A SYSTEMS APPROACH TO MOUNTAIN GOAT MANAGEMENT

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INTRODUCTION

The majority of species management programs in North America began with an assessment of harvest information (Table 1), progressed to refinement of population harvest analysis, and more recently incorporated inventory and survey information. Biological parameters associated with long-term cervid management programs were inappropriately assigned to mountain goat populations (Hebert and Turnbull 1977).

Age structure information (Table 1) obtained from populations and areas with undefined boundaries was collected at road checks in the East Kootenay and for the northern half of the Province at Cache Creek (Table 2).

Table 1. Aging methods for harvested goats by data source in British Columbia.

Data Source	Date Begun	Aging Methods: Horn Annuli	Aging Methods: Teeth (cementum layering)
Game checks			
Cache Creek	1947	1947	-
Kootenay	1958	1965	-
Compulsory Reporting	1976	1976	1976

Harvest estimates obtained from the hunter sample for large land areas (13,000 to 75,000 sq. km.) served to mask the effects of overharvest on local or individual populations (Phelps et al. 1976). Similarly, there

Table 2. SUMMARY OF GOAT HABITAT, HARVEST MONITORING METHODS, AND LIMITED ENTRY HUNTS, BY REGION, IN B.C.

	REGION						
	1	2	3	4	5	6	7
Estimated Area of Goat Habitat[1] (sq. kilometers)	7,525	28,600	26,550	35,855	36,425	144,390	98,625
Harvest Monitoring Methods							
Game Checks							
Cache Creek (1974-)			X	X	X	X	X
Kootenay (1958-)				X			
Hunter Sample (1962-)	X	X	X	X	X	X	X
Compulsory Reporting (1976-)	X	X	X	X	X	X	X
Limted Entry Hunts							
Date Begun	-	-	1977	1976	-	1974	-
No. of Permits							
1974						100	
1975						100	
1976				12		100	
1977			8	22		110	
1978			8	104		110	

[1]From Blower (1978)

was no definition of population boundaries, regional management boundaries often crossed ecotype boundaries and, usually, the same liberal season lengths and bag limits persisted between ecotypes (Hebert and Turnbull 1977). It has been demonstrated that social organization, sex and age structure, and habitat utilization are extremely sensitive to harvest pressure between ecotypes (Hebert and Turnbull 1977; Kuck 1977). More recently (1974), limited entry hunting restricted the number of hunters in one 3,600 square kilometer areas of the Nass range in northwestern B.C., and compulsory reporting (begun in 1976) aided in more accurately identifying the magnitude of the harvest and kill location.

In addition, there was little logical analysis supporting the divergence within bovid management. Mountain sheep management programs supported the harvest of males only and eventually changed from no horn curl restrictions (1960's) to a full curl or age restriction (1976) which crudely aligned trophy hunting restrictions, guide and limited entry hunt areas to population sensitivity. Until recently, all age and sex classes of mountain goat populations were harvested liberally and early seasons (August, September) actually enhanced the harvest of females and younger age classes, especially in areas where salt lick use was prevalent.

The ability to effectively manage mountain goats over their entire range will depend upon the identification of southern (Hebert and Turnbull 1977) and northern ecotypes, behavioral, population, and habitat characteristics which are species specific, and the relationship between the land base of inventoried and harvested populations. Thus, a major objective of mountain goat management is to obtain sufficient information to distribute an equitable and acceptable harvest throughout the entire

goat range according to ecotype characteristics, while reducing or eliminating areas of both under harvest (i.e., helicopter transport hunting in portions of the coastal mainland) and those of over harvest.

RESULTS AND DISCUSSION

The development of a systems approach to mountain goat management should not logically proceed from traditional harvests to incorporation of survey data, but from survey and population data to development of harvest rates for each ecotype. Similarly, within ecotypes harvest rates should be determined for individual watersheds and be related to group composition.

Distribution and Density

On a broad level (Provincial and Regional), general mountain goat distribution and density in B.C. was mapped (Blower 1978), in conjunction with regional biologists. However, similar land units (valley bottoms must be consistently included or excluded) must be utilized to produce standarized density and range area estimates for all management regions (Table 2). Within regions, more specific information on population density and distribution should be identified on map scales of 1:250,000; 1:125,000; or 1:50,000 for individual mountain ranges or blocks. The approximate area of mountain ranges, blocks, or elevational units (Hebert and Turnbull 1977) can be utilized to calculate population or seasonal density in order to define the broad ecotype boundaries. Stratification of the land base is necessary in order to establish the size of the management unit, ecotype characteristics, possibly population boundaries and allow selection of representative areas for both preliminary and detailed surveys.

