# Biology of the Great Gray Owl in Interior Alaska[1]

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Abstract.--The great gray owl was found frequently in the Yukon and Koyukuk River lowlands from 1981 to 1984 in successional white spruce forest. The owls occupied winter roosts which were habitually used in successive years. Yellow-cheeked vole (Microtus xanthognathus) composed 66%, by frequency, of the diet, other microtines composed 28%, and other mammalian and avian prey composed 6%.

## INTRODUCTION

The status of the great gray owl (Strix nebulosa) in Alaska is thought to be scarce or rare (Armstrong 1980); however, Gabrielson and Lincoln (1957) said the bird was found regularly but was by no means common. Brandt (1943) said it was "common in the heavily wooded bottomlands" and Dall and Bannister (1869) took eight specimens 20 miles east of Nulato in 1867-1868. Studies in Manitoba (Nero et al. 1984), Saskatchewan (Harris 1984), Idaho (A. Franklin pers. commun.) and Alaska (present study) have found that the bird can be found with predictable regularity once the habitat requirements are defined. In Alaska, from at least 1981 to 1984, the great gray owl was at a population peak which contributed to my ease in finding the birds. These "population highs" have been previously noted in Europe (Mikkola 1973) and Manitoba (Nero et al. 1984). It is of interest that the 1981-1984 population high I recorded appeared to also occur in the Manitoba-Minnesota region (R. Nero pers. commun.).

## STUDY AREA AND METHODS

My study was conducted in the floodplain areas adjacent to the confluence of the Yukon and Koyukuk Rivers. The majority of the data was collected from an 82 km$^2$ area located 5 km east of Bishop Rock (64°49'N, 157°22'W), on the islands and north bank of the Yukon River (fig. 1). Bishop Rock is located 24 km downriver from Galena and 35 km northeast of Nulato. The floodplain, varying from 10 to 25 km wide, is the product of extensive meanders of the Yukon River over thousands of years. Away from the main channel are old levees with varying stages of succession ranging from willow (Salix spp. dominated communities through balsam poplar (Populus balsamifera) stands to white spruce (Picea glauca) dominated communities. Adjacent to the old levees are oxbow lakes also in varying stages of succession from open water through reed grass (Calamagrostis sp.) meadows to willow/alder (Salix sp./Alnus sp.) meadows. In some areas these levees and oxbow remnants form concentric habitat bands. Interspersed are blocks of land with extensive permafrost layers close to the surface which only support an open community of stunted larch (Larix laricina), black spruce (Picea mariana), and bog-associated shrubs.

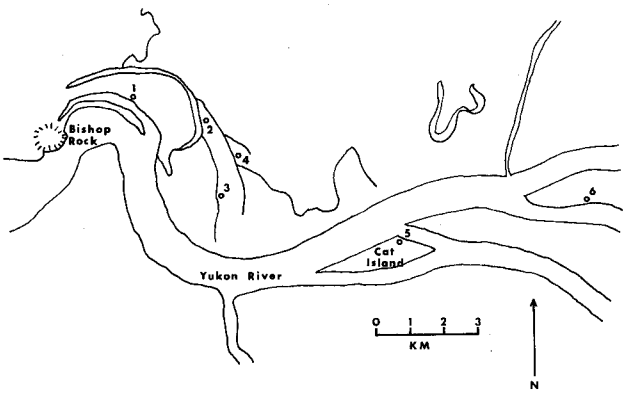


Figure 1.--Bishop Rock study area. Location of great gray owl nests (o) in 1984.

Climate in the area is continental subarctic characterized by great seasonal extremes of temperature ranging from -55°C to 33°C and daylight ranging from 3.5 h to 21.5 h. Ice is present from early October to late May, and average yearly snowfall is about 137 cm (Selkregg 1976). Flooding of low-lying areas is infrequent and can be caused by two different events: ice

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jam floods or high-water floods. During winter 1984-1985, deep snow up to 2 m in the Yukon and Tanana River drainages produced a high-water flood which inundated many of the old oxbow areas for up to three weeks.

