PEACE/WILLISTON
FISH & WILDLIFE
COMPENSATION
PROGRAM

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Williston Wildlife Compensation Program Management Plan, 1990

P. W. Davidson and R. Dawson
December 1990

PWFWCP Report No. 5

The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

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This report has been approved by the Peace/Williston Fish and Wildlife Compensation Program Fish Technical Committee.

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EXECUTIVESUMMARY

The construction of the W.A.C. Bennett hydro dam on the Peace River 30 km west of Hudson Hope in 1968 created the largest fresh water body in British Columbia. The Reservoir flooded 1,500 square kilometers of prime wildlife winter range and disrupted migration corridors of caribou and Stone sheep. The winter range carrying capacity for moose was reduced by 50% resulting in an estimated annual loss in hunting value of $1.53 million in 1988 dollars. Habitat for other game species including Stone sheep, elk, deer, grizzly bear, black bear, caribou and waterfowl was also reduced. Habitat for furbearing animals, waterfowl and other small birds and mammals was also impacted.

In 1988, B.C. Hydro agreed to provide $5 million for wildlife compensation in the Williston Reservoir Basin area and agreed to jointly participate with the Ministry of Environment(MOE)in Technical and Steering Committees required to administer the project. The compensation program will be delivered by the Ministry of Environment. As part of its commitment to the Williston compensation program,the Ministry of Environment hired two wildlife biologists during the summer of 1989 to begin wildlife compensation work. The Williston wildlife biologists have begun developing a wildlife compensation program by gathering information on wildlife distribution, wildlife abundance, habitat use, habitat enhancement potential and public expectations. The program is being developed using the following principles.

Management Principles:

1) The program will meet the public expectation for visible enhancement and protection activities based on sound biological information through a balance of enhancement projects and information gathering.

2) Compensation projects will be technically sound. Habitats and wildlife populations will be monitored to determine the effectiveness of the program.

3) The majority of compensation activities will be conducted in tributary watersheds to the reservoir. Some activities may be conducted in adjoining watersheds where habitat capability, wildlife populations, public demand and recreation opportunities justify action.

4) Where possible, compensation goals will be accomplished and sustained through integrated planning and joint activities with other resource management programs.

5) Project priorities will be based on the following criteria:

- biological soundness
- value, uniqueness, or vulnerability of the habitat or population
- public expectations
- impact and duration of benefits
- possibility for cooperative projects with other resource users
- cost-benefit and feasibility
- public participation

The Wildlife Compensation Program Management Plan was developed for the Williston Reservoir Basin after 1.5 years of biological assessment. The purpose of the Williston Lake Compensation Program is to protect and enhance Williston Basin wildlife populations and their habitat through implementation of long term management and enhancement plans. Habitat lost was critical for many wildlife species and cannot be replaced by enhancement activity. The compensation program will intensify management to enhance and preserve remaining wildlife resources within the limits of habitat capability.

PART I of the Williston Wildlife Management Plan outlines broad goals and strategies which detail broad goals will be met. Goals of the wildlife compensation program are to :

1. Develop an information base for wildlife in the Williston watershed.
2. Maintain and enhance wildlife populations
3. Protect key wildlife habitat.
4. Maintain habitat quality and diversity
5. Create recreational opportunities for the public
6. Ensure meaningful public involvement
7. Provide local employment opportunities where possible

PART II of the Wildlife Management Plan outlines:

1. The physical and vegetative characteristics of Williston Basin as well as animal use of habitat zones.

The Williston Basin has long, cold winters, short growing seasons and deep snow over most of the watershed. Some areas receive less snow because of their elevation or because the 'snow shadow' effect of surrounding mountains. Other areas have reduced snow depth as a result of wind action, melting or the shelter of mature forests. The resulting variation in snow depth is critical to the survival of many important wildlife species. The topography varies from rugged mountains to low elevation flats in the Rocky Mountain Trench and along the valleys of approximately 20 major rivers. There are south and west facing sidehills which lose their snow and green up first in the spring and north facing side slopes which hold snow a long time in the spring providing moister, cooler summer habitats. Vegetation varies from mature forests of spruce and pine to shrubby areas, grassy areas and deciduous forests of aspen or cottonwood. Marshes, small and large streams, acid bogs, lakes and the reservoir foreshore all provide wetland habitats that are used by wildlife.

2. Important habitat management concepts including habitat capability, habitat suitability, and limiting factors.

Habitat must provide the right kind and quantity of food, water, topography and cover for species to survive and reproduce. Habitat capability describes the potential of the land base to support wildlife under optimal vegetation and land use conditions while Habitat suitability describes the ability of the land base to support wildlife under current, possibly less than optimal vegetation conditions. The gap between habitat capability and suitability identifies opportunities for enhancement.

If all the requirements for an animal population are present in adequate quantity and quality except one, then that one is said to be the limiting factor for population growth. Identification of the factors limiting a wildlife population in any area is essential before effective enhancement or protection of any species can be done.

3. Land-use impacts and management.
Resource industries including forestry, hydro-electric power generation, mining and agriculture all have impacts on wildlife management and compensation activities in the Williston watershed. Often, the best gains for wildlife compensation can be made by working with resource industries to minimize the negative impacts and maximize positive impacts of industrial activity. This is called integrated management.

PART III of the Wildlife Management Plan presents proposed management and enhancement activities for individual wildlife species or species groups. These will be highlighted below. Brief statements of the distribution, population status, habitat requirements, and current economic value for each species are also provided in the report. The compensation program for each species will follow the same basic pattern. Biological information including habitat capability, habitat suitability and limiting factors will be determined through a variety of methods ranging from animal inventory and habitat surveys to interviews with local experts. This information, as well as public input, will be used to design and priorize potential compensation projects. Since the compensation program is financed by a perpetual fund, the programs can be designed with a long term approach which emphasizes sound planning. Well monitored pilot projects will often be used to evaluate enhancement techniques before they are used on a larger scale. Periodic program re-evaluations will use updated technical information and informed public input to improve methods and modify program direction as necessary.

Moose are the most abundant large mammal species in the Williston watershed. Important moose habitat will be identified through aerial inventory and mapping of snow depth and other habitat features. Compensation enhancement activities will focus on enhancing forage on important winter ranges through prescribed burning and mechanical treatments. Options for enhancing and protecting moose habitat value through integrated management with the forest industry will also be evaluated.

Woodland caribou are very sensitive to human intrusion and knowledge of their abundance, distribution and ecology in the Williston Basin is fragmentary. The primary requirement for the protection and enhancement of caribou populations is for better information on the abundance, distribution, seasonal habitat selection and population dynamics of important local herds. This information will be used to provide input to integrated forestry and access plans and to evaluate potential habitat enhancement treatments.

Stone sheep populations in the Williston Basin include about 10% of the world's population of these animals. The compensation program will establish new populations through animal tranlocations to suitable vacant habitat on the east slope of the Rocky Mountains southwest of Hudson Hope. Large populations in the Russel Range, east of the Finlay River will be inventoried and evaluated for potential habitat protection, enhancement and tranlocation projects .

Elk and deer are only able to survive in the lower snow depth areas of the Williston Basin. Both species require an optimal mix of forested and open habitat. Important areas for these species will be determined by winter inventories and habitat evaluations. Where required, forage will be enhanced using prescribed burning. The potential for establishing new elk populations through translocation

will be evaluated.

Many species of **waterfowl** stage or breed within the Williston Basin including more than 20 species of diving and dabbling ducks, Canada geese, and two swan species. Compensation projects will create or improve wetland habitat using techniques including pothole blasting or digging, dam construction, construction and placement of nest boxes and floating islands, and seeding of vegetation for waterfowl forage and cover. The feasibility of Canada goose transplants to boost populations in enhanced areas will be evaluated.

Grizzly and black bears are both present in the Williston Basin in significant numbers. Because of their low reproductive rate, grizzly bear are very susceptible to population declines from the increased legal and illegal kill resulting from increased road access. The compensation program will cooperate in projects to identify and map important grizzly bear habitats. These maps will guide resource development to protect grizzly bear habitat. Prescribed burning done primarily for ungulate species will often enhance forage for both grizzly and black bears.

The total **mountain goat** population in the Williston Basin is estimated to be about 2000 animals. Similar to grizzly bears, this species is susceptible to population declines from overharvest when new roads give close access to goat populations. Compensation projects will identify and map goat populations and goat habitat so that access and resource development plans can be modified to minimize negative impacts on goats. Better information will also result the development of hunting regulations which will better ensure safe harvest levels.

The **furbearing animals** in the Williston Basin can be divided into three groups based on their major habitat requirements. Aquatic furbearers including beaver, mink, muskrat and otter depend on wetland and lake habitats. Mature forests are critical habitat component for martens and squirrels. Lynx, snowshoe hare, fisher, wolverine, coyote, fox, skunk and weasel generally prefer a mixed vegetation pattern including openings, and young and mature forests. Fisher and wolverine are rare in much of their historic range throughout the world but exist in the Williston Basin. Detailed information on habitat requirements and enhancement techniques for major furbearers will be compiled and used to develop trials of innovative forestry practises to lessen the impacts of forest harvesting and silviculture on these animals. This will require the cooperation of both forest industry and local trappers. Wetland enhancement projects will be conducted to benefit both aquatic furbearers and waterfowl.

Two highly visible types of non-game birds in the watershed are amenable to active protection and enhancement activities include: 1. the fish-eating raptors, including bald eagles and ospreys 2. the cavity nesters including 7 species of woodpeckers, 5 species of owls, kestrel, red-breasted nuthatch, 3 species of chickadees, swallows and tree nesting ducks. Detailed information on habitat requirements and enhancement techniques for raptors and cavity nesters will be compiled. New forest harvesting systems designed to maintain snags for cavity nesting birds will be developed, tested and promoted. Present concentrations of raptor nesting sites will be surveyed and potential limiting factors evaluated. If these evaluations indicate that the supply of nesting sites is limiting populations, projects will be developed to protect existing sites and create new ones.

In addition to these species specific projects, compensation funds will be used to develop wildlife viewing areas in locations where wildlife or interesting aspects of wildlife ecology can be viewed by the public.

The Wildlife Compensation Management Plan gives clear direction for the program and is the first essential step in planning. Using this document as a basis, more detailed annual action plans will be prepared. These annual plans will benefit from the greater biological information and public input that will be gathered over the next few months and years.

ACKNOWLEDGEMENTS

Completion of the Wildlife Compensation Management Plan for Williston Reservoir required the input of many people. Special contributions were made by members of the Williston Reservoir Technical Committee including B.Churchill, K. Child, B. Bradley, John Kelly and Bruce Pendergast. G.Watts and Bill Arthur From the Ministry of Environment in Prince George also provided useful comments. D. Read has facilitated Program action as Coordinator of Community Relations for B.C. Hydro in Prince George.

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INTRODUCTION

The WAC Bennett dam was completed in 1968 and reached full flood by 1971 creating the largest fresh water body in British Columbia. The Reservoir flooded about 1500 square kilometers (Finlay Omineca Strategic Plan 1983) of prime wildlife habitat. Over one half of the submerged area was rated as Class I (Canada Land Inventory 1966) winter range for ungulates, which is the best quality range available. Canada Land Inventory mapping indicates a reduction in carrying capacity of 12,500 moose(Finlay Omenica Strategic Plan 1983). The estimated consumptive value of this loss of moose is $1.53 million annually based upon assumptions made in the footnote below.* Other big game species including caribou, elk, bear, deer and Stone sheep were also impacted by the Williston Reservoir. Furbearer (Bonar 1976), and waterfowl(Canada Land Inventory, 1966) habitat were also flooded. Habitat for many other birds and small mammals using the lowlands of the Finlay, Parsnip and Peace and drainages was also impacted.

Under the terms of their water license B.C. Hydro is obliged to provide compensation for wildlife losses in the Williston watershed. A tentative agreement for compensation was reached between the Ministry of Environment and B.C.Hydro in 1988 when B.C. Hydro agreed to a $5 million compensation program for wildlife. B.C. Hydro and MOE have agreed to jointly participate in Technical Committee and Steering Committees to administer the wildlife program.

The wildlife compensation program will be implemented by the Ministry of Environment. As part of that commitment two biologists were hired during the summer of 1989. Compensation projects including prescribed burns, pothole construction, development of specialized forestry techniques for wildlife enhancement, wildlife inventories, habitat mapping, snow depth inventories and translocation of Stone sheep have been undertaken since that time. The information gained from wildlife and snow depth inventories has been added to that gained from a search of existing literature to develop the following Wildlife Compensation Management Plan for the Williston Basin.

The plan is divided into three parts. Part I outlines the general goals, principals and strategies for the compensation program.

Part I describes the location, physiography, climate and vegetation of the Williston Basin. Also, important wildlife management concepts including limiting factors, habitat capability and habitat suitability are discussed.

Part lll outlines more specific goals, objectives and strategies for individual wildlife species or species groups in the Williston Basin. To show the relationship between compensation goals, objectives and strategies, brief statements of the distribution and abundance, value and habitat requirements of each species presented.

