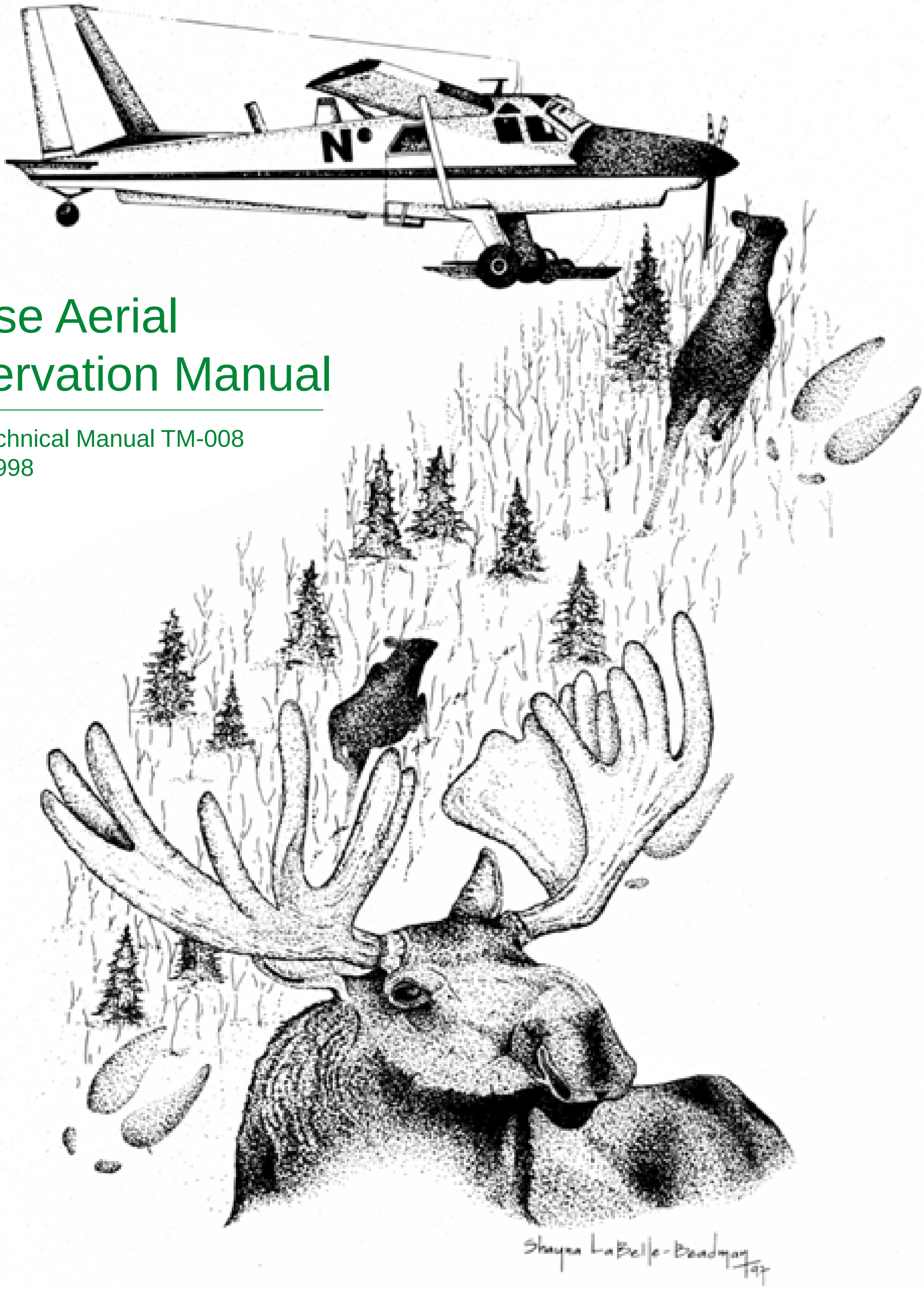

Moose Aerial Observation Manual

NEST Technical Manual TM-008
August 1998

Ontario

Boreal Science

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by
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Foreword

This manual is intended as an introduction to the aerial observation of moose for new observers, and as a refresher to observers with some experience. To simplify the text, references have been eliminated. This manual is not intended to be a review of scientific papers.

There is little, if any, new information in this guide. It is, rather, a collection of data gleaned from the writings of other researchers and observers, to whom the writer acknowledges his debt. The writer is also indebted to those persons who, over the years, aided and instructed him in the methods of aerial moose surveys.

1997 Revisions

The reprinting of this manual 15 years after its introduction, indicates that it has been of some use in the field. Over that time however, changes in sample plot set-up and flight technology have occurred. This updated version reflects those changes.

We also put a great deal of effort into taking a photocopy version of the original, re-drawing the illustrations on a computer, scanning and editing the text, and pulling the new version together using desktop publishing software.

Thanks to Al Bisset and to the Provincial Wildlife Inventory Program for sponsoring the republication of this manual.

Thanks to Kim Charrette of Classic Communications for new illustrations and layout, to Diane Wahlman for co-odinating the re-design of the manual and to Doug Skeggs for editing.

Table of Contents

LIST OF FIGURES

Figure

LIST OF APPENDICES

Appendix

Introduction

A. Moose Surveys in Ontario

Moose are Ontario's largest big-game animal and as part of an overall moose management strategy, their population status must be monitored by wildlife managers. Winter aerial surveys, using a variety of uniform techniques, can provide a high volume of good quality data to managers, to assist them in forming accurate conclusions about the status of their moose populations.

For practical purposes, the province is divided into Wildlife Management Units (WMU) for managing moose. For aerial inventory, each WMU is surveyed by laying out a number of sample plots of standard size (2.5 km x 10 km). All of the searching, sexing, ageing, and recording covered in this manual takes place on those sample plots.

B. The Importance of Sex and Age Data

At one time, moose surveys involved little more than a headcount. However, it was found that sex ratios and age structure played a large part in moose population dynamics. Because of this, accurate sexing and ageing during aerial inventories has been increasingly important, being used, for instance, to calculate recruitment rate (from the number of calves). It has become important in determining what animals may be taken in a selective harvest.

Because of the importance of sex and age data, aerial observers must base sex and age on the criteria outlined further on in this manual. This point cannot be stressed enough. If an observers is unable to determine sex and/or age, it is quite correct to record it as "unknown". With a little practice, observers will learn when the collection of sex and age data is practical, and when it is not.

C. Provincial Standards and Guidelines

The Ontario Moose Council has produced a document entitled "Standards and Guidelines for Moose Population Inventory in Ontario". All aerial observers should be familiar with its contents. It contains guidelines which standardize moose aerial inventories across the province. This manual attempts to expand on these guidelines by offering further detail on their field application.

Searching Techniques

A. Flight Crew

1. Introduction

Depending on the type of aircraft used in an aerial moose survey, each aircraft will seat, besides the pilot, either one, two, or three observers. Aircraft of a turbo-beaver size or larger will hold more observers, but four persons are sufficient to do a good survey. In all aircraft other than a two-seater, the amount of aerial survey experience dictates the seating arrangement in the aircraft.

2. Duties of Crew Members

a) Two-seater (Front and Aft) Aircraft (e.g. Piper Supercub or Robertson R22)

Pilot

- flies aircraft, may sit in front or rear
- follows flight line and navigates
- observes moose on one side of aircraft
- may assist in sexing, ageing, mapping
- follows instructions of observer re: when, where, how long to search or hover
- responsible for air safety decisions

Observer

- may assist in navigation
- observes moose on other side of aircraft
- responsible for sexing, ageing, recording
- responsible for overall accuracy and completeness of survey

b) Three-seater Aircraft (e.g. Cessna 180 or Robertson R44)

Pilot

- flies aircraft and navigates, is co-leader of the survey
- responsible for air safety decisions
- may assist in observing moose
- may assist in sexing, ageing, mapping
- follows instructions of navigator re: when, how long, where, to search or orbit

Navigator

- assists in navigation, is a co-leader of the survey
- responsible for sexing, ageing, recording
- observes moose on his side of aircraft
- responsible for overall accuracy and completeness of survey

Rear Observer

- observes moose on pilot side of aircraft
- forwards all observations to navigator

c) Four-seater (or larger) Aircraft (e.g. Turbo-Beaver, Long Ranger helicopter)

- Same as above except that there are two observers who each observe out of their side of the aircraft, and then forward all observations to the navigator.
- Whether in a fixed wing or rotary wing aircraft, the two observers sit in the rear, with the most experienced of the two sitting behind the pilot.

3. Flight Crew Experience

It is obvious that each member of a hypothetically perfect aerial survey crew would have lots of experience, but for various reasons, that is rarely the case. Pilots, for instance, often have to be accepted on a “come-as-you-are” basis. As well, all observers have to start sometime, and when manpower is a problem you can’t leave behind a potentially capable rookie because of their lack of experience.

In all cases, the navigator should be the most experienced member of the crew, and that individual should have many years of aerial survey experience. The navigator must decide whether or not to continue a survey under changing weather conditions, whether or not to commence or continue following a set of tracks, when and if adequate sex and age data has been collected on a moose, and so on. The quality and experience of a navigator can make or break a survey.

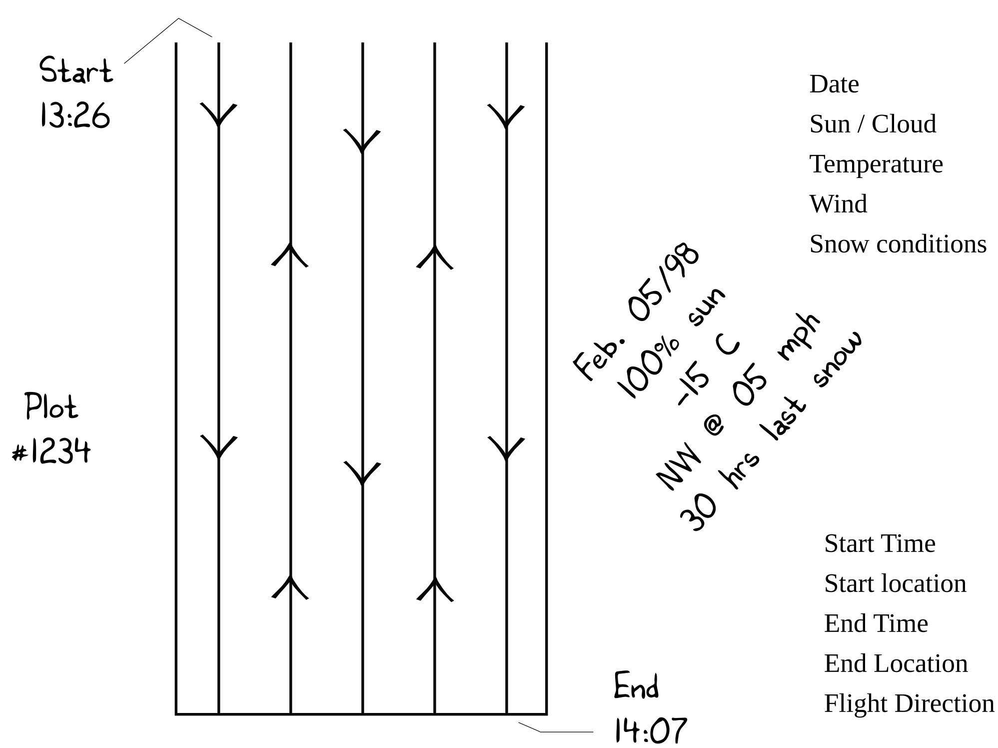
In a three-person crew, the rear observer should have some experience; and in a four-person crew, the rear observer (pilot side, who often has to cover for the pilot) should have more experience than the other rear observer. When tracks or moose are observed, most pilots prefer to circle to their side (i.e. left turns) and it is wise to have an observer with some experience on that side of the aircraft.

B. Flight Maps

Both the pilot and navigator should have a flight map for each plot. The navigator should use a new map, for the recording of moose locations, tracks, etc. If flying the same plots as the previous year, the pilot can use last year's map, as long as it shows the plot boundaries and flight lines. On the navigator's map it is usually convenient to record starting and ending times, flight line directions, and weather conditions on or beside each plot (Fig. 1, Fig. 64).

Figure 1. Recording Basic Data on Flight Maps

Although the Standards & Guidelines recommend noting this data on the inventory form in the aircraft, many navigators prefer to record data directly on the flight map as follows:



It is the navigator's responsibility to ensure that enough maps are properly made up, for each day's flying. Aerial photos, or photo mosaics, may be preferable in some areas, and are used in the same way as maps, except that a grease pencil is used to mark tracks, etc.

Plastic-covered maps facilitate the recording of data using a grease pencil, and the re-use of the same maps in the same or subsequent years.

The navigator should not use a plot map used and/or marked up from a previous flight. The survey may be biased through use of the previous year's moose locations to find this year's moose, and areas where no moose were found last year might be passed over too quickly.

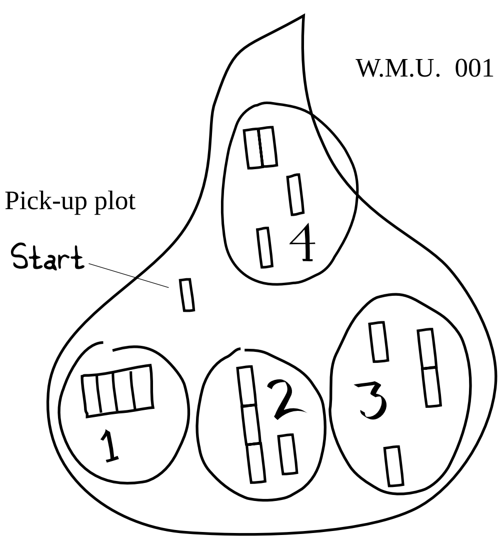
C. Flying The Plots

1. Order of Plots Flown

Once the sample plots in a WMU have been picked, lay them all out on a map, and pick the intended order of flying the plots. Ferrying time can be minimized through predetermining the order of plots to be flown (Fig. 2). Due to the short period of good illumination in mid-winter, and because of fatigue after prolonged aerial surveying, we recommend generally that a maximum of four plots per day be scheduled for surveying.

When the same as in previous surveys, plots and groups of plots should be flown in the same order and time period each year. This simple rule can help increase comparability in aerial moose surveys, particularly when the survey extends over a prolonged period of time (Fig. 2).

Figure 2. Annual Order of Plots Flown

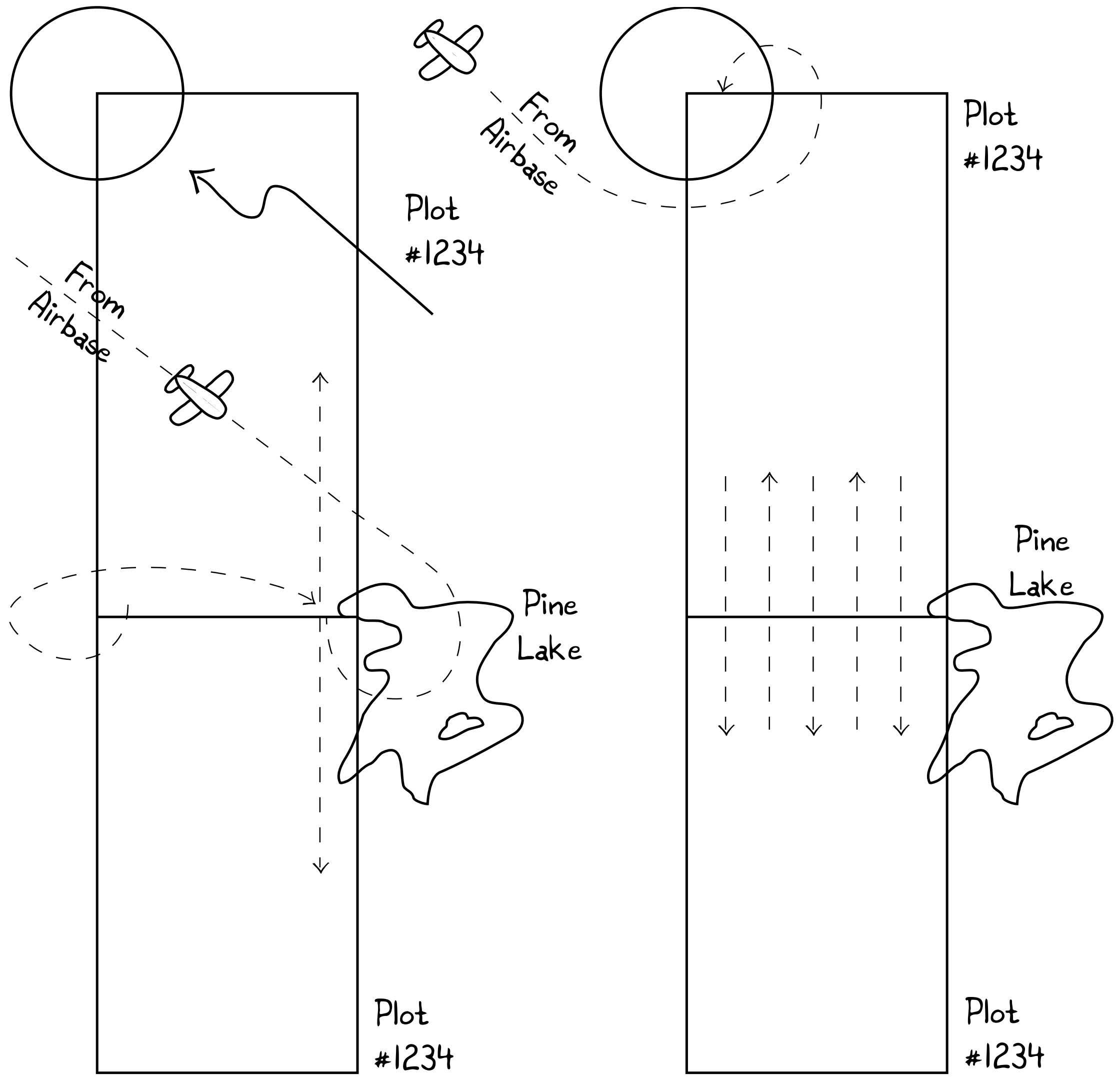


Fly each of the plot groupings in the same order and time period each survey year to reduce variables in the survey. Fly pick-up plots whenever convenient but as close as possible to dates in previous years.

Note: This applies only,when surveying the same plots as previously flown on the Unit.

The best available landmarks should always be used in establishing a starting point on the outside flight lines of individual sample plots or groups of sample plots. These landmarks include ridges, hills, lakes, rivers, roads and railways. Do not pick a starting point simply because it is the closest to the airbase (Fig. 3).

Figure 3. Starting Points on Survey Plots



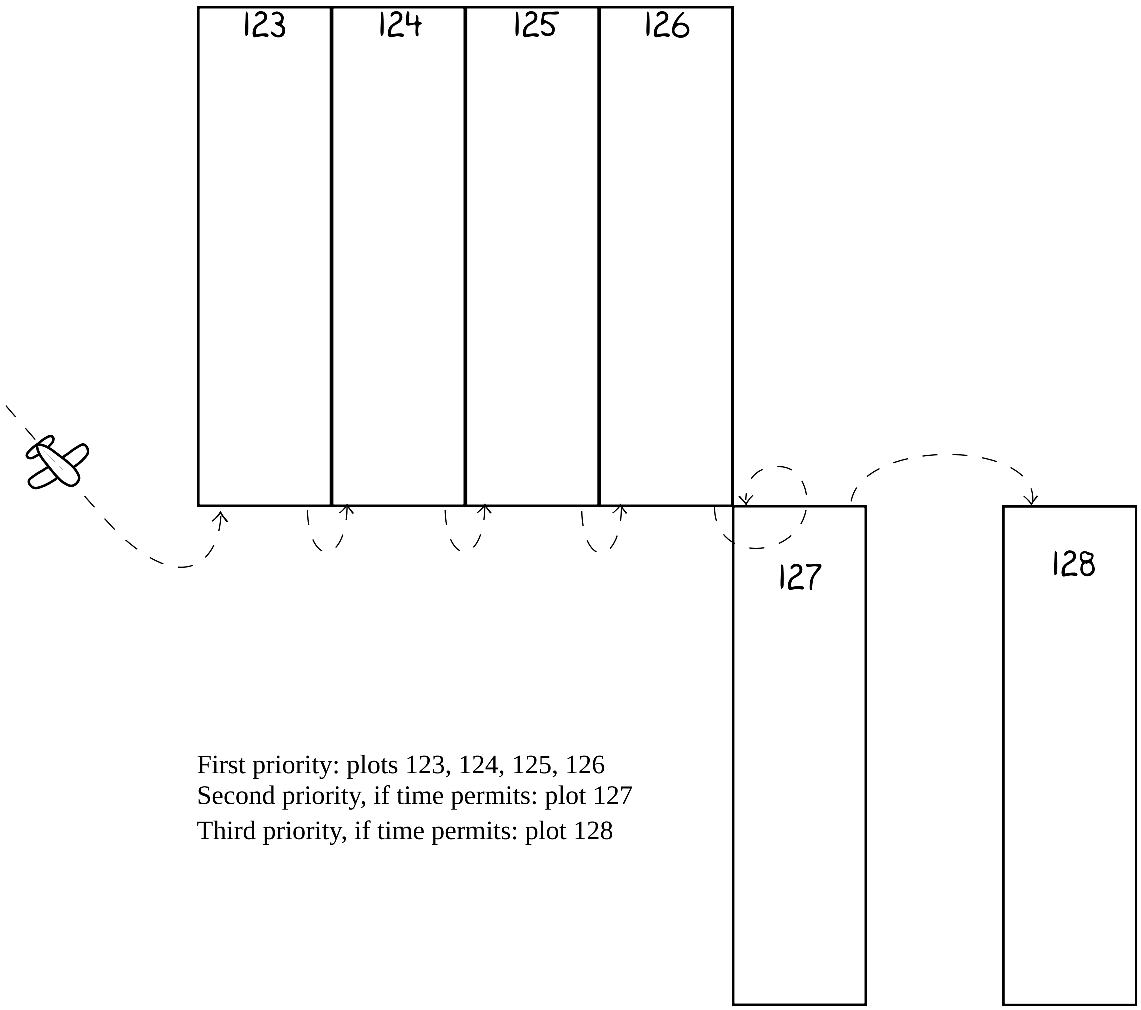
Right
1. each plot flown separately
2. best starting point used on each successive plot

Wrong
1. both plots flown together
2. poor starting point used on plot 1234

Fly each plot separately and record start and finish times separately for each plot.

When a number of plots join each other, in a block, or a string, make every attempt to fly them first during the day, leaving any stray, single plots till later in the day if there is time available. This helps prevent moose from being counted twice, by moving from one plot to another overnight (Fig. 4).

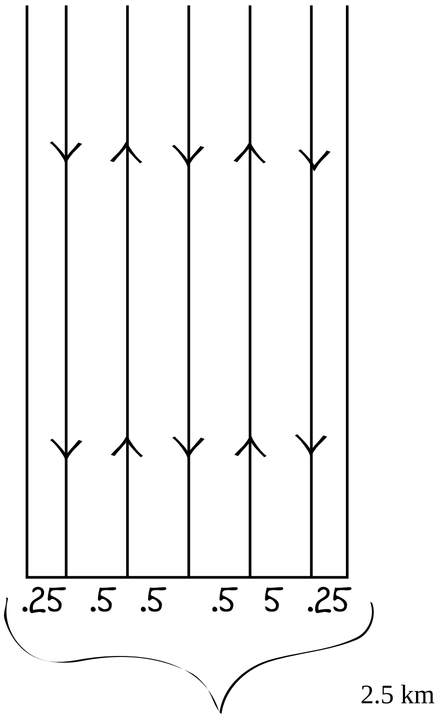
Figure 4. Surveying Plots That are Joined or Adjacent



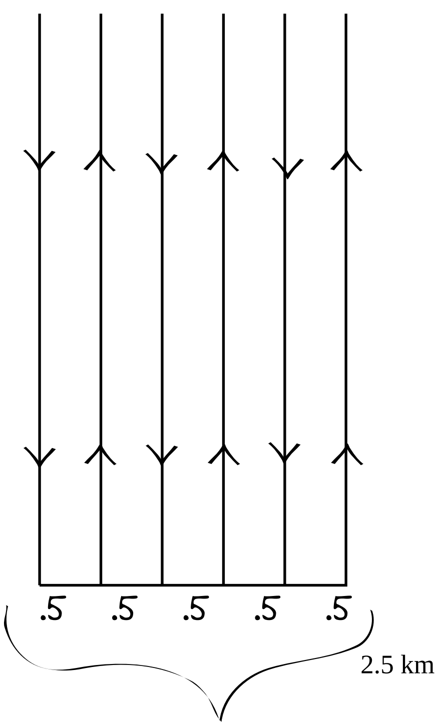
2. Flight Line Systems

All of the 10 x 2.5 km sample plots flown in Ontario should be systematically searched using five interior lines. There are times and places where six lines per plot are used, principally for re-flights.

Figure 5. Flight Line Systems



5 - line plot
- boundaries are not flown



6 - line plot
- boundaries from two of the flight lines
- non-standard, restricted use

The effect on observers that each type has, is as follows:

5-line plot

1. Less basic flying time than the 6-line, allowing shorter period of mental and physical concentration on each plot.

2. Using only interior flight lines is more efficient, as both observers are viewing new ground along each line.

6-line plot

1. Longer basic flying time, needing a longer period of mental and physical concentration on each plot.

2. The outside observer on the plot boundary lines is viewing ground outside the sample plot, which is not efficient.

To summarize, observers on 5-line plots are expected to search a relatively large area of always new and changing ground in a relatively short period of time. This requires maximum concentration while on the plot, and this high degree of concentration contributes to mental and physical fatigue, and moose being missed.

The minimum time of search should be at least 30 minutes per plot, with search times up to one hour necessary when warranted by numbers of moose or difficulty in tracking. This applies to all aircaft types, whether fixed-wing or rotary-wing.

3. Following Flight Lines

Flight lines are artificial lines drawn on plot maps:

(1) as a guide to ensure that all of the ground enclosed by the plot boundaries is adequately covered,
(2) to assist in the orderly navigation of aircraft while on the plot, and
(3) to assist in the marking of moose locations on the plot.

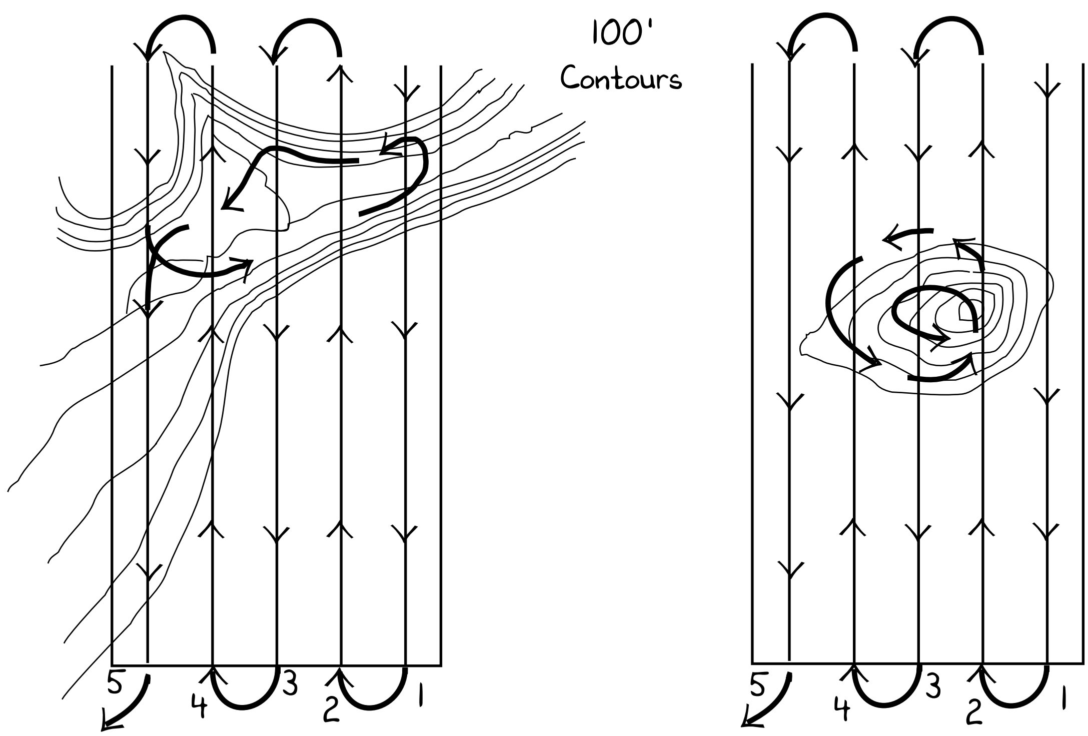
There is no special virtue in following flight lines while ignoring terrain, natural boundaries, or localized changes in moose habitat. Both pilots and observers should be flexible enough to deviate from the flight lines when necessary, not forgetting however, to return to the flight lines when the deviation is completed. The object of the exercise is not to see how straight a line the aircraft can fly, but to successfully find all the moose present on the survey plots. Observers should have a general awareness of the terrain and habitat preferred by moose, to assist in the degree of deviation from the flight lines necessary on any given plot. Illustrated below (Fig. 6, Fig. 7) are some, but not all, sets of conditions which may require deviation from the flight lines, to provide thorough coverage on the plot. Care must be taken to know where you are at all times in order to return to the exact point where you left the flight line.