Data on the owls were collected opportunistically during studies of moose (Alces alces). Observations were conducted at irregular intervals from January 1982 to February 1987; however, most data were collected during winter and spring months. Nest trees were climbed, if possible, and contents recorded. At nest sites, prey remains and pellets were collected. At winter roosts, pellets were collected monthly by digging through the snow and after snowmelt in June. At one site a 1.5 x 1.5 m pellet collector was constructed using a 2 x 4 wooden frame covered with plastic sheeting forming a funnel. A plastic bucket with water drain holes was placed below the funnel throat to catch the pellets. The pellet collection device was abandoned after black bears (Ursus americanus) ate the plastic components. Pellets were dissected, and I identified prey remains by skull and tooth characters using voucher specimens from the University of Alaska Museum.

Three small mammal traplines were run along the Yukon River during late August 1984 and 1985 to ascertain relative prey densities. Each trapline had 20 stations 17 m apart, with two Museum Special snap traps baited with peanut butter and one pitfall funnel trap at each station. Each line was run for three consecutive nights. One line was in a permafrost bog/open black spruce community running perpendicular to the river, one line was in a mature balsam poplar stand running parallel to the river and the third site was 1 km from the river in a (Calamagrostis sp.) meadow. In 1985 the meadow site was covered with 0.5 m of water for 19 days during June, prior to trapping.

During intensive aerial moose surveys, I occasionally observed great gray owls either perched on meadow edges or as they flushed from tree roosts. The surveys were conducted using a Super Cub aircraft flying at 112 kmph at 100 m above ground level with a minimum ground search intensity of 4 min/mi$^2$. The observations produced a relative index of abundance which was biased due to varying sightability of the owls and their individual reactions to aircraft (some would flush and some would not). Sixteen surveys were flown in November and one in April. Data were used from the following moose trend areas: Kaiyuh Slough near Nulato; Squirrel Creek near Koyukuk; Three Day Slough (65°29'N, 157°30'W); Deep Creek 20 km NW Ruby; and Nowitna/Sulatna Rivers confluence (64°36'N, 154°28'W). Another method used to determine density was vocalizations by the owls, either during certain daylight periods or at night. I usually would initiate calling by imitating the owl's call and then listening for responses and calculating their positions.

## RESULTS

The great gray owl occurred in successional white spruce lowland forests along the Yukon River. The meadows of grasses and sedges provided habitat for voles (Microtus spp.), were open hunting areas, and were fringed with willows and balsam poplars which provided hunting perches. Decadent balsam poplar and white spruce provided nesting sites. The area also had large breeding populations of common raven (Corvus corax) and red-tailed hawks (Buteo jamaicensis), which provided potential nest platforms. Mature spruce stands provided sheltered winter roost sites.

During the winter months, October to March, owls were found during daylight periods perched on the edge of open areas, such as meadows, creeks, sloughs, or along the main rivers. During the breeding season, April to July, the owls were always perched at or near the nest site. I was unable to observe owls while they were hunting during this period. I rarely observed owls once fledging occurred until winter conditions allowed access to the areas away from the river.

I was unable to ascertain if the owls were residents in the area or migrants, but since my sightings were mainly in the winter months, I suspect the birds were residents. I do not believe the breeding population was augmented by birds from other areas.

### Nesting

The study area had no man-made nesting structures, thus the density of owls was dependent upon natural regulatory factors. Great gray owls do not build nests and are limited to available nest sites (Nero 1982). If there are sufficient nest sites, then other factors, such as food supply, regulate the population. Along the Yukon River, I found raven nests approximately every 1.5 km and decayed balsam poplar stumps, similar to those used for nesting, occurred very frequently. I found six owl nests in the 82 km$^2$ study area during 1984. The nests averaged 2.8 km apart (range 0.6 to 5.2 km). The density of breeding owls I found (fig. 1) was probably a minimum since it was impossible to search the entire Bishop Rock area. During nocturnal owl calling sessions, at least two more owls were calling adjacent to the area to the north. Owls, presumably breeding, were also seen on the south bank of the Yukon River. In the Three Day Slough area, during an overcast day in late March 1984, six different owls were calling in a 78 km$^2$ area. Mikkola (1981) noted that in Finland, calling during the day had never been reported.

