

POPULATION STATUS AND MANAGEMENT OF DALL SHEEP IN ALASKA, 1984

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ABSTRACT

Changes in land status have had profound influences on Alaskan Dall sheep (*Ovis dalli dalli*) management since 1979. Legislation which officially recognized subsistence hunting and placed more than 25% of Alaska's Dall sheep in National Parks had the additional effect of providing for surveys of the Dall sheep inhabiting these areas. These surveys revealed more definitely the number of Dall sheep in Alaska. Former, conservative estimates were revised upward to more than 70,000 sheep. This probably resulted from more complete coverage than ever before rather than notable increases in actual Dall sheep numbers. Some populations are in transition, but most continue to exist at nearly stable levels with only slow changes in numbers. Hunter harvest has stabilized at about 1,100 Dall sheep, including both sport and subsistence harvests. Implementation of management plans is proceeding slowly. Subsistence hunting has had minimal effects since establishment of the subsistence priority, but continues to be a potential population threat requiring increased monitoring of affected populations. Nonsubsistence ewe hunting continues on a very limited basis, with little broad public interest. New Dall sheep research in Alaska centres on population definition and ecological description. New research efforts involving radio-collared animals are underway in the Tanana/Yukon Uplands in the western Brooks Range. The Bureau of Land Management and the National Park Service are working jointly with the Alaska Department of Fish and Game on these projects. Behavioral studies by the National Park Services are in progress at Denali National Park. The Alaska Department of Fish and Game continues to study reproductive performance and age-specific survival. The survival of sublegal rams in heavily hunted populations appears to be a fruitful area of management-related research for the near future.

INTRODUCTION

Alaskan political events in the past 15 years have had profound influences on the status of Dall sheep (*Ovis dalli dalli*) and their management in Alaska. Heimer (1978, 1980, 1982) reviewed the economic and political events which brought Dall sheep to their present population levels, management situations, and present status. It should be emphasized that the true status of Dall sheep in Alaska is

more complex than the sum of their abundance, distribution, and the use/demands which they support. The status and welfare of Dall sheep in Alaska is ultimately determined by their value to the people of the State. This most important aspect of status is beyond the scope of this paper which will be limited to abundance, distribution, and management. These aspects reflect the former status and present uses of Dall sheep in Alaska.

Dall sheep in Alaska inhabit 7 mountain masses which are arranged in 3 major bands of generally continuous habitat extending from west to east for hundreds of miles (Fig. 1). In Alaska, mountains of the Brooks Range extend from the Bering Sea eastward to the Canadian border. In Canada the eastward extensions of these mountains are known as the British Mountains, Barn Range and Richardson Mountains. Dall sheep also inhabit the glacial refugium of the Tanana/Yukon Uplands which may be thought of as an altitudinally lower, westward extension of Canada's Ogilvie Mountains. In central Alaska the Alaska Range forms a band of sheep habitat running from Lake Clark northwesterly to Mt. McKinley, and then generally eastward and somewhat southward toward the Canadian border where it merges with the northern slopes of the St. Elias Mountains in Canada. In Alaska, sheep distribution along the Alaska Range is discontinuous, being interrupted near Mt. McKinley. Hence, habitat is labeled as the Alaska Range "east" or "west" of Mt. McKinley. Sheep distribution is also interrupted by the lowlands of the Tok River. Mountains east of the Tok River are considered as the north side of the Wrangell Mountains. Just south of the central Alaska Range is an "island" of Dall sheep habitat, the Talkeetna Mountains. These mountains are not clearly identified with any major Alaskan or Canadian mountain mass. The southernmost extension of Dall sheep range in Alaska is in the mountains which begin on the Kenai Peninsula and proceed northeasterly to the Turnagain Arm of Cook Inlet near Anchorage. Beyond that point they are called the Chugach Mountains in Alaska, and they merge with the coastal portions of the St. Elias Mountains in Canada. In Alaska, Dall sheep habitats are called the Brooks Range, the Tanana/Yukon Uplands, the Alaska Range east of Mt. McKinley, the Alaska Range west of Mt. McKinley, the Talkeetna Mountain, the Wrangell Mountains, the Kenai Mountains, and the Chugach Mountains (Fig 1). I shall discuss Alaska's Dall sheep by grouping them in these mountain ranges. Dall sheep distribution is limited to the north slopes of the Kenai, Chugach, and Alaska Ranges. Prevailing weather renders the southern sides of these mountains uninhabitable because of heavy snowfall during winter.

