

**2008
Caribou Modified Response Plan**

Southeast Fire Centre



**GIS 492
Work Portfolio Report**

Bachelor's Global Information Systems
Selkirk College

Submitted by: Crystal Krefting
Date: August 27, 2008

Table of Contents

Executive Summary.....	3
Introduction.....	3
Background.....	4
Priority Caribou Habitat Data (SARCO/ILMB).....	4
Modified Response (Protection Branch, SEFC).....	5
Modified Response Data (GIS department, SEFC).....	6
Arc Catalog.....	6
Arc Map.....	6
Arc Toolbox.....	7
Modified & Full Response Data (BC Parks).....	7
Map Products (SEFC).....	7
Analyses.....	8
Conclusions.....	9
References.....	11
Appendix.....	12

2008 Caribou Modified Response Plan

Southeast Fire Centre

Executive Summary

With mountain caribou numbers dangerously dwindling, a group called the Species at Risk Coordination Office (SARCO) from the Ministry of Environment (MoE), has created and initiated recovery strategies that require negotiations and cooperation amongst government ministries and other stakeholders. Among these groups is the Protection Branch of the Ministry of Forests (MoF), which is responsible for wildfire suppression on both crown and private land. Because of a lack of resources, some fires are left to naturally burn off if they do not threaten values such as communities, tree plantations, wildlife areas, and parks. These areas are known as modified response; they are monitored and given a Fire Analysis Strategy (FAS) in the event fire suppression is required. With the new initiatives of SARCO to protect areas that have been deemed as critical habitat for mountain caribou, some of the areas that have historically been managed as modified response by the Protection Branch, must now be allocated all available fire suppression resources until the fire is declared out.

A Mountain Caribou Science Team has identified priority caribou habitat within the SEFC, which allows Fire Protection Officers to make informed decisions as to the type of fire suppression activity required for these newly designated areas. Many of the areas that are treated as modified response in the SEFC are identified from historical knowledge and years of experience within the Protection Branch. Because of heightened activity during fire season, a visual aid was required which would allow Forest Protection Officers the necessary assistance to make quick decisions as to the type of fire suppression required when fire occurs. The product created is the focus of the report, and compiles the work of three different branches of government. The project focuses primarily on the processes used to create the GIS data created for the SEFC, which involved digitizing polygons to represent the modified response areas. The report concludes by explaining the present and future functions of the map products created for the SEFC.

Introduction

The *2008 Caribou Modified Response Plan*, is written for audiences that have a basic understanding of GIS and ESRI's program Arc Map. This report focuses on the role that the Protection Branch, specifically the SEFC, is taking in response to the province of BC's initiative to increase mountain caribou population numbers. This role involves the SEFC increasing fire suppression activity in areas that have been identified as critical caribou habitat, so as to help maintain these areas and the connectivity between them.

I will begin the report by giving a brief background of the project that has begun to implement the caribou habitat planning within BC, specifically a GIS project that prioritizes caribou habitat. I will go on to discuss how the SEFC is going to use the priority habitat polygons as a reference tool for making decisions regarding fire suppression activity in areas historically managed as modified response. The body of the report will describe the process of how the modified response areas were converted from historical knowledge from the Forest Protection Officers, into a GIS layer that can be visualized on a map. I will also discuss how this GIS layer was used to create a product that could be used by the SEFC as a tool to help make decisions regarding fire suppression in priority caribou habitat. In my conclusion I will look at the potential application for this product by running an analysis that examines the 2008 fire season thus far (Jan.1/08 to Aug.14/08); looking at how many fires occurred within the overlapping areas of priority 1 habitat and historical modified response.

Background

In 2004, the Species at Risk Coordination Office (SARCO) was established within the Ministry of Environment (MoE) in BC to provide recommendations to the province in regards addressing species at risk and how to implement recovery planning. These planning initiatives aim to be science-based, creating a credible program for successfully increasing population numbers. One of the species allocated to SARCO, was the Mountain Caribou, with population numbers plummeting since 1995, aggressive recovery strategies are needed to prevent extirpation of the Southern BC herds. In 2005, a 14 member Mountain Caribou Science Team was created by SARCO to identify potential management activities that would help recover population numbers. A *Draft Mountain Caribou Recovery Strategy* was released by the group in 2006; the plan outlines initiatives to help increase population numbers over a duration of time. In 2007, the BC Provincial Government announced their support for implementation of the plan. The plan consists of 5 *Caribou Habitat Planning Units*, including Revelstoke/Shuswap, Wells Gary North Thompson, Caribou Chilcotin, Prince George, and Kootenay.

