**Avifauna in Arctic Tundra: Acoustic Monitoring of Migratory Birds in Northeastern Siberia**

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**Summary**

Not yet finished :P

**Background and Relevance**  
*Introduce your project, including the need you want to address. Tell us why the issue is important. Cite relevant literature, media coverage, or previous work where applicable (include citations in the Works Cited section below).*

Located at the northeastern Russia, Siberian arctic tundra is favored by numerous migratory bird species (Pearce et al., 1998b). Indigirka river delta (IRD) is one of the most productive tundra area in Siberia that supports 40 – 60 breeding species each summer (Goryachkin, 1994; Pearce et al., 1998a). IRD is the main breeding ground for many rare species, such as Siberian Crane (*Leucogeranus leucogeranus*), which is listed critically endangered in the Red List of IUCN (International, 2016). Other characteristic species include Sandhill Crane (*Grus canadensis*), Yellow-billed Loon (*Gavia adamsii*), Ross’ Gull (*Rhodostethia rosea*), and Steller’s Eider (*Polysticta stelleri*). It is not exaggerate to say IRD is the most important breeding grounds of the world for migratory birds.

There is no doubt that IRD deserves continued monitoring and conservation, however, only few research expeditions had been conducted and the quantitative data for bird community is lacking (Pearce et al., 1998a). The arctic tundra in IRD is one of the least explored biomes due to the harsh natural environment. Researchers are not able to get access to the IRD until the Indigirka river channel is open, around late May to June. The lack of transportation and the short summer (i.e., 50 to 60 days) substantially constrain both the spatial and temporal scale of the bird study. A long term monitoring for bird community in IRD Siberian arctic tundra is urgently needed and a new method must be imported to enhance the scale of monitoring.

In this study, we propose to import automatic recording systems to monitor the bird community in the arctic in IRD area. Autonomous recording system has been applied in diverse ecosystems to remotely and non-invasively monitor bird community (Blumstein et al., 2011). Species richness, abundance, composition, and other quantitative data can be derived. With the permanent recordings, automatic recording systems are proved to have the same or even better detection ability than traditional field survey (Celis‐Murillo et al., 2009). Given the progressive vocal activity of the breeding birds in arctic tundra, applying autonomous recordings systems in tundra is promising and will definitely enhance our understanding for the avifauna.

This study will be the first attempt of applying automatic recording systems in Siberian arctic tundra for monitoring migratory birds. By setting up the system, we will examine the bird species richness, abundance and community dynamic in different habitats along the breeding season (i.e., May to July). Large area and long-term detection of birds in tundra is not possible with conventional survey methods but can be achieved by the automatic recording system. We are looking forward to exploring the beauty of avifauna in arctic tundra with bioacoustics.

**Goals and Objectives**

*What do you plan to accomplish with this project?*

*\*A goal is a simple, clear, and general statement of the desired outcomes; there may be more than one goal. The objectives should be derived from the goal statement, defining specific, measurable targets; please make clear to which goal the objectives are linked.*

Goal 1: Dynamics of the quantitative observations

Using automatic recordings in Indigirka delta to monitoring birds activity during the breeding season.

Objective1-1: Assess the daily dynamics of breeding activity by compare the vocal activity within one day (richness, abundance and composition).

Objective1-2: Assess the long-term dynamics of breeding activity

Goal 2: Increase the database of bird sound for Xeno-Canto

Objective 2-1: Provide a revised annotated list of all species recorded (Put on the Xeno and Cornell lab of ornithology.

Our first objective in this study was to provide a revised annotated list of all species within the coastal portion of the IRD and to note their general abundance. Second, we assessed changes in the presence of breeding species by comparing our records to the historicl account of Uspenskii et al 1962. Third, we examined the avifaunal composition of the IRD in comparison to that of adjacent coastal Arctic areas within Eastern Siberia to investigate unique and shared attributes of the IRD avifauna. Finally, we compared records for these areas to breeding records from the Chukotka Peninsula to examine the west-east gradient suggested by Uspenskii et al and the regional groupings proposed by Zasypkin 1981.

I think the project is very good. No need to hurry, calmly write more details about the method with automatic sound recorder. it's will be new method for monitoring of birds of tundra. You are right not enough researchers because very hard natural conditions and too long distance from Yakutsk. The time for accounting birds too short. I'm plan to back to Yakutsk on 06 July. Need to choice the points for an annual voice recording on the different biotopes.

**Methodology Detail**

*Detail the methods you will use to complete your project and why these are the best methods. Note any special or unusual tools or techniques you plan to employ. List and describe the steps you will take to implement your approach, and provide a timeline for implementation. Indicate which populations, communities, and/or locations you will target with this project. If appropriate, specify the anticipated number of participants/subjects.*

**Study area**

The recording systems will be set in the arctic tundra of Indigirka river delta (IRD) area, specifically the Dzhyukarskoe lake (70˚56′37.0′′N, 148˚00′22.3′′E). Typical vegetation in the area is composed of dwarf shrubs, grasses, lichens, and mosses. The subsoil is permafrost. In summer time (i.e., breeding season), the temperature ranges from -4 to 22˚C, with an average of 5˚C. Two different habitats will be monitored with two sets of recording systems. There is a research station located by the Dzhyukarskoe lake that we will use during the fieldwork. Food supply and fuel will be purchased from the nearest village, Chokurdakh ([70°38′N 147°54′E](https://tools.wmflabs.org/geohack/geohack.php?pagename=Chokurdakh&params=70_38_N_147_54_E_region:RU-SA_type:city(2,367))). The IRD area is within the Kytalyk Reserve so that a permit is required from Siberian Branch of the Russian Academy of Sciences.

