<u>ᐅᑯᓐᓇᒃᑲ ᑐᓂᔭᐅᔪᖅ</u>

<u>ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔩᑦᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ</u>

<u>ᐆᒎᒃᑲ</u>

<u>ᑐᓴᒃᓴᑦ: X</u> **<u>ᐃᓱᒪᓂᐅᕈᑎᑦ:</u>**

ᐱᔾᔪᑖ: ᓄᓇᕗᑦ ᒐᕙᒪᒃᑲ, ᐊᕙᑎᓕᕆᔨᒃᑯᑦ–ᐊᔾᔨᒌᖕᖏᑦᑐᑦ ᐱᓕᕆᐊᖑᔪᑦ ᓄᑖᖖᒍᕆᐊᖅᓯᒪᔪᑦ

ᐊᒃᓴᒃᑕᐅᔪᑦ ᖃᐅᔨᓴᒃᓴᐃᓪᓗ

- ᓄᓇᕗᑦ ᑭᒻᒪᖅᑐᐃᕗᖅ ᐅᐊᓐᓇᖅᐸᓯᐊᓂ ᐊᒃᓴᖏᓐᓂ (*ᐊᒃᓚᐃᒡ*) ᓇᓂᑐᐃᓐᓈᖅᑐᑦ ᑲᓇᑕᒥ.
- ᐊᒃᓴᐃᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᑦ ᐃᓱᒫᓘᑕᐅᓪᓗᑎᒃ ᑲᓇᑕᒥ *ᐆᒪᔪᐃᑦ ᐊᑦᑕᕐᓇᖅᑐᒦᑦᑐᑦ ᐱᖁᔭᖓᑎᒎᑦ* (SARA) ᓇᓄᐃᓪᓗ ᓈᓄᒃᑕᐅᒐᔫᕗᑦ ᐋᓇᐅᒪᙳᑕᐅᓪᓗᑎᒃ, ᐃᓅᓯᕐᒥᒃ ᐊᒻᒪ ᐱᖁᑎᓂᒃ ᓴᐳᔾᔨᓇᓱᒃᐳᑎᒃ ᐊᒻᒪ ᕿᓇᐅᔭᓕᒡᔪᐊᓂᒃ ᐊᖑᓇᓯᕆᐊᖅᑎᑦᑎᕙᒃᐳᑎᒃ ᐅᓄᖕᖏᓐᓂᖅᓴᓂᑦ. ᐅᓄᖕᖏᑦᑐᑦ ᓂᐅᕖᒃᓴᖃᖃᑦᑕᖅᑐᑦ ᐊᒥᖏᓐᓂ ᐊᓯᖏᓐᓂᓪᓗ.
- ᖃᐅᔨᓴᒃᓴᓂᒃ ᓱᓕ ᑲᑎᖅᓱᐃᑎᑦᑎᖃᑦᑕᖅᐸᑦ ᖃᐅᔨᓇᓱᒃᐳᑎᒃ ᓄᓇᖑᐊᒃᑯᑦ ᓇᓅᓂᖏᓐᓂᒃ, ᑭᓲᓂᖏᓐᓂᒃ, ᐊᕐᕚᒍᖏᓐᓂᒡᓗ ᐊᒃᓴᐃᑦ ᐊᖑᔭᐅᕙᒃᑐᑦ ᓄᓇᕗᒻᒥ.
- ᐊᖑᓇᓱᒃᑎᑦ ᑐᓂᓯᖃᑦᑕᕐᑯᔭᐅᔪᑦ ᐊᓕᕈᐊᓂ ᐊᓕᕐᒥᑦ ᓂᐊᕐᑯᐃᓐᓇᖓᓂᓗᓐᓃᑦ, ᓄᑭᒥᑦ, ᐊᒥᑯᓗᖕᒥᓗ ᒥᖅᑯᖃᕐᓗᓂ (2 cm x 5 cm), ᑐᓴᖅᑎᑦᑎᓗᑎᓪᓗ ᖃᖓ ᓈᓄᓚᐅᕐᒪᖔᑦ (ᐅᓗᖓᓂ, ᓇᓂ, ᐊᓯᖏᓗ) ᐆᒪᔪᕐᓂᐊᖅᑎᖏᓐᓄᑦ. ᑭᒍᑎᖏᓐᓂ ᖃᐅᔨᓴᒃᓴᓂᑦ ᐊᑐᖃᑦᑕᖅᐳᑦ ᖃᐅᔨᔭᐅᓇᓱᒃᐳᓂ ᓈᓄᒃᑕᐅᔩᑉ ᐅᑭᐅᒃᑲ.
- 2020–ᒥᑦ 2024–ᒧᑦ ᑲᑎᕆᓗᒋᑦ 200–ᓂᒃ ᐊᒃᓴᓂᒃ ᓈᓄᒃᑕᐅᔪᓂᒃ ᐅᖃᐅᓯᐅᔪᖃᓚᐅᖅᐳᖅ, 109 ᖄᑎᕐᒥᐅᓂ ᐊᒻᒪ 91 ᑭᕙᓪᓕᕐᒥᐅᓂ.
- ᐊᒃᓴᒃᑕᐅᔫᓇᖅᑐᑦ ᐊᒃᑐᐊᓂᖃᖅᑐᑦ ᐊᖑᓇᓱᒃᑎᓄᑦ ᐱᔭᐅᔫᓇᖅᑐᓄᑦ; ᐅᑭᐅ ᐊᓂᒍᖅᐸᓪᓕᐊᖅᑎᓪᓗᒍ/ᐅᐱᕐᖓᖕᒍᓵᖅᑎᓪᓗᒍ ᐊᖑᓇᓱᒃᑏᑦ ᓯᑭᑑᒃᑯᖅᑲᑎᒃ ᐅᖓᓯᒃᑐᓕᐊᓲᖑᕗᑦ. ᐊᐅᔭᒃᑯᑦ, ᑎᓴᒪᓖᑦ ᐊᑐᖅᑕᐅᓲᖑᕗᑦ ᓄᓇᓕᖕᓂ ᐊᒻᒪᓗ ᐅᒥᐊᒃᑯᑦ ᐊᖑᓇᓱᒃᐸᑲᑎᒃ ᓯᓪᓗᒃᑰᖅᑲᑎᒃ.
- ᐊᒃᓴᒃᑕᐅᔪᑦ ᑲᑎᑕᐅᓯᒪᕗᑦ ᖄᑎᕐᒥᐅᓂ, ᖁᓪᓗᖅᑐᖅ, ᐃᖃᓗᑑᑎᐊᖅ ᖃᓂᖕᔪᓂ ᐊᒻᒪᓗ ᐊᖅᑯᑎᖕᔭᐅᕙᓚᐅᖅᑐᒥᑦ ᐃᖃᓗᒃᑑᑦᑎᐊᒥᑦ ᖃᖓᐅᒧᑦ. ᐊᕐᕕᐊᑦ ᐊᒻᒪ ᖃᒪᓂ'ᑐᐊᖅ ᑐᓂᓯᔪᑦ ᐅᓄᕈᖕᒍᓚᐅᖅᐳᑦ ᑭᕙᓪᓕᕐᒥᑦ ᐊᖑᔭᐅᔪᓂᑦ.
- 2019 ᐊᒻᒪ 2024 ᐊᑯᓐᓂᖓᓂ, ᐊᖑᔭᐅᔪᑦ ᒪᒃᑯᓐᓂᖅᓴᐅᓚᐅᖅᐳᑦ (ᐃᓇᕈᐊᓂᒃᓯᒪᖕᖏᑦᑐᑦ) ᑭᕙᓪᓕᕐᒥ ᐃᓇᐃᓪᓗ ᐃᓚᖏᑦ ᐱᔭᐅᔪᑦ 38–ᐳᓴᖕᖑᓪᓗᑎᒃ, ᐃᓇᐃᓪᓗ ᐃᓚᖏᑦ ᖄᑎᕐᒥᐅᓂᑦ ᐊᖑᔭᐅᔪᑦ 56–ᐳᓴᖕᖑᓪᓗᑎᒃ.
- ᐊᑯᓂᐅᔪᒥᑦ ᐅᖃᐅᓯᐅᓯᒪᔪᑦ ᓈᓄᒃᑕᐅᔪᑦ ᖃᓄᐃᑉᐸᓪᓕᐊᓂᖏᑦ ᐊᕿᒍᓂᑦ 15–ᓂᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᕗᑦ ᖄᑎᕐᒥᐅᓂ, ᓈᓄᒃᑕᐅᔪᑦ ᐅᓄᕐᓂᖏᑦ ᐊᕿᒍᑕᒫ 15–ᓂᑦ ᓈᓄᒃᑐᖃᖃᑦᑕᖅᐳᖅ (4-32 ᐊᑯᓐᓂᖓᓂ), ᐅᓄᕈᖕᒍᓚᐅᖅᖢᑎᓪᓗ 2021-ᒥ (32 ᓇᓄᐃᑦ).
- ᐊᒃᓴᒃᑕᐅᕙᒃᑐᑦ ᑭᕙᓪᓕᕐᒥ ᐅᓄᖅᓯᕆᐊᓚᐅᖅᐳᑦ ᑕᐃᒪᙵᑦ 2008–ᒥᑦ. 2010–ᒥ 2024–ᒧᑦ, ᐊᕙᑎᓂᒃ ᓈᓄᒐᔪᓚᐅᖅᐳᑦ ᐊᕿᒍᑕᒫᑦ (9–34 ᐊᑯᓐᓂᖓᓂ).
- ᖃᐅᔨᓴᒃᓴᓄᑦ ᐱᓕᕆᐊᖑᔪᖅ ᐃᑲᔪᕐᓂᖃᖅᐳᖅ ᑕᒻᒪᖅᓯᒪᙱᓐᓂᖅᓴᓂᒃ ᐊᖑᔭᐅᔪᑦ ᐅᓂᒃᑲᐅᓯᐅᓗᑎᒃ ᐅᖃᐅᔾᔨᓗᑎᓪᓗ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᖃᓄᐃᓕᐅᕈᑎᓂᑦ.

ᐊᒃᓴᐃᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᓗᑎᒃ

- ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᑦ ᑲᑐᔾᔨᖃᑎᒌᓚᐅᖅᐳᑦ *ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂ* (IQ)/ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂ ᖃᐅᔨᓴᕐᓂᖅ ᐊᒃᓴᐃᑦ ᒥᒃᓵᓄᑦ ᑭᕙᓪᓕᕐᒥ. ᖃᐅᔨᓴᖅᑐᑦ ᑐᕌᒐᖃᓚᐅᖅᐳᑦ ᑎᑎᕋᖅᓯᒪᓕᖅᑎᑦᑎᔪᒪᓪᓗᑎᒃ ᓄᓇᓕᖕᓂ ᖃᐅᔨᒪᔭᖏᓐᓂᒃ ᐊᒃᓴᐃᑦ ᐅᓄᕐᓂᕆᔭᖏᓐᓂᒃ, ᓇᓃᑉᐸᓐᓂᖏᓐᓂᒃ ᐆᒪᔪᓪᓗ ᓇᔪᒐᖏᓐᓂᒃ

ᑐᑭᓯᒋᐊᕈᑎᒃᓴᐃᓪᓗ ᐊᑐᕐᑕᐅᓗᑎᒃ ᐃᑲᔫᑎᐅᓂᐊᕐᑐᒥᒃ ᖃᐅᔨᓴᕐᑐᓕᕆᔨᑦ ᑎᑎᕋᕐᓯᒪᔪᖏᓐᓂ ᑐᓴᐅᒪᑎᑦᑎᓗᑎᒃ ᐊᐅᓚᑦᑎᕝᔪᑕᐅᔪᓂᑦ.

- ᖃᐅᔨᓴᕐᑐᑦ ᐊᑐᓚᐅᕐᐳᑦ ᐋᕐᑭᒃᓱᕐᓯᒪᔪᓂᒃ ᐊᐱᕐᑯᑎᒃᓴᓂᒃ ᐊᒻᒪᓗ ᐱᓕᕆᖃᑎᒌᒃᑯᑎᒃ ᓄᓇᖑᐊᒥᒃ ᐊᑐᕐᓗᑎᒃ ᐅᓂᒃᑲᐅᓯᖃᕐᓗᑎᒃ ᑎᑭᕌᕐᑕᐅᖃᑦᑕᕐᑐᓂᒃ, ᓇᓚᐅᑦᑖᕐᑕᐅᔪᓂᑦ ᓇᓂᑐᐃᓐᓈᕋᓱᕆᔭᐅᔪᓂᑦ ᐅᓄᕐᓂᖏᓐᓂᓪᓗ, ᐊᒻᒪᓗ ᖃᐅᔨᒪᔭᐅᔪᓂᑦ ᐊᒃᓱᐃᑦ ᓇᔪᖏᓐᓂᒃ ᐃᓄᐃᑦ ᐊᖑᓇᓱᒃᑎᖏᓐᓂᑦ ᐃᓐᓇᕐᓂᓪᓗ.
- ᐃᓚᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᓚᐅᕐᐳᑦ ᐅᓄᕐᓯᕚᓪᓕᕐᓂᖏᓐᓂᒃ ᐊᒃᓱᐃᑦ ᑭᕙᓪᓕᕐᒥᐅᓂ ᑕᐃᒪᙵᓂᑦ 2000 ᓯᕗᓂᐊᓂ, ᑕᑯᔭᐅᓚᔪᓚᐅᙱᕐᓱᑎᒃ 1960 ᑐᖅᑳᓂ ᑕᑯᔭᐅᓚᔪᓕᕐᐸᓪᓕᐊᓪᓗᑎᓪᓗ 1990−ᒥᑦ ᐅᖓᑖᓂᓪᓗ.
- ᑲᑎᒪᖃᑕᐅᔪᑦ ᐅᖃᓚᐅᕐᐳᑦ ᐊᒃᓱᐃᑦ ᑕᐃᔅᓯᒪᓂ ᐅᓄᓗᐊᓚᐅᙳᓂᖏᓐᓂᒃ ᑭᕙᓪᓕᕐᒥ, ᓇᓂᑐᐃᓐᓈᕐᓂᕋᕐᑕᐅᓕᕐᓱᑎᒃ ᐊᒃᓚᐃᑦ ᐅᑎᕐᐸᓪᓕᐊᖏᖅᑰᕐᓱᑎᒃ.
- ᐊᒃᓱᐃᑦ ᓄᓇᕐᐸᓯᒃᑐᒦᓐᓂᕐᓴᐅᓚᐅᕐᐳᑦ, ᑕᑯᔭᐅᓵᕐᓱᑎᒃ ᑕᓯᒃᑰᕐᑐᑦ ᑰᒃᑯᓪᓗ; ᑭᓯᐊᓂ, ᓯᒡᔭᕐᐸᓯᒃᑐᒥ ᑕᑯᔭᐅᓵᖕᓂᕐᓴᐅᓕᕐᑐᑦ.
- ᐊᒃᓱᐃᑦ ᐊᒥᓲᓂᖏᑦ ᓈᓴᕐᑕᐅᓚᐅᕐᑐᑦ ᑕᒪᐃᓐᓂᑦ ᐊᐱᕐᓱᕐᑕᐅᔪᑦ ᑎᑎᕋᕐᓯᒪᔪᓂᑦ ᐊᐱᕐᓱᕐᑕᐅᔪᓪᓗ ᑎᑎᕋᕐᓯᒪᔪᑦ ᐅᑯᐊᓗ ᑭᓇᐅᔾᔪᑎᖏᑦ ᖃᐅᔨᓴᒃᓴᐃᑦ (Awan et al. 2019) ᐊᑐᕐᓗᑎᒃ ᓇᓅᑉ ᐅᕐᑯᒪᐃᓐᓂᖅᓂᒃ ᐊᒻᒪ Empirical Bayesian Kriging (2.88-4.07 ᓇᓄᐃᑦ/1000km²) ᑲᑎᖕᓗᒋᑦ ᐅᓄᕐᓂᖏᑦ 1081-1515 ᓇᓄᐃᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᒥ.
- ᑕᒪᕐᒥᒃ ᓇᓚᐅᑦᑖᕐᑕᐅᔪᑦ 95−ᐳᓴᓐ CI ᐊᔾᔨᒌᙱᓐᓂᖅᑳᓂᑉᐳᑦ Awan et al−ᒧᑦ. (2019) 2.1-6.1 ᓇᓄᐃᑦ/1000km² ᐊᔾᔨᐸᓗᖏᓪᓗ ᐊᓯᖏᓐᓄᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᓄᑦ ᐊᔾᔨᐸᓗᖏᓐᓂᒃ ᓇᔪᖏᓐᓂᒃ.
- ᐃᓅᖃᑎᒌᓄᑦ−ᐆᒪᔪᓕᕆᓂᕐᒧᑦ ᐃᓗᓕᖓ ᑭᕙᓪᓕᕐᒥ ᐅᖃᐅᓯᐅᓯᒪᙱᑦᑐᕐ ᐊᓯᖏᓐᓄᑦ ᐊᕕᒃᑐᕐᓯᒪᔪᓂᑦ ᑲᓇᑕᒥ, ᖃᐅᔨᓴᕐᑐᓄᓪᓗ ᐃᓚᐅᖃᑕᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᓪᓗᑎᒃ ᐊᒃᓴᓂᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐊᑐᐊᓚᑦ ᐱᓕᕆᔾᔪᓯᓪᓗ ᐊᔾᔨᐅᙱᑦᑑᔭᕆᐊᓕᑦ ᐊᕕᒃᑐᕐᓯᒪᔪᑦ ᐋᕐᑭᒃᓯᒪᓂᖅᑲᓄᑦ.
- ᖃᐅᔨᓴᕐᑐᓄᑦ ᐃᓚᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᓚᐅᕐᐳᑦ ᐊᖑᔭᐅᕙᒃᑐᑦ ᑲᔪᓰᓐᓇᕈᓐᓇᕐᓂᖏᓐᓂᒃ, ᐊᑖᒋᕐᖢᑎᓪᓗ ᓇᓄᐃᑦ ᐅᓄᕐᓯᒋᐊᕐᓯᒪᓕᖅᖢᑎᒃ. ᐃᓚᐅᔪᑦ ᐊᒃᑐᐊᓂᖅᕐᑎᑦᑎᓯᒪᕗᑦ ᐅᓄᕐᓯᕙᓪᓕᐊᓂᖏᓐᓂᒃ ᐃᓄᐃᑦ−ᐆᒪᔪᑦ ᐊᒃᑐᐊᖃᖃᑦᑕᐅᑎᓂᖏᓐᓂᑦ.

ᐊᒪᕈᕐᑕᐅᔪᑦ ᖃᐅᔨᓴᒐᒃᓴᓪᓗ

- ᐱᐅᓯᒋᐊᕐᓯᒪᔪᑦ ᓂᕿᑐᕌᑦ ᐊᐅᓚᑦᑎᔾᔪᑎᖏᑦ ᐱᓕᕆᐊᖑᒐᒃᐳᑦ ᐃᑲᔪᕐᓱᐃᔾᔪᑕᐅᓗᑎᒃ ᐅᑎᕐᐸᓪᓕᐊᕐᑯᓗᒋᑦ ᐅᓄᕈᓐᓃᕐᐸᓪᓕᐊᔪᑦ ᑐᒃᑐᐃᑦ ᐊᑐᓕᕐᑯᔭᐅᓯᒪᓗᓂᓗ ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᕐᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ ᑭᖑᓂᑦᑎᓐᓂ ᐃᓱᒪᓕᐅᕈᑕᐅᖃᑦᑕᕐᓯᒪᔪᓂᒃ ᐃᓚᖏᓐᓂᒃ ᑐᒃᑐᓂᒃ (ᓱᕐᓗ ᑑᒃᑑᔭᕐᑑᑉ ᐃᓅᕕᐅᓪᓗ ᑐᒃᑐᖏᑦ).
- ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᐃᑲᔪᕐᑐᐃᕗᑦ ᓄᓇᕗᒻᒥ ᐊᖑᓇᓱᒃᑎᓂᒃ ᐃᑲᔪᕐᑐᐃᔾᔪᑎᕗᑦ ᐊᖑᓇᓱᒃᑎᓄᑦ ᐱᓕᕆᐊᑎᒍᑦ ᐊᒻᒪ ᐊᒪᕐᑯᓂᒃ ᖃᐅᔨᓴᒃᓴᓂᒃ ᑲᑎᕐᓱᐃᓪᓗᑎᒃ.
- ᑖᓐᓇ ᐱᓕᕆᐊᕐ ᐊᑭᓖᔾᔪᑕᐅᓲᖑᕗᕐ ᓄᓇᓕᖕᓂ ᐊᖑᓇᓱᒃᑎᓄᑦ ᐊᒪᕐᑯᓄᑦ ᐊᒻᒪ ᖃᐅᔨᓴᒃᓴᓂᒃ ᐊᑐᐃᓐᓇᕈᕐᑎᑦᑎᕝᕗᑎᒃ ᓇᓃᒻᒪᖐᑕᓗ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ. ᓴᕐᑭᑕᐅᕐᖓᓚᐅᕐᓯᒪᔪᕐ 2018−ᒥᑦ ᕿᑎᕐᒥᐅᓂᑦ ᐃᓚᒋᐊᕐᑕᐅᓗᓂᓗ ᓄᓇᕗᓕᒫᒥᑦ 2019−ᒥᑦ.
- ᐱᓕᕆᐊᖑᔪᕐ ᐊᖑᓇᓱᒃᑎᓂᑦ $500−ᑖᕐᑎᑦᑎᖃᑦᑕᕐᓂᐊᕐᐳᑦ ᐊᑕᐅᓯᕐᒧᑦ ᐊᒪᕐᑯᒧᑦ ᓄᓇᕘᓕᒫᒥ, ᐊᒻᒪ $900 ᐊᑕᐅᓯᕐ ᐊᒪᕈᕐ ᐃᓱᒫᓘᑕᐅᓗᐊᑕᕐᑐᓂ, ᓲᕐᓗ ᕿᙳᐅᑦ, ᑐᒃᑑᔭᕐᑑᑉ ᐃᓅᕕᐅᓪᓗ ᑐᒃᑐᖏᑦ.
- 2024-2025−ᒥ ᐊᕐᕌᒍᕆᔭᐅᔪᒥᑦ ᑲᑎᖕᓗᒋᑦ 518,000−ᒥ ᐊᑭᖓᓚᐅᕐᐳᑦ ᐊᒪᕐᑯᓄᑦ ᖃᐅᔨᓴᒃᓴᓂᑦ ᓄᓇᕗᒻᒥ ᐊᒪᕈᕋᓱᒃᐸᒃᑐᓄᑦ. ᑖᓐᓇ ᑕᑯᑎᑦᑎᕗᕐ 900−ᓂᒃ ᐊᒪᕐᑯᓂᒃ ᖃᐅᔨᓴᒃᓴᓂᒃ ᑐᓂᓯᔪᖃᓚᐅᕐᓂᖅᓴᓂᒃ, ᑭᒡᒐᕐᑐᐃᓪᓗᓂ ᑕᒪᐃᓐᓂᒃ ᐅᓄᓖᓂᒃ ᐊᒪᕐᑯᓂᒃ ᑐᓐᓂᕐᑯᑕᐅᓯᒪᔪᓂᒃ ᐱᓕᕆᐊᖑᔪᑎᒍᑦ, ᐅᓄᓖᓂᓪᓗ ᑐᓂᐅᕐᑲᐃᔪᖃᕐᓂ ᐊᖑᓇᓱᒃᑎᓄᑦ ᐊᑕᐅᓯᕐᒥ ᐊᕐᕌᒍᕆᔭᐅᔪᒥ.
- ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᖃᐅᔨᓴᓚᐅᕐᐳᑦ ᐊᒪᕐᑯᑦ ᐱᔭᐅᓯᒪᔪᑦ ᑎᑎᕋᕐᓯᒪᔪᑦ 1,500−ᓂᒃ ᐊᒪᕐᑯᓂᒃ ᑐᕐᑯᑕᐅᔪᓂᒃ ᐊᖑᓇᓱᒃᑎᓂᑦ ᓄᓇᕗᒻᒥ 2018-19 ᐊᒻᒪ 2020-21 ᐊᑯᓐᓂᖓᓂ.
- 2018-19−ᒥ, 146−ᓂᒃ ᐊᒪᕐᑯᓂᒃ ᐊᖑᓇᓱᒃᐸᒃᑐᑦ ᐅᖃᐅᓯᐅᓚᐅᕐᐳᑦ 52−ᓄᑦ ᐊᖑᓇᓱᒃᑎᓄᑦ ᕿᑎᕐᒥᐅᓂ, ᐱᓗᐊᕐᑐᒥ ᖁᕐᓗᕐᑐᕐᒥ ᐊᖑᓇᓱᒃᑎᓂᑦ.

- 2019-20–ᒥ, 658–ᓂᒃ ᐊᒪᖅᑯᓂᒃ ᐊᖑᓇᓱᒃᐸᒃᑐᑦ ᐅᖃᐅᓯᐅᓚᐅᖅᐳᑦ ᓄᓇᕘᓕᒫᒥ, 64–ᐳᓯᖕᒋᑦ ᐊᖑᔾᔪᐅᔪᑦ ᐊᕿᐊᓂ, ᖃᒪᓂ'ᑐᐊᕐᒥ ᐊᒻᒪ ᕐᑯᕐᓗᖅᑐᕐᒥ ᐊᖑᓇᓱᒃᑎᓂᒃ.
- 2020-21–ᒥ, 699–ᓂᒃ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ ᐅᖃᐅᓯᐅᓚᐅᖅᐳᑦ, 68–ᐳᓯᖕᒋᑦ ᐊᖑᔾᔪᐅᔪᑦ ᐊᕿᐊᓂ, ᖃᒪᓂ'ᑐᐊᕐᒥ ᐊᒻᒪ ᕐᑯᕐᓗᖅᑐᕐᒥ. ᑕᒪᐃᓐᓂ ᐊᕐᕗᒍᓂ, ᖃᔅᓯᐅᓂᖕᒋᑦ ᐱᕈᕙᖅᓯᒪᙱᑦᑐᑦ ᐊᖑᓇᓱᒃᑕᐅᕙᒃᑐᑦ ᐅᓄᕈᓐᓃᖅᐹᓪᓕᓚᐅᖅᐳᑦ ᖃᑯᙳᖅᑎᓪᓗᒍ ᐊᒻᒪ ᐅᓄᙱᕆᐊᕐᖓᑎᒃ ᐊᖑᓇᓱᒃᑏᑦ ᐃᑲᔪᕐᔪᐊᓚᐅᖅᐳᑦ ᐱᔾᔪᑎᓂᑦ.
- ᐊᔾᔨᒌᙱᒃᑲᓗᐊᖅᑎᓪᓗᒋᑦ ᓄᓇᓕᖕᓂ, ᐊᒪᖅᑯᑦ ᓄᓇᓕᖕᓄᑦ ᖃᓂᓐᓂᖅᓵᐅᓪᓗᑎᒃ ᓇᓐᓄᒃᑕᐅᖃᑦᑕᓚᐅᖅᐳᑦ ᕐᑯᕕᐊᓱᖕᕕᐅᑉ ᑐᖕᓕᓂ (75 ᑭᓛᒥᑕᓂᒃ ᐅᖓᓯᒃᑎᒋᓪᓗᑎᒃ) ᐊᒻᒪ ᓄᓇᓕᖕᓂ ᐅᖓᓯᑦᑎᒋᒃᑎᒋᓪᓗᑎᒃ ᐅᑭᐅᒃᑯᑦ, ᐅᖓᓯᓛᖑᓪᓗᑎᒃ ᐊᐃᕐᓇᓕᒥ ᐊᒻᒪ ᒪᐃᒥ (500 ᑭᓛᒥᑕᓄᑦ ᑎᑭᓪᓗᒍ).
- ᐊᕙᑎᓕᓇᔾᒃᑯᑦ ᖃᐅᔨᓴᖅᐸᓪᓕᐊᖕᒋᓇᖅᐳᑦ ᖃᐅᔨᓴᕐᕕᒃᓴᓂᒃ ᑐᓂᖅᑯᑕᐅᔪᓂᒃ ᑐᓴᖅᑎᑦᑎᒃᑲᓂᓚᖅᓱᑎᓪᓗ ᐊᐅᓚᑦᑎᔾᔭᐅᖃᑎᒌᓄᑦ ᑭᖑᓪᓕᖅᐸᕐᒥ ᐅᓂᒃᑳᑦ ᐊᑐᐃᓐᓇᐅᓕᖅᐸᑕ.

ᐊᒪᕈᖅᑕᐅᔪᑦ ᖃᐅᔨᓴᒐᒃᓴᓪᓗ

- ᓄᓇᕗᒻᒥ ᖃᕝᕚᓘᔭᐃᑦ (*ᖃᕝᕚᑦ*) ᐃᓂᖃᕐᓗᑎᒃ ᑕᒪᐃᓐᓂᑲᓯᒃ ᐊᕙᑎᖏᓐᓂ ᓄᓇᕗᒻᒥ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᓪᓗᑎᓪᓗ ᑕᒪᐃᓐᓄᑦ ᐊᒥᕐᓄᑦ ᐊᒻᒪ ᐊᖏᔪᓄᑦ ᓂᕐᔪᑎᓄᑦ *ᓄᓇᕗᒻᒥ ᐊᖏᕈᑎᖓᓂ*. ᑖᒃᑯᐊ ᐱᒻᒪᕆᐅᓪᓗᑎᒃ ᒥᖅᑯᓖᑦ ᓄᓇᕗᒻᒥ ᐃᓕᖅᑯᓯᖕᒋᓐᓂ ᑮᓇᐅᔭᓕᐅᕈᑎᒃᓯᖕᒋᓐᓂᓗ.
- ᖃᕝᕚᓘᔭᐃᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᖕᒥᔪᑦ ᐃᓱᒪᓘᑕᐅᓂᖕᒋᓐᓂᒃ ᑲᓇᑕᒥ *ᐆᒪᔪᑦ ᐊᑦᑕᕐᓇᖅᑐᓕᑦᑐᑦ ᐱᕐᑯᔭᖕᓂ* (SARA).
- ᑭᖑᓂᑦᑎᓐᓂ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᓂᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᐅᓄᕐᓂᖕᒋᑦ 1.6–ᓂᑦ 4.4–ᓄᑦ ᖃᕝᕚᓘᔭᐃᑦ/1,000 km^2 ᑭᕙᓪᓕᕐᒥᐅᓂ ᐊᒻᒪᓗ 4.14 ᖃᕝᕚᓘᔭᐃᑦ/1,000 km^2 ᓇᐸᕐᑐᓕᒃ ᑕᓯᖕᓚᓂ ᕿᑎᕐᒥᐅᓂ.
- ᓄᓇᕗᑦ ᒐᕙᒪᒃᑯᑦ ᑲᑎᖅᓱᐃᓲᖑᕗᑦ ᖃᕝᕚᓘᔭᐃᑦ ᓂᐊᕐᑯᖕᒋᓐᓂᒃ ᐊᒻᒪ ᑐᕐᖁᑕᐅᔫᑉ ᒥᒃᓵᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᒥᑦ ᐊᖑᔾᔪᐅᔪᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓪᓗᑎᒃ ᐊᒻᒪ ᖃᐅᔨᓴᕐᓗᒋᑦ ᐅᑭᐅᖕᒋᑦ ᐊᒻᒪ ᑭᓲᓂᖕᒋᑦ ᐊᖑᔾᔪᐅᔪᑦ.
- ᐊᖑᓇᓱᒃᑏᑦ ᑐᓂᓯᓚᐅᖅᓯᒪᔪᑦ ᓂᐊᕐᑯᖕᒋᑕ ᓴᐅᓂᖕᒋᓐᓂᒃ ᑐᕐᖁᑕᐅᔪᓪᓗ ᒥᒃᓵᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᑦ 691–ᓂᒃ ᖃᕝᕚᒃᑕᐅᔪᓂᒃ 2018-2019 ᐊᒻᒪ 2023-2024 ᐊᑯᓐᓂᖓᓂ.
- ᐅᓄᕐᓂᖅᓴᐃᑦ ᖃᕝᕚᒃᑕᐅᔪᑦ ᕿᑎᕐᒥᐅᓂᒃ ᐊᖑᔾᔪᐅᓚᐅᖅᓯᒪᔪᑦ, ᕐᑯᕐᓗᖅᑑᑉ ᖃᓂᒌᔭᓂᐸᓗᒃ, ᐅᓄᙱᓐᓂᖅᓴᐃᑦ ᐊᖑᔾᔪᐅᓂᑰᓪᓗᑎᒃ ᑲᓇᖕᓇᖅᐸᓯᖕᒥ.
- ᐊᕿᐊᑦ ᐊᒻᒪ ᖃᒪᓂ'ᑐᐊᖅ ᐊᖑᔾᔭᖕᒋᑦ ᐅᓄᕐᓛᖑᖃᑕᐅᓚᐅᖅᑐᑦ ᓇᐃᓴᖅᑕᐅᔪᓂ.
- ᐊᖑᔾᔪᐅᔪᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᑕᑯᑎᑦᑎᔪᑦ 84–ᐳᓯᓐ ᖃᕝᕚᒃᑕᐅᓚᐅᖅᑐᑦ ᕐᑯᑭᐅᑎᒧᑦ, 16–ᐳᓯᖕᒋᓪᓕ ᒥᑭᒋᐊᕐᓄᑦ/ᑮᔭᖃᑦᑕᓄᑦ ᐱᔭᐅᓪᓗᑎᒃ.
- ᖃᕝᕚᒃᑕᐅᔪᑦ ᐊᖑᓯᓪᓘᓪᓗᑎᒃ ᒪᕐᕈᐃᖅᓱᓪᓗᐊᖅᓱᓂ ᐊᖑᓯᓪᓗᐃᑦ ᐊᖑᔾᔪᐅᔪᑦ ᐅᓄᕐᓂᖅᓴᐅᓪᓗᑎᒃ ᐊᕐᓇᓪᓗᖕᓂᑦ ᐱᕈᕙᖅᓯᒪᙱᑦᑐᓄᑦ ᐊᑎᖅᑕᓄᓪᓗ ᐊᖑᔾᔪᐅᓪᓗᑎᒃ (63 ᐳᓯᓐ ᐊᖑᔾᔪᐅᔪᓕᒫᓂᑦ.
- ᐊᖑᔾᔪᐅᔪᑦ ᐃᓐᓇᕈᓕᕝᕐᓂᖅᓯᑦ ᐱᔭᐅᖃᑦᑕᓚᐅᖅᓱᑎᒃ ᐅᑭᐅᙳᓕᕝᖅᑎᓪᓗᒍ , ᐃᓐᓇᕈᖅᓯᒪᔪᓂᓪᓗ ᐊᖑᔾᔪᐅᔪᑦ ᐅᓄᖅᓯᒋᐊᖅᓱᑎᒃ ᐅᑭᐅᖑᑎᓪᓗᒍ.
- ᓇᓂᑐᐃᓐᓈᕐᓂᖕᒋᑦ, ᐅᑭᐅᖕᒋᑦ, ᐊᕐᓇᖅ/ᐊᖑᓯᓪᓗᖅ ᐱᔭᐅᔪᑦ ᖃᓄᐃᙱᓚᔪᓚᐅᖅᑐᑦ.
- ᑭᓯᐊᓂ, ᐅᓄᙱᓗᐊᖅᓱᑎᒃ ᐊᕐᓇᓪᓗᐃᑦ ᐊᖑᔾᔪᐅᔪᓂᑦ ᐅᔾᔨᕆᔭᐅᔭᕆᐊᓕᒃ ᖃᐅᔨᓴᖅᑕᐅᖕᒋᓇᕐᓂᐊᖅᓱᓂᓗ.

ᐊᕙᑎᓕᕆᔨᒃᑯᑦ
Department of Environment
Avatiliqiyikkut
Ministère de l'Environnement

GRIZZLY BEAR (*Ursus arctos*) HARVEST MONITORING IN NUNAVUT

Summary report

August 2025

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Summary

The purpose is to monitor the geographic distribution, sex, and age composition of grizzly bear harvest in Nunavut. Hunters were asked to return the lower jaw or whole skull, a piece of muscle, a small piece of the skin with hair (2x5cm), and to provide kill information (date, location, etc.) to their local Conservation Officer on a voluntary basis. Tooth samples were processed to determine age of the individuals. A total of 200 grizzly bears were reported harvested from 2020 to 2024, 109 from the Kitikmeot and 91 from the Kivalliq region. Grizzly bear harvest is tightly linked to hunter accessibility; in late winter/early spring hunters use snowmachines to access areas further from communities, and in summer ATVs are used to access areas around communities as well as boats to extend hunting off water channels. Grizzly bear harvest was concentrated in the western Kitikmeot, in the vicinity of Kugluktuk, Cambridge Bay and along the traditional travel route from the Cambridge Bay to the Bathurst Inlet area. Arviat and Baker Lake were the next highest contributors to the total harvest in the Kivalliq region.

Between 2019 and 2024, the harvest was dominated by a younger age class (<5 years) in the Kivalliq region and the proportion of adults in the harvest was 38%, while proportion of adults in Kitikmeot harvest was 56%. Long-term reported harvest trend (2010-2024) shows that in the Kitikmeot region, the number of bears harvested averaged 15 bears annually (SD = 7.3, range 4–32), and was significantly higher in 2021 (32 bears). Grizzly bear harvests in the Kivalliq have increased substantially since 2008. From 2010 to 2024, the harvest averaged 20 bears annually (SD = 6.9, range 9–34). The number of grizzly bears currently being harvested within the Kivalliq region may not be sustainable over the long term and may cause a population decline, highlighting the need to better understand the status of the population and determine viable harvest levels.

ᐊᒃᓴᐃᑦ (ᑲᔪᖅ ᓇᓄᖅ) ᐱᔾᐅᕙᑦᑐᓂᑦ ᖃᐅᔨᓴᕐᓂᖅ ᓄᓇᕗᒻᒥ

ᓇᐃᓈᖅᓯᒪᔪᖅ

ᐱᔾᔪᑕᐅᔪᖅ ᓇᐅᑎᖅᓱᐃᓂᕐᒧᑦ ᓄᓇᒥᑦ ᓇᑭᖕᒐᕐᒪᖕᒐᑕ, ᐊᕐᓇᓪᓗᖕᒪᖕᒐᑕ ᐊᖑᓯᓪᓗᖕᒪᖕᒐᑕ ᖃᔅᓯᓂ ᐅᑭᐅᖄᓕᕐᒪᖕᒐᑕ ᐊᖑᔭᐅᑎᓪᓗᒋᑦ ᓄᓇᕗᒻᒥᑦ. ᐊᖑᓇᓱᒃᑎᑦ ᑐᓂᓯᖃᑦᑕᕐᑯᔭᐅᔪᑦ ᐊᓪᓕᕈᓂᑦ ᓂᐊᕐᑯᐃᓐᓇᖓᓂᓪᓘᓐᓃᑦ, ᓄᑭᒥᑦ, ᐊᒥᐊᕐᔪᑯᓗᒃ ᒥᖅᑯᖃᕐᓗᓂ (2x5cm), ᑐᓴᖅᑎᑦᑎᓗᑎᒃᓗ ᖃᖓ ᓇᓐᓄᓚᐅᕐᒪᖔᖅᑭᓐᓂᑦ (ᐅᓪᓗᖓᓂ, ᓇᒥᑦ, ᑕᒪᒃᑯᐊ) ᐆᒪᔪᕐᓂᐊᖅᑎᕐᑯᑎᔅᓯᓐᓄᑦ ᐃᓱᒪᖅᓱᕐᓗᓯ. ᑭᒍᑎᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᔭᐅᓇᓱᒃᓱᑎᒃ ᖃᓄᑎᒋ ᐅᑭᐅᖄᓖᖕᒑᖕᒋᑦ. ᑲᑎᓪᓗᒋᑦ 200 ᐊᒃᓴᒃᑕᐅᓯᒪᓂᕋᖅᑕᐅᔪᑦ 2020−ᒥ 2024−ᒧᓄ, 109−ᓂ ᕿᑎᒻᒥᐅᓂᑦ 91−ᓗ ᑭᕙᓪᓕᒻᒥᑦ. ᐊᒃᓴᒃᑕᐅᔫᓇᖅᑐᑦ ᐊᖑᓇᓱᒃᑎᒧᑦ ᐱᔾᐅᔫᓇᑦᓯᐊᖅᐸᑦ; ᐅᑭᐅᑐᖃᐅᓕᖅᑎᓪᓗᒍ/ᐅᐱᕐᖔᑦᓵᖑᕋᑖᖅᑎᓪᓗᒍ ᐊᖑᓇᓱᒃᑏᑦ ᖃᒧᑕᐅᔾᔭᕐᓂᒃ ᐊᑐᖃᑦᑕᖅᐸᑦ ᓄᓇᓖᓐᓂ ᐅᖓᓯᓐᓂᖅᓴᒧᑦ ᐅᐸᒐᓱᒃᑕᒥᓄᑦ, ᐅᐱᕐᖔᒃᑯᓪᓗ ᓯᑕᒪᓈᑦ (ᑎᓴᒪᓈᑦ) ᐊᑐᖅᑕᐅᓲᖑᕗᑦ ᓄᓇᓕᓐᓂ ᖃᓂᒋᔭᖏᓐᓃᑦᑐᓄᑦ ᐊᒻᒪ ᐅᒥᐊᓄᑦ ᐊᖑᓇᓱᒋᐊᕐᕕᐅᓪᓗᑎᒃ ᐃᒪᒃᑯᑦ. ᐊᒃᓴᒃᑕᐅᔪᑦ ᕿᑎᕐᒥᐅᑦ ᐱᖕᒐᖕᓇᖕᒐᓂᓪᓗᐊᑕᐅᓚᐅᖅᑐᑦ, ᕐᑯᓪᓗᖅᑐᑉ ᐊᕙᑖᓂ, ᐃᖃᓗᑑᒃᑎᐊᒥ ᐊᖅᑯᑎᕆᔭᐅᕙᒃᑐᒥᓪᓗ ᐃᖃᓗᒃᑑᑦᑎᐊᒥᑦ ᕿᖕᒐᐅᓪᒧᑦ. ᐊᕐᕙᐊᑦ ᐊᒻᒪ ᖃᒪᓂ'ᑐᐊᖅ ᐊᖑᔭᖕᒋᑦ ᐅᓄᓛᖑᖃᑕᐅᓚᐅᖅᑐᑦ ᓇᐃᓴᖅᑕᐅᔪᓂ ᑭᕙᓪᓕᖕᒥᑦ.

ᐊᑯᓐᓂᖓᓂ 2019 ᐊᒻᒪᓗ 2024, ᐊᖑᓇᓱᒃᑕᐅᓪᓗᐊᑕᓚᐅᖅᑐᑦ ᒪᒃᑯᓐᓂᖅᓴᐃᑦ (ᑖᓪᓕᒪᐃᑦ ᐊᕐᕌᒍ) ᑭᕙᓪᓕᒻᒥᑦ ᐃᓐᓇᐅᓂᖅᓴᐃᓪᓗ ᐱᔭᑦ 38 ᐳᓴᓐᑎᐅᓪᓚᐅᖅᓱᑎᒃ, ᐃᓐᓇᐅᓂᖏᓪᓕ ᕿᑎᕐᒥᐅᓂᑦ 56 ᐳᓴᓐᑎᐅᓚᐅᖅᓱᑎᒃ. ᐊᑯᓂᐅᔫᒃᑯᑦ ᐅᖃᐅᓯᐅᓯᒪᔪᑦ ᓇᓄᒃᑕᐅᕙᒃᑐᑦ ᖃᓄᐃᓕᕙᓪᓕᐊᓂᖏᑦ (2010-2024) ᑕᑯᒃᓴᐅᑎᑦᓯᕗᖅ ᕿᑎᕐᒥᐅᓂ, ᖃᑦᓯᐅᓂᖏᑦ ᓇᓄᒃᑕᐅᔪᑦ 15-ᖑᓗᔪᓚᐅᖅᐸᑦ ᓇᓄᐃᑦ ᐊᕐᕌᒍᑕᒫ (SD = 7.3, ᐊᑯᓂᖏᑦ 4-32), ᐊᒻᒪᓗ ᐅᓄᕐᓂᖅᓴᐅᓪᓗᑎᒃ 2021-ᒥ (32 ᓇᓄᐃᑦ). ᐊᒃᓴᒃᑕᐅᕙᑦᑐᑦ ᑭᕙᓪᓕᕐᒥ ᐅᓄᖅᓯᕘᓪᓕᖅᓯᒪᕐᔪᐊᖅᐸᑦ ᑕᐃᒪᙵᑦ 2008−ᖑᓚᐅᖅᑎᓪᓗᒍ. 2010−ᒥ 2024−ᒧᓄ, ᓇᓄᒃᑕᐅᕙᒃᑐᑦ 20−ᓂ ᓇᓄᓐᓂᑦ ᐊᕐᕌᒍᑕᒫᑦ (SD = 6.9, ᐊᑯᑦᑐᓂᖓ 9-34). ᐊᒥᓲᓂᖏᑦ ᐊᒃᓴᒃᑕᐅᕙᒃᑐᑦ ᑭᕙᓪᓕᕐᒥᑦ ᐱᐅᕐᓯᐊᒐᒃᓴᐅᔫᓐᓃᑐᐃᓐᓇᕆᐊᓕᒃ ᐊᑯᓂᐅᔪᒥ ᐅᓄᕈᓐᓃᖅᐹᓪᓕᕈᑕᐅᓇᔾᔪᕐᓯᓂᓗ, ᑐᑭᓯᕚᓪᓕᓴᐊᖃᒻᒪᕆᓪᓕᕐᓗᑕ ᖃᓄᐃᓕᖕᒐᓕᕐᓂᖏᓐᓂᑦ ᐊᒥᓲᓂᖏᑦ ᖃᐅᔨᓇᓱᓪᓗᑕ ᐊᖑᓇᓱᒃᑕᐅᔭᒃᓴᓂᑦ.

Akhait (*Ursus arctos*) an’ngujauhimajunik munariniq Nunavunmi

Naittumik Titiraqhimajuq

Pidjutikhaq munagiyaangat humiliqaak nunami nayugangit, qanuritmangaat, ukiungitlu akhat anguyauvakhimayut Nunavunmi. An’nguniaqtut apigijaujut utiquplugit agliguit niaquaplu hauninganik, ilagani nukiip, mikkamik amirmit nujaqaqtumik (2x5cm) aktilanga, tunihijuqhatlu an’ngujarnik naunaitkutinik (ublua, humi, qanuqlu) An’nguhiqiijimun Havaktianut piumaluni piluni ilikkut. Kigutingnik uuktuutikharnik hanaqiyauvaktun naunaiyaiyaangat ukiungit akhat. Atauttimun 200 ngujut aqhait unniudjutaujut an’nguniaqtaujut talvanga 2020 min 2024 mun, 109 Kitikmeonit 92 lu Kivallirmin. Aqhanik an’nguniaqtaujut pidjutijut an’nguniaqtip pijaangnikkut; nunggunianut ukiumi/atulihaaliqtumi upin’ngaqhami an’nguniaqtit atuqhutik sikiituunik un’ngahiktuliariami nunamingnit, aujamilu haantaqhutik (ATVs) atuqtauvaktut pijaaginnik avataani nunallaanggit imaalu qajaqtuqhutiklu an’ngunahuariamingnik imakkut. Aqhanik an’nguniarnik ihumagigilluaqtaujut uataani Kitikmeot, haniani Kugluktup, Iqaluktuuttiaq in’ngilraangnitatlu aullaaqviujait Iqaluktuuttiarmin Kingaukmun nunainni. Arviat hamanilu Qamanittuaq tugliuyut amigainirit ikayuutait atautimun anguniaqtamingnun Kivallirmi.

Qitqani 2019 2024 milu, an’nguniarniq amigaitqijaujut nukaqhiinni (<5 ukiuni) iKivallirmi ilanggattauq inirnirit an’nguniaqtut 38 pusanngujuq, ilanganittauq inirni Kitikmeoni an’nguniarniq 56 pusanngujuq. Hivitunikkut unniudjaujut an’nguniarnirmik auladjutait (2010-2024) takupkaqtittijut Kitikmeoni, nampait aqhanik an’nguniaqtaujut imaa ittut 15 aqhaliqivaktut ukiuq tamaat (SD = 7.3, naunaitkutaa 4–32), imaalu amigaitqijaupluni 2021 mi (32 aqhat). Aqhat an’nguniaqtaujut Kivallirmi amigaiqjuummiktut talvamin 2008. Talvanga 2010 talvunga 2024, tahapkuat aqhaliqivaktut qitqanit 20 nik ukiuq tamaat (SD = 6.9, naunaitkut 9–34). Nampanggit aqhait hadja an’nguniaqtaujut Kivallirmi aulalimaittungnaqhijut hivitunirmi ikiqlijuummingniagungnaqhijutlu, takupkaqtitaqhunilu ihariangnia kangiqhittiaqtuqhatigut qanurinmanggaatigut qaffiutigut ihumaliurnikkutlu ihuaqtuniklu an’nguniaqtaujuqhatigun aadlatkiingni.

Surveillance de la récolte de grizzli (*Ursus arctos*) au Nunavut

Sommaire

Le but de cette initiative est de surveiller la distribution géographique des récoltes de grizzli au Nunavut ainsi que leur répartition en ce qui concerne le sexe et l’âge. Pour y parvenir, nous avons demandé aux adeptes de la chasse de grizzli de remettre à leur responsable de la conservation le crâne entier de leur prise, sinon sa mâchoire inférieure, ainsi qu’un échantillon de muscle et un petit morceau de fourrure (2 cm x 5 cm) prélevés sur celle-ci, de même qu’à fournir, sur une base facultative, des renseignements sur leur récolte (date, emplacement, etc.). L’âge des sujets a été déterminé grâce à l’analyse des échantillons dentaires. Pour la période de 2020 à 2024, la récolte déclarée s’élève à 200 grizzlis, dont 109 proviennent de la région du Kitikmeot et 91 de la région du Kivalliq. La récolte de grizzlis dépend étroitement de la facilité d’accéder à leurs populations. Les adeptes de la chasse utilisent la motoneige pour accéder aux populations éloignées de leur localité à la fin de l’hiver et au début du printemps; en été, on recourt au véhicule tout-terrain (VTT) pour la récolte à proximité, et à l’embarcation pour étendre les zones de chasse aux abords des cours d’eau. Les prises ont majoritairement été récoltées dans l’ouest du Kitikmeot, aux alentours de Kugluktuk et de Cambridge Bay, de même que le long du parcours traditionnellement emprunté pour se déplacer entre la région de Cambridge Bay et celle de Bathurst Inlet. Quant à Arviat et à Baker Lake, dans la région du Kivalliq, elles figuraient au deuxième rang parmi les grands contributeurs à la récolte totale.

Entre 2019 et 2024, la majeure partie de la récolte de grizzli dans le Kivalliq représentait la catégorie des jeunes (<5 ans) et les adultes comptaient pour 38 % des prises régionales, alors que dans la région du Kitikmeot, les sujets adultes représentaient 56 % de la récolte. Les données recueillies sur une longue période (2010-2024) concernant les récoltes déclarées démontrent que dans la région du Kitikmeot, une moyenne de 15 grizzlis était récoltée par année (écart-type : 7,3; intervalle de variation : 4 à 32), ce qui était considérablement inférieur aux données pour 2021 (32 grizzlis). La récolte de grizzlis dans le Kivalliq a considérablement augmenté depuis 2008. Entre 2010 et 2024, sa moyenne était de 20 grizzlis par année (écart-type : 6,9; intervalle de variation : 9 à 34). Les actuelles habitudes de récolte du grizzli dans la région du Kivalliq pourraient ne pas être durables à long terme et entrainer un déclin de la population, d’où la nécessité de bien en comprendre la situation et de déterminer des quotas de récolte viables.

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1.0 Introduction

Nunavut represents the northeastern edge of grizzly bear (*Ursus arctos*) distribution in Canada. Inuit observations, harvest records and research indicate an increase in numbers and range expansion eastward and northward (Clark 2007, Nirlungayuk 2011, Dumond et al. 2015, Awan et al. 2019, 2023, Barrueto et al. 2023, Harding et al. 2025, Awan et al. 2025). Grizzly bears are listed as a species of Special Concern under the federal Species at Risk Act (SARA) and bears are regularly harvested for subsistence, and a relatively small amount of revenue through trophy hunting and the sale of hides and parts. There are limited baseline data on grizzly bear distribution and density within Nunavut, in part because of the cost and challenge of surveying bears at low densities in vast and remote areas.

In Nunavut, grizzly bears are classified as both a furbearer and a big game animal under the *Nunavut Agreement*, and are classed as a Presumption as to Needs species where the full level of harvest is dedicated to Inuit (see 5.6.5(a) of the *Nunavut Agreement*). Currently, Inuit are able to harvest grizzly bears for subsistence use with no restrictions. The local Hunters and Trappers Organizations (HTOs) have the power to approve sport hunter harvesting of furbearers under 5.6.13(c) of the *Nunavut Agreement*. Therefore, the responsibility to limit harvesting of grizzly bears, fall strictly under the roles of HTOs and Regional Wildlife Organizations (RWOs). For a sport hunter (NU resident or a non-resident/non-resident foreigner) to hunt a grizzly, they would need HTO approval, along with a harvesting licence and a fur tag issued from the Government of Nunavut. They also need the services of an outfitter, with some specific exceptions under the Act/regulations.

For several years, hunters in the Kitikmeot have reported an increase in bear sightings and occurrences of bears in new areas (e.g. Victoria Island). Some Inuit hunters have suggested predation as a potential contributing factor in current caribou declines. Increasing grizzly bear populations was identified as a threat to caribou recovery. Similarly, hunters from Arviat, Baker Lake and Rankin Inlet have observed increasing grizzly bear numbers and voiced their concerns over problem bears around communities, at cabins, meat caches and regard grizzly bears as a problem animal (Awan 2021, Harding et al. 2025). However, the number of cabins has increased significantly over the past 30 years, likely increasing conflicts compared to temporary tent camps (Awan et al. 2025).

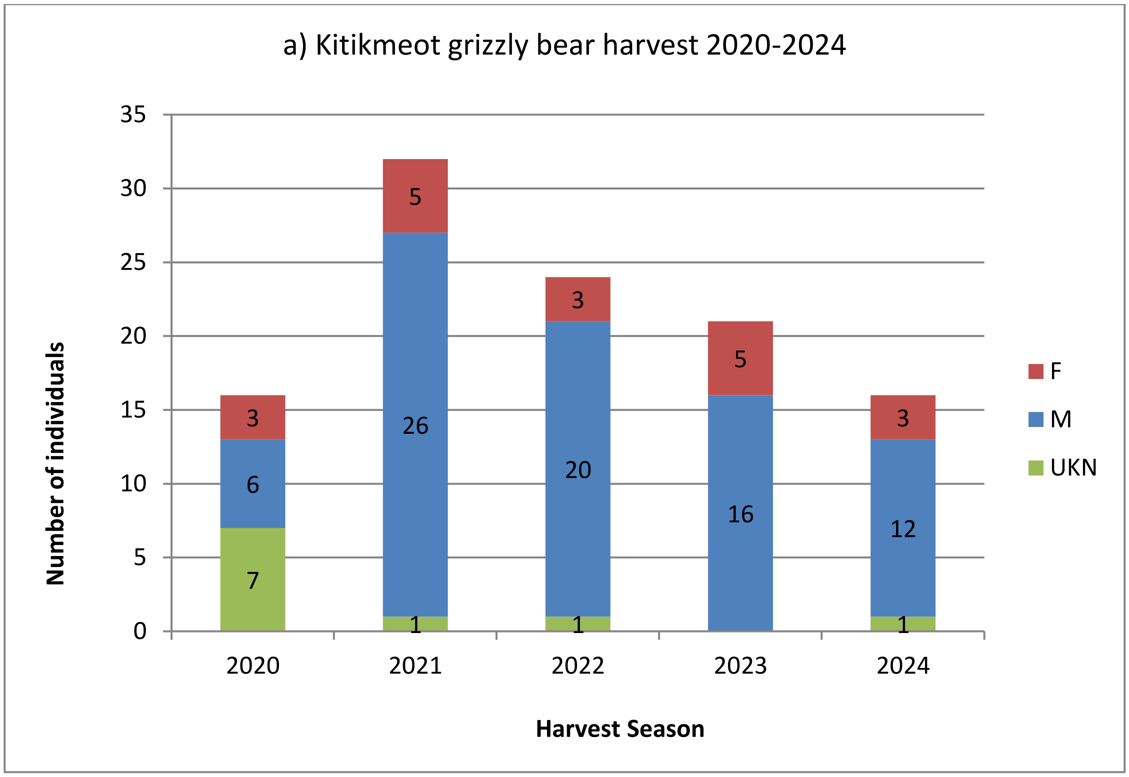
Although territory wide surveys have not been conducted, in 2016 and 2017, Awan et al. (2019) sampled 4 grids (49 km × 49 km) in the Kivalliq Region of Nunavut using DNA-hair tripods and estimated a density of 3.5 bears/1,000 km^2 (95% CI = 2.1–6.1 bears/1,000 km^2). We sampled the western mainland of the Kitikmeot Region using DNA hair snagging methods from 2021 to 2023 and updated the earlier results (2008/09, Dumond et al. 2015) and sampled the areas west of Bathurst Inlet in 2022 and area around and south of Bathurst Inlet in 2023. The overall density estimate from our 2021–2023 study is 5.92 bears per 1,000 km^2 (CI = 5.02–6.83, Awan et al. 2025). Monitoring of grizzly bear harvest numbers, sex and age composition of the harvested bears is fundamental to the conservation of the species and its sustainable use.

2.0 Methods

Subsistence harvesting reports are voluntary and, with few exceptions, hunters have been reporting the harvest with good return rates to-date. Hunters in the Kivalliq and Kitikmeot regions were asked to return the lower jaw or whole skull, a piece of muscle, a small piece of the skin with hair (2x5cm), and to provide kill information (date, location, etc.) to their local Conservation Officer for each harvested grizzly bear. To determine the age of the harvested individuals, we sent the first premolar (lower PM1) to Matson's Laboratory LLC (Milltown, MT, USA) for cementum analysis. This technique is based on the cyclic nature of cementum growth in teeth forming annular patterns of different darkness depending on the season (Matson 1981). Age results from the 2018-2019 season (2019) have been included in all analysis presented in this report which take into consideration the age of the individuals. The harvest year was assigned as the year at the end of the prescribed harvesting season, for example, 1 July 2019—30 June 2020 was the 2020 harvest year/season.

3.0 Results and Discussion

A total of 200 grizzly bears were reported harvested from the 2020 to 2024 harvest seasons, 109 (males = 80, females = 19 and unknown sex = 10) from the Kitikmeot and 91 (males = 57, females = 33 and unknown sex = 1) from the Kivalliq region (Fig. 1).



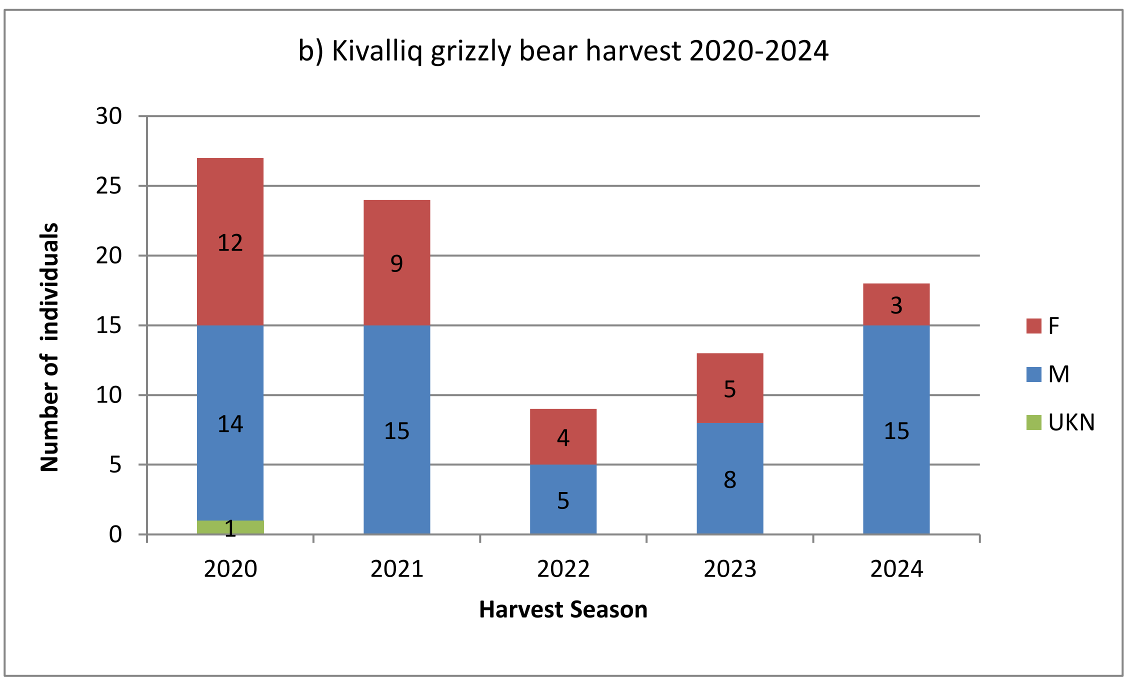


Figure 1: Proportion of males and females in reported harvest in Kitikmeot (a) and Kivalliq (b), from 2020 to 2024.

The known harvest, by region and community is summarized in Table 1. Most grizzly bears were harvested in the western Kitikmeot, in the vicinity of Kugluktuk, Cambridge Bay and along the traditional travel route from the Cambridge Bay to the Bathurst Inlet area, and few in the eastern communities. Arviat and Baker Lake were the highest contributors to the total harvest in the Kivalliq region (Fig. 2, Table 1). Grizzly bear harvest is tightly linked to hunter accessibility; in late winter/early spring hunters use snowmachines to access areas further from communities, and in summer all terrain vehicles (ATVs) are used to access areas around communities as well as boats to extend hunting off water channels.

Table 1: Reported grizzly bear harvest in Kitikmeot and Kivalliq regions between 2020 and 2024. RH = Regular Hunt, SH = Sport Hunt.