Preliminary Inventory and Survey

Preliminary surveys using fixed-wing aircraft may be necessary if the land base is large (2,500+ square kilometers), the population distribution uneven, or the density varied. Fixed-wing transect surveys should be undertaken at 150-500 meter intervals in subalpine and alpine areas depending on the area and number of mountain ranges or blocks to be surveyed and the terrain type. Group size can be determined, as well as the relationship between per cent family groups and population productivity among ecotypes, which appears evident in southern B.C. (Hebert and Turnbull 1977) and along the Rocky Mountain chain outside B.C. (Smith 1976; Holroyd 1967; Kuck 1976).

Survey dates can be varied across the Province from late June to late September, depending on the approximate date nursery groups are formed, nursery group size and structure (ability and need to identify group size and per cent family groups) and the need to utilize molt patterns to separate adult males, young males, non-reproductive females, and productive females. Large nursery groups are formed in northern B.C. by midsummer but appear infrequently in south coastal B.C. However, surveys in the Knight Inlet area of coastal B.C. must usually be delayed past the molt, until early August, due to a large land area comprised of glaciers and a lingering snowpack. In south central B.C., surveys are conducted in early spring prior to kidding, before goats move to tree covered subalpine areas. Surveys in eastern B.C., along the Rocky Mountain chain can be undertaken in mid July in order to utilize molt patterns, obtain group size information, and determine productivity ratios. Aerial surveys from fixed wing aircraft do not usually allow determination of sex ratios and recruitment but should allow identification of kids and group size

if done by late July or mid August.

Detailed Surveys

Detailed surveys are best accomplished in specific mountain ranges or blocks (i.e., Stanton or Hoodoo Creek; Hebert and Turnbull 1977), which are representative of larger land units. Transect design should incorporate 150-meter transects on north or south aspects, or both, provide information on total numbers, distribution, elevational and seasonal density, age ratios (kids, yearlings, possibly subadults, and adults), sex ratios (adult males to adult females), habitat types, and physical features (elevation, aspect, slope, terrain type, or topographic-moisture regime, etc.).

Survey design should incorporate the decision to obtain ratios of kids and yearlings/100 females (selection of a representative site and transect layout will identify female and nursery groups) or ratios of kids and yearlings/100 adults (selection of a representative site and transect layout should produce an accurate sex ratio). If only young/100 female ratios can be obtained, recruitment ratios should not be calculated without an estimate of the sex ratio. The inability to identify subadults (2.5 year olds of both sexes) will reduce the accuracy of productivity and recruitment (if a sex ratio is estimated) ratios. In actual fact, most surveys concentrate on female groups yet calculate ratios/100 adults but completely disregard sex ratios. If young/100 adult ratios are to be established, transect layout must assess range separation by sex according to elevation and aspect. The inability to identify subadults will affect the productivity and recruitment ratio less (assuming a sex ratio is obtained) because this category forms a

smaller proportion of the total number surveyed.

Chadwick (1976) established subadult/adult ratios of 37.2 subadults/100 adults (21 yearling/100 adults (12.4%) and 16.2 two year olds/100 adults (9.6%).) which could be used to adjust recruitment rates, and consequently harvest rates, along the Rocky Mountain chain.

Surveys which establish age ratios with a base of 100 females do not usually have a sex ratio to relate to harvest estimates or to a compulsory check system. Thus, the recruitment ratio may be distorted due to lack of a subadult ratio and/or sex ratio, causing harvest rates to be inaccurate. If conducted properly, however, the young-to-female ratios, adjusted with a subadult ratio, could provide an accurate estimate of productivity, recruitment, productive females as a proportion of the female segment of the population and potential harvest if a sex ratio can be established.

Ground surveys should accompany detailed aerial surveys (on a representative mountain block basis) in order to complete data collection on groups, sex and age ratios, and especially more accurate identification of yearlings and subadults.

