

I. Short and long-term research to understand ecosystem responses to climate change and consequences of potential management strategies (adaptation)

A. Data Integration

- *paleo and instrumental climate observation data, and localized climate projections*
- *ecosystem reference datasets (responses of communities, species, ecosystem processes at broad spatial scales)*
- *dynamic syntheses of best available data*
- *infrastructure to make this information readily available to a wide audience (e.g. NRIS).*

B. Vulnerability analyses

- *to guide other decisions such as monitoring and potential management actions*
- *Top down approach: vulnerability of community types to explore potential effects on species*
- *Hierarchical process: analysis of sensitivity of organisms and processes → list → value-based process → critical list of potential studies*

C. Selected Priority Research Topics

- 1) **Aquatic Systems** – *particularly cold water systems*
 - *How can water storage ability be increased using beaver?*
 - *What are the reactions of ecosystems to dewatering?*

- *What facilitates invasives?*
- *What are species tolerances and the effects of increasing water temperature?,*
- *What are the cascading effects of changes in lake ice-off dates and thermal structure?*
- *Which watersheds or streams are most susceptible to changes in temp and flow regimes?*
- *How will changing patterns of demand interact with climate change to impact aquatic systems?*

2) Alpine and Treeline Communities

- *What are Whitebark pine and other tree tolerances to fire, temperature and moisture, climate projections?*
- *What are the characteristics of a community in transition? What are the possible shifts and how do you manage for them?*
- *What are the observed characteristics of mortality and regeneration success of different tree or plant species?*
- *Need for high elevation climate monitoring to understand how snow input from high elevations contributes to streamflow,*

3) Snow

- *Need to research snow as a phenomenon and its implications for water availability*
- *How will soil moisture change across the landscape?*
- *What are cascading ecological changes in response to snow dynamics in the GYA?*

- *What is the actual contribution of persistent snow and ice to streamflow (baseflow)?*
- *Need for gauging stations on lower level streams*

4) Implications of large spatial changes in vegetation and ecotones along with cascading effects – biome shifts and sudden changes driven by extreme events

- *What are the interactions between climate change, land use change and ecosystem connectivity?*
- *What are the cascading effects on species dynamics (e.g. ungulates)?*
- *Long-term research on species and community responses (national parks can provide an ideal site),*
- *Establishment of long-term monitoring sites/plots to collect baseline data on plants and animals in areas where changes are expected.*

5) Disturbance Processes

- *what are the likely effects of projected climate on the frequency, distribution,*
- *magnitude and severity of key disturbance regimes in the GYA (drought, flood, fire, insects, pathogens, etc)?*
- *What are the effects on fire-insect interactions?*
- *What effects do management actions have on increasing/decreasing the likelihood of disturbance events?*

6) Monitoring

- *What should be monitored (and how, in a scientifically rigorous manner) to provide useful information management?*
- *Need question driven monitoring. Monitoring to document how systems respond to changes or disturbances to facilitate future projections (quick response monitoring to disturbance events).*

II. Research to provide decision support

- *Adaptive management*
- *Need targeted effort to understand the most important management needs*
- *What are the most important decisions facing managers related to climate change?*
- *Need to identify management choices – what is the range of potential management actions?*

III. Shared research needs: infrastructure, collaboration and science delivery

- *Create group to work together on high priority topics (e.g., high elevation communities, water availability, ungulate populations) using the best science and management*