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WINTER AVIFAUNA OF LEASE 17

A PRELIMINARY SURVEY

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ABSTRACT

During the periods 27 January, 3-6 February and 10-13 February 1977, a preliminary survey was conducted on Syncrude Lease 17 to gain the following information on wintering birds: species presence during mid winter; abundance of each species within representative habitats; and numbers of birds present in undisturbed, lightly disturbed, and highly disturbed habitats.

To accomplish these objectives, transect and flight surveys were established, together with listening posts, in three sample plots that are representative of the five major habitat types on Lease 17 (trembling aspen, black spruce, mixedwood, and riparian habitats, and the main cleared area).

A total of 14 species was observed on the study plots in 72 separate sightings. The gray jay was the most common species (57 sightings), followed by hoary and common redpolls (33 sightings), willow ptarmigan (24 sightings), boreal chickadee (10 sightings), black-capped chickadee (six sightings), hairy woodpecker (five sightings), downy woodpecker (four sightings), ruffed grouse and common raven (three sightings each), goshawk and black-backed three-toed woodpecker (two sightings each), and sharp-tailed grouse and snowy owl (one sighting each). One additional species, the house sparrow, was seen near the extraction plant.

The number of avifauna sightings made in each habitat type were: main cleared area 46, mixedwood 37, trembling aspen 34, black spruce 22, and riparian 12.

In undisturbed habitats 37 sightings of birds were made, while in lightly disturbed and highly disturbed habitats 45 and 69 sightings, respectively, were counted.

ACKNOWLEDGEMENTS

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George Calef, Territorial Game Branch, Yellowknife, assisted me in the field during the period 3-5 February 1977, and made important contributions to the survey. During the period 10-13 February, Mike English, Department of Geography, The University of Alberta, acted as field assistant.

To all these persons I extend gratitude.

1. INTRODUCTION

Syncrude Canada Ltd. is in the process of developing a bitumen extraction plant on Alberta Bituminous Sands Lease 17, located in northeast Alberta some 35 km north-northwest of Fort McMurray (Figure 1). Such development inevitably impacts the biophysical environment within which it occurs, thus Syncrude is committed to supporting an integrated research program designed to yield sufficient environmental baseline data to enable predictions concerning the types and degrees of alterations to the ecosystems of Lease 17.

The present study is that portion of Syncrude's research program which is designed to generate the information required to assess the impact of industrial developments on the winter avifauna population of Lease 17. It is a preliminary survey to gain introductory information on the ecology of wintering birds.

1.1 Field Work

This report is based on field work conducted during three periods: 27 January, 3-6 February, and 10-13 February 1977. A total of nine days was spent in the field, two on reconnaissance and seven conducting surveys on the sample plots. A total of 114 man hours was spent conducting the surveys.

1.2 Objectives

The objectives of this survey were to give the following preliminary information:

1) to determine the species of avifauna present on three sample plots within Syncrude Lease 17 during the first two weeks of

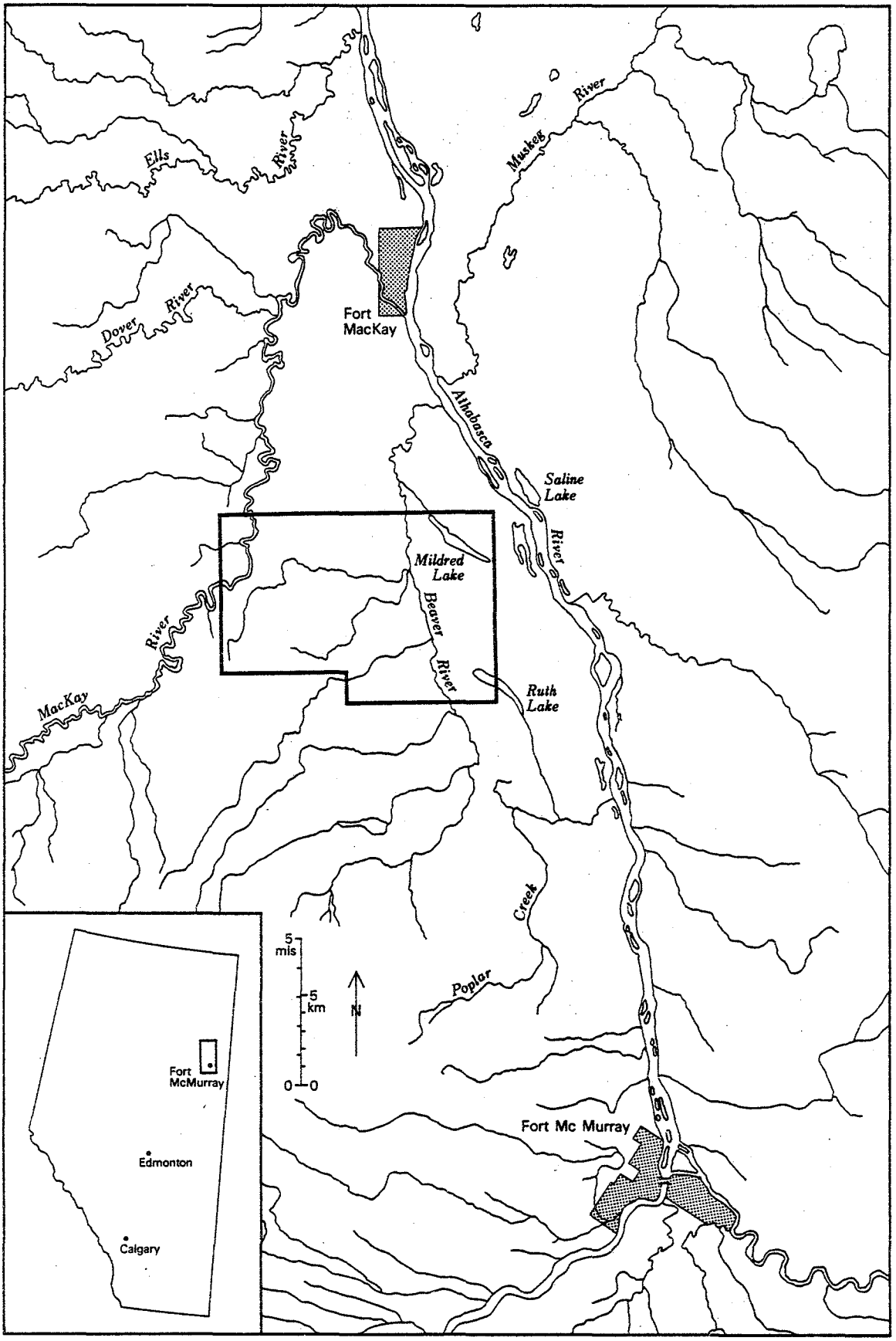

Figure 1
Location of study area in the vicinity of Syncrude Lease 17

February 1977;

2) to provide an index of the relative abundance of each species within five representative habitats on Lease 17 during this period;
3) to provide information on the habitats of wintering birds with emphasis on food availability, feeding and roosting habits;
4) to compare avifauna populations in undisturbed, lightly disturbed, and highly disturbed habitats.

1.3 Limitations of the Data

Because of the preliminary nature of this survey, the relatively short time spent in the field, the small numbers of species observed (14 - Table 3), the relatively few total sightings (151 - Table 3) and the fact that the transact method as used during this study produces a greater bias toward the inclusion of the more visible bird species, any conclusions drawn in this report are necessarily tentative. The limited sample base also makes it unrealistic to estimate total numbers of each species in the study area or to apply statistical techniques to test the data gained.