The effect of a distorted sex ratio on recruitment (yearling) ratios was demonstrated by data collected in 1977 in Knight Inlet (coastal B.C.) which indicated that approximately 2.9 yearlings/100 adults occurred (Table 3) in the south slope surveyed population, whereas the 1974-1976 data indicated that it contained 3.8 yearlings/100 adults. Considering the mild winters of 1975 and 1976, the yearling count in 1977 should have been higher. The low yearling count was possibly due to:

(a) higher overwinter mortality in 1976/1977 (this possibility is unlikely);

(b) yearlings were classed as adults from the helicopter due to

Table 3. A COMPARISON OF MOUNTAIN GOAT SEX AND AGE RATIOS IN THE KNIGHT INLET AREA (1974-1976 & 1977)

Survey Date	Total Goats	Per Cent			Kids/100 Adults	Yrl./100 Adults	Kids/100 Females	Yrl./100 Females
		Adult	Yrl.	Kid				
1974 & 1976	250	85.2	3.2	11.6	13.6	3.8	27.1	7.5
1977	111	70.3	2.7	27.0	38.4	3.8	65.2	6.5

SUMMARY OF 1977 KNIGHT INLET GOAT SURVEY

Survey[1]	Total Goats	Per Cent			Kids/100 Adults	Yrl./100 Adults	Kids/100 Females	Yrl./00 Females	Males/100 Females
		Adult	Yrl.	Kid					
South Facing	100	69.0	2.0	29.0	42.0	2.9	67.4	4.7	41.9
North Facing	11	81.8	9.1	9.1	11.1	11.1	33.3	33.3	200.0
Total or mean	111	70.3	2.7	27.0	38.4	3.8	65.2	6.5	52.2

[1]South facing survey equivalent to 1974-1976 surveys; North facing survey flown in 1977 only.

the mild winter and excellent growth achieved (partial source of error); and

(c) yearlings moved with males during the redistribution in the hot summer of 1977 and so were under-represented in the sample.

There is preliminary evidence to indicate that some yearlings accompany males or nonproductive females during July and August (Hebert 1967). Thus, yearlings increased from 2.9 to 11.1/100 adults when the proportion of males in the survey increased. Consequently, there were 3.8 yearlings/100 adults in the 1977 survey when north and south aspects were included, similar to that obtained during 1974-76. In contrast, Chadwick (1977) indicates that no yearlings accompanied males only during his surveys in Glacier National Park. Similarly, seasonal redistribution of males altered the sex ratio from 100/100 females in 1976 to approximately 41.9/100 females in 1977 on the south aspect of the Stanton Creek study area (Table 3). The male component of the sex ratio was increased to 52.2/100 females when a portion of the north aspect of that mountain block (Crevice Creek) was included in the survey.

Correction for sex and subadult distortion depends upon a good knowledge of mountain goat biology and consistent apriori design of survey methodology. If harvest is based upon surveys which select for south slopes, should the count be adjusted from 3 to 4% yearlings based on experience and mild winters (without additional surveys of north slopes), or should it be adjusted at all, especially in consideration of the additional cost of accounting for yearlings and males in some years. Also, if a survey is expanded to account for distortion, does a population constitute the north and south (or east and west) aspects of a mountain range or block or the facing aspects of a river valley?

In addition, a biologist experienced in mountain goat inventory and biology should accompany, at least once, all those undertaking goat surveys in order to standardize the technique, insure comparable data for inventory-harvest comparisons, and allow comparisons between ecotypes.

Harvest

To date, there are few instances in B.C. where actual harvest rates have been applied to a specific population or land area. Partial exceptions are the recent limited-entry hunts in the Nass River and the East Kootenay (Table 2), which are based on preliminary survey information, but do not include recruitment or sex ratio data. In addition, the goat season in the Keremeos area of the Okanagan is closed due to lack of adequate population data on which to base harvest rates.

Based on the preceding information, there are several combinations and levels of population information which can be used to establish harvest regimes. However, there are three types of information:

(1) the determination of the yearling and/or subadult component of the population;

(2) the sex ratio; and

(3) the land unit from which the harvest is to be obtained, which must be considered essential to proper management.

The proportion of females in the harvest should be as low as possible until the role, sensitivity, and winter-range requirements of the family group can be established by ecotype (southern and northern B.C.).

Mountain goat management, including harvest regimes, and differences in productivity and social organization between ecotypes could proceed in two directions where the land base is extremely large. Both systems are dependent, to differing degrees, on proper inventory and identification of inventoried and harvested populations within the same land unit.

