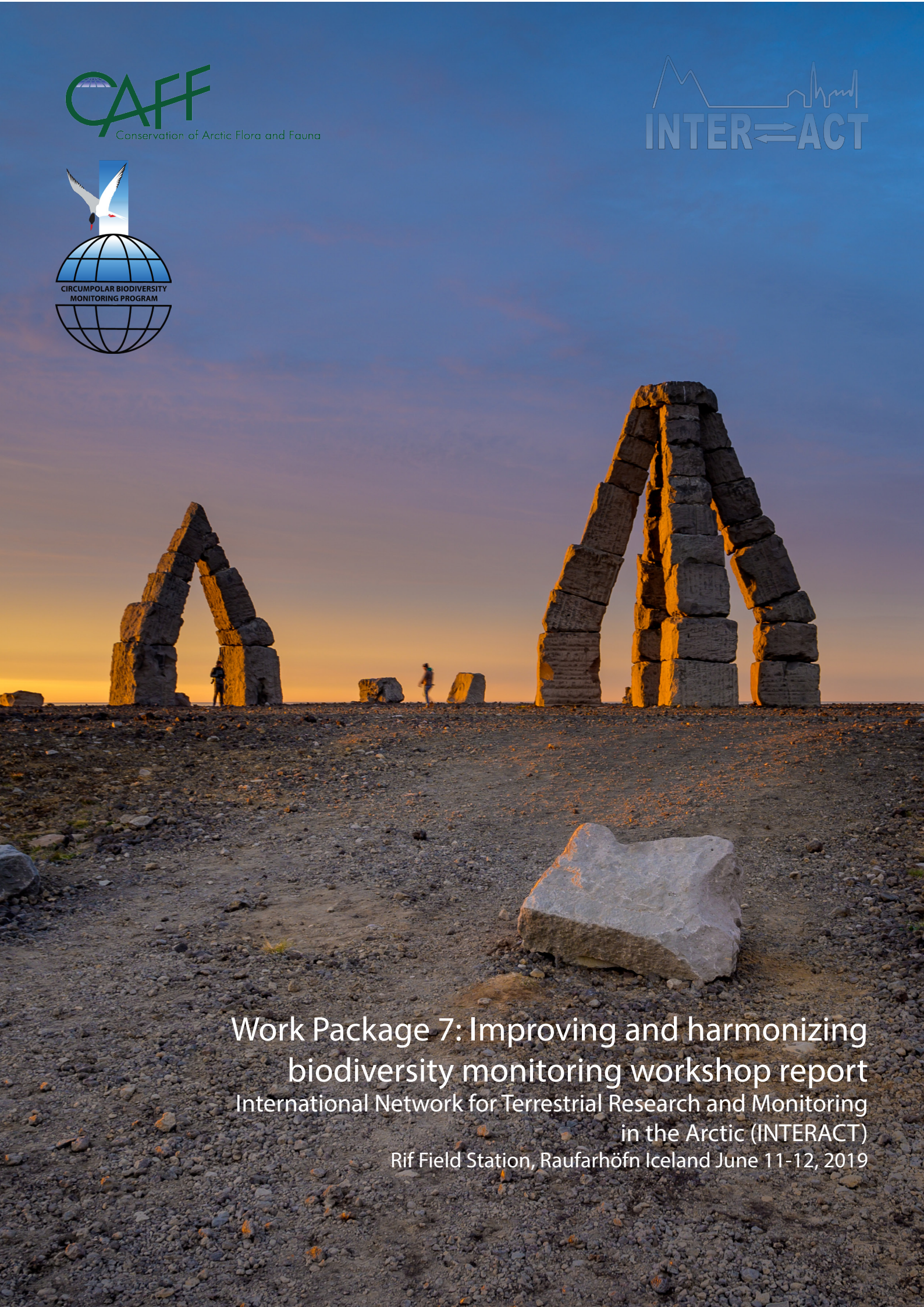

Work Package 7: Improving and harmonizing biodiversity monitoring workshop report

International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)

Rif Field Station, Raufarhöfn Iceland June 11-12, 2019

CAFF
Conservation of Arctic Flora and Fauna

Work Package 7: Improving and harmonizing biodiversity monitoring International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)

Raufarhöfn, June 11-12, 2019

1 Overview

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.

