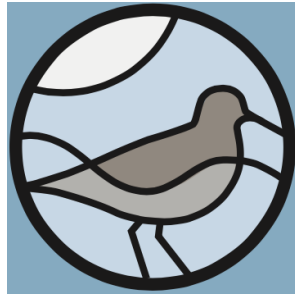


Rif Field Station



Research and Monitoring Plan 2021-2025



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1. Introduction

The Rif Field Station (Rif) is a non-profit organization, formally established on 23 May 2014 by Byggðastofnun, the municipality of Norðurþing and Náttúrustofa Norðausturlands, and is the outcome of the Regional Development Institute's project on "fragile settlements".

Rif is located in Raufarhöfn, which is a small fishing village on the northeast coast of Melrakkaslétta. It's the northernmost village in Iceland, located just south of the Arctic Circle. Only Grímsey Island is further north. Raufarhöfn is not only located in a fragile environment but is also socioeconomically fragile. Built up around fishing, it reached a maximum of 600 inhabitants in the 1980's. Those days, however, have passed and Raufarhöfn is now a quiet little fishing village with approximately 160 inhabitants, struggling for its survival.

The natural environment and biodiversity of Melrakkaslétta (figure 1) reflects its geographic location which, together with good road accessibility and local infrastructure, makes it a privileged place to study the arctic ecosystem, with an emphasis on climate change and its impact on the southern edge of the arctic ecosystem. In light of the possible opening of new arctic shipping routes, along with the current prospection of new oil drilling on the Jan Mayen ridge, ideas of building up a large shipping harbour in the northeast of Iceland have emerged. Such development plans should always take into account the fragile environment of the arctic. Therefore, monitoring the Melrakkaslétta biodiversity and the direct and indirect impacts of humans on the area is a priority for Rif.

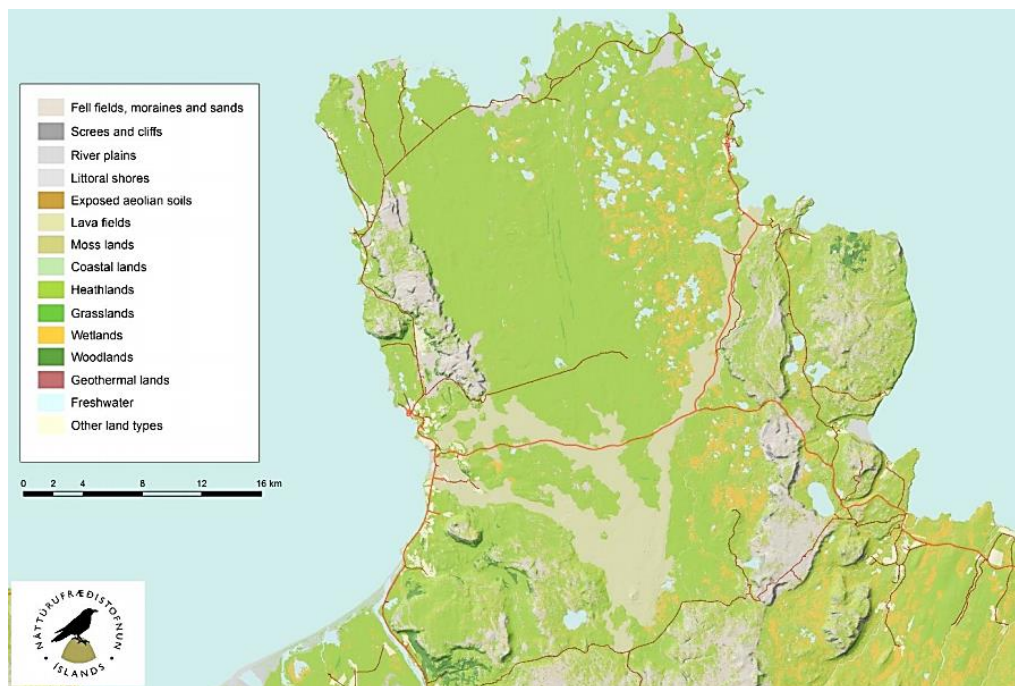


Figure 1. Habitat map of Melrakkaslétta peninsula. Provided by the Icelandic Institute of Natural History.

1.1. Rif objectives

The aim of Rif is the development of a basis for research and monitoring to achieve knowledge based on the natural uniqueness of the Melrakkaslétta Peninsula. Rif has three main goals and following objectives:

1. Promote research and monitoring projects in Melrakkaslétta peninsula, NE Iceland in collaboration with other Nature research institutions by:

- a. Providing basic facilities and accommodation for scientists doing research in the area;
- b. Defining and implementing minimal monitoring projects in collaboration with other Icelandic research institutions. By doing this the station will both support ongoing projects and promote new ones;
- c. Participating in international collaboration (i.e., CAFF) to improve our knowledge of arctic Nature and support our nation's liabilities concerning Nature- and environmental protection in the arctic;
- d. Bringing in international scientists who want to develop research in the area by participating in international joint efforts such as INTERACT (International Network for Terrestrial Research and Monitoring in the Arctic);
- e. Encouraging students to carry out research projects in the area, in collaboration with the universities.