One of the key habitat requirements recognized by the *Mountain Caribou Recovery Strategy* was the caribou's strong dependence on lichens for winter food. In forest systems that are not managed by forestry operations, the frequency and pattern of wildfire is a dominant factor in determining forest health and ecological succession; including the distribution and quantity of lichens. Because of fire suppression practices in the past, the province of BC has seen a shift in these forest ecosystems because of the removal of wildfires from many forest types that historically have depended on them to maintain forest health. The mountain pine beetle has caused an epidemic in BC's forests, and because of the additional fuel loading occurring in these dead and dying forests, caribou herds relying on the Pine-Lichen habitats are in jeopardy of losing this habitat to salvage-forestry operations and to wildfire. Not only does harvesting and wildfire remove lichen bearing trees, but these stand-replacing events return the forests back to an early seral stage, conditions which increase other ungulate species, thus increasing the predator populations.

Part of the *Mountain Caribou Recovery Strategy* is to increase caribou populations by increasing fire suppression resources in areas determined to be critical caribou habitat, in order to minimize further losses to habitat and connectivity corridors. Because of the minimal fire suppression resources throughout the province, it is necessary to provide reference information to the Protection Branch indicating the areas that are most critical to caribou populations, so resources can be prioritized. It has also been suggested that a caribou-herd specialist be available to Protection staff during fire season, so that expert advice can be given to help guide decision making. This project, which was initiated by the Protection Branch at the beginning of the 2008 fire season, has been named the *Priority Response System*.

Priority Caribou Habitat Data (SARCO/ILMB)

The goal set out by the *Mountain Caribou Recovery Strategy* was for caribou herd experts to prioritize areas that are deemed critical for caribou populations before the 2008 fire season, and to provide spatial representation of these areas to the Protection Branch for referencing. These areas were assigned because of a variety of criteria determined to be key characteristics for mountain caribou habitat, including slope, elevation, BEC (Biogeoclimatic Ecosystem Classification), and VRI (Vegetation Resource Information) data. Other objectives included connecting these habitat polygons to avoid fragmentation the landscape, and also to account for current land licensee holders (forestry, recreation) so as to avoid causing detrimental social and economic losses. It involved negotiation and a "swapping of land" between a broad range of stake holders and government ministries.

Contractors specializing in GIS services were hired to do slope and elevation analyses. These projects were turned over the Integrated Land Management Bureau (ILMB) when funds for the contractors ran out. The project took approximately 7 months in total, and as a result, priority caribou habitat polygons were designated and classified as priority 1, 2, and 3; priority 1 habitat polygons being the most critical. The priorities were defined as:

- 1) *The 1/3 of caribou habitat where stand consuming wildfire is most to be avoided.*
- 2) *The next 1/3 of caribou habitat where stand consuming wildfires are to be avoided.*
- 3) *The remaining 1/3 of caribou habitat.*

It was noted in the report that all three areas were considered to be important habitat, but were prioritized to provide reference to the Protection Branch when there were limited fire suppression resources available and decisions had to be made for allocating resources.

Modified Response (Protection Branch, SEFC)

The Southeast Fire Centre (SEFC) is one of six fire centres which covers the province of BC, and manages approximately 7 million hectares of land in the south east corner (see figure 1). The SEFC is typically the busiest fire centre in the province, and it is therefore necessary to prioritize fire suppression resources. Fires that are located at high elevation and encompass no property, timber, or recreation values are sometimes left to naturally burn so resources can be allocated to higher priority fires. These fires are called *modified response*, and while they are left to burn, they are given a Fire Analysis Strategy (FAS), which is a plan outlining the strategy and resources required to fight the fire in the event that it threatens other values. The areas that have historically been treated as modified response areas are also the areas that tend to be valuable caribou habitat (high elevation and little to no development). Part of testing the new priority response system during the 2008 fire season has required that the SEFC provide digital data indicating where these areas of historical modified response are located. Overlap between the modified response and priority 1 habitat polygons will show where the SEFC must make changes to their land management strategies.



