ᐅᑯᓇᖓ ᑐᓂᔭᐅᔪᖅ

ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᕐᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ

ᐆᒧᖓ

ᑐᑭᓯᒋᐊᕈᑎᒃᓴᑦ: X **ᐃᓱᒪᓕᐅᕈᑎᑦ:**

ᐱᔾᔪᑖ: ᑐᓴᖅᑎᑦᑎᓂᖅ ᐊᐅᓚᑦᑎᖃᑎᒌᒃᑐᓂᑦ ᓄᑖᒥᑦ ᐆᒪᔪᑦ ᐊᒥᖏᓂᖓᓐᓂᒃ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᓂᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂᑦ.

ᐱᓕᕆᐊᖑᓯᒪᔪᑦ

- ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ ᐊᕐᓇᐅᙱᑦᑑᕗᑦ ᐊᒻᒪ ᐅᓄᙱᓪᓗᑎᒃ ᑐᒃᑐᐃᑦ (ᑕᐃᔅᓱᒪᓂ 20,000 40,000-ᖑᓚᐅᖅᓯᒪᔪᑦ ᓂᕐᔪᑎᑦ) ᐊᖑᓇᓱᒃᑕᐅᕙᒃᓗᑎᒃ ᐊᖑᓇᓱᒃᑎᓂᑦ ᕿᑎᕐᒥᐅᓂ ᖃᔅᓯᑲᓪᓚᖓᓂᑦ ᓄᓇᓕᖓᓂ ᐊᒻᒪ ᓄᓇᓕᖓᓂ ᑲᓇᖕᓇᖅᐸᓯᖓᒥ ᓄᓇᑦᓯᐊᒥ.
- 2018–ᒥ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᑦ 4,105-ᖑᓇᓱᒋᔭᐅᓪᓗᑎᒃ (95% CI = 2,931 - 5,759). ᑖᒃᑯᐊ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᕗᑦ ᐅᓄᕈᓐᓃᖅᐸᓪᓕᕐᓂᖓᓐᓂᒃ 88%–ᒥ 1997–ᒥ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᓂᑦ 34,558–ᖑᓪᓗᑎᒃ (95% CI = 30,275 – 38,841).
- ᐋᖅᑭᒋᐊᖅᑕᐅᓚᐅᖅᑎᓪᓗᒍ ᖃᐅᔨᓴᕈᑕᐅᓂᐊᖅᑐᖅ ᐱᖃᓯᐅᑎᓪᓗᒋᑦ ᑎᒍᒥᐊᖅᑎᐅᖃᑕᐅᔪᑦ ᐊᑐᓕᕐᑯᔭᖏᑦ, ᑎᑎᖅᑲᑐᖃᕖᓃᑦ, ᕐᑯᖓᓯᕈᓕᖅᓯᐃᕝᕕᐅᓚᐅᖅᑐᑦ, ᐊᒻᒪ ᓄᓇᓕᖓᓂ ᖃᐅᔨᒪᔭᐅᔪᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᖅ ᐊᖏᓪᓕᒋᐊᕐᑯᓪᓗᒍ, ᖃᐅᔨᔭᐅᔪᑦ 2020–ᒥ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ 3,815–ᖑᓪᓗᑎᒃ (95% CI = 2,930 – 4,966, CV= 13%) ᑐᒃᑐᐃᑦ, ᒪᓕᓚᐅᖅᐳᑦ ᐅᓄᕈᓐᓃᖅᐸᓪᓕᐊᔪᓂᒃ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᓂᒃ 2018–ᒥ ᖃᐅᔨᓴᖅᑕᐅᔪᓂᒃ.
- ᑎᓯᐱᕆ 2020–ᒥ, ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᕐᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᑦ ᕿᒥᕐᕈᓚᐅᖅᐳᑦ ᓯᕗᓪᓕᖅᐹᖅᓯᐅᑎᒥᒃ ᐋᖅᑭᒃᓯᒪᓕᖅᑎᑕᐅᔪᒥᒃ ᐊᑐᓕᖅᑎᑦᑎᔪᒪᓪᓗᑎᒃ ᑲᑎᓪᓗᒋᑦ ᐊᖑᓇᓱᒃᑕᐅᔪᓐᓇᖅᑐᑦ 42–ᓂᒃ ᑐᒃᑐᓂᒃ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂᒃ. ᑲᑎᒪᔩᑦ ᐃᓱᒪᓕᐅᕆᓚᐅᖅᐳᑦ ᐅᓄᖅᓯᒋᐊᖅᑕᐅᕐᑯᓪᓗᒋᑦ ᑲᑎᕐᓗᒋᑦ ᐊᖑᓇᓱᒃᑕᐅᔪᓐᓇᖅᑐᑦ 105–ᖑᓕᕐᓗᑎᒃ ᑐᒃᑐᑦ ᐊᒻᒪ ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᑦ ᑖᒃᑯᓂᖓ ᒪᓕᒐᙳᖅᑎᑦᑎᓚᐅᖅᐳᑦ.
- ᐃᑲᔪᖅᑐᕈᒪᓪᓗᒋᑦ ᐅᑎᖅᑎᑦᑎᕙᓪᓕᐊᓂᖅ ᑐᒃᑐᓂᒃ, ᓄᓇᕗᑦ ᒐᕙᒪᖓ ᐊᑐᓕᖅᑎᑦᑎᓯᒪᕗᖅ ᓂᕿᑐᖅᐸᒃᑐᓂᑦ ᐊᐅᓚᑦᑎᔾᔪᑕᐅᓂᐊᖅᑐᒥᒃ ᐃᓚᒋᔭᐅᓗᓂ ᖃᐅᔨᓴᖅᑎᑦᑎᓗᑎᒃ ᐊᒃᓱᓂᒃ ᐊᒪᕈᖅᑐᓂᓗ ᕿᓇᐅᔭᓂᒃ ᒪᓂᒪᑎᑦᑎᓗᑎᒃ. ᐊᒃᑐᐊᓂᖃᖅᓱᓂ ᐅᓄᕈᓐᓃᖅᐸᓪᓕᐊᔪᓄᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂ, ᐊᒪᕈᖅᑐᓂᑦ ᕿᓇᐅᔭᑦ ᒪᓂᒪᑎᑕᐅᔪᑦ $900–ᖑᕗᖅ ᐊᑕᐅᓯᖅ ᖃᐅᔨᓴᒐᒃᓴᖅ ᐋᖅᑭᒃᓯᒪᔪᖅ (ᐊᓯᖏᓐᓂᓪᓕ $500–ᖑᓪᓗᓂ).
- ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂ ᕐᑯᖓᓯᕈᖅᓯᑲᑕᓚᐅᖅᐳᑦ ᐊᐃᓇᓕ 2021–ᒥ (36 ᐊᕐᓇᓗᐃᑦ) ᐊᒻᒪ ᒫᑦᓯ 2024–ᒥᑦ (35 ᐊᕐᓇᓗᐃᑦ). ᑎᒍᒥᐊᖅᑎᐅᖃᑕᐅᔪᑦ ᐃᓚᐅᓚᐅᖅᐳᑦ ᐸᕐᓇᐃᑎᓪᓗᒋᑦ, ᐊᒻᒪ ᐊᖑᓇᓱᒃᑐᓕᕆᔩᒃᑯᑦ ᑭᒡᒐᖅᑐᐃᔨᖓᑦ ᐃᓚᐅᓚᐅᖅᐳᖅ ᑕᒪᐃᓐᓂᒃ ᐱᔭᐅᔪᓂᒃ ᑖᒃᑯᓇᓂ ᐊᕐᕌᒍᓂᑦ.

ᒫᓐᓇ ᖃᓄᐃᓕᖓᓂᖓ

- ᒫᓐᓇ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑕ ᐊᒥᖏᓂᖏᑦ 8,000 ᑐᖕᒑᓃᑉᐳᑦ, 20%–ᖏᓐᓃᕐᓗᑎᒃ ᑕᐃᔅᓱᒪᓂᓕᓵᑦ. ᑕᐃᒪᐃᒻᒪᑦ, ᒫᓐᓇ ᐊᐅᓚᑦᑎᔾᔪᑕᐅᓂᐊᖅᑐᖅ ᑭᓪᓕᖅᑲᖅᑎᑦᑎᓗᑎᒃ ᐊᖑᓇᓱᒃᑕᐅᔪᓐᓇᖅᑐᓂᒃ ᐱᔾᔪᑎᖃᓗᐊᕐᓗᑎᒃ ᑐᒃᑐᖏᑦ ᐅᑎᖅᐸᓪᓕᐊᕐᑯᓪᓗᒋᑦ.
- ᓄᑖᖅ ᑎᖕᒥᔫᒃᑯᑦ ᐅᓄᕐᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᖅᑐᑦ ᐱᐊᓂᓚᐅᖅᐳᑦ ᐅᑐᐱᕆ 23–ᒥᑦ ᓄᕕᐱᕆ 2–ᒧᑦ, 2023. ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐸᕐᓇᐃᓂᖅ ᐱᖃᓯᐅᑎᓪᓗᒍ ᐅᖃᐅᓯᐅᓚᐅᖅᑐᑦ ᑎᒍᒥᐊᖅᑎᐅᖃᑕᐅᔪᓂᑦ ᐊᑐᕐᓗᑎᓪᓗ ᐊᔾᔨᐸᓗᖓᓂ

ᐋᖅᑭᒃᓯᒪᔪᒥᑦ 2020−ᒥᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᒥᑦ. ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂ−ᓂᕈᐊᖅᑕᐅᓯᒪᔪᑦ ᓄᓇᓕᖕᒥᐅᑦ ᐃᓚᐅᓚᐅᖅᐳᑦ ᖃᐅᔨᖃᑕᐅᓪᓗᑎᒃ.

- ᖃᐅᔨᓴᕈᑎᕕᓃᑦ 2023−ᒥᑦ ᓇᐃᓴᐃᑎᓪᓗᒋᑦ ᓇᓚᐅᑦᑖᓚᐅᖅᑐᑦ 5,229 (95% CI = 3,985 – 6,473, CV= 12%) ᑮᓕᓂᐅᑉ ᕿᑭᖅᑕᖓᓂ ᓄᓇᐃᓐᓇᕐᒥᓪᓗ. ᑖᓐᓇ ᓄᑖᖅ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᖅ ᓱᓕ 8,000 ᑐᒃᑑᖃᑎᒌᓄᑦ ᑐᖔᓃᑉᐳᖅ, ᑭᓯᐊᓂ, ᓇᓗᓇᐃᖅᓯᔪᖃᓚᐅᙱᓚᖅ ᐅᓄᕐᓂᕆᓴᖏᑦ ᓱᓕ ᐅᓄᕈᓐᓃᖅᐸᓪᓕᐊᓂᖏᓐᓂᒃ.
- ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᑦ ᐱᓕᕆᖃᑎᖃᖅᓯᒪᕗᑦ ᐱᓕᕆᖃᑎᖃᑦᑎᐊᖏᓐᓇᖅᓱᑎᓪᓗ ᐊᒃᑐᖅᑕᐅᓯᒪᔪᓂᒃ ᓄᓇᓕᖕᓂ, ᐊᐅᓚᑦᑎᔨᐅᖃᑎᒌᑦ ᐊᒻᒪ ᓄᓇᑦᓯᐊᑉ ᒐᕙᒪᒃᑯᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐱᓕᕆᐊᖏᓐᓂᒃ ᐊᒻᒪ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᔪᒥᒃ ᕿᑭᖅᑕᑦ ᑐᒃᑐᖏᓐᓂᒃ.

ᑐᓴᕋᓱᖕᓂᖅ:

- ᑲᑎᙵᓪᓗᑎᒃ ᑐᓴᕋᓱᓚᐅᖅᐳᑦ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂ ᐃᖃᓗᒃᑑᑦᑎᐊᒥ (ᕕᕗᐊᕆ 14, 2025), ᖁᕐᓗᖅᑐᒥ (ᕕᕗᐊᕆ 17, 2025), ᐊᒻᒪ ᕿᑎᕐᒥᐅᑦ ᐆᒪᔪᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᑦ (ᕕᕗᐊᕆ 28, 2025). ᐅᖃᖃᑎᖃᕋᓱᓚᐅᖅᑐᑦ ᐆᓐᓴᐃᑦ ᐊᒻᒪ ᐅᒥᖕᒪᒃᑑᖅ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂᑦ, ᑭᓯᐊᓂ ᑲᔪᓯᔪᓐᓇᓚᐅᙱᑦᑐᖅ. ᓇᐃᓈᖅᓯᒪᔪᓂᒃ ᑐᓴᕋᓱᒃᑎᑦᑎᓚᐅᖅᐳᑦ ᐃᕐᖐᓐᓈᖅᑕᐅᒃᑯᑦ ᐆᓐᓴᐃᑦ ᐊᒻᒪ ᐅᒥᖕᒪᒃᑑᖅ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᒃ ᑐᓂᓯᖁᔨᓪᓗᑎᒃ. ᑐᓴᖅᑎᑕᐅᓚᐅᙱᑦᑐᒍᑦ ᓱᓕ ᐃᕐᖐᓐᓈᖅᑕᐅᒃᑯᑦ ᑐᓴᐅᒪᖃᑦᑕᐅᑎᓚᐅᖅᑎᓪᓗᑕ ᒫᑦᓯ 28, 2025−ᒥ ᐱᒋᐊᖅᓱᓂ. ᒫᓐᓇ ᐋᖅᑭᒃᓱᐃᓇᓱᒃᐳᒍᑦ ᑐᓴᕋᓱᒃᑎᑦᑎᓂᐊᖅᑐᓂᒃ ᑭᓯᐊᓂ ᑐᒃᓯᕋᖅᐸᑕ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᒃᑯᑦ, ᑲᑎᒪᓖᖅᑐᑦ ᑐᓂᓯᓚᐅᖅᑎᓪᓗᒋᑦ ᐃᓱᓕᕝᕕᒃᓴᖕᒪᓂᑦ.

ᐊᑐᓕᖁᔭᐅᔪᖅ:

- ᑐᙵᕕᒋᓪᓗᒍ ᒫᓐᓇ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᑦ, ᑕᒪᕐᒥᑦᑎᐊᖅ ᐊᑐᐃᓐᓇᐅᔪᑦ ᖃᐅᔨᓴᖅᑐᓕᕆᔨᒃᑯᓐᓂ ᑐᑭᓯᒋᐊᕈᑎᒃᓴᑦ, ᖃᐅᔨᒪᔭᐅᔪᑐᖃᐃᓪᓗ/*ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ*, ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᑦ ᐊᓯᔾᔩᔪᒪᙱᑦᑐᑦ ᒫᓐᓇ ᐊᓯᔾᔩᖁᔨᙱᑦᑐᑦ ᑲᑎᖅᓱᒋᑦ ᐊᖑᓇᓱᒃᑕᐅᔪᓐᓇᖅᑐᑦ 105−ᓂᒃ.

