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WINTER MOUNTAIN GOAT DIETS IN SOUTHEAST ALASKA

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Abstract: We determined winter diets of mountain goats (*Oreamnos americanus*) by microhistological analysis of fecal pellets from forested wintering areas in southeast Alaska from 1980 to 1982. As snow depth increased, forbs and ferns declined as diet constituents, but conifers, lichens, and mosses remained important to the diet. The high proportion of conifers, arboreal lichens, and mosses in the diets indicates a need to consider goat habitat during timber management and a need for a better understanding of how goats survive on these forages.

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Mountain goats inhabit many vegetation types and use a wide variety of forages (Geist 1971, Adams and Bailey 1983, Dailey et al. 1984). Graminoids, shrubs, conifers, ferns, forbs, and cryptogams are consumed by goats (Hjeljord 1971, Johnson 1983, Dailey et al. 1984). Most goat winter diets have been determined in continental mountain ranges, that are more likely than coastal ranges to have snow-free windblown wintering sites (Hebert and Turnbull 1977). The importance of graminoids and deciduous browse in goat diets probably reflects the typically grass- and shrub-dominated forage available in continental mountain ranges.

In southeast Alaska, mountain goats commonly use forested wintering sites (Fox 1983, Smith 1984). In these coastal regions deep, wet snowpacks in the alpine zone forced goats down into forests where less snow accumulates. The forages available in forest communities and the way they are used by mountain goats have not been determined. However, many mountain goats occupy heavily forested coastal mountains that are managed for timber (Foster 1982, Smith and Raedeke 1982). It is important that managers know more about the potential effects of timber harvesting on goats along the Pacific Coast because of increased logging in mountain goat ranges in this region.

Our objectives were to describe winter diets of mountain goats inhabiting forested areas and to determine changes in diet related to snow depth. These are important in assessing the value of forested habitats to goats in southeast Alaska.

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STUDY AREA

We studied mountain goat diets in old-growth forest on the Cleveland Peninsula (56°15'N, 134°30'W), 45 km northwest of Ketchikan, Alaska. Elevations ranged from sea level to 1,200 m. Areas <750 m were dominated by forests of western hemlock (*Tsuga heterophylla*), Alaska yellow cedar (*Chamaecyparis nootkatensis*), and Sitka spruce (*Picea sitchensis*). Forest understories commonly included shrubs such as huckleberry (*Vaccinium ovalifolium, V. parvifolium,* and *V. alaskaense*) and rusty menziesia (*Menziesia ferruginea*), and herbs such as bunchberry (*Cornus canadensis*), trailing bramble (*Rubus pedatus*), and goldthread (*Coptis asplenifolia*). Lush subalpine meadows were intermixed with forest from 600 to 750 m. At higher elevations, these meadows graded into sparsely vegetated alpine meadows and rock outcrops. Plant communities are described by Harris and Farr (1974), Alaback (1980), and Fox (1983).

Precipitation during winter in southeast Alaska is typically 20–50 cm at sea level. Above 500 m precipitation generally falls as snow and can reach several meters in depth. Winter snow depth at sea level may reach 1 m in some years. In other years there is little snow below 500 m. There was below-normal snowfall near sea level in the winter of 1980–81, whereas in 1981–82 snowfall was normal at low elevations.

Most goat wintering sites in the region and those in our study area were below timberline.

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Wintering goats were found in heavily forested, but relatively steep sites from timberline to near sea level (Smith and Raedeke 1982, Fox 1983).

METHODS

Fecal pellets from mountain goats were collected from November through March from 1980 through 1982. Three collections were made at 1 site during 1980–81, and 12 at 2 sites during 1981–82. All pellets were collected in forested wintering areas at elevations from 250 to 650 m. The pellets were collected monthly and snow depth was measured at the time of each collection.

Five pellets from each of ≥20 pellet groups, representing droppings from ≥5 goats, formed a composite sample for each collection. Only fecal pellets found on top of the snowpack (<7 days old) were collected. Pellets were collected subsequent to the first winter snowfall. Snow depth did not always increase with each subsequent collection. Because the forest canopy and rugged terrain made snow depths extremely variable, more consistent (but greater) snow depths were measured in level, open areas at fixed locations adjacent to each forested collection site. Ten snow depth measurements were taken in open areas for each collection date.

