

Standard Operating Procedure (SOP) 7: Flying Transects, Version 1.0

Dall's Sheep Monitoring Protocol

Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks

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March 2017

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Please cite this Standard Operating Procedure as:

Rattenbury, K. L. and J. H. Schmidt. 2017. Standard Operating Procedure (SOP) 7: Flying Transects, Version 1.0. Dall's Sheep Monitoring Protocol, Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks. National Park Service, Fairbanks, Alaska. Available online at <https://irma.nps.gov/DataStore/Reference/Profile/2238927>.

The main Narrative for the Protocol for Monitoring Dall's Sheep, Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks is available from the NPS Inventory and Monitoring Arctic Network website (<http://science.nature.nps.gov/im/units/arcn/>), the NPS I&M Central Alaska Network website (<http://science.nature.nps.gov/im/units/cakn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>).

SOP 7 – Flying Transects

Standard Operating Procedure #7
 Version 1.0 (03/01/2017)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
Add rows as needed for each change or set of changes associated with each version.					

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SOP 7.0 – Introduction

SOP 7 outlines the roles and responsibilities of the pilot and the observer when flying transect surveys for ARCN and CAKN's Dall's sheep monitoring program. The pilot and observer have separate responsibilities, but must work closely together to fly safely, to search for sheep while on transect and to completely collect all data while on transect.

SOP 7.1 – Instructions for Pilots and Observers

- 1) The pilot and observer are to work as a team, paying close attention to the area closest to the transect line. It is very important that all sheep located close to the transect line are seen and marked. Fly roughly 300' above the transect and just off to the side, so that the transect line is roughly under the tire to account for the 'blind spot' under the plane. The pilot will probably have a better view of the line because he can see forward. Missing some sheep farther away from the plane is ok as long as all of the sheep close to the plane are recorded.
- 2) Fly ~300ft above ground level. If this is not possible based on weather conditions, try a different transect where the weather is more favorable. The elevation of the generated transect should be your guide – **see step 3**. The observer may need to give the elevation of the transect based on the topo map. If you need to pull away from the mountain to safely hold flight altitude, move away from the mountain, maintaining your initial flight altitude. This may mean putting considerable horizontal distance between you and a cliff face and considerably more than 300' between you and the ground below for certain sections of the transect. This is fine – just try to hold the predetermined flight altitude (**see step 3**). Altering the designated flight altitude for different transects affects the effective blind area under the plane and data analysis.
- 3) Determine your flight altitude for the transect as 300' above the generated transect line's elevation, head to the start of the transect, and hold that flight altitude while flying along the mountain contour. This is easier and safer than trying to follow the line on your GPS. The lines are generated in a computer Geographic Information System (GIS) mapping program, and tightly follow the mountain contours in a fashion that would be impossible to follow 100% by any aircraft. The transect lines are a guide, while the resulting flight path becomes the actual line that we use in data analysis to obtain the population estimate for the park. *If you need to pull away from the mountain to safely hold flight altitude, move away from the mountain, maintaining your initial flight altitude. This may mean putting considerable horizontal distance between you and a cliff face and considerably more than 300' between you and the ground below for certain sections of the transect. This is fine – just try to hold the predetermined flight altitude.* The observer will tell you when the transect ends (when the computer indicates that all on-transect segments total 20 km). Please see Figure SOP7-1 and Figure SOP7-2 below which show what the observer sees on the field computer (minus the labels and arrows). These illustrate generated transect lines and actual flight lines.

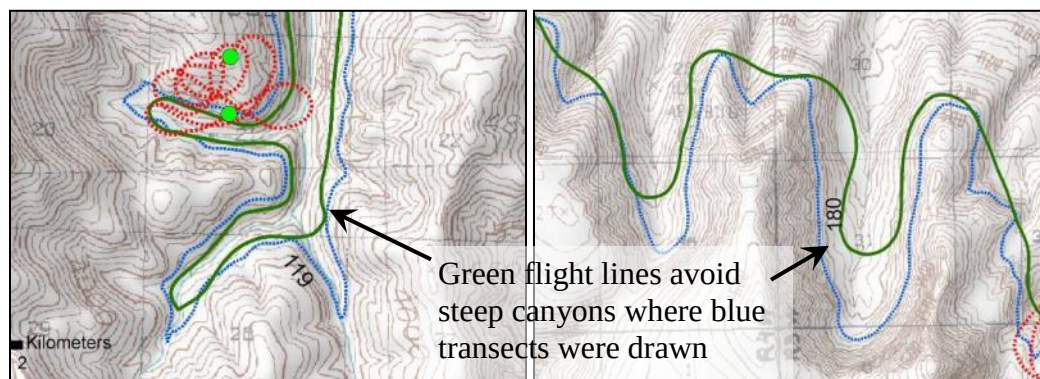
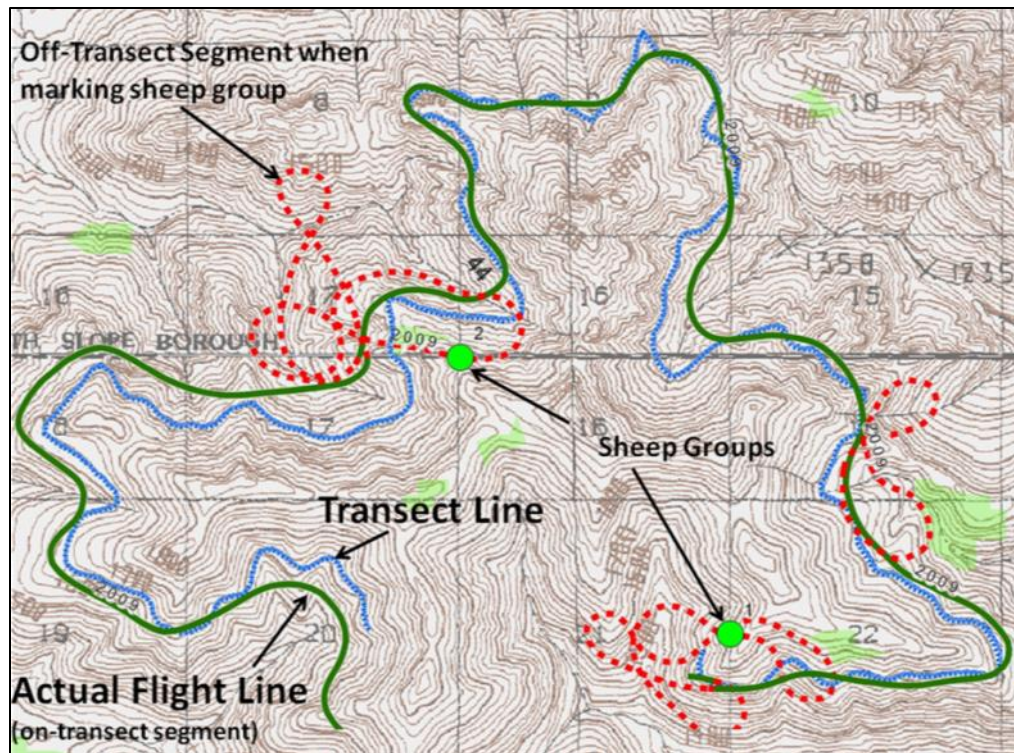