Community	2020		2021		2022		2023		2024	
	RH	SH	RH	SH	RH	SH	RH	SH	RH	SH
Cambridge Bay	7		9		9	5	5	4		7
Gjoa Haven					1					
Kugaaruk							1			
Kugluktuk	9		23		5	4	9	2	7	2
TOTAL KITIKMEOT	16		32		15	9	15	6	7	9
Arviat	15		20		3		6		7	
Baker Lake	12		2		4	1	3	1	7	1
Naujaat					1					
Rankin Inlet			1				3		3	
Whale Cove				1						
TOTAL KIVALLIQ	27		23	1	8	1	12	1	17	1

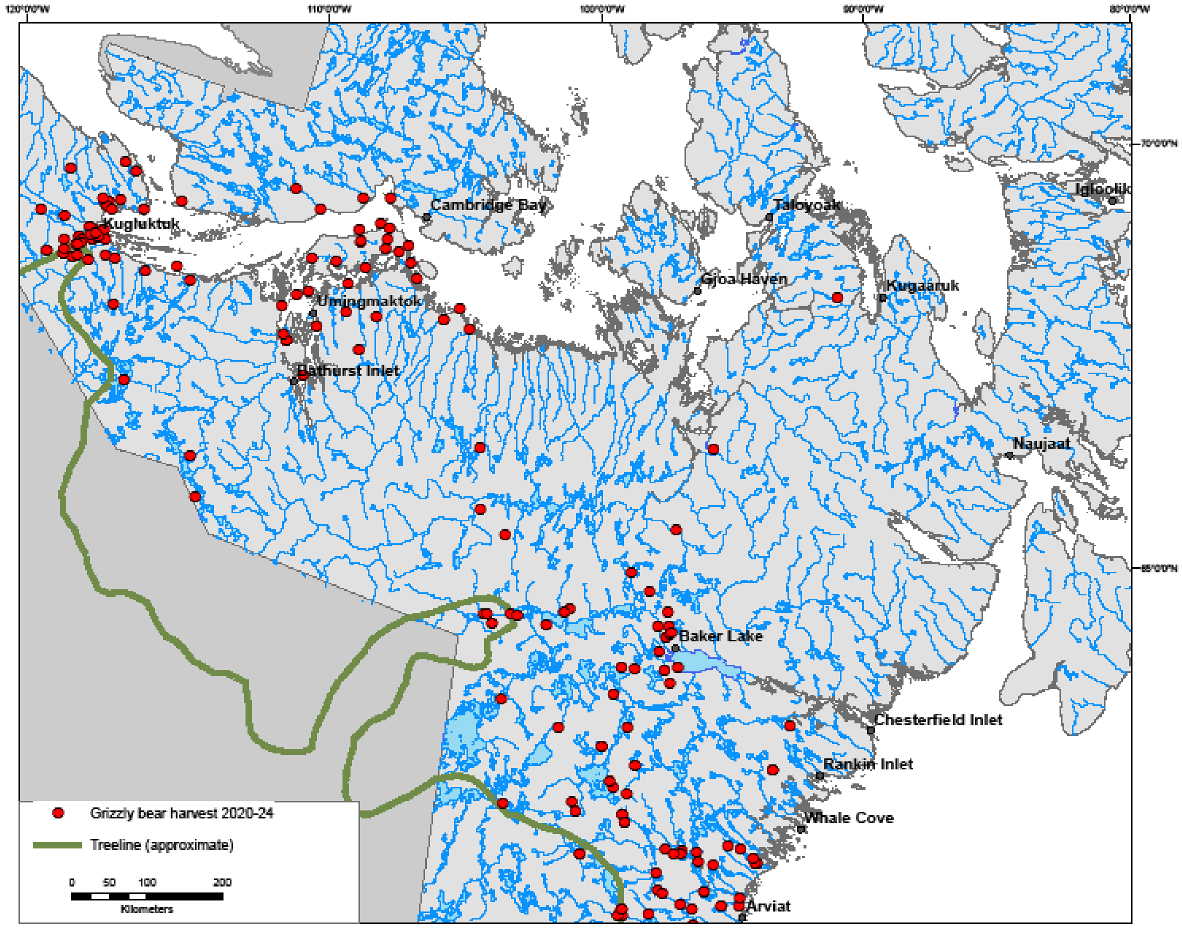


Figure 2: Distribution of reported grizzly bear harvest in Nunavut, from 2020 to 2024.

Long-term reported harvest trend of 15 years (2010-2024) shows that in the Kitikmeot region, the number of bears harvested averaged 15 bears annually (SD = 7.3, range 4–32; Fig. 3), and was significantly higher in 2021 (32 bears). Reported grizzly bear harvests in the Kivalliq have increased substantially since 2008. From 2010 to 2024, the harvest averaged 20 bears annually (SD = 6.9, range 9 –34; Fig. 3).

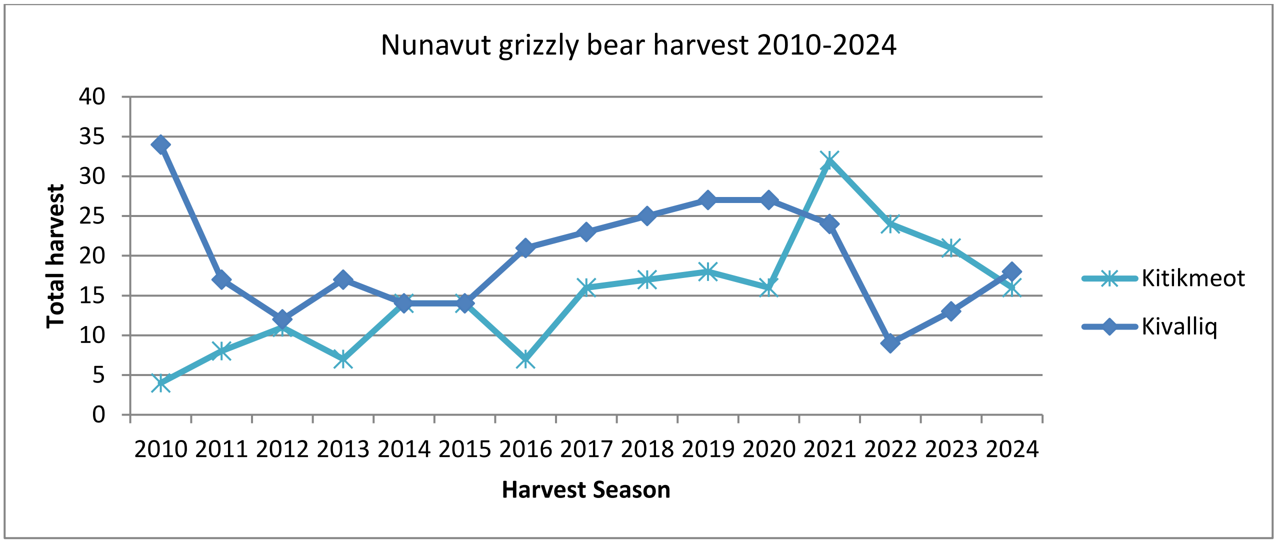


Figure 3: Reported grizzly bear harvest in Kivalliq and Kitikmeot regions between 2010 and 2024.

The male to female ratio in the harvest has been relatively stable for the last 15 years in the Kitikmeot region with males and females representing an average of 85% and 15% of the total harvest respectively (Fig. 4). Males composed >80% of the harvest in most of the last 15 years, indicating a stable and healthy population.

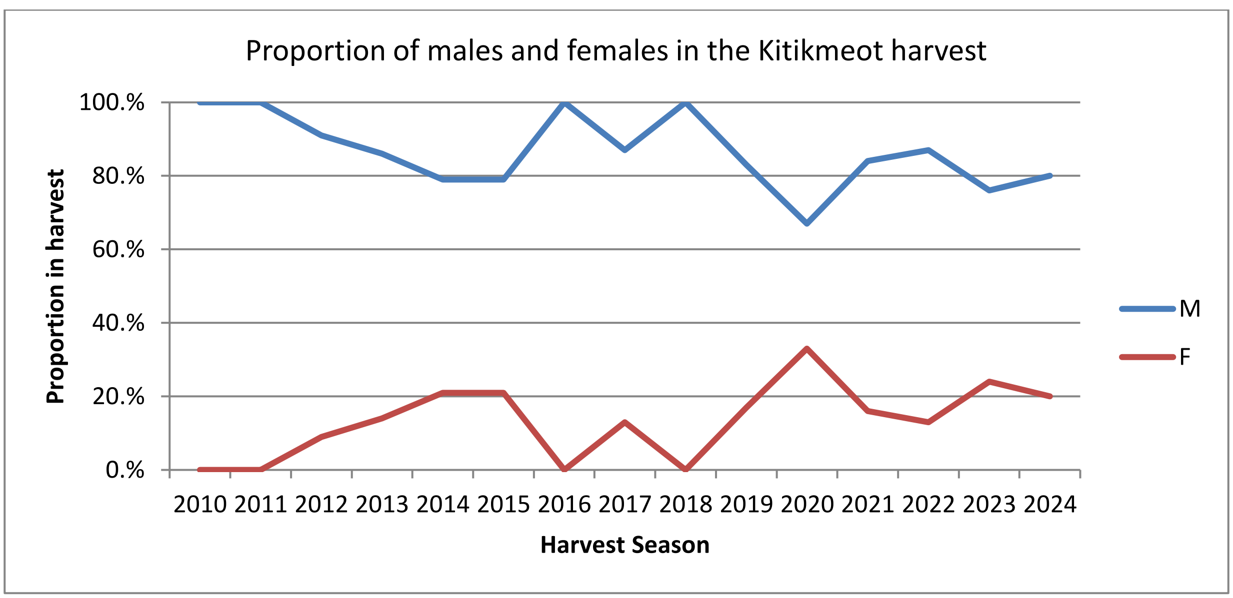


Figure 4: Proportion of males and females in reported harvest in the Kitikmeot region, from 2010 to 2024.

In the Kivalliq, a similar pattern was up to 2009 harvest season, with an average of 82% and 18% of males and females respectively in the harvest (Awan 2021). However, the proportion of females in the Kivalliq harvest increased to 32% and 71%, for the 2010 and 2011 seasons respectively, before dropping to average 29% from 2012 to 2024 season. A decline in the percentage of males taken in the 2011 harvest suggests fewer males are present (Fig. 5).

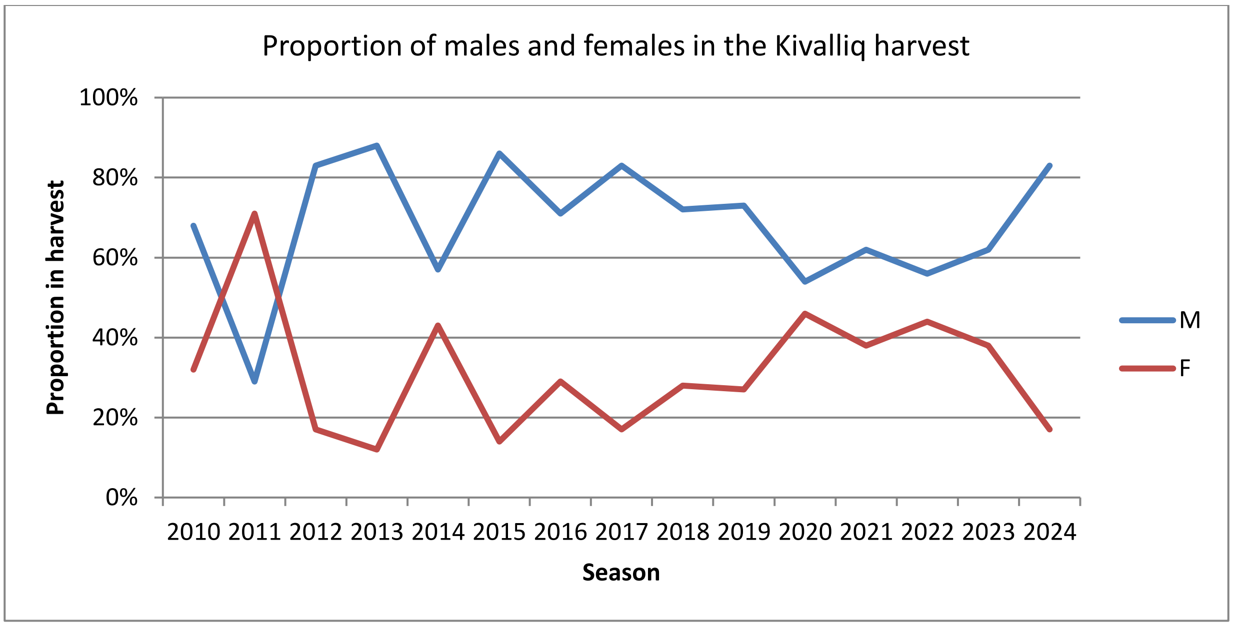


Figure 5: Proportion of males and females in reported harvest in the Kivalliq region, from 2010 to 2024.

The ages of harvested grizzly bears in Kitikmeot region ranged from 1 year to 23 years (Fig. 6). The oldest female (23 years) was killed by a hunter in 2020 in the Kugluktuk area.

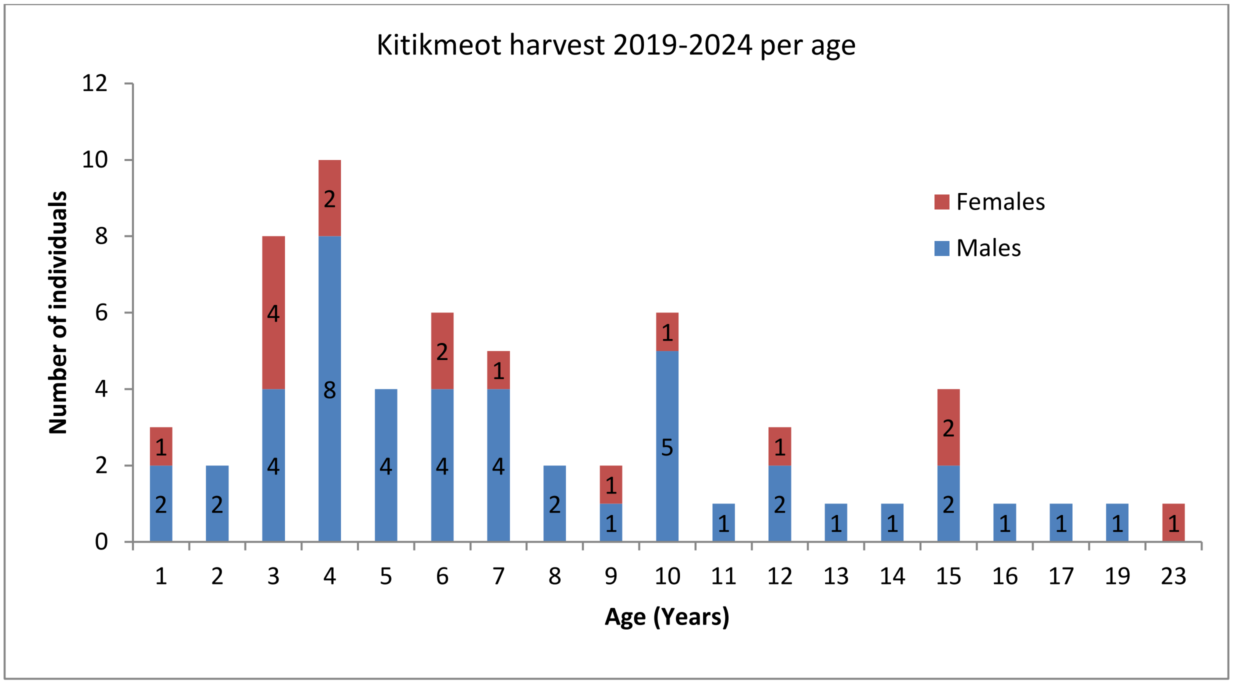


Figure 6: Age and sex structure of the reported Kitikmeot grizzly bear harvest, from 2019 to 2024.

The ages of harvested grizzly bears in Kivalliq region ranged from 1 year to 24 years (Fig. 7). The oldest male (24 years) was harvested in September 2021 about 80 km northeast of Arviat near the coast.

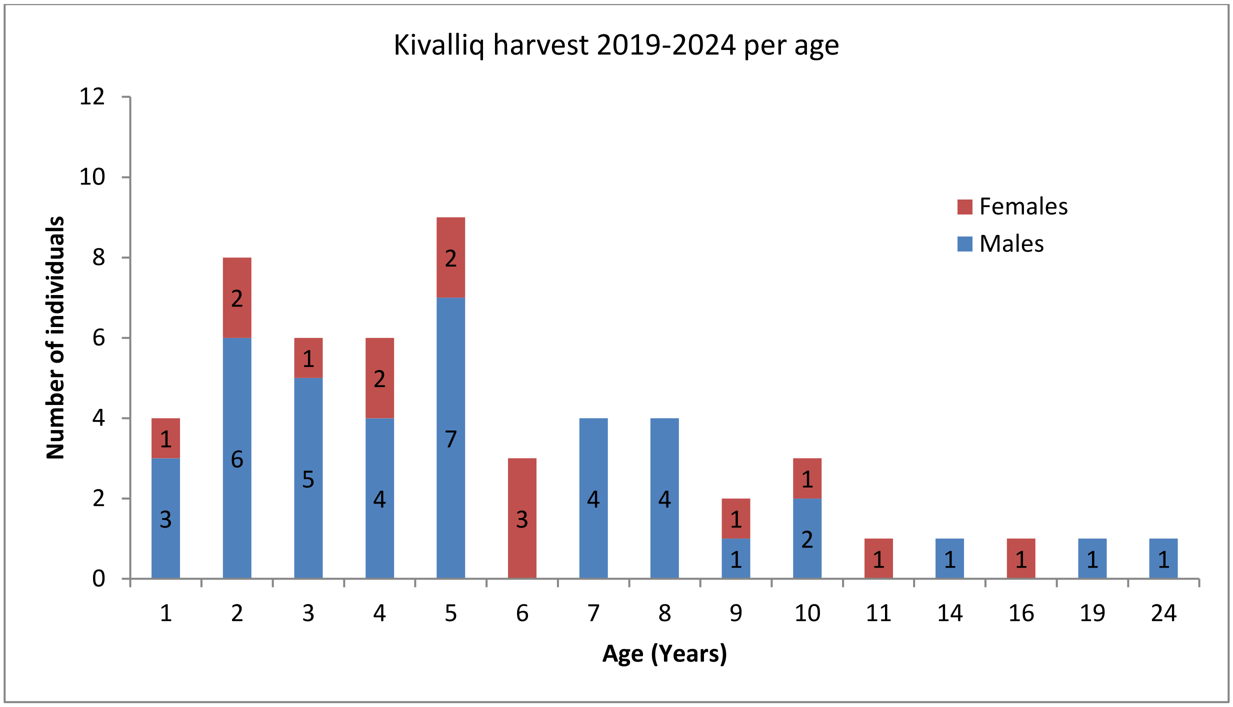


Figure 7: Age and sex structure of the reported Kivalliq grizzly bear harvest, from 2019 to 2024.

The average age of the grizzly bears harvested from 2019-2024 in the Kitikmeot was 7.48 years (n = 62) old, compared to 5.81 years (n = 55) old in the Kivalliq for the same period. The proportion of adults in the Kivalliq harvest was 38%, while proportion of adults in Kitikmeot harvest was 56% (Fig. 8). In both regions, the average age in the harvest slightly increased compare to 2013-2018 harvest period (Kitikmeot = 7.97 years, Kivalliq = 5.89 years; Awan 2021).

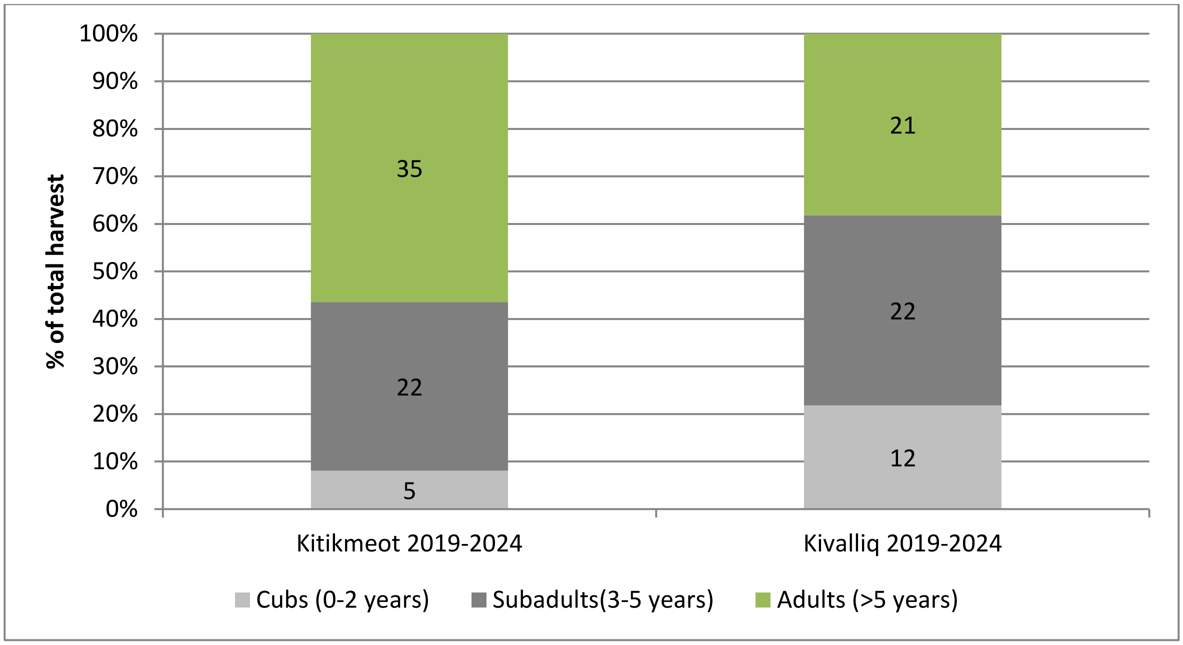


Figure 8: Proportion of age classes in the Kitikmeot and Kivalliq reported harvest, from 2019 to 2024.

In Nunavut, grizzly bears are being harvested both as part of traditional/subsistence (regular hunts) activities and as part of commercial activities (sport hunts). In the Kitikmeot region, approximately 28% of harvested grizzly bear harvest from 2010-2024 were taken in sport hunts, 93% of which were males. For the same period, in the Kivalliq region, approximately 3% were taken as sport hunts, 86% of which were males. Apparently, this low sport hunts success, seems attributed to logistic constraints, non-availability of sport hunters or dearth of high trophy quality. Regular harvest is increasing, grizzly bears on tundra have low reproductive potential (McLoughlin et al. 2003) and cannot afford high subsistence and sport hunt at the same time.

The large home range of males compared to females, and the fact that their highest movement rates happen during spring probably increase their vulnerability to harvest which occurs at the same time of year (den emergence to end of June) (McLoughlin et al. 1999). The continuous high proportion of males in the Kitikmeot harvest indicates that the population seems to support relatively well the current harvest despite the continuous strong bias towards the removal of males.

The average harvest in the Kitikmeot between 2020 and 2024 was 22 bears per year. It is usually agreed that an annual human-caused mortality of 2-3% is a safe management goal for most northern grizzly bear populations (Sidorowicz and Gilbert 1981, McLoughlin et al. 2003). Awan et al. (2025) population estimate was over 900 grizzly bears in the 156, 490 km2 study area of the western mainland Kitikmeot Region. Overall density estimate from our 2021-2023 study is 5.92 bears/1,000 km^2 in the western mainland of the Kitikmeot Region (Awan et al. 2025). Based on those densities and from the demographic parameters of barren ground grizzly bears in the Kitikmeot region (McLoughlin and Messier 2001), the current harvest thus appears to be within the recommended limits and should result in a stable population.

The average age and age distribution of the 2019-24 harvest is comparable to the long-term average and appears to be relatively well distributed among the whole range of age. This also seems to point towards a stable population and a sustainable current harvest. However, in 2021 the Kitikmeot harvest was 32 bears (Table 1), suggesting careful monitoring of harvest is warranted.

Similarly to the Kitikmeot region, the sex ratio in the Kivalliq harvest has historically been biased towards males representing approximately >80% of the total harvested individuals up to 2009 harvest season, however, the proportion of females increased to 32% in 2010 and 71% in 2011. The recent increase in the proportion of females in the Kivalliq harvest is concerning, but it seems that this occasional harvest is not a long-term conservation concern. The grizzly bear harvest in the Kivalliq should however continue to be monitored closely to ensure the durability of this population for future generations.

Due to limited food resources, barren-ground grizzly bears on the tundra have very large spatial requirements (McLoughlin et al. 2002a) and later ages of maturation than elsewhere, making them more susceptible to over-harvest and disturbance, given their overall low productivity and slow recovery potential (McLoughlin et al. 2003, McLellan et al. 2017). There is concern that the cumulative effects of various human-caused mortalities and increasing development on the land may cause the grizzly bear population to decline in Nunavut.

4.0 Acknowledgments

Thank you to everyone involved in the collection of the harvest information presented here – the hunters, the HTOs, and the Conservation Officers.

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Participatory assessment of aklak (Grizzly bear, *Ursus arctos*) abundance and distribution in the Kivalliq Region, Nunavut

Final Report, ECCC contract # 3000713560

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Naittut uqauhiit

Aklak (akhat, *Ursus arctos*) tautuktaujut nunaqaqtunit Kivallirmi, Nunavunmi, amigairjuumijut amigainiit tamaini aviktuqhimajuni. Atuqpaktugut amihunik ihuaqhautinik uqaqatiriigutinik ilauvlutiklu nunaujrnikkut atuqtunik nalunairiagani takuukhauniginik aturninginik, nalautaaganik humiiniginik amigainiginiklu, qaujimajaujuniklu aaliujuni nunami Inuit angunahuaqtinit iniqnririniklu. Ilaujut uqatiaqtut amigaiqpaaliriagani amigainigit aklaknik humiliqaak Kivalliqmi nunami aulaqtiriaqnigani tuaninik ukiunganik atuliqtuni, piqaluangitunik 1960-nit kihiani takunahivaliajut 1990-nit hivuatigun. Ilaujut uqatiaqtut aklak-mik taimani pitquhingni piqaluangitun amigainiginik Kivalliqmi, ihumagivlugit aalatqiinik ilagiaqniginik amigaitilaangit utiqtifaangitaangani. Tuniqhaininnga aklak hivulliqpaami nunami, talvani takuvaktut tahiqmi kuukkaniklu; kihimi, takuvaktut hinaani atuqtauqattaliqpaktut. Aklak najugaingit kititauvakhimajunik tahapkunanga tamangnit apiqhuijukhanik naunaitkutanik avaliitunik imalu aah DNA ihiviurhinikmun naunaijainikmun naunaitkutakhanik naunaikgutivaktukhaniklu (Awan et al. 2019) atuqhutik ungahinirmi uqumaitilaanik unalu Empirical Bayesian Kriging (2.88-4.07 nanuit/$1000km^2$) atautimun amigairniit 1081-1515 akhat naunaijautini najugaani. Tamangnik nallautiqhimajut talvaniitun 95 pusanmik CI-nik aulaniqaqtunik nallautiqhimajuq kingulirmi tapkuninga Awan et al. (2019) tahhvuna 2.1-6.1 akhat/1000kminik[2] aadjikiivjaktullu aalanun kinguani naunaijautit aadjikiivjaktunun najugaini. Qiniqhiavaliatilugilu una nutaaq

nalautaaqniganik pigiarutip aturniqatiaqniaqtuq. Tamna inuuhiliqinirmut-pijuq pijuq Kivallirmi naunaingittuq aadlanut avikturhimajunut Kaanatami, naunaijainiqlu ilaujut naunaiqtait atan'ngujat maligangit atuqtangillu uumunnga akhat pijuq aadlangajuq uumunnga aviktuqhimaninnganut pipluni.

Abstract

Aklak (grizzly bear, *Ursus arctos*) are viewed by residents of the Kivalliq region, Nunavut, as increasing in abundance across the region. We used semi-structured interviews and participatory mapping exercises to elicit narratives of encounters, estimates of spatial distribution and abundance, and knowledge of aklak ecology from Inuit hunters and elders. Participants uniformly emphasized an increase in the relative abundance of aklak across the Kivalliq region since the beginning of the twentieth century, with rare encounters prior to the 1960s but frequent encounters from the 1990s onward. Participants emphasized that aklak were not historically abundant in the Kivalliq, suggesting a range expansion rather than a population in recovery. The distribution of aklak was primarily inland, where encounters frequently occurred along lakes and rivers; however, sightings in coastal areas have become more common. Aklak densities were calculated from both interview data alone and interview data plus DNA sampling grid hits (Awan et al. 2019) using inverse distance weighting and Empirical Bayesian Kriging (2.88-4.07 bears/1000km^2) for a total abundance of 1081-1515 bears in the study area. Both estimates are within the 95% CI range estimated previously by Awan et al. (2019) of 2.1-6.1 bears/1000km^2 and are similar to other previous studies in similar habitat. Further exploration of this new estimation method would be useful. The socio-ecological context of the Kivalliq is not analogous to other regions in Canada, and study participants emphasized that management policies and practices for aklak should be distinctive to the region's context.

Résumé

Selon les résidents de la région de Kivalliq, au Nunavut, l'abondance d'aklaks (grizzli, *Ursus arctos*) a augmenté dans l'ensemble de la région. Nous avons eu recours à des entrevues semi-structurées et à des exercices de cartographie participative pour obtenir de chasseurs inuits et d'aînés des récits de rencontres, des estimations de la répartition spatiale et de l'abondance et des connaissances du milieu écologique de l'aklak. Les participants ont rapporté de façon unanime une augmentation de l'abondance relative de l'aklak dans l'ensemble de la région de Kivalliq depuis le début du vingtième siècle, les rencontres ayant été rares avant les années 1960, mais fréquentes depuis les années 1990. Les participants ont insisté pour dire que l'aklak n'a jamais été abondant dans les environs de Kivalliq, ce qui suggère une expansion de l'aire de répartition plutôt qu'une population en voie de rétablissement.
La répartition de l'aklak se limitait surtout à l'intérieur des terres, et les rencontres se produisaient fréquemment le long des lacs et des rivières; cependant, les observations dans les zones côtières sont devenues plus fréquentes. Les densités ont été calculées à partir des données recueillies lors des entrevues elles-mêmes et des données tirées des entrevues en plus des occurrences de la grille d'échantillonnage de l'ADN (Awan et coll. 2019) en utilisant la pondération de la distance inverse et le krigeage bayésien empirique (2,88 à 4,07 ours/1 000 km^2) pour une abondance totale de 1 081 à 1 515 ours dans la zone étudiée. Les deux estimations se situent dans l'IC de 95 % estimée précédemment par Awan et coll. (2019) de 2,1 à 6,1 ours/1 000 km2 et sont similaires à celles des autres

études semblables pour un habitat semblable. Un approfondissement de cette nouvelle méthode d’estimation serait utile. Le contexte socioécologique de Kivalliq ne s’apparente en rien aux autres régions du Canada, et les participants de l’étude ont souligné que les politiques et pratiques en matière de gestion de l’aklak devraient être adaptées au contexte particulier de la région.

ᐅᖃᐅᓯᑐᐃᓐᓇᕐᑎᒍᑦ ᓇᐃᓈᖅᓯᒪᔪᖅ

- ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑐᕌᒐᖅ: ᖃᐅᔨᑎᑦᑎᔪᓂ ᓄᓇᓕᖕᒥ ᖃᐅᔨᒪᓂᕐᒥᒃ ᐊᑯᒃᑲᐃᑦ ᐅᓄᕐᓂᖏᓐᓂᒃ, ᓇᓃᓐᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐆᒪᔪᑦ ᓇᔪᖕᒋᑕ ᓯᓚᑎᖕᒋᑕᓗ ᖃᓄᐃᑦᑑᓂᖏᑦ ᑭᕙᓪᓕᕐᒥ ᐊᑐᕐᓗᒋᓪᓗ ᖃᐅᔨᔾᔪᑕᐅᔪᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂᒃ (IQ) ᐃᑲᔪᕐᓗᒋᑦ ᐱᑕᖃᖅᑐᑦ ᑭᒃᓕᓯᓂᐊᕈᑎᓄᑦ ᑲᑎᖅᓱᖅᓯᒪᔪᓂ ᖃᐅᔨᑎᓪᓗᒋᑦ ᐆᒪᔪᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒥ ᐊᑐᕋᓲᑎᓂᒃ.
- 2022-2023−ᒥ, ᓄᓇᓕᖕᓂᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᑖᓚᐅᖅᑐᑦ ᐃᓄᖕᓂᑦ ᖃᐅᔨᓴᖅᑎᓂᑦ ᐊᐱᖅᓱᖅᓱᑎᒃ ᐊᕐᕕᐊᓂᑦ ᖃᒪᓂ'ᑐᐊᒥᓪᓗ, ᐃᑲᓐᓂᐊᕐᑎᑦᑎᓪᓗᑎᒃ 2023 ᐱᒋᐊᖕᓂᖖᓂᑦ. ᐊᒻᒪ ᓱᓕ, ᑭᖑᓂᖕᒫᑦᑎᓐᓂ ᐊᐱᖅᓱᕐᓂᐅᖃᑦᑕᓚᐅᖅᑐᑦ ᖃᒪᓂ'ᑐᐊᕐᒥ ᐊᖑᓇᓱᒃᑐᓕᕆᔩᒃᑯᓐᓂ ᐃᓚᓕᐅᔾᔭᐅᓚᐅᖅᐳᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᓂᒃ. ᑕᒪᕐᒥᒃ ᖃᒪᓂ'ᑐᐊᕐᒥ ᐊᒻᒪ ᐊᕐᕕᐊᕐᒥᐅᑦ ᐃᓚᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᐳᑦ ᐅᓄᖅᓯᕚᓕᖅᓯᒪᓂᖏᓐᓂᒃ ᐃᓄᐃᑦ ᑕᑯᖃᑦᑕᐅᑎᖃᑦᑕᕐᓂᖏᓐᓂᒃ ᐊᒃᓱᓂᒃ ᑭᕙᓪᓕᕐᒥ ᑕᐃᒪᙵᑦ 1990−ᖏᓐᓂ ᐃᓪᒪᖌ 1960−ᖏᓐᓃᑎᓪᓗᒍ.
- ᐃᓄᐃᑦ ᐊᒻᒪ ᐊᒃᓱᐃᑦ ᐊᑯᓐᓂᖓᓂ ᑰᒃᑯᑦ ᐊᒻᒪ ᑕᓰᒃᑯᑦ.
- ᐊᖑᓇᓱᒃᑕᐅᕙᒃᑐᑦ ᐊᒃᓱᖕᓂ ᐃᓱᒪᒋᔭᐅᕗᑦ ᑲᔪᓯᑎᑕᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ ᐃᓚᐅᔪᓂᑦ ᐅᓄᖅᓯᕙᓪᓕᐊᑎᓪᓗᒋᑦ.
- ᐱᔭᐅᔪᓐᓇᕐᑐᑦ ᑭᒡᓕᖃᖅᑎᑕᐅᔪᓪᓗ ᐊᒃᓱᒃᑕᐅᕙᒃᑐᑦ ᐃᓱᒪᒋᔭᐅᕙᑦ ᐱᐅᓗᐊᙱᓐᓂᖏᓐᓂᒃ ᐅᕝᕙᔫᓐᓃᑦ ᐱᔭᐅᔪᒪᙱᖅᓱᑎᒃ ᓄᓇᓕᖕᒥᐅᓄᑦ.
- ᐊᒥᓲᓂᖏᑦ ᐊᒃᓱᐃᑦ ᓄᓇᙳᐊᓂᑦ ᐃᓄᐃᑦ ᑕᑯᓯᒪᔭᖏᑦ ᐊᔾᔨᖃᖅᑐᑦ ᖃᐅᔨᔭᐅᔪᓂᑦ ᖃᐅᔨᓴᓚᐅᕐᑎᓪᓗᒋᑦ ᑭᓲᓂᖏᓐᓂᑦ ᐊᒃᓱᐃᑦ ᒥᖅᑯᖏᓐᓂᑦ ᕿᔩᓪᓗᑎᒃ ᓄᓇᒧᐊᖅᑕᐅᓚᐅᖅᑐᑦ.
- ᐃᓄᐃᑦ ᐱᐅᓯᖏᑦ ᐊᖑᓇᓱᖕᓂᕐᒥᑦ, ᐊᖑᓇᓱᖕᓂᕐᒥᑦ, ᐊᒻᒪᓗ ᕿᖕᓂᓂᕐᓂ ᑐᑦᑐᓂᑦ, ᐅᓗᕆᐊᓇᖅᑐᒦᑉᐳᑦ ᐅᓄᖅᓯᕙᓪᓕᐊᓂᖏᓐᓄᑦ ᓴᓪᓗᐃᑦ ᐅᓄᕐᓂᖏᑦ, ᑕᑯᔭᖕᓂᖅᓴᐅᓂᖏᓐᓄᑦ ᐊᒃᓱᖕᓂᑦ ᕿᓂᕐᓂᕐᒥᑦ ᕿᖕᓂᔪᓂᑦ ᐊᒻᒪᓗ ᐃᒡᓗᕋᓛᓂᑦ ᐊᑦᑕᕐᓇᖅᑑᕗᑦ ᐊᒻᒪᓗ ᐅᓚᕕᓴᐃᓪᓗᑎᒃ ᑕᒪᒃᑯᓂᖓ ᐱᓕᕆᔾᔭᐅᔪᓂᑦ.
- ᐱᓕᕆᐊᖓ ᐊᖑᐅᑉ ᐃᓅᖃᑎᒌᖕᓂᕐᒧᑦ−ᐆᒪᔪᑦ ᓄᓇᖏᑦ ᑭᕙᓪᓕᕐᒥ ᐊᔾᔨᐅᙱᑦᑑᔪᖅ ᐊᓯᖏᓐᓂ ᓄᓇᓕᖕᓂ ᐊᕕᒃᑐᖅᓯᒪᓂᐅᔪᓂ ᑲᓇᑕᒥ.
- ᐅᓄᖅᓯᕙᓪᓕᐊᑎᓪᓗᒋᑦ ᖃᐅᔨᔭᐅᕙᓪᓕᐊᔪᑦ, ᐃᓚᐅᔪᑦ ᑕᐅᑐᒃᐸᒃᐸᒃᐳᑦ ᐃᒪᓐᓇ, ᐸᒡᕕᓴᐃᓂᐅᓂᖖᓂᒃ ᐃᓅᖃᑎᒌᒃᐸᖕᓂᕐᒧᑦ−ᓄᓇᒥᙶᖅᑐᓂᒃ ᐊᑐᖅᑕᐅᕙᒃᑐᓂᒃ, ᐃᒪᓐᓇᐅᙱᖖᒫᖅᑐᖅ, ᓂᕐᔪᑎᑦ ᐱᔭᕆᐊᖃᖅᓱᑎᒃ ᓄᖑᕋᐃᓗᐊᖅᑕᐃᓕᒪᓂᕐᒧᑦ ᐱᓕᕆᕝᕕᖃᙱᓕᕐᓂᕐᒥᒃ.

Naunaitumik uqauhiq naitumik uqauhiq

- Naunaijainiq ihuaqtuq: pipkaidjutijuq nunallaani ilihimaniq uuminnga amigaitilaangat, tuniqhainiq nunanginniklu Kivallirmi avikturhimajumi aturninngalu tautuktuujaqtamiknik uumannga Inuit Qaujimajatuqangit (IQ) ilaliutigiami ittut nalunaqtunik nampangit naunaipkariami huradjanik munariniq atuqtamiknik.
- Uvani 2022-2023, nunamingni havaaniktut Inuit ihivriungnikkut ikajuqtit apiqhuijut Arviani Qamanittuamilu (Qamani'tuaq), katimaqjuarutit atulihaaliqtilugu 2023. Imaalu, kinguani apiqhuqtaujut tunijaujut Qamanittuami Anguniaqtit Katimajiit (HTO) ilaujut naunaijautini. Tamangnik Qamanittuaq (Qamani'tuaq) unalu Arviat ilaujut amigaiqjuumijut inungnun atuqtait akharnik avatiini Kivallirmi aviktuqniani talvanga 1990ni uvalu atulihaaliqtilugu 1960s.

- Atuqhugit qitqani inuit aklaklu hilait atuqtaujut kuukap uvalu tahiitlu.
- Angunnahuaknirmun aklak tautukhimajunik uumajunik ilaujunik pihimajunik amigaitilaangit angiklivalialiqtun.
- Qaffiutilaangit pittailijakhaillu aklak angunahuarniq ihumagijaungittut akhuraaluk piiqtaulimaittuqluuniit nunamiknit.
- Qaffiunigit aklak nunaujarmit Inuit takujainik nalaumajunik nanijaujunik hivuanit ilituqhaunmit naunaijagaujut DNA-nik aklak amiqmit mitquinik qiuknik napaqutinik atuliqhimajut nunami.
- Inuit atuqhimaaqtangit anguniarniq, angunahuarniq, pirlukhutiklu tuktu, iqhitaaqtaujut amigairjumiqtumit nunami amigaitni, atuqattaqhugit amiqhaat pirujat igluqpannuallu qajangnaqhivaktut pittailiplugillu hapkuat pirujat.
- Havaanga aklak inuuhiqmut-pijuq nunanga Kivallirmi avikturhimajuq aadlangajuq aadlanit aviktuqhimajunit Kaanatami.
- Amigaiqpalianigit atuqtait, ilaujut takuvaktut aklak-mik nuutqaqtitiniganik inuuhiqmi inuujuhiqmilu atuqtumik, ukuagugituq aalatqiit ihariagijauniginik angunahuarutikharnik nuutqaqtitijutinik.

Plain language summary

- Study objective: elicit local knowledge of aklak abundance, distribution and ecology in the Kivalliq region and use insights from Inuit Qaujimajatuqangit (IQ) to complement existing scientific data to inform wildlife management practices.
- In 2022-2023, locally hired Inuit research assistants conducted interviews in Arviat and Baker Lake (Qamani'tuaq), with workshops held in early 2023. Additionally, previous interviews provided by the Baker Lake Hunters and Trappers Organization (HTO) were included in the analysis. Both Baker Lake (Qamani'tuaq) and Arviat participants attested to increases in human encounters with aklak across the Kivalliq region since at least the 1990s and perhaps as early as the 1960s.
- Encounters between humans and aklak tend to occur along rivers and lakeshores.
- The harvest of aklak is viewed as sustainable by participants as the population is increasing.
- Quotas and restrictions on aklak harvest are considered not pragmatic or desirable by community members.
- The number of aklak from mapping Inuit observations aligns with findings from a previous study that sampled DNA from aklak hair snagged on wooden tripod posts deployed on the land.

- Inuit practices around hunting, harvesting, and caching caribou, are threatened by an increase in aklak abundance, as more frequent encounters with aklak scavenging caches and cabins pose safety risks and disrupt these practices.
- The role of aklak in the socio-ecological landscape of the Kivalliq region is distinct from that in other regions in Canada.
- With increasing encounters, participants view aklak as a disruption to the socio-ecological system, rather than as a species in need of conservation interventions.

Résumé en langage simple

- Objectif de l'étude : recueillir des connaissances locales sur l'abondance de l'aklak, sa répartition et son milieu écologique dans la région de Kivalliq et tirer parti des perspectives issues de l'Inuit Qaujimajatuqangit (IQ) pour bonifier les données scientifiques actuelles afin d'orienter les pratiques en matière de gestion des espèces sauvages.
- En 2022-2023, des assistants de recherche inuits embauchés localement ont mené des entrevues à Arviat et à Baker Lake (Qamani'tuaq) et ont animé des ateliers au début de 2023. De plus, des entrevues réalisées précédemment par l'organisation de chasseurs et de trappeurs (OCT) de Baker Lake ont été incluses dans l'analyse. Les participants de Baker Lake (Qamani'tuaq) et d'Arviat ont tous confirmé une augmentation du nombre d'humains ayant rencontré un aklak dans l'ensemble de la région de Kivalliq depuis au moins les années 1990, et peut-être même depuis les années 1960.
- Les rencontres entre un humain et un aklak ont tendance à se produire le long des lacs et des rivières.
- La récolte de l'aklak est perçue comme étant durable par les participants puisque la population augmente.
- Selon les membres des collectivités, les quotas et les restrictions visant la récolte de l'aklak ne sont ni pragmatiques ni souhaitables.
- Le nombre de spécimens de l'aklak, d'après la cartographie tirée des observations inuites, est conforme aux conclusions d'une étude précédente qui avait prélevé des échantillons d'ADN des poils de l'aklak accrochés à des trépieds en bois déployés dans les terres.
- Les pratiques inuites en matière de chasse, de récolte et de cache pour le caribou, sont menacées par une augmentation de l'abondance de l'aklak, puisque les rencontres plus fréquentes avec l'aklak détruisant les caches et les cabanes présentent un risque pour la sécurité et perturbent ces pratiques.
- Le rôle de l'aklak dans le paysage socioécologique de la région de Kivalliq est différent de celui qu'il joue dans d'autres régions du Canada.

- En raison de l’augmentation des rencontres avec l’aklak, les participants le perçoivent comme une perturbation du milieu socioécologique et non comme une espèce devant faire l’objet d’efforts de conservation.

Background

Members of the HTOs of Baker Lake (Qamani'tuaq) and Arviat have shared that they have witnessed an increase in aklak[7] abundance in the Kivalliq region for approximately the last fifty years (Clark and Slocombe 2011; Lokken et al. 2019). Community members have expressed concerns about human-wildlife conflict, as aklak cause damage to hunting cabins, dig up caches of caribou meat, and can pose risks to community safety (Nirlungayuk 2011; Manning 2022).

Climate change is impacting northern wildlife population dynamics (Humphries et al. 2004) and Indigenous communities are well-positioned to observe and interpret these changes (Etiendem et al. 2020; Henri et al. 2020; Jessen et al. 2022; Tomaselli et al. 2018). Furthermore, as pointed out by McLoughlin and Stenhouse (2021, 51), more information is needed to understand how climate change may be contributing to improved ecological conditions for aklak and shaping the dynamics of their range expansion in this region. The increasing population in the Kivalliq region provides a contrast to other areas in Canada with the implication that management strategies for this region ought to significantly differ from other regions (McLoughlin and Stenhouse 2021, 48-51).

Like all communities in Nunavut, the hamlets of Arviat and Baker Lake were formed as a result of Canadian government-driven relocations of Inuit people in the 1950s and 1960s (Tester and Kulchyski 2011). Arviat is now home to descendants of the Paallirmiut, who traditionally hunted in both inland and coastal areas, and Ihalmiut, whose territories lay inland near Ennadai Lake. Qamani'tuaq is home to eleven Inuit groups, including the coastal Utkuhiksalingmiut, Qaingningmiut, Paallirmiut, Natsilingmiut, Killirnirmiut, Iluilirmiut, Hanuniqtuurmiut and the inland Harvaqtuurmiut, Haningajurmiut, Akilinirmiut, and Ahiarmiut. The latter inland-oriented groups were known in the ethnographic literature as the Caribou Inuit due to their inland orientation and reliance on terrestrial mammals like caribou for subsistence (Tester and Kulchyski 2011). Inuit culture is deeply rooted in hunting, with knowledge of wildlife behaviour and distribution vital for Inuit survival.

Many of the Elders interviewed for this study were born on the land before the settlement of the hamlets and are fluent in their group's particular dialect of Inuktitut. Thus, they have access to knowledge gained from both their own long experiences on the land and knowledge passed on through oral traditions. Arviat, the southernmost mainland community in Nunavut, and Baker Lake, the only inland community. Prior to forced relocation in the 1950s, many of the Elders in the Kivalliq were members of inland-oriented Inuit groups. This is in contrast to other communities in Nunavut, which are coastal and oriented towards marine resources (while also still using inland resources). All participants asserted that aklak were more likely to be found inland, therefore community members in Baker Lake and Arviat have greater familiarity with the inland areas where aklak are more often found. Historically, aklak encounters were rare, but they were still known to Inuit communities: "*living and seeing with grizzly bears have always been in part of Inuit life*" (Norman Attungala, Baker Lake 2003).

[7] The terms "aklak" and "grizzly bear" will be used interchangeably throughout this report.

Objectives

The overall purpose of this study is to estimate grizzly bear abundance and distribution in the Kivalliq region by consulting Inuit Qaujimajatuqangit on aklak with existing scientific data and presenting the findings in ways that inform grizzly bear co-management. These two biological parameters are identified as monitoring priorities in the Co-Management Plan (Government of Nunavut 2017, 14).

Objectives of this study were to:

1. Generate estimates of grizzly bear abundance and changes in distribution through participatory exercises with HTO members in Arviat and Baker Lake.
2. Document Inuit observations and understanding of grizzly bear population trends, distribution, ecology, and the social, economic, cultural, and biological aspects of coexisting with grizzly bears— (including perceptions of risk, hunting practices, predation on caribou, human-bear conflicts, and effects of climate change).
3. Compare new data with past data from Baker Lake, specifically HTO’s 2002 interviews (if available), Clark’s 2003 interviews, and Loken’s 2014 TUNDRA interviews to identify changes and shifts in social tolerance for grizzlies in the region.

Methods

Individual semi-structured interviews

Semi-structured interviews were selected as appropriate given the cross-cultural context of research, small sample size, and our research goal to both elicit and respect Inuit Qaujimajatuqangit. Semi-structured interviews were conducted locally in Baker Lake (n=6) and Arviat (n=16). Questions revolved around participant observations of aklak abundance, distribution, ecology, and conflict with humans. Individual interviews were conducted by Emil Arnalak in Arviat and Russell Toolooktook in Baker Lake from April 2022 to February 2023 a local community member in either English or Inuktitut, based on participant preference, with most conducted in Inuktitut. Interviews were translated by local research assistant, Emil Arnalak, while Dr. Lauren Harding transcribed those conducted in English. Inuktitut interviews of 2002 from Baker Lake are still undergoing translation at the time of this report.

In addition to the data from community-based interviews in 2023, this study includes past interviews conducted in Qamani'tuaq in 2002 by Natasha Thorpe with Golder & Associates, translated by Lizzie Iblauk (n=1), and interviews conducted by Douglas Clark during his doctoral research in 2003 (n=12; Clark and Slocombe 2011). More interviews are undergoing translation, which once received will expand the temporal range and scope of our data set from Qamani'tuaq. NVivo software was used to conduct thematic analysis, identifying key themes and observations that emerged from the qualitative interview data.

Participatory mapping

Participatory mapping was a key method used in this study to capture Inuit knowledge and perceptions of aklak distribution. During each individual interview participants used markers to draw on a topographic map with a clear overlay to mark locations where they had encountered aklak and indicating areas where they believed aklak were likely or unlikely to be found (Figure 1). Standard topographic maps were used as base maps, and spatial categories emerged through dialogue with the participants and were not pre-determined by researchers. This approach aligns with established participatory mapping methods that seek to represent local perceptions of the landscape and allow for the cultural contextualization of data when possible and appropriate (Ernoul et al. 2018; Riddell et al. 2022; Robinson et al. 2016). The maps also provided a useful tool for the elicitation of place-based qualitative data. Qualitative spatial data was collected and marked on the map throughout the interview process, including areas of human-wildlife conflict (i.e., cabin break-ins) and known denning sites. The map overlays were digitized and integrated into spatial database by a geospatial analyst at Caslys Consulting (B.C.), ensuring the data was aligned with the geospatial framework of the study.

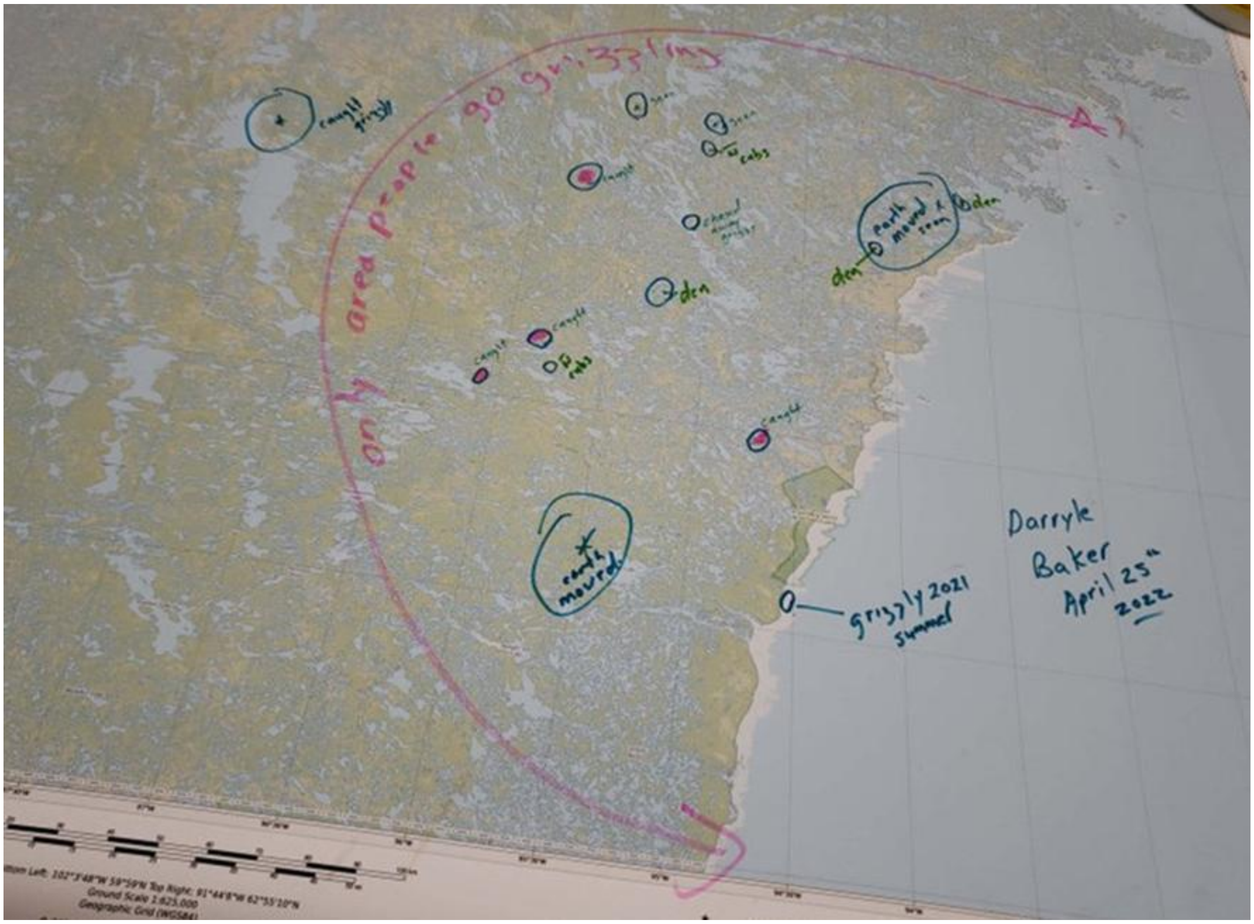

FIGURE 1. EXAMPLE OF PARTICIPATORY MAPPING EXERCISE.

Focus groups

The second phase of data collection employed focus groups and proportional piling methods to validate initial findings and gain deeper insights into aklak distribution and abundance. Focus group interviews were conducted in Arviat (n=6) and Baker Lake (n=2) in February 2023 during a community visit by Dr. Harding. In addition to the continued collection and confirmation of qualitative data on aklak, a second participatory mapping exercise was carried out oriented towards capturing relative abundance and spatial distribution.

Using proportional piling methods, participants collectively estimated aklak density on a topographic map (Figure 2), placing beads to represent relative abundance categories of 'few' or 'many'. Photographs of estimated aklak density from the group interviews was combined with participatory mapping data from individual interviews. A second proportional piling method was attempted in Arviat to graph change in population over time, but participants rejected this method in favour of a narrative approach to discuss changing abundance. Focus group sessions were recorded, transcribed, and thematically analyzed using NVivo software.

Proportional piling has been used effectively for estimating abundance of wildlife that congregate in groups like ungulates (Tomaselli et al. 2018) but may not be an effective method for estimating abundance of wildlife species like aklak which are encountered sporadically and individually. However, this method remains useful for this study as it enables participants to convey their perceptions of relative abundance across the landscape, offering valuable qualitative insights into aklak distribution patterns.

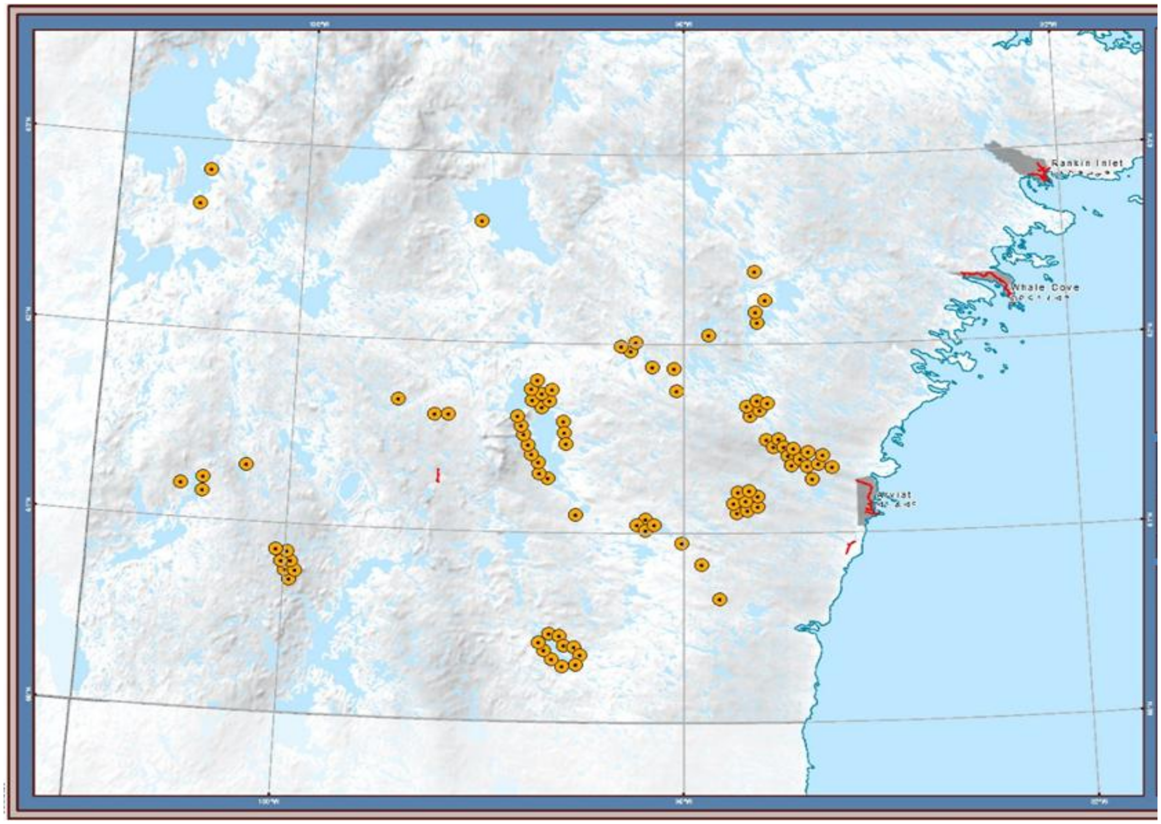

FIGURE 2. ARVIAT FOCUS GROUP PROPORTIONAL PILING EXERCISE.

Recruitment and participation

A list of potential participants in each community was created by the Government of Nunavut (GN) Department of Environment (ENV) and HTO board, who were then invited to give interviews in the wildlife office. This study faced several delays due to the need for face-to-face interviews, which were difficult to conduct during the COVID-19 pandemic. Focus group interview participation in Arviat was moderate with ten participants and participation in Baker Lake was low with two participants. The latter may be attributed to poor weather conditions, as it was communicated to the researchers that several Elders did not want to leave their homes in the high winds and low temperatures (windchill of -67 degrees Celsius) present during the one day allocated for the focus group.

Community validation

Several strategies have been employed in this study to ensure that participant contributions are accurately represented. This includes the use of a local interviewer in each community, which helps preserve the linguistic and cultural context of knowledge communication, as well as the fact that participants were invited from a list of acknowledged community experts generated by the GN, ENV and Inuit HTO.

Prior to visiting Arviat and Baker Lake, Harding reviewed the collected interviews and prepared a list of clarifying questions for focus group participants. During the focus groups, these questions were asked to clarify or expand on statements from the semi-structured interviews, as well as to better understand whether there was any disagreement or consensus among participants on the major themes that emerged. It should be noted that, as an 'outsider,' Dr. Harding was unlikely to observe dissenting opinions or internal community conflicts during the short interactions she had with participants. At the same time, a second attempt at community validation will occur when the contents of this report are shared with both participants and the wider community in Arviat and Baker Lake. We hope to circulate the contents of the final report in both English and Inuktitut and make use of digital storytelling tools to disseminate the study results in forms that are accessible and culturally appropriate.

Inuit Qaujimajatuqangit in this study context

This study explicitly engaged with Inuit Qaujimajatuqangit (IQ), in keeping with the Government of Nunavut's objective to integrate Inuit values across government programs and services. This approach also supports the specific goal of using IQ as expressed in the GN's Grizzly Bear Co-Management Plan (Government of Nunavut 2017).

The term Inuit Qaujimajatuqangit encompasses all aspects of traditional Inuit culture including values, worldview, language, social organization, knowledge, life skills, perceptions and expectations (Wenzel 2004, 240). It is a purposefully holistic and fluid concept, reflecting the intertwining of values, tradition, skill, and knowledge in Inuit expertise, as well as the continued expansion of Inuit knowledge through lived experience (Greene 2021, 198). It cannot simply be equated with "traditional ecological knowledge" (TEK) as it includes knowledge disseminated through ongoing oral traditions, knowledge accumulated through personal experience, and the interpretation of knowledge through the lens of Inuit values (Greene 2021, 207; Oosten and Miller 2018). Furthermore, IQ is relational, meaning the social relationship between speaker and listener influences its content and so cannot be separated from the social context in which it is articulated (Tester and Irniq 2008). For wildlife management, it is important to recognize that, for Inuit people, relations with non-human animals are both social and subsistence-based (Laugrand and Oosten 2022; Rasing 2018, 6-8).

It should be noted that IQ, as a formalized concept, has "predominately pertained to the interface between foreign-imposed non-Inuit governance and Inuit culture" (Greene 2021, 209). As such, our interpretation of IQ and the articulation of Qaujimajatuqangit by our research participants are artefacts of cross-cultural encounters. What this means is that we, as the authors of this study, are not attempting to conclusively represent IQ on aklak, but rather are collaboratively articulating knowledge on aklak that study participants considered useful, important, and of interest to non-Inuit researchers, policy makers, co-management and conservation practitioners.

Much of the interview data was collected in Inuktitut and the process of translation can impact the interpretation of qualitative data, especially in a cross-cultural context (Hennink 2008, 21). We wish to acknowledge these barriers to interpretation, but also highlight our attempts to counter it with community validation, as this reflexivity and transparency is key to scholarly rigor in qualitative methodologies (Hennink 2008, 22).

An important methodological consideration in this research is our efforts to address to what Pfeifer (2018, 29) has termed the 'credibility gap,' where Inuit knowledge "does not have [the same] credibility compared to Western academic knowledge". Pfeifer argues that there is a need to recognize Inuit knowledge and everyday practices on the land as "a qualitative mode of inquiry producing scientific evidence" and Inuit communities (hunters/harvesters/knowledge keepers) as equally valid references as those esteemed by academic publication standards (Pfeifer 2018, 31). This is particularly important given the impetus to decolonize research relations and the proven insights of Indigenous science in understanding complex socio-ecological systems (Reid et al. 2022; Turner et al. 2022). While the interview data collected in this study is descriptive and qualitative, it provides important insights that can:

1. be investigated quantitatively (below),
2. complement existing scientific data, and
3. direct future research priorities.

