

Regional Copper-Nickel Study
SNOWSHOE HARE (Lepus americanus)

Minnesota Environmental Quality Board
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ABSTRACT

Snowshoe hare are distributed throughout most of the forested regions of Canada and Alaska, extend southward at higher elevations in the western and eastern United States, and are found in the northern one-half of the Lake States and much of New England. This animal is an important prey species for numerous raptor and mammalian predators common to the Study Area.

Hare are relatively unimportant as a game animal in Minnesota. Their importance lies in the potential damage they can cause to conifer plantations, rather than their aesthetic value.

Hare utilize a wide variety of habitats but probably reach highest densities in young aspen-birch, young - middle aged spruce lowlands, and alder-willow shrub communities. Regardless of the forest cover type used dense shrubs are a basic habitat requirement.

A variety of food species are used and discussed in the text. There is no evidence that hares are currently competing with either deer or moose for similar foods in the Study Area, although their diets show considerable overlap.

Snowshoe hare are a cyclic species with highs occurring at about 10-year intervals. Densities in Manitoba and Alberta, Canada, may reach 1000-4000 hares/km², decreasing some 25 to 100 fold during lows. Densities in the Lake States probably range from 200-300 hares/km² during peaks, falling to about one-tenth that density during lows.

Hares may prove to be a valuable species for tissue analysis for long-term monitoring programs.

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INTRODUCTION TO THE REGIONAL COPPER-NICKEL STUDY

The Regional Copper-Nickel Environmental Impact Study is a comprehensive examination of the potential cumulative environmental, social, and economic impacts of copper-nickel mineral development in northeastern Minnesota. This study is being conducted for the Minnesota Legislature and state Executive Branch agencies, under the direction of the Minnesota Environmental Quality Board (MEQB) and with the funding, review, and concurrence of the Legislative Commission on Minnesota Resources.

A region along the surface contact of the Duluth Complex in St. Louis and Lake counties in northeastern Minnesota contains a major domestic resource of copper-nickel sulfide mineralization. This region has been explored by several mineral resource development companies for more than twenty years, and recently two firms, AMAX and International Nickel Company, have considered commercial operations. These exploration and mine planning activities indicate the potential establishment of a new mining and processing industry in Minnesota. In addition, these activities indicate the need for a comprehensive environmental, social, and economic analysis by the state in order to consider the cumulative regional implications of this new industry and to provide adequate information for future state policy review and development. In January, 1976, the MEQB organized and initiated the Regional Copper-Nickel Study.

The major objectives of the Regional Copper-Nickel Study are: 1) to characterize the region in its pre-copper-nickel development state; 2) to identify and describe the probable technologies which may be used to exploit the mineral resource and to convert it into salable commodities; 3) to identify and assess the impacts of primary copper-nickel development and secondary regional growth; 4) to conceptualize alternative degrees of regional copper-nickel development; and 5) to assess the cumulative environmental, social, and economic impacts of such hypothetical developments. The Regional Study is a scientific information gathering and analysis effort and will not present subjective social judgements on whether, where, when, or how copper-nickel development should or should not proceed. In addition, the Study will not make or propose state policy pertaining to copper-nickel development.

The Minnesota Environmental Quality Board is a state agency responsible for the implementation of the Minnesota Environmental Policy Act and promotes cooperation between state agencies on environmental matters. The Regional Copper-Nickel Study is an ad hoc effort of the MEQB and future regulatory and site specific environmental impact studies will most likely be the responsibility of the Minnesota Department of Natural Resources and the Minnesota Pollution Control Agency.

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INTRODUCTION

Snowshoe hare (Lepus americanus) are distributed throughout most of the forested regions of Canada and Alaska, extend southward at higher elevations in the western and eastern United States, and are found in the northern one-half of the Lake States and much of New England (Hansen et al. 1969). Hares are a very important prey species for a number of predators in these northern and boreal forests. Chief predators include the great horned owl (Bubo virginianus), great gray owl (Strix nebulosa), barred owl (Strix varia), lynx (Lynx lynx), bobcat (Lynx rufus), fox (Vulpes spp.), coyote (Canis latrans), wolf (Canis lupus), mink (Mustela vison) and man (Banfield 1974). Others include the goshawk (Accipiter gentilis), Cooper's (Accipiter cooperii), broad-wing (Buteo platyterus) and red-tailed hawk (Buteo jamaicensis). In Minnesota, snowshoes occur just north of the Twin Cities and north of a northwest diagonal across the State.

