Integrating Activities for Advanced Communities

D7.3 - A user manual for implementing CBMP at INTERACT stations

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PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	

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Publishable Executive Summary

The user manual is an online tool which guides the user through the stages needed to implement CBMP monitoring plans at INTERACT stations. The stages include to 1) decide what questions to answer and what to monitor; 2) decide where to monitor; 3) build your team; 4) develop a monitoring plan; 5) develop a data management plan; and 6) make your data available. The tasks required and the tools that need to be developed during each stage are explained, with templates and examples provided. It is intended as a living online tool which will be updated as new directions, developments and opportunities arise; and lessons learned used to evaluate progress and reflect changing priorities on a regular basis. The User Manual website is under construction and a draft version can be accessed at https://interact.caff.is/index.php/fec-s.

1. Introduction

The *International Network for Terrestrial Research and Monitoring in the Arctic* (INTERACT) is an EU funded initiative working towards building capacity to help identify, understand, predict and respond to environmental changes across the Arctic. This document provides an overview of deliverable **7.3 A user manual for implementing CBMP at INTERACT stations**

INTERACT Work Package (WP7) "*Improving and harmonizing biodiversity monitoring*" is led by the Conservation of Arctic Flora and Fauna (CAFF) Arctic Council Working Group. The overall goal of WP7 is to test the circumpolar Freshwater and Terrestrial Arctic biodiversity monitoring plans of CAFF's cornerstone program, the Circumpolar Biodiversity Monitoring Program (CBMP), at INTERACT stations. The goal of the CBMP monitoring plans is to harmonize and integrate efforts to monitor the Arctic's living resources through a network of scientists, governments, Indigenous organizations, and conservation groups. Through this harmonization and integration, the monitoring plans facilitate more rapid detection, communication, and response to the significant pressures affecting the circumpolar world.

The objectives of WP7 through pooling resources and experiences are to: 1) establish an efficient working interface between CBMP and INTERACT; 2) Test CBMP Freshwater & Terrestrial Plans in the field; and 3) identify how data from INTERACT stations can feed into Arctic Council Assessments. To achieve these objectives, WP7 undertook a series of tasks (each building upon the other) resulting in 3 deliverables to facilitate implementation of CBMP plans in the field:

7.2 Data management plan for the Icelandic RIF station in connection with ABDS for the selected focal ecosystem components;
7.3 User manual for implementing CBMP at INTERACT stations; and a
7.4 Report describing the flow of data from the field to Arctic Council assessments, monitoring and reporting activities.

2. User-Manual

The User Manual is an online tool which guides the user through the stages needed to implement CBMP monitoring plans at INTERACT stations (Figure 1). The tasks required and the tools that need to be developed during each stage are explained, with templates and examples provided. It is intended as a living online tool which will be updated as new directions, developments and opportunities arise; and lessons learned used to evaluate progress and reflect changing priorities on a regular basis. The User Manual website is under construction and a draft version can be accessed at https://interact.caff.is/index.php/fec-s.

Stages in implementing CBMP Plans
- Decide what to monitor
- Decide where to monitor
- Build your team
- Develop a monitoring plan
- Develop a data management plan
- Make your data available

Figure 1. Stages needed to implement CBMP monitoring plans at INTERACT stations

2.1. Process

The process to develop the user manual entailed a series of workshops (in 2017, 2018 and 2019; minutes are available on INTERACT's web site https://eu-interact.org/tracking-biodiversity/) to engage and receive advice and experience from WP7 participants in development of the WP7 deliverables:

- CAFF: Conservation of Arctic Flora and Fauna
- AU: Aarhus University
- SLU: Swedish University of Agricultural Sciences
- RFS: RIF Field Station
- CHARS: Canadian High Arctic Research Station

2.2. The Circumpolar Biodiversity Monitoring Programme (CBMP)

The CBMP has developed comprehensive frameworks for Marine, Coastal, Terrestrial and Freshwater ecosystems to guide and harmonise Arctic biodiversity monitoring (www.caff.is). The CBMP Plans now being implemented by the Arctic states build on existing capacity but also encourage the expansion of monitoring initiatives and coverage where opportunities exist. The CBMP Plans provide guidelines for selected priority focal ecosystem components (FECs) as well as essential (highest rank) and recommended (second priority) attributes that should be monitored as part of integrated designs to capture the overall status, function and health of ecosystems and biodiversity, including ecosystem processes, ecological interactions, and species or population trends.

