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NORMAN WELLS PIPELINE PROJECT - RAPTOR MONITORING PROGRAM

Sector: Wildlife Products

5-1-45

Analysis/Review

NORMAN WELLS PIPELINE PROJECT

RAPTOR MONITORING PROGRAM

1980 TO 1988

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NORMAN WELLS PIPELINE PROJECT
RAPTOR MONITORING PROGRAM
1980 TO 1988

S.B. MATTHEWS
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GOVERNMENT OF THE NORTHWEST TERRITORIES
YELLOWKNIFE, NWT

1989

Northwest Territories Renewable Resources

File Report No. 82

ABSTRACT

The Norman Wells Raptor Monitoring Program was initiated in 1983 to determine the effects of construction and operation of the Norman Wells pipeline on nesting peregrine falcons (*Falco peregrinus anatum*) and other birds of prey. From 1983 to 1988, annual raptor surveys were carried out in "experimental" raptor nesting areas along the pipeline route and in a control area northwest of Norman Wells. Each year, an occupancy survey was flown in June and a productivity survey followed in July. Information was obtained on nest occupancy, productivity and nesting phenology for all raptor species observed. Company compliance with raptor protection measures was documented and their effectiveness was evaluated.

Arrival dates for peregrine falcons were found to be two weeks earlier than has been previously reported. The pipeline areas supported a yearly average of 3.5 (n=8) breeding pairs of peregrine falcons compared to 8.8 (n=5) in the control areas. Peregrine production reached an estimated maximum of 10 young in 1988 in the pipeline areas and 25 in the same year in the control areas. Production of golden eagle young along the pipeline route reached a maximum of 6 in 1987 and 4 in 1988 in the control areas. Nest failure by peregrine falcons and golden eagles was not common in either of the study areas. Except for one year, 1984, the annual number of peregrine territories occupied was higher in the experimental pipeline areas than in the control areas. Annual mean brood size for peregrine falcons over a six year period was 2.1 for both the pipeline and control areas. The data suggest that construction and operation of the Norman Wells pipeline has had little or no effect on nest occupancy or reproductive success of raptors nesting along the Norman Wells pipeline route.

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PREFACE

The material contained in this report is the result of field surveys conducted by InterProvincial Pipe Line (NW) Ltd. in 1980 and 1981, and the Department of Renewable Resources from 1983 to 1988 in the central and upper Mackenzie Valley. The raptor monitoring program was conducted as a result of the Norman Wells Pipeline Project. The emphasis of the program was placed on the endangered subspecies of peregrine falcon (*Falco peregrinus anatum*) because of its importance both nationally and internationally.

Maps showing specific nest site locations are not included in this report. The Department of Renewable Resources has established a policy not to release this information to the general public. Persons with bona fide interest in nest site locations can request this information by writing to the Director, Wildlife Management Division, Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, Northwest Territories, X1A 2L9.

BACKGROUND

During the winters of 1978 and 1979, ESSO Resources Canada carried out an extensive exploration program to delineate the Norman Wells oilfield. With 60% of the field contained below the Mackenzie River and 40 million cubic metres of oil recoverable, ESSO proposed to expand the facilities at Norman Wells to include six artificial islands, 178 new oil production and water injection wells, a pipeline gathering and distribution system and support facilities such as roads, storage tanks, docks and a quarry (NWT, Department of Renewable Resources 1982). An increase in oil production from 1,600 cubic metres per day to approximately 5,100 cubic metres per day would require a transportation system to move the crude oil from Norman Wells to southern Canada. In 1979, Interprovincial Pipe Line (NW) Ltd. (IPL) proposed to build a small diameter, 30 cm (12.5 in) buried pipeline 866 km from Norman Wells to Zama, Alberta, to connect with an existing pipeline transportation system.

In April 1980, ESSO and IPL submitted a joint Environmental Impact Statement to the Federal Environmental Assessment Review Office (FEARO). At the same time, IPL applied to the National Energy Board for pipeline approval. Public hearings were held under the Environmental Assessment and Review Process (EARP) and the National Energy Board's public approval process. The Norman Wells Project was given conditional approval by the Minister of Indian and Northern Affairs Canada in July, 1981. Also that year, the National Energy Board approved the pipeline project by issuing IPL a Certificate of Public Convenience and Necessity (Matthews and Larson 1987).

Conditional approval of the project resulted in a two year delay in project start-up. Pipeline right-of-way clearing began in the winter of 1982/83 and continued the following year. Mainline construction of the pipeline was also a winter operation. Pipeline construction took place over two years during the winter months of 1983/84 and 1984/85. Summer construction activities along the pipeline route included construction of pump stations and remote maintenance bases, set-up of temporary mainline camps, stockpiling of materials and supplies, and major river crossings of the Great Bear and Mackenzie rivers.

The National Energy Board granted IPL leave-to-open in April 1985, following extensive testing of the pipeline system. IPL initiated routine monitoring programs for the operation phase of the project which included weekly overflights of the pipeline route.

Remedial work was also carried out at various locations along the pipeline route during the summer and winter months of operation, from 1985 to 1988.

INTRODUCTION

The Norman Wells Oilfield Expansion and Pipeline Project provided an important opportunity for the Department of Renewable Resources to take an active role in environmental monitoring and assessment activities of a large-scale development project in the Northwest Territories.

Through participation in the Environmental Assessment and Review Process (EARP) hearings held in 1980, the Department of Renewable Resources raised concerns about the potential impacts of the project on wildlife resources in the Mackenzie Valley. One of the concerns raised focused on the effects of pipeline construction and operation on nesting activities of endangered species of raptors (Canada, Federal Environmental Assessment Review Office 1981). IPL recognized the potential conflict between pipeline activities and nesting birds of prey and adopted raptor protection measures for the project (see Appendix A) .

Prior to pipeline construction, raptor surveys were carried out by IPL in 1980 and 1981 to identify potentially sensitive raptor nesting areas, to determine nest occupancy and to determine the importance of nesting areas in relation to proposed pipeline activities (Ealey 1982).

At the request of the Department of Renewable Resources, an ad hoc research and monitoring group was established in 1982 to develop and implement a research and monitoring program for the Norman Wells Project. Research and monitoring programs were initiated by the federal and territorial governments, ESSO Resources Canada, IPL and the Dene Nation.