* Assumptions: The acceptable harvest of moose is between 8.6% and 12.2%; the average number of days required for a resident to harvest a moose is 25.7 and for non-residents 12.5 days; the value of a resident hunter day in the Omineca-Peace Region is $45.40 and the value of a non-resident hunter day is $169 (Reid 1988).

PART I: COMPENSATION MISSION STATEMENT, GOALS AND STRATEGIES

The Mission of the Williston Wildlife Compensation Program is to protect and enhance the Williston Basin wildlife populations and their habitat through the implementation of long term management and enhancement plans. The Williston Wildlife Technical Committee will direct the collection of appropriate wildlife and habitat data and oversee its use to formulate and revise management plans.

The Williston Wildlife Compensation Program is designed to offset losses of habitat and wildlife resulting from creation of the Williston Reservoir. The habitat lost was critical for many wildlife species and cannot be replaced by enhancement work. The compensation program will intensify management to preserve and enhance remaining wildlife resources within limits of habitat capability. The general goals, strategies and management principals on which the compensation program is based are presented below.

General Goals and Strategies:

1) GOAL: Develop an information base for wildlife in the Williston watershed.

STRATEGIES:

a) conduct wildlife and habitat inventories
b) identify the critical habitat requirements of major game species, furbearers and non-game species
c) identify factors limiting wildlife populations
d) produce reports and maps based upon wildlife data collected

2) GOAL: Maintain and enhance wildlife populations.

STRATEGIES:

a) investigate wildlife/habitat relationships
b) conduct habitat enhancement projects
c) conduct population inventories
d) monitor results of enhancement activities.
e) recommend population management strategies
f) establish new populations by translocation

3) GOAL: Protect remaining key wildlife habitats.

STRATEGIES:

a) identify key habitats through data collected in GOAL 1
b) protect and manage crown lands of high wildlife capability through reserves and integrated management programs
c) purchase and manage private lands of high wildlife capability
d) manage wildlife habitat by entering into co-operative agreements

4) GOAL: Maintain habitat quality and diversity.

STRATEGIES:

a) identify enhancement opportunities using information base from Goal 1
b) plan and habitat enhancement projects
c) initiate and/or co-operate in integrated resource management with other government agencies

5) GOAL: Create recreational opportunities for the public.

STRATEGIES:

a) develop wildlife viewing areas
b) increase wildlife populations
c) protect and increase the diversity of wildlife habitat
d) increase hunting opportunities

6) GOAL: Ensure meaningful public involvement.

STRATEGIES:

a) present the compensation program at formal public meetings and request feedback
b) disseminate information to a wider public through news releases
c) invite feedback from local wildlife and nature groups through ongoing informal discussions

7) GOAL: Include local employment opportunities where possible.

STRATEGIES:

a) award contracts to local entrepreneurs when contract criteria are equally met by local and non-local applicants

Management Principles:

The following principles will guide the development of the compensation program.

1) The program will meet the public expectation for visible enhancement and protection activities based on sound biological information through a balance of enhancement projects and information gathering.

2) Compensation projects will be technically sound. Habitats and wildlife populations will be monitored to determine the effectiveness of the program.

3) The majority of compensation activities will be conducted in tributary watersheds to the reservoir. Some activities may be conducted in

adjoining watersheds where habitat capability, wildlife populations, public demand and recreation opportunities justify action.

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- public participation

PART II : BACKGROUND INFORMATION

A. DESCRIPTION OF MANAGEMENT AREA

Location

The management area for Williston Reservoir lies between 54 degrees and 58 degrees north latitude and 121 degrees and 128 degrees west longitude in north central British Columbia and occupies an area of 70,860 km 2 (Figure 1). The watershed is approximately 275 km in width and 525 km in length. The watershed includes three arms: the Finlay Arm from the headwaters of the Finlay River southeast 295 km to the Peace Arm; the Parsnip Arm running northwest 210 km from the headwaters of the Parsnip River at Summit Lake; and the Peace Arm running adjacent to the Peace River from the junction of the Omineca, Parsnip and Finlay Rivers in the Rocky Mountain Trench east 90 km through the Rocky Mountains to Hudson's Hope.

Physiography

The management area may be divided into three physiographic regions (Holland 1976, Figure 2). The Rocky Mountain Trench region is a valley 6-30 km wide formed by a tectonic plate fault line extending from the Yukon border in a south-easterly direction to Mexico. The Omineca Mountain region lies to the west of the Rocky Mountain Trench while the Rocky Mountain region lies to the east. The Management unit also includes part of the Cassiar Mountain region to the northwest (including Sifton and Stikine Ranges); the Spatsizi Plateau and the Skeena Mountains to the west; the Nechako Plateau, Fraser Basin and Mcgregor Plateau to the south (Figure 2).

Climate

The Williston Basin lies within the Continental Subarctic Climatic Zone dominated by continental polar air. From the Nabesche River east on the Peace Arm, Arctic weather events frequently occur because the Hart Foothills do not present a barrier to southward movement of Arctic air (Harper, 1988). During winter months, warm Maritime Pacific air coming from the southwest lifts as it rises over the Hart Mountains causing deep snow accumulations. The tunnel through the Rocky Mountains provided by the Peace River breaking through the Hart Mountain range permits warm chinook winds to blow over the lower south and west-facing slopes of the Hart Foothills, (eastern Peace Arm) resulting in shallow snow and relatively mild winter conditions. The Hart and Muskwa ranges are isolated mountains with plateaus to the west and east (Harper, 1988). Mountains to the north and south are higher, consequently, moist Maritime Pacific air is able to enter the Alberta Plateau from the west and Arctic air is able to move in from the northeast (Harper, 1988).

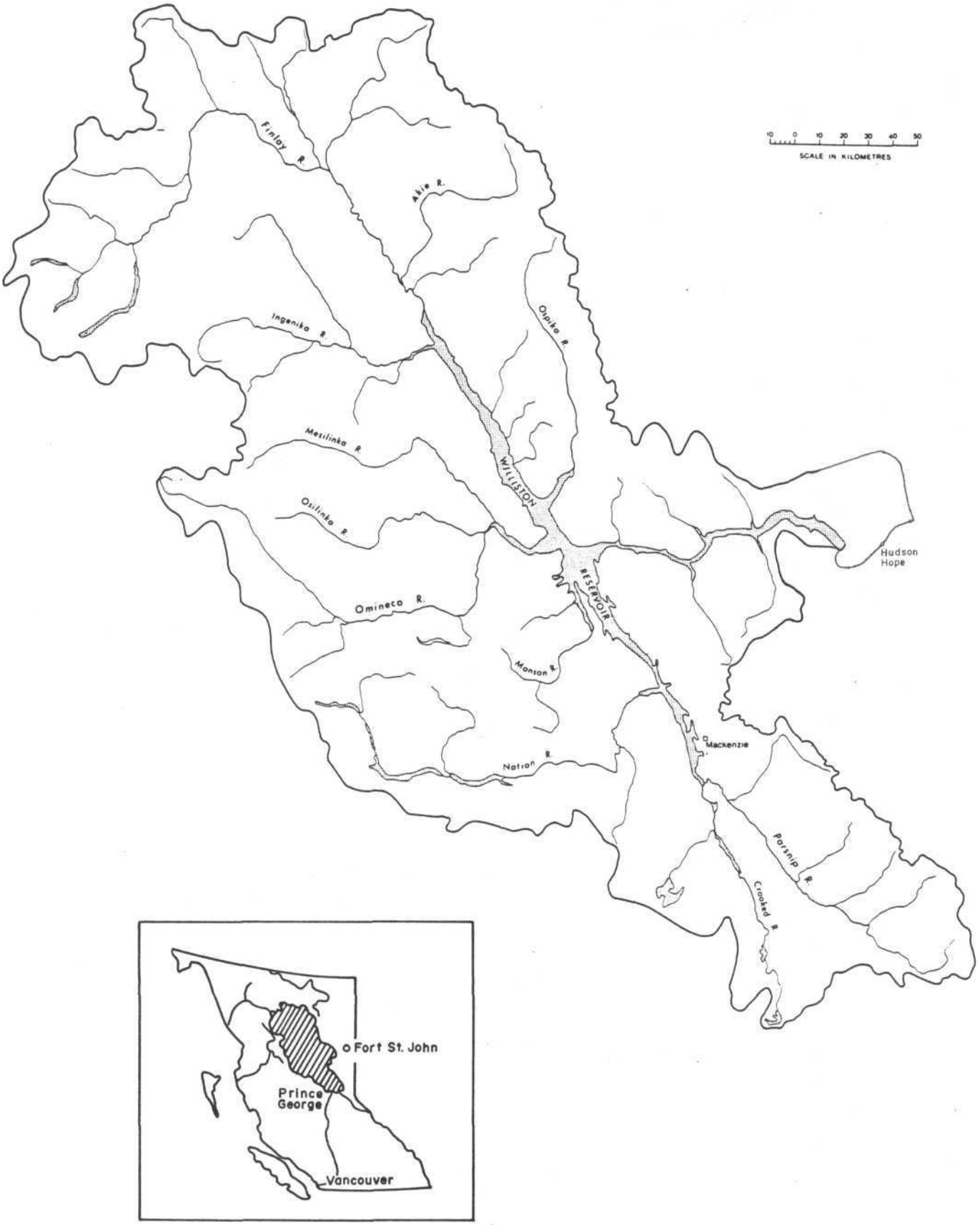


Fig.1. Location of the Williston Basin.

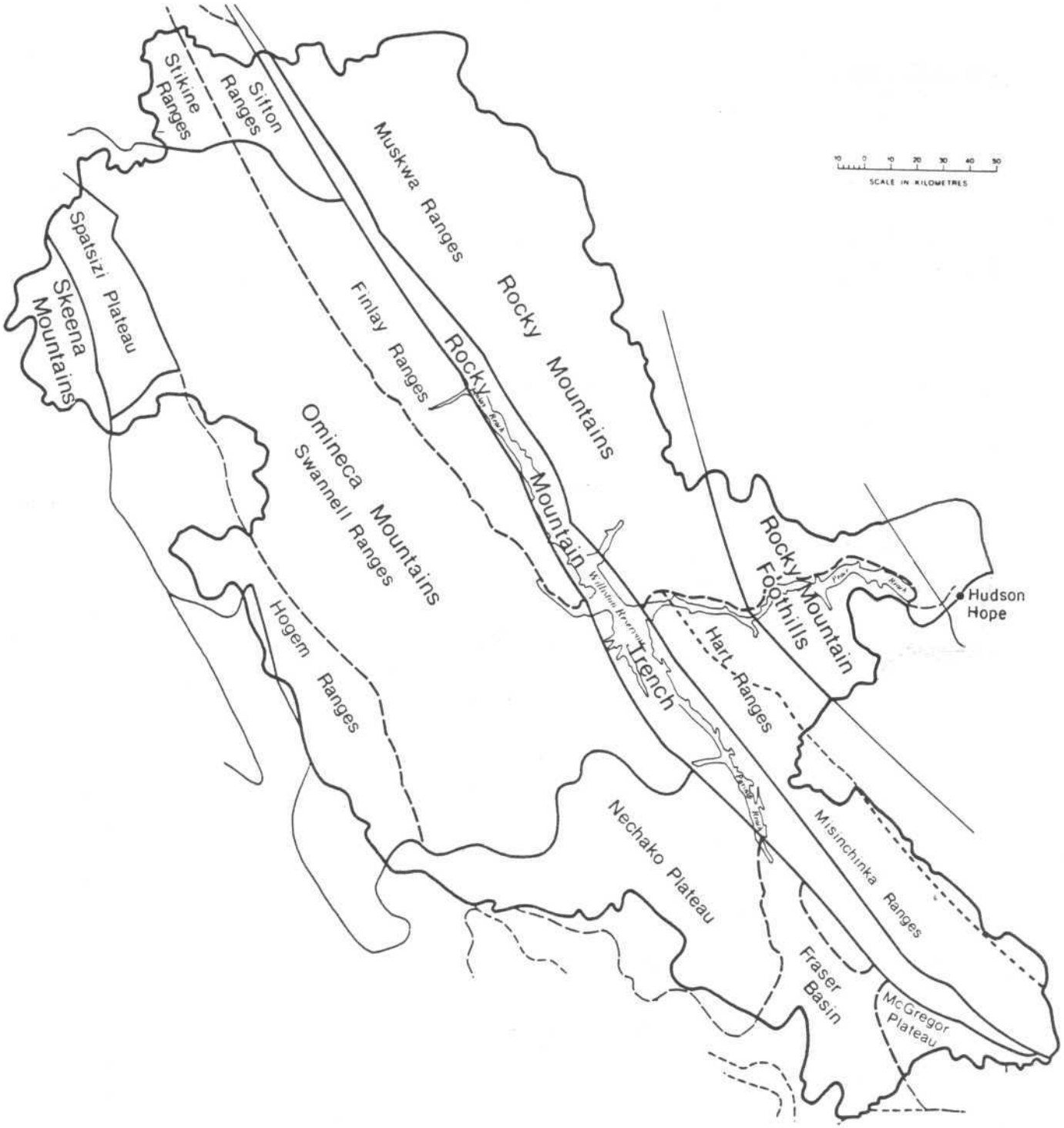


Fig.2. Physiography of the Williston Basin.