Furthermore, Inuit Qaujimajatuqangit is useful for managers attempting to understand temporal and spatial patterns in wildlife harvest, establish baselines to understand the rapid change happening in Arctic ecosystems, and understand community impacts of ecological change (Etiendem et al. 2020).

Quantitative abundance assessment methods

Defining the study area

The study area was defined by the geographic extent of all mapped data collected during the interview process (Figure 3). It includes the southern portion of Nunavut, with its northern boundary set by drawing a horizontal line from east to west at the latitude of the northernmost mapped interview observation.

Abundance estimation process

Data overview

The purpose of this segment of the project was to estimate the total number of aklak within the study area using knowledge collected on physical maps during interviews with community members and hunters. In addition to this primary data source, we incorporated two additional datasets on aklak locations within the study area for the period of interest. The first was derived from a DNA capture-recapture study conducted in 2016 and 2017 (Awan et al. 2019), and the second comprised GN, ENV harvest data spanning from 2008 to 2023. While all datasets fell within the defined study area, the coverage of aklak locations within each dataset differed. Figure 4 displays the distribution of each of the three datasets across and within the study area, with the DNA capture-recapture study represented by blocks, while the other two datasets are depicted as points.

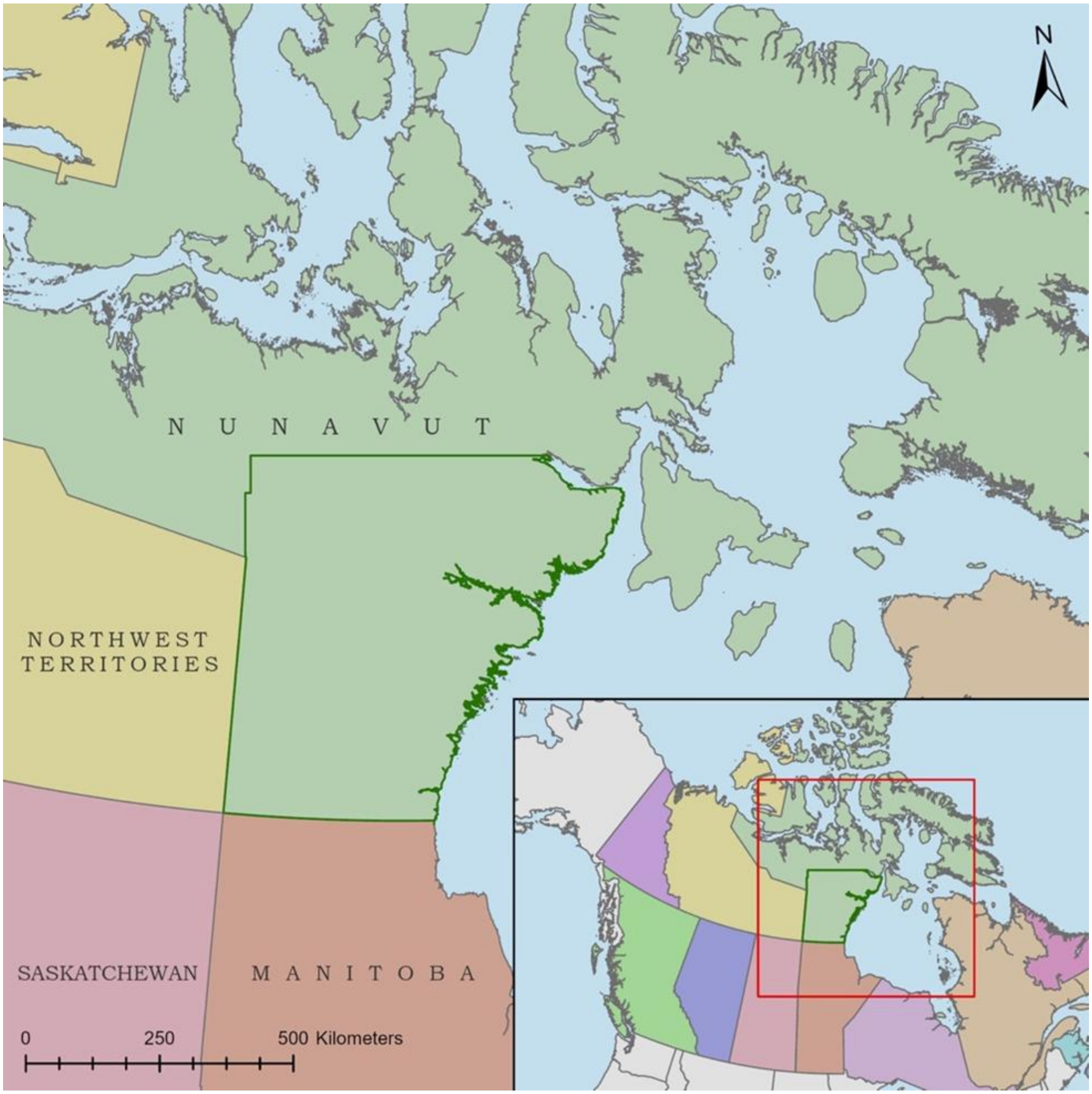

FIGURE 3. THE STUDY AREA IS DELINEATED BY THE GREEN BOUNDARY, WITH ITS SOUTHERN EDGE DEFINED BY NUNAVUT BORDER AND ITS NORTHERN LIMIT EXTENDING TO THE NORTHERNMOST INTERVIEW DATAPOINT.

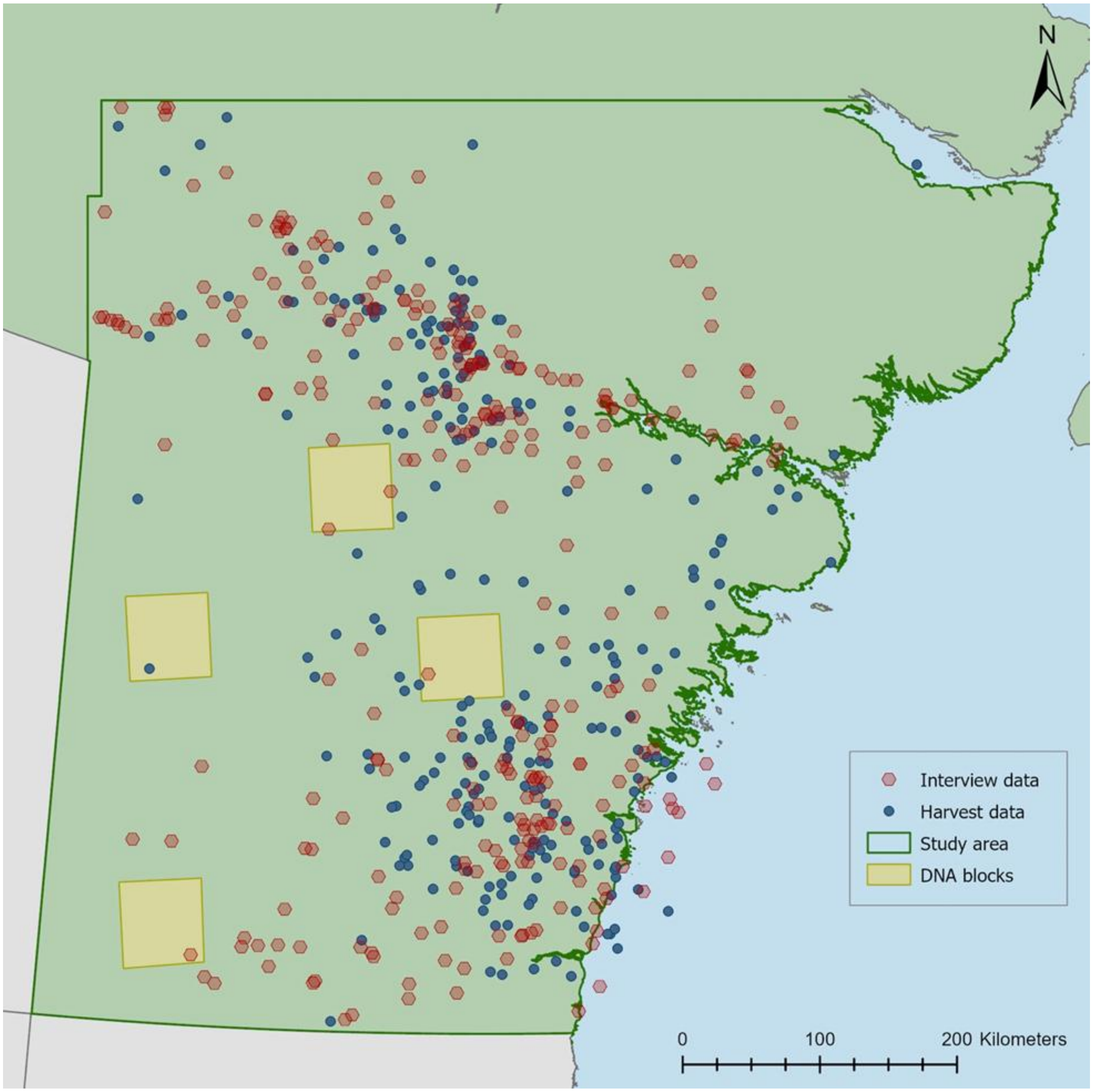

FIGURE 4. THE DISTRIBUTION OF THE THREE INPUT DATASETS, INCLUDING ALL INTERVIEW DATAPOINTS, HARVEST DATA, AND THE STUDY BLOCKS USED FROM THE AWAN ET AL. (2019) MARK-RECAPTURE STUDY.

Notably, data collected based on people's reported land use practices (the interview data and harvest data) largely overlaps, while data collected by Awan et al. (2019) using DNA capture-recapture does not intersect with the distribution of the other two datasets. Based on the distributions of the datasets, we identified the DNA study data as having the potential to complement the interview data in the spatial interpolation process. We determined that the harvest data was likely to overlap with the interview data not only in spatial extent, but also in individual aklak sightings (as interviewees reported places where aklak were harvested as well as observed in other contexts). Therefore, while the harvest data was not appropriate for use in the spatial interpolation process, it could be used as an alternative data source for abundance estimation via spatial interpolation.

Cleaning and processing interview data

The first step in the abundance estimation process involved cleaning and processing the interview data. All interview data were digitized using ArcGIS Pro software and saved into a geodatabase. Data points were digitized in two ways. First, vector shapefiles were created to accurately capture all map elements added by participants, including point, line, or polygon features. This required that interview data were digitized and saved into three separate feature classes (point, line, and polygon) depending on the feature type. Attribute tables were used to ascribe additional data to each feature, including an anonymized participant code; a description of the feature class (point, line, or polygon); and any comments that were added to the map for contextualization along with the feature. Second, all datapoints were compiled into a single feature class. This required that line and polygon features were transformed into points by calculating the centroid of each shape. Once all datapoints were compiled into a single feature class, the attribute table was exported, and data processing continued using Microsoft Excel.

The original maps produced in the interviews were consulted along with the feature comments to further categorize the data in Microsoft Excel. First, features were categorized according to whether they identified aklak signs, sightings, or something else (e.g., some participants noted typical aklak travel routes or geological features like eskers). Signs were further categorized by type, and columns were created to account for temporal data, including one for the year that the observation was made and one for the season (e.g., spring, summer, fall, or winter). Finally, a numeric column was created to store an estimate of the number of bears seen for each datapoint that constituted a sighting. For datapoints that suggested sightings but did not explicitly provide information about the number of aklak seen, conservative estimates were made using proxies (Table 1). Because the interviews produced qualitative data, we were conscientious in assigning numeric values to non-quantitative data points, including by keeping track of all assumptions with the justifications that informed decision-making in assigning proxy values throughout this process. Data points containing locations of aklak sightings (and locations of aklak signs that were "counted" as sightings) were taken forward for use in the spatial interpolation process.

Importantly, interviewees consistently observed that the abundance and locations of grizzly bears in the region had notably changed during the decade of the 1990s. As we are interested in recent aklak abundance, we removed aklak sightings made prior to the year 1990 from the dataset to be used for interpolation.

Using the single feature class containing all spatial data collected in interviews, we applied a kernel density calculation in ArcGIS Pro to produce a raster that contained information about the density of interview observations across the study area. The raster was classified using natural breaks into ten classes, and the bottom three classes (areas with the lowest observation density) were removed. The resulting area represented our "observation zone," which was used to differentiate between regions of the study area for which there was substantial local knowledge about aklak abundance and regions for which aklak abundance was largely unknown to local populations. In essence, the observation zone represents participants' land use patterns. The goal of the abundance estimation process thus requires using data contained in the observation zone (or "known" regions) to project aklak distribution in the areas of the study area outside of the observation zone (the "unknown" regions) using spatial interpolation, and then summing aklak abundance inside and outside the observation zone to produce a total abundance estimate within the study area.

TABLE 1. PROCESS FOR ASCRIBING PROXY VALUES TO AKLAK SIGHTINGS WITHOUT A DISCRETE NUMBER NOTED.

Key Words	Proxy	Number Used	Justification
grizzly with cubs; family; bear with cubs	Yes	3	Cub of the year litter size average: 2.23. Yearling litter size average: 1.86. Two-year-old litter size average: 1.85. Average family grouping will thus contain 3 bears (1 mother, 2 cubs). (McLoughlin and Messier, 2001).
lots of; more; grizzly area; grizzlies like it here; core area; main area	Yes	3	More than one sighting, but no quantity given. No mention of cubs or family. Presumably sightings were made separately, but interviewee includes a descriptor that suggests a number higher than two.
cubs	Yes	2	Cub of the year litter size average: 2.23. Yearling litter size average: 1.86. Two-year-old litter size average: 1.85. (McLoughlin and Messier, 2001).
grizzlies; sightings	Yes	2	More than one sighting, but no quantity given. No mention of cubs or family. Presumably sightings were made separately.
den	Yes	1	Grizzlies may dig multiple dens but only use one, so there is a chance that not all dens seen indicate a bear. In any given year a female of cub-bearing age (typically 5-8 years of age) will have an average of 1.5 cubs with her. Thus, the average number of bears per den can be rounded down to one (McLoughlin and Messier, 2001).
digging; tracks	Yes	1	Signs that clearly indicated grizzly presence were counted as sightings.
less; fewer; don't see	No	0	When interviewees indicated a lack of sightings, no sightings were counted.
cabins; smoke	No	0	Some datapoints referred to things other than grizzly signs or sightings.

Refining input data for spatial interpolation

The application of spatial interpolation strategies is limited by the format of the input data. To maximize our ability to apply various spatial interpolation strategies, we set some parameters on the format of our input data. Due to the nature of the interview approach and the scale of the maps used, the spatial precision of participant observations was limited. We created grid using the “Create Fishnet” tool in ArcGIS Pro that spanned the study area, aggregated the sightings within each grid cell, and then used grid centroids containing total number of aklak sightings within each 100 km ^{2} cell (10km by 10km) as the input dataset for the interpolation process (Figure 5). Values were only ascribed to those grid cells that overlapped with the observation zone; cells within the observation zone that did not contain sightings made by interviewees were ascribed a value of zero. Cells that fell outside of the observation zone were only ascribed a value if there were sightings recorded. We chose a grid cell size of 10 x 10 km for two reasons. First, because participant observations can be expected to demonstrate precision within approximately 10 km. Second, because the DNA study data, which we planned to use to complement the interview data in spatial interpolation calculations, was collected and reported on at 10 km intervals within each study block (sampling grid). This allowed us to seamlessly integrate the data collected via DNA capture into the grid within the grid cells that overlapped with the DNA study blocks. Grid cells that fell outside the interview observation zone and the DNA study blocks were not ascribed to any numeric values (null), to be populated based on the results of the spatial interpolation processes. After sighting data from interviews and DNA study data was ascribed to the relevant grid cells, the centroid of each grid cell with an ascribed value was exported into a point feature class to be used as input data for the spatial interpolation.

Exploring weighting variables

Before applying spatial interpolation, we explored whether there were potential variables that could be used to increase the accuracy of the abundance estimation by weighting the spatial interpolation. In their study examining grizzly bear habitat factors in the northwestern United States, Sells et al. (2023) used a normalized difference vegetation index (NDVI) to indicate abundance of food, while Chetkiewicz and Boyce (2009) found that greenness positively correlates with grizzly population in Canadian Rocky Mountains. NDVI is a metric used to quantify vegetation health and density using aerial imaging and sensor data. We determined that it would be worthwhile to explore whether a correlation exists in Nunavut between NDVI and aklak distribution by conducting geostatistical analyses using our various data sources on aklak presence. We decided to test for correlation between aklak sightings and NDVI within the observation zone, under the premise that if a correlation existed within the “known” regions of the study area, we could use NDVI data in the “unknown” to predict abundance outside of the observation zone more accurately.

We collected NDVI data from two sources: one raster dataset containing average NDVI values over the months of June, July, and August from 2016–2020 from Google Earth Engine (Earth Engine Data Catalog, 2024), and another containing trends in NDVI values between 1984–2012 (where significant negative values represent browning and significant positive values represent greening) from NASA’s Distributed Active Archive Center for Biogeochemical Dynamics (NASA Earth Data, 2019). Both data products had a resolution of 30 m and were collected by different generations of the LANDSAT satellites.

The NDVI raster files were added to ArcGIS Pro, and the datasets were cleaned by removing outlier values. The pixel values were aggregated to the 10 x 10 km grid cells by calculating the mean value within each cell to match the degree of precision of our data on aklak sighting. Three statistical tests were used to determine whether there was a correlation between NDVI and aklak abundance: local bivariate analysis in ArcGIS Pro, and Spearman and Pearson correlation tests in SPSS. All tests were run multiple times to assess the correlation between both NDVI datasets with all three data sources (interviews, DNA capture, and harvest), within their respective observation zones. We reran the local bivariate analysis test with a wide range of neighbour parameters.

There were no significant correlations between NDVI and any of the datasets, or between NDVI change and any of the datasets. Therefore, we did not take NDVI forward as a weighting variable for spatial interpolation.

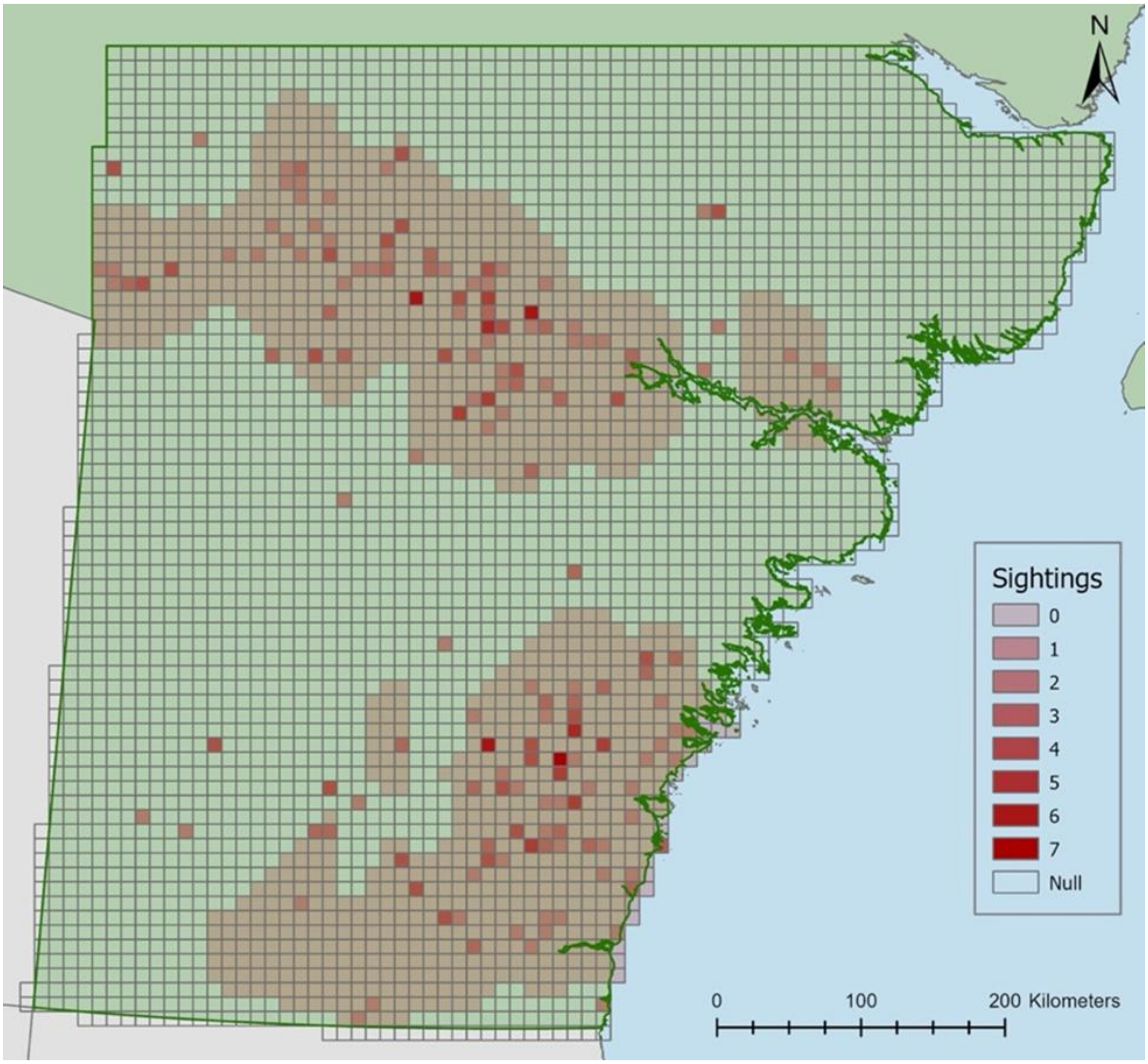

FIGURE 5. 10X10 KM GRID OVERLAID ONTO THE STUDY AREA, SHOWING THE GRID CELLS THAT INTERSECTED WITH THE OBSERVATION ZONE IN RED, WITH GRID CELLS CONTAINING OBSERVATIONS IN DARKER VALUES PROPORTIONAL TO THE NUMBER OF SIGHTINGS IN THAT AREA.

Interpolation strategies and total abundance calculation

Two interpolation strategies were applied: Inverse Distance Weighted (IDW) interpolation and Empirical Bayesian Kriging (EBK). Both interpolation processes function on the fundamental geographic premise that "everything is related to everything else, but near things are more related than distant things" (sometimes known as "Tobler's First Law of Geography") (Tobler 1970, 236). Both interpolation strategies were applied using the interview dataset alone (signs and sightings of aklak after 1990) as the input data, as well as using the interview dataset combined with the DNA study capture locations as input data. As discussed previously, the DNA capture locations offered spatial complementarity to the interview and harvest observation zones, allowing for a more spatially robust input dataset. Table 2 shows the parameters set for each interpolation method. For EBK, additional model parameters limited the maximum number of points in each local model to 100, the local model area overlap factor to 1, and the number of simulated semivariograms to 100. All interpolation calculations were done within the study area boundaries.

TABLE 2. PARAMETERS USED FOR INVERSE DISTANCE WEIGHTING AND EMPIRICAL BAYESIAN KRIGING INTERPOLATION PROCESSES.

Interpolation Method	Power	Search Neighbourhood	Max Neighbours	Min Neighbours
IDW	2	Standard	15	10
EBK	N/A	Standard circular	15	10

Both processes output continuous (floating point) raster files, with a single non-integer value ascribed to each cell. Based on our input dataset, the value ascribed to a given cell essentially represents the likelihood of aklak being observed in a discrete location at a given time. Because our input values were either zeros or positive integers, the majority of cell values in the output rasters ranged from zero to one. Total abundance was calculated by summing all cell values across the study area.

Results

Participant observation of changes in aklak abundance and distribution

This section summarizes the key themes reported by participants, including factors influencing aklak movement patterns and perceived population growth. The results are organized by descriptive codes that emerged from thematic analysis.

Relative abundance of aklak has rapidly increased since at least the 1990s:

Both Baker Lake (Qamani'tuaq) and Arviat participants attested to increases in human encounters with aklak across the Kivalliq region. Aklak are a known species within Inuit Qaujimajatuqangit, but prior to the mid-20th century encounters with aklak were rare. Aklak are viewed as increasing in abundance and distribution across the Kivalliq since at least the 1990s and perhaps as early as the 1960s. While one participant suggested that hunting may be limiting further population growth, all other translated interviews (n=18) indicated that the population is increasing rather than stable.

"There were not much grizzlies before the 1990s that I know of. I started catching grizzlies around the year 2000." (Ken Avaala, Baker Lake 2022)

Aklak prefer inland habitats, particularly around lakes, rivers, wetlands, and eskers:

While aklak are found everywhere in the Kivalliq mainland, encounters between humans and aklak tend to occur along rivers and lakeshores inland. In contrast to data the study authors collected in Northern Manitoba (Clark et al. 2022), participants in the Kivalliq all indicated that aklak were more likely to be found inland, but that there were more found near the coast than in the past.

"*I think the coast is where is where you would rarely see grizzly bears, along the whole coast.*" (Joe Savikataaq, Arviat, 2022)

"I think there's grizzlies all over the tundra. They're hardly close to the Hudson's Bay, they're mostly inland." (Ken Avaala, Baker Lake, 2022)

"They follow the rivers more for the fish." (Ken Avaala, Baker Lake, 2022)

Climate change is expanding aklak habitat northward:

Study participants perceive the rise in aklak populations in the Kivalliq as driven by climate change, rather than a sign of natural abundance. For example, one participant described changes in habitat and vegetation as bringing aklak further north:

"It is probably from what they had eaten. I think that their vegetations are starting to be different compared to in the past. It is from global warming that their behaviour is changing and where there vegetations are changing and it's affecting them from the changes and the growing population of grizzly bears are improving." (Norman Attungala, Baker Lake 2003)

"We're beginning to see some animals and birds that we were unheard of in earlier days. Just I think that probably has a lot to do with what is known as global warming you know, you know, you know as it warms up. It's not just the grizzlies that are beginning to move up here. So, I don't know, I guess it's hot. I believe that has a lot to do with it. They're just moving up and realizing that they can survive up here. But like I said, it's just not the grizzlies increasing, everything is increasing all your birds, mammals, even moose, we're even beginning to see moose. So that's probably it, they're just moving up, and probably will continue to do so." (Hugh Ikoe, Baker Lake, 2023)

Habitat destruction is driving wildlife north:

Participants in Arviat described wildfires in regions south of Nunavut as causing aklak to migrate into the Kivalliq. They described aklak as disliking smoke, and as moving in Nunavut to avoid the smoke from wildfires in Saskatchewan, Manitoba, and the Northwest Territories.

"*They are all over the world, they are in the world, in land, everywhere, but in white man's land, but the trees are on fire, right now, they have really increased.*" (Paul Kablutsiak, Arviat, 2022)

Participant observations of aklak ecology

Participant observations highlight aklak adaptability, intelligence, and ecological roles, offering valuable insights into their diet, habitat, and interactions with humans in the Kivalliq region.

Defending scavenged food:

Inuit caches are well-designed to keep out common scavengers like the Arctic fox, but participants noted that the traditional way of building a cache would not keep out aklak due to its size, strength and digging ability. When aklak dig up a cache, they will stay nearby and defend it:

"*they don't finish it in one day, they make a bed, look like this, I seen one, by the willow, they sleep there and the next day they start eating again."* (Alex Iglookyouak, Baker Lake, 2003)

Hiding from humans:

Participants described aklak as tricky, and as having the ability to hide themselves well despite their large size. Participants in Arviat spoke of how aklak were known to make a whistling noise, while Baker Lake participants did not have this attribute included in their traditional knowledge. Participants from both communities emphasized that traditional knowledge warned Inuit to be alert and wary if they suspect an aklak was around, as it could hide from humans. One participant described that in his own experience and from knowledge passed on to him by elders, he knew that aklak:

"*…pretend to run away and they look at you from someplace else.*" (Tom Mannik, Baker Lake, 2003)

Known to scavenge carcasses as well as hunt:

One participant observed aklak following wolf tracks and stated that the aklak intended to steal carcasses from wolves. See also Gunther and Smith (2004) for similar observations in Yellowstone National Park.

Known to den from November to April/May:

Females with cubs were observed to leave their dens later than males. One report of a winter-active aklak (February) from Baker Lake (focus group 2023) that was caught by a hunter and was very thin.

Regular diet includes bird eggs, geese, fish, caribou, musk-ox, and ground squirrel:

One participant observed an aklak attempting to drown a muskox. Muskox were also observed fleeing from aklak.

"*The muskox did not form a defensive circle, as they usually do, but ran and ran and ran.*" (Joe Savikataaq, Arviat, 2022)

Diggings for sik-sik (Arctic ground squirrel) were commonly observed.

"*Seems like loader had been there, part of it, maybe after ground squirrels*." (Ryan St. John, Arviat, 2022)

Observed feeding on vegetation:

"*They also like to be in the damp hummock in the land I guess they like plants that are moist. We mostly see them in the flatlands around hummock area."* (Norman Attungala, Baker Lake, 2003)

"*I shot a grizzly bear and there was nothing but berries inside its stomach.*" (Tony Uluadluak, Arviat, 2022)

Sexual dimorphism:

Females were known to be smaller than males, and one participant noted that the hind leg tracks of females were more triangular in shape.

"*You can tell by its size, their body, or by claws, yes, and by the face.*" (Daniel Kablutsiak, Arviat, 2022)

Observations of bears congregating in groups:

One participant described encountering five adult bears at one time, which may indicate the presence of an abundant and attractive food source.

Behavioural plasticity, intelligence, individual agency:

"All grizzly bears are different. Some will come attack a person, a human being, or some other grizzly bears run away." (Emily Alerk, Baker Lake, 2003)

"The way of living in their habitat is similar to us humans. We hunt where we can find food and we go to the hunting area and start having cabins there because we will know we will get what we want or because of way the land makes us feel or go to the place that we used to live, it is same as the animals they know where to get food, where to stay from their comfort zone. It is parallel living where an animal stays where they can find food just like humans do. They do not talk or communicate like humans do but they know what they eat, they know where to get food, they know what to do to get food and they know how the weather will be." (Norman Attungala, Baker Lake, 2003)

Maternal investment:

Participants noted that female aklak usually bore two cubs, with three being rare. It was described how aklak, like caribou, did not have cubs every season but waited at least two years between litters.

Avoiding conflict with humans:

"*Like grizzly, if it is not grizzly, it will flee, if it is a fox, it sees, that it is not a fox, it will flee. Animals were like that.*" (Dorothy Aglukark, Arviat, 2022)

"*The woman was going to face a grizzly, head on. She is petrified, the grizzly bear will have no match along with her carried child. Using Inuit Knowledge, she was told not to move and do not speak, when we see a large animal. I know this for a fact, because I have been told about this. She remembers this. "I will just stop, stop walking, just being still." She was being quiet along with her child, making sure she does not speak. Grizzly bear, there, was just coming. She was just like that, it just crossed by. She survived. She did not move even though the grizzly bear crossed very close by*." (Dorothy Aglukark, Arviat, 2022)

Inuit taxonomy based on colour and behaviour:

Different types of aklak were described by participating Elders.

"*He says there are three types of grizzlies. There [are] the brown ones. And the one that looked like ground squirrels, and the dark ones. The ones that look like ground squirrels, they're the mean ones, the vicious ones.*" (Arviat focus group 2023)

This taxonomic distinction differs from the Linnaean system used by biologists but as Polfus et al. (2016) found for caribou, Indigenous taxonomies can encompass features identifiable through focused scientific investigation. Phenotypic plasticity characterizes *Ursus arctos* across its circumpolar range and the history of taxonomic classifications of this species is a dynamic one that is not yet settled (Kitchener 2010). We therefore recommend that any future genomic research on grizzlies in the Kivalliq specifically look for population substructure. Moreover, knowledge about behavioural variation, whatever its potential relationship with physiognomy, is important for understanding and reducing human-wildlife conflict.

Participant attitudes towards aklak

The increasing abundance of aklak in the Kivalliq poses challenges to intangible cultural heritage, particularly Inuit practices surrounding hunting, harvesting, and caching caribou (Bortolotto 2007; Lenzerini 2011; UNESCO 2003). In February 2023, Hugh Ikoe of Baker Lake described how his family would make caches of caribou meat every season. He described how, in the past, wolves, foxes and wolverines might destroy up to a few of his family's caches, but the last time his family cached caribou meat, every single cache was destroyed by aklak. He stressed that this was a loss of approximately 15 caches full of caribou meat, which was significant to his community both financially—due to the time, fuel and labour invested—and culturally, as cached caribou is viewed as the most culturally important food for inland Inuit groups.

"When a grizzly bear finds a piruyaq (caribou meat cache) it thinks that it belongs to the grizzly bear. The bear can become aggressive to a person who went to go get its catch and starts to attack the person. What I heard and seen before is when a grizzly bear finds a caribou caches it will think that the food it his and will protect what it is find from any animal or from any human." (Norman Attungala, Baker Lake, 2003)

"The only reason why we survived up here you know, far in native country, is that it's cool enough that we can cache it [meat]. That was the only way to survive, bury it with rocks. And it will not go bad. You have to cache as much are you can, because if you didn't you're facing certain starvation, which did happen in 1958. Lot of people starved to death." (Hugh Ikoe, Baker Lake, 2023)

"So that [caching meat] was very much part of our culture. You know, we have to cache but today we can't. As you've probably heard, we can't do it anymore because of the grizzlies. This caching was such a part of our culture because it was like sausage, you know, like Italian or Ukrainian, everybody makes a sausage and everybody loved it, whether you are polish or German everybody made their own sausage and that. To us, it was the same thing. [Word for cached caribou in Inukitut] had a certain taste of its own. So basically, I called it our sausage. It was very much part of our culture. We would like to keep it but now you can't have cache anymore." (Hugh Ikoe, Baker Lake, 2023)

Participants also noted that it was more dangerous to camp in tents out on the land, and that many people were now scared to camp without a hard-sided cabin. Concerns about keeping young children and family members safe while camping out on the land were expressed in both communities. Some participants stated they no longer felt safe camping in inland areas once considered safe due to the absence of polar bears, as the increasing presence of aklak has changed this.

The harvest of aklak is viewed as sustainable by study participants as the population is generally viewed to be increasing. Quotas and restrictions on aklak harvest are not pragmatic or desirable for community members. Hunters who harvested intentionally rather than opportunistically did so in the spring, when aklak had just emerged from their dens. While aklak meat and pelts would be used when harvested, aklak were not a preferred food source. The harvest of aklak was viewed similarly to pest control. While some community members would hunt aklak in the spring, most aklak were harvested after a conflict with human. Participants characterized aklak negatively, using terms such as aggressive, dangerous, and nuisance as descriptors.

Geography of aklak observations

- **Higher observed density inland than in coastal areas.** This contrasts our data from northern Manitoba (Clark et al. 2022), suggesting either an observation bias in that data or different habitat preferences. Behavioural differences may also play a role, as all confirmed grizzly bear observations in northern Manitoba are of lone adult bears, often males, indicating a dispersing population at the edge of its range (Clark et al. 2022), rather than an established breeding population, as in the Kivalliq. Further investigation into this difference would be worthwhile.

- **Concentration of encounters around river corridors, lakeshores, and wetlands.** Participatory mapping exercises revealed most encounters with aklak occurred near lakes and rivers. While this may be due to the use of bodies of water as landmarks, it also was noted by participants that aklak preferred vegetation in wetter areas and with trees over the open tundra**.**

- **No differences noted in sex distribution of aklak.** Participants communicated no other observations about sex-specific space use differences and answered negatively when asked if they knew of any differences in distribution between sexes.

Quantitative assessment of aklak abundance

Cleaning and processing data

For those datapoints with temporal data included, observations made by participants spanned from the 1950s to the present. Total aklak sightings by interviewees since 1990 was 296. Figure 6 shows the distribution of sightings made by interviewees categorized by time period (pre-1990s, during the 1990s, and after 2000). Aklak sighting density within the 122,900km^2 observation zone (based on interview data alone) was 2.41 bears/1000km^2. While the observation zone does not overlap with the study area used in the DNA capture study (Awan et al. 2019), we compared this result to the DNA study findings, which estimated a population density of 3.5/1000km^2 within a 95% confidence interval of 2.1–6.1 bears/1000km^2.

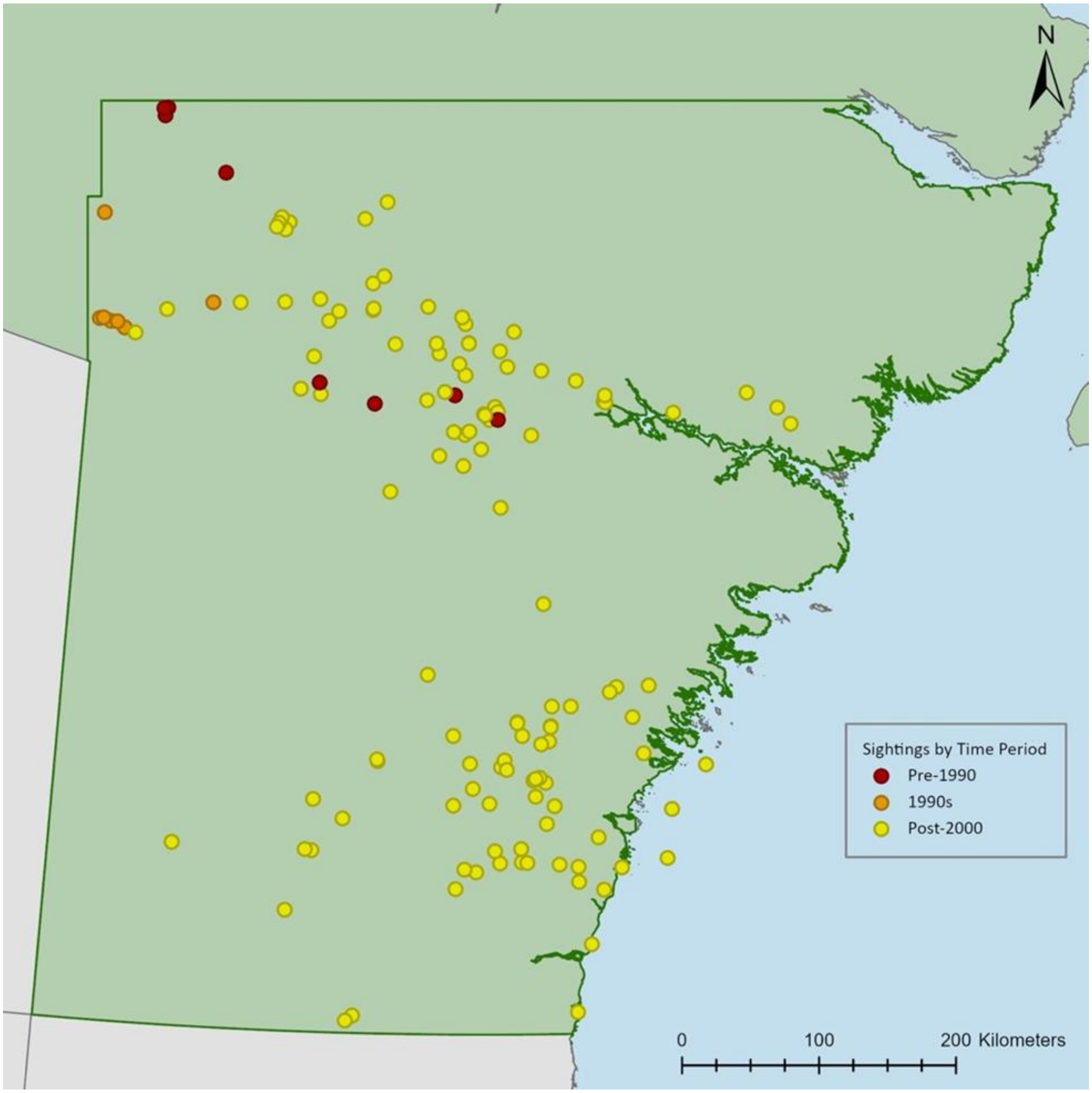

FIGURE 6. SIGHTINGS REPORTED BY PARTICIPANTS CATEGORIZED ACCORDING TO TIME PERIOD.

Spatial interpolation and total abundance

Figures 7 and 8 show the raster outputs for the IDW and EBK interpolation processes, respectively. The results of the interpolation using only the interview dataset as input are displayed in map A (on the left), while the results using the interview and DNA recapture study datasets as input are displayed in map B (on the right). Table 3 shows a selection of summary statistics from each of the four output rasters. Table 4 summarizes the abundance estimation results from the two spatial interpolation processes, including a total abundance estimate within the 371,600km^2 study area, and a density estimate of aklak per square kilometer within the study area. 95% confidence intervals were calculated for density and

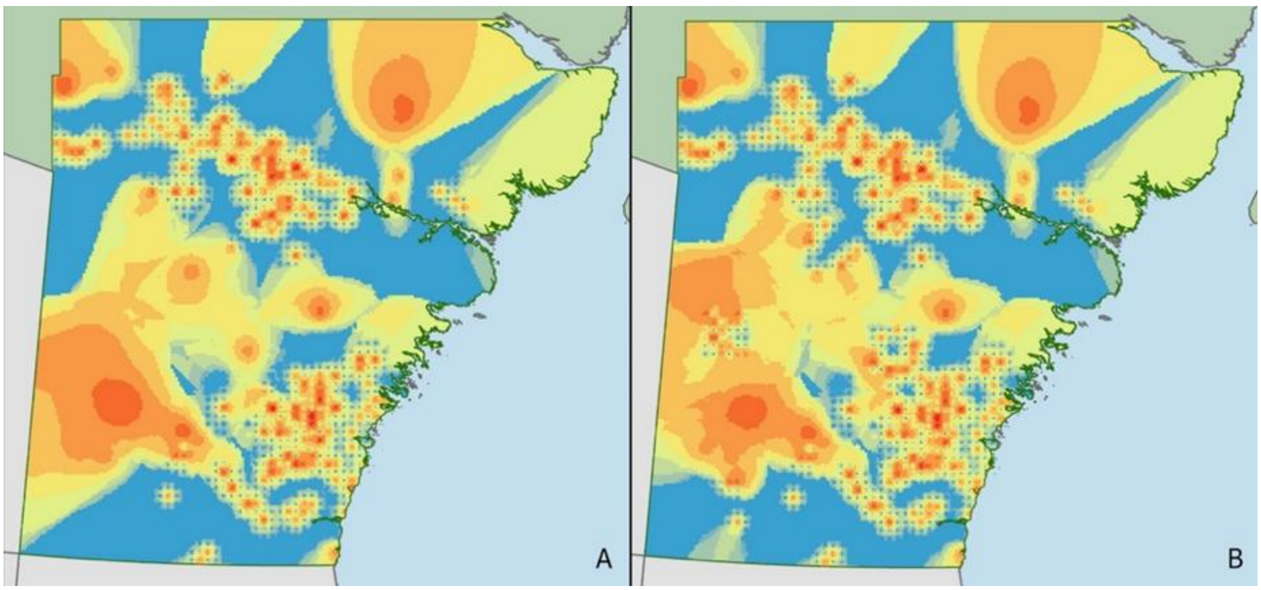

FIGURE 7. RESULTS OF INVERSE DISTANCE WEIGHTING SPATIAL INTERPOLATION, USING INTERVIEW DATA ONLY AS INPUT (MAP A) AND INTERVIEWED DATA COMBINED WITH DNA MARK RECAPTURE STUDY DATA (AWAN ET AL. 2019) AS INPUT (MAP B).

abundance using SPSS and are also shown in those tables.

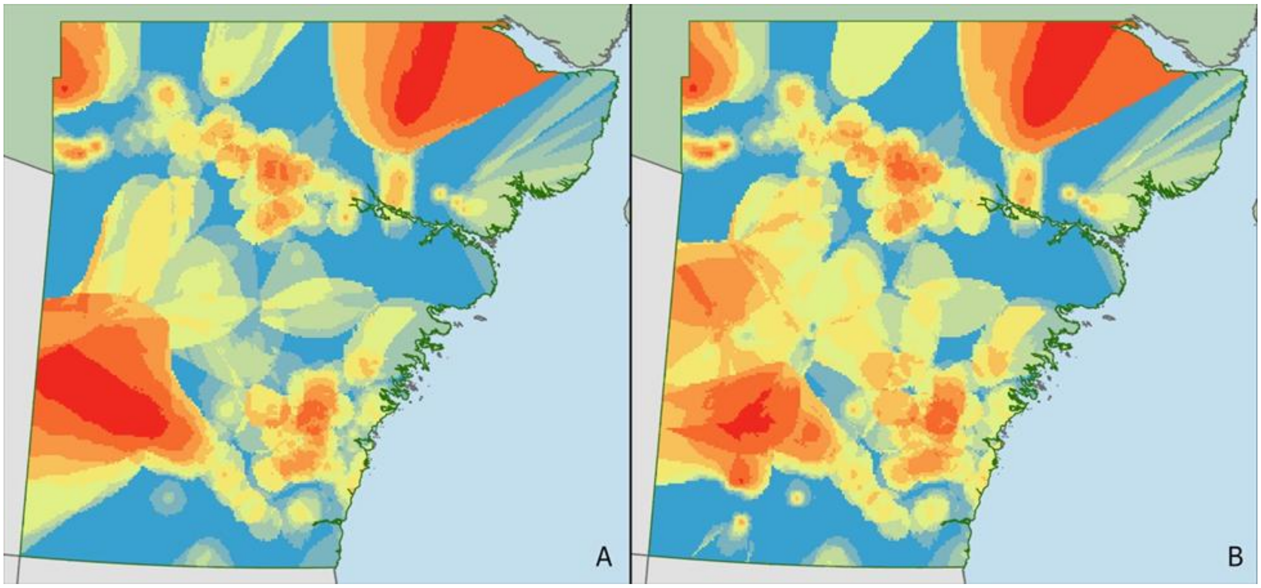

FIGURE 8. RESULTS OF EMPIRICAL BAYESIAN KRIGING SPATIAL INTERPOLATION USING INTERVIEW DATA ONLY AS INPUT (MAP A) AND INTERVIEW DATA COMBINED WITH DNA MARK RECAPTURE STUDY DATA (AWAN ET AL. 2019) AS INPUT (MAP B).

TABLE 3. SUMMARY DENSITY (BEARS/1000KM^2) STATISTICS FROM EACH OF THE FOUR OUTPUT RASTER DATASETS.

		Inverse Distance Weighting		*Empirical Bayesian Kriging*	
Input Data		*Interview*	*Interview and DNA*	*Interview*	*Interview and DNA*
Maximum		*3.93*	*3.93*	*2.58*	*2.21*
Minimum		*0*	*0*	*-0.05*	*-0.04*
Mean		*0.29*	*0.29*	*0.41*	*0.36*
Mean 95% CI	***Lower***	*0.28*	*0.28*	*0.39*	*0.35*
	Upper	*0.30*	*0.30*	*0.43*	*0.38*
Median		*0.14*	*0.14*	*0.18*	*0.21*
Standard Deviation		*0.41*	*0.39*	*0.54*	*0.43*

TABLE 4. ESTIMATED ABUNDANCE OF AKLAK WITHIN THE STUDY AREA USING INVERSE DISTANCE WEIGHTING AND EMPIRICAL BAYESIAN KRIGING.

		Inverse Distance Weighting		**Empirical Bayesian Kriging**	
Input Data		*Interview*	*Interview and DNA*	*Interview*	*Interview and DNA*
Total		1081	1073	1515	1351
95% CI	**Lower**	1032	1027	1450	1300
	Upper	1130	1120	1580	1404
Aklak per 1000 km^2		2.91	2.88	4.07	3.64
95% CI	**Lower**	2.77	2.76	3.90	3.50
	Upper	3.04	3.01	4.25	3.78

Conclusions

Aklak distribution, abundance, and implications

Mapped observations precisely indicate the southward spread of aklak observations since the 1990s, with the earliest documented observations from the region of the Thelon Game Sanctuary (Figure 6). Inuit Qaujimajatuqangit strongly suggests that aklak are undergoing a population increase and subsequent range expansion across the Kivalliq region that began decades ago. This situation is distinctive from other regions in Canada where grizzly bear populations are increasingly under threat from habitat destruction or are in recovery from a population decline (McLoughlin and Stenhouse 2021). Study participants are aware of this difference and recommend that management strategies should account for the unique social and ecological contexts that aklak experience in the Kivalliq region.

Quantitative estimation of aklak abundance

The estimated aklak densities from both interview data (2.91-4.07 bears/1000km^2) and interview data plus DNA grid hits (2.88-3.64 bears/1000km^2) are all within the 95% CI range estimated for our study area by Awan et al. (2019) of 2.1-6.1 bears/1000km^2. Our estimates are also consistent with results from previous studies in similar habitats: 3.5 bears/1000km^2 in the 1990s from the nearest other grizzly bear study area in Nunavut/NWT, which adjoins the Kivalliq (McLoughlin and Messier 2001); 5.2 – 6.7 bears/1000km^2 from the same area in 2012-2014 (Barrueto et al. 2023); and 5 to 6.6 bears/1000km^2 from the Kitikmeot region, Nunavut (Awan et al. 2023; Dumond et al. 2015). Further, they are even consistent with estimates at the lower range of the large-scale habitat- and mortality-based density projections by Mowat et al. (2013) and 3.9 bears/1000km^2 extrapolated from abundance estimates for the Arctic Coastal Plains grizzly bear zone by Banci et al. (1994). Such similarities with these geographically broader estimates are not unexpected, assuming that the habitat productivity/home range size relationships for grizzlies described elsewhere hold here too (McLoughlin et al. 2003).

While these similarities are promising it would be premature to consider it definitive validation of our study (or those other ones), for several reasons. First, our estimates are based on cumulative observations over 33 years, so it is not yet clear how comparable they are to those generated from short-duration mark-recapture studies. Nonetheless, the lack of change over two decades between the estimates in McLoughlin and Messier's original study area, despite industrial development there, suggests such comparisons may not be *a priori* invalid. Second, Awan et al. (2019) provided only provisional estimates, recommending a much larger sampling effort for greater accuracy and reliability. Third, recalling that our initial plan for abundance estimation was to use proportional piling exercises, we lack a theoretical framework for explaining how these observational data actually indicate abundance. Besides further methodological development (discussed below), it will be necessary to build such a framework, which should itself be done in a participatory way. Participants' observations about the limited applicability of proportional piling for solitary animals shows both the need and the value of further Inuit involvement in such research.

Aklak ecology

Participants provided detailed observations of aklak food habits and interspecific interactions, habitat selection, litter size and timing, and denning. Unsurprisingly, Inuit observations correspond with findings from scientific studies conducted in similar Arctic habitats (e.g. Arthur et al. 2017; Edwards et al. 2009, 2011; Gau et al. 2002; McLoughlin et al. 1999, 2002; Reynolds et al. 1987; Young and McCabe 1998).

We were surprised that neither NDVI nor NDVI change explained the spatial distribution of aklak observations given its strong predictive value for grizzly bears elsewhere (e.g. Apps et al. 2016; Mowat et al. 2013). While it's possible that NDVI might have stronger explanatory power at larger spatial scales, it's also possible that the species' range expansion in the region may not necessarily be driven by vegetation productivity, or perhaps not directly. Since Gau et al. (2002) found grizzlies adjacent to our area were predominantly carnivorous (on caribou), such a habit could explain the lack of dependence on vegetation productivity as measured by NDVI. Petzold and Goward (1988) demonstrated that NDVI doesn't accurately measure lichen productivity, indicating that if aklak distribution was governed by caribou – which are dependent on lichens – NDVI measures could well be insufficient to detect it. Consequently, more precise insights into what aklak eat in the Kivalliq, and whether their diet is comparable to other parts of the species' Arctic range, would be helpful.

Recommendations for further investigation

An important area for further inquiry is the investigation of solutions to the problem of caribou cache destruction by aklak. As noted above, aklak were viewed as the primary reason that Inuit were no longer able to cache caribou meat, a practice which is viewed by community members as vital to Inuit culture. If a way could be found to deter aklak from digging up caribou caches this could allow the practice of caching meat to continue and support Inuit cultural continuity. Participants also expressed a desire to deter aklak from entering their camps and cabins, particularly at night. Deterring bears from damaging property is a primary issue in reducing human-bear conflict across species and ecosystems. Further investigation into what deterrence methods are feasible, affordable, accessible, and efficient in remote communities in the Kivalliq region would be welcomed by communities.

Improving methods for estimating density and abundance from participatory mapping would be benefit aklak co-management and help bridge traditional and local knowledge with broader wildlife management goals. As Mowat et al. (2013) noted, conducting detailed abundance estimations is not feasible for most regions due to high costs and competing priorities. Since the cost of this project was considerably less than a mark-recapture field study, the potential benefits of fully and appropriately utilizing this kind of data are substantial. To be clear, this line of methodological inquiry is not a question of scientifically judging the reliability of IQ about aklak, which would be epistemologically inappropriate even if it was possible (Brook and McLachlan 2005). Rather, what's required is understanding of how comparable this observation-based approach to grizzly bear density and abundance estimation is to other established methods which use different information inputs. For example, many observations mapped by our participants were associated with lakes and rivers. Awan et al. (2019) sampled lakeshores specifically (as well as grids) where they detected a high number of individuals. They were concerned this could lead to erroneous density/abundance estimation, yet that doesn't appear to be the case with our data despite the same spatial associations.

Implications for co-management and planning

Unique situation of "threats" in the Kivalliq

Study results suggest that the positioning of aklak in the socio-ecological context of the Kivalliq region is not analogous to other regions in Canada as the threat they pose to Inuit food systems is the paramount concern of communities facing human-aklak conflict and the abundance and distribution of aklak is increasing. Aklak are perceived as a threat to the existing socio-ecological system, rather than as a species under threat and in need of protection.

Need for extended deterrence strategies

While harvest was presented as a primary means for reducing conflict with aklak, strategies for reducing encounters through deterrence and preventing habituation were also suggested by participants as something they'd like to know more about. Participants expressed a desire for strategies to deter aklak from damaging property and for more community education about the importance of proper food storage and garbage disposal. Participants were resigned to the increased presence of aklak on their territories, stating "*they're here to stay"* (Hugh Ikoe, Baker Lake, 2023). Participants expected aklak to continue to be a problem for the foreseeable future.

Participants do not desire a quota system and are skeptical of Canadian science-based wildlife management

Participants were uniformly adamant that a hunting quota system should not be reinstated for grizzly bears, and that Inuit should have the ability to judge for themselves the best course of action according to the conditions of a particular encounter. As noted previously, participants described aklak as varying in behaviour and temperament, which means that it was highly dependent on the individual bear and the specific context of the encounter whether lethal action was deemed necessary or not. Participants emphasized aklak intelligence and agency, and how during an encounter aklak also assessed the situation and decided on a course of action. It was emphasized that generalized rules and regulations such as quota systems are not responsive to the unique conditions of each aklak-human encounter. As stated by one participant commenting on the previous quota system: "*when a grizzly bear is going to be dangerous it will not think of the legislation"* (Simeon Mikkingwak, Baker Lake, 2003).

Participants in Clark's 2003 interviews indicated they believed the quota system was instated to protect bears due to concerns of low bear populations. Even though there is no longer a quota system, our data from 2022 suggests that community members continue to perceive the goal of aklak management to be an aklak population increase. For example, participants stated that in the past the government was "*trying to get more grizzlies*" (Avaala 2022). This was consistent with data from the 2003 interviews conducted by Dr. Douglas Clark. Participants expressed the view wildlife management regulations are designed to protect wildlife, not prevent human-wildlife conflict or protect Inuit communities and culture. Participants are aware that their cultural attitudes towards aklak differs from those of conservationists from southern Canada, where grizzly bears may be viewed with reverence (Harding 2014) or as cultural keystone species (Clark et al. 2021). It is important that non-Inuit managers and Conservation Officers are aware of the views expressed by participants that aklak are increasing partially due to protections introduced by a colonial government.

“*…they are increasing in our land. When they could be caught, I am alright with it, and it they were able to catch the cubs too, I would be okay with it.*” (Ludovic Onerk, Arviat, 2022)

“*…we hunters, inside, one hundred miles, radius, are stabilizers of grizzly bears, like, we will not make them increase.*” (Daniel Kablutsiak, Arviat, 2022)

“*It’s right, if it is caught. There seems to be many grizzly bears, if they are caught, it is alright.*” (Dudley Copland, Arviat, 2022)

“*No! I do not want it [the lack of a harvest quota] changed. If they do, your cache, your cache had been taken again on September. They keep saying that, I want them shot down. What good is it if they try and keep them alive? What good is it?*” (Paul Kablutsiak, Arviat, 2022)

“The thing I don't like about the grizzly is that it has completely taken away a very important part of our culture. Caching caribou is our culture. And what made it that way was at some point we were told that don't kill them, don't kill the grizzly or you're gonna go to jail and some people did.” (Hugh Ikoe, 2023)

Methodological recommendations for future wildlife research involving Inuit Qaujimajatuqangit

A more effective interview context for future studies involving qualitative data collection and IQ could be achieved by implementing the following approaches:

1. It is recommended that future interviews take place in a community setting other than the wildlife office. While Conservation Officers were supportive of this research, the association between the wildlife office and government oversight of hunting, particularly given the politically complex history of wildlife regulation in Nunavut, may have influenced some participants' willingness to engage fully.

2. Interview questions should be translated into Inuktitut in consultation with speakers of multiple dialects before interviews take place, pre-emptively addressing issues of dialect difference and translation that came up during the interview process.

3. Community validation would ideally take place over several days, to accommodate changing local conditions (adverse weather, overlapping community events) that affect participation.

4. Simultaneous translation was found to be more efficient than post-interview translation, with the researcher, interviewer/translator, and participant creating a dialogue discussing the meaning of participant statements as issues came up.

5. Greater involvement of community members in research design (question creation), data analysis, and the communication of results is recommended for future studies. While efforts were made in this study, the pandemic presented multiple barriers. Given the accessibility of the methods and the community’s interest for intergenerational knowledge transfer, the potential for capacity building is considerable (Greene and Zawadski 2022). This would require more involvement in the research process from community educators and organizations as facilitators.

Dissemination of study results

One of the challenges of this project is the cross-cultural context of the communication of not only the study data, but also the results. We have found throughout the data collection process that topographic maps are excellent tools for eliciting qualitative data from participants. Disseminating the study results to the community, which is an imperative for ethical research practice with Indigenous communities, can be a challenge given the bilingual and cross-cultural context. Maps are a valuable cross-cultural communication tool, complementing written reports and oral presentations. The digitized maps generated from the participatory mapping exercises can be uploaded onto a digital platform, along with participant descriptions, to create a 'storymap' interface (e.g. Kopatz et al. 2021). This approach locates study results within the landscape, emphasizing place-specific context, community connections to the conservation area, and the experiential elements integral to Inuit Qaujimajatuqangit.

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Baker Lake (Qamani'tuaq):

Barney Aaruaq
David Aksawnee
Emily Alerk
Norman Attungala
John Avaala
Ken Avaala
Harold Etegoyuk
Timothy Evviuk
Alex Iglookyouak
Hugh Ikoe
Joedee Joedee
Tom Mannik
Simeon Mikkingwak
Joe Niego
David Owingayak
Philip Putumiraqtuq
Joan Scottie
Hugh Tulurialik

Arviat:

Dorothy Aglukark
Peter Alareak

Thomas Siatalaaq Alikaswa
Darryl Baker
Dudley Copland
Joe Savikataaq
Leo Ikakhik
Louis Irkok
Cedric Manik
Arden Nibgoarsi
Ludovic Onerk Issumatardjuak
Daniel Kablutsiak
Paul Kablutsiak
Joe Savikataaq
Dominic Sinnisiak
Jordan St.John
Tony Uluadluak

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WOLVERINE (*Gulo gulo*) HARVEST MONITORING IN NUNAVUT

Summary report

February 2025

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Summary

Overall, Nunavut hunters submitted skulls and kill information from 691 harvested wolverines between 2019 and 2024 harvest years (1 July 2023 –30 June 2024 = 2024 harvest year). Most wolverines were harvested in the Kitikmeot region, in the vicinity of Kugluktuk, while relatively fewer were harvested in the eastern communities. Arviat and Baker Lake were the next highest contributors to the total harvest. Harvest data shows that 84% of wolverines were hunted with a rifle, while 16% were trapped. Sex ratio of the harvest was male biased with approximately two times as many males harvested than females. Juveniles and yearling predominated as 63% of the harvest while the other 37% were adults. The harvest was dominated by younger age classes during the early winter, while the harvest of adult individuals increased later in the winter. The spatial distribution, age, and sex structure of the harvest were typical of a healthy population. However, the relatively low number of mature females in the harvest is important to note and should be monitored closely.

