North Slope

Rapid Ecoregional Assessment

Final Work Plan

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Rapid Ecoregional Assessments

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Acronyms that might be used in this document

ADF&G	Alaska Department of Fish & Game
AKGAP	Alaska Gap Analysis Program
AKNHP	Alaska Natural Heritage Program
ALFRESCO	Alaska Frame-based EcoSystem Code
AMT	Assessment Management Team
AWC	Anadromous Waters Catalog
BLM	Bureau of Land Management
CA	Change Agent
CE	Conservation Element
ESRI	Environmental Services Research Institute
GCM	Global Circulation Model
GIPL	Geophysical Institute Permafrost Lab
HUC	Hydrologic Unit Code
ISER	Institute of Social and Economic Research
LCM	Landscape Condition Model
MAGT	Mean Annual Ground Temperature
MQ	Management Question
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NOS REA	North Slope Rapid Ecological Assessment
REA	Rapid Ecoregional Assessment
SNAP	Scenarios Network for Alaska and Arctic Planning
Tech Team	Technical Team
TEK	Traditional Ecological Knowledge
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Introduction

The fundamental goal of BLM's Rapid Ecological Assessments (REAs) is to provide an understanding of the current ecological status of the conservation elements (CEs) in the ecoregion, which change agents (CAs) are impacting them and where, the potential future status of CEs in relation to future projections of CAs, and the ecological integrity of the ecoregion as a whole. Informed by the management information needs [management questions (MQs)] identified for the North Slope (NOS) Rapid Ecoregional Assessment (REA), geospatial assessments of the ecological status of CEs, the landscape integrity of the ecoregion, and other assessments of the relationships between CAs and the CEs will be conducted to meet this goal.

The NOS REA is being conducted as an assistance agreement between BLM-Alaska and the Alaska Natural Heritage Program (AKNHP), University of Alaska Anchorage, in cooperation with the Scenarios Network for Alaska & Arctic Planning (SNAP), University of Alaska Fairbanks, and the Institute for Social and Economic Research (ISER), University of Alaska Anchorage. The three aforementioned University of Alaska entities will be referred to collectively as the UA Team for the remainder of the document.

As a large, cross-jurisdictional landscape assessment, the NOS REA is guided and focused by two inter-agency teams led by the BLM. The Assessment Management Team (AMT), comprised of land managers from federal, state, and local agencies that have direct responsibilities in the NOS Ecoregion, provides overall guidance and direction for the development of the REA and ensures that procedures and products are consistent with project objectives. The Technical Team, comprised of technical experts from participating federal, state, and local land management agencies, provides technical and ecological guidance, direction, review, and recommendations for the development of the REA. The purpose of these interactions is to facilitate interagency collaboration, cooperation, and resource sharing between the BLM and the UA Team and other agencies/entities.

Prior to the development and presentation of this Work Plan, the UA team had numerous opportunities to interact with both the AMT and Technical Team to present preliminary products and provide the opportunity for review and comment on draft products that fulfilled reporting requirements for the Pre-Assessment, Phase I of the project. All products and meeting notes are posted on the AKNHP product website for the North Slope REA and can be accessed on-line: http://aknhp.uaa.alaska.edu/landscape-ecology/north-slope-rea/products/#content. To date, these briefings have included:

1. **Memorandum I: Management Questions, Conservation Elements, and Change Agents**
   - This memo provides a summary of the selection of MQs, CEs, and CAs. It also provides a synopsis of the ecological and socio-economic resources present in the NOS Ecoregion, outlines the reporting units for results, and describes the Conceptual Ecoregional Model.
   - Presented to AMT and Technical Team members in Fairbanks, June 27, 2013.

2. **Memorandum II: Data Discovery**
    - Within this memo we present the results of potential datasets to be used in the assessment (CE, CA, and MQ), evaluated the data for utility and quality, and identified potential data gaps.
    - Presented to the AMT and Technical Team, December 5, 2013.
3. **Memorandum II: Methods**
    - Within this memo, the UA Team identified, described, and recommended models, methods, and tools for characterizing CEs, CAs, and their interactions, including draft conceptual models, process models, and attributes and indicators tables.
    - Presented to the AMT in Fairbanks, February 28, 2014.

This document provides a general overview of the products, workflow and deliverables the University of Alaska team (UA team) proposes as part of the NOS REA, Phase II: Assessment. The REA Work Plan (REAWP) represents the final deliverable for Phase 1: Pre-Assessment of the NOS REA.

Given the rapid nature of this assessment, this document will not review the methods proposed for this REA. Proposed methodologies were presented to the AMT during a full-day methods workshop (December 5, 2013), and are summarized in Memorandum III, which this document will refer to (http://aknhp.uaa.alaska.edu/landscape-ecology/north-slope-rea/products/#content). The focus of this Work Plan is to provide an outline of how and when the UA team plans to complete key deliverables for the assessment, and what those deliverables will include.