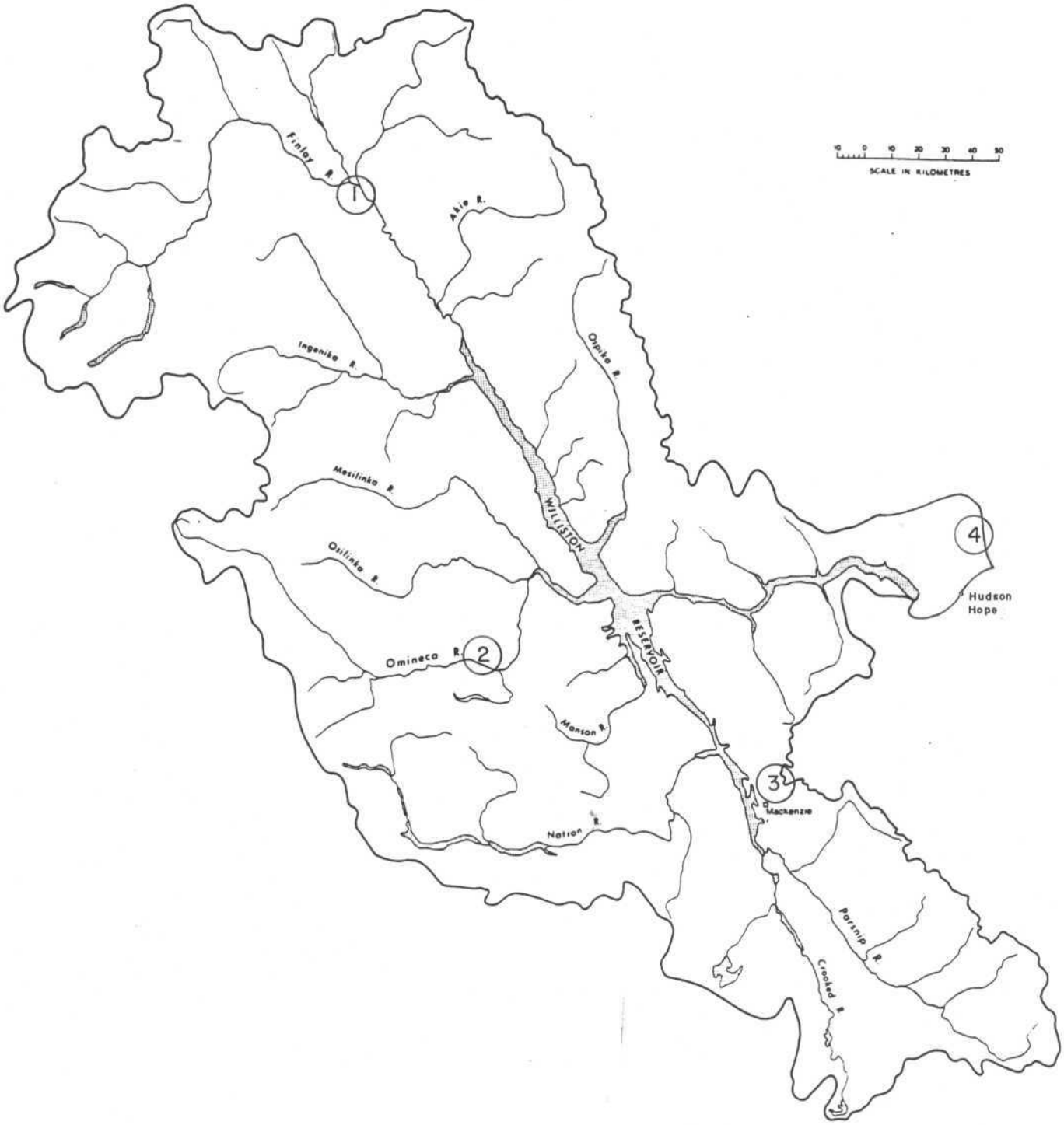


Fig.3. Location of permanent, low elevation snow stations in the Williston Basin
(1) FORT WARE (980m) (2) GERMANSEN LANDING (750m)
(3) Mackenzie (700m) (4) BULLHEAD MTN.- HUDSON'S HOPE (790m)

Precipitation

Precipitation levels are influenced by the Omineca and Rocky Mountain ranges which cause orographic lifting of warm, moist Maritime Pacific air. The result is more than 150 cm of annual precipitation on the wind-ward side and less than 50 cm of precipitation on the lee side of these ranges in Rocky Mountain Trench, lower Peace Arm, lower Nation Valley and the outer Hart Foothills due to a rain-shadow effect. About half the precipitin in the Rocky Mountain Trench and the Peace Arm comes as rain while in mountainous country about 1/4 of the annual precipitation comes as rain and 3/4 as snow.

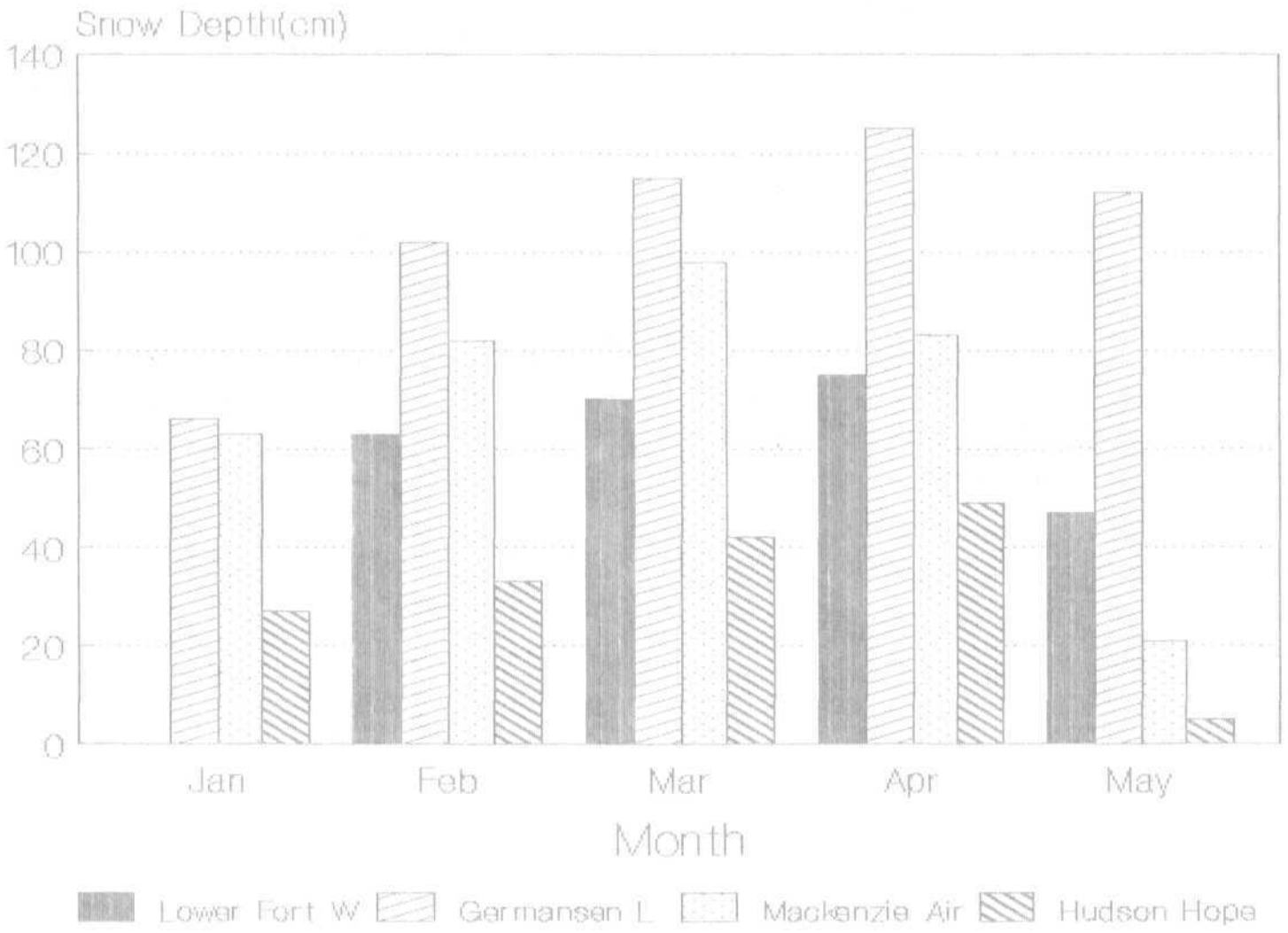
Snow begins falling in October and increases in depth until March or April (Figures 3 and 4). The snow pack does not decline significantly until May in most of the Finlay/Parsnip drainage and April in the Peace Arm. Snow depth increases with increasing elevation away from the Williston Reservoir and decreases to the east in the Peace Arm (Figure 4 and 5 *).

Temperature

Daily temperatures may range from +33 deg C in August to -49 Deg C. in January. Average daily temperatures are below 0 Deg C between October and April. The frost free growing period is less than 60 days in most of the Finlay/Parsnip area and less than 90 days in the Peace Arm. The growing season for vegetation begins in mid-May on the lower Peace Arm and about 2 weeks later in the Finlay and Parsnip Arms.

* Snow depth mapping (figure 5) was based on snow depths measured on over 110 standard sites on level ground in small forest openings during the month of February 1990. Snow depths were also inferred from observation of tracks and animals on the Peace Arm in early March. Snow pack depths were slightly above normal in most of the Williston Basin area (Snow Survey Measurements Ministry of Environment 1990). This mapping is intended to identify zones of different relative snowpack rather than to map absolute snow depths which will be different every year. Caution must be taken in interpreting snow depth mapping based on one year's data.

Snow Pack In Williston Basin



Snow Depth Zones

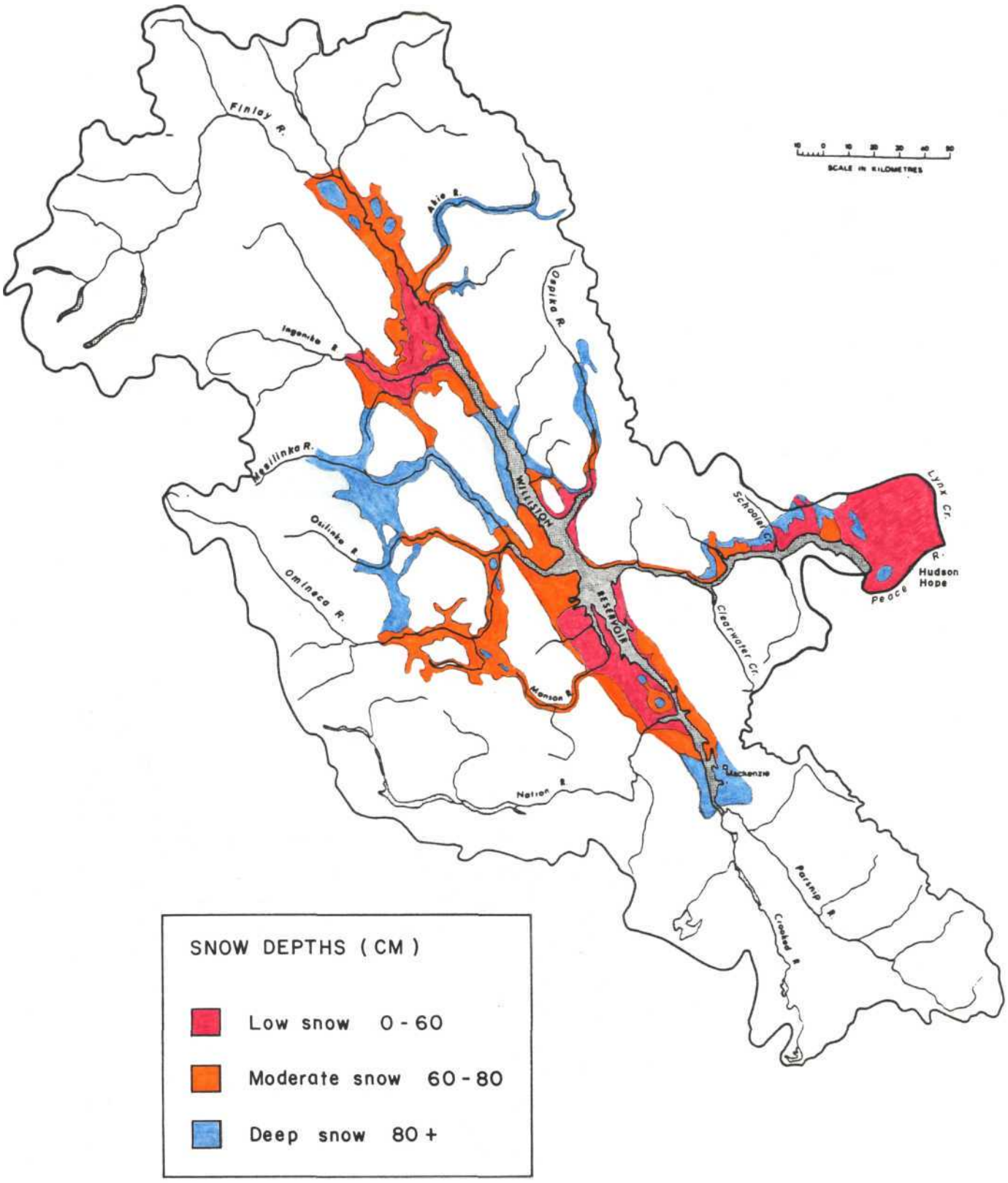


Fig.5. Relative mid-winter snow depth zones in lower elevation areas adjacent to the Williston Reservoir for the evaluation of lowland ungulate winter range capability. This map is simplified from a more detailed map compiled using data from 110 snow stations measured in February and March 1990.