I found a great gray owl nest on 5 June 1983 when it held two 300-400 g chicks. It was in an old raven nest near an area where I had seen owls in spring 1982. In March the nest had owl feathers and pellets on top of the snow-covered structure. On 24 June the nest was empty and the young were gone.

In 1984 I located 15 old raven nests in the area between Bishop Rock and Galena. The 1983 nest had signs of visitation, since the snow was "tramped" down, but no owls were seen at the nest by 14 April. On 15 April, I flushed a female great gray owl from a 4 m high balsam poplar stump (fig. 1, no. 3). She immediately returned to the stump and behaved as though she was incubating eggs. A male was perched nearby. On 19 April I checked all the old raven nests and likely stumps everywhere I had previously seen owls perched. I found five more occupied great gray owl nests. Three were in old raven nests (fig. 1, nos. 1, 5, 6), one was in a balsam poplar stump (fig. 1, no. 3), and one was in a white spruce stump (fig. 1, no. 4). Five of the nests were in balsam poplar woodland and one nest was in a white spruce-birch (Betula spp.) woodland. Only three of the nests were in trees I was able to climb. By 28 April two nests had a clutch of four and one had a clutch of five eggs. Four pairs produced three young each and two nesting attempts failed. I think two of the 1984 nest sites (nos. 3, 4) were active during the 1983 nesting season based on old pellets found under the leaf litter in 1984.

In 1985 owls were rarely seen during the winter. I checked all the previous nests and no eggs had been laid by the end of March. I checked the six old nests on 27 May and found two with incubating females (nos. 1, 3). One nest had two eggs on 5 June. On 22 June this nest had one dead 77 g chick and one live 150 g chick. The dead chick had an empty stomach and no fat reserves, which indicated that it died of starvation. On 5 July both nests had one young each. The very late laying dates, compared with 1984, may have been caused by the deep snow conditions. A. Franklin (pers. commun.) noted a three-week delay in mean egg-laying dates in Idaho following deep winter snow conditions.

In 1986 the nest sites were checked once in early May and none of the nests were active.

### Roosts

In May 1982 I found a collection of owl pellets on the ground below a white spruce tree. There were numerous feathers of great gray owls scattered around and in the branches of the tree. Some of the pellets were on top of dried leaves, having been deposited during the previous winter; others were under the leaves and buried in the moss, indicating that they were deposited during or prior to leaf-drop in 1981. The roost was located on a levee area in a dense stand of white spruce, but only 20 m from an open slough. Although I never observed an owl at the roost, I suspect that the roost was used at night and during periods of cold weather, but verification was not possible since the roost could not be approached undetected and it was not safe to travel during weather colder than -40°C. The bird or birds mainly used the one tree, but some alternate roost trees were found. The main roost was in use each winter up to December 1984, at which time it was abandoned. I did not check on the roost during winter 1985-1986, but the roost was in use again during December 1986. In other areas, more groups of pellets below spruce trees were found, indicating other habitual roosts. Habitual winter roosts have not been previously recorded for the species (R. Nero pers. commun., Mikkola 1981).

### Diet

The information on diet of the great gray owl in Alaska is scant. They are said to eat "mice and other small mammals and birds" (Gabrielson and Lincoln 1957) and "mice and ground squirrels" (Armstrong 1980). In my study area, of 411 prey items, microtine rodents composed 94% (table 1). Other mammals and birds composed only 6% of the diet. Pellets (n=99) were collected from one nest in 1983, five nests in 1984, and two nests in 1985. At nest sites voles were the main prey items, but species composition was different at winter roosts (table 1). Yellow-cheeked voles (Microtus xanthognathus) was the most important prey item (76.8%) during the winter months, but dropped to half (48.1%) during summer. Results of a $X^2$ test of these differences in seasonal preference are significant at the 0.01 level. The average number of microtines per pellet (n=114) was greater during winter (2.13 individuals/pellet) than during summer (1.28 individuals/pellet). The smaller number of individuals during summer may have been due partially to pellets from nestling birds being included in the sample.

The slight increase in the number of birds (table 1) in summer is probably due to the greater number of birds present in the habitat compared with winter.

## DISCUSSION

The reference by Armstrong (1980) to great gray owls eating ground squirrels (Citellus parryii) is probably an error and his source cannot be found (R. Armstrong pers. commun.).