2. THE STUDY AREA

2.1 Location, Number and Size of Sample Plots

Three representative sample plots were selected. These are located in the southern half of Syncrude Lease 17 to the west and south of the main cleared development area (Figure 2). Each plot is 3.0 km long and 2.5 km wide for an areal coverage of 7.5 km^2. Combined, they have an area of 22.5 km^2.

2.2 Physiography and Soils

Physiographically, the area lies within the Clearwater Lowlands Region of the Saskatchewan Plain. The bedrock is composed of rather flat-lying Middle Devonian limestones overlain by late Cretaceous bentonitic shales and sandstones that are poorly consolidated to unconsolidated (Bayrock 1961). The topography is flat to gently rolling, with the regional drainage east and northward to the Athabasca River via Beaver Creek (Figure 2). Elevation ranges from 380 m asl near the western edge of the study area to 295 m asl along the northern extent of Beaver Creek.

Mineral soils of the study area are derived principally from glacio-lacustrine materials which range in texture from clay and silt to sand. Exposures of glacial till also occur. Coarse, well drained lacustrine or till deposits generally form grey luvisol soils, while those developed on sandy parent material are podzolic. Poorly drained sites are characterized by gleysols and organic soils (Lindsay *et al.* 1961).

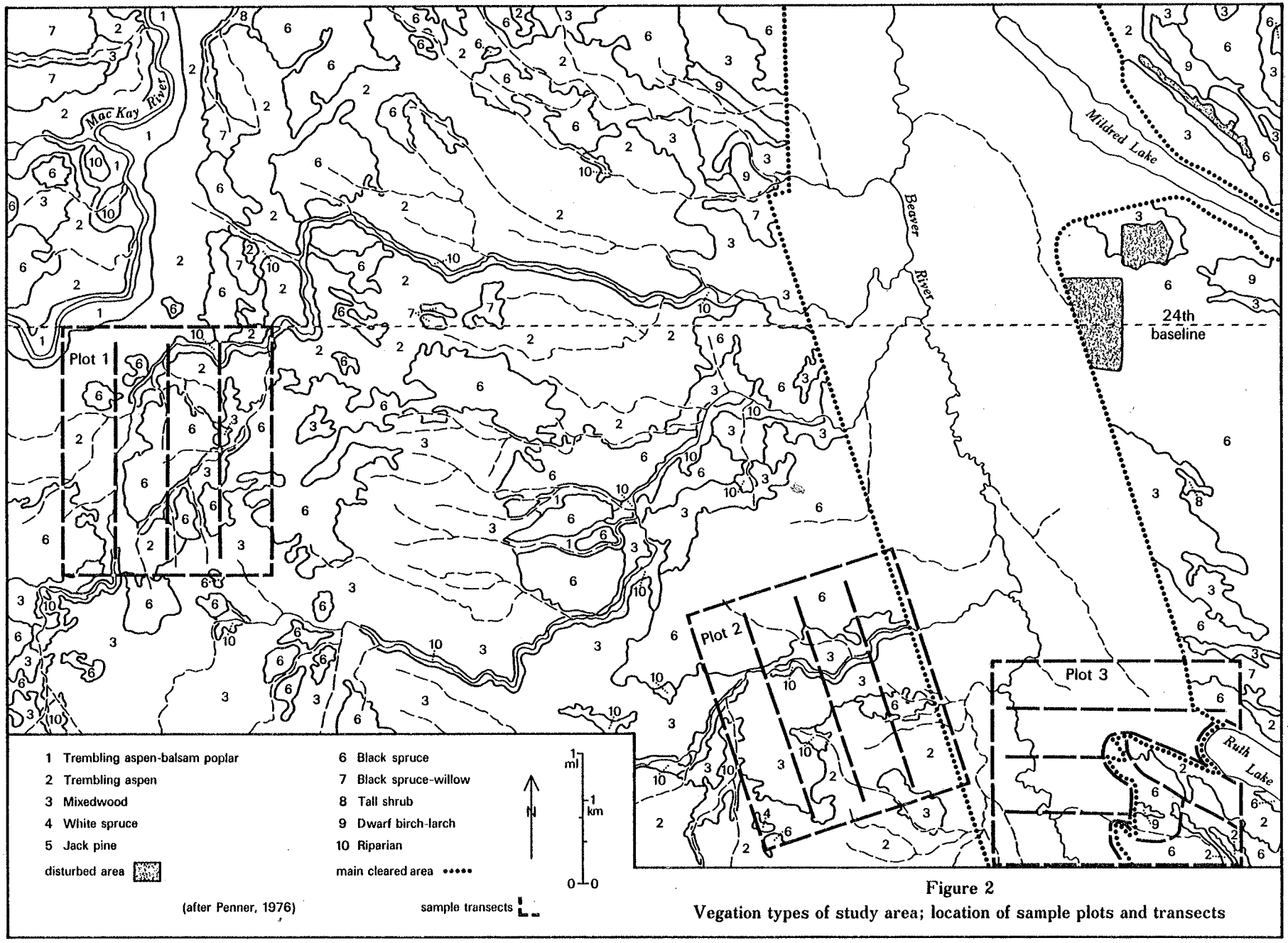

Figure 2
Vegation types of study area; location of sample plots and transects

2.3 Vegetation

The study area is more or less centrally located within Rowe's (1972) Mixedwood Section of the Boreal Forest Region. The mixedwood forest is composed of a mosaic of different-aged plant communities created by vegetation interactions with local site conditions and repeated disturbance. Mixedwood refers to forests that are composed of both deciduous and coniferous tree species; on Lease 17 trembling aspen *(Populus tremuloides)* is by far the dominant deciduous tree while black spruce *(Picea mariana)* is the most important conifer.

As also found by Penner (1976), a major environmental factor in determining forest composition in the study area has been the widespread wildfires that occurred during the late 1940s. On drier mineral soils, aspen succeeds rapidly after disturbance such as fire, and this has resulted in extensive even-aged stands of densely growing young aspen. On wetter sites, balsam poplar *(Populus balsamifera)* has become established after fire.

Many of the aspen stands, and most of the poplar stands, have an understory dominated by willow *(Salix* spp.), buffalo-berry *(Shepherdia canadensis)* and saskatoon *(Amelanchier alnifolia)*. In some areas aspen and balsam poplar are beginning to succeed to black spruce, and such locations have a well developed ground cover of Labrador tea *(Ledum groendlandicum)*. White birch *(Betula papyrifera)* is a relatively minor component of the deciduous forest cover throughout the study area.

Much of Lease 17 is covered by fine-grained moist mineral or organic soils, and these sites are largely dominated by young even-aged stands of black spruce, mostly dating in age from the fires of

the 1940s. Larch *(Larix laricina)* is an occasional associate.

Mature stands of white spruce *(Picea glauca)* are located in areas that escaped fire; these may be pure stands, but more commonly aspen co-dominates. Sandy soils and coarser tills are generally occupied by jackpine *(Pinus banksiana)*.

Seepage sites and drainage pathways are dominated by willow, alder *(Alnus tenuifolia and A. crispa)* red osier dogwood *(Cornus stolonifera)*, dwarf birch *(Betula glandulosa)*, and Labrador tea. This vegetation type is referred to here as riparian. For additional information on the vegetation of Lease 17 see Penner (1976).

2.4 The Winter Climate

The climate of the study area is outlined by Penner (1976). Lease 17 lies within the Cool Temperate Zone, which is characterized by short cool summers and long cold winters. The mean annual temperature is -0.5°C; lowest temperatures occur in January, with a mean monthly temperature of -21.5°C. Mean annual snowfall is 140 cm, which compacts to an average maximum depth of 38 cm in February. Maximum depths have reached 66 cm within the reporting period. Snow depths during the present investigation (February 1977) were close to the long-term average, but the snow was probably somewhat less dense than normal.

