SNOW COMPACTION SURVEY OF THE
MEDICINE BOW - ROUTT NATIONAL FOREST

2005 PROGRESS REPORT

prepared by

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SUMMARY

This project is intended to inventory snow compaction from anthropogenic recreational activities (i.e., skiing and snowmobiling) across the Medicine Bow - Routt National Forest. It is being conducted by the Wyoming Natural Diversity Database in cooperation with the Forest Service (Modification Number 03 to Challenge Cost Share Agreement 02-CS-11020600-033). Snow compaction may impact forest resources such as vegetation, soils, erosion, hydrology, animal behavior, and winter survival of wildlife through its alteration of the snowpack, but we currently have no information on how widespread or intense such compaction is on the forest. With this effort we will address the need to quantify this potential impact to forest resources; a need identified in both the Medicine Bow Forest Plan and the White Paper for amending the Routt Forest Plan's section on Management Indicator Species.

This project was initiated in the spring of 2005 and is scheduled for completion in the spring of 2006. Herein we provide a summary of our progress in the first 3 months, which largely entailed the following three tasks:

1. Coordinating with the Medicine Bow - Routt Wildlife Biologist to set goals, and priorities, establish our cooperative tasks, and obtain the necessary background data from the Forest Service.
2. Field reconnaissance via a test flight and ground survey on skis to investigate impacts to selected areas.
3. Developing a preliminary methodology for conducting snow compaction surveys based on prior knowledge and additional information gained from the test flight.

The results of the latter two of these tasks are presented in more detail in the following two sections.

FIELD ACTIVITIES

Spring 2005 – ground level evaluation of track visibility

On April 6, after a period of moderate snow (<4" total accumulation), we skied in to the snowy range pass area to evaluate the effect of a light to moderate snowfall event on track visibility (Figures 1 and 2). Skiing in the high use travel corridors of Brooklyn Lakes and Telephone Lakes it was apparent that the only visible contours in the snow were left where snowmachines had been driven on steep slopes or into hard turns. We learned that small amounts of new snow can obscure existing tracks sufficiently to compromise detection from low flying aircraft.

Spring 2005 – preliminary flight

Three separate scheduled flights were cancelled in March and April due to inclement weather. Given the concern that winter recreation was waning due to the condition of the snowpack we flew on April 20th . Our goal was test the transect methodology on predetermined routes. Dense clouds prevented us from reaching our predetermined transects. In the limited time during this flight with adequate visibility we flew the north slope of Medicine Bow Peak. Importantly, this flight gave us the impression that tracks in the snow remain visible under direct, high angle sunlight (Figures 3 and 4). There do not appear to be any limitations on what time of the day aerial transects surveys can be conducted; however, lower angle sun will create more shadow, and impressions in the snow will be slightly more visible.

The distribution of visible compaction in the snowpack was virtually contiguous in areas of open snow on the moderate to low angle slopes north of Medicine Bow Peak and Brown's Peak (Figures 3 and 4). A preliminary and conservative estimate of total acres of high snow compaction in the area described by the polygon in Figure 5 is 6,178 acres. This is an initial estimate, and will be not be confirmed until the conclusion of the aerial mapping surveys in 2006. The estimate was made during adverse flying conditions, and the pilot advised leaving the survey area before conditions worsened. In the area described in Figure 5, snow compaction easily exceeded the criteria for High Activity Level (*see* Appendix).

PRELIMINARY METHODS

This study will survey anthropogenic snow compaction in the Medicine Bow - Routt National Forest by observing and systematically recording evidence of compaction (e.g., ski tracks, snowmobile trails) from low-flying aircraft. Such flight-based surveys will allow us to cover large areas where land-based study is financially and logistically prohibitive. We have drawn extensively from our knowledge of aerial track surveys for wildlife in developing specific methods for this study. Aerial observation of wildlife has long been a method of surveying, monitoring, and capturing large-bodied mammals. In recent years, aerial delineation of large carnivore tracks in the snow has become a recommended option for documenting the presence, abundance, and/or habitat use of large carnivores in the northern United States and Canada (e.g., Ballard et al. 1995, MELP 1998). This knowledge base provides a broad base on which to base our protocol.

