CN 069

Regional Copper-Nickel Study

RUFFED GROUSE

(Bonasa umbellus)

Minnesota Environmental Quality Board
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PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Abstract

Ruffed grouse occur throughout the forested portion of Minnesota from the Canadian border to Iowa. Annual harvest from 1970-1976 averaged 676,700 grouse per year.

The Study Area is located in the northeastern (NE) census zone of the MDNR. The number of drums/stop during the spring drumming period have traditionally been lower in this portion of the state. This trend is confirmed by statistics presented in this paper.

A 96-stop drumming census was conducted in the Copper-Nickel development zone by copper-nickel and Amax biologists during the spring of 1977. The results suggest that the southern one-third of the area has a greater number of drumming males, and thus probably a higher density of breeding grouse, than the central or northern one-thirds. This is probably linked to the greater proportion of varied-aged aspen in the southern area.

Aspen and aspen-birch forest types less than 25 years old are considered the most productive, high density habitat. A proportion of the forest should also exceed 25 years to provide nesting cover and adequate male flower buds for winter food. In general, coniferous-deciduous and coniferous forest have ruffed grouse densities only one-half to one-third as high as found in forest dominated by trembling aspen. Alder fringes and alder-willow lowland shrub communities compliment aspen forest and provide valuable brood cover.

The winter diet of grouse is dominated by aspen buds and twigs. Other plants used heavily during other seasons are clover, sedge, dandelion, cherries,

raspberries, strawberries, hazel, ironwood, birch and dogwood. Buds, twigs, fruits and/or leaves of these plants are utilized.

Ruffed grouse and snowshoe hare are the major prey for many predators in this region. Man is also a predator. Hunting has a marginal effect on the population primarily due to limited road access and large, contiguous blocks of forest.

Extensive land withdrawal for mining within the Study Area may change local hunting patterns and force local sportsman to drive further to hunt for grouse. The state's ruffed grouse population, however, will be affected only slightly. Less than about 7 percent (Study Area) of the total range occurs within these areas.

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

Ruffed grouse (Bonasa umbellus) occur throughout the forested portion of Minnesota from the Canadian border to Iowa. This species is native to North America and one of the most important woodland game bird species in the state. Harvest rates from 1970-1976 have been estimated by the Minnesota Department of Natural Resources (MDNR) at a low of 367,000 in 1976 to a peak of 1,297,000 in 1971 (Longley & Knudson 1974; D. Carlson, MDNR, St. Paul, per. comm.). The mean annual harvest during this seven year period was 676,000 ruffed grouse.

Methods

The terrestrial biology staff, assisted by biologists from Amax, conducted a 96 stop drumming census along all main forest roads within the copper-nickel development zone in spring 1977. Habitats were classified visually by the predominant type at each stop and for each side of the road.

Food and habitat preferences, mortality and natural history data were obtained from a literature review.

Results

Distribution and Importance

The MDNR has established five census zones for ruffed grouse (Fig. 1). These zones are roughly associated with ecological differences between forest types occuring in each area. In all, portions or the entire area of 41 counties are included.

The area covered by forest within these five zones is 65,718km^2 (Minn. State Planning Agency 1975).

In the Study Area there are 4,638km^2 of forest, or 7 percent (4,638/65,718) of the total ruffed grouse habitat present within the entire state.

The northeastern (NE) management zone, which includes the entire area of St. Louis, Lake and Cook Counties, has a long history of depressed densities of ruffed grouse compared to most of the remainder of the state (Gullion 1970; B. Berg, MDNR, per. comm.). Statistical treatment (one-way analysis of variance) of spring census data from 1960-1977 (Berg 1976, 1977) provides additional proof of this trend (Table 1, 2). The NE had significantly fewer drums per stop ($\bar{x}$ = 0.62) than the north (N, $\bar{x}$ = 1.38, F = 41.86, $p<0.005$), the central hardwoods (CH, $\bar{x}$ = 0.82, F = 6.05, $p<0.050$) and the southeast zone (SE, $\bar{x}$ = 2.64, F = 44.35, $p<0.005$; all with 1.8 d.f.). The northwest zone (NW) had a mean density of 0.82 drums/stop for the five year period, and was not significantly different from the NE (F = 1.26, $p>0.25$; 1,8 d.f.). Similar data for a 13 year period (1960-1972, Table 2), but for only four zones (N, NE, CH, and SE), showed the mean density in the NE ($\bar{x}$ = 0.92) was significantly lower than that in the N ($\bar{x}$ = 2.10, F = 18.25, $p<0.005$) and SE ($\bar{x}$ = 1.79, F = 7.94, $p<0.001$), but was not significantly different from the CH ($\bar{x}$ = 1.03, F = 0.51, N.S., $p>0.25$; all with 1.25 d.f.).

