HeliCat Canada's Wildlife Observations Program: Trends and Findings 2012-2022

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Highlights

1. HeliCat Canada members operating in mountain caribou range have been collecting and reporting wildlife sightings data since 2010, resulting in more than 3,750 spatially referenced sightings of animals and tracks by the end of the 2022 operating season.
2. Mountain caribou, mountain goats, and wolverine have been the most commonly recorded species, with caribou observations generally declining over time, mountain goat sightings showing no trend, and observations of wolverines and their tracks increasing.
3. *No reaction* and *Unconcerned* are the most common responses of caribou and mountain goats to encounters with helicopters or skiers.
4. Behavioural responses are generally stronger at shorter encounter distances, but responses remain variable, with some animals still showing *No reaction* or an *Unconcerned* response to close encounters.
5. Recorded responses to skiers tend to be stronger than to helicopters, particularly among caribou.
6. The number and proportion of *Alarmed* or *Very alarmed* responses to encounters was higher in early years of monitoring but has been stable since about 2014.
7. Evidence suggesting that HeliCat activities are causing population declines of mountain caribou or mountain goats is lacking.
8. Opportunities to further reduce risk include: improved habitat mapping, expanded monitoring and reporting, telemetry data sharing, and passive detection of wildlife. However, the benefits of all of these approaches are also currently associated with a variety of limitations.

Introduction

Wildlife populations are under threat globally from habitat loss and alteration, direct exploitation, and climate change (e.g., Caro et al., 2022; Powers and Jetz, 2019; Schipper et al., 2020). Canada, and British

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Columbia in particular, is a significant hotspot of biodiversity and attracts visitors seeking experiences in its wildest places. This has generated a concern about the effects of human activity in the backcountry, generated by public recreation and adventure tourism activities, on the distribution and abundance of wildlife (e.g., Larson et al., 2019).

Isolating the impacts on wildlife of different types of human activity can be difficult because such activities often co-occur on the land base, and some are difficult to quantify (e.g., public recreation use; Buckley, 2009). The direct effect of human-related activity on the short-term behaviour of wildlife has long been a focus of observational research studies (e.g., (Frid, 2003; Goldstein et al., 2005; Gordon, 2003), and more recently of projects employing remote wildlife cameras. Observational studies have documented behavioural changes and cameras studies have linked the intensity of human-related activity to temporal or spatial displacement of wildlife (Barrueto et al., 2022; Heinemeyer et al., 2019; Ladle et al., 2019; Naidoo and Burton, 2020).

HeliCat Canada is the trade association of the Canadian helicopter and snowcat skiing industry, and their members have been collecting data on wildlife sightings and the behavioural reactions of animals for many years. The objective of collecting wildlife data is to better understand the effect of helicopter, snowcat, and skiing activities on wildlife, in order to improve management, promote co-existence with wildlife, and support reconciliation efforts in the traditional territories in which HeliCat members operate. The presence of HeliCat members in these habitats also provides an unprecedented opportunity to index relative species abundance, distribution, and perhaps infer trends.

This report summarizes the results of those sightings and provides recommendations for the ongoing adaptive management of HeliCat activities in wildlife habitat.

History of operating practices

Concern about the impacts of human-related activities on the behaviour of wildlife has a long history and has been a topic of scientific research for more than 50 years (e.g., (Gander and Ingold, 1997; Harrington and Veitch, 1991; Klein, 1971; Krausman and Hervert, 1983; Lesmerises et al., 2018; Stockwell et al., 1991). In British Columbia, concerns raised by Côté (1996) regarding the effects on mountain goats (*Oreamnos americanus*) of helicopter approaches led to a recommended research and adaptive management plan (Wilson and Shackleton, 2001), culminating in a project that measured the responses of radio-collared mountain goats to flight activity in a heli-skiing tenure (Cadsand, 2012).

More broadly, guidance for adventure tourism operators was developed by the Province in 2002 (BC Ministry of Water, Land and Air Protection, 2002) but received little support from the sector because guidelines were prescriptive and difficult to apply. Results-based tourism guidelines were then developed with the cooperation of the sector and were implemented in 2006 (BC Ministry of Environment, 2006).

All operators are required to adhere to these Tourism-Wildlife Guidelines, and they remain in force as of 2023, but are being revised by the Province.

A recovery strategy for mountain caribou (*Rangifer tarandus caribou*) was drafted in 2002 (Mountain Caribou Technical Advisory Committee, 2002) and as part of its implementation, HeliCat Canada and the Province entered into a Memorandum of Understanding (MOU) in 2006 to ensure that operators followed a set of consistent operating practices and regularly reported outcomes. The practices and recordkeeping that some members had been doing for many years served as an initial template for a standardized procedure that was piloted in 2009-2010, and then expanded to all members operating within the range of mountain caribou starting in 2011-2012.

The MOU expired in 2016 and was not renewed. An analysis of the caribou-specific data collected during the MOU period was published by Wilson and Wilmshurst (2019). Operators have continued to collect data on wildlife sightings and records have been collated and reviewed annually by HeliCat Canada. That dataset is the basis for the analysis presented here, up to the 2021-2022 operating season.

Company Obligations

Sightings are recorded daily, including days on which no wildlife are observed. Observations consisting of only tracks are also recorded and all locations are spatially referenced. Data recorded include:

- Species and number of animals observed.
- Distance from the animal(s).
- Aspect and elevation categories (alpine, treeline, below treeline).
- Animal reactions, classified after Penner (1988) as:
    - No overt response;
    - Unconcerned;
    - Curious;
    - Concerned;
    - Alarmed; and
    - Very alarmed – fled.
- Immediate action taken by the operator in response to the sighting.
- End-of-day action taken to minimize the likelihood of re-encounter.
- Whether the observation was made from a helicopter (light or heavy), snowcat, or while skiing.

Limitations

Because of visibility, not all animals encountered during HeliCat activities are expected to be observed. Based on encounters between radio-collared caribou <500 m from helicopters, Huebel (2012) estimated a sightability of 40% for that species. Additionally, only immediate reactions by animals to encounters can be observed and recorded. Research on longer-term behavioural effects of encounters is limited (Cadsand, 2012). While actions can be taken to avoid future encounters (e.g., temporarily closing areas to activities), the mobility of most species means that the same animals may be re-encountered, and sightings do not necessarily represent unique individuals.

Additionally, data have been collected by many people over many years and are subject to estimation errors and individual biases. Opportunities to see and report wildlife are necessarily limited by the distribution and frequency of flying, and some members consistently avoid areas they know or assume are occupied. Therefore, observations are not the result of systematic or random sampling.

What Wildlife Have Been Recorded?

As of the end of the 2021-2022 ski season, there had been 22,115 operator-days reported by members and entered into the HeliCat database, including 3,756 spatially referenced sightings of animals or tracks. Caribou, mountain goats, wolverines (*Gulo gulo*), and moose (*Alces alces*) were the most commonly observed species (Figure 1). Most sightings were from helicopters (62%), with 37% occurring while skiing, and <1% recorded from snowcats.

Annual caribou observations (excluding tracks) have generally declined since records began in 2010 (Figure 2). Note that 2010 and 2011 were pilot years that did not include all operators, data collection was paused until full implementation in 2013, and in 2021 skiing was limited due to COVID 19 restrictions. The decline in sightings mirrors the 43% population decline of the Southern Group of mountain caribou (roughly corresponding to the region within which heli- and snowcat skiing occurs in southeast BC) from the 2014 estimate of 1,540 animals (Environment Canada, 2014) to the 2021 estimate of 883.[2]

In contrast, the number of mountain goat observations (excluding tracks) varied over the years with no obvious trend (Figure 3). Mountain goats are not surveyed as frequently as caribou and there is no trend information available for the region that covers the same period as the collection of the wildlife sighting data. The most recent review in 2012 concluded that the Kootenay region population was stable (Kuzyk et al., 2012).