MATERIALS AND METHODS

Knowledge of Dall sheep distribution in Alaska is the cumulative record of human observations extending from the oral history of Alaska's aboriginal peoples and early explorers to the present time. The abundance of Dall sheep in modern times has been determined by aerial surveys of known Dall sheep habitats. These surveys have been primarily accomplished using Piper PA-18 150 hp Super Club aircraft. These aircraft accommodate a pilot and an observer seated behind. The



Fig. 1: Distribution of Dall Sheep in Alaska.

observer may look out windows on either side of the narrow fuselage. Super Cubs are safely capable of fairly slow (60-70 mph) flight and have sufficiently high performance that they are suitable for low-level mountain flying in calm weather.

Recently, biologists of the National Park Service developed helicopter survey techniques and applied them broadly in newly created National Parks throughout Alaska (Singer 1981, 1982; Singer and Johnson 1984). The helicopter used in these surveys was a Bell 206B Jet Ranger. Procedures were standardized using a pilot and 3 observers. When this technique is used, large groups of sheep are counted and classified by landing and observation with spotting scopes of high power (15-60X).

The philosophy of Dall sheep management in Alaska depends on land ownership and classification. On State or Federal lands not designated as National Parks, management approach is determined through the regulatory process of the State of Alaska, and management is the responsibility of the Alaska Department of Fish and Game. Under this system, management policies prepared by the Alaska Department of Fish and Game were presented to the public for comment, modified, and then to a politically appointed Board of Game. Upon approval by the Board of Game, the policies functioned as guidelines for management plans which lead to the specific regulations required to manage sheep populations accordingly. Changes in game regulations may be proposed by citizens of Alaska, as well as the Department of Fish and Game. The Board of Game then implements those proposals considered to be consistent with the management goals and in the best public interest.

On remaining Federal lands, management is determined by congressional mandate. Some National Park lands are closed to hunting completely, and some are open to subsistence hunting. Federal lands classified as National Park Preserves are currently managed to allow consumptive use of Dall sheep through the regulatory mechanisms described above.

On all lands open to hunting, hunters are required to report their success, hunt locations, the sex, horn length and base circumference, and estimated age of sheep taken, the method of transport to the hunting area, and length of time spent hunting to the Department of Fish and Game. Reporting from recreational hunters is considerably more reliable and the data gathering system more highly evolved than for subsistence sheep hunting.

RESULTS

Table 1 summarizes population size and management status of sheep by mountain range. Specifics will be discussed for each specific range beginning in the north.

Brooks Range:

Recent surveys by the National Park Service in Gates of the Arctic National Park and the Noatak National Preserve (Singer 1982, Singer and

Table 1. Population size, status, harvest, and management of Dall sheep in Alaska.

Mountain range	Population size	Trend over 10 years	Sheep available to hunt	Legal game	Planned management objective(%)	Average number hunters 1982&83	Annual ram kill	Pursuit of all management goals complete?
Alaska Range E. of McKinley	9,000	Stable	9,000	Full curl ram (open) Full curl ram (permit) Ewe (permit)	Max. opport. (61%) Aesthetics (17%) Trophy (22%)	500	200	Yes
Alaska Range W. of McKinley	4,000	Stable	3,000	7/8 curl ram (open)	Aesthetics (75%) Viewing* (25%)	200	100	No
Denali Nat. Park (McKinley)	3,500	Stable	0	None	Viewing* (100%)	None	None	Yes
Brooks Range	30,000	Stable	15,000	7/8 curl ram (open) Subsistence (permit)	Aesthetics (50%) Viewing* (50%)	350 (sport) 50 (subsist.)	200 100**	No
Chugach	5,000	Stable or increasing	4,000	7/8 curl ram (open) 7/8 curl ram (permit) Ewe (permit)	Aesthetics (100%)	350	100	No
Kenai	1,500	Declining	1,300	7/8 curl ram (open)	Max. opport. (87%) Viewing* (13%)	135	25	Yes

Table 1. Continued.