Figure SOP7-1. Map views from the field computer showing on- and off-transect line segments. The blue line represents the generated transect line, whereas the green line shows the actual flight path. The red dotted lines are flight paths off-transect to collect data about sheep groups seen from the transect.

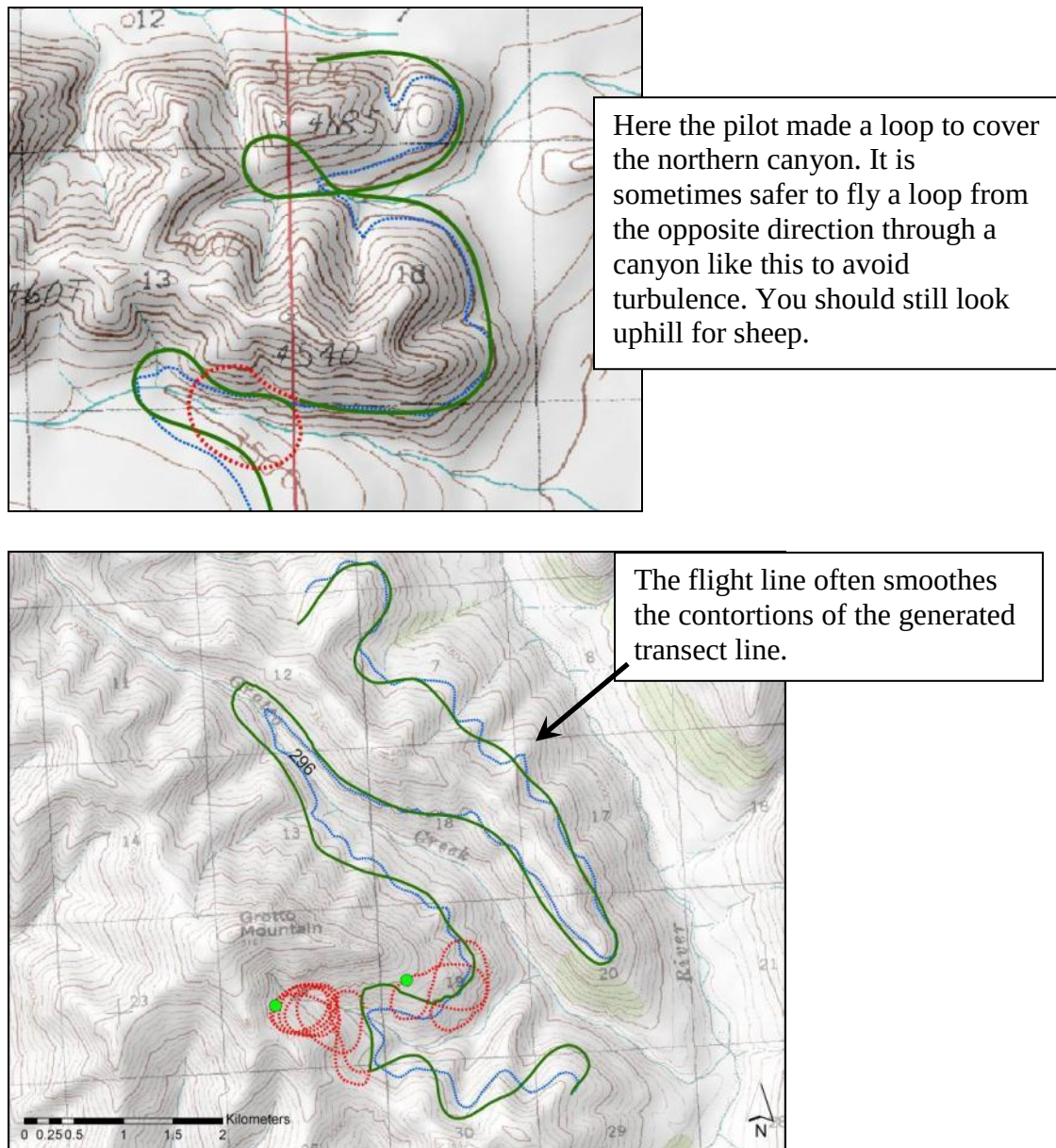


Figure SOP7-2. Map views from a field computer showing how generated transect lines are smoothed during flight, and how to fly a loop in a box canyon where a regular turn would have been impossible.