METHODS

Snowshoes were observed throughout the copper-nickel development zone. This species is probably found throughout the Study Area. Habitat and food preference, natural history and economic considerations of hares presented in this report are largely from the literature, but also include communication with professionals in the region. and Minnesota Department of Natural Resources (MDNR) statistics.

RESULTS

Economic Importance

Banfield (1974, P. 83) has stated that "the snowshoe hare is undoubtedly the most important small game mammal of Canada" and may be the primary winter food in remote sections of that country. By contrast, snowshoes are relatively unimportant as a game species in the forests of Minnesota.

Annual harvest estimates computed by MDNR place hares fifth (\bar{x} = 34428, 1970-76) behind other more heavily harvested mammals such as gray squirrels (Sciurus carolinensis, \bar{x} = 183750, 1970-73), fox squirrels (Sciurus niger, \bar{x} = 156250, 1970-73), and cotton tails (Sylvilagus floridanus, \bar{x} = 98286, 1970-76; Longley and Knudson 1974).

There is also a pronounced downward trend in the estimated harvest rate of snowshoes in Minnesota when comparable periods are considered from 1950 to 1974 (Longley and Knudson 1974). The first five years of each decade in the 1950's, 60's, and 70's had average harvest rates of 90.2, 45.2 and 34.8 (kill in 1000's). The later half of the 1950's and 60's had kill estimates of 62.8 and 18.2.

The apparent declining harvest rates may reflect a further reduction in hunter preference for snowshoes. Other factors may include advancing forest succession as it affects the quality and/or quantity of available habitat and food. Another bias could be the reduced number of hunter report cards in recent years used to estimate the harvest (B. Joslin, MDNR, per. comm. May 1978). Data suggest that: 1) snowshoe hares are a relatively unimportant game species in Minnesota; and 2) the relative abundance of this species can not be adequately determined from harvest statistics.

The importance of snowshoe hares in Minnesota lies in the potential damage they can cause, rather than their aesthetic value or value as a game animal. Some of the earliest attempts at establishing conifer plantation in the Lake States were 50-70 percent damaged by hares, and in some cases the entire stock of seedlings was destroyed. (Aldous and

Aldous 1944, Cook et al. 1945, Kittredge 1929, and others).

Hares remain a problem today, especially during cyclic highs that persisted during this study. Snowshoes are believed responsible for seedling mortality of over 50 percent on several sites examined in the Kawishiwi Ranger District in 1975 and 1976 (R. Bonde, USFS, per. comm., June 1978). Seedling damage may have been more serious owing to the drought. John Carey (USFS, per. comm. June 1978) suggested that severe hare damage on conifer plantations in the Aurora District has not been a problem in recent years. However, he noted that failure of entire plantings in 1976 and 1977 and attributed to the drought, may have also sustained substantial hare damage.

Other than plantations, it appears that neither snowshoes or deer (Odocoileus virginianus) have seriously affected forest vegetation in northern Minnesota in recent years. Krefting (1975) examined 21 exclosures in 1974 that were established in the 1950's to determine the long-term effects of browsing on shrubs and trees by hare, deer, and hare-deer combined. Both deer and hare had limited effect at all but three sites. In two of these instances browsings, deer and not snowshoes were the causal agent. Krefting concluded that the main factors affecting plant survival and growth were not browsing, but "root and plant competition and overhead shading by dominant trees..."

HABITAT PREFERENCE

Studies have shown that hares occupy almost every forest type within

their range. Conifer and mixed conifer swamps were generally preferred in Michigan's Upper Peninsula (Bookhout 1963), Wisconsin (Grange 1932), and New York State (Cook 1945). Conifer and mixed conifer uplands were heavily used in Alaska (Wolff 1978) and Colorado-Utah (Dolbeer and Clark 1975). Keith (1966) and his co-workers in Alberta, Canada have shown intensive use and high hare populations in trembling aspen (Populus tremuloides) forest (Windberg and Keith 1976, Keith 1974, Brand et al. 1975, Meslow and Keith 1968).