Mountain range	Population size	Trend over 10 years	Sheep available to hunt	Legal game	Planned management objective (%)	Average number hunters 1982-83	Annual ram kill	Pursuit of all management goals complete?
Tanana/Yukon Uplands	650	Declining	650	7/8 curl ram (open) Full curl ram (permit)	Aesthetics (100%)	40	16	Yes
Talkeetna	3,000	Stable	2,800	7/8 curl ram (open)	Max. opport. (62%) Aesthetics (31%) Viewing* (7%)	200	90	No
Wrangell Mtns. (north)	17,000	Stable	12,000	7/8 curl ram (open)	Max. opport. (75%)	400	200	Yes
(south)	4,000	Stable	3,000	Full curl ram (open)	Aesthetics (19%) Viewing* (6%)	200	90	No
Total	72,650		50,750			2,425	1,121**	
								Aesthetics = 39% Max. opport. = 28% Trophy = 3% Viewing = 30%

* No hunting allowed.

** Sheep of both sexes.

Johnson 1984) increased the number of sheep known to be present and consequently the estimated population size of Dall sheep in the Brooks Range. Since 1976, approximately 23,000 sheep have been counted in systematic aerial surveys of the Brooks Range. If surveyors saw 80% of the sheep present, the Brooks Range population is approximately 30,000 Dall sheep. Of these sheep, about 11,000 are within the National Arctic Wildlife Refuge (Fig. 1). These sheep are managed according to Alaskan State regulations. The management plan for this area provides for hunting in uncrowded, aesthetically pleasing conditions. Currently, the remoteness and high cost of hunting in this area limit hunters to acceptable levels. A lottery permit system was formerly in place here but was removed when it proved unnecessary to meet the management goal. Other lands open to hunting contain another estimated 3,000 sheep east of the Trans-Alaska Pipeline (Fig. 1). These sheep are also managed to allow aesthetically pleasing hunting opportunities. However, sheep within 5 miles on either side of the Trans-Alaska oil pipeline are managed for viewing and bowhunting since no firearms discharge is allowed within 5 miles of the oil pipeline. West of the pipeline, Gates of the Arctic National Park contains about 12,000 sheep. About 500 of these sheep are available for hunting in Gates of the Arctic National Park Preserve. The remaining 11,500 are protected from recreational hunting in the National Park. However, these sheep are available to subsistence hunters as defined by Congress in the Alaska National Interest Lands Conservation Act (ANILCA). Gates of the Arctic National Park also contains, in fully protected status, most of the sheep in the Noatak drainage of the western Brooks Range. About 700 sheep inhabit the Noatak National Preserve which is also managed to allow consumptive recreational use. In summary, management of about half of the Dall sheep in the Brooks Range (15,000) allows consumptive use under plans which call for aesthetically pleasing hunting conditions, 11,500 are protected in Gates of the Arctic National Park, and the remainder occupy the Trans-Alaska Pipeline Corridor.

About 350 recreational hunters harvest nearly 200 legal, 7/8 curl rams annually from the 15,000 huntable sheep. Most of these rams, about 60% are taken by nonresident hunters who must be accompanied by a guide according to Alaskan statute.

Several areas in the Brooks Range support harvest by subsistence users. Residents of Kaktovik village harvest about 35-40 sheep annually from approximately 2,000 sheep in the Hulahula River drainage of the Arctic National Wildlife Refuge. This hunt is closed to aircraft use for transportation of sheep meat or sheep hunters. Access is by ground transport (snow machine), and harvest occurs in November and April. The season runs from October 1 through April 30 and the bag limit is 3 sheep of any age or either sex. A quota of 50 sheep is set for the hunt each year, and hunters must obtain a registration permit in Kaktovik or Arctic Village before going afield. Crude population studies involving aerial surveys of the entire Hulahula drainage indicate this level of harvest (estimated at 30-40 sheep annually) has not measurably affected population levels in this area since 1976, even though the harvest is predominantly (70%) ewes (Heimer 1983). Within