2. Provide good data management of research findings and communicate information about the area's natural environment by:

- a. Establishing a station webpage;
- b. Keeping track of research findings from the area and communicating them to the scientific community, sponsors, authorities and local communities;
- c. Encouraging scientists to introduce their projects and research findings in the local community;
- d. Publishing annual reports about the field station, its financial status, status of research projects and their findings;
- e. Holding annual public and consultation meetings with local authorities and communities.

3. Support the local community by:

- a. Ensuring that all information and knowledge, provided from research findings, stays in the area for the benefits of the community;
- b. Encouraging that jobs created at the station will benefit the locals;
- c. Encouraging locals to participate in individual research and monitoring projects at the station.

1.2. Partnership

Rif is a partner of the cornerstone program of Conservation of Arctic Flora and Fauna (CAFF), the biodiversity working group of the Arctic Council, being a member of the Circumpolar Biodiversity Monitoring Program (CBMP), which 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. CBMP experts are 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.

Rif has been chosen by the International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT) as one of three stations that will implement the Freshwater and Terrestrial Arctic Biodiversity Monitoring Plans to test their requirements and protocols. The two other stations involved in this work package, called "Improving and harmonizing biodiversity monitoring", are the Canadian High Arctic Research Station (CHARS) in Cambridge Bay, Canada and the Zackenberg Station in Greenland.

Rif's activities have increased considerably since July 2015 with the arrival of a full-time manager whose mission was to strengthen ongoing research projects in the area and promote new ones in collaboration with national and international Institutions and to coordinate the INTERACT actions in northeast Iceland. The prospective research and monitoring projects benefit the science community, strengthen the foundations of decision making for human exploitation and livelihood in this fragile arctic environment, and open new possibilities for local communities.

1.3. The first years

The first five years of Rif shaped a stable foundation for research and monitoring in Melrakkaslétta area, and it was divided into two phases:

1. Pilot phase (2017-2019): Work within this phase aimed at the planning process, i.e., mapping the area, determining monitoring components, consulting with relevant parties, collecting and organizing existing data and establishing a database for current and future research and monitoring. Some overlapping with the second developmental phase described below may occur;

2. Implementation phase (2019-2020): Implementation of Rif monitoring plan building and strengthening scientific collaboration and partnerships with the relevant institutions involved in terrestrial and freshwater monitoring in Iceland.

Now, it is time to develop a third phase of Rif (2021-2025), which is the main core of the present Research and Monitoring Plan; the Establishment phase. To ensure long-term sustainability, implementations, continued development, usefulness and scientific relevance of the research and monitoring plan, a scientific committee will be established, based on the collaborations and partnerships developed through phase 1 and 2.

1.4. Rif Field Station organization and infrastructure

The field station is named after the northernmost part of Iceland, the peninsula of Rif that is only 3 km south from the Arctic Circle. The Rif peninsula is 15 km northwest from Raufarhöfn village. Rif is a non-profit organization. Therefore, the station will own itself.

A board of five people are responsible for running the station, financial commitments and research focus. The board represents seven Icelandic research institutions and universities, and the municipality of Norðurþing.:

- Aðalsteinn Örn Snæþórsson, representing the Náttúrustofa Norðausturlands;
- Embla Eir Oddsdóttir, representing the Háskólinn á Akureyri and the Stofnum Vilhjálms Stefánssonar;
- Hlynur Óskarsson, representing the Lanbúnaðarháskóli and the Háskóli Íslands;
- Níels Árni Lund, representing the Sveitarfélagið Norðurþing;
- Starri Heiðmarsson, representing the Náttúrufræðistofnum Íslands.

1.5. Staff

Since 10th May 2021, Pedro Rodrigues started to exercise the functions of Rif Station Manager. Hrönn G. Guðmundsdóttir, the former Manager (2018-2021), has an Environmental Scientist degree (Lund University, Sweden), and a BA degree in Philosophy and a diploma in Public Administration (both from the University of Iceland), continues to develop a partial remote work on the day-by-day management and financing. Árdís I. Höskuldsdóttir (graduated in Fisheries, University of Akureyri), works as a technician on the project HiLDA – Iceland as a model for high-latitude dust sources. Pedro Rodrigues has a First degree in Biology (University of Azores, Portugal), a Master in Marine Sciences (University of Porto, Portugal), and a PhD in Biology, expertise in Animal Biology – Natural History (University of Azores, Portugal). He also has experience in teaching (both at secondary and university level), 9 years of research experience in Portugal, Chile and Iceland, on diverse international projects, and has 40 articles in scientific peer reviewed journals and 40 communications in international conferences.