Forests in the NE zone are lower in grouse productivity than much of the forest cover in the remainder of the state. This probably results from a generally older forest and one dominated to a greater extent by conifers than other zones. Shallow and low fertility soils, a short growing season and severe winters may also have a detrimental affect.

A weighted average was calculated by multiplying the total forest cover in each of the five zones by the mean drum/stop for the 1973-1976 period (census data used from Table 1. This weighted proportion decreased the importance of the forest in the entire NE zone from 30.3 percent (based on physical area alone)

to 19.1 percent (physical area and relative density) of that available to ruffed grouse in the entire state. Similar weighted percentages downgraded the earlier figures for the Study Area (7.0 percent) to 4.4 percent.

Three of four watershed areas with considerably higher average drums/stop than the mean for the entire area (0.63) were south of the Laurentian Divide (Argo, 0.86; St. Louis, 0.73; and Whiteface, 1.33). Only one (Denley, 0.75) occurred to the north (Table 3). This trend was expected because of the large proportion of aspen (Populus spp.) and aspen-birch (Betula spp.) habitat in these southern watersheds. High variability in the census data, however, obscured all attempts to show significant differences between individual watersheds.

Habitat Requirements

A number of studies conducted in the Lake States and Canada have emphasized the importance of aspen and aspen-birch forest types to the maintenance of high density ruffed grouse populations. Bailey et al. (1955) was the first to recognize the remarkable agreement which exsists between the distribution of trembling aspen (Populus tremuloides) and ruffed grouse in North America. Rusch et al. (1971) concluded that "ruffed grouse used the aspen woods almost exclusively in all seasons of the year" in Alberta, Canada. Similar preference for aspen forest types by grouse have been shown in Wisconsin (Moulton 1968), Michigan (Berner et al. 1969), Minnesota (Gullion 1970; Svoboda and Gullion 1972), and elsewhere.

Results of long-term field studies of ruffed grouse at Cloquet, Minnesota by W.H. Marshal and G.W. Gullion and their associates can be directly applied to seasonal habitat requirements of grouse in the Study Area. Gullion (1971) has shown

that dense sucker growth aspen (1-10 years old) provides excellent summer brood range. The 10-25 year old class is used by drumming males and juveniles alike, and forms an important component of total seasonal cover and food requirements. Grouse also require access to aspen stands that exceed 25 years of age to provide nesting habitat and an adequate supply of male aspen buds for winter budding. Cover types which are primarily avoided or provide suitable cover for only low density populations are pine forest, lowland spruce-fir, lowland and upland hardwood (other than aspen-birch), and 50-80 year old (over mature) aspen stands (Gullion 1968).

One reason for the intense use of aspen forest is the generally high density of shrub cover in this type. Rusch et al. (1971) has found that absence of lowland shrubs in Alberta, Canada tends to concentrate broods and adults in aspen uplands where shrubs are most numerous. Dorney's (1959) work in northern Wisconsin suggested that elimination of shrubs from northern hardwood stands would render these areas unfavorable to breeding birds. This is substantiated by Moulton (1968) who suggests that advancing succession reduces shrub density on upland sites, forcing breeders to use lowland sites and reducing the total density.

Another cover type that can be extremely important as summer and early fall brood cover is shrub lowlands, especially if they are dominated by alder (either Alnus crispa or A. rugosa). Alder is especially important in Minnesota (Gullion 1970), Wisconsin (Dorney 1959) and Michigan (Berner et al. 1969). This habitat can also provide excellent cover at durmming logs (Palmer 1963), as well as summer cover for adults (Gullion 1970). Dorney (1959) has stated that even small quantities of lowland brush in Wisconsin "must be maintained, since its almost exclusive use by broods suggests that it is vital to grouse production."

