference, University of Alaska and others

Evaluation: The main type of monitoring would take place on the forest management side of this proposal. Managers would ensure that forest health and productivity was being maintained on sites and that best management practices (BMPs) were being applied. The state's Forest Resources and Practices Act could provide both effectiveness and implementation monitoring of BMPs.

Forest certification via a third party organization, such as the Sustainable Forestry Initiative (SFI) or the Forest Stewardship Council (FSC) could also ensure appropriate management standards are in place.

Research and Data Needs: The concept that wood fuels are carbon neutral should be thoroughly examined. This is a complex topic that involves carbon budgets and cycles in a dynamic environment. Protocols for certifying carbon storage and sequestration rates are needed for boreal and coastal forests.

Research in new harvesting equipment or application and adaptation of current equipment should be supported.

Air quality monitoring and testing of various wood burning appliances should be completed in an arctic environment. The Cold Climate Housing Research Center would be an ideal place to conduct this needed work.

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the ranked seventh, with no minority views. The TWG is in concurrence about the ranking of this option.

NS-8 Support Local Sustainable Agriculture in Alaska**Recommended Adaptation Option**

The State of Alaska should support and expand sustainable agriculture in Alaska to recognize the potential new opportunities for food production, and the importance of agriculture providing food security as the availability of other sources may change due to a changing climate.

Option Description

This Option will seek to expand and enhance food production in rural and urban Alaska to capitalize on new agricultural opportunities for food production and to address food security issues as other food sources are impacted by climate change or by increasing energy costs. The goal of this option is to increase participation in community-based agriculture in more communities across Alaska, including major population centers located on the road system or Alaska Marine Highway.

It is recommended that this option be implemented primarily through implementation of the Alaska Division of Agriculture's (ADOA) strategic plan, with the purpose of complementing the ADOA efforts to expand community-based agriculture all across Alaska.²

Prior to statehood, the people of Alaska realized the value of agriculture. Alaska's State seal recognizes the value of agriculture to the State by portraying a farmer, his horse and three shocks of wheat. Rural communities such as Ruby, Aniak and others had established community-based agriculture. Today, much of the of the general population does not understand the significance of agriculture, as the majority of Alaska's population is two or three generations removed from the farm.

² See ADOA's Draft Strategic Plan (November 2008), Challenges and Opportunities for the Future While Meeting the Needs of Today, Objective 3.2: "The ADOA, through the PMC will work cooperatively with other agencies, as climate changes occur, to address new crops and conservation issues."

Option Design

This is the heart of the option discussion. It is suggested that it be divided into the following sections.

Structure/design: Increased statewide participation in community-based agriculture and support for “Alaska Grown” agricultural products would require ADOA to provide leadership to a coalition of existing organizations, including Alaska based USDA entities, UAF Cooperative Extension Service and UAF Agricultural and Forestry Experiment Station, Denali Commission, and others.

Targets/goals: While there are lists of communities currently being threatened by the changing climate; no such list exists for communities with potential to develop community-based agriculture. The first target would be to develop such a list to serve as a baseline. Subsequent targets would be developed that are reflective of the resources and commitment of participating agencies and organizations and most importantly the community based producer(s).

Timing: To be completed.

Participants/Parties involved: ADOA (lead), Alaska based USDA entities, UAF Cooperative Extension Service and UAF Agricultural and Forestry Experiment Station, Denali Commission, and others.

Evaluation: To be completed.

Research and Data Needs: To be completed.

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

To be completed.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

During the ranking and evaluation by TWG members, this option was the ranked last, with no minority views, due to its lower rankings for significance, benefits and timing. The TWG is in concurrence about the ranking of this option.

Cross-Cutting Adaptation Options Recommended by Natural Systems TWG

The following two adaptation options related to capacity building, education and outreach would support Alaska’s effective adaptation to climate change. They are identified as “cross-cutting” because they address all adaptation topic areas, not just adaptation to changes in natural systems, and may also contribute to implementation of climate change mitigation options.

CC-1 Establish Alaska Center for Climate-Change Solutions: Capacity Building for Climate Change Adaptation

Recommended Adaptation Option

The State of Alaska will establish and fund an Alaska Center for Climate-Change Solutions that will provide a centralized source of information (e.g., climate projections, accurate mapping), adaptation tools, technical assistance and funding for communities, state agencies, NGOs, and businesses to enhance their capacity to plan for and adapt to climate change.

Option Description

Most Alaskan communities and businesses have very little understanding of the recent and projected environmental and ecological changes they are experiencing and little capacity to adapt in ways that minimize potential risks and costs and maximize future opportunities. In addition, most state and federal agencies responsible for planning and managing both natural resources and built/human capital are not sufficiently informed about climate-change research and predictions to make well-conceived decisions regarding strategies to adapt to climate change.

