Effects of Water Levels on Productivity of Canada Geese in the Northern Flathead Valley

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ABSTRACT

Effects of Water Levels on Productivity of Canada Geese in the Northern Flathead Valley, Montana.

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. Seasonal water level fluctuations and substantial habitat losses have occurred as a result of construction and operation of Kerr Dam, which regulates Flathead Lake. These fluctuations may impact goose populations through flooding or erosion of nesting and brood-rearing habitats, and increased susceptibility of nests and young to predation. The Bonneville Power Administration has funded a 3-year study to evaluate these effects.

The number, location, and success of goose nests were determined through pair surveys and nest searches. Counts of indicated pairs suggest there were 73-125 occupied nests in the study area; 44 were located in 1984. Twenty were island ground nests, 19 were tree nests, and 5 were on man-made structures. Hatching success was 76 percent. Sixty-one percent of all nests were in deciduous forest habitat; 87 percent were on riparian bench or island landforms. Seventy-four percent of all nests were within 5 m of the seasonal high water mark (HWM) and 85 percent of ground nests were 1 m or less above the BWM. Woody stem density and overstory canopy coverage were less at nest sites than at surrounding points. Shrub, litter, and forb were the dominant cover classes in the vicinity of ground nests. Tree nests were mostly in cottonwood (*Populus trichocarpa*); mean values for dbh, nest height, and tree height were 0.95 m, 17.8 m, and 20.2 m, respectively.

Production, habitat use, and distribution of broods were documented through aerial, boat, ground, and observation tower surveys. The Flathead Lake Waterfowl Production Area (WPA), on the north shore of Flathead Lake, received the greatest use by broods: 70 percent of 105 brood observations recorded April-June were in the open water/mudflat zone of 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 the earliest stages of egg-laying may disrupt some island ground nests. Low lake levels in May and early June coincide with the brood-rearing period. Mudflats are heavily 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 hopefully allow managers to optimize com-

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INTRODUCTION

The Columbia River Basin Fish and Wildlife Program was pub-. lished by the Northwest Power Planning Council in 1982, in response to the Pacific Northwest Electric Power Planning and Conservation Act of 1980. This program was developed specificallytoaddress 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.

The Fish and Wildlife Program (Section 1000, Table 7) 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. The current study (BPA Project 83-498) is designed to address the effects of these projects on the northern segment of the Flathead Valley Canada goose (*Branta canadensis moffitti*) population. The study was designedtoaddress 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

C) Losses in production and habitat requirements of waterfowl.

The emphasis of the study is to identify the size and productivity of the goose population, habitat conditions and their relationship to water level fluctuations, and to develop potential 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 Flathead Lake. 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.

Hung,-y 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 is determined in concert with the complex network of electrical energy producing systems, consumption needs, and flood control reguirements throughout the Pacific Northwest. Operation of Hungry Horse altered natural flow regimes in the South Fork and in the main stem Flathead River. The effects of the altered discharges on the main stem are moderatedbynatural flows from the unregulated North andMiddle Forks.

Kerr Dam, located 7 km downstream of the natural outlet of Flathead Lake, was completed in 1938. Operated by the Montana Power Company under a lease with the Confederated Salish and Kootenai Tribes, Kerr Dam is operated primarily for flood control and hydroelectric energy production. 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. A more detailed description of water level regimes is included in the study area description which follows.

The earliest studies of the Flathead Valley goose population were conducted by Harraclough (1954, also Geis 1956) who studied nesting andbrood-rearing throughout Flathead Lake. Shedocumented 160 goslings using the north shore ofthelake in1953, 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 (Harraclough 1954). As early as 1954, there was a concern that the broad expanses of mudflats, which resulted from low lake elevations during the brood-rearing period, might expose goslings to an increased risk of predation (Barraclcugh 1954).

Craighead and Stockstad (1964) estimated an average spring population of 800 geese in the Flathead Valley from 1953 through 1960. An average of 201 nests per year were estimated for the Flathead Valley, but research focused on Flathead bake, two National Waterfowl Refugees to the south (Ninepipe and Pablo), and the lower Flathead River. Their study area roughly corresponded to that currently being studied by CSKT biologists (Gregory et al. 1984, Mackey et al. 1985). Craighead and Stockstad (1964) documented decreases in nesting pairs at Flathead Lake during the course of their study, but attributed them to excessive hunting pressure rather than habitat characteristics or hydroelectric operations.

Between the time of Craighead's studies in the 1950's and 1974, the Montana Dept. of Fish and Game conducted aerial surveys of geese on the entire Flathead Valley system including most of the upper main stem Flathead River. These were limited to annual breeding pair counts and periodic fall surveys, and were not conducted each year.

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 Waterfowl Production Area located on the northern shore of Flathead Lake. Other areas surveyed included the Swan Lake system, several ponds and sloughs located within the Flathead Valley, and the main stem Flathead River from the Kalispell area south to the 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 the actual nesting and brood-rearing effort along the main stem north of the bake.

Ball (1981, 1983) documented Canada goose nesting populations and success in the Flathead Valley during 1980, 1981, and 1982 and made comparisons to the productivity figures reported earlier (Geis 1956, Craighead and Stockstad 1961, 1964). In general Ball (1983) noted current nesting populations for the entire Flathead system compared favorably to those of the 1950's although decreases in nest numbers occurred on the lower Flathead River and the northern shore of Flathead Lake. He suggested goose productivity was limited by the lack of suitable brood haoitat along most of the lake shoreline and by 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 high water channels which exposes island nest sites to predation.

Extensive erosion of the islands at the mouth of the Flathead River has been documented by Moore et al. (1982). Effects of flooding and channel dewatering have been documented for goose nesting areas along the Flathead River oelow Kerr dam (Gregory et al. 1984), but not on the main stem above Flathead bake.

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 influenced by water fluctuations due to hydroelectric operations at Hungry Horse and Kerr Dams. The ultimate goal of the study is to develop and implement mitigation measures for such effects; The specific objectives for 1984 were as follows:

A. Resting Studies

1. Identify effects of water level fluctuations on goose nesting success and nesting habitat.
    a. Describe habitat parameters at nest sites.
    b. Describe the distribution (location of nests) and size (number of pairs/nests) of the breeding population.

c. Determine hatching success (nest fate).

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

B. Brood Studies

1. Identify effects of water level fluctuation on gosling survival and brooding habitat.
   a. Document the production and 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. Won-breeding Season Studies

1. Describe post-fledging dispersal of local breeders.

2. Identify seasonal trends in distribution and numbers.

3. Identify seasonal trends in habitat use.

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

D. Other Wildlife Species

1. Identify interspecific relationships which influence goose productivity.

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

STUDY AREA

Selection of the area to be studied 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 mainstem Flathead River from its confluence with the South Fork, approximately 6.5 km east of Columbia Falls, downstream to the 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 km to a point 1.2 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 Flathead Lake. 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 adjacenttothe river. Land use in the surrounding floodplain is heavily dominated by agriculture, primarily wheat and hayfields.

The study area also included that portion of Flathead Lake north of Deep Bay on the west shore and woods Bay on theeastshore (Fig. 1). This southern boundary of the study area was selected to coincide roughly with the northern boundary of area currently being studied by Gregory et al. (1984). Most of the north shore of the lake is designated as the Flathead Lake Waterfowl Production Area (hereafter WPA), and is administered by the USFWS. Primarily floodplain, the north shore is dominated by flat topography and is character-izedprimarilybydenseherbaceous vegetation, varying from emergent stands of Typha sp. 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 prtion of Flathead Lake (Gregory et al. 1984), 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

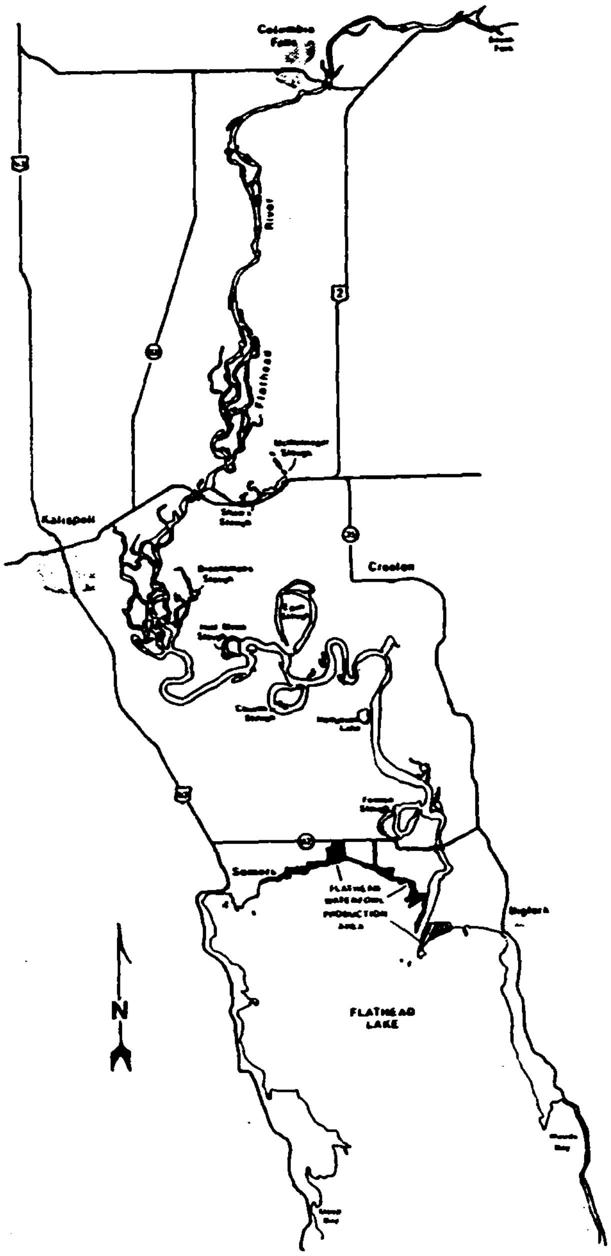


Fig. 1. study area for Canada goose project (BPA. Contract 83-498), northern Flathead Valley, Montana.

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: 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 occassionallyduring 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). Swan Lake National Wildlife Refuge, 18 km southeast of the study area, and Batavia and Smith Lake WPA's, 10 km to the west, were also surveyed occasionally to document the distribution of local birds and attempt radiolocation of marked birds.

Thenorthern Flathead Valley is characterizedby relatively short, warm summers and relatively long, cold winters. The annual mean temperature at Kalispell is 6%; monthly means vary from **-6°C** in January to 20% 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,** is cooler in summer and warmer in winter, and has greater annual precipitation (55.7 cm) than Kalispell.