Computerized navigation and mapping aids are now available, which are of value in assisting pilots and navigators to stay on flight lines, and to return to flight lines after circling on tracks or moose.

These aids may be built into the aircraft, or may be in the form of a lap-top computer with a separate Global Positioning System (GPS) input.

Navigators and pilots should check the current "Standards and Guidelines" for aerial moose surveys, for ground-speed and height-above-ground criteria while flying along the flight lines. These standards are identical whether the aircraft used is a fixed-wing or rotary-wing.

Figure 6. Intensive Search Patterns



Steep ridges or valleys

1. Follow first four flight lines
2. Part way down last flight line, fly up and down the valley.
3. Finish last flight line.

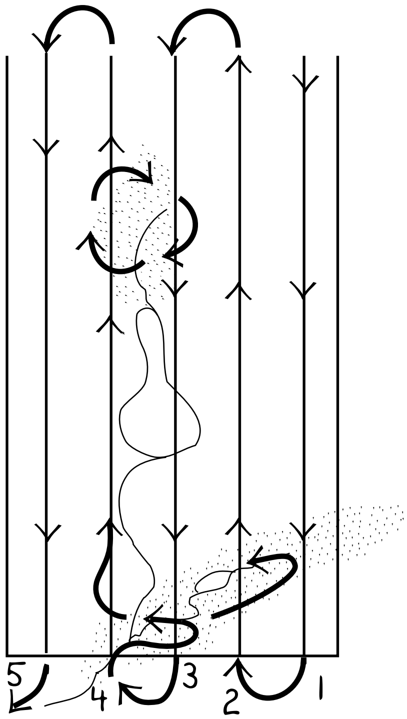
Reason: Where there are narrow, deep, valleys that cross flight lines, the aircraft cannot quickly compensate, and will be too high above the ground. Following the valley allows low-level aircraft flight and better chance to see tracks or moose.

Large hills or mountains

1. Start first flight line.
2. When hill is encountered, fly along the contours.

Reason: Following the contour lines allows observers on both sides of aircraft to have good observing conditions.

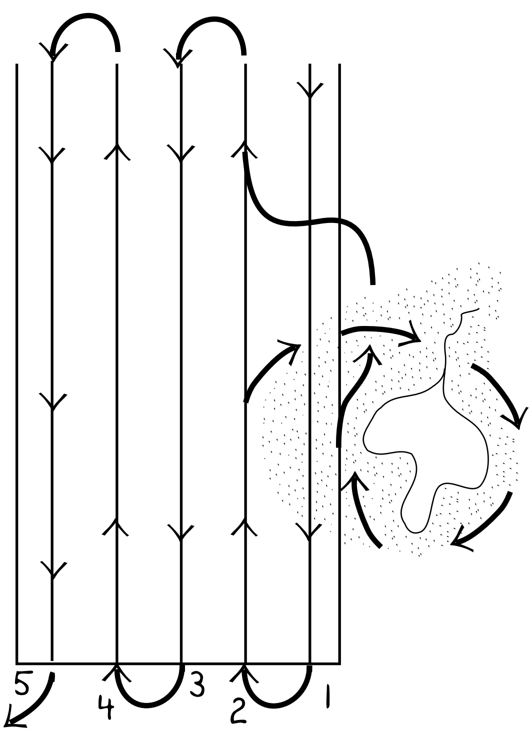
Figure 7. Intensive Search Patterns



Conifer stands in hardwood area.

1. Fly flight lines 1 and 2 in normal fashion, but :
2. During flight lines 3 or 4, fly up and down the conifer stand along the creek valley.
3. Circle the conifer stand near the small lake.
4. Follow the remaining flight lines in the normal fashion.

Reason: Moose may be restricted to conifers due to snow depth. Simply following flight lines may not allow an adequate look at conifer areas, where moose and track observation is more difficult.



Conifer stands barely on plot.

1. Fly the first flight line.
2. On the second flight line, crcle the conifer plots, both on and off the plot, paying close attention to the plot boundary.
3. Finish the flight line and the rest of the plot in the normal fashion.

Reason: A moose hidden in thick conifer just inside plot boundary may leave observable tracks only outside plot in conifer.

D. Moose Habitat

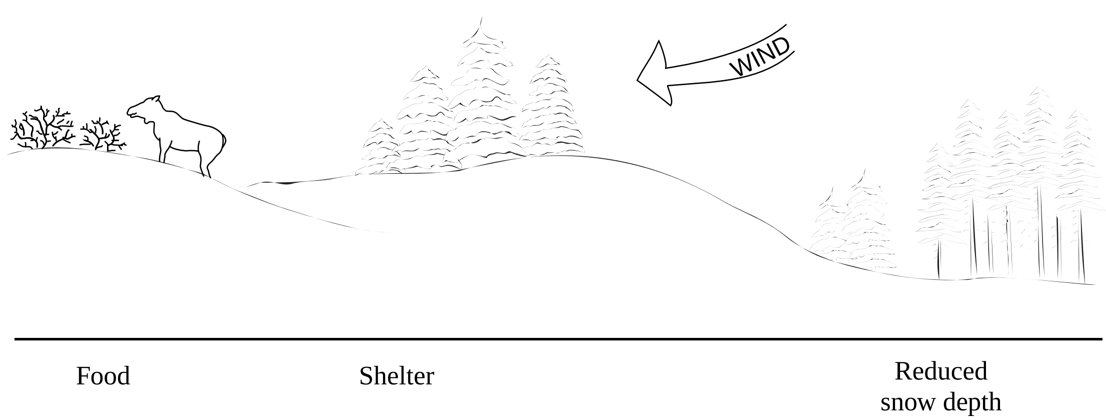
1. Introduction

The fact that moose are not randomly distributed over their total range, but instead are often found in specific habitat or cover types, is soon learned through experience by all aerial moose observers. These habitat preferences vary with the time of year, snow depth and predator disturbance, and are sometimes different for different sex and age classes of moose. Habitat preferences are based on at least the following factors (Fig. 8):

food availability - small trees and shrubs (e.g. dogwood, cherry, poplar, willow, honeysuckle)
shelter - from wind and the resulting windchill
snow depth - when greater than 70 cm (28 inches), moose movement is restricted. Snow depth is less under closed canopy conifer as these trees hold snow in their branches. Crusting is reduced under conifer.

While moose may be found in any or all habitat types on a plot (requiring a search of the whole plot), the following guidelines will hold true much of the time.

Figure 8. Habitat Requirements



Generally, in early winter (December and January), moose appear to select for food, and are found in cutovers and burns when these habitats are available. In mid-winter (January and February), when temperatures are extremely low and wind chill is high, moose often appear to select small sheltered patches near a food supply. Mixedwood slopes are also a preferred habitat at this time. In late winter (February, March, April) moose appear to prefer areas with a high mature conifer component to the forest cover, since these areas exhibit reduced snow depth and crusting compared to more open habitats. This allows moose to escape predators more easily. A common exception to the above are cow-calf groups, which often spend the entire winter in mature mixed stands, possibly because the calf is affected by snow depths which would inhibit movement in more open situations.

2. Typical Winter Habitats and Moose Use

Habitat Type	Shrub or Tree Species	Moose Use
1. alder swale	speckled alder	**very low** - no food, no shelter, (very deep snow)
2. recent clearcuts and burns (5 years)	variety of trees and shrubs	**very low** - some food, no shelter, (very deep snow)
3. older clearcuts and burns (5 to 20 years)	variety of trees and shrubs	**high** in early winter- lots of food, some shelter, deep snow
4. 100 percent hardwood stands (closed canopy)	poplar, white birch, maple	**low** - little food, little shelter, deep snow
5. 100 percent conifer stands (closed canopy)	jack pine, black spruce	**low** except in late winter when some use - little food, lots of shelter, shallow snow
6. conifer stands in tolerant hardwood areas	white spruce, balsam in maple	**medium to high** - some food,1ots of shelter, shallow snow
7. hardwood ridges in conifer areas	poplar in black spruce or jack pine	**medium to high** - some food,1ots of shelter, and shallow snow nearby
8. mature mixed-low conifer component	white birch, poplar, white spruce, balsam and shrubs	**medium to high** in early winter,1ess use later -lots of food, some shelter, medium snow depth
9. mature mixed-high conifer component	white birch, poplar, white spruce, balsam and shrubs	**medium to high** by cows and calves all winter, less use by others but increases in late winter - some food, good shelter, fairly shallow snow

E. Tracks

1. Introduction

Most of the moose on a plot are found only after a long and arduous process of following the tracks they have left over the previous day or two. Relatively few moose are spotted directly, that is, without spotting their tracks first. Therefore, new observers should learn as much about tracks as they can. While most of this learning can only take place in the air during the process of following and interpreting tracks, there are some guidelines that should be kept in mind.

2. Effects of Weather On Tracks and Tracking

a) Introduction

The reason the moose inventory guidelines are so emphatic regarding time since last snowfall, and amount of sunshine (cloud cover and time of day) is because of tracks. Strong light and the sun as high in the sky as the time of year allows are necessary just to spot tracks, let alone judge their freshness and what kind of animal made them. The observer will find that the only visible portion of the tracks is their SHADOW, and the stronger the light, the better the shadow shows up.

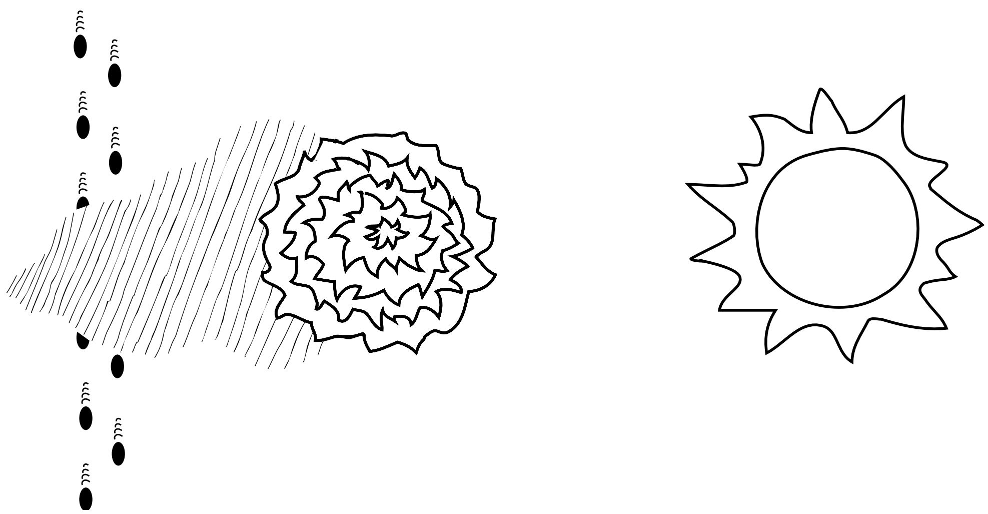
b) Illumination

The optimum observation time is relative to the sunrise and sunset times of each day. The sun must be high enough (10 a.m. to 2 p.m.) to illuminate as much ground as possible. When the sun is low, tracks in areas of conifer, and in areas in the shadow of hills, are not visible (Fig. 9). By 2 p.m. at the end of December, these shadowed areas may represent 50 percent or better of the area of a plot.

c) Time Since Last Snowfall

On a plot with a high moose density there may be so many tracks after three or four days without snow that it is impossible to sort them out. Relying on the direct spotting of moose, is not efficient, and a plot flown under those conditions will have more missed moose left on it. If crews start seeing moose prior to their tracks too often, it may indicate that light conditions have failed and the survey should be discontinued for that day. In addition, flying a plot too soon (within six hours) of a particularly heavy snowfall will not give the moose sufficient time to make tracks in the forest openings where they can be observed.

Figure 9. The Effect of Shadow on Track Observations



The moose track disappears in the shadow of a tree.

DO	**DON'T**
1. fly six to 72 hours after snowfall	**1.** fly before six hours or after 72 hours of snowfall
2. fly during mid-day	**2.** let lunch break use up best flying time
3. fly in strong light	**3.** fly in heavy overcast or ice crystal conditions

3. Species Differentiation

The aerial observer in northern Ontario should expect to see the tracks of the following animals in the snow: moose, caribou, wolf, otter, lynx, fox, marten, hare, and sometimes fisher, beaver, and white-tailed deer. Although the tracks that we humans create may sometimes be confused with those of moose, we generally leave behind other signs of civilization — roads, railways, cabins, snowmachine tracks and ice-fishing holes.

The major species are listed below, along with the reason of their importance in relation to moose surveys. Since the population and location of most of these species is important in its own right, notes should be made on the flight map whenever they are encountered.

Moose Tracks: lead to moose; can be counted as track aggregations if moose are on plot and cannot be seen

Wolf Tracks: lead to moose kills; lead to wolves (indicate pack size and territory); may be confused with moose tracks

Otter Tracks: may be confused with wolf or moose tracks, especially at a distance and by inexperienced observers

Caribou Tracks: may be confused with moose tracks

Deer Tracks: may be confused with moose or wolf tracks

Readers should refer to the diagrams of the tracks of these five species as seen from the air (Fig. 10). Pay particular attention to the overall impression left by the tracks, as this is their most striking feature at first glance from the air.

The next group of diagrams (Fig. 11 - 16) deals with the track patterns of moose, wolves, otters, and caribou; these track patterns seem to reflect the life styles of the animals involved. Moose, a browsing animal in winter, often (but not always) leave the impression that they are aimless wanderers, casually munching their way from one shrub to the next. Wolves and otters, both predators, leave the impression of purposeful traveling, the wolves on land and water, and the otters usually on watercourses alone.

Caribou in Ontario now exist in small herds, usually five to 30 animals, often found in localized, traditional areas. They are often found on the edges of rivers and lakes, where they feed on tree lichens (old man's beard) from trees overhanging the ice. They are also found in jack pine stands where they dig pits in the snow to obtain ground lichens (reindeer moss).

In comparison to moose, woodland caribou are smaller and have shorter legs. Individual caribou leave narrower trails, and leave foot drags and belly troughs in relatively shallower snow than moose do. In deep snow, caribou may jump or bound, leaving a distinctive track. Moose almost never jump through snow for any distance (Figs. 10, 15).

White-tail deer are found in localized areas within Ontario's moose range, often in distinctive deer yards. In any case, they do not range extensively in winter. They leave the narrowest trail of all ungulates, and often use the same trail over and over. Once the snow deepens, they are forced to jump or bound through it where trails have not yet been established (Fig. 10). Since deer yards are traditional, their locations should be known to local moose observers, thus minimizing confusion with moose tracks through the process of elimination.

Figure 10. Common Animal Tracks

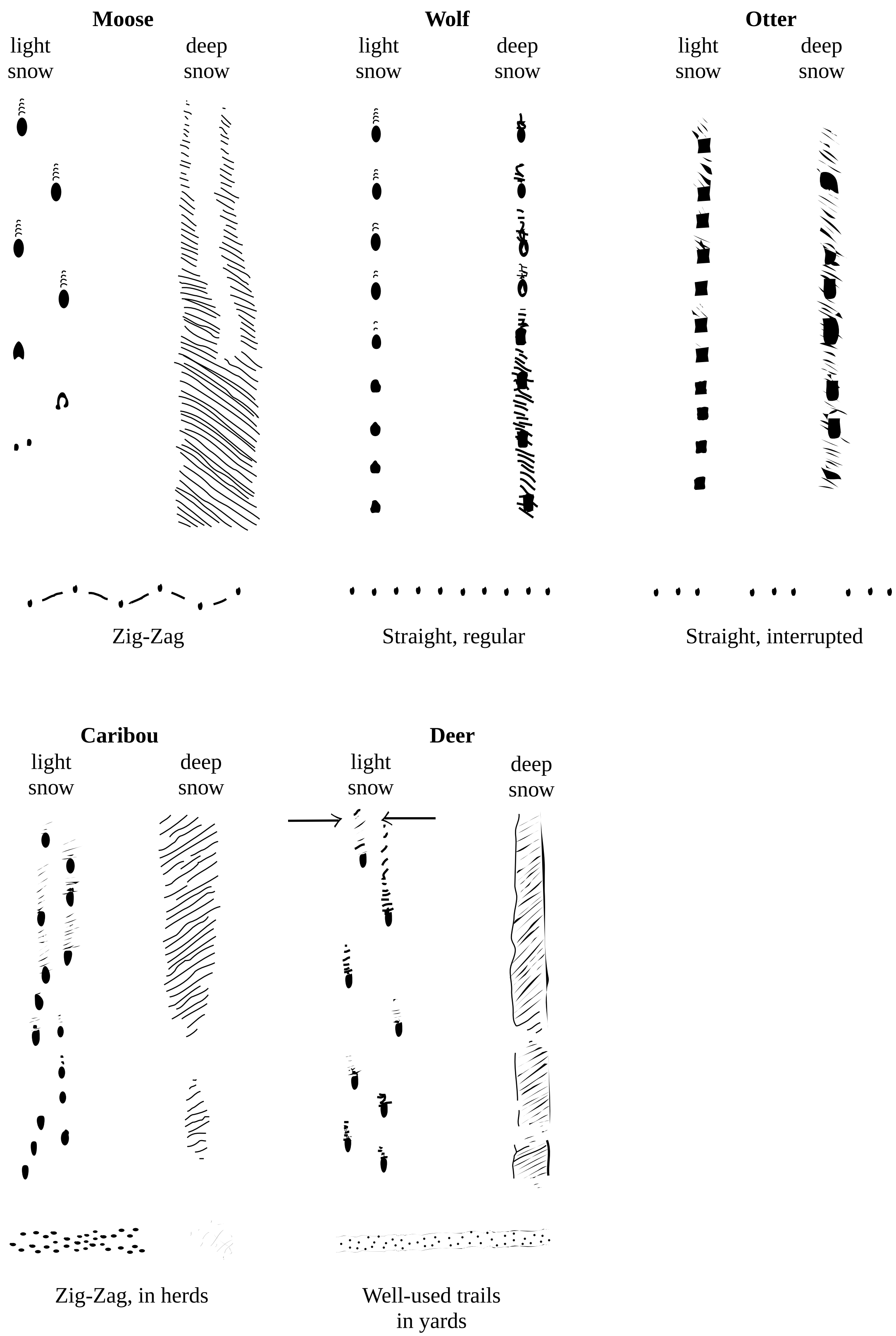
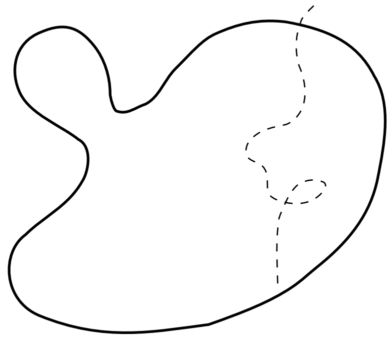
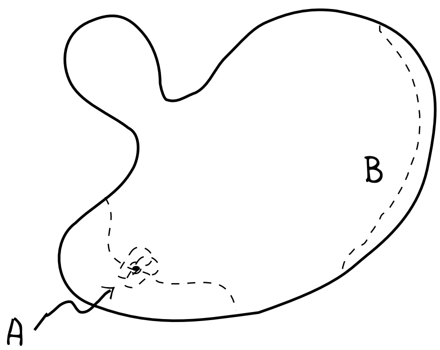


Figure 11. Moose Track Patterns On A Pond

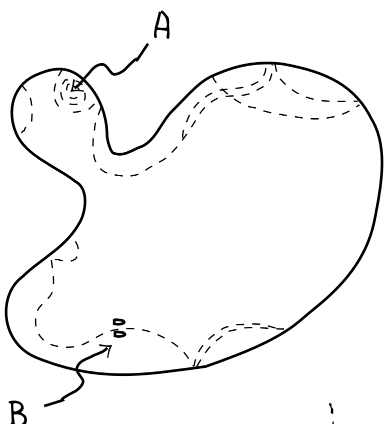


11.1
Track pattern of a single moose crossing a small lake. Note the apparent aimlessness of the pattern.



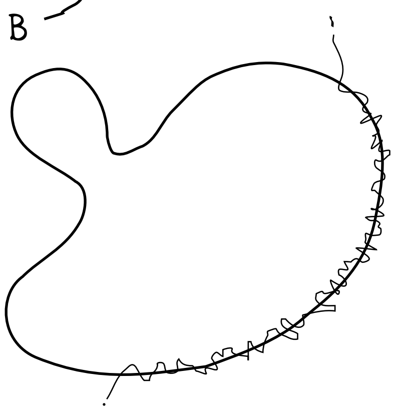
11.2
Track pattern of a single moose feeding and drinking on a small lake. Note the milling pattern (A) around a drinking hole and (B) the feeding track very close to shore.

Note: Similarity to caribou slush pit.



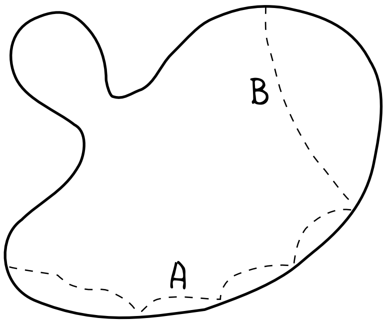
11.3
Track pattern of a group of two moose on a small lake, showing (A) a milling area, and (B) a bedding area. Note the criss-crossing and the doubling (back and forth) patterns.

Note: Moose may bed down once or twice prior to final bedding, therefore two beds may mean only one moose.

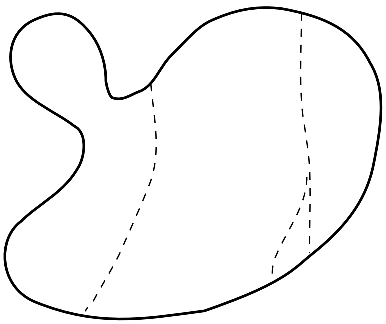


11.4
Track pattern of a single moose feeding along the shore of a small lake. This is a common variation of the track pattern illustrated in Fig. 11.2.

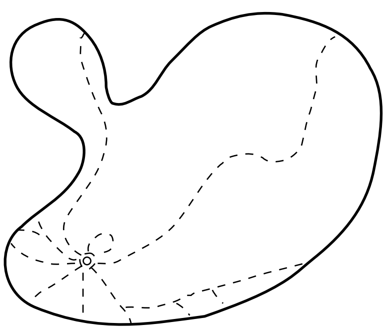
Figure 12. Wolf Track Patterns On A Pond



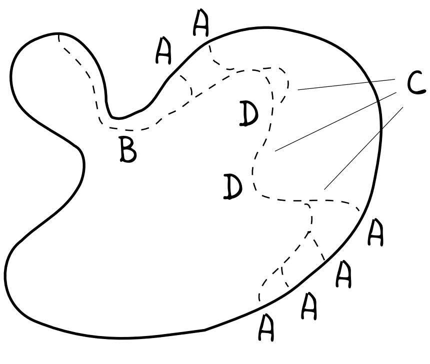
12.1
Track pattern of a single wolf on a small lake. Note how (A) the track shows the wolf checking out items of interest along the shoreline, and (B) the relatively straight line followed in crossing the lake.



12.2
Track pattern of at least three wolves crossing a small lake. Note that there appears to be no aimlessness or lack of direction. Also note the apparent single track splitting into two tracks. Also note that a group of moose crossing a lake usually leave a set of tracks much closer together.



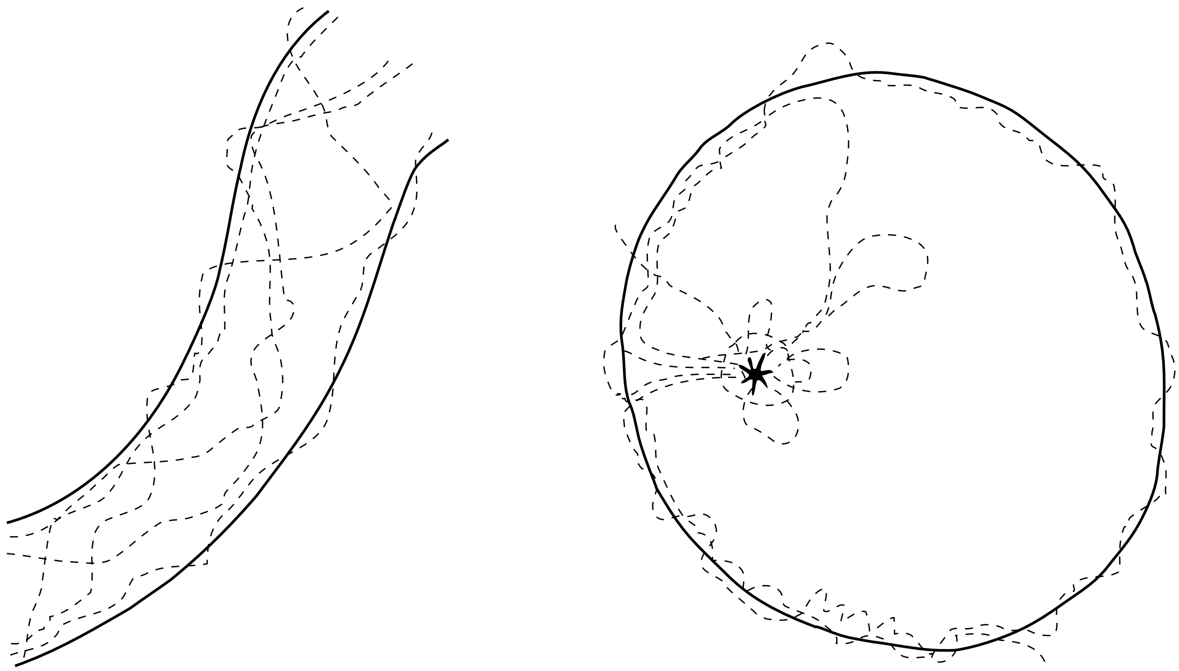
12.3
Track pattern of a pack of wolves at a moose kill site on a small lake. Note the tracks radiating from the kill, and the apparent purposefulness of the pattern in comparison to moose.



12.4
Track pattern of four or more wolves travelling on a small lake. Note: (A) the tracks of wolves joining and leaving the main track, (B) the tight rounding of a small point on the lake, (C) the single track line which does not change in size or character as other tracks join or leave it, and (D) the way in which individual wolves leave and rejoin the main track.

Note: As figure 11.3 shows, the characteristic "C" is also common to moose tracks.

Figure 13. Caribou Track Patterns



On a river

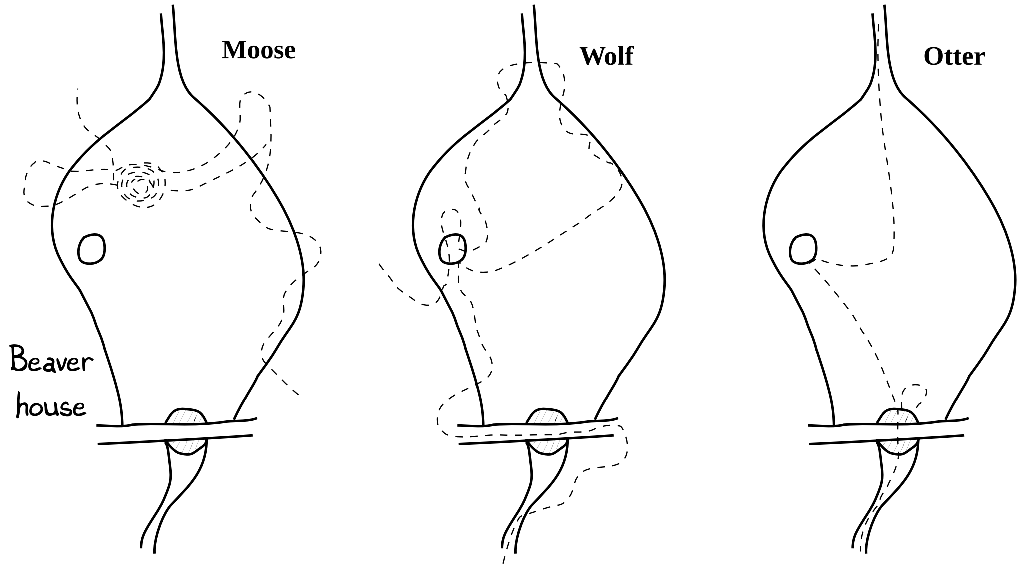
Note: 1. trails along banks.
2. criss-crossing tracks.

On a pond

Note: 1. slushing pit.
2. tracks along shore where lichens occur on leaning trees.

Note: the similarity to moose tracks (but usually they are more numerous)

Figure 14. Tracks On A Beaver Pond



Moose	Wolf	Otter
1. Milling area	**1.** No milling area.	**l.** No milling area.
2. No interest in beaver house.	**2.** Track up to and on beaver house.	**2.** Track into and out of beaver house.
3. No interest in beaver dam.	**3.** Uses beaver dam as bridge.	**3.** Crosses dam in middle.
4. No interest in creek.	**4.** Uses creek as travel route.	**4.** Uses creek as travel route.
5. General impression: aimless, in no hurry.	**5.** General impression: purposeful, curious.	**5.** General impression: purposeful, in a hurry.

