

GREAT GRAY OWL (Strix nebulosa)
SURVEYS ON THE PAYETTE NATIONAL FOREST

by

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ABSTRACT

From March - June, 1989, portions of the Payette National Forest (NF) were surveyed for Great Gray Owls. Surveys were conducted by playing tape recorded songs of Great Gray Owls or by vocally imitating these same songs and listening for an elicited response. Six species of owls were noted during the surveys: Great Horned Owl, Long-eared Owl, Northern Saw-whet Owl, Northern Pygmy-owl, Barred Owl, and Great Gray Owl. Other raptor species observed included Osprey, Northern Goshawk, Cooper's Hawk, Red-tailed Hawk, and American Kestrel. One unconfirmed Great Gray Owl was located during call surveys on the Payette NF. However, Great Gray Owls were observed on private lands adjacent to national forest as well as by other individuals on the Payette NF. Two areas occupied by Great Gray Owls were documented on private land in rural McCall, one of which contained a nest successfully fledging 3 young.

INTRODUCTION

Great Gray Owls (Strix nebulosa) are large forest owls which are relatively uncommon throughout their circumboreal range. Until recently, this species was considered rare in North America and merely a rare breeder in the United States (Nero, 1980; Franklin, 1987, 1988; Forsman and Bryan, 1987; Johnsgard, 1988; Bull et al., 1988a). Recent studies have documented small breeding populations in the Sierra Nevada of California, southeastern Idaho and northwestern Wyoming as well as in eastern Oregon (Winter, 1986; Franklin, 1987; Bull et al., 1988b). However, the extent of breeding populations in western North America is poorly understood.

Due to the questionable status and distribution of Great Gray Owls in Idaho and the fact that these owls may be partially dependent upon uncut stands of coniferous forest for breeding, the Idaho Department of Fish and Game (IDFG) has designated this species a Species of Special Concern.

Historical records indicate that Great Gray Owls have been observed in rural areas of McCall and Donnelly (Long Valley), Valley County, intermittently for many years (Natural Heritage Program database). Reported sightings of juvenile owls in areas

adjacent to the Payette NF imply that a breeding population of Great Gray Owls exists in the area. Therefore, in March, 1989, I initiated a survey to document the distribution of Great Gray Owls on the Payette NF. The purpose of this report is to summarize the results of this survey conducted by the Natural Heritage Program between March and June of 1989.

BACKGROUND INFORMATION

Great Gray Owls are the largest owl in North America, even though they weigh less than both Great Horned Owls (Bubo virginianus) and Snowy Owls (Nyctea scandiaca) (Johnsgard, 1988). This paradox is due to the very high amount and length of feathers in relation to body mass. This thick covering of soft feathers allows Great Gray Owls to fly almost silently and hover with little effort. Like most raptors, reverse sexual dimorphism is apparent in these large forest owls with females weighing approximately 30 percent more than males. For an overview of general Great Gray Owl natural history see Johnsgard (1988) (Appendix A).

Great Gray Owls forage heavily upon small rodents during the breeding season while occasionally taking larger species such as ground squirrels (Spermophilus spp.) and hares (Lepus spp.) (Johnsgard, 1988; Bull et al, 1988c). Voles (Microtus spp.) and northern pocket gophers (Thomomys talpoides) made up 52 and 29%,

respectively, of prey remains determined through pellet analysis in an Oregon study (Bull et al., 1988c). Franklin (1987) reported that the importance of Thomomys spp. in the diet of nesting owls was directly proportional to the amount of clearcut surrounding the nests. Great Gray Owls were observed foraging in clearcuts on national forest lands and in natural meadows on private holdings in southeastern Idaho. Clearcuts in that area may have higher abundances of pocket gophers while natural meadows may provide better vole habitat.

Bull et al. (1988b) reported that male Great Gray Owls concentrated 62% of their foraging in partially logged stands where prey density was high, perches were readily available, and few obstructions to the owls' free movement existed. Unlogged stands accounted for 35% of the foraging sites noted while only 3% of foraging sites occurred in clearcuts.

Based on radio-telemetry data, Great Gray Owl home range and dispersal in Oregon were shown to be highly variable between individual owls and between years for the same individual (Bull et al., 1988a). Average home range of adults was 67.3 km² while first-year juvenile home ranges averaged 167 km² decreasing to 13 km² during their second year of life. The inflated first year home range reflected juvenile dispersal from their natal areas. Nero (1980) reported greater movements of Great Gray Owls in winter than observed by Bull et al. (1988a) which may be accounted for by large winter movements in response to snow

depth. Deep snow, especially that which is encrusted, may severely hamper the foraging ability of Great Gray Owls (Susan Skiff, pers. comm.). These birds may in turn move out of areas with deep snow to lower elevations (Franklin, 1987).

Male Great Gray Owls begin territorial calling in February or March in western North America. Nesting by females follows while the ground is still snow covered (Bull et al., 1988b). Franklin (1987) observed that initiation of egg-laying in eastern Idaho was correlated with snow depth and elevation. Thus, in winters of high snowfall, clutch initiation may be delayed by several weeks. However, initiation of egg-laying was not correlated with snow depth in eastern Oregon (Evelyn Bull, pers. comm.).

During territory establishment, male Great Gray Owls are very vocal and remain so until the female begins incubation. At this time, vocalization rate drops somewhat, only to increase once the young have left the nest in early summer (Evelyn Bull, pers comm.).

Young Great Gray Owls leave the nest at approximately 28 days of age following an incubation period of 29.7 days (Franklin, 1987). Owls are asynchronous hatchers in which hatching occurs over several days, thus each fledgling averages 2 days older or younger than its closest sibling. At the time young leave the nest they are incapable of flight and climb to low perches using their bills and talons. This period

is characterized by high mortality caused by Great Horned Owls and Northern Goshawks (Accipiter gentilis) (Evelyn Bull, pers. comm.). Therefore, accessible perches such as leaning trees and stumps must be available to the young owls.

The nesting habitat of Great Gray Owls in North America has been described by several authors and appears to be somewhat variable (Nero, 1980; Franklin, 1987; Bull et al., 1988b). Franklin (1987) noted that Great Gray Owls nested in most of the forest habitat types occurring in southeastern Idaho and northwestern Wyoming within the lodgepole pine (Pinus contorta)-Douglas-fir (Pseudotsuga menziesii)-aspen (Populus tremuloides) zone and in fact, may have been using the most available habitat in which to nest. Most nests in this area were found on flat terrain at relatively low elevations averaging 143.2 m to the nearest clearcut. Bull et al. (1989b) also found Great Gray Owls nesting in all available forest types in eastern Oregon study sites. However, the majority of nests were found on north-facing slopes in over-mature stands of Douglas-fir and grand fir (Abies grandis) where abandoned stick nests of Northern Goshawks may have been more abundant. In fact, 72% of nests were found in unlogged stands where suitable snags or deserted raptor nests were available to Great Gray Owls.

Like many other large owls, Great Gray Owls rely upon broken-topped snags and vacated stick nests for nest sites. These resources may be limited in some areas due to timber

harvest methods which remove many large diameter dead and live trees. However, Great Gray Owls readily use artificial nest platforms (Bull et al., 1987; pers. observation) and the erection of artificial nest structures may enhance the use of certain areas by Great Gray Owls if adequate foraging habitat and areas suitable for use by fledglings.