Vegetation

Five biogeoclimatic zones occur in Williston Reservoir (Figure 6), each zone has its own vegetation pattern:

1. Alpine Tundra(AT)

The Alpine Tundra biogeoclimatic zone occurs mainly at elevations above 1700 m in the Williston drainage, but may occur at elevations as low as 1500 m in the Hart Foothills of the Peace Arm. The alpine tundra lacks trees and is often dominated by dwarf willow, cassiope, mountain-heather and black crowberry on medium-textured, moderately drained soils (Pojar 1983). Mountain avens, moss campion and sedge species are found on drier soils. Alpine grasslands are dominated by Altai fescue, fuzzy-spiked wildrye, broad glumed wheatgrass, purple reedgrass, sedges, Bellard's kobresia, alpine sweetgrass and terrestrial lichens (Finlay-Omineca Strategic Plan, 1983).

2. Engelmann Spruce-Subalpine Fir(ESSF)

The ESSF zone occurs at elevations between 1000 m and 1700 m and contains four sub-zones differentiated by the moisture regime. Engelmann spruce/white spruce hybrids, subalpine fir and lodgepole pine are the major tree species (Finlay-Omineca Strategic Plan, 1983). Black blueberry, oval-leaved blueberry, and white flowered rhododendron are common shrubs on moderately drained sites. Drier sites contain lodgepole pine, saskatoon, hairy wild ryegrass and lichens. This zone covers more than half the mountainous country of the Williston basin.

3. Boreal White and Black Spruce(BWBS)

This biogeoclimatic zone extends across the lower elevations of the Rocky Mountains and Rocky Mountain Trench. In the Williston drainage, the BWBS zone occurs at the upper ends of the Peace and Finlay Arms between lake level at 670 m and 1150 m elevation. The growing season is usually less than 60 days and the winters are long and cold resulting in low forest productivity. The dominant climatic climax vegetation of this zone is a mosaic of black spruce/tamarack bogs, white spruce, black/white spruce, trembling aspen and paper birch. Lodgepole pine and trembling aspen are young serai stages on drier sites while paper birch is a young serai stage on moister sites. White spruce and balsam poplar are common on floodplain deposits. Pine-lichen forests are located on the driest sites.

4. Sub-Boreal Spruce(SBS)

This zone occupies most of the lowlands adjacent to the Finlay and Parsnip Arms of the Reservoir up to approximately 1100m elevation.

ALPINE TUNDRA

The alpine tundra, essentially a treeless region characterized by a harsh climate, is found on high mountains throughout the Province. The long, cold winters and short, cool growing seasons create conditions too severe for the growth of most woody plants—except in dwarf form. Hence this zone is dominated by dwarf shrubs, herbs, mosses and lichens. This zone has high recreational appeal. It also provides important range for caribou, mountain goats and mountain sheep. Due to the severe climate it is extremely sensitive to use. Disturbed landscapes require decades, or even centuries, to recover to their natural states.

SPRUCE - WILLOW - BIRCH

This is a subalpine zone occurring in the severe climate of the north of the Province, at elevations above the boreal forest and below the alpine tundra. At lower elevations, the zone is characterized by open forests of primarily white spruce and subalpine fir; upper elevations are dominated by deciduous shrubs including scrub birch and willow. In some high wide valleys, cold air collects resulting in a mosaic of scrub, grassland and wetlands on valley floors below a band of forest on the valley sides. Above, the forest again gives way to shrubs. This zone provides extensive moose, caribou and, in the east, elk habitat.

BOREAL WHITE AND BLACK SPRUCE

This zone is part of the extensive belt of boreal coniferous forest occurring across Canada. It occupies the northern valleys west of the Rocky Mountains and the gently rolling topography of the Great Plains. Winters are long and cold and the growing season short; the ground remains frozen for much of the year. The severe climate results in forests of low productivity. Numerous past fires have created extensive successional forests of aspen and lodgepole pine. Where flat, the landscape is typically a mosaic of black spruce bogs and white spruce and trembling aspen stands. Valuable agricultural land is prevalent in the Peace River area. Moose and mosquitoes are very abundant.

SUB-BOREAL SPRUCE

This zone occurs in the central interior of the Province primarily on gently rolling plateaus. The zone is intermediate between the interior Douglas-fir forests to the south and the boreal forests to the north. Forest productivity is moderately good, and although the climate is severe, the winters are shorter and the growing season longer than in boreal areas. Hybrid Engelmann-white spruce and subalpine fir are the dominant trees; extensive stands of lodgepole pine occur in the drier portions of the zone due to numerous past fires. Wetlands are abundant, dotting the landscape in poorly drained areas. Moose are common throughout this zone.

ENGELMANN SPRUCE - SUBALPINE FIR

This is a subalpine zone occurring at high elevations throughout much of the interior. The climate is severe, with short cool growing seasons and long cold winters. Only those trees capable of tolerating extended periods of frozen ground occur. The landscape at the upper elevations is open parkland, with trees clumped and interspersed with meadow, heath, and grassland. Engelmann spruce, subalpine fir, and lodgepole pine are the dominant trees. Rhododendron and false azalea are common understory shrubs. Under drier conditions, extensive lodgepole pine and whitebark pine forests are common. In wetter areas where snowfall is more abundant, mountain hemlock occurs.

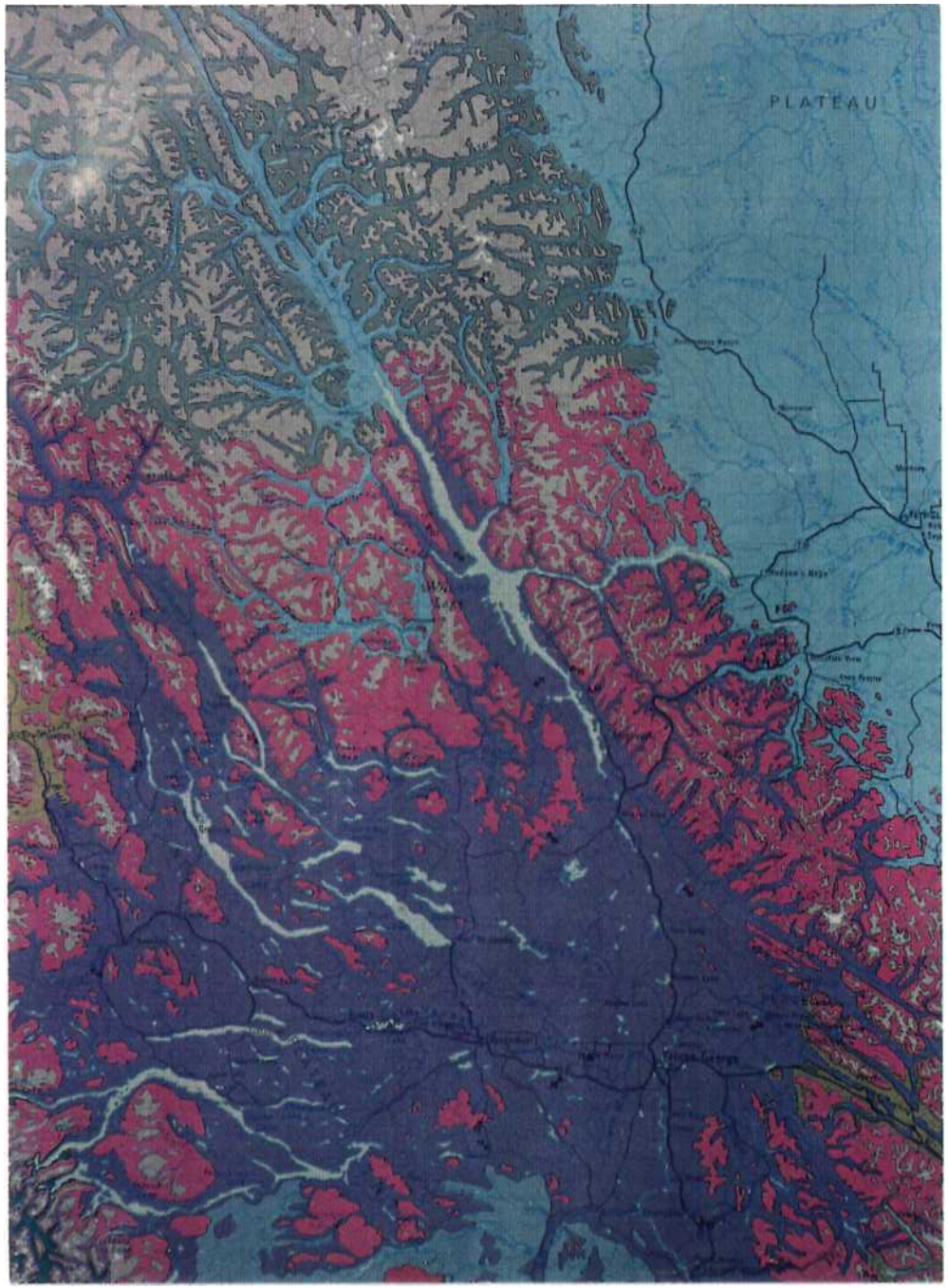


Fig.6. Biogeoclimatic zones of the Williston Basin and adjacent area.

Hybrid white spruce-Engelmann spruce and alpine fir are the dominant climatic climax tree species. Lodgepole pine and trembling aspen form the overstory in serai stands. Paper birch is often a pioneer tree on more moist and rich sites. Black spruce-sphagnum bogs occur on poorly drained organic soils. Devil's club and/or oak fern are common on imperfectly drained mineral soils. Black huckleberry, bunchberry, are common on moderately drained soils. Rapidly drained soils contain lodgepole pine with a variety of lichens.

5. Spruce-Willow-Birch(SWB)

The SWB occurs only in the northern part of Williston Basin where it occupies the zone above the BWBS zone between 900-1700m elevation. In this zone winters are long and cold, summers are brief and cool. Lower parts of this zone are forested mainly by white spruce and alpine fir, plus variable amounts of pine and aspen in the valley bottoms and on lower slopes. Upper elevations have scrub/parkland dominated by bog birch on poor nutrient soils and several species of willow on more nutrient rich soils. A pine-birch-lichen plant community occurs on rapidly drained soils.

Animal use of Habitat Zones

The landscape can be separated into broad habitat groups which provide for the needs of many types of wildlife.

The Alpine tundra zone is commonly used as winter range by mountain goat, Stone sheep, caribou, willow and white-tailed ptarmigan. Strong south-westerly winds(chinooks) blow ridge tops free of snow permitting easy access to forage and berries. Avalanche chutes provide excellent bear forage in the spring and crowberry patches are used as fall forage areas for bear. Alpine Tundra in the foothills of the Rocky Mountains is also used as winter habitat by sharp-tail grouse. Moose, mule deer, bear, golden eagle, wolverine, hoary marmots, coyotes and wolves are common summer-fall inhabitants of this zone.

Subalpine forests (ESSF and SWB) are inhabited between late spring and fall by caribou, moose, bear, Stone sheep, mule deer, and elk. Caribou, in some parts of the watershed, use lichen-bearing subalpine forests in the early and late winter. They move to wind-swept alpine slopes as the snow depth increases. Many moose remain in the subalpine zone until snow depths become greater than 80-90cm when they move down to the lower elevations (SBS or BWBS). In the Upper Finlay and Peace Arm, mule deer and elk move from the ESSF zone to the BWBS zone. Stone sheep may either move down to the Boreal White and Black spruce zone or up to the Alpine Tundra zone.

The lower elevation biogeoclimatic zones (BWBS and SBS) are the most important winter areas for ungulates and were most heavily impacted by flooding of the Williston Reservoir. Open grasslands and serai

shrublands on south-facing slopes of the Peace Reach are used by wintering elk, deer, stone sheep, and moose. Lower elevation floodplains and warm-aspect slopes in the Finlay and Parsnip drainages are used as winter range by moose and by mule deer and elk in the shallower snow areas. Low evevation lichen bearing lodgepole pine forests on coarse textured soil are important caribou winter habitats. Many species of birds(100 +), 20 species of rodents, 16 species of carnivores are found in this zone. Riparian areas are used by golden and bald eagles, ospreys and possibly the anatum variety of peregrine falcon. A variety of wetland types are used by waterfowl, aquatic furbearers, summering moose and many small mammals and birds.