ᑲᑐᑎᓪᓗᒍ ᓄᓇᕗᑦ ᐱᕈᖅᐸᓪᓕᐊᑎᓪᓗᒍ
Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

ᐊᕙᑎᓕᕆᔨᒃᑯᑦ
Department of Environment
Avatiliqiyikkut
Ministère de l'Environnement

Abundance estimates for the Dolphin and Union caribou herd (*Rangifer tarandus groenlandicus x pearyi*)

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Report

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The opinions in this report reflect those of the authors and not necessarily those of the Government of Nunavut, Department of Environment. Reference to any specific type of gear and/or equipment does not mean that it is endorsed by the authors or the institutions they represent.

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ABSTRACT

Fall is the traditional time to survey the Dolphin and Union caribou herd. This is when they gather along Victoria Island's southern coast, awaiting sea ice formation. Since the herd reached a population low in 2018, the survey frequency has increased. In 2023, effort was made to update the herd abundance. The two main goals of this study were: 1) to provide an estimate of abundance, and 2) to detect a trend in the population trajectory. Over a study area similar to 2020, an aerial survey was performed from October 23rd to November 2nd, 2023 using three Twin Otters. The survey effort resulted in 148 caribou groups seen on transect, for 718 caribou. Groups were ranging from 1 to 17 caribou, with a mean of 4.85 caribou in a group. The Dolphin and Union caribou herd formed two aggregations, one close to Read Island and the other inland north of Richardson Island. Since the caribou were clustered in the study area, a Density Surface Model (DSM) was used to estimate the number of caribou on Victoria Island and mainland. This resulted in an estimate of 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12). The population trend between 2020 and 2023 estimates for Victoria Island and mainland were not significantly different, and the overall finite rate of change was above 1. This study provided an accurate estimate of the abundance of the Dolphin and Union caribou for 2023, which can be deemed stable at best. The Dolphin and Union caribou herd with an estimate of 5,229 caribou is still considered in a low vulnerable phase (less than 8,000 caribou). Due to the importance of this herd in Inuit subsistence and culture, management actions should aim to continue to support its recovery.

INTRODUCTION

The Canadian Arctic is the home of caribou subspecies, such as the Peary (*Rangifer tarandus pearyi*), barren-ground (*Rangifer tarandus groenlandicus*), and the Dolphin and Union (*Rangifer tarandus groenlandicus x pearyi*) caribou. The Dolphin and Union caribou herd uniquely migrates twice yearly across sea ice, connecting its summer range on Victoria Island to its winter range on the Canadian mainland (Poole et al., 2010). Ecological monitoring of caribou abundance is a prerequisite for decision-making in wildlife management and conservation, and helps to describe population dynamics (Hauser et al., 2006). Having current caribou herd estimates and trends help to redirect management actions to either promote herd growth or reduce the herd to a desired level. Indigenous people still rely on wildlife abundance for their subsistence and the continuation of their traditional practices. Caribou herd estimates are deeply significant to Indigenous people subsistence, whose cultural practices rely on abundant wildlife.

Concomitant to other caribou herds facing a circumpolar decline, the Dolphin and Union caribou herd declined from 34,558 (95% CI = 27,757-41,359; CV = 0.12) caribou in 1997 to 18,413 (95% CI = 11,644-25,182; CV = 0.17) caribou in 2015 (Nishi and Gunn, 2004; Dumond and Lee, 2013; Leclerc and Boulanger, 2018). In 2017, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the Dolphin and Union caribou herd as Endangered due to continued population decline and numerous threats to the herd. In 2022, the Nunavut Wildlife Management Board (NWMB) and the Federal Minister of Environment recommended up listing the status of the subspecies to Endangered. Since the beginning of the listing process, the Dolphin and Union caribou herd continued to decline, with an estimate of 4,105 caribou in 2018 (Leclerc and Boulanger, 2020). In 2020, the herd stabilized with 3,815 caribou in a study area, including Victoria Island and part of the Canadian mainland (Campbell et al., 2021). The low abundance of the Dolphin and Union caribou sparked some conservation and management concerns (Worthington et al., 2018). Culturally central to the Western Canadian Arctic communities of Kugluktuk, Cambridge Bay, Ulukhaktok, and outpost camps of Bathurst Inlet and Bay Chimo, community members not only witnessed the decline, but were directly impacted by the consequence of reduction in country food (Tomaselli et al., 2018, Hanke and Kutz, 2020).

Monitoring frequency increased if the caribou herd was at or near a critical management threshold or declining. Abundance estimates rely on two main variables, a geographic area and detectability. The calving ground survey method for estimating abundance of barren-ground caribou herds was difficult to perform for the Dolphin and Union caribou herd (Nishi and Buckland, 2000). Then, an alternative fall abundance survey method was established by taking advantage of the herd aggregation on the coast of Victoria Island, while the entire herd await the sea ice to form (Nishi and Gunn, 2004). The fall survey method was revised in 2020, by using Distance Sampling instead of strip-transect method, and by increasing extensively the survey area (Campbell et al., 2021). In a declining herd, the species-level detectability is prone to vary over time, as caribou become more scarce and harder to detect. As a result, survey effort that was once reliable may become inadequate (Kéry, 2002). Decreasing detectability can warrant an increase in survey effort and coverage to ensure that shifts in distribution are captured and absence data can be distinguished from non-detections (McCarthy et al., 2013; Burns et al., 2019; Buckland et al., 2005).

Distance Sampling method models the detection probability of a focal species (caribou), as a function of the distance from a transect to generate an abundance estimate (Buckland et al., 2005). This method is cost-effective to monitor abundance for species that occur over larger area, by extrapolating abundance between transect lines of a defined region. Previous efforts have shown that part of the Dolphin and Union caribou herd can be found inland on Victoria Island (Figure 1). The very low density of caribou in a sparse study area paired with known coastal caribou aggregation was a challenge for Distance Sampling method, Mark-Recapture Distance Sampling (MRDS). Therefore, a model-based inference approach that also includes environmental parameters, Density Surface Model (DSM), was used to increase the accuracy of the estimate (Miller et al., 2013). Although the methods used to monitor the Dolphin and Union caribou herd have evolved with cutting-edge analysis, the surveys were consistently performed in late October, taking advantage of their seasonal aggregation on the coast of Victoria Island.

It was recommended to increase the monitoring frequency of the Dolphin and Union caribou herd abundance (Campbell et al., 2021), so co-management partners can be provided with more control over management actions. Timely revision and change of harvest management, based on up-to-date herd assessments, will help to ensure that a potentially declining caribou herd is not left in a vulnerable state.

OBJECTIVES

The main goal of this study was to monitor the Dolphin and Union caribou herd to support co-management partners, government agencies, and management boards in informing management actions aimed at increasing herd abundance while promoting its recovery. The two main objectives of this survey were: 1) to provide an estimate of Dolphin and Union caribou herd abundance, and 2) to detect a trend in the herd trajectory.

MATERIALS AND METHODS

Dolphin and Union Caribou Herd Seasonal Range

As recommended (Nishi and Gunn, 2004), the Dolphin and Union caribou have been consistently surveyed during the fall. Although the timing of staging period needs to be defined, the period of the rut, October 13th to November 7th (Nagy et al., 2011), was used in this study to be consistent with Campbell et al., (2021). The rut was an optimal time of the year to survey the Dolphin and Union caribou herd based on their distribution (Figure 1). During this period, the Dolphin and Union caribou herd migrates to the coast of Victoria Island and aggregates in higher densities, while both sexes mixed and their movements were reduced (Figure 1) (Leclerc and Boulanger, 2020). The range, at the rut, was more logistically feasible to survey than the entire range. To take into consideration caribou that could not complete their spring migration to Victoria Island, areas on the Canadian mainland were included in the study area as Campbell et al., (2021).

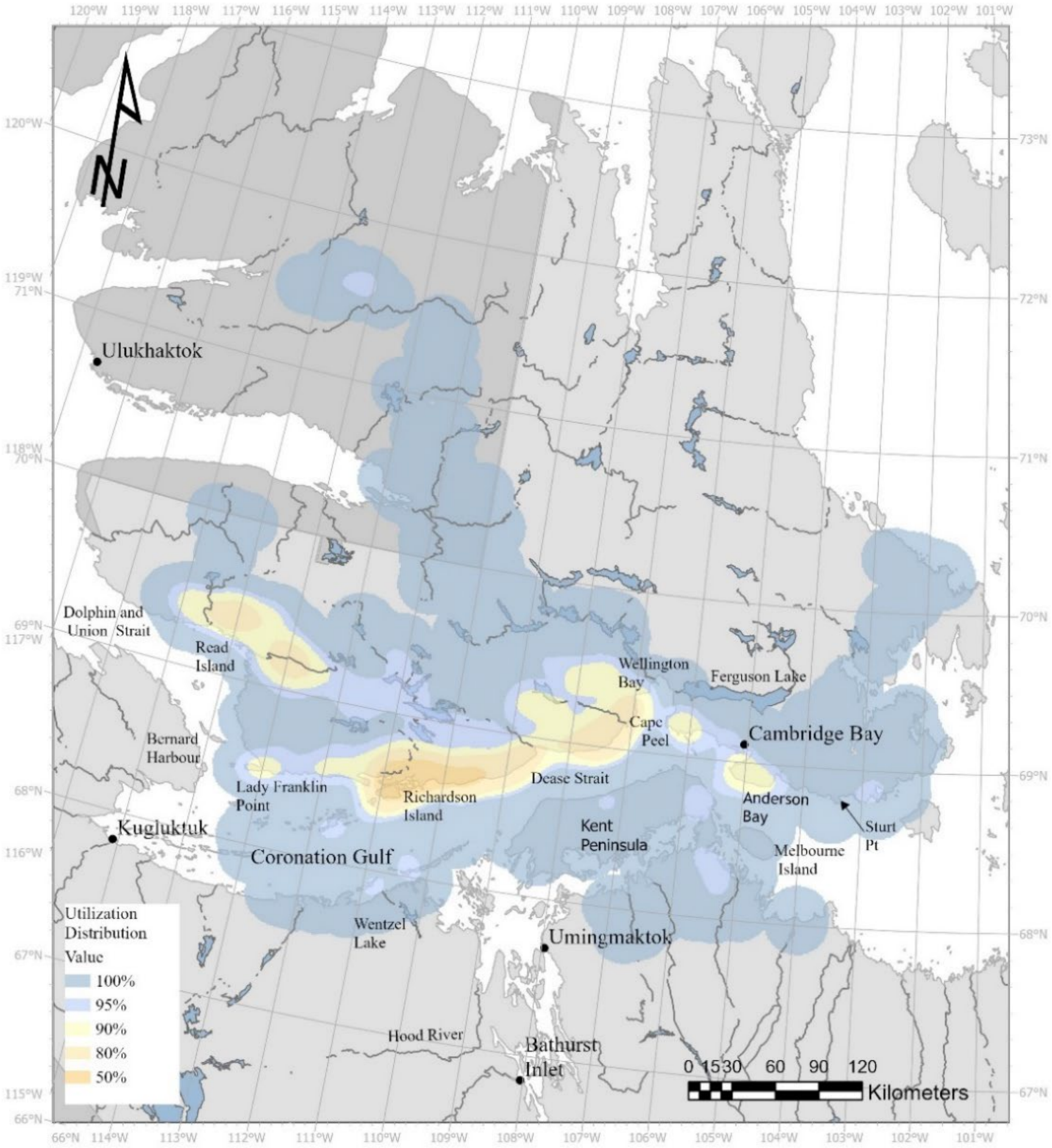

Figure 1: Dolphin and Union caribou herd utilization distribution (%) during the rut, October 13th to November 7th (Nagy et al., 2011).

Integration of IQ in the Survey Design

Consultations with the affected Hunters' and Trappers' Organizations (HTOs) and the Hunters' and Trappers' Committee (HTC) occurred on May 1st, June 1st, July 14th, and September 7th, 2023. The aim was to discuss the proposed survey design and solicit feedback. Since the intent was to use a design similar to the 2020 survey (Campbell et al., 2021), the HTOs and HTC were asked to review the 2020 design to determine if it was still accurately representative of the fall distribution of the Dolphin and Union caribou herd to design the 2023 survey. Because telemetry data provide limited information, which may not represent fully the herd seasonal distribution, incorporating IQ is valuable considering recent shifts in the Dolphin and Union caribou herd distribution (Hanke and Kutz, 2020; Kuptana 2022; Campbell et al., 2021).

During consultation, feedback received from the HTOs and HTC regarding the survey design was captured by creating digital polygons from the meeting map. Consistent with previous surveys (1997 to 2020), there was a consensus that the bulk of the distribution of caribou would be on the south coast of Victoria Island, from Cape Peel to Lady Franklin Point (Figure 2, pink). Due to the longer delay in sea ice formation, Kugluktukmiut and Ekaluktutiak hunters have seen Dolphin and Union caribou abandon their migration and turn back inland (Hanke et al., 2021). These observations reinforced the need to survey inland, leading to a strong recommendation to survey a considerable extent of Victoria Island (Figure 2, blue). IQ has mentioned that the Dolphin and Union caribou was present on the east side of Victoria Island. To acknowledge this information, this area was given a medium-low survey effort (Figure 2, blue). Since hunters have observed Dolphin and Union caribou at the Storkenson Peninsula and Collinson Peninsula, Ekaluktutiak knowledge holders recommended once more to include these areas in the 2023 survey design. Justification remained to include Bathurst Inlet and the Kent Peninsula, as hunters have seen repeatedly some caribou trying to cross back to Victoria Island when the sea ice was no longer adequate, which trapped them on the coast of the mainland in the summer (Haniliak et al., in press). Knowledge holders agreed that the northern and southern strata (Figure 2, dark grey) should be surveyed with minimal effort. The 2023 proposed survey design, representing the HTOs/HTC areas of interest (Figure 2), can be compared to the 2020 design map (Figure 2).