Aerial surveys will begin in the Winter of 2005 and conclude in the spring of 2006. The date flights depends largely on the weather, and will begin after snow accumulation enables regular and complete access to the forest by winter recreationalists (skiers and snowmobilers). Once accumulation is sufficient, specific weather and recreation days will determine when we fly. Flights should meet the following criteria:

- They should occur after a weekend or holiday of recreational activity, preferably having measurable snowfall within the preceding 3 days
- There should be no measurable snowfall and minimal wind activity between the dates of use and the date of the survey flight
- Flights should occur on partly sunny to sunny days, as overcast skies create flat light conditions that make it difficult to distinguish tracks
- Aerial surveys should be paired with estimates of use intensity (e.g., trailhead vehicle counts) taken during the period that the recreation occurred.
- Although tracks can be seen at any time of day, optimal track definition occurs when incident sunlight is not directly overhead, so surveys should, *when possible*, be conducted before 11 AM and after 2 PM

With reasonable advanced notice, we anticipate reserving flight times for Mondays, Tuesdays and Wednesdays when we expect all the above conditions to be met. Final decisions regarding specific flights will be made on-site as project staff evaluate conditions.

The field portion of the surveys will be conducted in three stages:

1. Transects: The entire Medicine Bow - Routt National Forest will be flown along systematically predefined line-transects. Observations will be made through a survey scope (Figure 6) at 15 second[*] intervals. Compaction at each observation point will be evaluated using established criteria and recorded onto field datasheets (drafts attached in Appendix). Transect data will allow statistically valid estimates of impact on a forest-wide scale with a reasonable degree of confidence. Further, it is systematic and replicable, which will allow comparison of use intensity over time, if monitoring is eventually required.
2. Mapping: The initial transect data, as defined above, will be used to highlight areas of high use intensity. These areas will be re-flown using ortho-photographs to delineate polygons representing the actual extent and level of use for these high intensity areas.
3. Replication: As time and budget permit, we will repeat the transect and mapping steps outlined above to provide a larger sample of data on which to base our estimates of snow compaction impacts.

An account of our preliminary field protocol is provided in the Appendix to this report. Although the methods are largely set, we fully expect that this protocol will be

[*] This is an estimated interval that we have calculated for planning purposes. It will be adjusted as flights commence in order to optimize data collection. Once the final decision on interval space has been made it will be set across all flights in the study.

adjusted slightly as the study progresses, in order to account for unforeseen complications that exist with every field project.

REFERENCES

Ballard, W.B., M.E. McNay, C.L. Gardner and D.J. Reid. 1995. Use of line intercept track sampling for estimating wolf densities. Pages 469 - 480 in Carbyn, L.N., S.H. Fritts, and D.R. Seip. 1995. Ecology and Conservation of Wolves in a Changing World. Canadian Circumpolar Institute, Occassional Publication No. 35, 642 pp.

MELP (Ministry of Environment, Lands and Parks). 1998. Inventory Methods for Wolf and Cougar: Standards for Components of British Columbia's Biodiversity No. 34. Ministry of Environment, Lands and Parks, Resources Inventory Committee, Vancouver, British Columbia.

FIGURES

Figure 1. Partially obscured snow machine track after light snow, North of WY 130 in the vicinity of Snowy Range Pass.

Figure 2. Heavy use area, with tracks obscured by recent snowfall, North of WY 130 in the vicinity of Snowy Range Pass.

Figure 3. Aerial photograph of heavy snowmachine use North of Medicine Bow Peak, Medicine Bow-Routt National Forest

Figure 4. Aerial photograph of nearly contiguous snowmachine tracks North of Medicine Bow Peak, Medicine Bow-Routt National Forest

Figure 5. Area North of Medicine Bow Peak and Brown's Peak surveyed during a preliminary flight, Spring 2005. This site has been initially categorized as a contiguous zone of High Activity.