INTERACT Work Package (WP) 7 "*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.

1.1 WP7 Goals

The objectives of WP7 are to:

- Establish an efficient working interface between CBMP and INTERACT;
- Test CBMP Freshwater & Terrestrial Plans in the field
- Identify how data from INTERACT stations can feed into Arctic Council Assessments

To achieve these objectives, WP7 is undertaking a series of tasks (each building upon the other) resulting in a series of products which can be used to help facilitate implementation of CBMP plans in the field.

1.2 WP7 Deliverables:

- Data management plan for the Icelandic Rif station (RFS) in connection with the Arctic Biodiversity Data Service (ABDS) for the selected focal ecosystem components.
- User manual for implementing CBMP at INTERACT stations.
- A report describing the flow of data from the field to Arctic Council assessments, monitoring and reporting activities.
- Please see WP7 Phase 1 report (accessible on project log-in website) for more detailed status on WP7 tasks.

2 Workshop 3:

As part of INTERACT WP7 a group comprising experts from Canada, the Kingdom of Denmark, Iceland, and Sweden met on June 11-12 Rif field station, Iceland to help improve and harmonize biodiversity monitoring in the Arctic by pooling resources and experiences (Annex 2). This workshop helped in moving work forwards by reviewing the status of the WP7 deliverables and whereby advice and experience from Canadian High Arctic Research Station (CHARS), Zackenberg Research Station and the leads of the CBMP Freshwater and Terrestrial biodiversity monitoring groups informed the development of RFS; review of the RFS monitoring and data management plans; and future cooperative projects between CHARS, Zackenberg and RFS building on the CBMP Focal ecosystem Components identified in the Terrestrial and Freshwater Plans.

WP7 Outcomes (status):

- **Workshop report** providing an overview of the meeting and its outcomes, i.e. decisions and actions and responsible parties for each action;
- **Project website** including a meeting login site where all WP7 documents and presentations from the workshop can be accessed [https://caff.is/interact];
- **RFS Monitoring plan** finalised;
- **RFS Mapping database** and first change analysis completed;
- **RFS Data Management Plan** finalised; and
- Agreement on the format and content of the **user manual for implementing CBMP** at INTERACT stations.

2.1 Station updates

Updates were provided by each station on developments since the 2018 Workshop with a focus on new developments and identifying potential areas for cooperation and lessons learnt that could be shared across the three stations.

The workshop highlighted that the cooperation between the three stations and its connection to policy via CAFF is unique and should be used to further develop the growing cooperation between the three stations. Consideration should be given to how this framework can be used to inform national obligations e.g. to RAMSAR, CBD etc. It was agreed to develop a Memorandum of Understanding (MoU) between the three stations to act as the platform to build cooperation and help facilitate securing of resources and funding. It was noted that the timing for this was opportune for Rif given the current Icelandic Chairmanship of the Arctic

Council; and should be completed prior to the end of the current INTERACT programme (October 2020).

2.2 GróLind (vegetation and soil monitoring)

A presentation was made on GróLind and how it will utilize Rif as a key site in its activities. GróLind is a long-term national vegetation and soil monitoring programme in Iceland. It is focused on variables linked to ecosystem functions and structure to assess the conditions of the vegetation and soil resources and any changes over time. The programme is be based on an adaptive monitoring approach, spanning several spatial scales and focusing on both land-use and vegetation and soil. Satellite images will provide large-scale data, while drones and on-site ecosystem analyses, will be used to obtain higher resolution data. In addition, the project aims at developing indicators of sustainable land-use, using experiments, available information and results from the monitoring programme. Its overall goal is to use these ecological data to promote, in collaboration with stakeholders, sustainable land management in Icelandic rangelands.