In 1983, the Department of Renewable Resources initiated a long-term raptor monitoring program for the Norman Wells Pipeline Project. With the assistance of IPL, the program was carried out over a six year period from 1983 to 1988. The objectives of the program were as follows:

1) to determine the effect of pipeline construction and operation on nesting birds of prey by comparing nest occupancy and reproductive success of raptors nesting within 3.2 km of the pipeline route (i.e., experimental sites) and an undisturbed area northwest of Norman Wells (i.e., control sites);

2) to determine whether or not the timing of the restricted period for construction activities was appropriate to protect nesting raptors along the pipeline route and at facility sites;

3) to document the behaviour of raptors nesting within the potentially sensitive zone of 3.2 km where construction activities were taking place;

4) to determine compliance with IPL's raptor protection measures; and

5) to evaluate the raptor protection measures and make recommendations for future pipeline projects.

This study focused primarily on the endangered subspecies of peregrine falcon, Falco peregrinus anatum. Other species of raptors were also studied as well as nesting ravens (Corvus corax) since they are considered to be a functional raptor (White and Cade 1971) whose nests are commonly used by several species of nesting raptors.

STUDY AREAS

Pipeline Ranter Areas

Information obtained from raptor surveys conducted along the Norman Wells Pipeline route in 1980 and 1981 (Ealey 1982) was employed to identify raptor nesting areas to be used as "experimental" study areas. Thirteen intensive study areas were selected along the Norman Wells Pipeline route from Norman Wells to Fort Simpson, a distance of approximately 525 km (Figure 1). Pipeline raptor areas were defined as those areas containing potential or known nesting sites within 3.2 km of the pipeline route or associated development sites (e.g. , pump stations, construction camp sites, maintenance bases and quarries). The distance of 3.2 km (2 mi) was adopted from Fyfe and Prescott (1973) who used it to define "critical" nesting zones along the Mackenzie Highway. The location of the pipeline raptor areas is given on the map contained in the back of this report.

Physiography

From Norman Wells to a point south of the

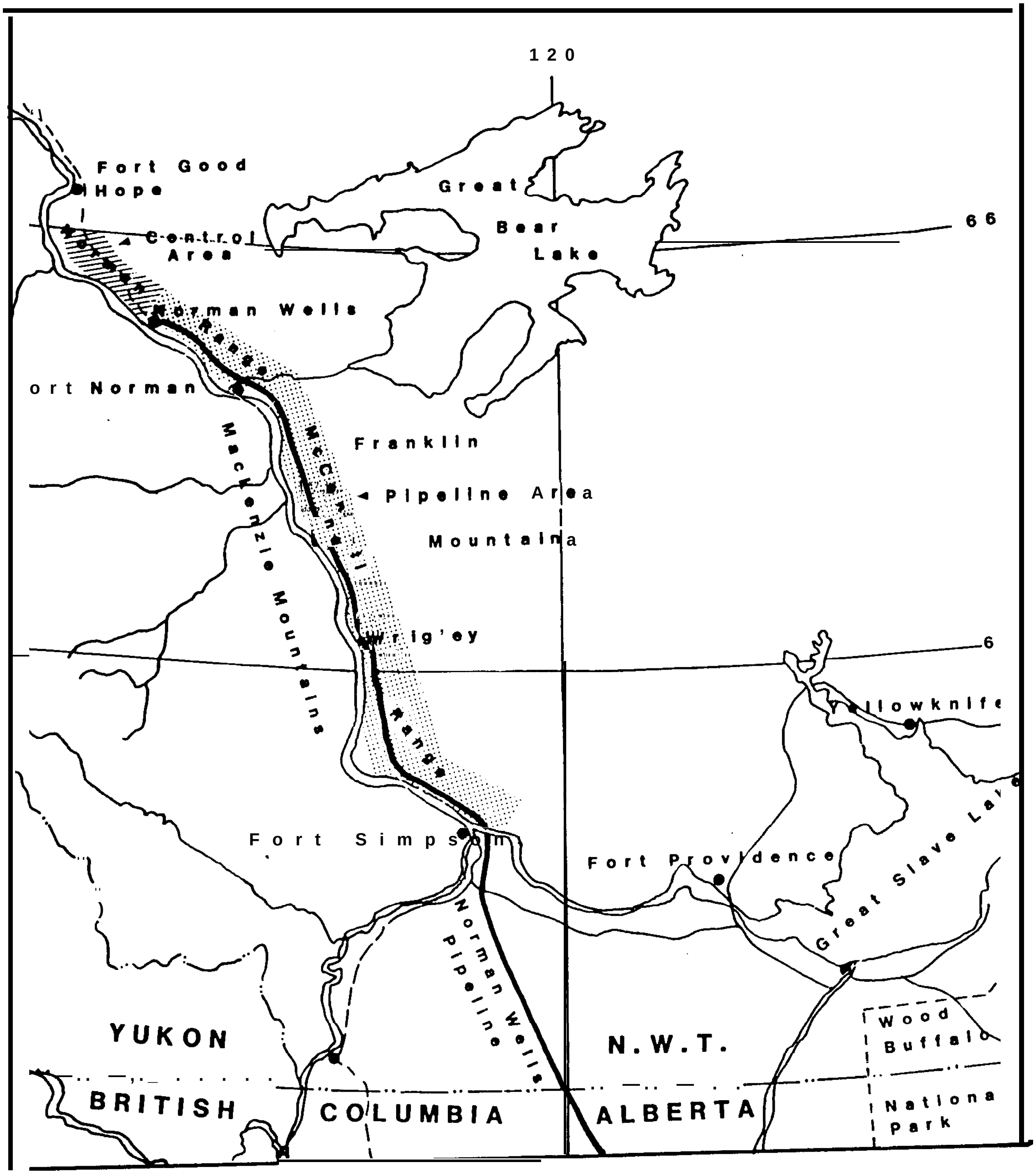


Figure 1. General study area for the pipeline and control raptor areas.

Willowlake River, the pipeline route lies mainly within the Mackenzie Plain Division of the Cordilleran Physiographic Region. South of the Willowlake River, the route traverses the Great Slave Plain Division of the Interior Plains Region (Interprovincial Pipe Line (NW) Ltd. 1980). The Mackenzie Plain is an area of low relief and elevation compared to the Great Slave Plain which is generally rolling in topography.

Climate

The south Mackenzie Valley, from Fort Simpson to Norman Wells is situated in the subarctic climatic zone. Summers are usually short and cool and winters are long and cold. Mean annual temperatures range from -3.8°C in the south to -6.2°C in the north (Reid 1974, Reid and Janz 1974). Warm air masses from the Pacific and south give mean daily temperatures of 16.8°C at Fort Simpson and 15.9°C at Norman Wells during the month of July. Mean annual precipitation for this section of the Mackenzie Valley is about 330 mm. Discontinuous permafrost extends south from Norman Wells to the vicinity of Fort Simpson.

