EFFECTS OF WATER LEVELS ON PRODUCTIVITY OF CANADA GEESE IN THE NORTHERN FLATHEAD VALLEY

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ABSTRACT

The Fish and Wildlife Program of the Northwest Power Planning Council calls for wildlife mitigation at hydroelectric projects in the Columbia River System Operation of Hungry Horse Dam on the South Fork Flathead River causes sporadic water level fluctuations along the main stem Flathead River. Changes in chronology of seasonal water level fluctuations and substantial habitat losses have occurredas a result of construction and operation of Kerr Dam, which regulates Flathead Lake. These fluctuations may impact goose populations through flooding and erosion of nesting and brood-rearing habitats, and increased susceptibility of nests and young to predation. The Bonneville Power Administration (BPA) has funded a 3-year study to evaluate these effects; this report summarizes the results of the second year's research efforts.

The number, location, and success of goose nests were determined through pair surveys and nest searches. Our 1985 pair count data indicated that 95-143 nests may have been present. An average of151 indicated pairs were recorded in the study area; 108 nests were found in the same area. Fifty seven of the nests were found on elevated sites: 25 in nests built by other species, 12 in natural snags, 5 on man-made structures, and 15 in weathered stumps on the remnant delta in the Flathead Waterfowl Production Area (WPA). Fifty-one of the nests wereground nests. Hatching success for 1985 nests (55%) was low compared to long-term averages for the region.Predation was the predominant cause of ground nest failure (25 nests); we documented 2 nest failures due to flooding. As in 1984, 85% of all ground nests were located within 1 m above or below the seasonal high water mark (HWM). Ten of 15 stump nests at the WPA were at or below full pool elevation (2893 ft.). Mostgroundnests werelocated on islands in marsh, shrub, or forest cover types. Both ground nest sites and adjacent sites 5 m from the nests were found in open (<25%) overstory canopy cover. Tree nests averaged 17.0 m above the ground in trees or snags averaging 20.0 m inheightand 0.96 m in diameter. All tree nests were found in deciduous forest on riparian benches. Twenty-eight percent of the trees containing nests were less than 2.0 m from the HWM and 52% were less than 5.0 m from the HWM. Stump nests found on the delta mudflats averaged 1.82 m in height and 3.73 m in circumference. The stump cavities averaged 32 cm x 47 cm at a depth of 38 cm.

The maximum gosling count in the study area for 1985 was 197. Total gosling production predicted by our nest total (108), hatching success (55%) and mean brood size (5.0), was 295 goslings for the study area. Six key brood-rearing areas were identified. Most (80%) sites were located in the herbaceous or pasture cover type and the riparian bench landform. All sites were less than 1.5 m above the HWM and 70% were less than 10.0 m horizontal

throughout the brood-rearing period. Activity budget surveys conducted at the WPA indicated that broods spend the majority of their time (54%) feeding, primarily (37%) in the extensive mudflats along the north shore in areas classified as either unvegetated or short herbaceous cover types. Analysis of 316 observations of individual broods indicated no decline in mean brood size over time or age class, either for the WPA or for the study area as a whole.

Analysis of aerial photographs taken prior to construction of Kerr Dam documented the loss of 1,859 acres of habitat along the north shore of Flathead Lake. Losses were attributed to inundation and to continuing erosion due to operation of Kerr Dam.

Twenty-two geese were equipped with radio-collars during 1985 trapping efforts. Five radio-collared geese nested in the study area; Geese nesting on the river raised their broods on nearby off-river sloughs. In three cases, geese traveled 19-37 km with their broods to the WPA.

Lake and river water level regimes were compared with the chronology of important periods in the nesting cycle. Fluctuations in the river levels during egg-laying and incubation may disrupt some island ground nests, through flooding and predation. Low lake levels in May and early Junecoincide with thebrood-rearing period. Mudflats areheavily used by broods, but their effect on survival must still be documented. Continued documentation of nesting and brood-rearing habitat, nesting success and gosling survival in relation to water level fluctuations will allow managers to optimize compatibility between water level regimes and goose production. Preliminary recommendations to protect and enhance Canada goose habitat and production are being developed.

ACKNOWLEDGEMENTS

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INTRODUCTION

The Columbia River Basin Fish and Wildlife Program was published by the Northwest Power Planning Council in 1982, in response to the Pacific Northwest Electric Power Planning and Conservation Act of 1980. The Program was developed toaddress protection, mitigation, and enhancement of fish and wildlife resources affected by the development, operation, and management of hydroelectric facilities on the Columbia River and its tributaries. It specifically called for evaluation of effects on wildlife and wildlife habitat attributable to both Hungry Horse and Kerr dams and development of mitigation plans to offset these effects. Thecurrent study (BPA Project 83-498) is designed to address the effects of these projects on the western Canada goose (*Brantacanadensis moffitti*) population inhabiting the northern portion of the Flathead Valley in northwest Montana. Our study was based on the following concerns expressed in Section 1000, Table 7 of the Fish and Wildlife Program:

A) The effects of water level fluctuations and reservoir drawdown;

B) The loss of habitat due to erosion, particularly on the north shore of Flathead Lake; and

Cl Losses in production and habitat requirements of waterfowl.

This report is a summary of the results from the second year of a 3-year study. The study is designed to identify the current size and productivity ofthegoose population, describe habitat conditions and their relationship to water level fluctuations, and to develop potential protection, mitigation and enhancement strategies for this population and its habitats. A similar study is being conducted by the Confederated Salish and Kootenai Tribes (CSKT) to evaluate the impact of water level fluctuations due to Kerr Dam on Canada goose populations inhabiting the southern half of Flathead Lake and the lower Flathead River below Kerr Dam. Coordination of the objectives, methodologies, and data analysis in these 2 studies will provide a data base which will facilitate both impact assessment and mitigation for this species throughout that portion of the Flathead Drainage which is influenced by Hungry Horse and Kerr Dams. Both projects are also being coordinated with the objectives of the Flathead Valley Canada Goose Committee (a multi-agency working group), established in 1975 to promote effective Canada goose management in the Flathead Valley.

Hungry Horse Dam is owned and operated by the U.S. Bureau of Reclamation. Located on the South Fork of the Flathead River, it was completed in 1953. The dam is operated primarily for flood control and hydroelectric energy production. Operation of Hungry

Horse Dam is determined in concert with the complex network of hydroelectric systems, consumption needs, and flood control requirements throughout the Pacific Northwest. Operation of Hungry Horse has altered natural flow regimes in the South Fork and in the main stem FlatheadRiver. The effects of the altered discharges on the main stem are moderated by natural flows from the unregulated North and Middle Forks.

Kerr Dam, located 7 km downstream of the natural outlet of Flathead Lake, was completed in 1938. Operated by the Montana Power Company (MPC) under a lease with the CSKT, Kerr Dam is operated primarily for flood control and hydroelectric energy production. Under current water regimes, the Kerr facility controls water levels of Flathead Lake between elevations 2,883 ft. and 2,893 ft. with maximum lake elevation reached in July and maintained into September, and minimum lake elevation occurring in March and April.

The earliest studies of the Flathead Valley goose population were conducted by Harraclough (1954, also Geis 1956) who studied nesting and brood-rearing throughout Flathead Lake. She documented 160 goslings using the north shore of the lake in 1953, including some which had hatched at Goose and Douglas Islands, 13 km to the south. She speculated that broods hatched from nests along the river north of the lake and from islands at the south end of the lake also may have been reared along the north shore. As early as 1954, there was a concernthatthe broad expanses of mudflats, which resulted from low lake elevations during the brood-rearing period, might expose goslings to an increased risk of predation (Barraclough 1954).

Craighead and Stockstad (1964) estimated an average spring population of 800 geese and 201 nests in the Flathead Valley from 1953 through1960. Their research focused on Flathead Lake, two National Waterfowl Refuges to the south (Ninepipe and Pablo), and the lower FlatheadRiver, an area roughly coinciding with that currently being studiedby CSKT biologists (Gregory etal. 1984, Mackey et al. 1985). Craighead and Stockstad (1964) documented decreases in the Flathead Valley goose population during the course of their study, butattributedthemto excessive hunting pressure rather than habitat characteristics or hydroelectric operations.

Since the time of Craighead's studies in the 1950's surveys of geese in the Flathead Valley system have been limited to annual breeding pair counts, brood counts and periodic fall surveys. The Montana Dept. of Fish and Game (now MDFWP) conducted these surveys until 1974, and the U.S. Fish and Wildlife Service (USFWS) has been conducting annual trend counts (aerial surveys) in the Flathead Valley since 1975. Breeding pair counts, brood counts, and fall migration surveys have all documented extensive use of the federally-administered WPA located on the northern shore of Flathead Lake. Data from these surveys have been used in conjunction with other regional data by the Flathead Valley Canada Goose Committee, in order to monitor trends and develop management goals for Canada geese in the Flathead Valley. Existing data are not detailed enough, however, to identify specific impacts due to hydroelectric development. There are no data, for example, from the river stretch upstream of Kalispell; and there have been no studies to document nesting and brood-rearing effort along the main stem north of the Lake.

Ball (1981, 1983) documented Canada goose nesting populations and success in the Flathead Valley during 1980, 1981, and 1982. Recent nesting populations for the entire Flathead system compared favorably to those of the 1950's, (Geis 1956, Craighead and Stockstad 1961, 19641, although decreases in nest numbers occurred on the lower Flathead River and the northern shore of Flathead Lake (Ball 1983). It has been suggestedthatgoose productivity was limitedbythelack of suitable brood habitat along most of the lake shoreline and by a shortage of secure nesting sites along the lower Flathead River. Particular concerns related to the effects of water level fluctuations included habitat losses due to erosion, flooding of nest sites, and dewatering of river channels which exposes island nest sites to predation (Ball 1983).

Extensive erosion of the islands at the mouth of the Flathead River has been documented by Moore et al. (1982). No previous attempt has been made, however, to document the acreages of particular habitat types lost to erosion, either in the delta islands or along the north shore in important brood-rearing areas. Similarly, the effects of island flooding and channel dewatering which have been documented along the Flathead River below Kerr Dam (Gregory et al. 1984) have not been assessed for nesting areas along the main stem above Flathead Lake.

The objectives of this study are to document the size, distribution and productivity of the Canada goose population in the northern Flathead Valley, and how they are (and have been) influenced by water fluctuations due to hydroelectric operations at Hungry Horse and Kerr Dams. The ultimate goal of the study is to develop mitigation measures for such effects which will be consistent with management goals for the species and with other mitigation procedures developed for the fish and wildlife resources of the Flathead Valley.

OBJECTIVES

The specific objectives of the 1985 phase of this study were as follows:

A. Nesting Studies

1. Identify effects of water level fluctuations on goose nesting success and nesting habitat, particularly at the Flathead Lake WPA and on main stem river islands.

a. Describe the distribution (location of nests) and size (number of pairs/nests) of the breeding population.

b. Describe habitat parameters at nest sites.

c. Determine hatching success (nest fate).

2. Formulate preliminary recommendations to protect and enhance Canada goose nesting habitat and nest success.

a. Identify "secure" and "high risk" nesting areas.

b. Describe the use and management potential of elevated nest sites.

B. Brood Studies

1. Identify effects of water level fluctuation on gosling survival and brooding habitat.

a. Document the production, dispersal, and (if possible) survival of goslings.

b. Describe the location, habitat, and land-use characteristics of brood-rearing areas.

c. Describe habitat selection by broods, particularly in relation to fluctuating water levels.

2. Formulate preliminary recommendations to protect and enhance Canada goose brood-rearing habitat.

a. Identify shoreline areas which have potential as brooding habitat.

b. Document location of existing brood-rearing areas in relation to fluctuating water levels.

C. Non-breeding Season Studies

1. Select locations for trapping, and capture birds for radiotelemetry.

2. Identify seasonal trends in distribution and numbers.

3. Identify seasonal trends in habitat use.

4. Describe post-fledging dispersal of local breeders.

D. Habitat Studies

1. Document characteristics of currently utilized habitats as noted for (A) and (B)

2. Develop a habitat loss estimate for the north shore of Flathead Lake.

E. Other Wildlife Species

1. Identify interspecific relationships which influence goose productivity, particularly competition for elevated nest sites, and predation.

2. Identify effects of water level fluctuations on other species, i.e. bald eagle (Haliaeetus leucocephalus), osprey (Pandion haliaetus), furbearers, and other waterfowl, possible within the scope of surveys conducted to meet objectives outlined for geese.

STUDY AREA

Selection of the study area was based on the influences of Kerr and Hungry Horse Dams on those portions of the northern Flathead Valley, Flathead County, Montana, known to be inhabited by breeding Canada geese. The study area included 74 km of the main stem Flathead River from its confluence with the South Fork, approximately 6.5 km east of Columbia Falls, downstreamtothe mouth of the river, on the north shore of Flathead Lake 1.4 km west of Bigfork (Fig. 1). The upper portion of this river section, from the South Fork downstream 38 kmto a point1.2 km southeast of Kalispell, is characterized by gravelly substrates, many islands and gravel bars, and extensive channelization. Islands and riparian bench areas are primarily dominated by deciduous (Populus trichocarpa) or mixed (Populus trichocarpa/Picea spp.) forests, while the dominant land-uses in the adjacent valley are agriculture and suburban development. The most extensively braided area is located near the mouth of the Stillwater River, immediately southeast of Kalispell. Here the river makes an abrupt transition to a single, wide meandering channel of low gradient, with fine sediment substrates and essentially no islands, for the remaining 36 km downstream to FlatheadLake. The characteristics of this lower river reach are accentuated by seasonal water level fluctuations due to the operation of Kerr Dam. Extensive stands of riparian forest occur along some portions of this reach, but in many places they are absent or limited to a very narrow strip immediately adjacent to the river. Land use in the surrounding floodplain is heavily dominated by agriculture, primarily wheat and hayfields.

The study area also includes that portion of Flathead Lake north of Deep Bay on the west shore and Woods Bay on the east shore (Fig. 1). This southern boundary of the study area was selected to coincide with the northern boundary of the area currently being studied by Gregory et al. (1984). Most of the north shore of the lake is designated as the Flathead Lake WPA, and is administered by the USFWS. Primarily floodplain, the north shore is dominated by flat topography and is characterized primarily by dense herbaceous vegetation, varying from emergent stands of Typha latifolia, Butomus umbellatus and Scirpus spp. to mixed grass/forb cover types (USFWS 1981). Those portions of the east and west shores within the study area, in contrast, are generally steep rocky topography dominated by coniferous forest, with profuse residential and recreational development characterizing the immediate shoreline areas. Unlike the southern portion of Flathead Lake (Gregory et al. 19841, the north end contains very few islands. These are limited to a few small rocky islands near Somers and the 2 islands which represent the remnant of the river delta in the WPA.

Though the study was limited primarily to the river and lake areas described, other areas outside the immediate river channel were included. Primary among these were several large oxbows

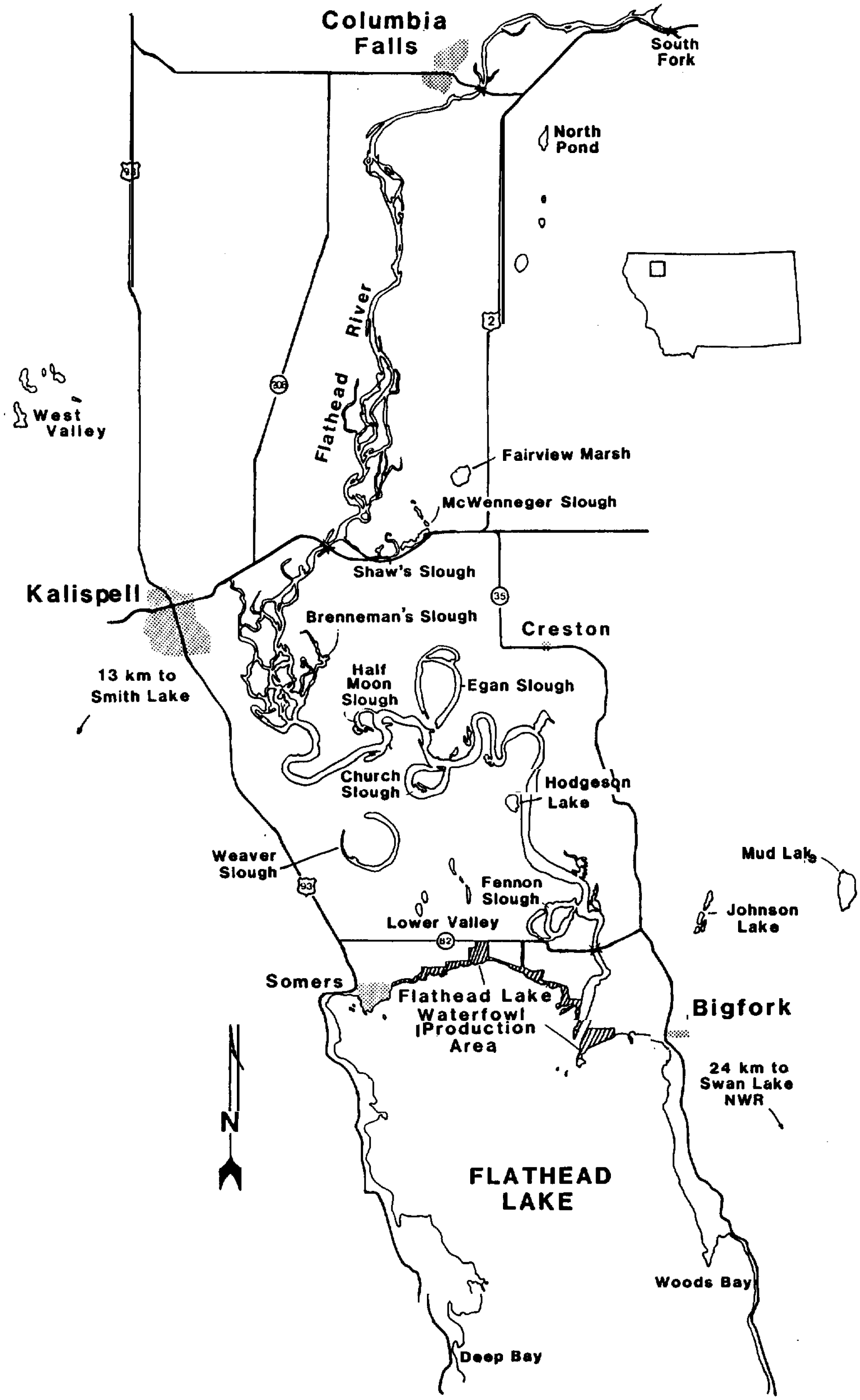


Figure 1. Study area for Canada goose project (BPA Contract 83-4981, northern Flathead Valley, Montana.

adjacent to the river: Half Moon, Egan, Church and Fennon Sloughs (Fig. 1). These areas were included because their water levels are influenced by Kerr Dam (except Egan); in addition, each received use by geese throughout the breeding season. Similarly, Weaver Slough, McWenneger Slough, and Fairview Marsh were included in the study area because of their use by geese and close proximity to the river.

Other areas peripheral to the study area were surveyed occasionally during certain phases of the study, particularly aerial surveys and radiolocation attempts. These included a series of ponds southeast of Columbia Falls along the base of the Swan Mountains, and Johnson and Mud Lakes which are east of the river and north of Bigfork (Fig. 1). Potholes and remnant sloughs between Kalispell and the lake (Lower Valley) and in an area northwest of Kalispell (West Valley) were also surveyed periodically. Swan Lake National Wildlife Refuge, 24 km southeast of the study area, and Batavia and Smith Lake WPA's, 13 km to the west, were also surveyed occasionally to document the distribution of local birds and attempt radiolocation of marked birds.

The northern Flathead Valley is characterized by relatively short, warm summers and long, cold winters. The annual mean temperature at Kalispell is 6°C; monthly means vary from -6°C in January to 20°C in July (Gaufin et al. 1976). Annual precipitation at Kalispell averages 38.5 cm; precipitation is greatest during winter (Nov. - Jan., 11 cm) and spring (May-June, 9 cm), with March, April and August being the driest months. Flathead Lake has an influence on local weather patterns, particularly along the east shore. Bigfork has warmer annual temperatures (8°C) than Kalispell, is cooler in summer and warmer in winter, and has greater annual precipitation (55.7 cm).

Spring 1985 was generally warmer and drier than normal at Kalispell (NOAA 1985). March was cold, with 24 days below normal temperatures and a monthly average of -2°C, compared to the normal average of 0°C. Average daily temperatures were higher than normal on 40 of 61 days in April and May, and the monthly averages were 7% and 12°C, in comparison to the normal averages of 6°C and ll°C for these two months respectively. June was slightly colder (average 14°C) than normal (15°C). Precipitation was below normal for each of the months of March through June, and the total for this period was 11.9 cm, compared to the average of 15.0 cm

The landscape of the Flathead Basin reflects a history of glaciation. Flathead Lake, the largest natural freshwater lake in the western United States at 125,741 acres (50,498 ha), is a remnant of the enormous glacial Lake Missoula, which was formed by the last of four major glacial advances approximately 25,000 years ago (Zackheim 1983). Soils in the study area are primarily of glacial and alluvial origin.

WATER LEVEL REGIMES

Construction and operation of Hungry Horse Dam as a power peaking facility has had a pronounced effect on water levels in the main stem downstream, except during those times of the year when runoff from the unregulated Worth and Middle Forks overrides these effects (Fraley and McMullin 1983). A typical hydrograph for flows taken on the main stem at Columbia Falls is presented in Fig. 2. Since 1982, a year-round minimum flow restriction of 3500 cubic feet per second (cfs) has been in effect to protect and enhance salmon spawning in the main stem. Since that time, abnormally low flows probably no longer occur, except perhaps during the period immediately preceding spring runoff (late March, early April), when this minimum flow (3500 cfs) may be less than naturally occurring minimum flows.

Peaking operations also may cause abnormally high flows early in the nesting period, when river levels can fluctuate 1 m or more daily at Columbia Falls (Fraley and McMullin 1983). Figure 3 represents water level changes during one day roughly corresponding to the mid-point of the incubation period for geese in the study area in 1984.

Daily minimum and maximum flow data for both the main stem and the South Fork for March-June, 1985 are presented in Appendix I. In contrast to 1984, when short-term (3-4 day) increases in flow and great daily fluctuations occurred on the main stem (Casey et al. 1985), 1985 was characterized by fewer flow peaks of longer duration and smaller daily fluctuations (Fig 4). This pattern can be attributed to high, early run-off and infrequent, generally small releases from Hungry Horse dam during this particular spring period though 2 of these flow peaks did include releases from the dam (Fig. 4).