2.3 Advice and actions for Rif to Consider

During the workshop a range of items were considered which were relevant for Rif to consider both in terms of baseline data, monitoring activities and strategic approaches to development of the Field Station. Adoption of these would facilitate comparison of Focal Ecosystem Components (FEC) across the three stations.

Baseline data and monitoring activities:

- Conduct extensive habitat mapping for the entire Rif area. This has been completed for CHARS who are now working with Zackenberg and have also offered to send experts to help conduct ecosystem mapping for Rif. This will involve use of remote sensing and ground proofing possibly in cooperation with the Icelandic Institute of Natural History.
- Focus on vegetation monitoring. Measurements can be done every 5 years, a higher frequency of data sampling is not needed except for a few variables (vegetation change is slow).
- Exclude sheep i.e. Grazing/protection from climate analysis
- Consider an interaction study looking at phenology and pollination e.g. how specific each insect is regarding flower species – sample pollen from the individual fly, as is being done in CHARS.

Strategic Actions

- Develop an MoU between the three stations
- Develop a five-year strategy for Rif, identifying milestones which are relevant both nationally and internationally.
- Identify key monitoring targets and management questions
- Develop a conceptual ecosystem model for Rif which would help inform understanding of change in the area and guide future development of the Rif Monitoring plan
- Sell the idea of Rif as a ‚simple system' which makes it easier to try out experiments.

2.4 Cooperative pilot studies

The workshop reviewed several ongoing cooperation's which might be applicable across all three stations:

- *BitCue:* CHARS has expressed in implementing BitCue which is already established at Rif and Zackenberg, and would facilitate comparable studies across the three sites. It was suggested that this could focus on arthropods and pollination – fundamental parts of the ecosystem.
- *Barcoding:* CHARS are barcoding and advised that the same would be done for Rif. It was noted that a reference point is needed for the arthropods to be able to use barcoding and Rif plans to join barcode of life. BitCue (Principal Investigator: Toke Hoye) is finalizing the procedure for using this technique, and will send to Rif once ready. It was also noted that one downside for the barcoding part is the cost: Takes substantial funding for barcoding the arthropods (thousands of samples), and need a whole field season to acquire the data needed.
- *Ecosystem mapping:* has been conducted in CHARS, and it was recommended it also be adopted in Zackenberg and Rif. This will involve use of remote sensing and ground proofing. CHARS is working with Zackenberg and offered to send experts to Rif to help conduct ecosystem mapping for Rif.

2.5 RFS Data Management Plan and Monitoring Plan

An update was provided on the Rif Monitoring plan including the plans aims and objectives, The environmental characteristics of the area, key monitoring components and questions, implementation plan and selected focal ecosystem components.

An update was provided on the Rif Data Management Plan (DMP) whose goal is to ensure that data on selected Focal Ecosystem Components (FECs) defined within CAFFs biodiversity monitoring plans collected at RFS are documented, made accessible, and preserved for future use via the Arctic Biodiversity Data Service (ABDS). The DMP provides descriptive details of the data collection and processing procedures to be applied at RFS and comprises the following components:

- Data Management Principles: describing the data management principles and guidelines for management of data from RFS;
- Data collection: describing data collection, storage and processing at RFS.
- Data handling: describing how data from RFS will be delivered to the ABDS

2.6 State of the Arctic Biodiversity Reports (Freshwater and Terrestrial)

Outcomes from the State of the Arctic Freshwater Biodiversity report (SAFBR) and the relevance of its Key Findings and advice for monitoring for all three stations were discussed. It was noted that the CBMP Freshwater is working on a more general guideline document for the monitoring of ecological integrity and biodiversity of freshwater habitats, including pressure analyses, establishment and planning of freshwater monitoring. A status on the development of the State of the Arctic Terrestrial Report (START) scheduled for completion in 2020 was also provided.

The following advice for Rif was provided with regards to what habitats, organisms and environmental parameters should be monitored;

What habitats should be monitored?

- Lakes: deep and large lakes are to some extent buffered and are therefore late in reflecting changes in the environment, e.g. temperature changes. However, deep, stratified lakes can provide important information about changes in thermal stratification and in surface water temperature. This is easy to record with T-loggers

deployed along a depth gradient and provides a good estimate of climate change effects on freshwaters.