[2] https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc_caribou_herds_population_estimates.pdf

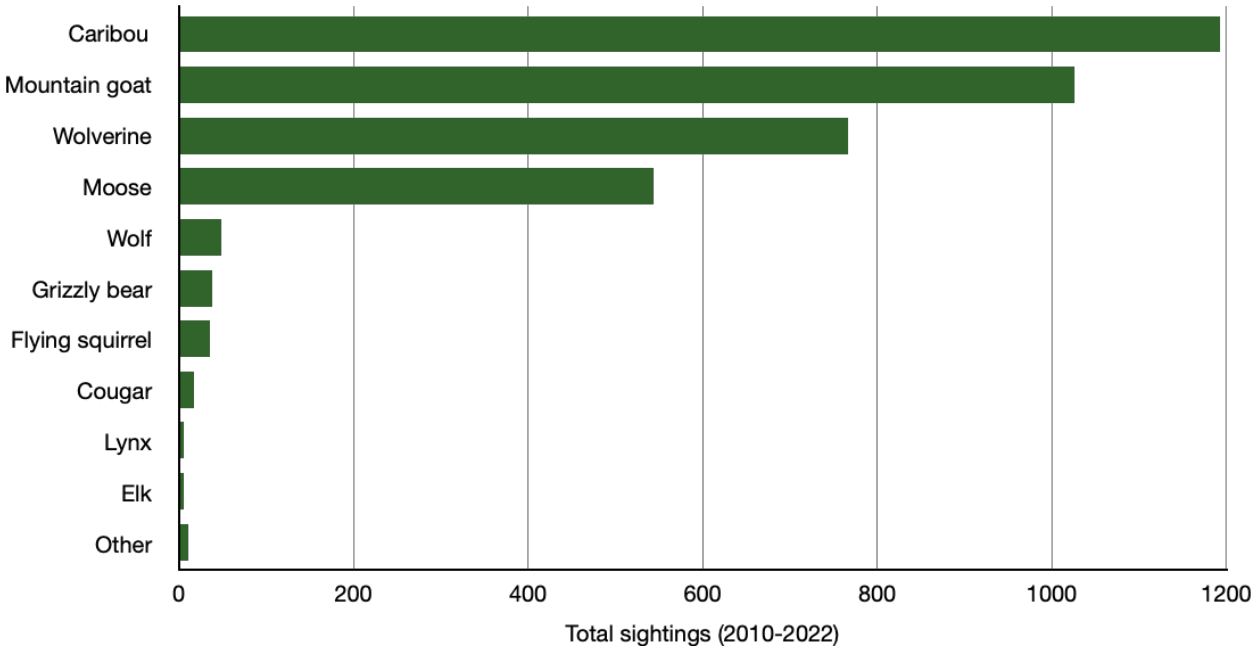

Figure 1. Total number of spatially referenced sighting of wildlife and tracks recorded by Helicat members operating with mountain caribou range.

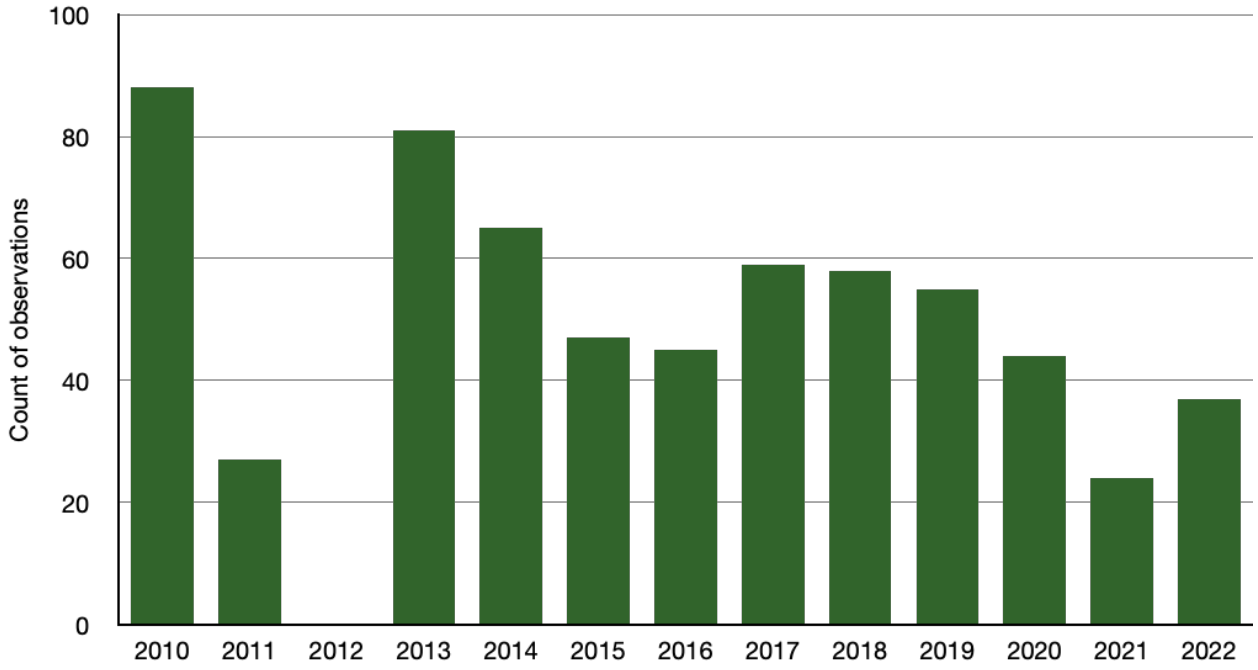

Figure 2. Sightings of caribou made by HeliCat operators, by year.

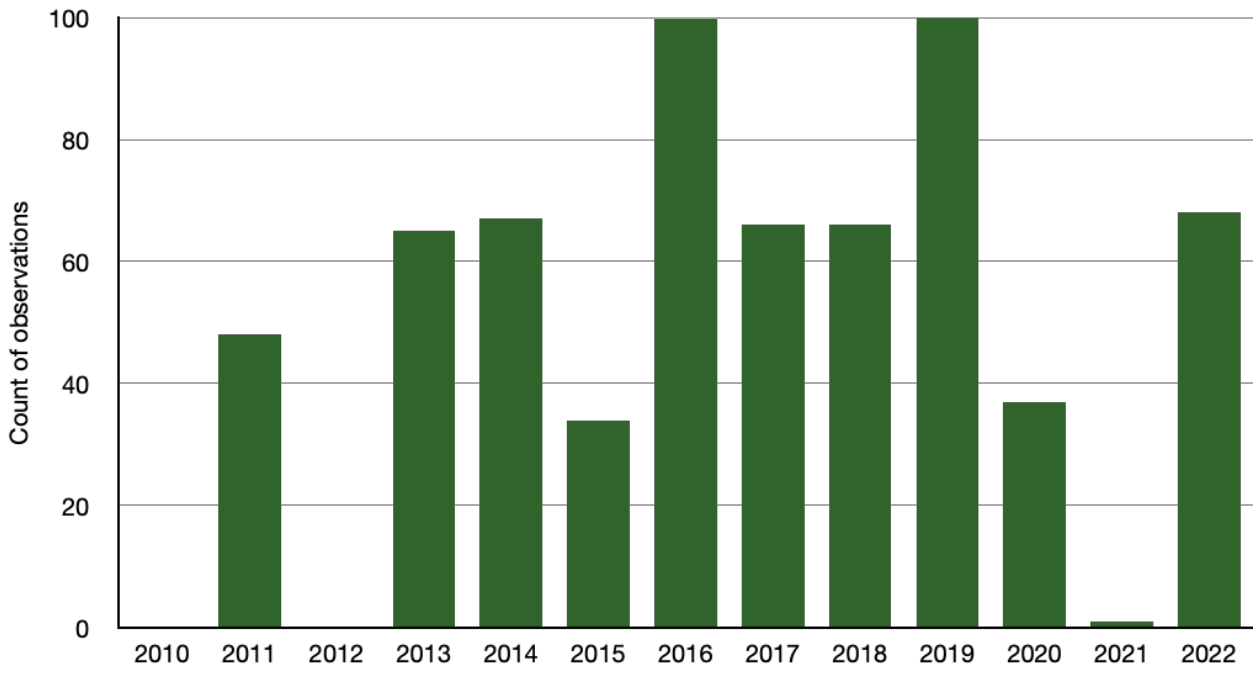

Figure 3. Sightings of mountain goats made by HeliCat operators, by year.