METHODS

From March to June, 1989, I surveyed national forest lands for Great Gray Owls by playing tape-recorded vocalizations of singing male and female Great Gray Owls or by imitating these songs and listening for an elicited response. Great Gray Owl songs consist of a series of 6-12 low hooting notes at approximately 1 second intervals. Male vocalizations are somewhat lower than those of females, the latter sounding more harsh. Each series of "hoots" is separated by approximately 30 seconds (Appendix B). I initiated surveys at dusk and continued them no later than 2400 hours by foot, cross-country skis, snowmobile, or 4-WD truck. I played tapes on a portable cassette tape recorder wired to a Portapage Megaphone at locations varying from 100 meters to 0.8 km (0.5 mi) apart depending upon topography and habitat. At each location, I played or imitated

vocalizations for periods of 10 seconds to 2 minutes in length and listened for a response for approximately 5 minutes. I then repeated this procedure at least once before moving to the next location.

Previous researchers have reported Great Gray Owls calling and/or nesting in forest-types including Douglas fir-grand fir, lodgepole pine-western larch (Larix occidentalis), ponderosa pine (Pinus ponderosa)-Douglas fir, ponderosa pine, as well as those habitats dominated by poplar (Populus spp.), tamarack (Larix laricina), and black spruce (Picea mariana) (Bull et al., 1989b; see Franklin, 1987). Great Gray Owl nesting attempts have often been associated with mesic habitats including bogs and wet meadows. Thus, I concentrated surveys in areas of coniferous forests interspersed with open and often wet meadows which I located on timber inventory maps of the Payette NF and topographic maps (Table 1).

I also concentrated efforts in areas containing historical Great Gray Owl sightings gleaned from the Idaho Natural Heritage Program database. I searched many of these areas in early morning or evening for nests or actively hunting owls (Table 2). Locations of survey routes are shown in Appendix C.

I distributed posters throughout the study area at post offices, gas stations, cafes, and grocery stores. These posters contained information on field identification of Great Gray Owls and urged those with sightings of this species to contact the

Table 1. Areas on the Payette National Forest surveyed for Great Gray Owls (includes both nocturnal and diurnal searches).

<u>Location</u>	<u>Dates Surveyed</u>
Farm to Market Rd.	3/24, 4/7
Forest Rd. 388	3/24, 5/15, 5/18, 5/25
Paddy Flat	5/15, 5/18, 5/25
Goose Ck.	4/16, 6/1
No Business L.O.	4/15, 4/21
E. Fk. Weiser R.	4/8
Middle Fk. Weiser R.	4/23, 5/6, 5/7
Rural McCall	4/16, 4/28, 4/29
Hornet Ck.	4/29, 6/5, 6/11
Mud Ck. to Round Valley (north)	5/16
Brundage Mtn.	4/16, 5/18, 6/13
Bear Basin	6/14, 6/18
Upper Payette Lk.	5/17
Rock Flat/Moorehead Flat	5/16, 5/17, 6/18
Horse Mtn.	6/7
Crooked R.	6/6
Cuprum	6/12

Idaho Department of Fish and Game or the Payette National Forest (Appendix D). Areas where sightings were reported were subsequently visited and searched for owls (Table 2).

RESULTS & DISCUSSION

From March to June, 1989, I surveyed 17 major areas for Great Gray Owls on the Payette NF and adjacent private lands. I surveyed each area at least once nocturnally and areas containing what I felt was suitable Great Gray Owl habitat were searched several times at night and/or during the day (Table 1). Included were locations of Great Gray Owl sightings as reported by the public and those listed in the Idaho Natural Heritage Program database (Table 2). I heard six species of owls during the surveys (Table 3): Great Gray Owl, Barred Owl (Strix varia), Great Horned Owl, Long-eared Owl (Asio otus), Northern Saw-whet Owl (Aegolius acadicus), and Northern Pygmy Owl (Glaucidium gnoma).

Two areas occupied by Great Gray Owl were located on private land in rural McCall. The first area occupied by a Great Gray Owl was located on private land southwest of Little Payette Lake (18S3ES11) on 16 April. Upon imitating the vocalization of a territorial male Great Gray Owl I heard a response. Duetting occurred between the owl and me as I approached its location only to have it curtailed when I played a Great Gray Owl song on

Table 2. Great Gray Owl sightings on the Payette National Forest and surrounding areas. (Source; Idaho Natural Heritage Program database and poster-response).

<u>Date</u>	<u>County</u>	<u>Location</u>	<u>TRS</u>
1964	Adams	Indian Valley	
1965	Adams	Indian Valley	
10/2/75	Valley	Soldier Bar Above Big Ck.	
1977	Adams	Cabin Ck./M. Fk. Weiser R.	(15N2ES6)
1979-89	Valley	2.5 m north of Donnelly	(17N3ES34)
6/6/81	Valley	Moorehead Flat	(19N2ES35)
11/6/82	Valley	Little Payette Lk.	(18N2ES2)
6/30/83	Valley	Rock Flat	(19N2ES35)
1983-88	Adams	Goose Ck.	(19N2ES22)
1983-88	Adams	Goose Ck.	(19N2ES11)
2/84	Idaho	Cold Meadows	(22N12ES35)
3/85	Idaho	Cold Meadows	(22N12ES35)
4/85	Idaho	Cold Meadows	(22N12ES35)
9/86	Valley	Gold Fk./Cascade Res.	(16N3ES24)
9/1/86	Adams	Brundage Mtn.	(19N2ES24)
1/3/87	Valley	SE of Warner Pd.	(13N4ES11)
5/87-7/87	Adams	Kimberland Meadows	(20N1ES26)
9/22/87	Valley	Boulder Ck. Rd.	(18N4ES20)
4/88	Valley	Alta Vista Est.	(18N3ES36)
4/88	Valley	Bear Basin	(19N2ES25)
5/15/88	Valley	Farm to Market Rd.	(18N3ES23)
5/16/88	Valley	Farm to Market Rd.	(18N3ES11)
3/11/89	Valley	Stocton Dr., McCall	(18N3ES11)
3/89-6/89	Valley	Jughandle Est.	(17N3ES7)
3/89-6/89	Valley	Wagon Wheel Est.	(16N3ES27)
6/89	Valley	Slab Lk.	(20N3ES7)
3/89	Idaho	Burgdorf	(22N4ES1)

Table 3. Dates and locations of raptors sighted or heard calling during the 1989 Great Gray Owl surveys on the Payette National Forest.