This is a draft version of the NOS Work Plan document. The UA team is planning to meet with members of the BLM Alaska State Office and Fairbanks/Central Yukon Field Office on September 5, 2014, in Fairbanks, Alaska, to present this preliminary document. During that meeting we hope to finalize key decisions applicable to the development and finalization of the NOS Work Plan, which will be delivered no later than one month following the September meeting.

Data Management Plan

We will adhere to the BLM Data Management Plan (DMP) version 2 (Aug. 2012), that provides details required by BLM's National Operations Center (NOC), who will review and take ownership of the final data products. We will also follow advice provided by the NOC on data format, delivery and logistics. This means all products will be properly cataloged and have sufficient and informative metadata. Additionally, all spatial data will be contained in ArcMap documents, and will have a descriptive name and layer file, and will be compatible with ESRI software.

Workflow and Deliverables

The Workflow and Deliverables section is focused on documenting the steps and schedule to complete the **Assessment, Phase II : Tasks 5, 6, 7,** and **8** of the REA. **Task 5** involves the compilation and generation of "source" data sets (distribution models); **Task 6** represents the analysis of data to generate findings related to both MQs and the core REA analyses (where are CEs, CAs and their

intersection); **Task 7** includes the development of the preliminary results report; and **Task 8** focuses on preparation of the REA final documents and products.

As defined by BLM, "source" data sets are those data layers needed to spatially represent CEs, CAs, and other features (e.g., permafrost, high biodiversity) included in the assessment. In many cases, substantial spatial analysis is needed in order to develop the "source" data sets. Because the line between generating source data sets (Task 5) and conducting analyses to answer assessment questions (Task 6) is often fuzzy, we reference both "source" and "generated" datasets as products in the below tables.

The objectives of Task 7 and 8 are to consolidate the information and findings from the REA into several products. We will prepare a draft REA report that summarizes our findings and present this information to the Technical Team to receive feedback and direction prior to preparation of the final work product documents. We will incorporate comments on the draft report and prepare the final REA report (described in detail below), which will be presented at an AMT workshop. At this juncture, the AMT will have the opportunity to comment on the final REA products prior to delivery. Simultaneously, we will be delivering all spatial data products following guidelines provided in the BLM Data Management Plan.

Workflow

This Work Plan marks the transition between the pre-assessment Phase I (Tasks 1 to 4) and assessment, Phase II (Tasks 5 to 8) of the REA. Table 1 shows the workflow and timelines for the REA beginning with Phase I ,Task 4 (Draft and Final Work Plans) and continues until the end of Phase II (Prepare REA documents). The numbers in the "REA Workflow" column correspond to the task numbers shown in the REA schedule of deliverables (Table 2), which lists both deliverable and proposed meeting dates for the remainder of Phase I and all of Phase II.

Draft Product Review

Review of preliminary products by Technical Team and AMT members is essential to the REA process, and serves as a "gut-check" for our modeling efforts so that any glaring issues can be resolved before the formal presentation of the final results during the AMT 6 workshop (see Table 1). We propose a sequence of four update webinars/meetings to be held at the end of each task to provide the AMT and Technical Team members the opportunity to review and comment on draft products as they become progressively available. The purpose of each webinar/meeting and the associated goals are described below, and the proposed meeting schedule is included in Table 2.

1. **Distribution Models (Task 5):** the purpose of this meeting is to present preliminary results of the source datasets and distribution models for the individual CAs and CEs. Meetings will be structured as technical webinars that will be organized topically (e.g. abiotic CAs, coarse-filter CEs) and last approximately 1 - 2 hours in duration.
    - **Goal:** to obtain approval of source datasets and distribution models to allow the UA team to move forward with integrated analyses.

- **Target Audience:** Technical Team and topical experts

2. **Integrated Products (Task 6):** we will present preliminary review of draft integrated products (the results of the spatial intersections to the CA x CE analysis and management questions) during a web-based rolling review, with a one-hour webinar by topical leads to answer questions about the mapped outputs.
    - **Purpose:** the intent of the rolling review is to provide a quick first look at data products to ensure the analysis is going in a direction supported by the Technical Team and AMT. Due to the rapid nature of the assessment, the rolling review is also quite rapid and will require quick turnaround from all reviewers
    - **Goal:** to obtain approval of integrated products to allow the UA Team to move forward with interpretation of results and begin to develop REA documents and materials.
    - **Target Audience:** Technical Team
3. **Preliminary Results (Task 7)**: we will prepare a draft final report and present preliminary results to the Technical Team and AMT during a two day meeting. This will occur approximately 2 months before the final AMT meeting and final report delivery to allow us to incorporate comments into the final REA products.
    - **Goal:** to obtain approval of preliminary results to allow the UA Team to produce the final REA report (s).
    - **Target Audience:** AMT and Technical Team
4. **Final Results (Task 8):** the purpose of this meeting will be to showcase the final NOS REA products to the members of the AMT and Technical Team, during a half-day meeting.
    - **Goal:** to provide an opportunity for final, collective input from the Tech Team and AMT prior to report delivery.
    - **Target Audience:** AMT and Technical Team

Table 1. REA Workflow.