1.6. Housing and research infrastructure

The station's housing facilities at Raufarhöfn will continue to be merged with the Nest guesthouse at Aðalbraut 16, which includes accommodation, cooking facilities, work facilities with a good internet connection as well as storage. The facility has also been used as an office for the station's staff and it is planned that this will continue.

Rif has a laboratory at Raufarhafnarskóli, renovated in 2019. In 2020, a microscope, refrigerator and equipment for storage and processing of samples were purchased. Other office and field work material were purchased, e.g., Laptop, binoculars, telescope, tripod, GPS, photographic machine, etc.

Rif continues to use the land of the former farm named Rif (figure 2), which is used as an intensive monitoring and research area, and it is the northernmost land in the country, only 3 km south from the Arctic Circle, 15 km northwest from Raufarhöfn village. There is an agreement for the use of the area until the year 2024, with the possibility of extending its use beyond this year.

The station encourages researchers to visit the area and offers facilities for research, both temporary and long-term. In the Rif area, there is a meteorological station implemented by Rif and the Icelandic Meteorological Office in September 2018. The meteorological station was financed through the INTERACT cooperation network. Its maintenance, data collection and data interface are managed by the Icelandic Meteorological Office.

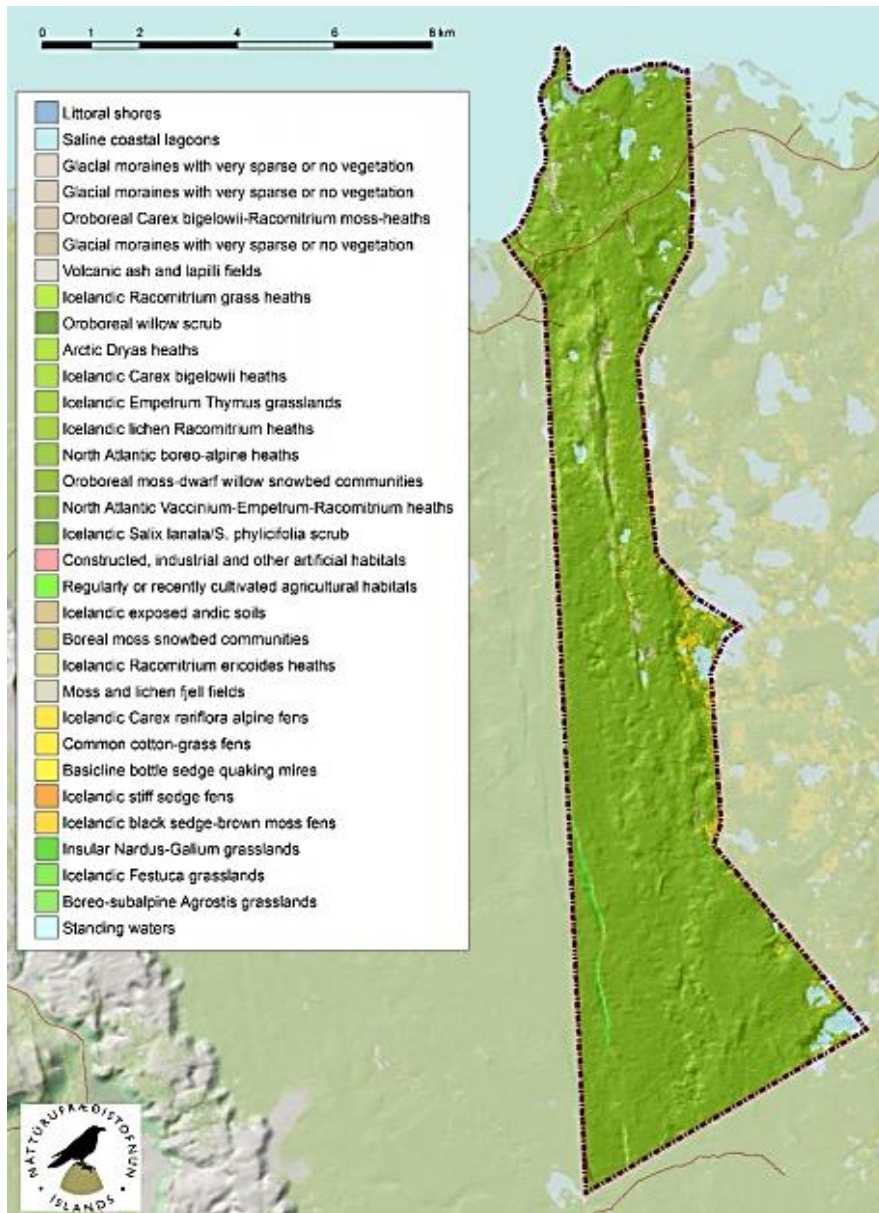


Figure 2. Habitat type map of the Rif site. Map provided by the Icelandic Institute of Natural History.