<u>Date</u>	<u>Species</u> [# seen(S) or heard(H)]	<u>Location</u> (TRS)	<u>Forest-type</u>
3/24	Northern Pygmy Owl [1H]	Forest Rd. 388	(17N3ES36) PP
3/24	Great Horned Owl [2H]	Forest Rd. 388	(17N3ES25) PP
4/15	Great Horned Owl [2H]	Forest Rd. 186	(16N2ES12) DF/GF
4/15	Great Horned Owl [1H]		(16N3ES30) DF/GF
4/15	Barred Owl [1H]		(16N2ES25) DF/GF
4/16	Great Gray Owl [1H]		(18N3ES11) DF/PP
4/21	Red-tailed Hawk [1S]	Forest Rd. 218	(16N2ES15) SF/ES
4/22	Great Gray Owl [2S=NEST]		(18N3ES23) PP
4/22	Long-eared Owl [1S=NEST]		(17N3ES27) LP/DF
4/29	Cooper's Hawk [1S]	Forest Rd. 541	(8S2WS8) PP
4/29	Great Horned Owl [1H]	Forest Rd. 541	(8S2WS4) PP
4/29	Great Horned Owl [2H]	Forest Rd. 121	(8S2WS20) DF/PP
4/29	Great Horned Owl [2H]	Forest Rd. 121	(8S2WS19) DF/PP
4/29	Great Horned Owl [1S]	Hornet Ck. G.S.	(8S2WS31) DF/PP
5/6	Great Gray Owl (?) [1H]	Cabin Ck. C.G.	(15N2ES6) DF/PP
5/15	Cooper's Hawk [1S]	Paddy Flat G.S.	(17N4ES26) LP
5/15	Osprey [1S=NEST]	Paddy Flat G.S.	(17N4ES34) DF/GF
5/16	Red-tailed Hawk [1S]	Mud Ck. Rd. 098	(20N1ES18) DF/PP
5/16	Accipiter Butcher-block	Mud Ck. Rd. 098	(20N1ES13) DF/GF
5/25	Long-eared Owl [1S]	Paddy Flat Summit	(17N4ES28) DF/GF
5/25	Northern Saw-whet Owl [1H]	Paddy Flat Summit	(17N4ES28) DF/GF
5/25	Northern Goshawk [1S]	Paddy Flat Summit	(17N4ES28) DF/GF
6/6	Northern Pygmy Owl [2H=NEST]	Crooked R.	(8S3WS15) DF/PP
6/6	Northern Pygmy Owl [1H]	Crooked R.	(8S3WS10) DF/PP
6/6	Northern Pygmy Owl [1H]	Forest Rd. 061	(8S3WS23) DF/PP

PP= Ponderosa Pine (Pinus ponderosa)
 DF= Douglas-fir (Pseudotsuga menziesii)
 GF= Grand Fir (Abies grandis)
 ES= Engelmann Spruce (Picea engelmanni)
 LP= Lodgepole Pine (Pinus contorta)
 SF= Subalpine Fir (Abies lasiocarpa)

a cassette recorder. No further responses were elicited and the area was searched during subsequent days for nests but none were found. The habitat consisted of ponderosa pine/Douglas-fir/quaking aspen/sedge (Carex spp.) and wet boggy areas, but few snags or large-diameter trees. I surveyed the above area in response to sightings turned in by persons seeing Great Gray Owl posters.

The second area occupied (18N3ES23) consisted of a Great Gray Owl pair occupying an artificial nest platform erected by the Raptor Research Center at Boise State University. The platform was placed approximately 12 m above the ground in a large ponderosa pine during the fall of 1988. This territory consisted of an open ponderosa pine/Douglas-fir stand, a large stockpond, and substantial wet meadow areas. An incubating female was flushed from 3 eggs on 22 April while a male perched nearby. On 25 May the platform was revisited and 3 young nestlings were present; approximate ages of 4, 6, and 8 days respectively (Marc Bechard, pers. comm.). The young were banded on 16 June at which time only the youngest owl remained in the nest (Richard Gerhardt, pers. comm.). Backdating from these data yields a clutch initiation date of 18 April, 1989. This date is slightly later than copulation noted in 1987 and 1988 (21 March and 9 April respectively) in the Donnelly and Jughandle areas (Leon Powers, pers. comm.). The delayed nesting in 1989 may have been related to the greater snow depth of this year (see Franklin, 1987).

A third possible Great Gray Owl sighting occurred near the Cabin Creek campground in the Middle Fork of the Weiser River. However, this bird was not positively identified and a search of the area the following day elicited no sign of Great Gray Owl nests or roosts.

From 1987 to 1989 Great Gray Owl nesting activity was observed in Jughandle Estates southeast of McCall and in the Wagon Wheel Estates area bordering Cascade Reservoir south of Donnelly. During this period, 5 pairs were observed exhibiting reproductive behavior. Calling was initially noted between the third week of March to the second week of April and incubation was confirmed between the second week of April and the third week of May (Leon Powers and Mike Muntz, pers. comm.).

Nocturnal call surveys for Great Gray Owls should begin in February and continue through April when male vocalization rate subsides. However, males increase vocal activity in June and July and may respond to calls at that time. Summer may in fact be a very productive time to perform Great Gray Owl surveys because males forage heavily during afternoon and the young are very vocal (Evelyn Bull, pers. comm.). Franklin (1987) reported that 42% of Great Gray Owl sightings were recorded in summer (Figure 1). Birds observed in late summer and fall on national forest lands may be juveniles dispersing into areas of high prey availability.

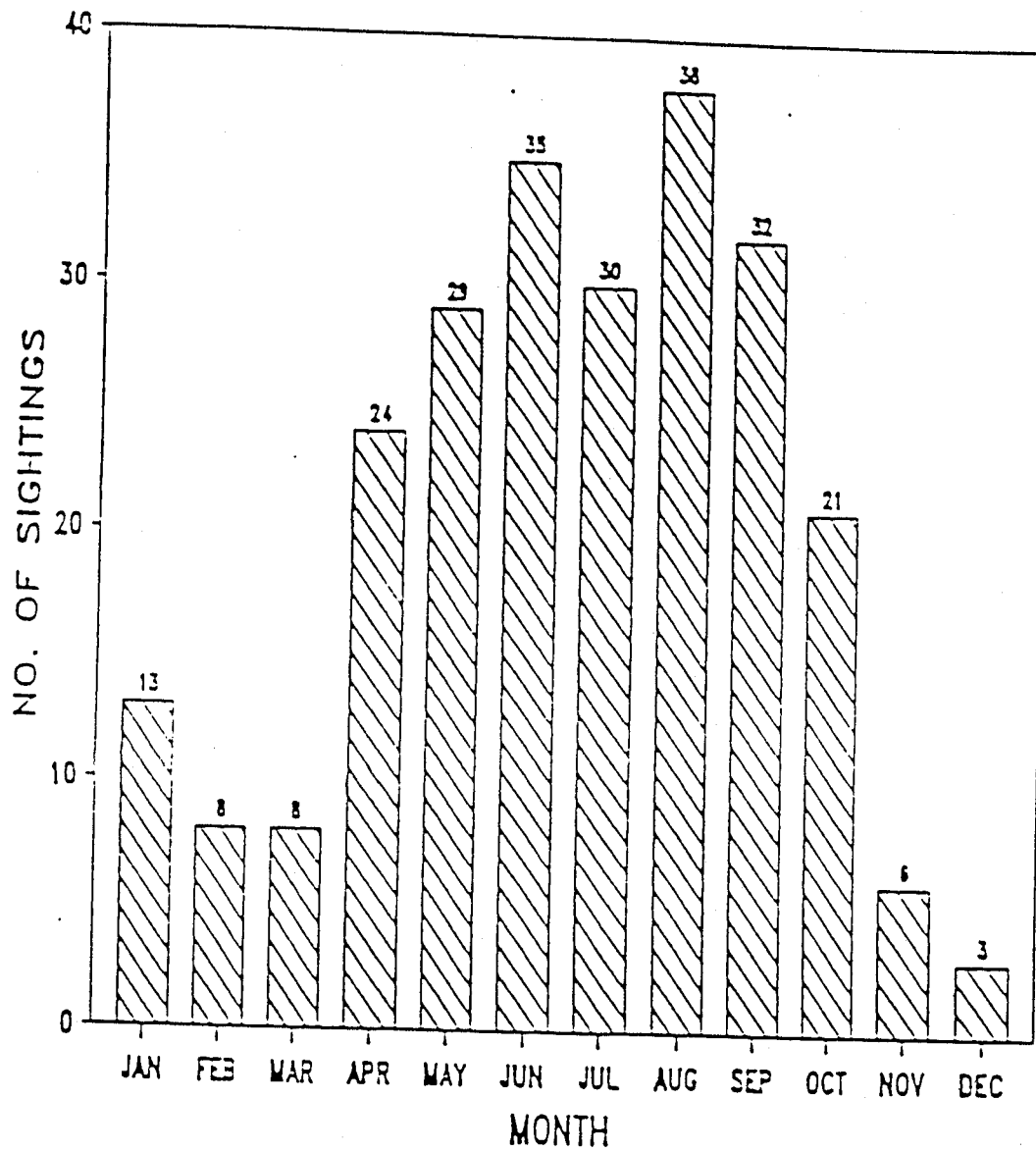


Figure 1. Distribution of 247 sightings of Great Gray Owls by month in southeastern Idaho and northwestern Wyoming between 1900 and 1984 (Franklin, 1987).