Gates of the Arctic National Park, villagers of Anaktuvuk Pass harvest about 30 Dall sheep annually. The population supporting this harvest contains less than 1,000 sheep. It is unknown whether harvest by Anaktuvuk Pass residents is materially affecting the welfare of populations they hunt. Anaktuvuk Pass residents hunt in the fall, usually from all-terrain vehicles, and seldom take sheep later than early November. Anaktuvuk residents selectively take rams of all ages but do not kill them after rut has begun because of alleged "poor eating qualities". Some subsistence hunting also occurs in the lower Noatak River and in several other villages scattered throughout the Brooks Range. Harvest levels by these hunters and the sizes of the populations they hunt are unknown. Harvests are thought to be small, and populations are not large.

Research in the Brooks Range includes monitoring the effects of subsistence hunting on local populations and studies of home range and range ecology. Work is being done jointly by the National Park Service and the Alaska Department of Fish and Game.

Tanana/Yukon Uplands

Dall sheep populations of the Tanana/Yukon Uplands (Fig. 1) are thought to contain about 650 individuals. This area is characterized by fairly low, rolling hills; alpine habitat is disjunct with broad, timbered valleys between suitable alpine sheep habitats. This habitat is considered by many as the ancestral refugium of thinhorn sheep, and habitat character is more like the steppe habitats of northern Asia than other Alaskan sheep habitats.

Escape habitat is sparse compared to other Alaskan Dall sheep habitats, and populations have apparently declined somewhat in recent years. Predation pressure is the most often hypothesized cause. The Tanana/Yukon Uplands are in close proximity to population centers, but difficult access limited hunting and harvest in the past. However, since establishment of National Parks (which encompass the habitat of more than 25% of the Dall sheep in Alaska), hunter interest in the Tanana/Yukon Uplands has increased, the access problems have been overcome by more hunters, and hunter participation and harvest are now relatively high. These 650 sheep supported about 40 hunters per year during the last 2 hunting seasons. These hunters took an average of 16 sheep each year during the last 2 years.

Management plans for this area allow hunting under aesthetically pleasing conditions. Since hunters "re-discovered" the Tanana/Yukon Uplands, these conditions have been deteriorating. The anticipated sustainable harvest of rams from 650 sheep should be about 20 rams annually if the population were stable (it is thought to be declining). Still, even at this optimistic level only 1 legal ram is being recruited for each 2 hunters. These statistics indicate crowded

hunting conditions relative to production. As a result, most of the Tanana/Yukon Uplands was placed on lottery permit to restrict hunter pressure in 1984.

Research in the Tanana/Yukon Uplands is being jointly conducted by the Bureau of Land Management and the Alaska Department of Fish and Game. Radio transmitters were attached to 6 ewes a year ago and revealed the ewes in this area are loyal to traditional ranges. They travel through the extensive timbered lowlands between their alpine ranges. Wolves took one marked ewe during the first year of the study (Durtsche 1984).

The most significant threat to sheep in the Tanana/Yukon Uplands is displacement and habitat loss attending development by the mineral industry. The land management agency for the area, the Bureau of Land Management, proposed closing crucial sheep habitat to mineral development in their resource management plan for a National Recreation Area and a National Conservation Area created in the Tanana/Yukon Uplands by ANILCA. Several mineral discoveries are apparently located in the area, but plans for future development have not been publicized. The most clearly identifiable threat is from asbestos and tungsten prospects being developed in areas not withdrawn from mineral entry.

Alaska Range:

The Alaska Range west of Mt. McKinley (Fig. 1) supports a population estimated at a minimum of 4,000 Dall sheep. Three thousand sheep are available to hunters, and about 1,000 sheep are in Lake Clark National Park. Sheep habitat in the Alaska Range is continuous alpine country and is considered classic Alaskan Dall sheep habitat. The western Alaska Range supports about 200 hunters annually, and harvest is about 100 7/8 curl or larger rams. This harvest rate is approaching or exceeding maximum sustainable levels if the number of sheep is actually 3,000 and the population is stable. The management goal for this area is to provide the opportunity to hunt Dall sheep under aesthetically pleasing conditions. Complaints about deterioration of the hunting experience in the western Alaska Range have not yet materialized, but the capacity of this area to continue absorbing pressure without yielding a compromised hunting experience seems questionable. No research is being conducted in the western Alaska Range.