2.5 Choice of Sample Plots

Wildlife habitat on Lease 17 has been affected by varying degrees of development; some areas remain undisturbed, some are lightly disturbed and others are highly disturbed. The survey was designed to equally sample each of these habitat categories. Yonge (1977) recommen-

ded three sample plots on Lease 17 as being suitable for a preliminary winter bird survey. These plots are representative of undisturbed and disturbed habitats as well as representing the various types of natural vegetation on Lease 17.

Penner (1976) categorized 17 vegetation types in the study area, but we concluded that for the purposes of a preliminary study, it would be impractical to survey avifauna associated with this number of habitats. Yonge (1977) therefore generalized Penner's vegetation types and found that four major habitats each cover more than 15 percent of the Lease (Table 1); together they include 87 percent of the area. As no other vegetation type covers more than 6 percent of the Lease, we decided that the four generalized habitat types (trembling aspen, black spruce, mixedwood and cleared) should serve as an adequate base for sampling the winter avifauna of Lease 17. One additional habitat type, riparian, was also included (Table 1). Although they cover little area, riparian habitats are narrow and sinuous, thus create much edge. Furthermore, the increased visibility afforded by the low growth form of this vegetation make riparian habitats efficient observation points. Therefore, although it covers only 2.2 percent of Lease 17 (Table 1), riparian vegetation is sufficiently important to winter avifauna in plots 1 and 2 (Section 4.3.3) that it was included as a separate habitat.

When a comparison is made in the areal coverage of major habitat types on the sample plots with the same class of coverage on Lease 17 (Table 1), it is seen that plots 1-3 have approximately the same proportion of each habitat as does the Lease; the study plots have 6.9 percent more trembling aspen, 3.5 percent more black spruce, 2.0 per-

TABLE 1. AREAL COVERAGE OF MAJOR HABITAT TYPES IN SAMPLE PLOTS COMPARED TO PERCENT OF TOTAL COVERAGE ON LEASE 17

HABITAT TYPE	AREA (KM^2) PLOT 1	AREA (KM^2) PLOT 2	AREA (KM^2) PLOT 3	TOTAL COVERAGE (KM^2)	PERCENT COVERAGE, SAMPLE PLOTS	PERCENT COVERAGE, LEASE 17[4]
trembling aspen	3.3[1]	2.1	0.7	6.1	27.1	20.2
black spruce	2.5	2.4	2.1[3]	7.0	31.1	27.6
mixedwood	1.4	2.7[2]		4.1	18.2	16.2
riparian	0.3	0.3		0.6	2.7	2.2
cleared			4.7	4.7	20.9	23.1
TOTALS	7.5	7.5	7.5	22.5	100.0	

[1] Includes small amount of trembling aspen-balsam poplar

[2] Includes small amount of white spruce

[3] Includes small amounts of black spruce-willow and dwarf birch-larch

[4] After Penner (1976)

cent more mixedwood, 0.2 percent more riparian, and 2.2 percent less cleared habitat.

2.6 Description of Sample Plots

Each sample plot is described as follows.

2.6.1 Sample Plot 1

The northwest corner of this plot is at the junction of the 24th Baseline and the MacKay River. Figure 2 illustrates that its 7.5 km^2 area is dominated by trembling aspen (3.3 km^2), followed by black spruce (2.5 km^2), mixedwood (1.4 km^2) and riparian (0.3 km^2). It is nearly 9 km distant from the main cleared area and has experienced no development activity, therefore it is representative of undisturbed habitat.

2.6.2 Sample Plot 2

The eastern boundary of this plot is formed by the southwest edge of the main cleared area. Figure 2 illustrates that its 7.5 km^2 area is dominated by mixedwood (2.7 km^2), followed by black spruce (2.4 km^2), trembling aspen (2.1 km^2) and riparian (0.3 km^2). Some line clearing has been done in the eastern half of this plot and a drainage ditch runs down its center; it is therefore representative of lightly disturbed habitats.

2.6.3 Sample Plot 3

This plot is located at the southern end of the main cleared area and abuts against the northwest end of Ruth Lake. Figure 2 illustrates that its 7.5 km^2 area is dominated by cleared forest (4.7 km^2), black spruce (2.1 km^2) and trembling aspen (0.7 km^2). Some 63 percent of the forest cover of this plot has been removed and it is therefore representative of highly disturbed habitats.

3. METHODS

3.1 Transect Surveys

Five transects, spaced approximately 0.6 km apart, were established in each sample plot parallel to the plot's long axis (except for plot 3 - Figure 2). In addition, the ends of each plot were surveyed (except for plot 3 where its eastern boundary is intercepted by Ruth Lake - Figure 2). Plots 1 and 2 have a total transect length of 20.0 km while plot 3 has a total transect length of 21.7 km (Table 2). Each plot was sampled twice, thus a total distance of 123.4 km was covered. Most of the distance was surveyed on foot, except for the north end of plot 1, the center and east boundary of plot 2, and approximately one-half of the cleared area of plot 3; these transects were surveyed from a relatively quiet and slow-moving snowmobile. As only clear areas with good visibility were surveyed by snowmobile, their use should not have detracted from the accuracy of the survey.

Table 2 outlines the total distance surveyed in each habitat type. It also gives the percent of total distance travelled in each habitat; comparison of these figures with the percent coverage of major habitats in Lease 17 (Table 1), further illustrates that the sample transects give a reasonable representation of the Lease as a whole.

Information noted each time a bird was sighted* along a transect included numbers, location, date and time of observation, weather conditions, habitat types (Appendix 1), food availability, and, where

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*When birds were heard (which happened only infrequently), they were quietly stalked until visual contact was made for positive identification.

TABLE 2. DISTANCE OF TRANSECTS SAMPLED IN EACH HABITAT TYPE
(Each plot sampled twice)

HABITAT TYPE	PLOT 1	PLOT 2	PLOT 3	TOTALS	PERCENT OF DISTANCE
trembling aspen	9.9 km	5.0 km	2.1 km	17.0 km	27.6
black spruce	5.0 km	5.9 km	3.5 km	14.4 km	23.3
mixedwood	3.4 km	4.2 km	0.0 km	7.6 km	12.3
riparian	1.7 km	1.9 km	0.0 km	3.6 km	5.8
cleared	0.0 km	3.0 km	16.1 km	19.1 km	31.0
TOTALS PER SAMPLE PERIOD	20.0 km	20.0 km	21.7 km	61.7 km	100.0
GRAND TOTAL DISTANCE SAMPLED	40.0 km	40.0 km	43.4 km	123.4 km	

applicable, feeding or roosting habits, and snow depth and density. Signs, such as tracks and snow burrows of willow ptarmigan, were also noted.

3.2 Flight Surveys

The only species that was observed to spend a considerable amount of time in flight during the survey was the common raven. Since they were not associated with a specific habitat type (except roosting - Appendix 1, Table 3) they were treated separately; information was noted as to location, date and time of observation, weather conditions, numbers in each flock, and direction of flight (Table 6).

3.3 Listening Posts

Several species of owl are common winter residents in the boreal forest environment of Lease 17 (Table 8), and should have been establishing territories during the field survey period (Bent 1961). Therefore, six two-hour periods were spent during the evenings of 3-5 and 10-12 February in selected locations within the study plots in an attempt to locate owl species by voice identification.

