Integrating Activities for Advanced Communities

D6.1- Report on the Rapid response action plan

Project No.730938– INTERACT

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PU	Public	X
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Publishable Executive Summary

Within the Work Package, we focused on identifying the most important and relevant potential risks to the Arctic environment and population. We carried out an extensive literature survey of various available sources of relevant information (e.g. scientific papers and annual reports of monitoring organizations and initiatives). We identified more than 40 potential hazards and sorted them into seven categories.

A questionnaire was sent to all stations involved in the INTERACT project to answer questions about events to obtain information on observations made around research stations and on the severity of individual perceived risks in order to identify the most important hazards and to take note of hazards not identified during the literature survey.

Initiatives, organizations or projects that are either directly focused on the monitoring of the Arctic (AMAP, CAFF and GEO) or initiatives and projects dealing with events that may be important for the Arctic in the future (CLINF, GEO, SUMAG, NEON) were identified and contacted.

A trial run aimed to determine the prevalence of selected tick- and mosquito-borne diseases in the Arctic by collecting samples of mosquitoes, ticks and animal droppings was conducted in the summer of 2018.

The preparation of the web site is underway. The site will provide information on potential hazards and protocols on how to collect data for their monitoring, links to ongoing trial run(s) and sampling campaigns, and contact information for reporting events or developments.

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1. Identification of potential hazards

1.1. Literature survey

We carried out a vast literature survey of various available sources of relevant information (scientific papers, annual reports of monitoring organizations or initiatives and final reports of projects). More than 40 potential hazards were identified and grouped into seven categories presented in Table 1.

Table 1. Identified groups of potential hazards with the most important events.

Group	Hazards
CLIMATE-SENSITIVE INFECTIONS	air-borne diseases, babesiosis, canine distemper, chronic wasting disease (CBD), *Coxiella burnetii*, cryptosporidiosis, echinococcosis, encephalitis, encephalitis, rabies, Spanish flu, toxoplasmosis, toxoplasmosis, fungal spores
NON-NATIVE AND RANGE-EXPANDING SPECIES	alien species/invasive species, expanding species, algal blooms
ENVIRONMENTAL CONTAMINANTS	air pollution (NO_x, SO_x, NH_3...), black carbon, carbon dust, contaminants from the oil and gas extraction industry, mercury, microplastic, nanoparticles, other chemical contaminants (e.g. from military activity), ozone depletion, POPs, radionuclides
HAZARDS	tsunamis, earthquakes, floods, oil spills, snow avalanches, methane eruptions, tundra wildfires, volcanic ash, windfall, rockfall
ENVIRONMENTAL INDICATORS OF CLIMATE CHANGE EVENTS	extreme weather events (rain on snow, winter warming, extreme rain/snowfall...)
ENVIRONMENTAL INDICATORS OF CLIMATE CHANGE TRENDS	air temperature, precipitation, duration of snow cover, mass balance of glaciers, climate gases, active layer depth, permafrost thawing
MISCELLANEOUS	meteorite strikes, noise and traffic

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1.2.Questionnaire

A questionnaire was sent to all station managers. The purpose of the survey was to gather information about the various risks and hazards they perceive or expect in the vicinity of their stations and the surrounding region. It was intended to collect as much information as possible and to assess the most important hazards that are currently causing or may potentially pose serious problems in the Arctic to people, animals, plants or the whole environment. We received a response from 40% of stations. We extended the pool of identified hazards and produced word cloud diagrams representing the perceived severity of each hazard within each category (Figure 1).