Sightings of wolverines and their tracks have increased over time (Figure 4). Only about 25% of sightings involve seeing animals. Barrueto et al., (2022) found that wolverines had declined between 2011 and 2022 both inside and adjacent to Banff, Kootenay, and Yoho National Parks. It is notable that wolverines are now the third most commonly reported species observed by HeliCat operators (and in fact the most frequently observed species in 2021-2022), despite evidence of their low and declining density in the southernmost part of the region.

Sightings of caribou, mountain goats, and wolverine have been widely distributed throughout the region, although mountain goat and wolverine sightings have been rarer in the north, in part because of lower HeliCat activity. There are also spatial gaps in observed caribou occupancy that reflect discontinuities in the caribou distribution (Figure 5). There is no clear evidence that the distribution of observed caribou occupancy has changed significantly over time.

How Have Wildlife Reacted to Activities?

Reactions of individuals to helicopter, snowcat and skier encounters have been routinely collected for both caribou and mountain goats. Observations from helicopters were the most common in the database (409), followed by skier observations (95), and those from snowcats (8). The most commonly recorded response of caribou observed while both flying and skiing was *Unconcerned* (Figure 6). Caribou tended to respond more strongly to skiers than to helicopters; almost 79% of observations from the air were of

caribou exhibiting either an *Unconcerned* response or *No reaction.* The same was true of fewer than 40% of observations by skiers.

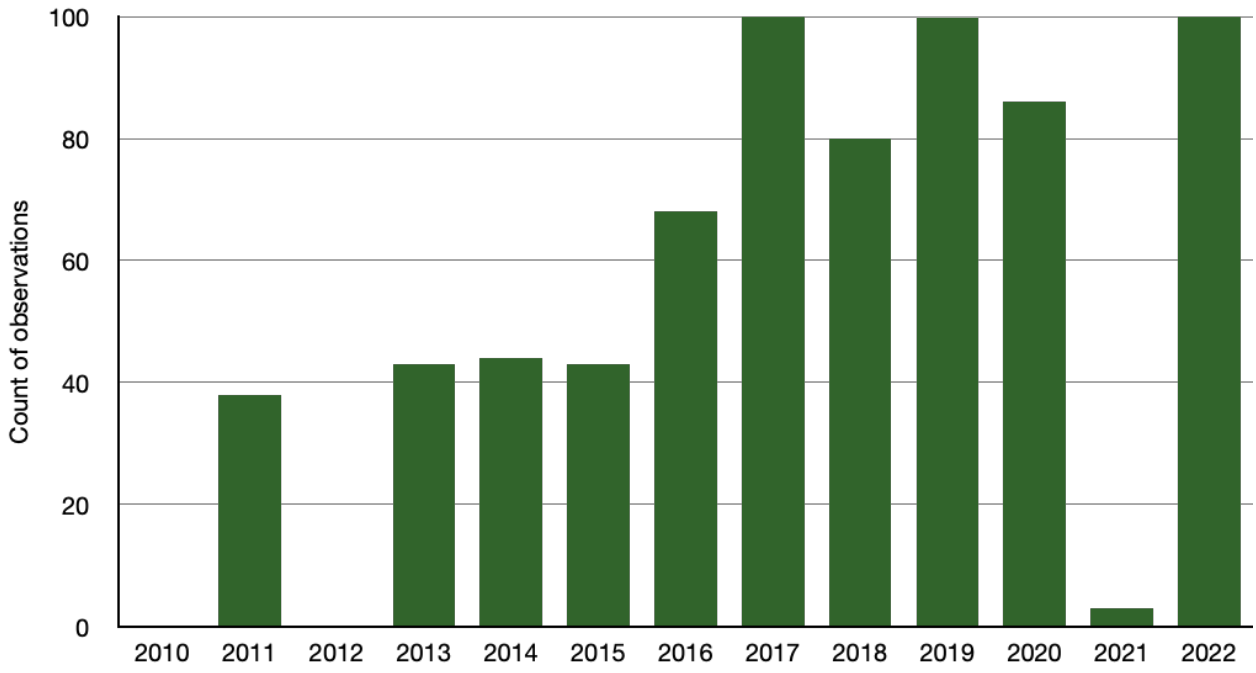

Figure 4. Sightings and tracks of wolverines observed by HeliCat operators, by year.

Unsurprisingly, skiers tended to encounter caribou at shorter distances than helicopters (Figure 7), which partly explains the difference in caribou reactions. The proportion of encounters with caribou at distances of 0-500 m by skiers (48%) was more than double that by helicopters (22%).

The relationship between distance and response can be illustrated with a "heatmap," which shows that the behavioural responses of caribou were less severe at longer distances for both flight and skier encounters (i.e., greener towards the bottom left of Figure 8 and Figure 9). While flight encounters were clustered among the *No reaction* and *Unconcerned* responses at 500-1000 m, observations by skiers were more variable, but still with stronger reactions generally occurring at shorter encounter distances. Close encounters elicited variable responses, with some animals' behaviour still being classified as *No reaction* or *Unconcerned.* Note that encounters with helicopters occurred more than four times more often than encounters with skiers.

HeliCat operators recorded 451 flight, 98 skiing, 3 snowcat, and 1 snowmobile observation of mountain goats. *No reaction* was the most commonly observed response while in flight and while skiing (Figure 10). The proportion of reactions to flight encounters classified as *No reaction* or *Unconcerned* were similar for mountain goats (78%) as they were for caribou, but reactions of mountain goats to skiers were similar to their reactions to helicopters (73%). *Alarmed* and *Very alarmed* responses by mountain goats occurred almost exclusively to helicopter encounters, but were relatively rare (10% of encounters).