4. RESULTS AND DISCUSSION

4.1 Chronological Observations of Winter Avifauna and Associated Habitat Types

Appendix 1 gives raw data on the number and species of birds observed during the field survey, together with the date and time of observation, weather conditions, sample plot location, and the type of habitat where they were observed. A total of 14 species was observed on the study plots in 72 separate sightings. Weather conditions were good to fair during most of the survey, except for the morning and afternoon of 13 February when wind, snow and fog made it impracticable to make observations.

4.2 Species and Number of Sightings Per Hour of Observation

Table 3 illustrates that three species accounted for the majority of total sightings and the average number of sightings per hour. As expected, the gray jay was the most numerous individual, with a total of 57 sightings, or 1.26 sightings per hour of observation. Second in number of sightings was the hoary (common?) redpoll, with 33 sightings or 0.74 per hour. This is a biased average, however, because redpolls congregate in flocks during winter, and the sighting of only two flocks resulted in the large aggregate number of individuals. Third in number of sightings were willow ptarmigan, with a total of 24 sightings or 0.54 per hour. Ptarmigan were seen as individuals or in small flocks up to five in number. All together, eight separate sightings (of individuals or flocks) were made (Appendix 1).

The remainder of sightings are shown in Table 3; they range from a high of 10 total sightings of the boreal chickadee (with 0.22 sight-

TABLE 3. SPECIES AND NUMBER OF WINTER AVIFAUNA SIGHTINGS ON SAMPLE PLOTS DURING 45 HOURS OF OBSERVATION

SPECIES		TOTAL NUMBER SIGHTED	NUMBER OF SIGHTINGS PER HOUR OF OBSERVATION
goshawk	*(Accipiter gentilis)*	2	0.04
ruffed grouse	*(Bonasa umbellus)*	3	0.07
sharp-tailed grouse	*(Pedioecetes phasianellus)*	1	0.02
willow ptarmigan	*(Lagopus lagopus)*	24	0.54
snowy owl	*(Nyctea scandiaca)*	1	0.02
hairy woodpecker	*(Dendrocopus villosus)*	5	0.11
downy woodpecker	*(Dendrocopus pubescens)*	4	0.09
black-backed three-toed woodpecker	*(Picoides arcticus)*	2	0.04
gray jay	*(Perisoreus canadensis)*	57	1.26
common raven	*(Corvus corax)*	3	0.07
black-capped chickadee	*(Parus atricapillus)*	6	0.13
boreal chickadee	*(Parus hudsonicus)*	10	0.22
hoary redpoll	*(Acanthis hornemanni)*	33	0.74
common redpoll	*(Acanthis flammea)*		
TOTALS		151	3.35

ings per hour of observation) to a low of 1 sighting of sharp-tailed grouse and snowy owl (for only 0.02 sightings per hour of observation).

In total, 151 sightings of winter avifauna were made, for an average of 3.35 sightings per hour of observation (Table 3).

4.3 Habitat Relationships

The relationships between avifauna and habitat are treated in two ways: the combined number of birds sighted in each habitat type per km of transect, and the number of sightings of individual species in each habitat type.

4.3.1 Number of Sightings in Each Habitat Per Kilometer of Transect

Based upon the number of sightings per km, the mixedwood habitat appears to support the largest number of wintering birds, with 2.4 seen per km of transect (Table 4). The second most important avifauna habitat is riparian. Although this vegetation type covers only 2.7 percent of the sample plots (Table 1), 1.6 birds were counted per km. As stated in Section 2.5, this habitat affords excellent visibility thus the relatively large number of sightings may partly be an artifact of being able to observe more birds. Nevertheless, the great amount of edge created by this vegetation type, together with the large quantities of willow browse available to species such as willow ptarmigan that depend upon buds and terminal twigs as a winter food source, make riparian vegetation a significant habitat for some species of wintering birds.

Table 4 indicates that the cleared area was third in habitat significance, with 1.2 sightings per km. However, as stated in Section

TABLE 4. NUMBER OF WINTER AVIFAUNA SIGHTINGS IN EACH HABITAT TYPE PER KILOMETER OF TRANSECT

HABITAT TYPE	TOTAL DISTANCE SAMPLED	NUMBER OF AVIFAUNA SIGHTINGS PER KM
trembling aspen	34.0 km	1.0
black spruce	28.8 km	0.8
mixedwood	15.2 km	2.4
riparian	7.2 km	1.6
cleared area	38.2 km	1.2

4.2, the two flocks of redpolls (totalling 33 individuals) biases this figure upward.

Trembling aspen is fourth in significance as winter avifauna habitat with 1.0 sightings per km, while black spruce is, as expected, the least important, with an average of 0.8 birds sighted per km.

4.3.2 Total Number of Sightings in Each Habitat Type

When the data are arranged by total sightings of avifauna (Table 5), it is seen that more birds were observed in the cleared area (46 sightings) than in any other habitat. Within the natural vegetation types, mixedwood was the most important with 37 sightings, followed by trembling aspen (34), black spruce (22), and riparian (12).

4.3.3 Number of Sightings by Species in Each Habitat Type

Looking at species individually, Table 5 suggests a number of habitat relationships. Care must be exercised in their interpretation, however, as the first account shows.

4.3.3.1 Goshawk

One goshawk each is listed as having been sighted in mixedwood and riparian habitats. The latter sighting is a reliable indicator of habitat preference, as this particular goshawk was perched in a tall dead snag, searching the riparian willows for ptarmigan (it was subsequently observed to make an apparently unsuccessful attempt to prey on a small flock of ptarmigan that were feeding in the willows). The sighting in mixedwood habitat is somewhat misleading, however, as this goshawk was perched at the top of a tall white spruce tree immediately adjacent to a black spruce-willow habitat (shown as number 7 in the northeast

TABLE 5. NUMBER OF WINTER AVIFAUNA SIGHTINGS MADE IN EACH HABITAT TYPE

SPECIES	TREMBLING ASPEN	BLACK SPRUCE	MIXEDWOOD	RIPARIAN	CLEARED
goshawk			1	1	
ruffed grouse	2		1		
sharp-tailed grouse					1
willow ptarmigan	8		1	4	11
snowy owl	1				
hairy woodpecker	1		2	2	
downy woodpecker		1	3		
black-backed three-toed woodpecker			2		
gray jay	22	16	13	5	1
common raven		1	2		
black-capped chickadee			6		
boreal chickadee		4	6		
hoary (common?) redpoll					33
TOTAL SIGHTINGS	34	22	37	12	46

corner of plot 3 - Figure 2) that also (judging from tracks) received heavy use by ptarmigan. Goshawks apparently prey heavily on willow ptarmigan during winter (Carbyn 1968), and since ptarmigan are associated with habitats where willows are a major component, it follows that goshawks will also be associated with this vegetation type.

4.3.3.2 Ruffed Grouse

Three ruffed grouse were observed, two of which were seen in trembling aspen habitat, where they were browsing upon the winter buds of young male aspen, a preferred winter food. Some one dozen sets of grouse tracks were also seen in aspen stands, adding to the indication that this is an important winter habitat for this species. Near Rochester, in central Alberta, Rusch and Keith (1971) also found that aspen woods were a preferred winter habitat for ruffed grouse.

A single grouse was observed in mixedwood, and one additional set of tracks was seen in this habitat. Although ruffed grouse are often associated with mixedwood stands, these habitats on Lease 17 are few in number and small in extent, and their overmaturity probably reduces the quality and quantity of the food source.

