WildREACH Workshop
Working Group Breakout Session Instructions

Sideboards and Assumptions

Geographic Scope: The geographic scope includes terrestrial and freshwater ecosystems from the crest of the Brooks Range northward. The boundary with the marine system is recognized as fuzzy; coastal processes are acknowledged to affect terrestrial and freshwater systems and *vice versa*. Processes that affect nearshore coastal environments may be considered for those species that cross ecosystem boundaries.

Priority Issues: It is recognized that climate change may influence organisms in multiple and complex ways. We intend to focus the discussion primarily on the following climate change effects:

1. Change in relative abundance and distribution of habitat types on the landscape.

2. Change in structural (including plant community structure) or physical characteristics of habitat.

3. Change in trophic systems, including primary and secondary productivity, phenology, and forage/prey availability.

The importance of other potential effects of climate change—such as competitive interactions, invasive species, prevalence of disease, and contaminants—are recognized, but are of secondary priority for this workshop.

Climate Scenarios: The Working Groups will use Climate Scenarios I and II as the premise for discussions (see Attachment A, also in Section 2 of Briefing Book materials).

Habitat Change: The hydrologic models (see Section 3) and ecosystem pathway models (see Section 5) provide a starting point for discussing the direction of change for habitat condition. Summaries are provided in Attachments B (Aquatic Ecotypes) and C (Terrestrial Ecotypes).

Working Group Breakout Session I (Monday afternoon)

The goals of this session are to:

- Identify species or species groups that are expected to be sensitive indicators of the changes hypothesized in the climate scenarios and ecosystem pathway models.
- For each species, develop hypotheses regarding positive or negative response to changes in the availability of habitat, based on knowledge of species' life histories and habitat requirements.
- For each species, identify specific parameters (e.g., distribution, abundance, demography, body condition, growth rate, etc.) that would be affected.

Groups should focus on landscape-level changes in habitat availability. Species should be selected for their value as indicators of climate change. Groups should NOT feel constrained to only those species or parameters that are easily measured. This breakout session is an opportunity for discussion on any and all species in the region that will be affected by climate change. Later in the workshop, we will consider feasibility issues when prioritizing the research and modeling needs that arise from the breakout group sessions. Refer to Section 6 in your Briefing Books for information on ecotypes and habitat models for birds (Figure 6.2), fish (Figure 6.3), and mammals (Figure 6.4). Groups will use a worksheet to track discussions and present the results in plenary (see Attachment D).

Working Group Breakout Session II (Tuesday morning)

The goal of this session is to refine draft conceptual models of climate effects on species, **including** processes that are not captured by habitat change models. Each Working Group will be presented with models drafted as a result of the scoping meetings; see Figures 7.1 and 7.2 for birds, Figure 7.3 for fish, and Figure 7.4 for mammals. Groups are encouraged to consider "reasonable worst-case scenarios," i.e., scenarios that are within the expected range of potential change AND would have the greatest magnitude effects, thus most detectable. For example:

- Birds: Trophic system shifts for consumers of invertebrates; coastal habitat availability.
- Mammals: Forage quantity and quality in summer; snow conditions, forage availability in winter.
- Fish: Stream system flow regimes; availability of river delta overwintering habitat.

Groups will have large poster-size hardcopies of the draft conceptual models to mark up and use in the breakout sessions, as appropriate. Each group will present in plenary conceptual model(s) ("box-and-arrow" diagram) illustrating processes thought to be most influential.

Working Group Breakout Session III (Tuesday afternoon)

The goal of this final breakout session is to review the products from the first two breakout sessions and identify **the most critical gaps in data and modeling needed to predict future habitats of arctic Alaska**. Gaps could be of at least two types:

- Models have not been constructed.
- Models exist but are not supported by adequate data.

Identified gaps should focus on the **underlying ecological and physical processes that may affect species in all three groups of interest (birds, fish, and mammals)**. The goal is to go beyond identification of data gaps for arctic species biology and refine our thinking of what is needed to gain predictive ability of the system-level physical processes and ecosystem functions.

Groups will use a matrix worksheet to identify the gaps, research approaches, species of relevance, and likely funding source (See Attachment E).

Breakout session results will form the core content for a five-year strategic plan that identifies the priority research, modeling, and synthesis activities needed to predict climate-related impacts to fish and wildlife populations in the Arctic.