The most intensive hare study, reviewed from Minnesota, was conducted in the Lake Alexander area in central Minnesota (Green and Evans 1940^A, 1940^B, 1940^C). This forest was predominantly aspen-birch-maple (Populus spp. - Betula spp. - Acer spp.), with only a few stands of evergreens present. Hares were found throughout this forest type.

The importance of aspen and balsam fir (Abies balsamea) was expressed by Grange (1932) for Wisconsin who suggested that "the lack of a goodly proportion of either aspen or balsam fir, or both, seems to be a limiting factor in many cases." Grange also concluded that "hardwood forests, are used only if conifer or bushy cover is present." Apparently shrubs or conifer cover can be substituted to provide favorable hare habitat within a variety of forest types. The necessity of an adequate shrub cover is also strongly supported by Keith (1966) for a trembling aspen forest in Alberta, Canada. During a population decline of 72 percent in a previously occupied habitat, "the first sections devoid of hares had the least amount of brushy cover, and the last to retain hares had the most."

In the Study Area, the following are considered "prime" snowshoe hare habitats:

1. Clearcuts (5 years old or older) regenerating back to aspen or aspen-birch and shrubs.
2. Shrub uplands with scattered trees.
3. Conifer plantations (approximately 5-15 years old) with large quantities of shrubs and/or profuse-sucker growth of aspen, birch and maple.
4. Alder (Alnus spp.) and willow (Salix spp.) lowlands.
5. Young and middle-aged black spruce (Picea mariana) lowlands.
6. Young and middle-aged aspen-birch uplands.

Food preference

Hansen and Flinders (1969) reviewed snowshoe food studies and concluded that the following food items were important to hares in the Lake States: willow, aspen, birches, jack pine (Pinus Banksiana), white pine (Pinus strobus) tamarack (Larix laricina), clover (Trifolium spp.), pussy toes (Antennaria spp.), dandelions (Taraxacum spp.), and jewelweed (Impatiens biflora). Aldous et al. (1944) added red pine (Pinus resinosa) and white spruce (Picea glauca) to this list for the same geographical area, while black spruce, balsam fir, white cedar (Thuja occidentalis), alder, raspberries and blackberries (Rubus spp.) were listed for Wisconsin by Grange (1932). Red maple (Acer rubrum), juneberry (Amelanchier spp.), and beaked hazel (Corylus cornuta) may also be important in the study Area as they were in the Upper Peninsula of Michigan (Bookhout 1965).

Hare-Deer-Moose Competition for Food

Competition between snowshoes, deer and moose for available browse has been tested by several studies with conflicting results. Olsen (1957) cited in Bookhout (1965) suggested that a hare decline in the Upper Peninsula of Michigan was caused by a food shortage "brought about by an overpopulation of deer." Bookhout (1965), working in the same geographical region, found 19 similar plant species used by both deer and hares on a deer wintering area. Neither species over-browsed the available food resource, while hares removed only a fraction of the browse consumed by deer.

Snowshoes and moose also overlap in their food requirements. In a Newfoundland study, Dodds (1960) suggested that heavy browsing by moose may be detrimental to snowshoe hare survival.

There is no conclusive local evidence to suggest that snowshoe hares are currently competing with these two principal big game species in the Study Area. The currently low deer density within the copper-nickel development zone, the insignificant amount of browsing at enclosures and control sites in the SNF (Krefting 1975), and the lack of overbrowsing by deer even on wintering areas in northeastern Minnesota (Wetzel 1972) all suggest that competition for browse may be relatively low. As stated earlier in this section, if competition does occur it is probably to the detriment of the hare population and not the big game species.

Hare Cycles

Many researchers have documented the cyclic fluctuations (regular, extreme fluctuations in density) of snowshoe hare populations. Keith (1963) compiled and interpreted pertinent papers on a number of species that show periodic fluctuations. He concluded that snowshoe cycles averaging 10 years in duration are a real and predictable phenomenon and that the greatest amplitude between peaks and lows occurred near the center of the species range from southern Manitoba to northern Alberta, Canada. Reproductive data summarized later (Keith et al. 1966) show a smaller litter size and fewer litters as one moves north to south from this belt of maximum cyclic variations. This results in a 35 percent reduction in the number of young born per adult female between Minnesota and their Alberta, Canada, study (Keith et al. 1966).