ᖃᕝᕕᒃ (ᒍᓗ ᒍᓗ) ᐱᓴᐅᔪᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ ᓄᓇᕗᒻᒥ

ᓇᐃᓈᖅᓯᒪᔪᑦ

ᐊᑕᖏᓕᒫᖅᑯᖏᑦ, ᓄᓇᕗᒻᒥ ᐊᖑᓇᓱᒃᑏᑦ ᑐᓂᓯᓚᐅᖅᓯᒪᔪᑦ ᓂᐊᖁᖏᑕ ᓴᐅᓂᖏᓐᓂᒃ ᑐᓴᖅᑕᐅᔪᒪᔪᓂᒡᓗ ᖃᕝᕕᓛᖅᔪᐃᑦ ᒥᒃᓵᓄᑦ 691−ᓂᒃ ᐊᖑᔭᕕᓂᖅᓂᒃ ᐅᑭᐅᑦ 2019 ᐊᒻᒪ 2024 ᐊᑯᓐᓂᐊᓂ (1 ᔪᓚᐃ 2023 - 30 ᔫᓂ 2024 = 2024 ᐊᖑᓇᓱᖕᓇᒥ). ᐅᓄᕐᓂᖅᓴᐃᑦ ᖃᕝᕕᒃᑕᐅᔪᑦ ᕿᑎᕐᒥᐅᓂᒃ ᐊᖑᔭᐅᓚᐅᖅᓯᒪᔪᑦ, ᖁᕐᓗᖅᑑᑉ ᖃᓂᒌᔭᓂᐸᓗᒃ, ᐅᓄᙱᓐᓂᖅᓴᐃᑦ ᐊᖑᔭᐅᓂᑰᓪᓗᑎᒃ ᑲᓇᖕᓇᖅᐸᓯᖕᒥ. ᐊᕐᕕᐊᑦ ᐊᒻᒪ ᖃᒪᓂ'ᑐᐊᖅ ᐊᖑᔭᖕᒋᑦ ᐅᓄᓛᖕᖑᖃᑕᐅᓚᐅᖅᑐᑦ ᓇᐃᓴᖅᑕᐅᔪᓂ. ᑲᑎᖅᓱᖅᑕᖕᒋᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ 84% ᖃᕝᕕᓛᖅᔪᒃᑕᐃᑦ ᖁᑭᐅᑎᒧᑦ ᐱᔭᐅᔪᕕᓃᑦ, ᑕᐃᒃᑯᐊ 16% ᒥᑭᐊᖅ/ᑮᔭᖃᑦᑕᖕᓄᑦ ᐱᔭᐅᓪᓗᑎᒃ. ᐊᖑᔭᐅᔪᓂ ᐊᖑᓯᓪᓗᐃᑦ ᐊᕐᓇᓪᓗᐃᓪᓗ ᓇᐃᓯᖅᑕᐅᑎᓪᓗᒋᑦ ᐊᖑᓯᓪᓗᐃᑦ ᐅᓄᕐᓂᖅᓯᐅᓚᐅᖅᑐᑦ ᒪᕐᕈᐃᓪᓗᐊᖅᑯᑎᒃ. ᐃᓐᓇᕈᓅᖅᓯᒪᙱᑦᑐᑦ ᐊᒻᒪ ᑎᓕᑐᕋᐃᑦ ᐅᓄᕐᓂᖅᓯᐅᓚᐅᕐᒥᔪᑦ 63% ᐊᖑᔭᐅᔪᓕᒫᓂ ᑕᐃᒃᑯᐊ ᐃᓐᓇᕈᐊᓂᒃᓯᒪᔪᑦ 37%−ᖑᓪᓗᑎᒃ. ᐅᑭᐅᙳᓵᖅᑎᓪᓗᒍ ᐃᓐᓇᕈᓕᓵᕐᓂᖅᓴᑦ ᐱᔭᐅᖃᑦᑕᓚᐅᖅᓱᑎᒃ, ᐃᓐᓇᕈᖅᓯᒪᓂᖅᓴᓪᓚᕉᑦ ᐅᑭᐅᖑᓪᓚᕆᓂᖅᑎᓪᓗᒍ ᐱᔭᐅᓪᓗᑎᒃ. ᓄᓇᓂ ᐅᖓᓯᒌᒃᑕᖅᑐᓂᒃ ᐱᔭᐅᓪᓗᑎᒃ, ᐅᑭᐅᖏᑦ, ᐊᕐᓇᖅ/ᐊᖑᓯᓪᓘᖕᒪᖕᓛᑕ ᓇᐃᓴᐃᔾᔪᔫᑦ ᑕᒪᐃᓐᓂᒃ ᑲᑎᖅᓱᐃᔾᔪᑕᐅᓚᐅᖅᑐᑦ. ᑭᓯᐊᓂᑦᑕᐅᖅ, ᕿᑐᕐᖏᐅᕈᓐᓇᖅᑐᓂᒃ ᓇᐃᓴᖅᑕᐅᔪᖃᖅᑲᙱᓗᐊᕐᓂᖓᓂᒃ ᐅᔾᔨᕆᔭᐅᔭᕆᐊᓕᒃ ᐊᒻᒪ ᐅᔾᔨᖅᓱᖅᑕᐅᑦᑎᐊᕐᓗᓂ.

Qalvik (*Gulo gulo*) anguniaqtunun munaridjutikhaq Nunavunmi

Naittuq Naunaijauti

Tamainun, Nunavunmi anguniaqtut tujuqtut niaqunik humilu tuquhimajatigut kangiqhidjutit hamanga 691 anguniaqtaujut qalviit qitqani 2019 unalu 2024 anguniarutini ukiuni (1 Taaqhivalirvia 2023 –30 Imaruqtirvia 2024 = 2024 anguniaqvingmi ukiungani). Tamavjaita qaviit angujaujut Kitikmeot aviktungnianin, qanilruani Kugluktup, ikitut angujaujut kivataanin nunallaanin. Arviat hamanilu Qamanittuaq tugliujut amigainirit ikajuutait atautimun anguniaqtamingnun. Angunianikkut naunaijautit takunaqtut tapkua 84 pusat qalviit hiquutikkut tuquhimajut, imaalu 16 pusat naniriaqhimajut. Qanuriniitigut amigainirit angujaujut angutiluat naamavjaktuq malruiqtughugu amigainiit angutit angujauluaqtut angnalurnin. Qalviat angujaujut imaa 63 pusat anguniaqtaujut aallat 37 pusat ininirit. Angujaujut amigaitqijaujut qalviat ukiungitigut naunaijaqhimajut ukiuq atulihaaqtilugu, angujaujut ininirnit atautit amigairjuumijun nungutinnagu ukiumi. Ilaujut tunijaujut, ukiungit, qanuriniit qanuqtut anguhimajut aanniaqtuqangitut. Kihimi, ikitpalaat qaffiuniit angnaluit angujaujuni aghuungnaqtut ilihimalugit munarijaujukhallu qanitukkut.

Contrôle de la récolte de carcajou (G*ulo gulo*) au Nunavut

Résumé

En tout, les adeptes de la chasse du Nunavut ont remis les crânes et les données provenant de 691 prises de carcajous lors des années de récolte de 2019 à 2024 (à titre indicatif, l'année de récolte de 2024 s'étend du 1er juillet 2023 au 30 juin 2024). La majeure partie de la récolte a eu lieu dans la région du Kitikmeot, aux environs de Kugluktuk, alors que le nombre de carcajous récoltés dans les localités de l'est était relativement peu élevé. Arviat et Baker Lake figuraient au deuxième rang parmi les grands contributeurs à la récolte totale. Les données de récolte révèlent que 84 % des carcajous ont été chassés au fusil et 16 % ont été piégés. Le ratio mâle-femelle de la récolte était biaisé en faveur des mâles, qui en représentaient environ les deux tiers. Les jeunes carcajous et les petits d'un an constituaient la majeure partie de la récolte, représentant 63 % des prises alors que les prises adultes en représentaient 37 %. En préhiver, les carcajous récoltés provenaient surtout de la population de jeunes, et c'est aux mois de mars et d'avril qu'on a vu une croissance de la récolte d'adultes. La répartition spatiale, l'âge et la répartition par sexe de la récolte étaient caractéristiques d'une population en bonne santé. Cependant, on souligne que la récolte comportait un nombre relativement peu élevé de femelles adultes, et cette population devrait faire l'objet d'une surveillance étroite.

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1.0 Introduction

For thousands of years, Inuit have relied on the harvest of wildlife for food, clothing, and trade. In Nunavut, the furbearer harvest for clothing and for income is a seasonal and traditional activity, where opportunities for other employment are scarce. Under the Nunavut Agreement, furbearer harvest rights are held by Inuit beneficiaries, non-Inuit who harvested furbearers legally in Nunavut settlement area prior to 1981, and non-Inuit whose application has been approved and recommended by local Hunters and Trappers Organizations (HTOs).

In Nunavut, wolverines (*Gulo gulo*) occupy almost all areas of the territory and are classified as both a furbearer and a big game animal under the Nunavut Agreement. They are an important furbearer in Nunavut's culture and economy and have traditionally been considered a vital resource for hunters because of the beauty and frost resistant properties of the fur, which make it unique and quite valuable (Hash 1987). Wolverine fur is highly prized in local communities as ruffs or trims on parkas (Cardinal 2004). Unlike most provinces, hunters and trappers in Nunavut do not have registered or traditionally exclusive family trap lines or hunting areas, so wolverines are generally harvested opportunistically wherever people travel (Mulders 2000) or harvested while hunting other game. Wolverine hunting in Nunavut is mainly by firearms from snow machines while in other provinces trapping is the major method (Lee 2016).

Wolverine densities are believed to be moderate in the western mainland of Nunavut but low on the Arctic islands and in the eastern mainland (Slough 2007, Species at Risk Committee 2014). Using DNA-based mark-recapture, Awan and Boulanger (2016), Awan et al. (2018) estimated density from 1.6 to 4.4 wolverines/1,000 km^2 in the Kivalliq region and 4.14 wolverines/1,000 km^2 in the Napaktulik Lake area in the Kitikmeot region (Awan et al. 2020). Inuit observations and recent harvest reports suggest that wolverine numbers in Nunavut are either stable or slightly increasing, and the species may be expanding its range eastward and northward (Awan et al. 2012, COSEWIC 2014). The wolverine has been assessed as a species of Special Concern in Canada and in 2018 was listed as the same under the *Species at Risk Act* (*SARA*). The wolverine is generally described as a scavenger (Banci 1987) and an opportunistic predator throughout its range, occurs in low densities, have low birthing and recruitment rates, are sensitive to human disturbance, and require large secure areas to maintain viable populations (Magoun 1985, Mattisson et al. 2011). It is considered a wilderness species and potential indicator of ecosystem health (Carroll et al. 2001). Mulders (2000) suggests that the arctic tundra contains large undisturbed tracts of habitat that may act as reservoirs to maintain harvestable populations of wolverine in Nunavut.

Nunavut contributes substantial numbers to the national harvest even though ecological data for tundra wolverine are sparse, especially in the northeastern edge of the species distribution. Currently, there is no quantitative limit on their harvest by Inuit and there is no requirement for hunters to report their harvest. The only mechanism for tracking the harvest or pelts is the Government of Nunavut’s Department of Environment (GN-ENV) fur-pricing program, which misses pelts, which are used locally or sold as raw frozen wolverine hides privately; the actual harvest is unknown. The current collection of wolverine skulls and kill information is an attempt to estimate the harvest, to monitor the age and sex of the harvest.

2.0 Methods

Each year we obtained the skull and a small piece of skin (~2.5 x 2.5 cm) with fur from hunters with the assistance of HTOs and Conservation Officers (COs). Hunters across Nunavut voluntarily reported and provided skull and skin samples from harvested wolverines via their local COs. A $50 subsidy was provided to hunters for each skull brought back to the COs office to encourage the reporting and return of samples. Recently, increased activity in the online buying and selling of wolverine skulls has led to less reporting under this program. The online skull buyers offer higher prices for skulls than our subsidy amount of $50. From January 2025 GN-ENV increased the subsidy amount to $100 per wolverine.

For each wolverine sample collected during the course of this study, COs filled out sample collection forms with information from hunters about the harvest location, date, wolverine sex, and method of harvest, and their opinion of the current abundance trend of the local wolverine population (decreasing, stable or increasing). The skinned skulls were stored frozen, and were thawed at room temperature for examination in early May each year. We extracted a lower canine and sent to Matson's Laboratory LLC (Milltown, MT, USA) for age estimation using cementum analysis. This technique is based on the cyclic nature of cementum growth in teeth forming annular patterns of different darkness depending on the season (Matson 1981).

Following Banci and Harestad (1988) and Vangen et al. (2001), individuals were then grouped into three age classes: juvenile (0-1 year, date of birth is set to March 1st), yearling (1-2 years) and adult (≥ 2 years).

3.0 Results and Discussion

A total of 691 wolverines were reported as harvested from July 2018 to June 2024, 397 from the Kitikmeot, 290 from the Kivalliq and 4 from the Qikiqtaaluk region (Igloolik and Sanirajak) (Fig. 1). According to our sample collection program, reported wolverine harvest in Nunavut has been fluctuating and the harvest report rate for this period (2019-24) appears to be lower compared to early 2000s in the Kitikmeot region (Awan et al. 2012).

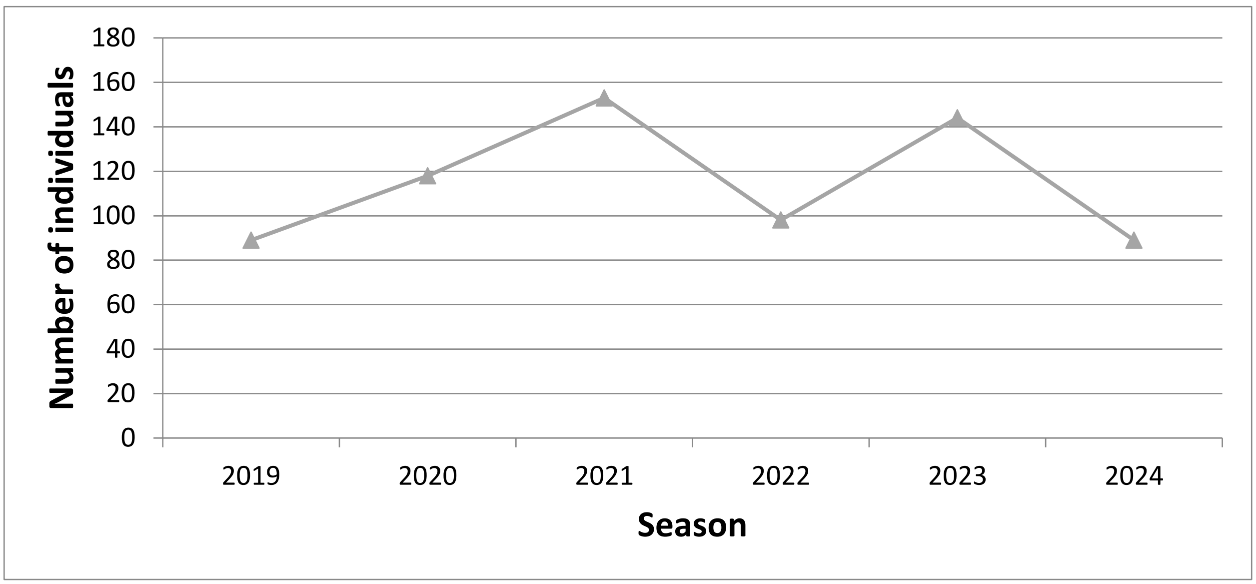

Figure 1. Reported wolverine harvest in Nunavut, from 2019 to 2024. Note that the harvest year is assigned as the year at the end of the regulations’ harvesting season, for example, 1 July 2018–30 June 2019 = 2019 harvest year.

The harvest was unevenly distributed throughout the territory, with most wolverines having been harvested in the western Kitikmeot. Harvest in the vicinity of Kugluktuk was particularly intense, and along the traditional travel route from the Kugluktuk to the Contwoyto Lake. Relatively fewer wolverine were harvested in the eastern communities, while Arviat and Baker Lake were the next major contributors to the total harvest (Fig. 2). Comparatively, high wolverine harvest happening out of Kugluktuk, when the caribou herds wintered nearby, was due to hunters spending more time on the land to hunt caribou. While hunting caribou, harvesters usually pursued wolverine when they saw wolverine or found fresh tracks.

Wolverine harvest distribution shows that harvest took place over a wider range on the Nunavut mainland, but it tended to be concentrated near communities. The surrounding areas without hunting may act as refugia or reservoirs that produce wolverines that move into the hunted areas and sustain the harvest (Mulders 2000, Lee 2016).

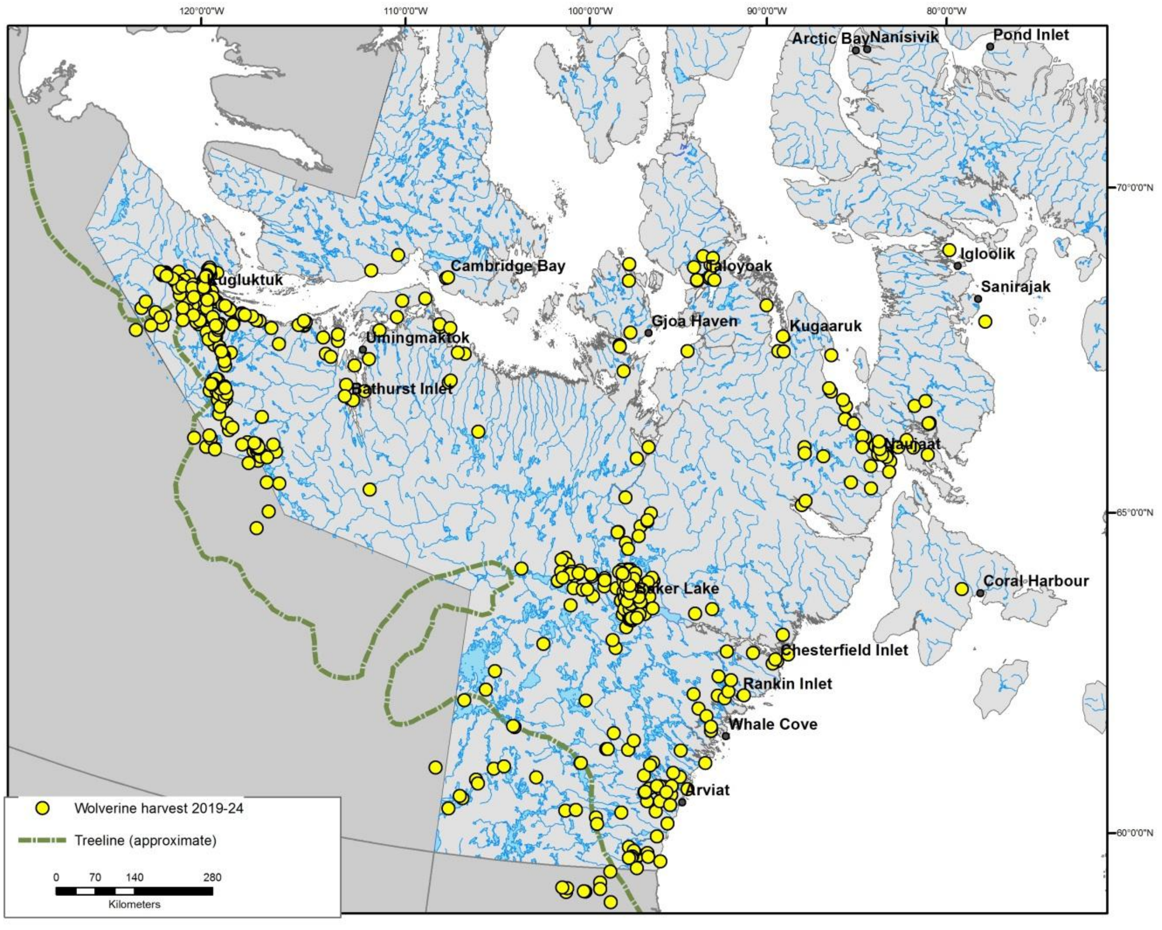

Figure 2. Distribution of reported wolverine harvest by Nunavut hunters from 2019 to 2024. Symbol may represent >1 wolverine harvested at that location.

Most wolverines were harvested between November and April each year (Fig. 3), when the fur is in prime condition. Harvest data shows that approximately 84% of wolverines were hunted with a rifle and 16% animals were trapped. Of the trapped animals (n = 109), 94% were killed in quick-kill traps and 6% in leg hold traps. In the Kivalliq region, only five hunters trapped 12 wolverines, while in the Kitikmeot region 97 wolverines were trapped by 15 hunters.

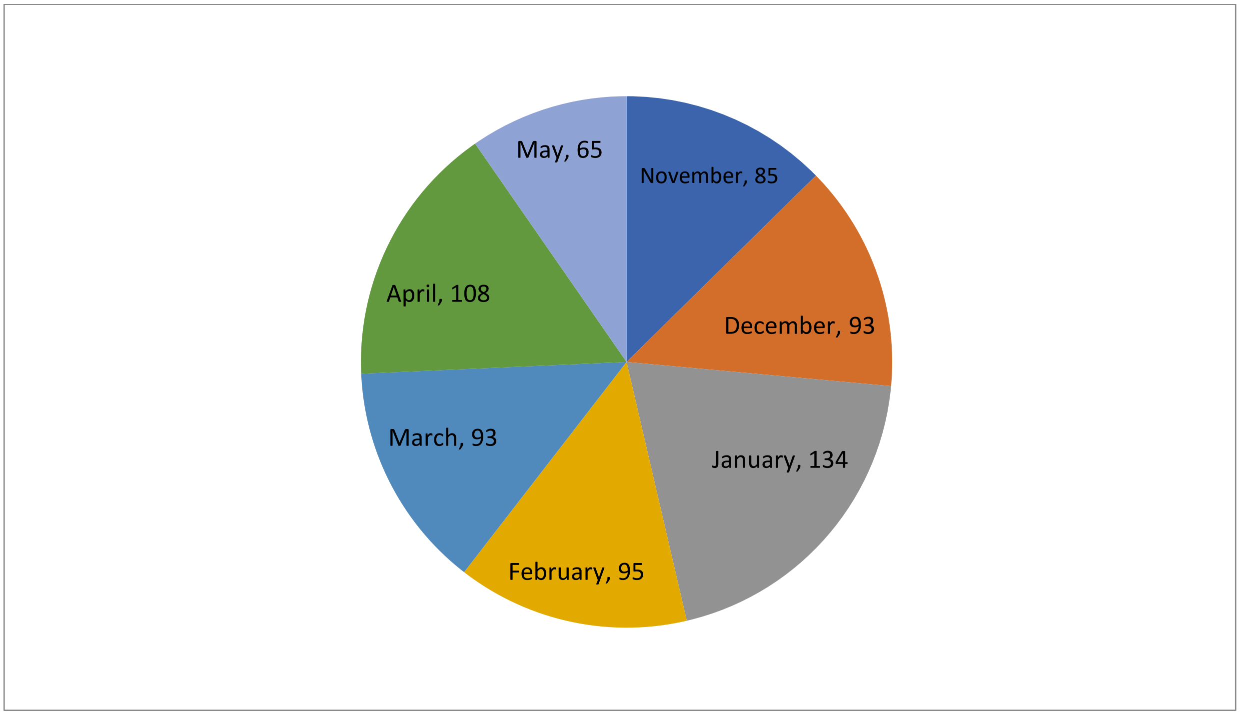

Figure 3. Wolverine reported monthly harvest in Nunavut, from 2019 to 2024. Label indicates total number of wolverines harvested per month.

The male:female ratio of the harvest was highly biased towards males (Fig. 4) with approximately twice as many males harvested than females (ratio = 1.7 and 2.1 in the Kitikmeot and the Kivalliq respectively), a typical figure for northern Canada (Mowat et al. 2020). We assumed sex ratio at birth in the population is 1:1, however, it is difficult to distinguish if this reflects the actual sex ratio of the population or a difference in vulnerability by sex. Lee (1994) also observed a 2:1 male to female ratio in the western Kitikmeot harvest in the early 1990s. However, his observations showed a strong male bias in the younger age classes (< 2 yo) while the adult sex ratio was not different from a 1:1 ratio. Examining the sex ratio per age class since 2019 seems to show the opposite with a male to female ratio higher in the older individuals (Table 1), possibly pointing towards a diminution in mature females in the population, which will need to be monitored closely.

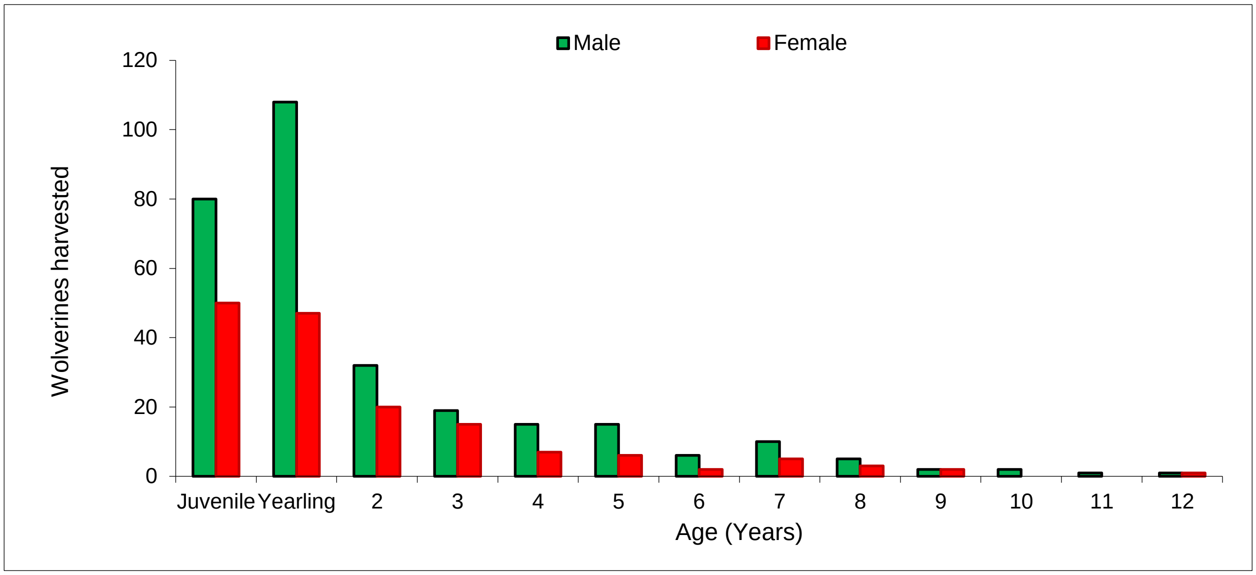

Figure 4. Age and sex structure of the reported wolverine harvest in Nunavut, from 2019 to 2023.

Table 1. Male to female sex ratio by age in the reported wolverine harvest in Nunavut, from 2019 to 2023.

Age	M:F total harvest	M:F sex ratio
Juveniles	80:50	1.6
Yearlings	108:47	2.3
2	32:20	1.6
3	19:15	1.3
4	15:7	2.1
5	15:6	2.5
6	6:2	3
7	10:5	2
8	5:3	1.7
9	2:2	1
10	2:0	-
11	1:0	-
12	1:1	1

The age distribution of the reported wolverine harvest from 2019 to 2023 is weighted more towards juvenile/yearling animals (Fig. 4). The ages of harvested wolverines ranged from <1 year to 12 years. The oldest female and male (12 years) were killed (shot) in Kugluktuk (n = 2) area in 2021 and 2022, respectively. Overall, 29% of the wolverines harvested in Nunavut during that period were juveniles, 34% were yearlings and 37% were adults (Table 2). A greater proportion of young animals in the harvest moderate the conservation risk of harvest (Mowat et al. 2020). However, the proportion of adult females in the harvest increased (13%) for this period (2019-23) compared to 2014-18 (9%, Awan 2020). Wolverine harvest appears to be biased towards younger males (Rausch and Pearson 1972, Lee 1994) probably due to their higher movement rates and vulnerability (Scrafford et al. 2024). Kukka et al. (2017, 2023) describe the high proportions of young males in the harvest to be because vacant areas created by the harvest of resident animals may be filled by dispersing young males (Magoun 1985). Others have reported long dispersal movements in yearlings from their natal area before reaching sexual maturity (Copeland 1996, Mulders 2000, Vangen et al. 2001, Inman et al. 2012) and movement of wolverines from areas with lower mortality to those with higher mortality (Gervasi et al. 2015, 2016). The high proportion of juveniles and yearlings (63%) and the low proportion of females (36%) among adults in the harvest may signal the importance of dispersal in the population dynamics of this species within the traditional harvesting areas. Yearlings and juveniles represented 64% of the known age male harvest, in contrast to 81% reported by Lee (1994) in the Kitikmeot region in the early 1990's, and by Rausch and Pearson (1972) who also reported wolverine harvest biased toward younger males in Alaska and Yukon.

Table 2. Age and sex distribution of reported wolverine harvest in Nunavut, from 2019 to 2023.

Age Class	Sex		Total (% of total)
	Males (% of males)	Females (% of females)	
Adult (≥ 2 years)	108 (36.5%)	61 (39%)	169 (37%)
Yearling	108 (36.5%)	47 (30%)	155 (34%)
Juvenile (< 1 year)	80 (27%)	50 (31%)	130 (29%)
Total	296	158	454

Figure 5 illustrates the temporal variation in the harvest according to age class. The harvest was dominated by younger age class during the winter while the harvest of adult individuals was comparatively high in March/April, which is similar to other wolverine harvest studies (Lee 2016, Kukka et al. 2017). For males, this corresponds to the time when maximal size of testes and highest levels of testosterone are attained (Pasitschniak-Arts and Larivière 1995), probably marking the start of the breeding season and resulting in increased movements and increased vulnerability of sexually mature males for harvest.

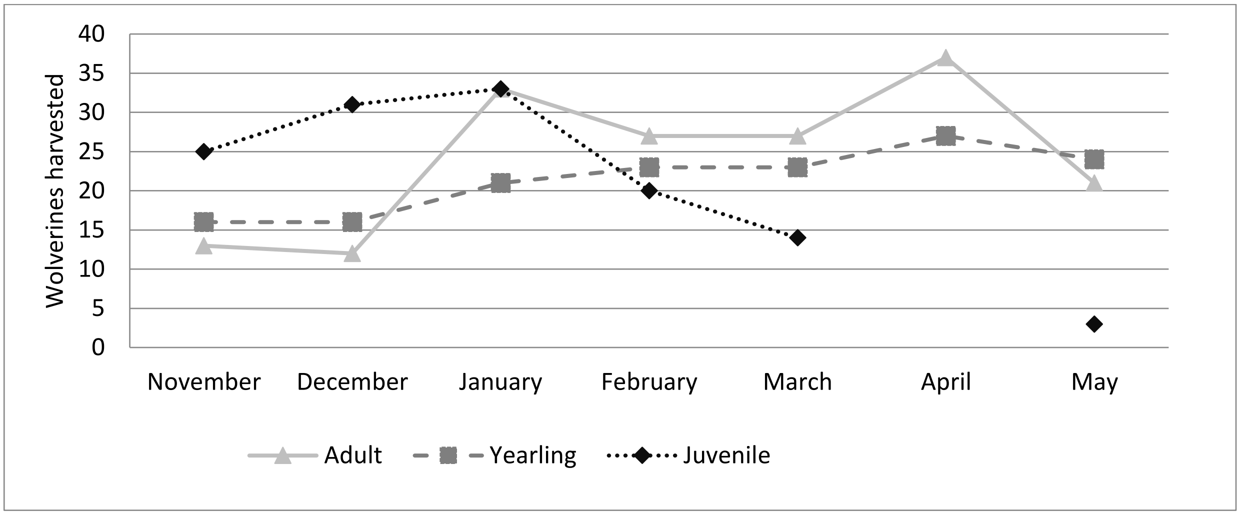

Figure 5. Monthly reported wolverine harvest per age class in Nunavut, from 2019 to 2023.

Wolverine populations in Nunavut are considered healthy. This seems to be supported by the sex and age distribution of the harvest. However, the relatively low number of mature females (13%) in the harvest is important to note and should be monitored closely.

In an effort to obtain information on wolverine population relative abundance, wolverine harvesters (a hunter may provide >1 harvested wolverine to the program within and among years) were asked to answer the following question when bringing back samples to their wildlife office: “Do you think the wolverine population is decreasing, stable or increasing?”. Harvesters’ perception about trends in wolverine populations differed among regions, but majority believed that numbers were stable. In the Kitikmeot (n = 371), most respondents believed the population was stable (67% stable, 32% increasing) while most respondents of the Kivalliq (n = 255) also believed their local population was stable (61% stable, 39% increasing). However, over the long term, the increasing resource development on the tundra and climate change may adversely affect the species, which suggests a need for continuous monitoring of the health of the wolverine population. Monitoring of the wolverine population is also important as part of predator research and management as it relates to ungulate species management in both the Kivalliq and Kitikmeot regions.

4.0 Acknowledgments

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Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

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Department of Environment
Avatiliqiyikkut
Ministère de l'Environnement

SPATIAL AND TEMPORAL PATTERNS OF WOLF HARVEST IN RELATION TO CARIBOU HERD MOVEMENTS IN NUNAVUT

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Summary

Enhanced wolf (*Canis lupus*) management actions are often employed to support recovery of declining caribou (*Rangifer tarandus*) herds. Most herds of migratory tundra caribou (*R. t. groenlandicus*) in Nunavut and adjacent Northwest Territories (NWT) are either in decline or at historically low population levels. Beginning in 2018-19 in the Kitikmeot Region and expanding to all of Nunavut in 2019-20, the Government of Nunavut (GN) Department of Environment (ENV) offered compensation through the Support for Active Harvesters program to local hunters to harvest wolves and provide sample and location data. We examined wolf harvest data from 1,500 wolves killed by hunters within Nunavut between 2018-19 and 2020-21 to describe the spatial and temporal patterns of the Nunavut wolf harvest in relation to caribou densities based on collared individuals. We examined the age and sex structure of the wolf harvest, and the spatial and temporal clustering of the harvest (i.e., whether hunting is effective at removing entire packs). We also provided rough estimates of the number of wolves associated with the Qamanirjuaq caribou herd and of the proportion of these wolves harvested by Nunavut hunters.

During 2018-19, 146 wolves were recorded harvested by 52 hunters within the Kitikmeot, primarily by hunters from Kugluktuk. Harvest numbers peaked in December and February–May, with a high proportion of the harvest during October–December comprised of juveniles and a wider distribution of ages harvested as the season progressed.

During 2019-20, 658 wolves were recorded harvested across Nunavut, with 64% of the harvest from Arviat, Baker Lake and Kugluktuk hunters. Harvest peaked in November and March–May. During 2020-21, 699 wolves were recorded harvested, with 68% of the harvest from Arviat, Baker Lake and Kugluktuk hunters. In both years, the proportion of juveniles in the harvest declined over time and a relatively small number of hunters contributed a large portion of the harvest. Nearly all (99%) of the wolves were shot and the remainder were trapped.

Although patterns differed among communities, wolves were generally harvested closer to communities prior to Christmas (generally within 75 km) and further from communities later in the winter, with peak distances in April and May (up to 500 km). Thus, even though the hunters were far from their communities, necessitating camping over day-trips, they were effective at harvesting larger numbers of wolves. Arviat hunters harvested wolves over a broad distance later in the winter, including over 450 km from the hamlet in 2019-20, but the distribution of harvest was higher closer to higher densities of caribou. The distribution of high densities of Qamanirjuaq caribou and hence the wolf harvest differed between years. The proportion of packs harvested differed among communities and generally decreased as pack size increased and increased as the season progressed.

Rough estimates of the number of wolves associated with the Qamanirjuaq caribou herd suggest that hunters annually removed approximately 12–25% of the wolves associated with the late winter and spring movements of the Qamanirjuaq herd. Estimates of wolf numbers and proportion of wolves harvested are based on assumed rather than observed relationships between caribou and wolf numbers and therefore should be interpreted very cautiously. More work is required to better estimate how many wolves may be associated with the migratory herds, especially the Qamanirjuaq herd, during winter and spring, but given high harvests of wolves south and southwest of Arviat during March, April and May, it is likely that

numbers of wolves and wolf-killed caribou are greatly reduced as the herd migrates to their calving grounds west of the coast of Hudson Bay, resulting in low numbers of wolves and reduced wolf predation on the calving and early post-calving grounds.

Wolf harvesting is a traditional part of the culture of Nunavut hunters, as well as a source of seasonal income. The effectiveness of Nunavut wolf hunters appears high, with large annual harvests from some communities, especially Arviat, Baker Lake and Kugluktuk. Nunavut wolf hunters appear able to target older and presumably potentially breeding portions of the population later in the winter after most natural losses would have occurred, increasing the additive impacts of these ground-based harvest efforts. In some areas wolf harvest during spring migration result in low numbers of wolves and reduced wolf predation on the calving and post-calving grounds. Since wolf populations can quickly rebound when treatment is removed due to immigration from surrounding areas and high reproductive rates, the incentive program should be continued.

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ᐊᐅᓚᑦᑎᔨᓂᓐᖞᖅᑐᑦ ᓇᐃᓈᖅᓯᔪᑦ

ᐱᐅᓯᒋᐊᖅᓯᒪᔪᖅ ᐊᒪᖅᑯᓂᒃ (*Canis lupus*) ᐊᐅᓚᑦᑎᓃᑦ ᖃᓄᐃᓕᐅᕈᑕᐅᔪᑦ ᐃᑲᔪᕐᓂᐊᕐᓗᒋᑦ ᐊᒥᓲᔾᔪᓂᖅᐸᓪᓕᐊᓂᖏᑦ ᐅᑎᖅᑎᑦᑐᒪᐸᓗᒋᑦ ᑕᒃᑐᐃᑦ (*Rangifer tarandus*) ᐊᒥᖑᐃᑦ. ᑕᒪᓗᒃᑖᕐᓚᒃ ᐊᒥᕐᖑᐃᑦ ᐅᑎᖅᑕᖃᑦᑕᖅᑐᑦ (*R. t. groenlandicus*) ᓄᓇᒧᑦ ᓄᓇᕗᒻᒥᑦ ᐊᒻᒪᓗ ᖃᓂᑖᓂᑦ ᓄᓇᑦᑎᐊᕐᒥᑦ ᐊᒥᓲᔾᔭᓃᖅᐸᓪᓕᐊᔪᑦ ᐅᕝᕙᓘᓐᓃᑦ ᑕᐃᒪᙵᓂᒥᑦ ᐊᒥᓲᑎᒋᓂᖏᑦ ᐊᑦᑎᓛᖑᓯᒪᓕᖅᑐᑦ. ᐱᒋᐊᓵᖅᑎᓪᓗᒍ 2018-19 ᕿᑎᕐᒥᐅᓂᑦ ᐊᒻᒪᓗ ᑎᑭᐅᑎᕙᓪᓕᐊᕐᓗᓂ ᓄᓇᕗᓗᒃᑖᕐᒧᑦ 2019-20-ᒥᑦ, ᓄᓇᕗᒻᒥ ᒐᕙᒪᒃᑯᑦ ᐊᕙᑎᓕᕆᔾᔪᑯᖏᑦ ᐅᑎᖅᑎᑦᑎᖃᑦᑕᕈᒪᓕᓚᐅᖅᑐᑦ ᐃᑲᔪᕐᓗᒍ ᒪᖃᐃᖃᑦᑕᖅᑐᓄᑦ ᑐᕌᖓᔪᒥᒃ ᓄᓇᓕᖕᒥᐅᑕᐃᑦ ᒪᖃᐃᓃᑦ ᐊᒪᕌᖓᑕ ᐊᒻᒪᓗ ᑐᓂᓯᓗᑎᒃ ᐆᒃᑐᕋᒃᓴᒥᒃ ᓲᕐᓗ ᓂᖠᖓᓂᑦ ᐊᒪᕉᑉ ᐊᒻᒪᓗ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᖃᓂᒃ. ᕿᒥᕈᓚᐅᖅᑕᕗᑦ ᐊᒪᕈᖅᑕᐅᓯᒪᔪᓂᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᖃᐃᑦ 1,500-ᖑᔪᓂᑦ ᐊᒪᕈᐃᑦ ᑐᑯᑕᐅᔪᓂᒃ ᒪᖃᐃᑎᓄᑦ ᓄᓇᕗᒻᒥᑦ ᐊᑯᓐᓂᖓᓂᑦ 2018-29 ᐊᒻᒪᓗ 2020-21 ᐅᖃᐅᓯᕆᓂᐊᕐᓗᒋᑦ ᐃᓂᒦᖅᑕᕐᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐊᑯᓂᐅᑎᒋᓂᖏᓐᓄᑦ ᖃᓄᐃᓕᐅᖅᐸᓪᓕᐊᓂᑦ ᓄᓇᕗᒻᒥ ᐊᒪᕈᖅᓯᐅᖅᑎᓂᑦ ᐱᔾᔪᑎᖃᖅᑐᓂᒃ ᑐᒃᑐᐃᑦ ᐊᒥᓲᑎᒋᓂᖏᓐᓄᑦ ᐊᑐᖅᓱᒋᑦ ᖁᖓᓯᕈᓯᖅᑕᐅᓯᒪᔪᑦ. ᕿᒥᕐᕈᓚᐅᖅᑕᕗᑦ ᐅᑭᐅᖏᑦ ᐊᒻᒪᓗ ᐊᖑᓴᓪᓗᐃᑦ ᐊᕐᓇᓪᓗᐃᑦ ᐋᖅᑭᐅᒪᓂᕆᔭᖏᑦ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ, ᐊᒻᒪᓗ ᐃᓂᒦᖅᑕᕐᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐊᑯᓂᐅᑎᒋᓂᖏᓐᓄᑦ ᑲᑎᓯᒪᔪᑦ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ (ᐆᒃᑑᑎᒋᓗᒍ, ᐊᒪᕈᖅᑕᐅᖃᑦᑕᕐᓂᖏᑦ ᐃᑲᔪᐃᓂᖃᕐᒪᖔᑦ ᐲᕐᓂᐊᕐᓗᒋᑦ ᑕᒪᕐᒥᓗᒃᑖᑦ ᐊᒪᕈᐃᑦ ᑲᑎᓯᒪᔪᑦ). ᑐᓂᓯᓚᐅᕐᒥᔪᒍᑦ ᓇᓚᐅᑦᑖᖅᓯᒪᔪᓂᒃ ᖃᑉᓯᐅᓂᖏᓐᓄᑦ ᐊᒪᕈᐃᑦ ᐊᒃᑐᐊᓂᖃᖅᑐᑦ ᖃᒪᓂᕐᔪᐊᖅ ᑐᒃᑐᐃᑦ ᐊᒥᕐᖓᓂᑦ ᐊᒻᒪᓗ ᐃᓚᖏᓐᓂᑦ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ ᓄᓇᕗᒻᒥ ᒪᖃᐃᑎᓄᑦ.

2018-19-ᒥᑦ, 146 ᐊᒪᕈᖅᑕᐅᔪᑦ ᑎᑎᖅᑐᐃᓯᐅᓚᐅᖅᑐᑦ 52 ᒪᖃᐃᑎᓄᑦ ᕿᑎᕐᒥᐅᓂᑦ, ᐱᓗᐊᖅᑐᒥᑦ ᒪᖃᐃᑎᓂᑦ ᖁᕐᓗᖅᑐᕐᒥᑦ. ᐊᒪᕈᖅᑕᐅᔪᑦ ᖃᑉᓯᐅᓂᖏᑦ ᐊᒥᓱᙳᓇᐊᓚᐅᖅᑐᑦ ᐋᔾᔪᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᐊᕗᓐᓂᕕᖕᒥᑦ ᓄᕐᖑᐃᑦ-ᒧᑦ, ᐊᒥᓯᑦ ᐃᓚᖏᑦ ᐊᒪᕈᖅᑕᐅᔪᑦ ᐃᓐᓇᕈᖅᐸᓪᓕᐊᓕᖠᖅᓱᑎᒃ ᐅᑭᐅᓖᑦᒥᑦ ᐋᔾᔪᕐᕕᖕᒧᑦ ᐊᒻᒪᓗ ᐊᔾᔨᒌᙱᑦᑐᓂᒃ ᐅᑭᐅᖃᕆᖅᑐᓂᒃ ᐊᒪᕈᖅᑕᐅᖃᑦᑕᖅᓱᑎᒃ ᐱᕙᓪᓕᐊᑎᓪᓗᒋᑦ ᑕᖅᑮᑦ ᒪᖃᐃᕝᕕᐅᖃᑦᑕᖅᑐᑦ.

2019-20, 658 ᐊᒪᕈᖅᑕᐅᔪᑦ ᑎᑎᖅᑐᐃᓯᐅᓚᐅᖅᑐᑦ ᓄᓇᕗᒻᒥᑦ, 64% ᐊᒪᕈᖅᑕᐅᐸᓗᑎᒃ ᐊᕐᕕᐊᓂᑦ, ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐊᒻᒪᓗ ᖁᕐᓗᖅᑐᕐᒥᑦ ᒪᖃᐃᑎᓄᑦ. ᐊᒪᕋᔪᕐᓂᖅᓴᐅᐸᓗᑎᒃ ᑲᑕᒫᓇᕝᕕᖕᒥᑦ ᐊᒻᒪᓗ ᓇᑦᑎᐊᕐᒥᑦ ᓄᕐᖑᐃᑦᒧᑦ. 2020-21-ᒥᑦ, 699 ᐊᒪᕈᖅᑕᐅᔪᑦ ᑎᑎᖅᑐᐃᓯᐅᓚᐅᖅᑐᑦ, 68% ᐊᒪᕈᖅᑕᐅᐸᓗᑎᒃ ᐊᕐᕕᐊᓂᑦ, ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐊᒻᒪᓗ ᖁᕐᓗᖅᑐᕐᒥᑦ ᒪᖃᐃᑎᓄᑦ. ᑕᒪᐃᓐᓂᑦ ᐅᑭᐅᓂᑦ, ᐃᓚᖏᑦ ᐃᓐᓇᕈᖅᐸᓪᓕᐊᓕᖠᖅᑐᑦ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ ᐊᒥᓲᔾᔭᓃᖅᐸᓪᓕᐊᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᐊᒥᓲᖏᑦᑐᑦ ᐊᒪᕈᓚᐅᖅᑐᑦ ᐊᖏᓂᖅᓴᐅᔪᒥᑦ ᐃᓚᖓᓂᑦ ᐊᒪᕈᖅᑕᐅᔪᓂᑦ. ᑕᒪᕐᒥᓗᒃᑖᖅᖃᔅᖅ (99%) ᐊᒪᕈᐃᑦ ᓯᖅᑯᖅᑎᑕᐅᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᐊᒥᐊᒃᑯᖏᑦ ᑮᔅᖃᑦᑕᒥᒃ ᐊᑐᖅᓱᑎᒃ.

ᓄᓇᓖᑦ ᐊᑯᓐᓂᖓᓂᑦ ᖃᓄᐃᓕᐅᖅᐸᓪᓕᐊᓂᖓᑦ ᐊᔾᔨᒋᓚᐅᙱᑦᑐᒐᓗᐃᑦ, ᐊᒪᕆᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᓄᓇᓕᖕᒧᑦ ᖃᓂᓐᓂᖅᓴᐅᔪᒥᖃᑦᑕᓚᐅᖅᑐᑦ ᐊᓂᕝᕚᐊ ᖃᑦᓕᓕᕌᖓᑦ (75 ᑭᓖᒥᑕᓂᒃ ᖃᓂᑎᒋᔪᒥᑦ) ᐊᒻᒪᓗ ᓄᓇᓕᖕᓂᑦ ᐅᖓᓯᒋᓐᓂᖅᓴᐅᔪᓂᑦ ᐅᑭᐅᖅᑎᓪᓗᒍ, ᐅᖓᓯᒃᓯᓂᖅᓴᐅᓕᖅᐳᑎᒃ ᑎᕆᒡᓗᐃᑦ-ᒥᑦ ᐊᒻᒪᓗ ᓄᕐᖃᐃᑦ-ᒥᑦ (500 ᑭᓖᒥᑕᓄᑦ ᑎᑭᓪᓗᒍ). ᑕᐃᒪᓐᓇᒧᑦ, ᒪᖃᐃᑏᑦ ᐅᖓᓯᒃᑲᓗᐊᖅᐳᑎᒃ ᓄᓇᓕᖕᒋᓐᓂᑦ, ᑖᓂᓚᐊᖃᑦᑕᖅᐳᑎᒃ, ᑕᐃᒪᓐᓇ ᐊᒥᓲᓂᖅᓴᓂᒃ ᐊᒪᕈᖃᑦᑕᓚᐅᖅᑐᑦ. ᐊᕐᕕᐊᓂᑦ ᒪᖃᐃᑏᑦ ᐊᒪᕈᓚᐅᖅᑐᑦ ᐅᖓᓯᒃᑐᑲᓪᓚᖕᒥᑦ ᐅᑭᐅᖑᓕᖅᑎᓪᓗᒍ, 450 ᑭᓖᒥᑕᓂᒃ ᐅᖓᓯᒃᑎᒋᔪᒥᑦ ᐊᕐᕕᐊᓂᑦ 2019-20-ᒥᑦ, ᑭᓯᐊᓂ ᓇᒧᖕᒐᐅᓯᒪᓂᖕᒋᑦ ᐊᒪᕆᖅᑕᐅᔪᑦ ᖁᑦᑎᖕᓂᖅᓴᐅᓚᐅᖅᑐᖅ ᖃᓐᓂᖅᓴᐅᔪᑦ ᐊᒥᓱᑎᒋᓂᐅᔪᓂᑦ ᑐᒃᑐᓂᑦ. ᓇᒧᖕᒐᐅᖃᑦᑕᕐᓂᖕᒋᑦ ᐊᒥᓱᑲᓪᓚᐅᐸᓗᑎᒃ ᖃᒪᓂᕐᔪᐊᖅ ᑐᒃᑐᖕᒋᑦ ᐊᒻᒪᓗ ᐊᒪᕆᖅᑕᐅᔪᑦ ᐊᔾᔨᒋᙵᖃᑦᑕᖅᑐᑦ ᐅᑭᐅᑦ ᐊᑯᓐᓂᖓᓂᑦ. ᐃᓚᖏᑦ ᑲᑎᒪᔪᑦ ᐊᒪᕆᖅᑕᐅᔪᑦ ᐊᔾᔨᒋᙵᖃᑦᑕᖅᑐᑦ ᓄᓇᓖᑦ ᐊᑯᓐᓂᖓᓂᑦ ᐊᒻᒪᓗ ᐊᒥᓲᔪᖕᓃᖅᐸᓪᓕᐊᐸᓗᑎᒃ ᑲᑎᒪᔪᑦ ᐊᖏᑎᒋᓂᖏᑦ ᐊᖏᓪᓕᒋᐊᖅᐳᓂ ᐊᒻᒪᓗ ᐊᖏᓪᓕᒋᐊᖅᐸᓪᓕᐊᖏᓐᓇᖅᐳᓂ ᐅᑭᐅᐸ ᐃᓗᐊᓂᑦ.

ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᖃᐸᐅᓂᖏᑦ ᐊᒪᕈᐃᑦ ᐱᔾᔪᑎᒋᐸᓗᒋᑦ ᖃᒪᓂᕐᔪᐊᖅ ᑐᒃᑐᐃᑦ ᐊᒥᕐᕿᐃᑦ ᐅᖃᖅᑐᑦ ᒪᖃᐃᑏᑦ ᐊᕐᕌᒎᑕᒦᒃᑯᑦ 12-25%-ᓗᐊᓂᒃ ᐊᒪᕆᖃᑦᑕᖅᑐᑦ ᐅᑭᐅᖑᓕᖅᑎᓪᓗᒍ ᐊᒻᒪᓗ ᐅᐱᕐᖓᖅᐸᓪᓕᐊᓕᖅᑎᓪᓗᒍ ᐊᐅᓚᓂᖏᓐᓂᑦ ᖃᒪᓂᕐᔪᐊᖅ ᐊᒥᕐᕿᖏᑦ. ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᖃᐸᐅᓂᖏᑦ ᐊᒪᕈᐃᑦ ᐊᒻᒪᓗ ᐃᓚᖏᑦ ᐊᒪᕆᖅᑕᐅᔪᑦ ᐊᑐᖅᑐᑦ ᐃᓯᒪᒋᔭᐅᔪᒥᒃ ᑕᑯᔭᐅᔪᓂᐅᖏᖖᖅᑐᖅ ᐱᔾᔪᑎᖃᖅᑐᓂᒃ ᐊᑯᓐᓂᖓᓂᑦ ᑐᒃᑐᐃᑦ ᐊᒻᒪᓗ ᐊᒪᕈᐃᑦ ᖃᐸᐅᓂᖏᑦ ᑕᐃᒪᓐᓇᒧᑦ ᑐᑭᓕᐅᖅᑕᐅᔭᕆᐊᓕᒃ ᐅᔾᔨᖅᑐᕐᓗᑎᒃ. ᐱᓕᕆᐊᖑᒃᑲᓐᓂᕆᐊᖃᖅᑐᑦ ᓇᓚᐅᑖᕆᑦᑎᐊᕐᓂᖅᓴᐅᓂᐊᕐᓗᓂ ᖃᐸᑦ ᐊᒪᕈᐃᑦ ᐊᒃᑐᐊᓂᖃᕐᒪᖔᑕ ᐅᑎᖅᑕᖃᑦᑕᖅᑐᑦ ᐊᒥᕐᕿᓂᒃ, ᐱᓗᐊᖅᑐᒥᑦ ᖃᒪᓂᕐᔪᐊᖅ ᐊᒥᕐᕿᓂᒃ, ᐅᑭᐅᖑᑎᓪᓗᒍ ᐊᒻᒪᓗ ᐅᐱᕐᖖᖑᑎᓪᓗᒍ, ᑭᓯᐊᓂ ᐊᒥᓱᐃᑦ ᐊᒪᕆᖅᑕᐅᖃᑦᑕᕐᓂᖅᑐᐅᑎᓪᓗᒋᑦ ᓂᕆᐊᓂᑦ ᐊᒻᒪᓗ ᓂᕆᖅᐸᓯᐊᓂᑦ ᐱᖓᓐᓇᖅᐸᓯᐊᓂᑦ ᐊᕐᕕᐊᓂᑦ ᓇᑦᑎᐊᑦ-ᒥᑦ, ᑎᕆᒡᓗᐃᑦ-ᒥᑦ ᐊᒻᒪᓗ ᓄᕐᖃᐃᑦ-ᒥᑦ, ᐊᒥᒌᑎᒋᓂᖏᑦ ᐊᒪᕈᐃᑦ ᐊᒻᒪᓗ ᐊᒪᕆᖅᑕᐅᔪᑦ ᒥᒃᓵᒋᐊᕐᔪᐊᖃᑦᑕᖅᑐᑦ ᐊᒥᕐᕿᐃᑦ ᓄᕐᖃᐅᕝᕕᖕᒋᓐᓄᙵᐅᓴᕌᖕᖓᑕ ᐱᖓᓐᓇᒥᑦ ᓯᕝᔭᖓᓂᑦ ᑕᓯᐅᔭᕐᔪᐊᑉ, ᑕᐃᒪᓐᓇᒧᑦ ᐊᒥᒎᙵᕆᖃᑦᑕᖅᑐᑦ ᐊᒪᕈᐃᑦ ᐊᒻᒪᓗ ᐊᒪᕈᐃᑦ ᓂᕈᔭᒃᓴᖅᓯᐅᖅᑐᑦ ᓄᕐᕈᐅᖅᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᓄᕐᕈᐅᕋᓃᖅᑎᓪᓗᒋᑦ ᐃᓂᒋᔭᐅᔪᓂᑦ.

ᐊᒪᕈᖃᑦᑕᕐᓃᑦ ᐱᖅᑯᓯᑐᖃᕈᓯᐅᔪᖅ ᓄᓇᕗᒻᒥ ᒪᖃᐃᑎᓄᑦ, ᐊᒻᒪᓗ ᐅᑭᐅᑉ ᐃᓚᖓᓂᑦ ᑮᓇᐅᔭᓕᐅᕈᑕᐅᖃᑦᑕᖅᐳᑎᒃ. ᐊᑑᑎᖃᕐᓂᖓ ᓄᓇᕗᒻᒥ ᐊᒪᕐᓯᐅᖅᑏᑦ ᖁᑦᑎᒃᑐᔭᖅᑐᖅ, ᐊᒥᓱᐃᑦ ᐊᕐᕌᒎᑖᑦ ᐊᒪᕆᖅᑕᐅᖃᑦᑕᖅᐳᑎᒃ ᐃᓚᖏᓐᓂᑦ ᓄᓇᓕᖕᓂᑦ, ᐱᓗᐊᖅᑐᒥᑦ ᐊᕐᕕᐊᓂᑦ, ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐊᒻᒪᓗ ᖁᕐᓗᖅᑐᒥᑦ. ᓄᓇᕗᒻᒥ ᐊᒪᕐᓯᐅᖅᑏᑦ ᐃᓐᓇᐅᓂᖅᓴᐅᔪᓂᒃ ᐊᒪᕐᓯᐅᖃᑦᑕᖅᑑᔭᖅᑐᑦ ᐊᒻᒪᓗ ᐱᐊᓖᓕᐅᖃᑦᑕᖅᑐᓂᒃ ᐃᓚᖏᓐᓂᒃ ᐊᒪᕐᓂᑦ ᐅᑭᐅᖑᓕᕆᖕᒋᑦ ᑭᖑᓂᐊᒍᑦ ᑕᒪᓗᒃᑖᕐᓚᒃ ᐃᖕᒥᓂᑦ ᑐᕐᑯᔪᑦ ᐱᖅᖃᖅᑎᓪᓗᒋᑦ, ᐊᖏᒡᓕᒋᐊᖅᓯᔪᖅ ᐃᓚᓯᓂᕐᒥᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᓂᒃ ᒪᖃᐃᖃᑦᑕᕐᓂᐅᔪᓂᒃ. ᐃᓚᖏᓐᓂᑦ ᐃᓂᐅᔪᓂᑦ ᐊᒪᕆᖅᑕᐅᔪᑦ ᐅᐱᕐᖖᖁᑦ ᐅᑎᖅᐸᓪᓕᐊᑎᓪᓗᒋᑦ ᐊᒥᓲᖕᒋᖃᑦᑕᖅᑐᑦ ᐊᒪᕈᐃᑦ ᐊᒻᒪᓗ ᐊᒪᕈᐃᑦ ᓂᕈᔭᒃᓴᖅᓯᐅᖅᑐᑦ ᓄᕐᕈᐅᕝᕕᐅᔪᓂᑦ ᐊᒻᒪᓗ ᓄᕐᕈᐅᕋᓂᒃᑎᓪᓗᒋᑦ ᐃᓂᒋᔭᐅᔪᓂᑦ. ᐊᒪᕈᐃᑦ ᐊᒥᒌᑎᒋᓂᖏᑦ ᐅᑎᒃᑲᓐᓂᑲᐅᑎᒋᔪᖕᓇᕐᒪᑕ ᐱᓕᕆᐊᖑᓂᖅ ᐲᖅᑕᐅᒃᐸᑕ ᐱᔾᔪᑎᒋᐸᓗᒋᑦ ᐅᑎᖅᑕᖅᑐᑦ ᖃᓂᑦᑐᓂᑦ ᐃᓂᐅᔪᓂᑦ ᐊᒻᒪᓗ ᖁᑦᑎᒃᑑᐸᓗᓂ ᐱᐊᓖᓕᐅᖃᑦᑕᕐᓂᖏᑦ, ᐱᓕᕆᐊᖑᓂᖏᓄᑦ ᑐᕌᖓᔪᖅ ᑲᔪᓯᑎᑕᐅᓯᒪᔭᕆᐊᖃᖅᑐᖅ.

ININGINNI TADJALU QANURILIURUTAIT AMARUNI ANGUNIARNIRNI PIDJUTIKKUT TUKTUT INGILRADJUTAINNI NUNAVUNMI

Aulapkaijini Naittuq Naunaijaruti

Pijuummiqtiqhimajunik amaruni (*Canis lupus*) munaridjutainni qanuriliurutait atuqtauvaktut ikajurnirmun ikikliliqtunun tuktuni (*Rangifer tarandus*). Amigaitqijaujun ingilrainnaqtuni ukiuqtaqtumi tuktuit (*R. t. groenlandicus*) Nunavunmi haniliriiktumilu Nunatsiami (NWT) naliani ikilivallialiqtun imaaluunniit ingilraarnitamin ikikliqpiaqtun amihuarjuutainni. Aullaqtiqhuni 2018-19mi Kitikmeoni pivaliqhunilu tamaat Nunavunmun 2019-20mi, Nunavut Kavamanga (GN) Avatiliqijikkut Havagvia (ENV) hailihimapkaijun manikhanik talvuuna Ikajuutikkut Anguniaqtinun pinhuarutimimi ukununga nunallaami anguniaqtinun anguniarnirnun amarunik tunilutiklu timaanin ihivriuqtakhamik humiinniinnilu naunaitkutainnik. Ihivriuqtavun amaruit angujauhimajun naunaitkutainnik ukunanga 1,500 amarunin anguniaqtinin Nunavunmi uvani 2018-19min uvanilu 2020-21mun naunaijariami humiinninginnik qangalu qanuriliurutait Nunavunmin amarunik angujaujunin pidjutaitigun tuktunun amigainniinnik tunnganiqarhuni qunguhirmiaqaqtunin tuktuinnin. Ihivriuqtavun ukiungit anguhaluujaakhaita arnarluujaakhaita amaruni angujauhimajuni, ukuallu humiittaakhaitat qangalu katihimadjutait anguniaqtaujuni (imaa, naliak anguniarniit ihuarutaukpat nungupkarutainnik tamainnik amaruqatigiingnik). Tunihimajugullu nalautinniarhimalugin qaffiujaakhainnik amaruit pidjutilgit uvani Qamanirjuaq tuktuinni avvainnilu hapkunani amaruni angujauhimajunik Nunavunmin anguniaqtiinnin.

Atuqtilugu 2018-19, 146 amarut titiraqtaujut angujaujut 52nik anguniaqtinin Kitikmeonin, taapkunanngalluarlu anguniaqtinin Kugluktumin. Anguniarnikkut qaffiuniit amigaitqijaujun Tisaipami Fibjualimi–Maymilu, amigaitqijaupluni anguniarniq uvani Aktuupami–Tisaipami ilaujut amaruat aallatqiillu ukiuqarutait angujaujun anguniarvik hivumuutillugu.

Talvani 2019-20, 658 amarut titiraqtauhimajun angujaujun tamaani Nunavunmi, pipluni 64% avvaanik anguniarutinin Arvianin, Qamanittuamin Kugluktuminlu anguniaqtiinnin. Anguniarniit amigaitqijaujun Nuvaipami uvanilu Maatsimi–Maymilu. Talvani 2020-21mi, 699 amarut titiraqhimajun angujaujun, pipluni 68% avvaanik anguniaqtaujun Arvianin, Qamanittuamin Kugluktumillu anguniaqtinin. Taapkuangni ukiuni, amigainniit amaruani angujaujuni ikiklilaaqtuq hivitunirmi taimaalu ikitqijaujullu anguniaqtiit pidjutijun amigaitqijaujumik avvaanik anguhinirmi. Tamatqiutivjaktun (99%) amarunik hiquqtauhimajun ilaquillu naniriaqtauhimajun.

Taimaitkaluaqhuni qanurinniit aallangajun naliinni nunallaani, amarut angujauvaktun qanitqijaujumik nunallaanun hivuagun Quviahukvingmi (imaakiaq iluani 75ni km) ungahitqijaujunilu nunallaanin atukhaarniani ukiup, piqarhuni ungahitqijaujunik Aprilmi Maymilu (talvunga 500nik km). Taimaatun, taapkuat anguniaqtiit ungahikkaluaqhutik nunallaamingin, piplutik tangmaaqpakhutik, nakuujumik anguniaqtun amigaitqijaujunik amarunik. Arvianin anguniaqtiit angujun amarunik ungahiktuni atukhaaqtumi ukiumi, ilaujuqlu avatquhimajumik 450 km haamlanganin 2019-20mi, kihimi pidjutaa anguniarniup amigaitqijauvaktuq qanitiqjaani amigaitqijauniqarnirni tuktuni. Una pidjutaa amigaitqijauniqarnirni uvani Qamanirjuaq tuktuni taimaidjutaa uvani amaruni angujaujuni aallakkiiktun ukiuni. Amigainniit amaruqatiinni angujaujuni aallangajuq nunallaani taimaalu ikiklijuummiqtun amaruqatiit amigairaangata amigaiqhutiklu ukiup hivumuuniani.