REA Workflow (August 2014 - June 2015)	2014					2015					
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
AMT Workshops and Webinars	**AMT 3**	**Webinar**			**AMT 4**			**AMT 5**		**AMT 6**	
Task 4: Prepare REA Work Plan	5										
Task 5: Compile and Generate Source Datasets (Distribution Models)		15-26									
Task 6: Conduct Analyses and Generate Findings (Integrated Products)					8-19						
Task 7: Preliminary Results								30			
Task 8: Prepare Rapid Ecoregional Assessment Documents and Final Report										25-29	

Numbers in red represent the anticipated date of deliverables, except in the case of AMT workshops where they represent the workshop number.

Table 2. Schedule of deliverables.

Phase I: Pre-Assessment	
Task/Deliverable	**Scheduled Completion/Delivery**
Task 4	**Prepare REA Work Plan**
Draft Work Plan to Arctic Field Office	29-Aug.-14
Work Plan Meeting	5-Sept.-14
BLM Comments to Contractor	12-Sept.-14
Final Work Plan	19-Sep-14
Phase II: Assessment	
Task/Deliverable	**Scheduled Completion/Delivery**
Task 5	**Compile and Generate Source Datasets (Distribution Models)**
Draft Results Webinars of distribution maps (1 – 2 hr per topic)	September 15-26, 2014
Task 6	**Conduct Analyses and Generate Findings (Integrated Products)**
Summarize Integrated Products via AKNHP Website	Week of November 17, 2014
Technical Team Review and comments to contractor (14 days following posting of materials on website)	5-Dec.-14
AMT 4 Webinars on posted products (1-hr q/a with topical leads)	December 8-19, 2014
Task 7	**Preliminary Results**
Draft Final Report to AMT	23-Mar.-15
AMT 5 Meeting (2 days)	30-Mar-15
AMT Comments to UA Team (14 days following AMT)	13-Apr-15
Test source data delivery to NOC	4-May-15
Task 8	**Prepare REA Documents and Final Results**
Updated Draft Final Report 2 to AMT	Week of May 18, 2015
AMT 6 Presentation (1/2 days)	Week of May 25, 2015
Workshop Summary	Week of June 1, 2015
Final REA Documents, Materials, and Datasets	30-Jun-15

Community Meetings to North Slope Planning Commission	**Scheduled Completion**
Barrow	30-Oct.-14
Barrow	28-May-15

Deliverables

Reporting Units and Scale

Reporting units for this analysis will be at the landscape level in scale and intent. The BLM has specified that results should be reported at the 5th level 10-digit hydrologic unit code (HUC), and that raw data should be provided at 30 m (or some derivative of 30 m) grid cell resolution or other native resolution as appropriate. Given the resolution of most available data in Alaska, raw data will be provided at 60 m grid cell resolution, when possible, and results will be reported at the 5th level HUCs, when appropriate. Exceptions include climate data, which are only available at a 771 m grid cell resolution. The 771 m grid cell resolution for climate data was proposed and accepted by the Technical Team during the NOS REA Data Discovery webinar.

We also plan to summarize climate data by terrestrial subregion, as defined by The Nature Conservancy (Figure 1). This level of analysis was not presented during the Data Discovery Webinar, and we are seeking approval for it now. The main reason that we are interested in having the climate data products summarized by subregions is that vegetation and permafrost are inherently linked to landscape position, and we expect that changes to active layer and the resultant impact on vegetation will differ by subregions across the REA. Having climate and active layer data summarized by subregion will allow for a more direct translation of the results to the landscape.