Climate Scenarios

For the purpose of discussion, the workshop will consider two provisional climate change scenarios, consistent with projections based on a composite of the five best-performing General Circulation Models for the Arctic (Walsh et al 2008, http://www.snap.uaf.edu/about), based on the IPCC A1B scenario (IPCC 2007), an intermediate emissions scenario that assumes a steady increase in CO_2 emissions for several decades, followed by a gradual decline as more efficient technologies are implemented. Model outputs were applied to a baseline dataset consisting of a 2-km resolution PRISM (Parameter-elevation Regressions on Independent Slopes Model) grid of mean monthly temperature and precipitation data for the period 1961–1990. This effectively "down-scaled" the GCM output to a 2-km resolution. There is considerable uncertainty associated with the point estimates for projected temperature and precipitation, deriving from both within- and among-model variation.

Projected average temperature and precipitation values (The Wilderness Society, unpublished) for the decade 2075–2084 are presented in Table 2.1. Climate scenario II is most consistent with these projections. Although precipitation is forecast to increase, there is considerable uncertainty associated with this prediction, and therefore we have chosen to also consider Scenario I, in which precipitation remains constant.

I. Warming Temperatures, Precipitation Constant

Mean annual temperatures increase 5–6 °C by the year 2080. Warming is more pronounced in winter (7.6–8.6 °C) than in summer (2.5–2.9 °C), with the range representing variation among ecoregions. Growing season length is expected to increase at a rate of 1.3, 2.4, and 3.0 days per decade for the northern Brooks Range, Arctic Foothills, and Arctic Coastal Plain, respectively, with a skew toward greater change in the fall (Table 2.2).

II. Warming Temperatures, Precipitation Increase

Mean annual temperatures increase 5–6 °C by the year 2080. Warming is more pronounced in winter (7.6–8.6 °C) than in summer (2.5–2.9 °C), with the range representing variation among ecoregions. Mean annual precipitation increases by 22%, 35%, and 43% for the northern Brooks Range, Arctic Foothills, and Arctic Coastal Plain, respectively. Precipitation increase is more pronounced in winter (31–60%) than in summer (16–30%), with the range representing among-ecoregion variation that mirrors the pattern for annual precipitation. Change in growing season as in the above scenario.

Table 2.1. Projected magnitude of change from historic[1] values for temperature and precipitation, Year 2080, by ecoregion and season[2].

Ecoregion	Temperature (Δ °C)		
	Winter	Summer	Annual
Arctic Coastal Plain	8.6	2.5	6.1
Arctic Foothills	8.1	2.8	5.9
N. Brooks Range	7.6	2.9	5.6
	Precipitation (% increase)		
	Winter	Summer	Annual
Arctic Coastal Plain	60	30	43
Arctic Foothills	45	27	35
N. Brooks Range	31	16	22

2. Summer (growing-season) is calculated as the average of May through September. Winter is calculated as the average of October through March.

1. Baseline temperature and precipitation values are based on the Parameter-Elevation Regression on Independent Slopes Model (PRISM) dataset created by the PRISM Group (Oregon State University, www.prism.oregonstate.edu). These data consist of 12 gridded mean maximum temperature, mean minimum temperature, and total precipitation files at 2-km resolution, one for each month averaged over 1961–1990 for the state of Alaska. This dataset was created using observational data from weather stations across the state and spatially interpolated over Alaska using weighted regression incorporating elevation and terrain effects on climate (Daly et al. 2002, Simpson et al. 2005). We averaged the minimum and maximum temperature grids together to create a dataset of mean monthly temperatures.

Table 2.2. Modeled change in growing season, from 2010 to 2080, rounded to nearest day.

Ecoregion	Growing Season Length	Advance in First Date Above Freezing (Spring)	Delay in First Date Below Freezing (Fall)
Arctic Coastal Plain	21	5	16
Arctic Foothills	17	6	11
N. Brooks Range	15	6	9

References

IPCC. 2007. http://www.ipcc.ch/ipccreports/ar4-syr.htm

Walsh, J.E., Chapman, W.L., Romanovsky, V., Christensen, J.H. and Stendel, M. 2008. Global climate model performance over Alaska and Greenland. Journal of Climate.