Kerr Dam altered the annual pattern of fluctuations in the level of Flathead Lake, by retaining spring runoff throughout most of the year (Fig. 5). Subsequent habitat losses have been most severe in the delta area at the mouth of the river (Fig. 6), where continued erosion due to wave action has reduced the delta to two small remnant islands (Moore et al. 1982).

Operation of Kerr Dam influences water levels of Flathead Lake on a seasonal basis; typically minimum pool is held in early spring, and full pool occurs from July through September (Fig. 5). Wave action as water levels recede and advance has also precluded establishment of emergent aquatic vegetation along the north shore (Moore et al. 1982). Expansive mudflats separate upland vegetated areas from open water when the lake is at minimum pool. In both 1984 and 1985, minimum pool corresponded almost precisely with the nesting and early brood-rearing period for geese (late March - May), and full pool was not reached until July (Fig. 7), when most broods had fledged. Gauge heights (lake elevations) for March-June 1985 are included in Appendix I.

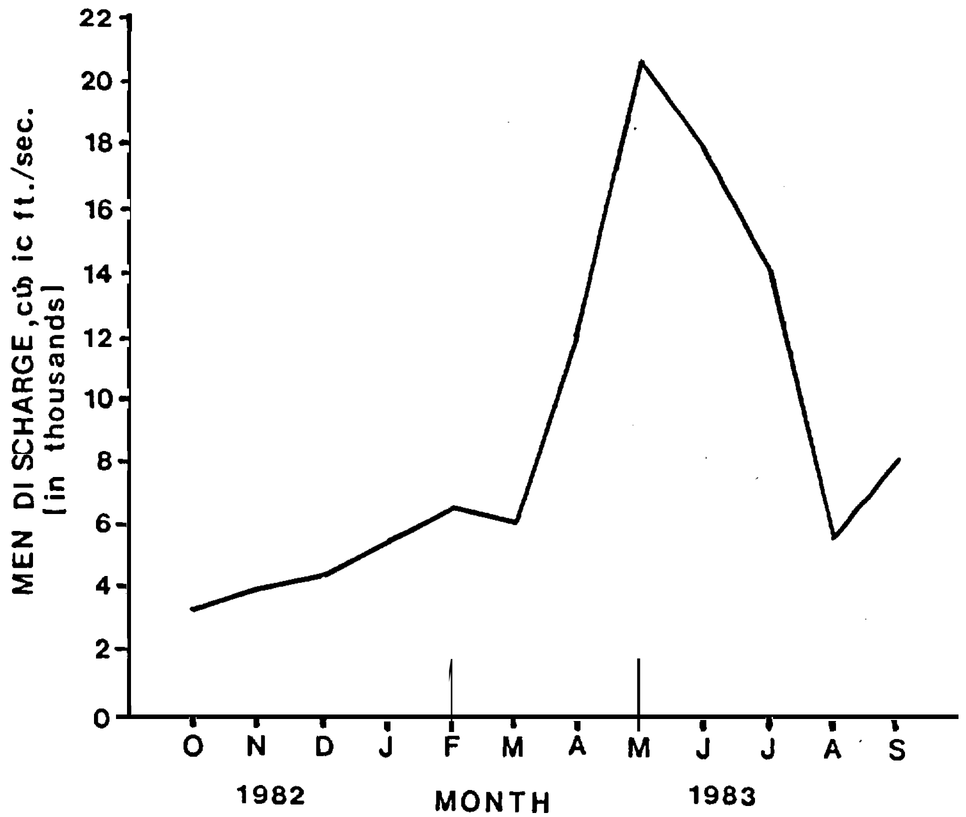
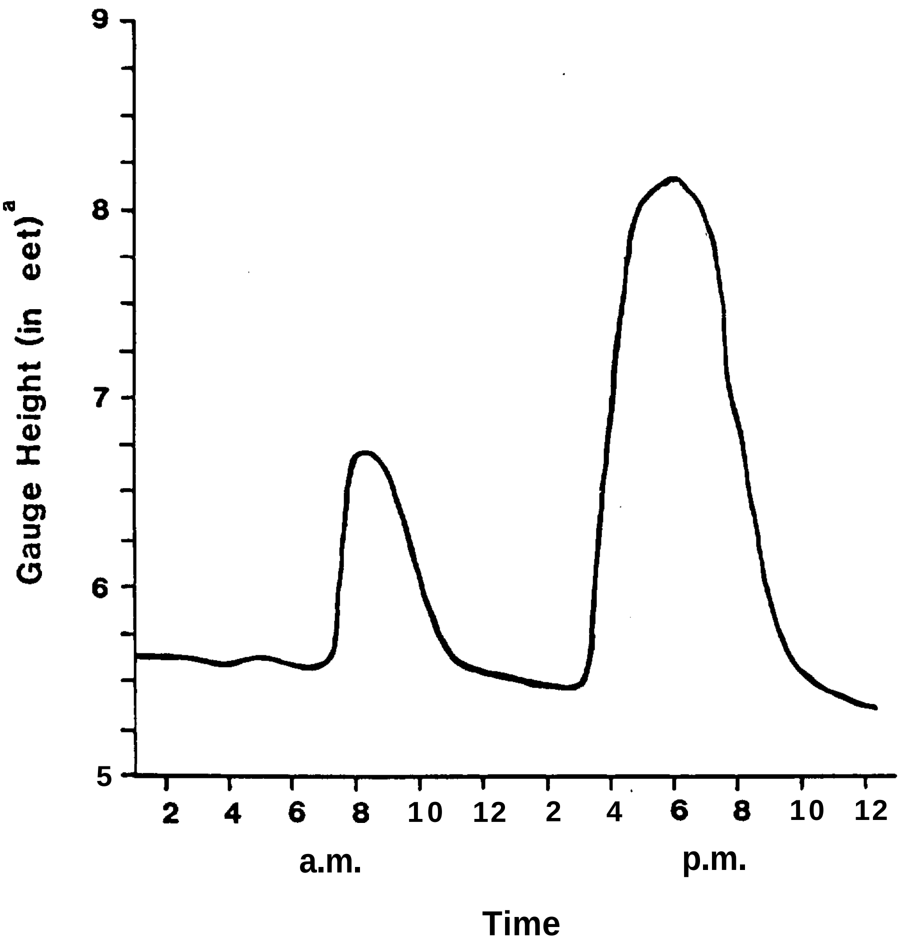


Figure 2. Typical annual discharge (cubic feet/second) for the main stem Flathead River recorded at Columbia Falls, Montana.



[a] Range corresponds to 9110 - 19025 cfs

Figure 3. Main stem Flathead River flow regime for 26 April, 1984 as influenced by Hungry Horse Dam and recorded at Columbia Falls, Montana.

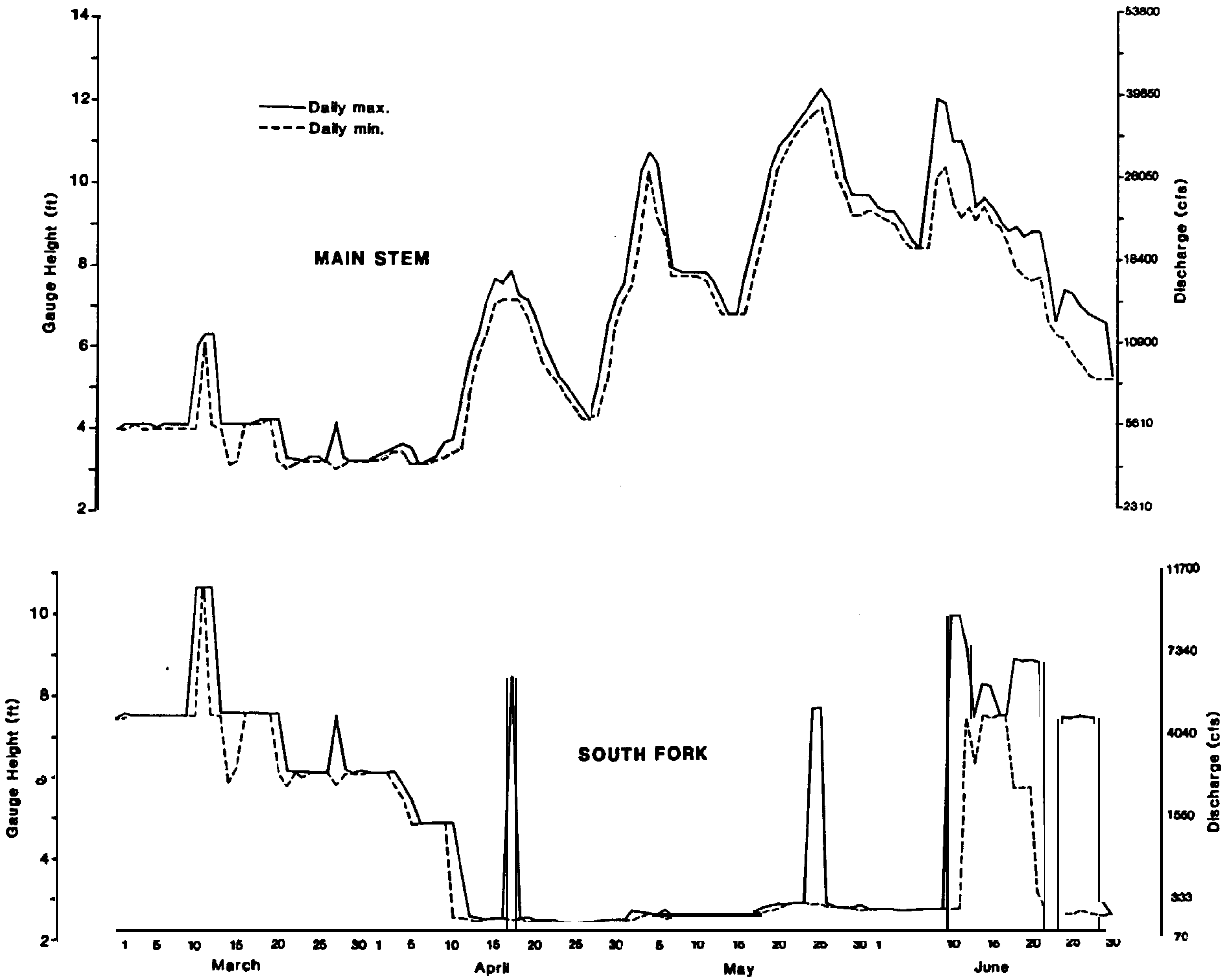


Figure 4. Maximum and minimum daily gauge height and discharge, main stem Flathead River and South Fork Flathead River near Columbia Falls, Montana, 28 Feb. - 30 June, 1985,

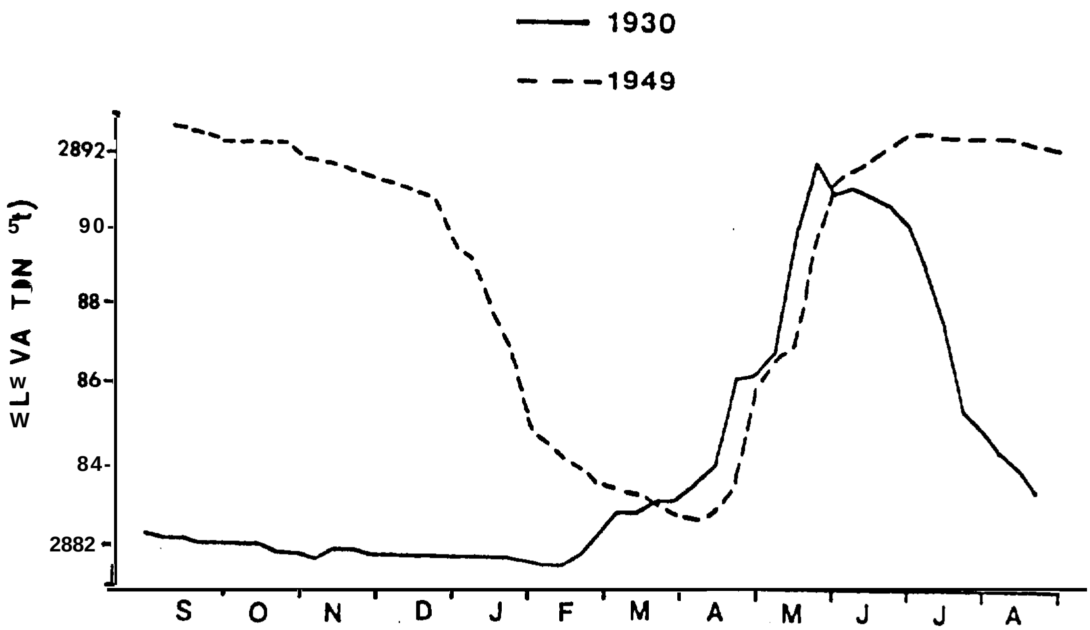


Figure 5. Annual water level fluctuations at Flathead Lake before and after the construction and operation of Kerr Dam

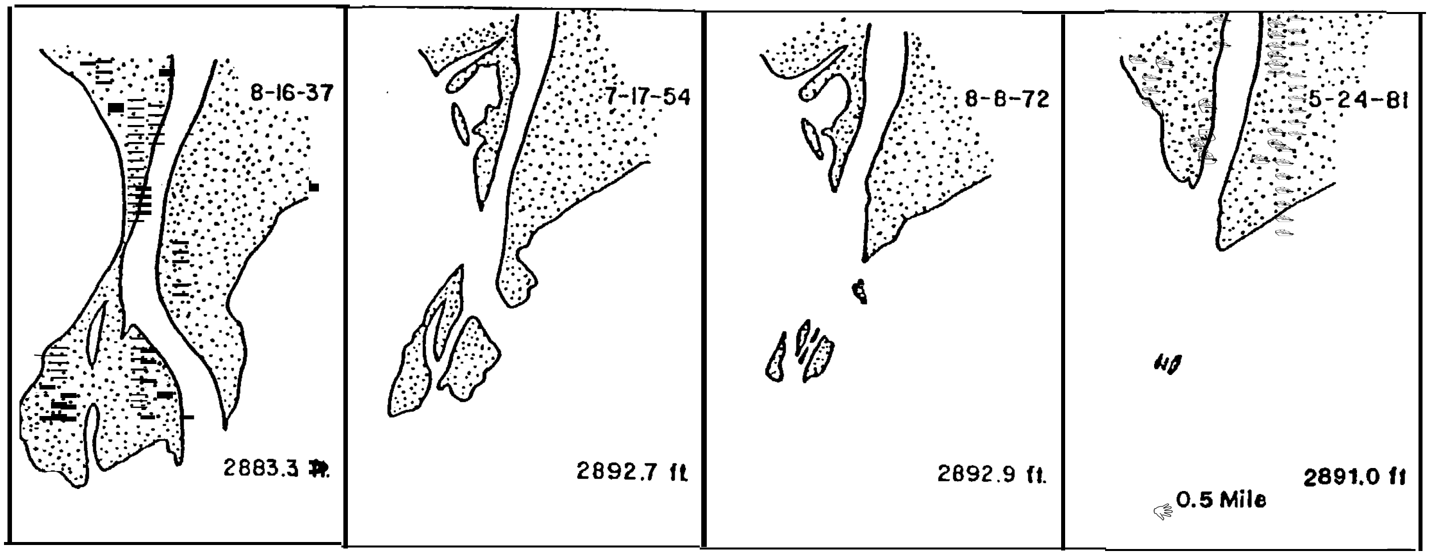


Figure 6. Changes in the Flathead River delta, 1937-1981, north shore Flathead Lake, (Moore et al. 1982).

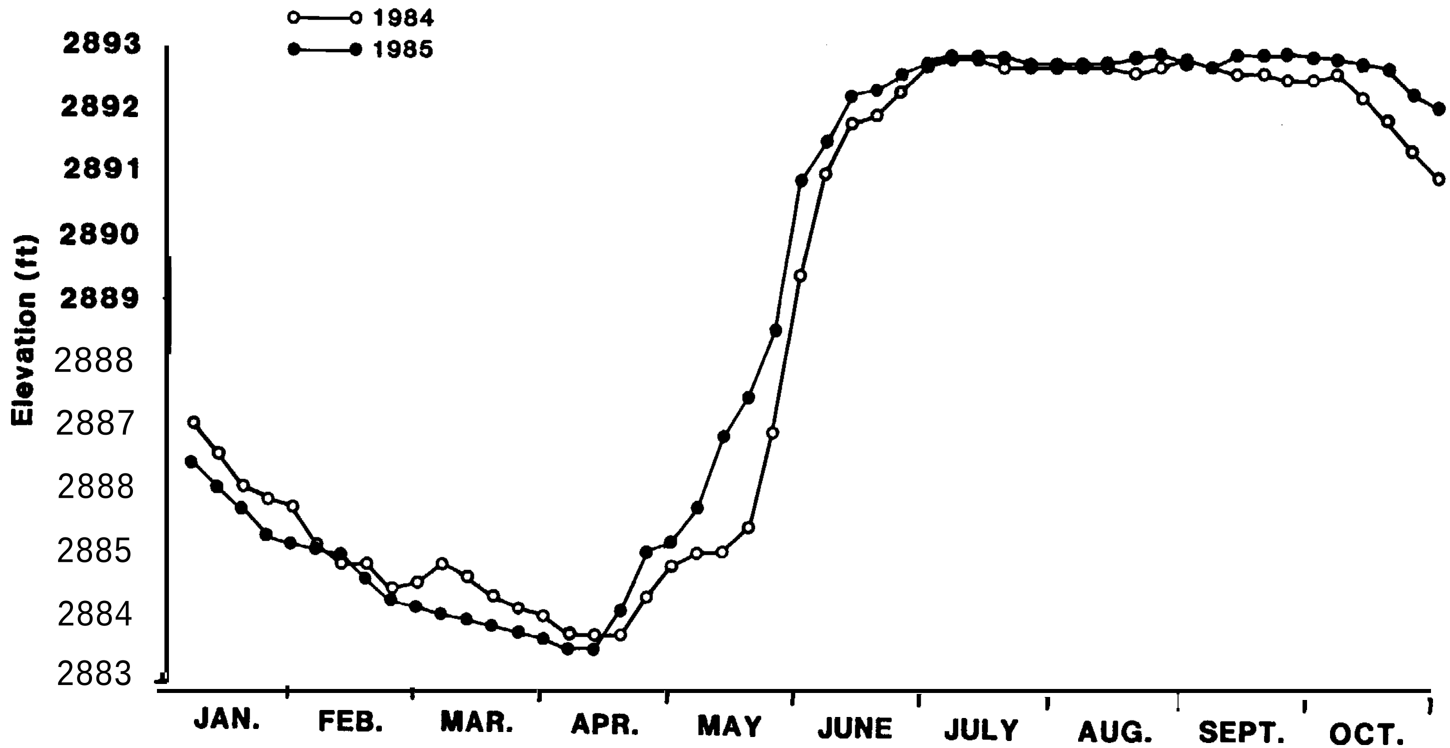


Figure 7. Elevation of Flathead Lake, as influenced by Kerr Dam, 1984 - 1985.

METHODS

NESTING STUDIES

Field studies for the 1985 breeding season were initiated during February, when the first inventories of tree nest sites were conducted. Pair counts and nest searches were continued into June to document the number, location and fate of goose nests throughout the study area.

Pair Surveys

Surveys of territorial pairs were conducted throughout the study area on a weekly basis from 7 March through 8 May, using a combination of aerial, boat, and ground surveys. Aerial surveys were selected as the most efficient way to systematically survey the entire study area. Eleven aerial surveys were conducted during the period 7 March - 14 May 1985, using a Cessna 172 airplane, pilot and two observers. All surveys were conducted between the hours of 0920 and 1252, with the exception of a flight 20 March (1412-1602). Other regional researchers have found no significant difference between morning and afternoon surveys, though afternoon counts are more variable (Mackey et al. 19851.

In addition to the aerial surveys, 2 boat surveys of the river reach below Kalispell, 5 boat surveys of the entire river portion of the study area, and one additional boat survey of the river reach above Kalispell were conducted using a 75-hp outboard jet boat. Surveys of the lower reach were conducted during the hours 1001-1512; those of the upper reach (above Kalispell) were conducted during the hours 1348-1600. Surveys were run at full throttle, goose locations were carefully noted, and alternate channels were run during round trip surveys to decrease the likelihood of duplicate observations.

During each survey, the time, location,number of geese,and behavior of each goose or group of geese were recorded. Indicated territorial pairs were determined by noting singles, pairs, nests and flocks separately using methods similar to Hanson and Eberhardt (1971) and Allen et al. (1978). Pairs of geese were counted as indicated territorial pairs if they were at least 10 m from any other geese when observed. Lone single geese were assumed to be males of nesting pairs, and therefore also were counted as an indicated territorial pair. Universal Transverse Mercator System (UTM) coordinates were used to code the mapped location of each indicated pair. Selection of areas to be searched for nests was based on these locations. The location and status of occupied nests were recorded for each nest observed during the pair surveys, and females on nests were counted as territorial pairs if no lone single (presumed male) goose was seen within 200 m.

Nest Searches

Nest search efforts for the 1985 breeding season were much more intensive than during the first year of the study (Casey et al. 1985). The 1985 effort included: an inventory of all elevated nests in the study area; ground searches of the remaining delta area in Flathead WPA, dredged islands in the western portion of the WPA, islandsin Somers Bay at the north end of the lake, and selected river islands; and ground and boat searches for marsh nests in selected off-river wetlands and sloughs.

Results of our 1984 studies indicated that elevated nest sites are particularly importanttothe northern segmentofthe Flathead Valley goose population. Nest search efforts were initiated during late February 1985, when we began an inventory of all elevated nest sites within the study area which might be suitable to geese. These included vacant osprey, bald eagle, red-tailed hawk (**Buteo jamaicensis**) and great blue heron (**Ardea herodias**) nests, as well as artificial nest structures. The location of each nest was mapped, and each was given a code number. This inventory was continually updated throughout the breeding season as more nest sites were found. The status of each nest (species in occupancy, number and behavior of birds on or near the nest, nest condition) was also updated throughout the breeding season, basedprimarilyuponthe results of the aerial pair surveys. One helicopter flight was conducted 25 April to document occupancy and clutch size. This flight was also useful for locating goose nests in the broken, hollow tops of natural snags which were easily missed during airplane and ground surveys.