4. “Fresh or Old” - Track Age

Once a set of tracks has been found, and recognized to be moose tracks, their age has to be determined. After all, tracks that are a week old are often not of much use in locating moose. In addition, old tracks should not be included in the track aggregation count, since the moose that made them may not still be on the plot, or may already have been counted. As stated before, it is only under conditions of good, strong light that an evaluation of track age can be made.

Track age determination is usually most effective at low level. The tracks are often first seen while flying at 100 to 200 metres over the ground, and then circled to determine the species. If they are moose tracks, go down to a low level to determine the freshness at that location, through observation of the amount of snow in the track, etc. (Figs. 15, 16). Then follow the track in one direction or another, and repeat the above process at least once. The difference in freshness at the two or more locations along the track indicates the direction of moose travel. Be careful not to choose sites that are either excessively exposed or excessively protected when doing this (Figs. 17, 18).

Figure 15. Track Age

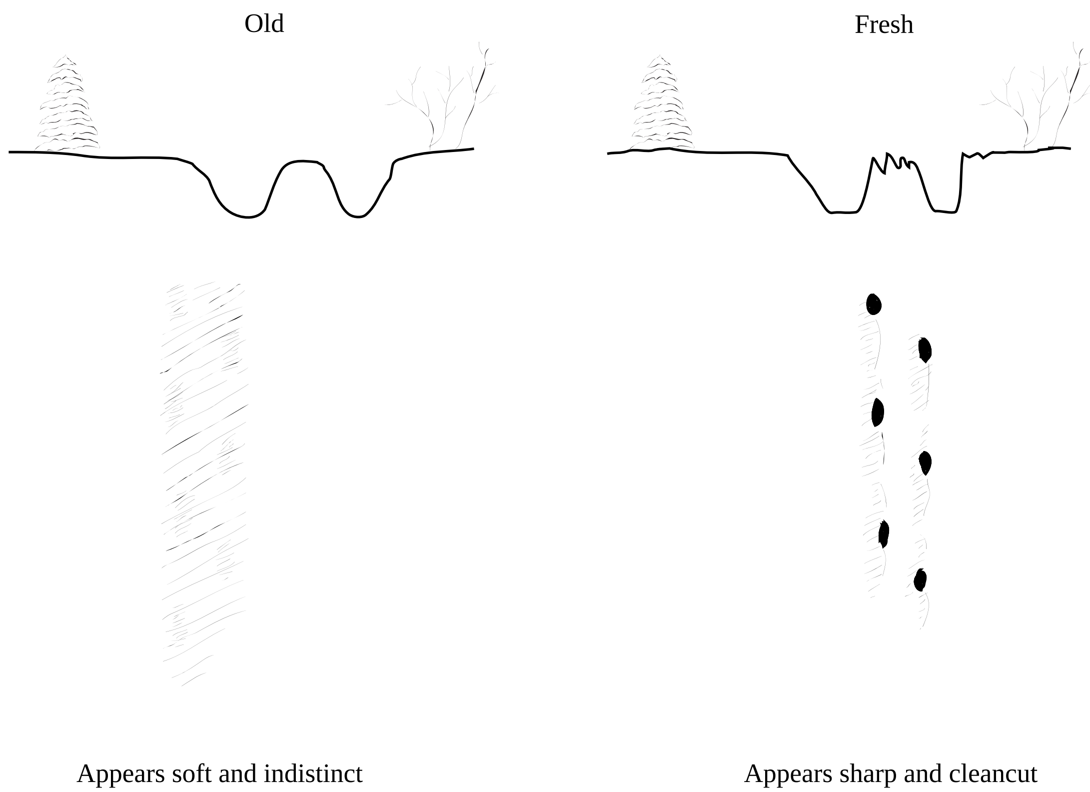
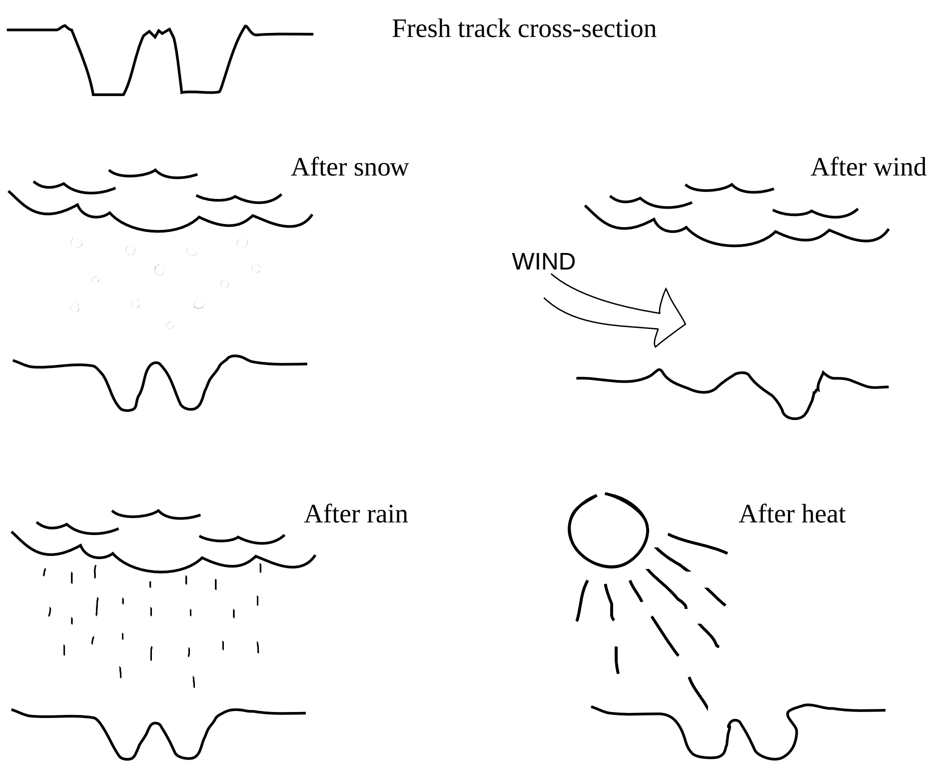


Figure 16. Weather Influences On Moose Tracks



It is unfortunate that neither diagrams nor descriptions are very effective in trying to illustrate track age. Possibly, the fresh tracks could be described as “clean and crisp”, while old tracks are “soft and worn”.

Aerial observers might be better to class tracks as fresh-looking and old-looking, rather than fresh and old, because a number of weather factors may affect the apparent age of tracks (Fig. 16). These include the following:

(1) Snow in the form of storms or squalls. The amount of snowfall in any one storm may or may not be enough to cover or partly fill existing tracks and beds. Usually, information or the time, place and amount of snowfall is readily available.

(2) Wind - meaning winds of 20 km/hr or better that may or may not be accompanied by snowfall. Winds not accompanied by snowfall will likely cause enough snow drifting and resultant filling of tracks to be useful. On an open lake, or other open area, even very light winds can cause enough snow drifting to fill, or partially fill, tracks. With practice, you can use this feature to date moose tracks in open areas. Some windstorms are quite noticeable and can be dated by moose observers.

3) Rain - meaning freak rain during the winter. This can cause two things: first, the “melting down” of all existing tracks, and second, forming a crust on the snow surface which forms a distinctive broken appearance when a moose breaks through it. Rain can be dated.

(4) Heat - meaning warm, sunny days toward the end of winter, when sufficient heat from the sun melts down the edge of existing tracks. Tracks affected this way have a distinctive “hollowed-out” appearance. Depending on the nature of the snow, these tracks may have crisp, clean edges, which could cause them to be confused with fresh tracks. Heat may cause a crust to form on the snow surface at night allowing observers to accurately age overnight tracks. Heat may be a local phenomena, affected by degree of slope of the ground, and conifer patches, thereby causing confusion in attempts to determine track age.

Observers should note that the four phenomena listed above are usually exaggerated or modified by the forest cover, or lack of it, around moose tracks (Figs. 18, 19).

(1) Open areas - ponds, lakes, rivers, roads, are subject to an almost constant drifting of snow and filling in of tracks. Determining track age because of this will be difficult without practice. Open areas are also more subject to snowfall, to rain, and to heat distortion of tracks.

(2) Dense conifer areas - are often not subject to wind and snowfall because the wind is kept out by the trees, and snow falls onto the trees, not the ground. Often tracks in dense conifer will appear to be fresh for much longer (e.g. one week) than tracks in open or semi-open areas. Heat does not have too much effect in heavy conifer (until late spring) because of the large amount of shadow. Even the effects of rain may be modified due to the thick crown canopy.

(3) Semi-open areas - old cutovers, hillsides with mixed cover, stag spruce areas, partly regenerated burns. These areas have a moderating effect on weather phenomena proportionate to the density, height, and amount of conifer species in the tree and shrub cover. Even deciduous shrubs have a good moderating effect on wind, but little effect on rain, heat and snowfall.

Figure 17. Track Direction

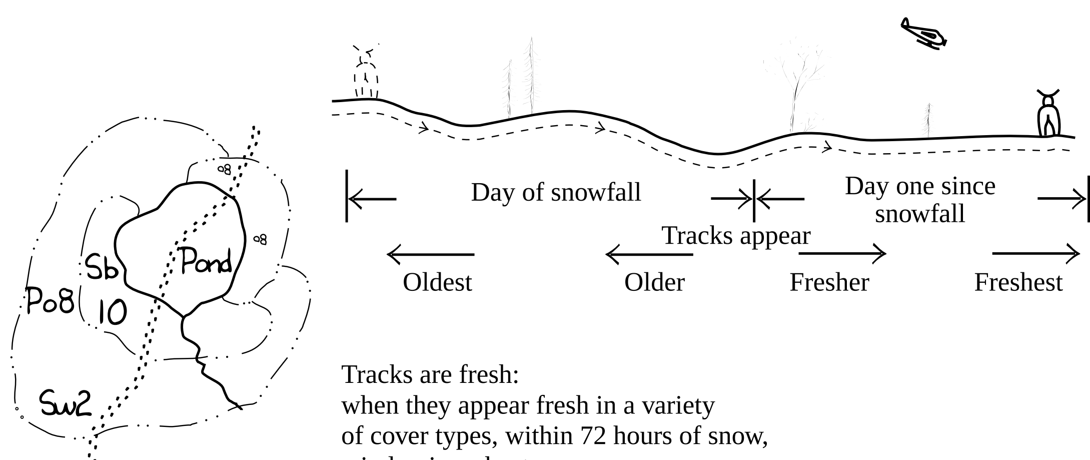
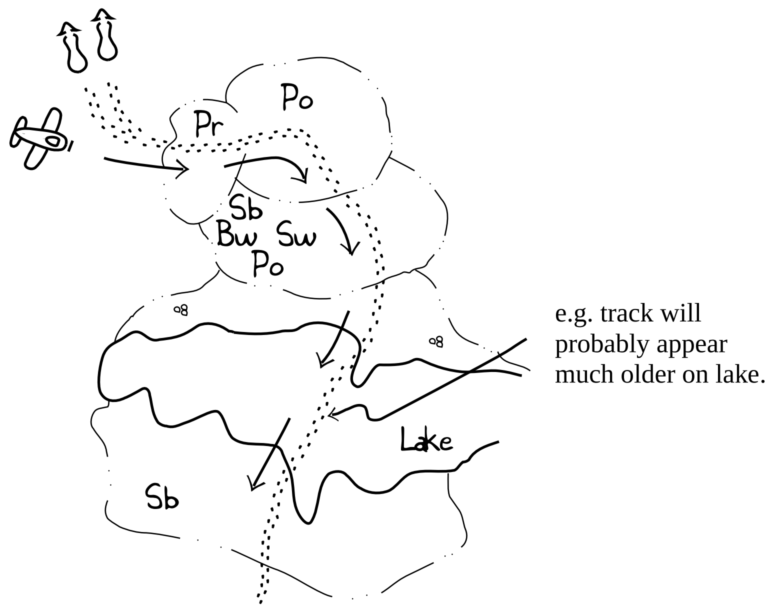


Figure 18. Determining Track Age



If snow conditions have been changing rapidly, it may be useful to backtrack moose to observe how weather has affected the track appearance over the day or two that the tracks can be followed. Pay close attention to track appearance changes in different cover types.

This technique can be useful in demonstrating track age to new or inexperienced observers.

5. Following Tracks

Observers should again be reminded that most moose on sample plots are not found by direct spotting, but by the slow, grinding process of following tracks. Almost every fresh moose track found on a plot must be followed until one of two things is found; moose or old sign. If moose are found, the search is ended, whether they are on the plot or not.

If old sign is found, the observers may have to back track until either the moose is found, or it is concluded that the moose is off the plot.

It will be found that when following tracks, after determining the direction of travel, the aircraft should fly as high as practical, dictated by keeping the track in sight in different terrain and forest cover types. The object of the exercise is to find either old sign or moose as efficiently as possible, not to plot the animal's every footstep.

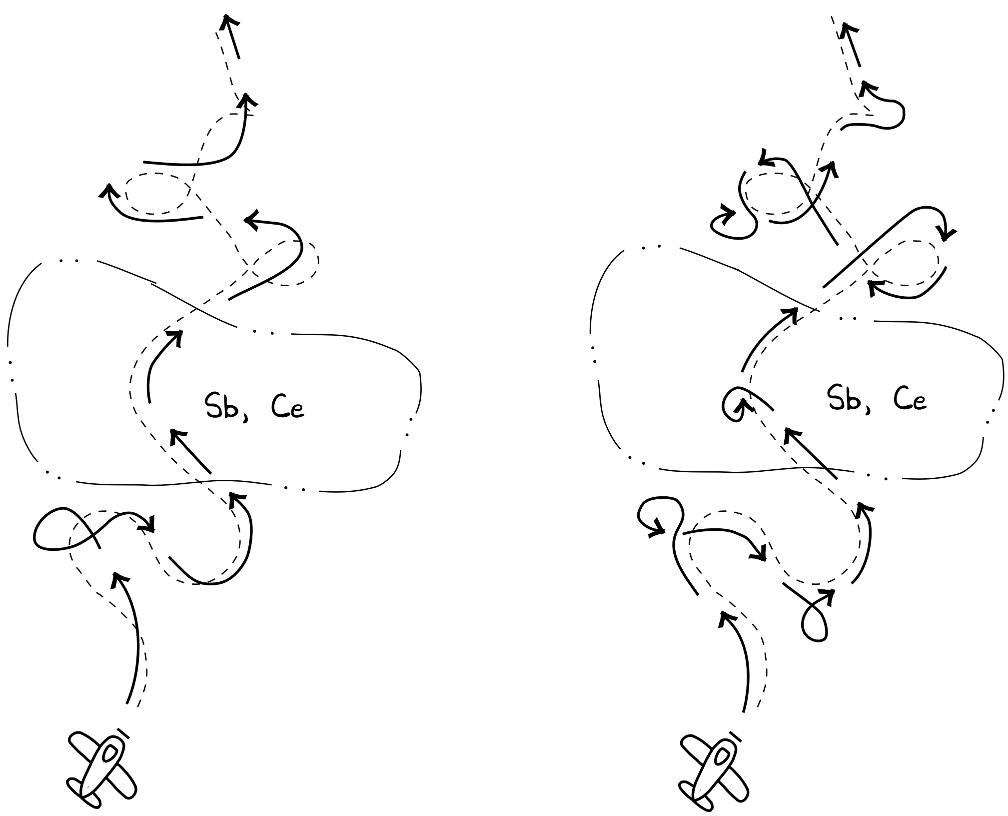
A few diagrams are included which illustrate the principles outlined above (Figs. 19 to 24).

Figure 19. Following Tracks

NOTE: It is not necessary to follow each footstep of the moose, only to follow its general direction in order to find either the moose or old sign.

High-level flight

Low-level flight



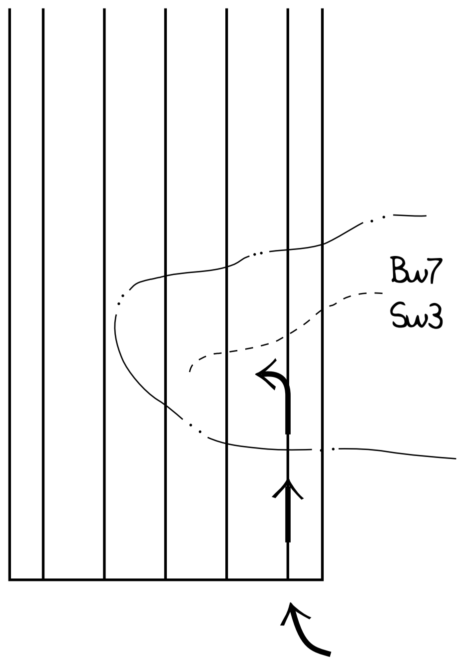
Following general direction of track results in easy, efficient conclusion with a minimum of time, fatigue and discomfort.

Following every footprint causes too much circling, (with fatigue, airsickness, waste of time) and leads to same conclusion.

Moral of story : It is not necessary to follow each footstep of the moose, only to follow its general direction in order to find either the moose or old sign.

Figure 20. General Rules On Following Tracks

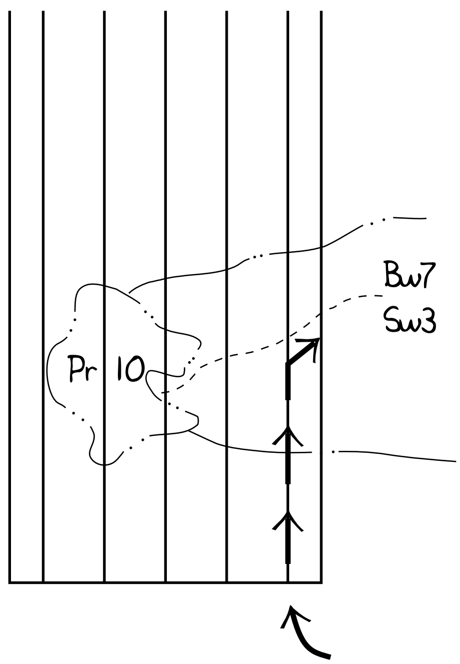
1. Use plot interior to determine initial following direction.



1. Follow track in direction of plot interior to use aircraft and observers most efficiently.
2. Determine direction of moose travel by means of track ageing.
3. Follow track in direction of moose travel.

Note: Following track towards interior allows observers additional time to spot other moose or tracks which may be present on the plot.

2. Use forest cover to determine initial following direction.

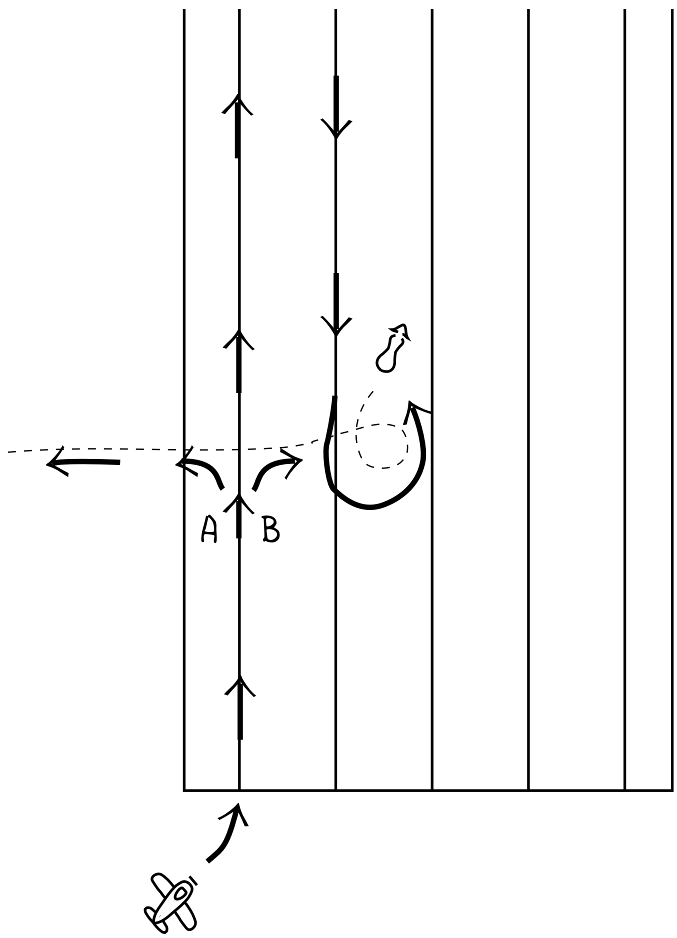


1. Follow track in direction of most open cover to use aircraft and observers most efficiently.
2. Determine direction of moose travel by means of track ageing.
3. Follow track in direction of moose travel.

Note: In this example, although the initial following direction is off the plot, the ease in track following in open cover off plot as opposed to the heavy conifer on plot, results in an overall time-saving. Also, it would be easier to determine track age in the open cover off plot.

Figure 21. Following Tracks

Method #1:
1. mark track location on map
2. on the second flightline, intercept track, determine track direction, and attempt to find moose.



Following track in direction A will probably result in loss of time.

Following track in direction B may result in immediate finding of moose, but may also result in spending much time over an area to be covered on next flightline.

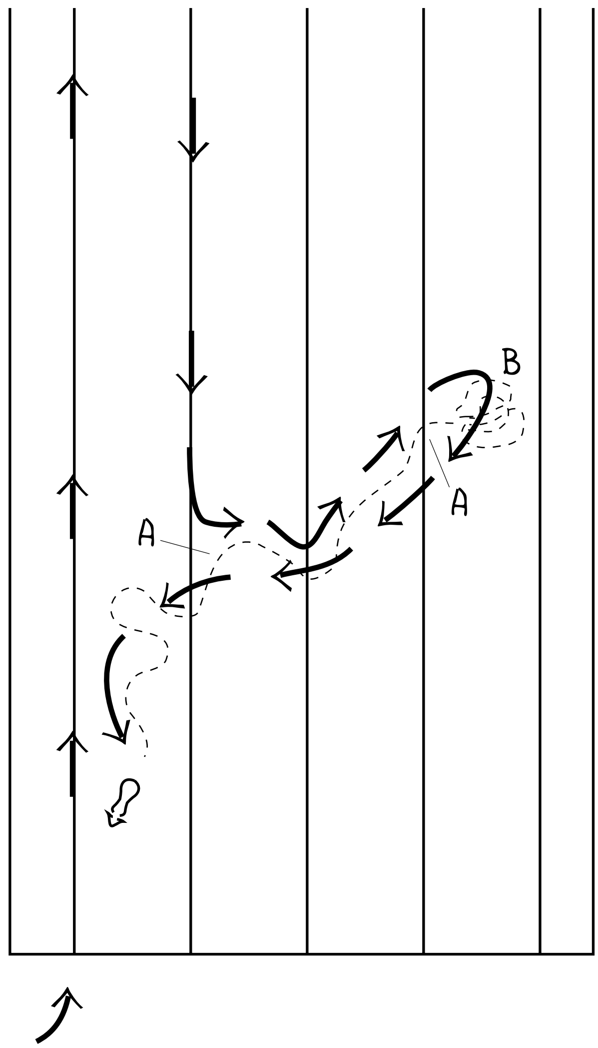
This Method is :

1. Suitable on low-density moose areas.
2. Suitable if tracks are visible for a reasonably long distance.
3. Suitable if tracks are found near edge of plot.

Figure 22. Following Tracks

Method #2:

1. When tracks are encountered, pick a direction using the general rules, and determine direction of moose travel.
2. Follow track and find moose.
3. Ignore plot boundaries in this method.



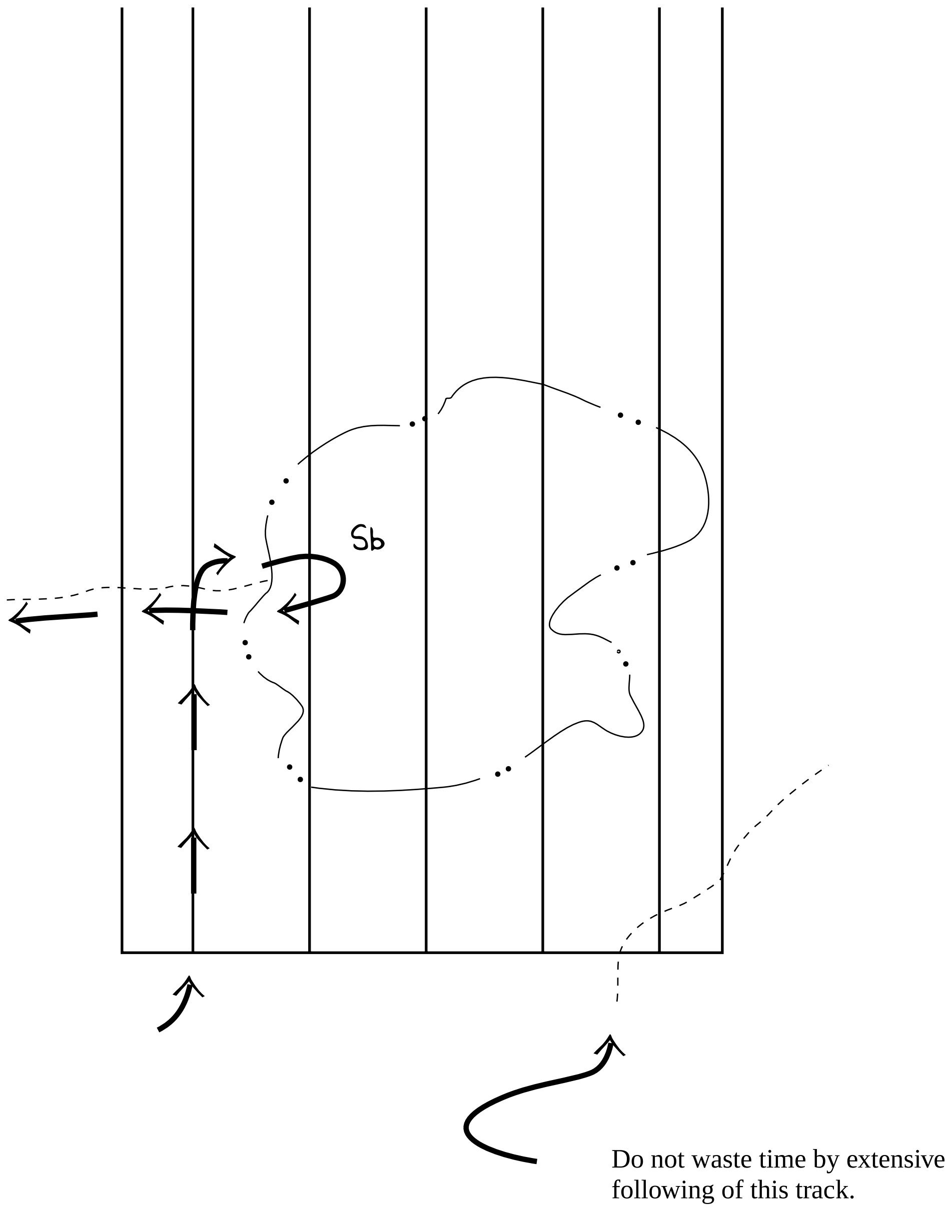
Legend:
A - fresh sign
B - old sign

This Method is:

1. Suitable on areas of any moose density.
2. Suitable under all terrain and forest cover.
3. Suitable for tracks found anywhere on plot.
4. Recommended over method #1, especially on medium to high moose density areas.

Figure 23. Following Tracks

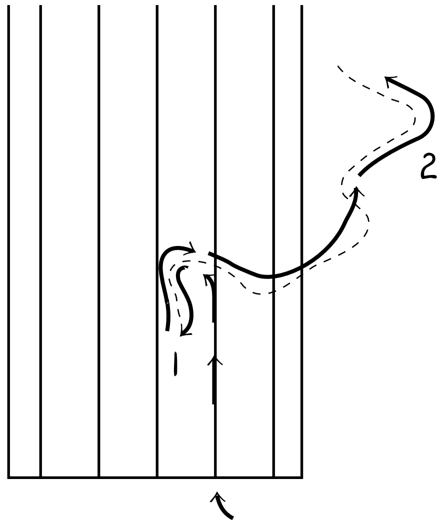
When fresh tracks that cross the plot edge are lost in heavy cover, the observers should back-track to a point well off the plot if necessary, to find either old sign or the moose.



Note: Do Not count a track aggregation until you are sure that the moose is on the plot.

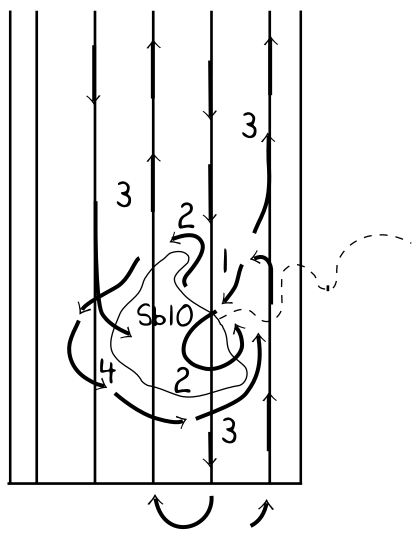
Figure 24. Following Tracks

Make sure moose and track aggregations are on or off plot.