1.7. Strategy and implementation of work processes

The principal milestone in Rif's strategy for the next few years will follow the present Research and Monitoring Plan 2021-2025. The development of Rif and its research and monitoring activities will be secured through a steering committee including the Ministry for the Environment and Natural Resources, the Norðurþing Municipality, and six national Institutes such as Agricultural University of Iceland, Icelandic Institute of Natural History, Northeast Iceland Nature Research Centre, Stefansson Arctic Institute, University of Akureyri and University of Iceland. It is also expected to continue to strengthen the network developed in phase 1 and 2 by collaborations with other national and international research institutes (e.g., national research centres and institutes, Interact stations, international universities, etc.).

During the third phase, Rif will prioritize three main goals related to Research, Education, and Local Development (see table I and points 1 and 2 for description).

At the Research level, Rif will continue to implement and develop the Freshwater and Terrestrial Arctic Biodiversity Monitoring Plan in collaboration with national and international institutions and within the Work Package 7 in the INTERACT, in order to enhance the scientific knowledge of the Arctic biodiversity and its threats. As part of these goals, Rif will continue to provide good data management and communication of scientific findings.

At the Education level, Rif will collaborate with the local schools through the development of projects, aiming to increase the interest in science, Nature and its conservation. Rif will encourage students to develop their research in the Melrakkaslétta area (i.e., Erasmus, Master and PhD theses, etc.), in collaboration with national and international universities and institutes. Small lectures and the development of projects will be established with local schools. Rif could also act as a precursor of summer courses for university students, ecotourism professionals and environmental staff employees.

At the Local Development level, Rif will support the local community being an active organization, encouraging that jobs created at the station will benefit locals, helping on the development of small ecotourism companies, giving formation on the biodiversity of Melrakkaslétta, implementing good practice rules in order to keep a sustainable tourism activity in the area, and engaging citizen science projects to include the local knowledge on Rif's projects and activities.

Table I. Priority goals and projects of the Establishment phase (2021-2025).

Goals	Projects	Objectives
1. Research	1. Freshwater and Terrestrial Biodiversity Monitoring Plan	Develop and continue the Rif Ecosystem Monitoring Plan to understand changes and trends in freshwater and terrestrial biodiversity and provide data management.
	2. New research projects	Implement new monitoring projects such as: i) development of a baseline study on Haemosporidian hosted by birds; ii) study of antimicrobial resistance genes in shorebirds; iii) constant effort site (ring station) on an arboreal vegetation area; iv) monitoring coastal macrobenthic communities. These projects will shed light on the effects of climate change and anthropogenic pressures on the biodiversity of the Melrakkaslétta peninsula.
	3. Research collaboration	Collaborate in on-going-projects and develop national and international networks to improve knowledge of Arctic Nature and its protection and support international scientists in Iceland.
	4. Science dissemination	Publish scientific papers, present results in national and international conferences and in the media. Promote local lectures.
	5. Coffee Science	Periodic meetings with the local community to present and discuss the projects developed at Rif, and to bring together the researchers using Rif's facilities and local people.
2. Education	1. School cooperation	Collaborate to increase the interest of students in science. Implementation of the project "Young Nature Guides"
	2. Students research projects	Encourage students to develop their research projects in the area and collaborate/co-supervise university thesis's degrees.
	3. Summer courses	Give formation to students and professionals aiming to develop their knowledge in areas related to the activities of Rif.
3. Local Development	1. Creation of jobs	Encouraging that jobs created at Rif will benefit locals, create summer jobs.
	2. Ecotourism	Collaborate with locals to develop new opportunities for business, giving formation and incentive to a sustainable use of resources.
	3. Citizen science	Include locals in the development of activities such as gathering field data and birdwatching.

2. Goals description for 2021-2025

2.1. Research

Several monitoring projects are already in development by Rif in collaboration with national and international institutes, following the Rif Field Station Ecosystem Monitoring developed with the direction of the Circumpolar Biodiversity Monitoring Program (CBMP) as part of INTERACT Work Package 7 (RFS_monitoringp_Web_final.pdf (eu-interact.org)). Additionally, other research/monitoring projects will be developed during the next five years (2021-2025), by Rif in collaboration with national and international institutes. It is expected to develop several manuscripts and scientific presentations to be submitted in scientific peer-reviewed journals and to be present in national and international congresses, respectively.

2.1.1. Freshwater and terrestrial biodiversity monitoring plan

Ongoing projects that will continue to be developed during the next five years.

Project: Freshwater monitoring

Main objective: To detect and understand the causes of changes in the composition and function of Arctic freshwater ecosystems.

Methodology: Monitorization of relevant parameters to freshwater biodiversity, including abiotic parameters such as water quality, temperature, pH, and biotic parameters such as fish, algae, invertebrates, phytoplankton, zooplankton and macrophytes diversity.

Cooperation: Náttúrustofa Norðausturlands, Náttúrufræðistofnum Íslands, and Hafrannsóknastofnum.

Duration of the project: continuous.



Figure 3. Collecting macrophytes in a river.