Throughout and immediately after the nesting season (15 April - 12 June), ground searches for nests were conducted on the remaining islands in the Flathead Lake WPA at the mouth of the Flathead River, dredged islands in the western portion of the WPA, lake islands in Somers Ray, and on selected islands in the Flathead River. Previous studies have shown that most ground nesting in the Flathead Valley occurs on islands (Geis 1956, Ball 1983, Gregory et al. 1984, Casey et al. 1985). Islands to be searched were selected based on the following criteria:

a. The presence of potential breeding pairs, as indicated by pair survey data:

b. Knownnesting inpreviousyears, in the case of the Flathead WPA (Ball 1983, Casey et al. 1985),

c. The presence of particular representative habitats and island sizes.

Criterion (c) was used in order to gather data representative of a variety of island types within the study area, because a complete census of all river islands was not feasible during the

1985 breeding season. Nest search efforts were concentrated on smaller islands dominated by herbaceous or shrubby habitat, though some larger wooded islands were also searched.

More than 93 islands or portions of islands in the Flathead River were searched for nests. These were primarily north of Kalispell and in the heavily braided river section immediately southeast of Kalispell (Fig. 1). Larger islands were searched using volunteer help from the University of Montana; teams of 3-7 people spaced approximately 10 m apart completely searched each island, except on the largest islands, where only the outermost 50 m was searched. Research has shown that the majority of island nests are within 20 m of the shoreline (Mackey et al. 1985, Casey et al. 1985). Smaller islands could be searched completely by 1 or 2 observers. Nests were usually found by spotting the female on the nest or by observing bits of down on vegetation near the nest.

The 2 small remnant islands in the delta portion of the Flathead WPA were searched completely for nests on 3 May. Prior to that date, at least 2 geese had been observed apparently nesting in stumps on the mudflats surrounding these islands, so the entire mudflat area west of the river mouth was searched for stump nests on 3 May as well. Stumps in the mudflats on the east side of the river mouth were searched 7 May. These mudflats have not been searched for stump nests by previous investigators (J. Hall, Montana Cooperative Wildl. Research Unit, pers. commun.).

On 7 June, 71 "islands" in the cattail marsh along the north shore in the central portion of the WPA were searched for nests. These sites varied from small natural hummocks to larger islands dredged by the USFWS in 1978 (USFWS 1981).

The location, number of eggs, stage of egg development (or nest fate), nest materials, general cover type and adjacent habitats, and distance to water were recorded for each nest. We attempted to visit all nests at least twice, before and after hatching, though many nests were not until after hatching. In order to minimize nest disturbance, decrease heat loss by the eggs, and prevent predation, a minimum amount of time was spent at each nest, and the eggs were covered with down upon leaving. Egg stage was determined by floating, using methods similar to Westerkov (1950) as adapted by Gregory et al. (1984). Nest fate was determined from eggshell fragments (Rearden 1951). Nest success was calculated as the percent of total nests of known fate in which at least one egg hatched (Geis 1956).

Dates of initiation of egg-laying, initiation of incubation and hatching were estimated using egg stage data or known hatching dates. These calculations were based on the assumptions of a 28 day incubation period, preceded by a 7-day egg-laying period (Hanson and Eberhardt 1971, Bellrose 1976). When using egg stage data, we assumed six days for stage 1, then four more equal length

(5-day) stages, one day pipping, one day hatching, and one day brooding in the nest. Because of the assumptions inherent in the back-dating method, and imprecision of the egg-floating technique (Westerkov 1950) for determining egg stage, we typically determined a 2- to 10-day period during which a nest was initiated or hatched, rather than identifying such dates as "on or before" a give date. For graphic representation of nest chronology throughout the study area, bar charts were developed by combining these estimated periods for each nest. Each bar therefore corresponded to the number of nests which may have been initiated on a given date. These graphs were therefore essentially probability distributions for initiation and hatching dates within the study area.

Data from the nest searches were used to develop a minimum known total of active nests. An assessment of the accuracy of this total was based on a comparison of nest count data and with the indicated pairs data, using pair/nest ratios calculated by other local and regional studies (Hanson and Eberhardt 1971, Ball 1981, Gregory et al. 1984), and by comparing brood count data to hatching success data.

Nest Site Habitat Measurements

Nest site characteristics were described using a variety of measurements of the physical environment and vegetation in the immediate vicinity of the nests, using methods similar to those used by Gregory et al (1984). These data were collected to describe nest locations both in terms of their relation to water level and to typical habitats used by nesting geese.

Descriptions of the physical environment at each nest site included the type of nest (ground, tree, structure), lateral and vertical distance to existing water level and to the seasonal high water mark, and evidence of disturbance or interspecific interactions. Of particular interest in the latter category was documentation of competition for, displacement, or alternate occupancy of osprey, bald eagle, or great blue heron nests by tree-nesting goose pairs. Seasonal high water mark was determined through evidence of scouring, wetted soils, or debris deposition.

Vegetation measurements in the immediate vicinity of nest sites included listing of dominant plant species present in the canopy, subcanopy, and understory; identification of cover and land types; and (at ground nests) determination of canopy coverage, woody stem density, and overhead cover. At tree nest sites, the condition, height and diameter at breast hieght (dbh) of the tree and height of the nest were also recorded. Heights were determined with a clinometer.

At stump nests in the delta, we measured the height and circumference of the stump, height, maximum and minimum depth and width of the bowl portion of the stump which contained the nest, height of nest above existing water level, and the aspect and relative amount of decomposition of the top of the stump. Aspect was defined as the orientation of the lowest point in the rim of the depression containing the nest. The elevations of the nests were calculated using gauge height data and nest height data from each day these nests were measured. This allowed us to calculate the heightofthe nests above (or below) full pool, and the date of nest inundation for those stump nests below the full pool elevation. These parameters will also be measured for each of a randomly-selected set of stumps which were not used for nesting in 1985.Comparisons useful for describing the amount of remaining nesting habitat in the delta area, and may have implications for mitigation strategies.

All tree and stumpnests were permanently marked for future reference. Markers consisted of large metal washers embossed with nest code numbers nailed to the stumps at approximately chest height. Three of the stumps so marked were used as reference photo points to document erosion of the remaining vegetated islands.

Canopy cover at ground nests was estimated using the line intercept method (Canfield 19411, extending a 10-m line north-south with the nest at the mid-point. Percent cover by class (graminoid, forb, shrub,tree,bare ground, litter, and log) was calculated by recording coverage to the nearest 0.1 m. Moss was grouped with litter, and water was grouped with bare ground where appropriate.

Overhead cover was estimated using a densiometer (Lemmon 1956) held at a height of 0.5 m over the nest and at each of the four cardinal directions 5 m from the nest (plot center). Woody stem density was measured at each ground nest site and 5 m from the nest (plot center) in each of the four cardinaldirections. All woody stems at a height of 1 dm, were counted within a 1 m^2 circle described by a plastic hoop. Similar habitat parameters at goose nest sites were investigated in greater detail by the CSKT study (Gregory et al. 1984). Data collected by during this study will allow comparisons between the two study areas.

At each nest site, the cover type and landform were recorded, as was the distance to the nearest other cover type(s) and landform(s)Cover type and landform classifications were similar to those used by Gregory et al. (1984), and based on those of Pfister et al. (1977), Cowardin et al. (1979), Mueggler and Stewart (1980), and Pfister and Batchelor (1984). Lists of the cover type and landform classes are provided in Appendices II and III.

BROOD STUDIES

Production, distribution, and survival of broods were documented through a combination of aerial, boat, and ground surveys. Surveys of the entire study area were conducted weekly (when possible) during the brood-rearing period (May-July). For each brood observation, the time, location, number of adults, number of young, age class of the young (Yocom and Harris 1965), andhabitatwere recorded. Aerial surveys were selected as the most efficient way to survey the entire study area for broods. Aerial brood surveys were conducted on the following days: 7, 14, 22 and 29 May: 6, 18, 27 June; and 3 July. All flights were conducted during the hours 0835-1230, except for the flight on 27 June which was a reconnaissance flight for a trapping effort, and was conductedbefore 0700. Data from these aerial surveys were combined with data from periodic ground surveys throughout the brood rearing period to derive an estimate of production for the study area. In an attempt to document survivorship of broods, we analyzed 316 observations of individual broods, by age class (Yocum and Harris 19651, and by date, to see if mean brood size decreased through time. Individual broods were defined as any number of goslings attended by 2 or fewer adults.

The locations of important brood-rearing areas were determined through a combination of radiotracking of collared adults with broods, the periodic brood surveys (mapped brood observations), and use of three 6-m observation towers which wereconstructed within the WPA. The locations of these towers were selected based on preliminary results of the brood surveys, discussions with USFWS personnel, and the distribution of habitats within the WPA. The towers were located in areas which allowed for relatively complete visual coverage of the WPA and adjacent habitats.

Brood Activity Budget Surveys

In order to document behavior, habitat usage and habitat selection by broods of various age classes, we utilized activity budget surveys (Altmann 1974) as modified by Matthews et al. (1985). These surveys were conducted from 1 May through mid-July, primarily from the 3 observation towers at the WPA (N=151), although we also surveyed broods at other upriver brood-rearing areas when possible (N=26). Typically, these latter activity budget surveys were performed on broods with radio-collared adults, because they were easy to locate and maintain as the "focal" brood for the 30-minute survey period. In cases where more than one brood was visible, focal broods were selected by setting the 50/80x scope at a compass bearing taken from a random numbers table, and scanning in a clockwise direction until a brood came into the field of view.

If several broods were together in a gang brood, one brood was selected for sampling. The activities and locations of one brood were monitored throughout the entire sampling period when possible. However, if the brood left the area or became mixed with other broods, we selected another brood for sampling. Frequently, two or more consecutive surveys were conducted using the same focalbrood.

Over 90 percent of the surveys were conducted during the hours 0500-1030, particularly those at the WPA. Broods were most easily observed in early morning because they were active and undisturbed, and optical distortion due to heat waves was minimized.

During each survey, one observation was made each minute within a 30-minute sampling period. For each observation, the activity, habitat type, and landform of one systematically selected gosling and one adult within the brood was recorded on coded data sheets. Gosling age classes were recorded using the plumage characteristics method of Yocom and Harris (1965).

Use of habitat types were determined by calculating the percent of observations in each habitat type (cover type, landform) for goslings and associated adults. General activity categories analyzed for adults and goslings were feeding, resting, locomotion, comfort movements, social interactions, brooding, alert, and disturbed. The percent of total observations in each activity type, were also calculated for both goslings and associated adults.

Brood-rearing Area Habitat Measurements

Brood-rearing areas which received consistent use, or those areas occupied by large numbers of broods were identified as key brood-rearing areas. Specific plant communities known to be used by broods were described within these key areas. If several distinct communities were present, each was sampled. Physical parameters including slope, aspect, landform, and vertical/lateral distance to the high water mark and the existing water level were described. Vegetation characteristics were described using several methods (Gregory et al. 1984). Herbaceous cover was determined by recording percent coverage (Daubenmire 1959) for each species or species group found in 10 circular frames (1 m^2), located in pairs at 5-m intervals along a 25-m transect. Tree and shrub cover was determined by recording species coverage in 10-m diameter circular plot placed at each end of the 25-m transect. Overstory cover was determined using a densiometer (Lemmon 1956) read at the center of the 2 circular (10-m diameter) plots. Cover type(s) (Appendix II) were recorded at each site.

HABITAT MAPPING

Three separate habitat mapping efforts were undertaken or continued during the 1985 phase of our study. Habitats lost to inundation and erosion along the north shore of the lake were mapped on black and white aerial photos (1937 series, scale 1:22,000) acquired from the University of Montana Biological Station at Yellow Bay. A habitat loss estimate was then developed by overlaying this habitat map with a map of the current shoreline, which was developed through a separate mapping effort with aerial photos taken 1 June 1985, when the lake was nearly at full pool (2891.3 ft.). This latter set of photos is also being usedinconjunction with an earlier (9 May19851 set in order to document intraseasonal changes in habitat availability during the peak of the brood-rearing period at the WPA. That analysis will continue throughout the remainder of our study, for inclusion in our final report in 1987.

In order to describe brood and nesting habitat available to Canada geesethroughoutthe study area, a draft habitat map was prepared in 1984. Riparian habitats were mapped on infrared aerial photographs (1978 series; scale 1:2,400) and blackand white aerial photographs (1979 series; scale approx. 1:16,000) for the main stem Flathead River and the WPA.

The limits of the riparian zone were defined by either a change in vegetation, a distinct increase in elevation, or the presence of a road. Allhabitatmapping was based on cover types similar to those defined by the CSKT study (Gregory et al. 1984) and incorporated habitat and wetland type classifications of Pfister etal. (1977), Pfister and Batchelor (1984), Cowardin et al. (1979), and Mueggler and Stewart (1980). Cover types were defined based on major differences in vegetation structure and species composition (Appendix II). Because of changes in island morphology in the heavily braided area near Kalispell (Fig. 11, it was necessary to augment the infraredphotographs with current aerial reconnaissance and oblique photos. All habitat mapping was field-checked.

NON-BREEDING SEASON STUDIES

Population Surveys

Periodic aerial, boat, and or ground surveys of the number and distribution of geese in the study area were conducted throughout the post-breeding season, autumn, and early winter. These included aerial surveys conducted on 9, 16 and 24 July; 17, 13, 20 and 29 August: 4, 13, 18 and 27 September; 4, 10, 18 and 24 October; and 1, 6 November. Opportunistic observations of geese during habitat field work during these months were also recorded. These surveys yielded data descriptive of the seasonal trends in goose numbers prior to and during the hunting season, seasonal importance of habitats within the study area, and the dispersal of local breeders. The number, location, and activity of all geese observed during these surveys were recorded; when possible the number of adults and juvenile birds in each flock was recorded.

Trapping/Banding/Radiotelemetry

Radio-marking of adult geese was an integral part of our 1985 field studies. Our objectives were to gather data throughout the nesting and brood-rearing period in order to describe movements between nests and brood-rearing areas, and to describe the habitat use and dispersal of broods. We also hoped to documentbothlocal and regional movement patterns during the non-breeding season.

Two separate trapping efforts were made in 1985. The first occurred during late winter in order to radio-equip adult geese prior to the nesting period. A site was selected on the main stem Flathead River west of Egan Slough, where geese had been consistently observed during aerial surveys. The trap site was pre-baited with whole wheat from 15 February through 25 February. A single rocket-net was used to capture geese during 11 trap-days between 26 February and12 March. Fifteen geese were equipped with radio-collars and 7 additional birds were banded.

The second trapping effort occurred in conjunction with the annual goose banding effort conducted by the USFWS, and consisted of drive-trapping along the north shore of Flathead Lake (WPA) during the flightless period. On 27 June, 49 geese were captured (14 adults and 35 goslings). Radio-collars were fitted on 7 adults and all geese were banded.

Throughout the course of the field studies, attempts were made to locate these 22 radio-marked geese, one we collared in 1984 (Casey et al. 1985), and additional birds equipped with radio-collars by CSKT biologists. Radiolocation attempts included use of hand held antenna during boat and ground surveys for nests and broods, and use of 2 wing-mounted antennas during all aerial surveys. Both low-level (<100 m) and higher flights (ca. 300-1000 m) were conducted. Visual confirmation of the location of marked birds was attempted for each radiolocation, and each was mapped.

OTHER WILDLIFE SPECIES

No formal surveys for other species were conducted; however, data descriptive of other wildlife species and their habitats in the study area were collected within the framework of the goose studies. Signs of furbearer presence and habitat use were recorded in field notes taken during ground surveys of pairs, nests, and broods of geese. These records were supplied to MDFWP biologists conducting furbearer studies along the Flathead River under funding from the MPC. The elevated nest inventory included collection of data describing the location, occupancy, and nest chronology of ospreys, bald eagles, and great blue herons within the study area. These data were useful for identifying potential interspecific conflicts which influence goose productivity and allowed close coordination with the field work being conducted under an ongoing MPC-funded bald eagle/osprey study. Incidental observations of wide variety of other wildlife species, particularly waterfowl and shorebirds, were recorded in field notes throughout the course of the studies.

RESULTS AND DISCUSSION

NESTING STUDIES

Pair Surveys

An average of 151 indicated pairs were counted during the aerial pair surveys (Table 1). The highest single count total was 171, on 30 April. Only those counts conducted between 28 March and 7 May were considered in the analysis (Table 1). This corresponded with the nesting period for geese in our study area. The mean total count for 3 earlier flights in March was only 86 indicated pairs; 122 were recorded during one later flight, 14 May.

Pair count totals were highest at Flathead WPA and along-the river stretch from Kalispell downstream to the lake; as in 1984 (Casey et al. 1985), 81 percent of the mean total pairs were recorded in these two areas. The mean pair count total of 151 was higher than our 1984 average (106), and higher than the mean number of indicated pairs (110) recorded during annual pair surveys conducted by the USFWS during the period 1975-1985 (USFWS, unpubl. data).

Boat pair survey totals were consistently lower than those recorded during aerial surveys (Table 2). This is primarily because only the main river channel was sampled. The mean pair count (54) for the lower river reach did not include such areas as Egan Slough, Church Slough, Fennon Slough, and other off-river wetlands which contributedtothe higher average for this reach (82) recorded during aerial surveys (Table 1). Totals for the upper reach, where there are no significant off-river wetlands, were the same (7 indicated pairs) using each of the two survey methods. Boat survey results were most useful for identifying potential nesting areas and for gathering status information for elevated nests.

Previous studies of Canada geese have shown that the number of indicated pairs usually correspond to the number of active nests at a ratio of approximately 1.2 indicated pairs/nest (Hanson and Eberhardt 1971, Ball et al. 1981). The CSKT studies of the Flathead Valley goose population (Gregory et al. 1984, Mackey et al. 1985) have noted ratios of 1.2-1.4 pairs/nest along the lower FlatheadRiver. Using a ratios of1.2 pairs/nest, our 1985 pair count totals indicate that 95-143 nests should have been present in the study area; the mean count value of 151 pairs yields an estimate of 126 nests. Subsequent nests searches throughout most of the area, however revealed fewer nests than predicted by the pair count data, and yeilded a ratio of 1.4 pairs/nest.

Table 1. Canada goose pair count data, aerial surveys, northern Flathead Valley, 1985.

Date	Flathead Lake WPA[a]			Flathead River: Kalispell-Lake[b]			Flathead River: Col.Falls-Kalispell			Valley Potholes[c]			McWenneger Slough			TOTALS		
	P	S	IP[d]	P	S	IP	P	S	IP	P	S	IP	P	S	IP	P	S	IP
28 Mar.	16	8	24	72	10	82	2	0	2	27	4	31	0	1	1	117	23	140
2 Apr.	27	4	31	39	21	60	6	1	7	6	0	6	9	1	10	87	27	114
9 Apr.	25	18	43	46	39	85	4	4	8	5	4	9	9	3	12	89	68	157
16 Apr.	19	15	34	42	36	78	8	3	11	11	5	16	6	11	17	86	70	156
24 Apr.	35	17	52	51	39	90	3	3	6	3	0	3	5	7	12	97	66	163
30 Apr.	15	23	38	59	46	105	4	7	11	5	3	8	4	5	9	87	84	171
7 May	35	27	62	40	31	71	2	4	6	3	2	5	5	3	8	85	67	152
$\bar{x}$	25	16	41	50	32	82	4	3	7	9	3	12	5	4	9	93	58	151
S.D.	8	8	13	12	12	14	2	2	3	9	2	10	3	4	5	12	23	19

a/ Flathead Lake Waterfowl Production Area: also includes all of Flathead Lake north of Deep Bay on the west and Woods Bay on the east.

b/ Also includes the following off-river or adjacent sloughs: Church, Egan, Fennon, Half Moon

c/ Includes Weaver Slough, Ashley Creek, ponds between Kalispell and Flathead Lake, and ponds S.E. of Columbia Falls.

d/ Indicated pairs (IP) are defined as the total of pairs (P) and singles (S) observed during a given survey.

Table 2. Canada goose pair counts during boat surveys on the main stem Flathead River above Flathead Lake, 1985.

Date	Flathead Lake WPA[a]			Flathead River Kalispell-Lake			Flathead River Col. Falls - Kal.			TOTALS		
	P	S	IP[b]	P	S	IP	P	S	IP	P	S	IP
25 March	0	0	0	46	7	53	4	0	4	50	7	57
1 April	3	0	3	52	15	67	8	3	11	63	18	81
8 April	0	1	1	27	19	46	2	2	4	29	22	51
11 April	0	0	0	28	23	51	4	3	7	32	26	58
5 April	0	3	3	18	35	53	5	3	8	23	41	64
$\bar{x}$	1	1	2	34	20	54	5	2	7	40	23	63
S.D.	1	1	2	14	10	8	2	1	3	17	12	12

a/ Includes only the remnant delta area at the mouth of the river.
b/ Indicated pairs (IP) are defined as the total of pairs (P) and singles (S) observed during a given survey.

Nest Searches

One hundred eight active nests were located in the study area in1985 (Appendix Iv). Fifty-seven (53%) werelocatedin trees, on stumps in the remnant delta in the WPA, and/or on some type of man-made structure (Table 3). Fifty-four percent of the nests found in 1984 were also in elevated sites (Casey et al. 1985). Most nests (85%) were found from Kalispelldownstream to (and including) the north shore of the lake.

Thirty nests were found within the Flathead WPA (Table 3). Seven of these were on the delta islands searched in previous years by Ball, who found 8 nests there in 1981 and 11 in 1982 (Ball 1983). An average of 13 nests (range 10-18) was found on these islands during studies conducted 1953-1960 (Geis 1956, Craighead and Stockstad 1961). Decreased nesting effort on these islands is probably due to erosion losses; 3 of the nest sites used in 1984 were lost to erosion subsequently (Casey et al. 1985). The remaining 22 nests located in the WPA were found in areas not searched by previous researchers. Most significant among these were 15 nests found on stumps in the mudflats which surround the remnant vegetated islands in the delta. All15 of these nests were in naturally weathered broken tops of stumps, which had no additional nesting materials added by ospreys. Five ground nests were found on islands in the cattail marsh along the central northern shore of the lake, one on a remnant dike section near the mouth of the river which is an island at high water, and one on an artificial nesting structure erected for ospreys.

The nest total of 35 for the WPA and Somers Bay area (Table 3) yields a pairs/nest ratio of 1.2 when compared to the mean number of indicated pairs'counted (41) for the same area (Table 1). Much lower ratios of 0.5 to 0.7 pairs/nest were reported for islands further south on the lake in 1984 (Mackey et al. 1985). In 1984, we recorded a much higher ratio (2.6 pairs/nest) for the WPA (Casey et al. 19851, but we did not search the mudflat stumps for nests; assuming that15 such nests were present would have yielded a pairs/nest ratio of 1.3.

Hatching success for WPA nests was 64%, above the average (55%) for the entire study area (Table 3). Nest success rates varied from 82% for the stump nests to only 20% for the marsh nests in the WPA.