The landscape of the Flathead Basin reflects a history of glaciation. Flathead Lake, the largest natural freshwater lake in the western United States (50,990 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 North 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 cfs has been in effect to protect and enhance salmon spawning on 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

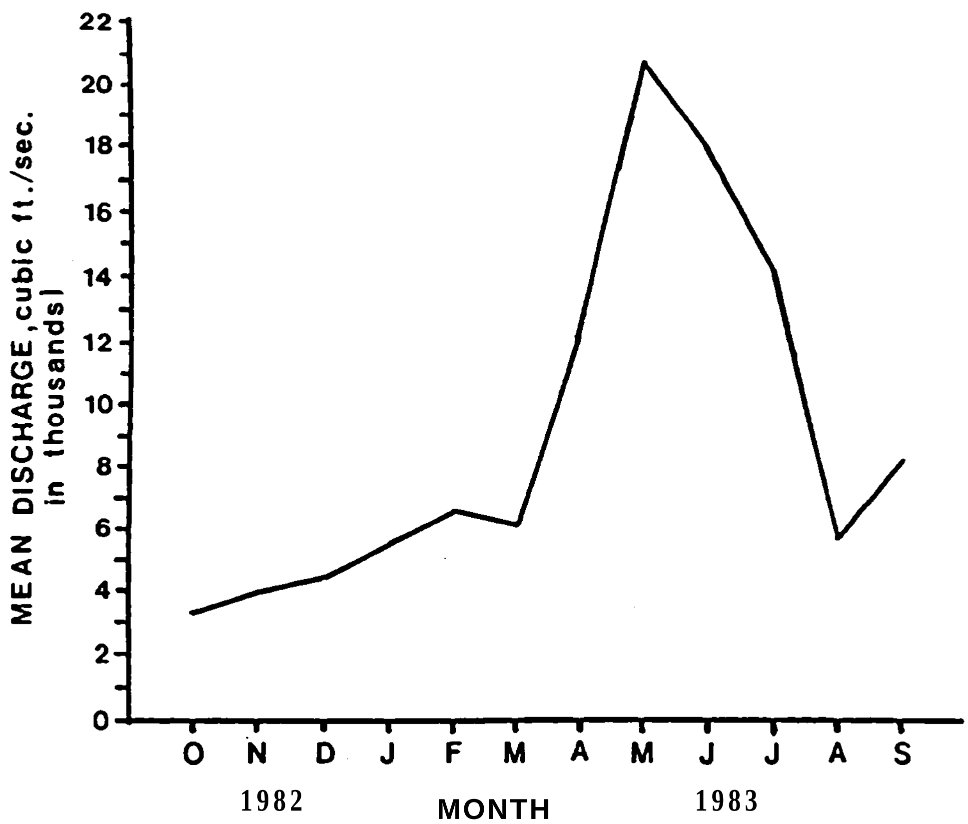


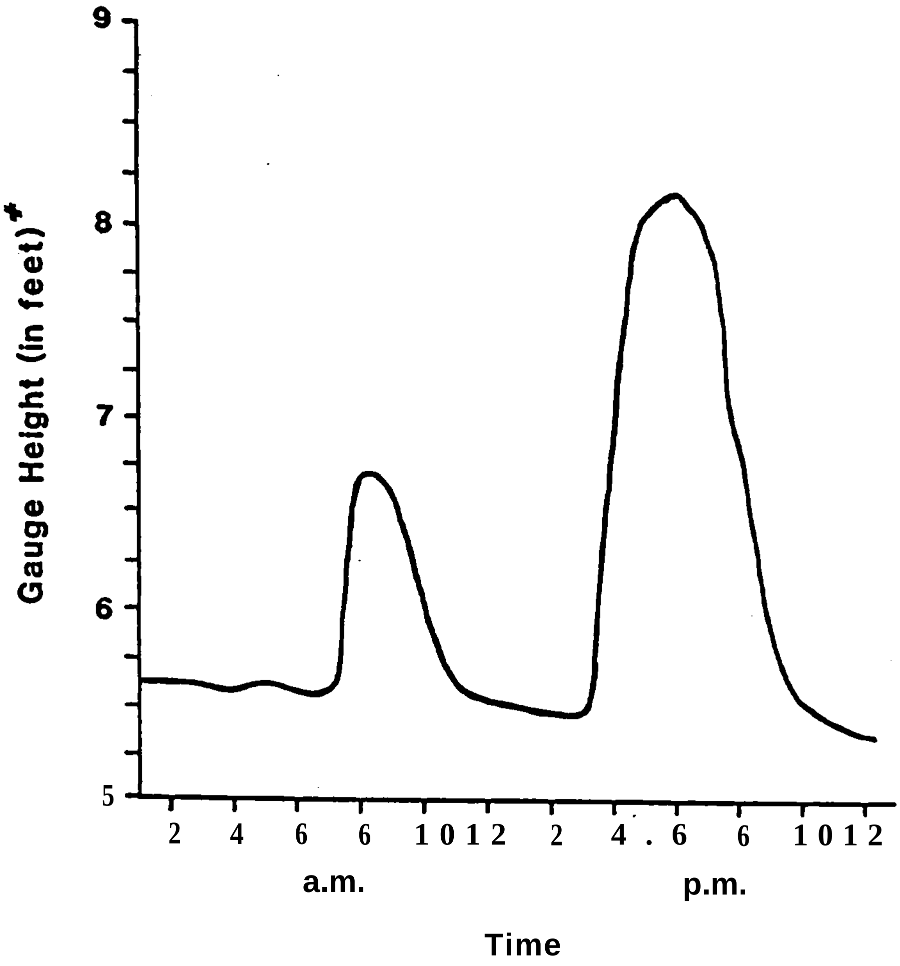
Fig. 2. **Annual discharge (cubic feet/second) fran Hungry** Horse Dam for the main stem Flathead River recorded **at Columbia Falls, Montana.**

(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 waterlevelchanges during one day roughlycorresponding to the mid-point of the incubation period for geese in the study area. Daily minimum, maximum, and mean flow data for March-June, 1984 are presented in **Appendix** I.

Kerr dam altered the annual pattern of fluctuations in the level of Flathead Lake, by retaining spring runoff throughout most of the year. Subsequent habitat losses have been most severe in the delta area at the mouth of the river (Fig. 4), 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 1984, minimumpoolcorresponded almostpreciselywiththe nesting and early brood-rearing period for geese (April and May), and full pool was not reached until early July (Fig. 5), when most broods had fledged.



*Range corresponds to 9110 - 19025 cfs

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

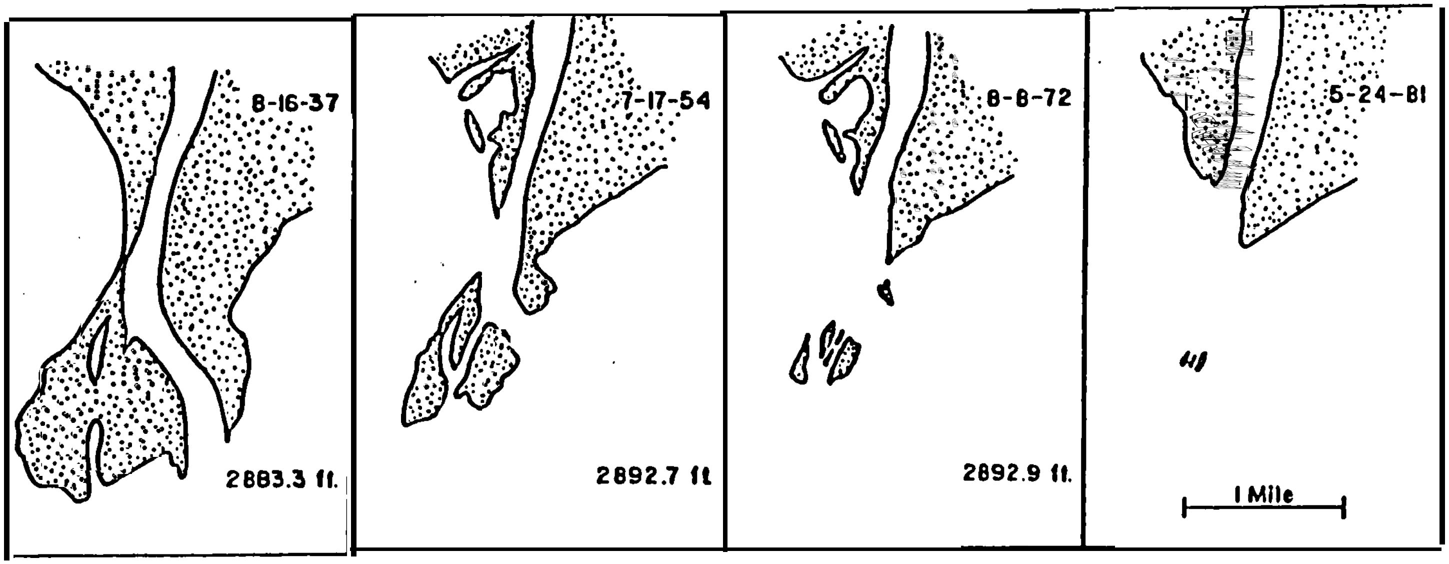


Fig. 4. Changes in the Flathead River Delta, 1937-1981, north shore Flathead Lake, Montana (Moore et al. 1982).