Changes made to benefit one species can have positive or negative impacts on other species living in the same area. For example, an area of continuous conifer forest could be opened up by burning or logging with appropriate silviculture to produce better moose forage. As a by-product, this could improve habitat conditions for snowshoe hare and for birds using forest edges. However, habitat conditions for pine marten, red squirrel and woodpeckers could be degraded. Habitat management must consider the effect of an activity on other animals other than the primary target species.

B. HABITAT MANAGEMENT CONCEPTS

Capability and suitability

Habitat must provide the right kind and quantity of food, water, topography and cover for species to survive and reproduce. Habitat capability describes the potential of the land base to support wildlife under optimal vegetation and land use conditions while Habitat suitability describes the ability of the land base to support wildlife under current, possibly less than optimal vegetation conditions. The gap between habitat capability and suitability identifies opportunities for enhancement. Habitat requirements of major wildlife species in the Williston Basin are discussed under the individual species statements in Part lll.

Limiting Factors

If all the requirements for an animal population are present in adequate quantity and quality except one, then that one is said to be the limiting factor for population growth. Identification of the factors limiting a wildlife population in any area is essential before effective enhancement or protection of any species can be done.

Availability of low snow areas is a major limiting factor for many wildlife species in the Williston watershed. Deep snow limits forage availability and restricts movement because of excessive energy requirements for travel. Snow depths greater than 40 cm restrict movement of Stone sheep and deer while depths greater than 80 cm

restrict movement of calf moose (Telfer and Kelsall 1971). Snow depths during mid-winter are greater than 80 cm over most of the Williston Basin Area (Figure 5). Less than 5% of the area generally has snow depths which would permit overwinter survival of Stone sheep and mule deer. Mule deer are able to survive in the Upper Finlay River area in snow depths greater than 40 cm by using the shedding and shading effect of mature conifers. Snow depth reduction by wind action and by melting on south and west facing slopes can be critical for winter survival of ungulates. Stone sheep, caribou and mountain goats depend on wind action in the Alpine Tundra zone to blow snow away so that lichens, grasses and sedges can be obtained. At low elevations on the eastern Peace Arm, deer, elk, moose and Stone sheep depend on warm chinook winds to reduce snow depths and make forage available. Snow density can also affect wildlife in a number of ways. Snowpack often does not solidify until late February in the Finlay and Parsnip Arms.

C. LAND USE IMPACTS AND MANAGEMENT

Other resource industries in the Williston Basin have impacts on wildlife management that must be considered when planning enhancement and protection strategies.

Forestry impacts

Forestry has by far the greatest impact on wildlife of all the resource extraction industries in the Williston Basin. Forestry activities can negatively impact wildlife in Williston Basin through:

1. Large cut-block size(> 40 ha) which reduces ungulate use of potential forage;
2. Cut-block configuration which limits edge;
3. Permanent access and habitat loss created by haul roads and semi-permanent acess created by skid roads;
4. Herbicide and other silviculture treatments which limit shrub forage for wildlife;
5. Cumulative effects of clear-cutting of lichenous forest stands that serve as winter range for caribou;
6. Removing mature forests which are critical for some species;
7. Altering the ratio of mature forest to openings in ways unfavourable for certain species;
8. Removal of existing and potential snags which are critical for many wildlife species;
9. Removal of large woody debris which provides important habitat elements for many small animals.

Forestry activities can positively impact wildlife in the Williston Basin through:

1. Increasing forage production by opening up the forest canopy;
2. Increasing the amount of open and forest edge habitat for

animals that prefer these habitats;
3. Creation of large woody debris which provides important habitat for many small animals;
4. Maintenance and creation of biological diversity.

Impacts of Hydro-electric power generation

Reservoir water level fluctuations of 10-12m annually and approximately 20m over a 10 year period result in poor vegetation establishment on much of the foreshore. This impacts forage for wildlife and productivity for fish in the reservoir and animals that eat fish. The lack of stable water levels impacts waterfowl breeding habitat and habitat for aquatic furbearers in areas adjacent to the reservoir.

Mining and Petroleum Exploration Impacts

Hard-rock mining and oil and gas exploration impact wildlife through creation of access and habitat alteration. Industrial activity during sensitive periods such as ungulate calving time may have significant impacts.

Agriculture Impacts

Agriculture impacts wildlife management on the north-east Peace Arm. Land alienation resrticts acess and may result in reduced recreational use by the public. Agricultural vegetation management practices may reduce wildlife habitat suitability.

Integrated Management

In many cases, the best gains for wildlife compensation in the Williston basin can be made by integrating wildlife management with the management of other resources.

This is especially true for forest management which has very significant affects on wildlife habitat. Therefore, the wildlife compensation program must work with foresters to integrate wildlife habitat values into forest management decisions. Avenues for the compensation program to provide input to integrated forestry/wildlife management include:

1) **Forestry Planning Processes - a) Timber Supply Area (TSA) Planning** - any compensation work which results in recommended changes in forest harvesting or silviculture techniques will have to be considered in the TSA planning process before widespread application is possible, b) Local Resource Use Planning (LRUP) - This is a committee of government, industry, and the public set up to plan for integrated resource management of particularly important or controversial areas. Any compensation work proposed for these areas will have to be included in this planning process. There are currently two LRUP's (Omineca valley and Ospika valley) in the Williston watershed, c) Coordinated Access Management Planning.

2) **Ministry of Forests Wildlife Habitat Research** - Research projects which contribute to the achievement of compensation objectives should be encouraged and cooperated with.

3) **Government/Industry management of forested wildlife habitat** - In many cases the best opportunities for wildlife enhancement or protection are through modifying the practises used by the forest industry. The compensation program will develop innovative forest management techniques for species enhancement by conducting well monitored pilot enhancement projects. These techniques will be developed in cooperation with habitat and forestry managers and turned over to them after testing and fine tuning for day to day implementation.

SUMMARY OF PART II

Creation of the Williston Reservoir resulted in habitat loss, particularly the winter habitat for moose, deer, caribou, elk and Stone sheep and wetland habitats for furbearers and waterfowl. Habitat at lower elevations in the Boreal White and Black Spruce and the Sub-Boreal Spruce biogeoclimatic zones are heavily used by most game species, waterfowl and furbearers and these zones were particularly impacted by flooding of the Williston Reservoir. A cool continental climate, and high snowfall results in a short growing season,long-cold winters and deep snowfall over most of the Williston drainage area. Wind action and local microclimate and topography are extremely important in maintaining wildlife populations on remaining habitat.

Opportunities for habitat enhancement can be identified by finding the gap between potential habitat capability and present habitat suitability. The identification of factors limiting animal populations is also essential to compensation activities. To be effective, the compensation program must work to integrate wildlife enhancement and protection with other resource uses.

PART III : WILDLIFE COMPENSATION PROGRAM BY SPECIES

This part describes the compensation program proposed for each major species or group of species. It describes current Ministry of Environment (MOE) management activities to show the relationship between compensation activities and the MOE wildlife management program. Information on distribution, habitat requirements, and species value are presented to provide perspective on program goals, objectives and strategies.

The compensation management plan follows the same logical sequence for each species, (Fig.7) from a broad statement of goals to more specific objectives. Strategies then outline how objectives will be met. Strategies include an information gathering component, a planning component, an implementation component and a monitoring component. Project activities will be monitored and the objectives and strategies will be amended by changes in methods, priority, or direction to insure that projects are cost-effective, biologically sound and meet public expectations.

The collection of adequate biological information is crucial to successful compensation projects. Biological systems are complex and manipulations can be largely ineffective or destructive if based on inadequate information. On the other hand, habitat and population manipulation, followed by monitoring may lead to a better understanding of important relationships. Therefore, the approach taken is a balanced mix of information gathering and well monitored management of habitat and animal populations.

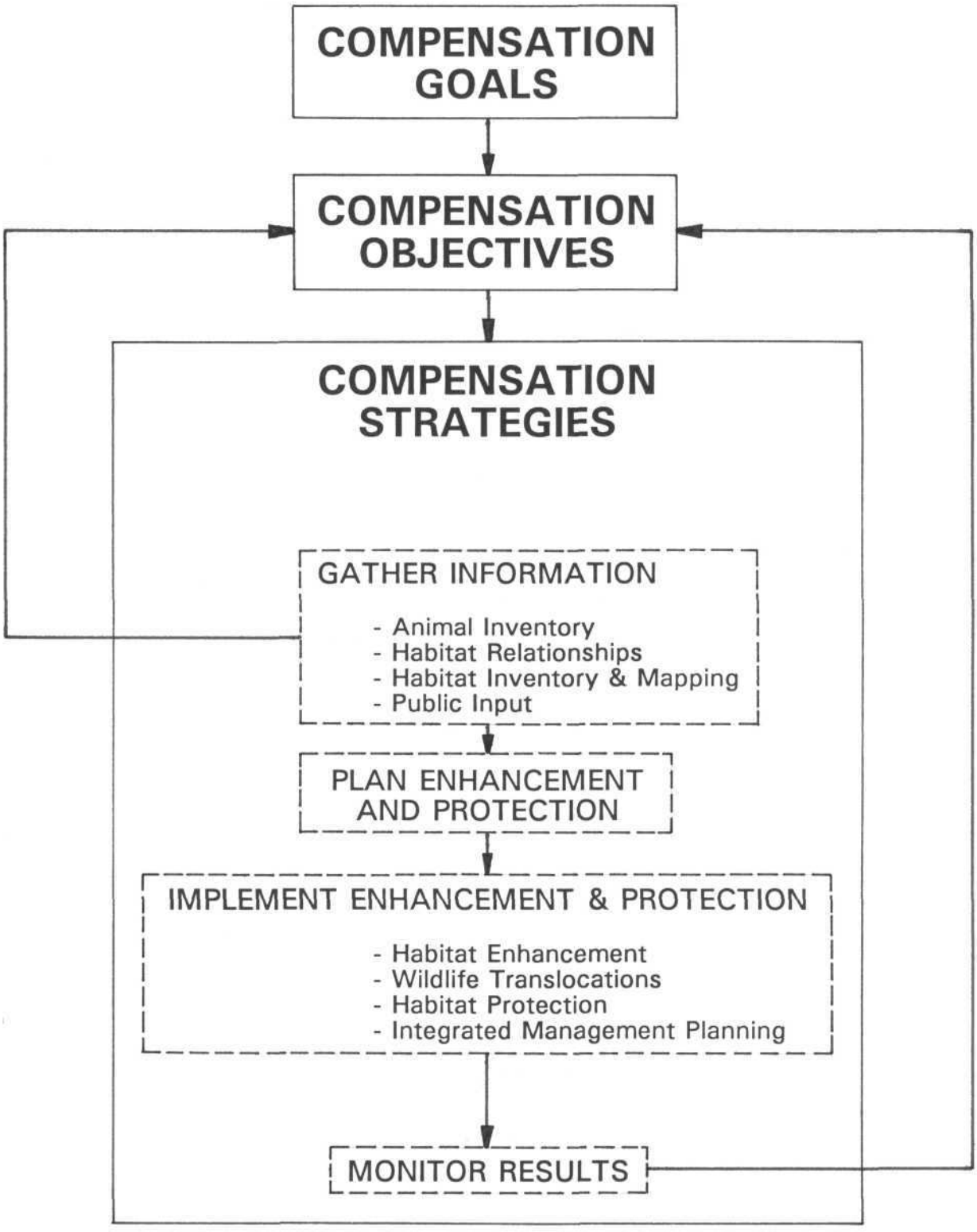


Fig. 7 **Flow Diagram** showing sequence **for** the development, implementation, and **improvement** of the Compensation **Program** for each species.

MOOSE

Introduction

Lands flooded by the Williston Reservoir included some of the best moose range in British Columbia. The flooding of this habitat resulted in an estimated reduction in moose carrying capacity of 12000 animals (Finaly Omineca Strategic Plan, 1983). Moose is still the major game species in the area but remaining habitat must be well managed to maintain and increase populations.

Distribution and Abundance

Moose inhabit most of the remaining lowland area in the Williston Basin. The greatest winter concentrations occur in areas which have relatively low snow depths, good production of preferred forage and availability of mature conifer cover for shelter. Preferred winter areas include the valleys and surrounding warm aspect hillsides of the major rivers of the Finlay and Parsnip drainages. On the Peace Arm, winter concentrations occur between Nabesche River and Alyard creek and from Butler ridge East to the watershed boundary. Significant concentrations also occur on agricultural land on the north east side of the Peace Arm. A population of approximately 1100 moose are estimated on the north side of the Peace Arm (Davidson 1990) while about 9000 moose are estimated for the Finlay and Parsnip drainages (Child and King 1988).