Taped vocalizations of Great Gray Owls elicit high response levels in southeastern Idaho (Craig Groves and Rick Wallen, pers. comm.). However, poor quality recordings may cause a drop in responsiveness (personal observation). Thus, it may be beneficial for the surveyor to perform vocalizations by mouth through imitation of recorded calls (Evelyn Bull, pers. comm.).

Lack of Great Gray Owl response should not be regarded as evidence that owls do not occupy these areas. For instance, owls at the time of survey may have already begun incubation and their responsiveness may be reduced. Suitable habitat should be searched for owls (day and night) several times throughout the year. Suitable habitat on the Payette NF may include coniferous stands (Douglas-fir/grand fir) of high snag-density bordering meadows or small clearcuts. These areas often are characterized by an understory of sedges and include habitat type numbers: 9 (Pseudotsuga menziesii/Carex geyeri, 10 (P. menziesii/C. rupestris, 15 (Abies grandis/C. rupestris, 23 (A. lasiocarpa/Calamagrostis canadensis, and 35 (A. lasiocarpa/C. rupestris (Steele, et al., 1981; Payette National Forest Habitat/Productivity Map).

MANAGEMENT CONSIDERATIONS

Great Gray Owls may be a species that can only persist through direct species-management on lands managed for timber harvest. The important points to consider for management or enhancement of Great Gray Owl populations are as follows (Evelyn Bull, pers. comm.):

- 1) Protection of nest sites.
- 2) Erection of artificial nesting platforms.
- 3) Retention or creation of hunting perches.
- 4) Retention or creation of juvenile perches.
- 5) Reduction of activity during nesting.
- 6) Enhancement of prey availability.

Areas that I consider to be potential nesting habitat for Great Gray Owl breeding include but are not limited to: Middle Fork of the Weiser River (Cabin Creek area), Paddy Flat and surrounding area, Goose Creek from Krigbaum Campground to Brundage Reservoir, Thorn Creek (Brundage Mountain), Bear Basin, Moorehead Flat, Eck Flat, and Rock Flat (Table 4). Each of these areas includes substantial open (clearcut or meadow) areas with high pocket gopher and/or ground squirrel densities suitable for Great Gray Owl foraging. The Burgdorf/Warren area may also contain suitable Great Gray Owl habitat but I did not survey this area.

Nesting sites appear limited in every area listed in Table 4 save the upper reaches of the Middle Fork of the Weiser River.

Table 4. Areas on the Payette National Forest containing potential foraging habitat for Great Gray Owls and assessment of nest-site and perch availability (as noted in the course of conducting owl surveys).

<u>Area</u>	<u>Opening-type</u>	<u>Nest-site Availability</u>	<u>Perch Availability</u>
M. Fk. Weiser R.	clearcut/meadow	Medium-High	Low-Medium
Paddy Flat	clearcut/meadow	Low	Medium-High
Goose Ck.	meadow	Medium	Medium
Thorn Ck.	clearcut/meadow	Low	Medium
Bear Basin	clearcut/meadow	Medium	Medium
Moorehead Flat	meadow	Low-Medium	Medium
Eck Flat	meadow	Low-Medium	Low
Rock Flat	clearcut/meadow	Low	Medium

Therefore, I recommend that artificial platforms for nesting be erected in these areas (Appendix E). These platforms should be placed at least 15 m high and be situated within conifer stands approximately 200 m from a clearcut or meadow. It may also be important that Great Gray Owls be given a choice between nest sites. Thus, platforms should be erected in pairs approximately 70 m apart (Evelyn Bull, pers. comm.).

Perches from which adult Great Gray Owls can forage are an important component of suitable habitat. Perches such as 2-5 m poles or trees should remain in cut-over areas or artificial perches (ie. planted fence-posts) should be erected in clearcuts or meadows. The area of habitat scanned by a raptor is proportional to the height of the perch used, therefore, one may want to erect perches of various heights throughout a cutting unit to increase foraging efficiency (Andersson, 1981). These perches may also be used by other raptor species and may provide a management technique applicable to the raptor guild in general (see Jaksic, 1988).

Suitable roost sites for juvenile owls should also be retained as a method of habitat enhancement. Perches used by juvenile Great Gray Owls include low stumps and downed trees, small trees and leaning trees ("leaners"), and trees with low branches accessed by leaners. Just-fledged owls use low stumps for roosting and subsequently move to higher perches as they age (Figure 2). The availability of leaners is very important to

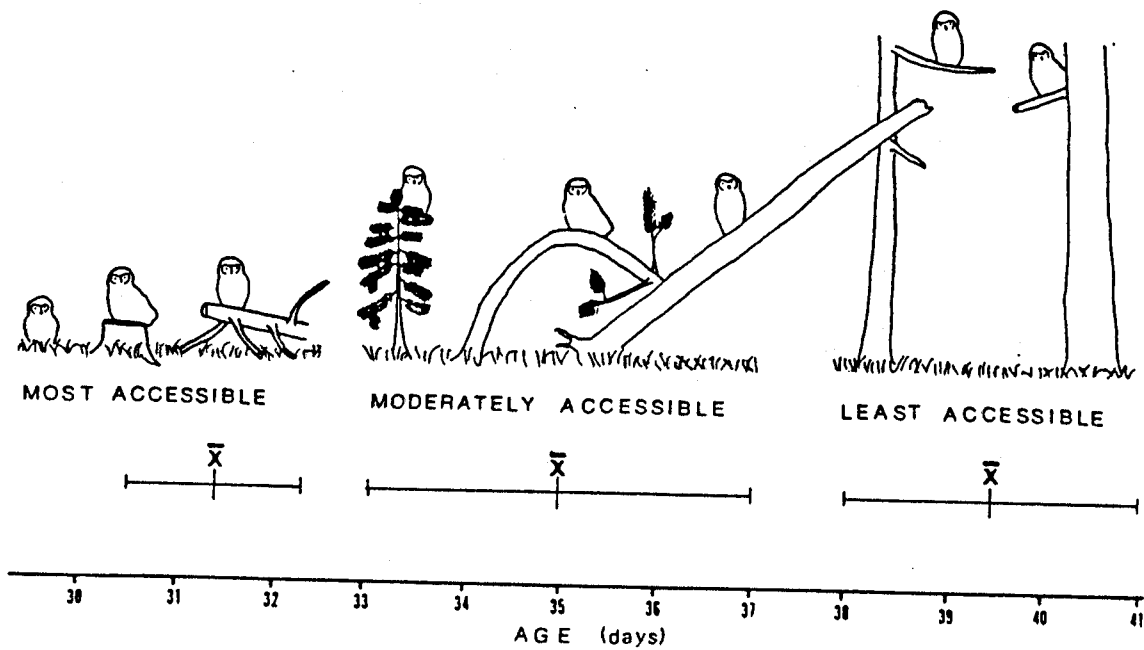


Figure 2. Mean age of fledgling Great Gray Owls using three categories of roosts in southeastern Idaho and northwestern Wyoming between 1981 and 1982. values represent $\pm 95\%$ confidence intervals of the mean (Franklin, 1987).

juvenile survival during the pre-flight period of their development (Franklin, 1987; Evelyn Bull, pers. comm.).

