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Smithers Method - Counting Mountain Goats

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Summary

Management of mountain goat (Oreamnos Americanus) populations in British Columbia (B.C.) is based in large part on information from aerial surveys. Current survey methods record population counts using paper forms. Our society introduces the Smithers Method, a new method of gathering additional data on an aerial survey. The new data provides a video/ photo/ audio record of each survey flight, and provides wildlife biologists with more information on the gender and age of surveyed mountain goat populations.

Background

Aerial surveys for mountain goats in British Columbia are conducted from a helicopter. The helicopter flies the length of each canyon in a mountain range, at a distance of 50 to 150 meters from the slope. Members of the crew spot each individual or group of mountain goats and record the number of goats on paper forms, along with additional site information. The information on the paper forms is later used to write a formal survey report.

The B.C. mountain goat hunt is based primarily on the harvest of mature males. Hunt managers urge hunters to avoid harvest of mature females. Yet the hunt managers lack any information about the actual number of mature males from current aerial survey flights. Some hunters harvest juvenile and female mountain goats mistakenly or by choice. but the number of juveniles and adult females in each herd is also not provided by current survey flight methods. Kids are the only mountain goat age group accurately counted using current methods.

Rationale

The Smithers Method makes it possible to photograph each mountain goat on a survey flight with a still camera. Each photo can provide all the information previously recorded on a paper form during a survey flight. In addition, each photo can be reviewed at any time to help determine the age and gender of each mountain goat as well as data about the terrain, ecosystem, tracks, weather or any other features that can be photographed.

The Smithers Method also records all voice communication in the helicopter during a wildlife survey flight. Recorded comments by the flight crew can replace hand-written notes and can follow a protocol defined before the flight. Flight results using the Smithers Method follow the standards set in the Biodiversity Inventory Methods of 2002.

Technology

Most cameras on the market are not suitable for photographing mountain goats on an aerial survey flight. Most cameras lack sufficient resolution. Cameras with telephoto lenses lack a wide field of view. It's very difficult to hand-hold a camera with a telephoto lens, find the target through the viewfinder and hold the camera still enough to avoid shake and blur.

The exception to the rule is the Fujifilm GFX 100s with a 45 mm lens. This camera has double the resolution of most cameras plus a 60 degree field of view. It's easy to hand-hold the camera and produce high-quality photos with no blur. The same camera is used by industry to photograph individual bolts on high tension electrical transmission towers from a helicopter. The photos of bolts reveal the amount of rust and wear, and are used to calculate when the bolts need to be replaced. For the same reasons, the GFX 100s is suitable for photographing mountain goats on an alpine slope from a moving helicopter.

Each photo from the GFX 100s in RAW format is 102 MB. The printed width of each photo at 100% size is 45 inches. At 250 meters from an alpine slope, each photo will span 288 meters of horizontal terrain. The resulting photo resolution is sufficient enough to help reveal the age and gender of each mountain goat.

Equipment

The Fujifilm GFX 100s camera is handheld and battery powered. The camera is set to record each image in both RAW and JPEG format on two SD cards. The battery in the GFX 100s can power 300 photos. Batteries can be swapped during the flight.

A handheld GPS provides navigation by a pre-determined route, records the track of the flight and is battery powered. A GoPro 12 camera is installed with a suction-cup mount inside the windshield of the helicopter. This camera faces forward and records the entire flight. Power is provided by a portable power pack attached by cable. We have operated the GoPro continuously for 3 hours with no problems.

A split adapter is attached from the helicopter audio system to the GoPro 12 camera in order to record all audio within the helicopter.

Figure 1 Main components of Smithers Method

Expertise required

Photographing mountain goats with the GFX 100s camera only requires basic camera skills. A shutter speed of 1/640 second to 1/800 second ensures that blur will be eliminated. The f/stop is fixed at 6.4 to ensure a deep field of view. Exposure compensation is adjusted by changing the ISO.

Downloading photo files and setting up Adobe Lightroom Classic to edit and geo-tag the photos require basic computer skills and can be taught in a day. The GoPro camera footage includes the audio from the helicopter sound system and needs no editing.