Habitat Requirements

Moose use mixed woodlands and require a mosaic of forest successional stages to meet their various needs. Moose need mature forest cover for hiding, summer shade, and winter snow interception. They require openings and wetlands to forage for a wide variety of herbaceous and woody plants. Moose distribution is strongly influenced by the presence of large quantities of shrub species available for winter forage. Snow depth is a very important factor in determining winter range capability. Moose energy outputs for travelling increase dramatically as snow depth increases above 90 cm. Deep snow will also bury moose forage.

Forestry activities can provide both positive and negative influences on moose habitat. Logging opens the forest canopy allowing more light to get to the ground and thus increasing the production of shrub forage for moose. However, in areas of intensive cutting and large block sizes, much of this forage is unavailable to moose because of the animals need for adjacent cover for shade, snow interception and security (Eastman 1977). Silvicultural practises designed to remove brush competition with conifers can degrade the value of moose habitat.

The carrying capacity for moose can also be reduced by the development of overmature vegetation communities on winter ranges that have traditionally been maintained in an early successional stage by wildfire

or prescribed fire. After disturbance such as logging or fire the moose forage value of a site increases with time peaking at 15 - 30 years and declining thereafter. Efficient fire suppression and lack of prescribed fire on important winter ranges have resulted in declining forage values.

Economic value

Moose is the largest North American member of the deer family, and is highly valued for its meat as well as for viewing. The average annual value of moose hunting in the Williston Basin to the economy between 1985 and 1989 was $1.603 million with $267,000(17%) coming from non-resident hunting and $1.336 million(83%) coming from residents. See Appendix I for further details.

Management Goal

1) Maintain and enhance moose populations in the Williston Basin.

Management Objectives

1) Identify major limiting factors.
2) Identify, protect and enhance moose winter ranges.
3) Protect and enhance moose habitat through integrated planning with the forest industry.
4) Manage hunter harvest to maintain healthy moose populations.

Management Strategy

Current MOE Activities

1) Set normal season and limited entry hunting seasons designed to hold harvest rates at 10% of the population and maintain favourable sex ratios and proportions of mature breeding bulls.
2) Monitor annual harvests and hunter success rate on a Management Unit basis.
3) Provide input into forestry cutting plans, development and Timber Supply Area planning.
4) Provide input into silvicultural referrals and monitor the response of forage species to herbicide applications.

Compensation Activities

1) Carry out reconnaissance surveys to identify moose winter habitat and to determine relative densities and habitat selection in the Finlay/Parsnip Arms.
2) Monitor moose densities in key areas to determine the success of management programs.
3) Recommend hunting regulations which will complement the compensation program.
4) Map relative snow depths in the lowlands (<4,000') in the entire watershed.

5) Map ungulate capability (1:50,000 scale) for the best moose ranges in the watershed. The areas tentatively scheduled for this work include the North Peace Arm, Ospika Valley, Omineca Valley, Ingenika/Finlay area.
6) Enhance forage on winter range areas, using prescribed fire or mechanical treatments.
7) Co-operate in the development of habitat guidelines for moose in the Williston watershed to emphasize forestry practises that will benefit moose.
8) Co-operate and provide input into integrated wildlife/forestry plans to benefit moose habitat.
9) Monitor vegetation and animal use response to enhancement projects.
10) Select and develop moose viewing opportunities in areas having good public access.
11) Investigate silvicultural treatment options for enhancing browse on winter, summer and riparian habitats.

CARIBOU

Introduction

Woodland caribou are an important and highly visible species in northern ecosystems. Single herds may have vast home ranges of which only part may be used each year. This species is very sensitive to human intrusion and the future maintenance of healthy populations will require careful integrated management and an improved information base.

Distribution and Abundance

Information on distribution and abundance of caribou in the Williston watershed is fragmentary. The estimated total populations are approximately 1000 - 1400 in the Finlay and Parsnip drainages (Child and King, 1983) approximately 225 on the Peace Arm (Harper, 1988). The largest concentrations are on the west side of the Rocky Mountain Trench from the Nation Lakes north to the Obo River and on the east side of the Trench north of Williston Reservoir. Scattered bands are present throughout all the mountainous areas of the Williston Basin.

Habitat Requirements

Caribou inhabit mature, lichenpus forested ranges and alpine ridges in the Williston watershed. They exhibit complex horizontal and elevational migration patterns as they frequent traditional calving, rutting, wintering, and post-calving ranges over a seasonal cycle. The location and relative importance of these ranges are poorly understood for the various sub-populations in the Williston Basin. Populations are limited by a complex interaction of habitat and predation factors which may vary between herds. Two types of wintering habitat are used in this area: 1) valley bottoms with lodgepole pine stands growing on coarse textured soil with terrestrial lichen ground cover, and 2) wind swept alpine ridges and adjacent subalpine

forests. Caribou in many parts of Canada have been found to be very sensitive to human intrusion and development. Access roads can result in increased legal and illegal hunting pressure, disruption of migration routes, and increased predation. Forest harvesting can reduce availability both of winter forage and forest cover required by caribou at various times in the seasonal cycle.To maintain populations requires good local information and careful management.

Management to maintain and increase moose populations may have negative impacts on local caribou populations. Siep (1990), and others have proposed that caribou populations may be threatened by high predation rates during calving seasons and fall migration by high densities of wolves which are maintained by moose populations located within the home range of caribou herds. Caribou wintering in the alpine are relatively immune to predation at that time of the year due to spatial separation from wolves feeding on moose in the valley bottoms. It is critical to determine if this wolf/moose/caribou relationship exists for local populations in the Williston Basin so that enhancement and management programs can be designed to minimize potentially conflicting objectives for caribou and moose.

The primary requirement to protect and enhance caribou populations in the Williston watershed is better information on their distribution, seasonal habitat selection and population status and dynamics. This information would facilitate development of an integrated plan for access and forest development and evaluation of the potential value of habitat enhancement.

Economic Value

The average annual value of caribou hunting in the Williston Basin between 1985 and 1989 was $201,000 with $178,000(89%) of this value coming from non-resident hunting and $23,000(11%) coming from resident hunting. See Appendix I for further details.

Management Goal

1) Maintain and enhance existing populations of caribou in the Williston watershed.

Management Objectives

1) Determine distribution and abundance of caribou in the watershed.
2) Identify major limiting factors.
3) Manage hunter harvest conservatively.
4) Protect caribou habitat in accordance with present knowledge of the species.
5) Seek opportunities to enhance caribou habitat.

Management Strategy

Current MOE Activities

1) Control male harvest at current levels by a combination of limited entry and antler restrictions.
2) Monitor annual harvests to ensure safe harvest rates.
3) Provide input into forestry and road development proposals using current limited knowledge of population distribution and ecology.

Compensation Activities

1) Inventory entire watershed to determine current population distribution and density.
2) Assess seasonal habitat selection and diet, migration patterns and the critical habitat and population factors for major caribou herds in the watershed.
3) Carry out 1:50,000 scale biophysical habitat mapping in the most important caribou ranges.
4) Use population information and biophysical mapping to assist in development of integrated forestry and access plans.
5) Evaluate potential for enhancement of key habitats through forestry practices and site manipulations.

STONE SHEEP

British Columbia and the southern Yukon contain the entire population of stone sheep in the world numbering about 11,000 animals. The Williston Basin contains about 10% of this total, primarily in the upper Finlay area. Stone sheep are a prized trophy for hunters and photographers. Dunlevy Inlet 40 km north of Hudson Hope is one of two locations in Canada where Stone sheep can readily be viewed from a vehicle.

Distribution and Population Status

Stone sheep are found adjacent to the Peace Arm between Butler Ridge and the Nabesche River. A small herd is also found in the upper Ospika River area. The total population in the Peace Arm is about 160 head. Stone sheep are found in the Russell Range,the Muskwa range and the Hart Range in the upper Finlay River area. The total population of Stone sheep adjacent to the Finlay Drainage is estimated to be 625-900(Child and King 1988).

Economic Value

The average annual value of Stone sheep hunting in the Williston Basin hunting between 1985 and 1989 was $112,000 with $31,000 (28%) coming from residents and $81,000 (72%) coming from non-residents. See Appendix I for further details.

Management Goals

1) Increase the Stone sheep population.
2) Maintain and protect the quality of Stone sheep habitat.

Management Objectives

1) Identify major limiting factors.
2) Increase the Stone sheep population in the Peace Arm by 40% by the year 2000 through habitat enhancement and protection of key habitat and by translocations to traditional or potential habitat.
3) Maintain the population of Stone sheep adjacent to the Finlay Arm.

Management Strategy

Current MOE Activities

1) Restrict hunting to trophy rams(full curl).
2) Set non-resident harvest quotas.
3) Protect Stone sheep range through habitat referrals, seismic restrictions, and participation in logging plans.
5) Develop an access management plan for Stone sheep herds in the Russell and Musqua Ranges.
6) Monitor the impact of prescribed fire on vegetation using Habitat Conservation Fund enhancement monitoring guidelines.

Compensation Activities

1) Translocate sheep to Mount Frank Roy and Mount MacAllister.
2) Complete reconnaissance inventories of Mount Selwyn, Ospika River, and Muskwa range herds.
3) Complete a detailed inventory of the Russell Range herd.
4) Enhance ranges by burning.
5) Provide input into access management in the Russell and Muskwa Ranges.
6) Determine foraging strategies, snow depth and factors affecting winter habitat suitability in potential sheep range.
7) Complete biophysical mapping of Stone sheep range in the Upper Finlay,the Peace Arm,and the Hart Foothills.

ELK

Introduction

Elk populations were abundant along the Peace Arm of Williston Reservoir between the time that Alexander Mackenzie travelled through the area in 1793 and the late 1880's when extensive wild fire and severe winter conditions nearly destroyed the population.

Distribution and Abundance

Elk are found in three areas of the Williston Basin including the Peace Arm, Ingenika and the east side of the Finlay, north of the reservoir. Small herds have also been reported in Finlay Bay and the Ospika valley. The north shore of the Peace Arm between the Nabesche River and Portage Mountain is estimated to contain about 300 elk. Between 1984 - 1986, 145 elk were transplanted to Dunlevy Inlet area from the east Kootenay (Harper 1988). Chief Pierre reported 20-30 elk in the Ingenika area during the fall of 1990. Small numbers of elk(< 20-40) are known to exist east of the Finlay River between the Pesika and Paul rivers. Elk populations adjacent to the Peace Arm are rapidly expanding (16%/yr, Harper 1988), while those of the Finlay Arm are slowly expanding (Child and King 1988).

Habitat Requirements

Habitat needs change throughout the year varying from open grasslands and early serai aspen during winter months to mature subalpine fir-Engelmann spruce stands during summer and fall months. Critical winter habitat in the Peace Arm is shrub-grassland habitats at low elevation on south and west-facing slopes adjacent to Williston Reservoir. Elk diets include most types of forage with preference for grasses and forbs. During winter months they will switch to browse species exclusively if snow accumulations are greater than about 60 cm. Elk populations were most abundant when aspen parklands were most extensive in North America. Conifer encroachment, due to lack of wildfire in some areas, has reduced the suitability of winter ranges. Thomas (1979) stated that the ratio of 40 percent of a land type in cover to 60 percent in more open forage areas of proper size and arrangement approximates optimum elk habitat in the Blue Mountains of Oregon State. A higher proportion of cover may be required in the deeper snow elk ranges in the Williston Basin. Logging practises including large clear-cuts, herbicide application to prevent shrub regeneration, and long-term access may soon reduce the suitability of winter range in the Finlay and Peace Arms of the Williston drainage unless integrated management for elk is implemented.

Economic Value

Hunting seasons for elk adjacent to the Peace Arm of Williston Lake were not initiated until the fall of 1989 and the value of that hunting was $42,900. Elk hunting is highly valued by residents and non-residents and public support for increasing elk populations is high. Non-consumptive use of elk may become as valuable as hunting as viewing areas are developed in the Dunlevy Creek area.

No elk hunting season exist west of the Upper Finlay River and only 5 elk were harvested between 1985 and 1989 in WMU 7-41 east of the Finlay River between Pesika and Scarcity Creeks.

Management Goals

1) Increase the elk population due to the high public demand for elk.

Management Objectives

1) Determine major limiting factors.
2) Increase the population of elk by habitat enhancement of key winter ranges.
3) Translocate elk to suitable habitat.
4) Protect key habitat through integrated resource management.

Management Strategy

Current MOE Activities

1) Provide recreation through seasons aimed at bull harvest.
2) Inventory elk and monitor harvest to set suitable harvest levels.
3) Protect habitat through referrals and guidelines to Timber Supply Area (T.S.A.) plans.
4) Increase enhancement activities in the Peace Arm.