Nest totals for the river portion of the study area were heavily skewed toward the downstream portion, primarily due to the high number of snag nests in that river stretch (Table 3). Pair/nest ratios for the 2 river reaches were also noticeably different. The 62 nests found along the lower reach yielded a ratio of 1.3 pairs/nest, whereas 9 nests (0.8 pairs/nest) were found in the upper reach. The predominance of tree nests on the lower river reach also led to higher nest success in that reach

Table 3. Summary of Canada goose nest type and fate, by location, northern Flathead Valley, 1985.

Location	Nest Type				Hatched	Failed Due To:				unknown	% Nest Success
	Ground	Tree	Structure	Stump		Predation	Flooded	Abandonment	Wind		(Known Fate)
Flathead Lake WPA											
delta Islands	7				4	1				2	80
Dredged Islands	5				1	4					20
Mudflats (Delta)				15	9	2				4	82
Other	1	1	1			1				2	0
SUBTOTAL	13	-i	1	15	14	a	–	–	–	8	64
Flathead Lake											
Somers Bay	3		2		4	1					80
Flathead River											
Hwy 2-Flthd. Lake[a/]	27	34	1		20	13	1		2	26	56
Col. Falls-Hwy 2	8	1			3	5	1				33
SUBTOTAL	35	35	1	—	23	18	2	–	2	26	51
McWenneger Slough											
weaver Slough			2					2			0
	—	–	–	–	—	—	—	–	–	–	
TOTALS	51	36	6	15	41	27	2	2	2	34	55

a/ Includes Fennon, Egan, Church and Half Moon Sloughs, Hodgeson Lake

(56%) as compared to the reach above Kalispell (33%). Tree nests had the highest hatching success rate (87%) of all nest types throughout the study area (Table 4).

A variety of elevated nest sites were used throughout the study area. (Appendix Iv). Twenty-one of the 37 tree nests were nests built by ospreys in previous years. The one bald eagle nest used by geese in 1984 (Casey et al. 1985) was used again this year. Two pairs occupiednests builtbygreatblueherons. One pair nested at a site reported as an active golden eagle (**Aquila chrysaetos**) nest in 1978 (USFWS, unpubl. data). The remaining tree nests were in the broken tops of natural snags. "Structure" nests included 2 on docks in Somers Bay, 1 osprey nest box on a power pole, and 2 on man-made nesting platforms at Weaver Slough, in addition to the WPA structure previously mentioned.

In additiontothe known activenests, we recorded geese on an additional 24 elevated sites during our elevated nest inventory efforts. These included 5 nests from which geese were displaced by ospreys before we were able to verify if the nests were active; and 19 other sites on which geese were seen only once or twice either early or late in the nesting period which were otherwise vacant. We assumed these latter observations represented either non-breeding, "exploring" sub-adults or failed nesters. A detailed analysis of the dynamics of tree nesting species in the study area, primarily ospreys and geese, will be included in our final report in 1987.

Hatching success for all known-fate nests was 55% (Table 3). This was well below the 1984 figures for our study area (76%) and the Flathead Lake (72%) and lower Flathead River (74%) portions of the CSKT study area (Mackey et al. 1985). The 1980-1984 average hatching success for Flathead Lake nests was 76% (Ball 1983, Mackey etal.1985). These values are similar to those reported for the species throughout its range (Bellrose 1976). Low nesting success for 1985 (40-53%) was also reported for the CSKT study area (Matthews et al. 1986).

In our study area, nesting success was lowest (14%) for "ground" nests in marsh habitats (Table 4). due to predation, and we found no nests at McWenneger Slough, where an average of 9 indicated pairs had been recorded (Table 1). Muskrat (**Ondatra zibethicus**) activity may have destroyed all signs of nesting by early June when we searched the muskrat lodges which offered the best nesting sites.

High predation rates of island ground nests was cited as the cause of low nesting success elsewhere in the Flathead Valley in 1985 (Matthews et al. 1986). Fifty percent of the known-fate island ground nests in our study area failed (Table 4); two of these flooded and the others were predated. Craighead and Stockstad (1961) determined the major causes of nesting failure for geese in the Flathead Valley were predation and desertion;

Table 4. Summary of Canada goose nest fate by nest type, northern Flathead Valley, 1985.

Nest Type	Hatched	Failed Due To: Predation	Flood	Abandonment	Wind	unknown	% Success (Known Fate)
Ground (N=51)							
Marsh (n=18)	2	12				4	14
Island (n=33)	15	13	2			3	50
SUBTOTAL	ii	25	2			7	39
Elevated (N=57)							
Stump (n=15)	9	2				4	82
Structure (n=6)	2			2		2	50
Tree (n=36)	13				2	21	87
Subtotal	24	2		2	2	27	80

Geis (1956) attributed most predation losses (90%) to ravens (*Corvus corax*) or crows (Corvus *brachyrhynchos*). A wide variety of mammals have been recordedas known or probable predators of goose nests in the Flathead Valley, including mink (*Mustela vison*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), dog (*Canis domesticus*) and raccoon (*Procyon lotor*) (Geis 1956, Mackey et al. 1985). We noted 4 failures due to bird predation and 2 due to mammal predation, but were unable to determine the predator type at the other nests which failed due to predation. We observed sign of coyote, dog, raccoon, and skunk on nesting islands, and both crows and ravens were common throughout the study area.

Elevated nests differed from ground nests not only in percent success (Table 4), but in clutch size and chronology as well. Mean clutch size for 18 ground nests was 5.83 ±1.51, and clutch size for 26 elevated nests was 5.31kl.54. This difference, however, was not found to be significant (p=0.27) using a grouped t-test (Snedecor and Cochran 1967).

Nest Chronology

The peak of nest initiation in the study area during 1985 spanned the period from 25 March through 15 April. Elevated nests were the earliest nests started, with the WPA stump nests apparently being initiated later than the other elevated sites (Fig. 8). This delay at the mudflat stumps may be due to the late date (4 April) that ice-out occurred at the lake in 1985. Similarly, hatching dates were later (10-20 May, peak) at the mudflat stumps than at other elevated nest sites, where the majority of the hatch had occurred by 10 May (Fig. 9).

The peak of ground nest initiation occurred during the first 2 weeks of April (Fig. 10). This is similar to the usual peak reported by previous regional studies (Geis 1956, Craighead and Stockstad 1964, Mackey et al. 1985), and to the peak date of 11 April which we reported for 1984 (Casey et al. 1985). The peak of the hatch for groundnests in our area in 1985 was 8-18 May (Fig. 11), slightly later than in 1984 (Casey et al.. 1985). Nesting may have been delayed by the fact that snow cover on most river islands did not melt completely until very late March or early April.

We compared water level data taken from the main stem at Columbia Falls and from the South Fork below Hungry Horse Dam (USGS, unpubl, data), to nest chronology data (Fig.lO,ll). Unlike 1984, when 5 pronounced peak flow days attributable to releases from Hungry Horse Dam occurred during the nest initiation period (Casey et al. 19851, 1985 was characterized by 2 longer periods of high flows which occurred during the nesting period. The first such peak flow period occurred 10-27 April, during and immediately after the peak of nest initiation (Fig. 10). Flows at Columbia Falls increased from a daily minimum of 4,326 cfs on 10 April to a

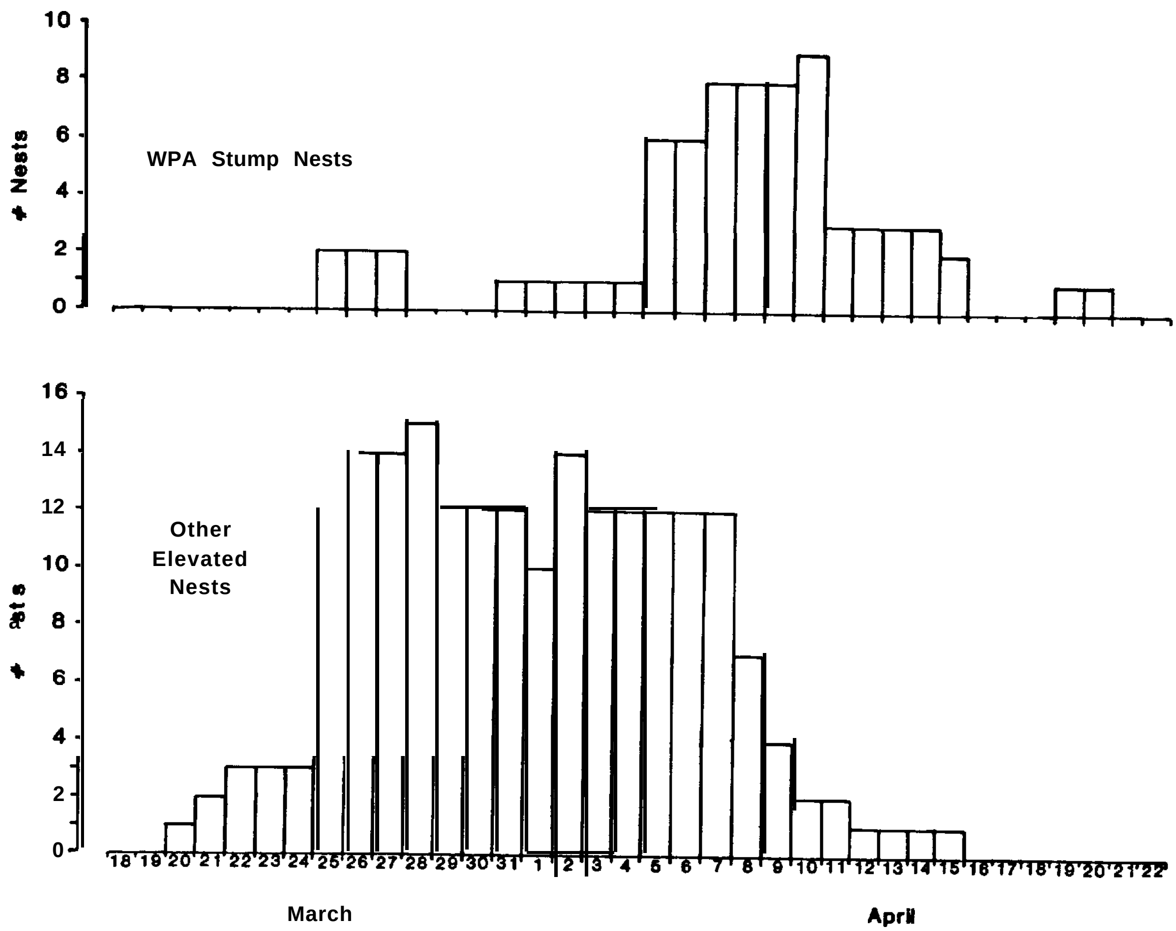


Figure 8. Estimated initiation dates, stump nests and other elevated nest sites used by Canada geese, northern Flathead Valley, 1985.

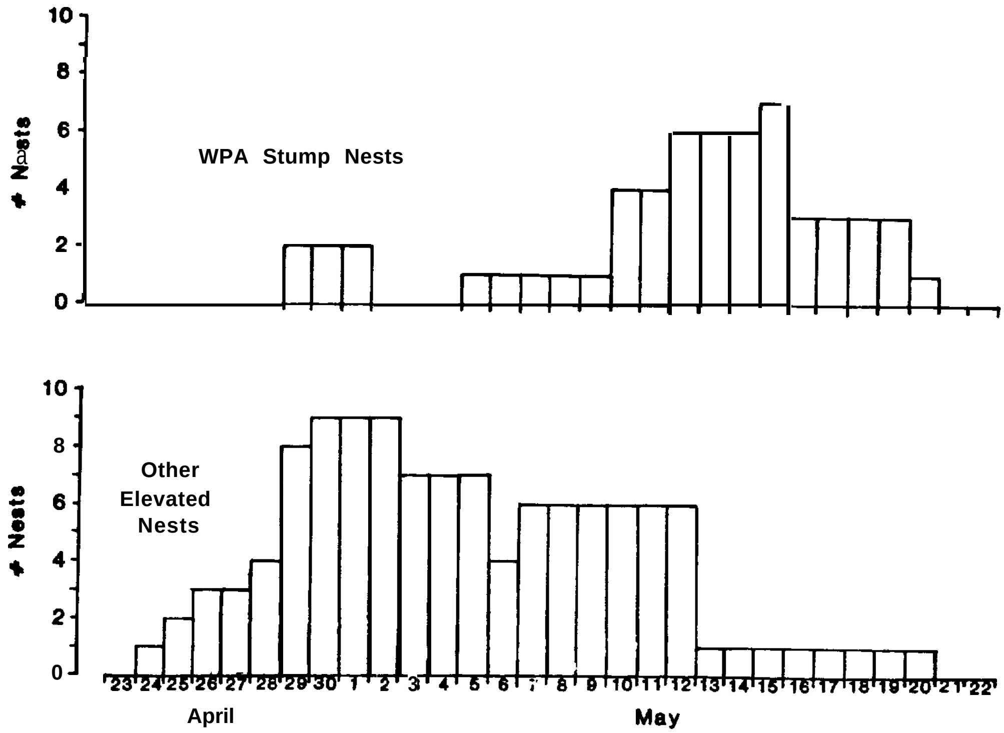


Figure 9. Estimated hatching dates, stump nests and other elevated nest sites used by Canada geese, northern Flathead Valley, 1985.

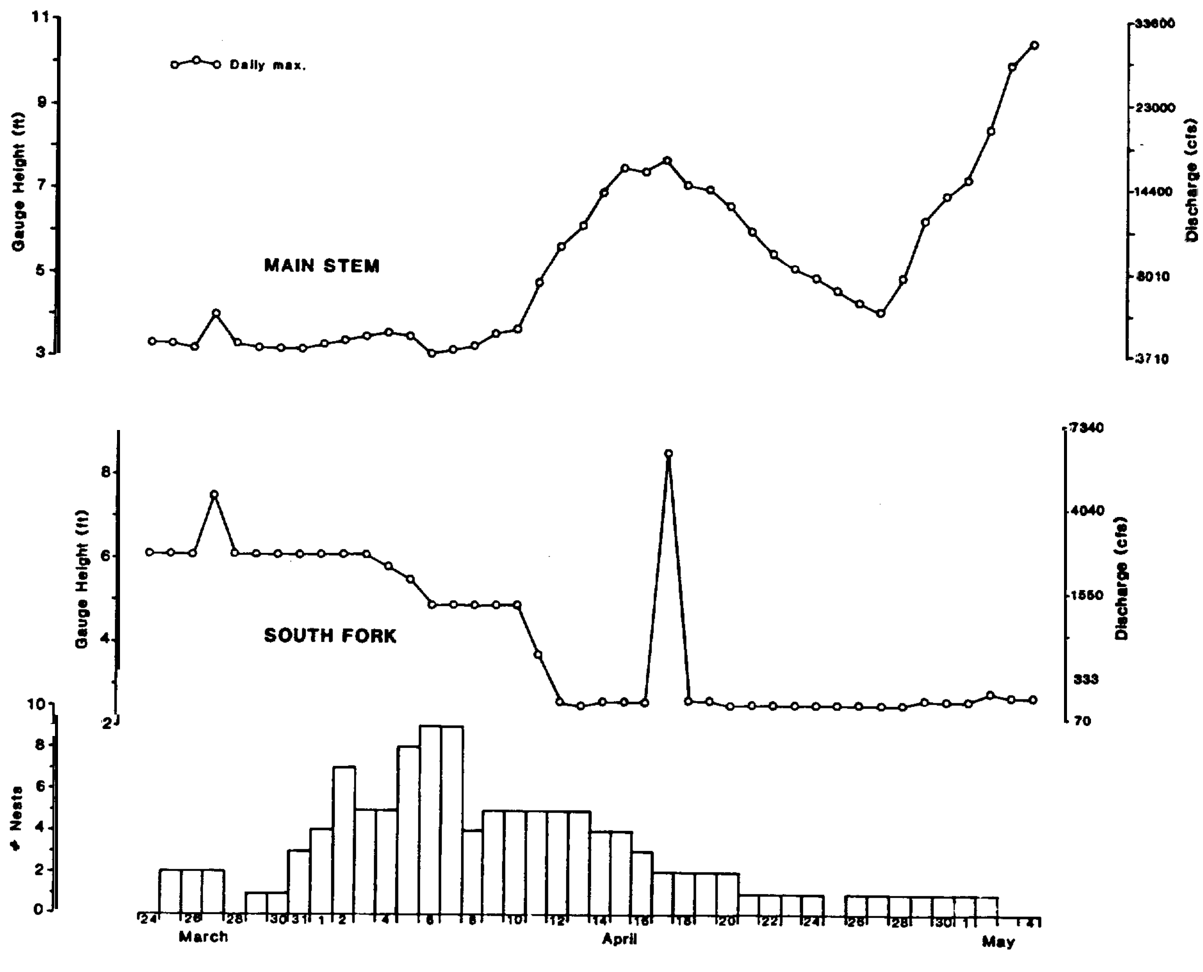


Figure 10. Estimated initiation dates, Canada goose ground nests compared to daily maximum and minimum gauge height and discharge, South Fork and main stem Flathead River, 1985.

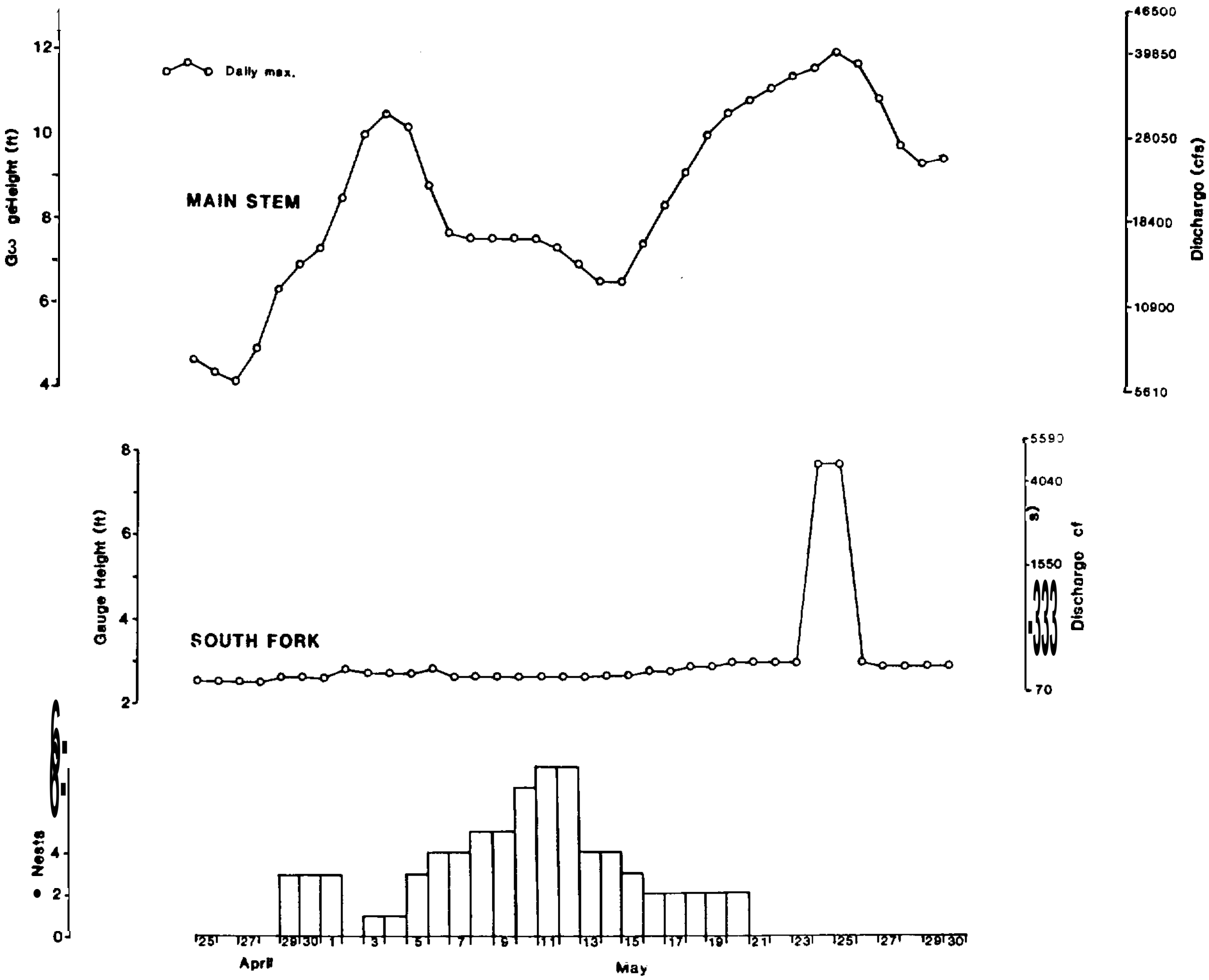


Figure 11. Estimated hatching dates, Canada goose ground nests, compared to daily maximum and minimum gauge height and discharge, South Fork and main stem Flathead River, 1985.

daily maximum of 17,560 cfs on 17 April, causing water level changes of 4.4 ft (1.3 m) at the Columbia Falls gauge. One release from Hungry Horse Dam caused a peak flow in the South Fork of 639 cfs, 17 April. South Fork flows were stable at a base load of about 184 cfs during the remainder of this period, so these main stem fluctuations were attributable to natural runoff. It is likely that some island nests were lost to flooding during this early peak flow period, particularly along the upper river reach (above Kalispell) and were therefore not located during subsequent nest searches.

The second large peak in river flows occurred between 27 April and 4 May (Fig 11), with flows peaking at 31,350 cfs on 4 May, the day which we conducted our most thorough search for upper river island nests. Water levels rose 6.4 ft (1.9 m) during this period, peaking 7.5 ft (2.3 m) above the minimum gauge height during the peak of nest initiation. Releases from Hungry Horse during May period were minimal (Fig. 11). This early high flow, attributable to abnormally high temperatures during the previous week (NOAA 1985), undoubtedly caused flooding of some ground nests which went unrecorded. The two nest failures which we attributed to flooding occurred 4 May and 25 May (at 39,900 cfs). The latter may have been a renest; it was near a predated nest site which also flooded in late May (after the nest had failed due to predation). Two other nest sites, one successful and one which failed due to predation, were flooded during high flows late in the month (25 May). Releases from Hungry Horse Dam contributed to high flows 24 and 25 May (Fig. 111, though the South Fork amounted to approximately 10-15% of the main stem discharge of those dates.