1. Follow track towards plot interior untill old sign is found.
2. Follow track in direction of moose travel, and continue to follow far enough to ensure that moose have not doubled back onto plot.

Stand perimeters and second looks.



1. Follow track in direction of moose travel toward interior.
2. Search conifer stand and if unsuccessful fly perimeter of the stand to determine if moose have left it.
3. If moose have not left, resume the flight lines.
4. Before ending plot, search the stand again.

Note: The initial search of the stand may cause moose to move around, thus becoming visible during the second look.

When a moose or group of moose are found on the plot, they should always be circled a few times to look for more moose. It has already been pointed out how moose (especially cow-calf groups) will walk in each other's trails leading the observer into under-estimating the actual number of moose present.

When moose are first spotted, the aircraft should be taken to a higher altitude (over 200 m) enabling the air crew to make a quick count, and enabling the navigator to plot the animals more rapidly and accurately. Then fly down to a low level to sex the animal(s). When this is completed, go up again and make one or two more circles, recounting the moose. The low level flight may have disturbed moose that were laying down or were hidden under cover, and they may be spotted on the recount.

This circling, whether used for the detection of additional moose, or for sex and age determination, or both, requires the active participation of everyone in the aircraft. As soon as the moose is spotted, the person who observed it must paint a mental picture of the moose's surroundings, so that the aircraft can be guided back over the spot the moose is located. Terrain, shorelines, small stands of trees, and oddly shaped individual trees are useful in this regard.

F. Searching Techniques for The Individual Observer

1. Introduction

So far, we have only dealt with searching techniques by the aircraft crew as a whole. It is the individual observers however, who do the actual spotting of moose and tracks. While the aircraft is over a sample plot, each individual must be as efficient as possible, that is, observing everything of importance while the aircraft flies at 140 km/hr down the flight lines. The following paragraphs outline some techniques that may be useful in this regard.

2. Ground Scanning

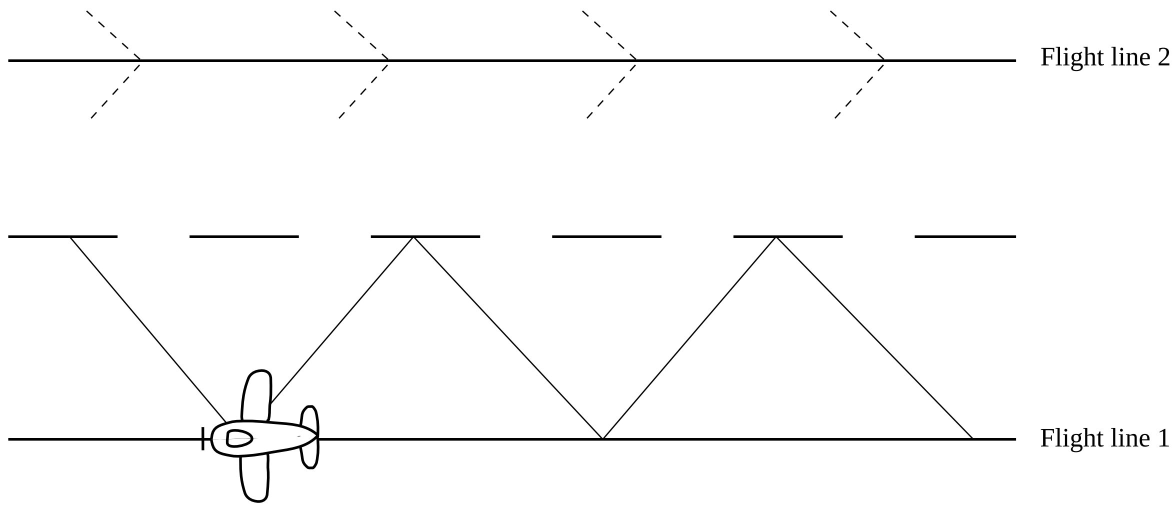
While on the plot, observers should sit as comfortably as possible, and if there is room for it, should twist around on the seat and try to face the aircraft window. This can minimize discomfort caused by sore necks. If the weather is very cold, don't breathe onto the window, as this will cause a frost build-up.

Once comfortable, the observer scans the ground within his vision range. At a height of 100 - 200 metres, you will be observing a strip about 250 metres wide. Since you will be moving at speeds approaching 140 kph, (90 mph) you cannot pay close attention to each square foot of ground, therefore, you must scan the terrain. Some observers use a rather mechanical zig-zag observation pattern, as illustrated in Figure 25 (A). It is recommended, however, that observers use a scanning pattern which is like the zig-zag, but takes advantage of openings between the trees, as depicted in Figure 25 (B). These openings or sighting lanes exist in most forest stands, and should be taken advantage of. Obviously, the thicker the forest cover (e.g. mature conifer stands) the more effort needed to spot tracks or moose.

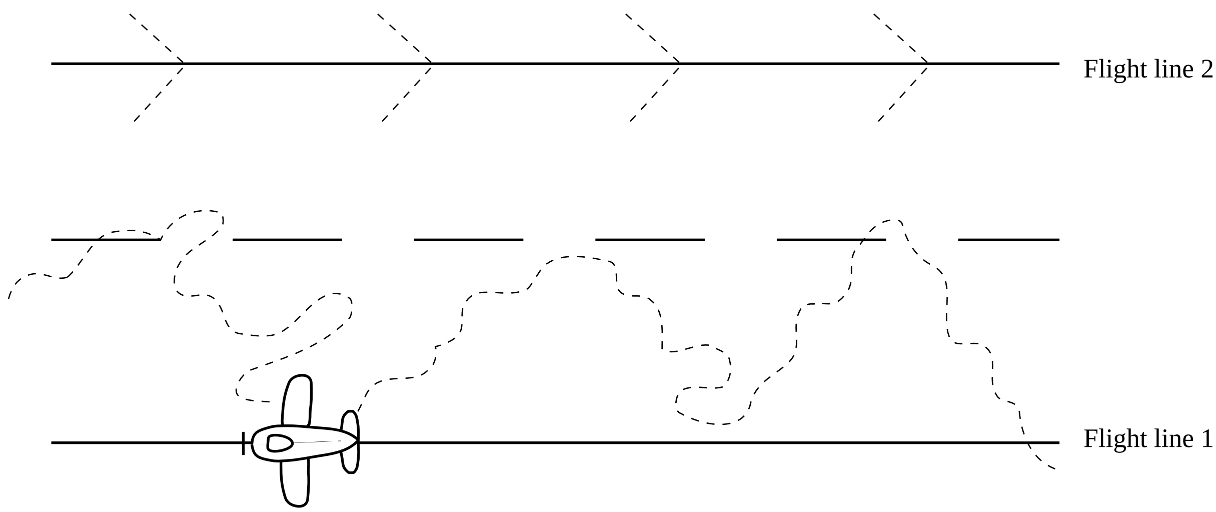
Observers should not attempt to scan too far into the distance, as the adjoining ground area will be better covered from the next flight line. Also, observers should not scan just a narrow strip close to the aircraft.

When fresh tracks or a possible moose are spotted, the observer should call out to the pilot and navigator naming the observation and the side of the aircraft it was seen from, i.e. "Circle right, possible fresh tracks" or "Circle left, possible moose". It is during the circling that track age or a moose sighting can be confirmed or not. If the tracks turn out to be old, or if the moose turns out to be a stump, no harm has been done. It is always better to call out a possible sighting and check it out, rather than not call it out and miss moose on the plot.

Figure 25. Ground Scanning Techniques



B. modified zig-zag scan



3. Preformed Mental Image

It is much easier to spot and recognize something if you know exactly what you are looking for. For this reason, the first aerial survey flight of the season is usually the most difficult, because the aircraft crew has forgotten exactly what moose tracks and moose look like from an aircraft. This is the reason why the Provincial Standards and Guidelines call for both observer experience, and observer currency (i.e. recent observer experience). It also is the reason why training flights for all observers are recommended at the beginning of each survey season.

It is often possible, while ferrying from the airbase to the first survey plot of the day, to spot either moose tracks or moose. These tracks or moose should be circled once or twice so that all observers can get a good look at them. This allows each observer to form and keep a mental image of the size, shape, and pattern of tracks, and the size, shape, and color of moose.

If it has been some time since an observer has seen moose or their tracks, and none are found while ferrying, it may help somewhat if he can remember and visualize what they looked like the last time he saw them.

4. Color of Moose

All moose, no matter how black looking, have red pigment in their hair. This shows up in varying degrees depending on the individual moose, angle of sunlight onto the moose, and amount of light. There may be a tendency for younger moose to exhibit this redness more than older moose. At any rate, it is the presence of the red pigment which makes moose stand out from other dark objects such as stumps and boulders.

Since people who are color-blind cannot see this red color, they may never become as proficient as others in spotting moose, and it may be desirable not to use color-blind individuals as moose observers.

For the same reason, color-blind individuals could have difficulty in sexing moose using face color. (See Page 62).

G. Moose Aggregations

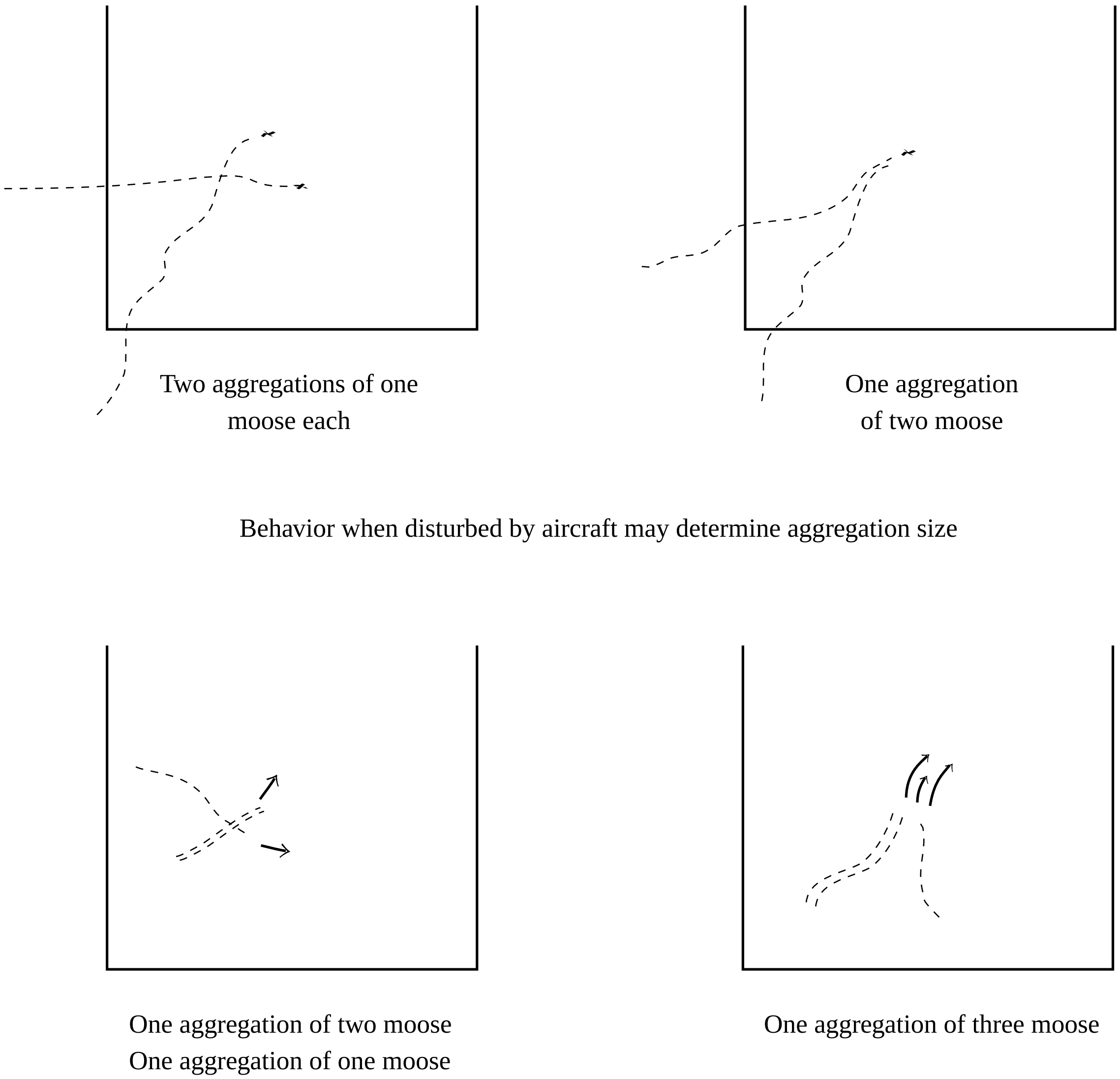
1. Determing Aggregation and Their Size

An aggregation is a group of one or more moose, when all the moose are in close proximity, and especially when there appears to be a behavioral or social bond between those moose. For instance, if a cow and calf are spotted, the observer can readily see their close proximity, and also their behavioral and social bond as evidenced by touching and then running together into cover. Another good example concerns the bulls-only group, when they have the same sized antlers (social bond), and are all bedded down (behavioral bond), within a 50-yard circle (proximity). Tracks, showing the past movements of groups of moose or individual moose, are a valuable indicator of whether the moose form an aggregation or not. When a group of moose appears to have been formed very recently, disturbing the moose with the aircraft may result in their running off together (one aggregation) or splitting into smaller groups and running apart (two or more aggregations). Usually, determining aggregation size is not difficult, and it is only occasionally that a judgement call must be made.

Aggregation size varies from one moose on up to 12, but large groups are usually temporary in nature, resulting from a large number of moose concentrating in a preferred early-winter feeding area, and breaking up into smaller units in a short time. In Ontario the average aggregation size is about 2 moose over the course of the winter; however, in some areas there appears to be a peak in early winter (December and January) and a low point in late winter (March and April). In other words, moose may form larger groups in early winter (during optimum survey time), and may tend to be found as singles and small groups in late winter, but this tendency can be easily affected by snow depth and local habitat conditions.

As an aerial observer, you cannot expect moose to behave according to general tendencies, that is, if you observe a single moose in late winter, you must continue to circle for at least a little while, in order to determine if the moose was really alone.

Figure 26. Track Pattern May Determine Aggregation Size

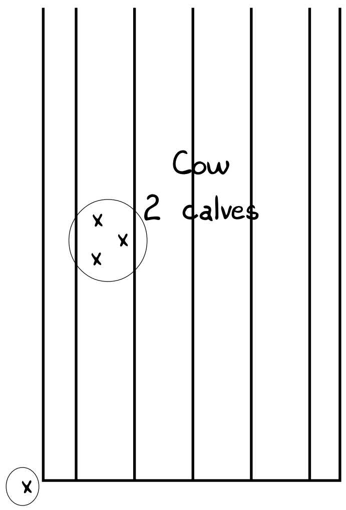


2. Recording Moose Aggregation

As is the case with other significant data, moose aggregation information must be accurately recorded in such a state that it can be easily deciphered and used. It does not make good sense to spend four expensive hours of flying time in obtaining valuable information, only to find that the observer forgot to record the data, or recorded it in such a sloppy or inconsistent manner that the data is useless. Fortunately, the recording of moose aggregation data is very simple. In surveys where all data is recorded on the map, the easiest recording method is to circle each aggregation separately, be it composed of one moose or ten moose. A second method uses an accompanying form, upon which aggregation data is recorded by circling or bracketing the consecutive moose numbers concerned, this method may be combined with the previous method. The latest in-flight laptop computer program collects moose data by aggregation.

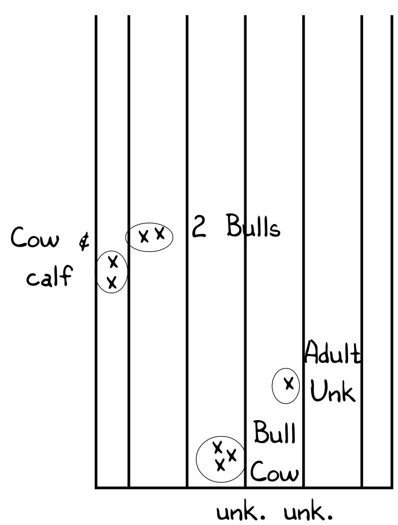
Figure 27. In-Flight Data Recording On Flight Maps

System #1



1. Use "X" to map each moose location.
2. Write sex and age beside each moose.
3. Circle each aggregation.
4. Record location only of moose just off plot.

System #2



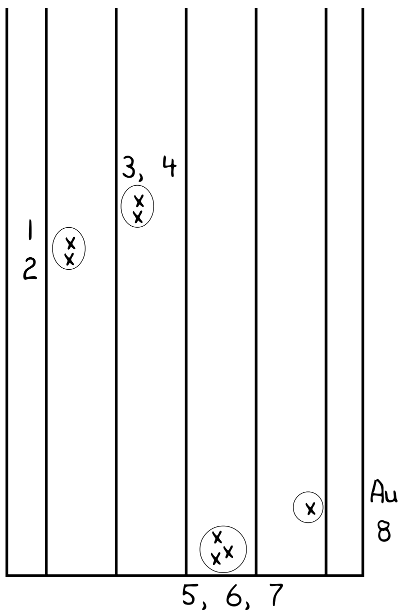
MA = male adult (bull)
FA = female adult (cow)
UA = unsexed adult
UC = unsexed calf
UU = unsexed unknown
(no sex or age information
C = calf

Note: It is often convenient to use short forms in recording sex and age information.

Although this data is now recorded in-flight by computer, batteries and programs have been known to fail. Do back-up this data on flight map.

Figure 28. In-Flight Data Recording On The Flight : Map And Checklist

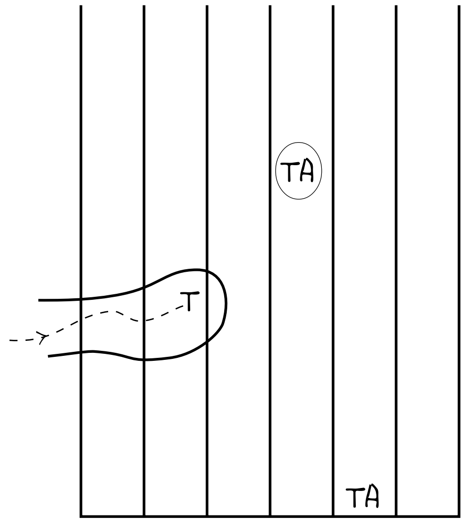
System #3



1. Use an "X" to locate each moose on the map.
2. Circle each moose aggregation.
3. Assign each moose on the plot a consecutive number, as they are found.
4. Record all sex and age information on the checklist by moose number, as they are found.
5. Circle or otherwise separate moose aggregations on the checklist.
6. Record and locate all moose just off plot as A1, A2, ect.

Note: This system is most useful when very high number of moose (up to 50) are on plot. Use the checklist in Fig.63.

Figure 29. Recording Track Aggregations



All track aggregations should be located on the map, and recorded by the letters “T” or “TA”.

It is recommended that the tracked area, and the letters “T” or “TA”, be circled to delineate groups.

H. Track Aggregations

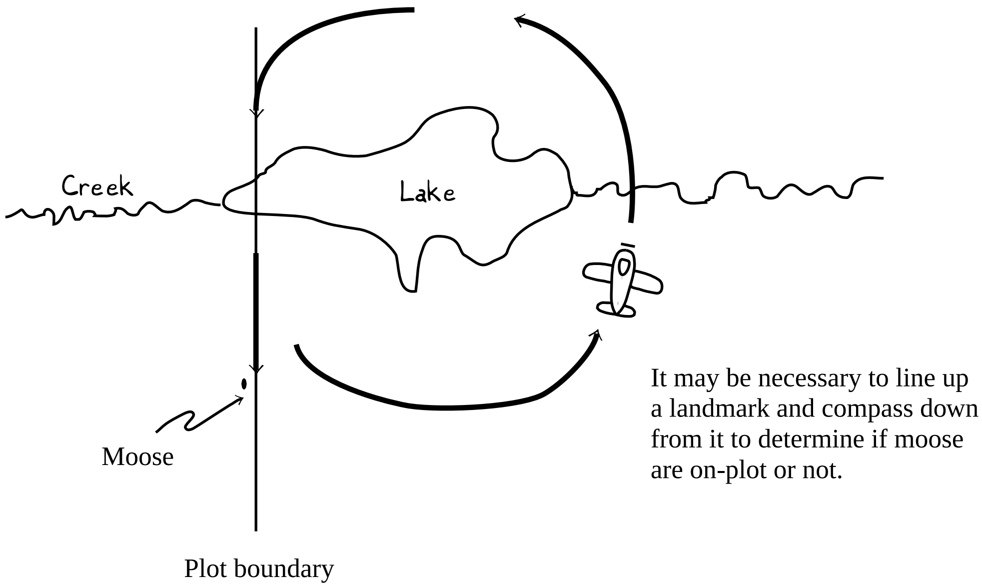
A track aggregation occurs when fresh tracks are found on a plot but the moose making them cannot be found, and the observers are positive that the moose have not left the plot. It is necessary, to search out all fresh-appearing tracks to the bitter end, firstly to find the moose that made them, and secondly to determine whether the moose left the plot or not. Often a few extra minutes of searching and track following can make a real difference in detailed results.

Remember that while accurate recording of track aggregations is very important, it is much preferable to find the moose. Count a track aggregate only when all else fails.

I. Moose “On” or “Off” The Plot

Locating moose accurately to determine whether they are on or off the plot is of the utmost importance in counting moose densities. Observers must not yield to the temptation of marking moose on a plot when they are actually outside the plot boundaries. Off-the-plot moose should not be counted to compensate for moose missed on the plot, as the density computations at the end of the survey may already do that. In certain areas, and under circumstances where it is very difficult to determine whether moose are on or off the plot, the best policy might be, “if you can’t be correct, at least be honest”. All moose observed, whether on or off a plot, should be located and marked as accurately as possible on the map or photo. Recent innovations in satellite-based navigation instruments has made it easier to determine if moose are on the plot or not.

Figure 30. Moose "On" Or "Off" The Plot



J. Summary

1) Distribute maps to pilot and navigator, and review plots and order to be flown with them.
2) Start plot at best landmark.
3) Record weather data and start time on map.
4) Use flight-lines as guide to search for tracks.
5) Find tracks and follow to determine track direction.
6) Find freshest track section.
7) Determine whether moose will be on or off plot.
8) Attempt to find moose on or close to plot.
9) If on-plot moose cannot be found, record a track aggregate and its location on the map.
10) If moose are found on-plot, record location on map where moose were first seen.
11) Determine sex and age of all moose if possible, and record.
12) Determine aggregation size and record on map and/or forms.
13) Return to flight line and use as guide to find other tracks.
14) When plot has been adequately covered, and completed, (at least 30 minutes) record finish time.
15) If there were any instances where you suspect moose were missed, perhaps go back and re-check before ending plot.
16) Check maps and forms for completeness and accuracy before starting next plot. Do they conform to the Provincial Standards & Guidelines?
17) Correct forms and add data if necessary while details are still fresh in mind.
18) Go to next plot.

Sex and Age Indicators

A. Introduction

Sex and age indicators can be defined as those visible physical attributes of moose, which are of value to the observer in determining sex or age. For instance, the presence of antlers is a visible physical attribute which always indicates a male over one year old. However, the male hormone testosterone is a physical attribute of all male moose, but is not visible and therefore of no use to the observer. Sex and age indicators can be divided into two classes:

1. Primary or positive,
2. Secondary or lesser value.

These two classes are listed below, and the following sections go into more detail on each indicator.

Primary or Positive Indicators

1. Antlers
2. Vulva Patch
3. Size
4. Face Color

Secondary Indicators

1. Behavior
2. Aggregation Make-up
3. Bell Size and Shape
4. Body Build and Colour
5. Antler Pedicel Scars

B. Antlers

1. Introduction

Antlers are a gift from above to the moose observer, to tell male moose from female moose. Moose undoubtedly find them useful for the same purpose. The presence of antlers is a positive indicator that you are observing a male. However, the absence of antlers, except in very early winter, (up to early December) is not a positive indicator of the female sex. All male moose, except calves, carry antlers of one sort or another during early winter, unless they have been wounded and prematurely drop them.

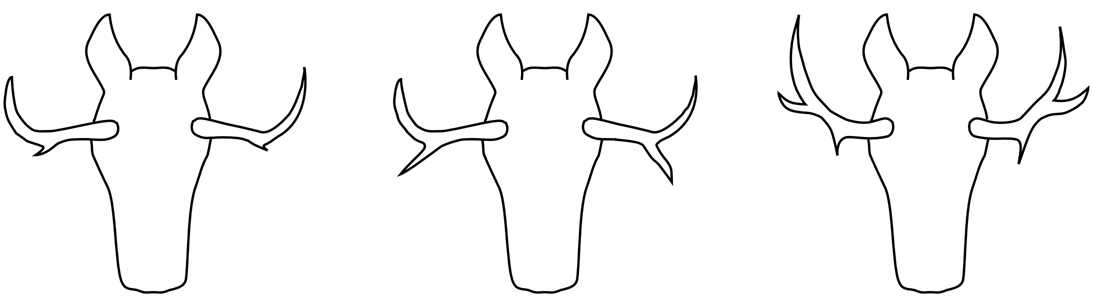
2. Antler Types

The recognition of antler types is important because they indicate roughly the numbers of prime, sub-prime, and young bulls in the herd on a management unit. Although studies are still underway on this subject, it appears that social maturation (the degree of “primeness”) compares to antler types about as follows:

Antler type		Approximate Age
Spike	Yearling	
Fork		
Small Palm (parallel)	Yearly	2 - 3 years
Cervicorn (3+ points)		
Medium Palm (beginning to open)	Young prime	4 - 5 years
Large Cervicorn		
Large Palm (open)	Best prime	6- 10 years

Readers should study the diagrams of different antler types(Figs. 31, 32, 46 to 48) and Appendix E.

Figure 31. Antler Types



Spike

Fork

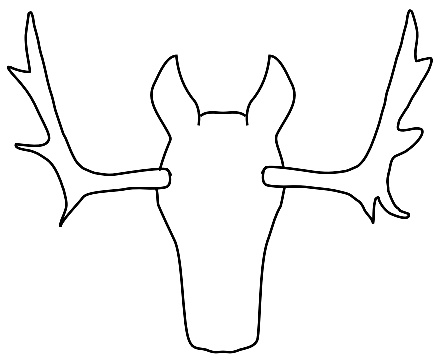
Cervicon (Deer-like)

- may appear as a very small and narrow shovel, which would be classed as a small palmate

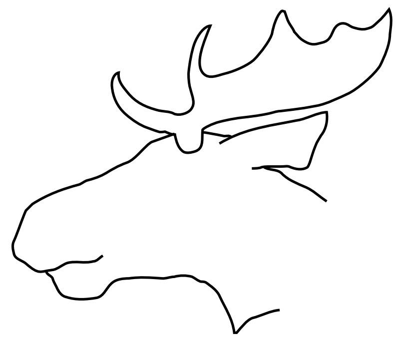
Compare with: Figs. 46, 47, 48. (from Bubenik, *et al*, 1977)

Figure 32. Antler Types

Medium Palmate (spike brow tines)

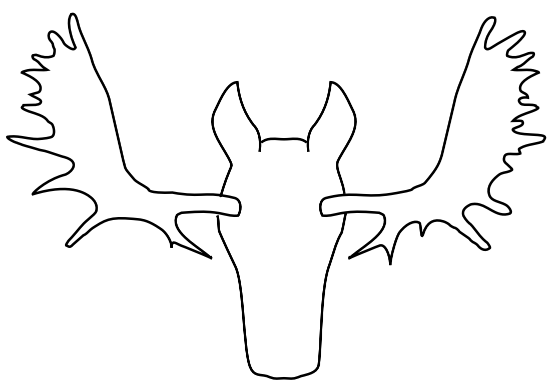


Upper view: narrow

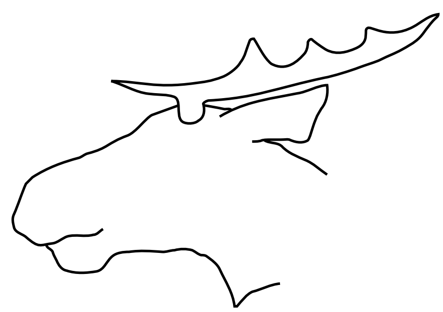


Side view: wide

Large Palmate (palm brow tines)



Upper view: wide



Side view: narrow

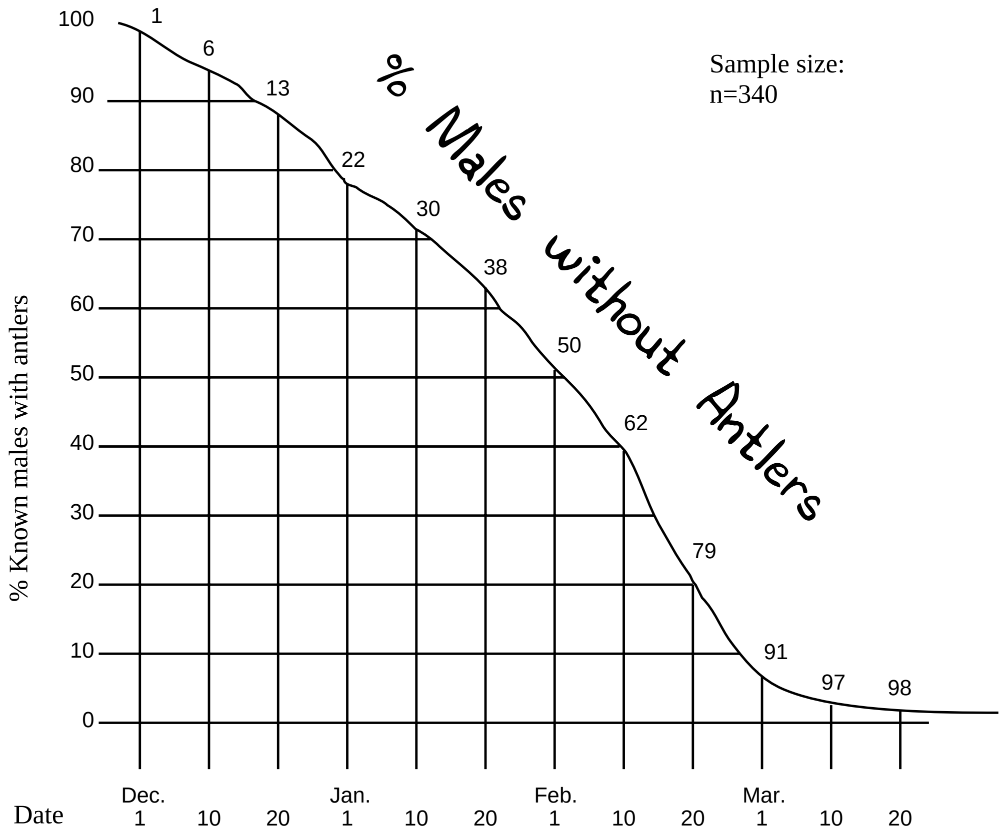
Note: The brow tines begin to shovel and to move inwards (to protect the eyes) as the moose becomes more prime.