The current hypothesis regarding snowshoe hare cycles centers around food as the limiting factor, at peak densities. Keith (1974) suggests, and field studies at least partially substantiate (Brand et al. 1975, Windberg and Keith 1976, Wolff 1978), the following sequence of events during hare cycles in Alberta, Canada: food is the direct limiting factor of hare populations at the peak of the cycle; after an initial population reduction, an increased proportion of animals are taken by predators; predation, operating on a substantially reduced number of hares, further reduces the population and extends the period required for recovery.

Browse study findings listed above generally negate a browse shortage in the Study Area. It is possible that hare populations near the margin

of their distribution are regulated by different factors than in regions where the sharpest demographic extremes occur.

The amplitude of the snowshoe cycle is a function of the survival and reproductive rate within a particular geographic region. During declines, the proportion of young that survive from birth to their first breeding season is extremely low (3 percent in Alberta, Canada), climbing to 24 percent during a period of increasing numbers (Meslow and Keith 1968). Adults, although only a small fraction of the total population, also show reduced survival during declines. If habitats preferred by hares are "broken" rather than occurring in large blocks of contiguous forest, hare populations may stabilize at much lower densities (Dolbeer and Clark 1975). The mechanism is probably a "dispersal of surplus juvenile hares into open habitat where the probability of survival is low."

The above factors are responsible for the dramatic variations in snowshoe hare density (hares/km²) during both peak and low periods in various regions. Wolff (1978) has estimated 620 hares/km² during a peak in Alaska, while Windberg and Keith (1976) estimated November densities of 1100-2300 hares/km² (peak) and interpolated September maximum densities at 2100-4300 hares/km² in Alberta, Canada. Lows on the same area may be 42 hares/km² (McInville et al. 1974), a reduction ratio of 26:1 for the smallest peak density estimates to 100:1 for the largest. Densities of 16 (low) and 163 (peak) hares/km² are reported for New Brunswick (Wood and Munroe 1977), with 0.4 (low) to 1300 (peak) hares/km² for Frankin Bay, Ontario, Canada (Mac Lulich 1937). Relatively stable populations in Utah and Colorado were estimated at 323 hares/km²

during a peak (Dolbeer and Clark 1975).

Studies in the Lake States have shown relatively low peaks compared to the Canadian and Alaskan areas. Valcour Island in Lake Champlain, New York had peak densities of 289 hares/km² (Cook et al. 1945). A central Minnesota population at Lake Alexander peaked at 207/km², being reduced to 21/km² at the low, a ratio of 9.9:1 (Green and Evans 1940^{A, B, C}). A Cloquet, Minnesota study estimated peak numbers at only 96 hares/km² (Moore 1939).

Wood and Munroe (1977) suggest that Lake State snowshoe hare populations probably fluctuate at or near a 10:1 ratio from peaks: lows. Snowshoe hare densities in the forested and/or shrub communities of the Study Area probably range from 10-20 hares/km² during lows to 100-200 hares/km² at cyclic peaks.

CONCLUSION

With the exception of mice, voles and shrews, snowshoe hares are the most numerous mammals on the Study Area. This species is extremely important in the food chain of a number of raptor and mammalian predators common to the region. Hares are also harvested by man for food. A permanent reduction in hare density could markedly affect the balance of the prey-predator system, resulting in a lower carrying capacity for the entire predator community.

The most detrimental effect to snowshoe populations will occur as a result of direct land use by mining operations. Other factors that could reduce hare densities include:

1. Reduction of forest shrub cover which is an important (if not the most important) factor determining hare distribution and/or density.
2. If favorable cover types within large units of contiguous forest are divided into smaller parcels by mining facilities (e.g. tailing ponds, waste-rock dumps, railroad-road-powerline corridors, etc.), overall hare survival and density may be reduced.
3. Mining utilization of young aspen-birch forest, young-medium aged spruce lowlands and aspen-willow shrub communities would have the most deleterious effect on hare populations. A reduced impact would result from use of unproductive lowland forest, mature conifer and deciduous uplands, or lowlands, and open habitats (marshes, clear-cuts with limited shrub growth due to forestry treatments and conifer plantations with limited or no shrub cover).

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