Table 1.--Great gray owl prey analysis from winter roosts and nests, Yukon River, Alaska, 1982-1985.

| Species | Winter roosts | | Nests | |
|---|---|---|---|---|
| | number | % | number | % |
| Mammals | | | | |
| Microtus xanthognathus | 196 | 76.8 | 75 | 48.1 |
| Microtus pennsylvanicus | 22 | 8.6 | 52 | 33.3 |
| Microtus oeconomous | 4 | 1.6 | 2 | 1.3 |
| Microtus spp. | -- | -- | 4 | 2.6 |
| Cleithrionomys rutilus | 23 | 9.0 | 8 | 5.2 |
| Syaptomys borealis | 4 | 1.6 | 3 | 1.9 |
| Sorex spp. | 1 | 0.4 | -- | -- |
| Mustela erminea | 1 | 0.4 | -- | -- |
| Lepus americanus | -- | -- | 1 | 0.6 |
| Birds | | | | |
| Grouse | 2 | 0.8 | 1 | 0.6 |
| Perisoreus canadensis | -- | -- | 1 | 0.6 |
| Passerine bird | -- | -- | 1 | 0.6 |
| Unidentified feathers | 2 | 0.8 | 8 | 5.2 |
| Totals | 255 | 100.0 | 156 | 99.9 |

The habitat of the ground squirrel (dry tundra) and the owl do not overlap. I never recorded the abundant and much more likely red squirrel (Tamiasciurus hudsonicus) in the owl's diet.

At nest sites, the meadow vole (Microtus pennsylvanicus) was only recorded in 1984 and 1985 which suggests that either meadow vole populations were low or the feeding area of the 1983 nest was not occupied by the vole. I suspect the vole population may have been low. At the roost, meadow voles composed only 4% of 124 microtines caught during 1982 and 1983, but 13% of 115 voles during 1984.

The results from the small mammal trapline indicated that the great gray owl was a selective predator. Shrews were abundant in the area in all habitats (table 2), composing 39% of the total animals caught, yet only one individual was found in the pellets (table 1). Mikkola (1981) compared the fall and winter diet of owls from Finland, Sweden, Canada, and USA and found the frequency of insectivores was 48.7, 21.5, 23.5, and 12.5%, respectively. However, in Finland the winter prey items may have been biased because they were from stomach contents of road-killed owls during years of low vole populations.

All great gray owl nests in California have been in broken off stumps (A. Franklin pers. commun.), in southern Oregon they used old goshawk (Accipiter gentilis) nests[3], in Idaho they utilized a 58:42 ratio of stumps and old raptor nests (A. Franklin pers. commun.), and in Canada all the nests were in old raptor nests or man-made raptor-like nests (Nero 1980). All previous owl nests in Alaska had been found in old raptor nests, almost all in old goshawk nests (D. G. Roseneau pers. commun.; Alaska Department of Fish and Game raptor records; Gabrielson and Lincoln 1957). There appeared to be a clinal behavior of the owls tending toward old raptor nests in the north and stumps in the south. The introduction of man-made nest platforms clouds the trend. Mikkola (1981) found a similar cline in Finland. He found the owl nesting more frequently in stumps in the south and almost all the nests in the north were in old goshawk nests. The reasons for the tendency to use raptor nests in the north may be related to the decrease in tree size and circumference in northern latitudes. Logging practices and frequent fires in Canada may reduce the number of suitable stumps.

I concentrated my efforts in searching for old hawk and raven nests. Goshawks were occasionally seen in the study area, but for nesting they prefer hillsides with aspen (Populus tremuloides) or paper birch (Betula papyrifera). Seven red-tailed hawk nests were located in the area

[3]Forsman, E. D. and T. Bryan. 1984. Distribution, abundance and habitat of Great Gray Owls in southcentral Oregon. Rep. to Dep. Fish and Wildlife, Bend, Oregon, 30 June 1984.