Nalautinniaqhimajun qaffiujaakhaita amaruit pidjutilgit uvani Qamanirjuaq tuktuni ihumagijun anguniaqtiit ukiuq tamaat anguvaktait imaakiaq 12-25% avvaani amaruni pidjutilgit atukhaarniani ukiumi upingaamilu ingilradjutainni uvani Qamanirjuaq tuktuinni. Nalautinniarhimajun amaruni qaffiujaakhainni ukunanilu qaffiujuni amarut angujauvaktun tunnganiqaqtun ihumagijaujuni kihiani tautukhimanikkut pidjutainni tuktuni amarunilu qaffiunirni taimaalu uqaqtaujukhat ihumagidjutiinnakkut. Havagjuummirniit ihariagijaujun nakuutqijaujumik qaffiujun amarut pidjutiqarniinni ukunani ingilrainnaqtuni tuktuinni, ukuallaunilu Qamanirjuaq tuktuinni, talvani ukiumi upinnaamilu, kihimi pidjutaani amigaittuni angudjutini amaruni hivuraani uvanilu hivuraani-ualliani Arviani Maatsimi, Aprilmi Maymilu, pijungnaqhijuq qaffiuniit amaruni ukunanilu amarunin-tuqutauvaktun tuktuit ikiklijuummiqpiaqpaktun taimaatun tuktui ingilradjutainni nuriviinnun nunanun ualliani hinaani Kangiqsualuup, pidjutingani qaffiunirnik ikittunik amarunik uvanilu ikittunik amarunin tuqutirutainnik nurrivingni uvanlu pilihaaliqtuni nurrihuirutimi nunainni.

Amarunik anguniarniit pitquhikkut ilaujuq pitquhiinni Nunavunmin anguniaqtiinnin, pidjutiujuqlu qakunguraanga maniliurutait. Nakuuniqarniit uvani Nunavunmin amarunik anguniaqtiinnin qulvahiktutun ittuq, amigaittuni ukiuq tamaat anguniarutinin ilanginnin nunallaanin, ukualluanin Arvianin, Qamanittuamin Kugluktumillu. Nunavunmin amarunik anguniaqtiit tautungnarniqaqtun turaangajait angajukhitqijanik najjijaaqtuni ilainni amaruni atukhaaqniani ukiumi kinguagun amigaitqijanik aularaanginnaqtukkut tuqudjutainnik pikpata, amigaiqjuummiqtiqhugin hapkuat ilaudjutaujun hulqutit hapkunani nunami-tunnganiqaqtun anguniarnikkut havagutit. Ilanginni nunani amaruni anguniarniit upingaami ingilradjutainni pidjutivaktun ikittunik amarunik imaalu ikiklijunik amarunin tuqutirutinik uvani nurrivingni uvanlu nurrihuirutimi nunainni. Taimaatun amaruit amigairniit qilamik amigaiqtaaqmata hanaqidjuti nutqaqtitaugaangat pidjutipluni qaidjutainnik hanianiittunin nunanin ukunangalu amigaittunin najjijunin aktilaanginnin, una pilaqhuutikkut pinahuaruti aulapkaqtitauhimmaaqtukhaq.

TENDANCES SPATIALES ET TEMPORELLES DE LA CHASSE DU LOUP PAR RAPPORT AUX DÉPLACEMENTS DES HARDES DE CARIBOUS AU NUNAVUT

Résumé

Des mesures de gestion du loup (*Canis lupus*) améliorées sont souvent utilisées pour appuyer la restauration des hardes de caribous (*Rangifer tarandus*) en déclin. La plupart des hardes de caribous migrateurs de la toundra (*R. t. groenlandicus)* au Nunavut et dans les Territoires du Nord-Ouest (T.N.-O.) sont en déclin ou à des niveaux de population historiquement bas. Depuis 2018-2019 dans la région de Kitikmeot, et depuis 2019-2020 dans l'ensemble du Nunavut, le ministère de l'Environnement du gouvernement du Nunavut (GN) offre une incitation dans le cadre du programme de soutien aux chasseurs actifs aux chasseurs locaux pour chasser le loup et fournir des échantillons et des données de localisation. Nous avons examiné les données de 1 500 loups tués par des chasseurs au Nunavut entre 2018-2019 et 2020-2021 afin de décrire les tendances spatiales et temporelles de la chasse du loup au Nunavut par rapport aux densités de caribous, fondées sur les animaux munis d'un collier. Nous avons examiné la structure par âge et par genre des loups chassés, ainsi que le regroupement spatial et temporel de la récolte (c.-à-d. si la chasse peut efficacement éliminer des meutes entières). Nous avons également fourni des estimations approximatives du nombre de loups associés à la harde de caribous de Qamanirjuaq et de la proportion de ces loups récoltés par les chasseurs du Nunavut.

En 2018-2019, 146 loups ont été récoltés par 52 chasseurs dans le Kitikmeot, principalement par des chasseurs de Kugluktuk. Le nombre de prises a atteint un sommet en décembre et en février-mai, avec une forte proportion de la récolte d'octobre à décembre ayant étant composée de jeunes loups. La distribution des âges des prises s'est élargie au fur et à mesure que la saison a avancé.

En 2019-2020, 658 loups ont été récoltés dans l'ensemble du Nunavut, dont 64 % par des chasseurs d'Arviat, de Baker Lake et de Kugluktuk. La récolte a atteint un sommet en novembre et en mars-mai. En 2020-2021, 699 loups ont été récoltés dans l'ensemble du Nunavut, dont 68 % par des chasseurs d'Arviat, de Baker Lake et de Kugluktuk. Au cours de ces deux années, la proportion de jeunes loups dans la récolte a diminué au fil du temps et un nombre relativement faible de chasseurs a contribué à une majorité de la récolte. Presque tous les loups (99 %) ont été abattus et le reste a été piégé.

Les tendances diffèrent d'une collectivité à l'autre, mais avant Noël, les loups étaient généralement récoltés près des collectivités (dans un rayon d'environ 75 km) et plus tard en hiver, ils l'étaient loin des collectivités, les plus grandes distances ayant été en avril et en mai (jusqu'à 500 km). Ainsi, même si les chasseurs étaient loin de leurs collectivités, nécessitant de camper sur site lors d'excursions de plus d'une journée, ils pouvaient efficacement récolter un plus grand nombre de loups. Les chasseurs d'Arviat ont chassé les loups sur une grande distance plus tard au cours de l'hiver, y compris à plus de 450 km du hameau en 2019-2020, mais la distribution des prises était supérieure plus près des densités élevées de caribous. La distribution des fortes densités de caribou de Qamanirjuaq et, par conséquent, la récolte de loups, a différé d'une année à l'autre. La proportion de meutes récoltées variait d'une collectivité à l'autre et diminuait généralement à mesure que la taille des meutes augmentait, et augmentait au fur et à mesure que la saison avançait.

Des estimations approximatives du nombre de loups associés à la harde de caribous de Qamanirjuaq suggèrent que les chasseurs ont éliminé annuellement environ 12 à 25 % des loups associés aux déplacements de la harde de Qamanirjuaq à la fin de l'hiver et au printemps. Les estimations du nombre de loups et de la proportion de loups récoltés sont fondées sur des relations présumées plutôt qu'observées entre le nombre de caribous et de loups et doivent donc être interprétées avec beaucoup de prudence. Du travail supplémentaire est nécessaire pour mieux estimer le nombre de loups qui pourraient être associés aux hardes migratrices, en particulier la harde de Qamanirjuaq, en hiver et au printemps, mais compte tenu des prises élevées de loups au sud et au sud-ouest d'Arviat en mars, en avril et en mai, il est probable que le nombre de loups et de caribous tués par les loups diminue considérablement à mesure que la harde migre vers ses aires de mise bas à l'ouest de la côte de la baie d'Hudson, entrainant ainsi un faible nombre de loups et une réduction de la prédation des loups dans les aires de mise bas et de début de la période postvêlage.

La chasse du loup fait partie intégrante de la culture des chasseurs du Nunavut et constitue une source de revenus saisonniers. L'efficacité des chasseurs de loups du Nunavut semble élevée, compte tenu des récoltes annuelles importantes dans certaines collectivités, en particulier Arviat, Baker Lake et Kugluktuk. Les chasseurs de loups du Nunavut semblent être en mesure de cibler les parties plus âgées et vraisemblablement reproductrices de la population plus tard au cours de l'hiver, après que la plupart des pertes naturelles se soient produites, ce qui augmente les effets cumulatifs de ces efforts de récolte au sol. Dans certaines régions, la récolte du loup pendant la migration printanière réduit le nombre de loups ainsi que la prédation des loups dans les aires de mise bas et de postvêlage. En raison du fait que les populations de loups peuvent rapidement rebondir lorsque le traitement est retiré en raison de l'immigration en provenance des régions environnantes et des taux de reproduction élevés, le programme d'incitation devrait être poursuivi.

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Introduction

Enhanced wolf (*Canis lupus*) management actions are often employed to support recovery of declining caribou (*Rangifer tarandus*) herds. These actions may include hunter training, support or incentives for ground-based harvesting, sterilization, poisoning, and aerial shooting, among other wolf removal options (Adams et al. 2008, Farnell 2009, Russell 2010, Hayes 2013, McLaren 2016, Boertje et al. 2017, WFATWG 2017). Experience in many jurisdictions suggests that wolf removal must be greater than 55–60% of the population annually for ≥4 years and carried out over a large area to maintain reduced wolf densities sufficiently to elicit a demographic response in an ungulate population (National Research Council 1997, McLaren 2016, Nishi et al. 2020). These levels of wolf harvest are often difficult for ground-based harvesting efforts to attain (Webb et al. 2011, McLaren 2016). Aerial shooting (often coupled with collaring of ≥1 member of a pack) has been effective in some areas (Russell 2010, Hayes 2013, McLaren 2016), but can be compromised by comparatively low wolf densities and difficulties in locating wolves, and high costs (WFATWG 2017, Nishi et al. 2020). Predator management strategies on migratory wolves following migratory herds are even more challenging (McLaren 2016). By late fall when young wolves are large and strong enough to travel with the pack, most wolves within the range of migratory caribou herds resume their close association with the migratory caribou and maintain it throughout winter (Musiani et al. 2007, Clark et al. 2021).

Most herds of migratory tundra caribou (*R. t. groenlandicus*) in Nunavut and adjacent Northwest Territories (NWT) are either in decline or at historically low population levels (COSEWIC 2016). Evidence from traditional and scientific sources indicates that caribou herds periodically increase and decrease at some interval (COSEWIC 2016, Bongelli et al. 2020). Although not fully understood, cyclical changes are likely largely due to trends in range quality, habitat disturbance (i.e., forest fires), climate, predation, disease and anthropogenic influences (COSEWIC 2016). Wolf predation is often singled out as a significant contributing factor (Hayes and Russell 2000, Russell 2010). Wolves are known to predate both adults and calves (Bergerud et al. 2008), and managing the wolf populations to reduce wolf predation on caribou is one of the few management levers available.

To support recovery of the Bathurst and Bluenose-East caribou herds, the Government of the NWT (GNWT) Environment and Climate Change (ECC) and Tłı̨chǫ Government (TG) began an aerial shooting program to supplement community wolf harvest incentive programs in late winter 2019-20, but the effectiveness of this program to reach wolf reduction targets (60–80% removal levels) within winter range has yet to be clarified (Nishi et al. 2020). Beginning in 2018-19 in the Kitikmeot Region and expanding to all of Nunavut in 2019-20, the Government of Nunavut (GN) Department of Environment (ENV) through the Support for Active Harvesters program offered compensation to local hunters to harvest wolves and provide samples and location data. Nearly 150 wolves were harvested by local hunters in the Kitikmeot in 2018-19, and over 650 and about 700 wolves were harvested Nunavut-wide during 2019-20 and 2020-21, respectively, the vast majority from within the Kitikmeot and Kivalliq regions. Through sample collection forms, carcass examination, and age analysis, we determined the location, date, sex and age of these harvested wolves. These data, coupled with GN and GNWT collar data of caribou herds in Nunavut, provide an opportunity to examine the spatial and temporal patterns of the wolf harvest in relation to caribou herd movements and distance from communities. Nunavut hunters are in a unique position as they are able to effectively hunt wolves on good snow conditions in the open tundra, as opposed to within the treeline where soft snow and forests often hamper hunter travel and effectiveness.

Although most migratory caribou herds within mainland NWT and Nunavut have shown steep rates of decline and low abundance, for example the Bathurst and Bluenose-East herds (Adamczewski et al. 2022, Boulanger et al. 2022), the Qamanirjuaq herd in the Kivalliq Region of Nunavut has instead demonstrated a moderate rate of decline of 2% based on the 2017 calving ground survey (Boulanger et al. 2018). Of key interest is whether relative stability of the Qamanirjuaq herd can be correlated to the more intensive wolf harvest measures undertaken on this herds' range.

The objectives of this analysis were:

1. Using GIS, describe the spatial and temporal patterns of the wolf harvest in Nunavut in relation to inferences of caribou herd locations/densities from collared caribou and distance from communities;
2. Temporally document the age and sex structure of the wolf harvest, including examination of spatial and temporal clustering of the harvest (i.e., whether hunting is effective at removing entire packs); and
3. Estimate shifts in age structure of wolves harvested as an index of the effectiveness of the ground-based wolf control program.

Study Area

While the Support for Active Harvesters program applied to all of Nunavut, our analysis of wolf harvest locations in relation to caribou distribution focussed on the Kitikmeot and Kivalliq regions within Nunavut, primarily mainland Nunavut and Victoria Island (Fig. 1). Other islands and peninsulas adjacent to and north of the Nunavut mainland (e.g., King William Island and Boothia Peninsula) had no supporting caribou collar data. Comparatively few wolves were harvested in the Qikiqtaaluk region during the study and there was no reported harvest on Baffin Island.

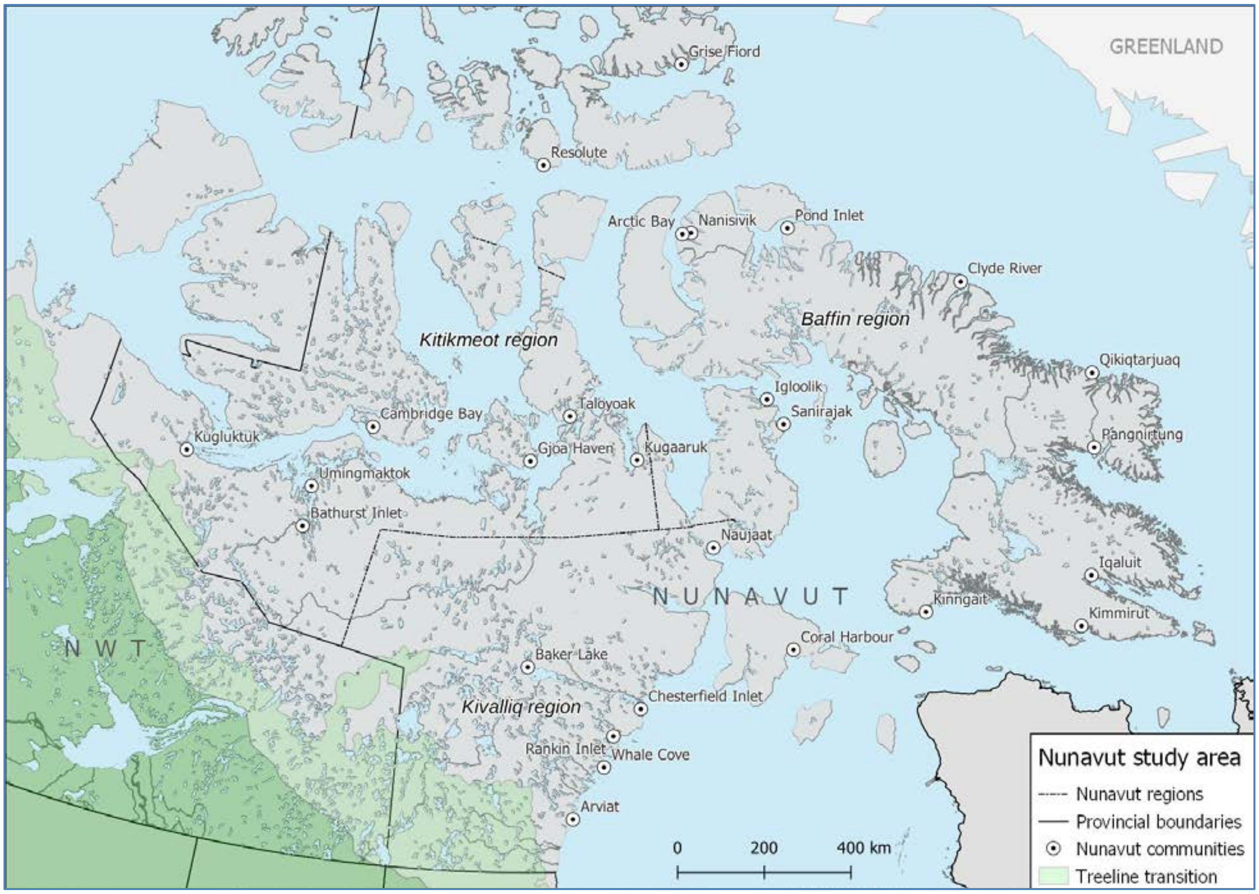

Figure 1. Map of Nunavut and communities; the Support for Active Harvesters program applies to the entire territory.

Study Design and Methodology

Spatial data acquisition

Wolf harvest data

Wolves occupy almost all of Nunavut, and are classified as both a furbearer and a big game mammal under the Nunavut Agreement (https://www.tc.canada.ca/sites/default/files/migrated/nunavut_land_claims_agreement.pdf). Under the Nunavut Agreement, furbearer harvest privileges are held by Inuit beneficiaries, non-Inuit who harvested furbearers legally in the Nunavut settlement area prior to 1981, and non-Inuit whose application has been approved by local Hunters and Trappers Organizations (HTOs). Unlike most provinces, hunters and trappers in Nunavut do not have registered or traditionally exclusive family trap lines or hunting areas.

Wolf hunting in Nunavut is mainly by firearms from snowmobiles, with few wolves trapped. With a very limited road network in the territory, snowmobiles are a vital form of transportation which hunters use to harvest wolves because it is the only practical method given the wide-open spaces of the Nunavut tundra. Early in the season (October to February) most hunters harvest wolves on day or weekend trips while harvesting caribou or muskoxen (*Ovibos moschatus*). From March onward hunter groups generally take trips 1–2 weeks in length specifically for wolf hunting.

There are no estimates of wolf numbers within Nunavut. Both migratory and resident wolves occur within the territory, with most individuals moving with migrating caribou herds. Additional large prey for wolves includes populations of muskoxen which are expanding throughout most of the mainland (with lower densities further east and northeast within Nunavut; Campbell and Lee 2019) and moose (*Alces alces*) around Bathurst Inlet and along the treeline, areas supporting quantities of shrubs. Other carnivores in the area include Arctic fox (*Vulpes lagopus*), red fox (*V. vulpes*), wolverine (*Gulo gulo*), grizzly bear (*Ursus arctos*) and black bear (*U. americanus*) along the treeline. Polar bears (*U. maritimus*) occur along coastal areas.

Each year we obtained the skull and a small piece of skin (~2.5 x 2.5 cm) with fur from hunters with the assistance of HTOs and Conservation Officers (CO). A $300 subsidy was provided to hunters for each skull brought back to their wildlife office to encourage the reporting and return of samples. For each wolf sample collected during the course of this study, COs filled out sample collection forms with information from hunters about their name (known only to the senior author) and home community, the harvest date, location, wolf sex, and method of harvest, and their opinion about the current abundance trend of the local wolf population: "Do you think the wolf population is decreasing, stable or increasing". The skinned skulls were stored frozen, and were thawed at room temperature for examination in early May each year. We sent the first premolar to Matson's Laboratory LLC (Milltown, MT, USA) for age estimation using cementum analysis. This technique is based on the cyclic nature of cementum growth in teeth forming annular patterns of different darkness depending on the season (Matson 1981). Following Mech (1970) and Gese and Mech (1991), individuals were then grouped into three age classes: juvenile (0-year-old), yearling (1-year-old) and adult (≥2 years).

Kitikmeot 2018-19: To support harvesting activities and contribute to the knowledge of wolf ecology and species management in Nunavut, ENV launched a pilot project of skull collections within the Kitikmeot Region as part of the Support for Active Harvesters Program and in response to community concerns, to provide samples for scientific research and examine wolf harvest effort and use of wolf harvest as a management tool in caribou recovery. There was no limit to the number of wolves submitted.

Nunavut 2019-20 and 2020-21: The Kitikmeot program was expanded Nunavut-wide in September 2019, again with no limit to the number of skulls submitted. Nunavut hunters killing wolves within the NWT North Slave Wolf Harvest Incentive Area received an additional $900 payment from the GNWT.

Caribou collar data

Caribou collar locations from October 2018 to June 2021 from collars deployed by ENV were obtained for the Qamanirjuaq (QM), Lorillard (LR), Wager Bay (WB), Ahiak (AH) and Dolphin and Union (DU) herds within Nunavut (Caslys Consulting Ltd., Saanichton, BC). Collar data from the DU herd ran from April 2015 to early December 2020, and resumed in April 2021 with additional collaring. Collars were deployed by ECC on the Bluenose-East (BE), Bathurst (BA) and Beverly/Ahiak (BV) herds (ENR 2021). Here we consider the Beverly and Beverly/Ahiak herds to be synonymous. Within the Nunavut data set all animals with Herd = UK designation were visually confirmed as QM caribou. Within the ECC data set, 13 of 18 caribou with

Herd = NA (not available) were assigned to herd based on movement paths or association with other collared caribou. Both sexes were represented in the collar data, with increasing numbers of bulls collared after 2015.

Collar fix rate varied, with most collars providing from 1 to several GPS locations daily. Over 1.5 million caribou collar locations were obtained. To facilitate GIS computations, to prevent more frequent fixes from skewing (unduly weighting) collar density maps, and because we did not require fine-scale temporal resolution to the data, we thinned/rarefied the data sets to one location daily and subset the collar data sets to cover the period from October 2018 to June 2021 (covering the 3 years of wolf harvest data). The ECC collar data had time and datetime stamp but Nunavut and DU data did not have a time component.

Data preparation

We conducted spatial analysis in QGIS (QGIS Development Team 2020), GRASS (GRASS Development Team 2020) and MapInfo (MapInfo 2000) using the Canada Lambert Conformal Conic (LCC) projection. We first conducted telemetry density (heat) mapping (kernel density estimation; Downs and Horner 2012) to display monthly patterns of caribou distribution. To determine heat map kernel radius, we estimated the median daily movements among the Nunavut and ECC data sets by month:

1. We added LLC coordinates to the files.
2. We sorted the data sets by caribou identification and date, and calculated the distance (in metres) between successive locations.
3. We calculated the number of days between successive fixes and applied a filter to remove all times >1 day, which accounts for missed fixes where a daily location was not obtained.
4. We calculated the mean distance moved per day by animal and month.
5. We calculated the animal sample size and median distance moved by month. Not unexpectedly, the median daily movement distances differed somewhat between the Nunavut and ECC data sets, and we used the average between data sets for heat mapping (Fig. 2).

Caribou herds often overlapped spatially and temporally; thus, the caribou heat map was run on the combined collar data set from all herds. However, sample sizes of collars varied among herds and over time as does the recent population estimate for each herd. For example, in December 2018 there were 27 collars on BA caribou, out of a population of approximately 8,200 (Adamczewski et al. 2019), thus each collar "represented" about 300 caribou. In contrast, there were 49 collars on QM caribou out of an estimated 288,000 caribou (Boulanger et al. 2018) – roughly one collar for every 5,900 caribou. To account for these differences, we weighted each caribou collar location by a relative factor of representativeness, ranging from 1 (DU or BA herds) to a high of 87 for the QM herd, based on the number of collared individuals and the most recent herd estimate (Appendix 1).

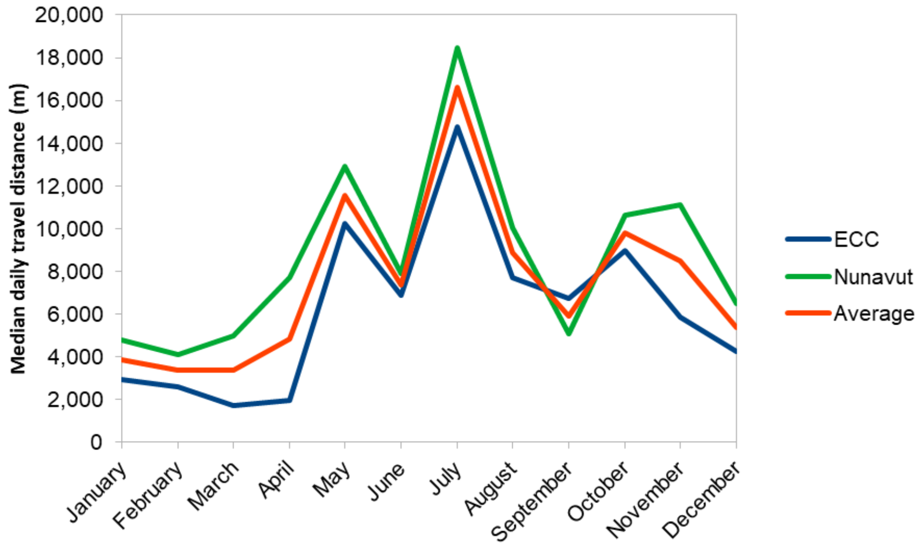

Figure 2. Median daily movement distances (m) by caribou for the GNWT Environment and Climate Change (ECC), and Government of Nunavut Department of Environment (Nunavut) data sets.

We used heat mapping to demonstrate the relative distribution of caribou collars on a monthly basis using the monthly median for kernel radius and Epanechnikov kernel shape (QGIS Heatmap plugin). To highlight areas where caribou collar density (and presumably caribou distribution) was greatest we mapped centers of activity as collar density above the mean map average (the average density across all mapped caribou distribution).

We produced monthly maps showing caribou distribution and the distribution of reported wolf harvests. Given the scale of mapping, adjacent wolf kill locations within ~25 km were shown on the maps as a single dot representing the cumulative number of wolves harvested.

For each reported wolf kill location we calculated:

1. The distance to the nearest caribou heat map boundary (the mapped boundary between caribou distribution and no caribou);
2. The distance to the nearest caribou center of activity (collar densities greater than the map average); and
3. Distance to the community from the kill data, where the hunting party originated.

To demonstrate the distribution of caribou herds in relation to the wolf harvest we also produced a single month's map from all seasons (March 2019, April 2020 and April 2021) using un-weighted heat mapping for each herd. We used a 10-km kernel for each herd.

Proportion of wolf packs harvested

We examined the spatial and temporal clustering of the harvest in an effort to assess whether hunting was effective at removing entire packs. We used two methods to examine this question. In the "QGIS assessment" method we examined the locations and dates of wolf harvest by community. Within the database we used reported data on whether the harvested wolf was alone, the number of individual wolves observed and comments to determine what proportion of entire groups were removed, as well as spatial and temporal associations to better interpret the data. For example, if two different wolf harvests on the same day within reasonable proximity to each other (often <5 km to a maximum of 15 km) both said pack size was two, we assumed the entire pack of two was removed. To a large extent this depended on accurate reporting of wolf harvest locations and whether the number of individual wolves in the pack was recorded. If no pack size was recorded the number of wolves in the pack prior to harvest was unknown.

In addition to the visual grouping, we also conducted a "rules-based" date and distance data assessment to 'assign' pack size using a hierarchical approach to group observations, initially grouping by community, date and location, assigning 6 apparent lone wolves to pairs (same date and latitude-longitude). We found some issues with the data where observed pack size and whether more than a lone wolf was observed and harvested were not consistently recorded. In addition, observations of harvest on the same day within a 5–10 km were considered a pack. If no observations of pack size were noted then the number observed was set equal to the number harvested for a given group. This may underestimate the number observed, however, again, it was not possible to evaluate this potential bias with the information available. We acknowledge that this approach might not classify packs or all harvest events correctly. For example, if a pack was hunted over a long distance with different latitude-longitude for each kill then it is possible that the pack would be divided into multiple harvest groups. As discussed later, to mitigate these issues we suggest that future data collection should include a "pack ID" of similar on each set of records in the database to delineate whether the same group of wolves was targeted among records.

Logistic regression (Hosmer and Lemeshow 2000) was used to test for factors that affected harvest success, with harvest success estimated as wolves harvested divided by wolves observed. An event/trials input format was used (i.e., wolves harvested/wolves observed) for logistic regression models, therefore accounting for different sample sizes of wolves observed in the estimation of percent harvested. Logistic regression analysis was conducted using the *glm* function included in program R (R Development Core Team 2009). Results from all analyses were plotted using the *ggplot2* package (Wickham 2009) with GIS analyses conducted using the *sf* package (Pebesma 2018) in *R.* Data manipulation was conducted using the *dplyr* (Wickham 2011) and *lubridate* (Grolemund and Wickham 2011) *R* packages.

Results

Wolf harvest

Seasonal caribou movements generally matched known patterns of calving in northern and eastern mainland Nunavut followed by movements south and west away from calving areas towards and into treeline for the winter (see monthly heat maps in Appendix 2). Collared DU caribou mostly calved and summered on Victoria Island and wintered on the Nunavut mainland.

Kitikmeot 2018-19

During 2018-19, 146 wolves were recorded harvested within the Kitikmeot, primarily by hunters from Kugluktuk (69% of the regional harvest; Table 1). Two main concentrations of harvest were detected from Kugluktuk hunters, around Napaktulik (Takijuq) Lake (*n* = 41) and around the northern portion of Contwoyto Lake (*n* = 44; Fig. 3). Cambridge Bay hunters primarily harvested wolves on the south coast of Victoria Island <100 km from the community and on Kent Peninsula. All wolves were reported as shot.

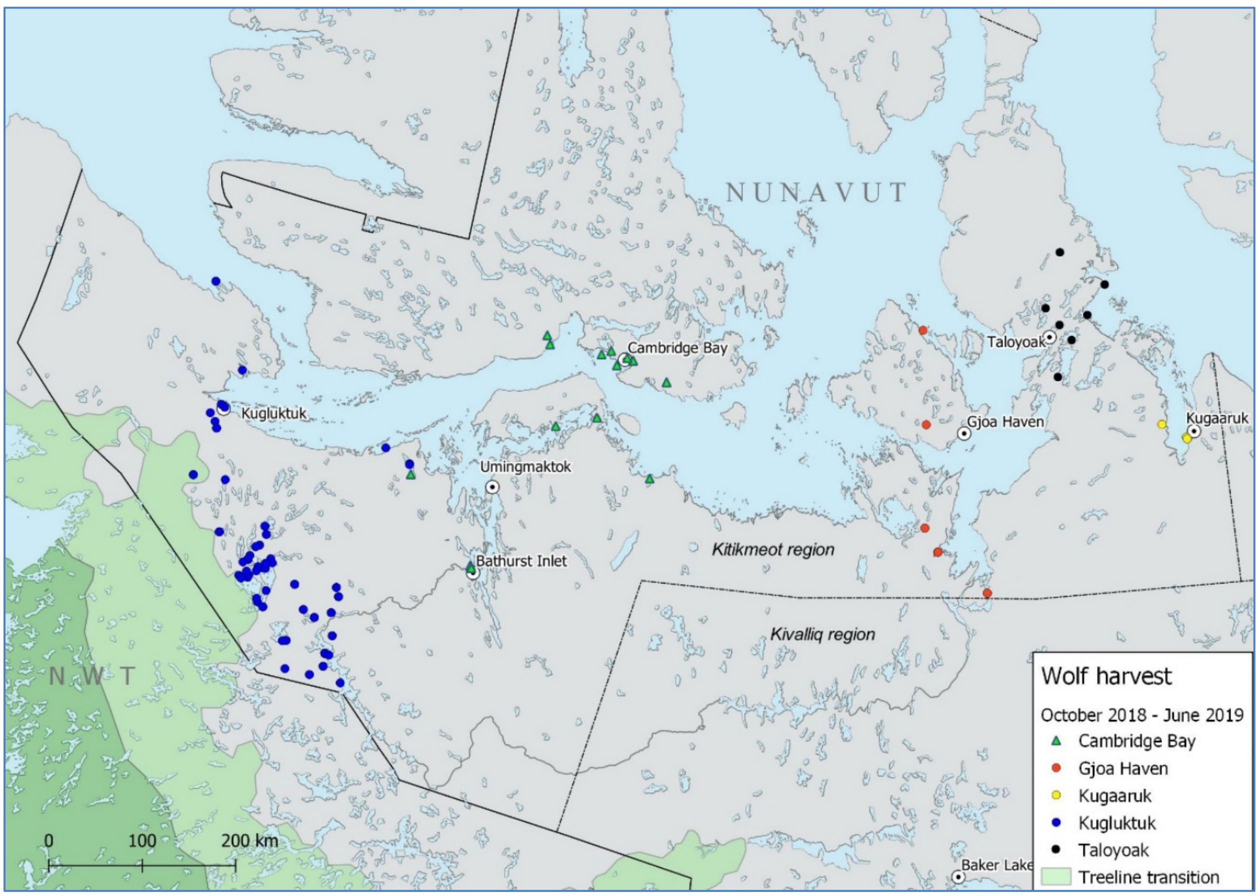

Figure 3. Distribution of reported wolf harvest in the Kitikmeot Region, 2018-19. Symbols may represent >1 wolf harvested at that location.

Table 1. Number and sex of recorded wolf harvests by community, Kitikmeot Region, 2018-19.

Community	Female	Male	Unknown	Total
Kugluktuk	36	50	15	101
Cambridge Bay	10	11	0	21
Gjoa Haven	2	11	0	13
Taloyoak	1	5	2	8
Kugaaruk	2	1	0	3
Total	51	78	17	146

A total of 52 hunters reported harvesting wolves. A single hunter from Kugluktuk (resident of an outpost camp) accounted for 32% of the regions' harvest (Table 2).

Table 2. Distribution of wolf harvest by individual hunters, Kitikmeot Region, 2018-19.

Number of wolves	1	2	3	4	5	6	12	46
Number of hunters	31	11	2	2	3	1	1	1
% of harvest	21	15	4	6	10	4	8	32

Four wolves were recorded as harvested in October and November 2018 (all relatively closes to communities), with increased harvest in December (Table 3). Nearly three-quarters (71%) of the regional harvest occurred during February to May.

Table 3. Distribution (*n* = 146), mean age (*n* = 139) and proportion of males (*n* = 128) in the monthly wolf harvest, Kitikmeot Region, 2018-19.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Number	2	2	21	11	31	25	27	21	6
Age (yrs)									
Mean	0.5	1.0	1.7	2.8	3.5	3.6	1.5	3.0	2.2
SE	0.49		0.52	0.60	0.47	0.52	0.35	0.48	0.90
n	2	1	21	10	29	25	25	20	6
Sex									
% males	100	100	67	55	52	60	52	68	100
n	2	2	6	11	31	25	27	19	5

Males comprised 60% of the harvest, with a slight peak in males in the harvest early and late in the season (Table 3). The age distribution of harvested wolves (*n* = 139) changed as the season progressed with juveniles comprising 54% of the harvest during October to December, with higher proportions of 1–3-

year-olds later in the season (Table 3, Fig. 4). Juveniles were heavily harvested early in the season and a wider distribution of ages harvested as the season progressed. The mean age of harvested wolves peaked in February and March (Table 3).

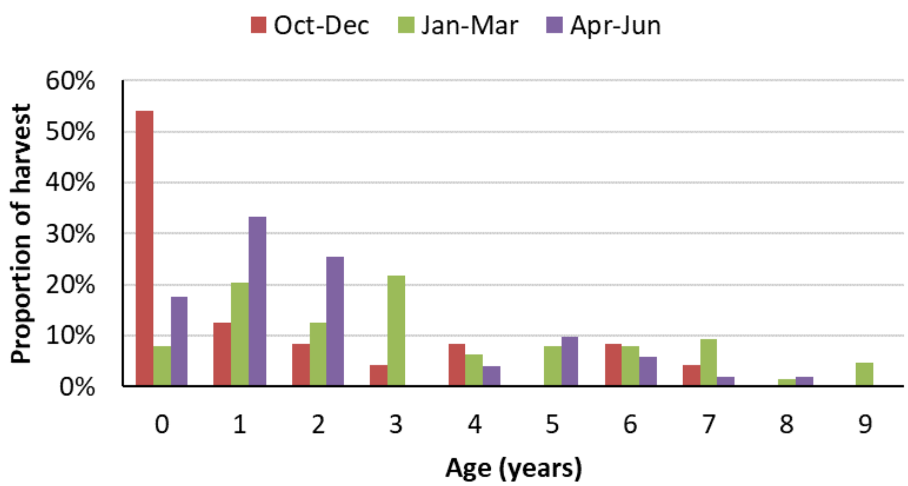

Figure 4. Distribution of age of harvested wolves by 3-month period, Kitikmeot Region, 2018-19 (*n* = 139).

Nunavut 2019-20

During 2019-20, 658 wolves were recorded harvested within Nunavut, with 64% of the harvest from Arviat, Baker Lake and Kugluktuk hunters (Fig. 5; Table 4). Only 34 wolves were reported harvested within the Qikiqtaaluk region (within the High Arctic), 5% of the Nunavut collection. Concentrations of harvested wolves included west and southwest of Arviat, near Dubawnt Lake, about 350 km west of Arviat, 50 km north of Baker Lake, and north of Aberdeen Lake. Rankin Inlet hunters occasionally travelled to meet the returning QM herd in late spring, to areas traditionally hunted by Arviat hunters. The distribution of peak harvest was bi-modal, with a small peak in November and a higher peak in March-May (Table 5). Six of the wolves (1%) were reported as trapped (4 of these from Baker Lake) and the remainder were shot.

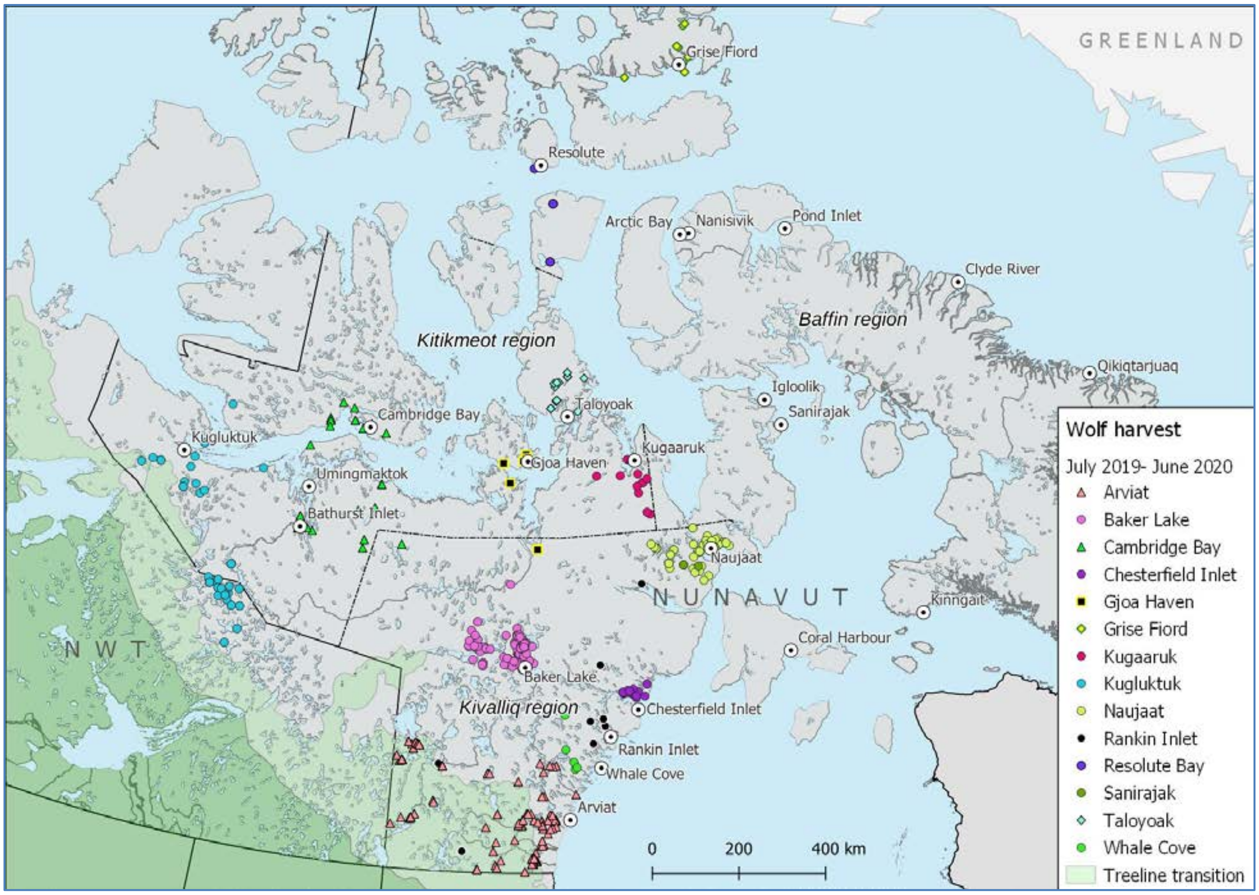

Figure 5. Distribution of reported wolf harvest in Nunavut, 2019-20. Symbols may represent >1 wolf harvested at that location.

Table 4. Number and sex of recorded wolf harvests by community, Nunavut, 2019-20.

Region	Community	Female	Male	Unknown	Total
Kitikmeot		**69**	**83**	**1**	**155**
	Cambridge Bay	10	25		35
	Gjoa Haven	4	5	1	10
	Kugaaruk	2	13		15
	Kugluktuk	29	35		64
	Taloyoak	24	5		29
Kivalliq		**188**	**226**	**57**	**471**
	Arviat	70	97	57	224
	Baker Lake	63	67		130
	Chesterfield Inlet	10	8		18
	Naujaat	28	30		58
	Rankin Inlet	13	23		36
	Whale Cove	4	1		5
Qikiqtaaluk		**13**	**18**	**3**	**34**
	Grise Fiord	1	7	3	11
	Sanirajak	2	1		3
	Resolute Bay	10	10		20
	Total	**270**	**327**	**61**	**658**

Table 5. Distribution (*n* = 653), mean age (*n* = 604) and proportion of males (*n* = 592) in the monthly wolf harvest, Nunavut, 2019-20.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No.	2	2	7	17	95	41	39	53	128	182	83	4
Age (yrs)												
Mean	4.0	0.5	0.5	1.7	1.3	1.3	0.9	1.5	1.5	1.4	1.8	1.0
SE	3.00	0.50	0.50	0.55	0.24	0.27	0.24	0.27	0.18	0.15	0.19	0.00
n	2	2	4	17	93	40	39	52	116	174	63	2
Sex												
% males	100	100	86	47	54	34	69	51	54	60	55	25
n	1	2	7	17	95	41	39	53	113	145	75	4

Male wolves comprised 55% of the Nunavut harvest in 2019-20, with higher proportions of the males in the harvest from January to May (Table 5). The age distribution of younger harvested wolves changed as the season progressed with juveniles comprising 53% of the harvest during October to December and declining, and yearlings comprising 23% of the harvest and increasing (Fig. 6). The proportion of harvested adult wolves changed little as the season progressed. The mean age of harvested wolves peaked early and late in the winter (Table 5).

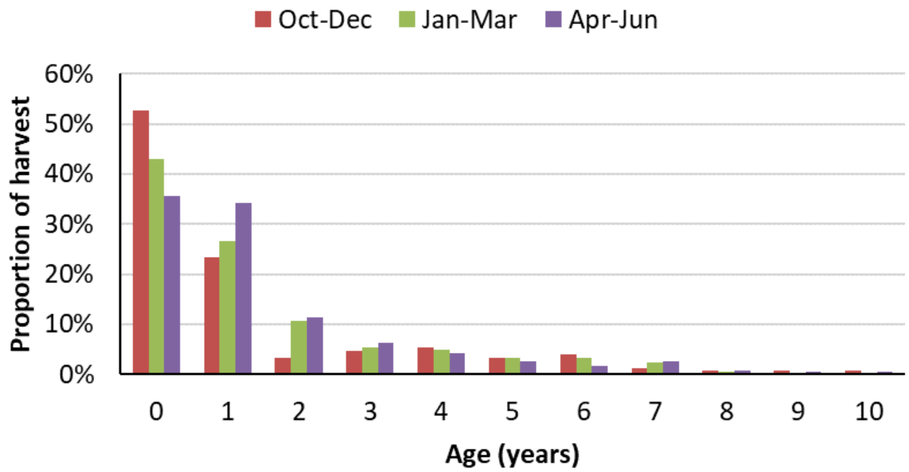

Figure 6. Distribution of age of harvested wolves by 3-month period, Nunavut, October 2019 – June 2020 (*n* = 596).

A total of 471 wolves were harvested by 123 hunters in the Kivalliq region during the 2019-20 season. (Table 6). Ten hunters (8%) each harvested over 10 wolves, contributing 38% of the wolf harvest, and 18 hunters (15%) took just over 50% of the wolves. A similar pattern was evident in the Kitikmeot region, with 8 (13%) of the 60 hunters harvesting 44% of the 153 wolves. Seven of the 21 hunters (33%) contributed nearly 60% of the 34 wolves harvested in the Qikiqtaaluk region.

Table 6. Distribution of wolf harvest by individual hunters by region, Nunavut, 2019-20.

Kitikmeot Region											
Number of wolves	1	2	3	4	5	6	7	8	11	18	
Number of hunters	36	6	4	5	1	4	1	1	1	1	
% of harvest	23	8	8	11	3	16	5	6	8	12	
Kivalliq Region											
Number of wolves	1	2	3	4	5	6	7	8	9	10	11-26
Number of hunters	49	22	16	5	13	2	1	1	2	2	10
% of harvest	10	9	10	4	14	3	1	2	4	4	38
Qikiqtaaluk Region											
Number of wolves	1	2	3	5							
Number of hunters	14	3	3	1							
% of harvest	41	18	26	15							

Nunavut 2020-21

During 2020-21, 699 wolves were recorded harvested within Nunavut, with 68% of the harvest from Arviat, Baker Lake and Kugluktuk hunters (Fig. 7; Table 7). Eight wolves were reported harvested within the Qikiqtaaluk region, 1% of the Nunavut total. Concentrations of harvested wolves included southwest of Arviat (but not as far west as in 2019-20), north, west and south of Baker Lake, and north of Point Lake in the NWT. Seven of the wolves (1%) were reported as trapped and the remainder were shot.

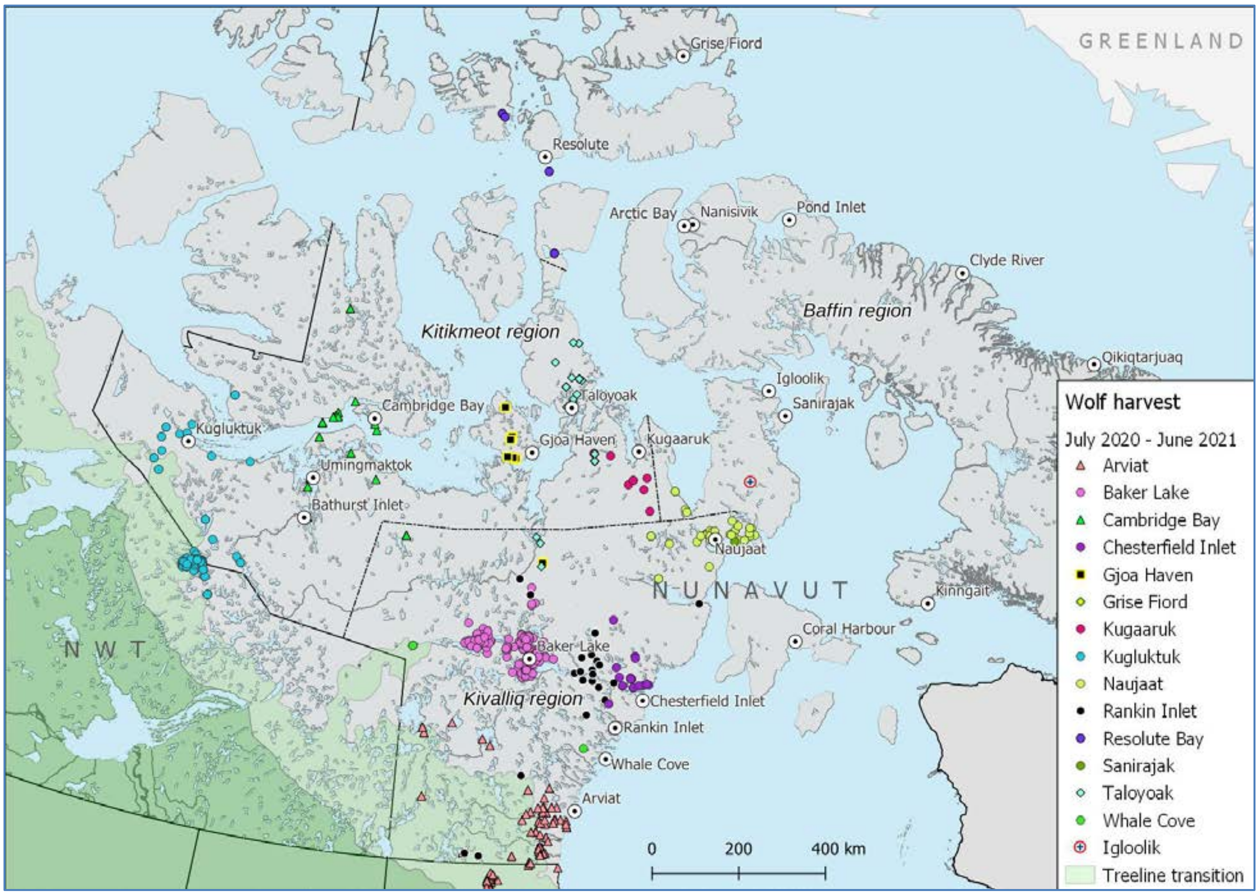

Figure 7. Distribution of reported wolf harvest in Nunavut, 2020-21. Symbols may represent >1 wolf harvested at that location.

Male wolves comprised 56% of the Nunavut harvest in 2020-21 (Table 7), with higher proportions of the males in the harvest in December and March (Table 8). The age distribution of younger harvested wolves changed as the season progressed with juveniles comprising 56% of the harvest during October to December and declining, and yearlings comprising 26% of the harvest and increasing (Fig. 8). The proportion of harvested 2-year-olds increased as the season progressed, and more 3–5-year-olds were harvested mid-winter. The mean age of harvested wolves peaked early and late in the winter (Table 8).

Table 7. Number and sex of recorded wolf harvests by community, Nunavut, 2020-21.

Region	Community	Female	Male	Unknown	Total
Kitikmeot		**84**	**120**	**10**	**214**
	Cambridge Bay	15	21		36
	Gjoa Haven	4	5		9
	Kugaaruk	5	7		12
	Kugluktuk	48	67	10	125
	Taloyoak	12	20		32
Kivalliq		**215**	**261**	**1**	**477**
	Arviat	58	74		132
	Baker Lake	108	113		221
	Chesterfield Inlet	8	15		23
	Naujaat	20	29	1	50
	Rankin Inlet	21	26		47
	Whale Cove		4		4
Qikiqtaaluk		**6**	**2**		**8**
	Sanirajak	1			1
	Igloolik		1		1
	Resolute Bay	5	1		6
	Total	**305**	**383**	**11**	**699**

Table 8. Distribution (*n* = 699), mean age (*n* = 599) and proportion of males (*n* = 685) in the monthly wolf harvest, Nunavut, 2020-21.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No.	4	1	5	7	113	81	85	78	142	113	60	6
Age (yrs)												
Mean	1.3	8.0	1.8	0.4	1.1	1.3	0.8	0.9	1.4	0.8	2.1	0.8
SE	0.33	0.00	1.18	0.20	0.19	0.22	0.17	0.18	0.16	0.18	0.28	0.17
n	3	1	4	7	113	80	79	53	114	81	58	6
Sex												
% males	50	100	60	86	53	59	46	54	64	55	47	83
n	4	1	5	7	113	81	85	78	141	104	60	6

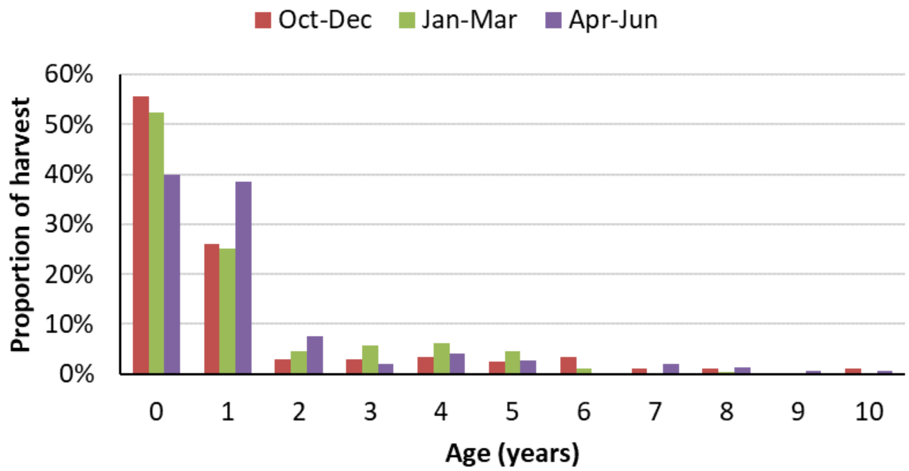

Figure 8. Distribution of age of harvested wolves by 3-month period, Nunavut, October 2020 – June 2021 (n = 591).

Summing among years, young wolves (aged 0–1 years) comprised 70–80% of the annual harvest in the Kitikmeot and Kivalliq regions in 2019-20 and 2020-21, increasing from 43% of the Kitikmeot harvest in 2018-19 (Fig. 9).

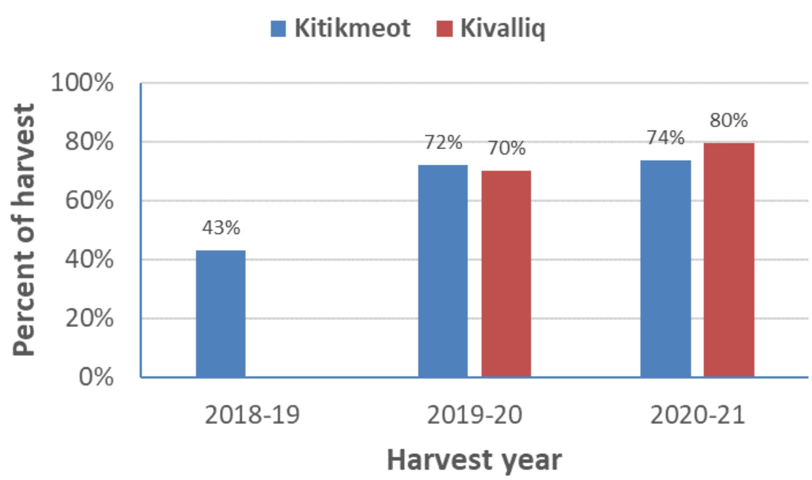

Figure 9. Proportion of young wolves within the annual harvest by Nunavut region, 2019-21.

A total of 477 wolves were harvested by 122 hunters in the Kivalliq region during the 2020-21 season. (Table 9). Nine hunters (7%) each harvested from 11-54 wolves, contributing 38% of the wolf harvest. One hunter from Baker Lake harvested 54 wolves, fully 11% of the regions harvest. In the Kitikmeot region, 4 (6%) of the 64 hunters harvesting 39% of the 214 wolves harvested, and one hunter accounted for 12% of the regions harvest.

Table 9. Distribution of wolf harvest by individual hunters by region, Nunavut, 2020-21.

Kitikmeot Region											
Number of wolves	1	2	3	4	5	6	8	10	11	26	
Number of hunters	31	7	13	3	1	2	2	1	2	1	
% of harvest	14	7	18	6	2	6	7	5	10	12	
Kivalliq Region											
Number of wolves	1	2	3	4	5	6	7	8	9	10	11-54
Number of hunters	51	22	16	8	1	8	1	4	2	0	9
% of harvest	11	9	10	7	1	10	1	7	4	0	38
Qikiqtaaluk Region											
Number of wolves	1	2									
Number of hunters	4	1									
% of harvest	67	33									

Harvesters' perception of wolf population trends

Harvesters' perception about trends in wolf populations differed among regions (χ^2 $P < 0.001$), but almost all believed that numbers were either stable or increasing (Table 10). About 16% more respondents believed wolf numbers were increasing in the Kitikmeot compared with the Kivalliq region. Note that the sample size does not reflect individual hunters, since a hunter may provide >1 harvested wolf to the program within and among years.

Table 10. Perception of wolf population trend (%) of wolf hunters providing carcasses for the Support for Active Harvesters program, 2018-19 – 2020-21.

Region	*n*	Decreasing	Stable	Increasing
Kitikmeot	504	0	40	60
Kivalliq	921	3	53	44
Qikiqtaaluk	24	0	33	67

Wolf harvest relative to distance from communities and caribou

Wolves were generally harvested closer to communities prior to Christmas (generally within 75 km) and further from communities later in the winter, with peak distances in April and May (Fig. 10). This pattern was less evident in 2018-19 within the Kitikmeot, where the harvest came predominantly from Kugluktuk hunters. However, in 2018-19 much of the Kugluktuk wolf harvest came from an outpost camp hunting near caribou concentrations around Napaktulik and Contwoyto lakes (M. Awan, unpubl. data).

Spatial and temporal patterns of wolf harvest differed among communities. Arviat hunters harvested wolves close to the community during October–December, and over a broad distance later in the winter, including over 450 km from the hamlet in 2019-20. Baker Lake showed a similar pattern at a reduced scale, harvesting within 100 km prior to Christmas (largely along the Meadowbank all-weather access road north of the hamlet), and further away during mid to late winter. Hunters from Kugluktuk largely harvested wolves further from the hamlet during the winter, depending on the winter distribution of caribou herds.

These patterns of harvest generally reflected the patterns of movement of higher densities of caribou (Appendix 2) and the restricted travel conditions early in the year.

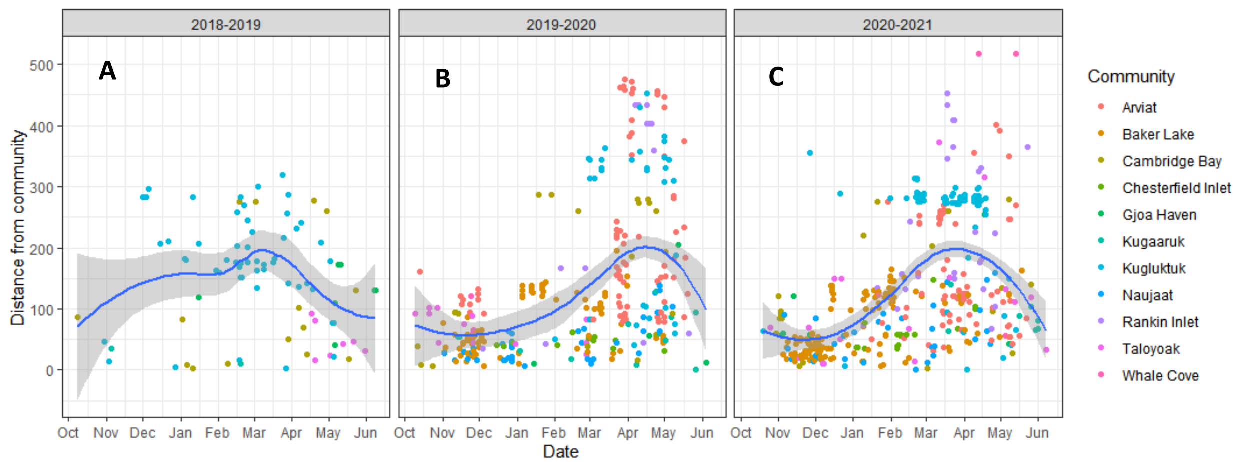

Figure 10. Wolf harvest locations plotted by distance from communities (km) during the A) 2018-19 (Kitikmeot), B) 2019-20 (Nunavut) and C) 2020-21 (Nunavut) harvest seasons. Smoothed lines provide an estimate of overall trend in the data set.

Hunters travelled up to 500 km from their communities to harvest wolves, but generally harvested wolves within 200 km of higher densities of collared caribou (Fig. 11). The communities that harvested wolves >200 km from higher density caribou occurrence were located where caribou collaring and hence caribou distribution within Nunavut were likely incomplete, mainly within the northeast Nunavut mainland: Kugaaruk, Naujaat, Taloyoak and Gjoa Haven, and to a lesser extent Cambridge Bay.

Estimated pack size and numbers of wolves harvested were higher closer to higher densities of caribou (Figs. 12, 13). Thus, even though the hunters were far from their communities, necessitating camping over day-trips, they encountered larger packs of wolves and were effective at harvesting larger number of wolves. Hunters from the communities of Kugaaruk, Naujaat, and Taloyoak did not follow this pattern, again likely related to limited collaring of caribou in those areas.

Communities such as Arviat and Kugluktuk, whose hunters move to areas with higher densities of caribou, were able to harvest large numbers of wolves close to those caribou. A spatial plot of this data set by year and distance from higher densities of caribou showed that areas of higher wolf harvest were often further from communities (Fig. 14). An exception appeared to be Baker Lake where most wolf harvest occurred within 150 km of the community.

In many cases the harvested wolves could be reliably "assigned" to a particular caribou herd when herd overlap was limited, but in some cases overlap of collared caribou from different herds meant assigning caribou herds to the wolf harvest was uncertain and problematic (Figs. 15, 16, 17).

Hunters appeared to focus their wolf harvest efforts where caribou densities were high. For example, the QM caribou herd was further from Arviat in April 2020 compared to April 2021, and the distribution of the wolf harvest mirrored this pattern (Figs. 16, 17).