Habitat preference of displaying males was tested along the transect routes. The proportion of 16 vegetation types that occurred at the 96 census stops was used to generate expected values used in the Chi-square statistic (Table 4). A highly significant x^2 value resulted (x^2 = 34.0, 12 d.f., $p<0.005$). Over one-half of this value was contributed by the 44 observed and only 23.5 expected males associated with the aspen-birch forest type. Lower observed than expected values were found for both upland conifer (jack pine, Pinus Banksiana; red pine, P. resinosa) and lowland conifer stands (Spruce-fir, Picea spp. - Abies spp; black spruce, Picea mariana). These census data strongly imply a preference by displaying ruffed grouse for the aspen and aspen-birch cover type in the Study Area. These findings compare well with other studies cited above.

Additional evidence was obtained by comparing the habitat surrounding 20 field located drumming logs. Fourteen of these logs (70 percent) were in forest dominated by aspen or aspen-birch. The remainder were in aspen-birch-pine (2, 10 percent), upland shrub (2, 10 percent), lowland shrub (1, 5 percent) and only 1 in black spruce (5 percent).

Food Requirements

The aspen cover types provide grouse with both protection and food. The leaves, catkins, buds (especially male flower buds) and current-year's twigs of aspen are utilized extensively during the winter and spring (Korchegen 1966, Svoboda and Gullion 1962, and others). Although young grouse utilize predominantly insects the first two weeks of life (Bump et al. 1947), older chicks and adults eat a variety of plants and fruits which are generally more abundant in the aspen ecosystem. Leaves, fruits or twigs of clover (Trifoleum spp.), sedge (Carex spp.) dandelion (Taraxacum spp.). Cherry (Prunus spp.), raspberry and blackberry (Rubus spp.), strawberry (Fragaria spp.), hazel (Corylus spp.), ironwood (Ostrya Virginiana), birch (Betula spp.) and dogwood (Cornus spp.)

are some of the major species utilized from these stands (Fisher 1939, Korschegen 1966, Dorney 1959, Svoboda and Gullion 1972, and others).

Sources of Mortality

Ruffed grouse, along with snowshoe hares (Lepus americanus), are extremely important prey species in the northern forest of the Lake states, Canada and Alaska. Both species form a substantial part of the diet of many common raptors and carnivores in this region.

The proportion of ruffed grouse fall populations taken by hunters in large, contiguous forest is probably seldom greater than 25 percent (Gullion 1970). With an annual natural mortality rate of 70 percent or more for unhunted populations, Gullion (1970) and Palmer (1956) have suggested that 50 percent of the fall population could be harvested each year with no detrimental effect.

Even a substantial increase in the human population in the Study Area will have a minor effect on the density of ruffed grouse. The main reason is that the predominant method of harvesting grouse ("road-hunting") allows hunters access only to a small fraction of the population because of the limited road system. Although "brush-hunting" may become more popular, even this method has been shown to have no effect on the spring breeding population (Michigan study; Palmer 1956).

Ruffed Grouse Density

Peak spring breeding densities of ruffed grouse may reach 1 pair/4 ha in 8-25 year old aspen or aspen-birch stands, while peak densities in similar aged pine stands are commonly only 1 pair/8 ha. A 10-25 year old spruce-fir forest would be expected to support peak densities of only 1 pair/16 ha. (Gullion 1970). It is apparent from these density estimates that use of areas presently dominated by conifer forest for copper-nickel mining operations would have minimal effects

on the local ruffed grouse population. Loss of large areas of upland aspen-birch forest and adjoining lowlands with alder-willow plant communities would have the most deleterious impact on grouse in the Study Area. In this same category would be long-term, gradual reductions in shrub and/or herb layers within these habitat types.

For those upland sites which are accessible to hunters (trails or logging roads present) and currently contain a variety of age classes of aspen-birch habitat, the loss of 10 hectares would roughly be equivalent to the loss of six ruffed grouse during peak populations (Gullion 1971). This might be reduced by a factor of 10 or more during cyclic lows.

Impact

Long-term land withdrawals may be detrimental to local grouse populations and the recreation they provide. Since ruffed grouse, along with snowshoe hares, are important components of the food chain in the Study Area, reduction of either or both may reduce the density of raptors and carnivores which depend on these species.