4.3.3.3 Sharp-tailed Grouse

Only one sharp-tailed grouse was seen, and that in the main cleared area. One probable set of sharp-tailed grouse tracks was also found in cleared habitat. Given this species' common association with natural and man-made grasslands, it is not surprising that it has begun to utilize the grassy and shrubby habitat of the main cleared area.

4.3.3.4 Willow Ptarmigan

Willow ptarmigan were observed in each habitat type except black spruce (although their easily-identified tracks were seen in the black

spruce-willow vegetation type - Section 4.3.3.1 - and in some black spruce stands where they had apparently browsed on Labrador tea and ground birch). Tracks were also seen in virtually every location where willows are a component. Most ptarmigan (and their tracks) were observed in the cleared area (11 sightings - Table 5), where an abundance of young successional willows provide an excellent source of browse. Snow conditions are also advantageous here; the open expanses enable the wind to compact the snow, making it possible for ptarmigan to move over the crusted surface in search of food with a minimum of expended energy. Only the edges of the cleared area are used to any extent however, as ptarmigan do not move too far from cover. Also, the much less dense but deeper snow immediately inside the adjacent wooded cover is used during the night and during periods of inclement weather for snow burrows. Some 80 such ptarmigan burrows were counted in various habitats adjacent to the main cleared area.

Another interesting aspect of the edge habitat along the main cleared area is related to the ptarmigan's need for grit. Like all gallinaceous birds, ptarmigan seek to ingest coarse materials such as sand to aid in the breakdown of foods, particularly necessary in winter when ligneous contents are high. Exposed sand banks are present along most edges of the cleared area where bulldozers have done their work, and ptarmigan in large numbers use these exposures as sources of grit.

Eight ptarmigan were observed in the trembling aspen habitat (Table 5), most of which were seen in areas that had an understory of willows (Section 2.3); numerous ptarmigan tracks were also observed in such locations. Four willow ptarmigan were counted in the riparian habitat, a comparatively significant number given the small coverage

of this vegetation type (Table 1). Large numbers of tracks were also located here. Given the dependence of ptarmigan during winter on willows as a food source, and the dominance of this genus in riparian sites, there is a long established association between willow ptarmigan and this type of habitat. Only one sighting of ptarmigan was made in the mixedwood vegetation type; although cover is excellent, a limited food source probably reduces its value to willow ptarmigan.

4.3.3.5 Snowy Owl

One snowy owl was encountered; although it is listed as being associated with trembling aspen habitat (Table 5), it was perched at the edge of an aspen stand facing the main cleared area where it appeared to be searching for small mammals, its principal source of food.

4.3.3.6 Hairy Woodpecker

Five hairy woodpeckers were sighted, two each in mixedwood and riparian, and one in trembling aspen habitat (Table 5). This woodpecker prefers openings and edge habitat (Godfrey 1966), thus selects such vegetation types as the riparian; in both cases where it was seen in the mixedwood habitat it was foraging near a stand's edge. One hairy woodpecker was also observed well into the center of a large aspen stand.

4.3.3.7 Downy Woodpecker

Three sightings of the downy woodpecker were made in its preferred mixedwood habitat (Godfrey 1966), and one was sighted in the center of a black spruce stand (Table 5). None were located in any other habitat.

4.3.3.8 Black-backed Three-toed Woodpecker

Two black-backed three-toed woodpeckers were observed, both in

mixedwood habitat (Table 5). None were seen in any other type.

4.3.3.9 Gray Jay

The ubiquitous gray jay occupies all available woodland habitats of the study area, and was even seen flying over the cleared area, far from cover (Table 5). Although this jay prefers coniferous and mixedwood forests (Godfrey 1966), most of the sightings (22) were made in trembling aspen stands. Given the relative lack of biological diversity within this habitat type and the apparent lack of food and nesting resources for an omnivorous bird that is not particularly specialized to use this type of habitat, it is rather surprising that more were observed here than in any other vegetation type. Bent (1964), however, reports that in northern Alberta the gray jay is commonly found in higher, drier stands of aspen. The fact that its winter range is much larger than its breeding territory may also account for the numerous sightings in aspen habitat.

Within the black spruce and mixedwood habitats, locations that more normally support large gray jay populations, 16 and 13 sightings were made, respectively. In the riparian habitat five sightings were made.

4.3.3.10 Common Raven

Although ravens are very numerous in the development area (Section 4.5), only three sightings were made of this species within the natural habitats of the study area. All three were seen roosting in tall snags, two in the mixedwood habitat and one in a black spruce stand (Table 1).

4.3.3.11 Black-capped Chickadee

Of the six sightings of black-capped chickadees, all were made in the mixedwood vegetation type (Table 5), one of their most preferred habitats.

4.3.3.12 Boreal Chickadee

Six sightings of the boreal chickadee were likewise made in the mixedwood habitat (Table 5), but these birds were feeding exclusively on white spruce trees, as similarly observed by Haftorn (1974) in Alaska. Four sightings were also made in a mature stand of the black spruce type, which is a more characteristic habitat for the boreal chickadee.

4.3.3.13 Hoary and Common Redpolls

Thirty-three sightings of redpolls were made, all in the main cleared area. In all cases the redpolls were active in the lower layers of air, usually flying less than 1.5 m above the snow surface, foraging through weed patches and low-growing shrubs. On one occasion a redpoll was seen to enter the snow cover through a hole in the crust, presumably to feed on subnivean seeds. This apparently is not an uncommon feeding adaptation to the northern winter (Cade 1953).

It was not determined whether the two flocks observed were made up of hoary redpolls or common redpolls or both, as the observations were made too distant for positive identification. The winter habitats of both redpoll species are open woodland, weed patches, and fields (Godfrey 1966), thus they should adapt readily to the open grassland and shrubland of the main cleared area.

4.4 Comparison of Avifauna Populations in Undisturbed, Lightly Disturbed and Highly Disturbed Habitats

As with all wildlife, there are species of avifauna that maintain viable populations only within a natural landscape that is undisturbed by man, while other species are able to adapt somewhat to man-altered habitats, and yet others that prosper in man-altered environments. This

process was observed to some extent during the present study. Table 6 compares numbers of bird sightings in undisturbed, lightly disturbed, and highly disturbed habitats. From these data some tentative evaluations can be made concerning the adaptability (or lack of adaptability) of some of Lease 17's winter avifauna to habitat change initiated by physical disturbance. No attempt was made to evaluate the potential effects of other disturbance factors such as noise and air or water pollution.

4.4.1 Goshawk

The two goshawk sightings were made in contrasting habitats (Table 6), and this, together with the small number of sightings, makes it impossible to draw any conclusions about its adaptability to disturbance. This hawk does commonly frequent forest edges and clearings (Godfrey 1966), however, thus it should use the margins of the main cleared area wherever other disturbances do not preclude it.

4.4.2 Ruffed Grouse

On Lease 17, as elsewhere, this is a species of deciduous and mixed forest habitats, and especially prefers non-mature forest stands. Therefore any disturbance that eventually results in successional shrub and forest vegetation is advantageous to ruffed grouse. However, they will not inhabit locations where all the overstory has been removed, such as in the main cleared area. Therefore the obvious conclusion is that while they will occupy lightly disturbed habitats (Table 6), any disturbance that completely removes the forest cover is inimical to this species.