(i) Under an ideal situation, populations could be harvested on the basis of sex and age ratios, distribution, and social organization. In ecotypes of low productivity, large males could be harvested, with other segments of the population, making up the harvestable quota as population figures indicate. This assumes that compensatory mortality plays little part in the maintenance of the population. In ecotypes of high productivity, the combination of sex and age components can be more variable and flexible. This system approaches that for mountain sheep, and could consider management of family groups on the winter range (Kuck 1977, Smith 1977).

(ii) in large land units with little population or social organization information, annual harvest based on survey information (yearling recruitment) from a representative mountain block, should be directed toward adult males on a rotating watershed basis (this was recommended in the East Kootenay in 1965-1967 but was never utilized). The rotation system will depend on the total land area involved, the number of watersheds or mountain blocks available, and the level of biological information. It assumes that compensatory mortality plays little part in the maintenance of populations. The number of watersheds available for harvest (harvest pressure) at any one time (Figure 1), and the number of years they will be open, is dependent upon the productivity of the ecotype, recruitment, and the desired harvest. The rotating watershed system implies that goat populations will change from organized, stable pop-

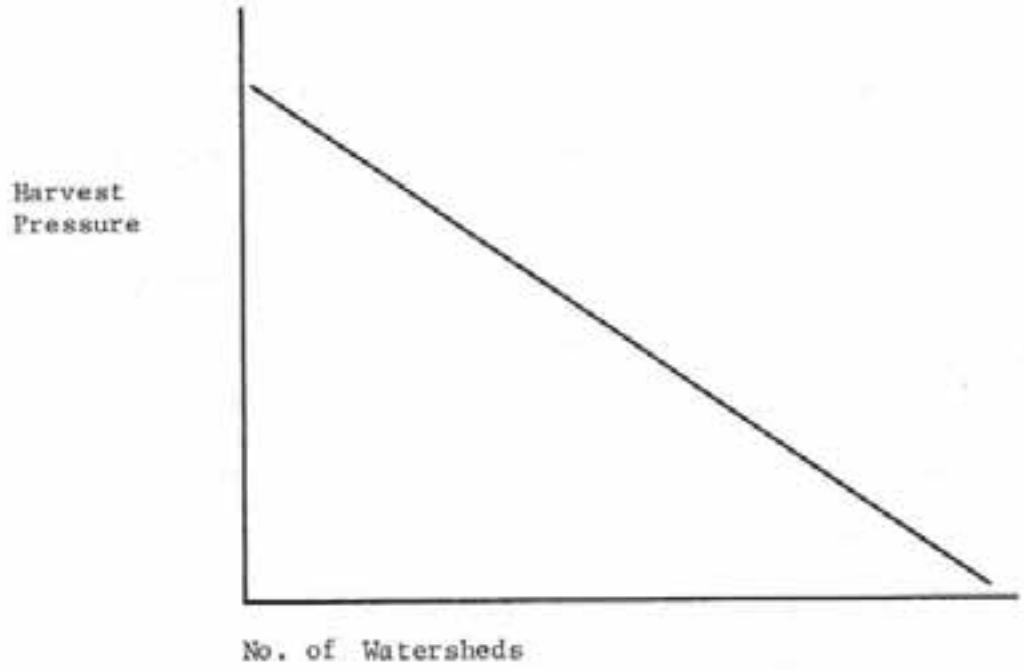

FIGURE 1. The relationship between harvest pressure and the number of watersheds available for rotational harvest.