The Dall sheep population of Denali National Park (Fig. 1) (formerly Mt. McKinley National Park) has been established at a minimum of 2,476 (Singer 1981). The population is estimated at about 3,500. These sheep are managed exclusively for nonconsumptive use according to guidelines for National Parks established by congress. Research on rutting behavior is being done in Denali Park by the National Park Service.

The Alaska Range east of Mt. McKinley (Fig. 1) contains approximately 9,000 Dall sheep. These sheep are managed to achieve 3 different management goals. Slightly more than 5,500 are managed to provide for maximum hunting opportunity for Dall sheep. Nearly 1,500 are managed

for aesthetically pleasing hunting conditions, and the management goal for the remaining 2,000 is production of trophy sheep. In total, the Alaska Range east of Mt. McKinley accommodates about 450 to 500 hunters annually. The harvest is about 200 rams. In the trophy area the minimum horn size has been full-curl for 10 years, and the mean harvest there has been about 40 rams annually. Since hunter participation is limited by lottery permits, this harvest rate is surprisingly high, particularly because the management goal defines a submaximal harvest. Still horn size and age among rams harvested is high and stable. A registration ewe hunt with a quota of 20 ewes is also offered in this area. Some local residents consistently hunt ewes, but interest is minimal compared with the ram hunt. In 1984, 1,404 hunters applied for the 120 ram permits issued by lottery drawing. In contrast, an open registration hunt for ewes attracted about 25 hunters. An average 5-7 ewes is taken each year.

Research in the Alaska Range east of Mt. McKinley is being conducted by the Alaska Department of Fish and Game. It centers on population welfare and includes studies of reproductive biology, population dynamics, range ecology, and age and sex specific mortality. Recently, data from studies of ram mortality suggested a strong behavioral mechanism exists which causes greatly enhanced mortality among sublegal rams when heavy cropping of legal rams above the age of 6 years is practiced. As a result, legal horn size for the entire eastern Alaska Range was raised to full-curl in 1984 to see if predicted larger harvests could be achieved.

Wrangell Mountains:

The Wrangell Mountains (Fig. 1) are currently thought to contain 16,000 Dall sheep. Most of these sheep (about 12,000) are on the north side of the mountain range in the Wrangell-St. Elias National Park Preserve. About 400 hunters annually use the northern Wrangell Mountains, and the yearly harvest is about 200 rams. This park preserve is managed to provide the greatest opportunity to participate in sheep hunting. The legal ram definition was changed from 7/8 to full-curl in 1984 due to public demand. It is unlikely the change to a full-curl regulation will have a great effect on harvest because the current harvest rate is low relative to the number of sheep present. However, populations may have declined due to severe winters in 1981-82 and 1982-83, and harvests could decline for the next few years.

The remaining 4,000 sheep in the Wrangell Mountains are on the west and south sides. These sheep (3,000) are mostly within the Wrangell-St. Elias National Park Preserve. The management plan for this area is to provide the opportunity to hunt sheep under aesthetically pleasing conditions. About 200 hunters use this area each year, and the average harvest is about 90 rams with 7/8 curl horns or larger. No research is being done in the Wrangell Mountains. The largest Dall rams in the world remain under total protection from hunting because they are within the Wrangell-St. Elias National Park at the southeast corner of this mountain range.