Because of their delayed initiation (Fig. 8), stump nests in the delta also had the potential for flooding when lake levels rose (Fig. 7). By comparing our calculations of the nest elevation (see following section) to lake level date (Appendix I), we determined 10 of these nest sites were inundated as water levels rose: 6 during the period 23-29 May, 2 during l-2 June, and 2 during 22-24 June. All but one nest had hatched or been predated prior to inundation. One nest still occupied 23 May was flooded by 29 May; its fate was unknown.

Nest Site Habitat Measurements

Physical habitat and vegetation measurements were completed on as many of the 108 nest sites as possible. All ground nests (n=5l) were sampled, and, data were collected for 23 of 27 tree nests. Analysis of habitat measurements were compiled separately for the major nest types (ground, stump, tree).

Grolnd Nests

All 51 ground nests were assessed for landform and cover type (Table 5). Most ground nests were found on islands (73%), with the remaining nests found in marsh (25%) or riparian bench (1%)

Table 5. Distribution of Canada goose ground nests by cover type and landform, northern Flathead Valley, 1985.

Category		Nunber of Nests	Percent
COVER TYPE:			
Forest			
Deciduous		8	16
Coniferous		1	2
Mixed		2	4
	Subtotal	11	22
Shrub			
Dense		8	16
Sparse		6	12
	Subtotal	14	27
Herbaceous			
Short		1	2
Medium		7	14
	Subtotal	8	16
Marsh		16	31
Unvegetated		2	4
	TOTAL	51	100
LANDFORM:			
Island		37	73
Marsh		13	25
Riparian bench		1	2
	TOTAL	51	100

landforms. Several cover types were almost equally represented by the ground nest locations, including the marsh type (31%), the shrub types (27%), the forested types (22%), and the herbaceous types (16%). Most of the nests found in the shrub types were located in cottonwood (*Populus* spp.); willow (*Salix* spp.) regeneration stands: and 8 nests were found in "true" shrub stands of rose (*Rosa* sp.), snowberry (*Symphoricarpus* sp.), alder (Alnus sp.) or juniper (*Juniperus* sp.). Of the 8 nests found in the herbaceous type, 5 nests were located on the dense "weedy" dredged islands on the WPA; the remaining 4nests were found in dense graminoid cover.

Stem density and overhead cover at the nest site and at sites 5 m from the nest were measuredat nest sites. No difference (t-test, $p=0.33$) was found in stem densitvbetweenthe nest site (5.3 $\pm 12.2/m^2$) and adjacent areas (3.4 $\pm 6.1/m^2$). Based on overhead cover categories used during last year's data analysis (Casey et al. 1985), both the nest sites and adjacent sites 5 m from the nest were found in open (<25%) cover.

Data from 46 ground nests were combined to determine average canopy cover. Litter (45%) and bare ground (37%) comprised the largest percent cover at the nest site. Litter most often included dry vegetation such as cattails (*Typha latifolia*), horse-tails (*Equisetum* spp.), and several grass species. The bare ground category included both open water and unvegetated substrate. Shrubs (21%) and graminoids (18%) provided the largest percentage of vegetativecover in the canopy. Forbs (9%), trees (9%), and logs (6%) comprised minor components of the canopy cover.

Data from 45 ground nests were combined to describe nest sites in relation to the seasonal HWM (Fig. 12). Eight nests (18%) were located below or at the HWM. Five nest sites flooded on the upper river section above and including the braided area southeast of Kalispell. Eighty-five percent of the ground nests were found within 1 m above or below the HWM. The same percentage (85%) was reported last year (Casey etal. 1985). Most (80%) of the ground nests were less than 2 m horizontal distance from the HWM. Thirteen nests were found at Egan Slough and Brosten's Pond (Hodgeson Lake), areas not directly influenced by water level fluctuations of the river or lake. The large percentage of nests found less than 1 m from the HWM indicates the potential for loss of nest sites due to flooding and erosion. Two nest sites on the upper river were lost when the supporting bank was washed away during high water flows in June. Additionally, at least 4 of the 7 ground nest sites found on the 2 delta islands near the mouth of the river were lost due to erosion once full pool was reached.

Tree Nests

Data from 23 tree nests were combined to describe habitat characteristics. Included in these 23 nest sites are 8 tree nests

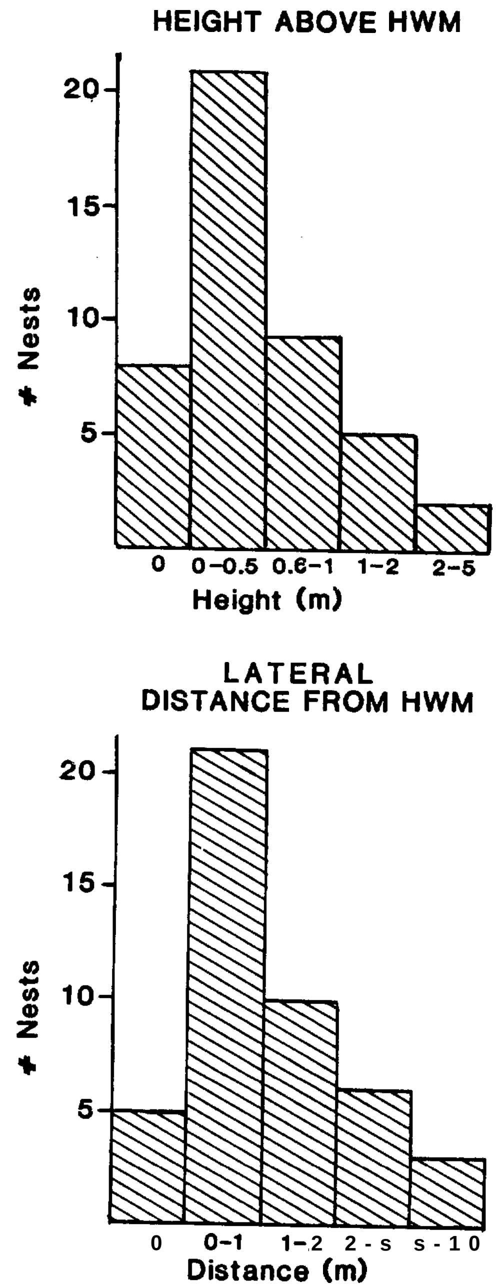


Figure 12. Canada goose nest locations in relation to the seasonal high water mark, northern Flathead Valley, 1984.

measured last year which were also active this year. Tree nests averaged 17.0 m in height in trees or snags averaging 20.0 m in height and 0.96 m in dbh. Very similar measurements were reported for tree nests usedbygeeselast year, when tree nests averaged 17.8 m in height in trees averaging 20.2 m in height and 0.95 m in dbh (Casey et al. 1985). All tree nests were found in cottonwoods: 11 were live trees and 12 were in dead trees or snags. All tree nests were found in deciduous forest on riparian benches except for one nest which was located on an island in the upper river.

The location of tree nests in relation to the HWM was measured for the 23 nest sites. The horizontal distance from the HWM was measured, since tree nests closer to the banks could be more susceptible to loss due to erosion. Twenty-eight percent of the trees were less than 2 m from the HWM and 52% werelessthan 5. m from the HWM.

Stump Nests

Physical characteristics were measured on 14 of the 15 stump nests found on the mudflats surrounding the small wooded island in the delta (Table 6). These stumps are the remnants of the extensive deciduous forest that was once found on the delta peninsula. When Flathead Lake is at minimum pool, stumps and their roots are exposed; during full pool only the taller stumps are visible. Stumps used by nesting geese included single stumps firmly rooted in the mudflat or with roots exposed, and large stump complexes with 2 or more stumps and their root systems. The stump nests averaged 1.82 m in height and ranged from 0.63 to 2.92 m in height. The average dimensions of 6 stump nests was 0.95 m x 1.20 m, not including those with extensive root systems. In one case the stump had weathered away and only the root system remained. The average circumference for 13 stumps used for nesting was 3.73 m and ranged from 2.42 m to 5.83 m for large stump complexes (Table 6).

The actual nest scrapes were found in the interior of the stumps, on the depression or cavity formed by weathering and erosion. Nest scrapes were composed of small (ca. 1 cm) wood chips and/or sand. Seven of 10 nest bowls had a southerly aspect; 2 had a northern exposure and 1 had a western exposure. The average depth of the depression with the nest scrape was 38 cm for 14 nest sites (Table 6). The size of the depression with the nest scrape averaged 32 cm x 47 cm for 14 nest sites.

The relationship of the nest bowl and the lake level were compared for14 stumpnests (Table 6). Ten nests werebelowthe full pool elevation (2,893 ft).

Table 6. Characteristics of Canada goose stump nests found on the delta, north shore Flathead Lake, 1985.

Nest #	Aspect	Nest Elev. a/ (ft)	Date Flooded	stump Height (m)	Nest Height (m)	Circumference of stump b/ (m)	Nest Bowl depth (cm)	Cavity Dimension& (cm)
B16	—	2893.09	--	1.77	1.55	2.32	15.0	33 x 44
B17	—	2893.49	—	2.26	1.90	2.95	21.5	35 x 45
B20	SW		—	1.14	---	3.71	34.9	30 x 50
B21	SE	2583.11	—	1.94	1.57	2.42	26.5	34 x 34
B22	SSE	2889.68	5/23-24	1.02	0.74	3.03	14.5	32 x 51
B23	NW	2890.87	5/27	1.78	0.88	5.52	54.0	40 x 92
B24	--	-----	5/24-25	0.63	0.30	3.68	17.8	29 x 43
B25	SSW	2893.84	--	2.92	1.65	3.66	76.4	24 x 51
B26	SE	2892.73	6/22	2.00	1.57	3.67	24.5	34 x 44
B27	SSE	2891.25	6/1	1.00	0.86	3.35	22.5	30 x 34
B28	—	2889.22-2891.08	5/23-29	--	—	—	—	---
B29	SW	2891.35	6/2	2.05	1.18	5.83	50.5	37 x 53
B30	—	2892.83	6/24	2.37	1.88	2.87	30.5	32 x 45
B31	NE	2890.24	5/24-25	2.52	1.22	--	72.0	22 x 43
B32	W	2891.02	5/28	2.04	1.05	5.46	66.5	29 x 53
$\bar{x}$				1.81	1.26	3.73	37.7	
S.D.				0.64	0.48	1.16	21.9	

a/ Full pool elevstion of Falthead rake is 2893.

b/ Measureskant taken at nest level and includes root system in some cases.

c/ Dimensions include only that portion of the cavity with the nest scrape; cavity used to describe concave top of stump.

BROOD STUDIES

Production

Results of selected aerial brood surveys are presented in Table 7. Earlier counts yielded few brood observations, and during later counts young could not be adequately distinguished from adults. The Flathead WPA received the greatest use by broods, with the largest numbers of goslings being recorded late in the brood-rearing period (after mid-June). Numbers increased at the WPA as adults with broods moved into the area to molt. We were able to document extensive brood movements through the use of radiotelemetry, including broods which travelled to the WPA from nesting areas 24 and 37 km upstream, and from Cedar Island, 19 km to the south.

The high brood count at the WPA for the season, 133, is similar to the1984 high count of155 (Casey et al. 1985), and to the number reported by Barraclough (1954) during the 1953 brood-rearing season (160). Annual trend counts have averaged 95 young (31-173) at the WPA during the years 1975-1985 (USFWS, MDFWP; unpubl. data). Similarly, the high count along the river from Kalispell to the lake (591, was similar to the ll-year mean of 63 (USFWS, MDFWP; unpubl. data). USFWS trend counts for 1985 totaled 87 goslings at the WPA and 59 along the river.

Using an average brood size of 5.0, the highest total count for the brood-rearing period (197) would be equivalent to 39 broods. This total is lower than the number of successful nests predicted by the nest total (108) and the 55% hatching success rate we observed (e.g. 55% of 108 is 59 successful nests). If we assume a brood size of 5.0, 59 successful nests would yield a production estimate of 295 goslings on the study area.

survival.

The only previous survival (gosling mortality) estimates which have been developed for this portion of the Flathead Valley Canada goose population were those of Barraclough (1954), who estimated 23% mortality at the lake as a whole, and 8% mortality of goslings using the north shore, for the years 1953 and 1954.

We found no decrease in brood size from age classes I through VIII; nor did brood size decrease when each 5 day period beginning 25 April and ending 5 July were compared, for broods observed throughout the study area (Table 8). Dropping broods of 10 or more goslings from the analysis had no effect on the results, and brood sizes at the WPA also showed no decline over time (Table 8). In all cases, mean brood size varied from 3.83 to6.25 but the mean of means was 4.76 for the entire brood-rearing period.

Table 7. Aerial survey results, Canada goose broods, northern Flathead Valley, Montana, 1985.

Location	Total Gosling Count by Date						
	7 May	14 May	22 May	29 May	6 June	18 June	27 June[a]
Flathead Lake WPA	13	15+	72+	65	58	69	131
Flathead River							
C. Falls - Kalispell		5	5	16			
Kalispell-Lake[b]	19+	13+	65	34	10	35	-
McWenneger Slough	5+	0	0	6	21	9	-
Ashley Cr.-Weaver Slough (Lower Valley)	0	0	55+	17	34	27	-
Johnson Lake	-	-	-	-	-	11	-
Mud Lake	-	-	-	-	-	6	-
TOTALS	37+	33+	197+	138	123	157	131

a/ Survey of WPA only

b/ Includes Egan, Fennon, Church and Half Moon Sloughs.

Table 8. Mean brood size of Canada geese by age class (Yocom and Harris 1965) and by date, northern Flathead Valley, Montana, 1985.

Category	(n)	$\bar{x}$ Brood Size, (All Broods) Study Area	$\bar{x}$ Brood Size, (All Broods) WPA Only[a]	$\bar{x}$ Brood Size (Broods of <10 goslings) Study Area	$\bar{x}$ Brood Size (Broods of <10 goslings) WPA Only[a]
Age Class I	(57)	5.0	5.2	5.0	5.2
II	(63)	5.0	5.2	4.5	4.8
III	(60)	4.7	5.1	4.6	4.9
IV	(63)	5.1	5.1	4.7	5.0
V	(30)	5.0	4.9	4.8	4.7
VI	(20)	5.0	5.0	5.0	5.0
VII	(12)	6.3	6.3	6.3	6.3
VIII	(11)	6.0	—	5.0	—
Date					
4/25-4/30	(3)	4.0	—	4.0	—
5/1 -5/5	(12)	5.3	—	5.3	—
5/6 -5/10	(28)	4.6	—	4.6	—
5/11-5/15	(32)	5.3	—	5.0	—
5/16-5/20	(7)	4.9	—	3.8	—
5/21-5/25	(75)	4.9	—	4.6	—
5/26-5/30	(31)	4.8	—	4.6	—
5/31-6/4	(37)	5.2	—	5.0	—
6/5 -6/9	(49)	5.0	—	5.0	—
6/10-6/14	(25)	4.4	—	3.9	—
6/15-6/19	(50)	5.0	—	5.0	—
6/20-6/24	(23)	5.6	—	5.1	—
6/25-6/29	(38)	5.8	—	5.6	—
6/30-7/4	(21)	5.4	—	5.4	—
7/5 -	(1)	6.0	—	6.0	—
					—

[a] For broods in the WPA, mean brood size by date was not calculated.

We witnessed 5 occasions where broods increased in size due to social interactions with other broods. In three cases, the brood gained one gosling (4-5, 5-6, 5-6), and in two cases the brood increased by 2 goslings (5-7,6-8). This type of brood mixing makes it difficult to assess survival based on mean brood size, particularly in situations such as two we witnessed where the adopted gosling(s) had been the only ones with the adults they left. For example, collared birds MY15 and MY17, who apparently hatched a brood of 5 young, were joined by a lone gosling from another pair, effectively changing the mean brood size from 3 (2 pairs, 6 goslings) to 6 (l pair with 6 goslings), since pairs with no young were not considered when developing these mean values.

Brood Activity Budgets

Computer analysis of the brood activity budget data has not yet been completed. A sub-sample of 43 surveys totaling 1290 individual observations of broods at Flathead WPA were analyzed to identify activities, landform and cover types utilized by both goslings and adults (Fig.13). Only surveys with less than 10 out-of-sight records for either goslings or adults were summarized, and for this analysis individual out-of-sight records were dropped from the time budget calculations.

Since data were collected from single goslings and adults within the same brood, time spent in each different landform and cover type differed little between goslings and adults (Fig. 13). Differences were recorded primarily when broods were in ecotones. Broods spent most of their time in mudflats, with the percentage slightly higher for goslings (37%) than for adults (35%). Marsh and intertidal (shoreline) were the next most frequented landforms (Fig. 13). Intertidal was used to describe the narrow ("l-3 m) zone immediately at the shoreline which included both wave-wetted mudflat and water shallow enough for geese to wade. Broods frequently grazed and traveled directly along the shoreline.

Goslings spent twice as much time feeding (54%) as adults (27%), and far less time alert (1% versus 29%). This was expected since adults typically stood watch while goslings fed. Much of the time spent by both goslings and adults in locomotion was probably in response to minor disturbance; only obvious disturbance responses were classified as such, leading to the low total for that category (1%) for both goslings and adults. Similarly, cover types without any visible vegetation were classified as unvegetated, leading to high totals for that cover type for both adults (47%) and goslings (49%). These observations included many situations where the geese were actively grazing on minute shoots in the mudflats. The cover types we used reflect phenology, and goslings feeding in the same area throughout the brood-rearing period were therefore sometimes coded as feeding in unvegetated, then short herbaceous, then medium herbaceous cover types as the season progressed, Rising water levels also led to

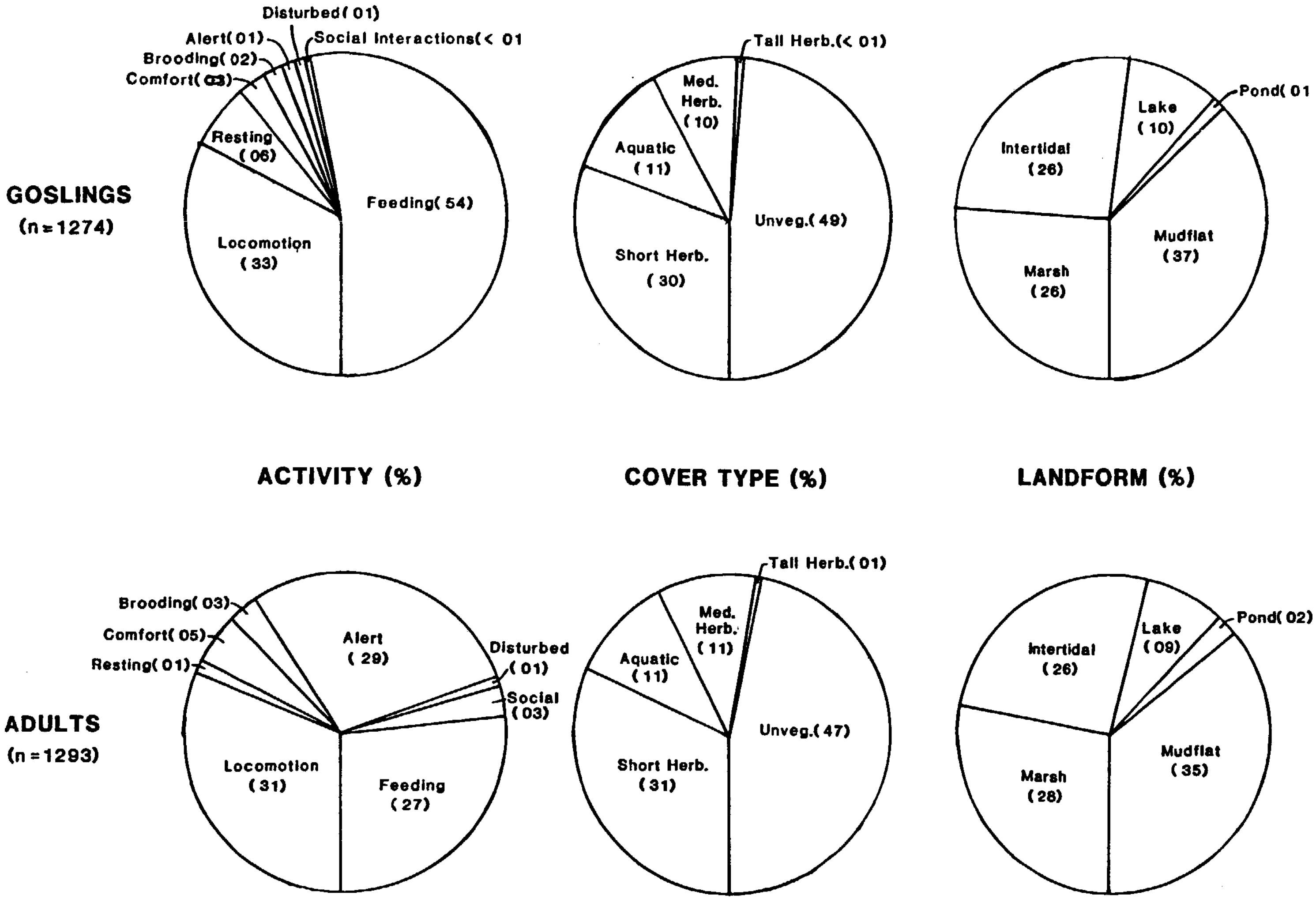


Figure 13. Activity type, cover type and landform use as determined through time budget surveys of Canada goose broods at Flathead Lake WPA, 1985.

changes in landform coding from mudflat to intertidal, to marsh in some areas. The vast majority of brood observations collected at Flathead WPA were in areas dominated by flowering rush (Butomus umbellatus), an introduced species of plant which tolerates a wide variety of water depths (A. Schuyler, Botanist, Academy Natural Sciences, Philadelphia, pers. commun.).

As we noted in 1984 (Casey et al. 19851, broods at the WPA spend a greatdealof time in exposed habitats. Goslings spent 79% of their time in unvegetated or short herbaceous cover types. It is still unclear if this trend of using the exposed mudflats affects survival of goslings. We witnessed several instances where predators came close enough to broods to influence their behavior, but witnessed no actual predation during our brood surveys. On several occasions, adults with broods showed no reaction to nearby avian predators. These included a northern harrier (Circu cyaneus which flew within 5 m of a brood, ospreys perched as close as 30 m to feeding broods, and bald eagles perched within 15 m of swimming broods. Reactions to avian predators ranged from swimming out into the lake to avoid a perched eagle, to alert adults "herding" goslings together as they swam past an eagle, to an instance where adults actually charged one of 3 nearby American crows which had not harassed the goslings. We witnessed one incidence of a red fox (Vulpes vulpes) approaching a large flock of geese at the WPA, but did not see the outcome. No other incidents with mammalian predators were witnessed, though adults showed a mildly disturbed (alert) reaction even to a beaver (Castor canadensis) swimming past a feeding brood.