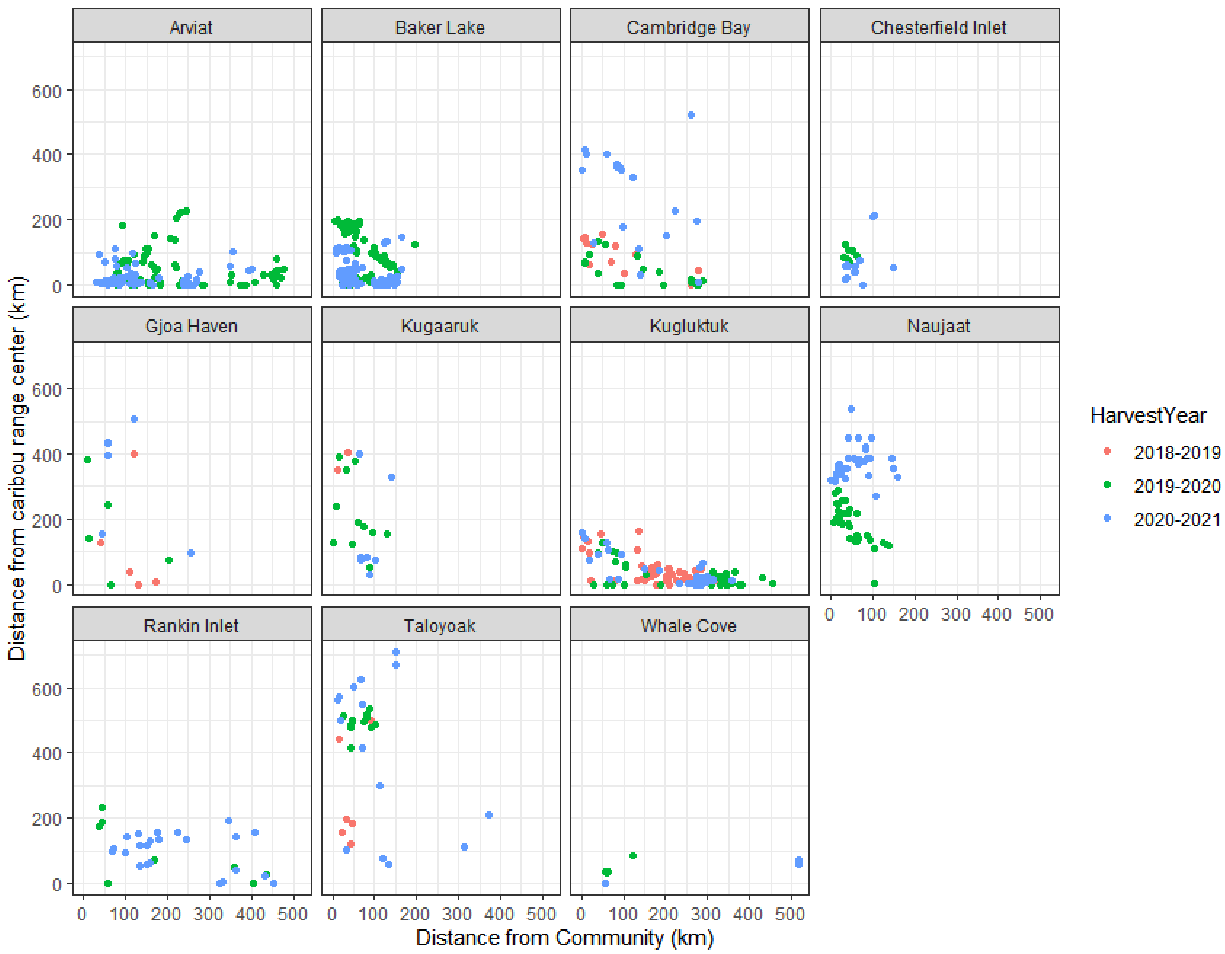

Figure 11. Relationship between wolf harvest distance from caribou centers of activity (higher densities) and communities, Kitikmeot 2018-19 and Nunavut 2019-20 and 2020-21.

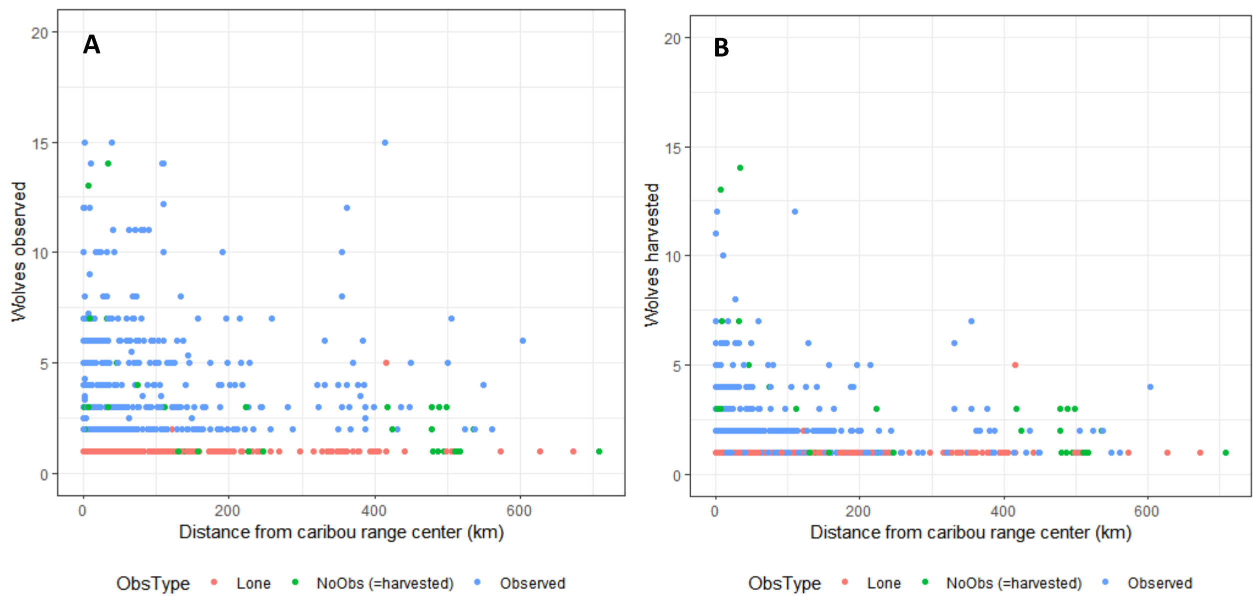

Figure 12. Number of wolves observed (A) and number of wolves harvested (B) relative to the distance from caribou centers of activity (higher densities), Kitikmeot 2018-19 and Nunavut 2019-20 and 2020-21 data combined. "Lone" = no group size reported but harvested at the same location on the same date; "NoObs" = no group size reported but harvested ≤5 km apart on the same date; "Observed" = pack size observation.

Figure 13. Number of wolves harvested related to distance from community and binned distances from higher densities of caribou, Kitikmeot 2018-19 and Nunavut 2019-20 and 2020-21.

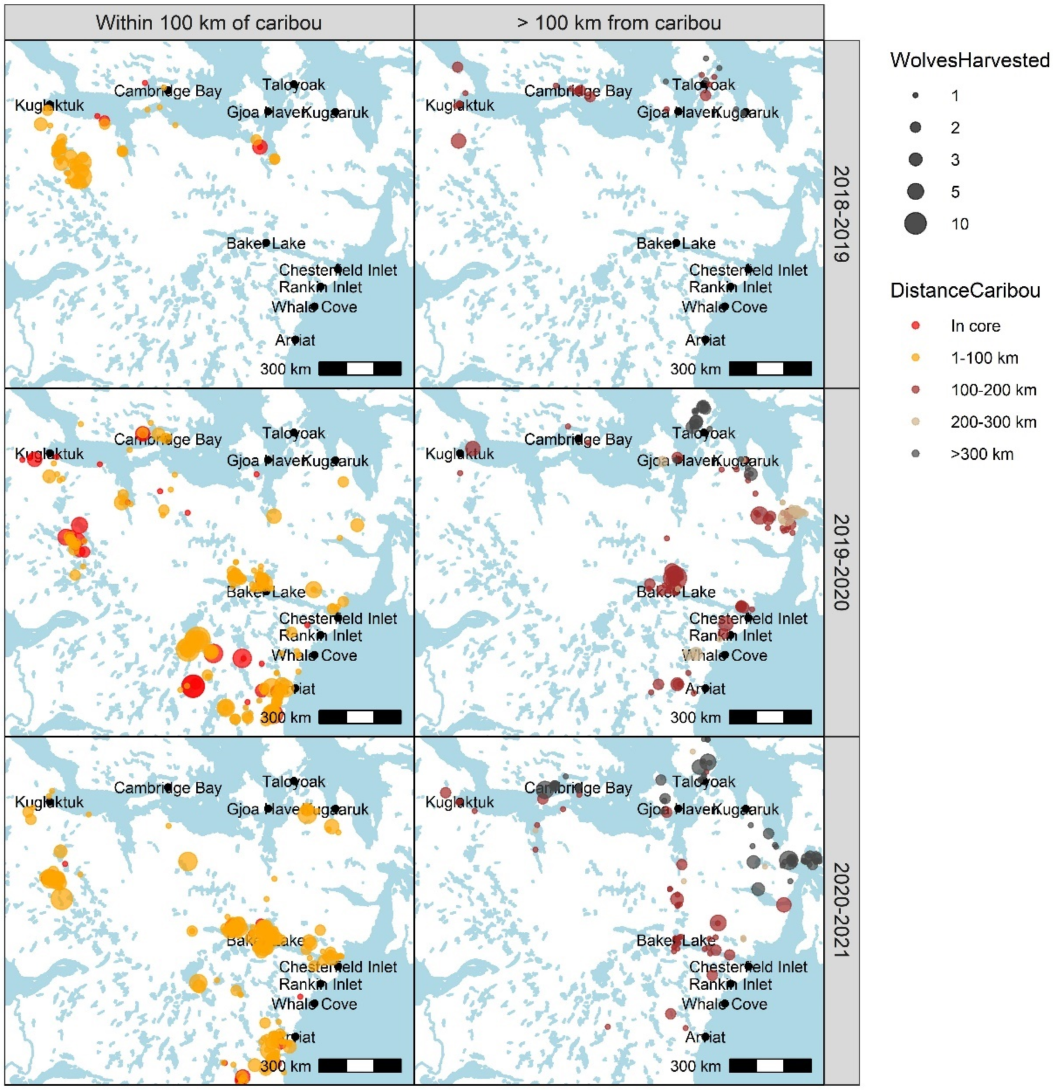

Figure 14. Locations of wolves harvested grouped by distance from areas of higher caribou density (DistanceCaribou), Kitikmeot 2018-19 and Nunavut 2019-20 and 2020-21.

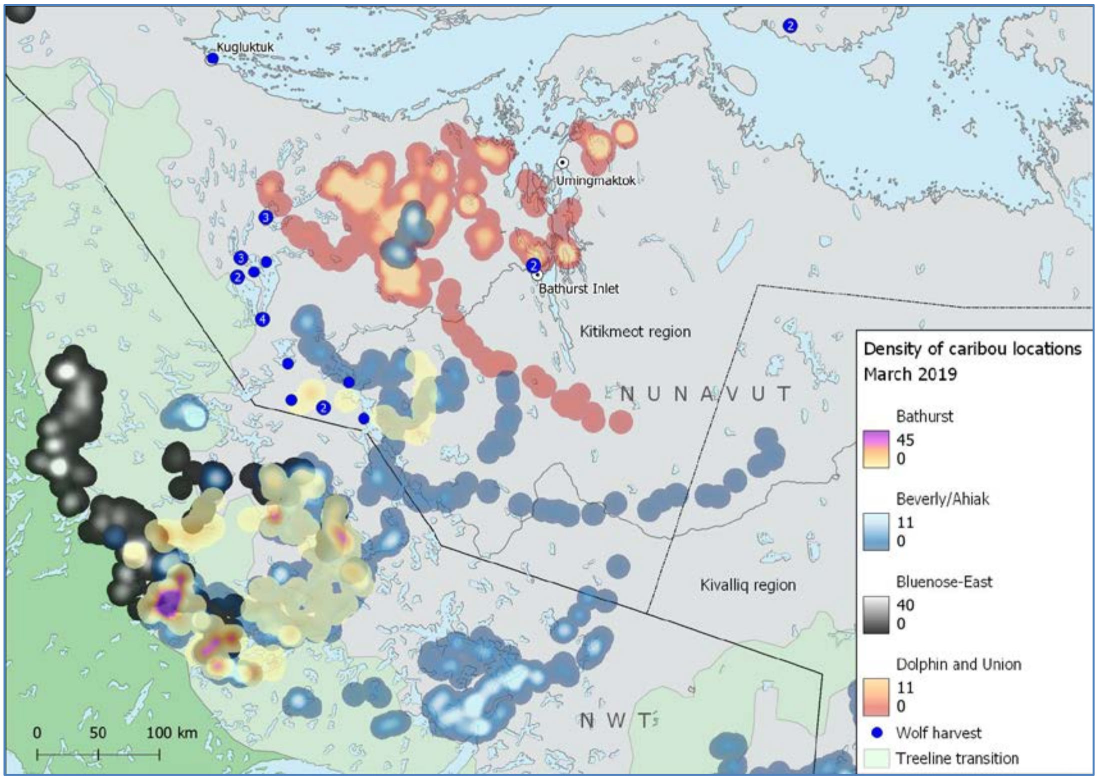

Figure 15. Collared caribou distribution by herd and wolf harvest collection locations, March 2019.

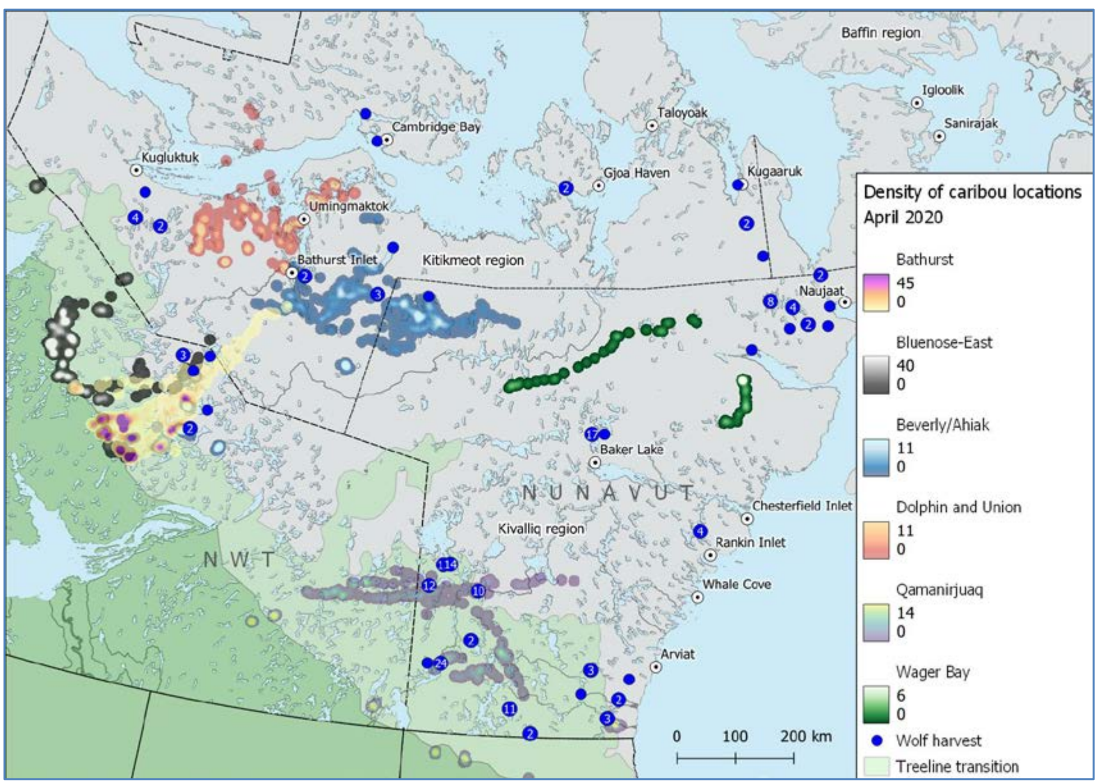

Figure 16. Collared caribou distribution by herd and wolf harvest collection locations, April 2020.

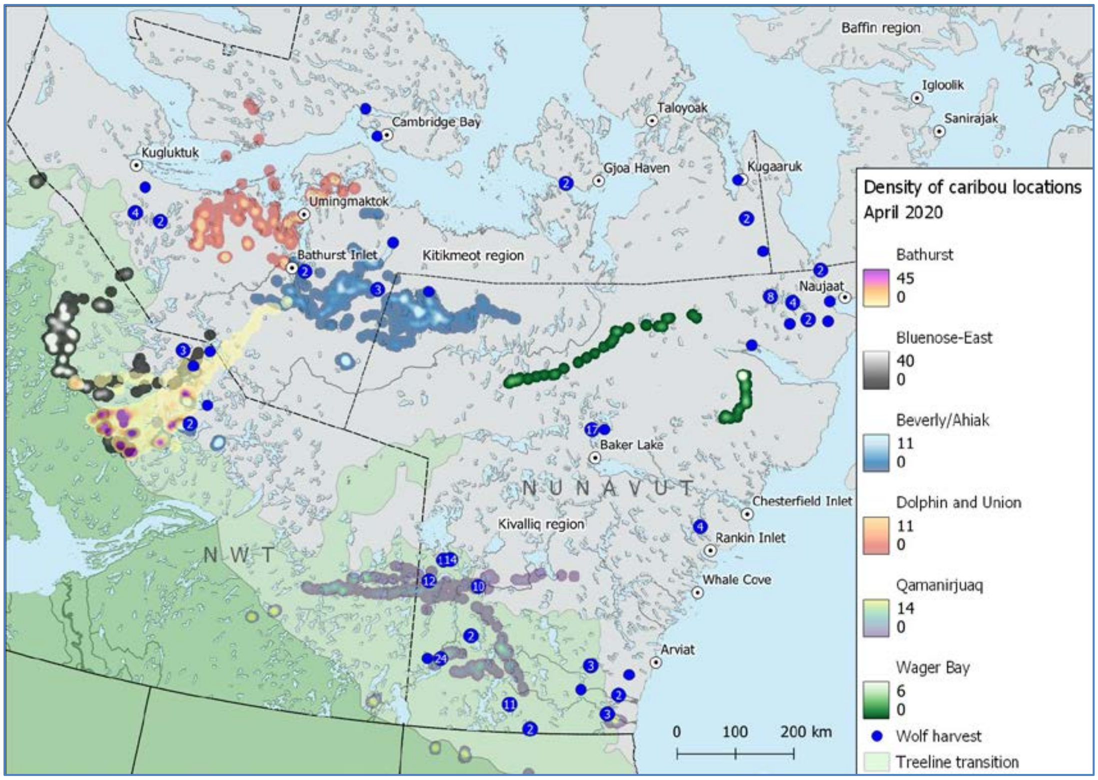

Figure 17. Collared caribou distribution by herd and wolf harvest collection locations, April 2021.

Proportion of wolf packs harvested

Kitikmeot 2018-19

Within the Kitikmeot in 2018-19 only Kugluktuk had sufficient samples sizes to examine the proportion of wolves harvested from packs observed (94% overall; *n* = 23 packs). The mean proportion of each pack harvested was high and trended higher across the winter, but monthly sample sizes were low (Fig. 18). Full packs were harvested on 87% of occasions.

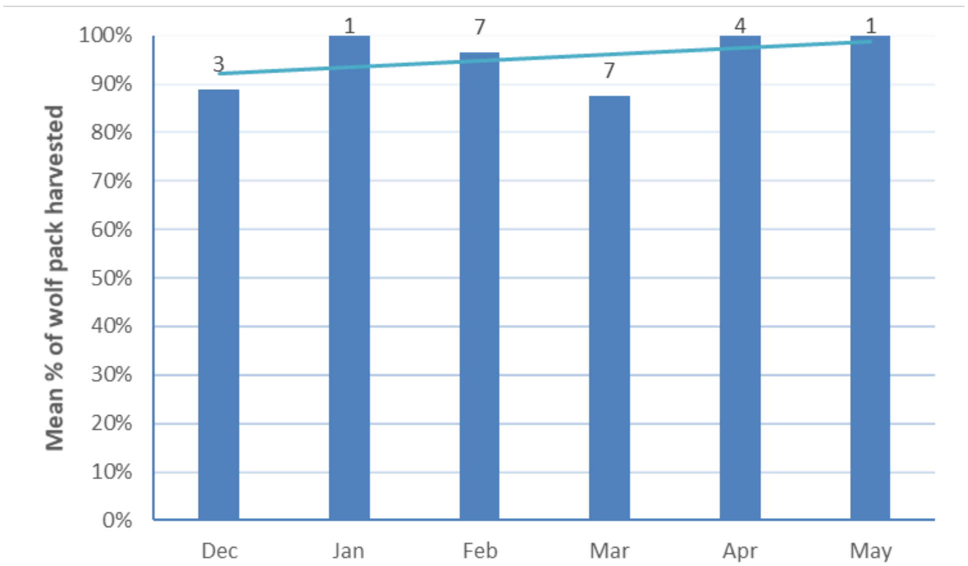

Figure 18. Mean proportion of wolf packs (≥2 wolves) harvested by month generated by QGIS assessment, Kitikmeot, 2018-19. Sample sizes shown above bars. Linear trendline added.

Nunavut 2019-20

Hunters from Arviat and Kugluktuk reported harvesting the greatest proportion of wolves from packs observed during 2019-20, roughly 75% (Fig. 19). Across Nunavut, the mean proportion of each pack harvested increased as the winter progressed from 50% in November to 75% in May (Fig. 20). Full packs were harvested on 35% of occasions across the season, with an increasing trend as the season progressed: 16% during October–December (*n* = 63), 39% during January–March (*n* = 76), and 50% during April and May (*n* = 68). It is likely that wolf packs in a given area were collectively harvested over time by different hunting parties until there were none left, but it is difficult to verify this assumption.

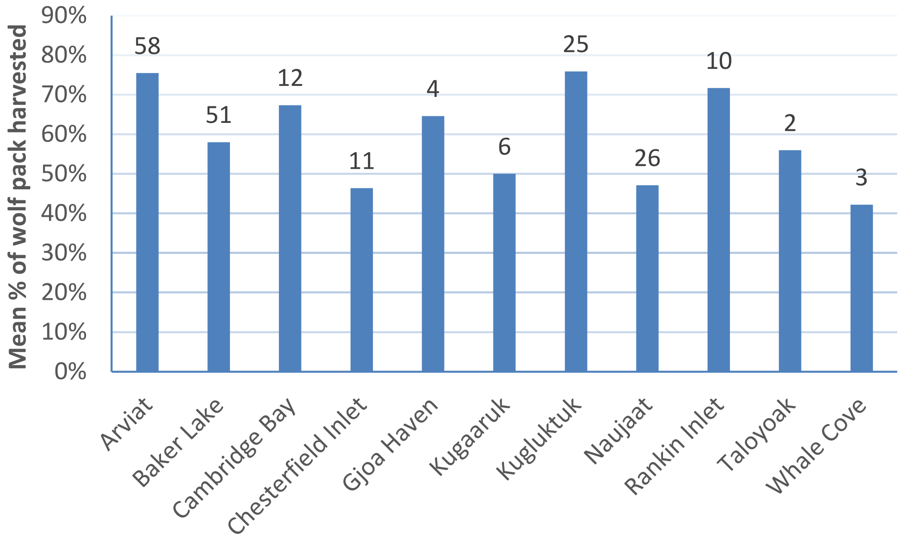

Figure 19. Mean proportion of wolf packs (≥2 wolves) harvested by community generated by QGIS assessment, Nunavut, 2019-20. Sample sizes shown above bars.

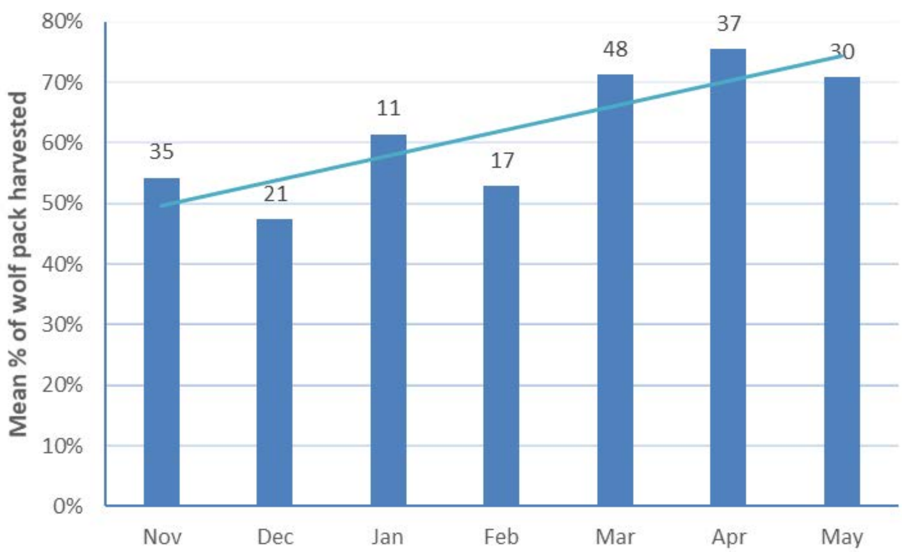

Figure 20. Mean proportion of wolf packs (≥2 wolves) harvested by month generated by QGIS assessment, Nunavut, 2019-20. Sample sizes shown above bars. Linear trendline added.

Nunavut 2020-21

Hunters from Arviat reported harvesting the greatest proportion of wolves from packs observed during 2020-21 (85%), with most harvesting 50–70% of packs (Fig. 21). Across Nunavut, the mean proportion of each pack harvested again increased as the winter progressed (Fig. 22). Full packs were harvested on 40%

of occasions across the season, with an increasing trend as the season progressed: 22% during October–December (n = 64), 42% during January–March (n = 102), and 56% during April and May (n = 54). Arviat hunters harvested full packs 73% the time overall.

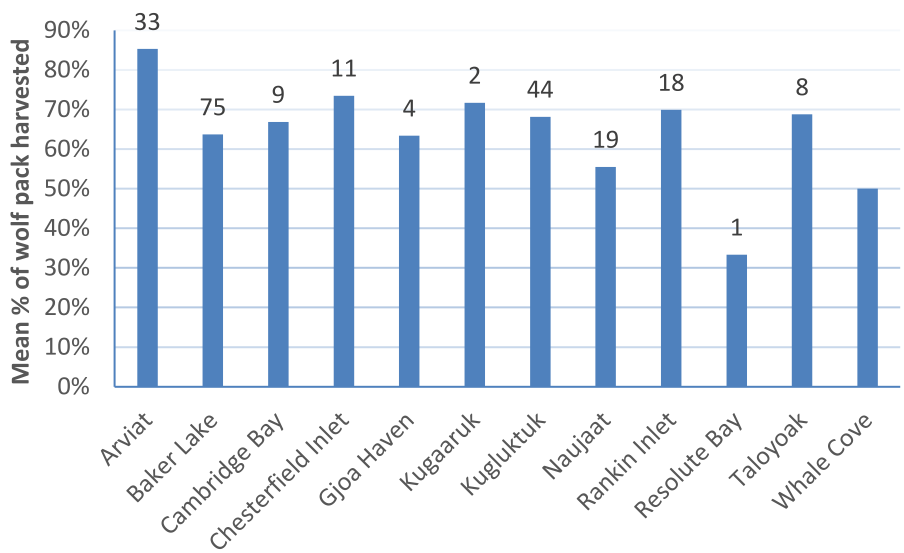

Figure 21. Mean proportion of wolf packs (≥2 wolves) harvested by community generated by QGIS assessment, Nunavut, 2020-21. Sample sizes shown above bars.

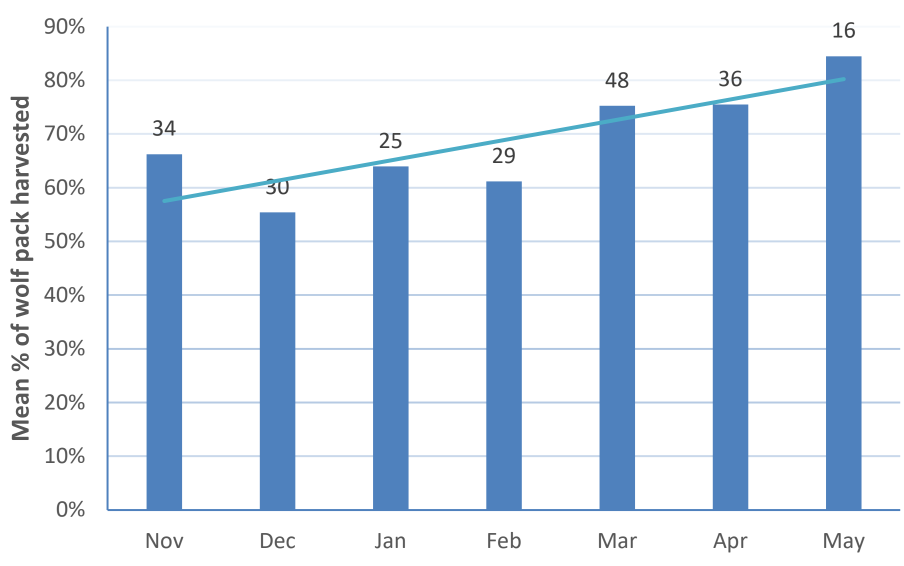

Figure 22. Mean proportion of wolf packs (≥2 wolves) harvested by month generated by QGIS assessment, Nunavut, 2020-21. Sample sizes shown above bars. Linear trendline added.

All data combined

Combining all data and using the rules-based assessment we tested the effect of the number of wolves observed, an index of pack size, on percent harvested. The resulting data set had 841 packs or individuals defined, 301 of which were single wolf observations and could not be used to define percent of pack or group harvested, leaving 540 groups of ≥2 wolves to assess harvest success. Wolves observed (log-transformed) was a significant predictor of percent harvested (Z = -5.7, *P* < 0.0001), with lower percentage of wolf packs harvested as pack size increased (Fig. 23). This result is likely because it is easier to harvest most or all of small packs than large packs.

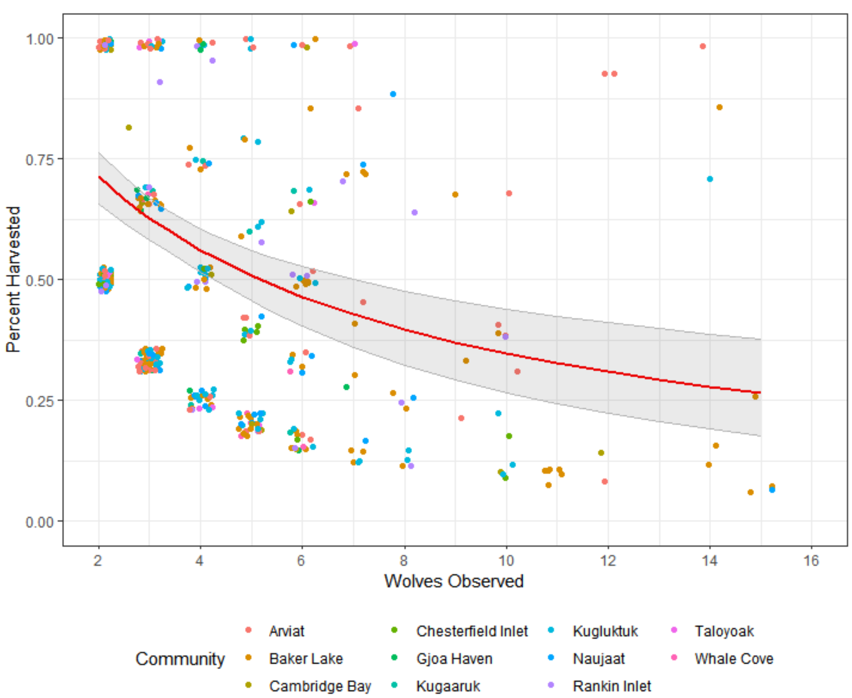

Figure 23. The proportion of wolf packs harvested by pack size (wolves observed) using a rules-based assessment, data combined for 2018-21. Points are jittered to increase interpretation. Predictions of mean percent harvested from logistic regression analysis with log(wolves observed) as a predictor are shown (red line). Confidence intervals are shaded around the prediction line.

Of additional interest was whether a temporal trend in harvest could be detected. For this analysis the data set was reduced to the 3 communities with the most harvest data – Arviat, Baker Lake, and Kugluktuk. Models were considered with community, wolves observed, and date for each harvest year. A model with harvest year, date of harvest, and wolves observed was used to control for harvest year and the effect of the number of wolves on harvest rate. Interactions between community and date of harvest were tested with no significant differences detected. A model with an additive effect of date across all communities had some support with date of harvest being significant (Z = 2.2, *P* = 0.02) in addition to pack size (Z = -

4.1, *P* < 0.0001; Fig. 24). A plot of predictions (standardized for a mean pack size of 4 wolves) revealed a weak trend with harvest rate increasing as the season progressed.

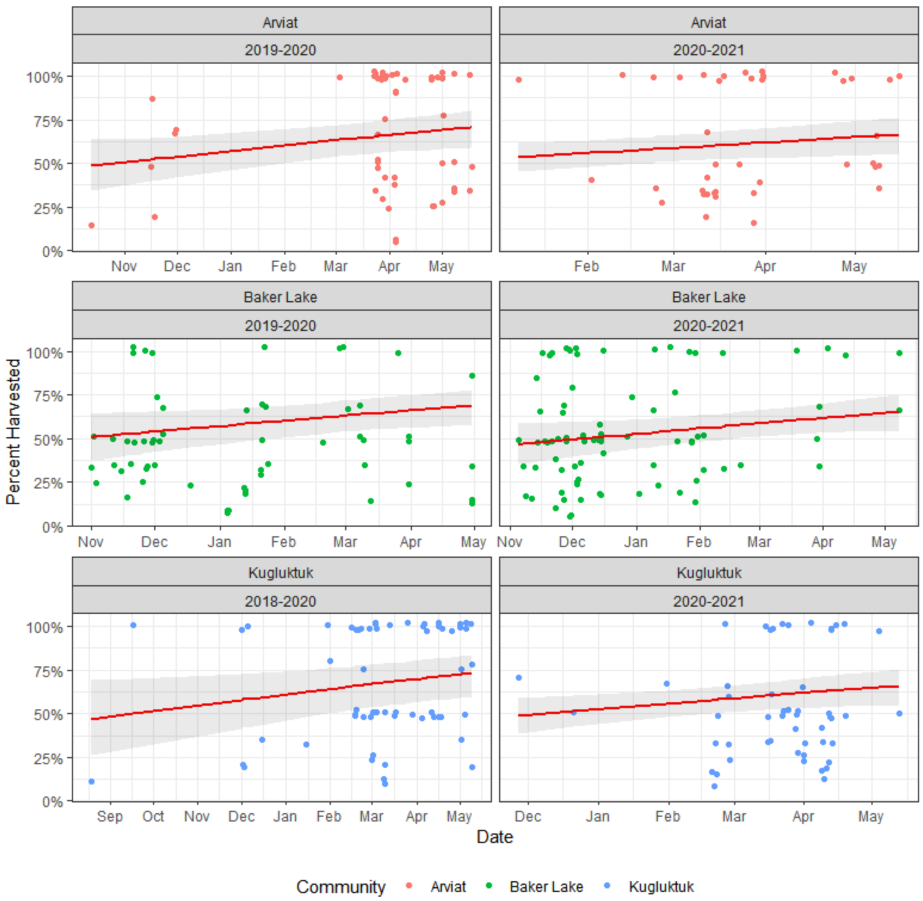

Figure 24. The proportion of wolf packs harvested by date using a rules-based assessment for 3 communities across different harvest periods. Points are jittered to increase interpretation. Predictions of mean percent harvested from logistic regression analysis with date as a predictor with log(wolves observed) set at mean values (4 wolves; red lines). Confidence intervals are shaded around the prediction line.

Wolf numbers and proportion harvested

One of our objectives was to attempt to estimate how many wolves may be associated with the migratory QM herd during winter, and thus what proportion of the wolves is being harvested by community hunters. We focussed on the QM herd because recent estimates of herd size were available (Boulanger et al. 2018) and there was little overlap with adjacent herds. No field-based estimates of wolf numbers in Nunavut are available. Methods to estimate wolf numbers using ungulate biomass (Kuzyk and Hatter 2014, Nishi et al. 2020) are complicated by the need to calculate wolf density over the massive range of the migratory

QM caribou herd, as well as to consider the substantial number of muskoxen present in portions of the range. The ungulate biomass method makes numerous assumptions and therefore this estimate may not pertain to the current wolf population in migratory caribou ranges. Ungulate biomass could be used to explore wolf numbers; however, we strongly caution against using these estimates to define management targets.

Nishi et al. (2020) used a 'ungulate biomass index' (UBI) regression equation (Kuzyk and Hatter 2014) to derive wolf density estimates applied to 95% utilization distribution of caribou winter range size.

$Y = 5.4x – 0.166x^2$

where y = wolf density (wolves/1,000 km^2) and x = ungulate biomass index/km^2. Barren-ground caribou were assigned a relative biomass value of 2, therefore estimates of caribou density (caribou/km^2) were multiplied by a factor of 2 to generate the UBI biomass index. Muskoxen and moose were not considered in this current 'back of the envelope' calculation.

Assuming approximately 250,000 QM caribou within a winter range covering about 70,000 km^2 (mean annual 95% utilization distribution from 2017-18 to 2021-22; Caslys Consulting, unpubl. data), the UBI calculation estimated approximately 2,100 wolves in total associated with the QM herd during winter. Alternatively, ECC used a ratio of roughly 10 wolves/1,000 caribou on winter range (Nishi et al. 2020: Tables 24–26), which means (assuming ~250,000 QM caribou) there would be ~2,500 wolves in total associated with the winter range of the QM herd. Parker (1972) estimated a ratio of 1 wolf per 114 caribou, equating to an estimate of approximately 2,200 wolves associated with the herd. This approach also assumes availability of caribou to wolves at all times and does not consider the impact of predator control or other measures on wolf abundance. All these factors likely will cause variation in actual wolf abundance and for this reason the UBI index and other ratios should be interpreted cautiously.

These rough calculations of wolf abundance associated with the QM caribou winter range suggest that, assuming the communities of Whale Cove, Arviat and Rankin Inlet hunt wolves associated with the QM herd and that the wolf harvest levels from 2019-20 (265 wolves) and 2020-21 (183 wolves) are usually attained, Nunavut hunters are harvesting ~9–13% of the wolf population associated with the QM herd during winter and spring each year. However, these calculations overlook that a portion of the wolf population will not follow the QM herd onto the tundra and become potentially available to NU hunters. The proportion of the wolf population associated with the QM herd that is available to NU harvesters is unknown, but based on movements of a limited number of collared wolves in the NWT and data from Russia, perhaps 50–70% of wolves migrate with herds in spring (Kolpaschikov et al. 2015, Clark et al. 2021), meaning that NU hunters are taking a larger proportion of the wolves associated with the QM and available to harvesting on the tundra, perhaps in the 12–25% range.

Discussion

Wolf harvesting is a traditional part of the culture of Nunavut hunters, as well as a source of seasonal income. During 2018-19 to 2020-21, the number of harvested wolves fluctuated but the number of hunters remain more or less the same. Some hunters hunt wolves occasionally while hunting caribou and/or muskoxen, and some hunt wolves on a more regular basis. Almost all wolves (~99%) were shot with few animals trapped. The effectiveness of Nunavut wolf hunters appears high, with large annual harvests from some communities, especially Arviat, Baker Lake and Kugluktuk. Within the North Slave region of the NWT, the catch per unit effort by Nunavut harvesters was 2 magnitudes higher than that of NWT harvesters (based on harvester questionnaires; Nishi et al. 2020). Nunavut hunters travel long distances to harvest wolves, often later in the winter and generally towards higher densities of caribou (as indexed by collared individuals), similar to other Arctic areas (Hayes et al. 2016).

The proportion of packs harvested differed among communities, but generally decreased as pack size increased and increased as the season progressed. Effectiveness of harvesting small packs of wolves was high, with roughly 50–60% harvest of packs with ≥3 individuals; the proportion of each pack removed increased as winter progresses, possibly related to longer daylight and better travel conditions. Removal of entire wolf packs may reduce caribou predation rates since partial removal can cause pack splitting and formation of more numerous packs (number of packs is a strong determinant on predation rates) and smaller packs (per capita kill rates are higher in smaller packs; Ballard et al. 1997, Hayes et al. 2000).

The proportion of immature individuals in a harvest is a valuable indicator of the impact of removal programs on carnivore populations (Kelsall 1968, Robinson et al. 2008). Largely based on the intensive wolf control programs (primarily wide-spread poisoning) conducted in the NWT during the mid-1950s to early 1960s, Kelsall (1968) and Fuller and Novakowski (1955) suggested that the proportion of young wolves in the harvest would shift from 10–20% in unexploited wolf populations, to 65–75% in heavily exploited populations. The age structure observed in both the Kitikmeot and Kivalliq regions in 2019-20 and 2020-21 (70–80% young wolves) indicate high levels of exploitation of the segment of the wolf population accessible to harvesters.

Many caribou herds within mainland NWT/Nunavut overlap during portions of the year, making it difficult to “assign” a harvested wolf to a particular herd. In recent years there has been extensive overlap north of Yellowknife among the BA, BE and BV herds (ECC, unpubl. data). ECC used an elaborate approach to assign harvested wolves to caribou herds when examining ground and aerial wolf harvest conducted in late winter 2019-20 (Nishi et al. 2020). However, hunters from Arviat, Whale Cove and Rankin Inlet target only what could be considered QM wolves, harvesting 265 and 183 wolves from the QM caribou herds’ range in 2019-20 and 2020-21, respectively. Although not a large proportion of the total number of wolves associated with the entire QM herd, assuming each wolf may consume approximately 29 caribou annually (Hayes and Russell 2000, WFATWG 2017: Appendix F), this represents about 5,300–7,700 caribou not predated or approximately 2–3% of the current QM population estimate.

For the QM herd where “assigning” harvested wolves to a particular herd is possible, approximately 12–25% of wolves associated with the herd during spring migration and pre-calving movements may be harvested by Nunavut hunters each year. These values, while impressive, are still far lower than the >55–

60% annual harvest required to maintain reduced wolf densities sufficiently to illicit a demographic response in an ungulate population (National Research Council 1997, McLaren 2016, Nishi et al. 2020). Regardless, given high harvests of wolves south and southwest of Arviat during March, April and May, it is likely that both the numbers of wolves and number of wolf-killed QM caribou are greatly reduced as the herd migrates during late winter and spring to their calving grounds west of the coast of Hudson Bay. This results in hunters targeting wolves following migrating caribou to their calving grounds and the removal of most resident wolves from the calving grounds, and therefore low numbers of wolves and reduced wolf predation on the calving and post-calving grounds. Low predation rates of new-born QM calves in the early 2010s were attributed to high harvest rates of wolves during pre-calving migration (Szor et al. 2014).

This level of harvest pressure requires annual effort since adjacent wolf populations can quickly respond to reduced wolf density by long-distance dispersal and increasing natality rates (Schmidt et al. 2017). It is possible that the traditional harvest of large numbers of wolves by coastal communities may have influenced demographic trends in the QM herd. Demographic analysis of the QM herd is being conducted in unison with the 2022 calving ground survey (J. Boulanger, pers. comm.). Results from this survey should provide further inference on QM status and associated demographic trends.

From 1995 to 1998, an average of 146 wolves were harvested annually in the Qikiqtaaluk Region, with about 80% taken from Baffin Island (Krizan 1999, unpubl. data). Caribou numbers on Baffin Island were likely high to declining during the 1990s (Campbell et al. 2015). These wolf harvests are minimum counts; a hunter survey in the Qikiqtaaluk region in 1998 showed that approximately one half of the harvest was used privately for clothing or sold locally (and hence not enumerated in the system), with the other half was sent to fur auctions (Krizan 1999). No wolves harvested from Baffin Island were detected by the Nunavut-wide Support for Active Harvesters program over 2 years, during a period of very low caribou numbers (Campbell et al. 2015, Ringrose 2018) and no significant secondary prey to maintain wolf populations. Where alternative large prey is absent, such as on Baffin Island, wolf populations will generally decline with declining primary prey (Mech 2005). Despite low and/or declining populations of caribou within the central mainland Nunavut (Kitikmeot Region), high wolf abundance can be sustained by alternative large prey, such as muskoxen and moose.

Except for hunters from Baker Lake, from October to late February Nunavut hunters mainly harvested wolves while hunting other game, leading to similar hunting effort from early to mid-winter among years. The number of wolves harvested appears to fluctuate depending on caribou numbers (and hence wolf numbers) in the area. Beginning in early March, hunters generally travelled to specifically hunt wolves, resulting in higher hunting effort and harvests.

Ground-based harvest efforts often remove the most naïve and vulnerable segments of the population (Adams et al. 2008), whereas control programs are thought to remove wolves more randomly since lethal control is less selective and breeders are more likely to be killed than they would be otherwise (Webb et al. 2011, Schmidt et al. 2017). If young or dispersing individuals make up a large portion of the harvest, harvest mortality may be compensatory because young naïve wolves exhibit the highest rates of natural mortality and dispersal (Boyd and Pletscher 1999; Hayes and Harestad 2000; Fuller et al. 2003; Smith et al. 2010). However, Nunavut wolf hunters appear able to target older and presumably potentially breeding portions of the population later in the winter after most natural losses would have occurred, increasing the additive impacts of these ground-based harvest efforts.

Hunters in the Kitikmeot Region, mainly from Kugluktuk, harvested wolves primarily from winter ranges. The high proportion of young in the Kitikmeot sample during 2019-20 and 2020-21 indicate relatively intense harvest within the areas accessed by hunters. However, few wolves were harvested in April and May during caribou spring migrations to the mainland calving grounds of the BA and BE herds (Appendix 2). Logistics and access may be limiting the ability of Kitikmeot harvesters to reduce wolf numbers as caribou approach the calving grounds.

Wolf populations can quickly rebound when treatment is removed due to immigration from surrounding areas and high reproductive rates (National Research Council 1997, Schmidt et al. 2017). Within Nunavut, wolves are an annual resource for hunters, and wolf harvest for clothing and for income is a seasonal and traditional activity. For example, in the range of the BE, BA and BV caribou herds, migratory wolves generally den around and below treeline (Heard and Williams 1992). Although this likely also occurs on QM range where these wolves would be distant and unharvestable by hunters from coastal communities on Hudson Bay, many wolves associated with the QM herd also den above treeline closer and within the calving grounds (Heard and Williams 1992). Either way, “crops” of wolves therefore follow caribou residing or moving onto the tundra where they are accessible to coastal hunters on an annual basis.

Limitations

Our analyses were of course limited by numbers and distribution of collared caribou among herds. It was evident that collar distribution was thin to non-existent in some areas, especially in the northeast Nunavut mainland (Appendix 2). In other areas, the attrition in collars was evident, for example collar sample size on the Lorillard and Wager Bay herds was greatly reduced by April 2020 when extensive wolf harvest associated with these two herds occurred north of Baker Lake (Fig. 5, Appendix 2).

Portions of our analyses and summaries were dependent on assumptions made on the wolf harvest data, largely related to the definition of pack size and numbers harvested. In some cases, it was easy to determine that, for example, 6 wolves were harvested from a pack of 6 wolves at the same location. Many other groupings were not so obvious. These data could be rendered clearer, facilitating more robust analyses, if the database were able to clarify which harvested wolves belonged to which recorded pack size and the number of wolves harvested from that particular pack -cross-referencing harvest ID numbers would be helpful. Also, harvest of individual wolves needs to be clarified that they were indeed lone wolves, and not associated with other individuals. In some cases, the database observations did not agree with the spatial records. In general, we consider the proportion of wolf pack harvested to be a crude measure of harvest effectiveness.

A measure of catch per unit effort (CPUE) by Nunavut wolf hunters would provide another indication of the effectiveness of harvest within the territory. The challenge with the current wolf harvest data set is that annual harvest effort is unknown and therefore it is difficult to ascertain if annual harvest success for some communities is due to greater harvest effort or higher harvest effectiveness. However, there are many variables that may affect measures of harvest effort: for example, effort likely varies with snow conditions and the winter distribution of caribou and hence the associated wolves; wolves are harvested during harvest trips for other species (e.g., caribou, muskoxen) as well as trips primarily focussed on hunting wolves; unsuccessful wolf harvest trips are not recorded; and harvest effectiveness likely varies between experienced and young hunters. Regardless, a data set that provides even a crude measure of effort, possibly the number of excursions and number of days of hunting and the number of kilometres travelled (and possibly details of routes taken) could provide a better overall estimate of harvest effectiveness (Clake et al. 2021).

More work is required to estimate how many wolves may be associated with the migratory QM herd (and possibly other herds) during winter. We suggest that using the UBI equation to estimate wolf numbers may be problematic for migratory barren-ground caribou for a number of reasons (Kuzyk and Hatter 2014). This equation was developed for wolf populations in British Columbia that prey on a variety of relatively stationary southern ungulate species, rather than northern wolves that primarily prey upon more ephemeral prey sources like populations of caribou and muskoxen. An inherent issue with the UBI calculation is that it does not consider that wolves do not have access to caribou across winter or seasonal ranges especially during the denning season (late winter) when movements by wolves are more restricted. Therefore, it is likely that only a proportion of caribou populations are "available" to wolves at any one time. Annually variable overlap among adjacent herds on winter ranges further complicates this relationship. Due to migratory caribou movements and restrictions of wolves to denning sites, the year-round availability of caribou to wolves is lower in northern populations and therefore the inherent relationship between wolf abundance and caribou biomass is different. Studies on functional response of predators to varying levels of prey density have shown that various relationships are possible, all of which have implications on the underlying relationship between prey and predator density (Zimmerman et al. 2005). Therefore, this likely produces an over-estimate of wolves given that only a proportion of caribou are available to wolves across the large seasonal range. We attempted to partially correct for this using crude estimates of the proportion of wolves that may be following the QM herd during spring migration. The UBI method also likely overestimates wolf abundance by assuming that the effectiveness of wolves in preying upon northern caribou is similar to the multitude of ungulate species available to southern wolves. It also assumes human-caused mortality rates do not exceed sustainable limits and wolf numbers have had time to adjust to prey biomass. For all these reasons we suggest estimates from this index are very crude, are likely overestimates, and should be treated cautiously.

Recommendations

1. The Support for Active Harvesters program facilitates harvest of wolves associated with concentrations of caribou within Nunavut, and appears to be an effective wolf management tool to remove a large proportion of accessible wolves while simultaneously providing additional support to hunters. Since wolf populations can quickly rebound when treatment is removed due to immigration from surrounding areas and high reproductive rates, the incentive program should be continued.
2. The Support for Active Harvesters program should ensure prompt payment to harvesters that submit skulls. The faster harvesters are paid, the more likely they will restock fuel and supplies and return to the land to hunt additional wolves.

3. Although challenging to obtain, we recommend that some form of hunter effort should be collected to supplement the wolf harvest data currently collected. The NWT program considers distance travelled for hunting and time spent hunting to estimate hunter effort (Clark et al. 2021). A data set that provides effort, possibly the number of excursions and number of days of hunting (and possibly details of routes taken) would provide a better overall estimate of harvest effectiveness.

4. The effectiveness of the wolf harvest program could be better examined by conducting a demographic analysis of caribou survival using the collar data. This would give a relative indication of how survival rates of the QM herd, where the proportion of wolves harvested during late winter and spring is thought to be comparatively high, compared to other herds.

5. Within the mainland Kitikmeot Region, much of the focus of wolf harvest incentives current target the winter ranges of the BE and BA herds. The effectiveness of harvest and resulting impacts on the demography of these herds would likely be enhanced by increased logistical support to harvesters from both sides of the border. Support and incentives to harvesters to continue to hunt wolves during migration from BE and BA winter ranges to calving ranges would enhance the effectiveness of the overall program; establishing forward operating camps and fuel caches may be useful. Expansion of the NWT Wolf Management Incentive Area into the Kitikmeot Region would provide additional incentives to Nunavut harvesters, further increasing the harvest of wolves associated with the BE and BA herds. It may be beneficial to engage and support experienced wolf hunters to set up harvester camps and focus on areas not normally accessible during spring caribou migration (*cf* Kolpaschikov et al. 2015, Clark et al. 2021).

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Appendix 1: Caribou collar sample size

Table 11. Collar sample size by caribou herd and month, December 2018 to June 2021, and most recent caribou herd estimates.

Year-Month	BA	BE	BV	QM	LR	WB	AH	DU
2018-Oct	27	43	42	49	16	9		3
2018-Nov	27	43	42	49	16	9		3
2018-Dec	27	43	42	49	16	9		33
2019-Jan	27	42	41	49	15	8		31
2019-Feb	28	42	40	48	13	8		31
2019-Mar	38	56	60	52	6	4		30
2019-Apr	39	57	59	55	3	4		28
2019-May	37	55	58	51	3	4		28
2019-Jun	36	51	53	44	2	4		24
2019-Jul	35	50	52	42	2	4		24
2019-Aug	35	49	51	29	1	3		24
2019-Sep	29	40	43	26	1	3		23
2019-Oct	26	39	33	23	1	3		21
2019-Nov	25	38	32	23	1	3		21
2019-Dec	25	36	31	23	1	3		20
2020-Jan	25	36	30	23	1	3		20
2020-Feb	31	32	29	24	1	3		21
2020-Mar	70	71	32	29	1	2		18
2020-Apr	71	67	26	23	1	2		16
2020-May	59	59	22	16	1	2		13
2020-Jun	57	55	22	12	1	2		12
2020-Jul								8
2020-Aug								7
2020-Sep	45	53	25	38	6	5	4	4
2020-Oct	43	53	25	38	6	5	4	4
2020-Nov	42	50	25	36	6	4	4	4
2020-Dec	41	49	25	36	5	4		3
2021-Jan	40	47	24	36	5	4		
2021-Feb	44	47	26	34	5	3	1	
2021-Mar	55	82	61	33	5	3	2	
2021-Apr	55	78	61	33	4	3	4	36
2021-May	55	78	60	32	5	3	4	35
2021-Jun	53	78	59	30	5	3	4	35
Herd size	8,200	22,350	103,400	288,250	41,000	41,000	71,340	3,800

Year of estimate and source of herd size estimates:

Bathurst (BA): 2018; Adamczewski et al. 2019.

Bluenose East (BE): 2018; Boulanger et al. 2019.

Beverly (BV): 2018; Campbell et al. 2019.

Qamanirjuaq (QM): 2017; Boulanger et al. 2018.

Lorillard (LR): 2002; COSEWIC 2016.

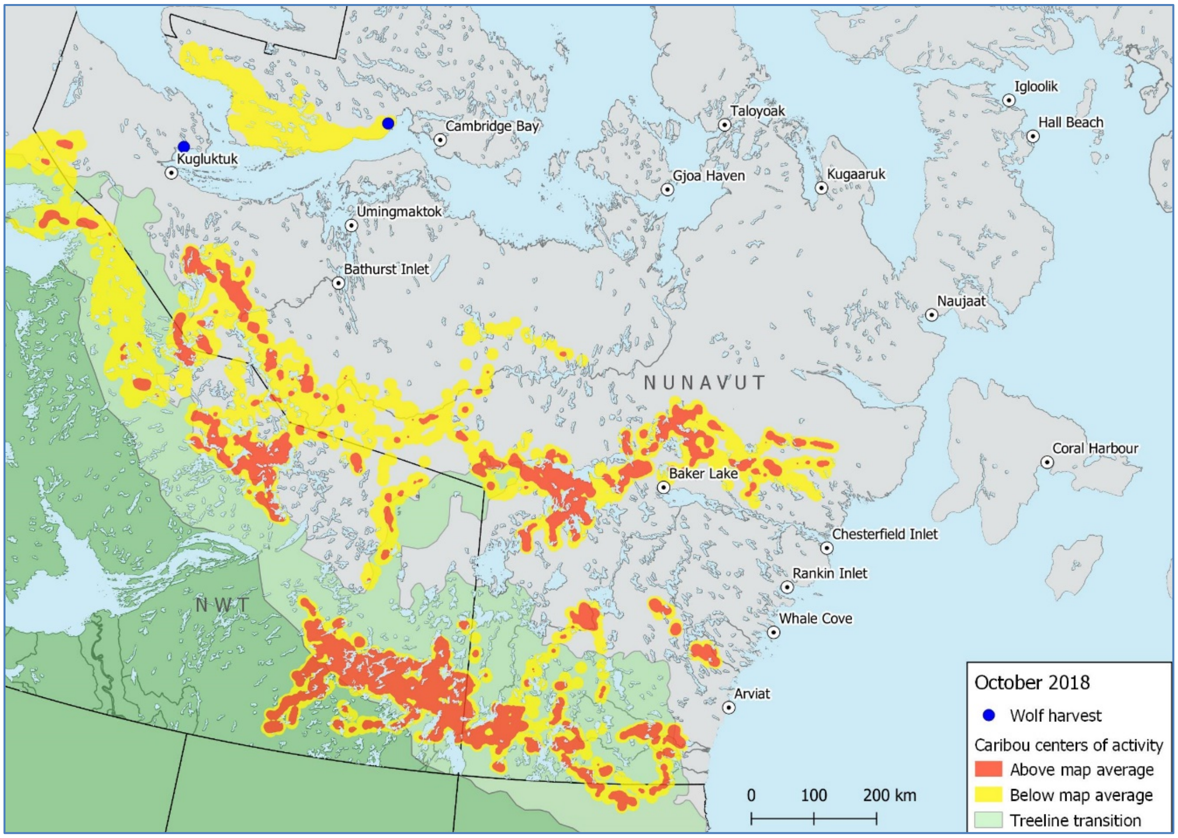
Wager Bay (WB): 2002; COSEWIC 2016.

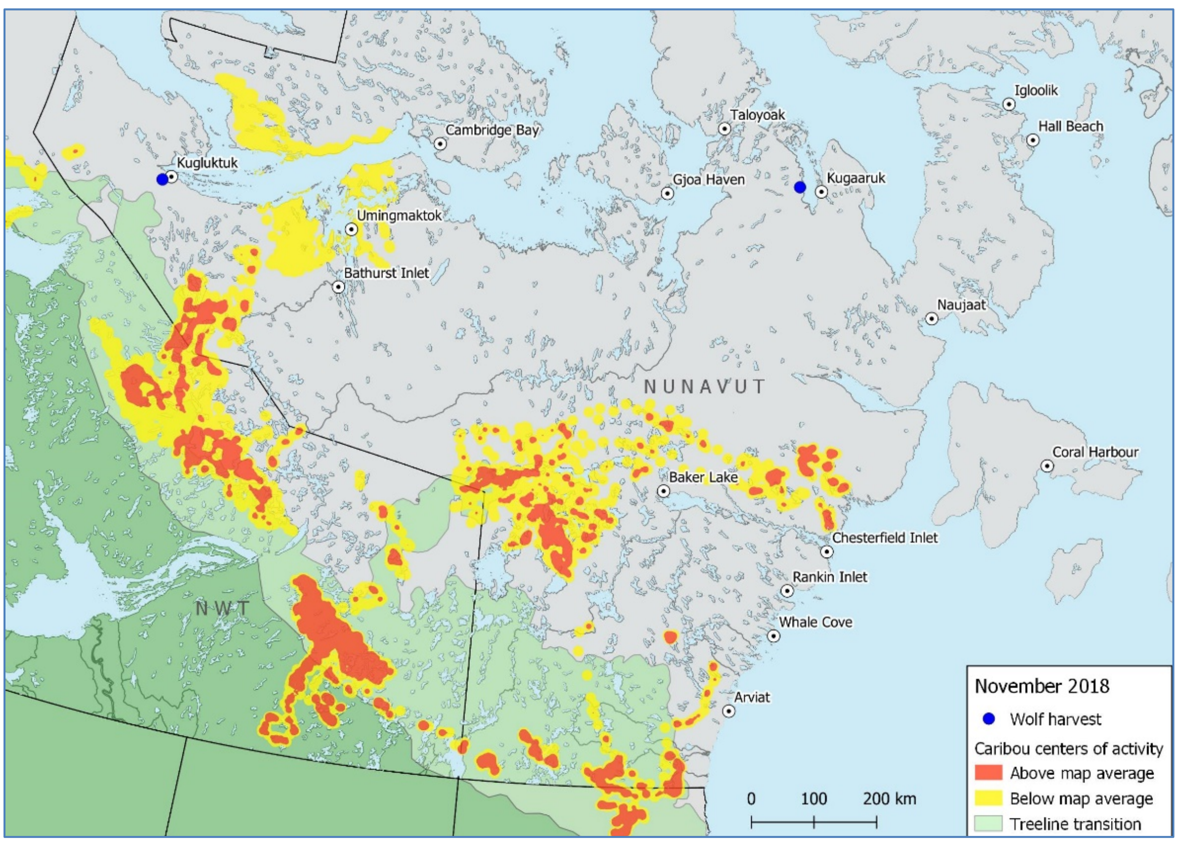
Ahiak (AH): 2011; Campbell et al. 2014.

Dolphin and Union (DU): 2020; Campbell et al. 2021.

Appendix 2: Monthly caribou and wolf harvest maps October 2018 – June 2021

Figure 25. Collared caribou distribution and centers of activity, and wolf harvest collection locations, October 2018 to June 2021 (see legends for month and year).