- 4) Transects should be snow- and cloud-free for surveying; if they are not, go to another transect. Please do not survey transects that have greater than 10% snow cover or where the upper portion of your view shed, or any section of the transect, is obscured by low clouds. See Figure SOP7-3. Permanent snow fields and glaciers are the exception. Mottled snow (partially melted in patchwork fashion) should be especially avoided. Additionally, if you have turbulence (e.g., constant, moderate turbulence; multiple downdrafts) that drastically changes how you could fly the transect without turbulence, move to another transect. These conditions affect sightability of sheep, which complicates survey results. Weather information including cloud cover, precipitation, temperature and turbulence is recorded on the field computer at the end of each transect. Snow and low clouds are not on the form because we should not be surveying under these conditions. In the event that you encounter mottled snow, low clouds, and/or constant turbulence more than halfway through a transect, but you feel that you can finish the transect quickly (within 15 minutes), the observer must make note of these conditions on the datasheet and the transect should be re-flown another day during the survey.



Figure SOP7-3. Photograph showing poor survey conditions due to greater than 10% snow cover, mottled snow and cloud cover obscuring a portion of the transect area.

- 5) Look for sheep on the uphill side of the aircraft only. 'Uphill' is determined from the location of the transect line. You may be able to see up and over a ridgeline – in that situation you should record sheep observed on the other side of the ridge too. The pilot may be able to see sheep on the other side of the transect line, but only sheep on the uphill side of the line should be recorded. If a sheep group overlaps the line, use the group's center as the location and only record the information if it is on the uphill side of the line. The distance searched from the plane should be restricted to a reasonable swath (e.g. $<3/4$ mile), or, for example, if you can see up to the ridge and down the other side. Do not look up the next hillside farther out. The observer must mark on the field computer whether uphill is left or right of the plane. This is entered when you select to start a transect (see SOP 8.6).

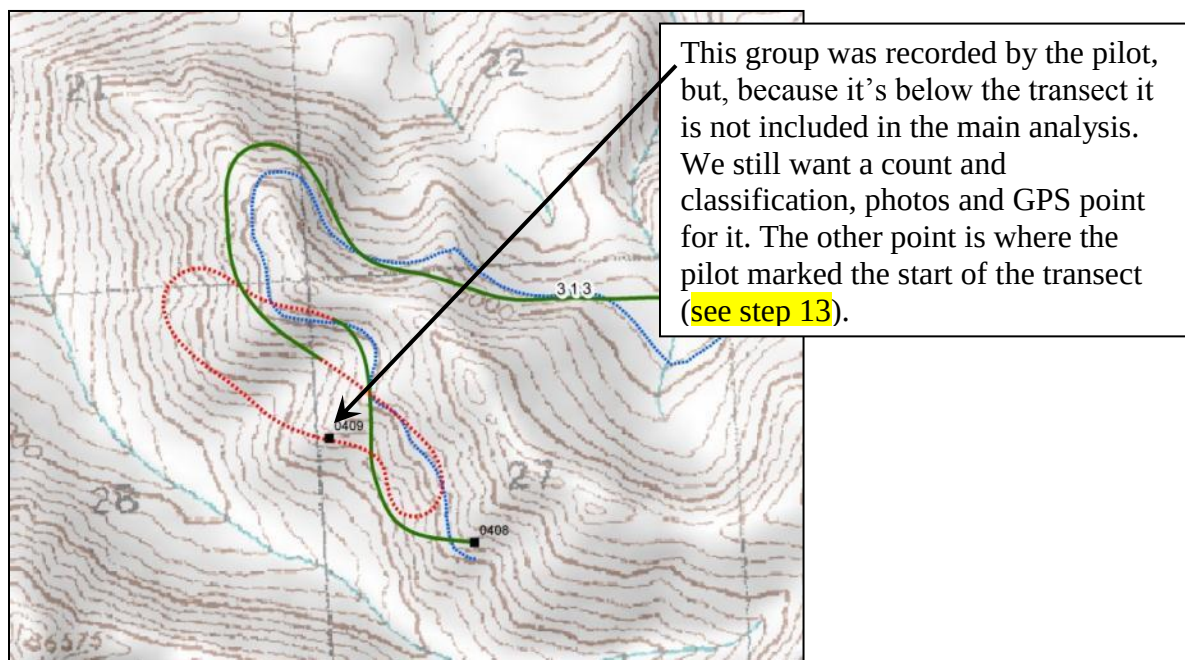


Figure SOP7-4. Map showing a sheep group observed below the transect. Sheep below the transect are not recorded on the field computer and are not analyzed with the rest of the data, but can be recorded with the pilot's GPS unit and on the datasheet.

- 6) GPS locations of sheep groups are to be marked where the group was initially located. As soon as a group is seen, note the place where they were first seen. Before heading off-transect, scan the area to see if there are any other groups in the vicinity to avoid losing track of their initial location. The initial location of each group is the point of interest, so mark that location with the GPS when the plane flies over, not the current location of the group if it has moved. The pilot should also collect a waypoint here as backup. If the mark location is inaccessible due to turbulence, please take a waypoint where you can and the observer should note this on the datasheet so that the point can be moved and notated later that evening during editing in ArcMap.
- 7) Mark the sheep group location while flying parallel to the transect. This will help to ensure that we get a more accurate distance-from-transect measurement because of the delay as the GPS takes a reading.