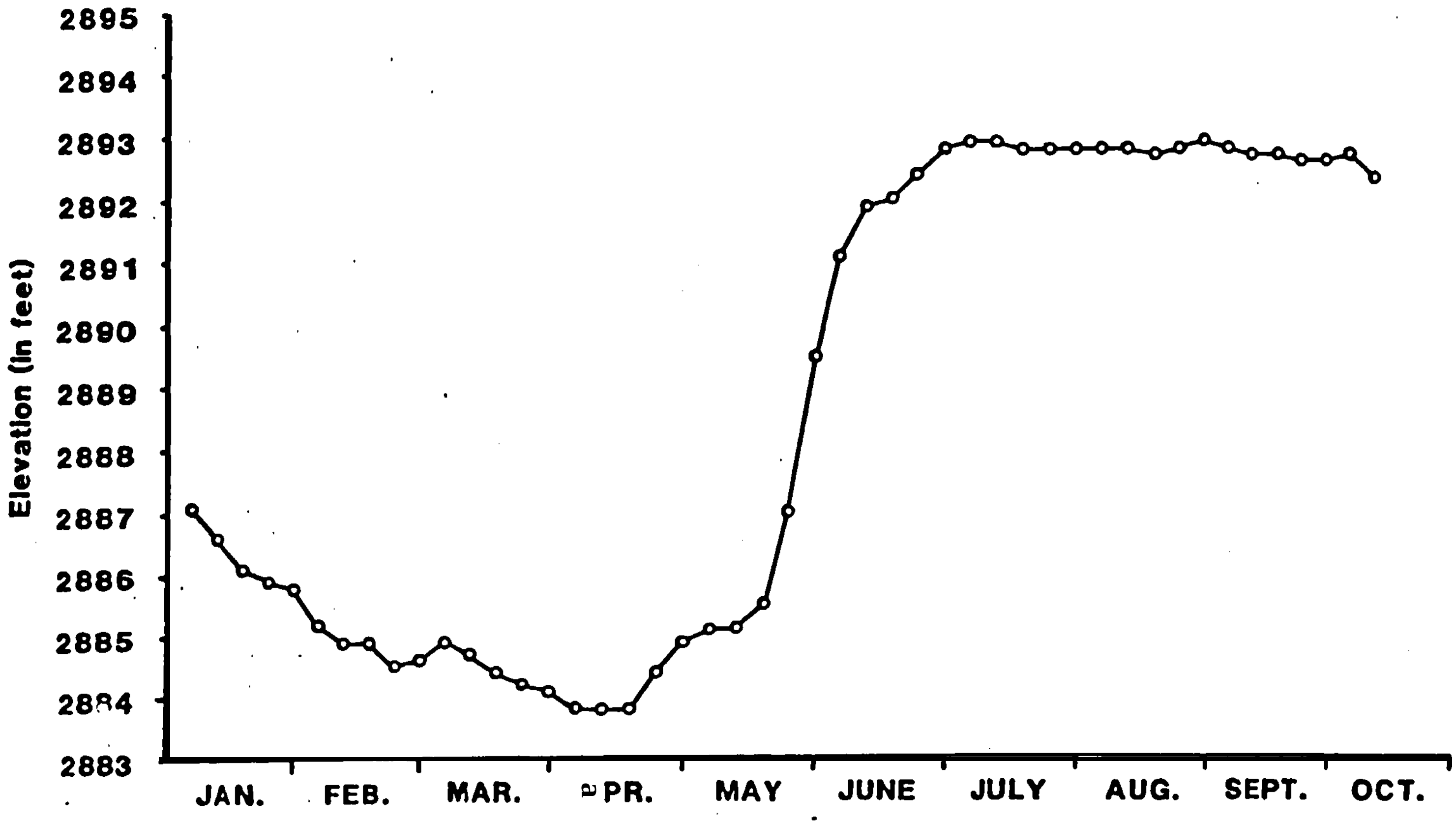


Fig. 5. Flathead Lake elevation as influenced by Kerr Dam, Montana, 1984.

METHODS

NESTING STUDIES

Field studies were initiated immediately following contract award on 4 April 1984. Since Canada geese in the Flathead Valley begin to defend territories and select nest sites in March (Geis 1956, Craighead and Stockstad 1964) the initial emphasis of the 1984 field studies was documentation of nesting effort in the study area. The number and location of goose nests were determined through a combination of techniques including surveys of territorial pairs and nest searches.

Pair Surveys

Surveys of territorial pairs were conducted throughout the study area on a weekly basis from 11 April through early May, using a combination of aerial, boat, and ground surveys. Only one complete survey of the river porticn of the study area was conducted from a boat; aerial surveys were selected as the most efficient way to systematically survey the entire study area. Gregory et al. (1984) found no significant differences between the results of boat and aerial surveys. Pairs surveys were conducted between the hours of 0800 and 1100, except for the one boat survey (0930-1145, 1400-1500). CSKT studies on the lower Flathead found no significant differences between morning and afternoon surveys, though afternoon surveys were more variable (Gregory et al. 1984, Mackey et al. 1985).

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. UTM coordinates were used to map the 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 was recorded for each nest observed during the pairs surveys, and females on nests were counted as territorial pairs if no lone single (presumed male) goose was seen within 200 m.

Nest Searches

Late in the nesting season (27 April - 18 May), 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, and on selected islands in the Flathead River. Previous studies have shown that most nesting in the Flathead Valley occurs on islands (Geis 1956, Ball 1983, Gregory etal.1984). Islandstobe searched were selected based on the following criteria:

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

b. Known nesting in previous years, in the case of the Flathead WPA (Ball l983);

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 islands was not feasible during the1984 breeding season. One other potential source of nest location data was through radiolocation of adult birds collared by CSKT biologists during the winter of 1983-84 (Gregory et al. 1984). None of thesebirds nested in our study area, however.

Twenty-seven islands in the Flathead River were searched for nests; 11 north of Kalispell and 16 in the heavily braided river section immediately southeast of Kalispell (Fig. 1). Larger islands were searched using volunteer help from the University of Montana; a team of 6 people spaced approximately10 m apart completely searched each island. 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 islands which remain in the delta portion of the Flathead WPA were searched completely by 2 observers on 8 May. Forty-two islands were dredged in an extensive cattail stand near the western end of the WPA in 1978 (USFWS 1981): 41 of these islands were located and searched by 2 observers on 18 May. Due to low water conditions and encroachment of emergent growth, 22 of these were not truly islands.

For each nest located during these searches, 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. A minimum amount of time was spent at each nest, and the eggs were covered with down upon leaving, in order to minimize nest disturbance, decrease heat loss by the eggs, and prevent predation. Egg stage was determined by floating, using methods similar to Westerkov (1950) as adapted by Gregory et al. (1984). West fate was determined from eggshell fragments (Rearden 1951). We attempted to visit all nests -at least twice, before and after hatching, though many nests were not first located until after hatching. 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 andhatching wereestimatedusing 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).

Data from the nest searches was used to develop a minimum known total of active nests, as well as an estimated or extrapolated total. The estimatedtotalwas 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 Hberhardt1971, Bal11981, Gregory et al.1984), andbycomparing 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. In addition, this information will be useful for focusing nest search efforts during the 1985 breeding season.

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 determination of canopy coverage, sapling density, and overhead cover. At tree nest sites, the height and dbh of the tree and height of the nest were also recorded, Heights were determined with a clinometer. Similar habitat parameters at goose nest sites were investigated in greater detail by the CSKT study (Gregory et al. 1984). Data collected by MDEWP will allow comparisons between the two study areas.

Canopy cover was estimated using the line-intercept method (Canfield 1941), extending a 10 m line north-south with the nest at mid-point. Percent cover by class (graminoid, forb, shrub, tree, bare ground, litter, and log) was calculated by recording coverage to the nearest 0.l m. Moss was grouped with litter, and water was grouped with bare ground where appropriate.

Overhead cover was estimated using a densiometer (Lemmcn 1956) held at 0.5 m height over the nest and at each of the four cardinal directions 5 m from the nest (plot center). Sapling density was measured at each ground nest site and 5 m from the nest (plot center) in each of the four cardinal directions. All woody stems at a height of 1 dm, were counted within a 1 m^2 circle described by a plastic hoop.

At each nest site, the cover type and landform in which the nest was located was recorded, as was the distance to the nearest other cover type(s) and landform(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 and survival of broods were documented through 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), and habitat were recorded. As with the pair surveys, 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: 2, 21, 30 May; 5, 13, 29 June; 6, 13, and 22 July. All flights were conducted during the hours 0818-1120, except for the flight 13 June, which was conducted from 1748 to 1910. Data from these aerial surveys was combined with data from periodic ground surveys throughout the brood rearing period to derive an estimate of production for the study area.

The locations of important brood-rearing areas were determined through a combination of the periodic brood surveys (mapped brood observations), and use of a 6-m observation tower which was constructed within the WPA during the brood-rearing period (22 May). The location of this tower was selected based on preliminary results of the brood surveys, discussions with USFWS personnel, and the distribution of habitats within the WPA. An attempt was made to locate the tower in an area which allowed for complete visual coverage of the eastern portion of the WPA and adjacent habitats. Five surveys were conducted from this tower on the following dates: 4, 12, and 28 June, and 9, 19 July. Each survey lasted a minimum of 2 hours: starting times varied from 0715 to 1455. A second tower was not completed until 26 July; its location will allow for more complete coverage of the WPA during subsequent field seasons. Survey efforts from the second tower were limited to the post-fledging period.

Compilation of mapped brood observations through the brood-rearing period allowed for determination of those areas which were most intensively used by broods. As these areas were identified, additional ground surveys of each were conducted in order to delineate the specific habitats and land-use types utilized by broods.

Use of the observation towers also allowed for documentation of behavior and habitat usage by broods of various age classes. Habitat selection by broods was described through the calculation of the percentage of brood sightings by habitat type.

HABITAT MAPPING

In order to describe brood and nesting habitat available to Canada geese, a draft habitat map was prepared. Riparian habitats were mapped on infrared aerial photographs (1978 series; 1 in. = 200 ft.) and black and white aerial photographs (1979 series; 1 in. = 1,320 ft.) for the main stem Flathead River and the WPR Because of changes. in island morphology in the heavily braided area near Kalispell (Fig. 1), it was necessary to augment the infrared photographs with current aerial reconnaissance and oblique photos. All habitat mapping was field-checked.

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. The habitat mapping 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 et al. (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). Refinement of the habitat map and quantification of the cover types will be continued through the following project year.

NON-BREEDING SEASON STUDIES

Population Surveys

Regular (bimonthly) 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 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

Six radio-collars suitable for adult geese and 5 smaller transmitters suitable for goslings were made available to this study through the auspices of the CSKT goose study. In addition, a receiver was made available through the Montana Cooperative Wildlife Research Unit in Missoula. Attempts were made to mark nesting adults with radio collars before the 1984 breeding season was completed, with the objective of gathering data throughout the brood-rearing period in order to describe movements between nests and brood-rearing areas, habitat use and dispersal of broods.

Three separate trapping efforts were made in 1984. The first of these was an attempt to capture a nesting female on an island nest in the braided river section near Kalispell. The method involved visiting the nest just prior to sunrise, and use of a high-intensity spotlight, recorded multi-frequency static, and a long-handled net. This method has been used successfully to trap other bird species on the nest, and was also experimented with by the CSKT goose study biologists (Matthews, pers. comm. 1984). This attempt, 9 May, was unsuccessful, as the female flushed from the nest before she could be netted.

The second trapping effort consisted of drive-trapping along the north shore of the lake (Flathead WPA) during the flightless period, using several boats and volunteer help from the USFWS, CSKT and MDFWP. On 27 June, 5 geese were trapped and banded; one, an adult female, was equipped with a radiocollar (#MH89). A second drivetrapping attempt 2 July was unsuccessful.

In September, a double cannon-net was set up at a private pond in the northeastern portion of the study area (southeast of Columbia Falls). The landowner had reported up to 200 geese using the pond early in the post-fledging period. More than 60 geese responded to bait during the day before the net was set up, but none returned during the following week and none were trapped.

Throughout the course of the field studies, attempts were made to locate birds equipped with radio-collars by CSKT biologists (Gregory et al. 1984). These included use of hand held antenna during boat and ground surveys for nests and broods, and use of a wing-mounted antenna during most aerial surveys. Roth low-level (<lOO m) and higher flights (ca. 1000 m) were conducted. Visual confirmation of the location of marked birds was attempted for each radiolocation, and each was mapped.