The loss of forest land within the Study Area would have limited effect on the state's ruffed grouse population since less than 7 percent of the present range will be effected. Harvest rates would not be proportionally reduced because a large percentage of the grouse population in the Study Area is distant from roads and largely inaccessable to hunters. However, large-scale land withdrawals could significantly affect local huntin habits. Residents would have to travel further to partake of a recreational activity that is currently readily accessible.

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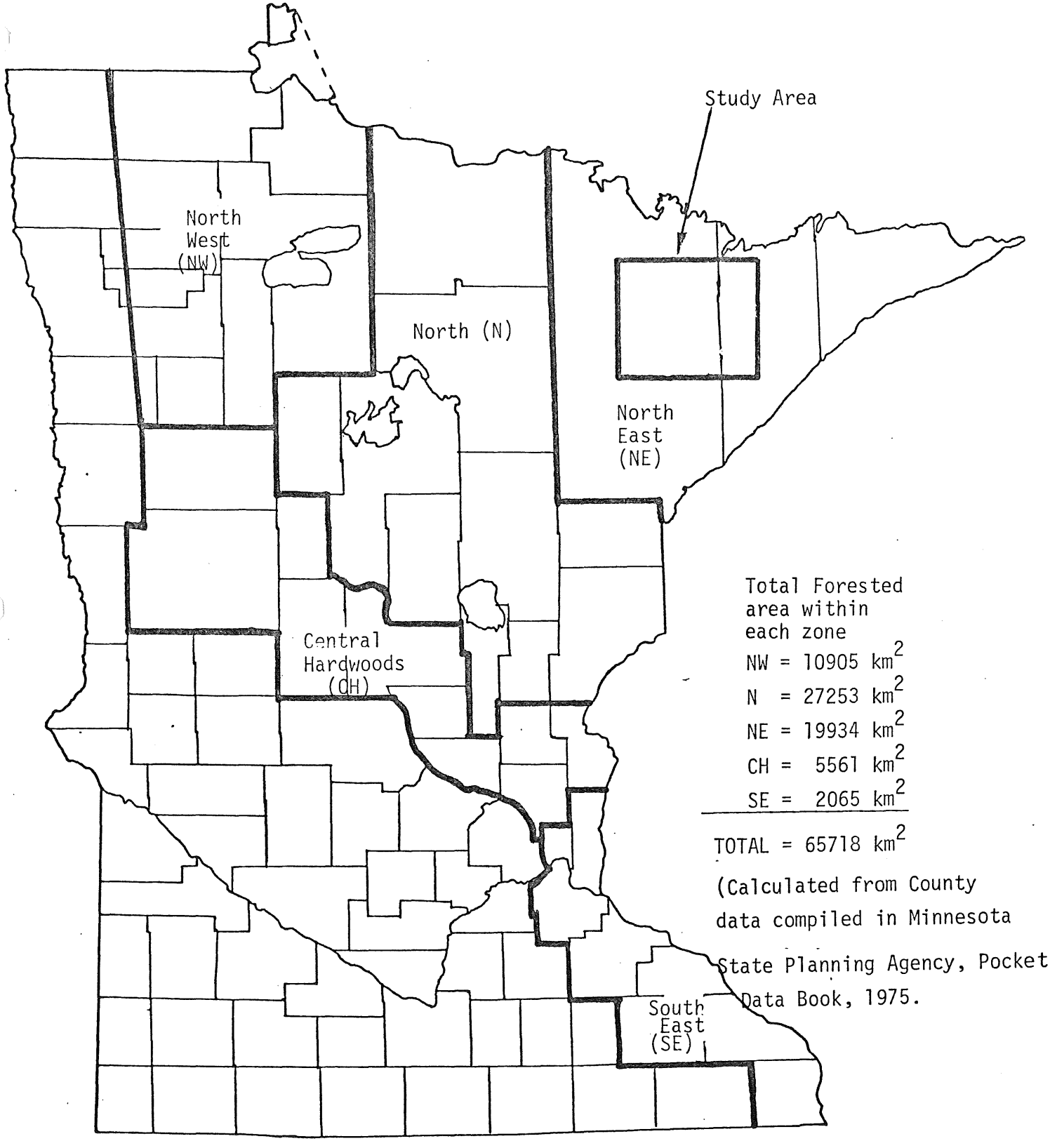
Fig. 1. Boundary of Ruffed grouse drumming census zones in Minnesota.