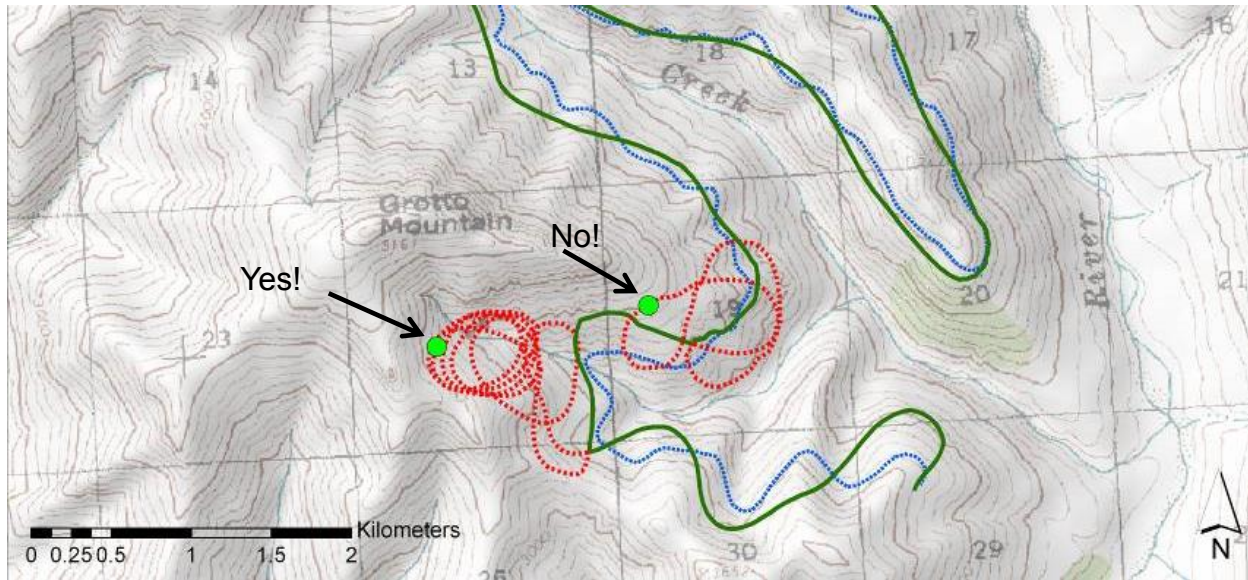


Figure SOP7-5. Map showing correct and incorrect flight directions for marking sheep. Sheep should be marked while flying parallel to the transect.

- 8) Differentiation between groups should be based on their original configuration when first seen, not after they have started running. Do not lump multiple groups that are close together into a single large group. Clumped groups of resting/feeding sheep that are separated by > 100 m (~one football field in length) are considered separate groups. If there is a string of moving/feeding sheep that covers a larger area, or a very diffuse band of sheep where individuals are << 100 m apart but spread across a hillside, you can lump those as one group and mark the center of their distribution. When you see several groups of sheep, take a photo encompassing as many groups as possible before you approach them, and take as many distinct locations/marks as possible. We can always lump groups back at the office. In general, if there is confusion on how to differentiate among groups, mark them separately, based on the original location where you spotted them from the transect line.

In situations where multiple groups are close together one possible strategy is to: first take a photo from a distance encompassing all groups if possible, count the number in each group (e.g. group of 3, group of 9, group of 5), fly over the groups clicking the 'Mark Animal' button without entering group size (location 1, 2, 3), and then either write down the group sizes associated with each location on the datasheet or go back and edit each point to input the group size info. If written down, the editing of the point info should be done in the evening. The idea is that it may be more efficient and accurate to mark the points in 1-2 passes without taking extra time entering group size as long as you are sure to record the size information separately so that it can be associated with each group location later. If you use this method, be sure to record the group sizes on the datasheet in the order the points were collected along with any other notes that may help with editing later. Also, be sure to update these points in the evening.

Please see the map (Figure SOP7-6) and photos (Figures SOP7-7 and SOP7-8) below regarding marking multiple groups in a small area.

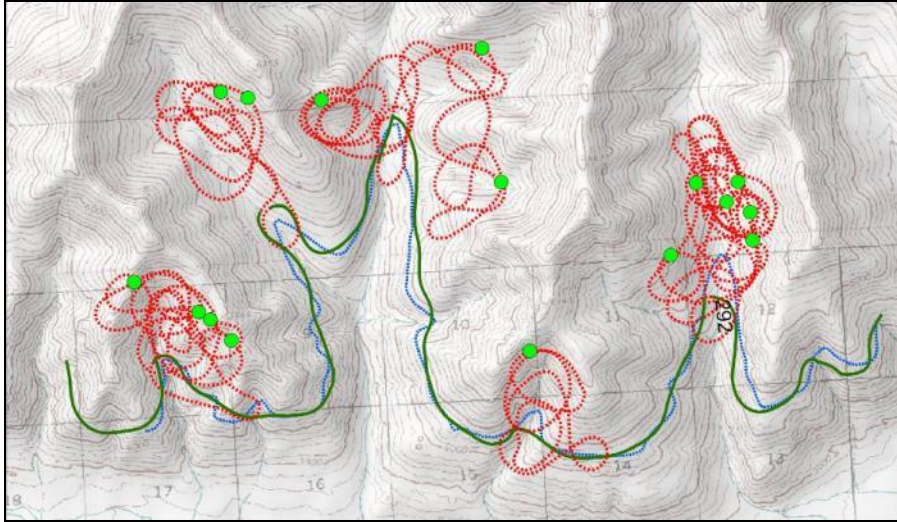


Figure SOP7-6. Map showing locations of multiple groups of sheep in close proximity on one transect.