We propose legislation to establish and fund a new Alaska Center for Climate-Change Solutions (ACCCS) that builds on the accomplishments of the Climate-Change Immediate-Action Working Group and on climate-change information centers at the University of Alaska. ACCCS will provide the information, adaptation tools, technical assistance, and funding to enable communities, agencies, NGOs, and businesses to develop the capacity to plan for and respond to climate change. This will consist of a State-University partnership that supplies site-specific information on climate change and on funding opportunities and procedures that enable communities, state agencies, NGOs, and businesses to prepare for and adapt to climate change. The Center will also provide technical expertise and competitive grants to communities that enable development and implementation of climate-change adaptation plans.

The policy facilitates climate-change adaptation by providing the information necessary to plan, the advice and assistance for acquiring necessary funding for adaptation implementation, and a community-directed process that enhances capacity of the State, individual communities, and businesses to adapt to climate change.

This policy is necessary because information about climate change is not readily available to communities, state agencies, NGOs, and businesses in a form that enables them to develop adaptation plans, and the programs that might assist in this adaptation planning are not easily identified and accessed by communities, state agencies, NGOs, and businesses. Finally, many communities, state agencies, NGOs, and businesses lack the experience and capacity to develop comprehensive climate-adaptation plans. Community-based adaptation planning is highly desirable because of the highly variable impacts of climate change on different communities (as well as complex interactions across regions) and the variation among communities in their concerns and preferred solutions. It also presents tremendous

opportunities for communities to strengthen their social and economic foundations and improve their self-sufficiency and sustainability, while reducing long-term operating costs.

Option Design

Structure/design: The Alaska Center for Climate-Change Solutions (ACCCS) will be a state-funded State-University partnership with four major responsibilities:

1. It provides information about climate change through the Scenarios Network for Alaska Planning [SNAP; terrestrial information], the Alaska Ocean Observing System (AOOS; a consortium of state, federal, and university partners that provide marine information), and the Geographic Information Network of Alaska (GINA; satellite imagery). These units will answer questions about climate change and provide information and maps of historical, current, and projected future conditions for the area requested for a specific community, business development, or land-management area (e.g., community traditional use area, seaport facility, wildlife refuge or hydroelectric project).
2. It provides a clearinghouse, the Alaska Center for Climate Analysis and Policy [ACCAP], that links funding opportunities and technical expertise with stakeholder needs. Funding opportunities include those university, state, federal, and NGO programs that provide funding and technical assistance appropriate for planning and implementing climate-change solutions. Examples include funding sources and subsidies for renewable energy, procedures for requesting a change in timing of subsistence harvests, funding for reducing hazardous fuels near communities, and funding to modify water and fuel systems threatened by permafrost thaw. Stakeholders to be served include communities, state agencies, NGOs, and businesses.
3. It will provide, on a competitive basis, small grants and technical assistance to develop and implement long-term climate-change adaptation plans. Web-available guidelines and information will describe the application process and criteria by which grant applications are evaluated. Adaptation-strategy workshops (including leaders from successful climate-change adaptation projects) will provide training in climate-change adaptation planning. ACCCS staff will be available to answer questions and provide feedback on stakeholder planning efforts.
4. It will provide a database of successful Alaska-relevant climate-change adaptation programs as well as contact information for the communities, agencies, NGOs, and businesses that developed these. This will enable stakeholder groups to learn quickly from others that have developed successful climate-change adaptation plans.

Targets/goals: A central goal of the policy is economic, social, and ecological sustainability of Alaska through planning flexibility to deal with climatic change. A focus on sustainability will benefit the State and communities in multiple ways by reducing needs for long-term government subsidies, improving efficiency, and increasing capacity to adjust to change. The ACCCS promotes a dynamic approach to finding climate change solutions and encourages the interdisciplinary application of research, academic and local expertise to reach its goals.

The initial goal (within three years) is to establish the Center and quickly develop examples of successful climate-change solutions that can serve as models for other communities or businesses facing similar challenges and opportunities. Subsequently (within five years), the goal is to apply or adapt successful strategies across a broader range of communities, state agencies, NGOs, and businesses.

Timing: The program should be implemented immediately. SNAP, AOOS, and GINA are poised to provide climate-change information now, and ACCAP has already developed a clearinghouse function that links stakeholders with sources of climate-change information and technical expertise. There are many state and federal programs that could assist with the adaptation process. Developing the technical

assistance program will require more time but should be possible within two years. We expect the implementation of some climate-change adaptation solutions to begin within two to three years.

