# Identification of Bighorn Sheep *(Ovis canadensis)* at the Nelson District Rod and Gun Club's Feeding Station, Kootenay Pass, British Columbia

By: Sarah Beaudoin

Study Partner: Kara Serruys

Faculty Advisor: Lui Marinelli

RFW 271 Applied Research Project

Selkirk College

April 5, 2020

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Final Report

April 5, 2020

### 1. Abstract

Wildlife identification is a requirement for multiple wildlife studies. The majority of identification methods used is invasive. Invasive identification methods can cause excessive stress and injury to the animal. Photo identification has been used as a non-invasive wildlife identification method. We tested the reliability of photo identification on a population of rocky mountain bighorn sheep (Ovis canadensis) at the Nelson District Rod and Gun Club's feeding station located on the Kootenay Pass. These bighorn sheep are habituated to humans, which makes it easy to take photographs. Last season (2018/2019) students from Recreation Fish and Wildlife at Selkirk College studied the bighorn sheep at the same feeding station and determined that photo identification works well short term. We took photographs of the sheep in the 2019/2020 season, and matched them with the photographs taken in the 2018/2019 season to determine if photo identification is a reliable method for long term studies. With the photographs from both seasons we studied the population dynamics of the herd too. There were 18 different sheep identified in the 2018/2019 season and 14 in the 2019/2020 season. Six of the bighorn sheep photographs from 2019/2020 were confidently identified with photographs from 2018/2019 (33% of 2019/2020's sheep). Because these sheep usually return to the feeding station season after season, these results indicate that photo identification is not a reliable method for long term studies. The population dynamics were quite similar between seasons. These sheep do not behave like a wild unhabituated herd, but there were some similarities, like their migration pattern. Photo identification works well short term with habituated bighorn sheep, but it will be a challenge to make it work for a long term study and/or in the wild.

### 2. Acknowledgements

This project took a while to complete, and there are many people to thank. I was guided through this project by my faculty advisor Lui Marinelli who explained the data collection methods and purposes. Brenda Beckwith taught me the best ways to present the data and how to write a report. A shout out to the students who studied the use of photo identification on the same sheep in the 2018/2019 season 4 Recreation Fish and Wildlife Students at Selkirk College (Colby Dunphy, Erin Groshko, Kaitlin Hancock and Darryl Fidler) and determined that photo

identification works well short term. My parents Heather and Brian Beaudoin drove me to the bighorn sheep feeding station on the Kootenay Pass during the scheduled feeding time. Thank you to my research partner Kara Serruys for helping with the data collection and analysis. The Nelson District Rod and Gun Club welcomed us to their feeding station for our data collection. Thank you all for helping me to complete this report.

### 3. Introduction

Wildlife identification is necessary to study the behaviour and population dynamics of wildlife (Duchateau et al. 2013). If a species is being monitored as part of a population, the individual animals need to be identified to get a true sense of how many are present and how they interact with the group (Perry et al. 2010). It will also provide information on the species' health, habitat, and threats (Speed et al. 2007). Invasive identification methods for tracking and population estimations, such as tagging, collaring, painting, and clipping, are highly reliable for identification (Duchateau et al. 2013). However, if the study is on the animal's behaviour, these invasive approaches can cause excessive stress or injury, which will negatively affect the animals and potentially influence the outcomes of the study (Antonini et al. 2016). Painting and clipping are short-term study methods too. Some studies require the animals to be identified for the rest of their lives (Perry et al. 2010).

One non-invasive way to identify animals is to record their natural markings. All individuals are different in some way. Photographic identification does not involve the capture of animals, and does not introduce anything new into or on the animal (Antonini et al. 2016). It is considered a humane method (Speed et al. 2007), but not all animals have easily distinguishing features to aid in identification. An animal's natural markings may also change overtime (Anderson et al. 2007).

The Rocky Mountain bighorn sheep *(Ovis canadensis)* population on the Kootenay Pass, British Columbia (BC) are currently being studied. There have been high numbers of roadkill bighorn sheep along Highway 3 just west of the pass, and to prevent further wildlife fatalities and motor vehicle accidents, the Nelson District Rod and Gun Club installed a feeding station 30 years ago to persuade the bighorn sheep to stay off the road. The number of road kills dropped after the

installation. I have volunteered for this program for the past 3 years. At the feeding station we provide salt licks to the bighorn sheep to prevent them from licking the road salts. Knowing which sheep are returning year after year could give us a better idea of how well the feeding station is working. There are some collared sheep that return season after season, but only 2 are currently collared. My research partner (Kara Serruys) and I are going to determine if photo identification is a reliable long term identification method.