4.4.3. Sharp-tailed Grouse

In contrast to the ruffed grouse, this species may prosper where the

TABLE 6. SPECIES AND NUMBER OF WINTER AVIFAUNA SIGHTINGS IN UNDISTURBED, LIGHTLY DISTURBED, AND HIGHLY DISTURBED HABITATS

SPECIES	UNDISTURBED	LIGHTLY DISTURBED	HIGHLY DISTURBED
goshawk	1		1
ruffed grouse	1	2	
sharp-tailed grouse			1
willow ptarmigan	7		17
snowy owl			1
hairy woodpecker	5		
downy woodpecker	2	2	
black-backed three-toed woodpecker		2	
gray jay	18	23	16
common raven		3	
black-capped chickadee	3	3	
boreal chickadee		10	
hoary (common?) redpoll			33
TOTAL SIGHTINGS	37	45	69

forest cover has been removed and is replaced by grassland. As stated in Section 4.3.2, the main cleared area appears to be the only type of habitat in the study region that supports this species. Therefore, it may be said that this grouse is adapted to certain physically disturbed habitats.

4.4.4 Willow Ptarmigan

As shown in Section 4.3.3.4, this species is also adapted to disturbed habitats. More than twice as many sightings of ptarmigan were made in the highly disturbed habitat of the main cleared area than in any other location (Table 6).

4.4.5 Snowy Owl

The snowy owl is an occasional winter visitor to the densely settled parts of southern Canada, thus it apparently tolerates disturbed habitats. Furthermore, during its southern migrations, it hunts open meadows (similar in appearance to its familiar tundra habitat),thus it is adapted to altered environments such as the main cleared area.

4.4.6 Hairy Woodpecker

Mature woodlands are the preferred habitats of this species (Godfrey 1966), and as suggested by Table 6, they prefer undisturbed habitats. Therefore any disturbance that results in the removal of the forest cover will also negatively affect the hairy woodpecker.

4.4.7 Downy Woodpecker

The downy woodpecker is more tolerant than the hairy woodpecker of young, smaller tree growth and during winter they may forage on non-woody plants in fields Godfrey 1966). Therefore this species is adapted to disturbed habitats where successional vegetation is becoming established. Table 6 shows that as many sightings of downy woodpeckers were made in lightly disturbed habitats as were counted in undisturbed areas.

4.4.8 Black-backed Three-toed Woodpecker

Although this woodpecker prefers coniferous woodlands and burned areas with standing dead trees (Godfrey 1966), both sightings took place in mixedwood stands within lightly disturbed locations (Table 6), which suggests that it may be somewhat tolerant of disturbed habitats.

4.4.9 Gray Jay

Nearly as many sightings of this species were made in the highly disturbed plot as were made in the undisturbed plot (Table 6). These figures are misleading, however, when it is shown that all but one of the sightings (Table 5) were made within the small wooded portion of plot 3. The gray jay therefore appears tolerant of disturbance only as long as wooded habitats remain available.

4.4.10 Common Raven

Rather than refer to the incomplete data for this species as shown in Table 6, other observations that we made on the raven will illustrate its well-known adaptability to disturbed habitats. Enroute to the study plots, we drove near the Syncrude extraction plant, where every day we observed ravens in large numbers, either perched on structures or using the updrafts over buildings to soar, much the same as they do in the wild where cliff faces are preferred nesting habitat.

Several wintering bird species of the boreal forest have adapted their feeding habits to take advantage of food supplied by man, and the common raven has proven to be one of the most adaptable (Stirling 1968), making particular use of refuse dumps. Syncrude's refuse ground,which is located just north of the extraction plant, attracts large numbers of this scavenging bird. Three separate counts were made on 4 and 10-11 February, and each time we estimated that in excess of 300 ravens were foraging at the dump. This concentration of ravens was also noted by

Sharp and Richardson (1966). During late October 1975 they counted over 100 ravens during each of three surveys. They correctly assumed that this dump is more heavily used by common ravens during winter than during summer and autumn months.

Many ravens were also observed in flight while we conducted the bird survey. The time of observation, their numbers, and direction of flight were noted, from which there appeared to be a movement during the morning from the surrounding forested areas toward the refuse dump, and a movement during the afternoon away from the dump. Table 7 illustrates that of the 74 ravens observed flying over the study plots, seven were seen to be flying toward the refuse dump during the morning and 51 were seen to be flying away from the dump during the afternoon. The other 16 ravens were flying in directions other than toward or away from the dump.

4.4.11 Black-capped Chickadee

The principal habitats of this species are woodlands and their edges (Godfrey 1966). Three sightings were made in undisturbed habitats and three were made in lightly disturbed areas. None were seen in the highly disturbed plot. They appear to adapt to a minor amount of disturbance, and do forage along the edge of artifically cleared areas (Bent 1946).

4.4.12 Boreal Chickadee

Ten sightings were made of this species, all in the lightly disturbed area, suggesting that they too adapt to this degree of disturbance.

4.4.13 Hoary and Common Redpolls

The preferred winter habitats of redpolls are open woodlands, weed patches, and fields (Godfrey 1966), thus this species prospers where the forest cover has been removed. Thirty-three redpolls were seen, all in the main cleared area (Table 6). It is therefore clear that they are

TABLE 7. DATES AND HOURS OF OBSERVATIONS OF COMMON RAVENS FLYING OVER STUDY PLOTS AT RELATIVELY CONSTANT ALTITUDE, AND DIRECTION OF FLIGHT

DATE (February 1977)	TIME (MST)	WEATHER CONDITIONS	NUMBERS	SAMPLE PLOT	DIRECTION OF FLIGHT
3	1220	cold, clear, no wind	1	1	NW
3	1510		2	1	WSW**
3	1600		3	1	WSW**
3	1705		5	3	S**
4	0840	mild, clear to partly	2	1	E*
4	0900	cloudy, light wind	1	1	ENE*
4	0950		2	2	N*
4	1055		1	2	W
4	1210		1	2	SE
4	1350		2	2	E
4	1540		1	2	SW**
4	1625		4	2	S**
5	0905	mild, partly cloudy,	1	3	S
5	1535	light wind	3	3	S**
10	1600	clear, mild, no wind	2	1	W**
10	1630		1	1	SE
10	1655		3	1	W**
11	0855	partly cloudy, mild,	2	1	N
11	0930	no wind	1	1	E*
11	1210		1	1	SE
11	1540		5	3	SE**
11	1545		2	3	S**
11	1555		6	3	S**
11	1610		3	3	S**
11	1630		2	3	SE**
11	1650		1	3	NW
12	0930	partly cloudy, mild,	2	2	N*
12	1035	light wind	1	2	E
12	1210		1	2	NW
12	1400		2	2	NE
12	1545		4	2	S**
12	1555		3	2	SSW**
12	1640		3	3	SE**

* Indicates flight during morning toward refuse ground

** Indicates flight during afternoon away from refuse ground

adapted to physically disturbed sites.

4.4.14 House Sparrow *(Passer domesticus)*

This species is not included in the previous discussion because it was observed only at the extraction plant, and is not associated with natural habitats. On 4 February, a flock of approximately 10 house sparrows was observed foraging around a stack of baled straw along the southern edge of the extraction plant. It is not surprising that the house sparrow has found its way so quickly to the main development area, as it follows wherever man establishes new roots, and is one of the very few animal species that is found only in close association with man (Gill and Bonnett 1973). Sharp and Richardson (1976) also noted a few house sparrows at the extraction plant construction site during the summer of 1975.

4.5 Negative Results

The study area lies within the normal winter range of 33 species of birds, and the range of 27 additional species might occasionally extend to include this area in winter (Table 8). Less than half of the 33 expected species were therefore located. This may be due to a number of factors: an insufficient number of habitats sampled, insufficient numbers and size of sample plots, insufficient time in the field, observer error, or some of the expected or potential species may not have been present in the study area. For example, in addition to the normal survey, twelve hours were spent over six evening periods in an attempt to locate owl species by voice identification (Section 3.3), but no owls were heard, indicating that they probably were not present in the study area during the sample period.