Participants/Parties involved: We recommend that the ACCCS be a State-University partnership that includes SNAP, AOOS, GINA, and ACCAP at the University of Alaska, representatives from selected state agencies who are knowledgeable about agency needs and expertise related to climate change, and perhaps representation from the Denali Commission, which has considerable experience in managing grants to meet community infrastructure needs. Additional participants include NOAA, which currently funds ACCAP, other federal agencies, NGOs, tribal organizations, and private foundations that could identify sources of funding and technical assistance to plan and implement climate-change solutions. It will also require that ACCCS staff serve as liaisons with communities, state agencies, NGOs, and businesses seeking to develop climate-change adaptation plans.

Evaluation: A key goal of the program is to develop the capacity within local communities, state agencies, NGOs, and businesses to develop and implement climate-change solutions. The success of these programs will be measured in terms of the success of these stakeholder groups to (1) develop a climate-change adaptation plan, (2) acquire funding to implement the plan, and (3) extend this planning process to address other environmental and social challenges. We recommend that careful records be kept for each community, state agency, and business planning effort in terms of the success or failure at each of these steps, so the program can learn from its mistakes and be modified accordingly.

Research and Data Needs: No preliminary research is needed prior to initiation of this policy. The Alaska Immediate-Action Working Group has initiated a mini-grant program with six Alaskan communities in immediate risk of climate-induced erosion that demonstrates the feasibility of such a program.

Implementation Mechanisms

We suggest that the ACCCS be implemented as an outgrowth of the State Climate Change Immediate Action Working Group and the University SNAP, AOOS, GINA, and ACCAP programs. The steps needed for it to be fully developed are as follows:

1. Establish long-term funding to sustain the program and permit long-term planning for mechanisms to implement climate-change adaptation planning.
2. Formalize a partnership between the State and the University of Alaska (and perhaps the Denali Commission) that provides long-term funding for all components of ACCCS.
3. Establish cooperative arrangements with state and federal agencies, NGOs, foundations, etc. to provide information and contacts to communities about potential sources of technical and financial resources for climate-change adaptation plans.
4. Provide, on a competitive basis, technical assistance and mini-grants to communities and businesses to develop the plans necessary to access resources from other agencies.

Related Policies/Programs and Resources

Related Policies/Programs/Actions: This program builds on and integrates the efforts of several entities that address climate change: State Climate Change Immediate Action Working Group and the University SNAP, AOOS, GINA, and ACCAP programs. Other programs such as the Denali Commission (which funds infrastructure), the Indian Environmental General Assistance Program (IGAP; which funds capacity-building) or regional tribal organizations could potentially provide resources or co-fund activities sponsored by ACCCS.

Available Resources: Each of these entities already has some state funding in place (direct state funding to CCIAWG and university funding to SNAP, AOOS, GINA, and ACCAP). There is additional federal

funding provided by NOAA to AOOS and ACCAP. These funding mechanisms have enabled these entities to develop substantial capacity and expertise but not at a scale or level of coordination sufficient to implement the ACCCS. In addition, The Denali Commission provides infrastructure to many communities, and the Alaska Federation of Natives holds an annual competition for innovative businesses that support sustainability in rural Alaska, so some businesses and communities are already familiar with the competitive grants process.

Feasibility

Feasibility: This program could be implemented immediately, perhaps using money from the federal stimulus package that is allocated to Alaska, because all the pieces are in place and have the technical expertise to conduct their part of the effort. The largest unresolved issue is how to formalize the State-University partnership in a way that makes it responsive to state needs but insulates it from short-term political crises and shifts in priorities; it may well be logical to include federal (e.g., NOAA) and NGO partners as well and to have representation from stakeholder groups (e.g., communities and businesses) or that it be a public-private partnership arrangement.

Constraints: We are not aware of any competing stakeholder views about the need for climate-change adaptation or the inadequacy of current mechanisms to connect information, funding sources, and stakeholder needs. There will be substantial stakeholder-capacity challenges in implementing this program effectively, but the Center described in this policy would be well poised to address these challenges.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

The TWG did not rank this option along with the NS adaptation options, but reached consensus on the recommendation that the AAG include this cross-cutting option related to capacity building in its final recommendations to the sub-cabinet.

CC-2 Promote Climate-Change Literacy: An Alaskan Program in Climate-Change Education and Outreach

Recommended Adaptation Option

The State of Alaska will promote climate-change education in the state by identifying climate change as a high-priority subject in the State K-12 Science Standards (both science content and science performance or grade level expectations), increasing coordination among existing programs and entities that address climate-change education in Alaska's schools, and supporting the development of outreach materials for distribution by resource-management agencies to the general public.

