Preserving the integrity of the Canadian northern ecosystems through reinforcement learning-based Arctic fox movement models

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The Arctic fox : An important ecological indicator

- The **Arctic fox** (*Vulpes lagopus*) is one of the **main predators** of the circumpolar world
- **Predators** are the **dominant force** controlling the Canadian Arctic food webs
- **Realistic modeling of the movement of the Arctic fox** is a **crucial first step** towards the understanding of how **variations in predations risk** impacts the local ecosystems in a context of climate change

A fundamentally limited baseline

The most common way to model the movement of an animal in ecology is through **Step Selection Function** (SSF) :

The SSF is a **fundamentally limited approach**, because it

- **Ignores** the **sequential nature of the data**
- **Is unable** to faithfully recreate **complex movement behaviors**

Reinforcement learning (RL) methods could be **well suited to address these shortcomings**.

Filling the gaps in movement modelling with RL

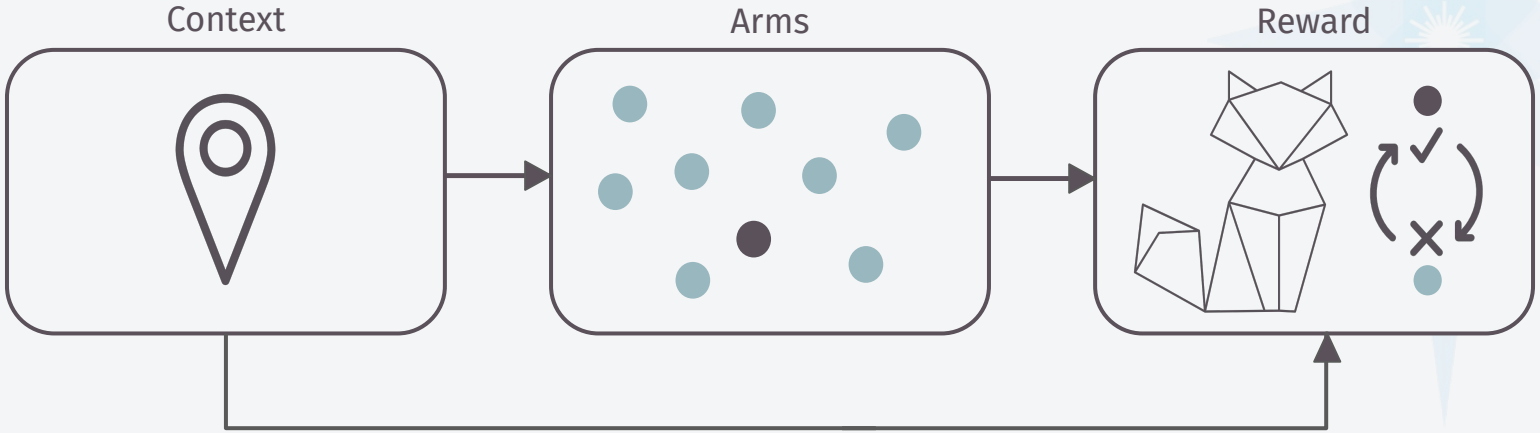
- Our goal is to **address the SSF shortcomings** with **reinforcement learning**
- We will use **GPS tracking data** of foxes as well as **habitat and prey abundance** information from the monitoring program of **Bylot Island, Nunavut**
- New data will be collected **every summer** for the **2021-2024** period

Lemmings & snow geese are the main preys on Bylot Island

Aim 1 : Demonstrating the potential of RL

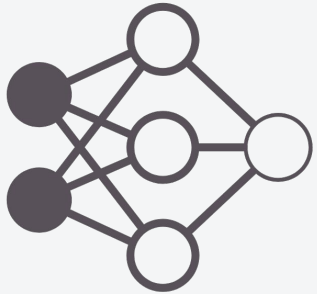
- We first aim to **reveal the potential of RL** by building a movement model based on **contextual bandits algorithms**.

- This initial model will allow us to demonstrate that RL approaches can educate us **at least as well as the SSF** on the basic aspects of the fox's behavior.



Aim 2 : Enable the emergence of complex movement behaviors

- The next step of our project will be to develop **realistic models** able to adequately capture the **sequential nature** of an Arctic fox's movement decisions
- We will leverage **offline RL strategies** and exploit **neural networks** to learn rich representations
- **Complex movement behaviors** are expected to emerge from these models



Aim 3 : Reveal the impact of territorial dynamics

We aim to extend our models to **multi-agent settings** in order to have a better understanding of the impact of the **complex territorial dynamics between neighboring foxes** on their ecological community.

Towards mutual enrichment

- This novel application of RL to a **real-world problem** should raise **interesting challenges for the RL research community**
- This interdisciplinary project could contribute to **bridging the gap between RL theory and practice**, while also opening **new research directions** for supporting the development of **rational conservations actions**

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Climate Change AI

Thanks!

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