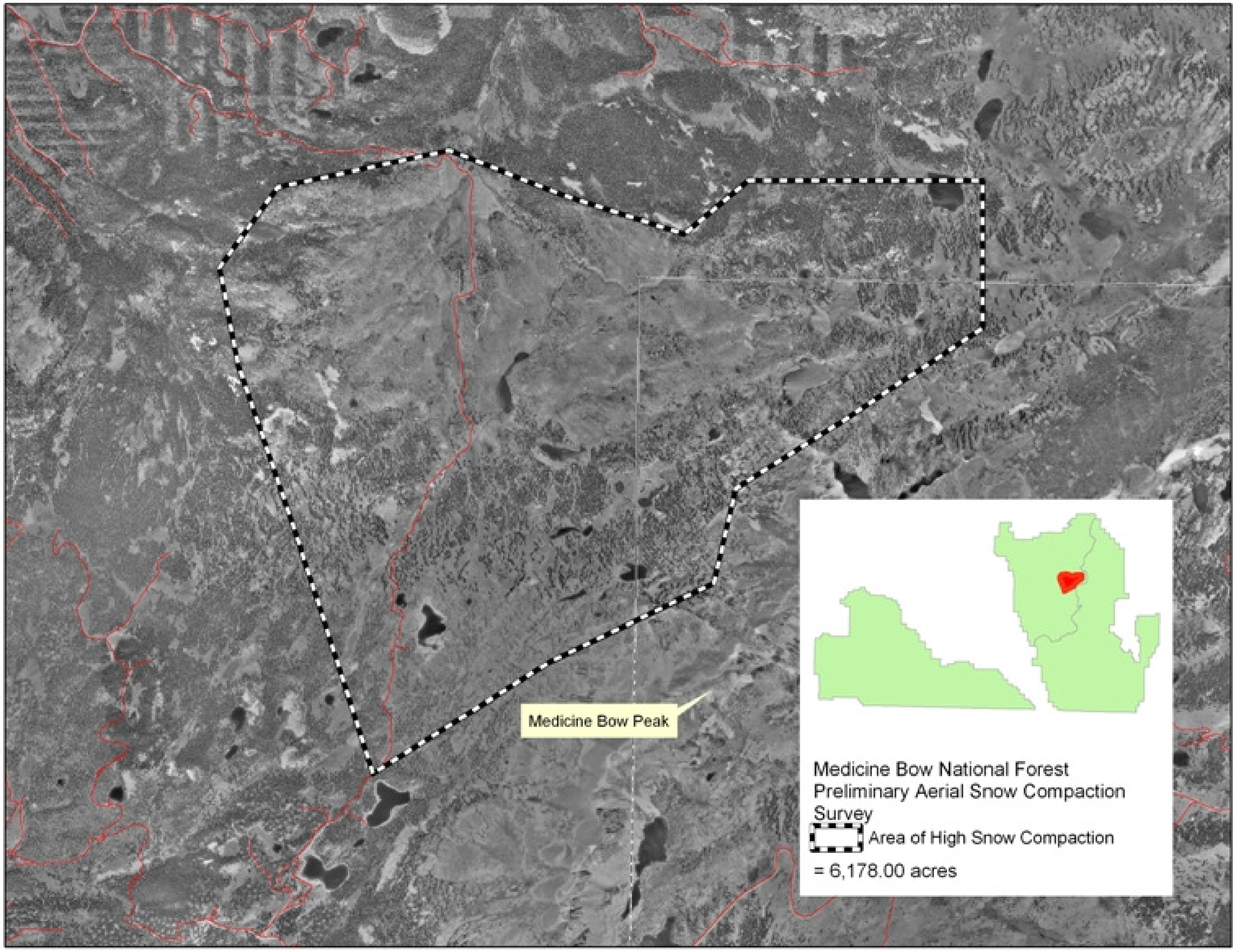

Figure 6: Calculation of field of view through the survey scope for aerial surveys in a) tabular form, b) graphic representation of the full extent of the system, and c) graphic representation of a close-up of the scope.

Figure 1a.

Variable	Value	Units	Calculation Notes
Tube height	2.00	inches	Given
Total Tube Length	8.00	inches	Given
Extension Length	2.00	inches	Given
Cut Length	2.83	inches	Sqrt (TH^2 + EL^2)
Theta1	45.00	degrees	ArcTan (TH/EL)
Theta2	7.13	degrees	ArcTan ((TH/2) / TTL))
Theta3	37.87	degrees	Theta1-Theta2 = 45deg-Theta2
Theta5	9.46	degrees	ArcTan ((TH/2) / (TTL-EL))
Theta6	54.46	degrees	180-(90+Theta1)+Theta5
Plane Height	1,000.00	feet	Given
Da	777.78	feet	PlainHeight * Tan(Theta3)
Db	1,403.96	feet	(PlaneHight+CutLength)*Tan(Theta6)
DeltaDf	626.18	feet	Db - Da
DeltaDy	208.73	yards	Db - Da
DeltaDm	190.86	meters	Db - Da