Figure 1: Fire Centres of BC

The SEFC is divided into 6 different fire zones; Cranbrook, Invermere, Columbia, Arrow, Boundary, and Kootenay Lake (refer to Figure 2). The Forest Protection Officers of each of the 6 zones were asked to provide maps of the areas of modified response in their respective zones. The polygons were hand drawn on topographical maps of scales varying from 1:200,000 to 1:350,000, and were created based on historic knowledge of the areas. These maps were submitted to the GIS department of the SEFC to be digitized into a workable layer.

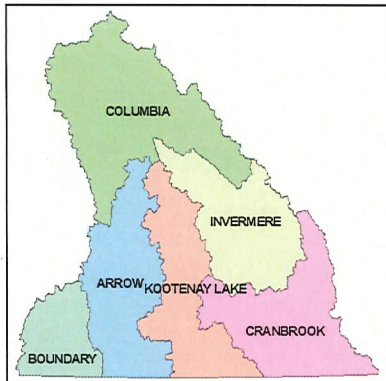


Figure 2: 6 zones of the Southeast Fire Centre

Modified Response Data (GIS department, SEFC)

The process for creating the modified response digital layer is broken into 3 sections (Arc Catalog, Arc Map, Arc Toolbox), according to where the process took place.

Arc Catalog

A shapefile was created in Arc Catalog to represent the modified response polygons. It was given a polygon feature type and projection NAD 83 UTM Zone 11N. A shapefile was used versus a geodatabase because of the single feature type that would be used to represent the modified response areas (polygons), and also because of the compatibility to directly digitize the polygons in Arc Map.

Arc Map

The GIS base layers used for the project primarily came from the Land Resource Data Warehouse (LRDW), the LRDW being the primary collection of BC's natural resource and land data, available to the different government ministries and certain external groups. A custom application installed in Arc Map called the *Layer Browser*, was used to add all of these layers with a single tool. The Layer Browser allows the user to grab layers that are already symbolized and organized by scale, so the user doesn't have to load and symbolize each layer added. The layers are taken from the LRDW, so the consistency of the data is maintained. A *20K Base Mapping* layer was used for the digitizing process to increase accuracy of the polygons, as the topographical features are displayed at a large scale (1:20,000) with contour intervals every 20 m.

The general area for the polygons was located using map sheet grids, cities, parks, and highway junctions. For the digitizing process, topographical features such as rivers and contour lines were primarily used for guidance. To increase accuracy of the digitizing, the *snapping* function was used to align the polygons with features (park boundaries). A total of 76 polygons were digitized.

An additional field was given to the attribute table of the Modified Response shapefile called "Desc_" and was used to designate a unique identifier to each polygon. The unique identifier consisted of a letter indicating what zone the polygon belonged to, as well as a number, the numbers running from 1 to 76 (i.e.: B-5, indicating the polygon was in the Boundary zone); it was added to the attribute table during the digitizing process.

Arc Toolbox

Using Arc Toolbox, the area for each modified response polygon was determined, which was then used to calculate total areas for each zone. The tool used was the *Calculate Areas* tool found at *Arc Toolbox* → *Spatial Statistics Tools* → *Utilities* → *Calculate Areas*. The areas calculated are in m², and therefore a field was added to the attribute table called "ha" to represent hectares. The *Field Calculator* was used to determine the number of hectares by creating a query that divided the m² value by 10,000. The attribute table was then exported as a dbf, where it was re-opened in Microsoft Excel. In Excel, the total number of hectares for each zone was calculated using the SUM function. (Refer to Table 1 in the Appendix to view the total hectares by zone for modified response polygons.)

Modified & Full Response Data (BC Parks)

The *Mountain Caribou Recovery Strategy* also required the input of BC Parks to determine caribou habitat suitability areas within park boundaries. Maps were submitted to the SEFC showing all of the National and Provincial Parks that lie within the caribou habitat planning units and have polygons outlined showing areas designated as *Full Response* and *Modified Response*, an indication to the fire centre as to the type of fire suppression activity required. Management objectives were also submitted for each park as to the type of suppression activity permitted and also values of concern. Some of these concerns included whether retardant use is allowed because of fish bearing streams, vehicle access, and man-made structures such as campgrounds, trails, and bridges. To represent the BC Park's Full and Modified Response polygons, a similar procedure to the SEFC's modified response polygons was performed. Two shapefiles were created in Arc Catalog, the polygons digitized in Arc Map by referencing park boundary and topographical features such as roads, contours, and streams.