- Ponds: are much quicker to react to all changes. However, they may dry up or freeze to the bottom, which then may affect the whole pond ecosystem and blur the picture we get when using ponds as candidates for monitoring environmental changes. Stochastic events such as bottom-freezing of drought has a large impact on the communities of ponds. As ponds have very small "catchments" they also mostly represent themselves and do not reflect landscape processes as larger lakes and rivers do. The biodiversity of ponds may, however, be very different from that of lakes and rivers (especially of they are fish-free) and contribute to the biodiversity of landscapes.
- Lakes and ponds: there are *pros and cons* by using either lakes or ponds for monitoring changes in the environment. The best solution is to use both types of habitats and ideally having few replicates for each, especially for ponds.
- Time Series: The major lakes in the Rif are should be subject to monitoring on an annual basis (to produce time series):
    - Monthly water chemistry (secchi depth, total-N, total-P, NH3-N, NO3-N, suspended matter, alkalinity, pH, water colour/DOM, chlorophyll at a minimum) during the ice-free season
    - Phytoplankton, zooplankton and benthic algae in summer;
    - Benthic algae in summer, Benthic invertebrates in the fall (e.g. early October) during each year; and
    - Fish and water plants every third year.

  It is important to note that sensors are suitable instruments for the continuous measurements of water chemistry and to consider specific contaminants if these are a problem in the region.
- Stratify biological sampling to specific habitats: to minimize variability due to habitat and increase the statistical power to detect change over time (and between years). In freshwater biomonitoring usually stony riffle sites are chosen for this as these sites contain most of the species (incl. indicator species).
- Conduct biodiversity surveys in rivers: in order to get a better sampling of the biodiversity of these systems by collecting an additional time-standardized (e.g. 2 or 5 min) search sample to collect additional species in other habitats at the site.
- Conduct biodiversity surveys in ponds and other lakes: in the area every third year during the summer (e.g. August). During these surveys, a sampling strategy that includes both a standardized sample and an additional search sample (e.g. 2 or 5 min) is recommended to get insight in the species composition of these freshwater habitats (incl. the detection of new species).
- Rivers/Streams: despite having in- and outflow, streams are open and linear system. One direction of flow. All nutrients etc. flow downstream. Just as lakes and ponds, streams have high connectivity to terrestrial habitats. Streams receive water, as surface water and ground water, on their flow from source to estuary. So, lots of minerals, nutrients, pollutant etc. will end up and mix with the stream water. Which consequently will either be beneficial or harmful for the stream biota. Therefore, in general streams (running water) are good candidates for monitoring changes in the environment and are widely used for that purpose.

What habitats should be monitored?

Suggested that all three habitat types (rivers/streams, ponds, lakes) should be included. It will be difficult to have many replicates for each type, so RIF should begin with to allocate 1-2 lakes, 5 ponds and 1 stream in the area for monitoring.

What organisms should be monitored?

This is challenging as different organisms react differently to changes e.g. temperature. Some are tolerant to temperature fluctuations and some are less sensitive. Therefore, important to keep in mind that monitoring should cross levels of organizations. This means all trophic levels should be included i.e. algae/bacteria, macrophytes, invertebrates, fish and birds. However, this is perhaps not possible where there are little resources to depend on carrying out the work. Therefore, there is a need to be very careful when choosing organisms on which to concentrate on; when timing the sampling for monitoring, e.g. late versus early season; and practical when doing so, i.e. sampling must be simple and inexpensive and not too time consuming. Bacteria and microbial parts of the food web should preferably be addressed in specific studies (research).

What environmental parameters should be monitored?

Some environmental parameters are essential and easy to monitor such as temperature. By using temperature data loggers, we will get very valuable data, which is a base for numerous other variables, both physical and biological. Transparency in lakes/ponds is another variable which is easy to measure and can give us an indication on the abundance of planktonic algae. Conductivity, pH-values and alkalinity of the water provides important background information on the chemical properties of the water. Note that there are sensors that can perform regular measurements with service only a few times per year. T-loggers are really cheap.