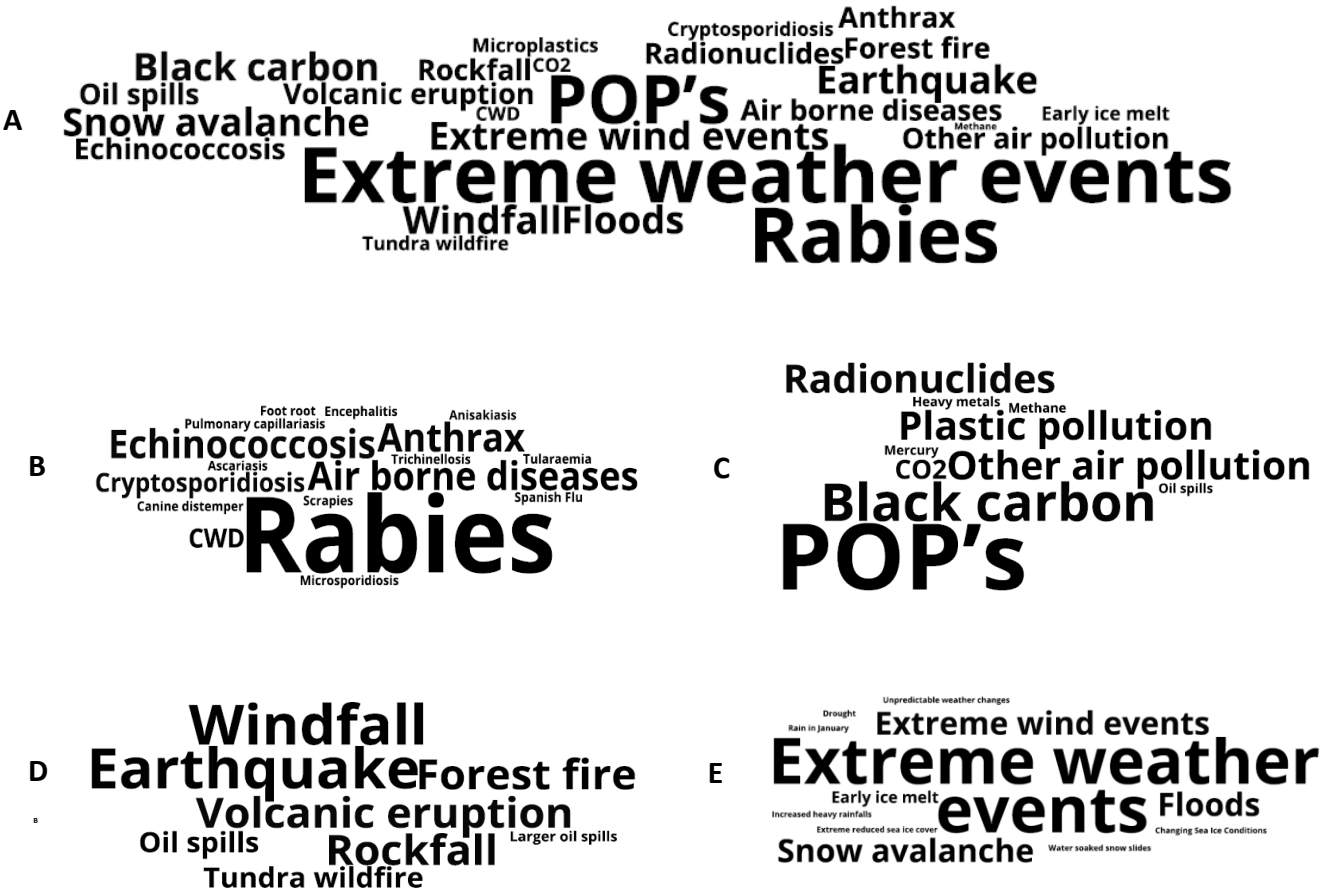

Figure 1 Word cloud diagram representing the severity or imminence of hazards in the vicinity of Arctic stations as reported by station managers. The bigger the word, the greater the severity of the hazard reported in the questionnaire by each station manager. (A) All risks together, (B) climate-sensitive infections, C) pollutants, D) hazards, and E) environmental indicators of climate change.

Based on the survey results, the most important reported risks are (a) diseases (rabies, air-borne diseases, e.g. anthrax, tuberculosis), (b) pollutants (POPs, black carbon, plastics), (c) catastrophic events such as earthquakes, windfalls or volcanic eruptions, and (d) weather related events such as instances of extreme weather (rain on snow, winter warming, extreme rain/snowfall...), floods or avalanches.

1.3. Description of the information flow

Figure 2 describes the proposed information flow when an environmental risk/event occurs. Events shall be reported by local communities or station staff to agencies/laboratories that analyse the data. The output shall be reported to scientists and local/national authorities, which shall take proper action to mitigate or manage the consequences. Effective communication with local communities and stations could decrease the costs of consequence mitigation.