Talkeetna Mountains:

Sheep in the Talkeetna Mountains (Fig. 1) are estimated to number about 3,000. Most of these sheep are concentrated in the south and east portions of this mountain mass. Two different management goals are defined for the Talkeetna Mountains. Most sheep habitat in the Talkeetna's is managed to provide for the greatest opportunity to participate in sheep hunting. However, the southwest corner has a differing management plan, to provide the opportunity to hunt sheep under aesthetically pleasing conditions. Approximately 200 hunters per year take an average of 75 rams from areas open to hunting. Sheep Mountain, a well-known sheep range supporting about 200 sheep which is close to the Glenn Highway, is closed to sheep hunting and has a management goal of providing the opportunity to view, photograph, and enjoy sheep. This area is one of several areas set aside by the State of Alaska for nonconsumptive use. It has been managed for this goal since 1959. No research is being conducted in the Talkeetna Mountains.

Kenai Mountains:

Generally severe winters from 1970 through the early 1980s reduced the estimated sheep population of the Kenai Mountains (Fig. 1) from 3,000 sheep to an estimated 1,500 at this time. Two different management goals have been proposed for the Kenai Mountains (Spraker, pers. commun.). The Cooper Landing Closed Area is quite similar to the closed area just described for the Talkeetna Mountains. It is adjacent to a road and has been closed to consumptive use by the State of Alaska since statehood in 1959. This population contains about 200 sheep. The remainder of the Kenai Mountains is managed to provide for maximum opportunity to participate in sheep hunting. For the last 2 years an average of 135 hunters have hunted on the Kenai Mountains. They reported taking an average of 25 rams with horns greater than or equal to 7/8 curl. Hunter success averaged 18% during these 2 years, the lowest in Alaska and about half of the statewide average. Low success could be due to mortality losses of the early 1980s centering on older rams or poor ram recruitment in the mid-1970s. The second alternative is more likely. No documented research is currently underway in the Kenai Mountains, but Nichols (1978) formerly conducted population studies there. Trend count areas are surveyed annually.

Chugach Mountains:

The Chugach Mountains (Fig. 1) are thought to contain at least 5,000 Dall sheep. Densities are highest near Anchorage, and decrease toward the east. Dall sheep populations are quite sparse east of the Copper River, but some are found on the north side of the Chugach Mountains south of the Chitina River. Sheep habitat in the Chugach is managed to provide for sheep hunting under aesthetically pleasing conditions.

In one management area near Anchorage this goal is met through a lottery permit system.

Much of this area lies within an Alaska State Park and presents a challenging management situation because of persistent attempts by the State Parks system to manage large portions of it like a National Park, i.e., exclusively for nonconsumptive use.

A lottery permit hunt for 10 ewe sheep has been offered in the northwestern Chugach Mountains for 3 years. An average of 146 applications has been received each year. The average number of hunters participating has been 6, and the average harvest has been 2 ewes per year. Through comparison with the lottery permit hunts offered for rams throughout Alaska, it appears the ewe hunt is not attractive to many sheep hunters. An average of 2,630 hunters apply for lottery ram permits each year and about 2,500 hunters participate in open ram hunting. Less than 50 nonsubsistence hunters go after ewes in open registration (see Alaska Range East) and lottery permit hunts.

Ram harvest is limited to 7/8 curl or greater rams in the Chugach Mountains. The Chugach Mountains usually produce a harvest of about 100 legal rams and support about 350 hunters.

In summary, the estimated number of Dall sheep in Alaska is greater than 70,000. Populations are generally considered to be stable, but some individual populations are apparently increasing as others decrease due to localized causes. Sheep of the Kenai Mountains declined due to winter severity in 1980. They are currently at low levels, but are presumably building. An average of about 2,500 hunters hunted sheep in each of the last 2 years. They reported taking about 1,000 sheep, 600 by residents and 400 by nonresidents each year. During these years, subsistence hunters have probably taken a minimum of 75 sheep annually, and controlled ewe hunts have accounted for less than 10 ewes per year. This totals about 1,100 sheep harvested per year.

Alaska Department of Fish and Game management plans call for sheep to be managed for a variety of human uses. Management goals are being achieved with respect to nonconsumptive use and the maximum opportunity to participate in Dall sheep hunting. Programs for achieving the management goals of providing aesthetically pleasing hunting conditions are approximately 50% operational. Trophy management goals are being actively pursued in 1 of the 2 areas for which they were originally set. The other area is now in a national park.