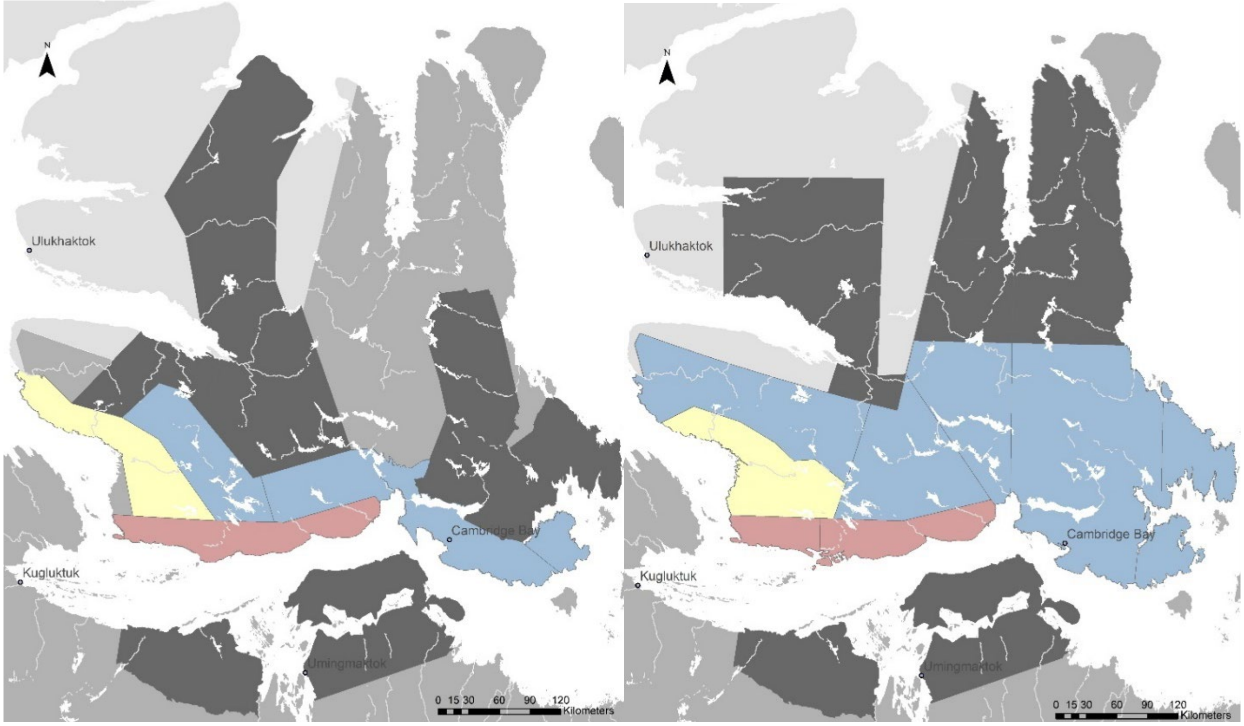

Figure 2: Left: 2020 Dolphin and Union strata placement and effort (dark grey= low effort, blue= medium effort, yellow = high effort, and pink= very high effort). Strata were designated based on historic survey observations, cumulative caribou telemetry data, IQ, and budgetary constraint. Right: Based on IQ, the revised 2023 strata boundaries. Note that the light grey is the Northwest Territories and the medium grey is Nunavut.

Dolphin and Union Daily Movement Rates

The Dolphin and Union caribou telemetry programs ran from 1996 to 2006 and from 2015 to present. Following the seasonal breakdown of barren-ground caribou of Nagy et al. (2011), the period of rut for 2023 was extracted from the entire data set. From October 13th to November 7th, the daily collar locations and movement rates were monitored using the package *TuktuTools* (Curriot et al., 2022) in the R software environment (R Development Core Team 2009). Low movement rates were ideal to time the survey and count caribou, as the animal movement between strata was limited (Leclerc and Boulanger, 2020).

Design of Distance Sampling Surveys

Sampling Design

Identified through IQ and scientific knowledge, the final 2023 study area was 137,549 km^2 (Figure 3). Known caribou density and IQ guided the stratification of this area into 15 strata of unequal effort allocation, 12 strata on Victoria Island and three strata on the mainland. Simulations were used to estimate bias, variance, and confidence interval that a change in survey design could cause, while other parameters (area, population size, detection function) remained constant (Buckland et al., 2005). Therefore, the effort and orientation of the transect lines were tested with respect to known gradients of caribou density to develop the best design. The true abundance value for each stratum was based on the results of the 2020 abundance estimate (Campbell et al., 2021). The probability of detecting caribou was modeled from a half-normal and hazard rate function, a scale parameter of 350, a truncation of 1,500 meters, and no covariate was used to model the detection probability. Models were tested and evaluated using an Akaike Information Criterion (AIC). Simulations were performed with the package *dsims* (Marshall, 2022a) called for R (R Development Core Team 2009). The best design was picked based on the best precision with: sd of means = 217.76, a mean SE = 249.49, RMSE = 216.68, and per cent bias = 0.06, while having the lowest amount of transect lines. Finally, since the Dolphin and Union caribou herd would aggregate on the coast in higher density, the number of transect lines was increased in the coastal strata.

An unequal amount of effort was set in each stratum following a limit of 19,000 km of transect lines. This led to allocate eight to 59 transect lines in each stratum, with at least 19% coverage in the low-density stratum and up to 74% in the high-density stratum, taking into consideration a maximal distance of 1,500 meters on each side of the plane. The transects, spanning the full width of the stratum, were set perpendicular to known density, to maintain the axes of the stratum, and to assure transects of relative equal length (Buckland et al., 2001). A total of 277 transect lines were randomly drawn using the package *dssd* in the R Statistical Platform (R Development Core Team 2009, Marshall and Rexstad, 2023) for 18,973 km of transects and 28,74% effort in the overall study area (Figure 3, Table 1).

Table 1: Summary of the proposed survey design by stratum, including the stratum area, number of transects per stratum, distance between transect, transect length, and the per cent coverage (effort) of the stratum with a survey strip of 1,500 meters.

Stratum	Area (km^2)	Number of Transects	Distance between Transect (km)	Transect Length (km)	Effort (%)
A	15,439	16	13.5	1,558	21.89
B	8,101	42	5.5	1,990	53.94
C	9,787	10	10	1,383	29.5
D	25,224	17	14	2,310	20.94
E	5,622	17	8.5	958	34.93
F	6,581	16	8.5	1,036	35.24
G	6,972	59	4	2,258	74.32
H	7,577	21	9.5	1,310	30.67
I	13,297	12	14	1,336	21.51
J	11,064	12	14	1,177	21.3
K	2,151	8	8	426	38.07
L	5,716	13	12	820	24.76
M	9,402	11	15	953	19.8
N	8,248	12	15	962	19.55
O	2,375	11	8	495	36.36
Study Area	137,549	277	---	18,973	28.74

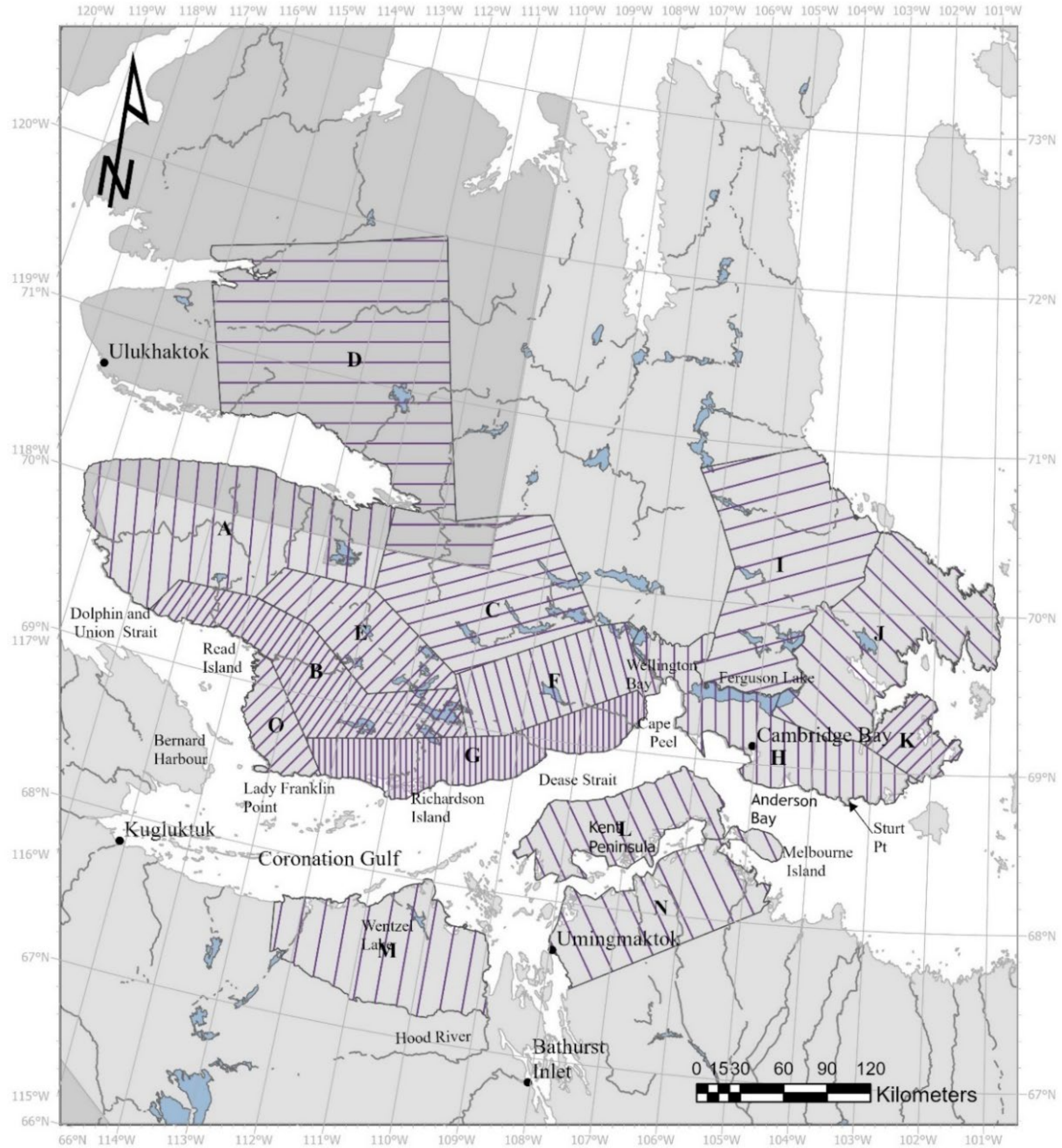

Figure 3: Final 2023 Dolphin and Union caribou herd survey design, with A to O strata and the transect lines.

Field Setting

Three Twin Otters were used to fly the survey, where one was based in Kugluktuk, Cambridge Bay (Nunavut), and the last one in Ulukhaktok (Northwest Territories). The transects were flown at a speed of 160-180 km/hr, while maintaining an altitude of 122 m (400 feet) taking into consideration the topography. Wing struts were equipped with rope to set spacing bins at: 0-200 meters, 200-400 meters, 400-600 meters, 600-1,000 meters, and 1,000-1,500 meters for a maximum sampling distance of 1,500 meters on each side of the plane (Campbell et al., 2021). Bins were calculated using the formula of Northon-Griffiths (1978):

$$w = W*h/H$$

Where W was the required strip width; h the height of the observer's eye from the tarmac; and H the required flying height. Since the observers could not see under the plane, the start of the first bin was extended beyond the wheel of the Twin Otters.

Since Distance Sampling needed at least 60 to 80 observations to fit a detection function, the dependent double-pair observer configuration was used to increase the probability that observers detect less conspicuous lone caribou and to assess the detection probability (Buckland et al., 2005; Campbell et al., 2021). In this configuration, both observers were fully aware of each other's observations, making the roles of the observers asymmetric. The detection pattern was: {1,0}, {0,1}, and {1,1} depending if the first observer only, the second observer only, or both observers detected the group. Observations were made perpendicular to the transect lines, and the observations were based on the groups of caribou observed. If the plane triggered a movement response from the caribou, the observers were required to call the bin before the movement had occured (Buckland et al., 2005). The first and second observers alternated place after each flight.

The overall detection probability was expected to be very high close to the aircraft and to decrease with increasing in distance (Buckland et al., 2001). To make sure this assumption was met, mandatory observers' training, recording the distance before caribou were disturbed and moved, and daily plotting of the data for immediate observers' behaviour correction were implemented in the field.

The first recorder logged the observations for both left front and back observers, and the second recorder noted the observations for right front and back observers. The recorder's task was restricted to data entry. Information documented included the GPS locations of the observation (group), the binned distance, the number of caribou, and sighting conditions, to name a few. Observations beyond 1,500 meters or made during ferry flights between transects were recorded as "off transect" and not included in the final analysis. Covariates influencing detections were recorded, such as snow cover, cloud cover, and presence/absence of fog. During this survey, other species sightings were recorded, such as, but not limited to: wolverine (*Gulo gulo*), wolf (*Canis lupus*), polar bear (*Ursus maritimus*), moose (*Alces alces*), and muskox (*Ovibos moschatus*).

Data Analysis

Despite some poor visibility conditions, the double observer pair structures were maintained during the survey, ensuring that the probability of an observer to detect a group was consistent across all events. Some transects were flown a second time to confirm that no additional groups and lone caribou were missed. The observation generated from the second flight was not used to derive the detection function or estimate analysis, because of the collapse in the double-pair observer structure. The pilots and recorders were assigned with different tasks and these distractions were making them unavailable to be committed to observe full time, impacting negatively their detection probability. In addition, observations made by the pilots and recorders were not taken into consideration, because the limitation of the current model in integrating a third pair of observers to compute detectability.

Mark-Recapture Distance Sampling (MRDS): Detection Function

First, a routine data visualization was performed to provide a firm rationale in the choice of covariates for the model. The distribution of the groups observed on transect was mapped in relation to the strata and a histogram was plotted to explore the frequency of observation for each group size. The frequency of distributions of each covariate (cloud cover, snow cover, group size, presence/absence of fog) as a function of distance was plotted to capture visually any trends between these variables. Since some observers had no observations, and observers spend an unequal amount of time surveying due to a high turnover rate, it was not possible to use observer as a covariate.

As both observers were aware of each other observations, the removal configuration was implemented in the MRDS analysis (method = rem), which limits the future use of alternative methods. The program R with the packages *Distance* and *mrds* were used use as a sequential approach for model building and to fit a detection function to the observations (Laake et al., 2012). The final covariates taken into consideration in the model were: distance, group size, cloud cover, presence/absence of fog (Table 2). Each model was evaluated using an Akaike Information Criterion (AIC) (Burnham and Anderson, 1998). In addition, a goodness-of-fit test (or chi-square test (χ^2)), was performed to test for adequate fit (Buckland et al., 1993; Buckland et al., 2005). The overdispersion (c) was calculated by using the observed chi-squared for a global model divided by its degrees of freedom. If there is no overdispersion, then c should be equal to 1. Selection of the best model was based on lowest AIC score, goodness-of-fit test, and overdispersion (Burnham and Anderson, 2001).

Table 2: Distance and mark-recapture model covariates.