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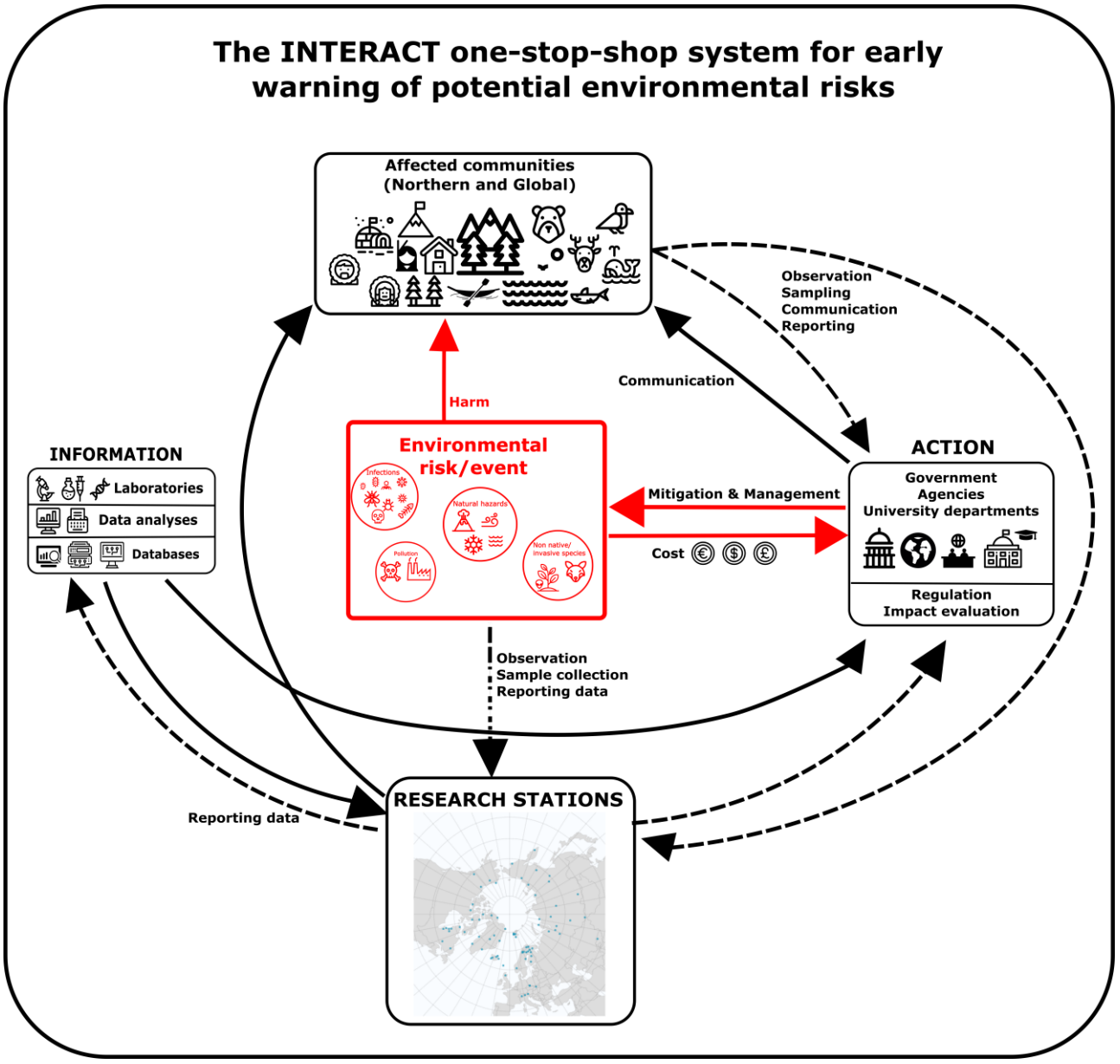

Figure 2 From Information to Action: Proposed flow of the information from the affected site to authorities.

2. Cooperation

2.1. Cooperation with institutions, organizations, initiatives or projects

We have established cooperation with several organizations and projects focused on the Arctic to consult possible hazards and to develop monitoring strategies or to extend the scope of present strategies. With the same objectives, we are also going to contact other organizations.

With the Laboratory of Arbovirology at the Biology Centre of the Czech Academy of Sciences, we started to cooperate on the determination of the prevalence of selected tick- and mosquito-borne diseases in the Arctic (such as influenza), which was used as trial run during the summer of 2018 (see section 3 for more information). The data obtained will serve as a baseline for the monitoring of future shifts in the distribution of selected diseases. To extend the list of possible diseases, we have initiated communication with the CLINF project (https://clinf.org), focused on the effects on climate change on the distribution of climate-sensitive infections and their impact on northern animal husbandry households. Similarly, we started to communicate with the National Ecological Observatory Network, NEON (https://www.neonscience.org), to identify opportunities for cooperation on receiving and analysing samples of selected diseases that could affect the health of people and animals.