Figure SOP7-7. Photographs showing two groups of sheep that later combined. These should be marked as two groups at their original locations. Note that the photos above show sheep that may be closer than 100 m apart (i.e. considered one group), but we kept the photos here to illustrate the point of splitting rather than combining groups.



Figure SOP 7-8. Photograph showing loosely grouped and scattered sheep where it may be difficult to differentiate between groups. This case is a bit trickier – take photos and multiple GPS points. We can always join groups later after looking at your photos.

- 9) Do NOT mark groups that you see *after* leaving the transect on the field slate, but DO ask the pilot take a waypoint and record the “missed on transect” group’s information on your datasheet. Recording groups that were seen after leaving the transect (while on an off-transect segment) cannot be combined with those groups seen while on-transect. We will consider those groups differently. Please record them on the datasheet as “missed on transect #XX”, record the group count and composition, the pilot’s waypoint number, and any comments such as, “this group was seen after going off-transect to mark group #XX that was seen on-transect.” All groups considered in the main analysis must be seen from the transect first, so this makes it very important to scan the area ahead of you before leaving the transect to make sure there aren’t other groups present. Try to photograph and get a rough count of sheep before flying over them to help identify and exclude additional groups that only become visible after leaving the transect line. Other observations of interest (bears, wolves, sheep seen after leaving the transect line) should NOT be entered on the computer. Locations may be taken with the pilot’s GPS and the information recorded on the paper datasheet if there is time. Identifying and recording sheep seen from the line is the top priority.

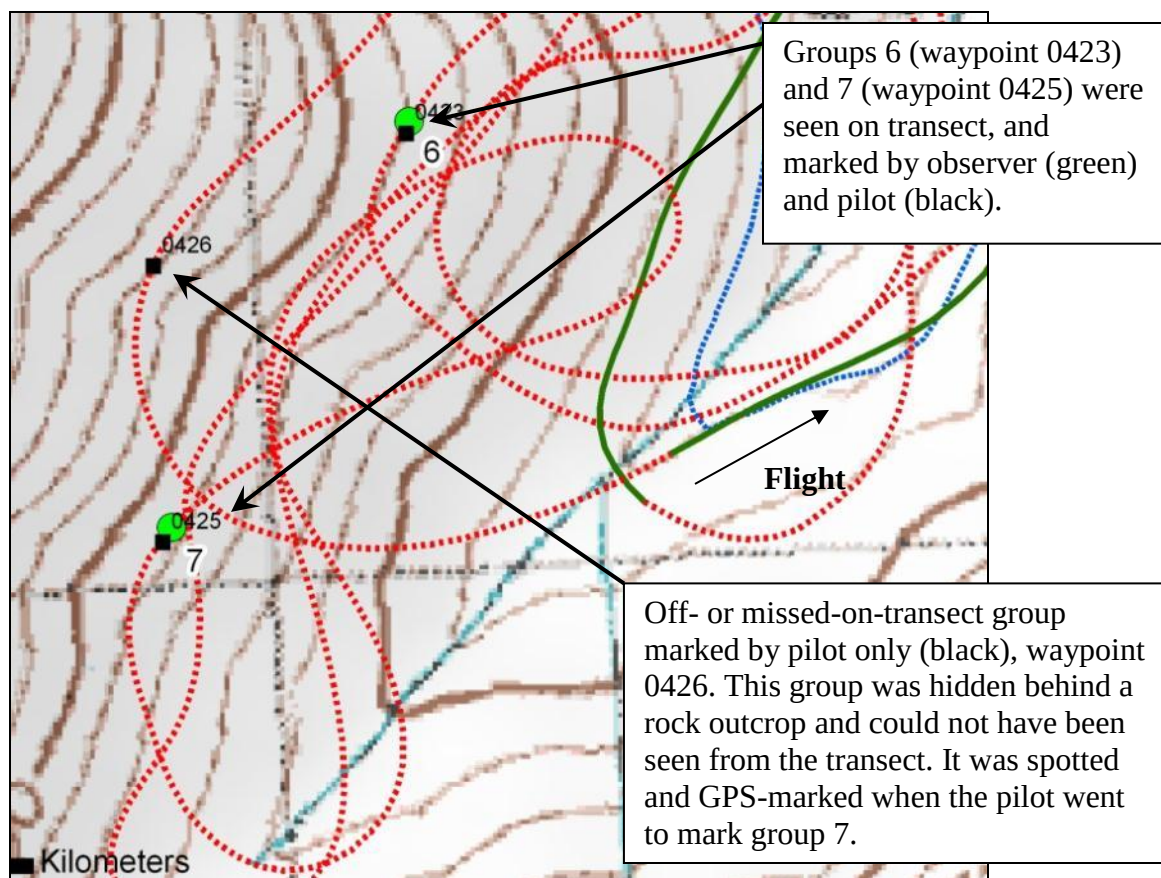
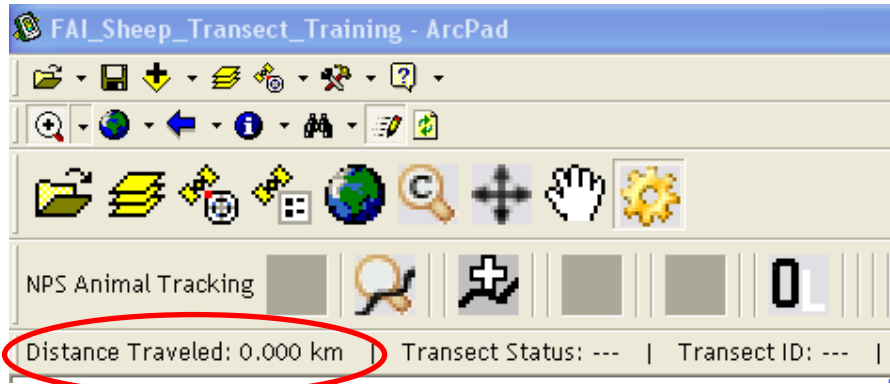


Figure SOP7-9. Map showing groups of sheep that were detected from the transect and a group that was off- or missed-on-transect.