Vegetation

The vegetation along the pipeline route from Norman Wells to Fort Simpson is made up of two Sections of the Boreal Forest Region - Upper Mackenzie and Northwestern Transition (Rowe 1972). The Upper Mackenzie Section extends south from Norman Wells to the Willowlake River and from the Ebbutt Hills south of Fort Simpson. Much of this area is characterized by low lying, poorly drained terrain of open and closed stands of black spruce (Picea mariana) and tamarack (Larix laricina). However, in some areas of the Mackenzie drainage, white spruce (Picea glauca) and balsam poplar (Populus balsamifera) form the main cover types. The Northwestern Transition covers only a small portion of the route and is made up of open stands of black spruce and tamarack intermixed with open bogs and fens (Interprovincial Pipe Line (NW) Ltd. 1980).

Raptor Nesting Habitat

Cliff nesting habitat for peregrine falcons (Falco peregrinus anatum), golden eagles (Aquila chrysaetos) and red-tailed hawks (Buteo jamaicensis) is found in the Norman and McConnell ranges of the Franklin

Mountains, rocky outcrops on the Mackenzie Plain, exposed cliffs created by eroding mountain creeks and the banks of the Mackenzie River. The McConnell Range generally provides poor cliff nesting habitat since many of its slopes are rounded and forested. Bald eagles (*Haliaeetus leucocephalus*), which nest throughout the Mackenzie Valley, are generally associated with forest lowland areas near lakes or major river systems.

Control Raptor Areas

A control area was selected northwest from Norman Wells to the Bat Hills of the Franklin Mountains, a distance of approximately 115 km. The study area is bounded by the Norman Range of the Franklin Mountains to the north and east, and the Mackenzie River to the south and west (Figure 1). Eleven intensive study areas were identified in the control area, each having at least one historical peregrine eyrie associated with it. The control raptor areas are located in a region which is considered to be undisturbed (i.e., no roads or other development has taken place). The map contained in this report shows the location of the control raptor areas.

Physiography

Between the Franklin Mountains and the Mackenzie River lies the Mackenzie Plain Division of the Cordilleran Physiographic Region. The Plain is a continuation of a narrow band of terrain which extends north from Norman Wells. The topography is level to rolling and ranges from 60 to 300 m above sea level. The Norman Range of the Franklin Mountains provides the greatest relief in the area with mountains ranging from 600 to 900 m in height.

Climate

The mid-Mackenzie Valley is in the subarctic and arctic climatic zones and also experiences short cool summers and long cold winters (Reid 1974) . The mean annual temperature is -5.6°C for the Norman Wells to Saris Sault Rapids area and the mean daily temperature is 16.5°C for the month of July. Mean annual precipitation is about 310 mm, of which 60% is rain and 40% is snow (Reid 1974). Discontinuous permafrost in the area greatly influences many of the different landscape features and much of the vegetation present.

Vegetation

The forest in the control areas is part of the Lower Mackenzie Section of the boreal forest. Great expanses of stunted black spruce prevail on much of the poorly drained terrain with mixtures of white birch (*Betula papyrifera*), white spruce and aspen (*Populus tremuloides*) on well drained knolls (Rowe 1974). A variety of bog and fen vegetation covers the non-forested areas (Reid 1974).

Raptor Nesting Habitat

Cliff nesting habitat in the control areas is generally of better quality than along the pipeline route from Norman Wells south. This section of the Norman Range, which includes Mount Thomas, Paige Mountain, Brokenoff Mountain and Gibson Ridge, contains extensive stretches of southwest-facing cliffs up to several hundred metres in height. The Mackenzie River between Norman Wells and the Bat Hills also provides several good sections of cliff nesting habitat along the river's banks. Wetland complexes on the Mackenzie Plain in the vicinity of the Hanna and Donelly rivers contribute to the good quality raptor habitat found in the control areas.

METHODS

Nesting Phenology

In an attempt to minimize disturbance to raptors nesting along the pipeline route and near associated development sites, IPL adopted the following raptor protection measure:

"ground and air access within 3.2 km of an identified raptor nest will be restricted during the period April 15 to September 15..." (Hardy Associates (1978) Ltd. 1984: 117).

Annual raptor surveys were conducted by Renewable Resource Officers to determine if the timing of the restricted period was appropriate to protect nesting raptors. For all study years, ground surveys of known peregrine eyries were conducted near Norman Wells and Fort Norman during the months of March and April. Nest sites were visited weekly and arrival dates recorded. Observations of first sightings of golden eagles and bald eagles were also recorded by Officers in communities along the pipeline route.

From 1983 to 1985, a fall departure survey was flown in mid-September along the pipeline route and in the control areas to determine whether or not raptors were still present on nesting territories. Two observers flew in a Cessna 185 and checked nest sites known to be occupied in that year. For the three years surveyed, an average of 3.0 hr was flown in the pipeline raptor areas and 1.5 hr in the control areas each year.

Nest Site Occupancy And Reproductive Success

Two aerial surveys were carried out annually in the pipeline and control raptor areas. Aerial surveys were flown using a Bell 206-B Jet Ranger or Long Ranger helicopter and three observers. Cliffs were systematically surveyed with one or more slow passes (4o to 60 km/hr) to ensure complete coverage of the rock face.

A spring occupancy survey was flown in mid-June during the late incubation stage for peregrine falcons to determine nesting pairs and clutch size. The summer productivity survey was conducted in mid- to late July, following hatch, to determine the number of young raised per successful nest. Raptor nesting areas surveyed along the pipeline route included known and potential cliff nesting habitat within 3.2 km of the pipeline route and associated development sites. New nest site locations were recorded on 1:250,000 scale topographic maps, detailed nest site descriptions were made, and two polaroid photographs of each nest site were taken. Information recorded at each occupied nest site included species, number of adults, eggs or young, age of young and adult behaviour. When raptors were sighted from the air, but no occupied nest was found, ground observations were made in an attempt to locate the nest site. In most cases, only one to two minutes were spent at each nest site to minimize disturbance to the birds. Other protective survey procedures were followed in accordance with Fyfe and Olendorff (1976).

From 1983 to 1988, annual flight times for the pipeline raptor areas averaged 7.0 hr for the occupancy survey and 8.2 hr for the productivity survey. In the control areas, annual flight times averaged 4.8 hr for the occupancy survey and 5.6 hr for the productivity survey. A detailed account of annual survey dates and flight times for the pipeline and control areas can be found in appendices B and C, respectively.