Project: Harbour seal monitoring

Main objective: Understand the population dynamics of *Phoca vitulina* in Iceland.

Methodology: Counting during the breeding season of adults and juveniles. There are 10 counting points across the Melrakkaslétta peninsula.

Cooperation: Selasetur Íslands.

Duration of the project: continuous



Figure 4. Harbour seal female and a pup.

Project: Biotic Interactions Tracked by Computer Vision (BITCue)

Main objective: Study *Dryas octopetala* and *D. integrifolia* across the Arctic with contrasting climate conditions in order to establish a computationally efficient analysis pipeline for automatic detection and identification of flowers and flower visitors. Time lapse sequences of images will be used to quantify flower visitation rates at high temporal resolution, to test if climatic sensitivity of flower visitation vary across the landscape and among a range of tundra sites, and to test if local and large-scale variation in flower visitation rates matter for seed set in a widespread Arctic plant.

Methodology: Analysis of images of 8 photograph cameras in Rif area at the Melrakkaslétta peninsula.

Each camera is located above *Dryas octopetala*, taking photographs in an interval of 1 minute during the blooming season.

Cooperation: Aarhus University, Denmark.

Duration of the project: continuous



Figure 5. Camera system mounted in Rif.

Project: HiLDA – Iceland as a model for high-latitude dust sources

Main objective: Characterization of dust emissions and its transport processes in Iceland, as mineral dust is, regarding climate impact and biosphere, one of the most important aerosol types in the atmosphere.

Methodology: Analysis of several dust meters installed across Raufarhöfn.

Cooperation: University of Darmstadt, Germany.

Duration of the project: continuous

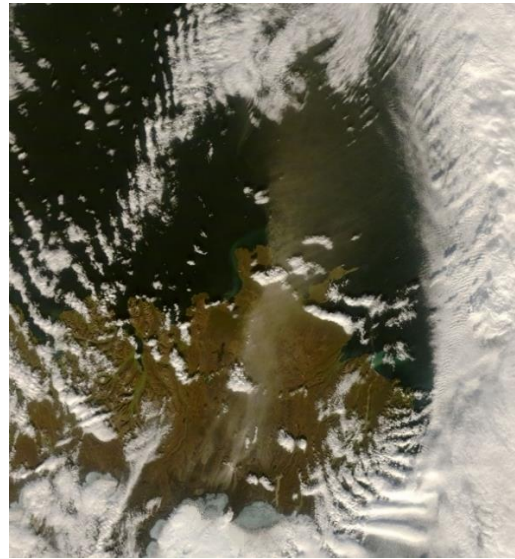


Figure 6. Dust emission in Iceland.

2.1.2. New research projects

To be developed by Rif in collaboration with national and international institutes.

Project: Haemosporidian parasites hosted by shorebirds from Melrakkaslétta

Main objective: to create a baseline study on Haemosporidian parasites hosted by shorebirds in the Melrakkaslétta peninsula.

Context: The rise of temperature due to climate change allows the expansion of vector-borne disease parasites to new geographic areas, which may result in severe consequences to Icelandic birds. Shorebirds will be used as a model species to determine the phylogeny of haemosporidians occurring in the Melrakkaslétta peninsula, i.e., the

identification of lineages, its origins and possible expansion to Iceland.

Methodology: Shorebirds will be captured during breeding season or during their migration season (depending if they are native or migratory species). Blood smears will be prepared for microscopic analysis to detect the presence of hemoparasites and blood samples will be obtained for molecular analysis to evaluate the infection rates and prevalence of parasites. Results also will allow the identification of lineages present in samples that could indicate the geographic origin of the hemoparasites.

Deliverables: It is expected to be developed at least two scientific publications and several presentations in national and international conferences.

Cooperation: Háskóli Íslands, Náttúrustofa Norðausturlands, Náttúrufræðistofnum Íslands.

Duration of the project: A Project Grant was submitted to RANNIS (15 July 2021), if accepted the project will be developed during the years 2022-2024, if not accepted, the molecular part of the project will depend on funds and could be developed later than 2024. Independently of

specific funds for the project, samples will be taken for future analysis and blood smears will be complete.

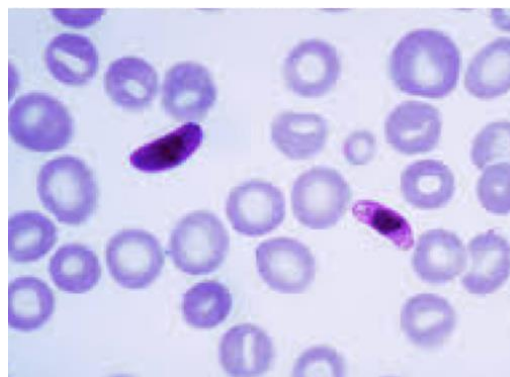


Figure 7. Plasmodium sp.