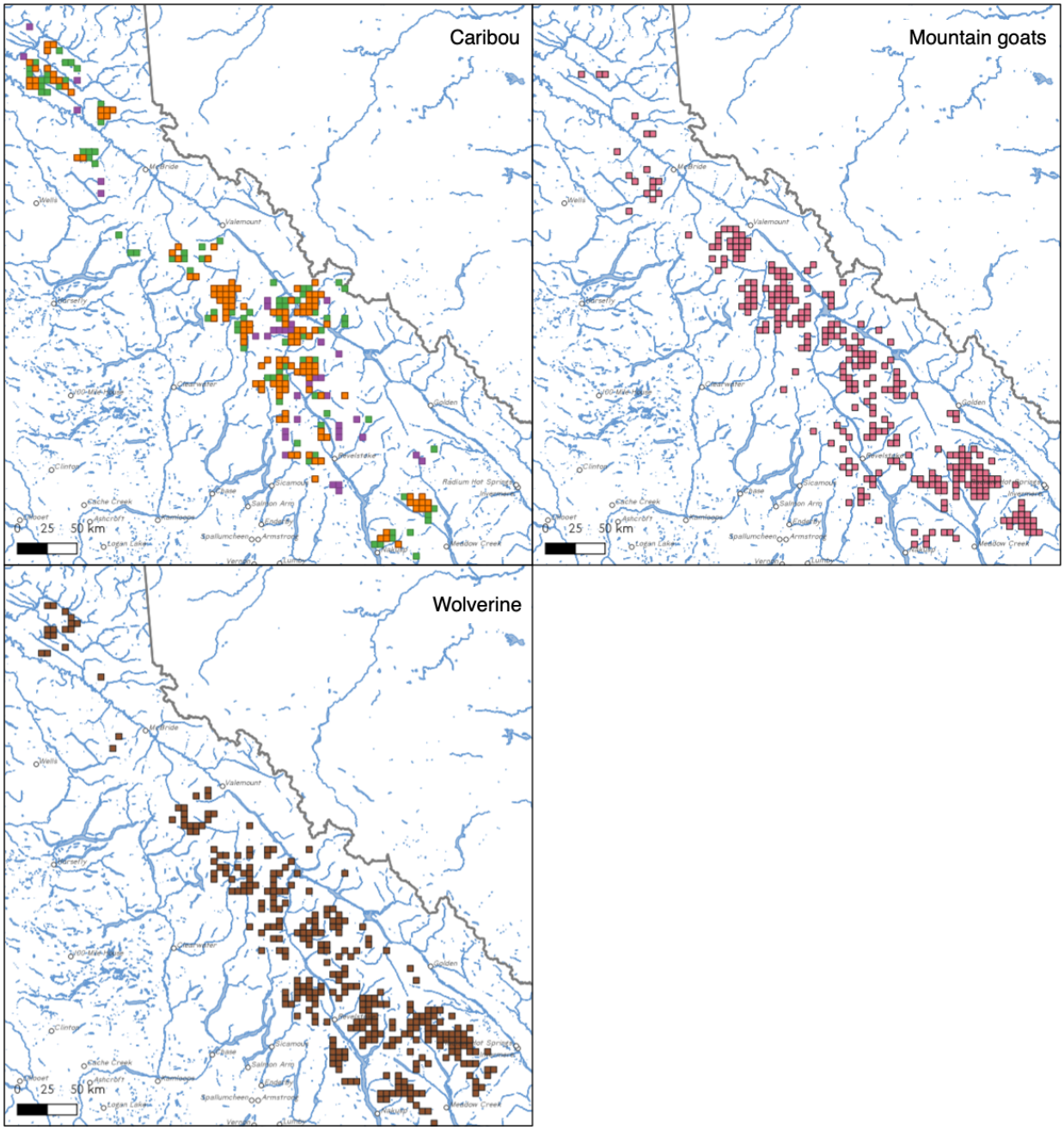

Figure 5. Observed occupancy of caribou, mountain goats, and wolverines, at a 5-km^2 resolution. Caribou occupancy is presented for 2010-2016 in purple, 2017-2022 in green, and for both time periods in orange.

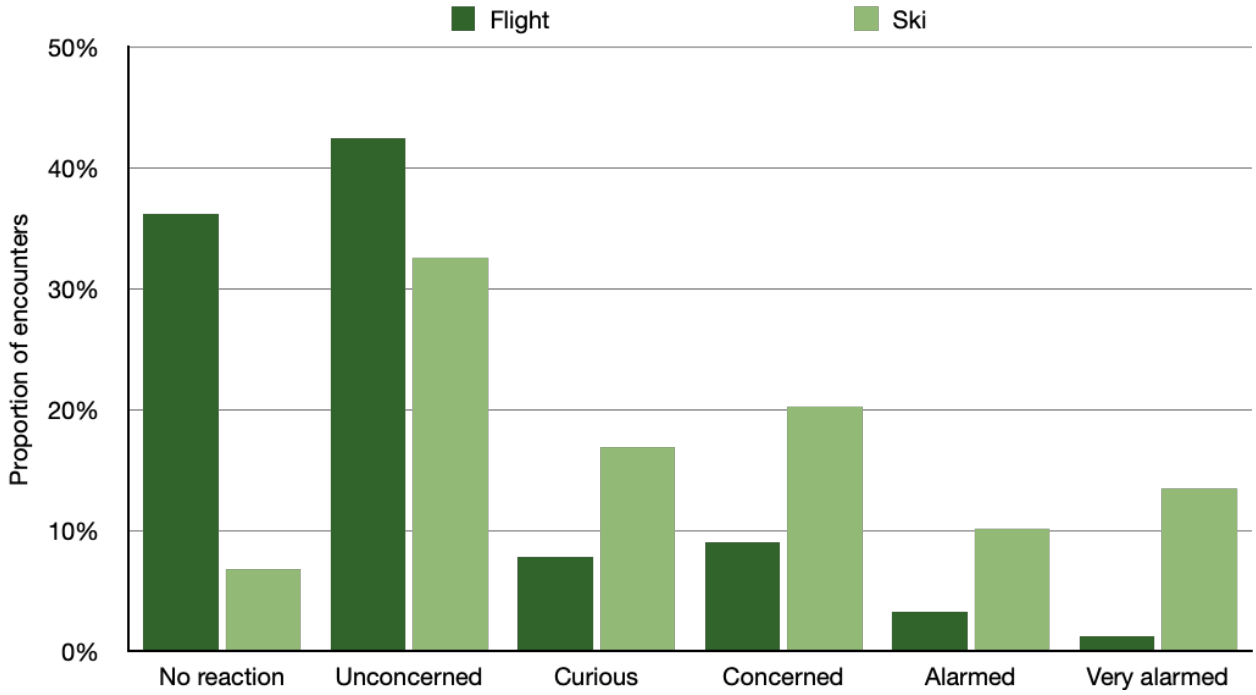

Figure 6. Frequency distribution of behavioural responses of caribou observed in flight and during skiing.

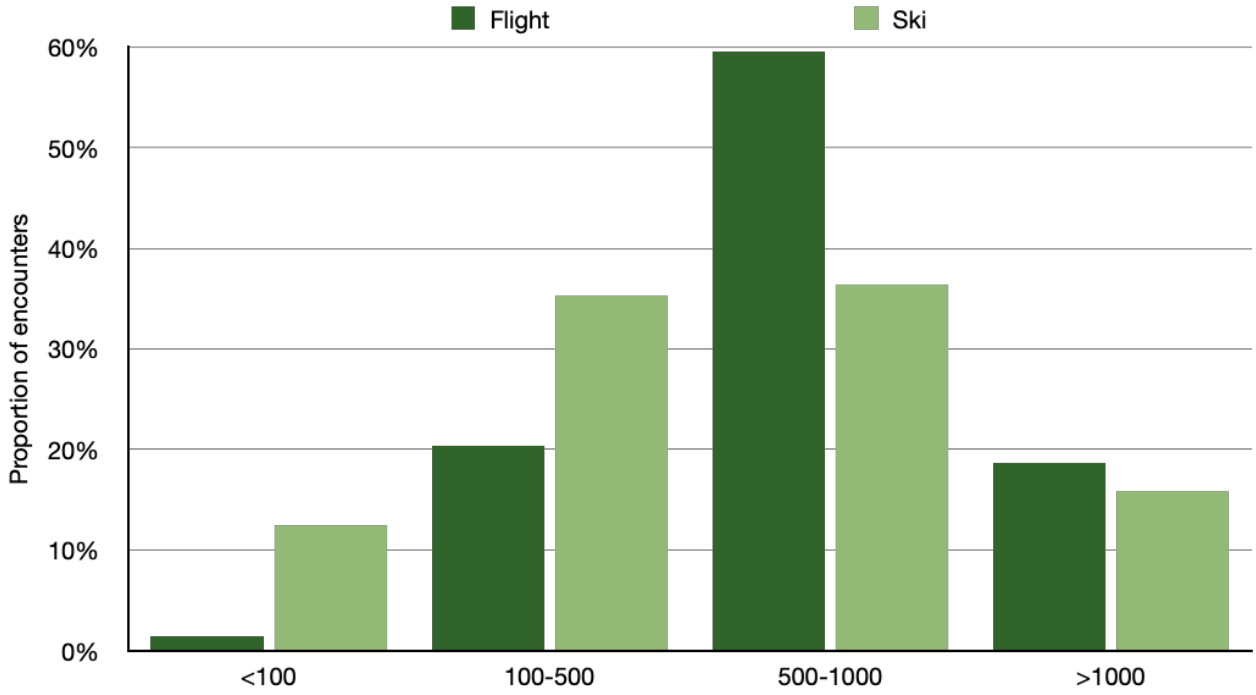

Figure 7. Frequency distribution of encounter distances recorded between caribou and HeliCat operators during flight and skiing activities.