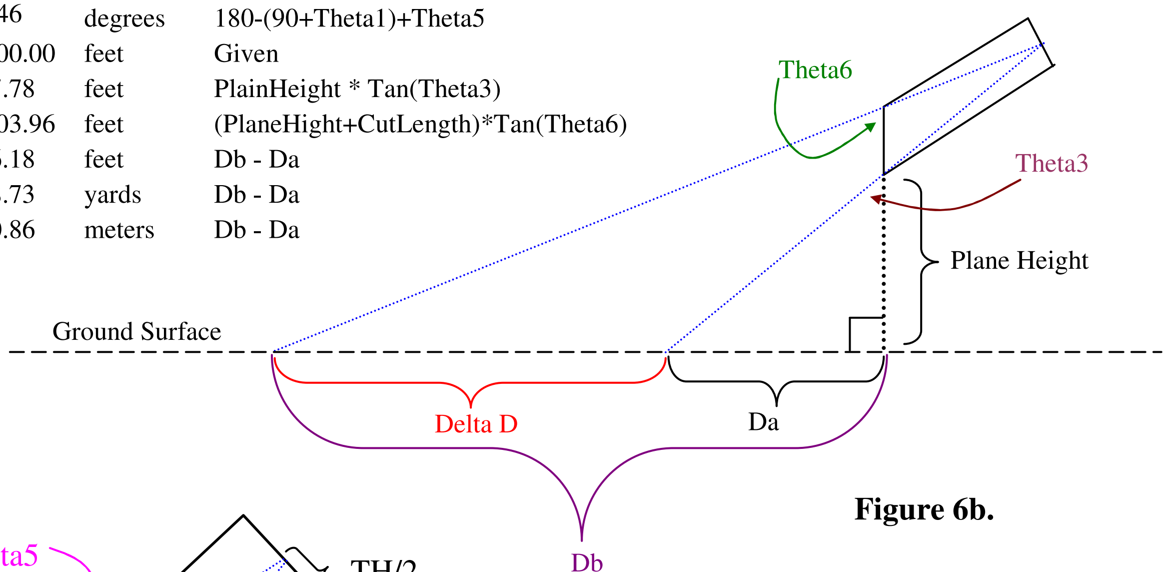

Figure 6b.

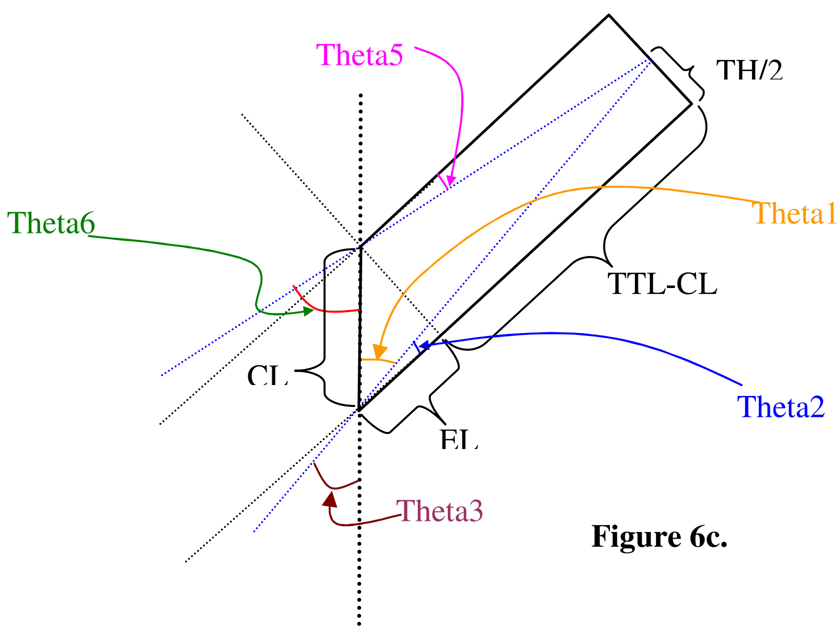

Figure 6c.