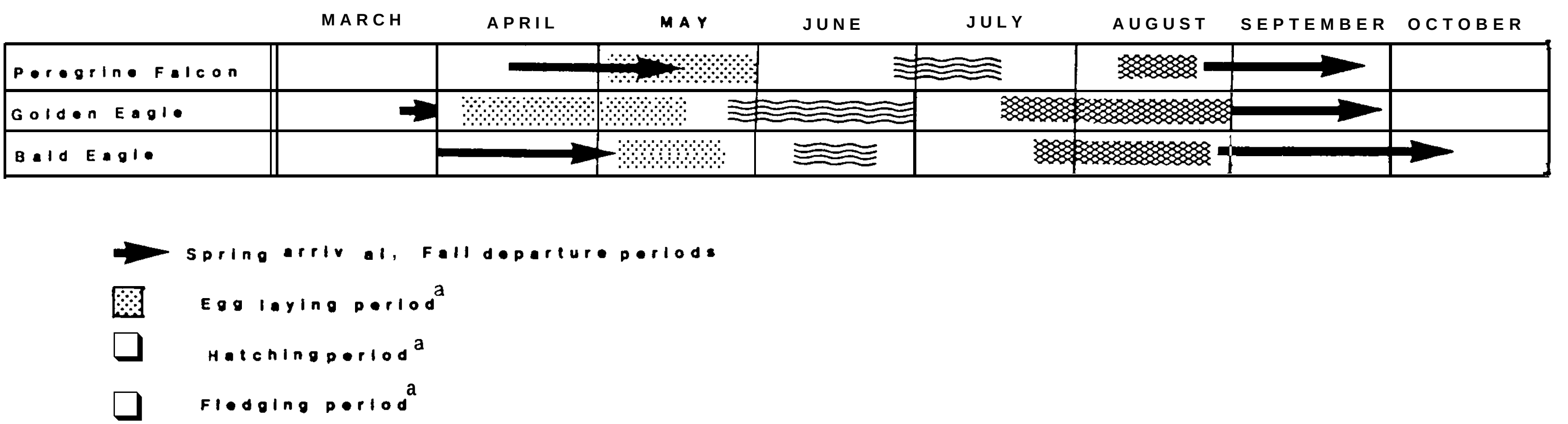
RESULTS AND DISCUSSION

Nesting Phenology

To determine whether or not IPL's "restricted" activity period of April 15 to September 15 was appropriate to protect nesting raptors, arrival and departure dates for raptors nesting along the pipeline route and control areas were recorded.

Figure 2 shows a revised estimate of nesting phenology for peregrine falcons, golden eagles and bald eagles. The egg laying, hatching and fledging periods were taken from the literature (Finney and Lang 1976). Peregrine falcons were found on territory two weeks earlier than has been reported in the past (Fyfe and Prescott 1973, Fyfe and Kemper 1975, Finney and Lang 1976). The earliest peregrine falcons were observed on territory was April 12, golden eagles on March 26, and bald eagles on April 3. Departure dates were similar to those found in the literature. Golden eagles could still be found on territory as late as September 14. Peregrine falcons and bald eagles were also observed near nest sites on September 13.

The most sensitive period during the nesting season for many raptors is the time of nest initiation,



[a] Data from Finney ● nd Lang, 1976.

Figure 2. Nesting phonology of ● oloc tad raptors found ● long the Norman W.lls pip. line route.

egg laying and early incubation (Fyfe and Olendorff 1976). Although nesting phenology of raptors may vary from year to year with climatic conditions, data from this study indicate that IPL's restricted period of April 15 to September 15 along the pipeline route was appropriate to protect nesting birds of prey.

Raptor Disturbance and Compliance Monitoring

Disturbance to nesting raptors can be minimized by selecting a particular pipeline route which avoids known and potential nest sites. Avoiding raptor nesting areas reduces potential conflicts which could result in the loss of birds, reduced production, destruction of nest sites or indirect loss through decreased prey populations (Fyfe and Kemper 1975).

Experience with the construction and operation of the Norman Wells Pipeline showed that such a project introduces an increased level of human activity to the pipeline corridor and adjacent raptor nesting areas. The potential for adverse effects on nesting raptors was present from human activity associated with construction and operation of the oil transportation system (e.g. , maintenance programs, routine monitoring overflights, etc.) as well as scientists conducting research and monitoring programs in association with the pipeline project. Where pipeline routing could not avoid occupied raptor nesting areas, raptor impacts *were* minimized by restricting pipeline associated activities during the nesting season.

Several raptor nesting areas are located within 3.2 km of the Norman Wells Pipeline route. The **Department's** Pipeline Monitoring Biologist worked with the proponent to *carry* out the raptor monitoring program which included an annual aerial survey (i.e., a June occupancy survey) to determine which nest sites were occupied in a particular year. This information was relayed to the company to assist in planning summer activities along the pipeline route and to ensure that occupied raptor nesting areas were avoided. During the six years of this study, pipeline construction and operation activities did not take place in proximity to occupied nesting areas where disturbance monitoring was considered necessary.

Nest Site Occupancy and Reproductive Success

Pipeline Raptor Areas

The Norman and McConnell ranges of the Franklin Mountains generally provide only poor habitat for cliff nesting raptors along the Norman Wells Pipeline route.

Rocky outcrops, creek valleys and the banks of the Mackenzie River, however, contribute some very good nesting sites. A large number of old, unoccupied stick nests were observed in areas considered to be marginal habitat and appear to have been used by ravens and other raptors such as red-tailed hawks. The small number of nests occupied by peregrine falcons is considered to reflect the quality of nesting and prey habitat. The most common raptors observed along this section of the Mackenzie Valley, from Fort Simpson to Norman Wells, are peregrine falcons (Falco peregrinus anatum), golden eagles (Aquila chrysaetos) and red-tailed hawks (Buteo jamaicensis). Table 1 provides a summary of nest occupancy for all cliff and tree nesting species observed during this study as well as observations made by Ealey (1982) in 1980 and 1981 for IPL. The largest number of breeding pairs observed in any year was in 1987 when peregrine falcons, golden eagles and ravens each occupied five nests. Areas A (Kee Scarp), C (Bear Rock) and E (Saline River) all have historical peregrine eyries and continue to be important nesting territories. Occupancy rates for peregrine falcons in these areas range from 75% in Area A and E to 100% in Area C. Bear Rock at Fort Norman provides the best cliff nesting habitat along the pipeline route and is capable of supporting several

Table 1. Summary of nest occupancy in pipeline raptor areas from 1980 to 1988.