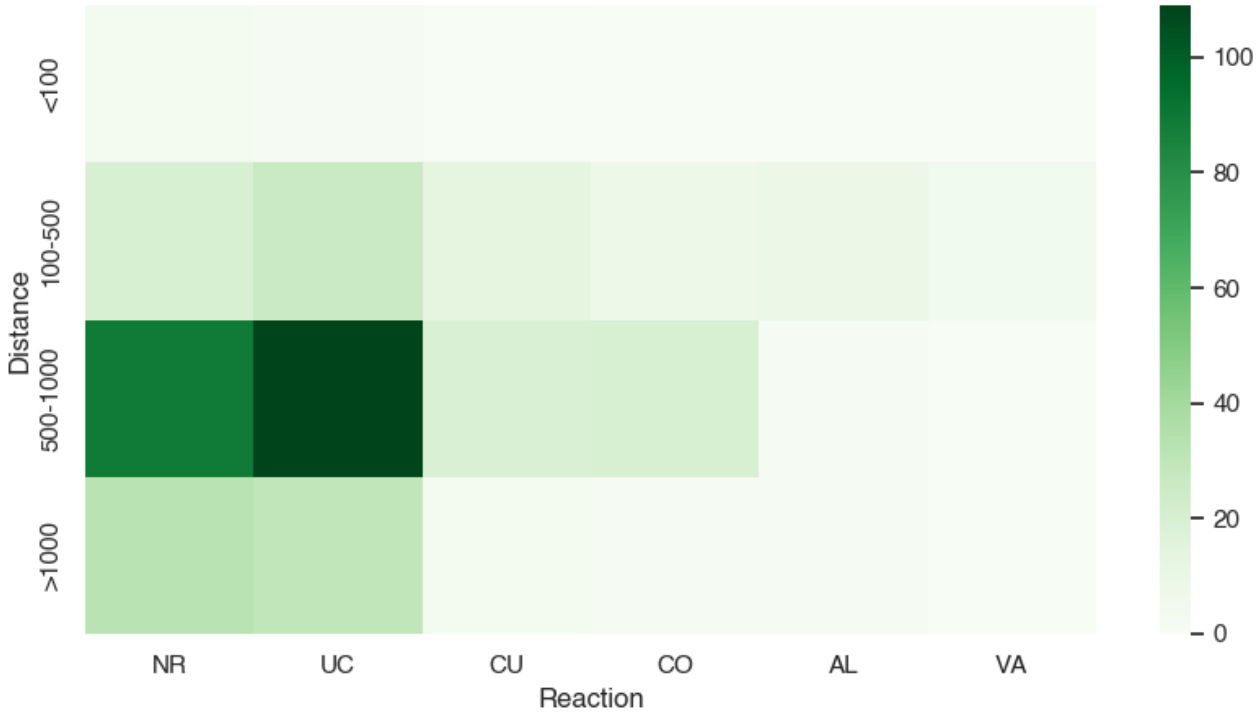

Figure 8. Heatmap illustrating the relationship between encounter distance and caribou behavioural responses for flight observations by HeliCat operators.

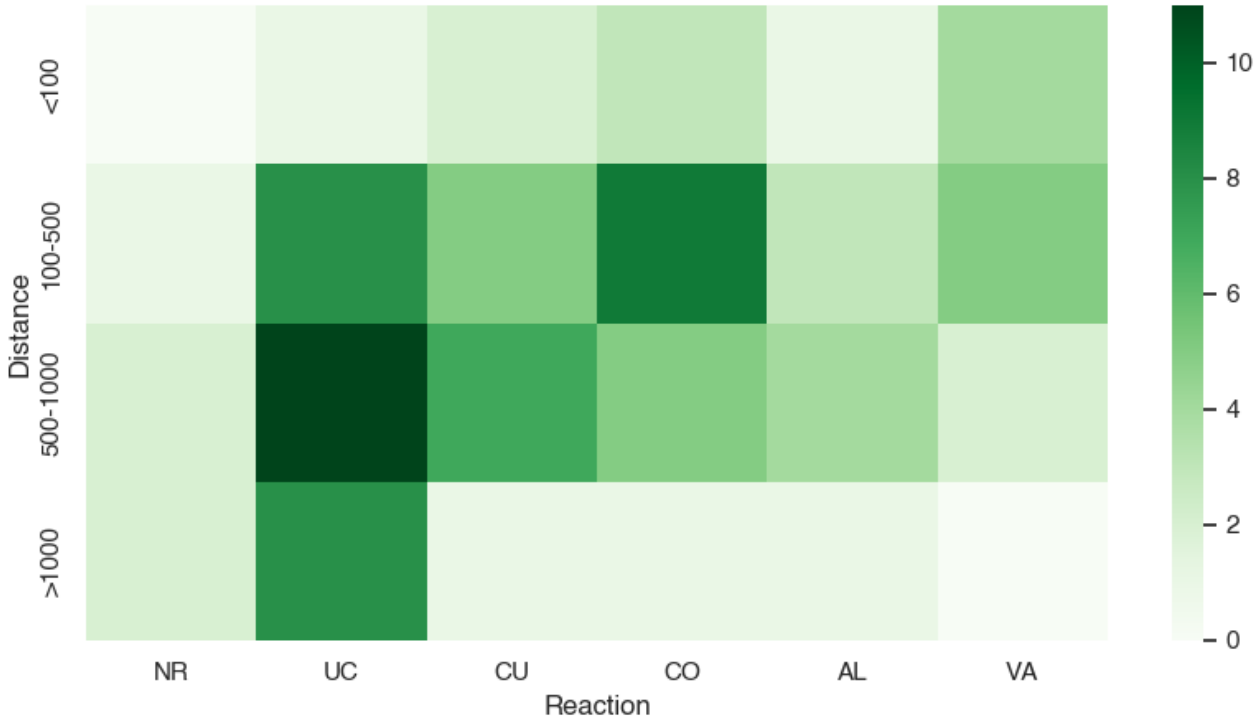

Figure 9. Heatmap illustrating the relationship between encounter distance and caribou behavioural responses for skiing observations by HeliCat operators.

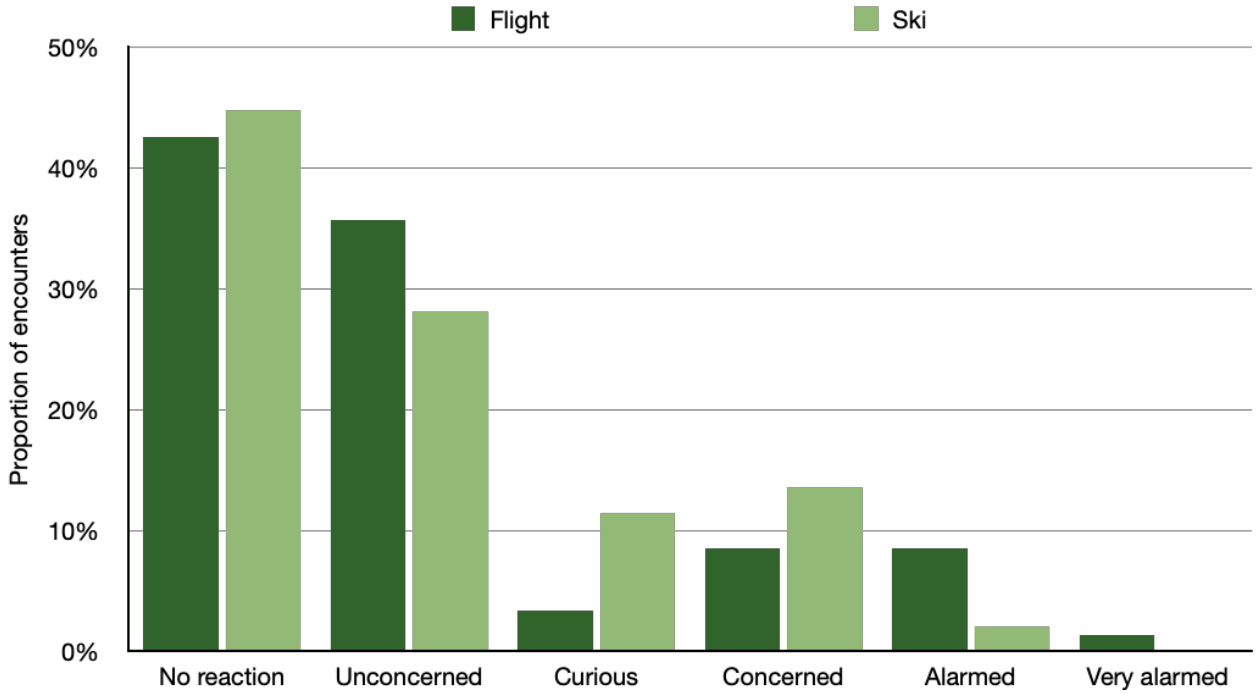

Figure 10. Frequency distribution of behavioural responses of mountain goats observed in flight and during skiing.