Late in Fiscal Year 1984 (January/February 1985), an effort will be made to place 10-20 radio-collars on adult geese, which should increase the chances of having local nesting birds monitored during the 1985 nesting season. Trapping efforts will therefore be concentrated in those areas where local geese winter, as identified through regular surveys of the study area, CSKT studies, and existing data. Initial efforts will concentrate on baited areas in the Flathead WPA. All birds caughtwillbebanded with standard USFWS leg bands, which may yield additional dispersal data.

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. For example, signs of furbearer preserve and habitat use were recorded in field notes taken during ground surveys of pairs, nests, and broods of geese. Because of their frequent use of tree nests, goose nesting data collection necessarily entailed collection of data describing the location, occupancy, and nest chronology of ospreys, bald eagles, and great blue herons within the study area. Incidental observations of wide variety of other wildlife species were recorded in field notes throughout the course of the studies.

RESULTS

NESTING STUDIES

Pair Surveys

An average of 106 indicated pairs were counted during the aerial pair surveys (Table 1). The highestsinglecounttotalwas 150 indicated pairs, recorded during the USFWS trend count on 13 April. Counts remained relatively stable at a lower value after that date. Pair count totals were highest at Flathead WPA and alcng the river stretch from Kalispell downstream to the lake; on the average, 81percent of the pairs recorded during each survey were found in these two areas. The mean pair count total of 106 was very similar to the mean number of indicated pairs (103) recorded during the annual trend counts conducted by the USFWS during the period 1975-1983 (USFWS, unpublished data).

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 12 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 Flathead River. Using a ratio of 1.2 pairs/nest, our 1984 pair count totals indicate that 73-125 nests should have been present in the study area: the mean count value of 106 pairs yields an estimate of 88 nests. Subsequent nest searches in portions of the area, however, revealed fewer nests than predicted by the pair count data. More intensive nest searches in1985 may indicate nesting populations more in line with those predicted by the pairs surveys, however, our 1984 data indicate that the ratio of indicated pairs to nests in our study area is greater than 1.2/l. The best example of this was at the Flathead WPA, where all islands were searched intensively and 15 nests were found, yet an average of 39 pairs were recorded during aerial surveys (2.6 pairs/nest).

Such discrepancies may be due to a large number of non-breeding birds which are paired; Craighead and Stockstad (1964) found that most l-year old birds paired and some actually defended territories, but none nested. Such paired non-breeders may be one cause of the high pair counts at Flathead WPA and elsewhere in the study area. Surprisingly, much lower ratios of 0.49 to 0.71 pairs/nest were reported for islands further south in Flathead Lake (Mackey et al. 1985).

Nest Searches

Forty-four nests were located in the study area in 1984 (Appendix IV). Twenty-four, or 54%, were located in trees, on stumps in the remnant delta in the WPA, and/or on some type of man-made structure (Table 2). This predominance of elevated nests was

Table 1. Canada goose pair count data, northern Flathead Valley, Montana, 1984.

	Flathead Lake W.P.A.[a]		Flathead River: Columbia Falls-Kalispell		Flathead River: Kalispell-Lake[b]		McWenneger Slough		Egan Slough		Totals	
Date	Ind. Pairs	Others	Ind. Pairs	Others	Ind. Pairs	Others	Ind. Pairs	Others	Ind. Pairs	Others	Ind. Pairs	Others
4/11[c]	—	—	2	0	49	41	—	—	—	—	(51)	(41)
4/13[d]	43	24	11	0	71	61	14	15	11	3	150	103
4/21	31	29	4	0	42	17	—	—	10	3	87	49
4/25	35	25	2	0	44	25	5	12	6	0	92	62
5/2	46	0	6	0	30	29	2	0	3	0	87	29
$\bar{X}$	39	20	5	0	47	35	7	9	8	2	106	66

a Includes Fennon, Church, Brenneman's, and Half Moon Sloughs, and Hodgeson Lake.

b Includes the north shores of Plathead Lake from Deep Say on the west to Woods Bay on the east.

c Boat survey, river only.

d USFWS trend count (unpub. data)

Table 2. Summary of Canada goose nest locations, types, and fate, northern Flathead Valley, Montana, 1984.

LOCATION	TYPE			FATE		
	Tree	Structure or Stump	Ground	Hatch	Pred.	Unk.
Flathead Lake WPA						
Delta Island Area		3	8	4	1	6
Dredged Cattail Area			4	3	1	
Flathead Lakeshore[a]		1		1		
Flathead River						
Columbia Falls - Kalispell			1	1		
Kalispell - **Lake**	19	1	6	4	2	20
McWenneger Slough	—	—	—	—		1
Totals	19	5	20	13	4	27

TOTAL NESTS: 44
SUCCESS (Known-fate Nests): 76%

[a] North of **Woods** Bay on the east shore, north of Deep **Bay** on the west shore.

due to the ease of locating such nests, and to the relatively limited search effort for island ground nests. On the lower river portion of our study area (from the Stillwater River downstream), however, there are no islands in the main river channel. Therefore the only secure nesting sites for geese in this lower river reach are in trees. Islands in the interior of oxbows and backwater sloughs along this river reach were not searched this year; some may be used by nesting geese.

Fifteen nests were found within the Flathead WPA (Table 2). Eight 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. The remaining nests located in the WPA (Table 2) were found in areas not searched by previous researchers.

Nest totals for the river portion of the study area were heavily skewed toward the downstream portion (Table 2). This is due both to the high number of snag nests and the more intensive search effort for ground nests in that river stretch.

Twenty of the elevated nests were nests built by osprey in previous years; 2 were in great blue heron colonies, and one pair used a nest formerly used by bald eagles, apparently displacing the eagle pair to a newly used site in the WPA. The low number of known-fate nests recorded in 1984 (Table 2) primarily is due to the high number of tree nests, for which fate could not be determined. Nine or ten of the tree nests were subsequently occupied by ospreys, two as early as 25 April. It is unknown whether goose pairs using these nests or the two heron nests were successful at hatching young or whether they were displaced by ospreys.

Hatching success for known-fate nests was 76%. This is comparable to hatching success reported for both 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 bake nests was 76% (Ball 1983, Mackey et al. 1985). These values are similar to those reported for the species through-cut its range (Bellrose 1976).

Two nest failures were attributed to mammalian predation, one to bird predation, and one to an unknown predator, based on characteristics of remaining eggshell fragments (Rearden 1951). Craighead and Stockstad (1961) determined the major causes of nesting failure for geese in the Flathead Valley were predation and desertion; Geis (1956) attributed most predation losses (90%) to ravens (Corvus corax) or crows (Corvus brachyrhynchos). A wide variety of mammals have been recorded as 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 observed sign of coyote, dog, raccoon, and skunk on nesting islands, and both crows and ravens were common throughout the study area.

During the 1984 nesting season, the peak of nest initiation in the study area apparently occurred on or before 11 April (Fig. 6). Most snag nests were occupied on this date, which was the first full day spent afield throughout the study area. Many of these nests were, therefore, likely to have been initiated much earlier; at least 2 were initiated before 17 March (Fig. 6), and many were vacant or occupied by ospreys by the first week of May, which implies a late March initiation date if these nests successfully hatched.

The peak of hatch in the study area occurred on or before 10 May: the data presented in Fig. 6 are skewed due to the fact that many nests had already hatched by the time they were found. The scarcity of hatch date data is due to the large number of unknown-fate elevated nests.

Comparison of main stem water level data taken at Columbia Falls (U.S.G.S., unpublished data) and nest chronology data revealed 5 pronounced peak flow days during late March and early April which caused changes of 1.44 to 3.22 ft. (0.44-0-98 m) in water level (Fig. 7). The greatest of these fluctuations corresponded closely with the peak of nest initiation (Fig. 7), and may therefore have led to the flooding of some nests, particularly on the upper river stretch between Columbia Falls and Kalispell, where water level fluctuations are greatest and few nests were found. Perhaps more critical to the success of river island ground nests were water level fluctuations late in the nesting period, when peak levels were as high as 7 ft. (2.13 m) above base levels during nest initiation (Fig. 7). Nests destroyed during this period would be lost completely, since Canada geese have a low propensity for renesting (Bellrose 1976). While such changes are in part due to the effects of runoff, peak runoff levels did not really begin until late May and early June (Appendix I).

Nest Habitat Measurements

Physical habitat and vegetation measurements were completed on as many of the 44 nest sites as possible. In some cases nests could not be relocated or were actually lost due to inundation or erosion. Two tree nests were not evaluated because they could not be accurately relocated within heronries. Cover and land types were described for all 44 nests.

Most nests were found in the riparian bench (48%) or island (39%) landforms; marsh (11%) and lake (2%) comprised the remaining landforms used by nesting geese (Fig. 8). These data may be skewed by the observability of tree nests found on riparian bench areas,