Covariate	Abbreviation	Type
Distance bin from plane	D	ordinal
Group size	S	continuous
Cloud cover	C	ordinal
Visibility (fog)	F	ordinal

As some transects were not surveyed in strata D and I, the lengths of these transects and area were adjusted to reflect the discrepancy with the planned design. The abundance estimate was then derived from the best model with strata-specific estimates. Variance was estimated in the *mrds* package, which considered the distance sampling, mark-recapture, and encounter rate variation (Innes et al., 2002). Two MRDS estimates were performed, one for Victoria Island/Mainland and one for Victoria Island only.

Density Surface Model (DSM)

Following a two-step approach, the spatial habitat components were added to the best MRDS model for Victoria Island/Mainland (Miller, 2012, 2013; Winiarski et al., 2013). Since the final 2020 abundance estimate was for Victoria Island/Mainland, the DSM analysis was performed only for this area. To help guide covariate selection, the covariates that were known to influence the spatial distribution of other caribou herds were first considered (MacNearney et al., 2016). Since the timing of the survey coincided with the fall migration, ecological factors that might have impacted their distribution were considered. Caribou have been found to express fidelity to their migration route, and therefore the distance from the historical crossing locations (XingDist) was taken into consideration, as well as the distance to lake (LakeDist) and river (RivDist) (Duquette, 1988; Nicholson et al., 2016). Since caribou are ruminant, patches of adequate foraging quantity and quality across the landscape can similarly affect their distribution pattern. The Normalized Difference Vegetation Index (NDVI) of July was used to inform areas with high photosynthetic activity and productivity. Since the survey occurred at the end of October, outside the peak of plant productivity, the Normalized Difference Tillage Index (NDVT) was also used to determine the non-photosynthetic biomass, crop residue, that would be available as winter forage for caribou. For the topographic variables, the topographic roughness index (TRI) and slope (Slope) were considered (Table 3). To facilitate the interpretation of the variables and avoid multi-collinearity, the collinearity between the covariates was assessed using a pearson correlation test with a threshold of 0.75.

Table 3: Environmental covariates used in the DSM model.

Covariate	Abbreviation	Description
Distance from crossing location	Xing Dist	Based on collar data 2015 to 2022 crossing location along the coast of Victoria Island
Distance to river	RivDist	Distance to large streams calculated using Canada National Atlas 2 million Hydrology
Distance to lake	LakeDist	Distance to large streams calculated using Canada National Atlas 2 million Hydrology
Slope	Slope	Slope based on 30 m digital elevation model (DEM)
Terrain Roughness Index	TRI	
Green Vegetation	NDVI	Normalized Difference Vegetation Index to measure photosynthetic biomass
Dry Vegetation	NDTI	Normalized Difference Tillage Index to measure non-photosynthetic biomass

Using the fitted detections functions from the MRDS, a Density Surface Model (DSM) was built by fitting the selected environmental covariates (Table 3). Beside deriving a more precise abundance estimate, the DSM provided clues to the environmental covariates that were potentially driving the spatial distribution observed during the survey. Thus, the workflow of the DSM can be illustrated as per Figure 4 (Adapted from Miller et al., 2013). The fitted model with the higher deviance explained was selected, checked for goodness-of-fit, and the randomized quantile residuals were plotted for visual exploration. The best DSM model was used to calculate the abundance estimate and to derive the uncertainty of the estimation (coefficient of variation).

The *Distance* and *dsm* packages were used as a sequential approach for model building to fit a detection function to the observations (Laake et al., 2012; Miller et al., 2013). The final density and CV maps were plotted over a Digital Elevation Model (DEM) to facilitate visualization (NRCan, 2017).

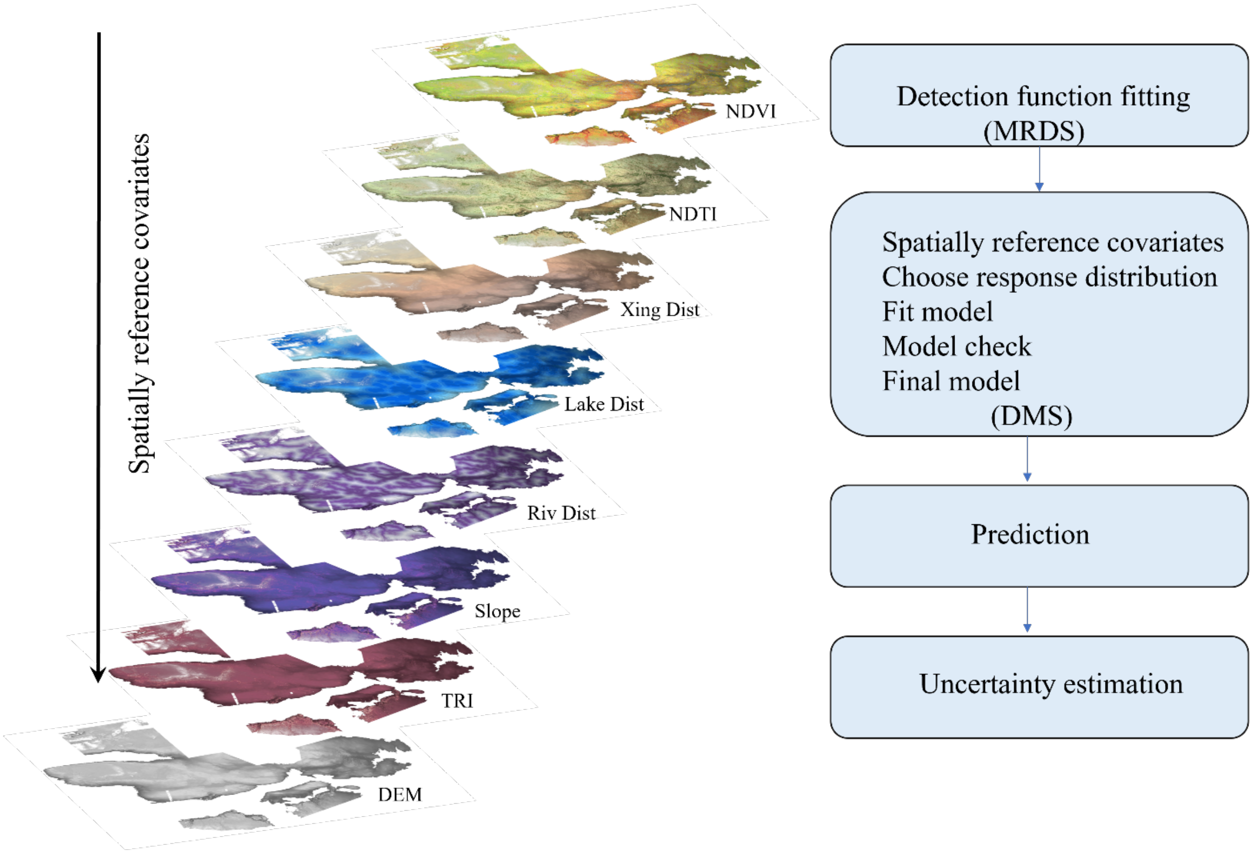

Figure 4: Work flow of the Density Surface Model (DSM) adapted from Miller et al., (2013).

Population Changes and Overall Trend

The 2023 estimate was initially compared to the 2020 estimate using a t-test ($\alpha = 0.05$) to determine if they were significantly different. In addition, the rate of change (lambda (λ)) between survey years was calculated following this equation:

$$\lambda = N_{t+1}/N_t$$

If λ is higher than 1, the population increased, below 1 the population decreased and very close to 1 the population is stable (Gasaway et al., 1986).

RESULTS

Dolphin and Union Daily Movement Rates

Daily, the collar locations of 21 cows were monitored to track their position in relation to the strata, hoping that the majority would have reached and aggregated in the high-density coastal Stratum G by the end of October (Figure 5). The 5 km/day threshold is usually used during calving ground survey to detect the peak of calving where cows' movement become very low. Early in the survey, some caribou movement rates were still above 5 km/ day and the movement of the third quartile rated became below the threshold as the strata were surveyed (Figure 5). Since the caribou showed low movement rates, caribou did not move out of the survey area or stratum. The movement rates increased slightly after the survey, but the median remained below the threshold. The displayed movement rates did not increase as expected, showing no sign that their fall migration resumed despite entering the month of November. In fact, the last day of the survey, November 2nd, none of the collars resumed their migration and none left Victoria Island for the sea ice (Figure 5). Therefore, the Dolphin and Union caribou that summered on the island were confidently captured on the island during the survey.

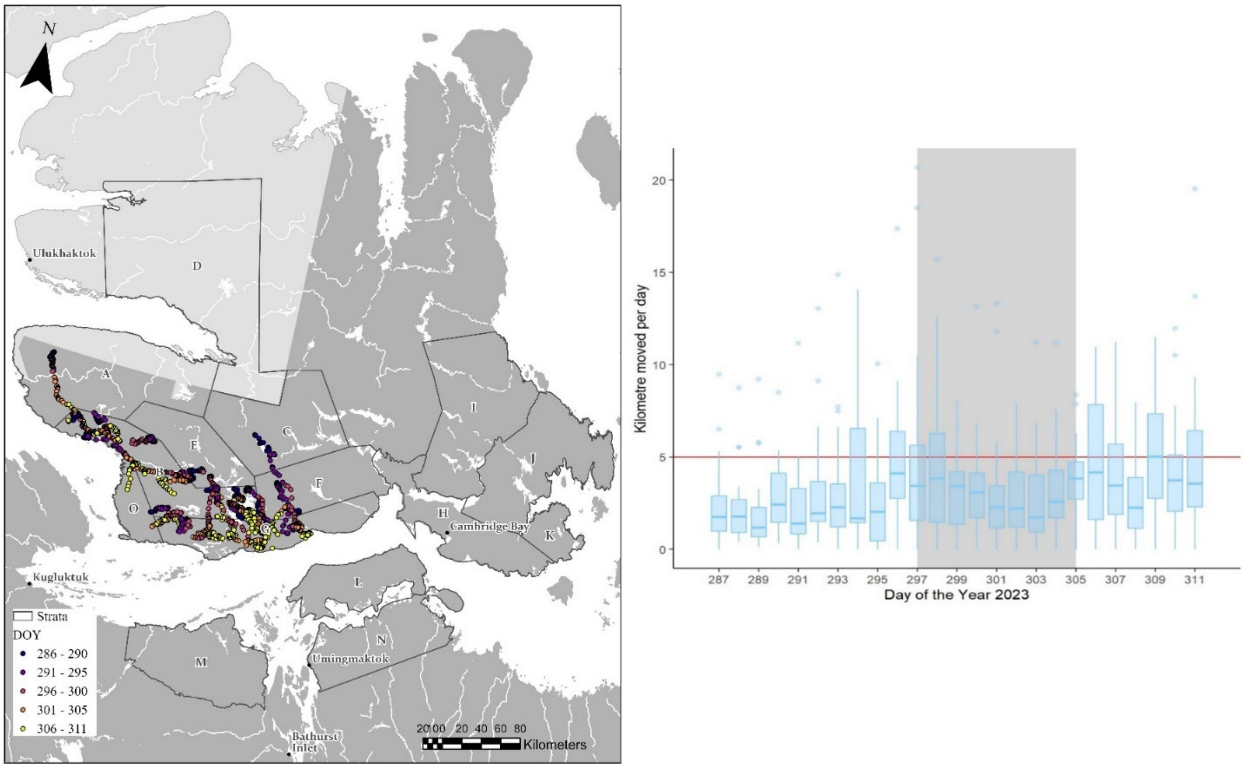

Figure 5: Left: Collar locations (n = 21) during the rut, which as has been established with a start date of October 13th (dark blue) and a final date of November 7th (yellow) for 2023. Right: Dolphin and Union collar daily movement rate from October 13th to November 7th, where the shaded grey highlights the period of the abundance survey.

Survey Conditions

The Dolphin and Union survey occurred from October 23rd to November 2nd, 2023, with three Twin Otters (C-GNPS, C-ATO, and C-FATM). The aircraft arrived at Kugluktuk on October 23rd. After being fitted, two planes departed, one to Cambridge Bay and the other to Ulukhaktok. On October 24th, the very-low-density stratum to the extreme north (D) and on the mainland strata (M, N, and L) (Table 4) were surveyed.

Strata A, E, O were progressively completed and the strata to the east of Cambridge Bay where no collars were present. On October 31st, the three planes surveyed simultaneously strata B, G, and F where the collars were located. The following day, the unfinished areas of those three strata were completed. Some transects were surveyed twice to make sure that no large groups were potentially missed because of poor visibility. The transect numbers 158 to 169 (Figure 7, light pink) in stratum G were flown twice, where nine groups of caribou were seen the first time and five groups were seen the second time. Since fewer groups were seen on the second attempt, the data were discarded. During the survey, two days of poor weather (October 25th and 30th) prohibited the planes from flying. There was a small section of stratum D and the northernmost four transects of stratum I that were left not surveyed (Figure 6).

Table 4: Timeline of the Dolphin and Union survey as each stratum was completed between October 23rd and November 2nd, 2023.