There is emerging cooperation with the ongoing project First Systematic Surveys in Greenland (SUMAG) regarding plastic pollution in the Arctic. Cooperation is also being negotiated with the Radioactivity Laboratory at Aarhus University, Institute of Bioscience, Arctic Environment Department, which started to operate recently.

The Arctic Invasive Alien Species (ARIAS) initiative under the Conservation of Arctic Flora and Fauna (CAFF) working group developed a Strategy and Action Plan which sets forth priority actions for the protection of the Arctic region against the most significant threat: the spread of invasive alien species. Protocols for the early detection and reporting of non-native invasive species in the Arctic will be included in the Rapid Response web platform as soon as they are developed.

The LEO network is a network of local observers and topic experts sharing knowledge about unusual animal-related, environmental and weather events. The network is currently active mostly in Alaska and west coast of the United States. Cooperation between the LEO network and the INTERACT Rapid Response work package would be greatly beneficial, as it would establish a connection with local communities involved in the network.

Other relevant agencies and initiatives will be contacted next to establish cooperation on other topics (AMAP for environmental contaminants, AWI for nanoplastics, GEO for environmental hazards, etc…).

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2.2. Cooperation with another WP within INTERACT

We have agreed to cooperate with Work Package 7 (Improving and harmonizing biodiversity monitoring) on implementing protocols for the monitoring of non-native/invasive species, developed together with the ARIAS initiative.

As mentioned above, the Rapid Response initiative has the ambition not only to involve the scientific staff of Arctic stations, but also to reach and benefit local communities and to get them to participate in the collection of data. First, they are the most exposed to hazards occurring in the Arctic, and, secondly, they are the most likely to observe or witness new developments. Together with Work Package 9 (Adapting to environmental change), we will work together on how to effectively communicate with locals and how to give them access to information about potential hazards or ongoing monitoring they could take part in (e.g. through the LEO network).

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3. Trial run

3.1. Event timing and selection

The trial was intended to run during the summer season of 2018 to keep one more season as a backup in case of non-success. The subject for the trial run had to be selected so that it would be (a) easy to understand, (b) widespread throughout the Arctic, (c) easy to realize, and (d) inexpensive.

We decided to cooperate with the Laboratory of Arbovirology at the Biology Centre of the Czech Academy of Sciences on collecting ticks, mosquitoes and bird or seal droppings for the determination of the prevalence of selected tick- and mosquito-borne diseases (e.g. arboviruses, influenza) in the Arctic. Mosquitoes are abundant in many parts of the Arctic and can be easily collected with an entomological net. *Ixodes uriae* ticks parasitize mostly on seabirds (such as auks and puffins) and can be found either directly on the bodies of birds or near their nests.

3.2. Realisation

We have prepared step-by-step sampling protocols for each type of sampling (attached). The protocols were designed to be as easy as possible to follow, so that there would be no serious obstacle and that everybody would understand the sampling process and that the sampling itself would not be time-consuming. The sampling procedures were designed so that they could be followed with no extra specialized equipment. The protocols included an equipment list and pictures of necessary items.

The samples had to be preserved either by deep freezing (to −20°C), on dry ice or in a special solution (DNAlater). Because we assumed that not every station would be equipped with a deep-freezer or have DNAlater available, the Laboratory of Arbovirology offered to provide appropriate amounts of DNAlater, as well as other sampling materials (e.g. vials) upon request.

3.3. Encountered problems

We sent the protocols to station managers in August 2018. Unfortunately, at most of the stations the season was already over. The trial run will be repeated next year at the beginning of the season (i.e. in spring).

Even though we received valuable feedback, the trial run revealed two important problems that need to be addressed:

A) The possible necessity to obtain permissions for collecting of samples (important e.g. in Greenland)

B) The shipping of parcels

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Even though we opted for the collection of samples that are not protected, in some areas it is mandatory to obtain permission to collect any type of samples. That is not a problem in planned sampling for monitoring. When urgent action is needed, however, this would pose a significant problem.