APPENDIX: PRELIMINARY FIELD PROTOCOL

1. GEAR: Be sure you have the following before getting into the plane.
    a. 2 GPS units: Ensure that they have adequate battery life and/or extra batteries are available. Make sure they have the transect routes loaded into them.
    b. 2 PVC sighting scopes.
    c. 50+ datasheets and associated ortho-photo sheets
    d. clipboard and writing utensils
    e. binoculars
    f. digital camera
    g. laptop: To download tracklogs and waypoints at the end of a flight (or whenever GPS memory is full).
    h. personal items: e.g., motion sickness pills, sunglasses, warm clothes, raingear, water, snacks.
2. Confer with pilot: If flying with a pilot that has not assisted us with these surveys previously, go over this protocol with him/her and make sure he/she understands it before you get up in the air. Make sure that the pilot is aware of the following:
    a. He/she must fly the plane due-north (or south) along transects from the designated starting points. It is important that we remain true to the transects.
    b. The plane height should be maintained at about 1000 m from the ground surface while transects are being conducted (i.e., adjust for topography).
    c. The plane should remain as level as possible to maintain a consistent viewing angle through the sighting scope (i.e., course corrections should be gradual, not abrupt).
3. Set GPS units: Make sure the clocks of the GPS units are synchronized and reporting time in 24hr format. Make sure they are set to *UTM NAD 83*. At the pre-determined starting point, set the GPS tracking feature to automatically record a position *every 15 seconds*.
4. Personnel Duties for TRANSECTS: This protocol is designed for two technicians working simultaneously.
    a. Pilot: Fly the plane according to the above noted guidelines and be attentive to plane and crew safety.
    b. "Scoper":
        i. Fill in all header information on the data sheets.
        ii. When instructed by the "GPSer", View the ground through the sighting scope by placing the side with the angular cut against the plains window and looking through the straight end. This should result in a viewing angle that is approximately 45º from horizontal.

iii. Record snow compaction data seen within the field of view of the sighting scope. If any part of a snow compaction event is visible, it is considered “in” and should be recorded on the data sheet (see attached). Note: Time of observations will be taken directly from the GPS unit that is also recording the tracklog and will be recorded to the nearest second in the following format: HHMM:SS (e.g., 1308:55 represents 8 minutes and 55 seconds after 1 PM). All other information will be recorded using codes listed on the bottom of the data sheet.

iv. The Scoper may use binoculars to determine the use-type and use-intensity of an observation.

c. "GPSer":

i. Using the clock on the GPS unit, call out the time at 15 second intervals, thus notifying the Scoper to record a data point.

ii. Use the GPS unit to ensure that the pilot is maintaining the transect bearing within about 100 m. Crosswinds and other factors will cause the plane to drift off course. Make frequent checks on the bearing, especially if the plane is not equipped with a GPS, and let the pilot know if he/she needs to make corrections.

iii. In-between points, scan the area around the plain and, if possible, sketch use areas on ortho-photo sheets provided for the transect. Record use type, intensity and habitat for each polygon sketched, using the same codes noted on the datasheet (see attached).

iv. Save each tracklog upon completion of the transect and label the file with its transect ID number.

v. Guide the pilot to the next transect starting point.

5. Procedure for Detailed MAPPING. Areas to me mapped will have been identified based on the transect data. GPS locations for the beginning of the mapped area will have been identified on ortho-photo sheets and loaded as waypoints into a GPS unit. Once at the starting point, both Technicians should regularly scan all visible area their side of the plane for compaction areas, paying particular attention to large and/or heavily used compaction areas. Delineate these use areas on ortho-photo sheets as noted below. The whole geographic extent of such an area should be mapped, even if it crosses onto another ortho-photo sheet. Don’t hesitate to ask the pilot to circle back one or more times if you want to get another look for any reason. Focal areas mapping because they show particularly evident use. Pay attention to the following data:

a. Area Boundaries and Track Lines:

i. Delineate the approximate boundaries of compacted areas that are larger than *15 acres*, and only document smaller areas if time permits. 15 acres is roughly equivalent to the Buttress of Medicine Bow Peak (for skiers) or the meadow by Green Rock Picnic area (for snowmobilers).

ii. The path of tracks that appear to be of at least moderate use (i.e., more than about 10 users since last snow fall) should also be mapped in detail, as such trails generally feed areas of high use.

iii. Any motorized activity encroaching on a wilderness area should be mapped in detail, regardless of size or activity level.

b. Activity Level: For each polygon delineated, estimate the level of activity and record it directly on the ortho-photo sheet as follows:

i. Low: < 25% of area covered in tracks

ii. Medium: 25 - 50% of area covered in tracks

iii. High: > 50% of area covered in tracks.