The purpose of my research project is to test the efficacy of photo-identification for bighorn sheep and, through the use of repeat photography, describe the population that visits the feeding station located near Highway 3 in the Kootenay Pass. These sheep are comfortable around humans because the feeding station has been in operation longer than they have been alive. This is the ideal herd of sheep for my project because I can get close to them for making observations.

To achieve my research purpose, I will meet the following objectives:

- With the use of a Canon Rebel camera, photograph the rumps and heads of bighorn sheep individuals.
- Use hair pigmentation patterns to identify individual bighorn sheep that used the feeding station in the 2018/2019 and 2019/2020 seasons.
- By reviewing the photographs, we will document the movement of the individuals each week to track the individuals to assess and describe the population dynamics of the herd over the course of the field season.
- Describe a photo-identification system that can be used in future studies

# 4. Methods:

### 4.1 Study Area

The study will take place at the bighorn sheep feeding station managed by the Nelson District Rod and Gun Club. It is located on Highway 3, 25 km east of Salmo on the west side of Kootenay Pass, and approximately 100 m from the highway to the north (Figure 1). This wintering ground is located in the Engelmann Spruce Sub Alpine Fir (ESSFwh3 103) BEC Zone. The ESSFwh3 103 has cool, wet winters with deep snow packs (MacKillop and Ehman et al. 2016). For these reasons, their wintering ground is south-facing because this aspect does not have as much snow accumulation as other aspects and receives more sunlight. It is a little warmer and easier for the sheep to walk in (Poole et al. 2016). Other than the pine trees, there is very little vegetation that peaks through the snow during the feeding season.

#### 4.2 Field Methods

I conducted this project with my research partner, Kara Seurrys. We are both students in the Recreation, Fish, and Wildlife Program (RFW) in the School of Environment and Geomatics (SEG) at Selkirk College, from September 2018 to April 2020. The bighorn sheep are fed on Mondays, Wednesdays, and Saturdays every week between 9:30 and 10:30 am, from early December to early April. We met at the feeding station during feeding hours on December 28, 2019, January 11, 18 and 25, 2020 and February 1 and 8, 2020. We were limited to collecting the data during their feeding hours because most of the sheep show up at that time. They are familiar with people being around them (habituated), so they will not try to avoid us when we are taking pictures. Wild bighorn sheep (unhabituated) without a feeding station would avoid us, which would prevent us from getting most of the photographs.

After walking onto the site from the road, we documented the environmental conditions at the feeding station, including date, weather, and any disturbances or disruptions to the feeding system, in our field notebooks. These notes helped assess the population dynamics and understand why one may have not shown up that day. We then counted the total number of sheep and the number of sheep in each category to record in our field books as well. There were three categories that we divided the sheep into based on observation. The rams are the male sheep with the horns that curl around their ears. The ewes are the female sheep with the horns larger than lamb's and shaped like antennas. Lambs, the sheep that are born in the past year, are the individuals with little to no horn.

The number system in the field was different than the number system in the office. In the field we recorded how many sheep of each category there were, and once the first sheep was photographed, we recorded that sheep as number 1 in that category. There was a column next to

their numbers for the head photograph and the rump photograph to make sure we got both photographs. The head and rump were both photographed, so we could have two photographs to identify the sheep with, and the head and the rump are the two most distinguishing parts. We did our best to photograph the head and rump of one sheep before moving onto the next to prevent double photographs.

We took photographs using a Canon Rebel camera and a Fujifilm Finepix XP70 camera of the sheep's head and rump. All of the sheep in one category were photographed before we moved on to the next to help prevent double counting. For example, if there were four rams, we took photographs of four different rams before we moved on to the photographing the ewes.

Once all of the photographs were taken, we double checked to make sure that we had them all. If we were missing any, we figured out which sheep it was and took the photographs. Back home we saved and uploaded our photographs to our computer, and matched them later in the week.

#### 4.3 Data Analysis

When we got back to the office, we uploaded our photographs onto a computer and noted any distinguishing characteristics among the sheep. In the office the sheep received the same number that they received week 1 in the field. The following weeks photographs were matched with the same sheep and number. We ordered the pictures in numerical and chronological sequence throughout the field season. If a new sheep was present, we added the photographs to the gallery and gave it a number that was not already in use.

Starting in week 2, we used digital copies of the photographs to identify the sheep based on the length, size and shape of the brown mark on their tail, the size and direction of their horns, the way their hair laid and the shades of colour and patterns on their body (Figures 2, 3). For example, Lamb 1's distinguishing feature was its hair on its head because it was much messier than the other sheep's hair. Ewe 8 had a much whiter face than the others, and her horns grew outwards more than the other ewes (Figure 3). Certain sheep, for example the collared individuals, were easy to identify. By matching the markings we were able to note and describe the population dynamics of the herd. The analysis of population attributes including herd number and composition, and weekly presence, could help us speculate on herd movement, relationships,

and possible emigration or mortality. However, all that we will know for sure is that the individual was not present during the feeding hours.