While responses to skiers by mountain goats were generally less severe than those by caribou, the encounter distances were somewhat longer, with 63% of encounters with mountain goats occurring at distances >500 m, compared to 52% for caribou, and with only rare encounters of skiers with mountain goats at <100 m (Figure 11). This is likely related to the preferred terrain of the two species, with goats occupying higher-elevation, rugged areas (e.g., Poole et al., 2009) that are less suitable for skiing, and caribou preferring gentler slopes at somewhat lower elevations (e.g., Rominger and Oldemeyer, 1989) where they are more likely to be encountered while tree-skiing.

These relationships were also evident in heatmaps illustrating the relationships between encounter distances and the behavioural responses of mountain goats. For both flight and skiing encounters, responses were strongly clustered among *No reaction* and *Unconcerned* responses at distances of 100-1000 m, with *Curious* and *Concerned* responses occurring more commonly during skiing encounters (Figure 12, Figure 13). Note that these inferences are based on small samples sizes, especially for encounter by skiers, and results may changes as additional data are collected.

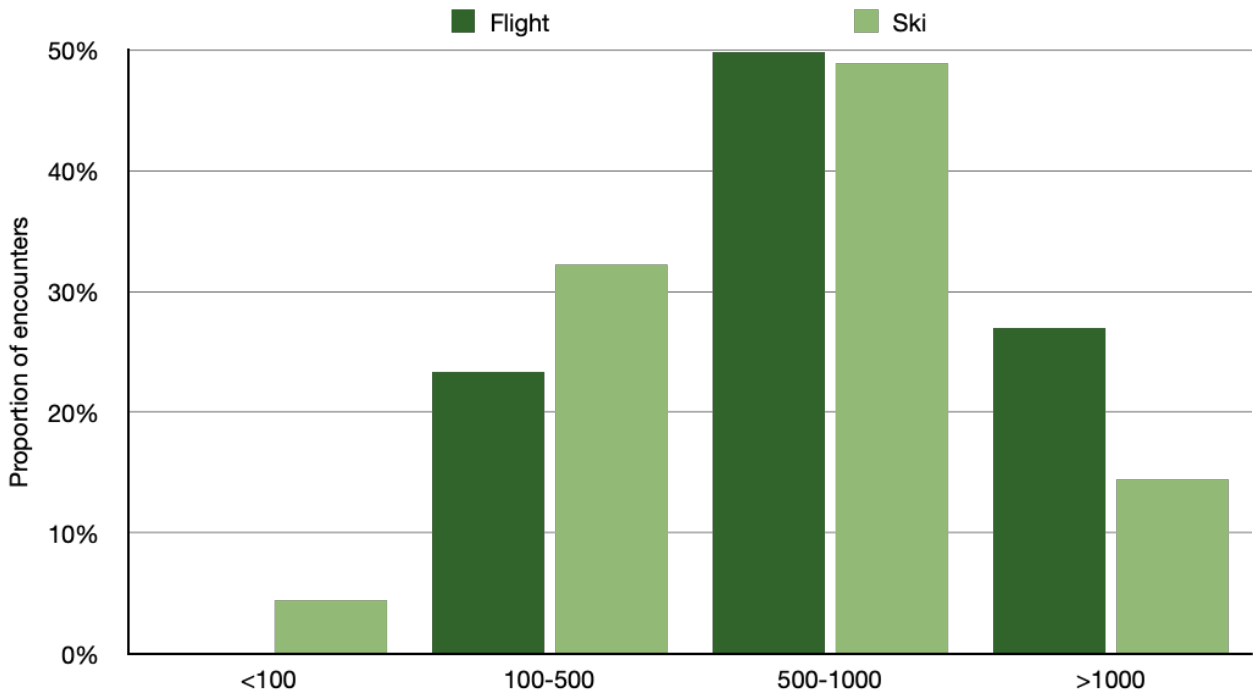

Figure 11. Frequency distribution of encounter distances recorded between mountain goats and HeliCat operators during flight and skiing activities.

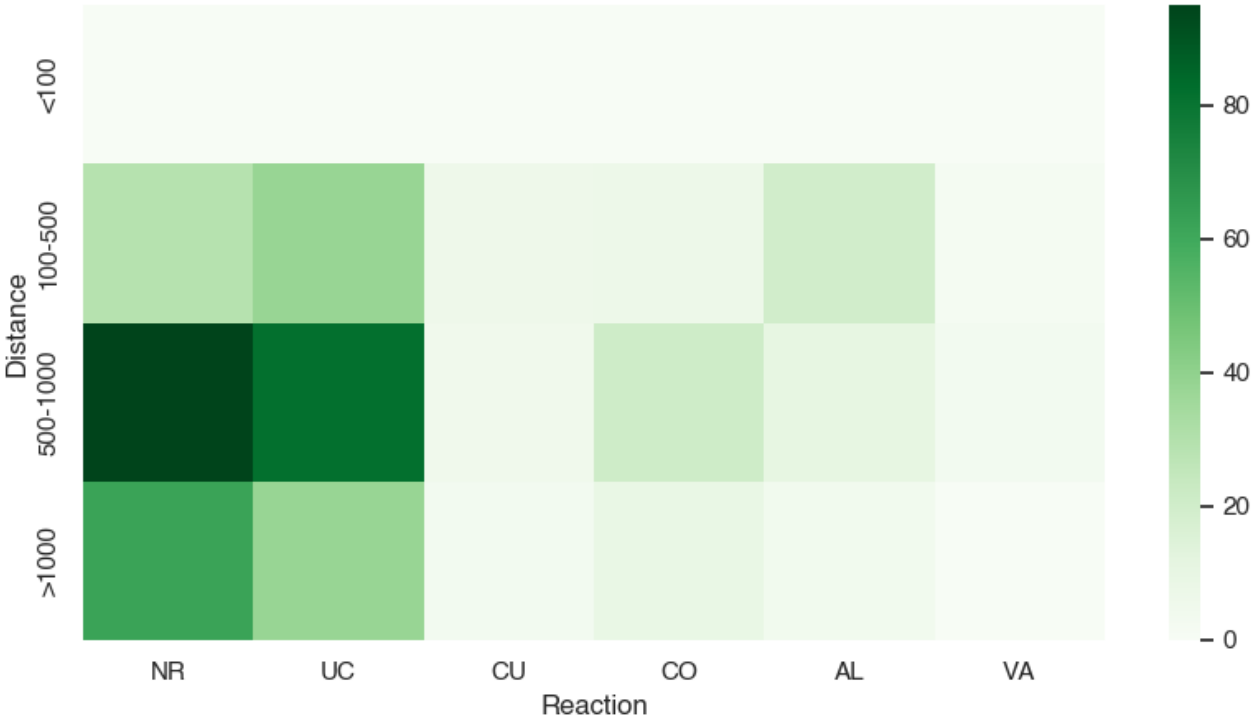

Figure 12. Heatmap illustrating the relationship between encounter distance and mountain goat behavioural responses for flight observations by HeliCat operators.