Predation is often viewed as an important force in structuring communities (Sih et al., 1985). The importance of primary predators upon prey levels can ultimately be assessed only through controlled field experiments and at this time it can only be speculated that Great Gray Owls have the capability to depress prey numbers. However, managing for forest raptors may become an important avenue for public relations and, in practice, may provide a method for indirectly modifying rodent numbers. The latter outcome may become an important facet in forest regeneration at a time when less emphasis is placed upon chemical methods of pest control. Thus, it may be advantageous to concentrate Great Gray Owl habitat enhancement activities in areas suffering from pocket gopher infestations.

National Forest wildlife and timber crews should be educated in the identification of Great Gray Owls. Sightings of this species, especially nests and/or fledglings, should be recorded and these areas be assessed for suitability to habitat enhancement. Great Gray Owls can be managed in coordination with timber harvest schemes and snag management plans through retention or erection of foraging and juvenile perches and by erecting nest platforms or snag-topping.

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APPENDIX A

Great Gray Owl Natural History (Johnsgard, 1988)

Great Gray Owl *Strix nebulosa* Forster 1772

Other Vernacular Names:
cinereous owl, Lapland Owl, sooty owl, speckled owl, spectral owl.

North American Range (Adapted from AOU, 1983.)

Breeds in North America from central Alaska, northern Yukon, northwestern and central Mackenzie, northern Manitoba, and northern Ontario south locally in the interior along the Cascades and Sierra Nevadas to central California; in the Rockies from northern Idaho and Montana to western Wyoming; and to central Alberta, central Saskatchewan, southern Manitoba, northern Minnesota, and south-central Ontario (rarely to northern Wisconsin and northern Michigan). Winters generally through the breeding range, but wanders south irregularly to southern Montana, North Dakota, southern Minnesota, southern Wisconsin, central Michigan, southern Ontario, and central New York, casually as far as southern Idaho, Nebraska, Iowa, Indiana, Ohio, and from southern and eastern Quebec, New Brunswick, and Nova Scotia south to Pennsylvania and New Jersey. Also distributed widely in northern Eurasia. (See Figure 40.)

North American Subspecies (Adapted from AOU, 1957.)

S. n. nebulosa Forster. Range in North America as described above.

Measurements

Wing (of *nebulosa*), males 410–447 mm (ave. of 5, 433), females 430–465 mm (ave. of 7, 446); tail, males 300–329 mm (ave. of 5, 313.6), females 310–347 mm (ave. of 7, 323.3) (Ridgway, 1914). The eggs of *nebulosa* average 54.2 × 43.4 mm (Bent, 1938).

Weights

Earhart and Johnson (1970) reported that 7 males averaged 935 g (range 790–1030), and that 6 females averaged 1296 g (range 1144–1454). Craighaed and Craighaed (1956) noted that 7 females averaged 1084 g. Mikkola (1983) stated that 24 males and 31 females of the Eurasian population averaged 871 and 1242 g respectively. The estimated egg weight is 53 g.

Description (of *nebulosa*)

Adults. Sexes alike, but females often appearing darker than males. General color of upperparts dusky grayish brown or sooty, broken by transverse mottlings of grayish white, the uniformly sooty median portions of the feathers producing an effect of irregular dusky stripes, most conspicuous on back and scapulars; outer webs of wing coverts variegated by whitish mottlings; alulae and primary coverts with very indistinct bands of paler brown; secondaries crossed by about nine bands of pale grayish brown, fading into paler on edges of outer webs; primaries crossed by nine transverse series of pale brownish gray spots; proximal secondaries and middle rectrices with coarse mottling or marbling of dusky brown or sooty and grayish white, the markings tending to form irregular, broken bars; rest of tail dusky crossed by about nine paler bands; ground color of underparts grayish white, each feather of neck, chest, breast, and abdomen with a broad median blackish stripe; sides, flanks, vent region, and under tail coverts narrowly banded or barred with sooty brown and grayish white, the legs with narrower, more irregular bars; superciliary "eyebrows," lores, and chin grayish white, with a dusky area immediately in front of eye; face disk grayish white with distinct concentric semicircular bars of dusky brown; facial disk circled by dark brown and becoming white on foreneck, where interrupted by a spot of brownish black on throat. Bill light dull yellow to bright yellow or pale olive green; iris lemon yellow; claws blackish.

Young. Newly hatched birds have grayish down dorsally and white down below, with yellowish legs and yellowish gray iris color. Juveniles are olive-brown, darkly barred and spotted with white above, barred below, with broad black facial markings. The wings and tail (if present) are as in the adult plumage, which is attained in less than five months (Mikkola, 1983), but first-year birds have gray-tipped flight feathers. These remiges are also shorter and narrower than in adults. Some first-year remiges may be retained for several years (Robert Nero, personal communication).