Botanical composition of feces was based on microhistological analysis (Sparks and Malechek 1968, Vavra and Holechek 1980), providing relative proportions of plant fragments in the fecal-pellet samples. Feces were analyzed by the Southeast Diet Analysis Lab, associated with the Pacific Northwest Forest and Range Experiment Station, Juneau, Alaska. For each composite, 100 microscope fields were observed. Biases of the microhistological technique have been discussed elsewhere (Vavra and Holechek 1980, Holechek et al. 1982, Gill et al. 1983). In the present analyses conifers and mosses, because of their relatively low digestibilities (Hanley and McKendrick 1983), were probably overrepresented compared with forbs, shrubs, and ferns. However, this bias is assumed to be minor compared to the major trends in goat diets. Newman-Keuls multiple-comparison test (Snedecor and Cochran 1967:273) was used to determine differences in diet content related to snow depth.

RESULTS

Fifty species of plants were found in the winter feces of mountain goats in southeast Alaska (J. L. Fox et al. Mountain goat ecology on Cleveland Peninsula, Alaska, 1980–82—addendum: dietary analyses. U.S. For. Serv., Juneau, Alas., 1983) (Table 1). Most occurred as minor diet constituents, with 25 species comprising ≤2% of any fecal sample. The conifers, Alaska yellow cedar, western hemlock, and mountain hemlock (*Tsuga mertensiana*); mosses (*Hylocomium* spp., *Rhytidiadelphus* spp.); and lichen (*Lobaria* spp.) were most commonly represented (Table 1), with each accounting for >30% of the material analyzed for ≥1 fecal composite sample. Species of secondary importance (5–10% in ≥1 fecal composite) included huckleberry, bramble (*Rubus* spp.), bunchberry, trailing bramble, deer fern (*Blechnum spicant*), and lichens (*Alectoria* spp. and *Usnea* spp.).

In early winter, when snow depth was <50 cm on open non-forest sites, conifers, forbs, ferns, lichens, and mosses were all important components of goat diets (Table 1). Forbs and ferns decreased in the diet ($P < 0.05$) as snow depth increased to ≥50 cm. Shrubs were a minor constituent at all snow depths, and conifers, lichens, and mosses remained as the major diet items when snow depth was ≥150 cm.

DISCUSSION AND MANAGEMENT IMPLICATIONS

Conifers, lichens, and mosses were more preponderant in the mountain goat's winter diet in southeast Alaska than in diets reported from other areas. Whereas several studies have shown conifers as important constituents of goat winter diets (Saunders 1955, Adams and Bailey 1983, Johnson 1983), only Harmon (1944) and Brandborg (1955) have reported substantial amounts of lichens or mosses in goat diets. In southeast Alaska, the goat wintering sites were more densely forested than any sites for which winter diets were previously reported. This may explain the abundance of lichens and mosses in our analyses.

Possible biases in the microhistological analyses do not alter the conclusion that conifers, mosses, and lichens form a major component of goat diets throughout the winter period and form the bulk of the diet during times of deep snowpack. Apparently, as snowpack in open areas increases above 50 cm, forbs and ferns become relatively unavailable as forage for goats within forest canopy. The abundance of conifers (from erect trees or in litterfall) and lichens (in litterfall or on tree trunks) in goat diet under all snow

Table 1. Relation of snow depth to the abundance of forages in feces of mountain goats on forested wintering sites in southeast Alaska, 1980–82.