Option Description

Despite the critical and growing importance of climate change to Alaska's residents, there is a generally poor level of public understanding of the causes and consequences of climate change. In order for Alaska to adapt effectively to climate change there is an urgent need to raise the level of literacy about climate change through formal and informal educational pathways and agency outreach to the general public.

This policy option will establish a framework through K-12 education and public outreach to rapidly improve public understanding of the causes and consequences of climate change in Alaska. The state will

identify climate change as a high-priority subject in the State K-12 Science Standards, increase coordination among existing programs and entities that address climate-change education in Alaska's schools, and support the development of outreach materials for distribution by resource-management agencies to the general public.

By incorporating climate-change education as a formal component of public education, Alaska will provide adequate educational resources to its residents to enable them to make wise choices about how to minimize the costs and maximize the opportunities that result from climate change. In the absence of such education and outreach initiatives, K-12 teachers in schools will not be able to teach about climate change because of the time and subject-matter constraints in their existing curricula. Alaskans are unlikely to take climate change seriously and will not be prepared to adapt to the environmental and ecological changes that are occurring.

Option Design

Structure/design: This policy has four major components:

1. The Alaska Dept. of Education will identify climate change as a high-priority subject and include it in the State K-12 Science Content and Performance (Grade Level Expectations, GLEs) Standards and provide funding for the rapid development of GLEs and curricular materials that enable teachers to present this material effectively to students. Climate-Change curricula can be developed in-house at the Alaska Department of Education or could be developed by another entity/entities funded through state competitive grants.
2. The state will provide coordination among existing programs and entities that address climate-change education in Alaska's schools through an Alaska Dept. of Education environmental/climate change science educator. [At present no coordination exists; the state does not even have an environmental science educator on board, much less a climate change science educator.]
3. The state will provide funding to the University of Alaska to develop courses targeted at K-12 teachers and natural resource managers so these professionals have the training necessary to teach about climate change in Alaska. These courses will involve professionals in education and extension/outreach.
4. The state will provide funding to resource-management agencies (DOF, DFG, DEC) to develop materials and train personnel to effectively inform the public about the consequences of climate change for Alaska's natural resources and its residents.

Targets/goals: The goal of this policy is to include climate change as an integral component of formal and informal education and training of Alaskan residents so they can make wise choices about adapting to climate change.

Timing: This policy can be implemented immediately. We suggest that climate-change content based on a national Climate Science Literacy Guide be incorporated in the K-12 State Science Content Standards and Grade Level Expectations within one year, and that curricula and teaching materials be actively developed so these standards can be implemented in the public school system within two years.

The document on Climate Literacy: Essential Principles of Climate Science has been developed by federal science agencies including NOAA and NSF in collaboration with many individuals and the following science and education partners: American Association for the Advancement of Science Project 2061, American Meteorological Society, Association of Science-Technology Centers, College of Exploration, Cooperative Institute for Research in Environmental Sciences, Federation of Earth Science Information Partners, Lawrence Hall of Science, University of California, Berkeley, National Environmental Education Foundation, National Geographic Education Programs, North American Association For Environmental Education, TERC, Inc., GLOBE Program, National Center for

Atmospheric Research and University Corporation for Atmospheric Research This Climate Science Literacy Guide includes science concepts aligned with the National Science Education Standards and the AAAS Benchmarks for Science, and provides a framework for understanding and communicating about climate change and climate science for Individuals and communities. We suggest that university courses and in-service training in climate change be developed and implemented within one year, so K-12 teachers are prepared to teach about climate change within two years. We suggest that the University of Alaska also develop climate-change courses for resource managers within one year and that agencies prepare materials and strategies for public outreach about climate change within two years.

Participants/Parties involved: Departments of Education, Natural Resources (Divisions of Forestry and Agriculture), Fish and Game, and Environmental Conservation.

Evaluation: Implementation of the adopted policy in classrooms can be monitored and evaluated through formative and summative assessments administered by classroom teachers and/or by the Alaska State Dept of Education, e.g., including climate change in the statewide science test materials. Community surveys prior to and post education outreach to the general public may also be used.

Research and Data Needs: No research is required prior to implementing this option.

Implementation Mechanisms

To be completed.

Related Policies/Programs and Resources

Several organizations that have initiated efforts to integrate climate-change understanding into the educational program include the Center for Ocean Sciences Education, International Arctic Research Center, and the Alaska Sealife Center.

Feasibility

To be completed.

Adaptation Benefits and Costs

To be completed.

TWG Approval and Deliberations

The TWG did not rank this option along with the NS adaptation options, but reached consensus on the recommendation that the AAG include this cross-cutting option related to climate change education and outreach in its final recommendations to the sub-cabinet.