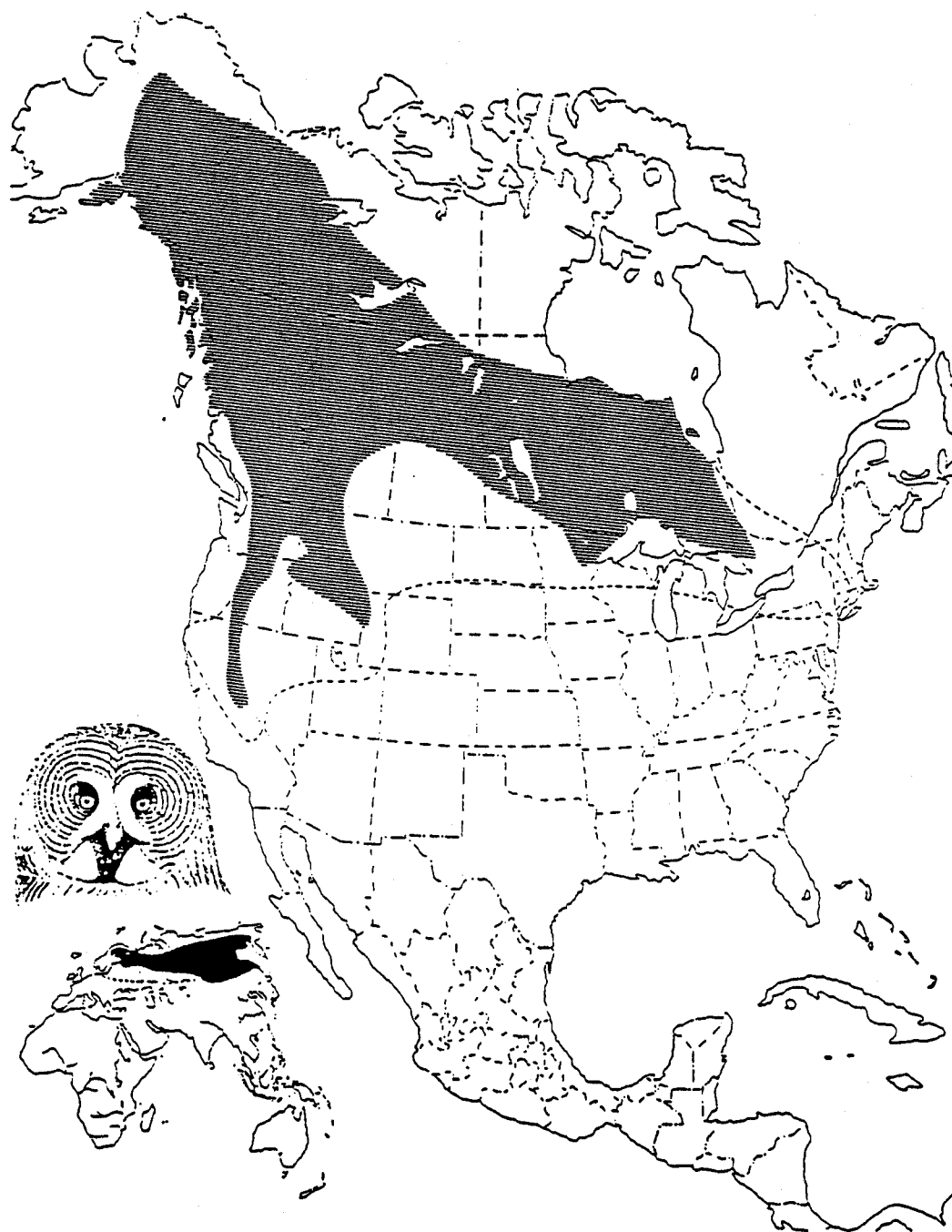


Figure 40. North American breeding distribution of the Great Gray Owl. The dashed line indicates usual limits of wintering vagrants. Extralimital distribution shown in inset.

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Identification

In the field. This enormous owl is almost instantly recognizable by its very large and "earless" head, and by a generally dark body plumage except for a white "moustache" that is variably broken in the middle by a black "bow tie." The usual call is a deliberate series of soft and low-pitched single- or double-syllable hoots that gradually drop in frequency and decelerate toward the end of the series.

In the hand. The large size (wing over 410 mm) and large but "earless" head, with yellow eyes that are surrounded by a series of dark concentric rings in a distinct and circular facial disk, instantly identify this species. The wing is broad, with the sixth primary the longest, and the inner webs of the outer five primaries emarginated. The tarsus and heavily feathered toes are both relatively short, but the claws are long and slender.

Vocalizations

The vocalizations of this species have only been carefully studied in Europe (Berggren and Wahlstedt, 1977), but there is no reason to believe that these findings are not applicable to the North American race, which to some degree has been described by Oeming (1955). In Scandinavia, the males begin their territorial calling in January or February, often during the first period of mild weather, with a peak in calling activity during the nesting period. Territorial calling there may also be heard late in the breeding season, during June or July, and again sometimes in autumn (Mikkola, 1983).

In the Sierra Nevadas of California the birds are vocal throughout the year, responding to tape-recorded calls at virtually any time, but primarily uttering territorial calls between March and mid-May. Typically there the calling begins late in the evening after sundown, with a pre-midnight peak, followed by a sharp decline around midnight but a second peak shortly thereafter, and then gradually declining. Each call phrase lasts 6–8 seconds, the individual soft hooting notes uttered at the rate of about 3 per 2 seconds, and with an average interval of 33 seconds between calls (Winter, 1981). Under ideal conditions the call can be heard for up to 800 meters, but it often carries only about 500 meters (Mikkola, 1983).

Although the female sometimes also utters the territorial call prior to the egg-laying period in spring, her most common note is a single soft and mellow hoot, described by Nero (1980) as a *whoop* and by Oeming (1955) as a soft and

dovelike *ooh-ah*. A similar hoot that can be heard for up to about 300 meters is used by the male at the nest. A double, excited *ooh-uh* is uttered by the female when the male is arriving with food. As a defensive or warning cry both sexes produce an extended series of double notes, uttered in groups of up to 100 in sequence and at the rate of up to 3 notes per second. The female's typical alarm call is a deep growling, together with bill snapping. During intense alarm, as when performing nest-distruction or injury-feigning displays, she may produce a series of wails, squeaks, and hoots, climaxed by a loud heronlike squawk or bark. Prior to and during copulation the female produces a call reminiscent of the begging calls of chicks and juveniles, the latter rapid, chattering *sher-richt* notes. The chicks also produce bill-snapping sounds when being handled or otherwise disturbed (Nero, 1980; Mikkola, 1983).

Habitats and Ecology

In North America the broad range of the great gray owl encompasses a variety of vegetational types, ranging from subalpine coniferous forests through dense boreal and montane coniferous forests to stunted forests transitional to arctic tundra. Nesting is commonly done in stands of mature poplars (*Populus* spp.) adjacent to muskegs. Islands of poplars or aspens amid stands of spruce or pines are common breeding locations, as are similar groves or marginal strips of often-stunted tamaracks (*Larix laricina*) in wetter sites (Nero, 1980). In the Sierra Nevadas of California the birds breed in mixed-conifer forests and red fir (*Abies magnifica*) forests (at about 900–1800 meters and 1800–2700 meters elevation respectively), especially in dense forest stands bordering meadows. During late summer and fall the birds are prone to move higher into lodgepole pines (*Pinus contorta*) forests, but they also use lower-altitude ponderosa pine (*Pinus ponderosa*) forests during fall and winter (Verner and Boss, 1980; Winter, 1986). In winter the birds often move out of the forest to hunt in open fields having scattered trees, scrub patches, weedy areas, and fencerows (Brenton and Pittaway, 1971).

In the western Palearctic the great gray owl is mainly associated with dense and mature lowland or sometimes montane coniferous forests that are dominated by pines, spruces, and firs, these sometimes interspersed with birches (*Betula*) (Cramp, 1985). Most hunting is not done in such forests, but rather in adjacent open habitats, including marshes and cleared

forests (Mikkola, 1983). Probably a combination of abundant small (up to about 100 grams) rodents occurring in semiopen habitats such as meadows or muskegs where they can be readily captured, plus proximity to dense coniferous forests offering both roosting and nesting sites, are primary aspects of breeding habitats.

In Manitoba the birds favor tamarack during summer, apparently avoiding jack pine (*Pinus banksiana*), black spruce (*Picea mariana*), open treeless areas, and habitats with a dense shrub layer. Factors affecting habitat selection include relative availability of microtine prey, suitable perches, and shrub density (Servos, 1987). Most Saskatchewan breedings have been in tamarack-black spruce forested wetlands, with 25 of 27 suspected nestings within 500 meters of such habitats (Harris, 1984). Although within areas of tamarack forests, 14 nest sites in Minnesota were associated with black ash (*Fraxinus nigra*) and basswood (*Tilia americana*), the forks of which provide better nest sites for raptors than the surrounding scrub tamaracks (Spreyer, 1987). Preferred winter habitat in Alaska consists of the ecotone between grassland meadows and tall willows, balsam poplars (*Populus balsamea*), and white spruce (*Picea alba*) (Osborne, 1987).

Population density estimates for North America are few, but Bull and Henjum (1987) found 3 nesting pairs in one 290 hectare study area, and 7 in an area of 937 hectares. Spreyer (1987) noted that in Minnesota as many as 8 nests in a single year occurred within a 52 square kilometer area. In Sweden variations in breeding density of from 7 pairs in 20 square kilometers to 9 pairs in 100 square kilometers (0.09–0.35 pairs per square kilometer) have been noted, and in one location 7 pairs occupied an area about 3 kilometers in diameter (Cramp, 1985). A nesting season home range of approximately 260 hectares, with a maximum diameter of about 2.3 kilometers, was estimated for great gray owls in the Grand Teton area of Wyoming by Craighead and Craighead (1956), based on sight records of unmarked birds. A winter home range of 45 hectares (maintained by one bird over an 11-day period) was estimated by Brenton and Pittaway (1971) in Quebec.