COMPARE WITH: Figs. 48, 49, 50.
(from Bubenik, *et al,* 1977)

3. Antler Fall and Its Effect on Sexing

During the rut, and for a time afterwards, all bull moose have antlers and all large unantlered moose are cows. By the first of December some prime bulls are already losing antlers, and by the first of January about one-quarter of all bulls have dropped their racks. Only a few yearlings carry antlers after the first of March (Fig. 33).

Figure 33. Approximate Rate Of Antler Drop Near Wawa, Ontario



Note: There is some evidence that in a moose population under stress, bulls tend to carry their antlers longer into the winter.

Some researchers have indicated that in a population with prime bulls composing 50 percent of the males, those prime bulls will lose their antlers from the end of November to the first of January. The yearlings cast their antlers from late February to late April. The same research indicates that in a disorganized population (not enough prime bulls, too many females) the antler fall is delayed up to two months in prime bulls. Wildlife managers may be using the timing of antler fall in the future, as an indicator of social well-being of moose populations.

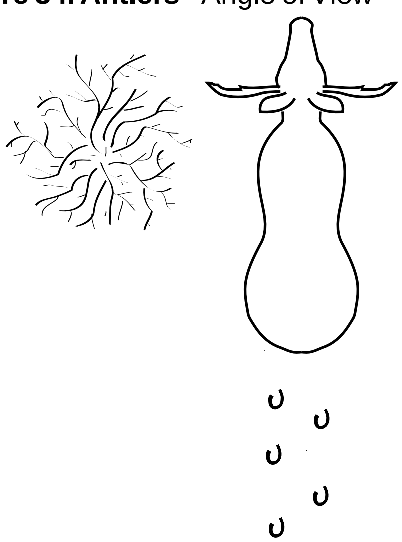
Since the presence of antlers is the single easiest way to sex moose, it naturally follows that the earlier you start and finish your flying commitments, the easier and more accurate your sexing of moose will be. The later into the winter a survey is conducted, the more skillful observers must be in recognizing other sex indicators such as face color and the presence of vulva patches. It would be well to point out here that early winter is the time for the observer to learn or brush up on these other sex indicators (muzzles and vulvas), so that the sex determined from them can be confirmed by the presence or absence of antlers.

Another advantage of using antler presence in early winter is that the technique is not affected by whether the moose is laying, standing, or running (a shortcoming in the vulva patch technique). Light and shadow conditions (a shortcoming of the face color technique) do not hinder antler determination nor does the maturity of the moose, which affects face color.

4. Angle of View

The presence of antlers and the type of antlers may be determined from almost any angle of view, and can usually be easily determined during normal circling of the moose. The spike and fork type of antlers often seen on yearlings can sometimes be very difficult to see when screened by branches and brush, both deciduous and conifer. It may be necessary to circle repeatedly and get the moose moving to clearly see those two types of antlers (Fig.34).

Figure 34. Antlers - Angle of View



A high overhead angle of view may cause the observer to miss small antlers. Small antlers often get “lost” in the ears or against bushes and branches.

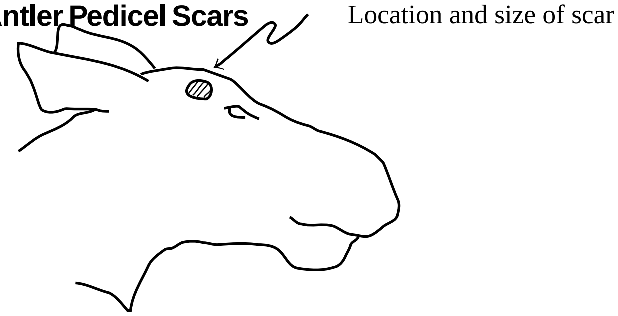
Be sure to look at both sides of the moose head when looking for antlers because of the possibility of single antlers (i.e. one having been cast and the other remaining). These single antlers are sometimes most difficult to see, especially as indicated above, the spike and fork types. Figures 46, 47 and 48 illustrate antler type and their appearance from different angles, on bulls of various ages.

5. Antler Pedicel Scars

When the antlers of a bull moose fall off, an open wound from one to two inches in diameter is left, flush with the skin. When fresh, the exposed area is reddish in color. This wound quickly scabs over, and is then known as a pedicel scar. Unfortunately for the moose observer, the scar is similarly colored to the hair around it, and is difficult to observe.

We recommend that observers in fixed-wing aircraft do not attempt to use the presence or absence of pedicel scars in sexing moose. Although it is not impossible to see these scars under ideal conditions from a fixed-wing, it is impractical. Observers using helicopters may have some success in sexing moose by antler pedicel scars, but it is still usually impractical.

Figure 35. Antler Pedicel Scars



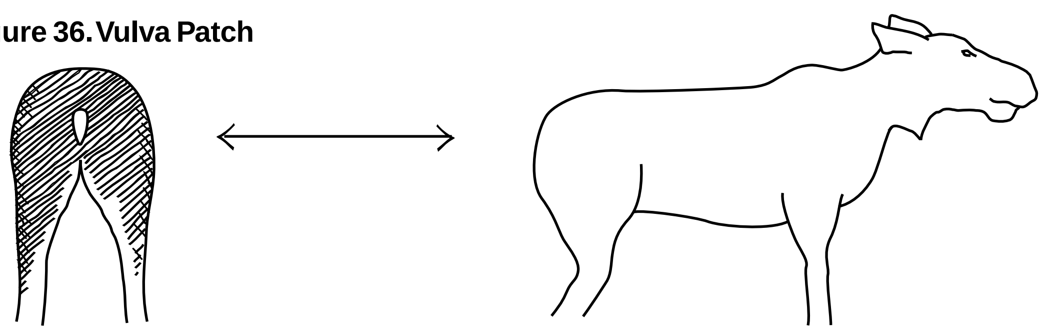
C. Vulva Patch

1. Description and Location

The vulva patch is a relatively small area of light colored hair found around the genital area of female moose of all ages. Its size does not exceed six inches by three inches, that is, it is big enough to see but small enough that you have to look for it. The patch itself is surrounded by, and shows good contrast to the dark hair of the tail, buttocks, and upper legs (Fig. 36). It is most visible when in direct sunlight.

Notwithstanding its relatively small size, presence of the vulva patch is the most reliable indicator of female moose after antler drop has started. Observers should always attempt to determine the presence or absence of this character on antlerless moose.

Figure 36. Vulva Patch

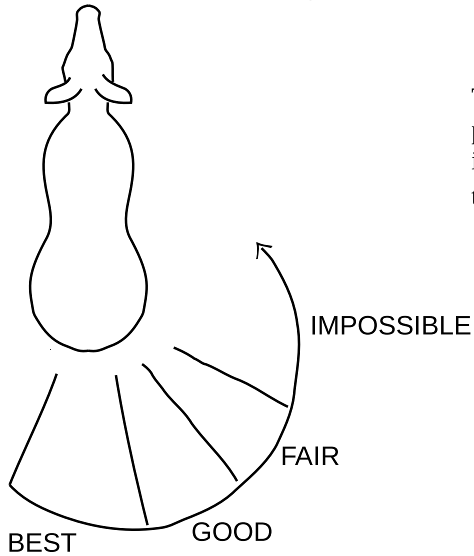


The vulva patch in the middle of the south end of a cow moose pointed north. It is easiest to see when the rear of the moose is in full sunlight, and shows up light against the dark body hair.

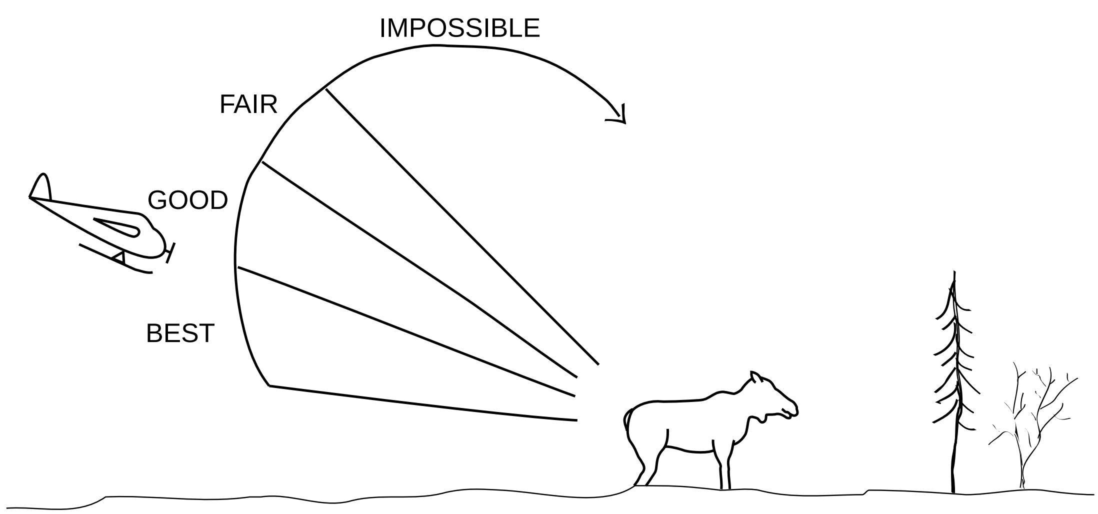
2. Angle of View

To obtain the highest success rate in determining the presence or absence of this sex indicator, the observer must view the moose from as close to the ground as possible, and from as directly behind the animal as possible (Fig. 37). To put this as plainly as possible: get down on the deck and fly right up its tail. This maneuver requires careful and skillful positioning of aircraft. If the targetted moose is standing still, try to quietly approach from behind it to prevent it bolting. If the targetted moose is lying down, you may want to increase the engine RPM and prop pitch to increase the noise level, jump it out of it's bed, and make the proper approach after turn is completed. Each situation will need to be assessed as to the most productive procedure.

Figure 37. Vulva Patch - Angle of View



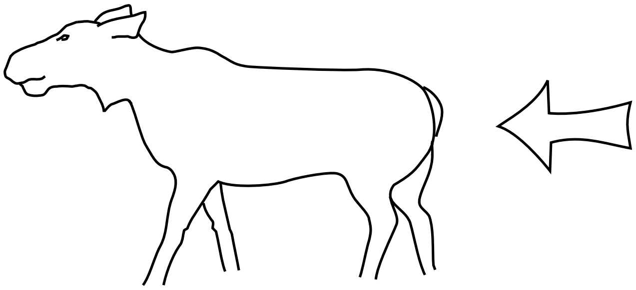
The observer's chances of noting the presence or absence of a vulva patch increase as he comes more in line with the long axis of the moose.



Observers and aircraft should approach the moose from as low an angle as possible for effective viewing of the vulva patch area.

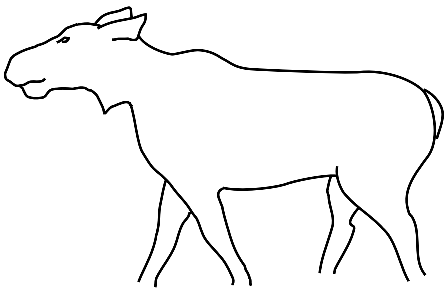
It is possible to see a vulva patch from a considerable side angle, but only if the moose is running or walking (Fig. 38). The vulva patch then appears as a white "flash" on every second step the moose makes. It is nevertheless more desirable to view the moose from behind.

FIGURE 38. VULVA PATCH - Angle of View



The vulva patch becomes briefly visible when the moose "scissors" its legs when running, but is visible from the side only when the near hind leg is forward and the far hind leg is trailing.

Vulva Patch
Exposed



When the near hind leg is trailing the vulva patch is not visible from a side view.

Vulva Patch
Not Exposed

3. Shortcomings of the Vulva Patch Technique

Moose that are laying down cannot be sexed by presence or absence of vulva patch. Moose can often be jumped from their beds by circling and diving with the aircraft, using a high RPM on a variable pitch aircraft. Some moose refuse to jump despite repeated efforts, and can never be sexed by this technique (Fig. 40).

Caution : Do Not attempt to jump unantlered moose after February unless other sex characters indicate a bull. Pregnant cows and unborn foetuses can suffer from the stress caused by jumping and running.

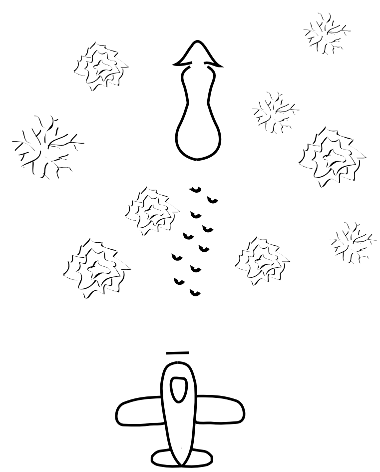
Moose in medium to dense conifer cover may be impossible to sex by this method unless an opening sighting lane exists behind the moose. This condition can be aggravated by the heavy shade in conifer stands, which can cause poor contrast between the vulva patch and the surrounding hair. Sometimes the moose can be pushed by the aircraft into a better location (Fig.39).

New observers, and observers new to sexing and ageing techniques, appear to find the vulva patch character the most difficult to learn. This can be remedied by training seasons using helicopters, or as a second choice, slides, and lots of practice. After antlers, vulva patches are the best sex determinator.

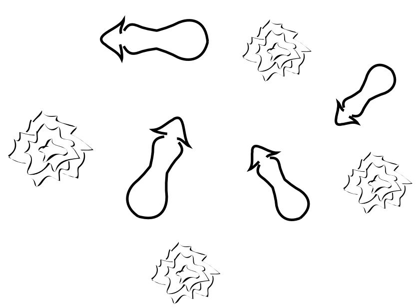
The technique is not usually applicable to calves except when there is an excellent angle of view, (e.g. when calves are found on lakes or shorelines and the aircraft is able to approach them from very low and straight behind). In any case, it is not generally considered necessary to spend valuable time in sexing calves, as their sex ratio is normally 1:1 anyway.

Other shortcomings of the vulva patch sexing technique are illustrated on the following pages.

Figure 39. Vulva Patch - Shortcomings of the Technique

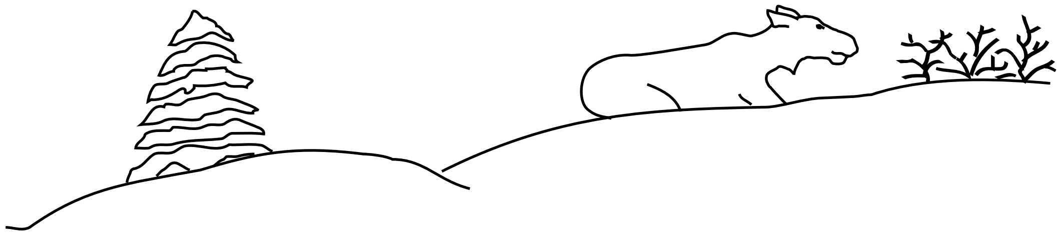


Moose in medium to dense cover may be impossible to sex by this method, except when an open sighting lane exists behind the moose.



When a number of moose are milling around in a group, it is difficult to detect the presence or absence of the vulva patch on more than one animal per pass. On succeeding passes, it is difficult to tell which animals have been sexed. It may be necessary to chase the animals apart so that they can be individually sexed.

Figure 40. Vulva Patch - Shortcomings of the Technique



It is impossible to detect the presence or absence of the vulva patch on a moose that is laying. It may be necessary to “jump” the moose using the aircraft noise.

Patches of snow or ice, or patches of discolored hair, could be mistaken for/or confused with a vulva patch.

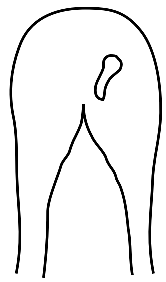
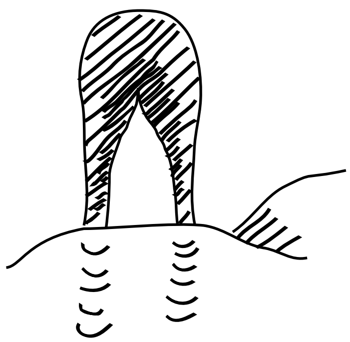
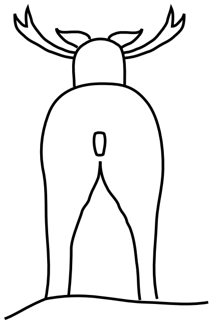


Figure 41. Vulva Patch - Shortcomings of the Technique



A moose moving through deep snow may have kicked snow up the rear side of the legs and lower back. This can completely obscure the area where the vulva patch is found.



A very few bulls are known to have a vulva patch.

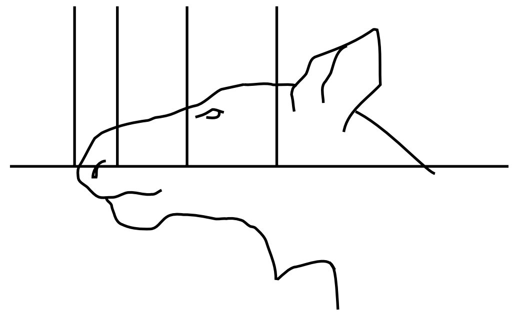
On some cows, the vulva patch may be so small or so placed as to make it possible to see only under ideal conditions.

D. Face Color

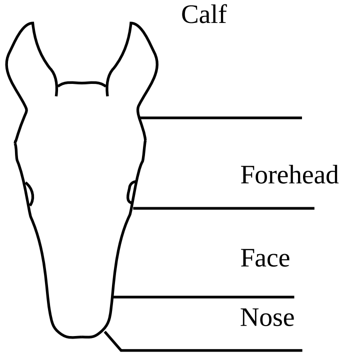
I. Description and Location

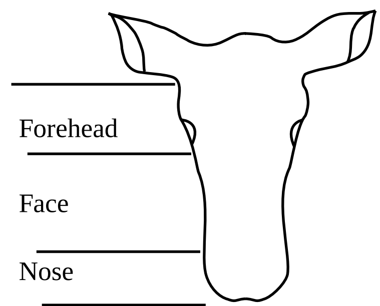
The faces of moose have hair which is pigmented in accordance with sex and age categories and time of year. For our purposes, the face may be defined as that area on the upper half of the head as seen in a side view, between the eye area and the nose area (Fig. 42).

Figure 42. Face Color - Location



The proper area to use in face color determination is located in the middle portion of the face, between the eye area and the nose, on the upper half of the head.





(from Bubenik, *et al*, 1977)

2. Effects of Sex and Age on Face Color

Although there is considerable individual variation among moose, face color is strongly related to sex, and to age. The faces of cows tend to become lighter with age, while the faces of bulls tend to darken with age. The faces of calves show the least variation between sexes, and aerial observers have found that it is not practical to sex calves by this method. The faces of yearlings are often intermediate in color, as well as the faces of some moose that are 2 1/2 years old. Beyond this age, there are few moose whose faces will not show strong light or dark coloration (Figs. 44 to 48).

The faces of cows tend to remain the same light color year round. For this reason, it is strongly recommended that commencing late February the observer try to sex moose by face color first, and if unsuccessful, then by vulva patch. Because cow moose are entering the latter stages of pregnancy at that time, it is important not to disturb them too much with the aircraft. The very light face on older cows is often easily visible, both from the side and top views, from a considerable distance, allowing the sexing of these moose with a minimum of stress to the animal. If the use of face color and other sex indicators still leaves the observer unclear as to the sex of the moose, then he should use the vulva patch technique, but use it with discretion.

In bulls, the amount of dark hair, and the degree of darkness, appears to be influenced by the seasonal production of testosterone, the male sex hormone. The faces of bulls are darkest in early winter, and may become lighter as the winter progresses. This lightening will likely affect observers more in the case of younger moose. The faces of some mature bulls seem to stay dark all winter.

3. Compara-Color

a) Compara-Color

Most observers prefer to class moose faces into two colors (light and dark). Light faced moose are classed as cows, while dark faced moose are classed as bulls, and moose whose faces are intermediate in color are classed as “unknown face color” (Fig. 43). At the present time, this two-color system is recommended for the following reasons:

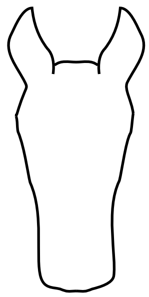
1. it is practical for sexing purposes
2. it is easy to learn and use
3. it makes efficient use of aircraft and observer

In this system, what we are really doing is comparing forehead color and face color. The color of the forehead, and around the eyes, is always light, regardless of sex. When there is a strong contrast between forehead and face (light forehead compared to dark face) a bull is indicated. When there is no contrast (light forehead, light face) a cow is indicated. When there is difficulty in determining contrast (light forehead, intermediate face) a “sex-unknown” moose is indicated.

Do not use the color of the nose when sexing moose. Nose color has no practical value in determining sex.

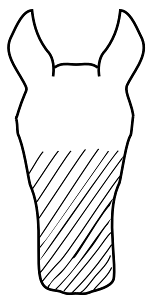
Do practice comparing forehead color and face color whenever possible, especially early in the year before antler drop. When making a tail-end vulva patch run, or while circling to determine antler type, take the opportunity to look at the face of the moose. This will give the observer an appreciation of face color variation in the two sexes of moose of different ages.

Figure 43. Face Color - The "Two-Color" System



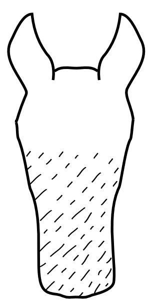
Light

The obvious light colour extending from forehead to nose makes this a cow.



Dark

The black face, contrasting strongly with the light forehead, indicates a bull.



Unknown

Since this intermediate face is neither light nor dark, the moose must be classed as having unknown face colour.

b) Three-Color System

The hair on moose faces comes in three colors:

light - a blond or yellow color
tan - a light or medium brown
black - a dark or very dark brown; true black

A classification system using these three colors (i.e. light, tan, dark brown), appears preferable if a count of yearling moose is wanted. This system shows promise in determining the maturity classes of unantlered moose, however, it is more difficult to learn and use (angle of view problems, light conditions). To complicate matters, these colors often intergrade on the face of the moose. Until there is a need to determine maturity classes of unantlered moose, it seems more reasonable to use the simpler two color system.

Figure 44. Head Pigmentation - Calves (1/2 years of age)

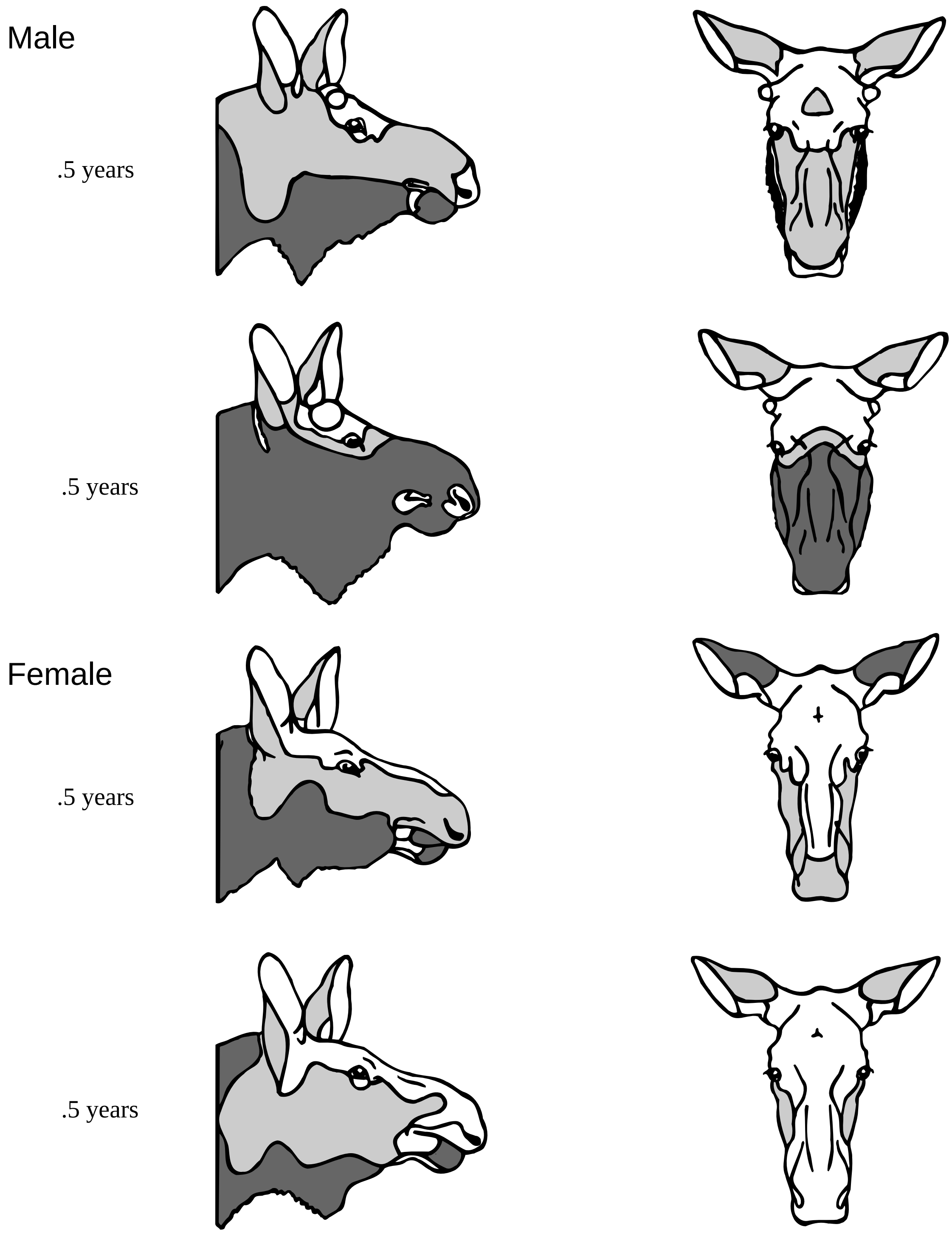


Figure 45. Head Pigmentation - Cows (1 1/2 -14 1/2 years)