Pipeline Raptor Area	Observations by Year							
	[a]1980	[a]1981	1983	1984	1985	1986	1987	1988
A	GE-s		PF-L	PF-L	PF-L	PF-L 2-RN-s	PF-L GE-s GHO-L	PF-L
B			RN-s	RTH-S RN-s		RN-s	GE-s RN-s	RTH-S
C	PF-L	PF-L	PF-L	PF-S	PF-L GE-s	2-PF-L GE-s	2-PF-L GE-s 2-RN-s	2-PF-L GE-s
D			GHO-L		GHO-L		PF-L	PF-L
E	PF-L	PF-L	Km-s		PF-L	PF-L	PF-L RN-s	PF-L RN-s
F		RN-s		RN-s	RN-s	RN-s	RN-s	RN-s
G							GE-s	
H								
I			GE-s	GE-s	GE-s	GE-s	GE-s	GE-s
J								
K								
L								
M							BE-s	BE-s
No. of Stick Nests Checked (Occupied):	24 (1)	44 (1)	13 (3)	39 (5)	35(3)	32 (6)	36(11)	38 (6)
No. of Ledge Nests Checked (Occupied):	8(2)	6(2)	5(3)	5(1)	5(4)	7(4)	6(6)	6(5)

[a]Ealey 1982.

Legend Example: [b]2-[c]PF-[d]L

[b]Number of occupied nests greater than one.

[c]Species nesting: PF - Peregrine falcon; GE - Golden eagle; BE - Bald eagle; RTH - Red-tailed hawk; GHO - Great horned owl; RN - Raven

[d]Nest type: L = ledge or scrape; S = stick.

pairs of nesting peregrine falcons and golden eagles. In 1987, two pairs of peregrine falcons successfully raised young within the Bear Rock complex. The pipeline raptor areas supported an average of 3.5 (n=8) breeding pairs of peregrine falcons each year. The annual number of occupied peregrine territories ranged from 2 to 5 (n=8). Observations of nest occupancy by ravens are also included in Table 1. Over the six year study period, ravens were present at 45% of all occupied nests. The abundance of unoccupied stick nests and ledges in the pipeline raptor areas indicates that cliff nesting habitat is presently not a limiting factor to the breeding population of raptors in the southern Mackenzie Valley. In high density years, more of these less favorable nest sites may be occupied by peregrine falcons or other important raptors.

Table 2 provides a summary of raptor production in the pipeline raptor areas from 1980 to 1981 (Ealey 1982) and from 1983 to 1988. Peregrine falcons occupying eyries in June successfully raised young 100% (n=6) of the time in Area A, 82% (n=11) of the time in Area C and 83% (n=6) of the time in Area E. Although the number of nesting pairs is small, these figures indicate that there was very little nest failure.

Within the pipeline raptor areas, peregrine falcons produced the greatest number of young, followed

Table 2. *Summary* of **raptor** production **in** pipeline **areas from 1980 to 1988.**

Pipeline Raptor Area	Raptor Production by Year 1980	1981	1983	1984	1985	1986	1987	1988
A	1 GE	0	1 PF	1 PF	3PF	3 P F	2PF 1 GE 2 GHO	[a]1 PF
B	0	0	0	2 RTH	0	o	2GE	2 RTH
C	1 PF	1 PF	4PF	o	1 GE	1 PF 1 PF 1 GE	[a]1 PF 2PF 1 GE	[a]1 PF 1 PF
D	0	0	0	0	0	o	0	3PF
E	1 PF	4PF	2 RTH	0	0	3 P F	3PF	2PF
F	0	0	0	0	0	o	0	0
G	0	0	0	0	0	0	1 GE	0
H	0	0	0	0	0	0	0	0
I	0	0	2GE	1 GE	0	2 G E	1 GE	2GE
J	0	0	0	o	0	o	0	0
K	0	0	0	0	0	0	0	0
L	0	0	0	0	0	0	0	0
M	0	0	0	0	0	0	2BE	1 BE
Total Observed Production:	2PF 1 GE	5PF	5 PF 2GE 2 RTH	1 PF 1 GE 2 RTH	3P)? 1 GE	8PF 3GE	8 PF 6GE 2GH0 2BE	8 PF 2GE 2RTH 1 BE

[a]Peregrine production of 1 is given as a minimum where the total number of young could not be determined.

Legend

PF - Peregrine falcon
BE - Bald eagle
GHo - Great horned owl
GE - Golden eagle
RTH - Red-tailed hawk

by golden eagles and red-tailed hawks. Total observed peregrine production for the pipeline raptor areas was the same from 1986 to 1988 with 8 young produced each year. In other years, peregrine production ranged from 1 to 5 young. Golden eagle production varied considerably from year to year. Production for this species ranged from zero to a high of 6 young in 1987. Five pairs of golden eagles occupied nests in 1987 and all successfully raised young. Twice as many breeding pairs of golden eagles were observed in 1987 than in any other year. This significant increase in the number of breeding golden eagles may be attributed to a peak in the prey population. Data on raven production is not included in this report. Raven young had usually fledged by the time of the productivity surveys in July. Production of young by other raptorial birds such as bald eagles, red-tailed hawks and great horned owls is also given in Table 2 and is considered to be minimal.

Control Raptor Areas

Raptors nesting in the control raptor areas were peregrine falcons, golden eagles and ravens (Table 3). Nesting and prey habitat in this section of the Mackenzie Valley is considerably better than that found

Table 3. Summary of nest occupancy in control raptor areas from 1983 to 1988.