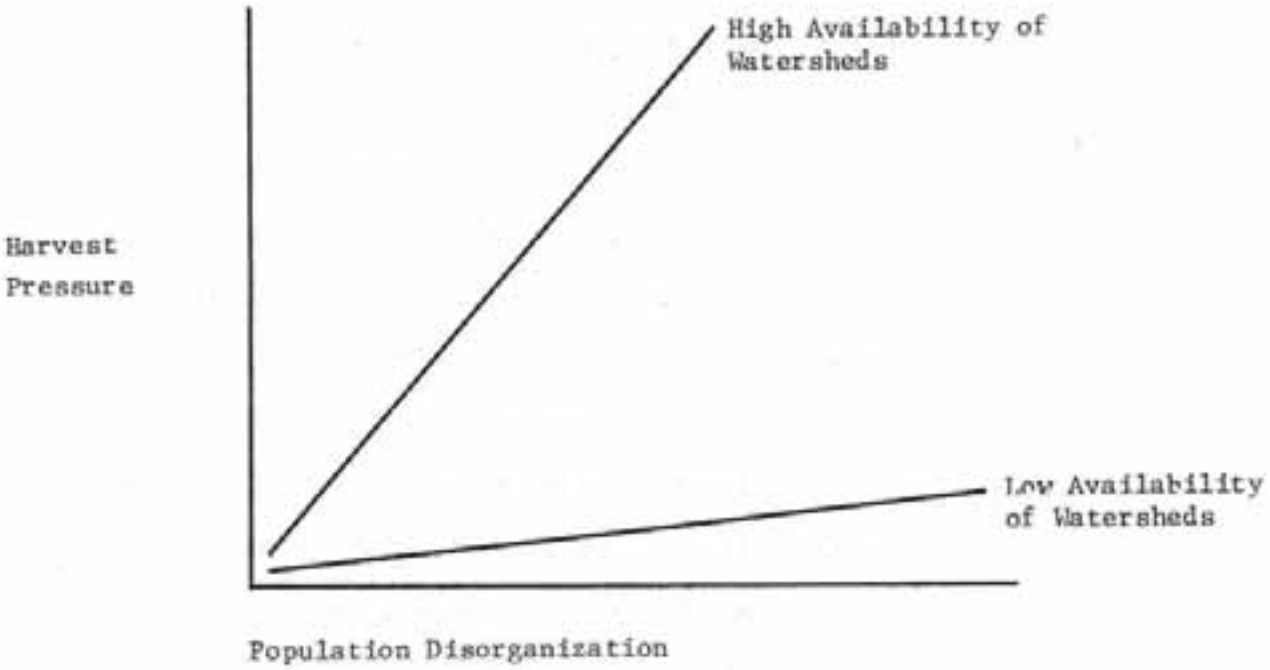

FIGURE 2. The relationship between harvest pressure and the level of population disorganization associated with the number of watersheds available for rotational harvest.

ulations to disorganized populations, (Figure 2) for various intervals of time dependent upon the availability of watersheds. Where a limited number of watersheds prevail, the level and period of disorganization may be monitored by harvest data from the compulsory check and/or the hunter sample, changes in the sex and age distribution from inventoried or harvested populations, changes in the harvest density and distribution, and changes in social organization and productivity from aerial and ground surveys.

Unless stringent controls are available, females may make up a large component of the harvest. For example, of the goats submitted through the compulsory check for aging (1977), approximately 33% of those harvested in Region 6 were female, and 58% of those harvested in Region 7 were female. It appears that game management unit (GMU) 7-39 is supplying at least 31% of the females harvested in Region 7 (Elliott, pers. comm.). The harvest distribution does not appear to center on a few populations, however, an evenly distributed harvest at this level of female harvest is also likely to be detrimental. It is possible that this population is disorganized to the extent that hunting should be curtailed for a period of time. If surveys identify a larger portion of the female component of the population, in comparison to the available male segment, the recruitment rate/100 adults will be inflated (Table 3) and, could cause an overharvest of females if sex identification by the hunter is not mandatory. Similarly, late October and November seasons may increase the vulnerability of early migrants to low-elevation winter ranges (often females and subadults). Bubenik (pers. comm.) has shown in other species that population quality changes in these circumstances,

Kuck (1977) has shown that less desirable habitats remain vacant as females are harvested and the population declines, and Hebert and Turnbull (1977) have indicated that productivity and recruitment may decline in more heavily hunted populations although the number of kids/100 adults may remain unchanged.

In populations of low productivity, recruitment is generally measured by the ratio of yearlings to adults. However, recruitment actually consists of females of 2.5 and/or 3.5 years of age. Examination of Chadwick's (1977) data suggests that there is a difference in recruitment of about 2% between yearlings and two year olds. It is likely that the difference is greater than 3% in low productive coastal populations. Thus, in the most sensitive ecotypes, recruitment and subsequently harvest is overestimated, especially if mortality occurs in the 2.5 or 3.5 year class. In higher productive populations or ecotypes, such as those on the Olympic Peninsula (Stevens, pers. comm.), overwinter mortality is reduced and recruitment more closely resembles the identifiable segment (yearling) of the population because all 3.5 year old females and many 2.5 year old females breed.