2.3. CBMP Freshwater and Terrestrial Arctic Biodiversity Monitoring Plans

The approach adopted in the CBMP Freshwater and Terrestrial plans follows the steps required for an adaptive and ecosystem-based monitoring program and includes a consideration of what future priority questions and user needs the program should address (Figure 2). This ecosystem-based approach integrates information across ecosystems, species, and their interactions, and lends itself to monitoring key aspects of ecosystems i.e. the FECs, where changes in FEC status likely indicates changes in the overall environment. This approach considers the integrity of entire ecosystems and their interaction with other ecosystems.

Each Arctic Biodiversity Monitoring Plan also describes expected outcomes and reporting, which is critical when considering how data from INTERACT stations might inform Arctic Council monitoring and assessment activities (see deliverable D7.4). The first outcome from implementation of these plans are a series of State of Arctic Biodiversity reports which provide a baseline from which to determine status and trends of biodiversity; determine gaps in our knowledge; and provide advice on how to better improve and harmonize Arctic monitoring activities. The State of the Arctic Freshwater Biodiversity Report (https://www.arcticbiodiversity.is/freshwater) was released in 2019 and the State of the Arctic Freshwater Biodiversity Report (START) is scheduled for release in 2020. Both these reports contribute to building a baseline for terrestrial and freshwater ecosystems of the Arctic and provide guidance and help inform the user manual and guidance to implement CBMP at field stations.

Figure 2. The CBMP takes an adaptive ecosystem-based approach to monitoring and data creation. This figure illustrates how management questions, conceptual ecosystem models, and existing monitoring networks guide the implementation of the freshwater and terrestrial monitoring plans. Monitoring outputs (data) feed into the assessment and decision-making processes (data, communication and reporting). The findings are feeding back into the monitoring program making adaptive changes possible.

2.4. User-Manual

This online User Manual presents steps to implement CBMP Freshwater and Terrestrial Integrated Monitoring Design at Field Stations or in Monitoring Programmes. It describes a proposed CBMP site design, the selected core essential ecosystem components and recommendations for protocols and implementation. It describes a proposed CBMP site design, the selected core essential ecosystem components i.e. FECs and recommendations for protocols and implementation (Figure 3). The tasks required and the tools that need to be developed during each stage are explained, with templates and examples provided. It is a dynamic tool which will be updated as new directions, developments and opportunities arise; and lessons learned used to evaluate progress and reflect changing priorities. A version of the User Manual can be accessed at https://interact.caff.is/index.php/fec-s.