Attachment B. Summary of Aquatic Ecotypes

Ecotype	**Climate Scenario I**	**Climate Scenario II**
Lowland Wet Sedge Tundra	○ Earlier water recharge in spring. ○ Less water available for plant growth ○ Increased rate of depletion of soil water. ○ Faster loss of surface water	○ Earlier water recharge in spring. ○ Less water available for plant growth unless increased precipitation compensates for projected increases in PET. ○ Faster loss of surface water unless compensated by increased precipitation.
Lacustrine Marsh (*Carex* and *Arctophila*)	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water ○ Lower mean water level	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water and lower mean water level. Water loss may be buffered by increases in precipitation.
Shallow Lake	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water ○ Lower mean water level	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water and lower mean water level. Water loss may be buffered by increases in precipitation.
Deep Lake	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water ○ Lower mean water level	○ Earlier water recharge in spring. ○ Earlier and faster loss of surface water and lower mean water level. Water loss may be buffered by increases in precipitation.
Riverine – Large Stream	○ Earlier spring snow melt leading to earlier peak streamflow. ○ Reduced peak streamflow because of increased water storage deficits of terrestrial habitats. ○ Increased base flow from suprapermafrost groundwater. ○ Reduced magnitude of peak flow following precipitation events (in Arctic Foothills Ecoregion).	○ Earlier spring snow melt leading to earlier peak streamflow. Timing changes may be offset by increased snowpack. ○ Increased peak streamflow from increased SWE. ○ Increased base flow from suprapermafrost groundwater. ○ Reduced magnitude of peak flow following precipitation events (in Arctic Foothills Ecoregion).

Riverine – Small Stream	○ Earlier spring snow melt leading to earlier peak streamflow. ○ Reduced peak streamflow because of increased water storage deficits of terrestrial habitats. ○ Increased base flow from suprapermafrost groundwater. ○ Reduced magnitude of peak flow following precipitation events (in Arctic Foothills Ecoregion).	○ Earlier spring snow melt leading to earlier peak streamflow. Timing changes may be offset by increased snowpack. ○ Increased peak streamflow from increased SWE. ○ Increased base flow from suprapermafrost groundwater. ○ Reduced magnitude of peak flow following precipitation events (in Arctic Foothills Ecoregion).
Coastal Water (Nearshore)	○ Earlier spring snow melt leading to earlier influx of freshwater. ○ Reduced volume of freshwater	○ Earlier spring snow melt leading to earlier influx of freshwater. ○ Increased volume of freshwater.

Attachment C. Summary of Terrestrial Ecotypes

Ecosystem type;	Increase	Decrease	In equilibrium
Coastal	Nearshore water	Lowland wet sedge tundra; Lowland moist sedge-shrub tundra; Upland tussock tundra;	Coastal Barrens (including salt-killed tundra); Coastal grass tundra; Coastal wet sedge tundra (saline); Coastal wet sedge tundra (brackish); Coastal dwarf shrub (willow)
Coastal Plain	Deep lakes; Shallow lakes, pits; Lacustrine grass meadows; Lowland bog meadows; Lowland low birch-willow shrub; Upland shrubby tussock tundra	Lowland wet sedge tundra; Lowland moist sedge-shrub tundra; Upland tussock tundra	Lacustrine grass marsh; Lacustrine barrens; Lacustrine sedge marsh; Lacustrine wet sedge tundra; Lacustrine low willow scrub
Riverine	Riverine tall alder-willow shrub; Riverine cottonwood forest; Riverine white spruce forest; Lowland bog meadow	Riverine moist tall willow shrub; Riverine moist sedge-shrub tundra; Riverine *Dryas* dwarf shrub; Lowland moist sedge-shrub tundra; Lowland wet sedge tundra;	Lower perennial river; Riverine barrens; Riverine grass marsh; Riverine low willow scrub; Riverine wet sedge tundra; Riverine lake; Upland dry tall willow shrub; Upland *Dryas* dwarf shrub; Upland low-birch-willow shrub; Upland crowberry dwarf shrub; Upland *Cassiope* dwarf shrub;
Upland	Deep thaw lakes; Lowland bog meadows; Wet sedge meadow; Lowland birch-willow shrub; Upland alder tall shrub (including alter-tussock)	Upland moist sedge-shrub tundra; Upland tussock tundra	Upland shrubby tussock tundra; Upland low birch-willow shrub; Upland *Dryas* dwarf shrub tundra (including ericaceous dwarf shrub, *Cassiope* dwarf shrub)

Attachment D. Worksheet for Working Group Breakout Session I (Monday afternoon)				
Species or Species Group	**Projected Change in Habitat Availability**	**Parameter** (e.g., distribution, growth rate, etc)	**Positive (+) or Negative (-) Effect**	**Rationale for Strong Response to Predicted Effect**
Red Phalarope and Pectoral Sandpiper	Less wet sedge tundra due to summer drying regime	Distribution, breeding density, breeding success	negative	Breeding habitat association with wet sedge tundra. Loss of habitat would limit distribution & abundance; lowered invertebrate productivity could reduce breeding success

Attachment E. Worksheet for Working Group Breakout Session III (Tuesday afternoon)				
Gap	**Data or Modeling?**	**Approach to Address Gap**	**Species of Relevance**	**Likely Funding Source**
Inadequate weather monitoring stations results in greater uncertainty in modeled precipitation projections.	Both	Install additional remote weather stations in strategic locations	All	Land management agencies, NSSI, industry?