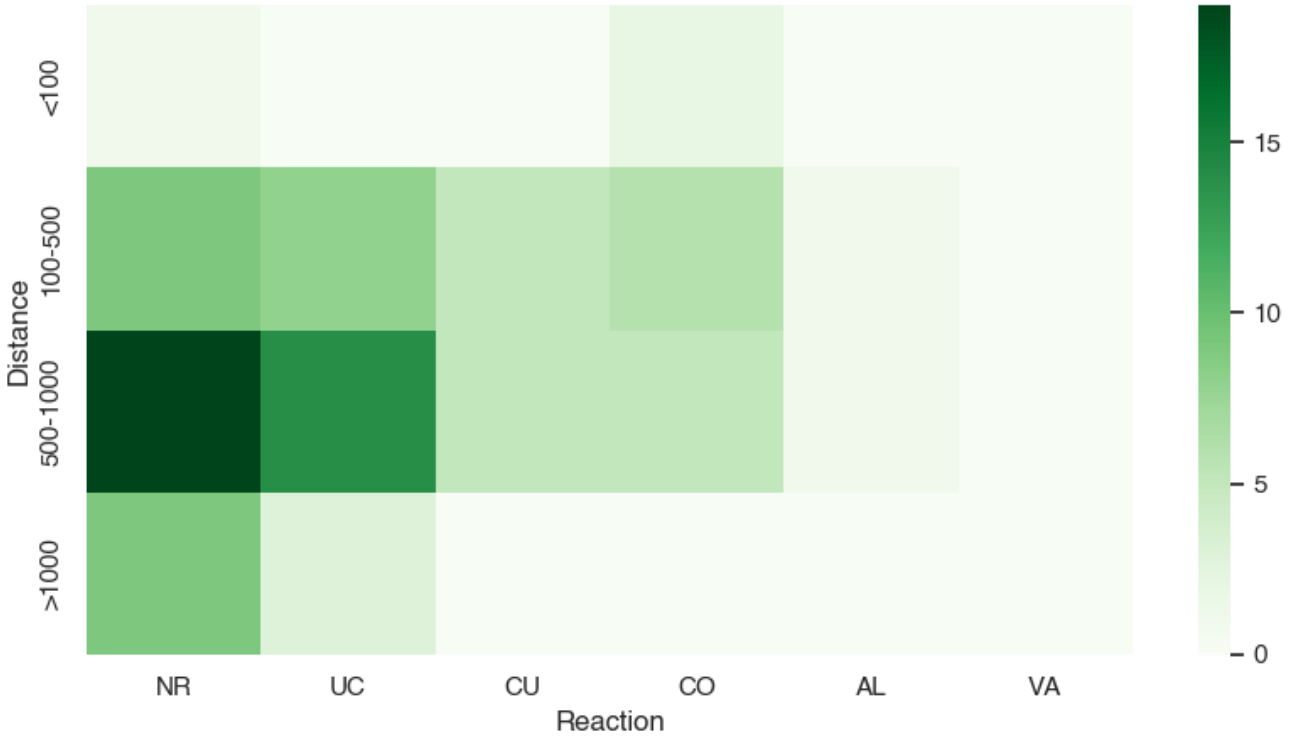

Figure 13. Heatmap illustrating the relationship between encounter distance and mountain goat behavioural responses for skier observations by HeliCat operators.

Minimizing the number of *Alarmed* and *Very alarmed* responses is an important adaptive management objective for HeliCat operators, but there is limited evidence of a decline in either the number, or the proportion, of observations falling into these categories after 2013 (Figure 14).

How Have Operators Responded to Encounters?

HeliCat operators record their management responses to their observations of caribou and mountain goats. Operators often recorded multiple actions and responded somewhat differently to the two species (Figure 15). Closing a ski run was the most common response to an encounter with either species, but *No action* was the second most common response to mountain goat encounters. In contrast, the next most common responses to caribou encounters were *Changed helicopter/snowcat path* or *Avoided ski run*. These differences are again likely due to the higher probability of mountain caribou being observed in skiable terrain. *No action* was the least common management response to an encounter with caribou.

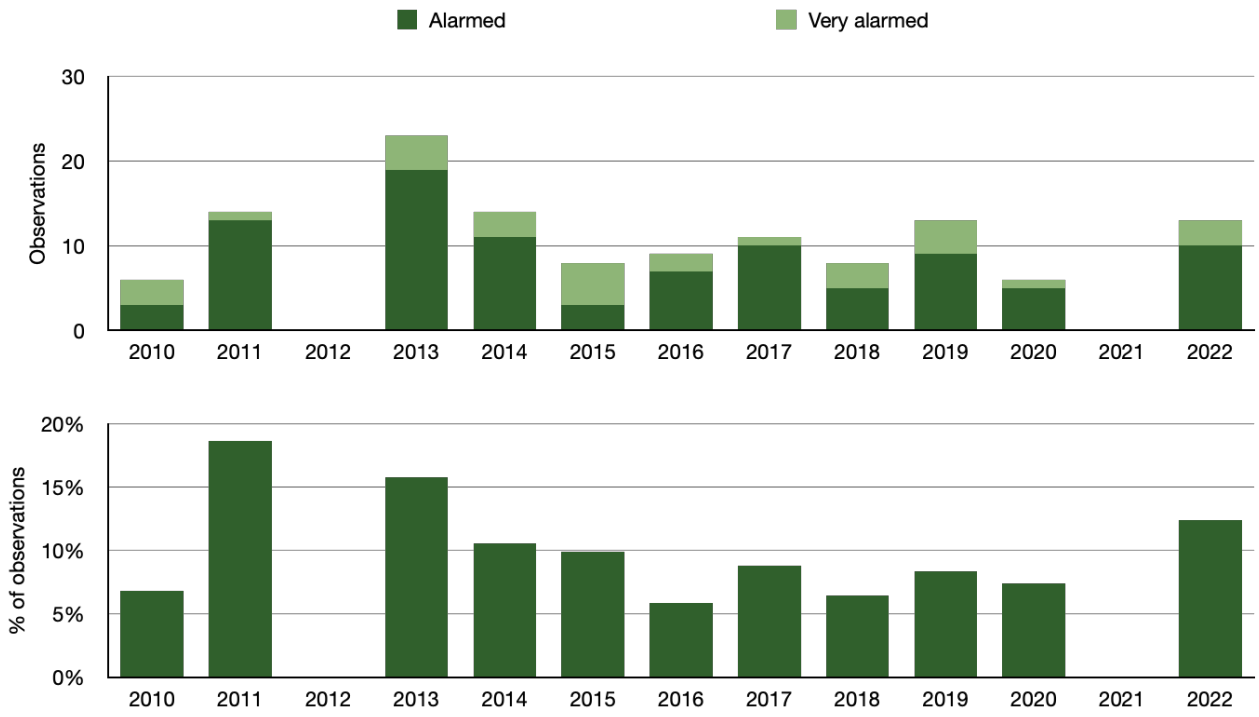

Figure 14. Number of alarmed and very alarmed response by caribou and mountain goats by year (top) and as a proportion of total observations, pooled for both alarmed and very alarmed, (bottom).

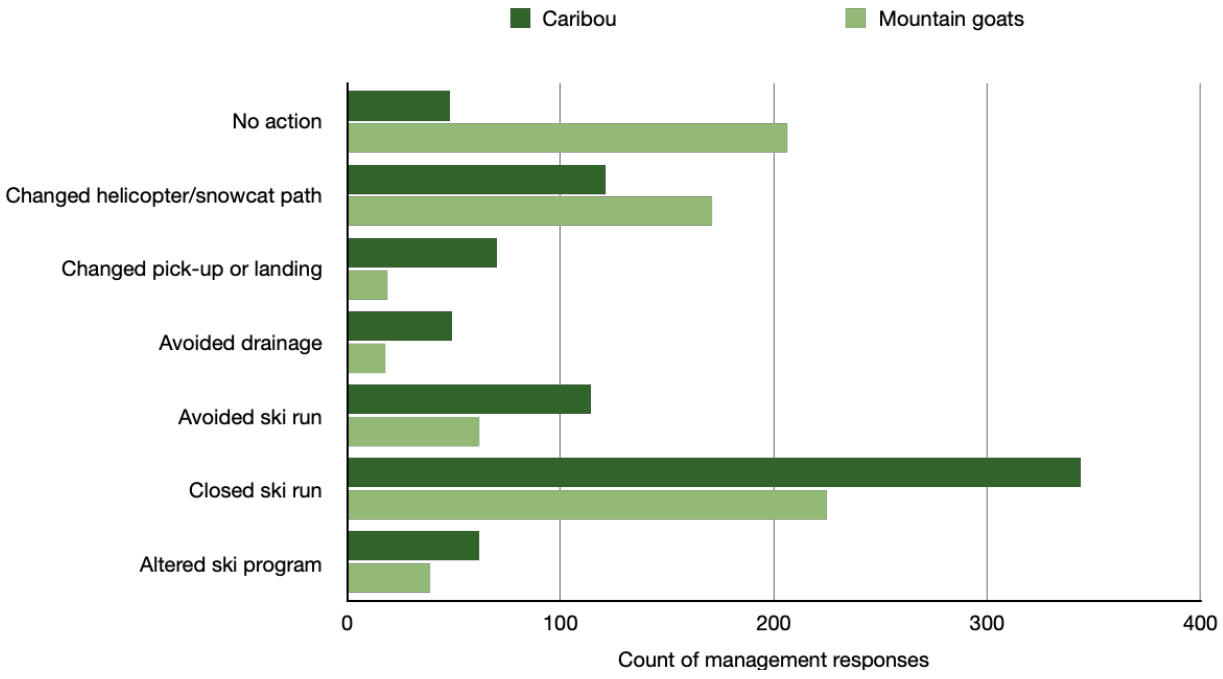

Figure 15. Management responses by HeliCat operators to observations of caribou and mountain goats.