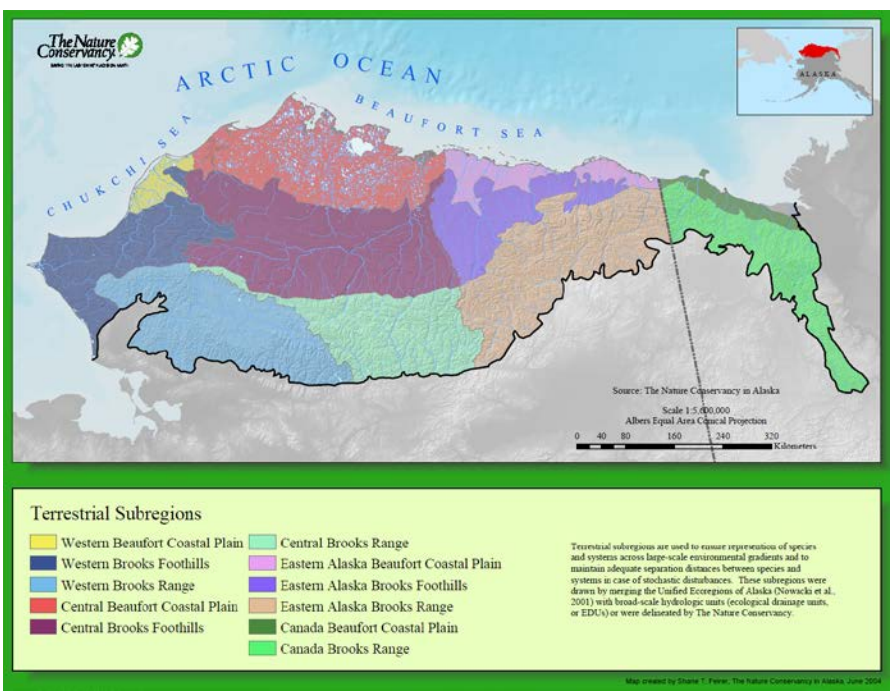

Figure 1: Terrestrial Subregions used to summarize climate and fire data for the North Slope REA.

Furthermore, BLM is strongly supporting landscape context as part of their Assessment, Inventory, and Monitoring (AIM) Program. The classification that AKNHP developed for AIM for the purpose of sample

stratification in NPR-A was closely linked to landscape process and ecoregion. Our understanding is that the coarse filter terrestrial CEs selected for the REA should be consistent with the landscape units that were defined for the AIM NPRA project, and summarizing results by ecoregion would help retain this consistency.

At the Work Plan meeting, it was suggested that in addition to the proposed analyses units referenced above, we should consider tailoring the REA deliverables so that they are relevant to the North Slope. In response, we agreed to work with BLM to summarize and deliver data at meaningful landscape units.

Final Proposed Products

To address regionally important questions, significant ecological resources and change agents, REAs focus on three primary elements:

- Change Agents (CAs), which are those features or phenomena that have the potential to affect the size, condition, and landscape context of ecological systems and components.
- Conservation Elements (CEs), which are biotic constituents or abiotic factors of regional importance in major ecosystems and habitats that can serve as surrogates for ecological condition across the ecoregion.
- Management questions (MQs), which are regionally specific questions developed by land managers that identify important management issues.

The CE and CA framework is synonymous with the core analysis of the REA. The "core analysis" refers to the status and distribution of CEs and CAs and the intersection of the two. The core REA analysis addresses the following five questions:

1. Where are conservation elements currently?
2. Where are conservation elements predicted to be in the future?
3. Where are change agents currently?
4. How might change agents change in the future?
5. What is the overlap between conservation elements and change agents now and in the future?

A total of 24 CEs and 5 CAs were selected for and approved by the AMT for the NOS REA. In addition to the core questions that are applied to all CEs and CAs, 20 specific MQs were also selected for this assessment (see Memorandum I).

Below we present a comprehensive list of prospective data products that will be generated for the NOS REA for the individual CEs and CAs, for the integrated CE x CA analysis, and for each of the MQs. We propose addressing each MQ using the CE and CA framework. We present our products list so that it reflects the relationship between the CEs/CAs and the MQs; therefore, you will find specific products related to each MQ nested within the specific CE or CA section that the MQ (s) is most closely aligned with.

Conservation Elements

Terrestrial Coarse-filter CEs

Terrestrial Coarse-filter CEs are defined as regionally important Biophysical Settings (BpS) that represent the characteristic vegetation assemblages, succession, and dominant ecological patterns of the North Slope Ecoregion. They adequately address the habitat requirements of most characteristic native species, ecological functions, and ecosystem services. A total of 9 Biophysical Settings within five different physiographic categories were selected as representative Terrestrial Coarse-filter CEs for this assessment (Table 3).

Table 3: List of Terrestrial Coarse-filter CEs (defined by Biophysical Settings) by physiographic regions for the North Slope Rapid Ecological Assessment.

Physiography	Biophysical Setting
Coast:	1. Tidal Marsh BpS
	2. Marine Beach, Spit, and Barrier Island BpS
Coastal Plain:	3. Coastal Plain Wetland BpS
	4. Coastal Plain Moist tundra BpS
	5. Sand Sheet Wetland BpS
	6. Sand Sheet Moist Tundra BpS
Foothills:	7. Foothills Tussock Tundra BpS
Alpine:	8. Alpine Dwarf Shrub BpS
Floodplains:	9. Floodplain Shrubland BpS

For each of these coarse-filter CEs, we propose the following list of data products which will be developed and delivered as part of the core analysis :

- Conceptual Model
- Current Distribution Map
    - Developed and delivered at 30 m resolution
- Current Status
    - Intersection of current distribution and landscape condition
- Future Status
    - Intersection of current distribution and future landscape condition (2025 & 2060).