- 10) Only record each group once per transect. If the transect continues around a hillside and a group is sighted again, do not record it a second time. Similarly, if a group sighted on one transect runs to the next transect and you see it again there, do not record it a second time. However, if you come back on a different day to survey that second transect, all observed groups should be recorded.
- 11) Survey the transect target length designated by the project manager, so long as there is available terrain at the transect elevation. For most ARCN and CAKN sheep surveys, the target length is 20 km. However, for smaller survey areas (e.g., DENA and the western Baird Mountains in NOAT), the target length may be 15 km to allow for increased sampling with tighter grid spacing. The total distance that you have traveled 'On-Transect' for a particular transect is displayed as 'Distance Traveled: X.XXX km' in the upper left corner of the ArcPad applet on the field slate, just below the NPS Animal Marking toolbar (see screenshot below). The applet will also warn you when the on-transect segments total the target length. See also [SOP 8.16](#).



Some transects were generated less than the target length due to limited terrain at that elevation. When the target length is 20 km, the project manager will extend any transects that were generated less than 15 km. When the target length is 15 km, the project manager will extend any transects that were generated less than 12 km. Therefore, for surveys with transect target lengths of 20 (or 15) km, you may see transects on the map that are drawn between 15-20 (or 12-15) km in length. In all cases, please continue flying until you have reached the target length if you have more terrain at that altitude. The computer will warn you when you've reached the target length. The exception to this is multi-part transects (see SOP 7, step 14).

Additionally, due to smoothing of the line while flying, the end of the computer-generated transect line may be reached before the target length has been covered by the plane. If additional un-surveyed terrain exists at the same elevation, continue the line until the target length has been covered (Figure SOP7-10).

Finally, if your flight line wraps back to the start (i.e., the transect circles a mountain top), just end the transect where you started. Pay attention to your flight line and the Distance Traveled updates below the NPS Animal Tracking toolbar in ArcPad.

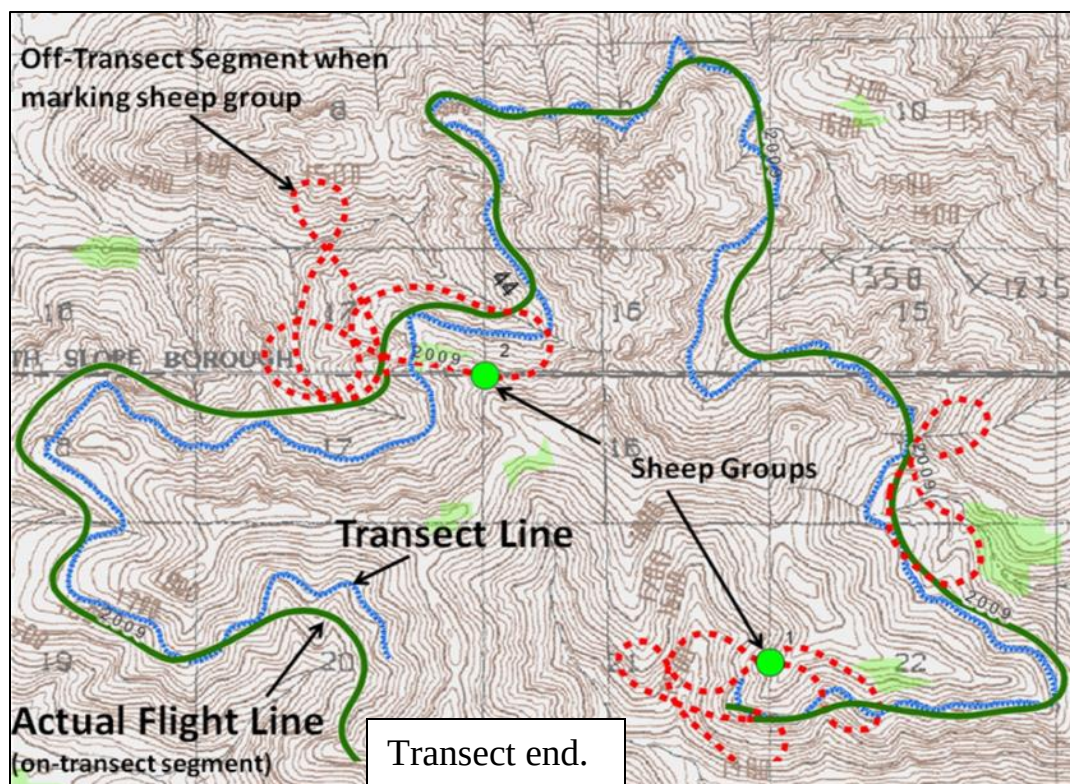


Figure SOP7-10. Map showing how the on-transect flight line (green line) was continued past the computer-generated transect line (blue line). This map also illustrates multiple on- and off-transect segments and two sheep groups. The combined distance of the on-transect segments should approximately equal the designated target length for the survey. This may require flying beyond the end of the generated transect line as shown here.