Forage class	Snow depth (cm)		
	0–50	50–150	>150
Trees	22 (8)[a]	39 (6)	36 (3)
n	4	6	5
Alaska yellow cedar	9	21	27
Common juniper (*Juniperus communis*)	tr[b]	1	tr
Western hemlock and mountain hemlock	13	17	8
Sitka spruce		tr	1
Others[c]		tr	tr
Shrubs	6 (2)	5 (2)	4 (1)
Mountain heath (*Phyllodoce aleutica*)	tr	1	
Bramble	3	tr	tr
Huckleberry	2	4	2
Others	1	1	1
Forbs	18 (2)A[d]	3 (1)B	1 (<1)B
Goldthread	1		
Bunchberry	6	1	tr
Trailing bramble	4	tr	tr
Foamflower (*Tiarella trifoliata* and *T. unifoliata*)	1	tr	
Others	1	tr	tr
Unidentified	5	1	1
Ferns	15 (3)A	3 (2)B	1 (<1)B
Ladyfern (*Athyrium filix-femina*)	2	1	tr
Deerfern	5	1	
Spreading woodfern (*Dryopteris dilatata*)	1	tr	tr
Bracken (*Pteridium aquilinum*)	2	tr	tr
Others	1	tr	tr
Unidentified	4	1	tr
Graminoids	4 (1)	1 (<1)	tr
Bluejoint (*Calamagrostis canadensis*)	1	tr	tr
Sedge (*Carex* spp.)	1	tr	
Others	tr	tr	tr
Unidentified	4	1	tr
Lichens	19 (4)	18 (7)	30 (5)
Alectoria spp./*Usnea* spp.	1	2	3
Lobaria spp.	18	16	26
Unidentified		tr	1
Mosses	16 (2)	31 (7)	27 (5)
Hylocomium spp./*Rhytidiadelphus* spp.	14	29	22
Sphagnum cuspidatum	1	tr	
Unidentified	1	2	5
Unidentified	1 (<1)	tr	tr

[a] SE (rounded off to whole numbers) are shown in parentheses.
[b] tr = <1%.
[c] Twenty-five species contributed <1% (see J. L. Fox et al. Mountain goat ecology on Cleveland Peninsula, Alaska 1980–82—addendum: dietary analyses. U.S. For. Serv., Juneau, Alas., 1983).
[d] Within a forage class, different capital letters indicate differences ($P < 0.05$) in composition among snow depths. Absence of letters indicates no difference. Newman-Keuls test (Snedecor and Cochran 1967:273) was used for multiple comparisons.

conditions is probably a function of their relatively high abundance and availability even in periods of deep snow. Winds >60 km/hour are common during winter in southeast Alaska and litterfall of conifer branch-tips and arboreal lichens is frequently available as forage in forested goat habitat throughout the winter (Fox 1983).

The high occurrence of mosses, especially during deep snow, is more difficult to explain. Mosses may be the least digestible (Hanley and McKendrick 1983) and most recognizable forage, and hence most over-represented component of goat winter diet in the present analysis. However, their relative occurrence remained high even during periods of deep snow, when mosses might become unavailable under the snow. Mosses are ubiquitous in the moist coastal

forests (Alaback 1980), including around the bases of trees, on vertical cliffs, and sometimes covering boulders. Snow does not accumulate on these microsites. They may provide the only exposed ground vegetation during periods of deep snow.

Dailey et al. (1984) found pronounced selectivity by mountain goats when a variety of forages are available. However, under snow conditions that restrict forage availability, mountain goats appear to rely heavily on the most abundant plants available. Reports of ungulate winter diets dominated by conifers, mosses, and lichens are uncommon. However, such diets are probably the rule for mountain goats in the coastal regions of southeast Alaska and British Columbia. The ability of goats to prosper on such a diet is indicated by the unusually low mortality levels and high rates of increase exhibited by coastal goat populations during the period when our collections were made (Smith 1984). The importance of conifers and arboreal lichens in the winter diets of coastal mountain goats suggests that removal of timber may produce a serious decline in forage availability for goats in southeast Alaska. Forest management in this region should take into consideration the effects of timber removal on forage availability for goats. The relatively low digestibility of these conifers, mosses, and lichens (Rochelle 1980, Hanley and McKendrick 1983) indicates that an explanation of goat survival on these forages will require a greater knowledge of the digestive physiology and energetics of wintering mountain goats.

LITERATURE CITED

ADAMS, L. G., AND J. A. BAILEY. 1983. Winter forages of mountain goats in central Colorado. J. Wildl. Manage. 47:1237–1243.