Total Forested area within each zone

NW = 10905 km^2

N = 27253 km^2

NE = 19934 km^2

CH = 5561 km^2

SE = 2065 km^2

TOTAL = 65718 km^2

(Calculated from County data compiled in Minnesota State Planning Agency, Pocket Data Book, 1975.

Fig. 2. Location of each of the 96 stops on the Copper-Nickel Ruffed Grouse Drumming Census with existing census routes shown.

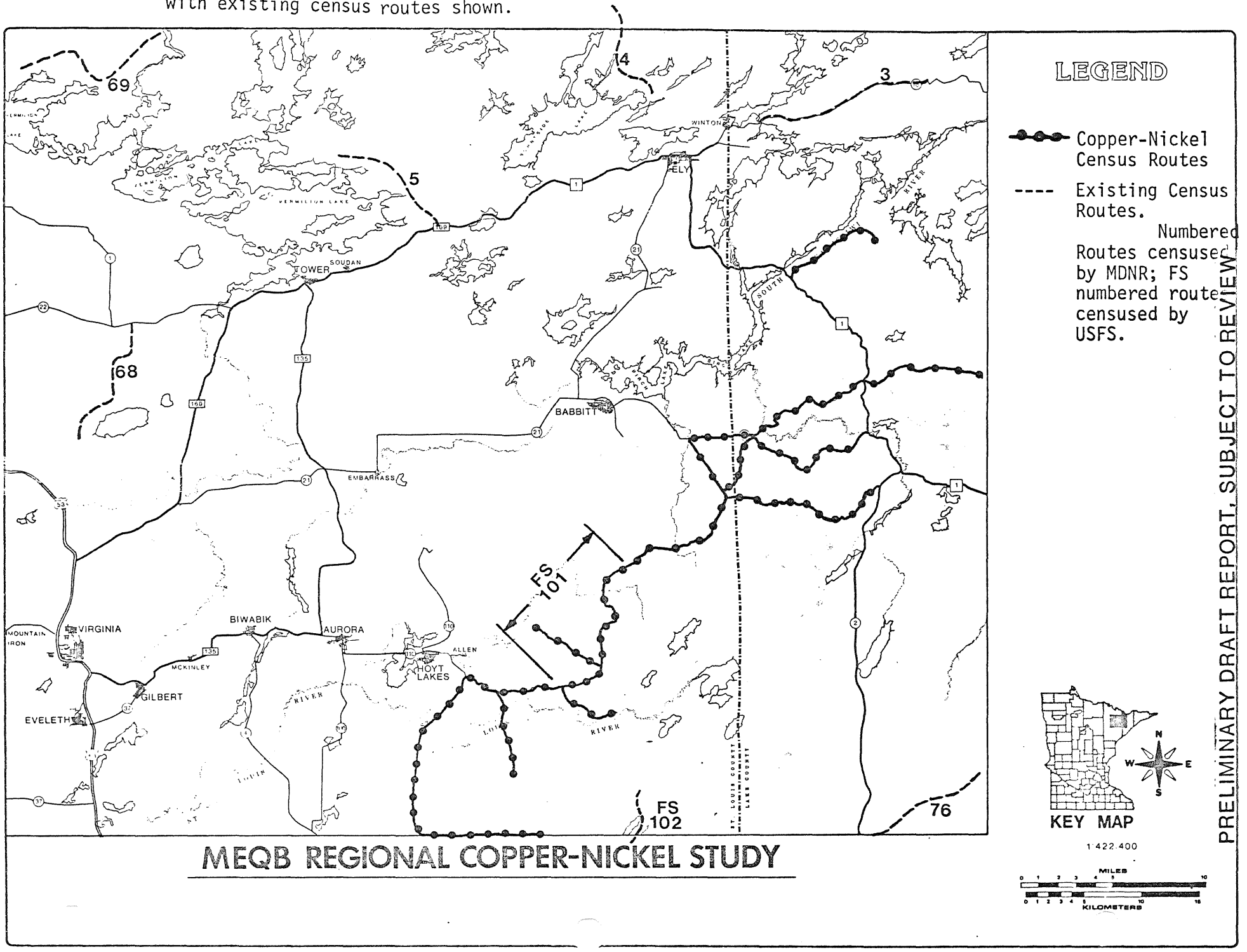


TABLE 1. Spring drumming census by zone, 1973-77.[A]