The shipping of parcels turns out to be much more complicated than expected. The samples collected as part of our trial run did not pose any health risk; however, we have asked the Czech customs office and several shipping companies how to send samples of this type and whether there are any limitations, but we did not get any satisfactory answer. The experiences of stations managers also differed considerably (problems are expected especially when sending samples from Russia), so precautions have to be made to ensure the safe delivery of parcels.

To follow the rules, because the samples potentially contained infected biological material, we instructed the station managers to mark each parcel as 'UN 3373 – Biological substance, Category B'. However, this labelling can cause delays in delivery as a result of customs processes (e.g. veterinary checks).

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4. Outreach

4.1. Web site

A web platform is currently being developed. It should serve as a hub for finding all necessary information about risks and hazards grouped into categories, links to ongoing trial runs or calls, as well as a 'red button' allowing to easily contact someone from the Rapid Response Work Package, who will forward the message to the proper recipient (Figure 3)

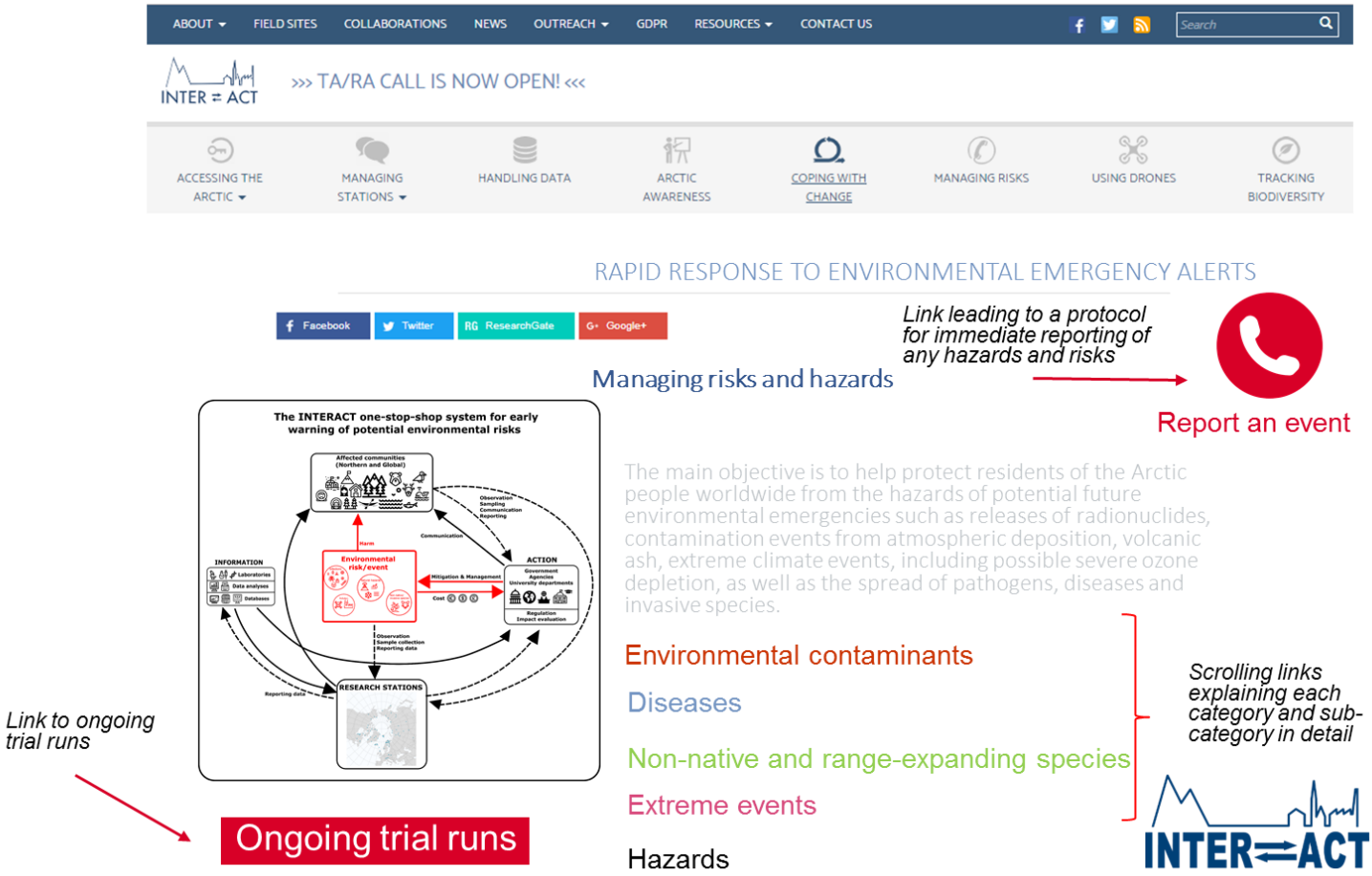

Figure 3 Rapid Response web page layout

Each potential hazard sheet will contain general information about its character and severity. Additionally, there will be links to organisations, initiatives, laboratories or projects dealing with each issue, which may be contacted regarding any questions or problems, as well as protocols describing sampling or monitoring processes.