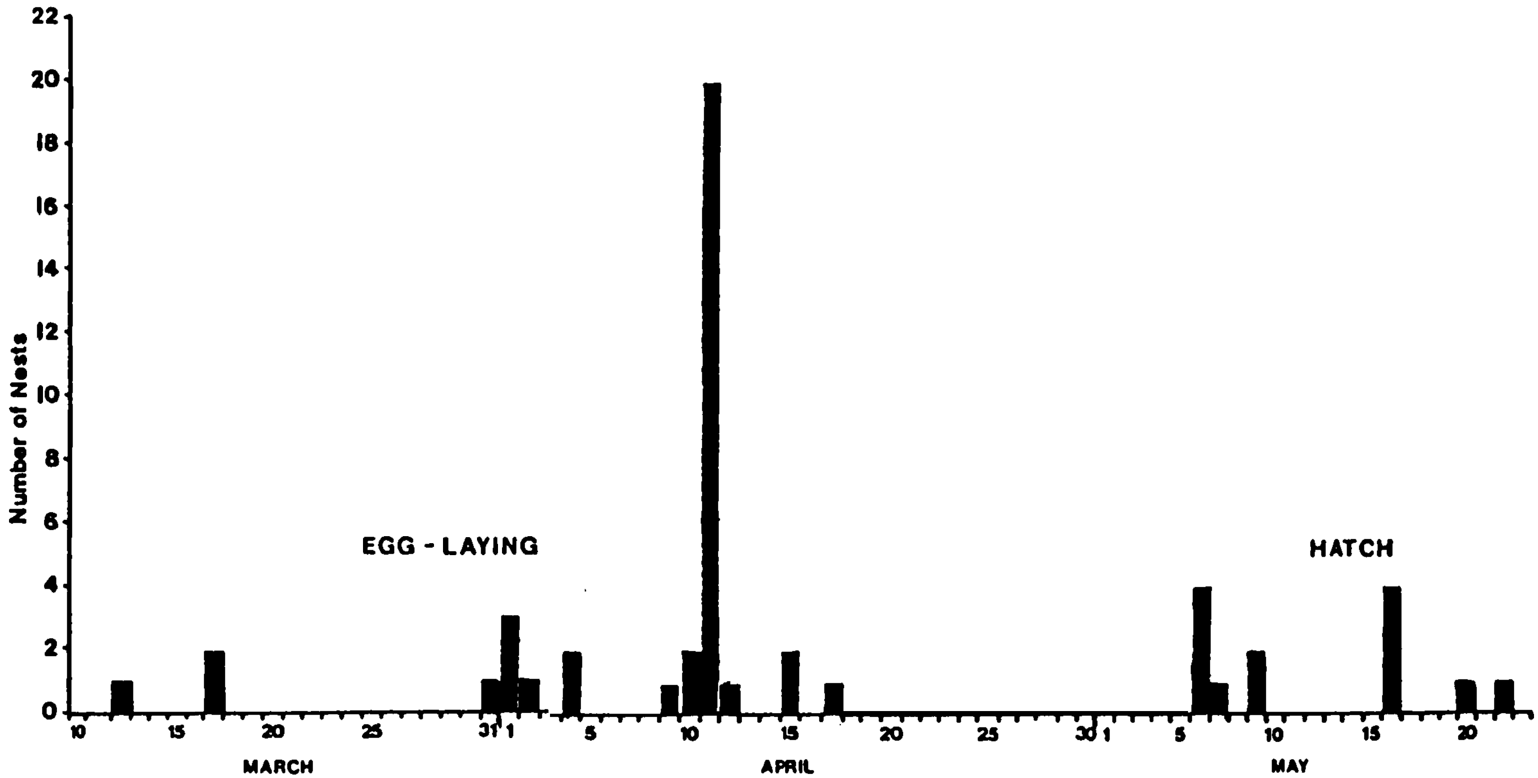


Fig. 6. Canada goose nesting chronology, northern Flathead Valley, Montana, 1984. (Bars correspond to number of nests in which egg-laying or hatch began on or before the date shown.)

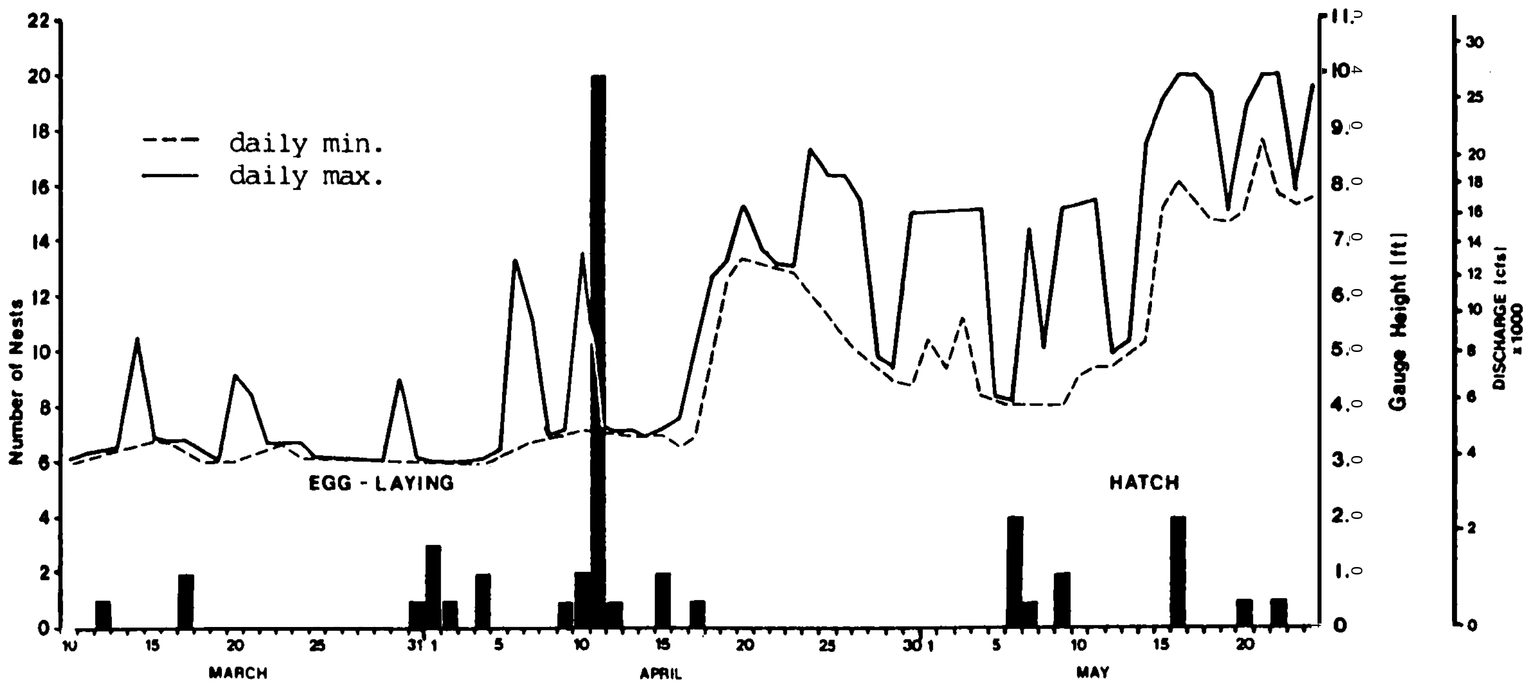


Fig. 7. Daily gauge height and discharge maximum and minimum, main stem Flathead River at Columbia Falls, Montana, compared to nesting chronology for Canada geese, March-May, 1984. (Bars correspond to the number of nests in which egg-laying or hatch began on or before the date shown.

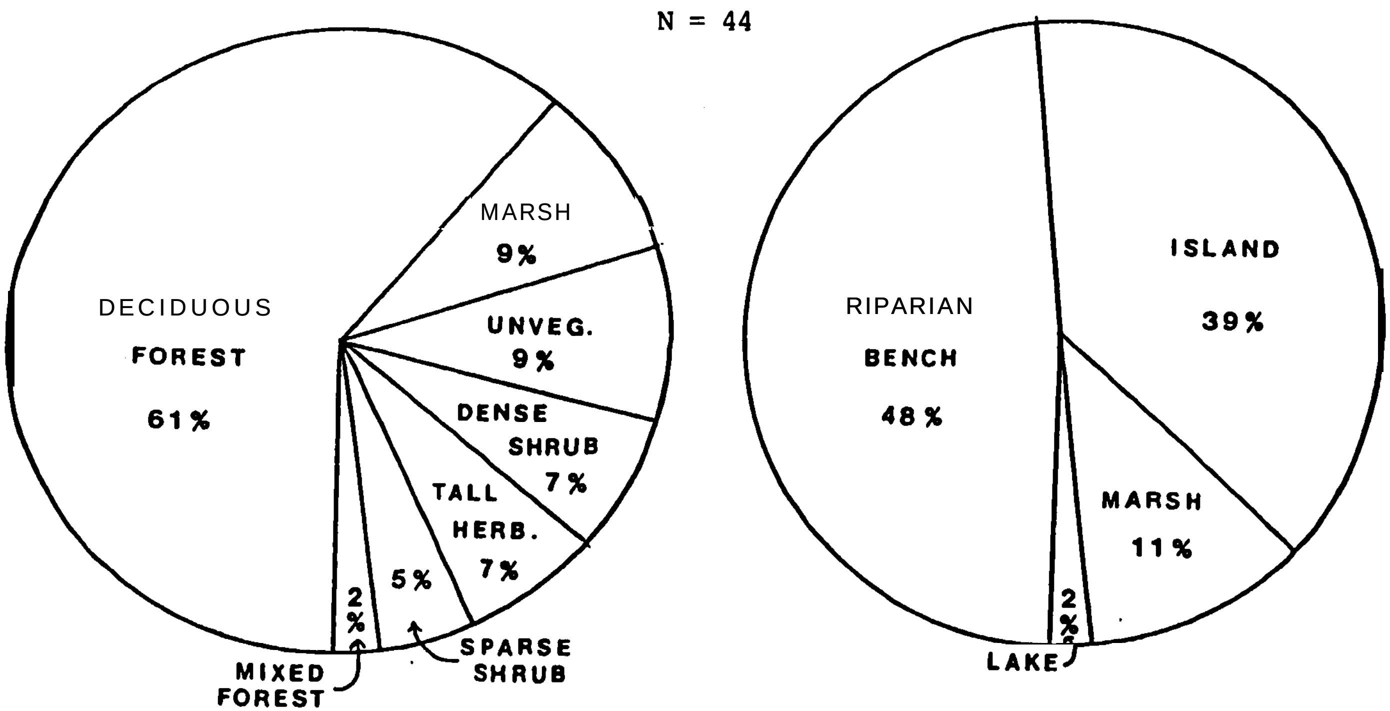


Fig. 8. Canada goose nest distribution by cover type and landform, northern Flathead Valley, Montana, 1984.

however, the CSKT. study also reported the preference for the riparian bench landform for both the river and lake areas (Mackey et al. 1985). Only 9% of the nests found on the lower Flathead River by the CSKT study were tree nests; the majority of nest sites were ground nests found on islands on both the lake and river area (Mackey et al. 1985). Extensive nest searches conducted during 1985 will likely identify more island nest sites in our study area, particularly in the river area north of Kalispell. However, additional tree nest sites also may be found; apparently there is greater use of tree nests on the upper river area (north of Flathead Lake) than along the lower Flathead River (Mackey etal. 1985).

Riparianbench and islandlandforms arethosehabitats most likely to be affected by water level fluctuations. Any nests found within thesehabitats mayalsobeaffected. Islandgroundnests in particular may be negatively affected; however, tree nests found in riparian bench areas may also be lost due to erosion caused by fluctuating water levels.

Seventy-four percent of all nests (n=38), and 74% of ground nests were located with 5 m of the HWM (Fig. 9). The CSKT study also found the majority of nests within 5 m (Mackey etal. 1985). Sixty-two percent of the 13 ground nests evaluated were located less than 0.5 m above the HWM, and 85% were within 1 m. Although no nests were found below the HWM, the close proximity of nest sites to the HWM emphasizes the potential for flooding of nests. Some nests may have been flooded by high spring flows prior to nest searches and, therefore, not found. The CSKT study found all ground nests on the river within 1.5 m above or below the HWM; 37% of the nests were found at or below the HWM. Mackey et al. (1985) indicated a preference for sites between 1 m and 4 m height above the HWM for nest sites on the lake. CSKT biologists documented flooding of 2 nests on the lower river during 1983 (Gregory et al. 1984).

Tree nests averaged 17.8 m in height in trees averaging 20.2 m in height and 0.95 m in diameter at breast height. Most (59%) tree nests were found in cottonwood snags, although 1 nest was fcund in a conifer snag and 6 nests were found in live cottonwood trees. Distance to HWM was evaluated for 15 tree nests. Most (67%) snags were within 5 m of the HWM; 33% were located less than 2 m from the HWM. Erosion of riverbanks may affect snag nest sites located close to the HWM.