Project: Antimicrobial resistance genes in shorebirds from Melrakkaslétta

Main objective: To detect antimicrobial resistance genes in shorebirds in the Melrakkaslétta peninsula.

Context: Climate change could lead to an increase of antimicrobial resistance across the ecosystems, especially in areas near human activities. Due to the excessive use of antimicrobial compounds by humans in medicine, fish farms, animal production, etc., animals in the surrounding areas of the effluents are getting a growth resistance to a broad range of antibiotics, with a huge risk for their well-being, and due to zoonosis, to all the food chain and ultimately to the human health.

Methodology: Shorebirds will be sampled (cloacal swabs) and used as a model species, using

molecular techniques, to understand the differences in antimicrobial resistance genes between migratory and resident birds in Melrakkaslétta peninsula and geographically distant areas in the north (Melrakkaslétta peninsula) and the south (Suðurnes peninsula) of Iceland. Antimicrobial resistance genes data will be correlated with anthropogenic stressors, in order to understand the present state of coastal ecosystem health.

Deliverables: It is expected to be developed at least two scientific publications and several presentations in national and international conferences.

Cooperation: Háskóli Íslands, Náttúrustofa Norðausturlands, Náttúrufræðistofnum Íslands,

Þekkingarsetur Suðurnesja and Moredun Research Institute, Scotland.

Duration of the project: A Project Grant was submitted to RANNIS (15 July 2021), if accepted the project will be developed during 2022-2024, if not accepted, the molecular part of the project will depend on funds and could be developed later than 2024. Independently of specific funds for the project, samples will be taken for future analysis.

Project: Constant effort site

Main objective: Implement a ring station on an arboreal vegetation area in Melrakkaslétta peninsula, which provides valuable trend information on abundance of adults and juveniles, productivity and adult survival rates for songbirds breeding in the area.

Context: The long-time data obtained by a constant effort site is important to estimate the population trends of passerines in the area and the health state of the ecosystem. Climate change could affect the patterns and some species could leave the area and others could arise.

Methodology: Mist nests will be used to capture passerines monthly during spring and summer and at least once in the winter. Birds will be identified for species, ringed and followed during time for their presence/absence in the sampling area.



Figure 8. The overuse of antibiotics leads to antimicrobial resistance.

Deliverables: A report and presentation in national conferences.

Cooperation: Náttúrustofa Norðausturlands, Náttúrufræðistofnum Íslands.

Duration of the project: It is intended to start the project in the spring of 2022 and maintain it continuously.



Figure 9. Mist nets.

Project: Monitorization of coastal macrobenthic communities

Main objective: To describe the macrozoobenthic community composition and to estimate inter-annual variation in the benthic biomass in a sand beach at the Melrakkaslétta peninsula

Context: Intertidal soft-bottom assembles located at high latitudes provide a critical food source for long-distance migratory animals which link biodiversity across distant areas. Monitoring these communities will shed light on bird population trends.

Methodology: Macrobenthic intertidal surveys will be conducted during spring across several stations 100 m apart at the low tide. Sampling will be carried out by collecting sediment cores, and macrobenthos will be identified and its density will be estimated.

Deliverables: It is expected to be developed at least one scientific publication and several presentations in national and international conferences.

Cooperation: Háskóli Íslands, Náttúrustofa Norðausturlands, Náttúrufræðistofnum Íslands, Náttúrustofa Suðvesturlands

Duration of the project: It is intended to start in the spring of 2023, then maintain it in a period of three to five years.

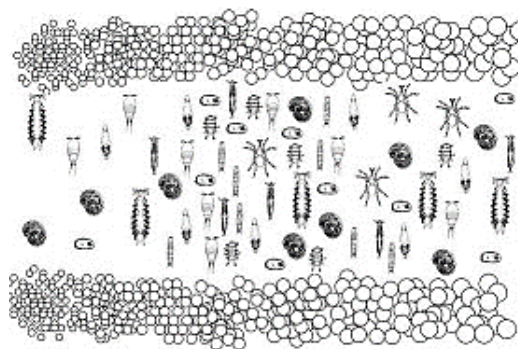


Figure 10. Macrozoobenthic community.

2.1.3. Research collaboration

During the time scale of 2021-2025, Rif will continue to collaborate in the on-going-projects and on new projects (see point 2 for the description of the projects).

During the next five years, Rif will receive scientists from INTERACT Network and will be active on remote studies from foreigner universities and research centres.

Table II presents Rif's collaborations with national and international institutes and it is aimed to continue to develop this network.

Table II. Rif Field Station collaborators in monitoring and research.