Combining the GoPro video with thumbnails of the still photos in video editor software takes basic skills familiar to anyone who works with video editing.

Pre-flight setup

The internal clocks of the cameras and the GPS are synchronized to the second before the flight. This synchronization allows all data to be accurately combined in a final project video.

The GFX 100s camera is set to 1/640 shutter speed, 400 ISO and f/6.4 aperture. Exposure compensation during flight is done by adjusting ISO. The best weather for a flight is sunny, or sun and cloud. Best time of day is between 10 am and 3 pm for maximum sunlight. Ideal dates for mountain goat survey flights are March 21 to May 1.

Advantages of March and April for census flights:

- Sufficient daylight for visibility/camera
- Goats avoid deep snow at high elevations, stay at middle elevations
- Herd keeps close compared to summer
- Smooth cold air for helicopter stability
- No leaves on trees
- Fresh tracks in snow are visible

In a Bell 206 Long Ranger, the pilot is forward on the right. A navigator/spotter is forward on the left. The camera operator is at the rear on the right and sees the same unobstructed view as the pilot. That means that the flight must proceed clockwise around the mountain to keep the pilot and camera operator on the same side of the aircraft and in full view of the slopes. A fourth crew member at the rear on the left side is optional, at the discretion of the lead biologist.

The pilot's primary task is to follow the navigator's instructions and to maintain a consistent flight distance from the mountain slope, from 100 to 250 meters. The actual distance can be checked periodically using a laser range finder such as the Nikon Prostaff 1000 or equivalent. The pilot's second duty is to serve as a spotter for mountain goats along with the navigator/spotter seated to the pilot's left.

The camera operator takes photos when mountain goats are in view and also acts as a spotter. Photos of tracks, non-target species or habitat, etc. may be included as necessary.

Post-production

All photos are downloaded from the SD cards within the GFX 100s camera into Adobe Lightroom Classic in both JPEG and RAW formats. The RAW and JPEG photos are duplicates. The RAW files are archival and can be edited to correct photo exposure or other parameters if necessary. Otherwise, the JPEG photos will be the version used for all post-production tasks. The JPEG images have smaller file sizes than RAW files and can be reviewed on any computer in order to count mountain goats and determine gender and age.

The track of the flight on the GPS is downloaded in .GPX format. The JPEG images and the .GPX track are imported into the MAP module of Lightroom Classic in order to geo-tag each photo and to locate each photo exactly on the flightpath shown on a terrain map in Lightroom.