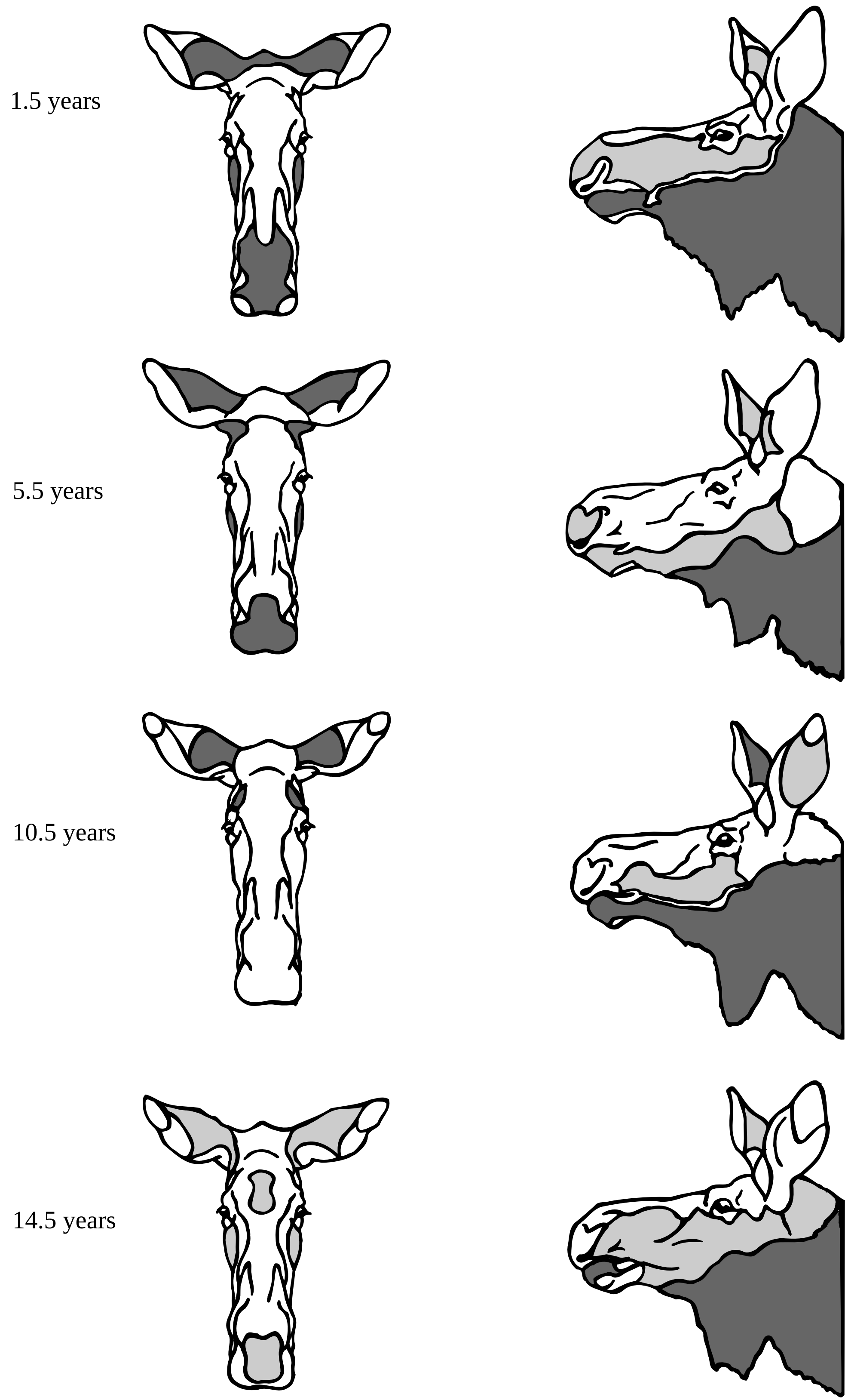
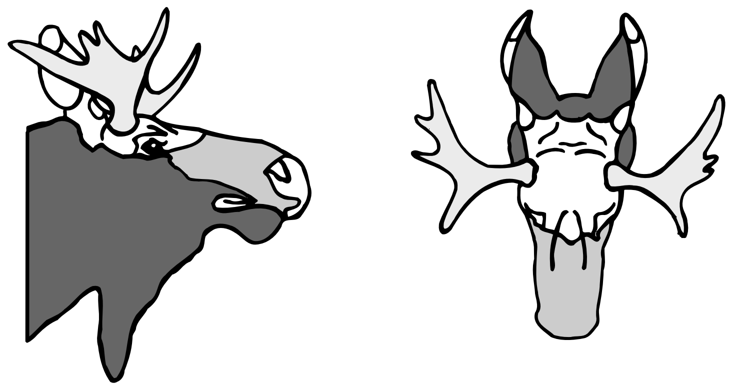
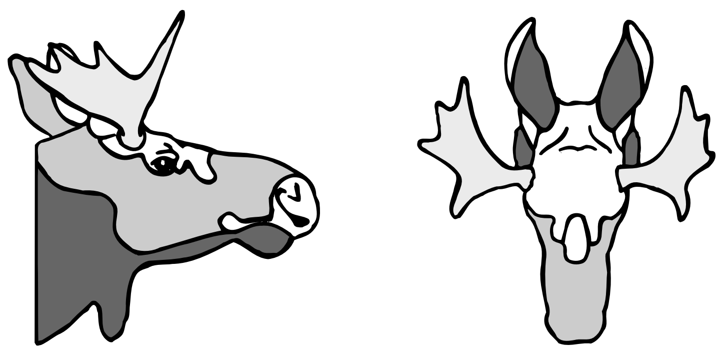


Figure 46. Head Pigmentation - Bulls (3 1/2 - 5 1/2 years)

3.5 years



3.5 years



4.5 years

5.5. years

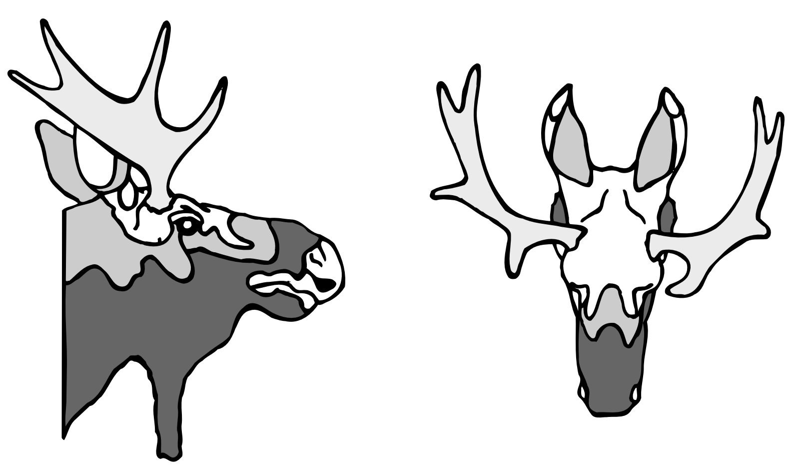


Figure 47. Head Pigmentation - Bulls (3 1/2 - 5 1/2 years)

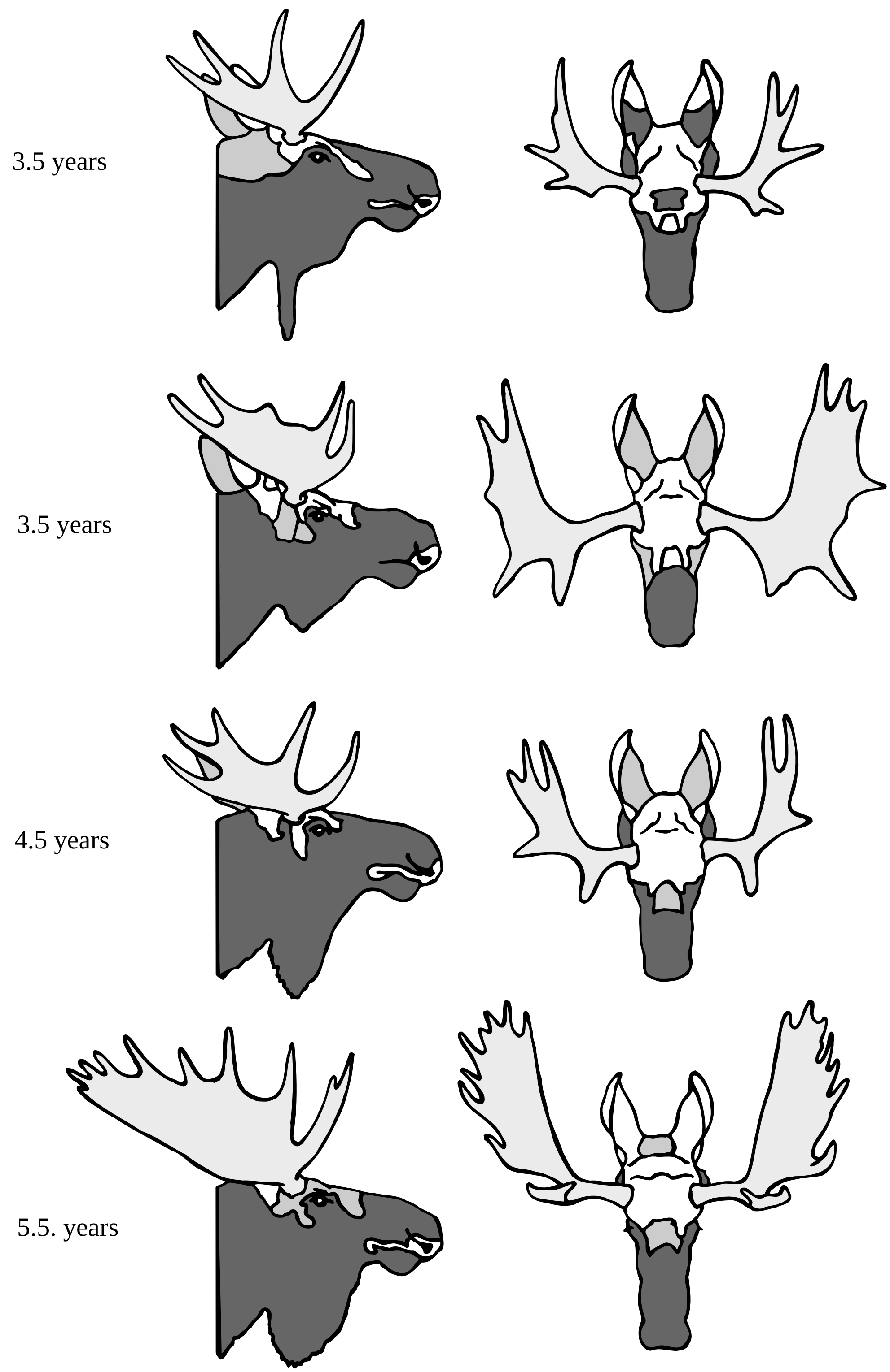
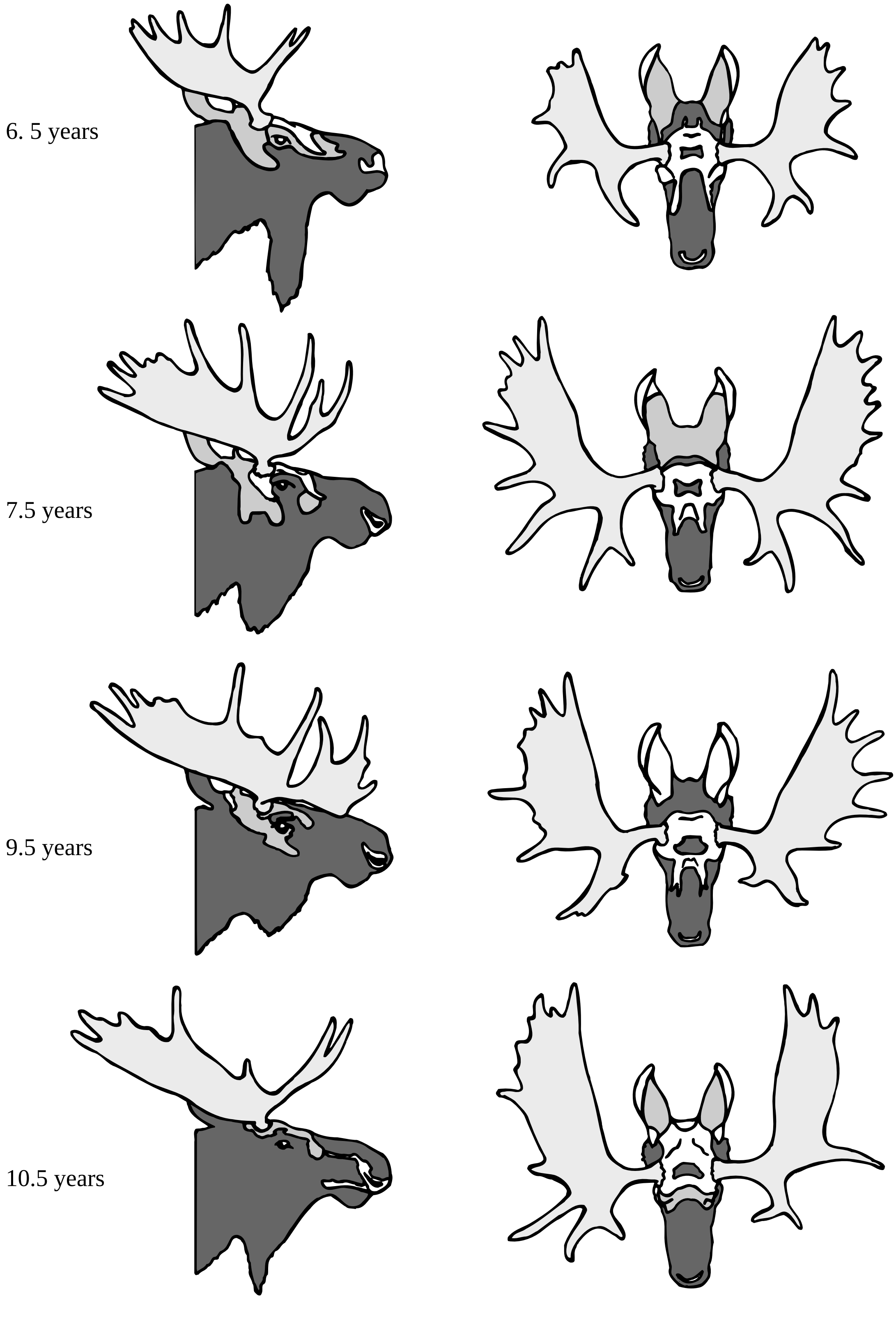


Figure 48. Head Pigmentation - Bulls (6 1/2 -10 1/2 years)



4. Angle of View

The best viewing angle for face color is from straight over the moose. This angle enables the observer to see the forehead-face contrast with the least trouble (Fig. 49).

The face color can also be seen from a low, side angle, particularly where bulls are concerned. This angle is sometimes made necessary by snow on the forehead and face (Fig. 51).

Some moose can be sexed easily from a high, side angle (Fig. 49). Usually these are cows standing in full sunlight. When they are standing at right angles to the observer, and turn their heads toward the observer, the light-colored face against the dark body can be seen from considerable distances. Some bulls can also be sexed in this manner.

In summary, the straight overhead angle of view is recommended for this sexing technique, when the face is in full sunlight.

5. Shortcomings of the Technique

a) This technique is valid mainly for older moose of both sexes. Younger moose, up to two and half years of age, do not always show this sex indicator very well, and often have to be classed as “face color unknown”.

b) Light conditions play an important role in determining face color. Poor light conditions are responsible for mistaken sex determination, and inability to sex moose at all. Poor light conditions manifest themselves in two ways:
1) poor color contrast **2)** shadow.

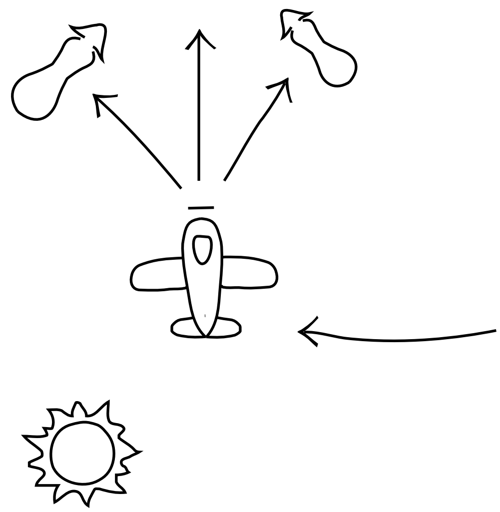
Poor color contrast occur when anything less than full, bright sunshine is present. Weather phenomena such as ice crystal, snow, fog, and cloud of all kinds, may be responsible. This condition also occurs when the moose are located in deep shadow areas such as valleys, ravines and in heavy conifer cover. Flying too early or too late in the day can also be a cause. When observing moose under less than ideal conditions extreme care should be exercised because the face colors will appear dull and there will be less contrast between the face and the forehead. Observers should expect the percentage of moose with unknown face color to be higher when conducting aerial moose inventories under these conditions.

Shadow manifests itself in two ways: First, when the head of the moose is in shadow, but the rest of the moose is not, the whole head (including the face) will appear darker because the human eye cannot adjust quickly enough to interpret true color in deep shade, after looking at a dark body in bright sun (Fig. 50). This condition can result in mistakenly calling the face dark. Under these conditions, using discretion, chase the moose or allow it to wander into an area where sunlight strikes the head, in order to make a positive determination of face color.

The second shadow problem occurs when the face is viewed in its own shadow, so to speak. This is caused by a wrong approach and angle of view, in that the observer is looking into the sun and at the side of the moose head which is in the shade. The problem can be resolved by a correct down-the-sun aircraft approach so that the observer sees the face in full sunlight (Fig. 50).

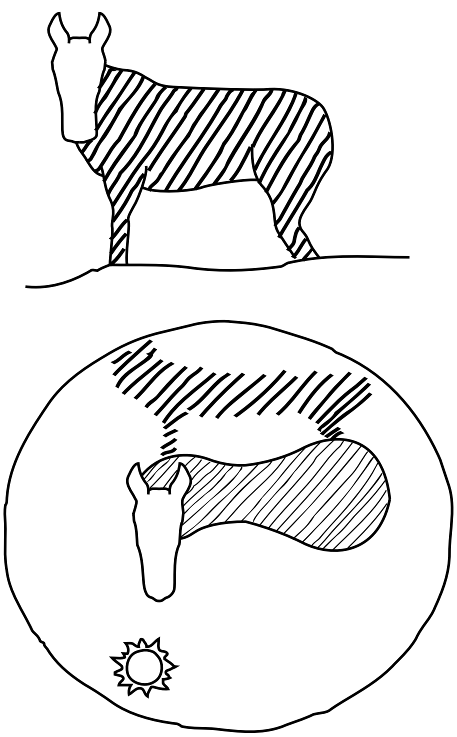
At times, some individual moose insist on standing with their backsides to the sun, so that the whole forward part of the head is in the shadow of the back of the head. Usually, the moose can be persuaded to move around enough that the face receives full sunshine.

Figure 49. Face Color - Angle of View



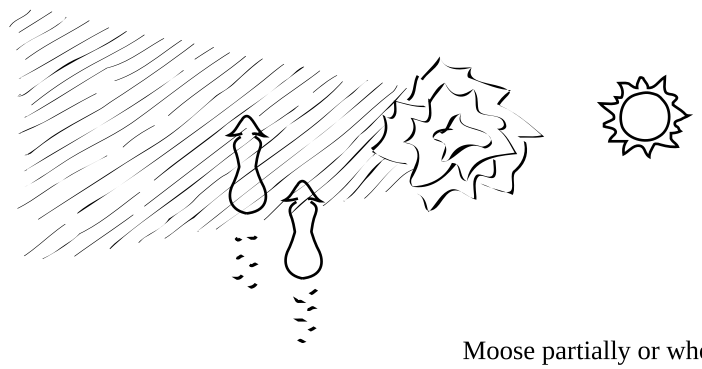
Always approach the moose with the sun at your back. This ensures maximum brightness of face color, both light and dark; and also ensures maximum contrast between face and forehead.

Plan the aircraft orbit to come down the sun each time. This allows a much longer look at each face in full sunlight, than coming in from other directions.



In full sunlight, when cow moose stand broadside and look at the observer, their light faces show up at long distances, in contrast to the dark body color. This shows up best when the observer is looking “down the sun” towards a moose facing him.

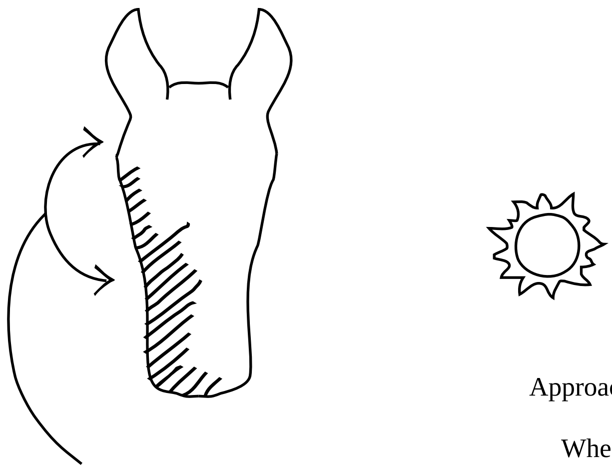
Figure 50. Face Color - Shortcomings of the Technique



Moose partially or wholly in shadow

1. When body is in full sun but head is in shadow, the face appears dark whether it is or not.

2. When whole moose is in shadow on a bright day, the whole moose (including face) appears darker than it really is.

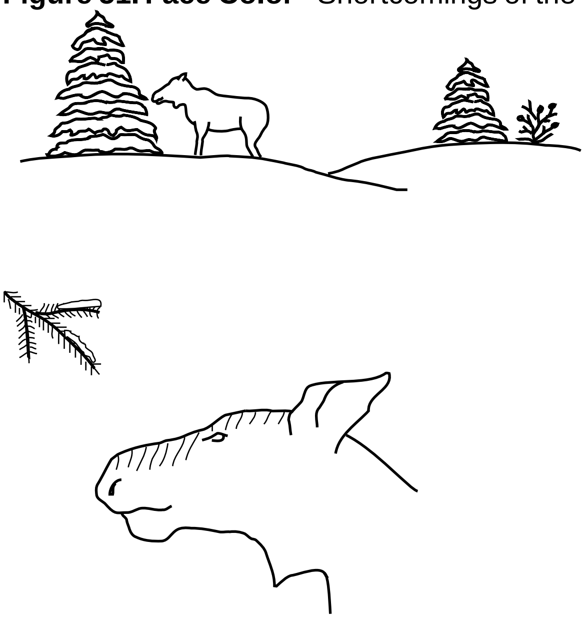


Mistaken contrast because forehead is in light and this side of head is in shadow

Approaching moose at wrong angle

When approaching into the sun, the shaded face will appear dark. If correctly viewed down the sun, the true face color is seen. Sometimes repeated circling is necessary, until the moose holds its head in the right position.

Figure 51. Face Color - Shortcomings of the Techniques



Snow on head

Due to movement through, and feeding on, snow-covered trees and shrubs, moose may have a dusting of snow on the face. This may cause:

1) mistaken determination of light face instead of dark;

2) if the condition is recognized, interference with use of face color as a sex indicator.

Despite this condition, sexing can still be conducted if care is used.

Note: This condition may sometimes be recognized by the presence of snow on the moose's neck or back.

E. Size

I. Introduction

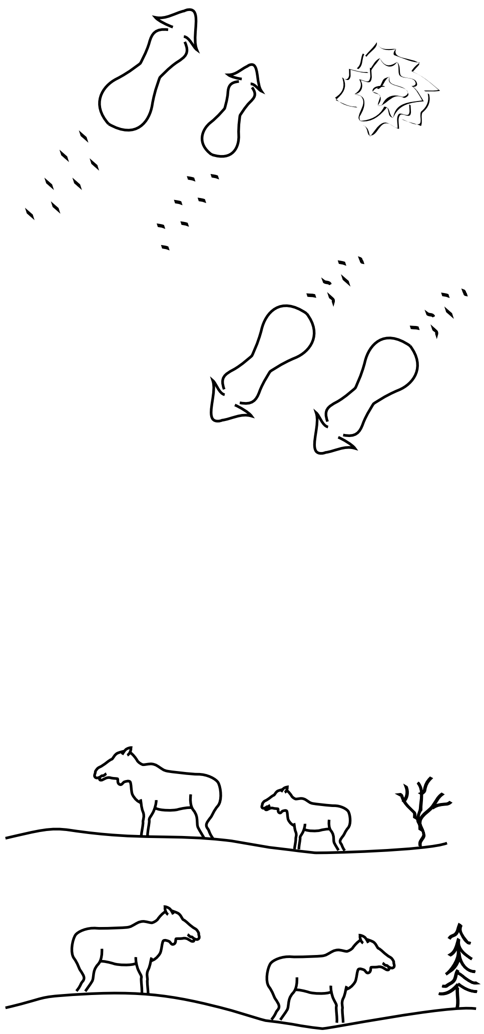
While size is obviously an indicator of the age class of moose, it is also useful, in the case of cow-calf aggregations, as a sex indicator. It is probably overstating the obvious to say that all large moose are adults (this class includes yearling and older) and that all small moose are calves. Observers should keep in mind however, that when we are speaking of the size of moose, we mean the relative size, that is, the size of one moose as compared to another, or the size of one moose as compared to another object. Most often, what we are looking for is the presence or absence of size difference.

2. Angle of View

The most effective view is from straight overhead (Fig.52). Usually, when a moose group is first spotted, it is a good idea to make an overhead circle to determine whether there are other moose in the aggregation. This first circle often creates an excellent opportunity to compare the sizes of moose seen. When observing a cow-calf aggregation, the size difference is quite noticeable, since the two animals are usually very close together. This overhead angle is effective in all cover types.

The second best angle of view occurs when the observer is very low to the ground and has a good broadside view of the moose (Fig.52). This angle is limited in effectiveness to open forest cover types, cutovers, and burns.

Figure 52. Size - Angle Of View



A straight-overhead angle of view is best for determining the relative size of moose.

The second best angle of view is from very low and broadside to the moose.

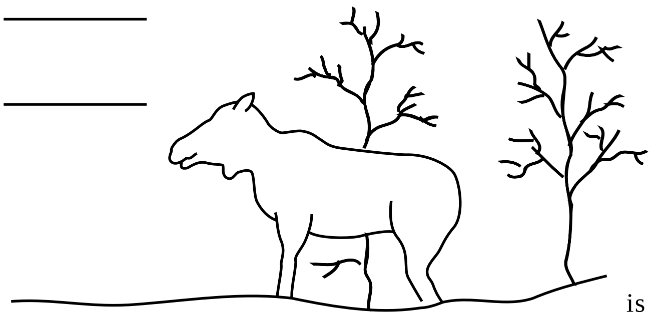
3. Shortcomings of Technique

a) Absolute versus Different Size

As mentioned before, the use of size as an age indicator depends on the comparison of sizes of two or more moose. It is very difficult to judge the absolute size of a single moose. Comparing the size of a single moose to the trees and shrubs around it is of limited use, because, for instance a small moose seen against small shrubs will appear larger (Fig. 53). Often, when an apparently large moose is observed, the largeness of the animal is actually judged by other indicators such as large bell, dark body color, and body shape.

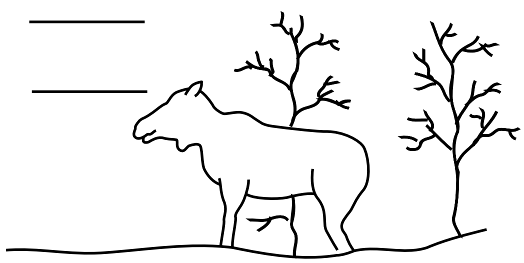
Figure 53. Size - Shortcomings of the Technique

Judging the size of lone moose is very difficult.



Large moose seen against large shrubs

While the moose diagrammed above is larger than the one below, they will appear to be the same size to the aerial observer because each is the same size relative to its surrounding and background objects.

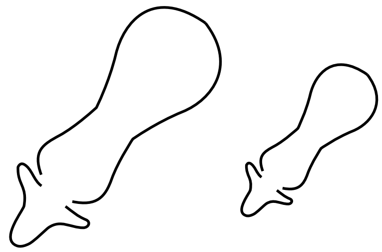


Small moose seen against small shrubs.

b) Cow-Calf Aggregates versus Cow-Yearling Aggregates

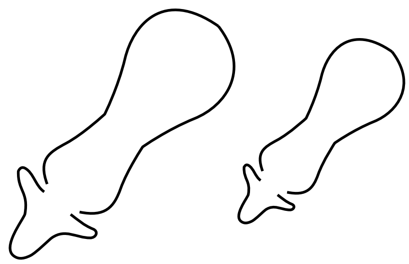
Cow-calf aggregations are often determined solely by the size difference between the two animals observed. It must be kept in mind, however, that a small cow with a calf will show the same relative size difference as a large cow with a yearling. While calves exhibit a different body shape, and have a more pointed snout or shorter face than other moose, these are subtle differences that are not always visible to the observer because of movement of the animals or because of tree cover (Fig. 54). Therefore, the determination of cow-calf aggregations should be reinforced by behavior indicators. The accurate counting of the calf segment of a moose population is very important in determining productivity of that population, which forms the basis for determining the annual allowable harvest of moose from some management units.

Figure 54. Size - Shortcomings of the Technique



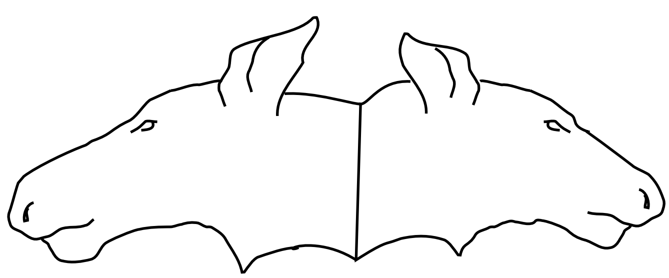
Small cow with calf.

Both sets of animals on the left exhibit the same degree of size difference. As a back-up, use behavior indicators and see below.



Large cow with yearling.

To help you decide the difference:



Cow Calf

Note: The more pointed and shorter face of the calf.