Date	**Aircraft and Strata**		
	C-GNPS	**C-ATO**	**C-FATM**
October 23	Arrival Kugluktuk	Arrival Cambridge Bay	Arrival to Ulukhaktok
October 24	Stratum M	Strata N&L	Stratum D
October 25	Stratum L	Strata H&I	Weather
October 26	Strata M&O	Strata I&K	Stratum D
October 27	Stratum A	Strata K&J	Stratum D
October 28	OFF	OFF	OFF
October 29	Stratum E	Stratum C	Stratum A
October 30	Weather	Stratum F	Weather
October 31	Stratra B&G	Strata B,G&F	Strata B&G
November 1	Stratum B &Departure	Strata G&F	Departure
November 2	----	Stratum G and Departure	----

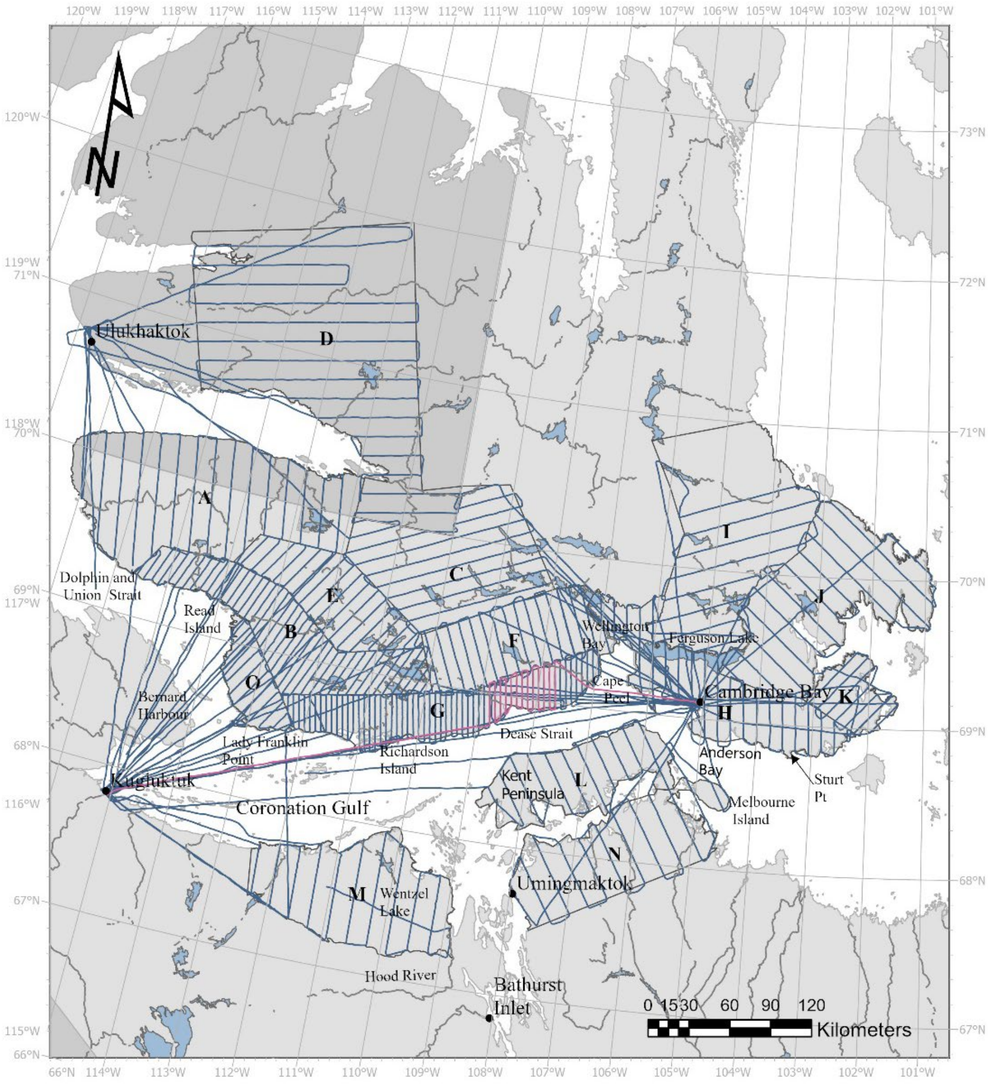

Figure 6: Flight tracks (blue) between October 23rd and November 1st, 2023. A section of G stratum was re-flown (light pink) on November 2nd, because of poor visibility during the first attempt.

Data Exploration

Distribution

During the survey, no caribou were seen in strata I, K, and M, whereas the bulk of the observations were in strata B, G, and F (Figure 7). Two separate aggregations were seen in the study area: one close to Read Island and the other 39 km north of Richardson Island inland. In this aggregation, most caribou groups were seen at the north boundary of the Stratum G and to the west in the Stratum B. Some caribou groups were seen on the east side of Bathurst Inlet and other groups were observed on the Kent Peninsula. Although there might be a possibility that the Dolphin and Union caribou summer on the Kent Peninsula, some observers noticed a mix of smaller, whiter caribou and some bigger, browner ones at this location. In the Northwest Territories (Stratum D), four caribou groups were observed. There were 148 groups of caribou seen on transect, summing to 718 Dolphin and Union caribou.

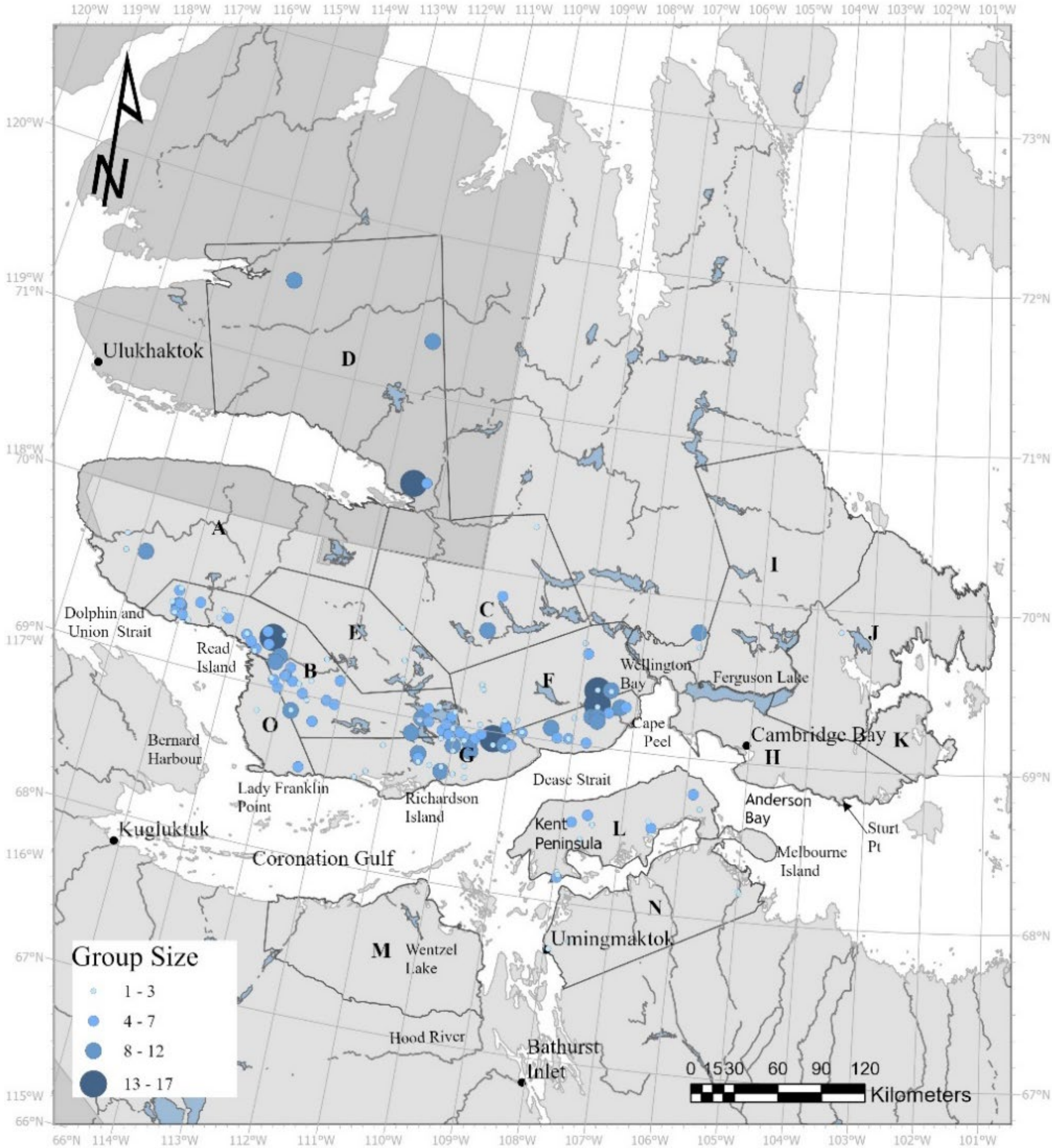

Figure 7: Overview of the 148 Dolphin and Union caribou groups' locations observed on transects during the survey.

Group Size

The group sizes encountered varied from a minimum of 1 to a maximum of 17, where most of the groups were small, with a mean of 4.85 (sd = 3.47) (Figure 8). As the maximum group size was 17, this suggests that the Dolphin and Union caribou did not form large groups in 2023. The data were skewed toward the first bin, 1-3, which reflects the asymmetry of the dataset.

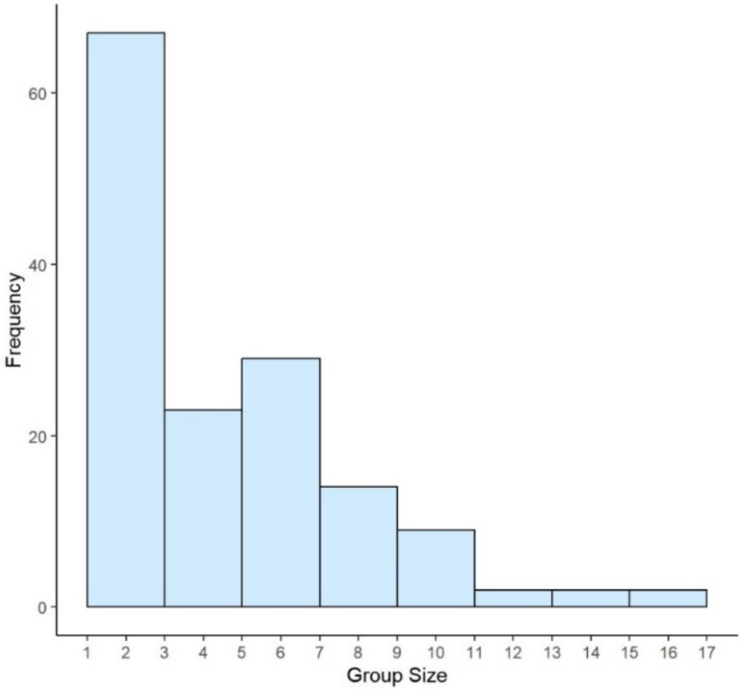

Figure 8: Histogram displaying the Dolphin and Union group size (n = 148) seen during the survey, where the bins ranged from 1 to 17.

Distance Sampling Analysis

Choice of Covariates

Initially, the relationship between each parameter and distance was visualized. Even if the distribution of the group size ranged from 1 to 17, smaller groups were easier to detect closer to the plane, while larger groups were easier to detect away from the plane. As shown by the box plot, the first two bins had a median of three individuals per group, increasing to six in the 4th and 5th bins (Figure 9). Small caribou groups were detected in the last bin confirming ideal detection conditions. To illustrate the underlying distribution in each bin, the individual observations are represented by points, which allowed to distinguish outliers.

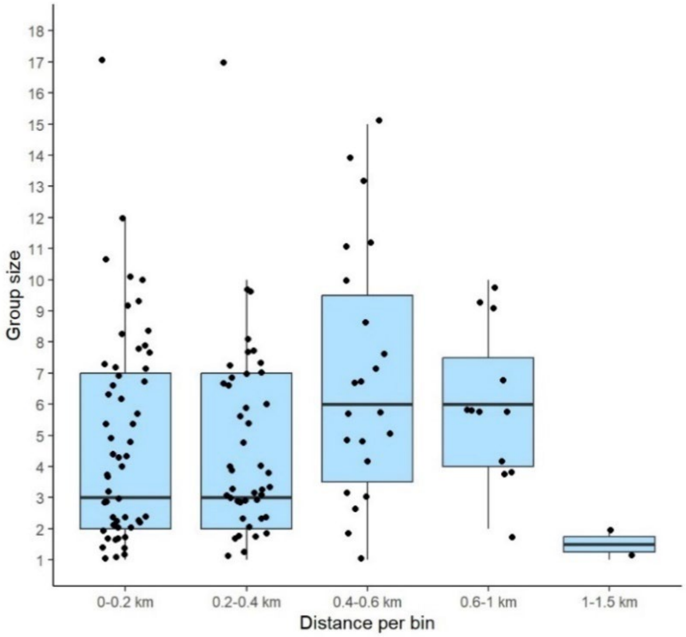

Figure 9: Box plot showing the variation in group size in function of the binned distance.

This plot confirmed that the assumption of the model was met (Figure 10). The number of observations varied as function of distance, as the number of detected events gradually decreased from the first bin. Thus, observers were detecting more caribou in the first bin.

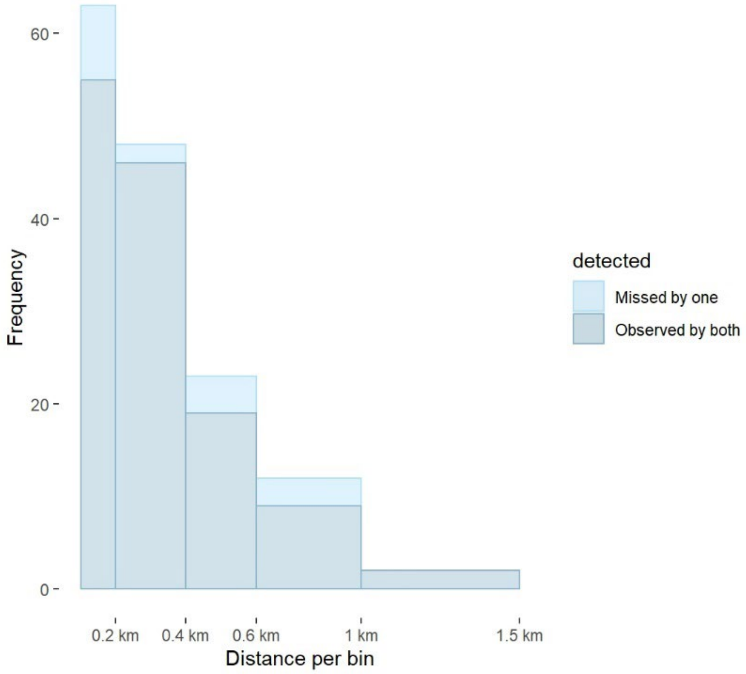

Figure 10: Histogram of detections in function of the binned distance, where events detected by both observers (grey) and events missed by one observer (light blue) were plotted.

The continuous variables, snow cover and cloud cover, were transformed into discrete variables based on a predefined category (Figure 11). Since the percentage of snow cover varied arbitrarily based on the judgment of different recorders, they were reclassified in four categories, where data were only available for two categories (50-75% and 75-100%). Only four observations were made in the 50 to 75% category, and the remaining (n = 144) fell into the 75-100% category. Since the snow cover was uniform in the study area, consistent snow cover would have had no effect on the detection probability (Figure 11). This parameter was no longer considered in the analysis.

Fog was classified as present or absent. Most of the observations (n = 118) were made in the absence of fog, which reinforces our confidence that the caribou groups were available to be detected and were less likely to have been missed. However, when the fog was present, a spike in the first bin was observed, and the number of observations quickly decreased as a function of distance. Fog can impair the ability to detect caribou, as the fog layer can be thick and obstruct the visibility. This parameter was kept and investigated in the model.

Finally, the cloud cover as a function of distance was also visualized. The survey occurred either in low (less than 25%) or high cloud cover (over 75%). Observer's perception could be affected by the intensity of the sun or the flat light created by a variation in cloud cover. Thus, this variable was considered.