Future Opportunities

Wildlife sightings data collected by HeliCat operators have provided important insights into how helicopter and snowcat skiing activities interact with wildlife in the backcountry. As noted, there are clear limitations to how the data should be interpreted because they are not based on random or systematic surveys, and are subject to the biases of observers. However, consistent results have emerged after many years of adhering to consistent data collection guidelines. This has revealed the shape of short-term behavioural responses of caribou and mountain goats to helicopter, snowcat, and skiing encouters, both in terms of magnitude and changes with significant covariates (e.g., distance, type of interaction). Specifically:

- *No reaction* and *Unconcerned* are the most common responses of caribou and mountain goats to encounters with helicopters or skiers.
- Behavioural responses are generally stronger at shorter encounter distances, but responses remain variable, with some animals still showing *No reaction* or an *Unconcerned* response to close encounters.
- Recorded responses to skiers tend to be stronger than to helicopters, particularly among caribou.
- After higher rates of *Alarmed* or *Very alarmed* responses among caribou and mountain goats were recorded during the early years of monitoring, the frequency of these responses fell and has remained stable.
- The number of caribou sightings has generally declined over the years, while there has been no obvious trend in mountain goat observations, and wolverine observations (tracks and sightings) have increased.

HeliCat Canada intends to continue to direct their members to collect wildlife sightings and behavioural response data; however, after 12 years of monitoring, the responses of mountain caribou and mountain goats to HeliCat activities are now well-characterized. With the proportion of *Alarmed* and *Very alarmed* responses remaining relatively stable for several years, there is likely little opportunity under status quo management to further reduce the likelihood of eliciting such responses. Because operators never have perfect knowledge about the distribution of these species in their operating areas, encounters are largely opportunistic occurrences and, by the time pilots and guides react, animals have already registered responses. Opportunities for additional mitigation under these circumstances is limited.

What is less clear is whether the current frequency of encounters and subsequent spectrum of responses poses an unacceptable risk to the sustainability of the wildlife populations. While observations of mountain caribou by operators have declined over time, as noted above, mountain caribou populations in general have declined by >40% during the past 10-15 years, both in areas where HeliCat activities occur but also where they do not, including in large, protected areas such as national parks. No trend among

mountain goat observations is evident in the wildlife sightings data. While sightings of wolverines remain relatively rare, their tracks are commonly observed, and HeliCat records may provide another line of evidence for researchers and managers concerned with wolverine conservation.

Regardless of whether current operating guidance poses an acceptable risk to wildlife populations, HeliCat Canada is committed to exploring feasible options to further promote the coexistence of their activities with sustainable wildlife populations. In the short term, the most promising approach to improving management is to improve the information available to pilots and guides regarding the distribution and abundance of wildlife within their tenures.

There are several approaches to accomplishing this, each with its benefits and limitations.

Habitat Mapping

Species-specific habitat suitability mapping can indicate where animals are more or less likely to occur. Suitability maps can be generated from a variety of information sources, but those produced from radio telemetry locations collected on a large sample of animals from the area of interest are considered most reliable (Boyce et al., 2002). However, such datasets are often not available, and mapping must be extrapolated from models developed for other areas. There is statistical error and sometimes bias associated with these maps, but they can also predict the relative probability of occupancy of different habitats with an acceptable accuracy. Skiing programs can be altered to accommodate the relative likelihood of encountering animals.

The general challenge with this approach is that a higher relative likelihood of occupancy does not necessarily correspond to occupancy. Both caribou and mountain goats occur at low densities and suitable but unoccupied habitat is the norm rather than the exception, particularly for caribou, which typically maintain winter home ranges of 50-100 km^2 (e.g., Wittmer et al., 2007). As a result, avoiding suitable caribou habitat will very often mean avoiding unoccupied habitat. While such an approach is precautionary with respect to managing sensitive species, it entails a cost in terms of loss of skiing terrain and operational flexibility. As a result, imposing such a regime can be costly to operators and generate either limited or no mitigation benefits.

In contrast, mountain goats have home ranges that typically average only 1-5 km^2 during the winter (Nietvelt, 2022; Poole et al., 2009; Shakeri et al., 2021) and, once located, are therefore easier for operators to avoid. In fact, if operators follow current guidance and maintain a separation distance of 1500 m from a known mountain goat location, the resulting avoidance zone covers 7 km^2.

Expanded Monitoring

More frequent surveys and the sharing of spatial inventory information can provide some additional, but limited, value to HeliCat operators. Caribou are already surveyed frequently and usually towards the end of the skiing season, so additional inventory is unlikely and not particularly helpful. In contrast, mountain goats are surveyed much less often and are far less mobile than caribou during winter, and better data on their distribution could provide HeliCat members with information to inform the season's operations.

Expanded Reporting

The observations and trends reported here are restricted to the interior wet-belt region of British Columbia because this corresponds to the range of mountain caribou and was the focus of the original MOU with the BC government that initiated the tracking and reporting of sightings. Some HeliCat operators from other areas of the Province have also been collecting wildlife sightings data and in some cases are now submitting records to HeliCat and/or to the provincial government as an obligation of their management plans. There is the opportunity to expand this reporting formally to improve our knowledge of interactions in the Skeena and coastal regions, where HeliCat tenures are common.

Telemetry sharing

Sharing real-time location data from GPS-collared animals allows operators to design daily flight and ski programs to avoid encounters. This has been piloted in the Central Selkirks range. The downside of this approach is it that requires animals to be fitted with active collars, which is invasive and expensive. In general, only a portion of the population is ever collared, so knowing recent point locations reduces, but does not eliminate the risk of encounter.

Passive detection

Emerging technologies are allowing for the continuous monitoring of wildlife distribution and abundance without invasive collaring programs. Large grids of wildlife cameras are now routinely deployed for research and monitoring purposes (Steenweg et al., 2017); however, these have limited value in informing operational flight and skiing decisions because cameras are still primarily "store on board" and do not transmit real-time animal locations. Also, large tenures require large grids of cameras and installing and maintaining such grids can be challenging in rugged terrain with limited access. Full coverage monitoring is infeasible because cameras capture only what is visible within their detection range and data collected would still represent only a sample of animal locations and movements.

The strategic deployment of cameras may be useful for adventure tourism operators more generally, especially if they are strategically deployed in high-use locations. Camera data could provide operators with some additional situational awareness of wildlife presence, although in winter, track observations can serve a similar purpose. Some cameras are integrating cellular radios, allowing remote download of images, and increasing the opportunity for real-time monitoring, at least in areas with cell coverage.

The other emerging opportunity for passive detection is forward-looking infrared radar (Smith et al., 2020), which can detect the infrared signatures of animals that might be otherwise unobserved or unobservable by operators. Recent advances pair this detection technique with machine-learning to process the datastream to reduce the probability of false positives. HeliCat is conducting initial trials with this technology but its operational feasibility is currently unknown.

Conclusions

Wildlife sightings data collected by HeliCat operators has clarified the relationship between heli- and snowcat-assisted skiing activity and the short-term behaviour of mountain caribou and mountain goats. While the outcome of any one encounter can be highly variable, years of monitoring have generated probabilities of different responses by the species when exposed to different activities at various approach distances. Whether the observed probabilities of responses pose an unacceptable risk to these wildlife populations is an outstanding question, but evidence suggesting that HeliCat activities are causing population declines is lacking. Still, best practices demand that the sector continues to explore options to reduce potential effects and promote the sustainability of wildlife in the habitats and traditional territories in which HeliCat members operate.

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