4. Additional Notes on Moose Size

The following rules hold true about 99 percent of the time:

1) Single moose are adults.
2) Two or more moose of the same size are adults.
3) One or two distinctly small moose with a relatively large moose are usually a cow-calf (or calves) aggregation. Follow-up with behavior characteristics.
4) One or two smaller moose with a larger one may be a cow-yearling(s) aggregation. Follow-up with behavior indicators and if necessary, other sex indicators.

F. Body Shape and Color

1. Body Shape

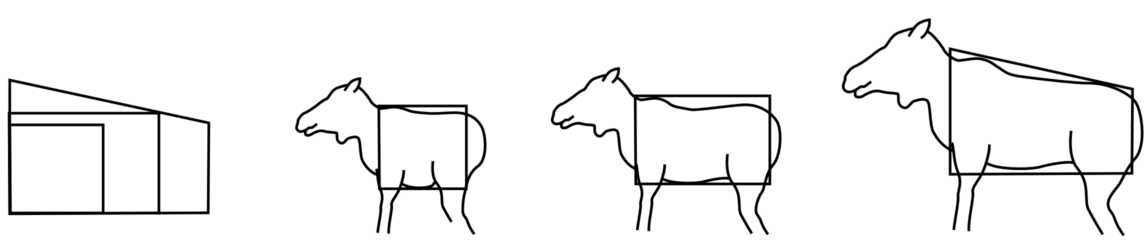
As moose grow, their shape, as seen in side view, changes. Calves have a square build, young moose (1 1/2 - 2 1/2 years) are rectangular, and prime animals (4 1/2 + years are trapezoid in shape (Fig.55). These shapes can only be seen from a very low,1ateral view. This feature is probably most noticeable and most useful in calves. In older animals, individual variation, and intergrading of shapes as the moose gradually ages, will limit the usefulness of this technique.

This technique could be used to assist in telling a small cow with calf aggregation from a large cow with yearling aggregation. It is probably the trapezoid shape, combined with heavy shoulder development, that makes prime bulls look larger than they really are.

2. Body Color

Prime bulls are often a very black color over the whole body. Cows and younger bulls often show a more brown body color. However, there is considerable color variation in moose and this indicator should never be used alone. The observer must follow-up with vulva patch and face color indicators.

Figure 55. Body Shape Of Moose



- comparison of the three body shapes | Square Calf | Rectangular Young moose (1 1/2 - 2 1/2 years) | Trapezoid Prime moose (4 1/2 years and older)

by A.B. Bubenik, pers. comm.

G. Behavior and Aggregation Indicators

1. Introduction

There are several aspects of moose behavior, and some aspects of the make-up of moose aggregations which are of use to the aerial observer. The moose is a social animal whose interaction with other moose and whose reaction to external disturbance, is often related to the sex and age of the animals involved. Notwithstanding the previous statement, all moose are individuals, so behavior and aggregation make-up do not always follow the observations noted below.

2. Cow-Calf Aggregations

These aggregations are almost always initially determined by size difference. The cow and calf will be found very close together; it is uncommon to find them separated by more than a hundred feet. They are generally found in or near heavy cover, or at least, cover heavier than most other moose are located in under the same snow depth and time-of-year conditions. Cow-calf aggregations stay together the whole winter, and many of them are sedentary, that is, they do not move around much on any given day. Often, they will live the whole winter in one fairly small area, usually separate from other moose.

Because of the habits noted above (heavy cover, sedentary), cow-calf aggregations are often believed by researchers to be easily missed or overlooked during aerial surveys. It is important that observers search the whole of each plot carefully, so that all moose including these hidden cow-calf groups will be found.

3. Cow-Calf Behavior

Cows and their calves interact in specific ways not found in other moose. Typically, the behavior sequence is as follows (Fig. 56):

1) when first observed cow is looking at the calf (which may or may not be visible)
2) the cow or calf, or both, run to the other and join
3) the cow and calf touch, often by the muzzle
4) the cow runs off, followed by the calf, into denser cover

The close mother-child bond is usually quite apparent to the observer. Sometimes, if both cow and calf are bedded and show no behavior indicators a dive by the aircraft will disturb them enough that they will begin the above sequence. Sometimes, if a lone cow is seen gazing steadily in a certain direction, it is a good clue to the presence of a hidden calf, and determined observation will often reveal that calf.

4. Bulls-Only Aggregations

Some time in early winter, after the rut is over, many bulls form into bachelor groups. Most of these aggregations appear to be comprised of bulls of the same social or maturity class, as evidenced by antler size and shape, bell size and shape, body size, build and color, and face color. They are often the easiest of all moose to find on a sample plot (during the early winter) as they typically choose very open habitat with lots of browse plants. They may wander considerable distances and usually leave a profusion of tracks. These aggregations may stay together for at least two or three weeks, and many may disband during the late winter period beginning in mid-February. Aggregation size runs from two to five, with three in a group being common. If there are three moose in an aggregation, two of whom are antlered bulls, the third but unantlered moose will almost always turn out to be a bull.

5. Bulls-Only Behavior

Despite the fact that bulls in aggregations seem to get along quite well together they occasionally show aggressive behavior to each other, which is probably related to maintaining dominance within the aggregation. This aggression may be aggravated by the impending or recent drop of antlers. It manifests itself in three ways:

- pushing or sparring with other bulls
- chasing other bulls
- stripping or rubbing small trees and shrubs

Pushing (or sparring) is the term used to describe the following sequence of events: (Fig. 56).

1) two bulls approach each other slowly, head to head
2) each lowers his head to the ground
3) slowly and gently they contact each other at the forehead and/or antlers
4) using their body weight and leg muscles, each attempt to push the other back
5) one of the two moose breaks off suddenly, and trots quickly away from the winner

Note: It is not necessary for each moose to have both sets of antlers to engage in this activity. Therefore, an unantlered moose pushing with a fully antlered bull, will also be a bull.

If there is a third moose present in the aggregation, he may either stand by and watch the whole procedure, or he may run towards the other two and join in the activity.

Chasing activity often follows pushing, with the winning bull chasing the loser. Chasing may also take place in bulls-only aggregations without immediately prior pushing or sparring.

The stripping or rubbing of small trees is occasionally practiced by individual bulls in an aggregation. It occurs only while a bull has antlers.

These groups sometimes are not easily affected by aircraft disturbance. Once the antlers have dropped and observers want to use the vulva patch technique, it often takes repeated low circling to get these animals to their feet. Aggregations of large, prime bulls do not frighten easily.

6. Other Aggregation and Behavior Patterns

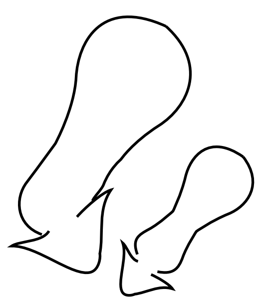
1) Lone bulls may strip or rub small trees and shrubs. They sometimes become aggressive when disturbed by the aircraft, so that observers will be occasionally treated to the sight of a bull chasing the aircraft and attempting to catch it in his antlers.

2) Cows often form aggregations of up to five animals, although two cows together seems to be most common. They do not seem to exhibit any distinct behavior pattern, and may be found in all habitat types.

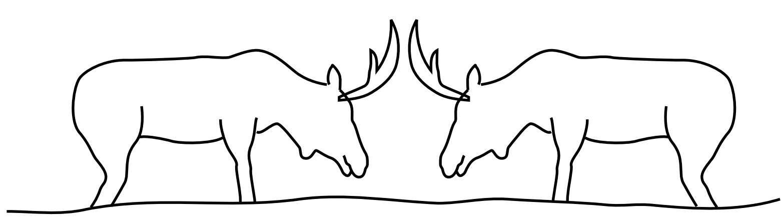
3) The cow and yearling aggregation has already been mentioned in connection with its similarity to the cow-calf aggregation. If they show any cow-calf behavior (looking, joining, etc.) at all, it is usually present to a much lesser degree than in cow-calf groups.

4) Large, mixed-sex aggregations of up to seven moose are sometimes seen. These usually contain a high percentage of younger moose (but no calves) as evidenced by antler types and face color. When disturbed by the aircraft, they often run about madly and may, if disturbed enough, split up into smaller units. The aggregate size recorded should be that of the original group before being disturbed, since their tracks usually indicate they have been grouped for some time.

Figure 56. Behavior Indicators



Touching is a behavior shown only by cow-calf aggregations.



Pushing is a behavior shown only by bulls.

Bells

1. Description and Location

The bell is hair-covered skin tissue in a flap or rope-like shape, hanging under the throat of moose. It plays a role, similar to antlers, in displaying the maturity or social standing of bulls. Its function on cow moose is not known.

2. Angle of View

To determine the shape of the bell, and to accurately assess its size, the only angle of view of any use is very low, and broadside to the moose. Some older moose have long bells that swing from side to side when the animal is moving; this feature is visible from a fairly high overhead angle, and is a rough indicator of size.

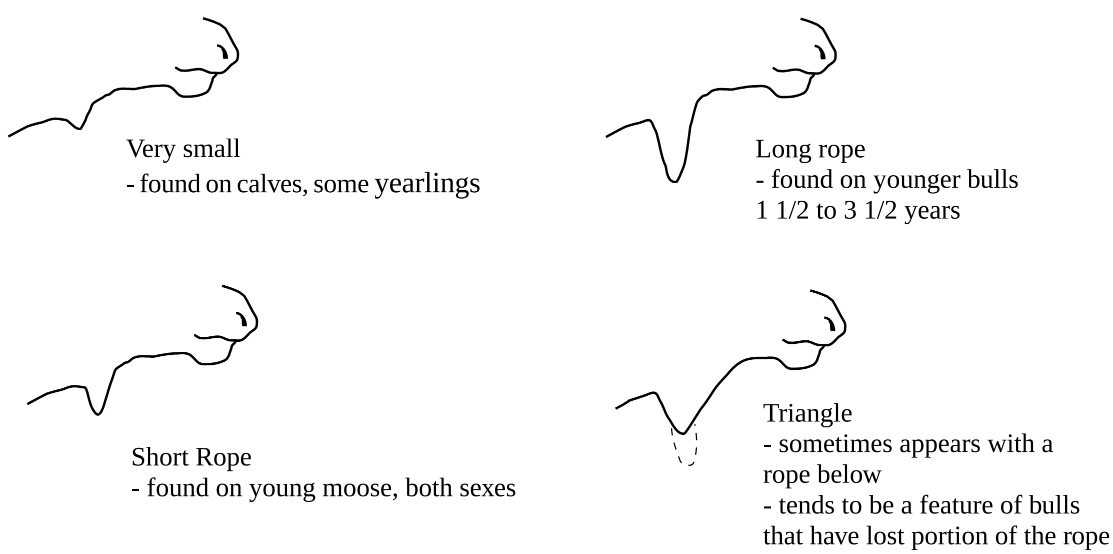
3. Effect of Sex and Age on Bells

Although there is considerable variation among individual moose, the following guidelines apply in general;

1. calves have a very small bell,
2. as moose grow older, the bell grows larger,
3. bulls have larger bells then cows of the same age,
4. cows tend to have rope-like bells with a small or no flap,
5. older bulls tend to have a large flap bell which may or may not be accompanied by a rope.
6. long rope-like bells may freeze off wholly or partially.

The common shapes and sizes, with the corresponding sex and age, are treated diagramatically (Figs. 57, 58). The only bell type that corresponds well with age and sex is the large round or oblong, with or without a rope behind, which is indicative of older bulls. All initial sex determination based on bells must be confirmed though other sexing and ageing techniques, particularly primary ones.

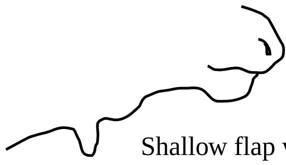
Figure 57. Bell Shapes And Sizes



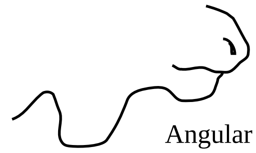
Caution: bell shape and size does not correspond accurately to moose sex and age.

Figure 58. Bell Shapes And Sizes (Cont’d)

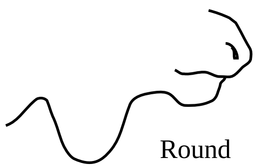
Caution: bell shape and size does not correspond accurately to moose sex and age.



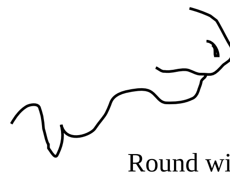
Shallow flap with short rope
- found on any age cow
- found on younger bulls



Angular
- usually large but size varies
- found on older bulls



Round
- usually large but size varies
- found on older bulls



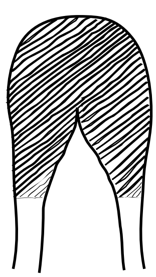
Round with Rope Behind
- also found as angular or triangle with rope behind
- usually large but size varies
- found on older bulls

4. Shortcomings of Technique

The proper angle of view is often not attainable because of the position of the moose and the forest cover around it. In addition, the size and shape of many bells does not correspond closely to the sex and age classes of moose, so this technique has a limited application.

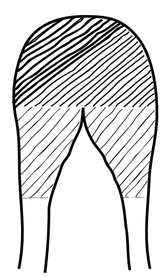
Figure 59. Supposed Stocking Determinator

Bull



Sharp and distinct color change

Cow



Gradual and indistinct color change

I. Rear "Stockings"

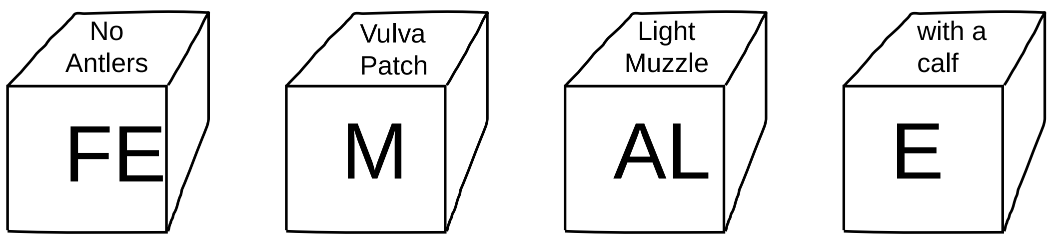
Some observers have noted that mature bulls sometimes have a fairly distinct break or "stocking line" between the lower legs and about one-third up the thighs, when viewed from behind. They claim that this break is less distinct on mature cows. Our experience has shown this feature to be totally unreliable and we recommend that observers do not attempt to use it to sex moose.

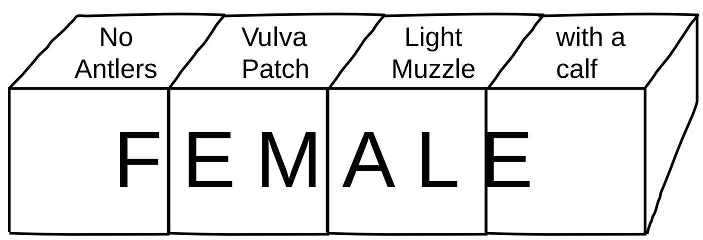
J. Summary of Sex and Age Indicators

Now that the individual techniques have been covered in some detail, it would be wise to point out that combinations of indicators are of much greater value than any single indicator in determining sex and age (Fig. 60).

Figure 60. Sex Indicators

Various individual characteristics are good indicators of sex.

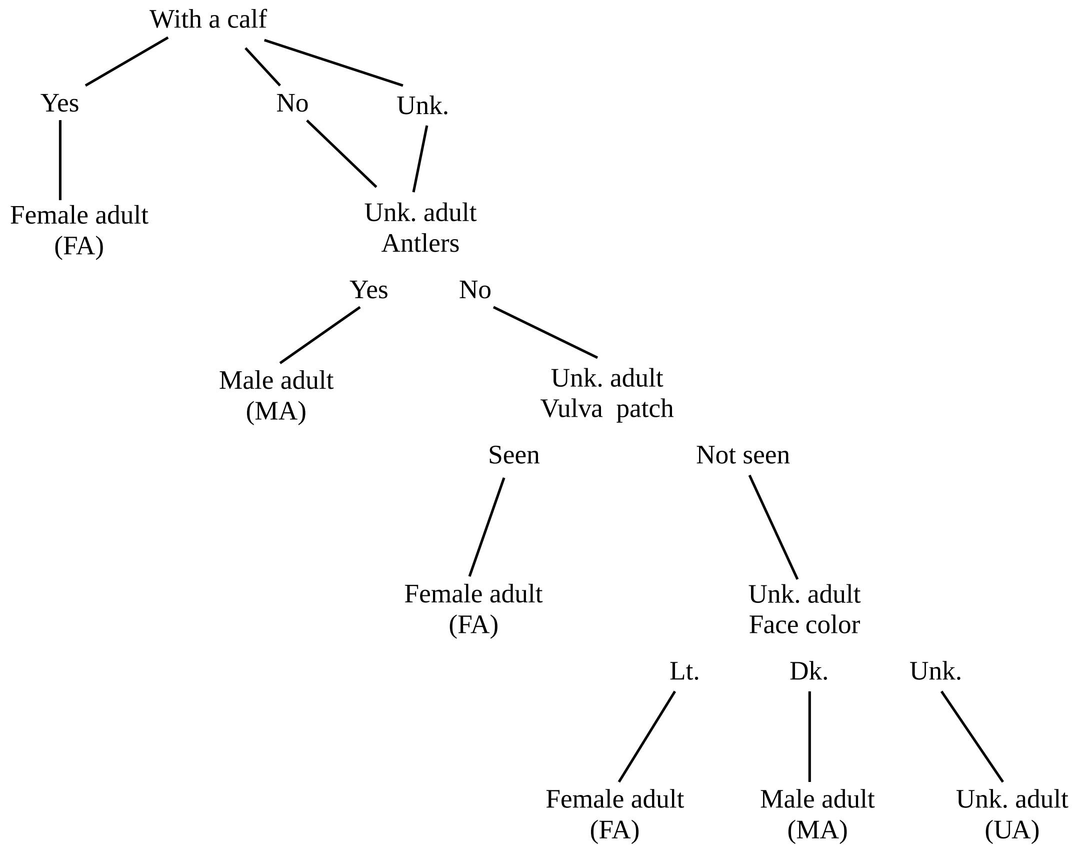




Combinations of characteristics are positive indicators of sex.

ALWAYS STRIVE FOR POSITIVE SEX IDENTIFICATION

FIGURE 61. Sometimes The Sex Of An Animal Can Only Be Determined Through Elimination



All moose can be placed into one of five sex and age classes, which are:

MA male adult - all bulls including yearlings
FA female adult - all cows including yearlings
UC unknown calf - calves, no sex class necessary
UA unknown adult - yearlings and older, sex unknown
UU unknown unknown - sex unknown, age unknown

Although observers should always try to determine both the sex and age of all moose observed, it is just as important to be accurate and honest in this determination; that is, if the sex or age cannot be positively determined, record the moose as an unknown adult or an unknown unknown rather than recording the wrong sex or age.

A Summary Of Indicators And Sex-Age Classes

	Bull	Cow	Calf	Unk. Ad.	Unk. Unk.
Antlers	Yes	No	No	No	No
Vulva Patch	No	Yes	Yes/No	No	No
Large	Yes	Yes	No	Yes	Unk.
Small	No	No	Yes	No	Unk.
Dark Face	Yes	No	-	Unk.	Unk.
Light Face	No	Yes	-	Unk.	Unk.
Cow-Calf Aggregate	No	Yes	Yes	No	No
Cow-Calf Behavior	No	Yes	Yes	No	No
Large Sac-Bell	Prob.	Prob.Not	No	Yes/No	No
Short Rope Bell	Yes/No	Prob.	Prob.Not	Yes/No	Yes/No
Heavy Body	Prob.	Prob.Not	No	No	No
Black Body	Yes/No	No	No	No	No
Sparring	Yes	No	No	No	No

In-Flight Data Recording

A. Introduction

As pointed out before, there is not much sense in spending time and money to obtain information which is not properly recorded, and therefore cannot be retrieved and used. As much data as possible should be recorded in-flight on the plot, as soon as observations are made.

Readers should refer back to pages 3, 37, 38, 39, 40, and 41, and Figures 1, 27, 28, 29.

B. Lap-Top Computer

At the date of this revision (January 1997) the preferred method of data recording in the air is through a Visual Navigation Program (VNP) in a lap-top computer, connected to a Global Positioning System (GPS) navigating computer which is integral in the aircraft or attached as a remote unit. The navigator records the location of each moose aggregation and track aggregation in the VNP. This integrated system also records the details of the sex and age make-up of each moose aggregation, as well as such data as plot start and finish times. This data can be downloaded directly into a GIS ARC-INFO database. Starting in 1998, download data will produce a completed Plot Survey Form.

C. On the Map

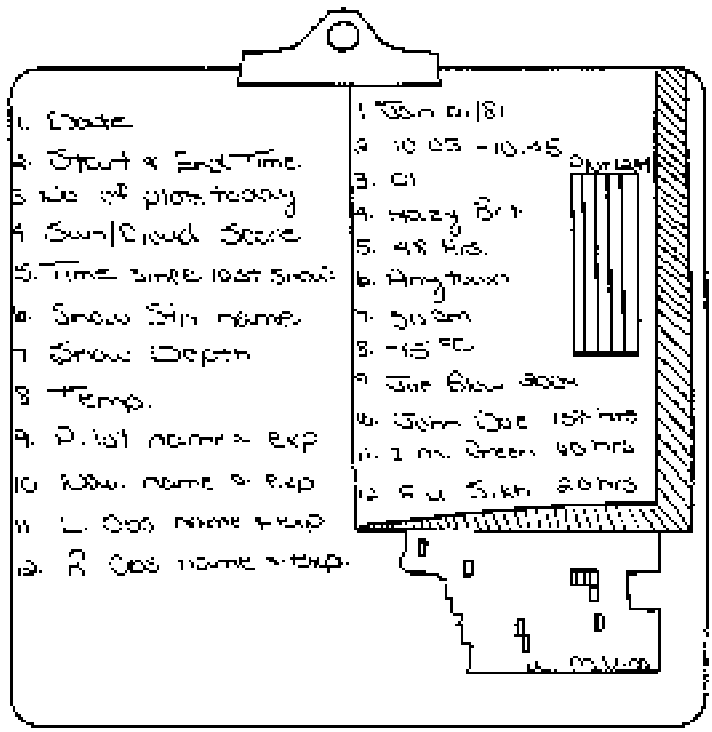
Since all electronic and mechanical systems are subject to breaking down from lost or interrupted power supply, program malfunction, and human error, it is strongly recommended that all the data is backed up onto the flight map.

The following is a summary of the data that can be recorded on the flight map:

1. starting and ending points on plot
2. flight direction flown on flight lines
3. cloud conditions
4. hours since last snowfall (if known
5. date flown
6. temperature and wind
7. location of all track only aggregations
8. location of all moose aggregations
9. sex and age of all moose
10. other items of interest
   a) wolves, wolf tracks, kills
   b) human activity, new logging roads, etc.

Whatever short forms or abbreviations are used on the map, a pre-arranged and simple coding system should be used so that all persons subsequently taking data off the map can do so easily and accurately. It is a good idea to record a legend on the maps so that future references will be possible. This is especially true of age and sex composition, and aggregation locations.

Figure 62. An Alternate Method Of Recording Data On Map



Clip board has numbers one to 12 with data for Moose Aerial Inventory Form listed. The navigator fills in required data on flight map opposite the numbers, which correspond with numbers and headings on clipboard. Use a standard clipboard or a piece of 12" x 18" hardboard.

Also glue an eight-mile per inch map of the WMU to the board, showing all plot locations and numbers. Use this for navigating to plots and for keeping track of what is done.

This is a suggestion from the late Ron Campbell, M.N.R. North Bay.

D. Moose Aerial Inventory Form

This is the standardized yellow form (#1692) used to record plot data for all wildlife management units in the province. The method of filling it out is self-explanatory, and is detailed in the provincial standards and guidelines. It is generally the navigator's responsibility to complete this form.

When as much data as possible is recorded in-flight on the plot maps, it is a simple matter to transfer that data onto the Inventory Form back at the office. This saves the navigator the nuisance of an extra form to fill out in the aircraft, especially as the form usually must be re-copied due to hurried or messy printing in the aircraft caused by lack of time and bumpy air conditions. Take care when transferring data. This function may be computerized soon.

One final note: print the form, don't write on it.

E. Sex and Age Checklist

This is an extra in-flight form which has proved its value in the recording and determination of sex and age of moose observed on the plot. In actual use a number of these forms are kept on a clipboard by the navigator, and a new one used on each plot. As each moose is observed, the checklist is a constant reminder to look for the main sex and age indicators. The checklist also encourages the sexing and ageing of moose based on combinations of indicators, and discourages the practice of guessing when good indicators are lacking.

When this form is used, all moose on the plot must be assigned a consecutive number, as they are observed. Aggregation data can be recorded both on the map and on the checklist. Weather data, etc., should also be recorded on the map. See Fig. 28, 63.

F. Tape Recorders and Cameras

While the data recording systems, as outlined previously, are quite adequate for normal aerial moose surveys, sometimes more sophisticated surveys are conducted during which as much data as possible (on sex indicators, location, habitat, behavior, etc.) is recorded. Because of the high volume of on-plot data, tape recorders and cameras are used.

The tape recorder should be operated by the navigator, who feeds in data as he observes it, and as the other observers relay it to him. It should be a six-volt battery operated type and if possible it should be equipped with an external jack for auxiliary six-volt power supplied by a large flashlight battery. Most TV repair shops can install such an auxiliary power-jack at a reasonable cost. The recorder should come with a remote microphone and a remote on-off control. The navigator should jury-rig some sort of microphone holder to an ear-protector headset so that the mike is situated in front of his mouth. In use, the tape recorder is turned on to record and the hand held remote switch is left off; when a moose is observed or data is to be fed in, the navigator turns the remote switch on and speaks into the mike. If the mike is in the correct position, a normal speaking voice is adequate, and aircraft noise will be kept to a minimum.

The best type of camera for recording the immediate habitat around a moose is the common 35 mm SLR equipped with a 50 mm lens. A combination of polarized and amber filters are usually necessary to eliminate glare from snow and to render true color. Color slide film in ASA 64 or similar will prove useful because of low cost. The slide can be projected to a very large size allowing close inspection of the moose and its surroundings. Telephoto lenses for close-ups of moose do not seem compatible with fixed-wing aircraft due to:

1) difficulty in finding the moose through a high-powered lens from a fast moving aircraft while, and **2)** difficulty in focusing the moose length is changing rapidly due to aircraft movement. Some observers, with practice, may be able to overcome these difficulties.

Figure 63.

MOOSE OBSERVATION CHECKLIST W.M.U. ______ PLOT ______

DATE ______ PILOT ______ NAV ______ L.OBS ______ R.OBS ______

MOOSE NO.	ANTLERS			ANTLERS FORM					MUZZLE			VULVA PATCH			SIZE			SEX			AGE		COW/CALF BEHAVIOUR
	YES	NO	UNK	SP.	FK.	MULT.	PALM	UNK	DK	LT	UNK	YES	NO	UNK	LG.	SM.	UNK	M	F	UNK	AD.	UNK	YES / UNK
1.																							
2.																							
3.																							
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Appendix A
Flight Map Preparation

Aerial survey plots (and flight lines) should be drawn onto topographic maps of the largest scale that can be handled in the cramped quarters of a small aircraft.

The national topographic series, with a scale of 1:50,000, is ideal. The survey plots should be drawn onto these maps well in advance (a few months) of actual flying; this leaves enough time for ordering and receiving additional maps if local shortages exist. It is usually convenient, if permanent sample plots are used, to make up enough flight maps at one time to last for a few years. The use of permanent, indelible ink, felt tip marking pens is recommended for drawing the plot boundaries and flight lines; a different color should be used for each. Black and red, respectively, are useful, they stand out well and are not easily confused with each other, nor with lines printed on the map. The use of ball point or other hard tipped pens should be avoided, as they have a tendency to score the paper which may then rip when the map is folded.

In many cases, it will be found necessary to join two or more maps when survey plots cross map edges. When joining maps, never use scotch tape or similar products: the darned stuff doesn't stick well, and neither pencil, pen, grease pencil, nor marking pen seems to make much impression on it. Use rubber cement instead. It holds more securely and does not impair the use of pens and pencils when marking moose location and other data on the map (See Fig. 64).

People making up flight maps are also advised to make the maps large enough to ensure lots of map "edge" around each plot, especially to the north and south of each plot. Both pilots and navigators can then use landmarks beyond the plot boundaries for lining up flight lines and boundaries. Sometimes it is useful to draw extended flight lines and boundaries when they line up with prominent landmarks. If necessary, glue a portion of an adjoining map sheet to the flight map, when the survey plot lies close to the edge of a sheet (Fig. 65).

When drawing survey plots and flight lines onto a map, keep the following in mind:

1) Make sure the plots you draw are exactly the right size (2.5 x 10 km).

2) Make sure the plot boundaries fall exactly where they were drawn on the original survey.

3) Do not draw flight direction markings onto the flight lines.

4) Print plot numbers beside, not on, each plot (Fig. 66).

5) Try to print plot numbers in the same place in relation to each plot (Fig. 66).

6) Draw flight lines and boundary lines as narrow as possible, without resorting to hard pointed pens.