We witnessed geese using stumps, logs, depressions in the mudflats, and emergent (cattail, flowering rush) stands as escape or resting cover at the WPA. Broods in the mudflats fled either to upland/mudflat ecotones or onto the open water of the lake, depending on the direction of the perceived threat.

Brood-rearing Area Habitat Measurements

On the main stem Flathead River above the lake, most brood use occurred on the associated oxbow sloughs, particularly Half Moon and Egan Slough. Weaver Slough was also used by broods; however, because of the lack of direct observations of specific habitat use, this area was not sampled. Only one area within the main stem Flathead River was identified as a key brood-rearing site. Broods were observed consistently on one side channel in the braided section of the river southeast of Kalispell.

That portion of the WPA west of the mouth of the river and along the north shore Flathead Lake received extensive use by broods throughout the brood-rearing period. Surveys indicated bays free of dense cattails were the preferred sites within the WPA.

Six important brood-rearing areas were sampled in order to describe physical and vegetative habitat characteristics. Within each area, one or more sites were selected for sampling, based on the number of plant communities associated with the brood rearing area. These sites were also selected based on the specific locations wherebroods were observed. A total of 10 sites were sampled (Table 9).

Data from all10 sites werecompiledto describe characteristics of brood areas in general (Appendix V). The majority (80%) were in either the medium herbaceous or pasture cover type: marsh was the only other cover type represented (20%). At 50% of the sites marsh was the closest other cover type. Most sites were found in the riparian bench landform (70%). The closest other landform was aquatic in all cases. All sites were less than 1.5 m above the HWM, and less than 20.0 m lateral distance from the HWM. Seventy percent of the sites were less than 10.0 m from the HWM.

Total species composition, frequency, and percent cover for the 10 sites are listed in Appendix VI. Graminoid (55.7%) and forb (49.7%) species provided the most plant cover. These species groups also had the highest frequency of occurrence with graminoids occurring in 82% of the plots and forbs occurring in 78% of the plots. Shrubs only contributed a small percentage (4.2%) to the total plant cover. Typically, the **Populus** and salix species occurred as sub-shrubs (seedlings or young saplings). Aquatic and semi-aquatic plants occurred frequently (41%) and contributed 25% of the vegetative cover.

Braided Section -Flathead River

This brood area was located on the eastern channel of the braided section of the river southeast of Kalispell.. Broods were observed on an island, the river channel, and the mainland bank above the river. Distinct plant communities were sampled at separate island and bank sites.

The first site was located on a herbaceous peninsula on the island and was characterized by dense (65%) graminoid cover (Table 9). Dominant graminoid species included several species of **Juncus** and Carex. Forbs provided 47% vegetation cover with **Equisetum** spp. dominating. **Salix** saplings (<l m in height) contributed 32% vegetation cover. This site was immediately adjacent to the river channel and level with the high water mark.

The second site sampled was located on the pasture immediately above (1.5 m) the river channel. This site was dominated (85% cover) by dense, heavily grazed grasses (Table 9), including **Agrostis, Poa, Agropyron, Phleum,** and **Dactylis** species. **Trifolium** spp. (22%) and **Taraxacum officinale** (14%) were the dominant forbs present.

Table 9. Canopy cover (percent) at 10 sites in 6 Canada goose brood-rearing areas, northern Flathead Valley, Montana, 1985.

Site#	Brood Area	Graminoid	Percent Forb	Cover Shrub	Aquatic	Other[a]
1	Braided Section	65.00	47.25	36.00	0.00	6.25
2	Braided Section	85.00	62.00	6.00	0.00	0.00
3	Egan Slough	4.50	16.50	0.00	126.00	25.25
4	Egan Slough	4.00	96.50	0.00	0.00	8.25
5	Esan Slough	83.25	21.00	0.00	14.25	0.00
6	McWenneger Slough	64.25	135.75	0.00	1.75	0.00
7	McWenneger Slough	103.50	12.00	0.00	19.75	8.00
8	Shaw's Slough	85.00	44.50	0.00	0.00	0.00
9	Half Moon Slough	62.50	61.75	0.00	0.00	0.00
10	WPA	0.00	0.00	0.00	88.25	3.75

[a] Includes open water and bare ground.

Egan Slough

Egan Slough is an old oxbow of the river and although it remains connected to the river, its water levels are regulated by a culvert system. Broods were observed on Egan Slough throughout thebrood-rearing period, particularlyon the west "arm" of the slough. Two radio-equipped geese (MY13 and MY14) raised their broods here.

The first site sampled at Egan Slough was located on a small flat peninsula that was a section of pasture grazed by horses. Graminoid species dominated (73.5%) the site (Table 9) and included **Agrostis**, **Festuca, Poa, Agropyron,** and **Carex** species. **Scirpus acutus** was common and provided 14% vegetative cover.

The second area which received extensive use by broods included a barley field on the interior of the slough, and the herbaceous zone between the field and the open water of the slough (Table 9). We sampled the loafing site adjacent to the barley field and the aquatic area within the slough. The loafing site was dominated **by Cirsium(15%), Amaranthus** (10.881, and several unidentified forbs (64.2%). The aquatic community was dominated by **'Equisetumfolia** (45%) and **Scirpus acutus** (52%). Equisetum spp. comprised the largest forb coverage (16.5%). Several aquatic species provided high species diversity for this site.

McWenneger Slough

Most observations of broods at McWennqer Slough occurred on a pasture and medium herbaceous site adjacent to a pond at the northern end of the slough. The pond, slough, and adjacent emergent stands probably received use by broods as well, but very few observations were recorded in those types.

The pasture site (Table 9) was dominated (63%) by **Poa** and **Carex** species. Diverse forbs were found at this site including **Trifolium (60%), Cirsium** (21%), and **Prunnela** (31%). The pasture had been heavily grazed by horses and cattle.

Between the pasture and the pond was an area of dense medium herbaceous vegetation also utilized by broods. This site (Table 9) was characterized by moist-site graminoids including **Carex** spp. (62%) and **Phalaris arundinacea(40%).** Moist site forbs were also common including **Polygonum amphibium,** Hippuris vulgaris, **Equisetum** spp., and **Sagittaria cunneata.**

Shaw's Slough

Shaw's Slough includes the channel that connects Mcwenneger Slough with the main stem Flathead River. Broods were observed occupying a pasture between the slough and a pond to the north. Heavily grazed grasses dominated (85%) the vegetation cover (Table 9), and included **Agrostis, Poa, Phleum, and Agropyron** species. Few forbs were present but they comprised **32.5%** of the vegetation cover. **Taraxacum officinale Trifolium** spp. **Cirsium** spp, and Plantago sp. were the common species.

Half Moon Slough

The Half Moon Slough sampling site was selected in part due to data collected during broodactivitybudget surveys of a radio-equipped pair of geese. Observations of that brood and others indicated extensive use of a narrow strip of pasture between the slough and a remnant oxbow pond. Vegetative cover was dominated (62.5%) by grasses (Table 9), including **Agrostis** sp., **Poa sp.,** and **Agropyron sp..** The most abundant forbs at this site were **Taraxacum officinale** (22.8%), **Trifolium** spp. (22.0%) and Plantago sp. (11.3%).

Half Moon Slough is directly influenced by water level fluctuations of the lower river resulting from lake level changes. During periods of low water, broods were observed on the intertidal zone between the pasture and the slough. This habitat was not sampled because of high water levels during fieldwork; however, this site was dominated by Carey species and several aquatic species including **Potamogeton richardsoni, Potamogeton natans, Ceratophyllum demersum, Myriophyllum** sp., and **Eleodea** species.

Flathead Lake WPA

Observations compiled from activity budget surveys indicated extensive brood use of the north shore of Flathead Lake (WPA) west of the river delta. Heavily used areas included bays adjacent to the extensive cattail marsh stands. All sites were nearly identical in plant species composition and density: therefore only 1 site was sampled (Table 9). This nearly monotypic community was dominated by **Butomus umbellatus** (85%). **Polygonum amphibium** was the only other species present and comprised 3.8% of the vegetation cover.

The Butomus stands were sampled during full pool when most plants were approximately 0.5 m in height but still emergent. During the early brood-rearing period when lake level was at minimum pool, Butomus was present as shoots at specific sites on the mudflats. These pockets of vegetation were used extensively by broods.

Table 10. Habitat losses on the north shore Flathead Lake, Montana, 1937-1985, as determined from aerial photographs.

Habitat-	No. Acres Inundated/Eroded
Forest[a/]	571
Dense shrub	76
Herbaceous	
Grass/forb, sparse	671
Wet meadow	114
Intertidal	190
Pasture	118
Hayfield	86
Wetlands (ponds/marsh) (n=12)	33
TOTAL	1,859

a/ Includes coniferous, deciduous, and mixed coniferous-deciduous stands.

HABITAT LOSS ESTIMATES

Analysis of aerial photographs taken prior to construction of Kerr Dam (1937) documented the loss of 1,859 acres of habitat (Table 10) along the north shore of Flathead Lake. Losses are attributed to inundation after construction of Kerr Dam and to the continuing erosion impact due to operation of that facility (Moore et al. 1982).

Habitat types were mapped from aerial photographs (Fig. 14) in order to assess possible impacts to Canada geese. Most (63%) of the habitat lost included herbaceous habitat types (Table 10) which may have been utilized by geese during the brood-rearing period. Barraclough (1954) documented the use of the north shore by broods during 1953. Thirty-one percent of the habitat lost included forested areas.

In addition to the acres actually lost due to inundation or erosion, it is apparent from the photographs that changes occurred in the adjacent remaining habitat. These changes were not quantitatively described because of the difficulty in assessing whether these changes were due to water levels, natural succession, or mechanical manipulation.

Historical vegetation data were useful in further describing plant communities existing prior to construction of Kerr Dam. Shoreline vegetation in the delta was described by Norton (ca. 1910) as dense shrub stands of serviceberry (Amelanchier sp.), chokecherry (Prunus sp.), rose, ninebark (Physocarpus sp.), willow and extensive stands of cottonwood, aspen, and birch (Betula sp.). Swamps and meadows were also noted along the north shore.

Jones (ca. 1910) reported a "great delta, miles in extent, covered with a forest of cottonwoods interspersed with evergreens, and "one giant species of Populus not found elsewhere)" Extensive aquatic beds were reported in the lake at the mouth of Flathead River, with species composition similar to the large swamp at the south end of the lake (Polson Bay). Currently, the north shore area no longer supports the diversity or the quantity of aquatic plants that is found along the south shore (A. Schuyler, botanist, Academy of Natural Sciences, Philadelphia, pers. commun.).

Direct measurements and photo-documentation in 1985 revealed continued loss of terrestrial habitat in the delta area. Prior to the lake reaching full pool, the remnant cattail island was 47.4 m long and about 411 m^2 in area. The wooded island was approximately 20 m long and 90 m^2 ($\pm$ 10 m^2) in area (T. O'Neil, biologist, Montana Power Company, pers. commun.). By November, the cattail island had been completely eroded away and the wooded island had eroded down to an estimated 30-40 m^2.

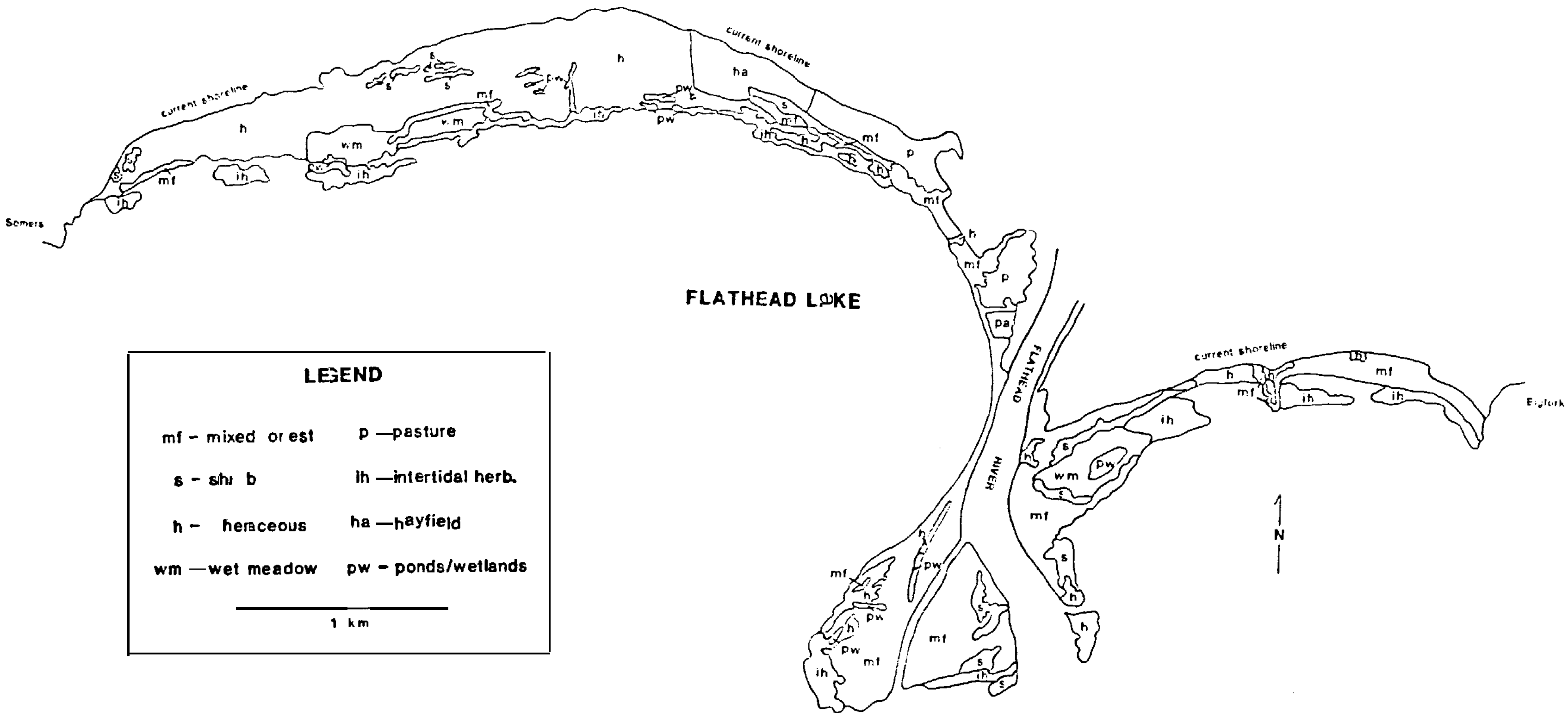


Figure 14. Habitat losses, north shore of Flathead Lake, 1937-1985.

NON BREEDING SEASON STUDIES

Population Surveys

Results of aerial surveys conducted Jan. - Nov. 1985 are presented in Table 11. Total goose numbers in the study area varied seasonally. During January and February, Flathead Lake and most sloughs in the study area were frozen. Geese were observed primarily on the river reach below Kalispell, andtotalnumbers were relatively stable (468-640). By March, migration was underway, and totals increased dramatically (to 962-1977). Most geese were seen on the river until late in the month, when a combination of meltwater ponds and sprouting wheat in the Lower Valley attracted large feeding flocks.

Total adult goose numbers dropped drastically as the breeding season began and remainedconsistentlylow (274-344) until late May (521-616). Geese dispersed throughout the study area during the breeding season. Higher numbers in late May were probably due to flocks of molt migrants passing through on their way to molting areas in Canada. June totals were low (92; 124), but birds with broods were secretive and many non-breeders may have left on molt migration.

Following the brood-rearing period, numbers increased again in late July and August (452-768),due in part to the fact that young birds were indistinguishable from adults and were therefore included inthetotals. Wheat fields throughout the valley were used extensively for feeding as they were harvested, during late summer and into September. Sheltered off-river sloughs and the WPA were used for loafing areas.

Once the hunting season began (28 Sept.) goose distribution in the study area shifted dramatically away from the WPA, most of which is open to hunting. The largest flocks of geese were seen near Mud and Johnson Lakes, in areas closed to hunting. Total numbers in September and October ranged from 339 to 699. An apparent influx of migrants occurred by early November (886), when birds started frequenting the river again as off-river sloughs began to freeze.

Radiotelemetry

Twenty-two geese equipped with radio-collars during 1985 trapping efforts plus two geese radio-collared by CSKT biologists provided data descriptive of habitat use and movements within the study are (Appendix VII). Between 7 March and12 December, 317 locations were documented for the 24 radio-collared geese. Most (219) locations were obtained during aerial surveys with additional locations recorded during brood activity budget surveys and general field work. CSKT biologists provided locations for MDFWP radio-collared geese found on the southern half Flathead

APPENDIX VII

Table 11. Total numbers of adult Canada geese observed during aerial surveys, northern Flathead Valley, 1985.

Date	Time at Start	Flathead Lake WPA[a/]	Flathead River Hwy. 2 - Lake[b/]	Flathead River C. Falls-Hwy. 2[c/]	McWenneger Slough	Fairview Marsh	Valley Potholes[d/]	Mud Lake, Johnson Lake	Study Area Total
11 Jan.		36	455	62	—	--	--	--	553
31 Jan.	1107	0	434	49	—	--	—	—	483
14 Feb.	1032	0	640	0	--	--	—	--	640
7 Mar.	1057	157	797	8	0	--	—	--	962
15 Mar.	1112	821	366	29	0	0	--	--	1216
20 Mar.	1412	318	177	17	0	—	1465	—	1977
28 Mar.	1012	387	382	93	7	--	542	--	1411
2 Apr.	1033	79	156	13	22	--	25	--	295
9 Apr.	0928	116	148	25	32	—	10	—	331
16 Apr.	0919	76	137	19	23	10	17	—	282
24 Apr.	0935	87	170	9	17	--	6	—	289
30 Apr.	0920	62	183	19	19	--	17	—	300
7 May	1033	122	123	8	13	--	8	—	274
14 May	1019	148	160	12	10	--	14	—	344
22 May	0930	294	235	4	34	--	55	—	616
29 May	0910	281	126	87	2	—	25	--	521
6 June	1030	99	—	--	10	—	16	—	124
18 June	1007	48	20	0	6	--	10	8	92
3 July	0845	95	64	0	26	--	40	23	248
24 July	0846	99	71	—	80	--	202	0	452
1 Aug.	0955	217	52	--	43	0	196	--	508
13 Aug.	1055	449	95	118	22	--	49	35	768
29 Aug.	0853	1	84	128	0	8	319	—	540
13 Sept	0853	9	128	106	25	39	326	—	633
27 Sept	0846	5	227	0	0	0	450	17	699
10 Oct.	0844	0	62	0	0	0	2	461	522
24 Oct.	0958	4	87	14	0	0	0	234	339
6 Nov.	0850	84	424	93	0	0	2	283	886
22 Nov.	1400	281	23	74	0	-	143	54	575
4 Dec.	0920	0	16	0	-	-	35	0	51
16 Dec.	1488	13	17	65	0	0	-	0	95

a/ Includes the shores of Flathead lake north of Deep Bay on the west and Woods Bay on the east.
b/ Includes Egan, Fennon, Church, and Half Moon sloughs, Hodgeson Lake.
c/ Includes a series of potholes at the base of Columbia Mtn. southeast of Columbia Falls.
d/ Includes Weaver Slough, Ashley Creek, the "Lower Valley" region between Kalispell and Flathead Lake, and the "West Valley" region northwest of Kalispell.

Lake and nearby reservoirs. The single goose radio-collared during the 1984 field season (MH89) was not located during this year.

Several of the geese trapped and radio-collared in February apparently did not nest in the study area. Two geese (MY04 and MY05) left the trap area within a few days and were located on the southern half of Flathead Lake through May. Although MY04 and MY05 were apparently a mated pair, the nest site was not found and no broods were observed (B. Matthews, biologist, CSKT, pers. commun.). Five geese (MY09, MY10, MY11, MY12, and MY16) left the area by the end of March. Four geese (MY01, MY02, MY03, and MY06) remained in the study area throughout winter but were not located again after the third week of May. Those birds leaving the area in May could represent non-breeders within the population which participate in a molt migration to secure areas in Canada as documented for other goose populations (Davis et al. 1985). CSKT biologists noted the disappearance of several of their radio-collared geese during the same period (B. Matthews, pers. commun.).

Four adult geese (MY13, MY14, MY15, and MY17) radio-collared in February remained in the study area and provided data descriptive of habitat use throughout the breeding and non-breeding seasons. One pair, MY15 and MY17, nested in a tree at Foy's Bend, just below Kalispell on the lower river. The presence of a brood with this pair was first noted 30 April, when they were observed with at least 3 goslings on Ashley Creek approximately 6.5 km downstream from the nest site. Aerial and ground observations (brood activity budget surveys) indicated the pair and their brood occupied Half Moon Slough from 1-17 May. During this period we observed their brood increase from 5 to 6 goslings when a lone gosling was "stolen" from another pair. By 22 May the pair and brood had moved to Weaver's Slough, approximately 6.4 km from Half Moon Slough. The pair with brood remained at Weaver's Slough until 9 July. During the post-breeding period MY15 and MY17 were located at several grainfields within the lower valley (area north of the WPA). During October and November this pair remained in the area near their nest site.

Specific nesting locations of MY13 and MY14 were unknown, however, both collared geese were observed on 20 May with their mates and a gang brood of 11 goslings at Egan Slough. Both collared geese and their broods remained at Egan Slough throughout June. On 12 July, MY14 and a brood of 4 goslings were located on the WPA, approximately 24 km downstream from Egan Slough. MY14 remained on the WPA until the first week of August. MY13 remained at Egan Slough throughout the brood-rearing period. During fall aerial surveys MY13 and MY14 were found together on grainfields near Egan Slough, Mud Lake, and north of the WPA.

One adult-female goose (MHl2), trapped by CSKT biologists on the south end Flathead Lake in 1984, apparently nested on an island in the braided section of the river southeast of Kalispell. This assumption was based on repeated radiolocations from 20 March through 29 May, though we were unable to verify that any of the nearbynestsites was used by this bird. On 17 June, MH12 and a brood of 5 goslings were observed on the WPA, a distance of approximately 37 km from the nesting area. MH12 remained on the WPA until at least 12 July; no locations were obtained after that date.

Another goose radio-collared by CSKT biologists, MH84, also raised its brood on the WPA after apparently nesting on Cedar Island (B. Matthews, biologist, CSKT, pers. commun.). MH84 was first observed on 14 May with a brood of 5 goslings on the WPA. The collared goose remained on the WPA throughout the brood-rearing period, however the brood size decreased to 3 goslings. After 20 August MH84 left the northern Flathead Valley and returned to the southern end of Flathead Lake; radiolocations indicate this bird remained in that area through November (B. Matthews, biologist, CKST, pers. commun.) and returned to the grainfields in the Lower Valley in December.