Compensation Activities

1) Identify locations, habitat use, numbers and mortality of elk through inventory, radio-telemetry and diet analysis.
2) Make recommendations to initiate L.E.H. seasons on non-trophy elk when populations near carrying capacity.
3) Continue translocations where suitable habitat exists and populations are low or absent. Initial surveys indicate that potential areas are: the east side of the upper Finlay and the Omineca River area. High density herds on the Peace Arm may be used as source stock for translocations.
4) Determine seasonal habitat use.
5) Map existing and potential elk habitat. Potential elk habitat will be mapped at a scale of 1:50,000 utilizing snow depth mapping and habitat relationship research data.
6) Establish guidelines for protection of elk habitat in the Williston area based upon habitat relationship and inventory data.
7) Enhance potential and existing elk habitat through prescribed burning and patch-cut logging.
8) Make recommendations to control access to key elk range.
9) Determine the effects of cut-block size and logging techniques on elk populations in the Boreal white spruce black spruce biogeoclimatic zone.

DEER

INTRODUCTION

Two species of deer occur in the Williston Basin, the mule deer and the white-tailed deer. Population levels of both species can fluctuate widely in response to winter severity(Harper 1988).

Distribution

White-tailed deer are found on the north shore of Williston Reservoir between Hudson Hope and Bevel Creek, on the Finlay Arm, and on the south shore of Williston Lake between Hudson's Hope and Carbon Creek. Mule deer have a wider distribution inhabiting most drainages of the Peace Reach during some months of the year and the north shore of the Peace Arm between Weasel Creek and Hudson Hope year round. Mule dear are found in the Parsnip Valley on the west side of the Parsnip Arm near Burden Lake and the east side of the Parsnip Arm near Mackenzie and between Scott Creek and Finlay Bay. Mule deer are found in the Ingenika area on the west side of the Finlay Arm, and in low densities on the east side of the Finlay drainage.

Habitat Requirements

Mule deer use a great variety of habitats and may be found in every biogeoclimatic zone,whereas white-tailed deer prefer riparian habitat and open agricultural areas year round. The key factors affecting mule deer populations are snow depths and forage availability.

Areas of low snow depth<40 cm) required by wintering deer constitute a very small proportion of the Williston watershed. Both mule deer and white-tailed deer winter at low elevation on south and west-facing slopes and river banks. In the Finlay-Parsnip area open deciduous areas with adjacent old growth forest having low to moderate snow fall are selected as winter range. Young serai aspen stands on low elevation, south-facing slopes are used as winter range by both deer species in the Peace Arm. In mountainous terrain of the Peace Arm, most mule deer move up slope to the subalpine zone with spring melt. Snow accumulation in the fall drives them back down to low elevations. On the rolling or level terrain of the eastern part of the Peace Arm, mule deer frequently winter on river breaks. Mule deer may move great distances between seasonal ranges (MOE, Fort St John), but white-tailed deer usually have small home ranges.In the Finlay and Parsnip Arms little is known about seasonal deer movements.

Shrubs usually compose the largest proportion of mule deer diets during winter months when snow depths limit access to grasses and forbs. White-tailed deer prefer the forage of agricultural areas if forest canopy cover has been preserved nearby. Livestock grazing has reduced the suitability of some deer range adjacent to the Peace River breaks. Large clear cut blocks and herbicide application to prevent shrub regrowth have

reduced suitability of deer winter range in some parts of the Finlay and Parsnipdrainages.

Economic Value

The number of hunters,number of hunter days and harvest of deer in the Finlay-Parsnip area fluctuated widely between 1976 and 1986 but remained fairly stable in the Peace area (Appendix 1).
The estimated averaged(10 year) annual value of deer hunting in the Williston drainage area is $74,000.

Management Goal

1) Maintain existing deer populations in the Peace and Finlay-Parsnip Arms of the Williston Basin.

Management Objectives

1) Determine major limiting factors.
2) Maintain existing critical deer habitats.
3) Enhance key winter range.

Management Strategy

Current MOE Activities

1) Adjust hunting seasons and bag limits to population trends.
2) Allow doe and fawn harvest by Limited Entry Hunt permit only.
3) Conduct deer inventories on the Peace Arm.
4) Process logging, mineral and mining referrals on deer range.
5) Conduct integrated resource management through forestry planning (5-year plans, TSA).

Compensation Activities

1) Conduct deer habitat inventories.
2) Determine major limiting factors by radio-telemetry, diet analysis, snow analysis and inventories.
3) Map snow depth over a period of several years.
4) Map biophysical capability of key ranges at 1:50 000 scale.
5) Carry out habitat enhancement through prescribed burning.
6) Assist in the development of integrated resource management land-use plans.
7) Make recommendations for access control on key deer winter range.
8) Determine seasonal habitat use and migration corridors in important ranges by radio-telemetry.

WATERFOWL

Introduction

Many species of waterfowl stage or breed within the Williston Basin including more than 20 species of diving and dabbling ducks, as well as Canada geese, and two swan species: trumpeter and tundra. Diving ducks include greater and lesser scaup, red heads, canvasback, ruddy ducks, mergansers (common, red breasted, hooded), ring-necked duck, white winged, and surf scooter, Barrow's and common goldeneye, harlequin ducks, and buffleheads. Dabblers include teal (blue-winged, green-winged, and cinnamon), mallards, pintails, gadwalls, American widgeon, and shovellers. Most species migrate far south of the watershed for the winter. An exception to this is the trumpeter swan which has a wintering population on the Crooked River at the southern end of the watershed.

Distribution and Abundance

Few data are available on waterfowl in the Williston watershed. Approximately 80 Trumpeter Swans winter on the Crooked River system (Bill Arthur pers com 1990). The Rocky Mountain Trench is *a* minor migration corridor for waterfowl breeding farther north. A long time resident in the area reports that before reservoir flooding, Canada Geese migrating south in the fall would use areas along the Finlay River as resting and feeding sites. The lowlands of the Parsnip and Finlay drainages have numerous wetlands including oxbow lakes, ponds, marshes, and low-gradient bays on the reservoir foreshore suitable for waterfowl breeding. The Peace Arm is generally steep sided and has few wetlands suitable for waterfowl.

Habitat Requirements

Waterfowl require wetlands with relatively stable water levels, suitable aquatic or terrestrial forage species, and adequate surrounding terrestrial vegetation for nesting cover. Optimal water depths and vegetation will vary with the waterfowl. Divers require deeper more permanent water bodies than dabblers. Dabblers usually nest in dense tall grass near water. Tree nesting ducks require large diameter snags or nest boxes for nesting.

Many bays in Williston Reservoir with a shallow gradient could provide good habitat for Canada geese and some species of ducks if large annual fluctuation in reservoir water levels did not occur. However, rising spring water levels flood out nests and cover vegetation critical for hiding and foraging. Possible techniques to counter these problems include:

(1) dyking to stabilize water levels;
(2) providing floating islands for nesting;
(3) creation of ponds and ditches in the upper foreshore areas.

Wetland projects will be done jointly with Ducks Unlimited where possible.

All wetland projects should be designed to benefit aquatic furbearers as well as waterfowl if feasible.

Economic Value

Since waterfowl congregate at certain times of year they are good candidates for viewing. Hunting of waterfowl is a popular sport where good populations of birds are present and would likely become more popular in the Williston area if populations increase.

Management Goal

1) Maintain and enhance populations of waterfowl within the Williston watershed.
2) Increase the public's opportunity to view and hunt waterfowl in the Williston watershed.

Management Objectives

1) Protect and enhance nesting, loafing, and brooding habitat for waterfowl in the Williston watershed.
2) Provide areas for the public to view and learn about waterfowl.
3) Evaluate the possibility to attract migrating waterfowl to specific sites in the watershed .

Management Strategy

Current MOE Activities

1) Protect wetlands used by waterfowl as migrant and wintering habitat.

Compensation Activities

1) Locate, evaluate, and priorize wetland sites for waterfowl habitat enhancement projects.
2) Conduct habitat enhancement projects including: pothole blasting or digging, dam construction, construction and placement of floating islands and nest boxes and seeding of forage and cover vegetation for waterfowl.
3) Evaluate feasibility of Canada geese transplants to boost populations in enhanced areas.
4) Provide facilities and information signs to encourage waterfowl viewing and public understanding of enhancement efforts.
5) Evaluate potential for enhancing Spring and Fall staging sites for Canada Geese and other waterfowl that nest farther north.

GRIZZLY BEAR AND BLACK BEAR

Introduction

The grizzly bear is endangered in the United States but not in Canada. These animals have been extirpated from most of their range in the United States due to overharvest, human /bear conflicts and habitat loss. Grizzly bear are sensitive to overharvest due to low average recruitment rates. Females do not usually give birth until 6 or 7 years of age. One to three cubs are born every third year thereafter if food sources are adequate, especially prior to denning in the fall.

Black bear populations are stable or declining in most of the Province. Black bear commonly give birth at 3 years of age to 1 to 4 cubs. Cubs are born every year or every second year resulting in much higher average recruitment rates than grizzly bears. Liberal bag limits and extensive seasons(spring and fall) are believed to have been the cause for a decline in accessible areas of northeastern British Columbia.

Distribution and Abundance

Grizzly bear and black bear are found in many habitats throughout the Williston Basin. The population of grizzly bear in the Williston Basin is estimated to be about 1250 and the number of black bear 5000 based upon density in various biogeoclimatic zones,hunter harvest and field observations (Harper 1988, Child and King 1988).

Habitat Requirements

Key habitat requirements are denning areas, foraging areas, scavenging areas, and ungulate birthing sites. Bear prefer riparian areas during spring and summer and subalpine habitat where huckleberry and crowberry patches are abundant during the fall. Grizzly and black bear of the interior of British Columbia are omnivorous with the largest portion of the diet being plant material. Riparian areas provide preferred forage species and are very productive. Berry patches provide the energy required for a large store of body fat. Hunter kills provide a meat source during fall months and are often revisited after the bear leaves the den. Denning sites are located where snow conditions are stable,usually subalpine areas. The density of black bear may be controlled by the density of grizzly bear in each drainage(Harper 1988).

Economic Value

Bears are primarily pursued as a trophy animal by hunters and photographers. Bear hunting in the Williston Basin is second only to moose in annual value to the economy. The value of claws,bear gall and tanned bear hide make each harvested bear worth $380 to $1400 depending upon where the parts and hide are sold. The average annual value of grizzly bear hunting to the economy between 1985 and 1989 was $221,000 with

$175,000(79%) coming from non-resident hunters and $46,000 coming from resident hunters. The average annual value of black bear hunting to the economy between 1985 and 1989 was $391,000 with $300,000(77%) coming from non-residents and $91,000 coming from residents. The consumptive value of bear hunting is presented in Appendix I.

Management Goals

1) Maintain existing populations of black and grizzly bear.
2) Prevent human-bear conflicts.
3) Protect key habitat.

Management Objectives

1) Encourage utilization of grizzly and black bear as a trophy animals.
2) Regulate hunting seasons which ensure continued hunting opportunities.
3) Restrict access to known bear concentrations.
4) Promote suitable garbage disposal to prevent habituation and conflict.
5) Identify and map critical bear habitats.

Management Strategy

Current MOE Activities

1) Provide maximum recreation to black bear hunters by liberal hunting seasons and bag limits.
2) Protect grizzly bear populations by establishing guide outfitter quotas and restricting hunting where overharvest has occurred.
3) Translocate nuisance grizzly bear, if feasible.
4) Monitor the trade in bear parts to determine the trend and impact on populations.
5) Monitor population trends to determine the effects of management strategies.
6) Discourage road construction into key grizzly bear habitat.
7) Enforce suitable garbagedisposal(preferablyincineration) at all camp sites in back country.

Compensation Activities

1) Recommend hunting regulations which will complement the compensation program.
2) Map key bear habitat.
3) Develop bear habitat maps which would be used to guide resource development and protect bear habitat.
4) Initiate access management for grizzly and black bear.
5) Cooperate in research projects to determine population dynamics and habitat requirements of grizzly bear in northern Interior British Columbia.

MOUNTAIN GOATS

Introduction

British Columbia contains about 55,000 mountain goats which is 60% of the worlds population. The goat population of British Columbia declined in the late 1960's and early 1970's due to overharvest but has been slowly increasing in the 1980's. Mountain goats are susceptible to overharvest because their strategy of escaping predators by methodically climbing steep rocky terrain makes them an easy target for the high-powered rifle of modern man.

Distribution and Population Status

Goat populations are found in the Muskwa and Hart Ranges of the Rocky Mountains, the Hart Foothills, and the Sifton, Stikine, Finlay, and Swannell Ranges of the Omineca Mountains. Total goat populations in the Williston Basin area number about 2000. Highest concentrations are found between the Wicked River and the Kwadacha Plateau east of the Finlay drainage and between the Omineca River and the headwaters of the Finlay River west of the Reservoir.

Habitat Requirements

Most goat herds adjacent to the Peace Arm winter on south or west-facing wind blown slopes adjacent to steep,rocky terrain which is used as thermal and hiding cover. In the Finlay and Parsnip drainages goats are believed to winter on south-facing slopes and utilize mature forest cover at mid-elevation for thermal and hiding cover (Child and King 1988). Accumulation of deep snow and lack of wind scouring frequently cause high mortality among kid and yearling age classes because of the difficulty in obtaining forage. Summer range is usually in the Alpine Tundra zone near rocky outcrops at the head-walls of cirques. Adjacent conifer cover is used for shade in the summer and thermal cover and forage during winter months. Resource extraction can impact on goat populations by permitting easy access and high harvest rates. Other factors limiting goat populations including predation and disease are not known for this area. Goat range is largely undisturbed in the Williston Basin area.