Most nests (61%) were found in the deciduous forest type (Fig. 8). The remaining nests were found in almost equal portions in the marsh (9%), unvegetated (9%), dense shrub (7%), tall herbaceous (7%), sparse shrub (5%) and mixed forest (2%) cover types. The prevalence of nests in thedeciduous forestmaybeexplainedby the number of tree nests used by geese in our study area; 66% of nests on the lower Flathead River were in shrub habitats, while most (65%) nests on the southern half of the lake were found in

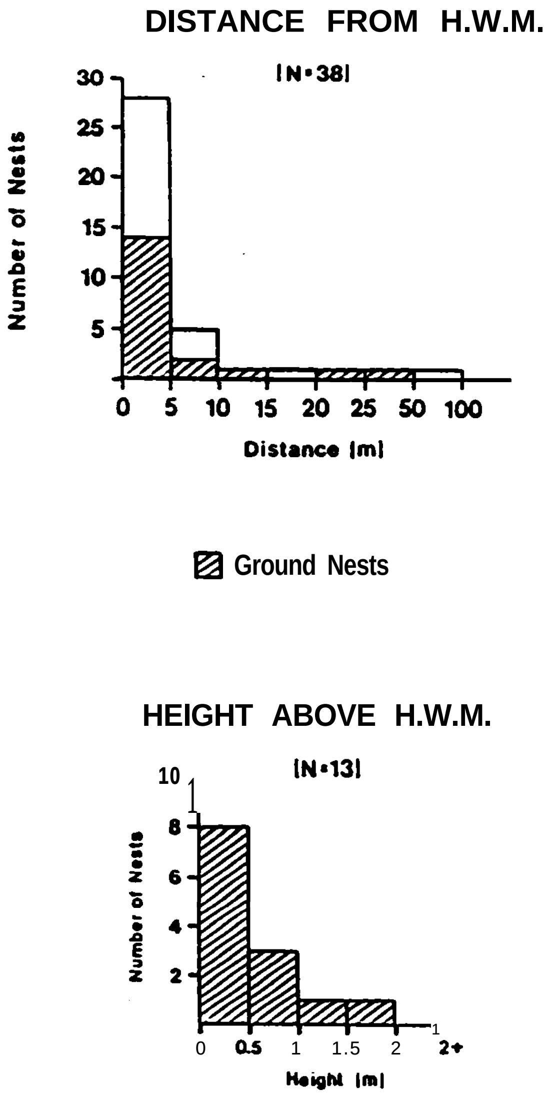


Fig. 9. Canada goose nest location in relation to the seasonal high water mark, northern Flathead Valley, Montana, 1984.

coniferous forest (Mackey et al. 1985).

In general, the density of vegetation was less at nest sites than at surrounding points. The average stem density at the nest sites was 4.3 stems/m^2 for the 15 ground nests sampled. Areas sampled at the cardinal points 5 m from the nests averaged 7.9 stems/m^2. Although not statistically tested because of small sample size, the difference in stem density may suggest that nest sites found in shrubby habitats are located in less dense sites. Less cover at the nest site may provide greater visibility for nesting geese. Geis (1956) also found most nests in areas with high visibility from the nest.

Overhead cover categories were defined by the CSKT biologist (Mackey et al. 1985) to include: open (<25%), sparse (25-49%), moderate (50-75%), and dense (>75%). Based on these categories, average overhead cover at ground nests in our study area was sparse both at nest sites (32%) and at areas 5 m from the nest sites (43%). Similar average overhead coverage (30%) was found at nest sites on the lower river by the CSKT study, although more dense average cover (60%+) occurred at nest sites on the lake where coniferous forest habitat was dominant (Mackey et al. 1985).

Data from 15 ground nest sites were combined to determine average canopy cover for all nest sites. Shrub, litter, and forb were the dominant cover classes in the vicinity of ground nests. The average cover composition for all nests was 40% shrub, 35% litter, 26% forb, 17% graminoid, 13% tree, 12% log, and 8% bareground. The CSKT study documented a preference for shrub dominated sites for river nests, and shrub-tree dominated sites for nests within the lake area (Mackey et al. 1985).

BROOD STUDIES

Results of selected brood surveys are presented in Table 3. The one earlier count (2 May) yielded few observations, and during later counts (29 June - 22 July) young could not be adequately distinguished from adults. The Flathead WPA received the greatest use by broods, however, large numbers of goslings were not seen at the WPA until relatively late in the brood-rearing period (after mid-June). This trend may be due to 2 factors; the secretive habits of pairs with very young broods (Ball et al. 1981), and apparent movement to the WPA from other areas, as indicated by decreased counts along the river later in the season (Table 3). In addition, broods hatched from islands in the CSKT study area (Mackey et al. 1985) may also move to the WPA during the brood-rearing period. Barraclough (1954) reported movement of marked broods from both Goose and Douglas islands to the north shore of the lake.

The high brood count at the WPA for the season, 155, is similar to the number reported by Barraclough (1954) during the 1953 brood-rearing season (160). Annual trend counts have averaged

Table 3. Aerial survey results, Canada goose broods, northern Flathead Valley, Montana, 1984.

Location	Total Goslings					
	5/21	5/30	6/5	6/12[a]	6/13	6/28[b]
Flathead Lake WPA	14	68	62	155	80	120
Flathead River						
Columbia Falls - Kalispell		4			15	
Kalispell - Lake	11	21	10	59		
Hodgeson Lake		8	5		7	
Egan Slough		19				
Half Moon Slough		23				
McWenneger Slough	—	—	—	—	—	
TOTALS:	25	145	86	261	102	120
$\bar{X}$ Brood Size	4.2	4.3	4.3		3.8	

a USFWS trend count (# young/brood not available).

b Flathead Lake WPA only; large gang broods.

89 young (31-173) at the WPA during the years 1975-1983 (USFWS, MDFWP; unpublished data). Similarly, the high count along the river from Kalispell to the lake (59), was similar to the 9-year mean of 65 (USFWS, MDFWP; unpublished data).

Using an average brood size of 4.0, the highest total count for the brood-rearing period (261) would be equivalent to 65 broods. This total is consistent with the number of successful nests predicted by the mean pair count data (88) and the hatching success we observed (76%), e.g. 76% of 88 is 67 successful nests. This consistency may merely represent a coincidence caused by immigration of broods from further south on the lake since we noted a discrepancy in the number of indicated pairs and nests, particularly at the WPA. The highest gosling count (155) at the WPA (Table 3), corresponds to approximately 39 broods. Since we found only 15 nests in the WPA, these data indicate that the WPA is important as a rearing area for broods hatched elsewhere.

No good estimates of gosling survival could be developed from our data. Mean brood size remained fairly constant from late May through mid-June (Table 3), and large gang broods were seen thereafter. Since the observation towers were not constructed until relatively late in the brood-rearing period, we were unable to collect detailed ground survey data repeatedly throughout the period, necessary to develop survival estimates. 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.

Compilation of brood observations gathered during aerial surveys, tower surveys, and opportunistically during other phases of the field work, indicated that broods used open water and mudflat areas extensively (Fig. 10). The majority of observations took place within 100 m of the shoreline of the mudflats in the WPA. This pattern is obviously due, in part, to the observability of broods in such areas compared to densely vegetated cover types; however, broods were seen loafing and feeding on the mudflats throughout the brood-rearing period. Whether use of such areas-is related to the security offered by the open water or by feeding preferences could not be determined. Use of such areas may increase the risk of predation, as suggested by Barraclough (1954) and Ball (1981, 1983), but no such predation was documented this year.

Specific important brood-rearing sites could not be accurately delineated from our 1984 data. Mapping of observations of broods from both aerial and tower surveys indicated widespread use of the WPA, and the criteria of 10 brood observations, used by CSKT biologists to outline brood-rearing sites (Mackey et al. 1985), was not met at any of the other areas in our study area used by broods. For these reasons, no habitat measurements were taken at brood-

N = 106

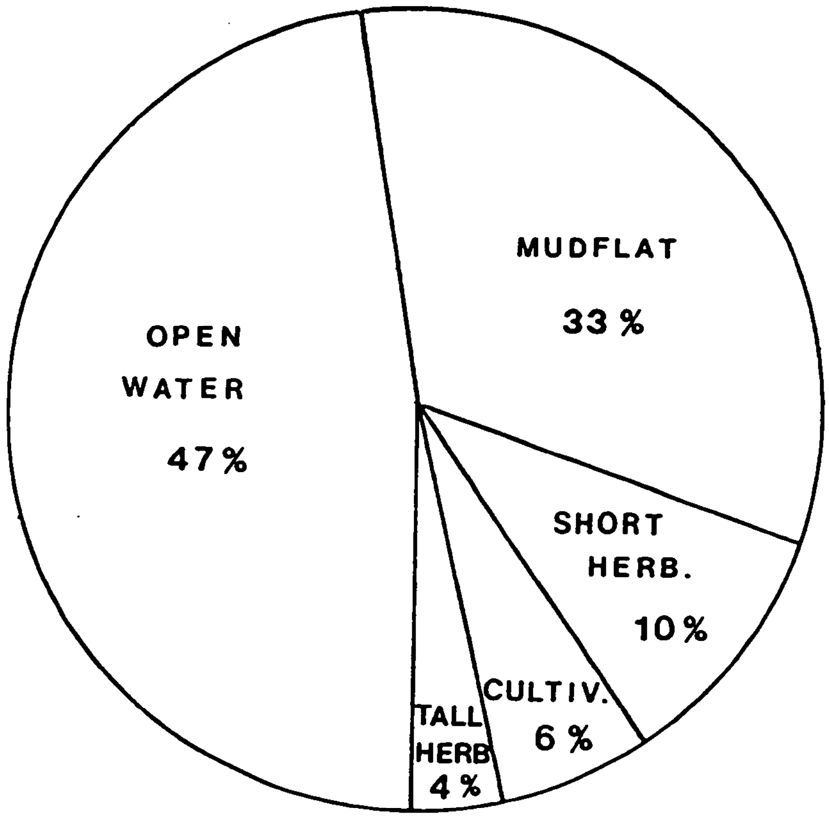


Fig 10. Canada goose brood habitat use, northern Flathead Valley, Montana, 1984.

rearing areas. Areas in which broods were seen along the river portion of our study area were typically short herbaceous cover types such as sparsely vegetated gravel bars, graminoid cover on downstream ends of river islands, and bottomland hay meadows. These areas are similar to those described by Mackey et al. (1985) for the lower Flathead River.

HABITAT MAPPING

Mapping of habitats by cover types (Appendix II) was completed for the reach of river from the confluence with the South Fork Flathead River to just below the heavily braided section of river southeast of Kalispell (Figure 1). Portions of the WPA have been previously described (USFWS 1981) and will be incorporated into the habitat map. Habitat mapping will be completed in 1985 and acreages for each cover type will be determined.