4.2. Conference presentations

The Rapid Response Work Package has been presented at several conferences and meetings:

Arctic Change 2017, Quebec, Canada
POLAR 2018, Davos, Switzerland
At Home in Svalbard 2018, Longyearbyen, Svalbard
Arctic Biodiversity Congress 2018, Rovaniemi, Finland

5. Future

In the next period, we will focus on following activities:

- Deepening of already established cooperation
- Contacting other organizations and looking for new potential partners
- Identifying laboratories for sample/data analyses
- Populating the web platform with information about potential hazards
- Repeating the trial run on the determination of the prevalence of selected tick- and mosquito-borne diseases in the Arctic
- Realisation of another trial run on a different topic
- Analysis of existing constraints on sample collection and transport (such as permissions and cross-border export limitations), and proposals for solutions
- Cooperation with initiatives or projects in the preparation of sampling/monitoring protocols

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Appendix I: Trial run guidelines

Arboviruses sampling protocol

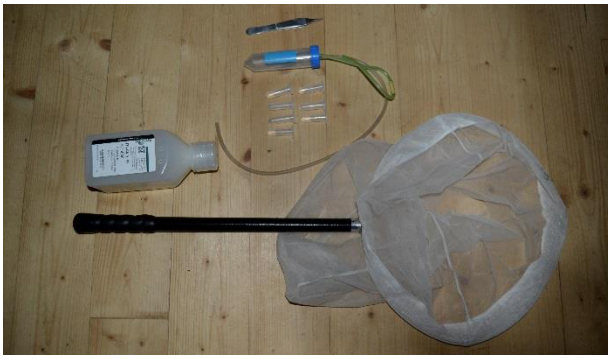
Author: Jiří Černý, Institute of Parasitology, Biology Centre Czech Academy of Sciences
July 2018

Arthropod-borne viruses are an important group of viruses causing tens of thousands of human deaths worldwide every year. Many arboviruses are present in the Arctic, such as the human pathogenic tick-borne encephalitis virus, which has been detected in areas around the polar circle in Norway. Other arboviruses (e.g. the snowshoe hare virus) have been detected at latitudes of up to 70°. As arthropods transmitting these arboviruses are known to occur in the Arctic, the viruses are also expected to be found further north. Arboviruses are transmitted either by *Ixodes uriae* ticks or by various species of mosquitoes.
Mosquitoes are abundant in many parts of the Arctic and can be easily collected with an entomological net. *Ixodes uriae* ticks parasitize mostly on seabirds (such as auks and puffins) and can be found either directly on the bodies of birds or near their nests.

For a meaningful study, hundreds of mosquitoes or tens of ticks from each locality are needed (the more, the better; however, every sample counts).

Mosquito collection

MATERIAL LIST: Entomological net, zip-lock bags, 1.5-ml microcentrifuge tubes, forceps, RNAlater, pipette



1) Mosquitoes can be easily caught into entomological nets, placed in zip-lock bags, frozen and transferred into test tubes. This short video shows how to catch insects into a sweep net: https://www.youtube.com/watch?v=vKVVrIkSW5w.
2) Collect samples from one locality into one or more tubes (approx. 50 individuals in one tube). Please never mix samples from different localities. If possible, optionally separate different mosquito species.
3) Please write down the main characteristics of the samples on the sheet. You may include additional information that can be used to determine mosquito activity (number of individuals attacking you per minute, time, wind speed, temperature, weather, etc.).

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4) Mosquitoes can be collected into 1.5-ml plastic centrifuge tubes in numbers of up to 50 individuals per tube (if possible divided by species or genus; help with their identification can be requested from Jiří Černý).
5) Samples of mosquitoes should be frozen at −20°C (or lower) as soon as possible after collection. They must stay frozen during storage and transport. If freezing facilities are not available for storage and transport, samples should be fixed with RNAlater, which can be provided upon request. Samples fixed with RNAlater can be kept for several days at room temperature or for several weeks at 4°C. If using RNAlater, simply add approximately 1 ml of the RNAlater solution to the 1.5-ml tube containing the mosquitoes.