- 12) In some cases, the ends of two transects overlap at similar elevations ($< 1000'$ difference), and surveying each complete transect would involve searching the same area twice. If the two transects are surveyed on separate days, this is not a problem and you should survey both completely. If they are scheduled to be flown on the same day, start at the non-overlapping end of one transect and survey it entirely. Then transition to the elevation of the second transect at the point where the overlap ends, survey the non-overlapping portion, and (assuming that additional area at the same elevation is available) continue surveying at that elevation until the transect target length (e.g., 20 km) has been covered (Figure SOP7-11). Transects are not considered to be overlapping if they are at substantially different elevations ($> 1000'$ difference) on the same slope. If they are far enough apart that the same sheep are unlikely to be seen on both transects, and sheep on the second transect are not disturbed by a survey of the first transect, both can be flown in their entirety on the same day (Figure SOP7-12). This will depend on the elevation difference between the two transects as well as the particular characteristics of the location (e.g. slope).

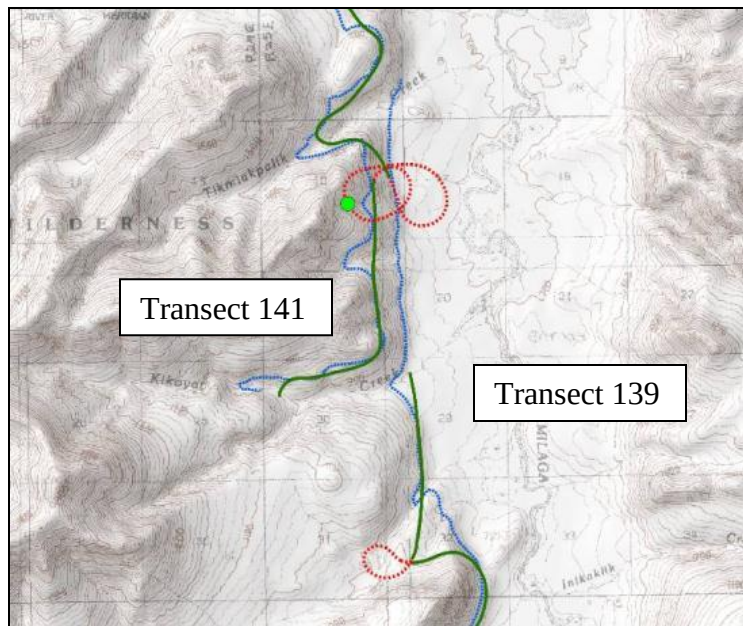


Figure SOP7-11. Map showing overlapping transects at similar elevations (< 1000' difference). This map shows where overlapping transects cover the same area and the overlapping section is not flown. Transect 141 was flown first. Then the pilot started Transect 139 at the end of the overlapping section.

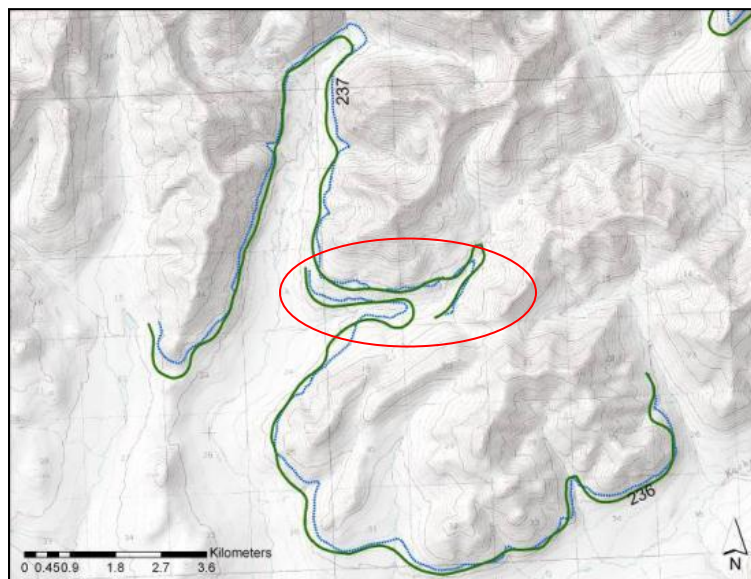


Figure SOP7-12. Map showing overlapping transects at substantially different (> 1000') elevations. Both can be flown, including the “overlapping area” on the same day including the overlap because the search zone is also at different elevations. These transects were flown on the same day by the same pilot.

- 13) The pilot should mark the beginning and end of each transect, and each sheep group you see as a waypoint on his/her GPS. He/she can tell you the number of each point to write on the datasheet. That way if your GPS fails, you can use the pilot's tracklog and waypoints to digitize the flown transects and the sheep locations. See [Figure SOP7-13](#). It is also highly recommended that the pilot take a waypoint when he/she leaves the on-transect flight line to look at a group of sheep (i.e., at the start of the “off-transect” [red] segment).