NON-BREEDING SEASON STUDIES

Results of aerial surveys conducted during the post-fledging, fall migration, and early winter periods are presented in Appendix V. Total numbers of geese in the study area remained fairly constant at 200-300 through the post-fledging period, increasing to over 600 by early September and reaching a peak of 1240 by 25 September (Appendix V).

The Flathead WPA was used by large flocks of geese throughout the late summer and fall; results of the tower surveys indicate that emergent bulrush (Scirpus spp.) stands were used for feeding, and floating debris (logs) along the shore were used for loafing. Large numbers of geese were also seen in the braided river stretch near Kalispell and at small lakes and sloughs throughout the study area during late summer and fall (Appendix V). During this period, wheatfields throughout the valley were used extensively for feeding, and sheltered off-river sloughs and the WPA were used for loafing areas.

The one adult female goose captured and equipped with a radio-collar in late June was relocated on several occasions during subsequent aerial surveys (Table 4). Between August and October this bird was recorded twice at Pablo Reservoir, south of Flathead Lake, appearing back at the WPA in the interim (Table 4). Movements by other geese between Flathead Lake and Pablo, and between other widespread areas within the Flathead Valley, have been recorded by other researchers as well (Geis 1956, Gregory et al. 1984, Mackey et al.1985), though movements between the northern valley and lower Flathead River area have not been well documented. Continued studies with radio-collared birds will help identify interchange between our study area and the CSKT study area, particularly by those birds which molt at the WPA.

Table 4. Radiolocations of adult female Canada goose trapped in northern Flathead Valley, Montana, 1984, and equipped with collar MH89.

DATE	LOCATION	COMMENTS
28 June	WPA West (trap site)	Caught with four male goslings
15 July	WPA west (near tower #2)	With group of 12 - 15
22 Aug.	Pablo Reservoir	Probable location; B. Matthews pers. commun.
28 Aug.	Pablo Reservoir	B. Matthews pers. commun.
4 Sept.	Bird Point, E. Bay, Flathead Lake	With field-feeding flock
27 Sept.	WPA (delta islands)	With group of 4
4 Oct.(?)	Pablo Reservoir	Date (?); D. Mackey pers. commun.
11 Oct.	Pablo Reservoir	D. Mackey pers. commun.
18 Oct.	WPA (delta islands)	With group of 7
5 Nov.	Mud Lake	With group of 180
15 Nov.	Johnson Lake	With group of 23

OTHER WILDLIFE SPECIES

Observation data for species other than Canada goose were not analyzed for inclusion in this report. Collection and reporting of bald eagle sightings has been coordinated with USF'WS biologists throughout the course of the study.

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 1984 phase of the study yielded data needed to meet each of these objectives. Data were limited for many phases of the study, primarily due to the late starting date (one month into the nesting season) and the time spent early in the project acquiring equipment, designing the study and building observation towers during the period when just one biologist was involved in the project. Results of the first year studies did, however, provide data descriptive of goose distribution, nesting effort, brood-rearing, and water level fluctuations, within the study area.

Both pair count and brood count data indicated that 73-125 nests may have been present in the study area, using pairs/nest ratios determined elsewhere in the Valley (Mackey et al. 1985). Forty-four nests were located in 1984; discrepancies between nests located and pair count data indicate that many non-breeding pairs may be present in the area, particularly along the north shore of the lake (Flathead WPA). High brood counts there may be a result of movements of broods from upriver within the study area, or from lake islands further south, as previously documented by Barraclough (1954).

Most nesting occurred along the river south of Kalispell and along the north shore of Flathead bake. Tree-nesting was common along the river. The total number of nests found in the Flathead Lake WPA was consistent with previous studies (Ball 1981, 1983). However, 3 of 8 island ground nest sites in the WPA were lost to erosion subsequent to the nesting period. The delta islands which have historically supported nesting geese may be totally lost to erosion before this **study** is concluded. Documentation of this loss will be emphasized during subsequent breeding seasons.

The peak of egg-laying in the study area was on or before 11 April, and the peak of hatch on or before 10 May. Analysis of river discharge data revealed substantial daily and intra-seasonal fluctuations (l-2 m) due to peaking operations at Hungry Horse Dam throughout the nesting period, particularly during the latter stages of incubation. While no nest flooding was documented in 1984, the majority of ground nests were within 0.5 m above and 5 m from the seasonal HWM. More intensive nest searches and water level data analyses need to be **conducted** in 1985 and 1986.

Most nests were located in the deciduous forest cover type and riparian bench or island landforms. Woody stem density and overstory canopy coverage were less at nest sites than at surrounding points. Shrub, litter, and forb were the dominant cover classes in the vicinity of groundnests. Ehbitat measurements at 1984 nest sites will be useful for selecting areas to be searched in subsequent years.

A reliable estimate of gosling production could not be developed from the1984 **data; the high count of 251 goslings** in the study area included 155 at the WPA. Broods were observed to use mudflats at the WPA extensively, particularly during the latter portions of the brood-rearing period. No habitat measurements were taken in brood-rearing areas, since no specific sites were delineated from the sightings data. Much more intensive brood surveys will be **conducted** in subsequent years, particularly early in thebrood-rearing period.

Radiolocations of one collared goose indicated widespread movements after the molt, between our study area and areas to the south within the Flathead Valley. Hopefully, this bird will breed in one of these areas in 1985.

One objective of the 1984 study was to develop preliminary 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, it is perhaps improper to recommend specific mitigation measures. Preliminary indications from the 1984 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). Similarly, availability of brood-rearing habitat at Flathead Lake may serve to limit the population (Bal11981, 1983), and broods currently use the broad mudflats along the shore, perhaps risking increased predation (Barraclough 1964, Ball1983). Certainly, the interspersion of open water, emergent vegetation and short herbaceous **feeding** areas, considered to be optimum brood-rearing habitat for this species (Williams and Sooter 1940, Hanson and Hberhardt 1971), is not available along the north shore of the lake during the brood-rearing period, under current water regimes. 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 losses 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 recommendations.

A work statement for 1985 has been prepared for submittal to BPA. 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 efforts.

Objectives and methodologies will, for the most part, be as described for 1984. In order to guantify and describe goose nesting effort in the study area, pairs surveys, nest searches, and nest site habitat measurements will again be employed. Pair surveys (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 no tree nests were located in 1984 and where water level fluctuations due to Hungry Horse operations are the greatest. 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 HWIY and the vegetation measurements taken during 1984.

Hopefully, trapping efforts during late winter will result in the opportunity to track 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 existing 2 observation towers in the WPA, and one more to be built in 1985. 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 quantification of erosion losses in the delta area.

The primary objective of the 1985 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 enhancegoose populations,nesting andbrood-rearing habitats willbebased on on the 1985 and 1986 results, with the level of . ıtigation 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 bake 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). Data from the 1985 nesting studies will be used to clarify project goals and methodologies for 1986.

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APPENDIX I

Gauge height and discharge, Flathead River at Columbia Falls, March-June 1984 (USGS, unpublished data).

MARCH

	Gauge Height			Discharge		
Day	**Min.**	**Max.**	**X̄**	**Min.**	**Max.**	**X̄**
1	6.29	6.30	6.29	11850	11880	11900
2	6.28	6.30	6.29	11810	11880	11900
3	6.28	6.37	6.35	11810	12100	12000
4	6.33	6.36	6.35	11980	I.2070	12000
5	4.61	6.37	6.06	7130	12100	11200
6	2.92	6.28	5.17	3670	11810	9000
7'	2.91	6.24	3.93	3660	11690	5940
8	2.89	4.79	3.24	3620	7570	4300
9	3.03	3.05	3.04	3860	3900	3880
10	3.03	3.06	3.05	3860	3910	3900
11	3.06	3.14	3.10	3910	4050	3980
12	3.14	3.21	3.18	4050	4180	4130
13	3.21	3.26	3.23	4180	4270	4210
14	3.25	5.28	3.44	4250	8850	4650
15	3.38	3.42	3.40	4490	4570	4520
16	3.36	3.38	3.37	4450	4490	4470
17	3.18	3.39	3.33	4130	4510	4390
18	3.00	3.20	3.16	3810	4160	4090
19	2.99	3.01	3.00	3790	3830	3810
20	3.00	4.59	3.90	3810	7080	5650
21	3.11	4.20	3.27	4000	6170	4290
22	3.24	3.31	3.28	4230	4360	4300
23	3.30	3.34	3.32	4340	4420	4380
24	3.09	3.35	3.21	3970	4430	4180
25	3.07	3.10	3.09	3930	3980	3960
26	3.06	3.09	3.07	3910	3970	3930
27	3.04	3.07	3.05	3880	3930	3900
28	3.02	3.04	3.03	3840	3880	3860
29	3.01	3.03	3.01	3830	3860	3840
30	3.01	4.45	3.16	3830	6750	4120
31	2.99	3.02	3.01	3790	3840	3820

Gauge height and discharge, Flathead River at Columbia Falls, March-June 1984 (USGS, unpublished data). (Continued)

APRIL

Day	Gauge Height Min.	Gauge Height Max.	Gauge Height X	Discharge Min.	Discharge Max.	Discharge $\bar{X}$
1	2.97	3.00	2.99	3760	3810	3790
2	2.97	2.99	2.98	3760	3790	3780
3	2.99	3.00	2.99	3790	3810	3800
4	2.99	3.03	3.01	3790	3860	3820
5	3.03	3.19	3.10	3860	4140	3990
6	3.19	6.64	4.61	4140	13000	7650
7	3.37	5.59	3.71	4470	9720	5230
8	3.40	3.49	3.44	4530	4700	4600
9	3.50	3.56	3.54	4720	4840	4800
10	3.55	6.77	4.44	4820	13440	7110
11	3.56	3.62	3.59	4840	4950	4890
12	3.52	3.56	3.54	4760	4840	4800
13	3.47	3.52	3.50	4660	4760	4710
14	3.45	3.47	3.46	4620	4660	4650
15	3.47	3.59	3.51	4660	4890	4750
16	3.26	3.78	3.53	4270	5270	4780
17	3.42	5.00	4.26	4570	8110	6310
18	5.00	6.31	5.70	8110	11910	10000
19	6.31	6.64	6.52	11910	13000	12600
20	6.64	7.61	6.88	13000	16500	13800
21	6.59	6.87	6.74	12830	13790	13300
22	6.45	6.59	6.52	12370	12830	12600
23	6.42	6.51	6.45	12270	12560	12400
24	5.98	8.62	6.42	10880	20650	I2300
25	5.60	8.13	6.08	9750	18570	11200
26	5.25	8.16	6.08	8770	18700	11200
27	4.92	7.66	5.34	7900	16700	9020
28	4.70	4.92	4.80	7350	7900	7600
29	4.47	4.70	4.58	6790	7350	7060
30	4.37	7.50	5.92	6560	16080	10700

Gauge height and discharge, Flathead River at Columbia Falls, March-June1984 (USGS, unpublished data). (Continued)