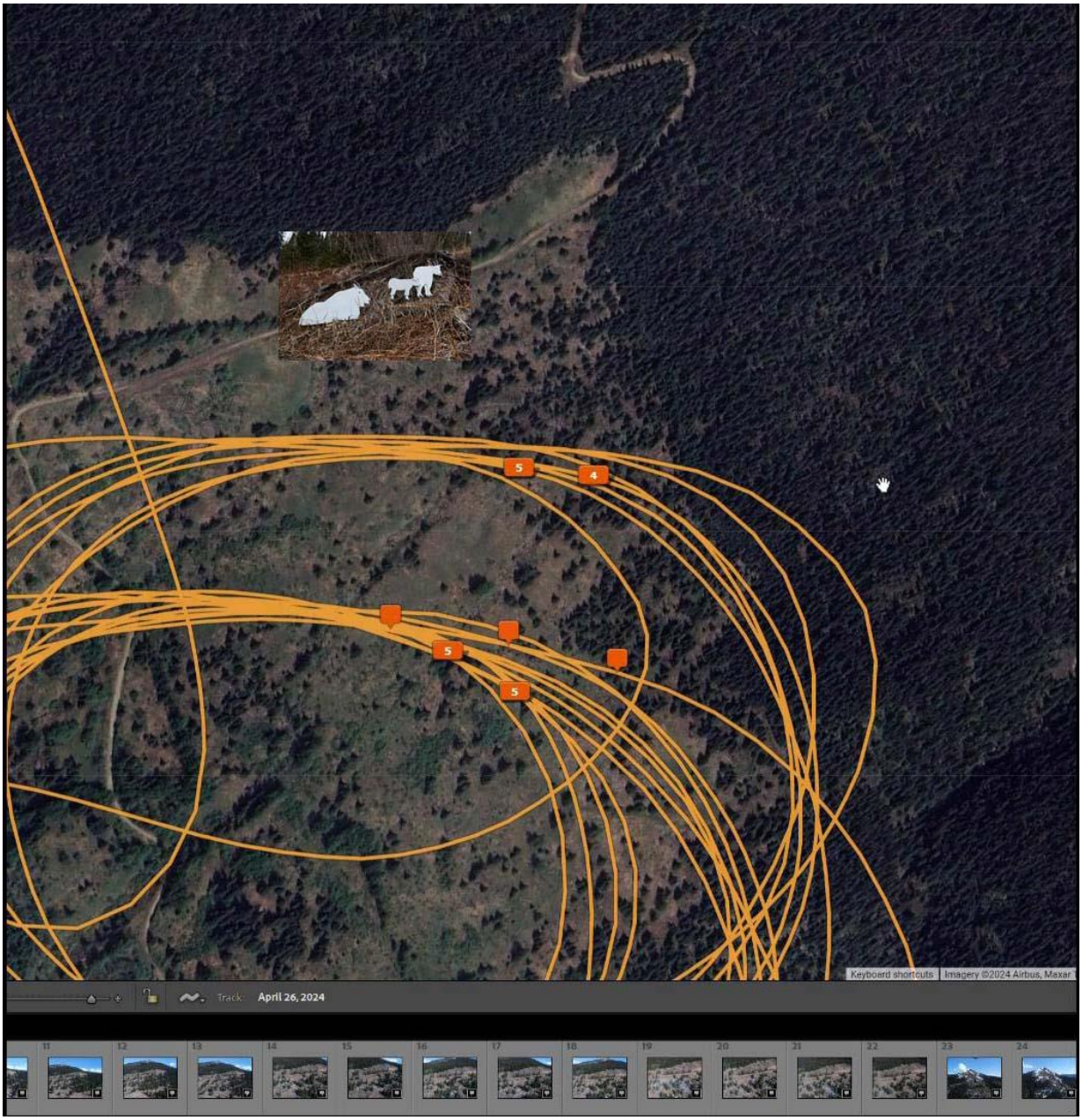

Figure 2 GPS flight path shown in yellow, location of each photo shown by orange icon

The GoPro 12 video/audio file is downloaded into a video editor such as Cyberlink PowerDirector. The camera photos can be placed on a separate timeline at the location where each photo was taken. Each photo then displays briefly on the GoPro video to indicate location. The value of the movie is that the audio track is combined with the GoPro video track and thumbnails of each still photo to provide a complete context of the flight.

Analysis

Analysis is best conducted in Adobe Lightroom Classic. All photos are individually available for review. The terrain map shows the flight path and geo-location of each photo. Click on a photo and the relevant icon lights up. Click on each icon and the relevant photo shows up. Photos of each group of mountain goats offer an opportunity for experts to review the number of goats, as well as the gender and age of each goat. Analysis of the audio from the flight is done by reviewing the GoPro footage. Analysis of the gender and age can also follow social context probability as shown in the following table. Probabilities apply only to mountain goats in north-central B.C.

Social context probability for identity of mountain goats

Identity	**Probability**	**Remarks**
Nanny with kid	95%	Kid follows mother
Nanny with kid and yearling	90%	Yearling follows at small distance
Two or more nannies with one kid	90%	Nannies without kid associate with nanny with a kid
Nanny with yearling	80%	Nanny without kid may allow her yearling to stay close
More than one mature male	80%	Male group - separate but within 100 meters – body confirmation includes heavy shoulders and neck
Single adult alone	80%	Mature male
Nanny with 2-year old juvenile	50%	Nanny without kid may allow her juvenile to stay close, especially female juvenile
Nanny with 2 kids	50%	Not twins – nanny for second kid is hidden and nearby
Mature male with male yearling or juvenile	50%	Young males may follow older males at distance
More than one nanny with no kids or yearlings	30%	There is usually a kid or yearling with a nanny group
Mature male and nanny	30%	Only during severe cold and deep snow (except rut)
One or more yearlings separated from nanny group	20%	Yearllngs normally stay with nanny or nanny herd
Nanny with 2 kids	10%	Twins – very rare occurrence in central British Columbia
Mature male and kid	5%	Kid is lost