The 7 geese (MY18, MY19, MY52, MY53, MY54, MY55, and MY561 radio-collared during the June trapping effort on the WPA provided data descriptive of late summer and fall movements. The collared geese remained on the WPA through July and then dispersed to various locations throughout the study area. Radiolocations were documented in several grainfields north of the WPA (Lower Valley area), Mud and Johnson lakes, and the ponds southeast of Columbia Falls (Fig. 1). Several of the radio-collared geese (MY52, MY53, MY54, MY55, and MY56) moved to Pablo Reservoir south of Flathead Lake in September: all but 2 of these (MY54 and MY56) returned to the study area in October. During November and Deember the geese were found in grainfields in the Lower Valley.

Five radio-equippedgeese were shot during the 1985 hunting season. Three geese (MY07, MYO9, MY12) were shot on the Snake River in southeast Idaho between 7 December anbd 13 December. Two geese (MY19 and MY52) were shot on the study area. On 28 September MY19 was shot over a grainfield in the Lower Valley and on 24 November MY52 was shot on the river above the Highway 2 bridge.

OTHER WILDLIFE SPECIES

Observation data for species other than Canada goose were not analyzed in detail for inclusion in this report. We did, however, collect data describing the effects of water level fluctuations on the status of other species in our study area.

During our elevated nest inventory and subsequent status checks of tree nests, we were able to document 4 active bald eagle nests in the study. One of these was a newly discovered nest in a territory which had been occupied in previous years (R Magaddino, biologist, USFWS, pers. commun.). This new nest was the only unsuccessful eagle nest of the 4; the other 3 pairs fledged a total of 7 young. Data from each of these sites were supplied to the Montana Bald Eagle Working Group for their annual statewide inventory of eagle nests. These data and osprey nesting data were also coordinated with an ongoing study of these species funded by the MPC. We found 58 active osprey nests in the study area, 38 of which were successful.

Large-scale habitat losses at the north shore of Flathead Lake undoubtedly led to corresponding losses in a variety of wildlife populations, including white-tailed deer (Odocoileus virginianus), furbearers, and a wide variety of both game and nongame bird species. In this latter category, we documented the loss of the delta cattail island which was utilized by ring-billed gulls (Larus delawarensis), common terns (Sterna hirundo) and spotted sandpipers (Actitus macularis) as nesting habitat, Two species of diving birds, the Clark's grebe (Aechmophorus clarkii) and common loon (Gavig immer), may also have lost important nesting habitat as a result of the construction and operation of Kerr Dam. Both species are dependent on small islands and floating vegetation for nesting. Flocks of grebes and at least one pair of loons were observed throughout the breeding season, but no nests or young were seen.

SUMMARY-CONCLUSIONS

In order to meet the objectives of this 3-year study, it will be necessary to identify the size, distribution, and limiting factors of the Canada goose population in the northern Flathead Valley. Quantification of water level regimes and their impacts to this population are also necessary in order to determine the type and level of mitigation which will be proposed as an end result of these studies. The 1985 phase of the study yielded data needed to meet each of these objectives. Results of this year's studies provided data descriptive of goose distribution, population size, nesting effort,brood-rearing,and water level fluctuation effects within the study area.

Water level fluctuations along the main stem during the 1985 goose breeding season differed from those which occurred in 1984, when short-term increases in discharge and large daily fluctuations in water level occurred frequently in response to releases from Hungry Horse Dam. This year, 2 large peaks in discharge attributable to early, high spring runoff, occurred between the peak of nest initiation and the peak of hatch. The first of these peaks (14,500 cfs) included a release of 6,390 cfs from Hungry Horse which may have contributedtothe flooding of some river island nests.

As in 1984, minimum pool at Flathead Lake corresponded almost precisely with the nesting and early brood-rearing period for geese (March-May). Full pool was not reached until early July.

Our 1985 pair count data indicated that about 126 nests should have been present in the study area, using pairs/nest ratios determined elsewhere in the Valley (Mackey etal. 1985). An average of 151 indicated pairs were recorded in the study area: 108 nests were found in the same area, resulting in a pairs/nest ratio of1.4 for our study area. As in 1984, 81% of the pairs and 85% of the nests were located south of Kalispell on the lower river reach and along the north shore of the lake.

Our 1985 nest surveys indicated that the tree nests are an important component of this segment of the Flathead Valley Canada goose population. Fifty seven (54%) of the nests were found on elevated sites; 25 were in nests built by other species,12 were in natural snags, 5 on man-made structures, and 15 on weathered stumps in the remnant delta in the Flathead WPA. These latter nests were found in areas not searched by previous researchers.

The total number of ground nests found in the Flathead Lake WPA was consistent with previous studies (Ball 1981, 1983). However, at least 4 of the 7 island ground nests sites in the WPA were lost to erosion subsequent to the nesting period. The delta islands which have historically supported nesting geese will be totally lost to erosion before this study is concluded; one of the 2 islands, and over 90% of the vegetated area of the 2 islands combined was lost to erosion during July - Nov. 1985.

Hatching success for 1985 nests (55%) was low compared to long-term averages for the region. The importance of elevated nest sites was emphasized by higher success rates (80%) as compared to ground nests (39%). Predation was the predominant cause of ground nest failure (25 nests); we documented 2 nest failures due to flooding.

The peak of egg-laying for ground nests in the study area was during the first 2 weeks of April, and the peak of hatch 8-18 May. Analysis of river discharge data revealed 2 periods of substantial increases in flow due to high, early runoff during the nesting period. The first of these (17 April, peak) included a release from Hungry Horse dam. This period of high flows resulted in water level changes of 2.3 m at Columbia Falls, and probably resulted in the loss of some ground nests which went unrecorded. Eighty-five percent of all ground nests were located within lm above or below the seasonal HWM. Of 5 nests sites which flooded in 1985, 2 were predated prior to flooding, one hatched before flooding, and 2 failed due to flooding. The 2 failures occurred 4 May and 25 May, at flows of 30,300 and 39,900 cfs, respectively. Hungry Horse Dam was near base load (240 cfs) 4 May, and released a peak of 5,010 cfs, 25 May. Nest flooding in these cases was apparently attributable to natural runoff.

Ten of 15 stump nests at the Flathead Lake WPA were at or below fullpoolelevation (2893 ft.). All but one had hatched or failed prior to inundation; one late nest may have flooded.

Most ground nests were located on the island landform in either the marsh, shrub, or forest cover type. No difference was found in stem density between the nest site and adjacent areas. Both the nest site and adjacent sites 5 m from the nest were found in open (<25%) overstory canopy cover, Litter and bare ground comprised the largest percent cover at nest sites.

Tree nests averaged 17.0 m in height in trees or snags averaging 20.0 m in height and 0.96 m in diameter. All tree nests were found in deciduous forest cover type and on the riparian bench landform except for one nest which was located on an island. Twenty-eight percent of the tree nests were less than 2.0 m from the HWM and 52% were less than 5.0 m from the HWM.

Stump nests found on the delta mudflats averaged 1.82 m in height and 3.73 m in circumference. The stump cavities averaged 32 cm x 47 cm at a depth of 38 cm. Seventy percent of the nest bowls had a southerly exposure. Nest scrapes were composed of wood chips and sand.

The maximum gosling count in the study area for 1985 was 197. Total gosling production predicted by our nest total (108), hatching success (55%) and mean brood size (5.01, was 295 goslings for the study area. As in 1984, the Flathead Lake WPA received the greatest amount of use by broods, with a maximum count of 133 goslings on 27 June.

Six key brood-rearing areas were identified and 10 plant community sites within these areas were sampled. The areas included 4 off-river sloughs (Egan, Half Moon, McWenneger, and Shaw's), one channel of the braided section of the river, and the WPA west of the river delta. Most (80%) sites were located in the herbaceous or pasture cover type and the riparian bench landform. All sites were less than 1.5 m above the HWM and 70% were less than 10.0 m horizontal distance from the HWM. Graminoid (55.7%) and forb (49.7%) species provided the majorityofplantcover at these sites. The WPA received the most use by broods throughout the brood-rearing period, and sites were dominated (85%) by a single species, the flowering rush.

Activity budget surveys conducted at the WPA indicated that broods spend the majority of their time (54%) feeding, primarily (37%) in the extensive mudflats along the north shore. Most of their time (79%) was spent in areas classified as either unvegetated or short herbaceous cover types. The effects of these habitat use patterns on survival were difficult to assess; we documented no predation during 151 activity budget surveys at the WPA. Analysis of 316 observations of individual broods indicated no decline in mean brood size over time or age class, either for the WPA or for the study area as a whole. Brood mixing is apparently frequent, and may mask decreases in brood size due to gosling mortality.

Analysis of aerial photographs taken prior to construction of Kerr Dam documented the loss of 1,859 acres (747 ha) of habitat along the north shore of Flathead Lake. Losses were attributed to inundation and to continuing erosion due to operation of Kerr Dam. Most (63%) of the habitat lost included herbaceous habitat types, which may have been valuable as brood habitat. Thirty-one percent of the habitat lost included forested areas. Historical records document the existence of extensive deciduous forests, dense shrub stands, swamps, meadows, and aquatic beds occurring in the delta area prior to construction of Kerr Dam. Loss of these habitats is likely to have had adverse effects on a number of species in addition to the Canada goose.

Twenty-two geese were equipped with radio-collars during 1985 trapping efforts. Data descriptive of habitat use, brood movements and distribution during the breeding season were obtained from severalcollaredgeese. One pair, MY15 and MY17, raised their brood at Half Moon Slough and Weaver's Slough distances of 6.5 km and 12.5 km respectively from the nest site. Two other collared male geese (MY13, MY141 raised their broods at

Egan Slough. By July, MY14 and a brood of 4 goslings were located on the WPA, approximately 24 km downstream from Egan Slough. One adult female goose trapped by CSKT biologists on the south end Flathead Lake apparently nested on an island in the braided section of the river and raised a brood of 5 goslings on the WPA approximately 37 km from the nesting area. Another goose radio-collared by CSKT biologists nested on Cedar Island, 19 km south on the lake, and raised its brood on the WPA. During the non-breeding season, radio-equipped geese were found in scattered locations throughout the study area, including grainfields in the Lower Valley, Mud and Johnson lakes, and the ponds southeast of Columbia Falls. Movements between our study area and the southern end of the lake and lower river were also documented.

One objective of the 1985 study was to developpreliminary recommendations for enhancement/mitigation strategies. Until more data have been gathered describing the relative severity of negative impacts due to the operation of Hungry Horse Dam, and the construction and operation of Kerr Dam, specific mitigation measures will not be proposed. Preliminary indications from the 1984 and 1985 data are that the availability of secure nest sites may indeed be limiting to the Canada goose population in the study area, particularly along the Flathead River from Columbia Falls to Kalispell, as suggested by Ball (1983). Our 1985 data indicate that in certain years, however, flooding effects due to the operation of Hungry Horse Dam may be masked by early natural runoff, but that flooding effects do play a part in limiting nest site availability.

Availability of brood-rearing habitat at Flathead Lake may serve to limit the population (Ball 1981, 1983), and broods currently use the broad mudflats along the shore, perhaps risking increased predation (Barraclough 1964, Ball 1983). Certainly the interspersion of open water, emergent vegetation and shore herbaceous feeding areas, considered to be optimum brood-rearing habitat for this species (Williams and Sooter 1984, Hanson and Eberhardt 1971), is not available along the north shore of the lake during the brood-rearing period, under current water regimes. Extensive losses of terrestrial habitats suitable for brood-rearing have occurred along the north shore of the lake, and nesting habitat is being lost rapidly at the mouth of the Flathead River.

Construction of artificial nesting structures may be the most cost-effective method to mitigate nesting due to water level fluctuations. They have been used throughout the range of Canada geese with much success (Bellrose 1976), including the Flathead Valley (Craighead and Stockstad 1961). Mackey et al. (1985) are continuing research into the use of artificial structures as enhancement tools. Brood habitat manipulation is likely to be the most effective means of mitigating negative impacts to brood-rearing. During the next 2 years of this study, use of any artificial nest structures or artificially-created brood-rearing habitat will be included within the scope of the nesting and brood studies. In this way, site-specific data describing the effectiveness of these strategies can be incorporated into final mitigation recomnendations.

A work statement for 1986-87 has been submitted to HPA. This document describes the specific methodologies which will be employed to meet the objectives of the study, as refined by the results of the 1984 and 1985 efforts. Objectives and methodologies will, for the most part, be as described for 1985. In order to quantify and describe goose nesting effort in the study area, pair surveys, nest searches, and nest site habitat measurements will again be employed. Pair surveys and an elevated nest inventory (boat and aerial) will commence in early March and continue through April. Nest searches will begin in April; intensive searches of river islands will be concentrated in the area north of Kalispell, where water level fluctuations due to Hungry Horse operations are the greatest, in an attempt to document early season flooding effects. In order to assess the role tree nests play in total gosling production, a concerted effort will be made to assess chronology and nest fate at such sites. Such data will be crucial to assessing the relative impact of ground nests affected by water level fluctuations. Nest site habitat measurements will be taken simultaneously with nest search efforts, and will concentrate on the relationship to HWM and the vegetation measurements taken during 1984.

Hopefully, trapping efforts during late winter will result in the opportunity to track additional radio-collared birds throughout the breeding season, providing detailed information on brood movements and habitat use throughout the brood-rearing period. These data will also be collected during surveys from the 3 observation towers in the WPA. These surveys should also yield survival estimates and more accurate delineation of important brood-rearing areas and habitats. Photodocumentation of available habitat at Flathead Lake as water levels rise will allow for determination of how such changes influence brood habitat use and survival. This photodocumentation will also include continued quantification of erosion losses in the delta area.

The primary objective of the 1986 and 1987 field studies will be to identify those factors which limit production of Canada geese in the northern Flathead Valley, and assess the importance of impacts due to water level fluctuations within the context of these limiting factors. Recommendations to protect and enhance goose populations, nesting and brood-rearing habitats will be based on the 1984-1986 results, with the level of mitigation dependent on the relative influence which water levels have on the population. This analysis will include integration of hourly, daily, monthly, and/or seasonal water flow and crest gauge level data collected by the U.S.G.S. along the Flathead River, and Flathead Lake water level measurements. An important aspect of this analysis will be chronology of water level regimes in relation to the chronology of important periods in the breeding cycle (nest -initiation, egg-laying, hatching, brood-rearing).

Field studies during the 1987 goose breeding season will be designed to fill in data gaps identified during data analysis and final report preparation during winter 1986-1987, and to collect trend data essential to the formulation and evaluation of mitigation strategies. The final report for this study will be submitted to BPA in August 1987.

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APPENDIX I

Gauge height (ft.) and discharge (cfs), main stem Flathead River at Columbia Falls and South Fork Flathead River below Hungry Horse Dam, and Flathead Lake elevation (ft above mean sea level), March-June 1985 (USGS, unpublished data).

MARCH

	Main Stem				South Fork				Flathead Lake
	Gauge Ht.		Discharge		Gauge Ht.		Discharge		(elev.)
Day	Min	Max	Min	Max	Min	Max	Min	Max	
1	4.01	4.09	5760	5930	7.37	7.47	4590	4790	2884.18
2	4.06	4.09	5870	5930	7.44	7.47	4700	4740	84.13
3	4.01	4.06	5760	5870	7.44	7.46	4700	4730	---
4	3.95	4.05	5630	5840	7.43	7.47	4680	4740	84.06
5	4.01	4.04	5760	5820	7.43	7.45	4680	4710	84.04
6	4.03	4.06	5800	5870	7.43	7.46	4680	4730	84.01
7	4.01	4.06	5760	5870	7.43	7.47	4680	4740	84.00
8	4.01	4.06	5760	5870	7.45	7.47	4710	4740	83.96
9	4.02	4.07	5780	5890	7.45	7.47	4710	4740	83.96
10	4.03	5.96	5800	10800	7.44	10.58	4700	10700	83.93
11	6.10	6.30	11200	11900	10.57	10.61	10700	10800	83.92
12	4.08	6.32	5910	11900	7.48	10.62	4760	10800	84.00
13	4.04	4.10	5820	5950	7.44	7.54	4700	4850	83.98
14	3.10	4.10	3980	5950	5.83	7.53	2480	4840	83.95
15	3.17	4.10	4110	5950	6.23	7.54	2980	4850	83.94
16	4.08	4.11	5910	5970	7.52	7.55	4820	4870	83.91
17	4.10	4.13	5950	6020	7.52	7.54	4820	4850	83.89
18	4.12	4.15	6000	6060	7.51	7.54	4810	4850	83.87
19	4.15	4.18	6060	6130	7.51	7.54	4810	4850	83.85
20	3.23	4.19	4210	6150	6.08	7.53	2790	4840	83.86
21	3.00	3.26	3810	4270	5.72	6.11	2340	2830	83.82
22	3.13	3.24	4040	4230	6.08	6.11	2790	2830	83.78
23	3.20	3.22	4160	4200	6.08	6.09	2790	2800	83.78
24	3.21	3.28	4180	4310	6.08	6.09	2790	2800	83.75
25	3.23	3.27	4210	4290	6.08	6.09	2790	2800	83.75
26	3.18	3.24	4130	4230	6.08	6.09	2790	2800	83.72
27	2.99	4.08	3790	5910	5.74	7.48	2370	4760	83.69
28	3.13	3.25	4040	4250	6.07	6.13	2780	2850	83.69
29	3.18	3.21	4130	4180	6.06	6.08	2760	2790	83.65
30	3.19	3.24	4140	4230	6.06	6.12	2760	2840	83.65
31	3.21	3.23	4180	4210	5.11	6.11	2830	2830	83.61

Gauge height (ft.) and discharge (cfs), main stem Flathead River at Columbia Falls and South Fork Flathead River below Hungry Horse Dam, and Flathead Lake elevation (ft above mean sea level), March-June 1985. (continued)

APRIL

	Main Stem				South Fork				Flathead Lake (elev.)
	Gauge Ht.		Discharge		Gauge Ht.		Discharge		
Day	Min	Max	Min	Max	Min	Max	Min	Max	
1	3.22	3.27	4200	4290	6.11	6.12	2830	2840	2883.59
2	3.28	3.37	4310	4470	6.11	6.12	2830	2840	83.59
3	3.37	3.53	4470	4780	5.76	6.13	2390	2850	83.50
4	3.42	3.56	4570	4840	5.45	5.77	2030	2400	83.54
5	3.07	3.46	3930	4640	4.85	5.46	1400	2040	83.55
6	3.08	3.12	3950	4020	4.85	4.89	1400	1440	83.55
7	3.10	3.16	3980	4090	4.87	4.88	1420	1430	83.55
8	3.16	3.28	4090	4310	4.86	4.88	1410	1430	83.54
9	3.28	3.57	4310	4850	4.87	4.91	1420	1460	83.56
10	3.37	3.72	4470	5150	2.53	4.91	188	1460	83.48
11	3.54	4.83	4800	7670	2.55	3.74	194	623	83.50
12	4.84	5.71	7700	10100	2.51	2.58	183	202	83.65
13	5.72	6.18	10100	11500	2.48	2.54	175	191	83.73
14	6.19	6.99	11500	14200	2.50	2.55	180	190	83.87
15	7.00	7.56	14200	16300	2.54	2.58	191	202	84.11
16	7.10	7.52	14600	16200	2.52	2.58	185	202	84.11
17	7.07	7.79	14500	17200	2.53	8.47	188	6390	84.46
18	7.09	7.21	14600	15000	2.54	2.57	191	199	84.62
19	6.66	7.09	13100	14600	2.49	2.57	177	199	---
20	6.08	6.66	11200	13100	2.48	2.53	175	188	84.92
21	5.64	6.08	9860	11200	2.47	2.53	172	188	85.07
22	5.20	5.63	8630	9830	2.45	2.52	167	185	85.16
23	4.97	5.20	8030	8630	2.45	2.49	167	177	85.07
24	4.67	4.96	7270	8000	2.44	2.49	164	177	85.24
25	4.42	4.66	6680	7250	2.44	2.48	164	175	85.27
26	4.23	4.42	6240	6680	2.44	2.50	164	180	85.24
27	4.17	4.23	6110	6240	2.47	2.50	172	180	---
28	4.23	5.01	6240	8130	2.48	2.54	175	191	85.22
29	5.03	6.40	8180	12200	2.50	2.56	180	197	85.19
30	6.41	6.95	12200	14100	2.52	2.59	185	205	85.24

Gauge height (ft.) and discharge (cfs), main stem Flathead River at Columbia Falls and South Fork Flathead River below Hungry Horse Dam, and Flathead Lake elevation (ft above mean sea level), March-June 1985. (continued)

MAY

	Main Stem				South Fork				Flathead Lake
	Gauge Ht.		Discharge		Gauge Ht.		Discharge		(elev.)
Day	Min	Max	Min	Max	Min	Max	Min	Max	
1	6.95	7.37	14100	15600	2.53	2.58	188	202	2885.31
2	7.38	8.59	15600	20500	2.56	2.75	197	252	85.33
3	8.61	10.09	20600	27600	2.62	2.70	214	237	85.55
4	10.09	10.60	27600	30300	2.66	2.71	225	240	85.94
5	8.95	10.26	22100	28500	2.63	2.67	216	228	86.29
6	8.55	8.94	20300	22100	2.60	2.77	208	258	86.49
7	7.60	7.78	16500	17200	2.59	2.62	205	214	86.69
8	7.58	7.73	16400	17000	2.59	2.63	205	216	86.77
9	7.63	7.72	16600	16900	2.60	2.63	208	216	86.90
10	7.63	7.74	16600	17000	2.60	2.63	208	219	87.00
11	7.53	7.71	16200	16900	2.60	2.64	208	219	87.14
12	7.10	7.53	14600	16200	2.60	2.64	208	219	87.21
13	6.74	7.10	13300	14600	2.56	2.62	197	214	87.36
14	6.70	6.74	13200	13300	2.59	2.64	205	219	87.44
15	6.66	6.73	13100	13300	2.61	2.64	211	219	87.52
16	6.74	7.58	13300	16400	2.62	2.67	214	228	87.58
17	7.59	8.52	16400	20200	2.63	2.70	216	237	87.67
18	8.53	9.32	20300	23800	2.67	2.78	228	262	87.88
19	9.33	10.18	23900	28100	2.73	2.81	246	271	88.08
20	10.18	10.74	28100	31100	2.79	2.87	265	290	88.42
21	10.72	11.02	31000	32600	2.84	2.88	281	293	88.84
22	11.01	11.34	32600	34400	2.86	2.92	287	306	89.22
23	11.29	11.56	34200	35700	2.87	2.90	290	300	---
24	11.49	11.80	35300	37200	2.87	7.63	290	4990	---
25	11.66	12.24	36300	39900	2.87	7.64	290	5010	90.48
26	11.13	11.94	33200	38000	2.82	2.89	274	297	90.79
27	10.05	11.13	27400	33200	2.79	2.83	265	277	90.94
28	9.55	10.05	24900	27400	2.77	2.81	258	271	91.07
29	9.13	9.55	22900	24900	2.76	2.80	255	268	91.08
30	9.12	9.66	22900	25500	2.75	2.84	252	281	91.19
31	9.17	9.55	23100	24900	2.72	2.77	243	258	91.22