Harvest systems which are not dependent on inventory systems provide an inadequate basis for temporal comparison and often populations are reduced or removed prior to recognition by managers (Figure 3). In addition, identification of access and access policy must be related to individual populations. Lack of access control often results in an overharvest of newly available underharvested populations every 2-5 years. Air access in the north provides a somewhat more even distribution of harvest for a longer period of time, but eventually it can also become

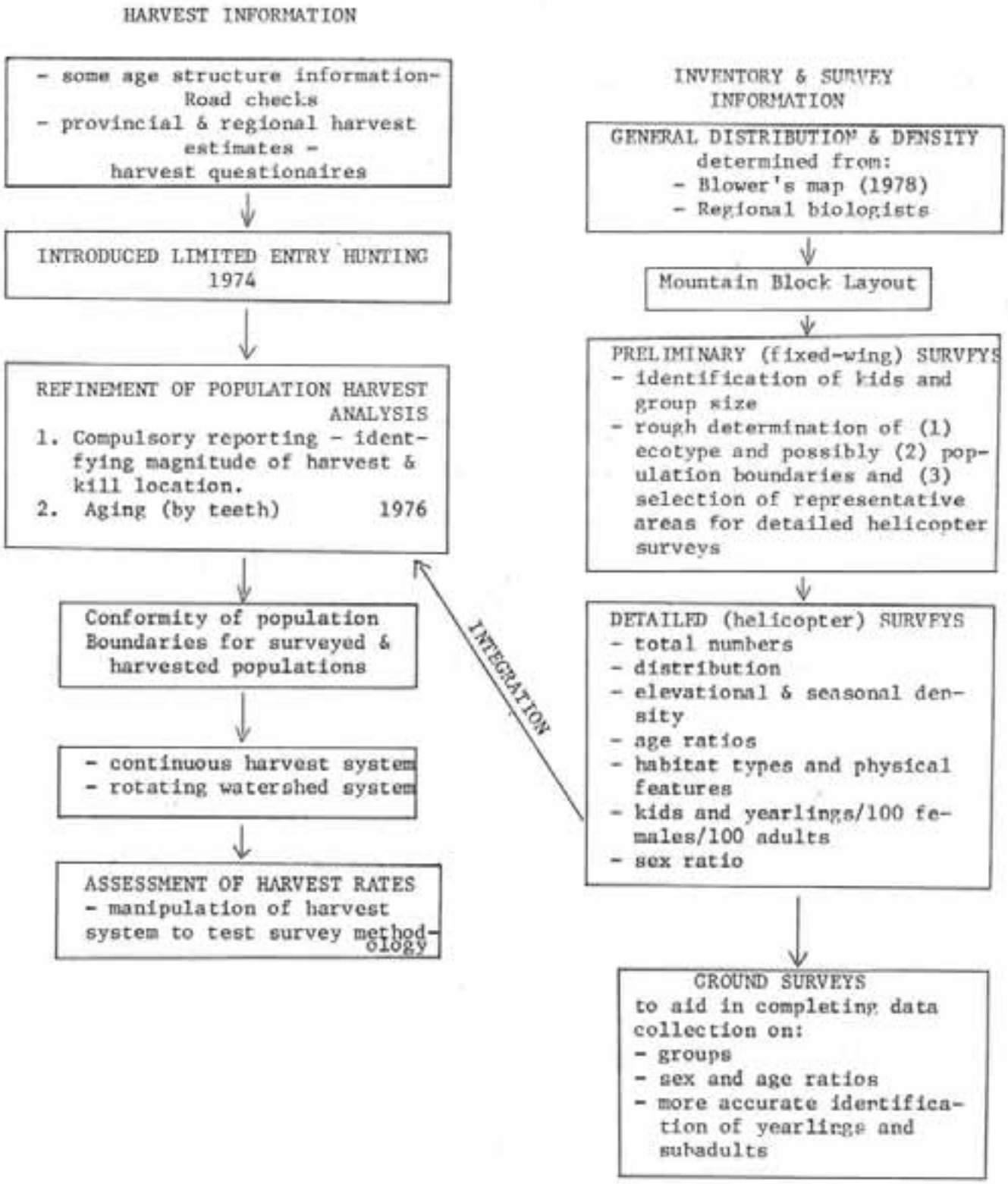

Figure 3. The relationship between harvest and survey systems.

clumped. Similarly, populations may be underharvested due to the insensitivity of the system. Management in large land units, by numbers alone, in the face of advancing access, has led to the decimation of several populations in the Province because the system could not adequately quantify population characteristics, harvest location, and magnitude of harvest.