DISCUSSION

Increases in the total number of Dall sheep estimated in Alaska suggest a re-examination of the distribution of these sheep with respect to prevailing management policy. Gates to the Arctic Park contains an estimated 11,500 sheep, Wrangell-St. Elias about 3,000 sheep, Denali National Park about 3,500, and Lake Clark National Park about 1,000.

These National Parks contain an estimated total of 19,000 Dall sheep. This comes to 27% of the Statewide total. While some subsistence hunting may be allowed on these lands under terms of ANILCA, neither sport hunting nor the use of aircraft for support of subsistence hunting is allowed. Also, state-managed viewing areas and the de facto viewing area along the pipeline contain another 3%. About 30% of the Dall sheep in Alaska are managed primarily for viewing.

A futile effort to reestablish consumptive use as a management option on newly created park lands was made in 1984. It failed. It now seems that the "golden moment" for passage of the Alaska Hunting Bill has faded into history, and it appears unlikely that Congress is likely to deal with the issue in the near future.

Still, the grim consequences predicted by Heimer (1978, 1980, 1982) have, for the most part, not materialized. Heimer assumed sheep hunting effort would continue to show increases even through the huntable population of sheep decreased considerably. Surprisingly, participation in sheep hunting unexpectedly declined by about 20 to 25%. Also, the discovery of more sheep (mostly on the north side of the Wrangell Mountains) acted to diminish the problems anticipated in maintaining harvest. Still, harvest diminished by about the same percentage as hunters afield. As a result, the success rate of hunters remained about the same as before land classifications changed. Hunter numbers are expected to increase in the future.

Subsistence hunting has had unknown effects on those sheep populations which support it. Populations in the Hulahula River, which support subsistence hunters from the village of Kaktovik on Alaska's north coast, were found to be undetectably affected by subsistence hunting in which ewes are predominantly selected. This hunting usually results in harvest of about 24 ewes from a population of 2,000 sheep. It remains to be seen whether other populations can continue to provide the harvest they are yielding at present. Subsistence hunting by the villagers of Anaktuvuk Pass in the central Brooks Range is most interesting. The number of sheep killed relative to population sizes appears to be quite high, but these hunters prefer to take rams. Harvest of this type certainly carries a lower population risk than a ewe harvest. Still, population studies are needed to determine the safety of this management practice.

Benefits resulting from the trauma of the last 6 years of turmoil in Alaskan Dall sheep management should not be overlooked. More complete censuses than ever thought possible have been accomplished because the newly created National Parks were established with funding supplied for a basic resource inventory. Sheep abundance is much better understood as a result. Research programs which were previously far beyond the economic resources of the Alaska Department of Fish and Game have been undertaken in the Brooks Range and the Tanana/Yukon Uplands. Finally, sheep managers were forced to examine the traditional premises upon which the management was based. This led to some interesting hypotheses which are now undergoing evaluation. The application of full-curl management to areas which are to be managed for maximum hunting opportunity is an example. Small-scale studies and theoretical

considerations indicated sustainable yield should be higher at full-curl than at the traditional 3/4 or 7/8 curl levels. This hypothesis is now being tested on a fairly large scale in Interior Alaska.

HUNTER INFORMATION

The annual harvest of Dall sheep in Alaska comes to nearly 1,000 rams. Resident hunters take about 600 rams annually using licenses that cost \$20. There is no tag fee for resident hunters. Nonresident hunters take the other 400 rams. A nonresident hunting license costs \$60, and nonresidents must purchase a Dall sheep tag for \$400. Lottery-type permit drawings are open to both residents and nonresidents. In some hunts, nonresidents are guaranteed a percentage of the permits. Permit applications cost \$5, and sheep hunters may apply for only 1 permit hunt each year. Nonresidents may not hunt sheep without hiring a guide licensed by the State of Alaska, or being accompanied by a resident adult within the third degree of kindred. Registered guides charge from \$4,000 to \$7,000 for a sheep hunt depending on the hunting area, the quality of services offered to the hunter, and the reputation of the guide. For further information, write to: Wayne Heimer, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701.

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