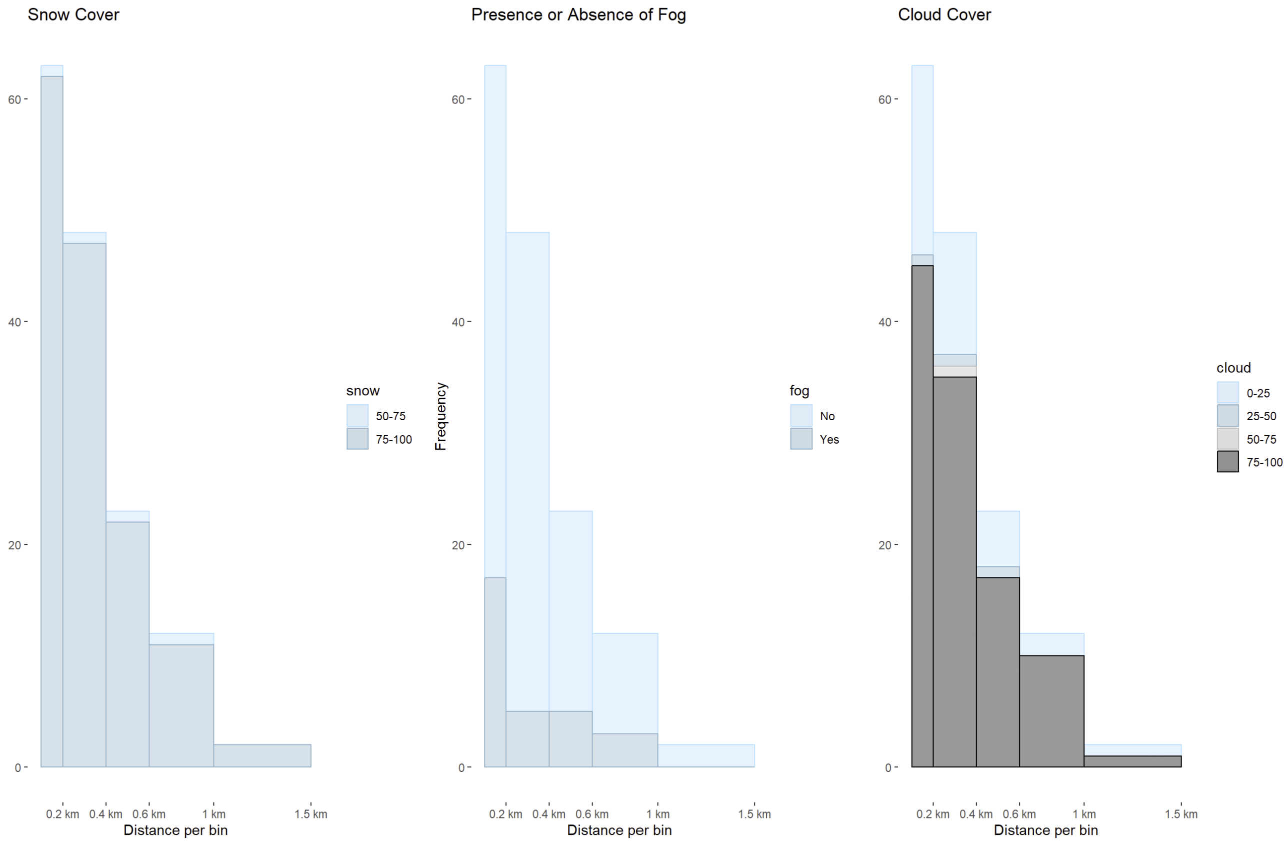

Figure 11: Using histogram, exploration of the different covariates (Snow Cover, Fog, and Cloud Cover) in function of the binned distance.

Mark-Recapture Distance Sampling (MRDS): Model Selection

Since the observers worked together to detect caribou, the caribou observed by the front observer was detected by the back observer with certainty. This resulted in our inability to estimate the detection probability of the back observer, rendering it not a mark-recapture event (Buckland et al., 2007). Therefore, a slight modification to the calculation for likelihood was applied and the "removal configuration" method was used. A forward stepwise model selection procedure based on the AIC score was implemented, starting by investigating the Distance Sampling (DS) model and Mark-Recapture (MR) model with no predictor covariate for the half-normal (hn) and hazard-rate (hr) key function (Model 00 and 01). A combination of different variables was iteratively introduced until all were included. In many ecological situations, multiple models in the candidate set may be reasonable, and the "best" model was not apparent. This is valid when all the model with AIC difference is less than 2 (see Model 00 and 01) (Burnham and Anderson, 2001). A goodness-of-fit assessment (χ^2) was performed to further test the fit of the model on the true values. The Model 03, with the lowest AIC score, had an acceptable fit ($\chi^2 = 9.42$, df = 4, p = 0.051), but an overdispersion of 2.33 showing a lack of fit (Burnham and Anderson, 2001). The fit between the true values and the Model 8 was acceptable ($\chi^2 = 8.00$, df = 5, p = 0.091) with an overdispersion c = 1.6. From the distribution of the data, the half-normal represented a better visual fit, as it assumed that sightability decreased quickly with distance, which is particular to aerial survey because of the difficulty of detecting animals from higher altitude (Clancy et al., 1997). Based on its lower AIC score, goodness-of-fit, overdispersion closer to 1, the model that included the terms distance, groups size, and fog in the MR model (Model 8) was selected as the best model (Table 5). Model 8 was characterized by a point estimate of p (0) for both platforms combined of 0.98 (SE = 0.010).

Table 5: Model specifications and model selections results for point independence analysis with removal configuration of observer. Note, hr indicates a hazard-rate model and hn shows a half-normal model, other covariates symbology are explained in Table 2.

Model	Key	DS model $g.(\underline{z})$	MR model $p_{j\|3-j}(y,\underline{z})$	K	AICc	ΔAICc	w_i	likg	GOF p-value
03	hr	logS	S	5	484.5401	0.000	0.517	1.00	0.051
02	hr	S	1	5	487.1513	2.611	0.140	0.271	0.196
8	hn	1	D+S+F	5	487.3154	2.775	0.129	0.249	0.0915
7	hn	1	D+F	4	489.1471	4.607	0.052	0.099	0.2775
01	hn	1	1	2	490.2732	5.733	0.029	0.057	0.2791
9	hn	1	D+C+F	5	490.7420	6.202	0.023	0.045	0.1624
10	hn	1	D+S+C	5	491.0470	6.507	0.019	0.039	0.0478
5	hn	1	D+S	4	491.1175	6.577	0.019	0.037	0.1124
00	hr	1	1	3	491.5933	7.053	0.015	0.029	0.2714
1	hn	1	D	3	491.7291	7.189	0.014	0.027	0.2791
6	hn	1	D+C	4	491.9118	7.372	0.013	0.025	0.1705
2	hn	S	D	4	492.5159	7.976	0.009	0.019	0.2206
0	hr	1	D	4	493.0493	8.509	0.007	0.014	0.7073
4	hn	F	D	4	493.4028	8.863	0.006	0.012	0.1879
3	hn	C	D	4	493.7184	9.178	0.005	0.010	0.1945

A visual exploration of the plot of the relative detection probability for Model 8 (Figure 12) did not suggest any lack of model fit, as the estimated probabilities were all below the true values. Figure 13, showing the proportion of success at different distance of the line, the smooth line is going down slowly, showing that the heterogeneity of detection has been considered and modelled. However, there was still some unmodelled heterogeneity for the further bins, as the line would have expected to come down more (Buckland et al., 2007). If heterogeneity is not adequately modelled with the MR model, large bias can ensue with a positive bias in estimation of the detection probability and negative bias in estimation of the abundance (Link, 2003). Heterogeneity was not properly modelled in Model 03 and Model 02, as the smooth line was horizontal across all distances (data not shown), inferring that using the covariate size alone was not enough to model heterogeneity. Since there was still some heterogeneity remaining in Model 8, a point independence model was used, so the model was less sensitivity to this remaining unmodelled heterogeneity (Fewster and Pople, 2008). This resulted in an estimate overall average detection probability ($\hat{p}$) of 0.3.

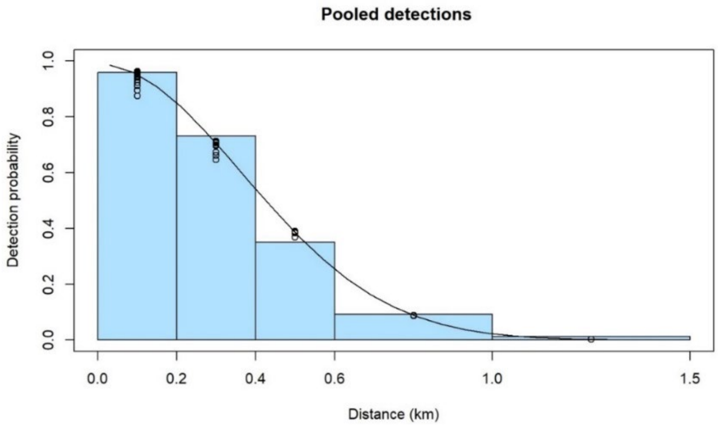

Figure 12: Fitted relative detections probability for Model 8 overlaid on a histogram of the true detection probability.

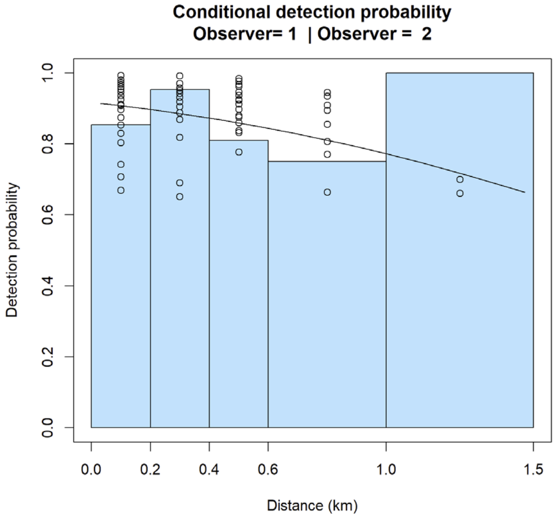

Figure 13: Proportion of success of the two observers at different distance bins with fitted relative detection probability for Model 8.

Estimates

the best MRDS model, Model 8, the estimate was 4,589 (95% Cl = 3,391-6,210, CV = 0.15) caribou for Victoria Island and 5,363 caribou (95% Cl = 4,061-7,081, CV = 0.14) for Victoria Island and the mainland (Table 6). The bulk of the observations were made in the Strata B, F, and G accounting for over 60% of the total estimate (Table 6). The stratum in the Northwest Territories (Stratum D) and the Kent Peninsula had a sizable number of caribou, 649 and 620 respectively. However, the confidence in these numbers was low, as in Stratum D only four groups were seen over a very large area (24,518 km^2) and in Stratum L barren-ground caribou was confirmed by observers. On the mainland, a large majority of the observations were made on the Kent Peninsula (Stratum L), but the number was still minimal, with only 47 caribou counted. In both cases the coefficients of variation (CV) were higher than the recommended threshold of 0.20 (Pollock et al., 1990). These two MRDS estimates (Victoria Island and Victoria Island and the mainland) were relatively precise, with a coefficient below 0.20, providing confidence in the total caribou estimated.

Table 6: Summary of the estimated number of caribou in each surveyed stratum derived from the detection function fitted with Model 8.

	Stratum	Caribou	N	SE	CIL	CIU	CV	Area (km^2)
Victoria Island								
	A	12	181.63	125.83	47.89	688.82	0.69	15,432
	B	272	1,667.72	353.63	1,093.80	2,542.79	0.21	8,101
	C	19	217.01	119.44	68.02	692.30	0.55	9,787
	D	39	648.52	388.40	200.88	2,093.68	0.60	24,518
	E	7	66.83	38.94	21.28	209.88	0.58	5,622
	F	70	568.03	262.24	223.10	1,446.25	0.46	6,581
	G	239	1,030.63	237.13	654.85	1,622.05	0.23	6,972
	H	10	105.91	102.39	19.47	576.19	0.97	7,577
	I	0	0	0	0	0	0	8,539
	J	2	31.42	31.18	5.09	194.11	0.99	11,064
	K	0	0	0	0	0	0	2,151
	O	8	71.67	44.26	20.25	253.58	0.62	2,375
	Victoria Island:	**662**	**4,589.38**	**705.01**	**3,391.32**	**6,210.67**	**0.15**	**108,719**
Mainland								
	L	47	620.43	212.22	301.82	1,275.40	0.34	5,716
	M	0	0	0	0	0	0	9,402
	N	9	153.81	95.66	43.57	539.98	0.62	8,248
	Total Mainland:	56	773.81	234.05	415.49	1,441.16	0.30	23,366
Victoria Island/Mainland								
	Victoria Island/Mainland:	**718**	**5,363.19**	**757.62**	**4,061.91**	**7,081.34**	**0.14**	**132,085**

Density Surface Model

This vast study area spanned across high and less suitable caribou habitat, as the distribution of caribou in the survey area was not uniformly distributed (Figure 7). Most caribou were aggregated in three strata (B, F, G), which inferred a relationship between variation of density and specific environmental covariates in the study area. Therefore, the MRDS model (Model 8) was further modelled using a Density Surface Model (DSM) to provide inference about caribou abundance and habitat. A pearson correlation test was run on the covariates to investigate the strength and the direction of the linear relationship between them. Two pairs of variables, NDVI and NDTI as well as TRI and Slope, had a correlation coefficient (r) higher than 0.75, and were not taken into consideration together in a model. Choice between these covariates was made by selecting the DSM providing the highest percentage of deviance explained (Table 7).

Model Selection

After estimating the abundance for each transect segment, a generalized model was fitted to the resulting estimate using a quasi-Poisson structure. Since a Tweedie distribution provides adequate flexibility and better captures the over-dispersion in the data, it was used to create a smooth function. Each covariate was investigated separately. The preferred model was selected based on the higher deviance explained. Thus, Model 10 with the highest deviance explained, 28.5, was selected. This model was also tested using goodness-of-fit test (NDVI $p = 0.94$; Slope $p = 0.12$). Randomized quantile residuals were investigated by transforming the residuals to be normally distributed, and the residuals versus a linear predictor were plotted, visually explored, and interpreted with caution to assure model fit.

Table 7: Model specification and model selection results for the DSMs, where the model with the highest deviance explained was selected. Note that the covariates were detailed in Table 3.