Figure 64. Making Up Flight Maps

Do Not Use Clear Tape To Join Map Sheets

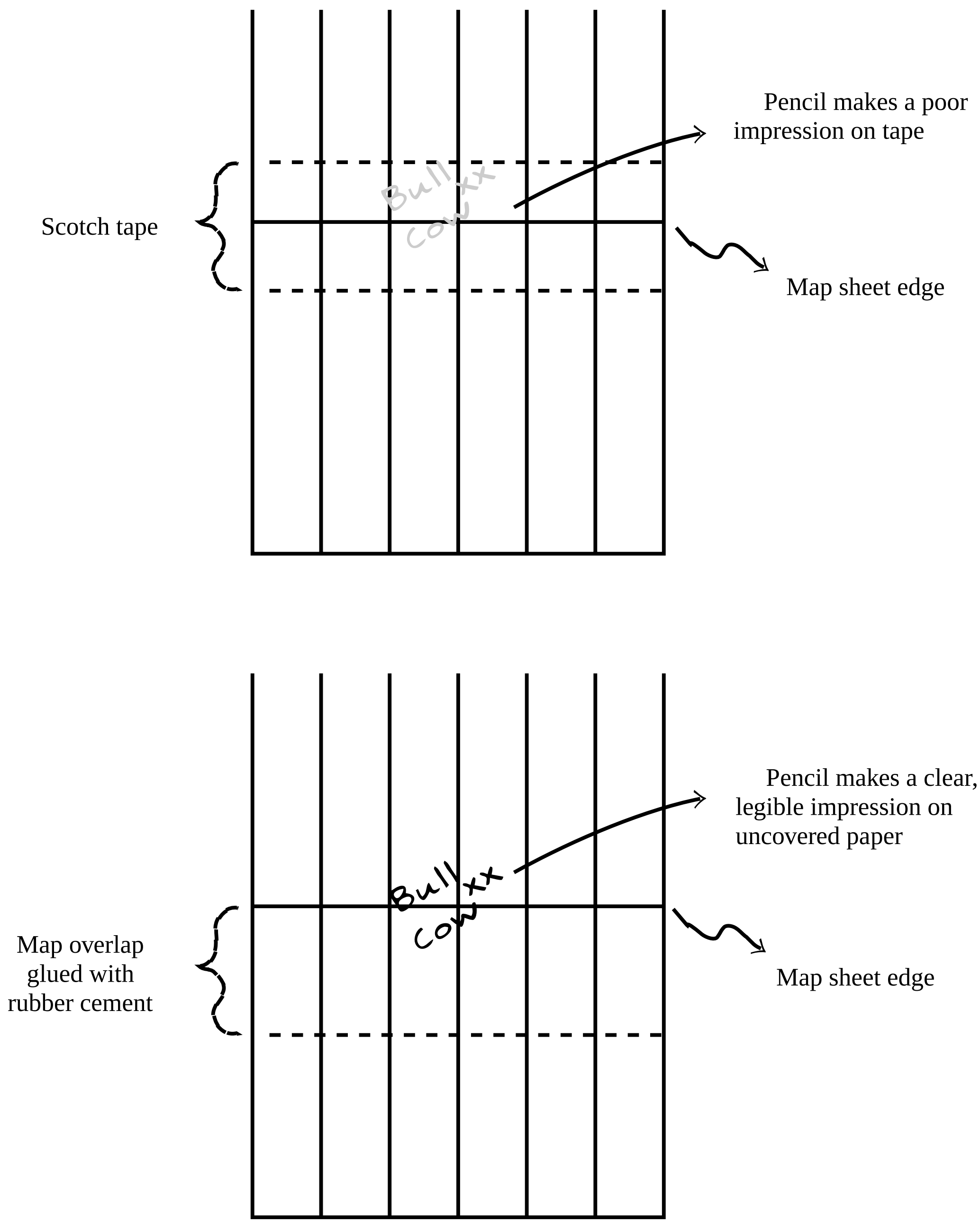
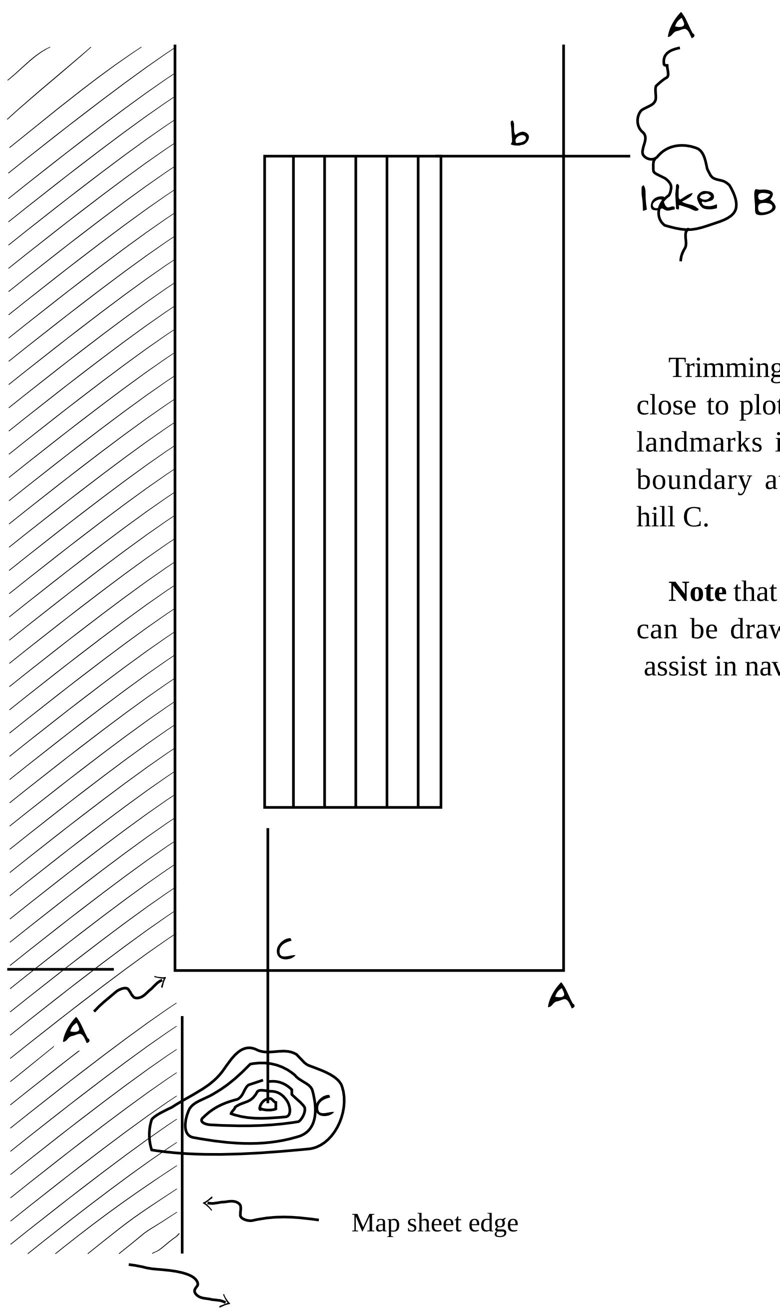


Figure 65. Making Up Flight Maps

Ensure Enough Map Edge To. Assist Navigation



Trimming map at AAA, too close to plot, cuts off visible landmarks in line with plot boundary at lake B, and at hill C.

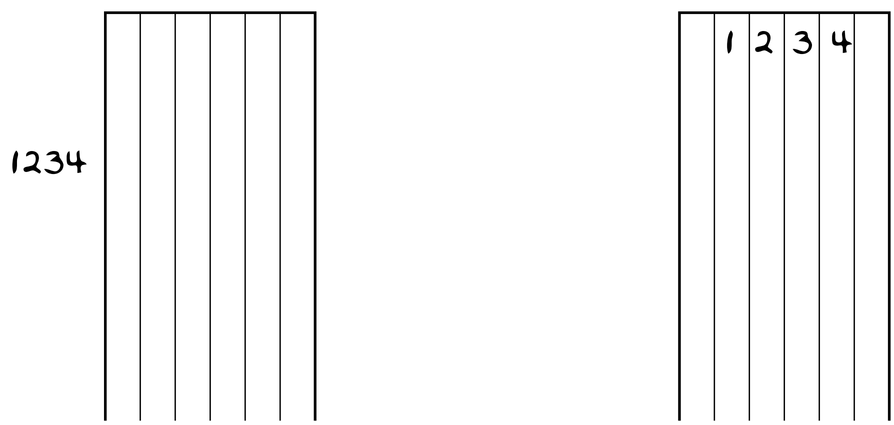
Note that lines “b” and “c” can be drawn in on map to assist in navigation.

Strip From Adjoining Map Sheet Glued On With Rubber Cement

Figure 66. Making Up Flight Maps

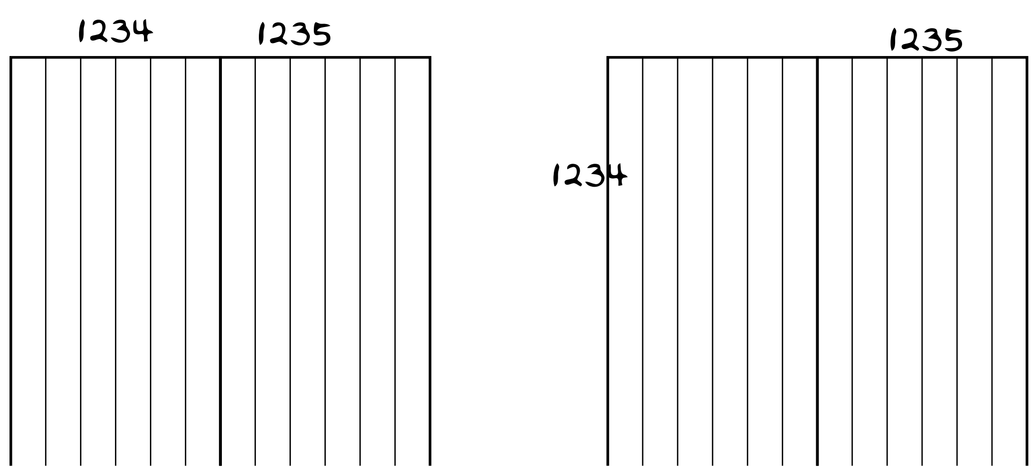
Print Plot Numbers Beside Plots, Not On Them

This ...Not this



Be Consistent In Location Of Plot Number

This ...Not this



Appendix B
Observer Aids

The following is a list of items, in no particular order, that the aerial observer may find useful:

1. **Lunch -** take one with you, to eat while flying or during a quick noon break.

2. **Coffee** - great stuff in a thermos, but don't drink too much just before a long flight.

3. **Motion sickness bags -** the manufactured ones are best, but bread bags are an acceptable substitute. Try to avoid a last minute reliance on hats and tea pails.

4. **Motion sickness pills (Gravol) -** the use of half a pill often prevents illness, and is not enough to cause drowsiness. Be sure to take it about a half hour before you get in the aircraft. Some people find that wearing a patch is more effective. There are also pressure-point wristlets (some of them electronic) that may prevent motion sickness.

5. **Warm clothing -** either wear it or take it with you in the aircraft. Layers are best.

6. **Ear protectors -** the earphone or shooting muff types, if available, are best, otherwise use the foam earplug type. Most aircraft are now rigged with headphones and micro phone sets.

7. **Sunglasses** - some observers like them, others don't, but they are useful in reducing eye strain. Different lens colors (yellow, grey) are useful under different light condition. You should wear sunglasses with UVA and UVB blockers.

8. **Baseball caps -** reduce eye strain considerably, especially if the underside of the eyeshade is dark colored.

9. **Sleep -** try to get lots of this before the flight, not during it. A good night's sleep may help to reduce motion sickness.

10. **Breakfast -** avoid overloading with exotic foods before a flight. Experiment a little, as the type and proper amount of food (or lack of it) in the stomach has a lot to do with motion sickness.

11. **Pit stop -** take one just before the flight commences. It might be four or five hours before the next one.

12. **Packsack** - carry a small one with you, to hold your lunch, thermos, dry socks, survival gear, etc.

13. **Credit card -** or other type of scraper, to scrape frost from the aircraft window. Always check with your pilot before using these: many aircraft don't require window defrosting at all, and scraping may scratch the window.

14. **Cloth** - such as wool mittens or toque, to rub frost from windows.

15. **Noon break** - land on a convenient lake to stretch your legs, have a quick sandwich, etc. Keep the break short so as to make use of the time of day when the sun is highest. Never fly to town for a restaurant meal - it takes too long.

16. **Cigarettes** - smoking is prohibited in MNR aircraft. You are locked in a small, enclosed place, probably with non-smokers. The presence of cigarette smoke can cause increased motion sickness to both smokers and non-smokers. Pipes and cigars are even worse.

Appendix C
Aircraft Safety and Survival

The following is an excerpt from the handout of the same name, prepared by the Air Service staff of the Northeastern Region. Anyone wanting the complete package should contact:

Chief Pilot, Aviation Branch
Ministry of Natural Resources
RR#1, Box 2
475 Airport Road
Sault Ste. Marie, Ontario P6A 5K6
(705)779-2149

In addition, Aviation Branch staff will usually hold district workshops on request, regarding air safety and winter survival.

While the following material is Ministry oriented, it is applicable to private and contract aircraft. In the latter case, carry your own or otherwise ensure that there is a survival pack on the aircraft each time you use it.

Safety Around Aircraft

It is worthy to note that most aircraft operations pose hazards which may not be encountered in day to day operation where aircraft are not being used.For the benefit of all personnel we will list a few rules which should be strictly adhered to:

1. When entering dock areas walk don't run.

2. Keep alert around docking areas, noise from running aircraft can sometimes be confusing.

3. No smoking in the vicinity of aircraft being loaded and at the pilot's discretion only, when in the aircraft.

4. Beware of propellers and rotors on all aircraft, whether running or not, keep well away. Always approach a helicopter under the direction of the pilot.

5. Loading of aircraft must always be supervised by the pilot.

6. Vehicles driven on to dock areas should be guided by one person so as to prevent any damage to aircraft or gas hoses.

7. Boarding aircraft :
   a) Ensure that you have received a safety briefing from the pilot.
   b) Pilot will make sure doors are closed and/or locked.
   c) Make sure your aircraft seat is properly secured in position.
   d) Your seat belt MUST be properly fastened.
   e) Take time to read the emergency procedure card located in the back of each seat pocket.

Remember the pilot is in command of the aircraft at all times. If there is anything pertaining to safety in or around the aircraft, do not hesitate to ask.

Downed Aircraft Procedures

Emergency Landings

In case of an emergency landing, remain claim and follow the instructions of the pilot. Remove sharp objects such as pens and pencils, and eye glasses, and place in a seat pocket. Sit well back in the seat and pull your seat belt tight. Get into the positions illustrated in Figures 67 and 68. Stay in that position until the aircraft stops.

ELT Procedures

Al1 ELT's operate on frequencies in the VHF and UHF range and, consequently are effective only in line-of-sight. To obtain the best range, the transmitter should be placed on level ground and as high as possible so that there are no obstructions between it and the horizon. The antenna should be vertical to ensure optimum radiation of the signal.

Placing the transmitter on a piece of metal or even the wing of the aircraft if it is level, will provide the reflectivity to extend transmission range. DO NOT hold the transmitter close to your body to save battery power, doing so will interfere with transmitting.

Switch on your ELT manually as soon as you can. The impact may have been sufficient to activate the transmitter; however, to ensure your transmitter is functioning you should manually switch it on. The ELT will have instructions on it.

Don't panic. Keep in mind that the signal will be picked up by satellite almost immediately, and that it can be picked up by high-altitude jet aircraft for distances of over 100 miles and that the volume of commercial traffic is constantly increasing. Weather will not delay an ELT search. The initial search from a high altitude military aircraft will detect signals from 100 miles away, and signal homing technology will bring the search right to you. It is not impossible that a rescue helicopter will land beside you before you can unship the emergency rations and boil your first cup of tea.

Ground-to Air Signal

You may not be able to determine if your ELT is transmitting, therefore you should make the forced landing site as conspicuous as possible. The emergency kit carried in each MNR aircraft includes an orange tarp: spread it on the ground in an opening between the trees during the day. If you can , snowhoe a large X or O on a lake, creek, or other opening. As soon as possible after landing build a campfire. In addition to providing warmth, cheering up, and heat for that cup of tea, the fire together with a pile of green branches will produce a smudge to assist searches.

Don't panic. Even though no ELT signal has been received, a visual ground search will commence as soon as you have overstayed your flight plan or radio call-in period.

Unless you land near a plowed road or a cabin, stay near the aircraft. The search is to locate the aircraft.

Survival

Your ability to assist the search can depend on the success of your survival efforts. Emergency equipment is carried on all flights conducted by MNR. As of this printing (1997) the basic equipment includes:

Axe and Saw	Flare gun	Fire extinguisher
First aid kit	Survival manual	2 pair Snowshoes
Pilot's Sleeping Bag		

Rotary wing aircraft have a small tent with a built-in sleeping bag for the pilot. Each observer should bring snowshoes, a sleeping bag, and perhaps additional clothing. Wing covers can be userfor ground-to-air signaling and for night shelter.

By law, every aircraft is required to carry the Canada Flight Supplement, a book of some 500 pages. Section F1: Emergency Section, details search and rescue procedures. The book is also interesting reading and non-essential portions of it can be used for personal hygiene purposes.

Each MNR aircraft has on board sufficient food for six days placed in an easily opened, watertight, yellow bag. It contains the tarp, survival manual, and flare gun, as well as a variety of snack foods and hot drink mixes.

Experience shows that persons with a knowledge of survival techniques have saved their own and others' lives. You might want to check your public library for books on survival, if you want to learn more about this field.

Appendix D
"Some Physiological Aspects of Aerial Censusing"

A short paper with that title, written in 1957, illustrates the fact that some things don't change very much. Despite an increasing sophistication in moose management techniques, aerial observers are still subject to the same stresses and responsibilities as occurred way back then. Most of our present moose management decisions, and much of our total knowledge of moose, still rely on the aerial observers who have learned to live with motion sickness and monotony, who have flown enough to learn to recognize moose and their sex and age indicators, and who are dedicated enough to maintain their enthusiasm and intellectual integrity. This will continue to be the case in the future.

The complete paper is reprinted here.

Geraldton District
Some Psychological Aspects of Aerial Censusing

H. G. Cumming

For some time it has been recognized that psychology is a factor - an unknown quantity - which should be considered in relation to aerial censusing. We have stated rather vaguely, from time to time, that some people are better at this aerial work than others. We have recognized more or less subconsciously, that seeing is more than the mechanical reception of light waves by the eye. No attempt is here made to present a scientific thesis on psychology. Rather, an effort has been made to point out some of the possible subjective hazards involved in aerial censusing.

There are perhaps five psychological phenomena which affect our aerial censusing. They might be designated as follows:

Motion Sickness
Monotony
Enthusiasm
Ability to Recognize
Intellectual Integrity

These will be considered in the above order.

Motion Sickness

This problem seems to be partly psychological and partly physiological. At any rate we must recognize that it has a definite bearing on a person's ability to remain alert. A sick person cannot possibly be expected to be as keen an observer. This fact is probably one argument on the side of straight line surveys where there is less tendency to sickness. The only other remedy is to use only people who are not affected by motion. We cannot blame those who are.

Monotony

Straight flight lines, warm aircraft, steady drone of the motor, sparse observations, steadily passing countryside, all add up to monotony and sleepiness. Even if an actual stage of slumber is not reached, there is an almost irresistible tendency to relax and grow careless. One remedy is to fly more irregular flight patterns. Otherwise, there is nothing for it but to be continually on guard. Any possible breaks, such as, landing for lunch, also help greatly to reduce the hypnotic effects of monotony.

Ability to Recognize

This term describes a rather common psychological phenomenon. It can be demonstrated by the ordinary eye test chart where if letters just beyond the recognizable range are once known, they immediately become plain so that we wonder why we could not see them before. To quote a recent article on psychology in Life magazine, “as soon as we know what is there, our eyes readily see it. If we do not know, they try hard to at least see something”. This fact should always be considered when either new people are being used or new animals censused. Perhaps the best possible way to assure that the objects to be observed are thoroughly recognizable is to fly one or two flights strictly for spotting before any actual survey is undertaken. This is especially desirable if some classification of the objects is required to be distinguished by the observer. All the description in the world does not replace a flight on which the classifications can be pointed out.

Enthusiasm

Several people have mentioned in the past year that the enthusiasm of the people involved played a large part in the development of what is now called the Gogama Method of moose censusing. When everyone on an aircraft is keen and the pilot is enthusiastic, a friendly rivalry builds up between observers and much more will be seen than when every one is quite indifferent. Although this is a widely recognized fact, the problem of how to build enthusiasm remains a knotty one. Adequate explanation of the purpose and importance of the survey is one important means. Another aid is to have at least one or two enthusiastic people in the survey crew. As the old saying goes, “enthusiasm is contagious”. At any rate an enthusiastic crew is most apt to be a successful crew in aerial censusing.

Intellectual Integrity

Accurate reporting is essential. We are not here for questioning the veracity of the observer but rather examining a psychological phenomenon which leads to the observation that we do not necessarily see what we think we see. Any number of biases which may be more or less subconscious is apt to affect our observations. We may wish to prove some point and in so doing distort our recording. We may wish to beat some one else in the friendly rivalry mentioned before. We may be trying for results which we think someone else wants in order to please. When only a glimpse is possible before passing over, any such bias can be disastrous to good wildlife management. It is much worse to get a doctored count than to get an honestly poor count. We are absolutely dependent on the mental integrity of our observers in order to have a true picture of conditions in the field.

In order to illustrate some of the points which have been considered, a comparison of the beaver house count done in the Geraldton District this fall and the moose census flown this winter is given below. It will be seen that each method has its problems in psychology.

Beaver House Survey Moose Census

Moose Census	Beaver House Survey
1. Strip Count	**1.** Modified Strip Count
2. No.observers per Observation - 1	**2.** No. Observers per Observation - 4
3. No chance to check observation	**3.** Each observation checked thoroughly
4. Possibility of misclassification	**4.** No chance of misclassification
5. Shapes various and relatively difficult to distinguish	**5.** Shapes constant and easily recognized
6. Straight flying	**6.** Circling

Conclusion

From the above discussion, it seems safe to conclude that the process of observing is not by any means a mechanical one. Many factors affecting the observer have an influence upon what they eventually record. These problems seem to be intensified in the case of aerial surveys. It would be well for anyone planning or organizing an aerial survey to take into consideration the psychological aspects of the techniques involved and modify their methods so as to eliminate as many hazards as possible.

Summary

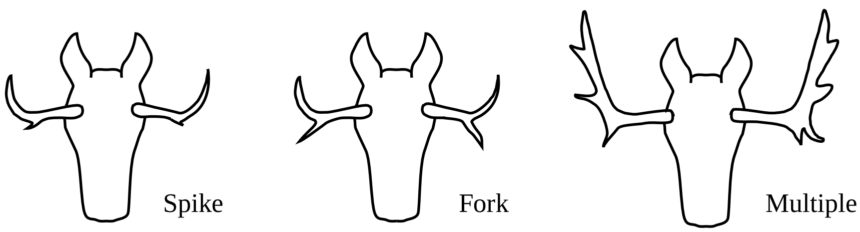
The large part which psychology plays in aerial censusing is here outlined. Five main factors are discussed as being important considerations. These are motion sickness, monotony, ability to recognize, enthusiasm and intellectual integrity.

It is concluded that the psychological implications should be considered when any aerial survey is being planned or organized.

Appendix E
Antler Classification System

This is an excerpt from “Criteria for standard moose sex and age surveys by helicopter” prepared by the MNR staff in at Thunder Bay. They have evolved a practical antler classification system, which is detailed below. For the purpose of aerial determination of social maturation (the degree of “primeness”) antlers should be placed in one of three classes listed below:

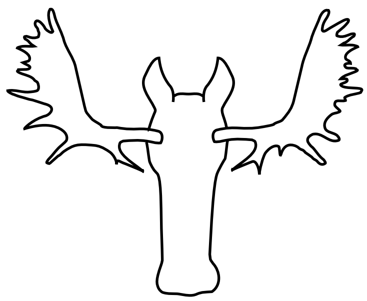
Teen (Class 1)

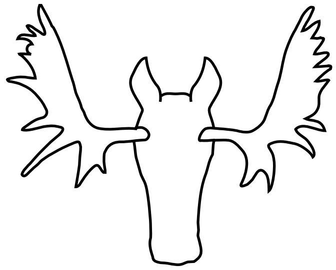


Sub-Prime (Class 2)

- main palm (not including points) extends beyond ear tips
- usually forked or palmated brow tine
- width of individual palms approximately as wide as the width of the head at the widest point
- points are generally long and numerous
- antler spread generally greater than 42 - 45 inches

Prime (Class 3)



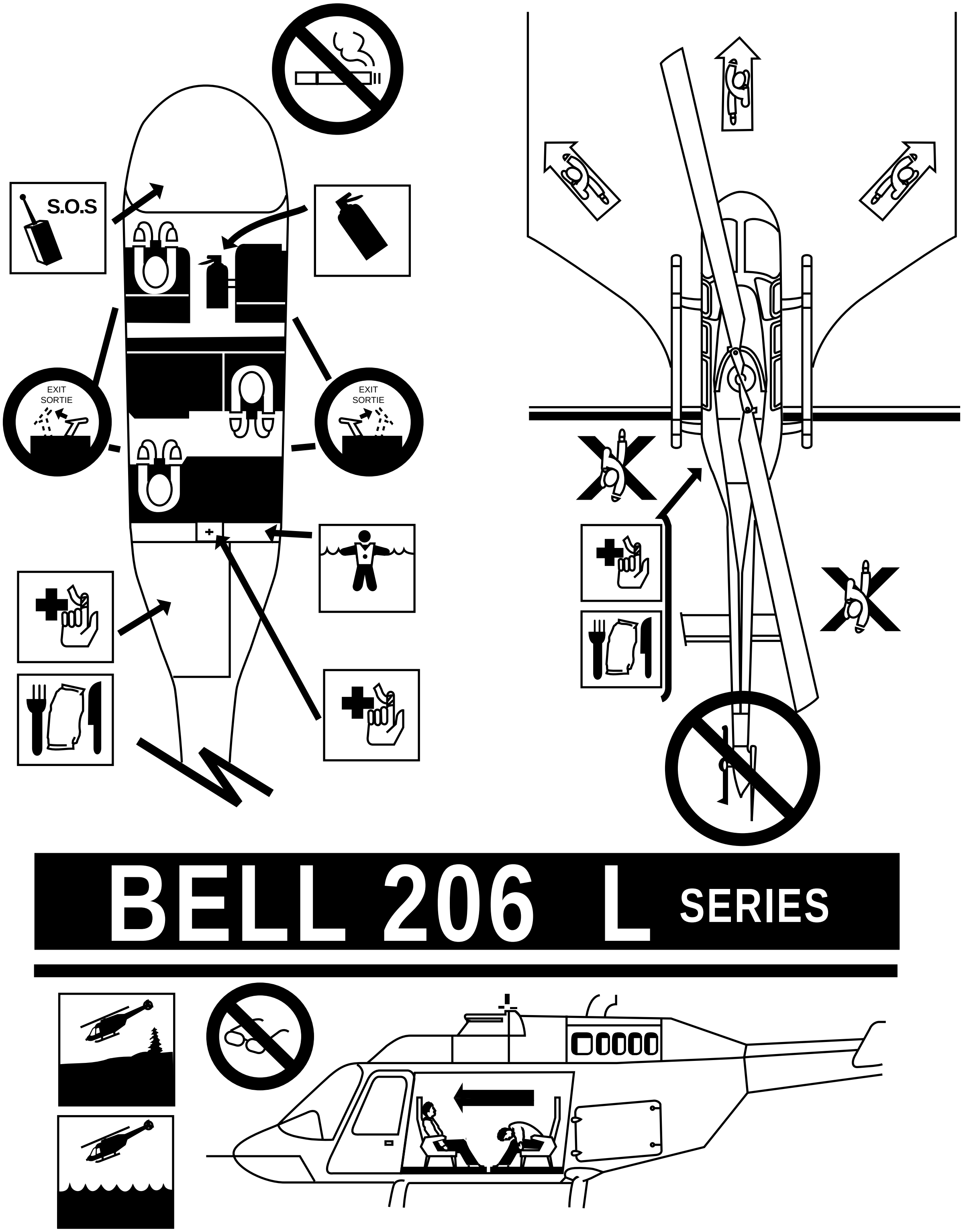


Further to the above, North Central Region states:
"All moose can be placed into one of seven sex and age classes as follows:

1. Bull Antler Class I - teen bulls
2. Bull Antler Class II - sub-prime bulls
3. Bull Antler Class III - prime bulls
4. Female Adult - all cows including yearlings
5. Unknown Adult - unidentified sex, yearling or older
6. Unknown Calf - all calves, no sex necessary
"Unknown Unknown - sex and age unknown."

Figure 67. Turbo Beaver Safety Information

Figure 68. Bell 206 L Series Safety Information



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