Tick collection

We are aware of the fact that collecting ticks off birds or from their nests is a specialized activity subject to permission at most localities. However, if someone at your station is involved with the monitoring of birds and their nests, we would be very grateful if he or she would help us by collecting ticks for the purpose of monitoring arboviruses.

MATERIAL LIST: 1.5/15 or 50-ml tubes, forceps, RNAlater, pipette

1) Collect all ticks from one bird or nest into one or more tubes. Up to twenty ticks can be placed in one tube. (Never mix ticks from different birds or nests together.)
2) Please write down the overall characteristics of the colony on to the provided sample sheet. Note the main characteristics of the host (date, species, age, etc.).
3) Live ticks can be kept for weeks at 4°C, but samples should ideally be frozen at −20°C (optimally −70°C) as soon as possible after collection. They must stay frozen during storage and transport. If reliable freezing facilities are not available for storage and transport, samples should be fixed with RNAlater, which can be provided upon request. If using RNAlater, simply add approximately 1ml of the RNAlater solution to the 1.5 ml tube containing the ticks. Samples fixed with RNAlater can be kept for several weeks at 4°C or frozen when possible.

1. Droppings collection protocol for the detection of the influenza virus

Author: Jiri Cerny, Institute of Parasitology, Biology Centre of the Czech Academy of Sciences
July 2018

Despite being thought of as a normal seasonal disease, influenza is one of most deadly diseases, causing the deaths of many patients worldwide. Different influenza strains can easily recombine, creating new potentially highly pathogenic strains. It is therefore important to monitor not only pathogenic strains, but the whole virus population. In the Arctic, the influenza A virus frequently infects seabirds, geese, ducks and seals whereas the influenza B virus has been found only in seals. In infected birds, the influenza virus is secreted with excrements, which can be easily collected.
Any number of samples is greatly appreciated, but tens of samples from each bird or seal colony are necessary for a statistically significant analysis.

Droppings collection

MATERIAL LIST: 1.5/15 or 50-ml tubes, laboratory gloves or plastic bags, toothpicks (or safety matches), RNAlater, pipette

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1) Please write down the general information about the colony under study (animal species, numbers of individuals, locality, etc.) on the sheet.
2) Droppings must be collected as fresh as possible (still viscous, not dry).
3) Collect droppings into an empty 1.5-ml tube or into a tube containing RNAlater (can be provided upon request) using a new wooden toothpick or some similar object (e.g. a pipette tip). Never reuse the tool.


Wear laboratory gloves (or plastic bags) when handling the droppings and wash your hands afterwards.

4) Write down the main characteristics of all samples (date, bird/seal species, etc.). Try not to collect samples from the same individuals.
5) Please sample each bird colony within three days or less to avoid bias caused by epidemiological dynamics. The same colony can be resampled after 14 days to study the dynamics of epidemics.
6) Samples should be frozen at −20°C (or lower) as soon as possible after collection. They must stay frozen during storage and transport. If reliable freezing facilities are not available for storage and transport, samples should be fixed with RNAlater, which can be provided upon request. Samples fixed with RNAlater can be kept for several days at room temperature or several weeks at 4°C. If using RNAlater, simply add approximately 1 ml of the RNAlater solution to the 1.5-ml tube containing the droppings. Each sample has to be fully immersed in the solution.

Final notes

Samples should be sent to:
Jiří Černý, Institute of Parasitology, Biology Centre CAS,
Branišovská 31,
370 05 České Budějovice, Czech Republic.

There should not be any problems connected with the sending of samples across national borders. The samples do not pose any health risk; however, to follow the rules, the parcel should be marked as 'UN 3373 – Biological substance, Category B'. Please ensure proper packaging and storage. It may also be necessary to fill in a 'commercial invoice'. It is important to state some low value of the parcel (e.g. 1 or 2 USD) to avoid the payment of customs fees.

RNAlater is necessary for the preservation of samples during transport when it is impossible to send them in frozen form. If you do not have it at your disposal, please contact Jiří Černý at cerny@paru.cas.cz, and we will send you an appropriate amount.

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