Igloolik
Hall Beach
Taloyoak
Cambridge Bay
Kugluktuk
Gjoa Haven
Kugaaruk
Umingmaktok
Bathurst Inlet
Naujaat
NUNAVUT
Coral Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
NWT
Whale Cove
Arviat
0 100 200 km
October 2018
Wolf harvest
Caribou centers of activity
Above map average
Below map average
Treeline transition


Igloolik
Hall Beach
Taloyoak
Cambridge Bay
Kugluktuk
Gjoa Haven
Kugaaruk
Umingmaktok
Bathurst Inlet
Naujaat
NUNAVUT
Coral Harbour
Baker Lake
Chesterfield Inlet
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Caribou centers of activity
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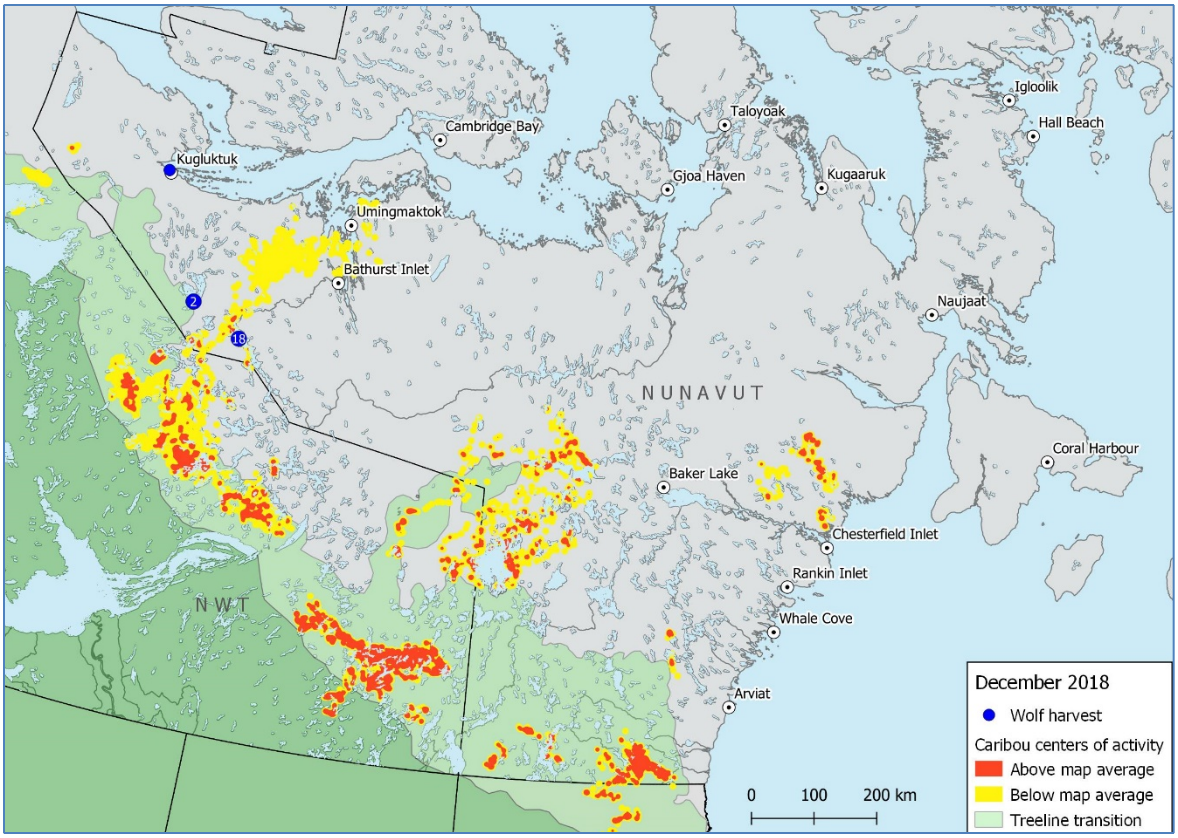
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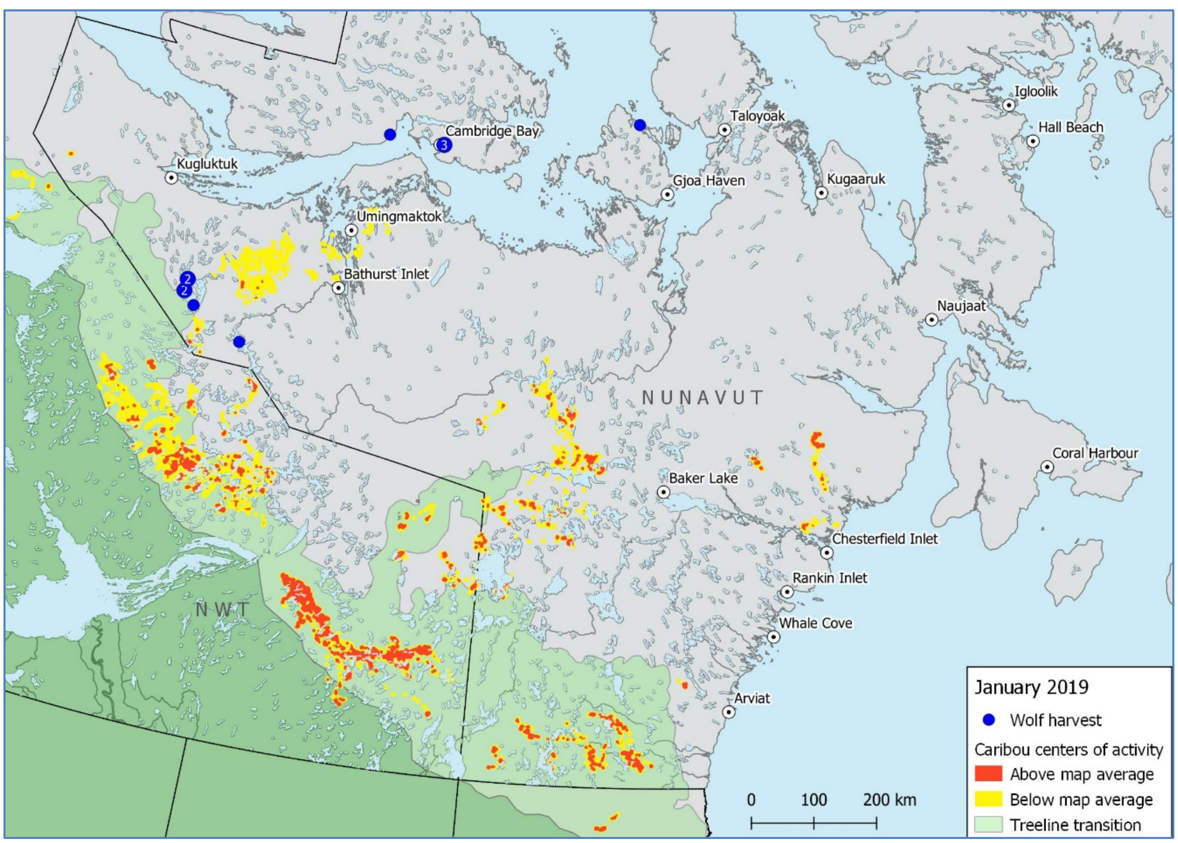
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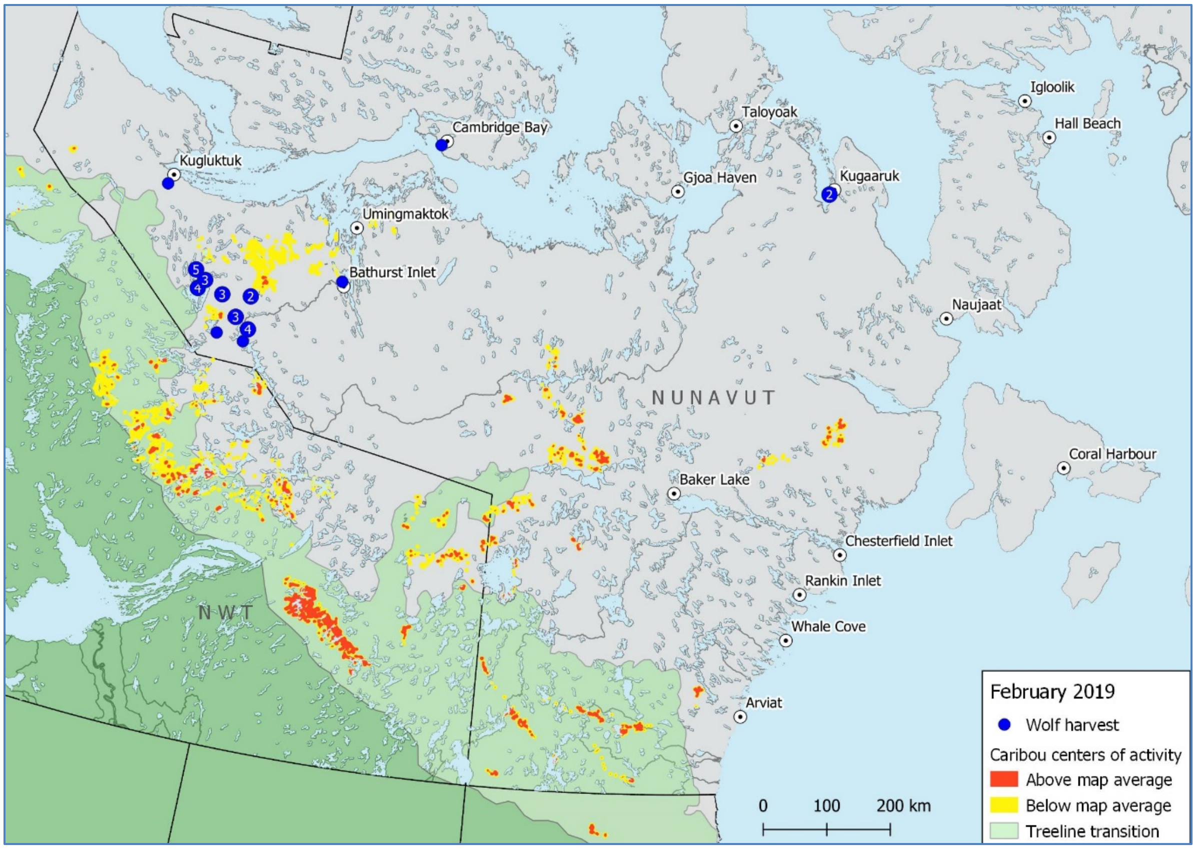
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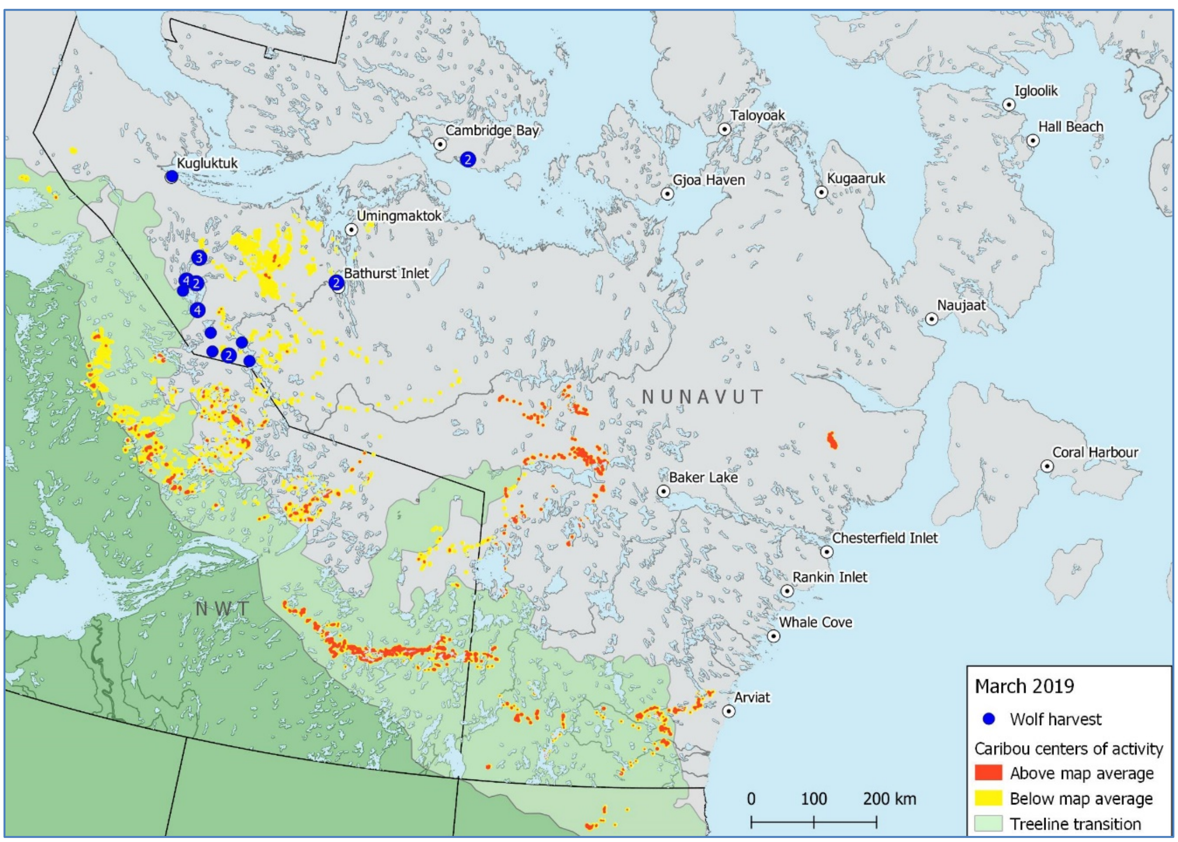
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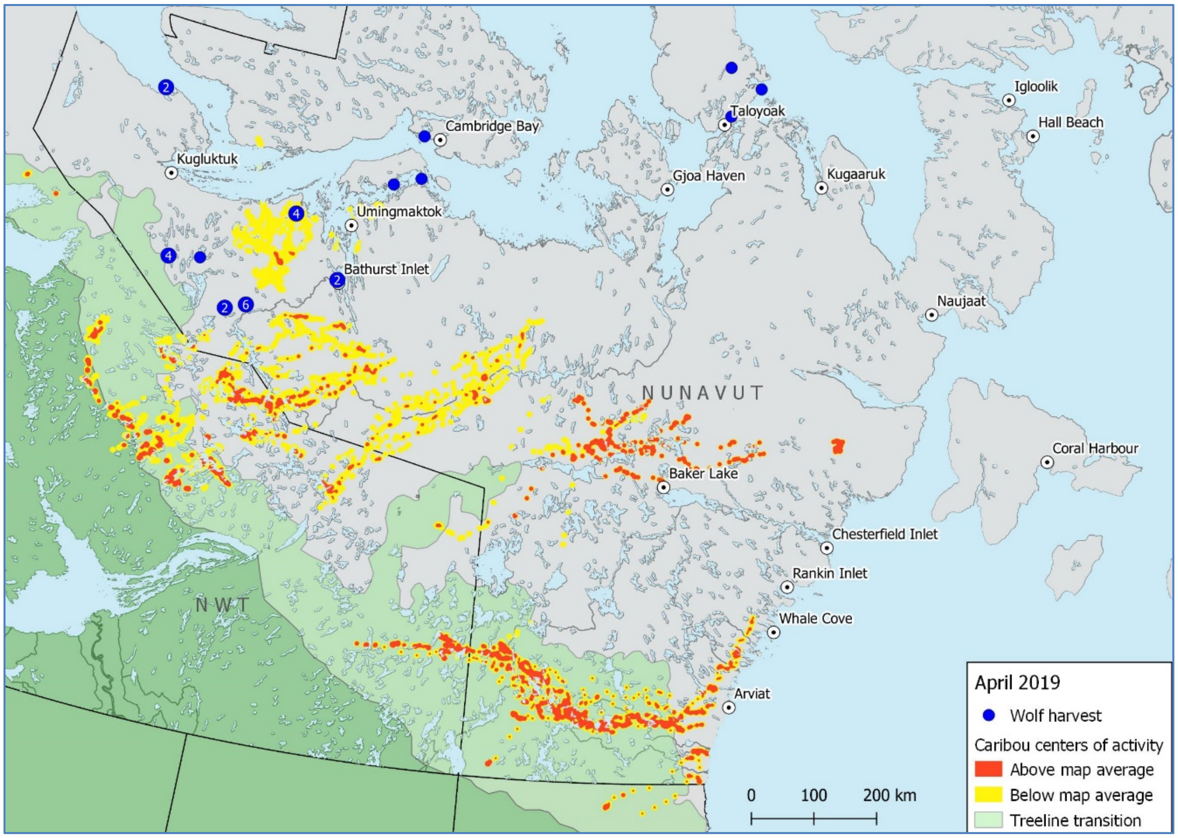
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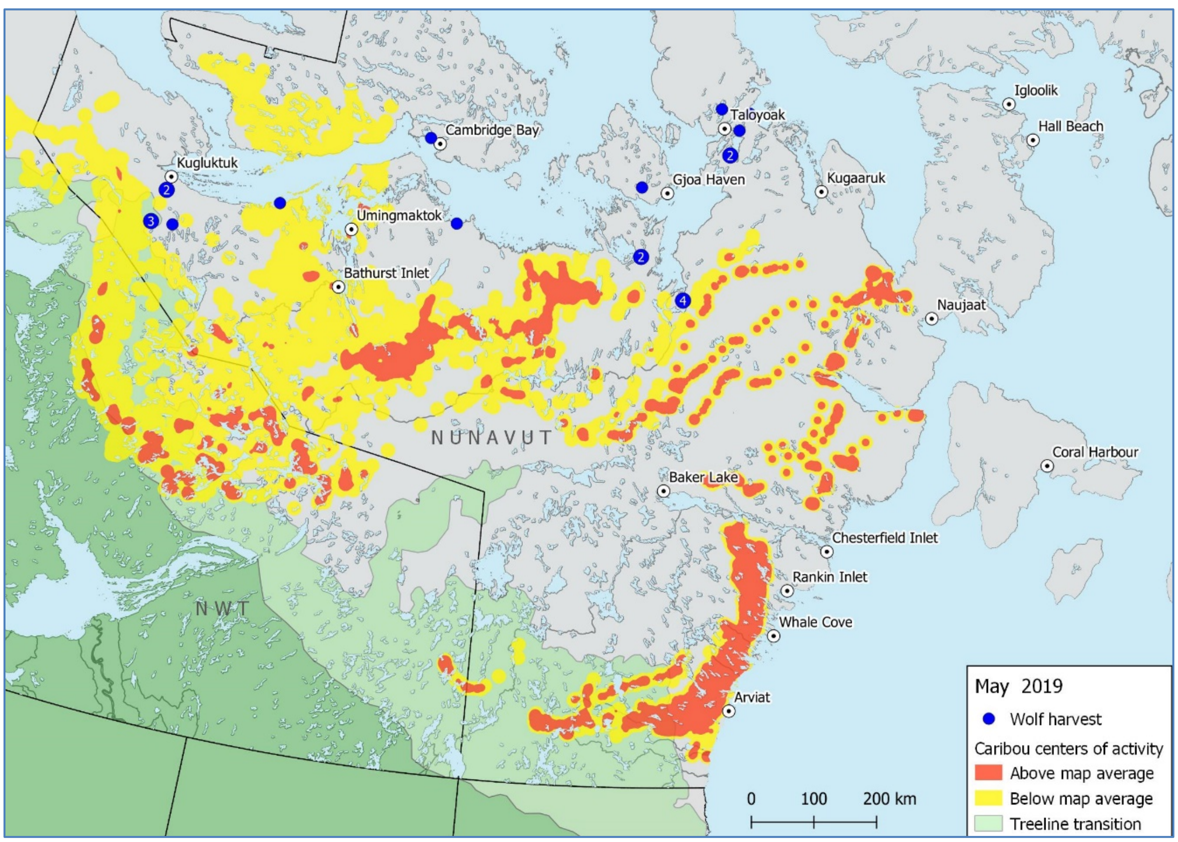
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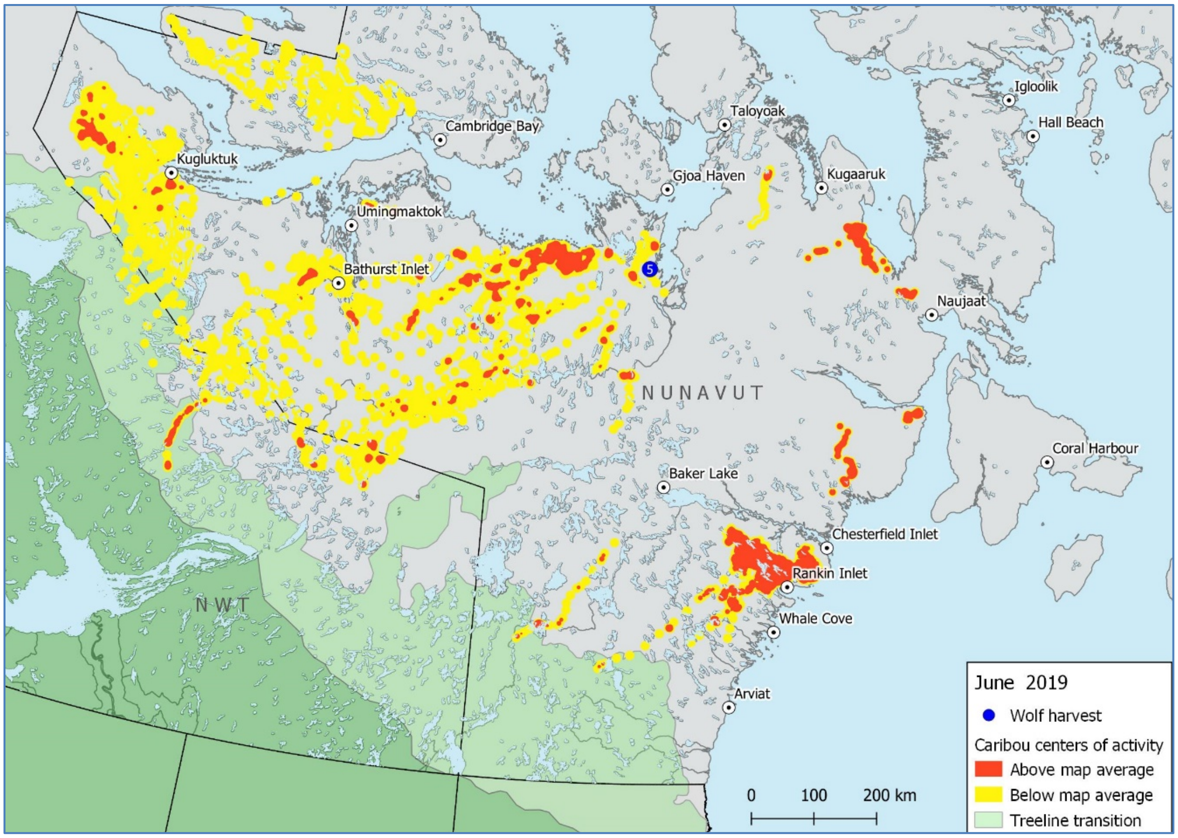
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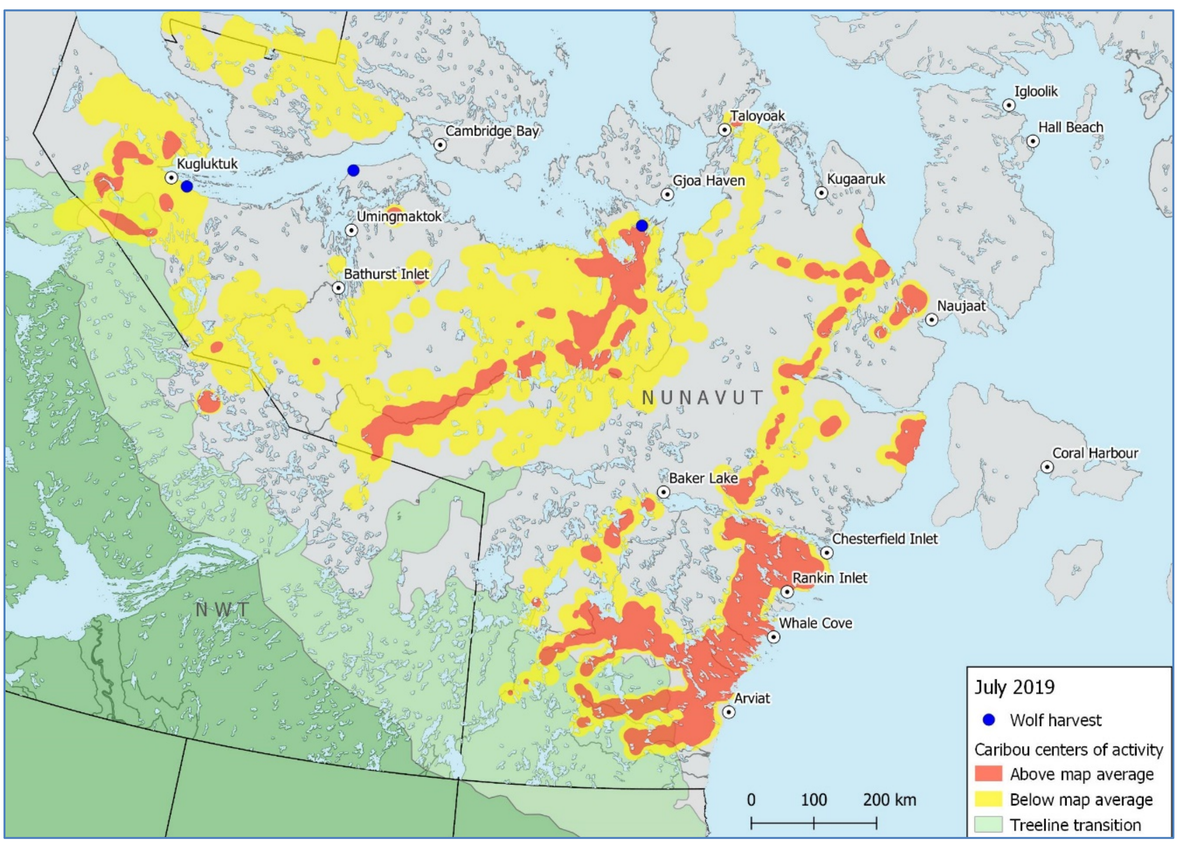
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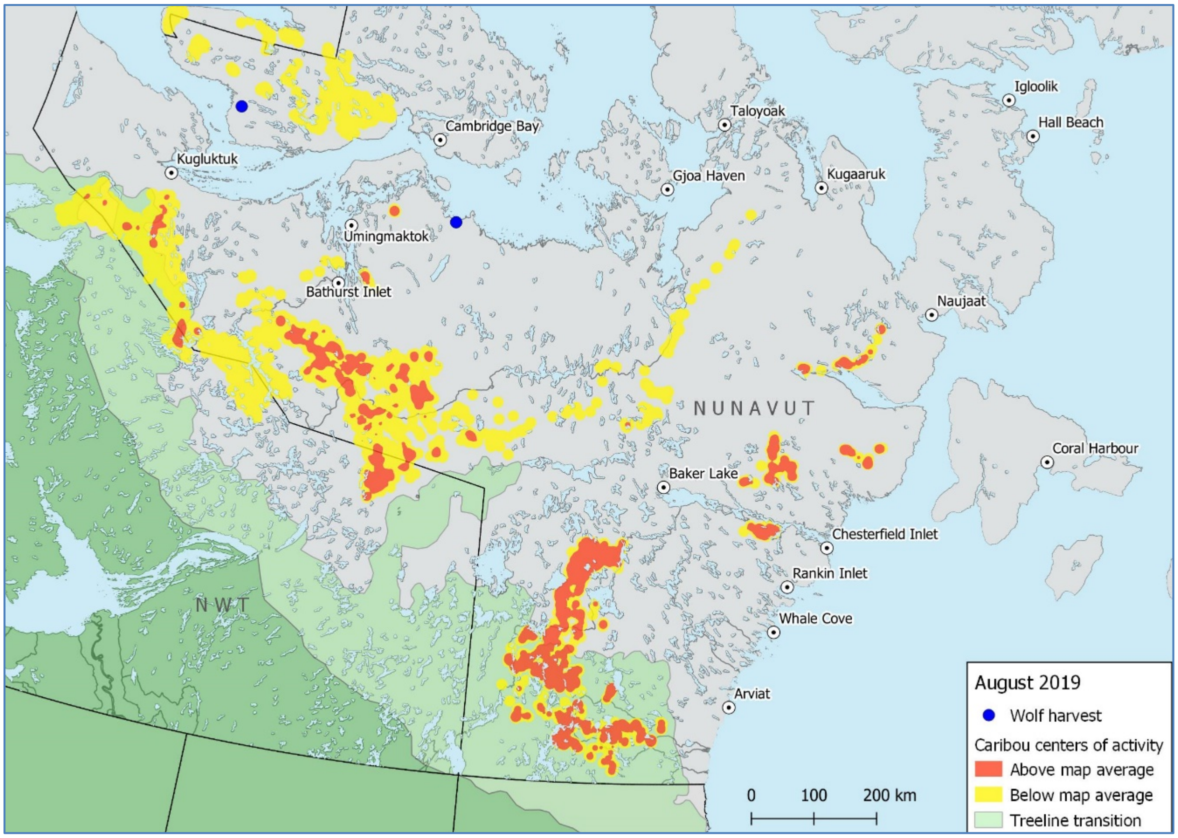
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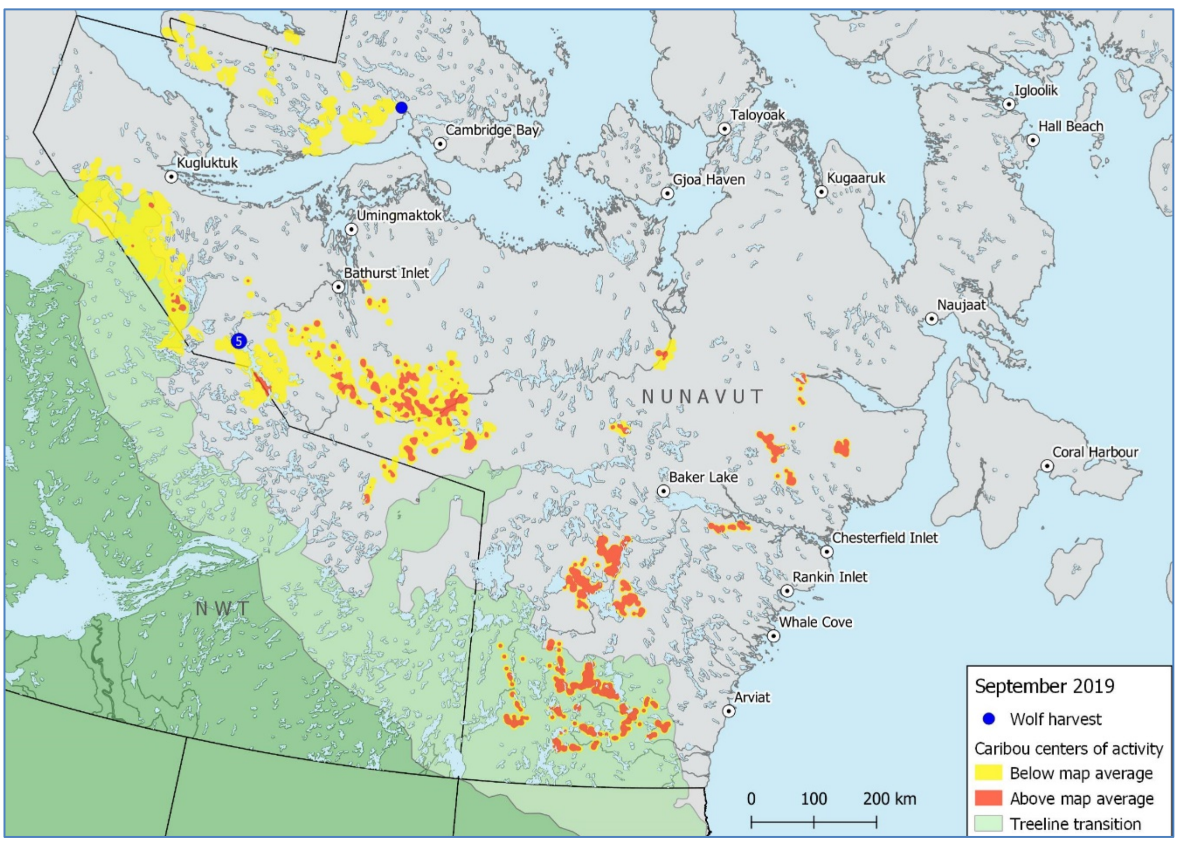
Treeline transition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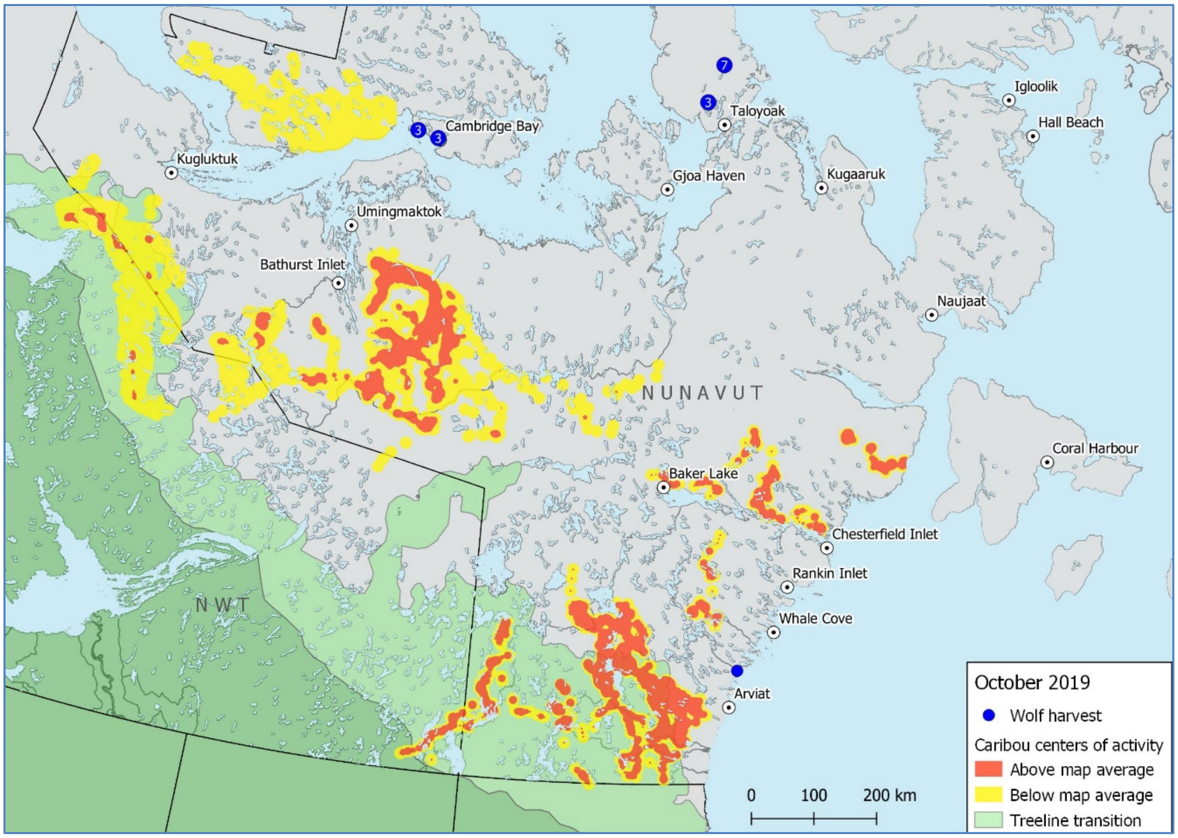
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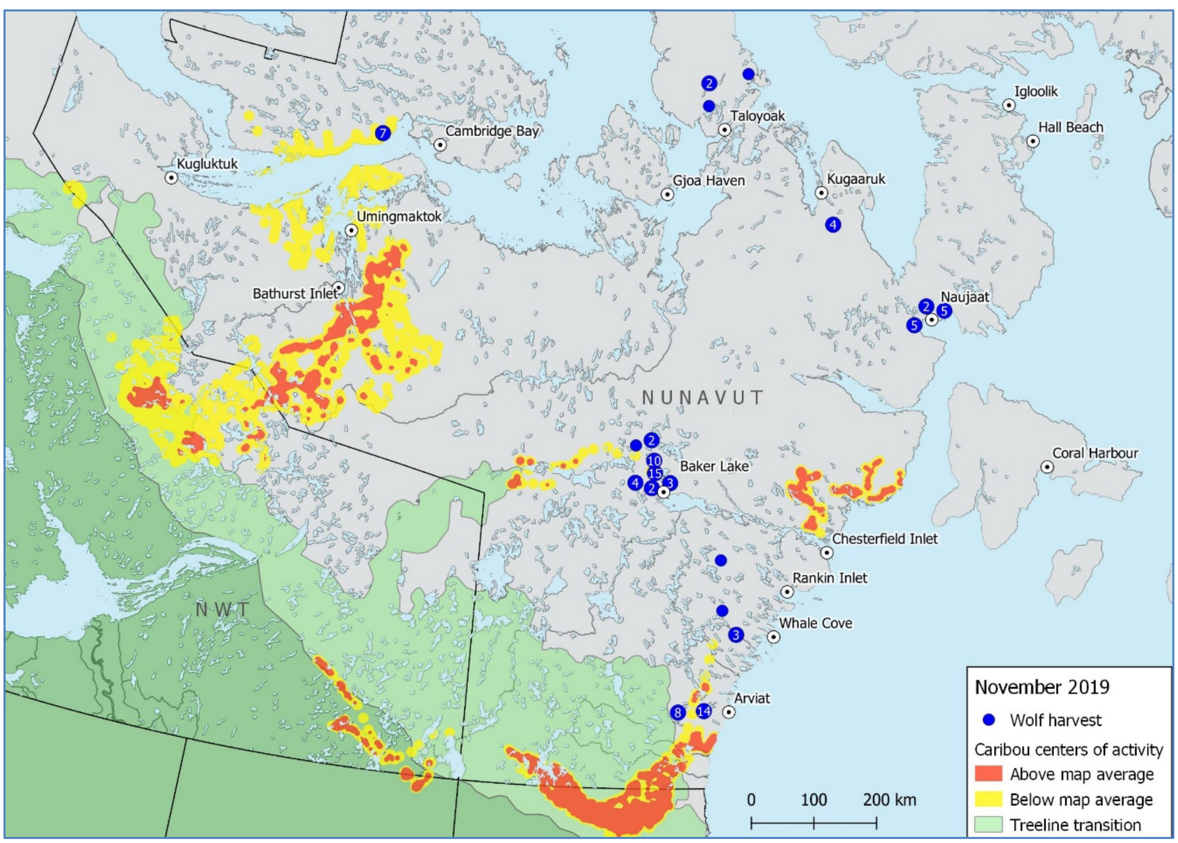
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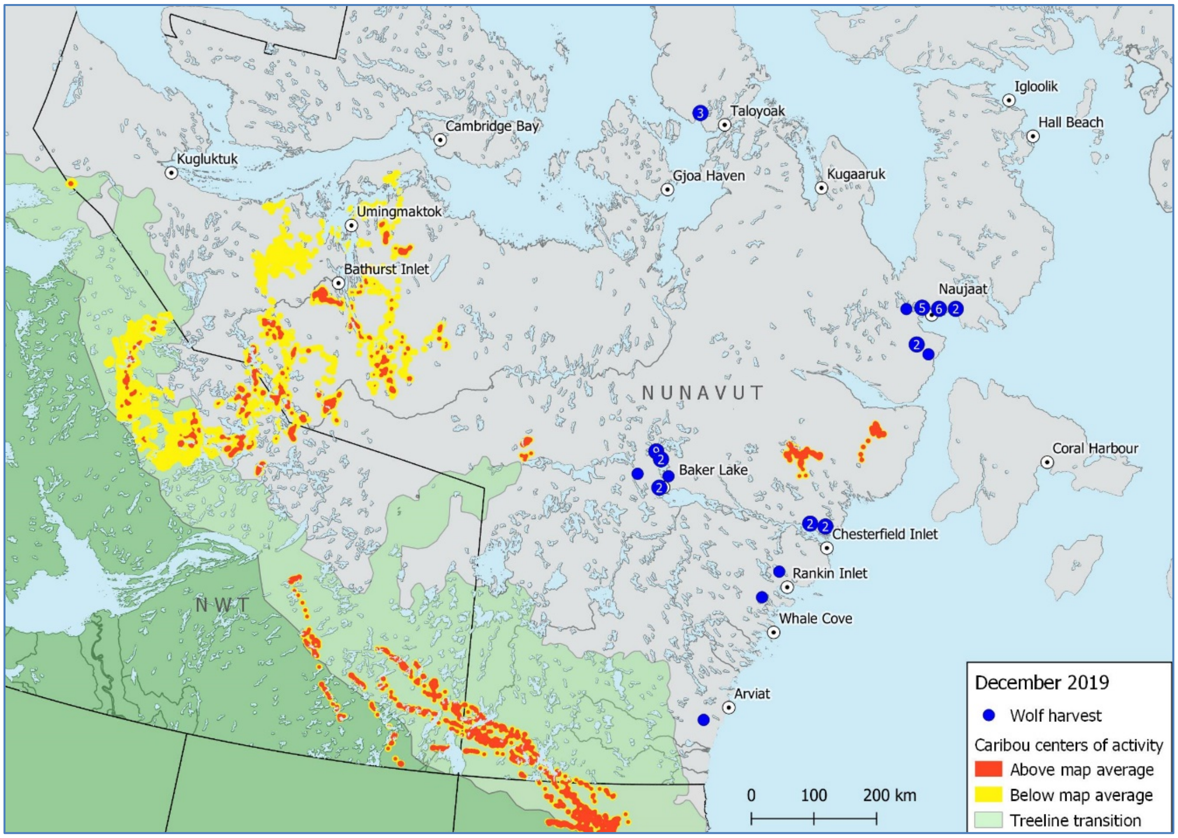
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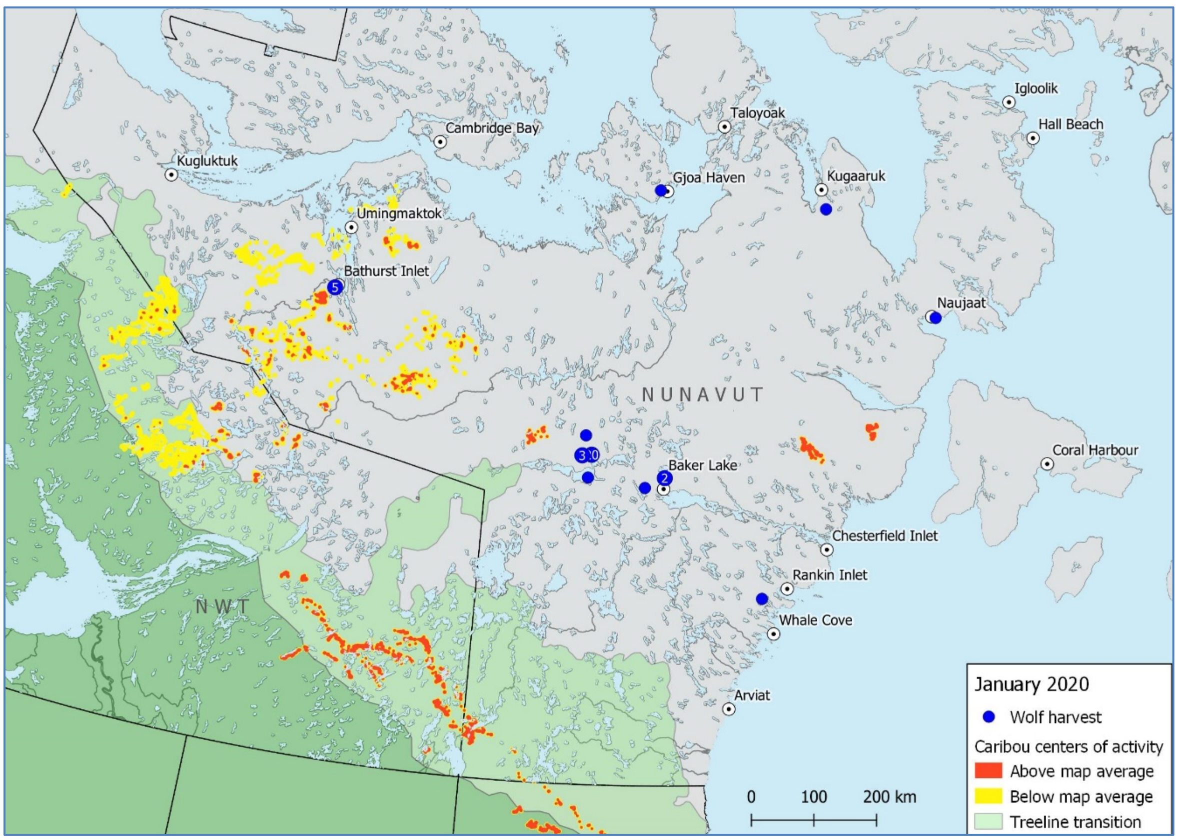
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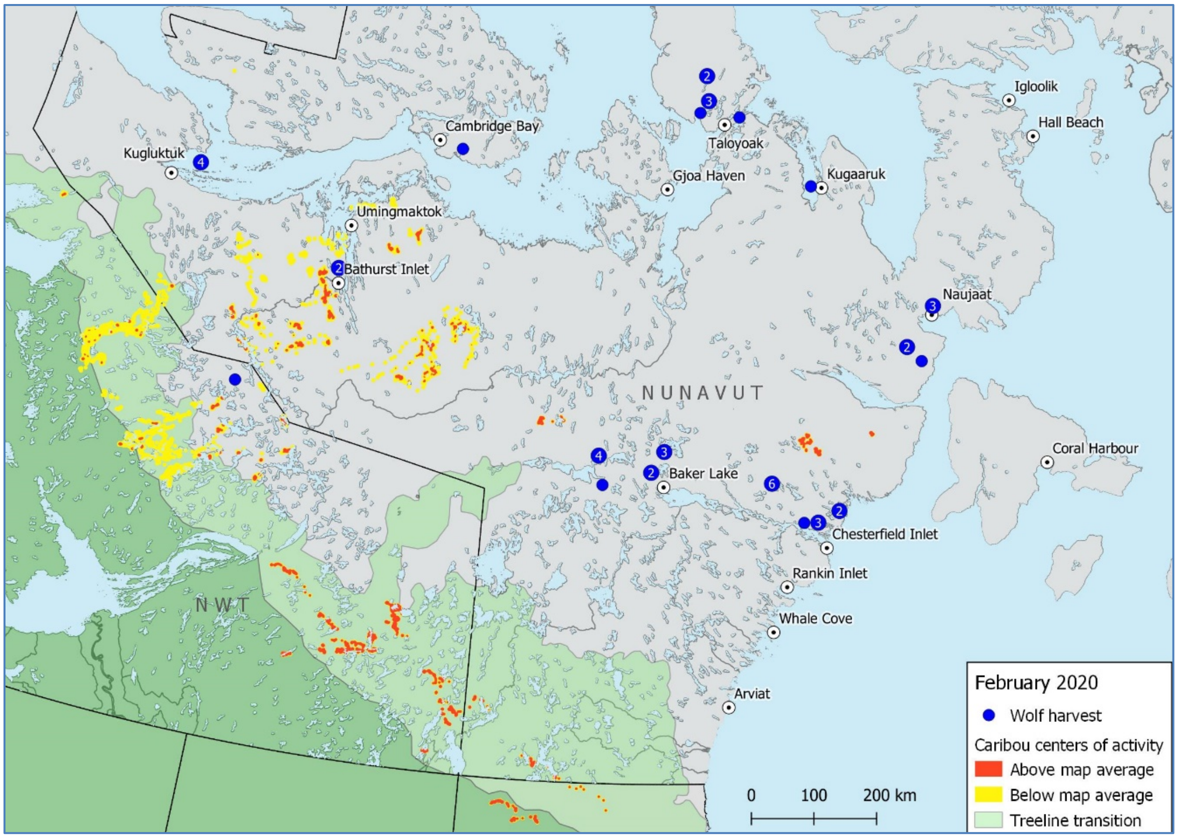

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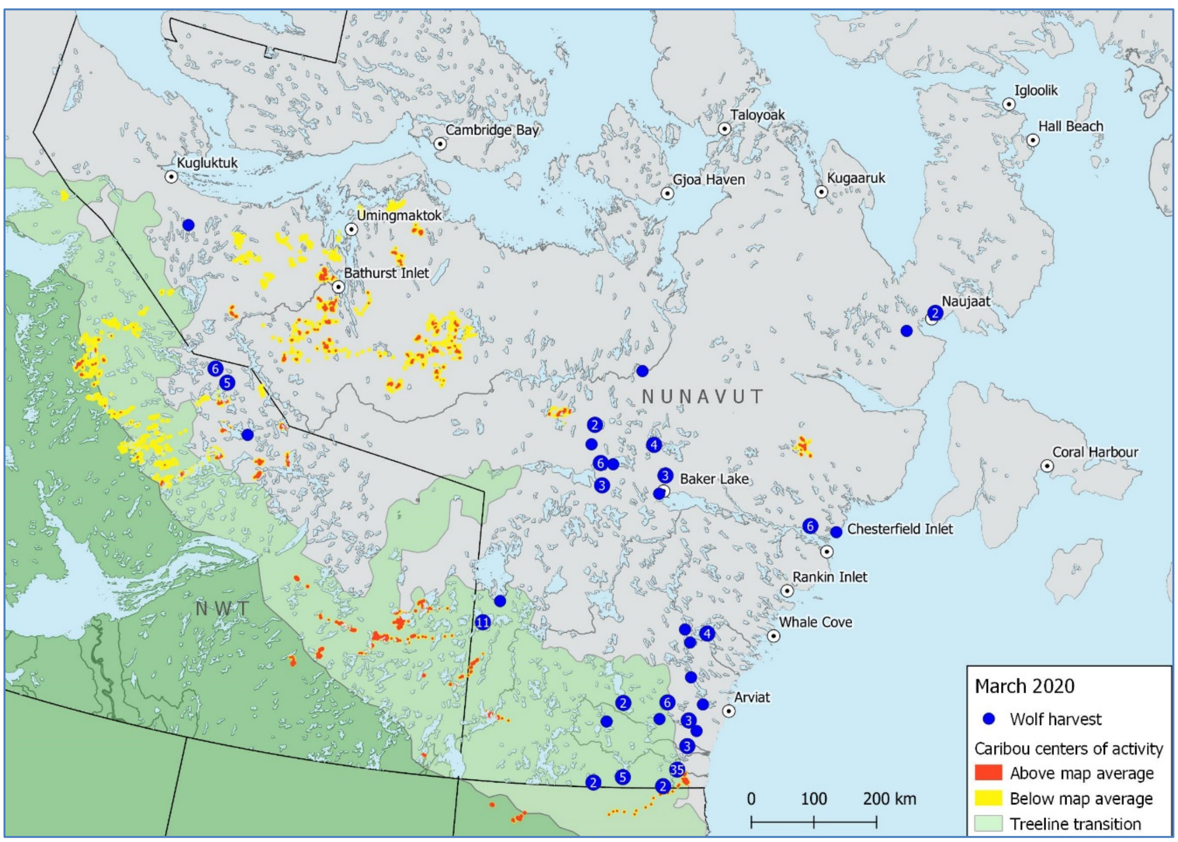