Control Raptor Area	1983	1984	1985	1986	1987	1988
AA			GE-s	PF-L RN-s	RN-s	RN-s
BB			PF-L	GE-s	PF-L GE-s	PF-L GE-s
CC					PF-L	PF-L
DD		PF-L				
EE	PF-L	PF-L	PF-L	PF-L	PF-L GE-s	PF-L
FF	GE-s					
GG	PF-L	PF-L	PF-L	PF-L	2-PF-L RN-S	3-PF-L
HH		PF-S	PF-L	PF-S	PF-L RN-s	PF-L RN-s
II	PF-L	PF-L GE-s	PF-L	PF-L RN-s	PF-L	PF-L GE-s
JJ	Not Surveyed	PF-L GE-s	PF-L		2-PF-L	3-PF-L GE-s RN-s
KK	Not Surveyed	PF-L		2-PF-L GE-s	2-PF-L GE-s RN-s	2-PF-L
No. of Stick Nests Checked:	11(1)	29(3)	28(1)	35 (5)	29 (7)	34(6)
No. of Ledge Nests Checked:	6(3)	6(6)	12 (6)	13 (6)	18(11)	21(13)

Legend Example: [a]2-[b]PF-[c]L

[a]Number of occupied nests greater than one.
[b]Species nesting: PF - Peregrine falcon
GE - Golden eagle
RN - Raven
[c]Nest type: L = ledge or scrape; S = stick.

along the Norman Range of the Franklin Mountains south of Norman Wells. The northern section of the Norman Range has extensive southwest-facing cliffs reaching heights of up to 500 m. Wetland complexes which dominate the valley floor support a diverse prey base for peregrine falcons and other birds of prey. This high quality raptor habitat supports a relatively dense population of nesting peregrine falcons. The annual number of nesting pairs of peregrine falcons found in the control areas ranged from 6 to 13 and averaged 8.8 (n=5). An increasing breeding population of peregrine was observed over the last several years of the monitoring program. The total number of peregrine young produced in the control areas increased while average brood sizes remained similar from year to year. Raptor production in 1988 was the highest of any year of the study. Observed production was 23 peregrine falcons and 4 golden eagles (Table 4). Only one nest failure for peregrine falcons, in 1986, was documented in the control areas during the six years of the study. The annual number of nests occupied by golden eagles ranged from 1 to 3 with mean brood size of 1.4 young per successful pair (n=8). Production of golden eagles reached a maximum of 4 young in 1988. Nest failures were more frequent for golden eagles than for peregrine falcons. Two nest failures occurred in 1986, and one

Table 4. Summary of raptor production in control areas from 1983 to 1988.

Control Raptor Area	Raptor Production By Year					
	1983	1984	1985	1986	1987	1988
AA	o	o	1 GE	3 P F	o	o
BB	o	0	1 PF	o	2P)? 1 GE	2 PF 2 GE
c c	o	0	o	0	[a]1 PF	[a]1 PF
DD	o	2 PF	0	0	0	0
EE	2 PF	2 PF	1 PF	[a]1 PF	2 PF 1 GE	[a]1 PF
FF	2 GE	0	o	o	0	0
GG	[a]1 PF	4 PF	1 PF	[a]1 PI?	2 PF 1 PF	3PF 3PF 1 PF
HH	o	3PF	3PF	2 PF	2PF	4PF
II	2 PF	2 PF 1 GE	2 PF	[a]1 PF	[a]1 PF	1 PF
JJ		3PF 1 GE	3 PF	o	[a]1 PF 2 PF	1 PF 1 PF 2 GE
KK		3 PF	0	1 PF	[a]1 PF 3PF	2 PF 3 PF

[a]Peregrine production of 1 is given as a minimum where the total number of young could not be determined.

Legend

PI? - Peregrine falcon
GE - Golden eagle

in 1987 and 1988. Of all stick nests occupied, ravens occupied an average of 26% annually.

Comparison of Nest Site Occupancy and Reproductive Success for Peregrine Falcons in the Pipeline and Control Raptor Areas

Nest site occupancy and reproductive success of peregrine falcons nesting along the pipeline route and in a control area were compared. Pre-construction raptor data was not available for the control areas to compare with areas from 1983 to 1988 pipeline data collected by Ealey (1982) in 1980 and 1981. The following discussion of population monitoring of peregrine falcons is, therefore, limited to the construction phase of the pipeline project, 1983 and 1984, and the operation phase, 1985 to 1988.

Tables 5 and 6 provide a summary of peregrine falcon nesting territories in the pipeline and control raptor areas, respectively. Annual occupancy rates for peregrine falcons nesting along the pipeline route (Figure 3) were 50% during construction of the pipeline (1983 and 1984) and varied between 75% and 100% during the four years of operation (1985 to 1988). Control raptor areas had lower rates of occupancy (Figure 3) than the pipeline areas in all but one year of the

Table 5. Sum'nary of peregrine falcon (*Falco peregrinus anatum*) nesting territories in the pipeline raptor areas fran 1980 to 1988.

Year	No. of known territories checked	No. of new territories found	[a]No. of known territories occupied n(%)	No. of productive sites of: sites n(%)	No. of productive sites of: occupied (%)	No. of young per successful pair $\bar{x}$(n)	No. of young fledged per June pair $\bar{x}$(n)	Estimate of Production x(n)
1980	3	1	1 (33)	1 (33)	(loo)	1.0 (2)		2 (2)
1981	4	0	2 (50)	2 (50)	(100)	2.5 (2)		5 (2)
1983	4	0	2 (50)	2 (50)	(100)	2.5 (2)	2.5 (2)	5 (2)
1984	4	0	2 (50)	1 (25)	(50)	1.0 (1)	0.5 (2)	1 (1)
1985	4	0	3 (75)	1 (25)	(33)	3.0 (1)	1.5 (2)	3 (1)
1986	4	0	4 (loo)	4 (loo)	(loo)	2.0 (4)	1.7 (3)	8 (4)
1987	4	2	3 (75)	3 (75)	(100)	2.3 (3)	1.7 (3)	9 (4)
1988	6	0	5 (83)	5 (83)	(100)	2.0 (3)	2.0 (3)	10 (5)

[a]An occupied territory is one in which at least one territorial adult was observed during either the June occupancy or July productivity survey.

Table **6.** Summary of peregrine falcon (Falco peregrinus anatum) nesting **territories** in the control raptor areas fran 1983 to 1988.

Year	No. of known territories checked	No. of new territories found	[a]No. of known territories occupied n(%)	No. of productive sites of: sites checked n(%)	No. of productive sites of: occupied sites (%)	No. of young per successful pair $\overline{x}$(n)	No young fledged per June pair $\overline{x}$(n)	Estimate of Production x(n)
1983	11	l	3 (27)	2 (18)	(loo)	2.0 (2)	-	6 (3)
1984	12	0	7 (58)	7 (58)	(loo)	2.7 (7)	2.5 (2)	19 (7)
1985	12	2	6 (50)	6 (50)	(loo)	1.8 (6)	2.0 (4)	ll (6)
1986	14	l	7 (50)	6 (43)	(86)	2.0 (3)	1.0 (3)	1 2 (6)
1987	15	2	ll (73)	ll (73)	(loo)	2.0 (7)	1.7 (3)	22 (11)
1988	17	0	13 (76)	12 (70)	(loo)	2.1 (lo)	1.7 (9)	25 (12)

[a]An occupied territory is one in which at least one territorial adult was observed during either the June occupancy or July productivity survey.