Year	North West	North	North East	Central Hardwoods	South East	Range-Wide State Mean
1977	0.9	1.6	0.5	0.9	2.4	1.3[B]
1976	0.8	1.5	0.4	0.9	2.2	1.1
1975	1.3	1.4	0.8	0.8	2.0	1.2
1974	0.8	1.1	0.8	0.7	3.0	1.4
1973	0.3	1.3	0.6	0.9	3.6	1.2
Zone Mean($\bar{x}$) =	0.82	1.38	0.62	0.82	2.64	1.22

A. Figures are mean number of drums heard/4 minute stop for all routes within each zone. Data from Berg 1976, 1977.

B. Calculated by dividing sum of 5 means by 5. Not given for 1977 by Berg (1977)

TABLE 2. Spring drumming census by zone, 1960-1972[A]

Year	North	North East	Central Hardwoods	South East	Range-wide State Mean ($\bar{x}$)
1972	3.4	1.0	0.9	3.6	1.2
1971	3.3	1.2	1.6	3.7	2.4
1970	3.1	0.9	1.6	2.1	2.2
1969	2.8	1.4	1.4	2.3	2.2
1968	2.6	1.6	1.0	1.3	2.0
1967	2.0	1.2	1.0	2.2	1.7
1966	1.3	0.6	0.7	1.9	1.0
1965	1.3	0.7	0.5	1.4	1.0
1964	0.7	0.9	0.3	1.3	0.6
1963	0.6	0.5	0.4	2.1	0.6
1962	2.3	0.5	1.6	0.5	1.9
1961	2.0	0.9	1.1	0.2	1.7
1960	1.9	0.5	1.3	0.7	1.6
Zone Mean ($\bar{x}$) =	2.10	0.92	1.03	1.79	1.55

A. Figures are mean number of drums heard/4 minute stop for all routes within each zone. Data from Berg, 1976.

TABLE 3 Spring 1977 Ruffed grouse drumming census in the Copper-Nickel development zone.[A]

Watershed Name	Grouped Watershed Number	No. of Census Stops	$\bar{x}$ Drums/ Stop
South Kawishiwi	I	6	0.33
Isabella	III	6	0.17
Denley	I	4	0.75
Stony	III	7	0.57
Nip	III	11	0.45
Dunka	II	17	0.59
Argo	II	7	0.86
Colvin	II	6	0.33
St. Louis	IV	26	0.73
Whiteface	IV	6	1.33
	TOTAL	96	$\bar{x}$ = 0.63[A]

A. Calculated from: 60 (Total drums heard) ÷ 96 (Total Stops).

TABLE 4. Observed and expected habitat use by drumming males in the Copper-Nickel development zone

Type[A]	Frequency of type at Census Stops[B]	Drumming Males[C] Observed[D]	Expected[E]	X^2
Aspen-Birch	39.1	44	23.5	17.88
Spruce-Fir	3.6	0	2.2	2.20
Lowland Shrub	2.6	2	1.6	0.10
Ash-Elm-Maple	1.0	0	0.6	0.60
Hazel-Pincherry-etc.	2.6	2	1.6	0.10
Jack pine	15.1	5	9.1	1.85
Mixed aspen-birch-fir-pine	5.2	2	3,1	0.39
Marsh & bog	1.6	0	1.0	1.00
Mixed spruce-fir-cedar	1.6	0	1.0	1.00
Red pine	6.2	0	3.7	3.70
Black Spruce	17.2	5	10.3	2.73
Tamarack	1.0	0	0.6	0.60
Harvested (<2 yr.old)	3.1	0	1.9	1.90
	99.9%	60.0	60.2	34.05** P<0.005

A. Chi-square does not recognize zero for both observed and expected values. For this reason white cedar, northern hardwoods and white pine (not represented at any site) were excluded from the above list.
B. Each side of road at 96 census stops (N=192) classified by the dominant cover present on a 1Ha plot.
C. Each drum within 4 min. period assumed to represent a different male.
D. Observed males heard drumming per habitat.
E. Expected value generated by multiplying 60 total drums by the percent of forest type in Copper-Nickel development zone.