Map Products (GIS, SEFC)

Two final products were created for the SEFC. The first product shows the polygons from all 3 organizations; the Protection Branch, BC parks, and ILMB. Creating this product proved cartographically challenging because of the number of overlapping polygons. Using transparency and a variety of colours and fill hatches, a product was created that successfully symbolized the work of all 3 organizations (refer to map 1 in Appendix), and maintained legibility. Minimal additional layers were used to avoid cluttering the map; they included highways, cities, lakes, streams, parks, Fire Zones, and weather stations. The weather stations are an important feature on the map as they are "tie" areas to historic BUI (Built-up-Index) anomaly maps. These BUI maps are important tools for prediction, as they are an indication of how much fuel is available to fires. The BUI is a combination of DMC (duff moisture codes) and DC (drought codes), and is able to represent a broad spectrum of areas based on vegetation and elevation. These help the Protection Branch monitor Modified Response areas as a fire's behaviour (spread rate, intensity, etc) can be more accurately predicted.

The second product required by the SEFC was a map showing the SEFC's modified response polygons that overlapped the priority 1 caribou habitat polygons, as the Protection Branch has only been required to take full response on priority 1 areas at this time (Refer to Map 2 in Appendix). This map is currently being used as a tool by the SEFC to aid in the decision making process regarding the allocation of fire suppression resources. If a fire is located in priority 1 habitat, the fire will be given a full response fire suppression plan, despite if it is located in an area that has historically been managed as modified response.

Analyses

To examine the applications of these map products, I performed 3 analyses. The first was to determine how much area that has historically been managed as modified response, now lies within priority 1 caribou habitat. This is of interest, as the additional area will require fire suppression resources, potentially resulting in increased expenditures and/or the removal of resources from other areas. To perform the analyses, I used a similar procedure to that of creating and calculating the area of the SEFC's modified response polygons.

I created a shapefile and then digitized the areas of overlap between the modified response polygons and priority 1 caribou habitat polygons. I used the *Calculate Areas* tool from Arc Toolbox to calculate the total area of overlap. The hectares were calculated using the field calculator in the layer's attribute table, and summed in Microsoft Excel. The results concluded that approximately 100 000 ha (107 830 ha) of the modified response areas are located in priority 1 caribou habitat.

Note: Because the initial raw data involved in creating the modified response polygons was based on estimation, and the inaccuracies involved in digitizing, the number should be used as an approximation.

The second question was to determine how many fires during the 2008 fire season were located in the overlap area (the analysis run was from Jan.1/08 to Aug.14/08). To create a point layer representing the 2008 fires, I ran a customized report using Fire Chart (an application available to the Protection Branch) (refer to Figure 6).

FCReports 2.0.47

Select a report to run:
Custom Report, Formatted

Custom Report Setup

Available Fields

- Size, Second Report
- Slope
- Ticket Issued - Violation
- Ticket Issued - Warning
- Timber - Immature Area Destroyed
- Timber - Immature Damage
- Timber - Mature Area Destroyed

Selected Fields

- Fire Year
- Fire Number
- Latitude
- Longitude
- Status

The custom report can take a while to generate. After you press the Run Report button, be prepared to wait for a few minutes, especially if you have requested more than 1,000 records. Shorter reports (eg 50 records) are quite quick to appear.

☐ Calculate TOTAL
☐ Calculate AVERAGE

☐ Set Column Widths Manually

Boundary

Boundary	Fire Centre	District	Fire Type	Start Year
Provincial	2 Coastal	0 Fire Centre	Duplicate	2008
Forest Regions	3 North West	1 Cranbrook	Fire	2008
Forest Districts	4 Prince George	2 Invermere	Nuisance	2008
	5 Kamloops	4 Columbia	Reserved ID	2008
	6 Squamish	5 Arrow	Smoke Chase	2008
	7 Cariboo	6 Boundary	Test/Training	2008
		7 Kootenay Lake	Unknown	2008

Select as many additional criteria as you wish, below. Click the Add button to add more lines.