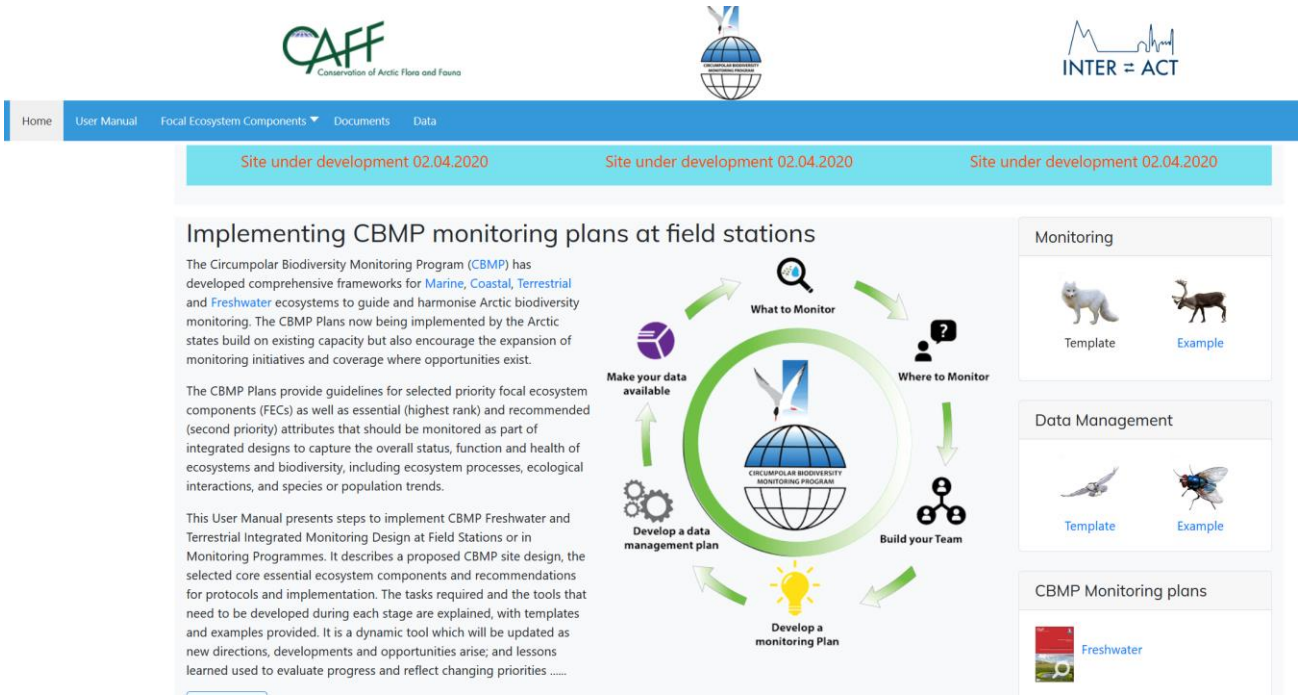

Figure 3. Entry page for the User Manual

2.5. User-Manual: Structure

The user manual guides the user through the following stages when planning how to implement CBMP Plan(s) at a field station (Figure 4):

- ***Decide what questions to answer and what to monitor:*** The User Manual provides a tool allowing the user to search the FECs defined in the Freshwater and Terrestrial monitoring plans (Culp et al, 2012; Christensen et al, 2013); and access the FECS based upon the parametres and attributes defined as important to collect information on. A full list of the suggested FECs and their attributes can be accessed in the https://interact.caff.is/index.php/fecs (*note this tool is under development and subject to change*).

Figure 4. Stages to follow when planning how to implement CBMP plan at field stations.

Deciding what to monitor is crucial when determining what management and science questions your programme would be able to answer. As a parallel to this, conceptual ecosystem models (see section 2.6) should be designed based on guidance from the CBMP Freshwater and Terrestrial monitoring Plans. Based upon this, your final decision on the FEC´s to be monitored can be taken.

- ***Decide where to monitor**:* Monitoring in the Arctic is challenging and restricted by ability to access remote locations and the costs entailed. The CBMP utilizes existing monitoring capacity in the Arctic through enhanced coordination and integration of already established monitoring resources. Through the enhanced coordination of existing monitoring resources, there is an improved ability to identify priority gaps in current capacity, and improves, comprehensive and cost-effective monitoring. To this end co-locating of monitoring measurements of FECs at integrated, long-term monitoring sites is highly desirable.

  To facilitate this approach the CBMP Freshwater and Terrestrial monitoring plans provide sampling designs for biological components and identify critical abiotic parameters which affect and drive biological change that should be monitored as part of an integrated ecosystem approach. Monitoring for the CBMP site-based monitoring design is guided by the following questions which would be answered at a site scale:

  - What is the status and trends in abundance, distributions and diversity of focal ecosystem components?
  - Are distributions of species changing or are species assemblages changing?
  - Are ecosystem boundaries in the Arctic and Sub-Arctic shifting?
  - Are these ecosystems functions changing?
  - How are drivers causing changes in priority FEC attributes at a site scale?