Movements

It is well known that great gray owls are irregularly irruptive or migratory, with periodic invasions into various northern states and southern Canadian provinces (Eckert, 1984; Nero, 1969). In the winter of 1983–84 more

than 400 birds were seen in southern Ontario alone, the numbers peaking in January (*American Birds* 38:312). Nero (1980) thought that these winter invasions might often be the result of a combination of years of good reproductive success followed by prey declines, or perhaps the birds may be forced out of breeding areas because of deep snow accumulations or icy crusts that affect hunting success. There is some evidence that winter incursions may to a large degree be made up of immature birds: Nero and Copland (1981) noted that 20 of 24 birds banded during winter along the Trans-Canada Highway in southern Manitoba were immatures. Nero also noted (1980) that two females that bred successfully one year were repeatedly seen the following winter within a mile or two of their nest sites.

Postfledging movements of juvenile birds are sometimes quite extensive, judging from European banding data. Thus, in Finland 11 juveniles moved up to 226 kilometers, and in Sweden 16 juveniles moved up to 490 kilometers from the nest. At least the Swedish movements were not correlated with rodent population levels, but instead the dispersal pattern was random. A few long-distance movements of adults, including two females that moved 110 and 430 kilometers over periods of 2–4 years, have also been reported (Cramp, 1985). One long-distance movement of an immature was mentioned by Nero (1980), the bird being a nestling banded near Winnipeg and recovered the following winter about 753 kilometers southeast in extreme southern Minnesota. In an Oregon study, 11 radio-tagged juveniles traveled 8.8–31.4 kilometers from their nests in one year, while 11 adults moved 3.1–42.9 kilometers during the same period, suggesting that little if any age difference in mobility occurred there (Bull and Henjum, 1985).

Foods and Foraging Behavior

In spite of its large size, the great gray owl subsists almost entirely on relatively small rodents. Mikkola (1983) determined that of nearly 5200 prey items from the breeding season, 87.7 percent were of prey species averaging from 10 to 49.9 grams as adults, and only about 10 percent were of species averaging more than 100 grams. Studies at 61 nest sites in Finland and Scandinavia indicated that about 94 percent of the prey items were of rodents, and *Microtus* species alone comprised nearly 75 percent, with *Clethrionomys* the second most important genus, adding about 10 percent. Birds contributed

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Great Gray Owl

only about 1 percent. When breeding-season data are analyzed on a biomass basis, small microtine voles are responsible for 86.5 percent of the total, larger mammals (mostly of *Arvicola* voles) about 9 percent, and birds about 2 percent. Outside the breeding season the biomass representation of small voles declined somewhat, the latter two prey categories totaling about 20 percent of the estimated biomass consumption (Cramp, 1985).

Although North American studies are far less extensive, a similar rodent-based dietary picture emerges. Winter (1986, 1987) estimated the average weight of 662 prey items in California as about 75 grams, with pocket gophers (*Thomomys bottae*) contributing about 57 percent of the prey items and nearly 80 percent of the prey biomass. *Microtus* voles were of secondary importance, comprising 33 percent of the prey items and an estimated 17 percent of the total biomass. In Oregon, breeding-season prey consisted of about 58 percent *Microtus* voles and 34 percent pocket gophers (*Thomomys talpoides*) (Bull and Henjum, 1985). In the Grand Teton National Park area these two prey types likewise constituted 93 percent of the prey identified in a recent study (Franklin, 1985). The use of pocket gophers as summer prey has also been observed in Montana (Tryon, 1943). Limited observations in Quebec (Brenton and Pittaway, 1971) suggest that there the birds subsist almost exclusively on *Microtus* voles during winter, and *Microtus xanthognathus* comprised 66 percent of a sample of more than 200 pellets from Alaska, with other microtines contributing 28 percent and miscellaneous mammals and birds the remainder. Oeming (1955) similarly reported a concentration of *Microtus* voles in Alberta. Both Bent (1938) and Nero (1980) suggested that other mammalian species such as squirrels, moles, rats, young rabbits and hares, and weasels are also taken, as well as birds, usually quite small but sometimes as large as ducks and grouse.

Great gray owls prefer to hunt in relatively open country where scattered trees or forest margins provide for suitable vantage points for visual searching. Winter (1987) found that about 90 percent of monitored birds' time was spent within 124 meters of an open meadow. In the winter the birds hunt primarily in early morning and again from late afternoon to dusk, with little or no nocturnal activity, judging from Brenton and Pittaway's (1971) observations. Oeming (1955) also reported that, prior to the nesting season, most hunting is done in late afternoon, but while feeding young both daytime and nocturnal hunting may be

done. Similar observations during winter in Finland suggest that the birds prefer to hunt at dusk, but modify their crepuscular tendencies to include daytime during midwinter, when the day is very short, and especially during dull, overcast days. On the other hand, during the short nights of summer at high latitudes the birds concentrate their foraging around midnight, although the great need for food during the nestling period may force the male to be active throughout the daylight hours (Mikkola, 1983).

There is good evidence that the great gray owl has remarkable visual acuity and is able to see small rodent prey running across the snow at distances of up to about 200 meters. Additionally they are able to locate and capture live prey from deep beneath the snow by acoustic clues alone (Nero, 1980). This is done by dropping down from a perch or a nearly motionless hovering position above the invisible prey, reaching down with their legs and crashing through the snow to depths of about 30 centimeters. Tryon (1943) also saw an owl crash through the roof of a feeding runway of a pocket gopher's burrow to get at the animal below.

Social Behavior

As a seminoadic species, it is not to be expected that great gray owls would have permanent pair bonds or strong nesting-site tenacity, and this generally appears to be the case. If food is locally abundant over a period of years the females may return to nest at the same sites, with records of a nest used for as long as five years, but at other times they may move elsewhere. Similarly, some young birds return to breed near their natal areas, while others may breed as far as 100 kilometers away (Cramp, 1985; Mikkola, 1983). Judging from limited data, both hand-raised and wild females can sometimes breed at a year of age, but two years might be the normal age of initial breeding. The pair bond is apparently monogamous but of unknown duration, and it is not maintained outside of the breeding season (Glutz and Bauer, 1980).