1

Add Del

Figure 6: Creating a report using Fire Chart

This report was saved as a CSV file, brought into Microsoft Excel and saved in dbf format. Including the lat and long coordinates of the fires in the report enabled the dbf file to be converted into a shapefile in Arc Catalog, using the *Create Feature Class* → *from XY table* function.

The point shapefile representing the 2008 fires was added in Arc Map, and using the *Select by Location* function, a query was run to determine how many of the fires were located within the polygons representing the overlap. The results of the query determined that 8 fires during the 2008 fire season occurred within these areas.

The last part of the analysis was to examine whether or not the 8 fires that occurred within this priority 1 habitat, were allocated fire suppression resources. I examined each individual fire report, which includes information such as the date of discovery, date the fire is

declared out, type of response (modified vs. full), type of resources, etc. The fire reports showed that all 8 of the fires were extinguished by Initial Attack crews before they reached 1 ha (Refer to Figure 3).

Fire Number	Date, Discovery	Date, Fire Out	Geographic	Size (Ha)	Crew Type
N20499	2008-08-08 17:06	2008-08-10 17:50	Skookumchuck ck	0.009	IA
N40137	2008-07-03 16:36	2008-07-05 16:00	North Frisby Ridge	0.01	IA
N40156	2008-07-05 11:02	2008-07-07 13:00	S. end top of the Downie	0.003	IA
N40159	2008-07-05 11:30	2008-07-07 16:00	N. end top of the Downie	0.001	IA
N50495	2008-08-08 16:58	2008-08-10 16:15	NEWTON #3	0.01	IA
N50496	2008-08-08 16:59	2008-08-11 13:45	KUSKANAX #2	0.01	IA
N50497	2008-08-08 17:01	2008-08-10 19:00	KUSKANAX #3	0.01	IA
N70237	2008-07-16 16:00	2008-07-18 8:30	Mobbs Creek	0.075	IA

Figure 3: The 8 fires that occurred within the areas of overlap between modified response and priority 1 caribou habitat.

Conclusions

From the results of the analyses it appears that the SEFC was successful in using the Priority Response System. All 8 fires that occurred within Priority 1 Caribou Habitat areas were treated with full response versus modified response. The fires were all extinguished before they reached 1 ha, thereby preserving the caribou habitat. Also, the *2008 Caribou Modified Response* map was used in determining whether or not to allocate full fire suppression resources to the fires, therefore displaying the purpose of the map.

However, because this is the first fire season to test the Priority Response System, it is difficult to make concrete conclusions as there is no previous data for comparison. There were also only 8 fires (out of more than 500) which occurred within the areas of interest, so there are relatively few examples to draw conclusions from. The analyses did not take into account the availability of fire resources, which could indicate how resources were deployed throughout the season, and whether or not caribou habitat was in fact prioritized. However, it should be noted that the fires all took place during the months of July and August, which are typically the busiest months for the SEFC.

When examining the success of the Priority Response System on a larger provincial scale, it will likely take additional monitoring by scientists and herd experts that study BC's mountain caribou populations. They can determine if the Protection Branch's additional efforts to extinguish fires in areas deemed important for caribou are helping to restore population numbers by preserving habitat. Feedback from the Protection Branch will also be beneficial in determining how useful the maps were during fire season in helping to allocate resources to priority areas. In the future, the maps could also help to compare fire suppression costs from previous fire

seasons, to fire seasons that are now implementing the Priority Response System; potentially allocating resources to areas that were previously left to naturally burn.

Additional challenges faced in the long term planning for fire suppression in caribou habitat must take into account that most ecosystems within BC's forests are maintained by periodic wildfires, and are therefore, crucial for maintaining healthy forests for caribou populations. A fine balance exists between protecting caribou habitat with wildfire suppression, and enhancing caribou habitat by allowing wildfire to maintain forest health. While the Protection Branch is only one group out of the many government ministries and other stakeholders affected by the Mountain Caribou Recovery Strategy, they play an important role in maintaining and enhancing caribou habitat through the management of wildfires in our forests.

RESOURCES

Articles

Lishman, Peter RPF. Mountain Caribou Management Implementation Update. Kamloops: FrontCounter BC/Mountain Caribou Implementation, October 30 2007.

Stock, Dr. Art and Ken White, Harold Armleder, Dr. Bruce McLellan, Nikki Rivette, Chris Betuzzi, Jim Jones, Bruce Fraser, and Tavis McDonald. Mountain Caribou and Forest Health Management. Ministry of Forests and Range, May 16 2008.