  The Freshwater monitoring plan building upon this approach also identifies a set of criteria for the selection of preferable monitoring sites, namely:

  - Sites with high-quality and long-term data sets
  - biodiversity hotspots, i.e., areas with high species richness or unique species composition (e.g. rare species) and high conservation value
  - medium to small river catchments and lakes to ensure effective sampling effort and representative species collection; and
  - sites of high significance to local communities. Additional variables for consideration during the selection of sites may include water source (e.g. glacial vs. non-glacial water bodies), presence or absence of fish, and geomorphic characteristics (e.g. mean stream width, mean lake depth).

- ***Build your team**:* A successful research station is built on cooperation between a variety of actors and institutions. Each individual case will vary but in general it is recommended to link up to national monitoring programs which in many cases will be able to provide guidance and link data generated at the station into regional, national and even international processes. It is recommended that each FEC or group of FECs has a scientific lead which is responsible for the monitoring in question and oversight with field scientists. Furthermore, a research station

requires a station manager able to maintain oversight and manage daily operation of the stations as well as access to personnel with data management capacities.

- ***Develop a monitoring plan***: Implementing CBMP monitoring plans at a field station requires that a monitoring plan is in place which is recommended to address the following:
    - Questions and objectives to be addressed
    - Conceptual ecosystem models based on the questions and the species in your area
    - Suite of chosen indicator/ FEC´s, based on the above 2 bullet points
    - List of attributes and parameters to monitor
    - Description and map of geographical area and the nature
    - Description of baseline conditions (reference conditions)
    - Description of monitoring methods and basic protocols to use
    - Frequency of and responsibility for monitoring
    - Frequency of and parties responsible for assessments
    - Financial support required
    - Identify the intended audience(s) for the information generated
    - Make clear the links between the monitoring and management decisions

  An example of how one field station (the RIF field station in Iceland https://rifresearch.is/) has developed a monitoring plan addressing the above components is found at https://eu-interact.org/app/uploads/2018/10/RFS_monitoringp_Web_final.pdf . A template to guide development of a monitoring plan is currently under development and will be made available once completed.

- ***Develop a data management plan***: A key step in ensuring that data generated at a field station can flow into and inform CBMP monitoring and assessment activities is the development of a data management plan. The User Manual provides a template which offers a framework within which develop a data management plan. Each user case may have different requirements however, an example is also provided of how one field station applied this template in developing their field station data management plan (https://interact.caff.is/images/files/Data_Management_plan_Template_CAFF-2April2020.docx). CAFFs Arctic Biodiversity Data Service (https://abds.is/) an online, interoperable data management system for biodiversity data generated via the activities of CAFF, including the CBMP is also being made available for partners collecting biodiversity data to submit, store and make available data via the ABDS if requested.

- ***Make your data available***: provides guidance on how monitoring data collected at a station might be submitted to inform Arctic Council biodiversity monitoring and assessment activities; and provides an example of how one station is doing so. A key step to ensure that data generated on FECs at a field station can inform Arctic Council monitoring and assessment activities is once a data management plan in place to ensure that FEC data generated is:
    - Submitted to the CAFFs Arctic Biodiversity Data Service (https://abds.is/), an online, interoperable data management system for biodiversity data generated via the activities of CAFF, including the CBMP can be used by partners collecting biodiversity

data to submit, store and make available data via the ABDS if requested; or ensure that the

- Data archive where the data is stored is interoperable with the ABDS so that the data can be harvested.

2.6.Conceptual models as part of the monitoring design

The CBMP integrated monitoring approach needs to reach across programs, jurisdictions, stakeholders and agencies to manage for ecosystem sustainability. A conceptual model represents a working hypothesis about key system relationships, functions and organization. Developing a monitoring program based on a structured and well-thought-out ecosystem-based conceptual model approach can generate a comprehensive, system-based understanding that provides the foundation to identify and assess a suite of key FECs and related attributes, and priority ecosystem structures, functions, and processes as well as their linkages to abiotic and biotic drivers.