Ground testing

In order to test the GFX 100s camera, we constructed three life-size silhouettes of mountain goats using 2-inch foam board. The silhouette "herd" consists of a large male bedded down, a young nanny and her ten-month old kid. The herd was placed at the end of a road. Photos of the herd were taken at 100 meters, 150 meters and 200 meters. The camera was hand-held with the following settings: ISO 200, f/6.4 and 1/640 second. The photos below are cropped from the original images at 100% size. As the distance increases, the resolution decreases but even at 200 meters, the image is good enough to distinguish gender and age.

Flight testing

On April 26, 2024, we flew a helicopter test flight in a Bell 206 Long Ranger provided by Canadian Helicopters Ltd.. The silhouette “herd” was placed near the top of the Onion Road, 19 km east of Smithers BC. The helicopter flew across the slope at 125 meters from the herd and again at 250 meters. The GFX 100s was hand-held and set to ISO 400, f/6.4 and 1/640 second. The airspeed varied from 30 mph to 90 mph with no loss of photo quality. The shutter speed was varied from 1/800 to 1/640 and 1/400 second with no appreciable difference in photo quality noted. The weather was sunny.

We have created a short movie with photo samples. The movie is available at:

Flight Test for Smithers Method April 2024 (youtube.com)

On an actual survey flight, the entire GoPro video would be maintained uncut, as an historical record with audio.

Four JPEG photos from the April flight are available with the following links. Note the wide field of view. Zoom the image to 100% to see detail. Two of the photos have our “herd” in view. Two of the photos are of bare subalpine. You may have to wait briefly for each photo to open to full resolution.

https://drive.google.com/file/d/1JEAcKWgtpDRoBStwhK_lhDWiTe8YvaLz/view?usp=sharing

https://drive.google.com/file/d/1hVba0tZ3mpT5ddm0f1YcC1CmnzGa4LXn/view?usp=sharing

https://drive.google.com/file/d/12GYFKHMsYzFDKbn4da8RbM41mp2nj_DZ/view?usp=sharing

https://drive.google.com/file/d/1-3btdgB_XBYp1ZIEsPPDqZHZZloOFB_Q/view?usp=sharing

The terrain map image shown in the movie was generated in the MAP module of Adobe Lightroom Classic. The MAP module automatically adds the geo-location data to the permanent metadata of each photo.

Cost comparisons

The Smithers Method uses the same helicopter time and flight path as the current no-camera aerial survey method. The Smithers Method uses three crew members minimum. A fourth crew member can be added.

The cost of the camera and related flight equipment totals $12,644 - . Adobe Lightroom Classic is available by subscription for $14- per month. Video editor Cyberlink PowerDirector is available for purchase at $160 -. Our British Columbia Mountain Goat Society is willing to loan the camera equipment to B.C. provincial agencies to evaluate the Smithers Method at no cost. Our society is also available to brief staff on procedures.

Discussion

The Smithers Method delivers more data from each flight than no-camera surveys at the same cost for helicopter time. The Smithers Method has no need for written notes. The Smithers Method records all voice communication among the flight crew in sync with the GoPro video footage. Crew members simply speak about data that cannot be photographed. All comments are saved for review, including those comments that may not easily be remembered post-flight. A crew member that previously filled in paper forms can now spend all their time spotting for mountain goats. Photos and audio can be reviewed by experts anywhere, at any time after the survey flight.

Most important, the Smithers Method can provide more information for mountain goat hunt managers. This data will make it easier for hunt managers to make accurate and sustainable decisions before the hunt, and to make adaptive management decisions after the hunt.

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