MAY

Day	Gauge Height, Min.	Max.	X̄	Discharge Min.	Max.	X̄
1	5.19	7.50	7.28	8610	16080	15300
2	4.66	7.52	7.22	7250	16160	15000
3	5.60	7.55	7.40	9750	16270	15700
4	4.18	7.53	6.35	6130	16200	12000
5	4.09	4.18	4.12	5930	6130	6000
6	4.01	4.09	4.04	5760	5930	5820
7	4.01	7.20	4.57	5760	14970	7030
8	4.00	5.07	4.14	5740	8290	6040
9	4.02	7.57	5.90	5780	16350	10600
10	4.56	7.63	5.80	7010	16580	10300
11	4.69	7.71	5.87	7320	16890	10500
12	4.69	4.94	4.80	7320	7950	7600
13	4.94	5.16	5.04	7950	8530	8210
14	5.16	8.64	6.58	8530	20740	12800
15	7.56	9.45	8.60	16310	24450	20600
16	8.02	9.98	8.75	18120	27060	21200
17	7.62	9.98	8.57	16540	27060	20400
18	7.37	9.63	8.03	15590	25320	18200
19	7.31	7.51	7.39	15370	16120	15700
20	7.51	9.40	8.46	16120	24210	20000
21	8.76	9.97	9.23	21270	27010	23400
22	7.83	9.97	8.58	17360	27010	20500
23	7.66	7.87	7.73	16700	17520	17000
24	7.73	9.73	8.06	16970	25810	18300
25	7.34	9.63	7.98	15480	25320	18100
26	7.01	7.33	7.15	14280	15440	14800
27	6.90	7.01	6.97	13890	14280	14100
28	6.88	6.94	6.91	13820	14030	13900
29	6.94	7.51	7.17	14030	16120	14900
30	7.52	10.44	8.81	16160	29450	21700
31	9.92	11.33	10.85	26760	34390	31800

Gauge height and discharge, Flathead River at Columbia Falls, March-June1984 (USGS, unpublisheddata). (Continued)

JUNE

Day	Gauge Height, Min.	Max.	X	Discharge Min.	Max.	X
1	9.30	11.06	10.16	23740	32840	28100
2	8.19	9.28	8.69	18820	23640	21000
3	7.77	8.19	7.96	17130	18820	17900
4	7.67	7.77	7.70	16740	17130	16900
5	7.66	7.76	7.70	16700	17090	16900
6	7.76	7.91	7.85	17090	17680	17400
7	7.87	7.91	7.89	17520	17680	17600
8	7.86	7.92	7.88	17480	17720	17600
9	7.87	8.00	7.95	17520	18040	17800
10	7.43	7.87	7.64	15820	17520	16600
11	7.32	7.42	7.36	15410	15780	15600
12	7.31	7.38	7.36	15370	15630	15500
13	7.38	7.64	7.50	15630	16620	16100
14	7.65	9.63	8.12	16660	25320	18600
15	8.32	10.34	8.95	19370	28920	22200
16	8.91	9.57	9.42	21940	25030	24300
17	9.43	9.67	9.61	24350	25520	25200
18	8.93	9.42	9.20	22030	24310	23300
19	8.61	8.93	8.79	20610	22030	21400
20	8.51	8.60	8.54	20170	20560	20300
21	8.52	9.33	8.80	20220	23880	21500
22	8.99	9.49	9.33	22300	24640	23900
23	7.91	8.98	8.35	17680	22250	19500
24	7.80	7.91	7.86	17240	17680	17500
25	7.81	8.70	8.38	17280	21000	19600
26	8.70	8.94	8.86	21000	22070	21700
27	8.82	9.79	9.19	21530	26110	23200
28	9.11	9.42	9.33	22850	24310	23900
29	9.00	9.12	9.08	22350	22900	22700
30	7.53	9.01	8.00	16200	22390	18100

APPENDIX II

Cover types based on existing plant species dominance.

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 virginiana), Douglas hawthorn (Crataegus douglasii), and alder (Alnus sp.).

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

  dense upland shrub with common snowberry (Symphoricarpus albus), buffaloberry (Shepherdia canadensis) -and silverberry (Elaeagnus commutata).

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

3.1 Tall herbaceous

- > .5 m tall.
- Includes several graminoids: reed canary grass (Phalaris arundinaceae), bulrush (Scirpus acutus), spike-rush (Eleocharis 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 an 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

- Cultivated hay field.

4.4 Orchard

- Tree farms.

4.5 Lawn

- Non-native grass species.

4.6 Other

- Includes homesites, farms, buildings.

5.0 Marsh

- Emergent plants dominant.
- Includes sites with cattails (Typha spp.).

6.0 Submerged aquatic
- Includes ponds or sloughs with submerged aquatic plants dominating.

7.0 Unvegetated
- <10% vegetation cover.
- Includes roads and gravel bars.

APPENDIX III

Landforms used to describe nest sites and the general study area.

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
2.1	Gravel bar
2.2	Mudflat
2.3	Marsh
3.1	Buildings -housing area
3.2	Dock- launch
3.3	Natural shore
4.1	Riparianbench
4.2	Riparian Swale
4.3	Riparian slop
4.4	Riprian cliff
5.1	Upland flat
5.2	upland slope
5.3	Upland swale
5.4	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, Montana, 1994.

NEST #	TYPE	GENERAL LOCATION	FATE	COVER TYPE	LAND FORM
001	Tree-snag (Eagle nest)	Lower river[1]	Unknown	Deciduous forest	Riparian bench
002	Ground	Valley - pond	Unknown	Marsh	Marsh
003	Utility pole(osprey)	Lower river	Unknown	Sparse shrub	Riparian bench
004	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
005	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
006	Tree-snag (osprey)	Lower river	Unknown	Mixed forest	Riparian bench
007	Tree-heronry	Lower river	Unknown	Deciduous forest	Island
008	Tree-live (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
009	Tree-live (osprey)	Lower river	Unknown	Ueciduous forest	Ripariaii bench
010	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
011	Tree-live (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
012	Tree-snag (osprey)	Lower river	unknown	Deciduous forest	Riparian bench
013	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
014	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
015	Tree-live (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
016	Tree-live (osprey)	Lower river	unknown	Ueciduous forest	Riparian bench
017	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparian bench
318	Tree-heronry	Lower river	Unknown	Ueciduous forest	Riparian bench
019	Tree-snag (osprey)	Lower river	Unknown	Deciduous forest	Riparin bench
020	Tree-snag (osprey)	Lower river	Unknown	Ueciduous forest	Riparian bench
021	Stump with platform	WPA-Delta Islands	Unknown	Unvegetated	Island
022	Structure-nest box	Flathead Lake	Unknown	Unvegetated	Lake-dock
023	Ground	Lower river	Hatched	Deciduous forest	Island
024	Ground	Lower river	Hatched	Sparse shrub	Island
025	Ground	Lower river	Hatched	Deciduous forest	Island
026	Ground	Lower river	Hatched	Deciduous forest	Island
027	Ground	Lower river	Predated	Dense shrub	Island
028	Ground	Lower river	Predated	Dense shrub	Riparian bench
029	Stump-platform	WPA - Delta	Unknown	Unvegetated	Island
030	Stump-platform	WPA - Delta	Unknown	Unvegetated	Lake
031	Ground	Upper river[2]	Hatched	Dense shrub	Island
032	Tree-live (osprey)	Lower river	unknown	Deciduous forest	Riparian bench
033	Ground	WPA - Delta	Hatched	Marsh	Island
034	Ground	WPA - Delta	Unknown[3]	Marsh	Island
035	Ground	WPA - Delta	Hatched[3]	Deciduous. forest	Island
036	Ground	WPA - Delta	Hatched	Deciduous forest	Island
037	Ground	WPA - Delta	Unknown	Deciduous forest	Island
038	Ground	WPA - Delta	Predated	Deciduous forest	Island
039	Ground	WPA - Delta	Unknown	Deciduous forest	Island
040	Ground	WPA - Delta	Unknown[3]	Deciduous forest	Island
041	Ground	WPA - W. shore	Hatched	Tall herbaceous	Marsh
042	Ground	WPA - W. shore	Predated	Harsh	Marsh
043	Ground	WA - W. shore	Hatched	Tall herbaceous	Harsh
044	Ground	WPA - W. shore	Hatched	Tall herbaceous	Marsh

[1] The lower river includes the main stan Flathead River south of the Highway 2 bridge.

[2] The upper river includes the main stem Flathead River north of the Highway 2 bridge.

[3] Nest lost due to erosion of Delta island.

APPENDIX V

Total numbers of Canada geese recorded during aerial surveys, northern Flathead Valley, Montana, July - December 1984.

Date	Time at Start	Flathead W.P.A. [a]	Flathead R. C. Falls-Hwy 2	Flathead R. Hwy 2-Lake	McWenneger Slough	Fairview Marsh	Mud Lake	Johnson Lake	Other Valley Locations [b]	Study Area Total	Swan Valley [c]	West Valley W.P.A.'s [d]	TOTAL
6 July	1021	117	0	125	16	0	—	—		258	—	—	258
13 July	0840	70	0	107	—	—	—	—		177	—	—	177
22 July	0824	39	0	76	18	—	—	—	13	146	—	—	146
28 July	0950	12	—	169	—	—	—	—	21	202	—	—	202
2 Aug.	0934	100	32	253	0	0	—	—		385	—	—	385
10 Aug.	0932	224	0	215	0	—	—	—	28	467	—	—	467
18 Aug.	0800	4	—	240	0	0	—	—		244	0	—	244
24 Aug.	0824	0	0	242	7	—	—	—		249	—	—	249
5 Sept.	1028	336	65	192	0	0	—	—	65	658	—	—	658
25 Sept.[e]	a.m.	922	—	23	180	0	115	0		1240	47	57	1344
27 Sept.	1404	514	0	151	0	0	—	—	7	672	—	—	672
10 Oct.	1141	94	0	26	0	2	85	0	175	382	—	—	382
18 Oct.	1035	43	—	229	0	0	—	—	30	302	—	—	302
5 Nov.	1136	562	0	143	0	5	180	0		890	360	—	1250
6 Nov.[e]	a.m.	410	—	38	43	0	185	0		676	165	28	869
15 Nov.	1011	259	0	151	0	124	210	23	1	768	—	160	928
4 Dec.	1442	253	59	121	0	0	0	—		433	—	—	433
14 Dec.[e]	a.m.	40	—	63	0	0	0	0		103	180	0	283

[a] Includes Flathead Lake, north of Woods Bay on the east shore and Deep Bay on the west shore (in addition to W.P.A.)

[b] Weaver Slough, Sliter's Pond, "potholes" southeast of Columbia Falls

[c] Swan River, Swan River N.W.R., Swan Lake

[d] Batavia W.P.A., Smith Lake W.P.A.

[e] USFWS trend counts (unpublished data, starting time not provided)