In addition, we will be addressing the following Management Questions related to these CEs: TC1 and TC4 (Table 4).

Table 4. Management questions for the Terrestrial Coarse-Filter CEs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Format	Comments
TC 1	What are the impacts of oil/gas development (i.e. gravel pad and road construction; pipeline construction) on vegetation and hydrology? (Known impacts include burial, dust, saline runoff and altered soil moisture.)	Spatial model and literature review	Spatial component will include an overlay of footprint on the CE distribution.
TC 4	What are the expected changes to habitat as a result of coastal erosion and coastal salinization?	Literature review	We will review current studies and compile available information documenting coastal erosion and inundation. For study sites at which specific rates of erosion have been defined, we will be able to project the impact of coastal bluff erosion at 25 and 50 years.

Aquatic Coarse-filter CEs

Four habitat types were selected as Aquatic Coarse-Filter CEs the North Slope Rapid Ecological Assessment:

1. large streams
2. small streams
3. deep connected lakes
4. shallow connected lakes

The NOS lacks an aquatic habitat classification map necessary to define Aquatic Coarse-Filter CEs by habitat and to develop distribution models. Thus, the Aquatic Coarse-Filter CEs were identified as a **data gap**. The limitations of this mapping effort were summarized in Memorandum III: Methods.

For each of the Aquatic Coarse-Filter CEs, we propose the following list data products which will be developed and delivered as part of the core analysis:

- Conceptual Model
    - We plan to develop conceptual models at a level of detail such that they include drivers and effects that are specific to a stream or lake type, although that will limit their generality to the mapped spatial distributions. Examples include temperature effects on shallow lakes or expected changes in hydrology to small streams.
- Current Distribution Map
    - We plan to develop distribution maps for both shallow and deep connected lakes at 60m resolution, but we do not anticipate being able to develop distribution maps for

large and small streams due to the poor quality Digital Elevation Model (DEM) that is available for the NOS REA.

- Current Status
  - Intersection of current distribution and landscape condition –summarized for each 5th level HUC .
- Future Status
  - Intersection of current distribution and future landscape condition (2025 & 2060)

In addition, we will be addressing the following Management Questions related to the Aquatic Coarse-Filter CEs: AC1, AC2 (Table 5).

Table 5. Management questions for the Aquatic Coarse-Filter CEs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Format	Comments
AC 1	How does water withdrawal from lakes for oil and gas activities (year-round industrial and domestic use and winter operations) affect lake water quantity and water quality, outflow/stream connectivity, and down-basin stream habitat?	literature review	A large majority of the industrial activities on the North Slope acquire Temporary Water Use Permits from the State of Alaska. This data is not geocoded nor in a queryable format, thus we do not have access to an organized database that would allow us to spatially represent lakes being used for oil and gas activities. This question will be answered with a literature review.
AC 2	How does oil and gas infrastructure (e.g. roads, pads, pipeline), both permanent and temporary, affect fish habitat, fish distribution, and fish movements?	spatial and literature review	Lake distribution maps and fish occurrence maps will be overlaid with oil and gas infrastructure map; fish movement data are considered a data gap; effects of oil and gas infrastructure on fish habitats and distribution will be answered with a literature review.

Terrestrial Fine-filter CEs

Seven vertebrate species were selected as Terrestrial Fine-filter CEs for the North Slope REA. These include:

1. Caribou (*Rangifer tarandus*)
2. Nearctic brown lemming (*Dicrostonyx trimucronatus*)
3. Arctic fox (*Vulpes lagopus*)
4. Lapland longspur (*Calcarius lapponicus*)
5. Raptor assemblage
6. Willow ptarmigan (*Lagopus lagopus*)
7. Greater white-fronted goose (*Anser albifrons*)

For each of the terrestrial fine-filter CEs, we propose the following list of data products which will be developed and delivered as part of the core analysis :

- Conceptual Model
- Current Distribution Map
    - Developed and delivered at 60 m resolution
- Intersection of Current Distribution Map with CAs (current, near-term and long-term)
    - Summarized for each CA and delivered in tabular format
    - Specific maps will be developed and delivered only for those CE x CA relationships that are biologically meaningful (identified through the conceptual model and assessment of attributes and indicators) at 60 m resolution
- Current Status
    - Intersection of Current Distribution Map and the sum of all indicators identified as meaningful to the CE. For specific details see Memorandum III.
    - Developed and delivered at 60 m resolution
- Future Status
    - Intersection of *Current Distribution Map* and future status of CA indicators (2025 & 2060)
    - Note: we will not be predicting future distributions of the Fine-filter CEs, only comparing them to near-and long-term models of CAs to identify potential for future changes in within the species known range.