2.7 User manual

How to structure the user manual and what it will contain were discussed and it was agreed that it should be useful, relevant and practical.The user manual will be an online resource, not a huge manual that requires printing etc. It will be a “process” mirroring the steps taken in this work package 7 that will consist of a series of components each building upon the other. Templates will be created for each step in the process and WP7 products and achievements will be used as case studies to illustrate how this has been approached.

Annex 1: Workshop participants

- Donald McLennan, CHARS research station
- Mora Aronsson, Swedish University of Agricultural Sciences and CBMP Terrestrial co-lead
- Hólmgrímur Helgason, CAFF secretariat
- Jónína Sigríður Þorláksdóttir, Rif station manager
- Hrönn Guðmundsdóttir, Rif Field Station
- Kári Fannar Lárusson, CAFF secretariat
- Starri Heiðmarsson, Icelandic Institute of Natural History, CBMP Terrestrial co lead and Rif board
- Tom Christensen, Aarhus University and CBMP co-Lead
- Tom Barry, CAFF secretariat
- Willem Goedkoop, Swedish University of Agricultural Sciences and CBMP Freshwater co-Lead
- Þorkell Lindberg Þórarinsson, Northeast Iceland Nature Research Centre and Rif board
- Embla Eir Oddsdóttir, Rif Board
- Bryndís Marteinsdóttir, GróLind
- Guðmundur Örn Benediktsson, Local expert

Annex 2: The Circumpolar Biodiversity Monitoring Program (CBMP)

The Circumpolar Biodiversity Monitoring Programme (CBMP) Circumpolar Biodiversity Monitoring Program (CBMP) is a cornerstone program of the Conservation of Arctic Flora and Fauna (CAFF) Arctic Council Working Group. It is an international network of scientists, government agencies, Indigenous organizations and conservation groups working together to harmonize and integrate efforts to monitor the Arctic's living resources.

The CBMP is developing four coordinated and integrated Arctic Biodiversity Monitoring Plans to help guide circumpolar monitoring efforts. Results will be channelled into effective conservation, mitigation and adaptation policies supporting the Arctic. These plans represent the Arctic's major ecosystems: Marine; Freshwater; Terrestrial; and Coastal

The CBMP facilitates Arctic biodiversity conservation and the sustainable use of the region's natural resources. Its goal is to facilitate more rapid detection, communication, and response to significant biodiversity-related trends and pressures. It does this by:

- Harmonizing and enhancing Arctic monitoring efforts, thereby improving the ability to detect and understand significant trends; and,
- Reporting to, and communicating with, key decision makers and stakeholders, thereby enabling effective conservation and adaptation responses to changes in Arctic biodiversity.

Annex 3: The International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)

INTERACT is an infrastructure project under the auspices of SCANNET, a circumarctic network of currently 79 terrestrial field bases in northern Europe, Russia, US, Canada, Greenland, Iceland, the Faroe Islands and Scotland as well as stations in northern alpine areas. INTERACT specifically seeks to build capacity for research and monitoring in the European Arctic and beyond, and is offering access to numerous research stations through the Transnational

Access program.

Funded by the EU, INTERACT has a main objective to build capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic. This is necessary because the Arctic is so vast and so sparsely populated that environmental observing capacity is limited compared to most other latitudes.

INTERACT is multidisciplinary: together, the stations in INTERACT host thousands of scientists from around the world who work on projects within the fields of glaciology, permafrost, climate, ecology, biodiversity and biogeochemical cycling. The INTERACT stations also host and facilitate many international single-discipline networks and aid training by hosting summer schools.

INTERACT station managers and researchers have established partnerships that are developing more efficient networks of sensors to measure changing environmental conditions and the partnerships are also making data storage and accessibility more efficient through a single portal. New will communities of researchers are being offered access to terrestrial infrastructures while local stakeholders as well as major international organizations are involved in interactions with the infrastructures.

Further information can be found on the project website: https://caff.is/interact