Gauge height (ft.) and discharge (cfs), main stem Flathead River at Columbia Falls and South Fork Flathead River below Hungry Horse Dam, and Flathead Lake elevation (ft above mean sea level), March-June 1985. (continued)

JUNE

Day	Main Stem Gauge Ht. Min	Main Stem Gauge Ht. Max	Main Stem Discharge Min	Main Stem Discharge Max	South Fork Gauge Ht. Min	South Fork Gauge Ht. Max	South Fork Discharge Min	South Fork Discharge Max	Flathead Lake (elev.)
1	9.09	9.25	22800	23500	2.72	2.76	243	255	2891.30
2	9.04	9.15	22500	23000	2.73	2.79	246	265	91.48
3	8.87	9.16	21800	23100	2.74	2.78	249	262	91.59
4	8.50	8.87	20100	21800	2.69	2.75	234	252	91.66
5	8.28	8.49	19200	20100	2.71	2.75	240	252	91.76
6	8.28	8.33	19200	19400	2.70	2.76	237	255	91.92
7	8.34	9.93	19400	26800	2.74	2.79	249	265	92.00
8	9.95	11.85	26900	37500	2.75	2.78	252	262	92.22
9	10.28	11.79	28600	37100	2.71	2.77	240	258	92.40
10	9.37	10.88	24100	31800	2.73	9.91	246	9190	92.50
11	8.97	10.85	22200	31700	2.79	9.91	265	9190	92.53
12	9.26	10.36	23500	29000	7.40	9.12	4630	7570	92.49
13	9.03	9.34	22500	23900	6.29	7.47	3060	4740	92.44
14	9.29	9.50	23700	24700	7.45	8.24	4710	5990	92.4s
15	8.87	9.29	21800	23700	7.40	8.22	4630	5960	92.43
16	8.75	8.93	21200	22000	7.44	7.49	4700	4770	92.41
17	8.43	8.74	19800	21200	7.45	7.49	4710	4770	92.41
18	7.77	8.78	17100	21400	5.69	8.84	2310	7050	92.40
19	7.56	8.61	16300	20600	5.72	8.78	2340	6940	92.42
20	7.49	8.68	16000	20900	5.71	8.79	2330	6950	92.60'
21	7.62	8.65	16500	20800	3.17	8.78	393	6940	92.65
22	6.46	7.68	12400	16800	2.65	2.94	222	313	92.79
23	6.19	S.45	11500	12400	2.62	2.67	214	228	92.80
24	6.09	7.28	11200	15300	2.52	7.40	214	4.430	92.88
25	5.80	7.18	10300	14900	2.59	7.40	205	4630	92.82
26	5.51	6.94	9490	14000	2.69	7.43	234	4680	92.85
27	5.23	6.72	8720	13300	2.63	7.42	216	4670	92.88
28	5.11	6.57	8390	12800	2.59	7.42	205	4670	92.88
29	5.09	6.54	8340	12700	2.57	2.92	139	306	---
30	5.11	5.16	8390	8530	2.55	2.51	194	211	92.87

APPENDIX II

Cover types, based on existing plant species dominance, used to describe Canada goose nest and brood-rearing sites, northern Flathead Valley, 1985.

1.1 Coniferous forest
- >4.8 m tall and >25% canopy cover.
- Tree species include: Douglas-fir (Pseudotsuga menziesii) and spruce (Picea spp.).

1.2 Deciduous forest
- >4.8 m tall and >25% canopy cover.
- Tree species include: black cottonwood (Populus trichocarpa), aspen (Populus tremuloides), birch (Betula papyrifera).
- Varies from extensive stands of large, mature trees to younger, less diverse cottonwood forests.

1.3 Mixed forest
- >4.8 m tall and >25% canopy cover total for both deciduous and coniferous trees.
- Must contain at least 20% canopy cover of either deciduous or coniferous trees to be mixed forest.

2.1 Dense shrub
- >20% shrub cover.
- Subtypes include:

  dense mixed shrub with red-osier dogwood (Cornus stolonifera), chokecherry (Prunus virsiniana), Douglas hawthorn (Crataeuu douslasii), and alder (Alnus sp.).

  dense riparian shrub with cottonwood and/or willow (Salix spp.) regeneration.

  dense upland shrub with common snowberry (Symphoricarpus albus), buffalo (Shepherdepher ia canadensis) and silverberry (Elaeagnus tata).

2.2 Sparse shrub
- Between 10-20% shrub cover.
- Generally includes those areas supporting sparse cottonwood and/or willow regeneration.

Cover types, based on existing plant species dominance, used to describe Canada goose nest and brood-rearing sites, northern Flathead Valley, 1985 (continued).

3.1 Tall herbaceous
- > .5 m tall.
- Includes several graminoids: reed canary grass (Phalaris arundinaceae), bulrush (Scirpus acutus), spike-rush (Elecharis spp.), and sedges (Carex spp.).
- Forb dominated sites included: horsetail (Equisetum spp.), clover (Trifolium spp.), and nightshade (Solanum spp.)

3.2 Short herbaceous
- < 10 cm tall.
- Generally dominated by graminoids and forbs and can occur as early successional communities on mudflats or gravel bars. Herbaceous communities altered by fire or grazing may also be included in this type.

3.3 Medium herbaceous
- Between 10 to 50 cm tall.
- Graminoids include: wheatgrass (Agropyron spp.), bluegrass (Poa spp.), timothy (Phleum spp.), and bentgrass (Agrostis spp.).
- Diverse forbs were also found in this type.

4.1 Pasture
- Native and non-native grass pastures grazed by livestock.

4.2 Grainfields
- Cultivated fields, usually wheat crops.

4.3 Alfalfa
- Culitvated hay field.

4.4 Orchard
- Tree farms.

4.5 Lawn
- Non-native grass species.

Cover types, based on existing plant species dominance, used to describe Canada goose nest and brood-rearing sites, northern Flathead Valley, 1985 (continued).

4.6 Other
- Includes homesites, farms, buildings.

5.0 Marsh
- Emergent plants dominant.
- Includes sites with cattails (*Typha* spp.) and flowering rush (*Butomus umbellatus*).

5.0 -Aquatic vegetation
- Includes ponds or sloughs with submerged aquatic plants dominating.
- shallow areas on the north shore Flathead Lake supporting aquatic vegetation are also included.

7.0 Wnvegetated
- (10% vegetation cover.
- Includes unvegetated sites such as roads, gravel bars and open water areas.

APPENEIX III

Landforms used to describe Canada goose nest and brood-rearing sites in the northern Flathead Valley, 1985.

1.0	Island
1.1	River
1.2	Stream
1.3	Backwater/channel
1.4	Lake
1.5	Reservoir
1.6	Pond/slough
1.7	Marsh
2.0	Intertidal-shoreline
2.1	Gravel bar
2.6	Mudflat
2.7	Marsh
2.8	Developed dock area
3.1	Riparian bench/flat area
3.2	Riparian swale
3.3	Riparian slope
3.4	Raparian cliff
4.1	Upland flat
4.2	Upland slope
4.3	Upland swale
4.4	Upland cliff

APPENDIX IV

Summary of nest site data for Canada geese inhabiting the upper main stem Flathead River and northern half of Flathead Lake, 1985.

Nest #	Type	Location	Fate
A01	Structure (box on dock)	Somers Bay	Hatched
A02	Structure (weathered dock	Somers Bay	Hatched
B04	Tree (osprey)	River mouth, WPA	Unknown
B09	Structure (4-leg platform)	Slough E. of river, WPA	Unknown
B16	Stump	Delta mudflats, WPA	Hatched
B17	Stump	Delta mudflats, WPA	Hatched
B20	Stump	Delta mudflats, WPA	Hatched
B21	Stump	Delta mudflats, WPA	Unknown
B22	Stump	Delta mudflats, WPA	Hatched
B23	Stump	Delta mudflats, WPA	Hatched
B24	Stump	Delta mudflats, WPA	Predation
B25	Stump	Delta mudflats, WPA	Hatched
B26	Stump	Delta mudflats, WPA	Hatched
B27	Stump	Delta mudflats, WPA	Unknown
B28	Stump	Delta mudflats, WPA	Unknown
B29	Stump	Delta mudflats, WPA	Predation
B30	Stump	Delta mudflats, WPA	Hatched
B31	Stump	Delta mudflats, WPA	Unknown
B32	Stump	Delta mudflats, WPA	Hatched
C01	Tree (osprey)	Lower River	Hatched
C02	Tree (osprey)	Lower River	Unknown
C09	Tree (osprey)	Lower River, Fennon Slough	Hatched
C11	Tree (bald eagle)	Fennon Slough	Hatched
C15	Tree (osprey)	Lower River	Hatched
C18	Tree (osprey)	Lower River	Unknown
C22	Tree (osprey)	Lower River	Hatched
C23	Tree (osprey)	Lower River	Unknown
C26	Tree (osprey)	Lower River	Unknown
C32	Tree (osprey)	Lower River	Unknown
C33	Tree (osprey)	Lower River, Church Slough	Hatched
C34	Tree (osprey)	Lower River, Church Slough	Unknown
C35	Tree (osprey)	Church Slough	Unknown
C36	Tree (osprey)	Lower River	Blew down
C37	Tree (osprey)	Lower River, Egan Slough	Unknown
C39	Tree (osprey)	Lower River, Ashley Creek	Unknown
C40	Tree (osprey)	Lower River	Hatched
C41	Structure (box, utility pole)	Lower River, Foy's Bend	Unknown
C43	Tree (osprey)	Lower River, Foy's Bend	Hatched
C48	Tree (osprey)	Brenneman's Slough	Hatched
C50	Tree (osprey)	Lower Stillwater River	Unknown
C53	Tree (osprey)	Lower River (braided section)	Hatched
C55	Tree (osprey)	Lower River	Hatched
C56	Tree (osprey)	Lower River (braided section)	Blew down
C65	Natural Snag	Lower River (Robocker's ponds)	Unknown

Summary of nest site data for Canada geese inhabiting the upper main stem Flathead River and northern half of Flathead Lake, 1985 (continued).

Nest #	Type	Location	Fate
C72	Natural Snag	Lower Stillwater River	Hatched
C77	Natural Snag	Fennon Slough	Unknown
C79	Natural Snag	Lower River	Unknown
C80	Natural Snag	Lower Stillwater River	Unknown
C84	Natural Snag	Half Moon Slough	Unknown
C85	Natural Snag	Lower River	Unknown
C86	Natural Snag	Lower River (Robocker's ponds)	Unknown
C87	Natural Snag	Lower River	Unknown
C88	Tree (great blue heron)	Rose Creek mouth	Unknown
C89	Tree (great blue heron)	Rose Creek mouth	Unknown
D03	Tree (golden eagle)	Upper River	Hatched
E01	Structure (box over water)	Weaver Slough	Abandoned
E02	Structure (box over water)	Weaver Slough	Abandoned
G01	Ground (river island)	Upper River	Flooded
G02	Ground (river island)	Upper River	Predation
G03	Ground (river island)	Upper River	Hatched
G04	Ground (river island)	Upper River	Hatched
G05	Ground (river island)	Upper River	Predation
G06	Ground (river island)	Upper River	Predation
G07	Ground (river island)	Lower River (braided section)	Hatched
G08	Ground (river island)	Lower River (braided section	Predation
G09	Ground (marsh island)	WPA (dredged ponds)	Predation
G10	Ground (wooded island)	WPA (delta)	Hatched
G11	Ground (wooded island)	WPA (delta)	Hatched
G12	Ground (wooded island)	WPA (delta)	Hatched
G13	Ground (wooded island)	WPA (delta)	Unknown
G14	Ground (wooded island)	WPA (delta)	Predation
G15	Ground (cattail island)	WPA (delta)	Unknown
G16	Ground (cattail island)	WPA (delta)	Predation
G17	Ground (river island)	Upper River	Predation
G18	Ground (river island)	Upper River	Predation
G19	Ground (lake island)	Pig Island - Somers	Hatched
G20	Ground (lake island)	Pig Island - Somers	Hatched
G21	Ground (lake island)	Somers Bay	Predation
G22	Ground (river island)	Fennon Slough	Predation
G23	Ground (river island)	Fennon Slough	Predation
G24	Ground (river island)	Fennon Slough	Hatched
G25	Ground (river island)	Lower River (braided section)	Unknown
G26	Ground (river island)	Lower River (braided section)	Predation
G27	Ground (river island)	Lower River (braided section)	Hatched
G28	Ground (river island)	Lower River (braided section)	Hatched
G29	Ground (river island)	Lower River (braided section)	Hatched
G30	Ground (river island)	Lower River (braided section)	Hatched
G31	Ground (river island)	Lower River (braided section)	Flooded
G32	Ground (river island)	Lower River (braided section)	Predation
G33	Ground (muskrat lodge)	Egan Slough	Unknown

Summary of nest site data for Canada geese inhabiting the upper main stem Flathead River and northern half of Flathead Lake, 1985 (continued).

Nest #	Type	Location	Fate
G34	Ground (river island)	Lower River (braided section)	Hatched
G35	Ground (dike remnant)	WPA	Predation
G36	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G37	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Unknown
G38	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Unknown
G39	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G40	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G41	Ground (muskrat lodge)	Brosten's Pond (Hodgeson Lake)	Predation
G42	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G43	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G44	Ground (muskrat Lodge)	Brosten's Pond (Hodgeson Lake)	Predation
G45	Ground (matted cattails)	Brosten's Pond (Hodgeson Lake)	Predation
G46	Ground (muskrat lodge)	Egan Slough	Unknown
G47	Ground (matted cattails)	Egan Slough	Hatched
G48	Ground (marsh island)	WPA (dredged ponds)	Predation
G49	Ground (marsh island)	WPA (dredged ponds)	Predation
G50	Ground (marsh island)	WPA (dredged ponds)	Predation
G51	Ground (marsh island)	WPA (dredged ponds)	Hatched

APPENDIX V

Characteristics of Canada goose brood-rearing areas, based on 10 sites sampledinthe northern Flathead Valley, 1985.

Site#	Area	Cover Type	Closest other cover type	Iandform	Closest other Landform	Height above: HWM (m)	Height above: Existing water (m)	Distance from HWM (m)	Distance from Existing' water (m)
1	Braided Section	Med. herbaceous	Marsh	Island	River	0.00	0.02	0.00	4.70
2	Braided Section	Pasture	Decid. forest	Riparian bench	River	1.50	9.00	1.50	9.00
3	Egan Slough	Marsh	Grainfield	Marsh	Slough	0.00	0.00	0.00	0.00
4	Egan Slough	Med. herbaceous	Marsh	Riparian bench	Slough	1.00	1.00	4.75	4.75
5	Egan Slough	Med. herbaceous	Marsh	Riparian bench	Slough	1.00	1.00	9.30	9.30
6	McWenneger Slough	Pasture	Marsh	Riparian bench	Pond	1.00	1.00	20.00	20.00
7	McNenneger Slough	Med. herbaceous	Marsh	Riparian bench	Pond	0.00	1.00	0.00	5.00
8	Shaw's Slough	Pasture	Med. hcrbaceous	Riparian bench	Pond	1.00	1.00	20.00	20.00
9	Half Moon Slough	Pasture	Unvegetated	Riparian bench	Slough	1.00	1.00	12.00	12.00
10	WPA	Marsh	Unvegetated	Marsh	Lake	0.00	0.00	0.00	0 .00

APPENDIX VI

Frequency (n=l00) and average % coverage of plant species and species groups found on 10 Canada goose brood-rearing sites in the northern Flathead Valley, 1985.

Species Group/Species	Frequenc	%Cover
I Graminoid[a]	(82)	(55.70)
Agrostis alba	17	8.83
Agrostis sp.	7	0.18
Agropyron sp.	1	0.03
Avena sativa	3	0.08
Beckmannia sizigachne	1	0.03
Carex spp.	13	1.44
Festuca sp.	4	0.60
Glyceria grandis	1	0.15
Hordeum jubatum	5	0.25
Hordeum vulgare	8	0.33
Juncus spp.	11	4.55
Phalaris arundinacea	11	4.33
Poa spp.	11	6.28
II Forb	(78)	(49.73)
Agoseris sp.	3	0.08
Amaranthus retroflexus	8	1.08
Aster spp.	10	1.13
Chenopodium hybridum	1	0.03
Cirsium arvense	21	3.58
Cirsium sp.	13	1.20
Convolvulus arvensis	1	0.03
Descurainia sophia	1	0.03
Epilobium watsonii	2	0.05
Equ um spp.	53	7.80
Erigeron spp.	4	0.10
Lithospermum arvense	1	0.03
Mentha arvensis	2	0.05
Myosotis sp.	7	0.55
Plantago sp.	45	4.13
Potentilla sp.	6	0.28
Prunnella vulgaris	13	3.28
Rumex sp.	3	0.55
Stellaria sp.	9	0.23
Taraxacum officinale	42	5.58
Thlaspi arvense	3	0.08
Trifolium #1[b]	51	12.48
Trifolium #2	20	1.00
Unknown #13	1	0.03

Frequency h=lOO) and average % coverage of plant species and species groups found on 10 Canada goose brood-rearing sites in the northern Flathesd Valley, 1985 (continued).

Species Group/Species	Freuuencv	%Cover
Unknown #14	8	0.20
Unknown #20	6	2.18
Unknown #21	2	0.03
Unknown #22	9	4.25
Unknown #23	2	0.05
Unknown #41	2	0.18
Unknown #42	10	0.98
Unknown #46	1	0.03
III Shrub	(17)	(4.20)
Populus angustifolium	17	0.93
Salix spp.	10	3.23
Symphoricarpus sp.	2	0.05
IV Aquatic/Semi-aquatic	(41)	(25.00)
Butumbellatus	10	8.50
Ceratophyllum demersum	2	0.05
Elodea canadensis	3	0.33
Hippuris vulgaris	7	0.18
Lemna minor	10	0.25
Lemna trisulca	6	0.15
Myriophyllum sp.	7	0.80
Polygonum amphibium	25	5.53
Potamogeton natans	3	0.05
Sagitta ia cunneata	6	0.28
Scirpus acutus	22	6.85
Spirodela polyrhiza	6	0.15
Typha latifolia	10	4.53.
Utricularia vulgaris	2	0.05
Wolfia columbiana	10	0.25
V Other	(37)	(5.15)
Bare ground	22	2.25
Open water	15	6.28

_a/ Frequency and percent cover for individual grass species are under represented due to the inability to distinguish species which were heavily grazed.

b/ Identification of voucher specimens for numbered unknowns has not yet been completed.

APPENDIX VII

Status of radio-equipped Canada geese found in the northern Flathead Valley, Feb. - Nov. 1985.

COLLAR NUMBER	AGE/SEX		TRAP DATE	TRAP LOCATION	NUMBER OF LOCATIONS	LOCATION/COMMENTS	STATUS
MY01	A	F	02-26-85	River	18	Egan Slough	NO locations after 5-22-85
MY02	SA	M	02-27-85	River	6	Lower Valley, Rose Creek	No locations after 4-26-85
MY03	A	M	02-27-85	River	18	Braided area, McWenneger's Slough	Left area 5/29, one location on 12-5-85
MY04	A	F	02-28-85	River	5	South end, lake, paired with MY05	No locations after 5-13-85
MY05	A	M	02-28-85	River	6	South end, lake; paired with MY04	No locations after 5-29-85
MY07	SA	M	02-28-85	River	7	Lower river and valley; frequency overlap with CSKT collar	Shot 12-11-85 Idaho
MY09	A	M	02-28-85	River	2	Delta island; possible frequency overlap With CSKT collar	Shot 12-7-85 I&ho
MY10	A	M	02-28-85	River	4	WPA to Polson return WPA	No locations after 3-27-85
MY11	A	M	02-28-85	River	2	Lower River to Polson	No locations after 3-22-85
MY12	A	F	02-28-85	River	4	Lower river and valley	No locations after 3-15-85
MY13	A	M	03-05-85	River	27	Egan Slough; raised brood	Present as of 11-22-85
MY14	A	M	03-05-85	River	19	Egan Slough, WPA; raised brood	Present as of 11-22-85
MY15	A	F	03-12-85	River	25	my's Bend, Half Moon and weaver's Slough; paired with MY17; raised brood	Present as of 11-6-85
MY16	SA	M	03-12-85	River	1	Lower river	No location after 3-13-85
MY17	A	a	03-12-85	River	39	Foy's Bend, Half Moon & Weavers' Slough, paired with MY15; raised brood	Present as of 11-6-85
MY18	A	M	06-27-85	WPA	14	WPA and Lower Valley; Johnson Lake	Present as of lo-IO-85
MY19	A	F	06-27-85	WPA	8	WPA and Lower Valley	Shot 9-28-85 grainfields Lower Valley
My52	A	M	06-27-85	WPA	13	WPA, Columbia Falls, Pablo Reservoir, Johnson Lake	Shot 11-24-85 above Highway 2
MY53	A	M	06-27-85	WPA	15	WPA, Lower Valley, Pablo Reservoir, Mud Lake	Present as of 12-4-85
NY54	A	M	06-27-85	WPA	11	WPA, Lower Valley Pablo Reservoir	No locations after 10-3-85
MY55	A	M	06-27-85	WPA	13	WPA, Lower Valley Pablo Reservoir	Present as of 11-6-85
My55	A	El	06-27-85	WPA	10	WPA, Lower Valley Pablo Reservoir	No locations after 10-3-85
MH89	A	F	06-27-84	WPA	·	No recent locations	No locations after 10-18-84
MH12	A	F	01-25-84	Elmo Bay	20	Braided area, WPA; raised brood	No locations after 7-12-85
MH84	A	F	02-22-85	River below Kerr Dam	24	Cedar Island (south Flathead Lake), WPA; raised brood	Present as of 12-4-85