**Bird species**

The updated species list of IRD area consists 93 species and 57 of them are migratory birds (species list: <https://goo.gl/Ma9q7Y>). We are interested in monitoring all the migratory species especially for the following target species:

* Siberian Crane (*Grus leucogeranus*): One of the rarest species breeding in tundra. The Siberian Crane is listed critically endangered in the Red List of IUCN and only 3,750 individuals were left in the wild.
* Sandhill Crane (*Grus canadensis*): A species has intraspecific competition with Siberian Crane.
* Rough-legged Buzzard (*Buteo lagopus*): A migratory raptor staying in south Asia during winter time. The population of Rough-legged Buzzard is decreasing due to the agriculture management in the south Asia (i.e., poison rats).
* Ross’s Gull (*Rhodostethia rosea*): Not yet well studied in Indigirka river

**Recording equipment**

The type of autonomous recording unit (ARU) we plan to use is the Song Meter SM4 Acoustic Recorder provided by Wildlife Acoustics. Two built-in microphones in SM4 are omnidirectional (i.e., capture sound equally from all directions) with sensitivity at -28dB +/- 3dB at 1kHz. The frequency response of the microphones ranges from 20Hz to 48kHz, which fully covers the frequency of bird sounds, ranging from 1kHz to 8kHz. The SM4 features on its low power consumption, large data storage (i.e., more than one terabyte total capacity), and malleable operation environment (i.e., during rain and low temperature down to -20 ˚C). Furthermore, it provides the flexibility in powering system so that the external solar panels can be connected to provide the electricity. The combination of these features makes SM4 a suitable acoustic recorder in our study.

We will use the scheduled recording function of SM4 to record 10 minutes per hour, 24 hours a day during the breeding season. Given the fact that IRD is with the Arctic Circle, recording bird sounds for 24 hours per day will help us to understand the daily dynamic of vocalization under midnight sun.

**Audio interpretation**

The audio recordings collected in the field will be analyzed in the laboratory by human experts. The analysis can be broken into two stages: signal detection and signal classification. Signal detection involves the extraction of structured sounds of interest while signal classification involves the identification of bird species. We will apply logistic occupancy model to detect the presence of birds in each audio file, then identified the species by comparing the recordings with the bird sound database: Xeno-Canto. For each audio file we will then be able to derive the species richness (i.e., the number of species), abundance (i.e., the number of individuals of each species), and composition.

**Project timeline**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. |
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|  |  |  |  |  |  |  |  |  |  |  |
| VISA application |  |  |  |  |  |  |  |  |  |  |
| Field gear |  |  |  |  |  |  |  |  |  |  |
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**Methodology Justification**

*Explain why you believe the activities you have planned will achieve the result(s) you expect. Include any assumptions necessary for this project to succeed (e.g., critical relationships or external factors outside of your control).*

In the summer of 2017, I cooperated with Russian Academic of Sciences to record tundra birds in the Indigirka river delta (IRD) area. Based on the experience, I listed two potential constrains in this study and the reasons why I am optimistic in achieving our goals.

Location selection and accessibility

The IRD area is one of the most productive tundra delta consisting 57 breeding species, including the majority of the population of several rare species. Furthermore, several arctic species still stay unrecorded. The IRD is no doubt the best location to apply long-term acoustic monitoring. My local cooperator, Sergei M. Sleptsov, is an ornithologist from Russian Academic of Sciences. He is an experienced researcher working in tundra and visits IRD area every summer. He will help to apply the permit to get to the Kytalyk Reserve and arrange all the local transportations.

Long-term monitoring system

Recording bird sounds in tundra is a challenging task due to the extreme weather conditions (i.e., low temperature, limited electricity source, and strong winds). In my 2017 visit in IRD area, I used Telinga SM2 parabolic microphone system and successfully got high quality recordings (Xeno-Canto link). According to the experience, I listed possible challenges for the SM4 we are going to use in this study.

-Low temperature: The lower limit of SM4 operation temperature (i.e., -20 ˚C) is lower than the lowest temperature in summer in the IRD area (i.e., -4 ˚C), so the system will work well. However, the low temperature will substantially reduce the battery life, which we will discuss in the next paragraph.

-Limited electricity source: The SM4 build-in batteries can support 300 hours of recording. The SM4 also supports external power so powering the system with solar panels for a long-term operation is possible.

-Strong wind: The wind speed in tundra is around~. We will use extra windshield layers on the SM4 microphones to prevent noise due to the wind.

**Summary of Outputs and Results**

*Please describe all relevant outputs you expect to produce (e.g., data, new tool, new method, media). Describe the changes, if any, you expect to result from these outputs and specify who/what will benefit.*

**How do you plan to disseminate your results and to whom?**

1. Publish all species recordings to the bird sound library Xeno-Canto (<https://www.xeno-canto.org/>)
2. Publish the research process in the social media and science articles website to general public.
3. Publish the research in BranchLine to students, faculty members, and publics.
4. Conference presentation (International Ornithology Congress 2019) to the ornithologist peers.
5. Paper publication for specific group.

**How will you evaluate your work and results?**

*Please list the indicators you will use to monitor progress toward your goal(s). Include current baselines and expected targets, if applicable.*

Number of species recorded. Hard question

**External Capacity Development**  
*If applicable, please describe how your project contributes to the socioeconomic or professional development of local students, community members, collaborators, or other individuals through education, training, mentoring, or other methods.*

Share the data with Russia Academic of Science.

**Works Cited**

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