Collaborator Institution	Country	Project
Náttúrustofa Norðausturlands	Iceland	Freshwater and Terrestrial Biodiversity Monitoring Plan; Haemosporidian parasites hosted by shorebirds from Melrakkaslétta; Antimicrobial resistance genes in shorebirds from Melrakkaslétta, Constant effort site; Monitorization of coastal macrobenthic communities.
Náttúrufræðistofnum Íslands	Iceland	Freshwater and Terrestrial Biodiversity Monitoring Plan; Haemosporidian parasites hosted by shorebirds from Melrakkaslétta; Antimicrobial resistance genes in shorebirds from Melrakkaslétta, Constant effort site; Monitorization of coastal macrobenthic communities.
Hafrannsóknastofnum	Iceland	Freshwater and Terrestrial Biodiversity Monitoring Plan.
Háskóli Íslands	Iceland	Haemosporidian parasites hosted by shorebirds from Melrakkaslétta; Antimicrobial resistance genes in shorebirds from Melrakkaslétta, Monitorization of coastal macrobenthic communities.
Náttúrustofa Suðvesturlands	Iceland	Monitorization of coastal macrobenthic communities.
Selasetur Íslands	Iceland	Harbour seal monitoring.
Þekkingarsetur Suðurnesja	Iceland	Antimicrobial resistance genes in shorebirds from Melrakkaslétta.
Aarhus University	Denmark	Biotic Interactions Tracked by Computer Vision (BITCue).
University of Darmstadt	Germany	HiLDA – Iceland as a model for high-latitude dust sources.
Moredun Research Institute	Scotland	Antimicrobial resistance genes in shorebirds from Melrakkaslétta.

2.1.4. Science dissemination

The objectives of science dissemination are:

- i) present results of Rif's projects; ii) spread research developed by Rif; iii) develop the interest of the scientific community on the Melrakkaslétta biodiversity; iv) inform the local communities and the general society about the bio-importance of Melrakkaslétta; v) contribute to the body of knowledge.

During July 2021, it was accepted for publication the first scientific paper, for the time period 2021-2025 where one of the authors is affiliated to Rif Field Station (Pedro Rodrigues), in collaboration with researchers from Náttúrustofa Suðvesturlands: Micael J, Rodrigues P and Gíslason S. 2021. Native vs. non-indigenous

macroalgae in Iceland: the state of knowledge. *Regional Studies in Marine Science* (in press): Native vs. non-indigenous macroalgae in Iceland: The state of knowledge - ScienceDirect.

During the next five years, it is expected to be submitted several scientific manuscripts to peer-reviewed journals. These manuscripts aim to present the results of Rif's research projects. Results from research and monitoring data, will be presented in national meetings such as the Annual Meeting of the Icelandic Ecology Society (every year), and the Icelandic Biology Congress (2022, 2024), and at the international conferences such as the 47th Annual Meeting of the Waterbird Society (2023) and others, depending on funding.

Rif will develop several lectures for the local community to present Rif's projects and results, but also inviting national and international researchers to talk about their work in Melrakkaslétta (some of these researchers come to Raufarhöfn in collaboration with Rif and INTERACT), and across Iceland.

Several projects will be developed with the local communities to disseminate science (see below Coffee Science point).

From July 2021 will be published once a month a short article about Rif's projects and the biodiversity of Melrakkaslétta at Rif Facebook page (Rannsóknastöðin Rif - Rif Field Station | Facebook) and at Raufarhofn.net page (Raufarhofn.net | Facebook).

Rif also has a web page to present its projects (Rannsóknastöðin Rif — Rif research).

2.1.5. Coffee Science

Riff will develop periodic meetings with the local community to present and discuss the projects developed by Rif, by researchers using Rif's facilities, and by invited researchers from national universities and the local community.

The first Coffee Science session took place on June 26th 2021, on a local Coffee Shop (figure 11), to present some of Rif's projects and to present the work of Dr. Jose Valdebenito (Department of Zoology at the University of Debrecen, Hungary), that was in Rif for two weeks developing his scientific project (in collaboration with INTERACT), to the local community. Ten people attended the meeting and discussed ideas.

It is intended to continue developing Coffee Science sessions on a regular basis over the next 5 years.



Figure 11. First Coffee Science developed by Rif at the Kaupfélagið Raufarhöfn coffee shop.

2.2 Education

This goal aims to raise the interest in the Melrakkaslétta biodiversity, to increase the curiosity of local young people in science and Nature activities, and to create and develop new projects for university students in cooperation with national and international universities.

2.2.1. School cooperation

Rif will collaborate with the local schools to increase the interest of students (from 6 to 16 years old) in science, Nature and its conservation. Several lectures will be developed with the schoolteachers to bring new knowledge for students about biology, ecology and conservation of Melrakkaslétta. Rif will collaborate with any initiative from the school related to Nature and conservation.

A project called “Young Nature Guides” was already presented to the principal and teacher of Raufarhafnarskóli, and it was accepted.

Project: Young Nature Guides

Main objective: To provide Raufarhafnarskóli students the basic knowledge of the Melrakkaslétta biodiversity and the tools to develop their skills on identification of species (e.g., subarctic flora, waders, seabirds, mammals, etc.), so that they can act as guides for students from other schools who come to visit the area.