Model #	Model name	Description	Deviance explained
1	Dsm.xy	Bivariate smooth of location, quasi-Poisson	23.6
2	Dsm.xy.tw	Bivariate smooth of location, Tweedie	26.4
3	Dsm.xy.twL	Bivariate smooth of location, Tweedie, smooth of LakeDist	26.7
4	Dsm.xy.twR	Bivariate smooth of location, Tweedie, smooth of RivDist	26.3
5	Dsm.xy.twX	Bivariate smooth of location, Tweedie, smooth of XingDist	26.4
6	Dsm.xy.twS	Bivariate smooth of location, Tweedie, smooth of Slope	27.3
7	Dsm.xy.twT	Bivariate smooth of location, Tweedie, smooth of TRI	27.2
8	Dsm.xy.twV	Bivariate smooth of location, Tweedie, smooth of NDTI	26.7
9	Dsm.xy.twND	Bivariate smooth of location, Tweedie, smooth of NDVI	27.8
10	Dsm.xy.twNDS	Bivariate smooth of location, Tweedie, smooth of NDVI+Slope	28.6

Abundance estimation and variance estimation

The best performing model, Model 10, was used to predict the abundance for Victoria Island and the mainland. Having made a prediction for each cell (9 km^2), the caribou abundance and respective coefficient of variation were both mapped (Figure 14). There were two main locations where the abundance was high. One of them was the north coast of the Dolphin and Union Strait around Read Island and the second location was between Richardson Island and Cape Peel 39 km inland from the coast (Figure 14). The DSM model resulted in an abundance estimate of 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12), which was not statistically different from the 5,363 caribou (95% Cl = 4,061-7,081, CV = 0.14) estimate for Victoria Island and the mainland using MRDS ($t' = 0.14 < t_{0.05,\ 287} = 1.96$). As DSM was more precise than the MRDS estimate and accounted for caribou aggregation in the study area, the use of the DSM abundance estimates as the 2023 Dolphin and Union caribou herd estimate for Victoria Island and the mainland was strongly justified.

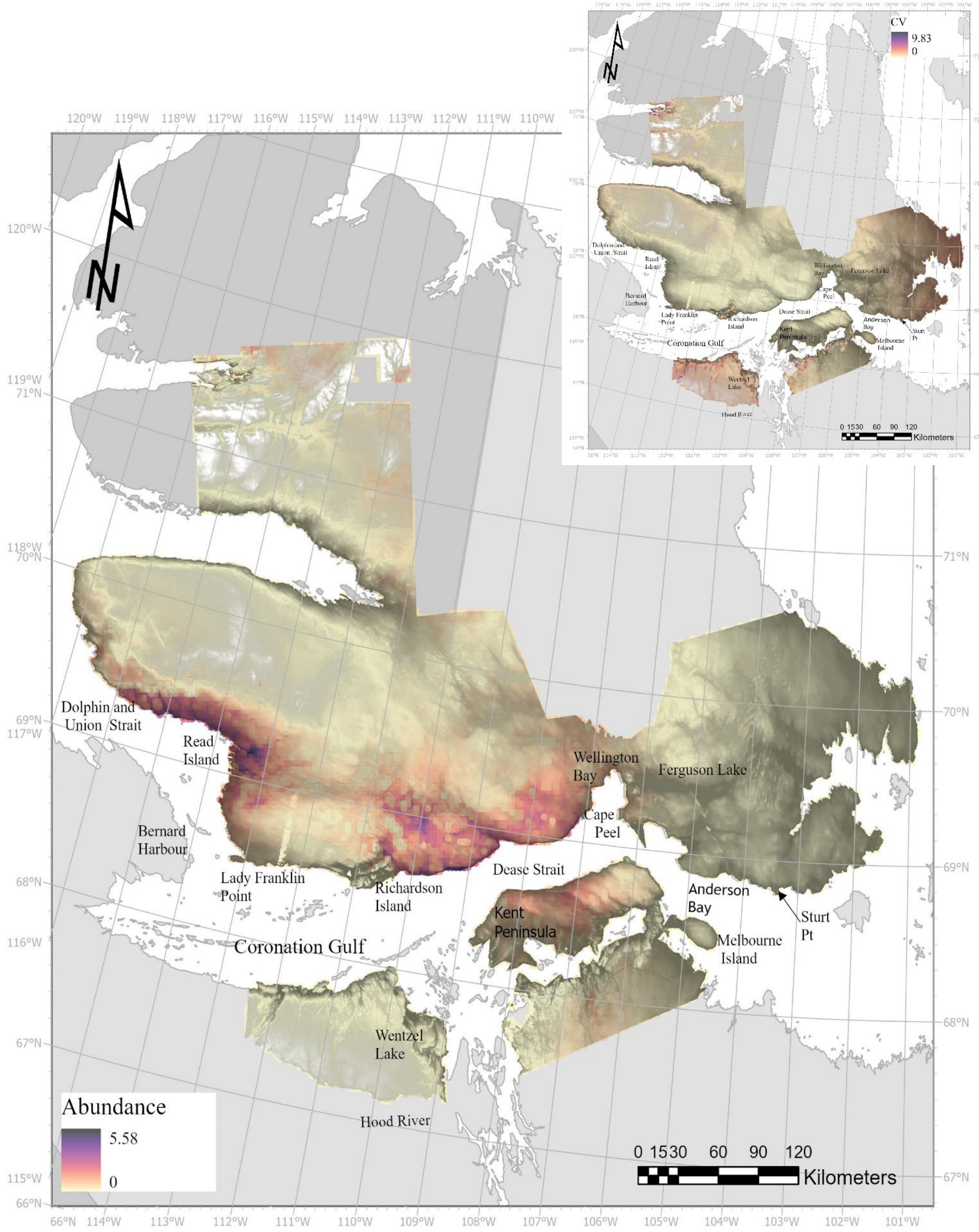

Figure 14: Predicted density surface with NDVI and Slope as bivariate smooth for *x* and *y* location as predictor. The resulting abundance of caribou is shown within each predicted grid cell of size 9 km^2. The smaller map shows the coefficient of variation per predicted grid cell over the study area to inform areas of higher uncertainty.

Population Changes and Overall Trend

Table 8 summarized the estimates resulting from the Dolphin and Union caribou herd monitoring program conducted between 1997 and 2023. Comparison between the 2020 and 2023 estimates was conducted for both Victoria Island and the Victoria Island and mainland. The results were compared using a two-way t-test ($\alpha = 0.05$) to determine if the estimates were statistically significantly different.

The number of caribou on Victoria Island increased from 3,579 in 2020 to 4,589 in 2023, but this difference was not significant ($t' = 1.19 < t_{0.05, 246} = 1.96$). Even when the 2018 and 2023 estimates were compared, there was no statistical difference detected between estimates ($t' = 0.49 < t_{0.05, 216} = 1.96$) upholding status quo. For Victoria Island and mainland, the 2023 estimate was not different from the 2020 estimate ($t' = 1.73 < t_{0.05, 308} = 1.96$) (Table 8).

The overall finite rate of change between survey year (lambda (λ)) was calculated as the ratio of the population size in year plus 1 to the population size (Gasaway et al., 1986). Since the time interval is over two years, a constant rate is assumed between this interval. Thus, the estimated finite rate of change was below 1 before 2020, and was higher than 1 in 2023, showing positive growth (Table 8). The overall finite rate of change (lambda (λ)) were provided (Table 8).

Table 8: Estimates of the Dolphin Union herd from 1997-2023 for Victoria Island (VI). The 2020 and 2023 estimates for the Dolphin Union for the Victoria Island and mainland (VI/Mainland) are in two separate rows.

Year	N	SE	Conf. Limit		CV	df	t-test	λ
1997 (VI)	34,558	4283.0	27,757	41,359	0.12			
2007 (VI)	27,787	3613.0	20,250	35,324	0.13	21	-1.21	0.80
2015 (VI)	18,413	3133.8	11,644	25,182	0.17	55	-1.96	0.66
2018 (VI)	4,105	694.8	2,931	5,750	0.17	54	-4.46	0.22
2020 (VI)	3,579	476.5	2,758	4,644	0.13	379	-0.62	0.87
2023 (VI)	4,589	705	3,391	6,211	0.15	246	1.19	1.28
2020(VI/Mainland)	3,815	513.7	2,930	4,966	0.13			
2023 (VI/Mainland)	5,229	635.0	3,985	6,473	0.12	308	1.73	1.37

Figure 15 shows the Dolphin and Union caribou herd estimates between 1997 and 2023 on Victoria Island, with the latest 2023 survey resulted in an estimate of 4,589 caribou (95% Cl = 3,391-6,210, CV = 0.15). The survey frequency between surveys was wider before 2015 until a declining trend was confirmed, and the monitoring increased to every 2-3 years. Between 2018 to 2023, the herd abundance was low and the abundance estimate remained at best consistent with no further decline recorded (Figure 15). Since 2020, a portion of the Canadian mainland and the Kent Peninsula are included in the Dolphin and Union study area to derive the herd estimate (Figure 15). Consistently with Campbell et al., (2021), an abundance estimate for Victoria Island and the mainland was provided, resulting in 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12). The estimates for Victoria Island and the mainland are higher than if Victoria Island only is considered. Although, for consistency with 2020, this report provided the final herd estimate for Victoria Island and the mainland, caution with this estimate should applied because: this area of the Canadian mainland is known to potentially overlap with other barren-ground herds, the lack of sea ice prohibited the caribou to start their crossing during the survey, and no collared caribou were trapped at this location the previous spring.

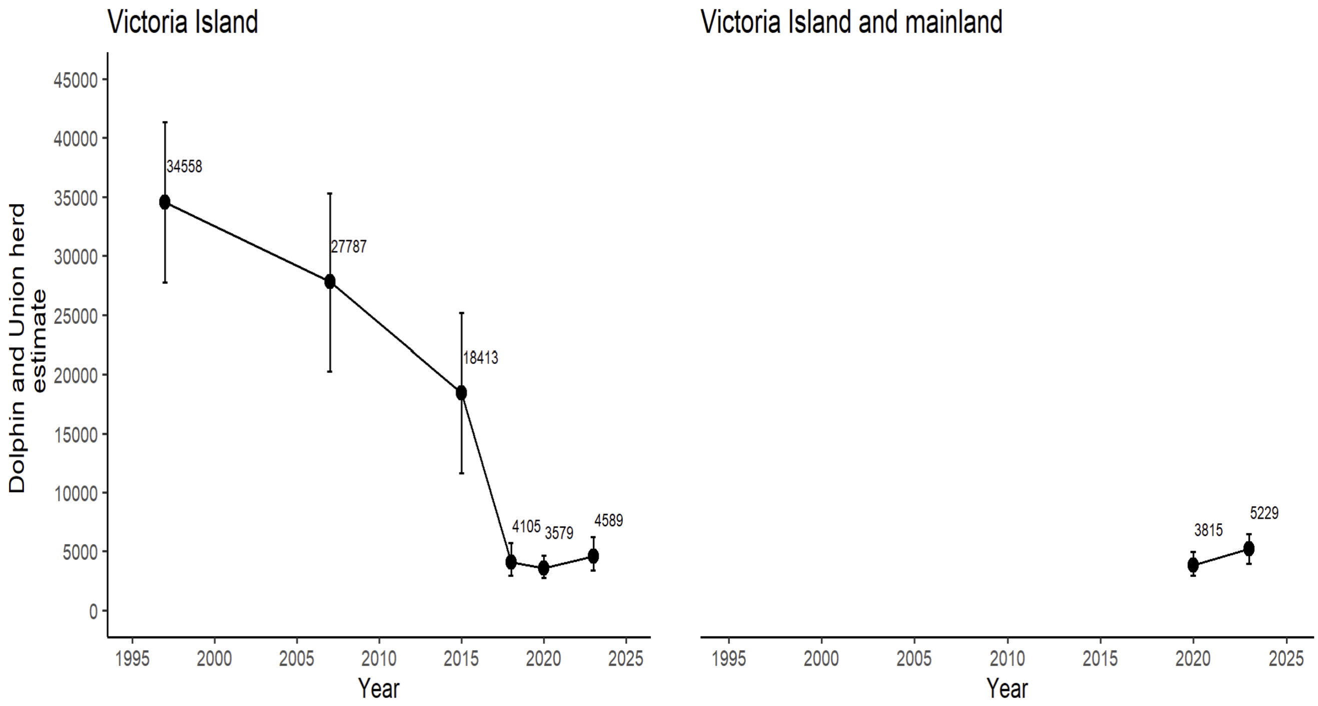

Figure 15: Left: Estimates for the Dolphin Union caribou herd on Victoria Island from 1997 to 2023. Right: Population estimates for the Dolphin Union caribou herd on Victoria Island and mainland for 2020 and 2023.

DISCUSSION

The same monitoring effort as the 2020 survey was used to generate an abundance estimate in 2023, as the same area was surveyed with minor modifications (Hauser et al., 2006). Prior to 2015, groups with over 100 individuals were seen (Leclerc and Boulanger, 2018). In 2023, the mean group size was 4.85 (sd = 3.47), and no group larger than 17 was observed (Figure 8). The greater frequency of small group observed could be explained by the caribou having not reached the coastline, where groups combined to form larger ones along the shoreline. Since groups were small, although hard to detect, when detected observers could accurately count the number of caribou in each group (Heard 1985; Heard and Jackson 1990).

Typically, 60 to 80 observations are needed to fit a detection function (Buckland et al., 2005). The number of groups seen in each stratum was less than 60, even in the two high density strata B and G. All the observations in the study area resulted in 148 groups of caribou across all strata. This is less than in 2020 with 202 groups, but more than in 2018 with 91 groups (Campbell et al., 2021; Leclerc and Boulanger, 2020). To meet the main assumption of Distance Sampling, mandatory observers' training, recording the distance before caribou are disturbed were implemented (Buckland et al., 2001). It was possible to have good detection in the first bin even when using Twin Otter, which did not provide an optimal seating position and bubble windows. Most of the observations were made in the closest bins to the aircraft and declined gradually with distance (Figure 10). The shape of the histogram of detection was an improvement from the 2020 survey (Campbell et al., 2021).

Dolphin and Union caribou herd distribution in the study area was informed by the collars (n = 21) and caribou observation gathered during the survey. At the time of the survey, no collar started to resume their migration and venture outside of the study area since the sea ice did not form and the daily movement rate was below 5 km/day (Figure 5), providing confidence in the survey results, as a minimum movement within the study area occurred. Where no collars were observed, the aerial survey allowed us to detect additional caribou inland within the Strata D, C, A, and E, as well as on the Kent Peninsula (Stratum L), and a negligible number of caribou in Strata O and J (Figure 7). Collars and observations both confirmed caribou aggregated in two distinct clusters; one close to Read Island and the other north of Richardson Island, 39 km inland (Figure 7). The distribution of caribou in 2023 differed from what was recorded in previous coastal surveys, as then the majority of caribou were within 20 km inland from the coast (Stratum G). The unexpected distribution created additional caribou clustering in some Strata B, G, and F (Figure 7).