Economic Value

Goats are considered a trophy animal by most resident and all non-resident hunters and are an important wildlife viewing species. The average annual net economic value of goat hunting in the Williston Basin from 1985-1989 was $135,000 with $118,000(87%) coming from non-residents and $17,000(23%) coming from residents. See Appendix I. for further details.

Management Goals

1) Maintain the existing population of goats in the Williston Basin.

Management Objectives

1) Determine major limiting factors to goat populations.
2) Set hunting regulations designed for herds of different ecological units because population dynamics vary widely between herds.
3) Conservative harvest levels(<10%-Child and King 1988)and L.E.H seasons on herds which are easily accessible to hunting pressure.
4) Set guidelines to protect Alpine Tundra habitat.

Management Strategy

Current MOE Activities

1) Determine number and status of goat populations in the Williston Basin.
2) Regulate hunting seasons which reflect population levels and hunting pressure.
3) Encourage hunter harvest of males only.
4) Restrict development in Alpine Tundra habitat.
5) Allow only portable seismic activity in Alpine Tundra areas.

Compensation Activities

1) Determine major limiting factors by analysis of diet, predator scat, and snow depth.
2) Inventory goat populations.
3) Recommend establishment of L.E.H. seasons or closures where resource development road and camp development result in easy and abundant access to goat populations.
4) Establish an access management plan for major goat populations in the Williston drainage.
5) Map goat habitats.
6) Establish guidelines to protect goat habitat.

FURBEARING ANIMALS

Introduction

Furbearing animals can be divided into three groups based on their major habitat requirements. Aquatic furbearers including beaver, mink, muskrat and otter depend on wetland and lake habitats. Mature forests are critical habitat component for martens and squirrels. Lynx, snowshoe hare, fisher, wolverine, coyote, fox, skunk and weasel generally prefer a mixed vegetation pattern including openings, and young and mature forests. Fisher and wolverine are rare in much of their historic range throughout the world. However, relatively large populations are believed to exist in the Williston Basin area based upon trapper returns.

Distribution and Abundance

The Omineca Sub-regional plan (Child and King 1988) classifies the furbearers in the Finlay/Parsnip into three classes of abundance:

Few	: fisher, fox, mink, muskrat, skunk
Moderate Density	: weasel, wolf, wolverine, otter, beaver
Abundant	: marten, squirrel, lynx(cyclic)

Habitat Requirements

Habitat requirements will be presented for the four furbearers which provide most of the trapping revenue in Williston Basin(marten, beaver, lynx and mink) and for fisher and wolverine.

Mature forests are a critical component of marten habitat. Large trees and logs are important den sites. Stumps, slash and deadfalls which provide access to prey below the snow are critical habitat elements in winter. Overhead cover is also an important factor in habitat selection. Marten will tolerate a variety of habitats if food and cover are available. Extensive clearcutting or large fires will seriously reduce the habitat value for marten.

Beaver require suitable water conditions and an adequate supply of preferred food. They reach maximum densities in slow meandering streams and lakes that have an abundant supplies of trembling aspen within 100 m of the water. Beaver are negatively affected by development which interferes with stable water levels or which destroys vegetation adjacent to wetlands.

Lynx depend on snowshoe hare as their principal food and consequently good hare habitat is good lynx habitat. Lynx population cycles follow the well known 10-year hare population cycle. Snowshoe hare prefer diverse forests with alternate stands of conifer for cover and shrubby openings for feeding. An irregular pattern of logging or fire in boreal forest should produce prime lynx habitat if forest successional is allowed to follow normal successional patterns.

Mink occupy a variety of wetlands including streams, rivers, lakes and marshes. Permanence of water and the presence of shoreline and aquatic vegetation are important factors for mink. Enhancement and protection activities for these four major species will also benefit other small mammals, birds and other furbearers.

Wolverines use a wide range of habitats but avoid large openings. Their large home ranges include unbroken wilderness. Diets are largely composed of carrion. Fisher are found in mixed wood forest but prefer mature coniferous forests during periods of deep snow.

Economic Value

These animals are valuable components of the ecosystems they live in and their presence enhances the experience of people travelling in the woods. The 93 traplines registered in the Williston watershed in 1980/81 produced an estimated gross revenue in 1980/81 of $150,000 - $200,000 which represented 5% of the provincial for trapping (Finlay/Omineca Strategic Plan, 1983). Four species producing the most trapping revenue are the marten, lynx, beaver and mink. Fisher and wolverine are important species because of their relative rarity and their endangered status in other parts of the world.

Management Goal

1) Maintain acceptable quantity and quality of habitat for furbearing animals with an emphasis on marten, lynx, beaver, mink, wolverine and fisher.

Management Objectives

1) Protect furbearer habitat through integrated management planning and projects.
2) Ensure that trappers have information needed to allow successful management.
3) Ensure that forestry personnel have information necessary to understand the inter-relationship of furbearer habitat requirements with forestry practises.

Management Strategy

Current MOE Activities

1) Gather local information from trappers on habitat used by furbearers.
2) Develop and deliver harvest management guidelines and management strategies to trappers.
3) Develop habitat protection guidelines for species with narrow habitat requirements. Implement these guidelines through development referral

Compensation Management Activities

1) Compile detailed information on habitat requirements and habitat enhancement techniques for major furbearers through literature surveys and interviews with trappers and specialists.
2) Initiate trials of innovative forestry practises to lessen the impacts of forest harvesting and silviculture on fur bearing animals.
3) Conduct wetland enhancement projects which will benefit both aquatic furbearers and waterfowl.

NON-GAME BIRDS

Introduction

Non-game birds include all bird species except waterfowl and upland game birds. Most non-game species are migratory, wintering far south of the Williston watershed. Some nest in the area while others only stage here during migration. There are two highly visible types of birds in the watershed that are amenable to active protection and enhancement activities. The first type is the fish-eating raptors, including bald eagles and ospreys. The second type are the cavity nesters including 7 species of woodpeckers, 5 species of owls, kestrel, red-breasted nuthatch, 3 species of chickadees, swallows and tree nesting ducks.

Abundance. Distribution and Habitat Requirements

The fish-eating raptors and their nests are a relatively common sight along some parts of the reservoir and adjacent rivers. They have adapted well to the flooding of the Rocky Mountain Trench, and are using many of the standing snags created by the reservoir as nesting and perching sites. However, many of these snags have decayed and fallen down. In some areas, forestry and firewood cutting activities could threaten important nesting or perching areas.

Cavity nesters depend on snags for nesting and perching requirements. In areas of intensive forest harvest, the destruction of desirable snags can limit populations of these species.

Species value

Both of these types of birds are very visible and important parts of the ecosystem. Fish-eating raptors, being at the top of the food chain are indicators of the health of the ecosystem. Woodpeckers play a role in the regulation of forest pest insects such as spruce bark beetle. Both these types of birds are valued by bird watchers.

Management Goals

1) Maintain current populations of ospreys and bald eagles.
2) Maintain acceptable populations of cavity nesting bird species.

Management Stategy

Current MOE activities

1) Provide habitat protection recommendations to resource developers based on current knowledge.

Compensation activities

1) Review and summarize the available literature on the habitat requirements of bald eagles, ospreys, and cavity nesting birds.
2) Survey and map present concentrations of osprey and eagle nesting sites.
3) Evaluate potential habitat factors limiting osprey and eagle populations, and if necessary develop projects to ensure adequate nesting habitat remains.
4) Develop, test, and promote new forest harvesting systems designed to maintain snags for cavity nesting birds.

CONCLUSION

The Compensation Management Plan has laid out the general approach proposed for wildlife compensation in the Williston watershed and the activities required for the enhancement and protection of major species. This report gives a clear direction for the program and is a first essential step in planning. Using this document as a basis, more detailed annual action plans will be prepared. These annual plans will benefit from the greater biological information and public input that will be gathered over the next few months and years.

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APPENDIX I - Hunter statistics for the Williston Basin

Table 1. Average annual moose harvest,number of hunters, hunter days and value fo moose hunting in the Williston watershed between 1985 and 1989.

LOCATION	HARVEST		NO. HUNTERS		HUNTER DAYS		VALUE (x$ 1000)	
	Res.	N. R.	Res.	N. R.	Res.	N. R.	Res.	N. R.
FINLAY/PARSNIP	860	99	3069	174	22100	1240	1048	220
PEACE ARM	414	43	956	58	6118	337	278	47
TOTAL	1274	142	4025	232	28218	1577	1336	267

The value of a non-resident hunter day is $169.30 while the value of a resident hunter day is $47.34(Reid 1988)

Table 2. Average annual caribou harvest,number of hunters,number of hunter days and value of caribou hunting in the Williston watershed between 1985 and 1989.

LOCATION	HARVEST		NO. HUNTERS		HUNTER DAYS		VALUE(x$1000)	
	Res.	N. R.	Res.	N. R.	Res.	N. R.	Res.	N. R.
FINLAY/PARSNIP	9	35	72	73	461	476	19	138
PEACE ARM	1	8	15	7	98	137	4	40
TOTAL	10	43	89	90	559	613	23	178

The value of a non-resident hunter day for caribou is $290 while that of a resident hunter day is $41 (Reid 1988).

Table 3. Average annual harvest,number of hunters number of hunter days and value of Stone sheep hunting in the Williston watershed between 1985 and 1989.

Location	Harvested		No. Hunters		Hunter Days		Value (xl000)	
	Res.	N. R.	Res.	N. R.	Res.	N. R.	Res.	N. R.
Finlay/Parsnip	9	16	34	23	271	180	22	62
Peace Arm	2	4	15	7	116	55	9	19
Total	11	20	49	30	387	235	31	81

The net value of a resident hunter day was $80.90(1988 dollars),while that of a non-resident hunter day was $347.

Table 4. Harvest,number of hunters,hunter days, and value of hunting elk in W.M.U's 7-35 and 7-36 in 1989 *.

W.M.U.	Hunters		Harvest		Hunt Days	
	Rep.	Est.	Est.	Actual	Reported	Estimated
7-35	84	135	11	15	427	738
7-36	50	80	12	7	194	330
Total	134	215	23	22	621	1068

* All elk harvested in the South Peace Subregion required compulsory inspection in 1989 and 16 bull elk were harvested by resident hunters that year. At an average value of $40.20 per hunter day(Reid 1988),the 1989 value of elk hunting near the Williston Reservoir was $42,900.

Table 5. Average annual harvest.number of hunters,number of hunter days, and value of deer hunting in the Williston Basin area, 1976-1986.

LOCATION	Harvest	No. Hunters	Hunter Days	Value(xl000)
FINLAY/PARSNIP	18	353	1885	67
PEACE ARM*	4	53	207	7
Total	22	406	2092	74

* Guesstimated-the number of hunters,hunter days and harvest of deer in the Peace Arm is unknown because the largest proportion of deer hunting activity occurs in W.M.U.7-35 most which is not part of the Williston watershed. Most deer hunting pressure comes from residents. The value of a resident hunter day is $35.37(Reid 1988).

Table 6. Average annual number of bear harvested,number of hunters,number of hunter days, and value of hunting bear in the Williston Basin area.

Grizzly Bear

Location	Harvest		No. Hunters		No. Hunter Days		Value (x 1000)	
	Res.	N.R.	Res.	N.R.	Res.	N.R.	Res.	N.R.
Finlay-Parsnip	10	19	63	72	460	652	31	141
Peace Arm	6	6	39	18	232	161	15	34
Total	16	25	102	90	692	813	46	175

Black Bear

Location	Harvest		No. Hunters		No. Hunter Days		Value (x 1000)	
	Res.	N.R.	Res.	N.R.	Res.	N.R .	Res.	N.R.
Finlay/Parsnip	114	78	401	132	2717	1094	69	239
Peace Arm	59	28	154	41	899	292	22	61
Total	173	106	555	173	2616	1386	91	300
Grand Total	189	131	657	263	3308	2199	137	475

The average daily net economic value of grizzly bear hunting was $207 for non-residents and $63.60 to residents(Reid 1988). The average net economic value of black bear hunting was $210 for non-residents and $24.50 for residents(Reid 1988).

Table 7. Average annual harvest of goats, number of hunters, hunter days and net annual value of goat hunting in the Williston Basin 1985/1989.

Location	Harvest		Hunters		Hunter days		Value (X 1000)	
	Res.	N.R.*	Res.	N.R.	Res.	N.R.	Res.	N.R.
Finlay-Parsnip	19	68	51	102	273	581	13	98
Peace Arm	5	13	18	20	74	114	4	20
Total	24	81	69	122	347	695	17	118

The daily net value of goat hunting is $169 for non-residents and $48.20 for residents(Reid 1988).

The total net annual economic value of hunting in the Williston Basin area is $2.668 million with $1.630 million coming from resident hunters and $1.038 million coming from non-resident hunters.