Context: Students from schools visit other schools in different areas across Iceland. Every year students from schools outside the Melrakkaslétta peninsula come to visit and learn a little more about Raufarhöfn and the surrounding area. Local students could act as guides for their colleagues from other schools to give information and lead a small safari, showing the most interesting areas in the peninsula to see birds, seals, arctic flora, etc.

Methodology: To be discussed with teachers. Several interactive lectures will be given at the school and in the field. We will apply for funds to buy binoculars and birds/flora guidebooks for the school to be used by students. Independently of funds the project will go on.

Deliverables: Several Coffee Science sessions are planned with students giving presentations about the local fauna and flora, and several tours will be made with students guiding local people.

Cooperation: Raufarhafnarskóli, Samtök sveitarfélaga og atvinnuþróunar á Norðurlandi eystra.

Duration of the project: It is intended to start during the school year 2021-2022, then maintain it constant in time.

2.2.2. Students research projects

Rif will encourage university students (undergraduate, master and PhD thesis) to develop their thesis's degrees and research projects in the Melrakkaslétta area in collaboration/co-supervision with universities, and will receive Erasmus students, from international universities, interested in Arctic and Subarctic environmental studies. Students are welcome to use Rif infrastructures and to participate in Rif activities.

2.2.3. Summer courses

During the next five years it is expected to be developed several summer courses to give formation to everyone interested in developing their knowledge in different areas related to science and Nature, and also to develop the interest in the Melrakkaslétta biodiversity. Some of these courses will be appropriate for students or professionals aiming to develop their knowledge in areas related to their studies/activities, e.g., biology, marine biology and environmental science students, Nature guides, Environmental staff, etc.

Courses will be developed by Rif and invited teachers such as researchers and professors from national and international universities and research institutions. Courses will have a cost to the participants in order to cover the expenses related to the activities of the courses and invited teachers. Rif will apply for funds to develop those courses and to reduce fees' costs.

Examples of summer courses that could be proposed by Rif, depending of the general interest: Ornithology Basic Course, Marine Coastal Fauna, Fauna and Flora of Melrakkaslétta, Ecotourism and Pedestrianism, etc.



Figure 12. Summer course “Research Methods in Bird Ecology”.

2.3. Local development

During the next five years, Rif will support and cooperate in projects using the natural environment of Melrakkaslétta as ignition to promote growth, progress and positive changes on local communities. The purpose of these projects is to improve the quality of community life, expanding the local income and employment opportunities, without damaging the environmental resources, in order to maintain or increase the number of inhabitants of local towns. Rif will also encourage the use of local restaurants, markets, hotels and facilities by researchers and students to stimulate the local economy.

2.3.1. Creation of jobs

With the development of the Rif's projects, mentioned in Research and Education points, jobs should be created and benefit primarily the local inhabitants. Due to the seasonality of some projects/tasks of these projects, summer jobs will also be created.

For more specific jobs, targeting qualified workers as for instance biologists, geologists, etc., Rif will discuss the best candidates with the members of the board.

Rif will submit projects to several institutions as RANNIS, and will collaborate with Samtök sveitarfélaga og atvinnuþróunar á Norðurlandi eystra in order to find the best ways to apply for local funds.

2.3.2. Ecotourism

Tourism is increasing in the Melrakkaslétta area as more tourist operators realize the area's uniqueness as an opportunity for nature-based tourism, especially birdwatching. Tourism built upon birdwatching has been increasing in Iceland and northeast Iceland is very suitable for this kind of tourism. In recent years a cooperative project run by tourist operators, organizations and individuals in the northeast has promoted bird watching and birding tourism in the region under the name of Birding trail Northeast Iceland. Rif could collaborate with these operators giving summer courses, already mentioned in Education point, to develop their knowledge on the area and to increase the sustainability of resources.

Rif also aim to collaborate with local communities and institutes in the development of new opportunities for business related with ecotourism and Nature and to cooperate with any operator who want to create a new ecotourism company related with walking trails, birdwatching, flora and fauna, etc., using Melrakkaslétta and the surrounding areas as background.

2.3.3. Citizen Science

The objective of the voluntary involvement of the general public in scientific research, is to harness the information of local people about the Melrakkaslétta area. Their empirical knowledge will help researchers and resource managers gather data and knowledge to better understand the Natural environment of the area and better design experiments, collect data and analyse results.

Rif will collaborate with ongoing projects developed by local people, for instance in long term data on bird migratory arrivals.

3. Conclusion

Taking into consideration what was achieved since its establishment in 2014, with the implementation of Rif Field Station Ecosystem Monitoring Plan and the development of a network of experts from national and international institutes, Rif has established itself as one of the centres of Arctic research in Iceland. During the next five years (2021-2025), Rif's main objective will be to ensure the long-term sustainability of the station applying the above priority projects and points in collaboration with national and international institutes, in order to build the foundations for its future international recognition as an institute of excellence for the study of climate change and its impact on the southern edge of the Arctic ecosystem.

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