Conceptual ecological models for the Arctic, based on science and other expert input, are tools that can provide a "common language" to elucidate and communicate the critical components, processes and drivers of ecosystem sustainability within and across resource disciplines. The conceptual models that are relevant at an Arctic field station should allow for the identification and selection of priority monitoring elements that will meaningfully describe the status of many parts of the ecosystem and the likely cause of change with the least effort possible. This is especially critical when monitoring remote, difficult to access Arctic locations and field stations, where a program cannot monitor everything, everywhere, and all of the time. Once established and fully vetted, the conceptual models provide a basis for resource-use decisions predicated on maintaining or restoring ecosystem capacities through monitoring FECs, functions, processes, and their associated attributes and parameters.

Understanding linkages between the biotic and abiotic drivers of the system and the potential FEC attributes is critical to development of a successful, efficient monitoring program. Differential driver impacts, or strength of impacts, have direct relevance on what, where and how often to monitor. Understanding what biodiversity components are likely to be affected by a given driver(s), may prioritize the component or driver(s) for monitoring. Understanding where priority components exist, or which potential sampling strata are likely to be influenced first, or most heavily, by any given driver(s), may prioritize the sampling design. Similarly, understanding that any driver may influence a component or location first or more heavily than others, may prioritize the component for more frequent monitoring compared to other components that are likely to change more slowly through time. For these reasons it is important to identify drivers in the development of the conceptual model. Methods, steps and lessons learned for a field station to consider, to develop a relevant and CBMP conceptualized conceptual model can be found in the online at https://interact.caff.is/index.php/fec-s. (*note this tool is under development and subject to change*).

2.7. How to select the FEC´s and the connected attributes and parameters?

The list of potential FECs can be generated based on a combination of the conceptual models, expert opinion and management and community needs. Conceptual models can be generated for each biotic group, but should be based on the suggested overall models and FEC descriptions in the terrestrial and freshwater monitoring plans. A process to identify and rank the most relevant FECs and their attributes can be based on a simple sum of scores for several factors, including:

- Ecological relevance;
- Relevance to ecosystem services;
- Relevance to Arctic Indigenous and local peoples;
- Relevance to management and legislation;
- Highly-ranked FECs (greater than 75% of the potential score) plus several additional FECs and FEC attributes;
- Agreed management and/or community needs, were carried forward as priorities for the CBMP-Plans;
- Sensitivity to natural or anthropogenic drivers;
- Availability and sustainability of monitoring capacity and expertise;
- Relevance to targets and thresholds; and
- Practicality.

The identified priority FEC attributes are the targets of the monitoring effort, since they represent biodiversity entities that indicate critical functioning and resiliency of the ecosystem. FEC attributes describe various aspects or characteristics of each component. For each attribute, desired/proposed sampling parameters (metrics), methods, monitoring frequency, and spatial scales, were identified. A set of common attributes are defined in the two CBMP monitoring plans. Examples include:

- Diversity: in species, communities, genetics, etc
- Abundance: the number, density, etc
- Composition: morphology, traits, general structure, etc
- Phenology: timing of seasonal activities, annual cycles, etc
- Demographics: age and sex structures, survival, etc
- Spatial structure: distribution in space, migration, etc
- Size structure
- Biomass
- Temporal cycles: stochastic ecological interactions such as predator-prey population relationships,
- Timing of important life history events
- Contaminant concentration
- Health: disease prevalence, body condition, etc
- Productivity: biomass, reproductive output, etc
- Ecosystem functions and processes: nutrient cycling, etc

The FEC search tool provides more specific information on the terrestrial and freshwater FEC´s, attributes and parametres: https://interact.caff.is/index.php/fec-s

3. Supporting documentation

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