In addition, we will be addressing the following Management Questions related to these CEs: TF1, TF2, TF3, TF4 (Table 6).

Table 6. Management questions for the Terrestrial Fine-Filter CEs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Format	Comments
TF 1	What are the baseline data for the species composition, numbers of individuals, vegetation type used, and change in numbers/species composition of landbirds and their habitat over time?	Spatial model	Based on discussions with the AMT, we will assemble baseline occurrence data to answer the first half of this question. Assessing changes over time were deemed beyond the scope of the REA.
TF 2	What are caribou preferences for vegetation communities? Where do these vegetation communities exist?	Spatial model	We will produce 2 products for this analysis: summer and winter vegetation maps.
TF 4	What are caribou seasonal distribution and movement patterns and how are they related to season and weather?	Spatial model and literature review	Assessment of movement patterns may be hindered by lack of available radio-collar data. If unavailable, will substitute with available polygon maps digitized from published reports.

Aquatic Fine-filter CEs

Five species were selected as Aquatic Fine-Filter CEs and approved by the AMT during the AMT I Workshop. These include:

1. broad whitefish (*Coregonus nasus*)
2. Dolly Varden (*Salvelinus malma*)
3. chum salmon (*Oncorhynchus keta*)
4. arctic grayling (*Thymallus arcticus*)
5. burbot (*Lota lota*)

Existing spatial data that would enable us to map the distribution of the five selected Aquatic Fine-Filter CEs is extremely limited. The most comprehensive datasets for anadromous fish is the ADF&G Anadromous Waters Catalog, and for resident fishes is the ADF&G Freshwater Fish Inventory. Both of these datasets are extremely data poor for the NOS study area, to a point that we are not able to accurately produce even occurrence maps. As such, we were originally considering classifying the Aquatic Fine-Filter CEs as a data gap.

More recently, we have been working closely with BLM Fisheries Biologists, Matthew Whittman and Matt Varner, to devise an alternative data product that would help forward our knowledge of the distribution of these five Aquatic Fine-Filter CEs, while still adhering to the objectives and goals of the REA. We are proposing a new approach to addressing the data gaps associated with the Aquatic Fine-Filter CE's for the NOS REA, as follow:

- Occurrence data do exist for the five Aquatic Fine-Filter CEs, however most of these data are presently available only in non-digitized format (e.g., hardcopies, inventory reports, unpublished data, etc.).
- We propose to assist Matthew Whittman and Matt Varner with their efforts to enter tabular data into the geodatabase "RipFish" that has already been developed by BLM.
- Our contribution to this database will serve as a final product for the Aquatics Fine-Filter CEs and will allow managers to readily have access to fish distribution data.
- As a metric of our success, we will produce maps of known occurrences before data entry into RipFish and after data entry is completed.
- We will use the data structure of the Anadromous Waters Catalog and Alaska Freshwater Fish Inventory, so this information could eventually be incorporated into the ADF&G datasets and enable broader public availability of these data.

Because the majority of our efforts for the Aquatic Fine-Filter CEs will be focused on entering tabular data into the RipFish database, we do not intend to produce distribution models for the individual CEs. As a result, we will not be able to produce all the required data products that result from the core analysis. However, we will produce:

- Conceptual Models for each CE

- Change Agent layers (both climate and development) that can be used in future analyses of fish distribution, and will be delivered as spatial data layers. These were identified in the attributes and indicators table and can be found in Memorandum III: Methods.

In addition, we will be addressing the following Management Questions related to these CEs: AF1, AF2, and AT3 (Table 7).

Table 7. Management questions for the Aquatic Fine-Filter CEs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Format	Comments
AF1	What are baseline characteristics and trends in fish habitat (lakes and streams), fish distribution, and fish movements?	Literature review	We will answer the baseline characteristics through literature review; distribution will partially be answered through the entry of occurrence data into the RipFish Database; movements will be considered a data gap.
AF2	What are the measurable and perceived impacts of development on subsistence harvest of fish?	Spatial model and literature review	Measureable impacts will result in map of current subsistence use areas that overlay with developed areas; perceived impacts will be presented as a literature synthesis.
AT3	What additional contaminants baseline data are needed for fish, birds, marine and terrestrial species, particularly those that affect the health and safety of subsistence foods?	Literature review	In addition to literature review, we will provide an assessment of pathways of contamination. Available data will be assessed for extent and quality.