TABLE 8. SPECIES OF BIRDS EXPECTED TO OCCUR ON LEASE 17 IN WINTER (After Yonge 1977)

Within Normal Range	Occasional Occurrence Expected
*goshawk	Canada goose
gyrfalcon	mallard
spruce grouse	pintail
*ruffed grouse	American widgeon
*sharp-tailed grouse	shoveler
*willow ptarmigan	green-winged teal
rock dove	ring-necked duck
great horned owl	lesser scaup
*snowy owl	common goldeneye
barred owl	bufflehead
great gray owl	common merganser
hawk owl	Cooper's hawk
boreal owl	sharp-shinned hawk
saw-whet owl	rough-legged hawk
pileated woodpecker	red-tailed hawk
*hairy woodpecker	golden eagle
*downy woodpecker	long-eared owl
*black-backed three-toed woodpecker	short-eared owl
northern three-toed woodpecker	horned lark
*gray jay	blue jay
*common raven	black-billed magpie
*black-capped chickadee	Clark's nutcracker
*boreal chickadee	common crow
northern shrike	white-breasted nuthatch
*house sparrow	starling
evening grosbeak	dark-eyed junco
pine grosbeak	
gray-crowned rosy finch	
*hoary redpoll	
*common redpoll	
red crossbill	
white-winged crossbill	
snow bunting	

* Species sighted during survey

4.6 Summary List of Species

This section summarizes the information gained on each species of bird observed during the survey, and compares population counts from other sources.

4.6.1 Goshawk

Two sightings of goshawks were made, one in mixedwood habitat and one in riparian habitat. Although some goshawks apparently migrate every year, some individuals occur as permanent residents in the general study area (Godfrey 1966, Salt and Wilk 1966). Sharp and Richardson (1976) state that a pair of goshawks was resident on the study area during 1975, while Ward *et al.* (1976) made 6 sightings of the goshawk on Lease 17 during the summer of 1975.

4.6.2 Ruffed Grouse

Three sightings of ruffed grouse were made, two in trembling aspen habitat and one in mixedwood habitat. Ths species is a permanent resident of the study area (Godfrey 1966). Sharp and Richardson (1976) observed 9 territorial males in the deciduous and mixed forest habitats of the study area during the spring of 1975, while Ward *et al.* (1976) saw three on Lease 17 during the summer of 1975.

4.6.3 Sharp-tailed Grouse

One sharp-tailed grouse was observed, and that sighting took place in the cleared area of plot 3. It is a permanent resident in northeast Alberta (Godfrey 1966). Sharp and Richardson (1976) made 11 sightings of this species in the study area, and Ward *et al.* (1976) identified two sharp-tailed grouse.

4.6.4 Willow Ptarmigan

Twenty-four sightings of willow ptarmigan were made, in all habitats except black spruce. This species is not a permanent resident of north-

east Alberta, and occurs only as an annual winter migrant. Willow Ptarmigan breed in tundra some 800 km or more northeast of the study area, and reach the southern limit of their normal wintering range near Fort McMurray, although they have been reported as far south as the northern agricultural fringe of central Alberta (Aleksiuk 1977).

4.6.5 Snowy Owl

One snowy owl was observed, in trembling aspen habitat. Like the willow ptarmigan, it is a winter visitor to the study area, moving southward from the tundra. Relatively large numbers of snowy owls appear in the south, usually during one winter in four (Godfrey 1966), coinciding with the population lows of the arctic lemmings, their principal source of food.

4.6.6 Hairy Woodpecker

Five sightings of this species were made, one in trembling aspen, 2 in mixedwood, and 2 in riparian habitat. The hairy woodpecker is a permanent resident in wooded regions of northern Alberta (Salt and Wilk 1966). In the study area, Sharp and Richardson (1966) observed this species to be establishing territories and nesting in a number of locations during the 1975 field season. Ward *et al.* (1966) made 70 sightings of this woodpecker during the summer of 1975.

4.6.7 Downy Woodpecker

Four sightings of downy woodpeckers were made, one in black spruce and three in mixedwood. This species is a rather scarce permanent resident of northern Alberta, although some individuals migrate (Godfrey 1966, Salt and Wilk 1966). Sharp and Richardson (1976) did not observe this species during their work on the study area during the summer of 1975, but Ward *et al.* (1976) during that period made five sight records and identified two more individuals from their calls.

4.6.8 Black-backed Three-toed Woodpecker

Two sightings of this woodpecker were made, both in mixedwood habitats. This species is a year-round resident of the study area (Godfrey 1966), and Sharp and Richardson (1976) made 4 sightings of this woodpecker during the late summer and fall of 1975. Ward *et al.* (1976) report sighting two of these birds during October 1975.

4.6.9 Gray Jay

Fifty-seven sightings of this bird were made in every habitat of the study area. This common permanent resident (Godfrey 1966, Salt and Wilk 1966) was observed regularly (113 records) throughout Lease 17 during the 1975 field season by Sharp and Richardson (1976). Ward *et al.* (1976) made a total of 589 sightings of the gray jay, although it is probable that a large number of the records consisted of repeated observations of the same resident birds.

4.6.10 Common Raven

Three sightings of ravens were made on the study plots (in black spruce and mixedwood habitats), 74 were seen flying over the plots, and approximately 350 were observed around the extraction plant and refuse dump. Ravens are common permanent residents in northeast Alberta (Salt and Wilk 1966), and they were daily observed in the study area during the summer of 1975 by Sharp and Richardson (1976). Ward *et al.* (1976) made a total of 2641 sightings of the common raven on Lease 17 during the 1975 field season.

4.6.11 Black-capped Chickadee

Six sightings of this species were made, all in mixedwood habitat. Black-capped chickadees are year-round residents of the study area (Godfrey 1966) and nested there in 1975 (Sharp and Richardson 1976). During the latter study 102 records of this bird were made during the

field season. Ward *et al.* (1976) also found this chickadee to be nesting in the study area, and made 458 sightings of this species.

4.6.12 Boreal Chickadee

Ten sightings of the boreal chickadee were made, four in black spruce habitat and six in mixedwood. This species is a permanent resident of the study region (Godfrey 1966), although it is apparently not common. Sharp and Richardson (1976) sighted this species infrequently during the 1975 field season, and Ward *et al.* (1976) made only seven sightings.

4.6.13 Hoary and Common Redpolls

Thirty-three redpolls were seen in the main cleared area. It was not determined whether the flocks observed were hoary redpolls, common redpolls or both (they frequently flock together during winter). Both species of redpoll occur in Alberta principally as winter visitors. Most nest farther north (Salt and Wilk 1966) but a few common redpolls nest as far south as central Alberta (Godfrey 1966). Sharp and Richardson (1976) did not identify any redpolls on the study area during the summer of 1975, but observed redpolls during the spring and fall migrations. In the same year, Ward *et al.* (1976) recorded 101 sightings of redpolls during the spring migration and 5559 during the fall migration.

REFERENCES CITED

Aleksiuk, M. Syncrude Canada Ltd. Personal Communication, 27 January 1977.

Bayrock, L. 1961. Surficial geology. *In* Lindsay, J., S. Pawluk, and W. Odynsky (Eds.) Exploratory soil survey of Alberta Map Sheets 74-M, 74-L, 74-E, and 73-L. Research Council of Alberta, Preliminary Soil Survey Report 62-1. 55 p.

Bent, 1964. Life histories of North American jays, crows, and titmice. Dover Publications, Inc. New York. 412 p.