Table 2.--Numbers of small mammals caught in three habitats during August, 1984 and 1985, Yukon River Alaska. Results from 90 trap-nights/habitat/year.

| Species | Open black spruce | | Balsam poplar | | Grass meadow | |
|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 |
| Microtus xanthognathus | 0 | 0 | 0 | 2 | 11 | 0 |
| Microtus pennsylvanicus | 0 | 1 | 0 | 0 | 1 | 19 |
| Cleithrionomys rutilus | 7 | 21 | 35 | 33 | 3 | 0 |
| Syaptomys borealis | 0 | 0 | 0 | 0 | 1 | 0 |
| Sorex cinereus | 20 | 4 | 24 | 1 | 20 | 4 |
| Sorex hoyi | 0 | 2 | 0 | 1 | 0 | 1 |
| Sorex tundrensis | 0 | 0 | 1 | 2 | 0 | 0 |
| Sorex. spp. | 2 | 0 | 3 | 1 | 0 | 1 |
| Totals | 29 | 28 | 63 | 40 | 36 | 25 |

and none were used by the owls for nesting. Perhaps the reason red-tailed hawk nests were not used may be because they build their nests closer to the top of the canopy. Thus their nests may expose the owls to harassment of passing raptors, or the young may be more subject to heat stress from the sun. All the nests selected by great gray owls were within the canopy of the tree or stand. Both ravens and goshawks build their nests below the canopy, usually at a level which is 2/3 the height of the tree. Of the nine nesting attempts, the owls used old raven nests five times and stumps four times. The use of stumps for nest sites in Alaska has not previously been recorded.

I believe that the owl population was high from the beginning of my study, although the breeding data I collected may indicate that the owl population increased from 1981 to a peak in 1984. The apparent increase was due to my increased familiarity which enabled me to find more pairs. The owl population in Alaska has probably undergone fluctuations in the past. This would account for the discrepancies in its status as reported earlier (Dall and Bannister 1869, Brandt 1943, Gabrielson and Lincoln 1957). The exact location where Dall (Dall and Bannister 1869) collected his owls is unknown. He reported the site as Takatisky, 20 miles east of Nulato. The location of Takatisky is attributed to the Kaiyuh Hills (Orth 1971); however, Zagoskin (Michael 1967) used the name "Takayaska" for both the Kaiyuh Hills and a settlement at the confluence of the Yukon and Koyukuk Rivers. If the location was 20 miles due east of Nulato, as reported by Dall, then the Bishop Rock study area is only 5 km north of where Dall collected his data.

I observed a decline in the breeding population of the owls over the period 1984-1986. The relative abundance of the owls observed

Table 3.--Aerial sightings of great gray owls during moose surveys, Middle Yukon River area, Alaska.

| Year | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|
| Owls observed | 9 | 3 | 4 | 1 | 0 |
| km² surveyed | 799 | 543 | 606 | 484 | 216 |
| Relative density birds/km² | 1/89 | 1/181 | 1/151 | 1/484 | 0/216 |

during winter moose surveys also declined from 1984 to 1986 (table 3). I attributed the decline to the abnormally deep snow during winter 1984-1985 and a consequent reduction in food supplies (voles) following the 1985 flood of the meadows. After the flood, the vole species composition of the grass meadow changed from yellow-cheeked vole (Microtus xanthognathus) to meadow vole (M. pennsylvanicus) and the total numbers were reduced (table 2). Yellow-cheeked voles are dominant over other Microtus species in Alaska, and their presence in an area would tend to lower populations of the other voles (Wolff and Lidicker 1980). Presumably after the flood, meadow voles were able to recolonize the meadow faster than yellow-cheeked voles. Yellow-cheeked voles are very active diurnal voles and are the largest vole in Alaska, with males averaging 120 g (Wolff and Lidicker 1980). Deep snow during winter could have impaired owl hunting efficiency which caused them to emigrate from the area, winter roosts were abandoned, and owl hunting plunge-marks in the snow were only infrequently observed.

The presence of great gray owl hunting plunge-marks (see Nero 1980 for photographs) could be used as an indicator of owl habitat use, prey densities, and owl densities. As a method, its advantage is that owls do not have to be directly observed to detect their activities. I realized the value of using plunge-marks to indicate owl habitat use and density during December 1984. The snow was falling frequently and deep enough to make plunge counts a useful method; however, when I visited the area in January 1985 no owls were using the area and thus the method remains untested here.

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