In previous systems, hunters, weather, season length, and bag limit dictated the harvest. Present inventory - management systems must determine the harvest rate and be sensitive enough to indicate detrimental effects to the population at the time they are occuring. In addition to rotating watershed management within large land units, ground or aerial checks of representative study areas at two to five year intervals (depending on intensity of harvest) must occur in order to adjust the system. Where possible, limited entry hunting systems and compulsory checks should be used in relation to social organization, particularly for sensitive populations. Development of a conceptual framework for survey and harvest systems allows integration and the ability to test one system against the other. This requires that population or ecotype boundaries be consistent with management unit (MU) or subunit boundaries; harvest and inventory boundaries must coincide and units must be reduced in size. One of the strongest tools available to wildlife managers is the ability to manipulate harvests while testing the sensitivity of inventory methodology. However, this method has remained unused due to the inadequacy of current data systems in the B.C. Fish and Wildlife Branch and due to inadequate and inefficiently utilized inventory funds.

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MOUNTAIN GOAT MANAGEMENT - Chairman: K. M. Sumanik

J. N. Bone - Status of the Mountain Goat (Oreamnos americanus) of the Similkameen River, British Columbia.

Wayne Heimer: What is a juvenile and how do you tell?

Jack Bone: Size. Even a small adult is much bigger than an 11 month old juvenile.

Joel Berger: How do you determine the difference between males and females?

Jack Bone: Mainly by the shape of the horns; female horns curve back flatter and are usually smaller. You can also watch urination posture. Size is not often a good criterion. Usually males are by themselves; females will be in a group or with younger animals.

Bryan Foster: How many times a year do you conduct your counts?

Jack Bone: We do a very rapid count early in the spring; April - May.

Rolf Johnson: With the use of a helicopter did you experience much harassment?

Jack Bone: When they are on the precipitous areas they don't seem to react too badly. But in the spring, when they are on the lower slopes on the green-up ranges, they can move pretty fast to get back to the bluffs.

Anonymous: Do you have any idea of the per cent of goats that you see with your helicopter surveys in April and May?

Jack Bone: I think on the north side of the river, we are probably seeing about 80%, and on the south side we are seeing maybe 30%.

Bill Hall: What was the sex breakdown on your kill?

Jack Bone: It was quite high to females, about 65% to 70%.

Bill Hall: I see in your survey that you are classifying adults and juveniles and you are not doing them during the kidding time. Is this information adequate for management purposes?

Jack Bone: No, we need more population parameters: age class, sex class, better recruitment, productivity and natural mortality data.

Jim Bailey: When you had more restricted seasons and perhaps more local hunters, did you tend to get a higher ratio of males in the kill?

Jack Bone: Yes, we did.

R. Jamieson - Goat management in the Kootenays.

Jim Bailey: Regarding the delayed response of four to five years that the goat populations showed to lower density and closing of the season, do you think the delay is real, or an artifact of where you were looking for goats?

Bob Jamieson: I think we had some impact on goats in addition to the harvest. Harassment had some impact as well.. There are annual fluctuations in the population; there is a long term (50 year) forest-cycle fluctuation and there is a fluctuation in the five to twelve year period. I don't understand what it is, but I don't think it is an artifact of our technique.

Jim Bailey: You don't think it was poor weather-that the response could not occur until you had some better years?

Bob Jamieson: One winter, 1968-1969, was tough on all the game, but there is no indication that there was a series of hard winters.

Joel Berger: Have you tried to compare body size data, of hunter kills from your population to those which have been hunted elsewhere?

Bob Jamieson: I have some information from a pretty reliable fellow in the Elk Valley. He suggests that in two valleys separated by two ridges the average weight of goats in one valley is one hundred pounds more than in the other valley.

Joel Berger: If the carrying capacity of one population is increasing and the other one is decreasing, there could be a lot of competition. Do you think that might be one of the reasons?

Bob Jamieson: I have no idea with those particular herds.

W.K. Hall and J.A. Bibaud - Goats and their management in Alberta.

Tim Baumann: On your spring counts, do you fly prescribed routes, or do you just fly the area till you think you have seen all the goats?

Bill Hall: We fly each drainage, each alpine valley. We do cover more intensively areas where we know there should be goats.

Tim Baumann: You made a comment about 37% given mortality. Was that due to winter kill? What's causing your kid mortality?