Bent, A. 1961. Life histories of North American birds of prey. Dover Publications, Inc. New York. 555 p.

Cade, T. 1953. Sub-nival feeding of the redpoll in interior Alaska: a possible adaptation to the northern winter. The Condor 55: 43-44.

Carbyn, L. 1968. Overwintering birds observed along the Mackenzie-Great Slave Lake Highways. Arctic 21: 294-297.

Gill, D. and P. Bonnett. 1973. Nature in the urban landscape, a study of city ecosystems. York Press, Baltimore. 209 p.

Godfrey, W. 1966. The birds of Canada. National Museum of Canada, Bulletin No. 203. 428 p.

Haftorn, S. 1974. Storage of surplus food by the boreal chickadee *Parus hudsonicus* in Alaska, with some records on the Mountain chickadee *Parus gambeli* in Colorado. Ornis Scandinavica 5: 145-161.

Lindsay, J., S. Pawluk, and W. Odynsky. 1961. Exploratory soil survey of Alberta Map Sheets 84-B, 84-A, and 74-D. Research Council of Alberta, Preliminary Soil Survey Report 58-1. 36 p.

Penner, D. 1976. Preliminary baseline investigations of furbearing and ungulate mammals using lease no. 17. Environmental Research Monograph 1976-3, Syncrude Canada Ltd. 181 p.

Rowe, J. 1972. Forest regions of Canada. Department of Environment, Canadian Forestry Service Publication No. 1300. 172 p.

Rusch, D. and L. Keith. 1971. Ruffed grouse - vegetation relationship in central Alberta. The Journal of Wildlife Management 35: 417-429.

Salt, W. and A. Wilk. 1966. The birds of Alberta. Department of Industry and Development, Government of Alberta. 511 p.

Sharp, P. and W. Richardson. 1976. Inventory studies of birds on and near crown lease number 17, Athabasca Oil Sands, 1975. Unpublished Report to Syncrude Canada Ltd. by LGL Ltd. Environmental Research Associates. 669 p.

Stirling, D. 1968. Notes on food and feeding habits of some wintering birds. The Canadian Field-Naturalist 82: 14-17.

Ward, J., G. Dyke, and P. Sharp. 1976. Bird migration watches on crown lease number 17, Athabasca Oil Sands, Alberta, 1975. Unpublished Report to Syncrude Canada Ltd. by LGL Ltd. Environmental Research Associates. 289 p.

Yonge, K. Syncrude Canada Ltd. Personal Communication, 10 January 1977.

APPENDIX 1. CHRONOLOGICAL OBSERVATIONS OF WINTER AVIFAUNA AND ASSOCIATED HABITAT TYPES

NUMBER	SPECIES	DATE (February 1977)	TIME (MST)	WEATHER CONDITIONS	SAMPLE PLOT	HABITAT TYPE
1	hairy woodpecker	3	1305	cold, clear no wind	1	riparian
1	black-capped chickadee	3	1355		1	mixedwood
2	gray jay	3	1425		1	trembling aspen
2	hairy woodpecker	3	1500		1	mixedwood
1	gray jay	3	1550		1	mixedwood
25	hoary (common?) redpoll	3	1645		3	cleared
1	gray jay	4	0835	mild, clear to partly	1	trembling aspen
2	willow ptarmigan	4	0840	cloudy, light wind	1	trembling aspen
4	gray jay	4	0935		2	mixedwood
1	common raven	4	0935		2	mixedwood
1	gray jay	4	1005		2	trembling aspen
1	ruffed grouse	4	1040		2	trembling aspen
2	black-capped chickadee	4	1120		2	mixedwood
1	gray jay	4	1125		2	riparian
1	black-capped chickadee	4	1200		2	mixedwood
5	boreal chickadee	4	1240		2	mixedwood
1	black-backed three-toed woodpecker	4	1510		2	mixedwood
1	common raven	4	1520		2	mixedwood
2	gray jay	4	1650		2	trembling aspen
1	gray jay	4	1715		2	trembling aspen
2	gray jay	5	0920	mild, partly cloudy,	3	trembling aspen
1	gray jay	5	0930	light wind	3	trembling aspen
1	gray jay	5	1020		3	trembling aspen
1	gray jay	5	1030		3	trembling aspen
1	gray jay	5	1035		3	black spruce
1	gray jay	5	1045		3	cleared
1	gray jay	5	1300		3	trembling aspen
4	willow ptarmigan	5	1320		3	cleared

APPENDIX 1. (continued)

NUMBER	SPECIES	DATE (February 1977)	TIME (MST)	WEATHER CONDITIONS	SAMPLE PLOT	HABITAT TYPE
8	hoary (common?) redpoll	5	1330		3	cleared
1	gray jay	5	1410		3	trembling aspen
1	willow ptarmigan	5	1510		3	trembling aspen
1	gray jay	5	1550		3	trembling aspen
5	willow ptarmigan	5	1700		3	trembling aspen
1	ruffed grouse	10	1310	clear, mild, no wind	1	mixedwood
2	gray jay	10	1315		1	black spruce
2	gray jay	10	1340		1	riparian
1	downy woodpecker	10	1355		1	mixedwood
1	willow ptarmigan	10	1430		1	mixedwood
1	hairy woodpecker	10	1520		1	riparian
2	gray jay	10	1550		1	trembling aspen
2	gray jay	10	1640		1	trembling aspen
1	hairy woodpecker	10	1655		1	trembling aspen
2	gray jay	11	0850	partly cloudy, mild,	1	trembling aspen
4	willow ptarmigan	11	0855	no wind	1	riparian
1	goshawk	11	1010		1	riparian
1	downy woodpecker	11	1040		1	mixedwood
2	black-capped chickadee	11	1040		1	mixedwood
2	gray jay	11	1125		1	riparian
2	gray jay	11	1440		1	black spruce
1	goshawk	11	1620		3	mixedwood
1	sharptailed grouse	11	1630		3	cleared
3	gray jay	11	1720		2	mixedwood
2	gray jay	11	1735		2	black spruce
2	gray jay	12	0910	partly cloudy, mild,	2	mixedwood
1	gray jay	12	0920	light wind	2	mixedwood
2	gray jay	12	0945		2	black spruce
4	boreal chickadee	12	0950		2	black spruce
1	downy woodpecker	12	1000		2	black spruce
1	gray jay	12	1000		2	black spruce

APPENDIX 1. (continued)

NUMBER	SPECIES	DATE (February 1977)	TIME (MST)	WEATHER CONDITIONS	SAMPLE PLOT	HABITAT TYPE
1	common raven	12	1010		2	black spruce
1	gray jay	12	1135		2	mixedwood
2	gray jay	12	1250		2	trembling aspen
1	ruffed grouse	12	1420		2	mixedwood
1	black-backed three-toed woodpecker	12	1515		2	mixedwood
1	downy woodpecker	12	1535		2	mixedwood
1	boreal chickadee	12	1550		2	mixedwood
4	willow ptarmigan	12	1655		3	cleared
1	gray jay	12	1700		3	trembling aspen
1	snowy owl	12	1750		3	trembling aspen
1	gray jay	13	1050	morning - cloudy, light	3	black spruce
4	gray jay	13	1135	snow, cold, windy;	3	black spruce
3	willow ptarmigan	13	1200	mid-day - clear, no wind; afternoon - cloudy, fog	3	cleared

Conditions of Use

Gill, D., 1979. Winter avifauna of Lease 17, a preliminary survey. Syncrude Canada Ltd., Edmonton, Alberta. Professional Paper 1979-3. 41 pp.