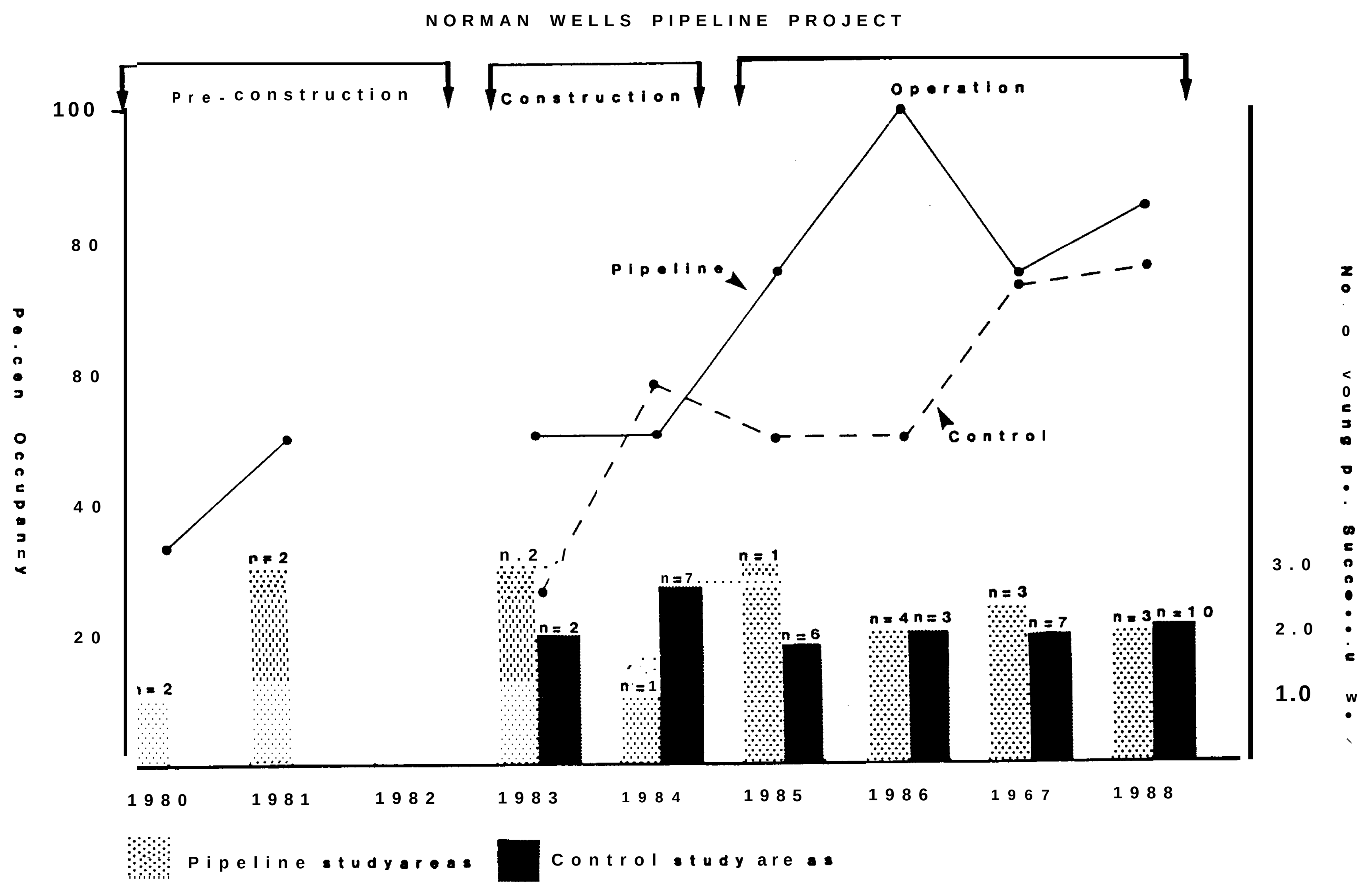


Figure 3. Comparison of territory occupancy and productivity for peregrine falcons (*Falco peregrinus anatum*) in the pipeline and control raptor areas.

study, 1984. A statistical comparison of occupancy rates for the pipeline and control areas (Kolmogorov-Smirnov two-sample test, D=.333, $p=0.01$) indicated a significant difference. It is difficult to explain why occupancy rates were higher in the pipeline areas than in the control areas. With fewer nest sites available along the pipeline route, competition for these sites may be higher than in the control areas. Occupancy rates for the pipeline and control areas were no lower than occupancy rates reported for the entire Mackenzie Valley (Bromley and Matthews 1988) during the same period.

A second indicator of potential pipeline impacts examined in this study was mean brood size or the number of peregrine young fledged per successful pair (Tables 5 and 6, Figure 3). From 1983 to 1988, during construction and operation of the Norman Wells Pipeline, the experimental (i.e., pipeline) and control areas had the same mean brood size of 2.1 young per successful pair ($SD=1.0$, $n=14$ for the experimental areas and $SD=0.9$, $n=35$ for the control areas) .

A better indicator of peregrine productivity is mean brood size based on the number of young fledged per pair of nesting peregrines observed during the June occupancy survey. This is a more accurate estimate of productivity because it takes into account lost production through nest abandonment or nest failure. Data on the number of young fledged per June pair is provided in Tables 5 and 6. Differences between the pipeline and control areas appear to be small. Because of small sample sizes, a statistical comparison of mean brood size per June pair for the two areas was not performed.

In conclusion, data collected on peregrine falcon nest occupancy and productivity along the Norman Wells pipeline route and a control area indicates that there was little or no difference between the two areas which could be attributed to pipeline construction and operation. Data from both areas suggests that the breeding population of Mackenzie Valley peregrine falcons, *Falco peregrinus anatum*, is increasing. This conclusion is supported by a recent assessment of population trends for peregrine in the Mackenzie Valley (Bromley and Matthews 1988).

Evaluation of Raptor Protection Measures

Raptor protection measures provide one means of minimizing disturbance to nesting birds of prey. The planning stage of a pipeline development is, however, the best opportunity to ensure that impacts on raptors are prevented or minimized. The route selection process should take into consideration important raptor habitat such as nesting areas. Raptor protection measures such as those implemented by InterProvincial Pipe Line are self-imposed and self-regulated. It is believed that the company did comply with these procedures. However, in some cases, pipeline routing cannot maintain a safe distance, in this case 3.2 km, from nesting habitat. In such situations, an increased level of disturbance during the nesting season is unavoidable. Although construction of the pipeline system in the north is typically a winter operation, right-of-way maintenance and routine low-level inspection flights take place year-round. Development projects such as the Norman Wells Pipeline project also attract numerous other people to the pipeline corridor including project regulators, research and monitoring scientists and other interested parties. All this activity adds to the level of disturbance which can potentially disrupt nesting activities of raptors. Environmental planning must continue to be an integral part of development projects in the Northwest Territories. The cooperation of government and industry, as experienced with the Norman Wells project, is essential to ensure that environmental impacts to natural resources such as raptors are minimized.

