**Acoustic monitoring for migratory birds in Siberian Arctic tundra**

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**Background and Relevance**

Located in northeastern Russia, Siberian arctic tundra is favored by numerous migratory bird species due to its wide marsh areas (Pearce et al., 1998b). Indigirka River Delta (IRD, 5,000 km2) is one of the most productive tundra area in Siberia that supports 40 – 60 breeding species each summer (Goryachkin, 1994; Pearce et al., 1998a). The delta is the main breeding ground for many rare species, such as Siberian Crane (*Leucogeranus leucogeranus*), which is listed as critically endangered in the IUCN Red List (IUCN, 2017). Other rare species include Yellow-billed Loon (*Gavia adamsii*), Ross’s Gull (*Rhodostethia rosea*), and Steller’s Eider (*Polysticta stelleri*). There is no doubt that the delta deserves continued monitoring and conservation, however, only few research expeditions had been conducted since it is difficult and expensive to survey with human observers (Pearce et al., 1998a). A new method must be introduced to enhance the scale of avian monitoring in the Indigirka River Delta tundra area.

Automated acoustic recording systems are recognized as a powerful tool for studying bird across broad landscapes due to its capacity in collecting large amounts of vocalization data (Sidie‐Slettedahl et al., 2015). Advantages of automated recorders include the remote monitoring, and the programmable collection of acoustic data 24 hr/day, which provide spatial and temporal replication for monitoring bird communities. Another advantage is the reduction of inter-observer error (Alldredge et al., 2007), which can be achieved by analyzing all recordings by a single interpreter and validating the results by other interpreters (Celis‐Murillo et al., 2009). Furthermore, automated recorders provide permanent recordings that can be examined repeatedly with spectrograms, resolving the logistical problems often encountered in field studies, such as the limited availability of field observers (Hobson et al., 2002).

Despite the advantages of automated recorders, difference of the detection performance between recorders and field observers needs to be carefully considered before implement (Haselmayer & Quinn, 2000). Automated recorders are not able to detect non-vocalizing birds, implying the existence of species bias. Furthermore, the effective sampling distance of recorders may differ from that of a field observer and depend on the habitat characteristics (Mc New & Handel, 2015). Previous research has shown that automated recorders often perform better than field observers when measuring species diversity, especially when different species are vocalizing simultaneously (Acevedo & Villanueva-Rivera, 2006; Bart & Schoultz, 1984). Still other research, however, found automated recorders perform poorly in densely forested landscapes (Hutto & Stutzman, 2009). These opposite results suggest the importance of evaluating the detection performance of automated recorders under spatially variable survey conditions in advance of implementation (Hutto & Stutzman, 2009).

In this study, we are interested in examining the potential of using automated recorders as a tool to investigate seasonal patterns of avian abundance in the tundra areas, which are difficult and expensive to survey with human observers. We will compare the detection performance between automated recorders and field observers to access the feasibility of introducing acoustic recorders in Indigirka River Delta. Our objectives are to 1) compare the number of bird species detected by a field observer and an automated recorder among the same time period; 2) evaluate the effect of distance on detection probability of birds for a field observer and an automated recorder; and 3) evaluate how the difference of detection probability between a field observer and an automated recorders relates to habitat characteristics (i.e., shrub characteristics). This study will provide detailed evaluations of detection performance of automated recorders in Indigirka River Delta arctic tundra. Applying the automated recorders as a supplement to, or replacement for, field observers for long-term monitoring in the Indigirka River Delta arctic tundra is desired ultimately.

**Goals and Objectives**

\*Goal 1: Compare the detection performance of automated recorders and field observers for monitoring Siberian tundra bird communities

Objective 1-1: Compare the number of bird species detected by a field observer and an automated recorder among the same time period. We hypothesize the field observer will detect more bird individuals and species comparing to recorders since the records can not detect non-vocalizing birds. On the other hands, we also hypothesize that the recorders will catch some birds species missed by the field observer during periods of high song activity.

Objective1-2: Evaluate the effect of distance on detection probability of birds for a field observer and an automated recorder. We hypothesize the distance will have a non-linear effect on detection probability of birds for both recorders and field observers. The detection rate will be highest between 50 to 100 meters to the point count center and decrease in when getting closer and further of the point count center.

Objective1-3: Evaluate how the difference of detection probability between a field observer and an automated recorders relates to habitat characteristics (i.e., shrub characteristics). We hypothesize the shrub characteristics will influence the difference of detection probability between field observers and automated recorders. Furthermore, we different guild of birds will have different react to shrub characteristics since vertical structure, density and diversity of shrubs were proven to influence on both the occurrence and detectability of birds in the arctic (Amundson et al., 2014). We are particularly interested in defining the influence of shrub characteristics on the difference of detection probability between a field observer and an automated recorders. This result will provide us an idea whether we will need a habitat-specific correction when setting automated recorders in different habitats in future studies.

\*Goal 2: Sharing bird sound recordings in public database

Objective 2-1: Increasing the collection of bird sounds on Xeno-Canto. In Xeno-Canto, the world’s biggest bird sound database, there are only 55 recordings from 10 species being recorded in Siberian arctic tundra. We will provide all the recordings from our study in this public platform and thus provide materials for future studies.

**Works Cited**

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Other information

Date: Project from Feb. 15 to Dec 15, 2019. Fieldwork from May 15 to July 15, 2019

Location: Siberia Arctic Tundra, Russia (70.943601, 148.006196)

Focus: Conservation, Research for Wildlife

Field: Biodiversity Conservation, Ecology, Ornithology, Acoustic Monitoring