MRDS method assumed uniform distribution of animal, but this assumption was challenged with the 2023 aggregation of caribou within stratum. A model allowing for this consequential heterogeneity of the landscape, such inference between the habitat variation and abundance, became preferable. The DSM, which allows for integrating the roles of environmental factors in abundance estimate (Miller et al., 2013), was therefore used to provide a more precise and robust estimate of the Dolphin and Union caribou herd for Victoria Island and the mainland. In fact, this method estimates the relationship between the distribution of animals, as a function of environmental covariates while estimating abundance.

The 2023 Dolphin and Union survey effort was successful in generating an accurate abundance estimate for the herd. The analysis using DSM for Victoria Island and the mainland resulted in an estimate of 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12). DSM was a robust method to model estimate, especially because caribou are clustered in two main areas. The abundance was modestly explained (28.6), by two environmental characteristics: NDVI and slope (Winiarski et al., 2013). The Dolphin and Union caribou herd selected areas that had a gentle slope and where plant productivity was high during the growing season. In the future, there is still a need to better determine the habitat characteristics that contribute to the Dolphin and Union caribou herd distribution during the rut by exploring the inclusion of other covariates, such as snow depth. The coefficient of variation (CV) of the best DSM model (Model 10) was less than 0.20 (Pollock et al., 1990). Skalski et al., (2005) suggest that a coefficient of variation below 0.128 is accurate for management, while 0.255 is acceptable for rough management. The predictive distribution and abundance mapping (Figure 14) could better stratify the sampling and increase efficiency of future survey.

Having the inability to tell confidently other subspecies of caribou apart from the aircraft, it is possible that some other caribou subspecies were counted as Dolphin and Union caribou in areas of range overlap. Some strata overlapped with the distribution of Peary caribou on Victoria Island (Stratum D), while others on the Canadian mainland (i.e. Strata L and N) overlapped with tundra wintering herds. The rate of mixing at these locations of range overlap is currently unknown. It is more likely that including caribou belonging to other subspecies may have inflated the Dolphin and Union counts. This contributed to potentially overestimate the true Dolphin and Union caribou herd estimate. Therefore, careful consideration should be taken when making harvest recommendations based on the total estimate presented in this report for Victoria Island and the mainland. A more conservative study area might be warranted.

Although the past two survey results were for the Victoria Island and the mainland, the estimate of Dolphin and Union caribou only for Victoria Island goes back to 1997. The Dolphin and Union caribou herd experienced a slow decline from 1997 to 2015, which precipitated rapidly between 2015 and 2018 (Figure 15). The last three surveys conducted in 2018, 2020, and 2023 for Victoria Island only, showed that the herd has remained stable, as the estimates were not statistically significant between 2018-2020 (Campbell et al., 2021), and between 2020-2023 ($t' = 1.19 < t_{0.05, 246} = 1.96$) (Figure15). For the last two surveys, a larger study area was set. The increase in number from 3,815 (95% Cl = 2,930–4,966, CV=0.13) to 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12) is also not statistically significant ($t' = 1.73 < t_{0.05, 308} = 1.96$). Although the 2023 estimate was precise (CV < 0.20), a potential small true biological change in the Dolphin and Union caribou herd trend trajectory was not detected with confidence within the 3-year frequency interval between survey (Conroy et al., 2018). Inclusion of local knowledge and health monitoring information would provide complementary information to the Dolphin and Union caribou herd trend. In conclusion, either for Victoria Island or for Victoria Island and mainland, the estimated number of caribou was at best stable based on the 2023 results.

Before the next survey, it is recommended to determine the minimal change in abundance estimate (i.e., minimum biologically significant effect size) that would cause change in the management strategy of the Dolphin and Union herd. Statistical power analysis would be useful in the research planning effort to design a survey with the CV needed to detect a management threshold with more confidence (Conroy et al. 2018). Such an effort should be strategically located where only the Dolphin and Union caribou are likely to be found in high density to calculate a reliable detection function. However, as community confidence in the survey design and result is paramount, there could be an interest to continue to fly a large survey area, such as the full range at the rut.

In conclusion, although the population estimate of the Dolphin and Union herd has been low since 2018, there have been no further declines reported. Meanwhile, the current estimate, 5,229 caribou (95% Cl = 3,985–6,473, CV = 0.12) for Victoria Island and the mainland, still felt below 8,000 caribou, which is the threshold used to determine the low point in their cycle (Worthington et al., 2018). Emphasis between survey years should be put forward to monitor the herd demographic indicators, such as reproduction rate, calf production, recruitment rate, and cow survival. Dolphin and Union caribou are adapting to unpredictable climatic conditions under a warming Arctic and the herd is still in a state of vulnerability. Preserving this herd is a critical conservation priority, as it is central to the preservation of Inuit subsistence and preservation of the traditional values of the communities in the western Kitikmeot and the eastern Inuvialuit communities.

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ᑲᑐᑎᓗᒍ ᓄᓇᕗᑦ ᐱᕈᖅᐸᓪᓕᐊᑎᓪᓚᕗᑦ
Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

ᐊᕙᑎᓕᕆᔨᒃᑯᑦ
Department of Environment
Avatiliqiyikkut
Ministère de l’Environnement

ᑐᑭᓯᒋᐊᖅᑎᑦᑎᔾᔪᑎ ᓇᐃᓈᖅᓯᒪᔪᖅ

ᐅᓄᕐᓂᖏᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ

ᐅᑭᐊᒃᓵᒃᑯᑦ 2023

ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓ ᑐᒃᑐᖃᕐᕕᐅᕗᖅ, ᐲᕐᓗ ᕿᑭᖅᑕᓂ ᑐᒃᑐᐃᑦ (*Rangifer tarandus pearyi*), ᓇᐹᖅᑐᖃᙱᑦᑐᒥᑦ (*Rangifer tarandus groenlandicus*), ᐊᒻᒪᓗ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ (*Rangifer tarandus groenlandicus x pearyi*). ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂ ᓇᔪᖅᑕᐅᕙᒃᑐᑦ ᐅᑯᓇᓂ ᐃᖃᓗᒃᑑᑦᑎᐊᑉ ᕿᕿᖅᑖᓗᓕᒫᑲᓯᖓ ᐊᒻᒪᓗ ᑲᓇᑕᐅᑉ ᓄᓇᖅᐸᓯᐊᓂ ᐅᐊᖕᓇᖓᓂ.

ᑲᑎᒪᔨᕋᓛᖏᑦ ᐊᑦᑕᕐᓇᖅᑐᒦᑦᑐᓂᑦ ᐆᒪᔪᓂᑦ ᑲᓇᑕᒥ (COSEWIC) ᖃᐅᔨᓴᓚᐅᖅᑐᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᓐᓂ ᓄᖑᑐᐃᓐᓇᕆᐊᖃᓕᕐᓂᕋᐃᔪᑦ. ᑭᖑᓂᐊᒍᓪᓗ, 2022-ᒥ, ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᓂᕐᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᑦ ᓴᕙᒪᑐᖃᒃᑯᓪᓗ ᒥᓂᔅᑕᖓ ᐊᕙᑎᓕᕆᔨᒃᑯᖓᓄᑦ ᑎᑎᕋᖅᑕᐅᖁᔨᓚᐅᖅᓱᑎᒃ ᐊᔾᔨᒌᙱᑦᑐᑦ ᐊᑦᑕᕐᓇᖅᑐᒦᓕᖅᐸᓪᓕᐊᓂᖏᓐᓂᒃ.

ᑎᖕᒥᓲᒃᑯᑦ ᐅᓄᕐᓂᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ 2018-ᒥ ᐅᓄᕈᓐᓃᖅᐹᓪᓕᕐᓂᖏᓐᓂᒃ ᑕᑯᓚᐅᖅᐳᑦ 4,105-ᐸᓗᓄᑦ ᑐᒃᑐᓄᑦ ᐃᖃᓗᒃᑑᑦᑎᐊᑉ ᕿᑭᖅᑕᖓᓂ. ᑭᓯᐊᓂ, ᐅᓄᕐᓂᖏᑦ ᐊᓯᔾᔨᓗᐊᓚᐅᙱᑦᑐᑦ 2020-ᒥ, ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᓚᐅᖅᐳᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓪᓗᑎᒡᓗ 3,815-ᖑᓇᓱᒋᔭᐅᓪᓗᑎᒃ ᑐᒃᑐᐃᑦ, ᐱᖃᓯᐅᑎᓪᓗᒋᑦ ᐃᖃᓗᒃᑑᑦᑎᐊᑉ ᕿᑭᖅᑕᖓᓃᑦᑐᑦ ᓄᓇᐃᓐᓇᕐᒦᑦᑐᓪᓗ.

ᐅᑯᐊ ᒪᕐᕉᒃ ᑐᕌᒐᓇᔭᐅᓪᓗᐊᑕᓚᐅᖅᑐᑦ ᓈᓴᐃᑎᓪᓗᒋᑦ: 1) ᐅᓄᕐᓂᖏᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᑦ ᓴᖅᑭᑎᓪᓗᒋᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ ᐊᒻᒪᓗ 2) ᖃᓄᐃᑉᐸᓪᓕᐊᓂᖏᑦ ᖃᐅᔨᓇᓱᒡᓗᒋᑦ ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ.

ᖃᐅᔨᓴᕈᑎᕙᓃᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᑦ 4,589-ᖑᓚᐅᖅᐳᑦ ᐃᖃᓗᒃᑑᑦᑎᐊᑉ ᕿᑭᖅᑕᖓᓂ ᐊᒻᒪᓗ 5,229 ᑐᒃᑐᐃᑦ ᐃᖃᓗᒃᑑᑦᑎᐊᑉ ᕿᑭᖅᑕᖓᓂᑦ ᓄᓇᐃᓐᓇᕐᒥᓪᓗ. ᐊᒥᓲᓂᖏᑦ ᖃᓄᐃᑉᐸᓪᓕᐊᓂᖏᑦ ᓱᕐᕌᙱᓐᓇᓱᒋᔭᐅᓇᔭᖅᐳᑦ 2023-ᒥ ᐊᒥᓲᓂᖏᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᑦ ᑕᐅᑐᒃᓱᒋᑦ ᒪᕐᕉᖕᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᓯᒪᔫᖕᓄᑦ.

ᕿᑭᖅᑖᓘᑉ ᑐᒃᑐᖏᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ 5,229-ᖑᓇᓱᒋᔭᐅᔪᑦ ᑐᒃᑐᐃᑦ, ᓱᓕ ᐊᑦᑎᓗᐊᕋᓱᒋᔭᐅᕗᑦ (8,000

ᑐᖕᒑᓂ). ᑖᒃᑯᐊ ᑐᒃᑐᐃᑦ ᐱᒻᒪᕆᐅᓂᖕᒋᓐᓄᑦ ᐃᓄᖕᓄᑦ ᐊᓐᓇᐅᒪᔾᔪᑕᐅᓪᓗᑎᒃ ᐃᓕᖅᑯᓯᖕᒐᓄᓪᓗ, ᐊᐅᓚᑦᑎᔾᔪᑕᐅᔪᑦ ᐃᑲᔪᖅᑐᐃᖕᒋᓐᓇᓇᐊᖅᑲᖅᐳᑦ ᐅᑎᖅᐸᓪᓕᐊᓂᖕᒋᓐᓂᑦ.

Kugluktuk Angoniatit Association ● Hunters' & Trappers' Organization
PO Box 309, Kugluktuk NU X0B 0E0 ● Phone: (867) 982-4908 ● Email: kugluktuk@krwb.ca

PITJUTAOYOK: Kugluktuk Angoniatit Katimayiit (HTO-kut) titigakhimayot kiotjutigivlugit ukkua Nunavut Kavamatkut kiotjutigihimayaitnik tahapkununga umingmait munagitjutaitnik mighagot tahamani nunaoyami MX-07-mi.

HIVUNIGHITJUTAT:

- Umingmait kangagalok nikkigiyaokataktot hapkua Kugluktukmiut Inuinaknin.
- Kugluktumiut anguniaktit atokataktait tahapkua pingahut aviktoghimaniit nunaoyami anguniakvigivlugit tahapkua: MX-11 kivatani Kugluktumi; MX-07 Kiilikinikmi MX-09, tatvalu una MX-11 tahapkua atogaoloaktot anguniaktiit anguniakvigivlutjuk.
- Anguniakviohimangitok tahamna aviktoghimaninga nunaoyamin MX-07-mi Kugluktukmiot anguniaktitnin tatvanganin 2019-min kinguaniitlo, ikittunuanik umingmakviohimayok
- Kugluktukmiut anguniaktit takkuhimaliktot ikkilivalianinganik tahapkua amigaitilangit umingmait tahamani (anniakutikakpaliktuniklo) taimatot ahiani aviktoghimayuni nunauyami angutiakpaliktot.
- Kugluktumi HTO-kut ikkayokhiotihimangitat ukkua Nunavut Kavamatkut parnaiyaotatnik naunaiyagomavlutjuk tahamna aviktokhimayomi nunaoyami MX-07.

UBLUMI KANOGININGANIK:

- Ukkua Kugluktumi HTO-kut katimakatigihimayat ukkua Nunavut Kavamatkut havaktiit tatvani June 18, 2025-mi ukkaotigivlugit tahapkua naunaiyaotaohimayot.
- Ukkaotikakhimayot tahapkuninga Kititaohimayot Anguniakutikhat Ataatait ikkilivaligomangmatjuk 400-mit talimanut ataatakhanik tamatkiklugo tahamna aviktoghimayomi nunaoyami.
- Ukkua Kugluktumi HTO-kut ikkayoghiotingitaat tahamna tatvalu uktokuyaat ukkua Nunavut Kavamatkut katimakatigitkovlugit nunaliitni nallaktitlugit.
- Ukkua Kugluktumi HTO-kut atokataktat una MX-11-mi nunaoyami hapkua nunaliitni anguniagangata Nunakatigit Nikkighakhiokhugit Avakuktakhanik.

UKTOKUYAOYUT:

- Ukkua Kugluktuk-mi HTO-kut pihimayomayat ukkua Kititaohimayot Anguniakutikhat Ataataghat aulaakuvlugit 400-nik ataataghat tatvalu tamaita hapkua anguniaktit katimayiiit ilikut angutighanik munagitjutighaitnik ihuaghaitkoyait tahapkuani aviktoghimayomi nunaoyami, taimatotaok inmingnik havagihimayaitnik.
- Ukkua Kugluktumi HTO-kut katimakatigiyomayait hapkua allaat Anguniaktit Katimayiit tatvalu Ikkayoktigikhutik Munaghiyioyot kiotjutighanik hivunighami tahapkua Nunavumi Anguhighalikiyiit Munaghiyiolutik Katimayiit katimakatigiyomavlugit ahivakulugit tahapkua Kititaohimayot Anguniakutikhat Ataatakhat umingmakhiokutit tatvani Aviktoghimayomi Nunaoyami MX-11-mi.

Titigakhimaya uma

Amanda Dumond, Ataniata