To examine the herd between years, our faculty advisor Lui Marinelli provided us with the photographs and results documented by [Colby Dunphy] (2018/2019), [Erin Groshko] (2018/2019), [Kaitlin Hancock] (2018/2019) and [Darryl Fidler] (2018/2019) who were students in the Recreation, Fish, and Wildlife Program (RFW) at Selkirk College and worked on this same project last year. Brenda Beckwith provided me with Erin Gorshko's final report. It was determined that the bighorn sheep could be identified week to week (short term) (Groshko 2019). We compared our photographs with their photographs to determine if photo identification could work year to year (long term).

### 5. Results

#### 5.1 This Field Season

From December 28, 2019 until February 8, 2020 we took photographs of the bighorn sheep on Saturdays between 9:30 and 10:30. Later in the week (except for the first) we would match the photographs with the previous weeks. In general the photographs we got in the 2019/2020 season matched very well week to week. Some of the pictures were a clear match (Figure 4), while others required a closer look for a variety of reasons, which included lighting, angle, the way their hair laid and if the sheep was dirty or clean (Figure 5). After some analysis, all of the photographs from the 2019/2020 season were matched week to week.

There were 14 different sheep identified at the feeding station throughout our study. Most bighorn sheep return to the feeding station week after week. Although not every identified individual was there at every feeding, there were variations of the same group of a total of 14 bighorn sheep. There were usually 8 ewes (57%), 2 rams (14%), and 4 lambs (29%). Ram 1 was not present week 3, and was the only sheep present during the week 5 feeding hours.

#### 5.2 2019-2020 Season Compared to 2018-2019 Season

Some of the photographs were comparable between the 2018/2019 season and the 2019/2020 season. For example, Ewe 4 was an easy match between seasons (Figure 6). She still has the same small dark brown patch on her tail and the lighter coloured hair on her rump meets the darker coloured hair on her body in the same areas.

Other photographs were challenging to match. Many of the photographs from the 2019/2020 season did not match with any from the 2018/2019 season. Figure 7 shows that Ram 2's rump patterns do not match very well. The dark brown patch on his tail in the 2018/2019 season extends upwards and has a little bit of light coloured fur spreading into the dark brown patch to give it a slight curve. In the 2019/2020 season the same dark brown patch extends upwards, but there is no light coloured fur spreading into the darker patch. Ram 2 has been wearing the blue collar for the past two years.

Last year there were 18 individual sheep recorded over the course of the field study. Ten of them were ewes (56%), 4 rams (22%) and 4 lambs (22%). This year there were 14 sheep identified total (78%). We were only able to confidently identify that 6 of this year's 14 sheep were at the feeding station last year (33%) (Table 1).

### 6. Discussion

#### 6.1 Photo Identification

During our study we were quite confident that we could identify the bighorn sheep with head and rump photographs week to week. The most reliable physical features we used to identify the sheep was the shape and size of the darker brown patch on the tail, the shape and size of the horns and different shades of brown on the face. The students from Recreation, Fish and Wildlife (RFW) at Selkirk College last year had the same result (Groshko 2019). However, we discovered that photo quality affected our ability to positively identify each animal. For example, some photographs made it harder to identify the sheep than others due to lighting and the angle of the shot. With both photographs and some analysis, we could confidently identify which sheep were there.

Matching our photographs with those taken from last year was not as easy as matching our photos to the live herd at the feeding station. The rump photograph we have of Ram 2 on January 26, 2019 (Figure 7), for instance, has noticeable differences from the photograph of Ram 2's rump on January 25, 2020. The dark brown patch on its tail is not as pointed on the top in 2019 as it is in 2020. We know that this is the same sheep, though, because it is the blue collared one. This implies that, like humans, bighorn sheep's appearance changes overtime. Photo identification is a reliable short-term identification method, but without consistent photographs, it will not work well long-term.

Alternatively, some of the photographs match very well. We were able to confidently identify 6 of the 14 sheep we saw this season with photographs from last season (33%) (Table1). However, one of the sheep was identified from his collar, not from his natural markings.

#### **6.2 Population Dynamics**

Because we could confidently identify the sheep from week to week, we could assess the population dynamics with the same data. At each feed there were variations of the same 14 sheep (8 ewes (57%), 2 rams (14%), and 4 lambs (29%)). Sometimes all 14 were there, other times there were less. On occasion Ram 1 would be separate from the herd. This is common for unhabituated bighorn sheep outside of breeding season (Schoenecker et al. 2015). The feeding station pulls the rams and ewes together outside of the breeding season during the winter months. Ram 2 was consistently with the rest of the herd. This is one factor that separates these sheep from unhabituated wild sheep (Schoenecker et al. 2015).