Change Agents

Change agents (CAs) are those features or phenomena that have the potential to affect the size, condition, and landscape context of Conservation Elements (CEs). Change Agents in the region are broadly organized as:

- Climate Change (Abiotic)
- Wildfire (Abiotic)
- Invasive Species (Biotic)
- Anthropogenic Uses (Anthropogenic)

Abiotic CAs

Abiotic change agents were retained as described in the methods document. We intend to provide modeled outputs for 10 climatic variables (Table 8). These will be delivered as standalone products and

for use in further analyses to describe their relationship with the various CEs. As described in the methods document, this project will focus on the A2 emissions scenario. Decadal averages will be used, as opposed to data for single years, in order to reduce error due to the stochastic nature of GCM outputs, which mimic the true inter-annual variability of climate. Thus, the project will use climate data for the 2020s rather than just 2025, and the 2060s rather than the single year 2060.

Table 8. List of Abiotic CAs by metric.

Climate Change – Precipitation (summer and winter, seasonally)	Climate Change – Monthly Snow Day Fraction
Climate Change – Temperature (hottest and coldest months)	Fire - Return Interval
Climate Change - Thaw Date	Fire - Vegetation Response
Climate Change - Freeze Date	Permafrost - Ground Temperature at one meter depth
Climate Change - Cliomes	Permafrost - Active Layer Thickness

For each of these change agents, we propose the following list of data products which will be developed and delivered as part of the core analysis :

- Current distribution
- Near-term distribution (2020s)
- Long-term distribution (2060s)

In addition, we will be addressing the following Management Questions related to abiotic CAs: AB1, AB2, TC2, TC3 (Table 9).

Table 9. Management questions for the Abiotic CAs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Product Type	Comments
AB 1	Is the fire regime changing on the North Slope and what is the likely future fire regime (or range of regimes) based on climate projections and current knowledge of the relationships between climate and fire?	Spatial model	These outputs will, hopefully, include not only frequency but also vegetation shifts post fire.
AB 2	How will permafrost change spatially and temporally over the next two decades?	Spatial model	Outputs are at 2 km resolution.
TC2	What are the changes in habitat and vegetation related to changing	Spatial model and literature	Literature will be reviewed to summarize the types of vegetation change associated with

	permafrost conditions, and what will these changes mean to wildlife and habitats?	review	changes in active layer thickness, permafrost thaw, and associated changes in drainage. Where applicable, these changes will be discussed spatially and predictively in relation to spatial outputs from permafrost modeling efforts. We will attempt to summarize permafrost changes by Torre's Eco Landscapes—we will do some aggregating of units to better match the CE boundaries. The success of this method will depend on the resolution of the permafrost/ground temp model. If the permafrost model is too general, then we will just have a literature review.
TC3	How will changes in precipitation, evapotranspiration, and active layer depth alter summer surface water availability in shallow-water and mesic/wet tundra habitats and how reliable are these projections?	Spatial model and literature review	We will review the literature linking these abiotic variables, and, where possible, create linkages between known relationships and modeled outputs from precipitation and permafrost models. We will discuss the reliability of these models, as well as the lack of reliability of evapotranspiration models. The complexity of these interactions at very fine scales may hamper accurate spatial modeling.
TC5	How is climate change affecting the timing of snow melt and snow onset, spring breakup and green-up, and growing season length?	Spatial model and literature review	Based on climate model outputs from SNAP, literature review, and remote sensing data pertaining to the timing of snow onset, snow melt, and green-up, we will attempt to quantitatively and spatially answer this question with regard to recent trends and future projections.

Biotic CAs

Invasive species is the only biotic change agent that will be addressed in this assessment. While much of Alaska, including the North Slope, has not witnessed dramatic impacts of invasive species in natural systems, they are increasing in abundance, distribution, and economic harm. For this CA, we propose the following list of deliverables:

- Current distribution
- Predicted potential distribution (2060)
    - Invasion vulnerability maps will be estimated using the 2060 predicted growing season length, mean annual temperature, mean July temperature, and identifying which species are currently associated with those values (described in Methods document).
    - Levels of invasion vulnerability will be delineated as : those in which no known invasive species are expected to occur; areas in which the climate is suitable for a small cohort

(<10 species) of weakly to modestly invasive non-native species may occur; areas in which climate is suitable for a larger cohort (>10 species); and areas in which the climate is suitable for one or more species considered moderately to highly invasive.

There are no Management Questions related to the biotic CAs.

Anthropogenic CAs

Anthropogenic CAs were retained from the methods memo (Table 10). A map of the current human footprint will be the primary data product for the anthropogenic CAs. The source data obtained for this project to develop the current human footprint layer will be shared with the NSSI Scenarios Project, which they will use to develop the future human footprint for the North Slope, and that we will incorporate for use in the core REA analysis.

For the human foot print CAs we separated them into two classes to separate linear and point\polygon features: Anthropogenic – Permanent Block Features (Buildings, mines, etc.) and Anthropogenic – Permanent Linear Features (Roads. Rivers, etc.).