For each track sketched, estimate its rough level of use as follows:

iv. Moderate: 10 -20 users (e.g., Libby Creek ski loop, ????)

v. Heavy: > 20 users (e.g., Barbra Lake Trail, Sand Lake Road)

6. Defer to the pilot's discretion in instances where the transect enters areas which are unsafe to fly or crosses restricted airspace. Record the point at which the transect is discontinued and the point at which it is resumed.

7. If the plane must refuel, weather creates unsafe flying conditions (e.g., heavy winds, lightning, etc.), or weather hinders your ability to conduct the survey (e.g., heavy fog or rain) temporarily suspend the transect until conditions are favorable, then resume transect at the point of suspension.

8. Identification Numbers:

a. Transects: Code = T f # x. (e.g., Tm5a is the identification for the first visit to the fifth transect of the Medicine Bow unit.)

i. T designates a transect

ii. f designates the forest unit (R - Route, S - Sierra Madre, M - Medicine Bow)

iii. # designates the transect number (1 - 20)

iv. x denotes the date of visit (a - first visit, b - second visit, c - third visit)

b. Ortho-photo sheets: Code = f # x - y. (e.g., s7b-24 is the identification for the sheet from the 2nd visit to the 7th transect of the Sierra Madre unit that is at the 24th row of photo sheets from the southern boundary of the study.)

i. f designates the forest unit (R - Route, S - Sierra Madre, M - Medicine Bow)

ii. # designates the transect number with which the ortho-photo sheet is associated

iii. x denotes the date of visit (a - first visit, b - second visit, c - third visit)

iv. y denotes the north-south component of the sheet's orientation along the transect, where all transects at the same latitude have the same y-value. The southernmost ortho-photo sheet of the entire project will have y=1.

c. Detail Polygons: Code = D f x - z. (e.g., Drc-32 represents the 32nd detailed impact area mapped on the 3rd flight over the Route National Forest. This will have a use type and use level associated with it on the map, such as Medium-use Play Area.)

i. D designates this as a Detailed Map identifier

ii. f designates the forest unit in which the map occurs (R - Route, S - Sierra Madre, M - Medicine Bow)

iii. x denotes the date of visit and should correspond to x in the Transect and ortho-photo sheet identifiers (a - first visit, b - second visit, c - third visit)

iv. z is the number of the mapped figure, which should start sequentially at the beginning of the day's survey.

Sheet Number ____

MedBow-Route Snow Compaction Inventory -- Aerial Survey Datasheet

Please Return To: Douglas A. Keinath, University of Wyoming, 307-766-3013, dkeinath@uwyo.edu

Date (dd-MMM-yy)**:**	**Transect ID:**	**Scope Tech**:	**GPS Tech:**
GPS Information: *All data recorded in UTM Zone13, NAD1983*		**Trackfile(s):**	
Transect Start UTM-E:	UTM-N:	**Transect End** UTM-E:	UTM-N:
Notes (weather, etc.):		**Pilot**: ____________________ **Plane Type**:	

GPS Time (hhmm:ss)	Use Type[1]	Use Level[2]	Cover Type[3]	_____ (____)	Photo Number	______ ______	Notes

[1] Use Type: Ski Track = ST, Ski Slope = SS; snowmobile Track = MT, snowmobile Play Area = PA

[2] Use Level: Low use = 1 (single-use track or <25% of area covered in tracks), Medium use = 2 (multiple-use track or 25-50% of area covered), High use = 3 (>20 users of track or >50% of area covered).

[3] Cover Types: Dense Conifer - ConD; Sparse Conifer - ConS; Aspen - Asp; Shrubland (sage, willow, mahagany, etc.) - Shrub; Meadow or Clearcut - Open; Alpine (above timberline) - Alp; Developed (road, parking lot, etc.) - Dev.

GPS Time (24hr)	Use Type[1]	Use Level[2]	Cover Type[3]	Detail (#)	Photo Number	______ ______	Notes

[1] Use Type: Ski Track = ST, Ski Slope = SS; snowmobile Track = MT, snowmobile Play Area = PA

[2] Use Level: Low use = 1 (single-use track or <25% of area covered in tracks), Medium use = 2 (multiple-use track or 25-50% of area covered), High use = 3 (>20 users of track or >50% of area covered).

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