There is a decrease in population size from the 2018/2019 season (Groshko 2019). Six of our fourteen sheep this season were present last season (33%). This does not mean that the other sheep were not present last season. The photo identification that was used is not a suitable long term study method under these circumstances (consistent photographs were missing). Bighorn sheep commonly migrate, and return to the same summer and winter habitats (Poole et al. 2016). There are 4 lambs in the 2019/2020 season that most likely were not present in the 2018/2019 season. The 4 lambs in the 2018/2019 season have likely grown into adults. There has likely been some mortality, which can happen for a variety of reasons, such as roadkill, predation and starvation.

### 6.3 Photo identification in the Wild

Photo identification could be a useful tool for many wildlife studies. Wildlife has to be identified for numerous studies (Speed et al. 2007). It is a non-invasive way to identify wildlife. But it does not work under all circumstances.

Photo identification was possible with these sheep because they are habituated to people. This makes it easy to take an accurate photograph. We also know that there are many sheep returning to the same area at specific times. We were constantly taking photographs of the same sheep, so their natural markings did not noticeably change. All of these reasons made the study work well at the feeding station.

Carefully designed studies using bighorn sheep photo identification could work in the wild (Dorning and Harris 2019). There will be a lot to consider in making the study work. There would have to be a method to get close to the animals, or a method for taking long distance photographs. Unhabituated sheep will view people as a threat, and not allow a technician the opportunity for photographs (Poole et al. 2016). The technician would have to know where and when to meet the sheep for the photographs. The study would have to be short-term, or would require regular photographs of the animals to confidently identify them throughout the study. If there is a way around all of these considerations, photographic identification may work in the wild.

### 6.4 Future Recommendations

This study was built off of last year's bighorn sheep photo identification study completed by [Colby Dunphy] (2018/2019), [Erin Groshko] (2018/2019), [Kaitlin Hancock] (2018/2019) and [Darryl Fidler] (2018/2019) who were students in the Recreation, Fish, and Wildlife Program (RFW) at Selkirk College in the 2018/2019 season. We took some of their recommendations, like using higher quality cameras, but there are still some recommendations I would give to anyone who would like to complete a similar study, which include:

• Start matching the photographs from the past season with the photographs from the current season in week 1. This will give you more time to think about the match and confirm it the following weeks, which could make results more accurate.

- I would try to find a different way to keep track of which sheep had been photographed, and which ones had not. It worked very well when the sheep were standing still. If they were moving, it was easy to lose track and we sometimes had to review our photographs to see which ones we had photographed.
- With all of the considerations mentioned in section 6.3 Photo Identification in the Wild, I would recommend testing the method in the wild.

# 7. Conclusion

Photo identification works under some circumstances, but not often. The study has to be short term, or have consistent photographs taken throughout the study because the sheep's appearance changes overtime. This method worked week to week on this bighorn sheep population because they are habituated to humans. They share some characteristics with unhabituated wild bighorn sheep, but many characteristics separate them. The next step would be trying photo identification on an unhabituated population of bighorn sheep.

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Figure 1. Feeding Station Location (11U 487417m E 5429196m N).



Figure 2. Lamb 1's head photograph week 6, February 8, 2020.



Figure 3. Ewe 8's head photograph week 3, January 18, 2020



Figure 4. Ewe 2's rump photographs comparison of week 2 (January 11, 2020) and week 6 (February 8, 2020), 2019/2020 season



Lamb 4 Week 2 (January 11, 2020)

Lamb 4 Week 6 (February 8, 2020)

Figure 5. Poor quality photo of Lamb 4 Week 2 (January 11, 2020) due to angle. High quality photo of Lamb 4 Week 6 (February 8, 2020)



Week 2 2018/2019 season (January 19, 2019) Week 2 2019/2020 season (January 11, 2020)

Figure 6. Ewe 4's rump photographs comparison of week 2 of the 2018/2019 season (January 18, 2019) and week 2 of the 2019/2020 season (January 11, 2020)



Week 3 2018/2019 season (January 26, 2019)



Week 4 2019/2020 season (January 25, 2020)

Figure 7. Ram 2's rump photographs comparison of week 3 of the 2018/2019 season (January 26, 2019) and week 4 of the 2019/2020 season (January 25, 2020)

2019/2020 Season's Sheep	Presence in the 2018/2019 season
E1	yes
E2	yes
E3	no
E4	yes
E5	no
E6	no
E7	no
E8	yes
R1	yes
R2	*yes
L1	no
L2	no
L3	no
L4	no

**Table 1.** The Number of Bighorn Sheep from the 2019/2020 season whose photographs matchwith the 2018/2019 photographs.

\*We know that Ram 2 was present in the 2018/2019 season because he is collared, but his natural markings did not match.