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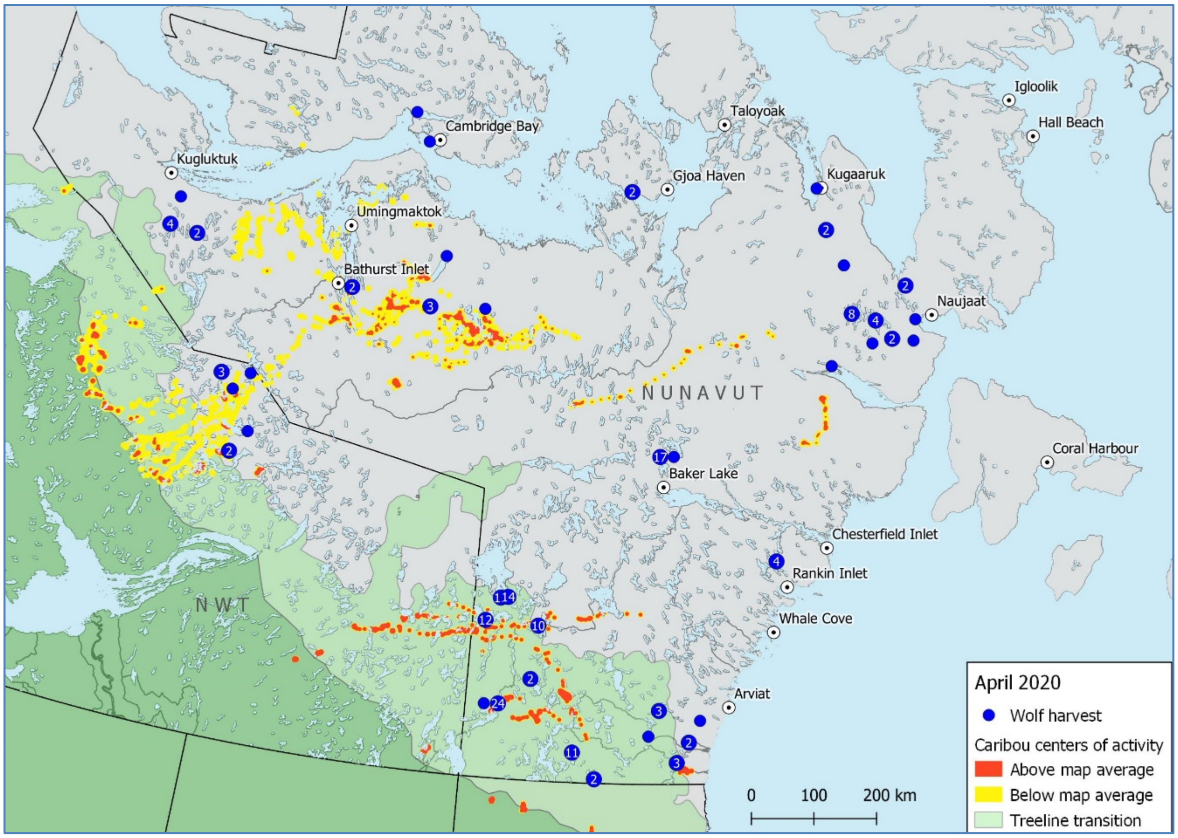
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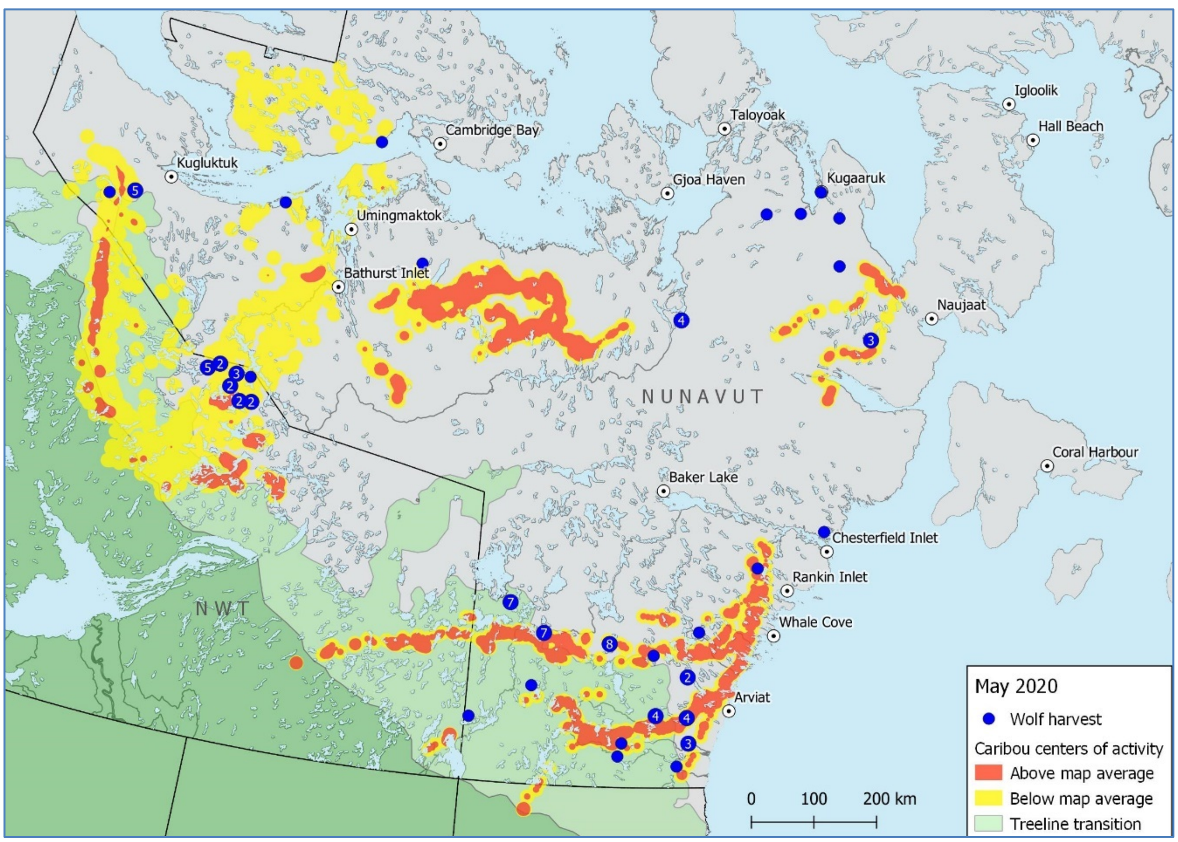
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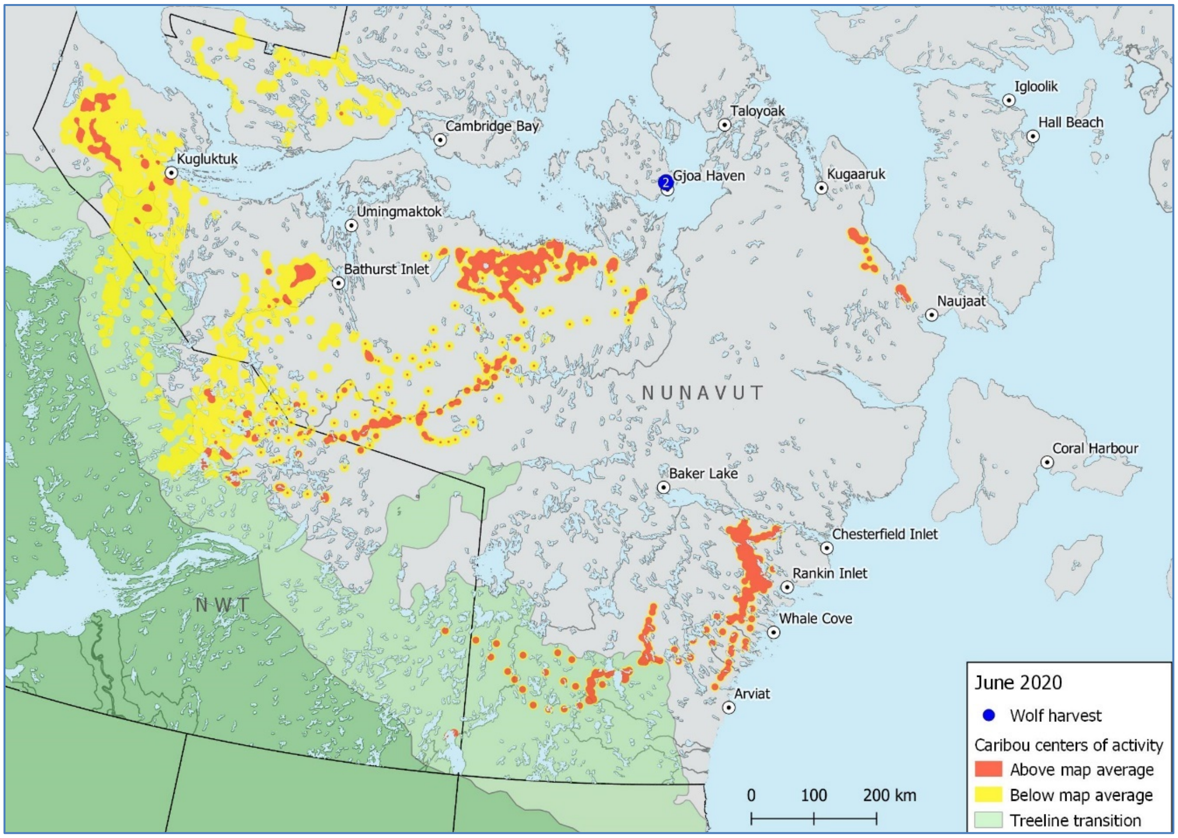
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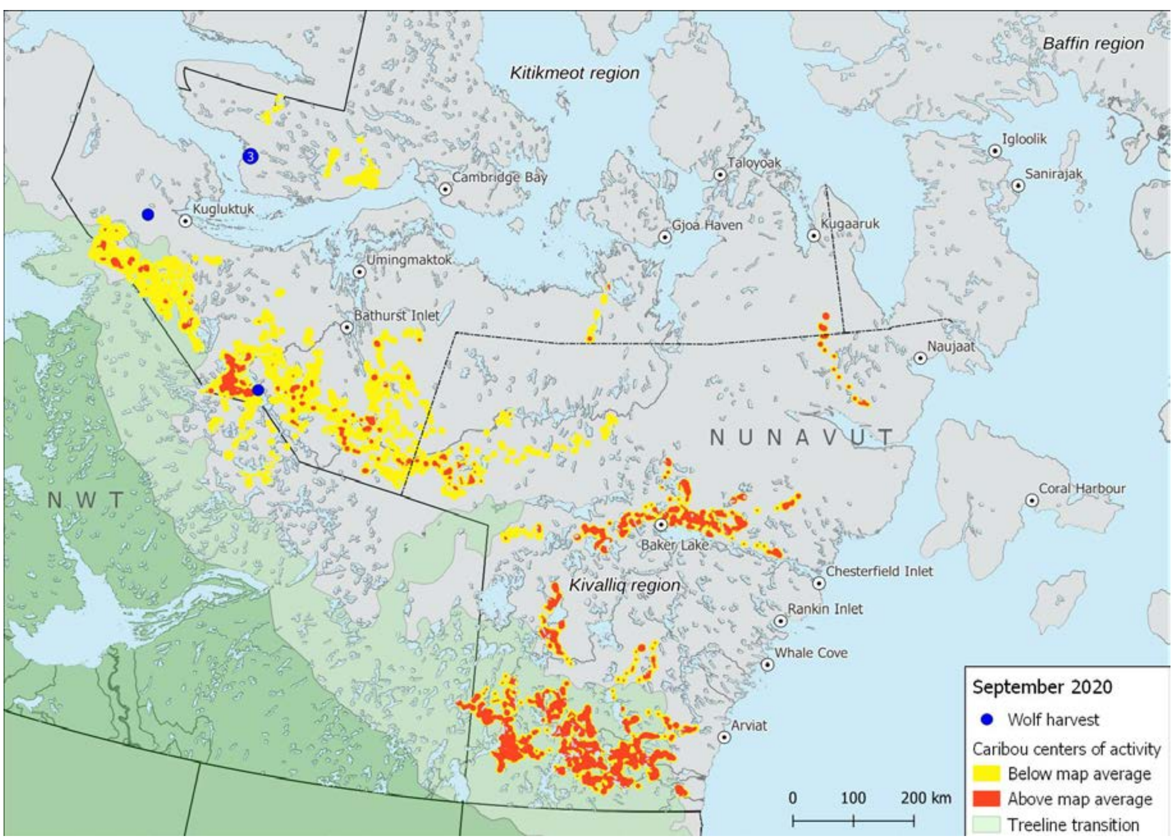
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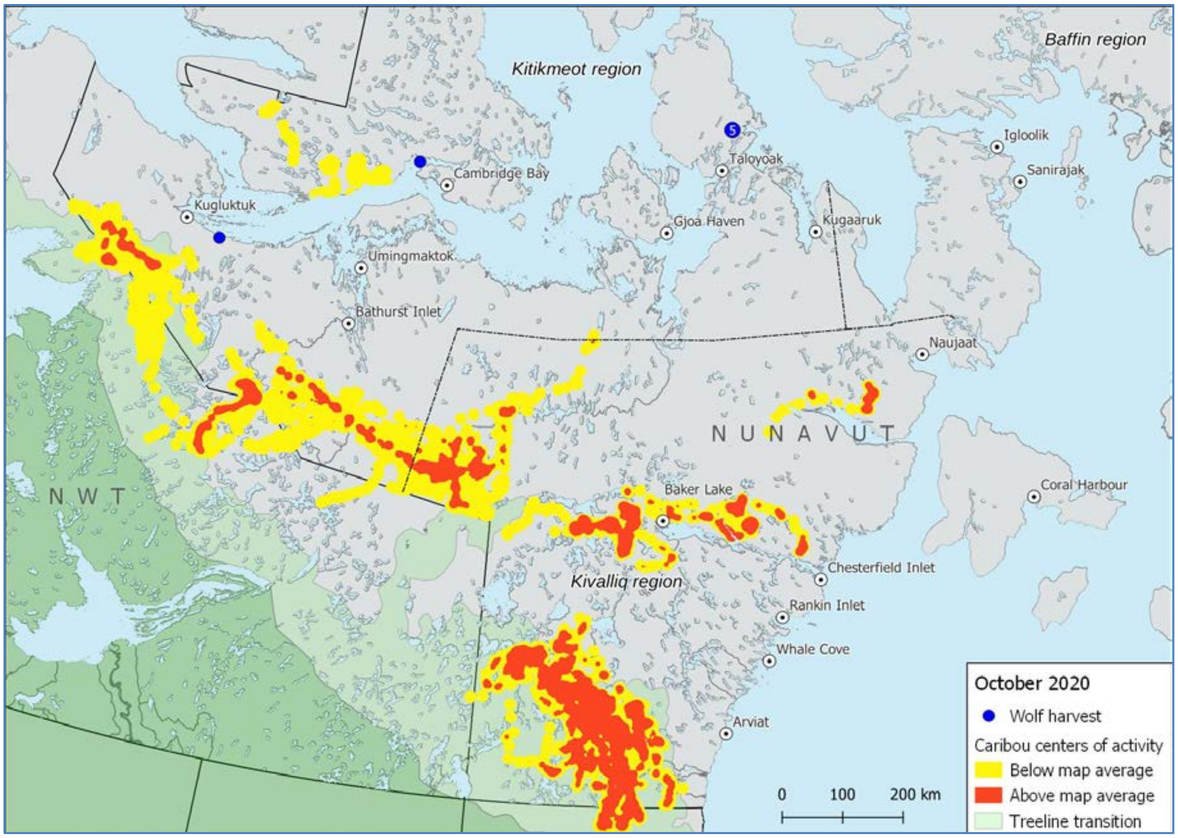
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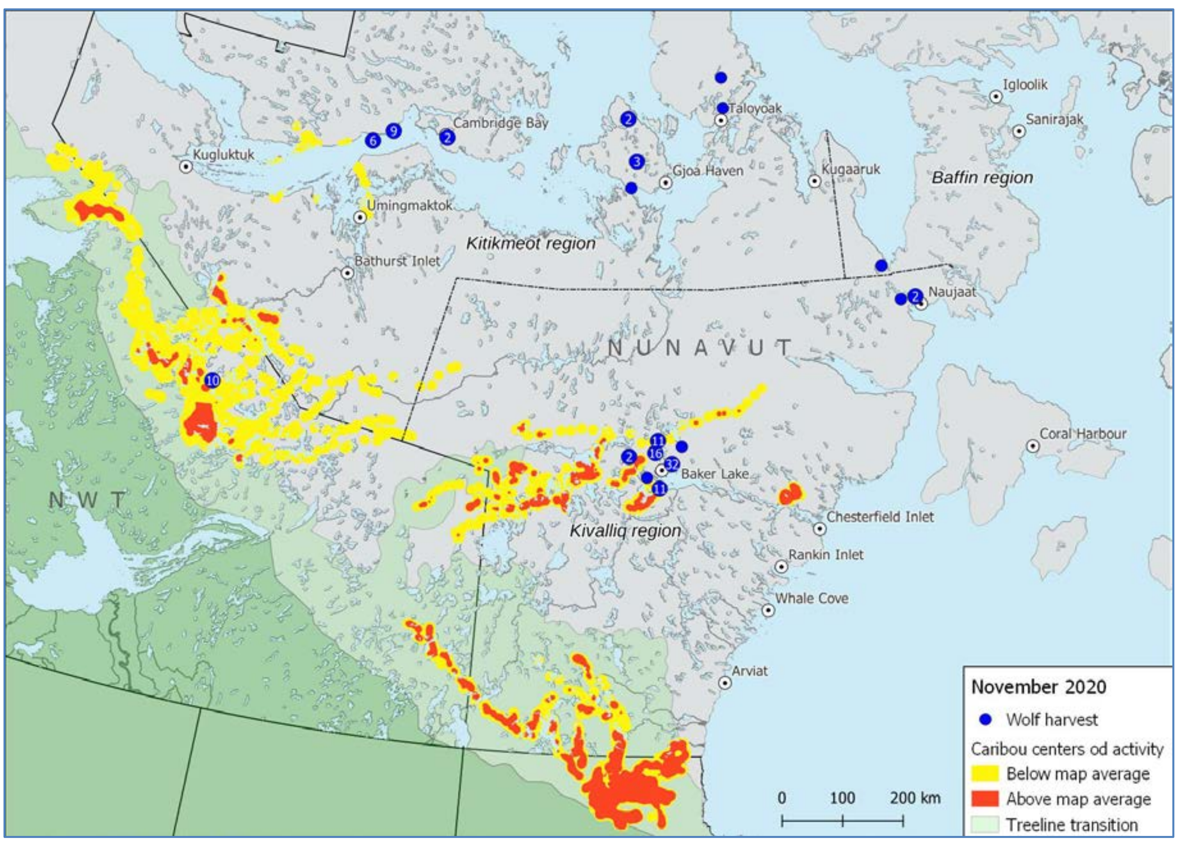
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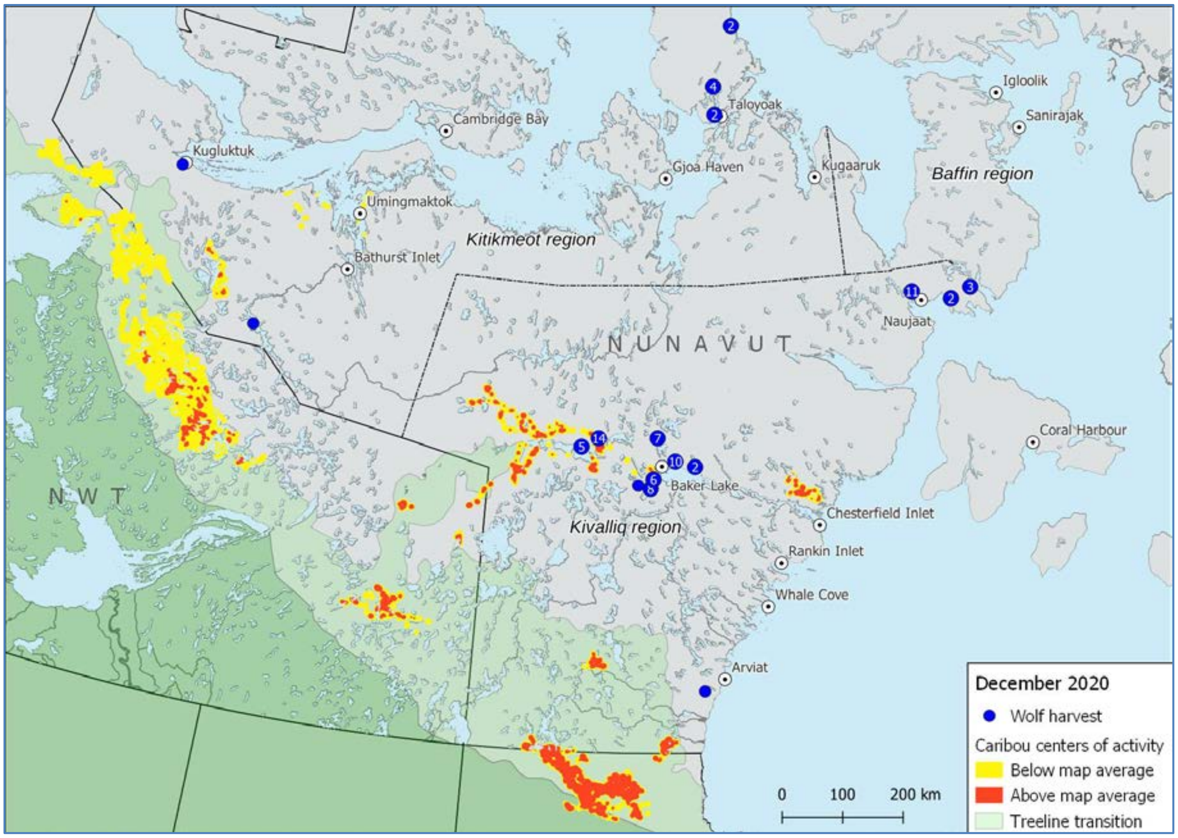
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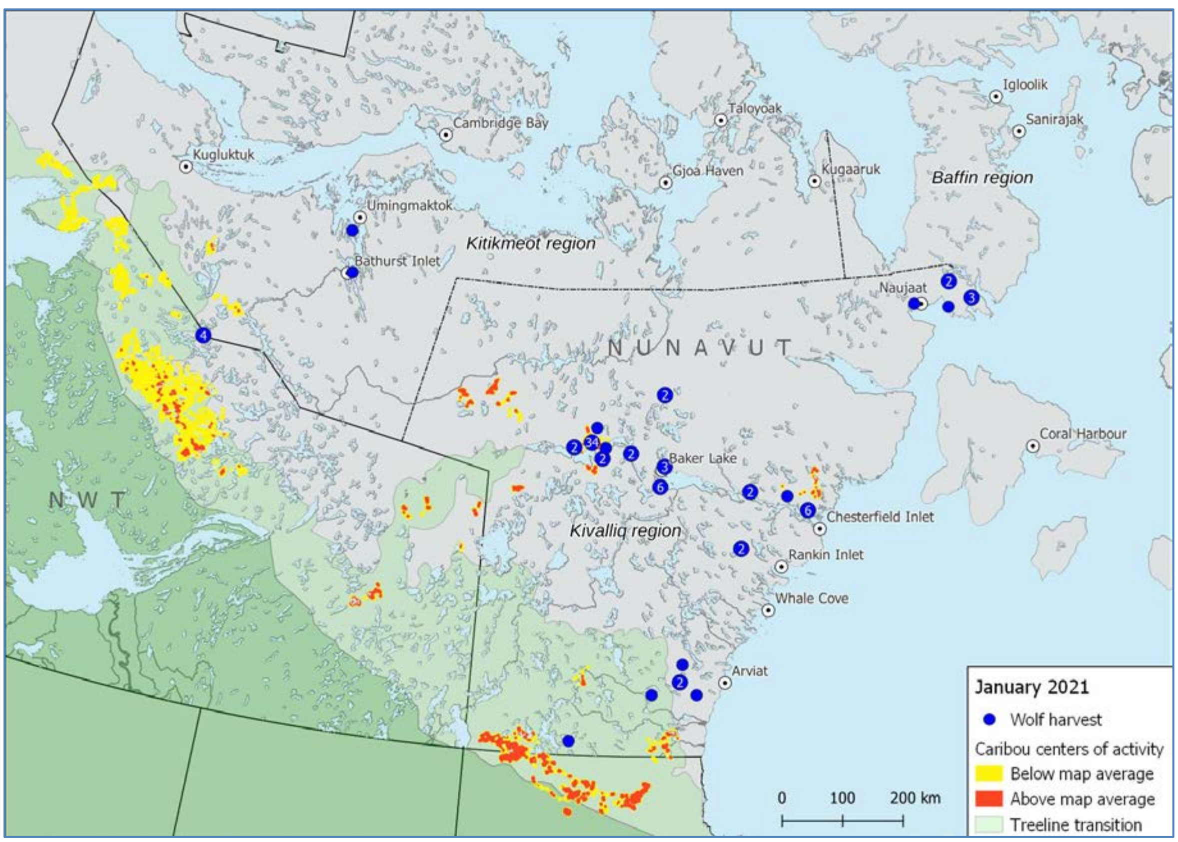
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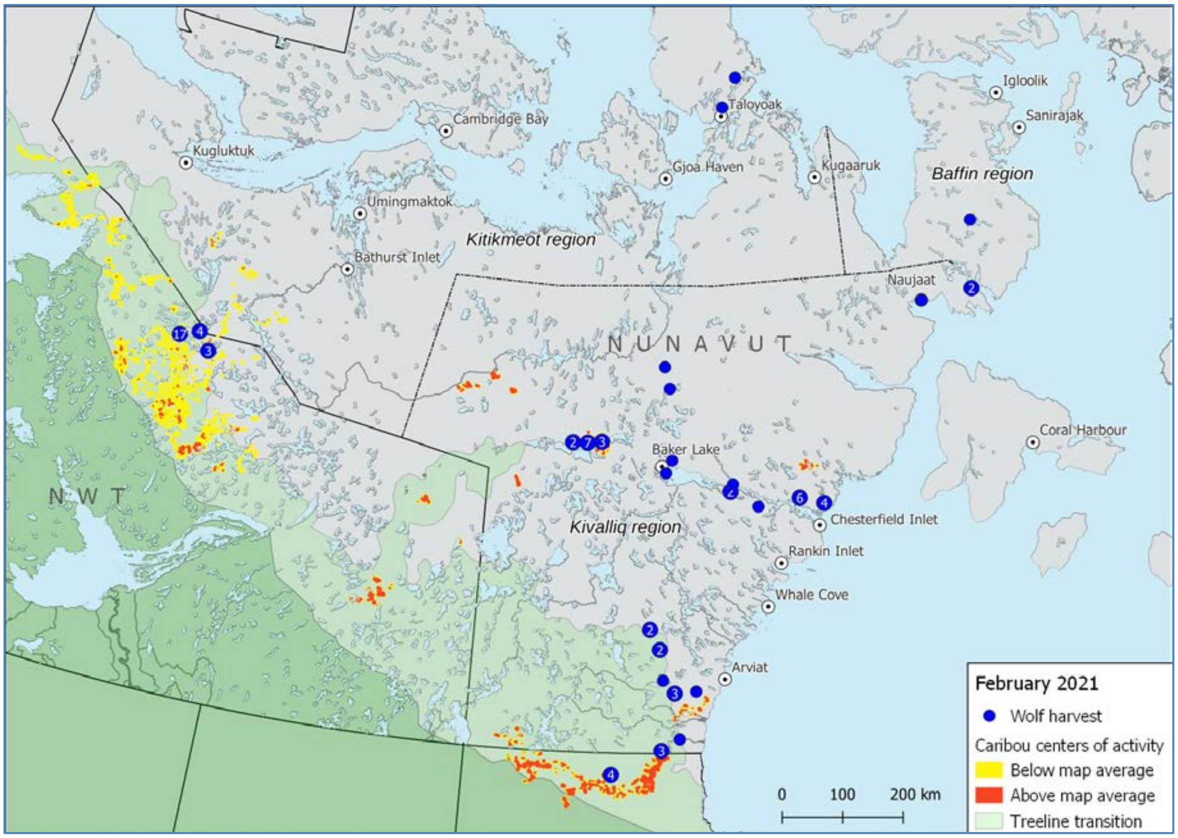
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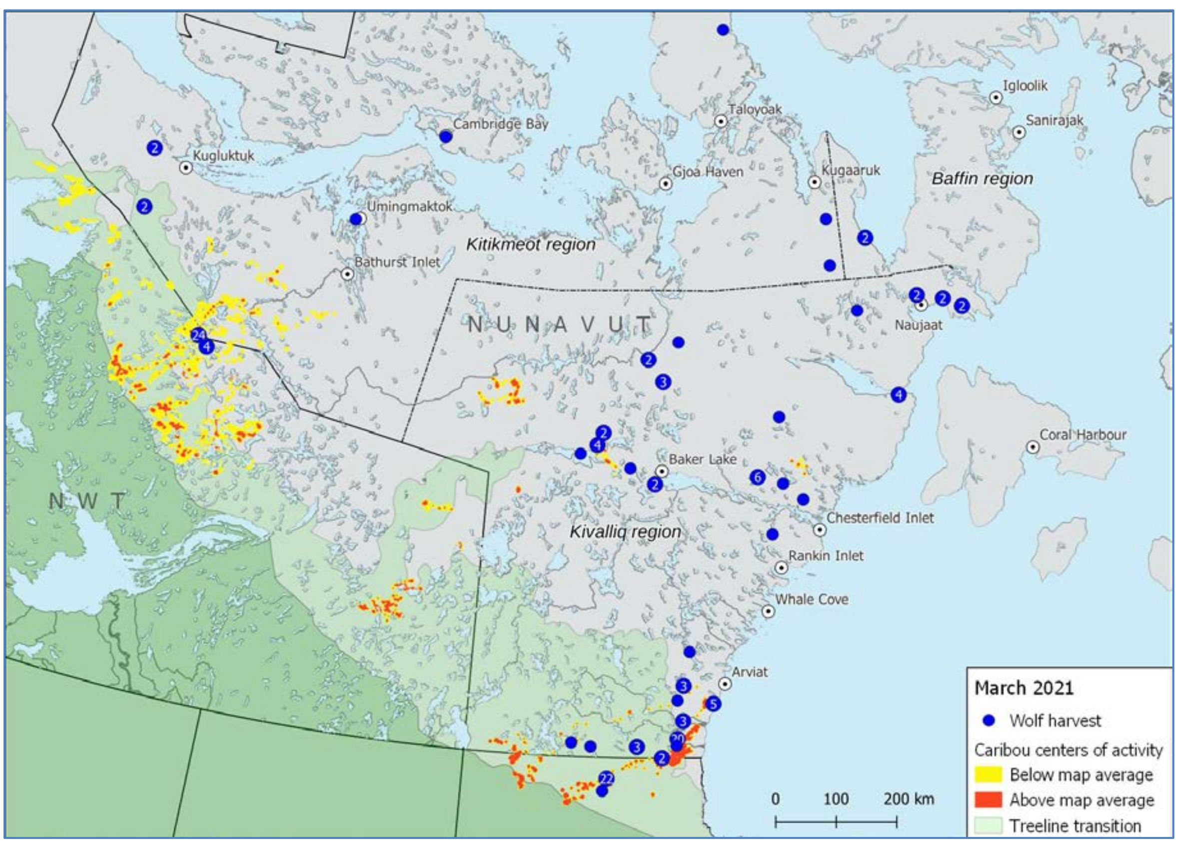
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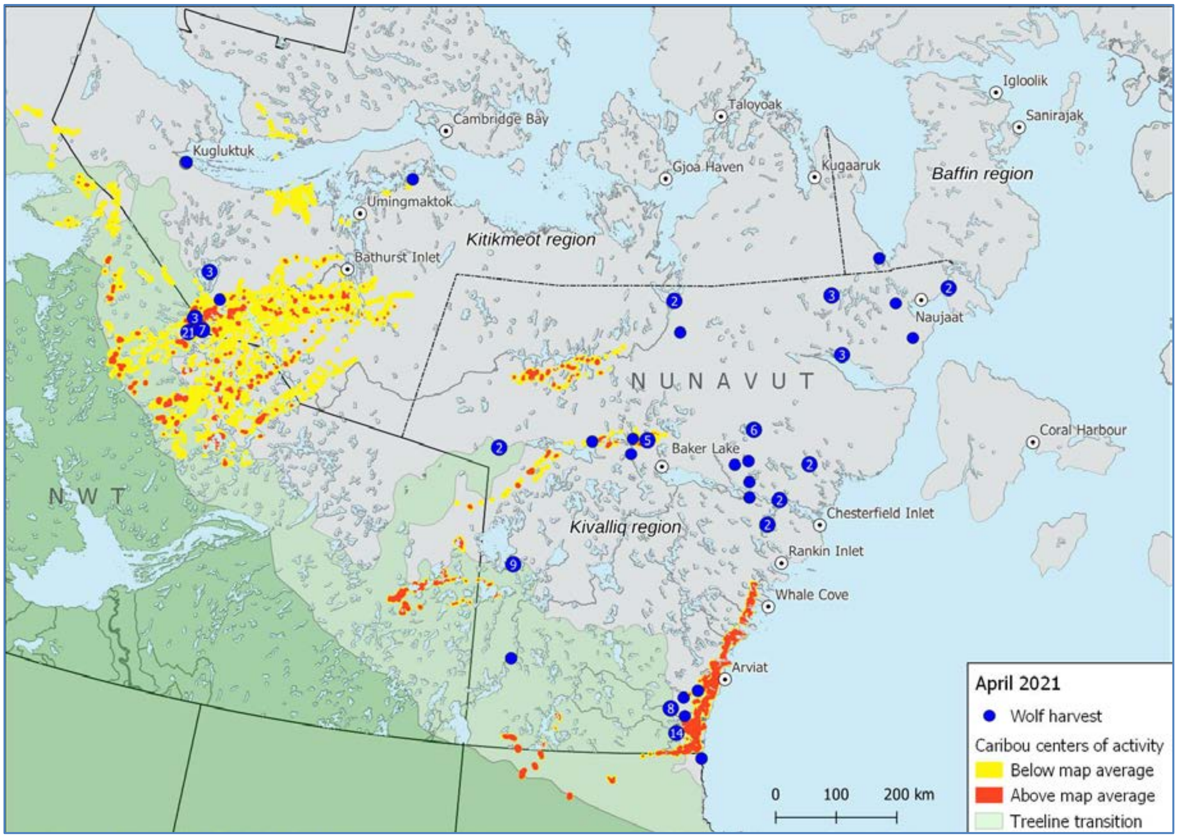
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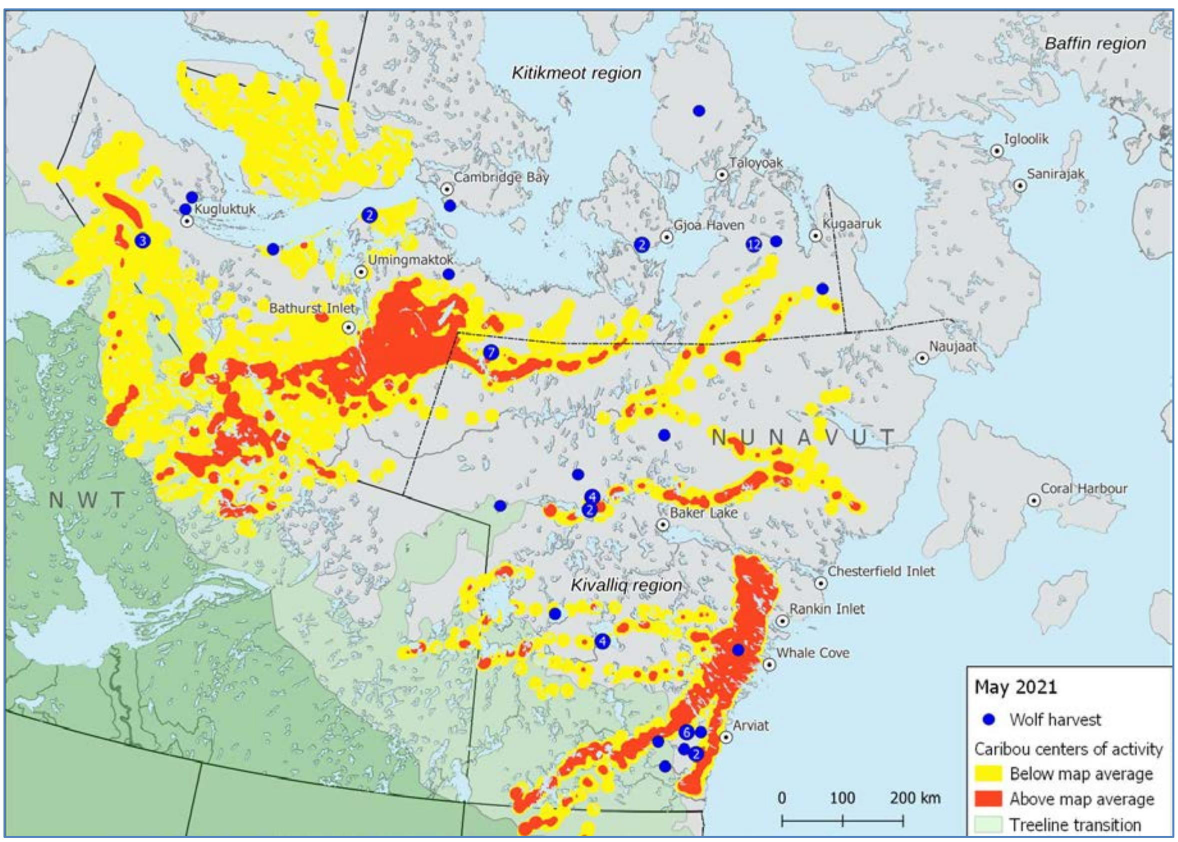
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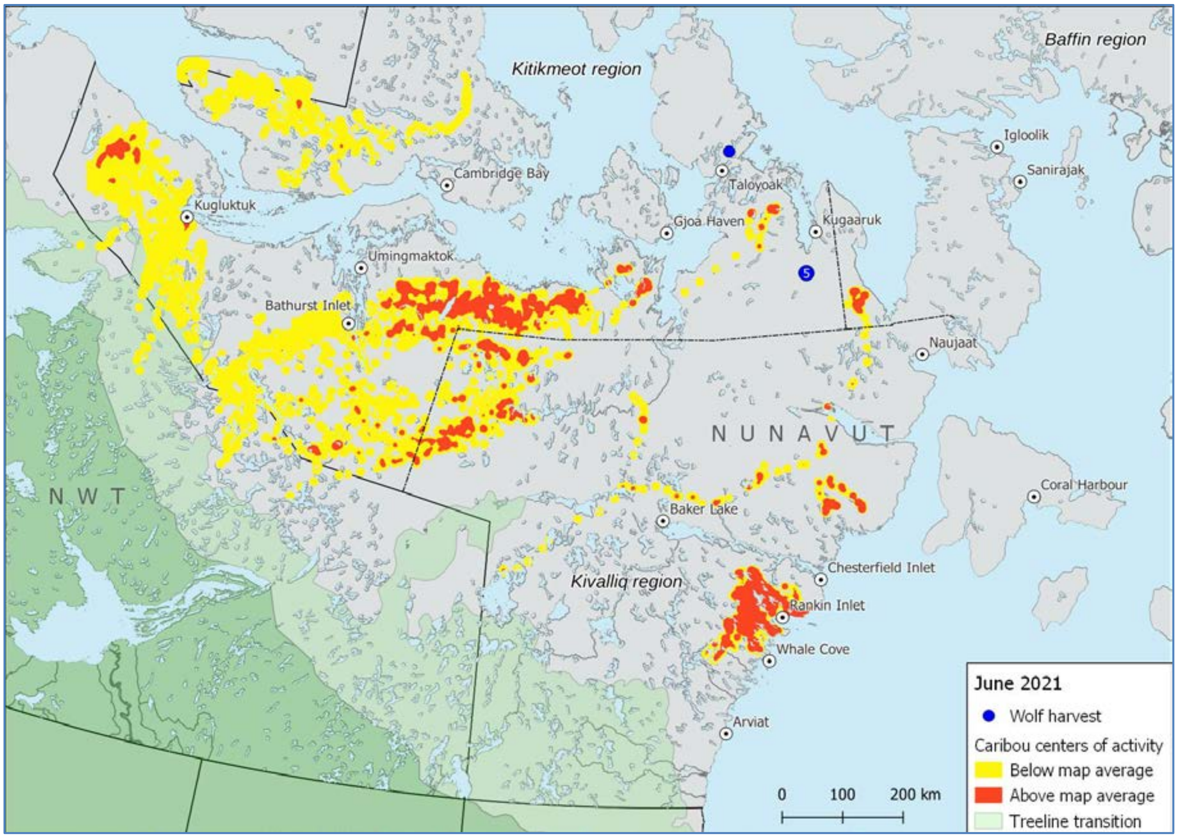
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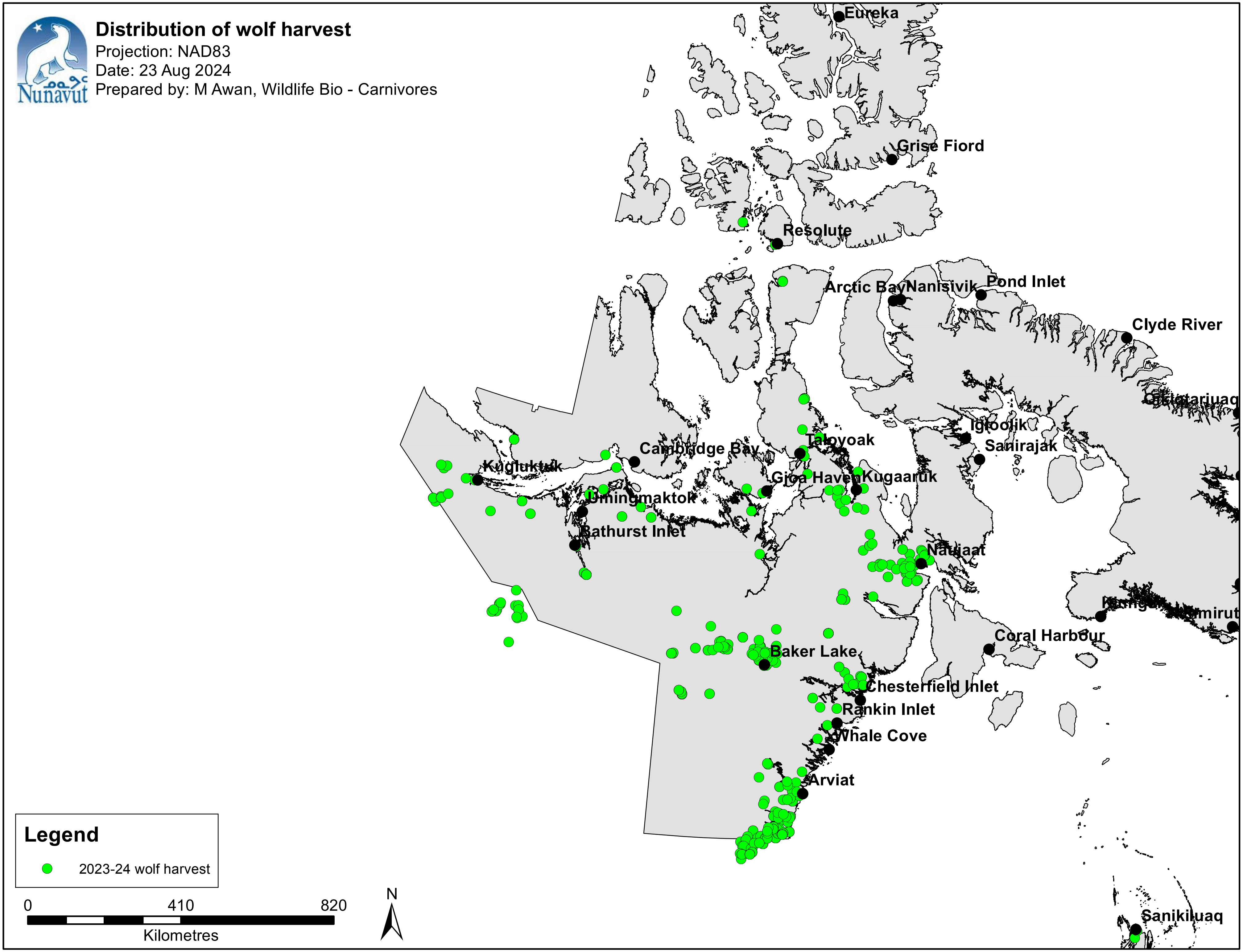
Treeline transition



Distribution of wolf harvest
Projection: NAD83
Date: 23 Aug 2024
Prepared by: M Awan, Wildlife Bio - Carnivores
Nunavut
Eureka
Grise Fiord
Resolute
Arctic Bay
Nanisivik
Pond Inlet
Clyde River
Igloolik
Sanirajak
Taloyoak
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Gjoa Haven
Kugaaruk
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Bathurst Inlet
Naujaat
Coral Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
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Legend
2023-24 wolf harvest
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N

Building Nunavut Together
Nunavuliuqatigiingniq
Bâtir le Nunavut ensemble

WOLVERINE (*Gulo gulo*) HARVEST MONITORING IN NUNAVUT

Summary report

February 2025

Malik Awan
Department of Environment
PO Box 120
Arviat, Nunavut
X0C 0E0

Summary

Overall, Nunavut hunters submitted skulls and kill information from 691 harvested wolverines between 2019 and 2024 harvest years (1 July 2023 –30 June 2024 = 2024 harvest year). Most wolverines were harvested in the Kitikmeot region, in the vicinity of Kugluktuk, while relatively fewer were harvested in the eastern communities. Arviat and Baker Lake were the next highest contributors to the total harvest. Harvest data shows that 84% of wolverines were hunted with a rifle, while 16% were trapped. Sex ratio of the harvest was male biased with approximately two times as many males harvested than females. Juveniles and yearling predominated as 63% of the harvest while the other 37% were adults. The harvest was dominated by younger age classes during the early winter, while the harvest of adult individuals increased later in the winter. The spatial distribution, age, and sex structure of the harvest were typical of a healthy population. However, the relatively low number of mature females in the harvest is important to note and should be monitored closely.

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ᐊᑕᖕᒋᓕᒫᖅᖢᒋᑦ, ᓄᓇᕗᒻᒥ ᐊᖑᓇᓱᒃᑏᑦ ᑐᓂᓯᓚᐅᖅᓯᒪᔪᑦ ᓂᐊᕐᑯᖕᒋᑕ ᓴᐅᓂᖕᒋᓐᓂᒃ ᑐᓴᖅᑕᐅᔪᒪᔪᓂᒡᓗ ᖃᕝᕕᓘᕐᔪᐃᑦ ᒥᒃᓵᓄᑦ 691−ᓂᒃ ᐊᖑᔾᕕᓂᕐᓂᒃ ᐅᑭᐅᑦ 2019 ᐊᒻᒪ 2024 ᐊᑯᓐᓂᐊᓂ (1 ᔪᓚᐃ 2023 - 30 ᔫᓂ 2024 = 2024 ᐊᖑᓇᓱᖕᓇᒥ). ᐅᓄᕐᓂᖅᓴᐃᑦ ᖃᕝᕕᒃᑕᐅᔪᑦ ᕿᑎᕐᒥᐅᓂᒃ ᐊᖑᔾᐅᓚᐅᖅᓯᒪᔪᑦ, ᕐᑯᕐᓗᖅᑑᑉ ᖃᓂᒌᔾᓂᐸᓗᒃ, ᐅᓄᙱᓐᓂᖅᓴᐃᑦ ᐊᖑᔾᐅᓂᖁᒡᓗᑎᒃ ᑲᓇᖕᓇᖅᐸᓯᖕᒥ. ᐊᕐᕕᐊᑦ ᐊᒻᒪ ᖃᒪᓂ'ᑐᐊᖅ ᐊᖑᔾᖕᒋᑦ ᐅᓄᕈᖑᖃᑕᐅᓚᐅᖅᑐᑦ ᓇᐃᓴᖅᑕᐅᔪᓂ. ᑲᑎᖅᓱᖅᑕᖕᒋᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ 84% ᖃᕝᕕᓘᕐᔪᒃᑕᐃᑦ ᕐᑯᑭᐅᑎᒧᑦ ᐱᔾᐅᔦᕕᓃᑦ, ᑕᐃᒃᑯᐊ 16% ᒥᑭᒥᐊᖅ/ᐲᔾᖃᑦᑕᖕᓄᑦ ᐱᔾᐅᓪᓗᑎᒃ. ᐊᖑᔾᐅᔦᓂ ᐊᖑᓴᓪᓗᐃᑦ ᐊᕐᓇᓪᓗᐃᓪᓗ ᓇᐃᓴᖅᑕᐅᑎᓪᓗᒋᑦ ᐊᖑᓴᓪᓗᐃᑦ ᐅᓄᕐᓂᖅᓴᐅᓚᐅᖅᑐᑦ ᒪᕐᕈᐃᓪᓗᐊᖅᖢᑎᒃ. ᐃᓐᓇᕈᓅᖅᓯᒪᙵᒋᑦᑐᑦ ᐊᒻᒪ ᑎᓇᑐᕋᐃᑦ ᐅᓄᕐᓂᖅᓴᐅᓚᐅᕐᒥᔪᑦ 63% ᐊᖑᔾᐅᔪᓕᒫᓂ ᑕᐃᒃᑯᐊ ᐃᓐᓇᕈᐊᓂᒃᓯᒪᔪᑦ 37%−ᖑᓪᓗᑎᒃ. ᐅᑭᐅᙳᓵᖅᑎᓪᓗᒍ ᐃᓐᓇᕈᓕᓵᕐᓂᖅᓴᑦ ᐱᔾᐅᖃᑦᑕᓚᐅᖅᖢᑎᒃ, ᐃᓐᓇᕈᖅᓯᒪᓂᖅᓴᓪᓚᓅᑦ ᐅᑭᐅᖑᓪᓚᓇᓕᖅᑎᓪᓗᒍ ᐱᔾᐅᓪᓗᑎᒃ. ᓄᓇᓂ ᐅᖕᓚᓯᒦᒃᑕᖅᑐᓂᒃ ᐱᔾᐅᓪᓗᑎᒃ, ᐅᑭᐅᖕᒋᑦ, ᐊᕐᓇᖅ/ᐊᖑᓴᓪᓘᖕᒪᖕᓚᑕ ᓇᐃᓴᐃᔾᔪᓰᑦ ᑕᒪᐃᓐᓂᒃ ᑲᑎᖅᓱᐃᔾᔪᑕᐅᓚᐅᖅᑐᑦ. ᑭᓯᐊᓂᑦᑕᐅᖅ, ᕿᑐᕐᖕᒋᐅᕈᓐᓇᖅᑐᓂᒃ ᓇᐃᓴᖅᑕᐅᔪᖃᙱᓗᐊᕐᓂᖕᓚᓂᒃ ᐅᔾᔨᕆᔾᐅᔾᕆᐊᓕᒃ ᐊᒻᒪ ᐅᔾᔨᖅᓱᖅᑕᐅᑦᑎᐊᕐᓗᓂ.

Qalvik (*Gulo gulo*) anguniaqtunun munaridjutikhaq Nunavunmi

Naittuq Naunaijauti

Tamainun, Nunavunmi anguniaqtut tujuqtut niaqunik humilu tuquhimajatigut kangiqhidjutit hamanga 691 anguniaqtaujut qalviit qitqani 2019 unalu 2024 anguniarutini ukiuni (1 Taaqhivalirvia 2023 –30 Imaruqtirvia 2024 = 2024 anguniaqvingmi ukiungani). Tamavjaita qaviit angujaujut Kitikmeot aviktungnianin, qanilruani Kugluktup, ikitut angujaujut kivataanin nunallaanin. Arviat hamanilu Qamanittuaq tugliujut amigainirit ikajuutait atautimun anguniaqtamingnun. Angunianikkut naunaijautit takunaqtut tapkua 84 pusat qalviit hiquutikkut tuquhimajut, imaalu 16 pusat naniriaqhimajut. Qanuriniitigut amigainirit angujaujut angutiluat naamavjaktuq malruiqtughugu amigainiit angutit angujauluaqtut angnalurnin. Qalviat angujaujut imaa 63 pusat anguniaqtaujut aallat 37 pusat ininirit. Angujaujut amigaitqijaujut qalviat ukiungitigut naunaijaqhimajut ukiuq atulihaaqtilugu, angujaujut ininirnit atautit amigairjuumijun nungutinnagu ukiumi. Ilaujut tunijaujut, ukiungit, qanuriniit qanuqtut anguhimajut aanniaqtuqangitut. Kihimi, ikitpalaat qaffiuniit angnaluit angujaujuni aghuungnaqtut ilihimalugit munarijaujukhallu qanitukkut.

Contrôle de la récolte de carcajou (G*ulo gulo*) au Nunavut

Résumé

En tout, les adeptes de la chasse du Nunavut ont remis les crânes et les données provenant de 691 prises de carcajous lors des années de récolte de 2019 à 2024 (à titre indicatif, l'année de récolte de 2024 s'étend du 1er juillet 2023 au 30 juin 2024). La majeure partie de la récolte a eu lieu dans la région du Kitikmeot, aux environs de Kugluktuk, alors que le nombre de carcajous récoltés dans les localités de l'est était relativement peu élevé. Arviat et Baker Lake figuraient au deuxième rang parmi les grands contributeurs à la récolte totale. Les données de récolte révèlent que 84 % des carcajous ont été chassés au fusil et 16 % ont été piégés. Le ratio mâle-femelle de la récolte était biaisé en faveur des mâles, qui en représentaient environ les deux tiers. Les jeunes carcajous et les petits d'un an constituaient la majeure partie de la récolte, représentant 63 % des prises alors que les prises adultes en représentaient 37 %. En préhiver, les carcajous récoltés provenaient surtout de la population de jeunes, et c'est aux mois de mars et d'avril qu'on a vu une croissance de la récolte d'adultes. La répartition spatiale, l'âge et la répartition par sexe de la récolte étaient caractéristiques d'une population en bonne santé. Cependant, on souligne que la récolte comportait un nombre relativement peu élevé de femelles adultes, et cette population devrait faire l'objet d'une surveillance étroite.

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1.0 Introduction

For thousands of years, Inuit have relied on the harvest of wildlife for food, clothing, and trade. In Nunavut, the furbearer harvest for clothing and for income is a seasonal and traditional activity, where opportunities for other employment are scarce. Under the Nunavut Agreement, furbearer harvest rights are held by Inuit beneficiaries, non-Inuit who harvested furbearers legally in Nunavut settlement area prior to 1981, and non-Inuit whose application has been approved and recommended by local Hunters and Trappers Organizations (HTOs).

In Nunavut, wolverines (*Gulo gulo*) occupy almost all areas of the territory and are classified as both a furbearer and a big game animal under the Nunavut Agreement. They are an important furbearer in Nunavut's culture and economy and have traditionally been considered a vital resource for hunters because of the beauty and frost resistant properties of the fur, which make it unique and quite valuable (Hash 1987). Wolverine fur is highly prized in local communities as ruffs or trims on parkas (Cardinal 2004). Unlike most provinces, hunters and trappers in Nunavut do not have registered or traditionally exclusive family trap lines or hunting areas, so wolverines are generally harvested opportunistically wherever people travel (Mulders 2000) or harvested while hunting other game. Wolverine hunting in Nunavut is mainly by firearms from snow machines while in other provinces trapping is the major method (Lee 2016).

Wolverine densities are believed to be moderate in the western mainland of Nunavut but low on the Arctic islands and in the eastern mainland (Slough 2007, Species at Risk Committee 2014). Using DNA-based mark-recapture, Awan and Boulanger (2016), Awan et al. (2018) estimated density from 1.6 to 4.4 wolverines/1,000 km^2 in the Kivalliq region and 4.14 wolverines/1,000 km^2 in the Napaktulik Lake area in the Kitikmeot region (Awan et al. 2020). Inuit observations and recent harvest reports suggest that wolverine numbers in Nunavut are either stable or slightly increasing, and the species may be expanding its range eastward and northward (Awan et al. 2012, COSEWIC 2014). The wolverine has been assessed as a species of Special Concern in Canada and in 2018 was listed as the same under the *Species at Risk Act* (*SARA*). The wolverine is generally described as a scavenger (Banci 1987) and an opportunistic predator throughout its range, occurs in low densities, have low birthing and recruitment rates, are sensitive to human disturbance, and require large secure areas to maintain viable populations (Magoun 1985, Mattisson et al. 2011). It is considered a wilderness species and potential indicator of ecosystem health (Carroll et al. 2001). Mulders (2000) suggests that the arctic tundra contains large undisturbed tracts of habitat that may act as reservoirs to maintain harvestable populations of wolverine in Nunavut.

Nunavut contributes substantial numbers to the national harvest even though ecological data for tundra wolverine are sparse, especially in the northeastern edge of the species distribution. Currently, there is no quantitative limit on their harvest by Inuit and there is no requirement for hunters to report their harvest. The only mechanism for tracking the harvest or pelts is the Government of Nunavut's Department of Environment (GN-ENV) fur-pricing program, which misses pelts, which are used locally or sold as raw frozen wolverine hides privately; the actual harvest is unknown. The current collection of wolverine skulls and kill information is an attempt to estimate the harvest, to monitor the age and sex of the harvest.

2.0 Methods

Each year we obtained the skull and a small piece of skin (~2.5 x 2.5 cm) with fur from hunters with the assistance of HTOs and Conservation Officers (COs). Hunters across Nunavut voluntarily reported and provided skull and skin samples from harvested wolverines via their local COs. A $50 subsidy was provided to hunters for each skull brought back to the COs office to encourage the reporting and return of samples. Recently, increased activity in the online buying and selling of wolverine skulls has led to less reporting under this program. The online skull buyers offer higher prices for skulls than our subsidy amount of $50. From January 2025 GN-ENV increased the subsidy amount to $100 per wolverine.

For each wolverine sample collected during the course of this study, COs filled out sample collection forms with information from hunters about the harvest location, date, wolverine sex, and method of harvest, and their opinion of the current abundance trend of the local wolverine population (decreasing, stable or increasing). The skinned skulls were stored frozen, and were thawed at room temperature for examination in early May each year. We extracted a lower canine and sent to Matson's Laboratory LLC (Milltown, MT, USA) for age estimation using cementum analysis. This technique is based on the cyclic nature of cementum growth in teeth forming annular patterns of different darkness depending on the season (Matson 1981).

Following Banci and Harestad (1988) and Vangen et al. (2001), individuals were then grouped into three age classes: juvenile (0-1 year, date of birth is set to March 1st), yearling (1-2 years) and adult (≥ 2 years).

3.0 Results and Discussion

A total of 691 wolverines were reported as harvested from July 2018 to June 2024, 397 from the Kitikmeot, 290 from the Kivalliq and 4 from the Qikiqtaaluk region (Igloolik and Sanirajak) (Fig. 1). According to our sample collection program, reported wolverine harvest in Nunavut has been fluctuating and the harvest report rate for this period (2019-24) appears to be lower compared to early 2000s in the Kitikmeot region (Awan et al. 2012).

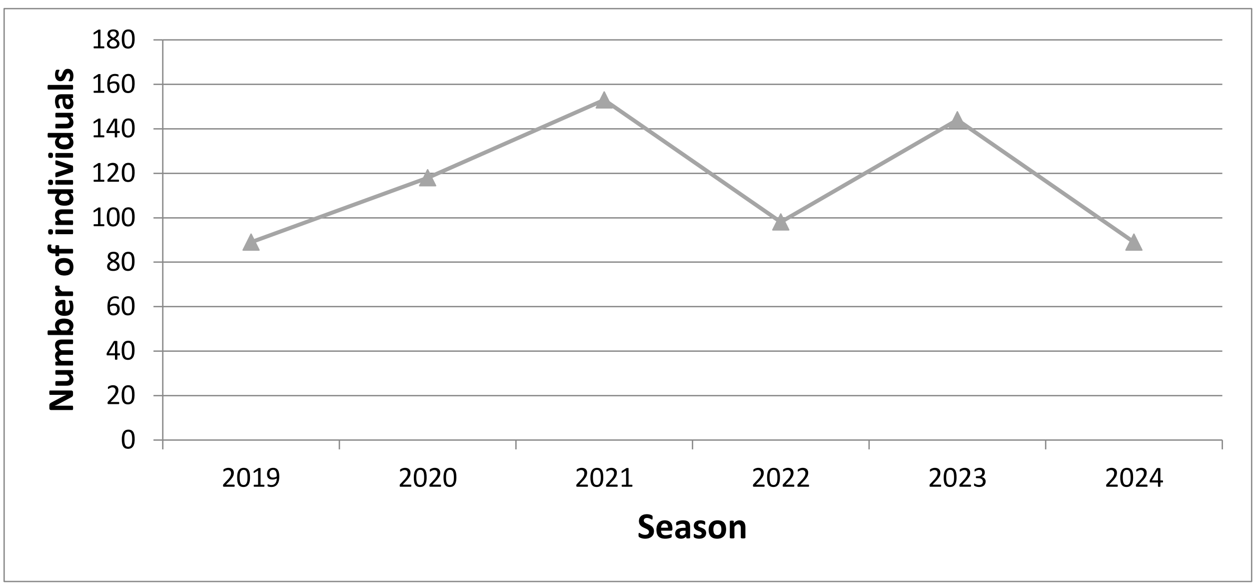

Figure 1. Reported wolverine harvest in Nunavut, from 2019 to 2024. Note that the harvest year is assigned as the year at the end of the regulations' harvesting season, for example, 1 July 2018–30 June 2019 = 2019 harvest year.

The harvest was unevenly distributed throughout the territory, with most wolverines having been harvested in the western Kitikmeot. Harvest in the vicinity of Kugluktuk was particularly intense, and along the traditional travel route from the Kugluktuk to the Contwoyto Lake. Relatively fewer wolverine were harvested in the eastern communities, while Arviat and Baker Lake were the next major contributors to the total harvest (Fig. 2). Comparatively, high wolverine harvest happening out of Kugluktuk, when the caribou herds wintered nearby, was due to hunters spending more time on the land to hunt caribou. While hunting caribou, harvesters usually pursued wolverine when they saw wolverine or found fresh tracks.

Wolverine harvest distribution shows that harvest took place over a wider range on the Nunavut mainland, but it tended to be concentrated near communities. The surrounding areas without hunting may act as refugia or reservoirs that produce wolverines that move into the hunted areas and sustain the harvest (Mulders 2000, Lee 2016).

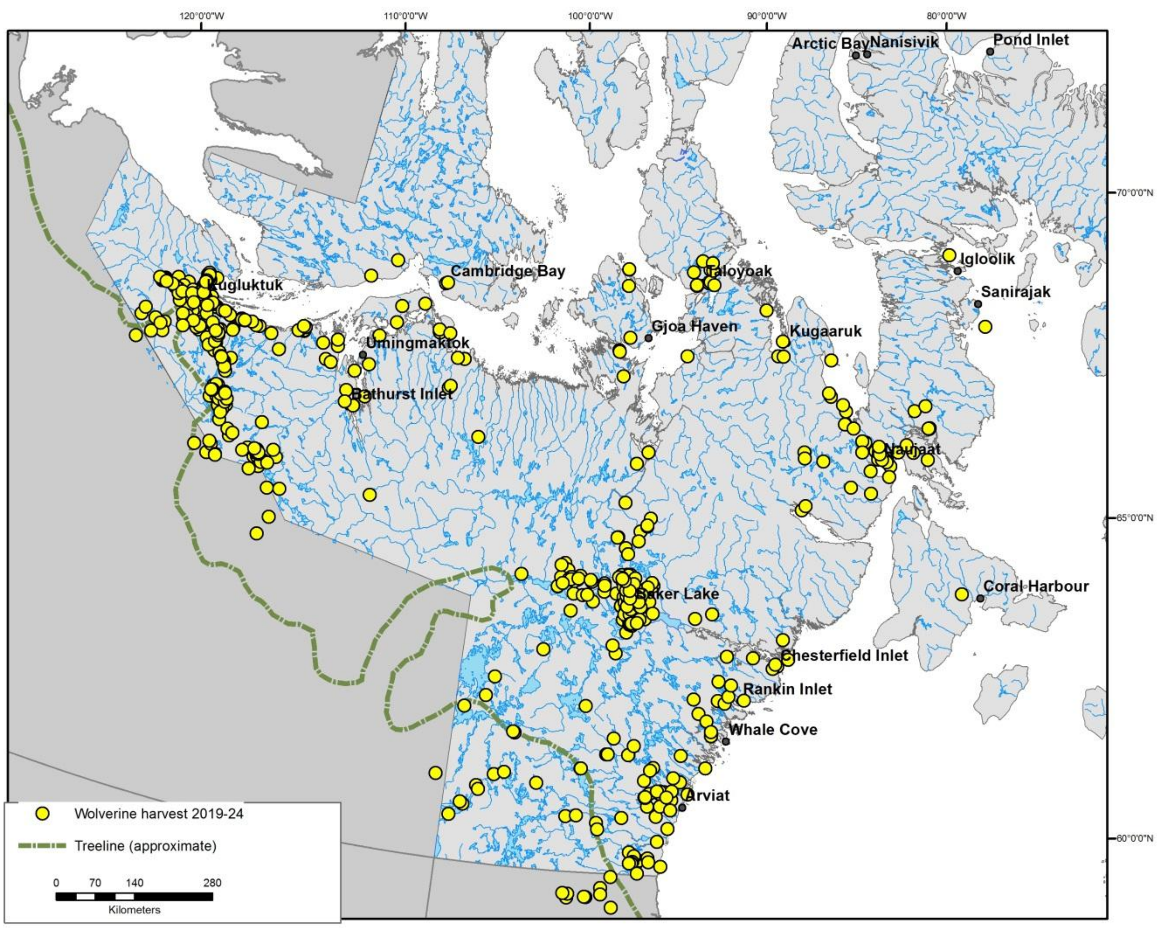

Figure 2. Distribution of reported wolverine harvest by Nunavut hunters from 2019 to 2024. Symbol may represent >1 wolverine harvested at that location.

Most wolverines were harvested between November and April each year (Fig. 3), when the fur is in prime condition. Harvest data shows that approximately 84% of wolverines were hunted with a rifle and 16% animals were trapped. Of the trapped animals (n = 109), 94% were killed in quick-kill traps and 6% in leg hold traps. In the Kivalliq region, only five hunters trapped 12 wolverines, while in the Kitikmeot region 97 wolverines were trapped by 15 hunters.

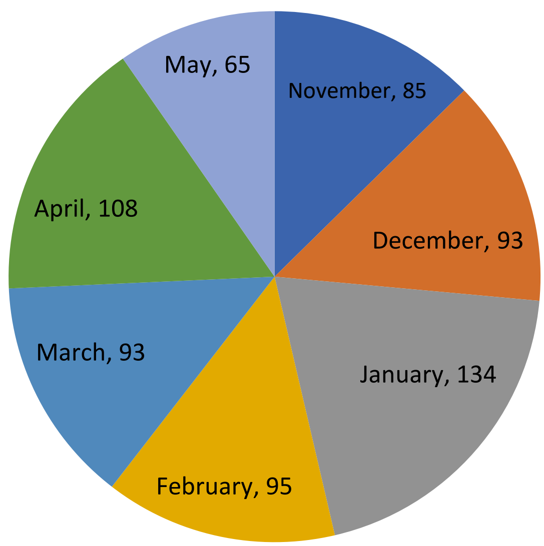

Figure 3. Wolverine reported monthly harvest in Nunavut, from 2019 to 2024. Label indicates total number of wolverines harvested per month.

The male:female ratio of the harvest was highly biased towards males (Fig. 4) with approximately twice as many males harvested than females (ratio = 1.7 and 2.1 in the Kitikmeot and the Kivalliq respectively), a typical figure for northern Canada (Mowat et al. 2020). We assumed sex ratio at birth in the population is 1:1, however, it is difficult to distinguish if this reflects the actual sex ratio of the population or a difference in vulnerability by sex. Lee (1994) also observed a 2:1 male to female ratio in the western Kitikmeot harvest in the early 1990s. However, his observations showed a strong male bias in the younger age classes (< 2 yo) while the adult sex ratio was not different from a 1:1 ratio. Examining the sex ratio per age class since 2019 seems to show the opposite with a male to female ratio higher in the older individuals (Table 1), possibly pointing towards a diminution in mature females in the population, which will need to be monitored closely.

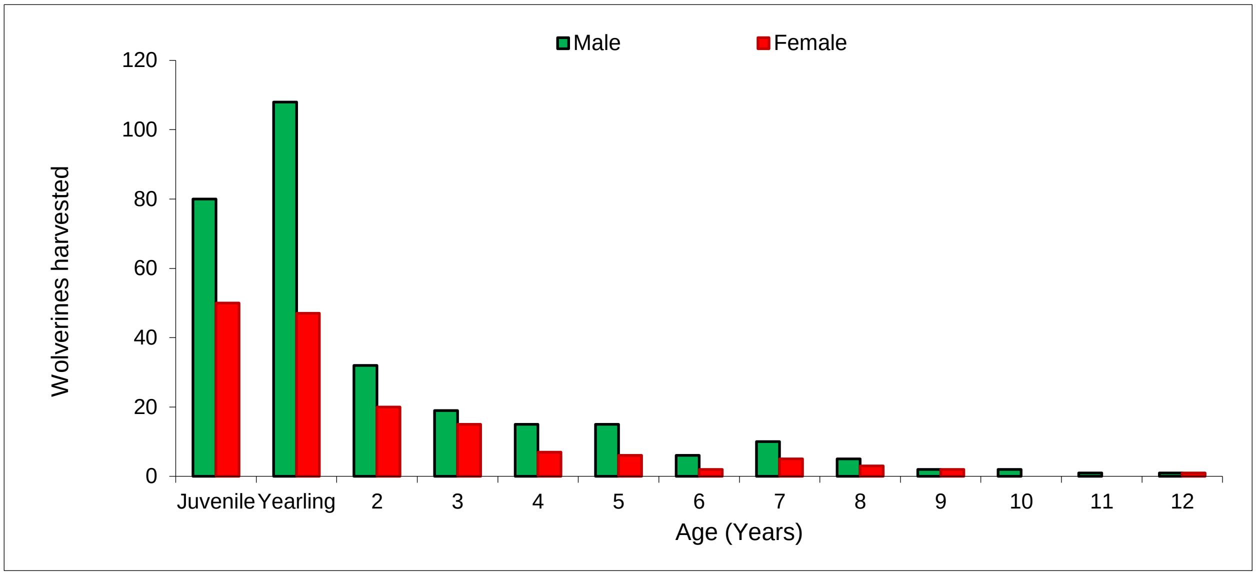

Figure 4. Age and sex structure of the reported wolverine harvest in Nunavut, from 2019 to 2023.

Table 1. Male to female sex ratio by age in the reported wolverine harvest in Nunavut, from 2019 to 2023.

Age	M:F total harvest	M:F sex ratio
Juveniles	80:50	1.6
Yearlings	108:47	2.3
2	32:20	1.6
3	19:15	1.3
4	15:7	2.1
5	15:6	2.5
6	6:2	3
7	10:5	2
8	5:3	1.7
9	2:2	1
10	2:0	-
11	1:0	-
12	1:1	1

The age distribution of the reported wolverine harvest from 2019 to 2023 is weighted more towards juvenile/yearling animals (Fig. 4). The ages of harvested wolverines ranged from <1 year to 12 years. The oldest female and male (12 years) were killed (shot) in Kugluktuk (n = 2) area in 2021 and 2022, respectively. Overall, 29% of the wolverines harvested in Nunavut during that period were juveniles, 34% were yearlings and 37% were adults (Table 2). A greater proportion of young animals in the harvest moderate the conservation risk of harvest (Mowat et al. 2020). However, the proportion of adult females in the harvest increased (13%) for this period (2019-23) compared to 2014-18 (9%, Awan 2020). Wolverine harvest appears to be biased towards younger males (Rausch and Pearson 1972, Lee 1994) probably due to their higher movement rates and vulnerability (Scrafford et al. 2024). Kukka et al. (2017, 2023) describe the high proportions of young males in the harvest to be because vacant areas created by the harvest of resident animals may be filled by dispersing young males (Magoun 1985). Others have reported long dispersal movements in yearlings from their natal area before reaching sexual maturity (Copeland 1996, Mulders 2000, Vangen et al. 2001, Inman et al. 2012) and movement of wolverines from areas with lower mortality to those with higher mortality (Gervasi et al. 2015, 2016). The high proportion of juveniles and yearlings (63%) and the low proportion of females (36%) among adults in the harvest may signal the importance of dispersal in the population dynamics of this species within the traditional harvesting areas. Yearlings and juveniles represented 64% of the known age male harvest, in contrast to 81% reported by Lee (1994) in the Kitikmeot region in the early 1990's, and by Rausch and Pearson (1972) who also reported wolverine harvest biased toward younger males in Alaska and Yukon.

Table 2. Age and sex distribution of reported wolverine harvest in Nunavut, from 2019 to 2023.

Age Class	Sex		Total (% of total)
	Males (% of males)	Females (% of females)	
Adult (≥ 2 years)	108 (36.5%)	61 (39%)	169 (37%)
Yearling	108 (36.5%)	47 (30%)	155 (34%)
Juvenile (< 1 year)	80 (27%)	50 (31%)	130 (29%)
Total	296	158	454

Figure 5 illustrates the temporal variation in the harvest according to age class. The harvest was dominated by younger age class during the winter while the harvest of adult individuals was comparatively high in March/April, which is similar to other wolverine harvest studies (Lee 2016, Kukka et al. 2017). For males, this corresponds to the time when maximal size of testes and highest levels of testosterone are attained (Pasitschniak-Arts and Larivière 1995), probably marking the start of the breeding season and resulting in increased movements and increased vulnerability of sexually mature males for harvest.

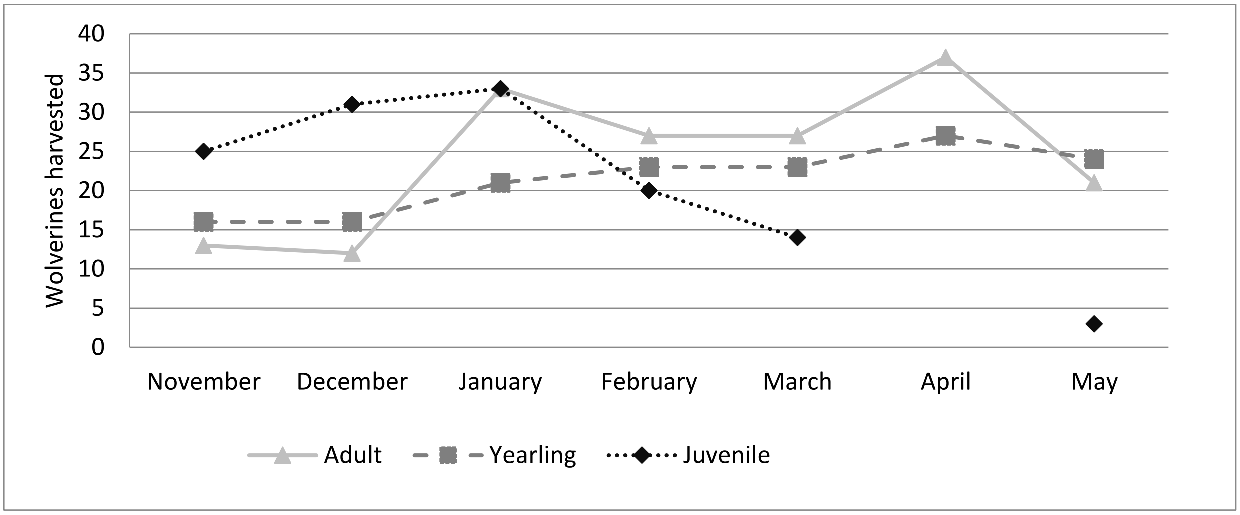

Figure 5. Monthly reported wolverine harvest per age class in Nunavut, from 2019 to 2023.

Wolverine populations in Nunavut are considered healthy. This seems to be supported by the sex and age distribution of the harvest. However, the relatively low number of mature females (13%) in the harvest is important to note and should be monitored closely.

In an effort to obtain information on wolverine population relative abundance, wolverine harvesters (a hunter may provide >1 harvested wolverine to the program within and among years) were asked to answer the following question when bringing back samples to their wildlife office: “Do you think the wolverine population is decreasing, stable or increasing?”. Harvesters’ perception about trends in wolverine populations differed among regions, but majority believed that numbers were stable. In the Kitikmeot (n = 371), most respondents believed the population was stable (67% stable, 32% increasing) while most respondents of the Kivalliq (n = 255) also believed their local population was stable (61% stable, 39% increasing). However, over the long term, the increasing resource development on the tundra and climate change may adversely affect the species, which suggests a need for continuous monitoring of the health of the wolverine population. Monitoring of the wolverine population is also important as part of predator research and management as it relates to ungulate species management in both the Kivalliq and Kitikmeot regions.

4.0 Acknowledgments

Thank you to everyone involved in the collection of the harvest data presented here – the hunters, the HTOs, the Conservation Officers, and the biologists.

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