Bill Hall: It's mainly due to winter severity. There are both wolves and cougars in the area, and in the summer we have grizzly bears but I don't know what their effect is. There was virtually no difference in figures between surveys flown in June and July.

Anonymous: You had two winters followed by low production and involving high mortality. Were those winters severe?

Bill Hall: No, the snow cover and the type of winter have not been that bad the last three years.

Daryll Hebert: Have you been successful with your ground and aerial surveys since 1973 in estimating more accurate or more definitive sex ratios?

Bill Hall: No, we have not. We classify adult males when possible.

Daryll Hebert: I was asking because recruitment ratios generally use kids and yearlings per 100 adults, but the fluctuation of the number of males/100 adults is anywhere from 0 to 80 or 90%.

Ray Demarchi: Do you feel that kids orphaned by hunters killing the nanny are destined to die?

Bill Hall: I think the kid and the yearling depend on the nanny a lot more than sheep do. I would say the chances of an orphaned kid surviving are probably less than if they were with a female.

Ray Demarchi: I think if you isolate your nursery groups and have another look at your data there is ample kid production. Natural mortality may run between 7 and 12% and average around 9%, but you do not need to produce a lot of kids and yearlings to maintain a population.

Victoria Stephens and C. Driver - Initial observations on a tagged mountain goat population in the Olympic Mountains.

Daryll Hebert: What per cent of the whole area are you covering in that count?

Tory Stephens: I'm not really sure how much of the area we are covering. We have seen 94% of the tagged adult females (since September) and so that is a pretty good indication that we are seeing quite a bit of the nursery group range at least. We are probably missing a lot of the males that are still in the area.

Randy Bennett: You said you had some problems with females with poor skin condition, in late winter, and you trapped the goats in summer. Did you observe any ectoparasites on the goats at this time?

Tory Stephens: No, I have not. However, I have never trapped one of the goats that looked like this so I have not been able to get a sample of it.

Jim Bailey: Did you feel that social groups, the animals tagged together, stayed together throughout the year?

Tory Stephens: They stayed in the same geographical area, but every time I went up I saw different combinations of the tagged animals.

Jim Bailey: How big a place are we talking about?

Tory Stephens: The distance between these two areas on the top of the ridge is about a mile, two miles.

D.M. Hatler - The Goats of Goat Mountain: Evaluation of a proposal.

John Elliot: Do you have any information which would give us further insight into how goats are able to move into a new range, and whether there are managment implications in that?

Dave Hatler: I do not know how well goats can colonize. The experience

seems to be that we have a lot of areas that do not now have mountain goats but probably did have.

Rick Ellis: Given that there are a lot of isolated populations and a lot of phenotypic, if not genotypic, differences, do you think there really are such things as generalities about goats?

Dave Hatler: I think you have to be management specific, particularly for these isolated populations.

B.R. Foster - Horn growth and quality management for mountain goats

Joel Berger: How do high and low quality populations differ in their parameters from populations that are increasing or decreasing?

Bryan Foster: The analyses with sheep are that high quality populations, mentioning the characteristics that I did, would represent increasing populations.

Joel Berger: Is there something specific about ungulates then, which makes you use the terms high and low quality? Or could you use these terms for any population?

Bryan Foster: You could use them for any population at any level. It is only a convenient criterion for indexing populations that one cannot get out to look at in the field.

D.M. Hebert - A systems approach to mountain goat management

Dave Hatler: The difference between high and low quality populations may be how they respond to different kinds of weather years. Perhaps in some years there may be no difference?

Daryll Hebert: After looking at goat populations in Alberta, B.C., Montana, and Washington, the animals I appreciate most are the goats that inhabit the coastal mainland in B.C. where the climate is extremely harsh. We have seen, over a three year survey period (1974-1976), both our kid ratio and our yearling ratio vary very little. In 1977 our kid production doubled, strictly, as far as I'm concerned, due to the increasing mild climate.

I'm fully convinced that behaviour and use of the habitat by the family group are really dictated by the winter climate. Where it is milder, there is less influence, but where it is harsh there is almost total control by climate.

Bob Jamieson: You talked about kid/adult ratios, female/kid ratios and so on, and the effect of not being able to count males. We also need to count the two year olds, since they are messing up that ratio too.

Daryll Hebert: The two year old component can disturb recruitment as much as not being able to survey for males. If you are surveying a low productivity ecotype, true recruitment may not really be till 3.5 years, but you are still calling recruitment yearlings/100 adults.