RECCN$MENDATIONS

1. The route selection process for linear development projects such as pipelines should **be used** to **site** proposed facilities in areas which avoid **important** raptor habitat such as nesting areas.

2. Population monitoring of **important** (e.g., rare or endangered) raptor species should continue on a regular basis. Information collected from such work will assist government and industry to plan future development projects in areas where impacts on raptors can be minimized.

3. Site specific raptor monitoring should be carried out in areas where raptor nesting areas cannot be avoided and conflicts between development activities and raptors may occur.

4. Raptor protection measures should continue to be included in Environmental Protection Plans developed by the project proponent in consultation with resource management agencies.

5. The raptor protection measures implemented by InterProvincial Pipe Line (Appendix A) should be applied to future **pipeline** projects.

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LITERATURE CITED

Bromley, R.G. and S.B. Matthews. 1988. Status of the peregrine falcon in the Mackenzie River Valley, Northwest Territories, 1969-1985. In: Cade, T.J., J.H. Enderson, C.G. Thelander and C.M. White (eds.) . Peregrine Falcon populations - their management and recovery. The Peregrine Fund Inc. 949 pp.

Canada, Federal Environmental Assessment Review Office. 1981. Norman Wells oilfield development and pipeline project - report of the environmental assessment panel. 98 pp.

Ealey, D.M. 1982. Raptor survey along the Norman Wells pipeline route, 1981. Prepared for InterProvincial Pipe Line (NW) Ltd. 13 pp.

Finney, G. and V. Lang. 1976. Eagles, hawks and falcons of the Mackenzie Valley and their relationship to pipeline development. Foothills Pipe Lines Ltd. Biological Field Program Report: 1975. Volume IV, Section 4. 51 pp.

Fyfe, R.W. and J.B. Kemper. 1975. Endangered raptor breeding territories near the proposed Mackenzie Valley gas pipeline route and recommendations for their protection. Canadian Wildlife Service. Draft Copy. 42 pp.

Fyfe, R.W. and R.R. Olendorff. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Canadian Wildlife Service Occasional Paper No. 23. 17 pp.

Fyfe, R.W. and W.H. Prescott. 1973. Endangered raptor breeding territories near the Mackenzie Highway route and their protection. Canadian Wildlife Service Report. 18 pp.

Hardy Associates (1978) Ltd. 1984. Norman Wells to Zama pipeline environmental protection plan. Volume A: protection procedures: construction. Prepared for Interprovincial Pipe Line (NW) Ltd. 3 vol.

InterProvincial Pipe Line (NW) Ltd. 1980. Norman Wells Pipeline Project - environmental impact statement. Vol. 3B.

Matthews, S.B. and R.M. Larson. 1987. An evaluation of the Norman Wells project by the Department of Renewable Resources, Government of the Northwest Territories. NWT Department of Renewable Resources, Policy and Planning Division. 100 pp.

NWT, Department of Renewable Resources. 1982. Norman Wells oilfield expansion and pipeline project. Environmental Planning and Assessment Division. 14 pp.

Reid, D.E. 1974. Vegetation of the Mackenzie Valley - Part One. Canadian Arctic Gas Study Limited. Biological Report Series - Volume Three. 145 pp.

Reid, D.E. and A. Janz. 1974. Vegetation of the Mackenzie Valley - Part Two. Canadian Arctic Gas Study Limited. Biological Report Series - Volume Three. 166 pp.

Rowe, J.S. 1972. Forest regions of Canada. Department of Fisheries and the Environment, Canadian Forestry Service Publication No. 1300. 172 pp.

White, C.M. and T.J. Cade. 1971. Cliff-nesting raptors and ravens along the Colville River in Arctic Alaska. Living Bird 10: 107-150.

APPENDIX A. Raptor Protection Procedures - InterProvincial Pipe Line (NW) Ltd.

1. Ground and air access within 3.2 km of an identified raptor nest is restricted during the period April 15 to September 15 unless otherwise directed. Access during this restricted time period will be permitted only under the approval and supervision of the Field Environmental Inspector.

2. If overflight of restricted raptor areas cannot be avoided, aircraft will maintain a minimum altitude of 760 m above ground level.

3. Blasting activities which are unavoidable within 3.2 km of raptor nests, and during the restricted times April 15 to September 15, and which are of sufficient magnitude to cause potential disruption of successful breeding raptors, will be planned in consultation with appropriate environmental representatives.

APPENDIX B. Summary of Survey Flight Data for Raptor Surveys Conducted in the Pipeline Raptor Areas from 1980 to 3988.

Year	Dates		Helicopter Hours Flown	
	Occupancy Survey	Productivity Survey	Occupancy Survey	Productivity Survey
%980		August 15-17		[c]N.A.
[b]1981		June 27 - July 1		N.A.
1983	June 21,24	July 22, 29	' 5.6	7.3
1984	June 12,13	July 19, 20	6.8	8.7
1985	June 11	July 25, 30, August 2	10.1	9.2
1986	June 10,14	July 15, 19	7.8	7.9
1987	June 11,15	July 15, 20	8.1	9.7
1988	June 14	July 16	[d]3.8	6.6

[a] Ealey and McCourt 1980.
[b] Ealey 1982.
[c] N.A. = Not Available
[d] Only areas A to E were surveyed in June 1988.

APPENDIX C. Summary of Survey Flight Data for Raptor Surveys Conducted in the Control Raptor Areas from 1983 to 1988.

	Dates		Helicopter Hours Flown	
Year	Occupancy Survey	Productivity Survey	Occupancy Survey	Productivity Survey
1983	June 24	July 22 -24	4.0	5.7
1984	June 15	July 21, 22	5.9	4.5
1985	June 13, 15	July 26	5.8	5.5
1986	June 11, 12	July 16, 18	4.3	5.8
1987	June 12, 14	July 16, 19	4.9	6.7
1988	June 15	July 19	4.2	5.5

APPENDIX D.

Map of Pipeline and Control Raptor Areas
in the Mackenzie Valley, Northwest Territories