ALABACK, P. 1980. Biomass and production of understory vegetation in seral Sitka spruce–western hemlock forests of southeast Alaska. Ph.D. Thesis, Oregon State Univ., Corvallis. 79pp.

BRANDBORG, S. M. 1955. Life history and management of the mountain goat in Idaho. Id. Dep. Fish and Game Wildl. Bull. 2. 142pp.

DAILEY, T. V., N. T. HOBBS, AND T. N. WOODWARD. 1984. Experimental comparisons of diet selection by mountain goats and mountain sheep in Colorado. J. Wildl. Manage. 48:799–806.

FOSTER, B. R. 1982. Observability and habitat characteristics of the mountain goat (*Oreamnos americanus* Blainville, 1816) in west-central British Columbia. M.S. Thesis, Univ. British Columbia, Vancouver. 134pp.

FOX, J. L. 1983. Constraints on winter habitat selection by the mountain goat (*Oreamnos americanus*) in Alaska. Ph.D. Thesis, Univ. Washington, Seattle. 147pp.

GEIST, V. 1971. Mountain sheep. Univ. Chicago Press, Chicago, Ill. 383pp.

GILL, R. B., L. H. CARPENTER, R. M. BARTMAN, D. L. BAKER, AND G. G. SCHOONVELD. 1983. Fecal analysis to estimate mule deer diets. J. Wildl. Manage. 47:902–915.

HANLEY, T. A., AND J. MCKENDRICK. 1983. Seasonal changes in chemical composition and nutritive value of native forages in a spruce–hemlock forest, southeast Alaska. U.S. For. Serv. Pacific Northwest For. and Range Exp. Stn. Res. Pap. 312. 41pp.

HARMON, W. 1944. Notes on mountain goats in the Black Hills. J. Mammal. 25:149–151.

HARRIS, A. S., AND W. A. FARR. 1974. The forest ecosystem of southeast Alaska—7. Forest ecology and timber management. U.S. For. Serv. Pacific Northwest For. and Range Exp. Stn. Gen. Tech. Rep. 25. 109pp.

HEBERT, D. M., AND W. G. TURNBULL. 1977. A description of southern interior and coastal mountain goat ecotypes in British Columbia. Int. Mountain Goat Symposium 1:126–146.

HJELJORD, O. G. 1971. Feeding ecology and habitat preference of the mountain goat in Alaska. M.S. Thesis, Univ. Alaska, Fairbanks. 126pp.

HOLECHEK, J. L., M. VAVRA, AND R. D. PIEPER. 1982. Botanical composition detemination of range herbivore diets: a review. J. Range Manage. 35: 309–315.

JOHNSON, R. 1983. Mountain goats and mountain sheep of Washington. Wash. Dep. Game Biol. Bull. 18. 196pp.

ROCHELLE, J. A. 1980. Mature forests, litterfall and patterns of forage quality as factors in the nutrition of black-tailed deer on northern Vancouver Island. Ph.D. Thesis, Univ. British Columbia, Vancouver. 295pp.

SAUNDERS, J. K. 1955. Food habits and range use of the Rocky Mountain goat in the Crazy Mountains, Montana. J. Wildl. Manage. 19:429–437.

SMITH, C. A. 1984. Evaluation and management implications of long-term trends in coastal mountain goat populations in southeastern Alaska. Bienn. Symposium North. Wild Sheep and Goat Counc. 4:395–424.

———, AND K. J. RAEDEKE. 1982. Group size and movements of a dispersed, low density goat population with comments on inbreeding and human impact. Bienn. Symposium North. Wild Sheep and Goat Counc. 3:54–67.

SNEDECOR, G. W., AND W. G. COCHRAN. 1967. Statistical methods. Sixth ed. Iowa State Univ. Press, Ames. 593pp.

SPARKS, D. R., AND J. C. MALECHEK. 1968. Estimating percentage dry weight in diets using a microscope technique. J. Range Manage. 21:264–265.

VAVRA, M., AND J. L. HOLECHEK. 1980. Factors influencing microhistological analysis of herbivore diets. J. Range Manage. 33:371–374.

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