Unknown author. Mountain Caribou. Ministry of Forests and Range, date unknown.

Websites

<http://www.cosewic.gc.ca>

http://fire.cfs.nrcan.gc.ca/cwfs_e.php

<http://www.ilmb.gov.bc.ca/sarco>

<http://wlapwww.gov.bc.ca>

<http://icw.for.gov.bc.ca/protect>

Interviews

Dana Diotte, Spatial Information Analyst, ILMB, August 8 2008.

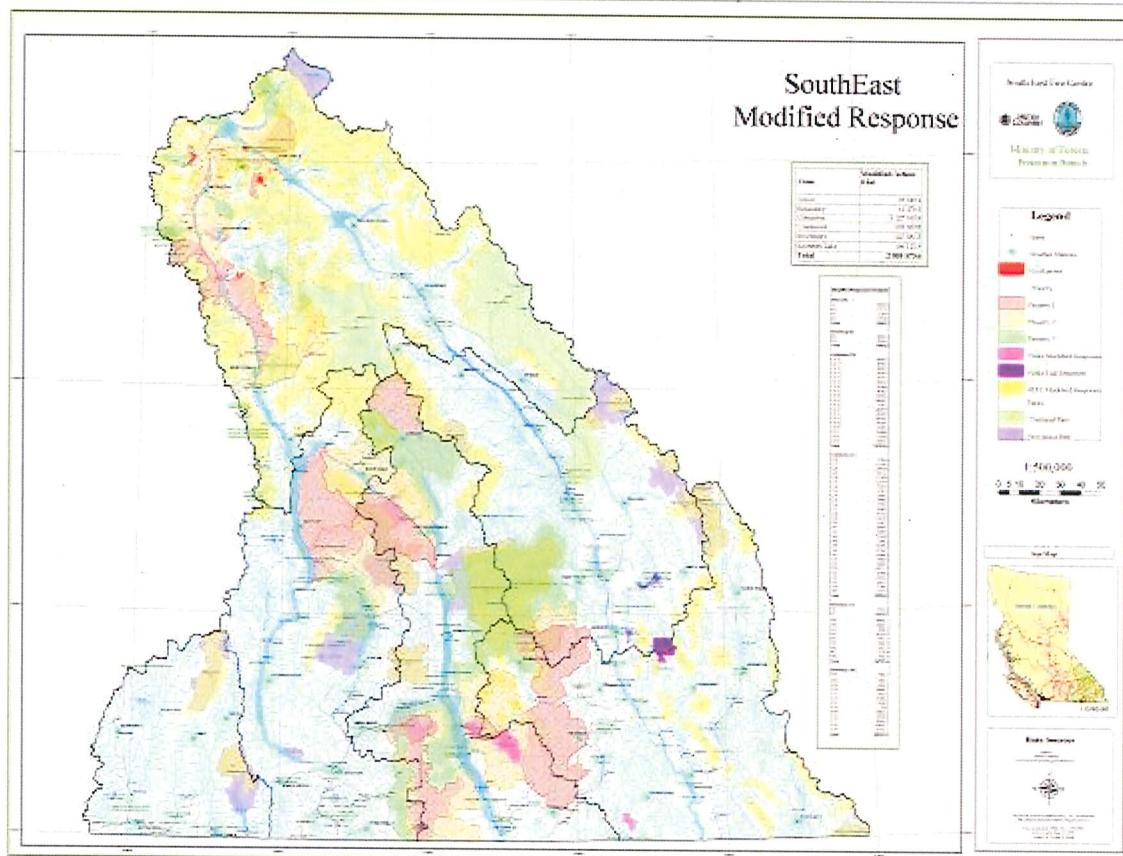
Ron Kassian, Sr. Protection Office, Protection Branch, August 4 2008.

APPENDIX

Table 1: Summary of hectares by zone of modified response

Zone	Modified Response (Ha)
Arrow	93 549.1
Boundary	61 476.9
Columbia	1 127 919.8
Cranbrook	278 922.8
Invermere	247 581.5
Kootenay Lake	196 123.5
Total	2 005 573.6

Map 1: Map Product showing Polygons from SEFC, MoE, and BC Parks



Map 2: Map Product showing SEFC modified response polygons and MoE priority 1 habitat