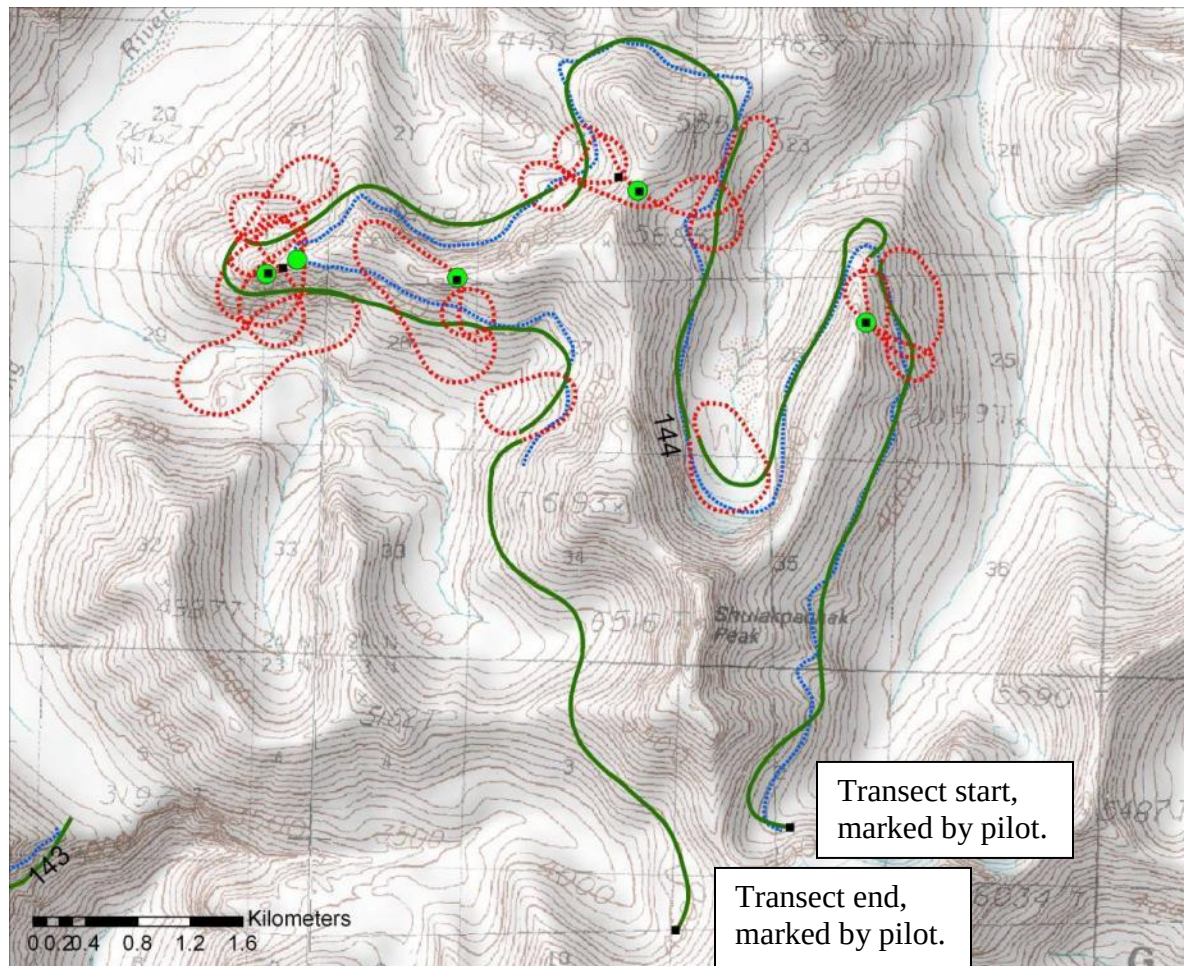


Figure SOP7-13. Map showing where the pilot took a waypoint at the beginning and end of the transect and for each sheep group as backup data. The black squares show the pilot's waypoints, green circles were marked by the observer.

14) For multi-part transects (e.g., [Figure SOP7.14](#)), fly them consecutively, but treat them as separate transects on the field computer, the pilot's GPS unit and the datasheet. They are a pair or trio of transects that total the target length for one transect. These are drawn when there is limited terrain at the randomly selected transect elevation and are common at the higher elevations for the survey area. We need to survey those elevations to get a representative and random sample within all sheep habitat in the survey area.

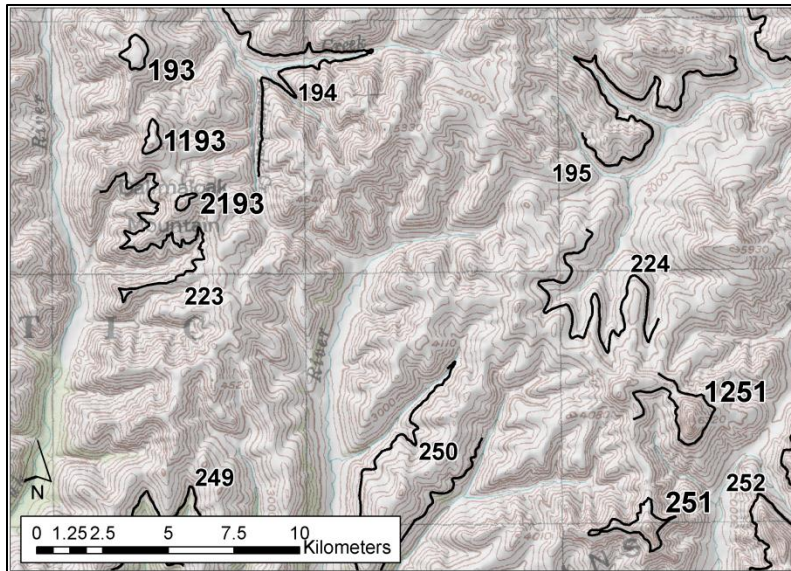


Figure SOP7.14. Multi-part transects generated for a Dall's sheep survey, Gates of the Arctic National Park and Preserve, Alaska, 2010. Lines 193, 1193 and 2193 compose a three-part transect at 1,400 m elevation, totaling 12 km in length. Lines 251 and 1251 compose a two-part transect at 1,400 m elevation, totaling 20 km in length. All other transects shown here are single-part transects of 15-20 km in length.

- 15) The pilot's and your (observer's) Garmin GPS units display and record waypoints and tracklogs in the geographic coordinate system WGS84. However the ArcPad applet on your computer is in the projected coordinate system of NAD83, Alaska Albers. If you see a weird discrepancy between where you think you're flying and the map on your field slate, check the projection and talk to the pilot.