Several MQs require a review of primary source documents such as meeting minutes. In some cases, review of gray literature may be the only available method. Where accessible and available, primary source documents will be obtained and analyzed to answer questions. Gray literature may include reports from various sources such as Alaska Department of Fish and Game or the North Slope Borough.

Table 10. List of Anthropogenic CAs.

Transportation and Communication Infrastructure
Energy Development
Subsistence
Natural Resource Extraction
Recreation

For each of these change agents, we propose the following list of data products which will be developed and delivered as part of the core analysis:

- Current distribution
- Future distributions (2025 and 2060): We intend to produce future distributions for two points in time – Near Term Distribution (2025) and Long-Term Distribution (2060). However, given the lack of clear direction in future policy and adequate past data, it may not be feasible to produce meaningful products for these time horizons.

In addition, we will be addressing the following Management Questions related to anthropogenic CAs: AP1, AP2, AT1, AT2, TF3 (Table 11).

Table 11. Management questions for the Anthropogenic CAs, the anticipated format of the final data product (s), and additional comments.

MQ #	Management Question	Data Product Type	Comments
AP1	What physical and perceptual limitations to access to subsistence resources by local residents are caused by oil/gas activities?	Spatial and literature review	Physical limitations will result in a spatial product; perceptual limitations are based on review and analysis of minutes from various meetings, and some gray literature.
AP2	How are oil, gas, and mineral development on the North Slope impacting near- and far-field air quality, with particular emphasis on communities and "sensitive class 2" areas such as ANWR, Gates, Noatak?	Database, non-spatial model	A comprehensive data review, literature review, and model review will be assembled in a relational database.
AT1	What parameters can help measure impacts from anthropogenic activities independently of natural cycles and vice versa?	Spatial	
AT2	What potential impacts will oil/gas exploration and development have on CE habitat?	Literature review	Literature will be reviewed to identify methods used to assess impacts, and recognized impacts of individual anthropogenic activities on each CE will be documented.
TF3	What are the measurable and perceived impacts of development on subsistence harvest of caribou?	Spatial and literature review	Measureable impacts will result in map of current subsistence use areas that intersect with developed areas; Subsistence use areas may be compiled from spatial data available from ADF&G. These data require substantial processing and the AMT will be kept informed of the progress on this work. Perceived impacts will be identified from review of primary source documents (e.g., minutes of meetings involving resident subsistence users) and secondary documents that include such information.

Integrated Products

Landscape Integrity

Ecological *integrity* was originally proposed in the scope of work provided by the BLM. However, based on conversations with, and approval by, the AMT during the Methods Workshop, we intend to model "Landscape Integrity" in place of ecological integrity. This will enable us to provide a measure of how contiguous the landscape is (i.e. the fragmentation of an ecosystem).

We propose the following list of **integrated products,** which will be developed as part of the core analysis:

1. Landscape condition model (LCM)
    a. Combined impact of human development and invasive species on overall condition
    b. Used to assess CE status
    c. Developed for current, near, and long-term time periods
    d. Developed and delivered at 60m resolution, summarized at 5th level HUC
2. Landscape integrity
    a. Assessment of large intact blocks
    b. Developed for current, near, and long-term time periods
3. Cumulative Climate Impacts
    a. Measure of the magnitude of climate change, derived from the AK Cliomes analysis
    b. Developed for near and long-term time periods
    c. Summarized at 5th level HUC
4. Cumulative Human Impacts
    a. Sum of all human-derived impacts in the future (2025 & 2060)
    b. Summarized at 5th-level HUC

Final Report

After all the REA products have been reviewed and accepted by the Tech Team and AMT, we will summarize all the results into a final report, which will be partitioned into two distinct documents. The first document will be a **Summary Report** that outlines the key findings of the North Slope REA. The second document will be a **Technical Supplement**, which is intended for readers with interest and expertise in the various components of the REA and who want to understand more specific details regarding methods, results, applications, limitations, and data gaps than are provided in the Summery Report.

At a minimum, the following information will be included in the final summary documents:

- Summary
- Introduction, including description of the ecoregional assessment process
- Ecoregional resource concerns and MQs
- Brief summary of the methodologies used in the investigation

- Summary of ecoregion conditions regarding CEs and CAs
- Results and findings of output products regarding status and potential for change
- Specific answers to MQs
- An appendix listing all the data gaps encountered throughout the course of the data discovery and analysis.

The final report will be accompanied by an AMT meeting to review and discuss all the findings of this REA. The draft final report will be made available by early May 2015, followed by an AMT in mid-May. The final report will be provided to the BLM by June 30, 2015.

References

BLM REA DMP. 2012. Bureau of Land Management Rapid Ecoregional Assessment Data Management Plan. Version 2. Division of Resource Services, National Operations Center, Bureau of Land Management, U.S. Department of the Interior. Denver, CO. 44 pp.