When perched, the birds typically remain almost motionless while standing close to the main bole of the tree, where their barlike plumage pattern allows them to blend into their surroundings remarkably well. When aware of approach by humans, they assume an upright, sleeked posture with the eyes remaining open and the breast rather than the wing directed toward the intruder (Figure 41, right). On the

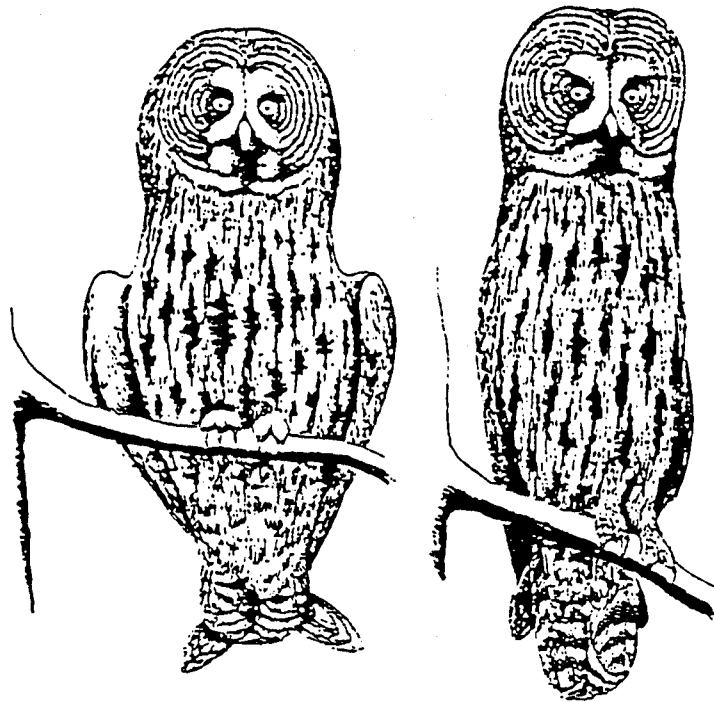


Figure 41. Postures of the Great Gray Owl, including (left) preattack posture and (right) concealment posture. After drawings in Mikkola (1983).

other hand, when about to attack an intruder the bill is snapped, the head feathers are fluffed, and the wings are spread slightly and drooped somewhat prior to takeoff (Figure 41, left).

The two most evident aspects of courtship behavior in great gray owls are courtship feeding and mutual preening. Nero (1980) regarded the latter as one of the most significant aspects of pair-bonding behavior and found that it could be easily elicited from adults of both sexes as well as from subadults. Even badly injured owls would respond to his tilting the top of his head toward them by running their beaks through his hair, gently nibbling on the scalp and often pulling on a few hairs. Similarly, Oeming (1955) observed mutual preening in captive birds. The birds would first stand with breasts touching and face to face as the male rubbed his beak over the female while uttering a humming sound; he would then circle her in a similar manner. Males have also been observed "combing" the breast feathers of the female with their talons, and although males apparently initiate mutual grooming the female may actually groom her mate more than the male (Katherine McKeever, quoted in Nero, 1980).

Courtship feeding begins in midwinter (lasting from January to mid-April in Manitoba), the female beginning to hoot softly and shifting her weight from leg to leg when she sees her mate carrying a prey animal. Stimulated by the female, the male flies to perch beside her, closes his eyes as he leans toward her, and holds out the prey for her to receive. The female seizes it with closed eyes and a slight mewling sound, thereby helping to form or re-establish the pair bond (Nero, 1980). Duncan (1987) reported seeing an immature male feeding a mated female at the nest, apparently representing the first record of possible nest helping among owls, although the possibility of this has been suggested for long-eared owls.

Nero (1980) described one attempted copulation that occurred in late February. The male flew into a tree where he was shortly joined by the female, who perched on the same branch some ten feet higher up. The male then flew and, cupping his wings, braked and dropped momentarily on the female's back. They then separated and flew away. In another incomplete observation the male was observed vigorously flapping his wings during copulation, while one or both birds uttered a peculiar

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Great Gray Owl

rasping screech. Shortly after that the male flew away and the female resumed hunting.

Nest visits may begin as early as mid-February in Manitoba, with the male uttering a nest-showing or advertisement call, while the female calls in response. When she visits the nest site she often sits and makes scraping movements. The male may then fly off, followed by the female. He may thus show her several possible nesting sites, the final choice presumably being made by the female. Selection of a nest site may in part be influenced by the relative local prey population, and this factor may also affect the timing of initial egg laying (Nero, 1980; Cramp, 1985; Mikkola, 1983).

Breeding Biology

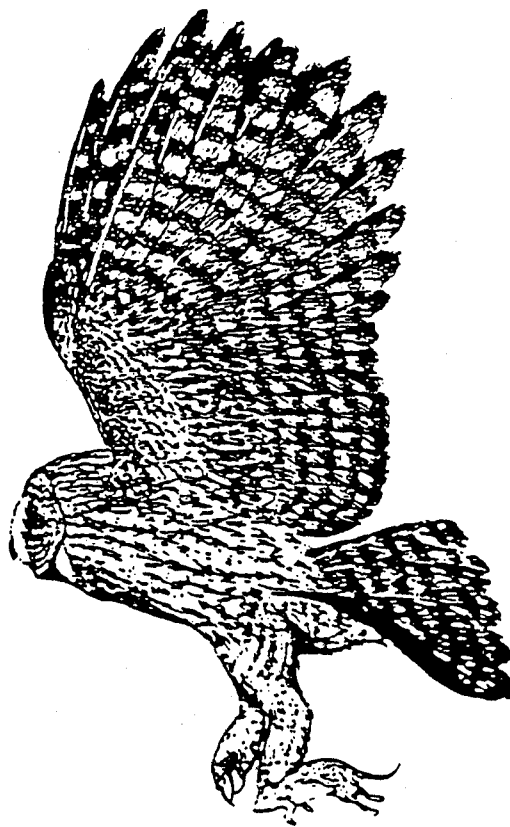
Egg records in North America are rather limited, but 15 records from Alberta are from March 23 to May 15, with 8 occurring between April 9 and May 1. Three records from Alaska and arctic Canada are from May 15 to July 19 (Bent, 1938). In Alberta most nests have complete clutches by April 15, with the earliest record of a complete clutch being March 23 (Oeming, 1955). In Ontario eggs have been reported between April 29 and June 5 (Peck and James, 1983), and in the Sierra Nevadas of California breeding occurs from late February to mid-June, with a peak from mid-April to late May (Verner and Boss, 1980; Winter, 1986). Early April was reported as the earliest laying time by the Craigheads (1956) for the Grand Teton area, and Nero (1980) stated that laying may begin as early as mid-March, presumably referring to the area around Winnipeg.

Of 185 nests found in Finland (Mikkola, 1983), about 83 percent were twig nests originally built by raptors or corvids, 13 percent were on stumps, and the remainder in miscellaneous locations. Of 106 nests, 45 percent were in "damp heath" coniferous forests, 35 percent were in spruce bogs, 11 percent in "dry heath" coniferous forests, and the remaining 9 percent in pine peat bogs or herb-rich forests. About half of the nests had marsh areas located within 1,000 meters, and nearly half had an area cleared by felling within 500 meters. The majority of the stick nests had originally been made by goshawks (*Accipiter gentilis*), while those of buzzards (*Buteo buteo*) comprised the next most common category.

Franklin (1985) noted that 9 of 15 nest sites in the Grand Teton area were in broken-top snags, and almost 80 percent of the active nest sites were reused at least once. Of 52 nests in Oregon, half were in old raptor nests, 21 per-

cent on artificial platforms, 19 percent on broken-top snags, and 10 percent in mistletoe clumps (Bull and Henjum, 1985). All of five California nests were located on the tops of large snags (Winter, 1980). Of 32 Canadian (apparently mostly Manitoban) nests mentioned by Nero (1980), 16 were in man-made structures, 10 were in completely artificial nests, and 6 were in rebuilt natural nests (Nero, 1980). Oeming (1955) stated that in Alberta favored nesting areas are among poplar woods, which often are lightly mixed with conifers and usually are close to areas of muskeg that are used for hunting. Among 23 sites from Alberta, 15 were in aspens (*Populus tremuloides*), 3 were in balsam poplars (*P. balsamifera*), 3 in black spruces (*Picea mariana*), and 2 in tamaracks (*Larix laricina*). They were typically in old, unmodified raptor or crow nests averaging 13 meters above ground (Oeming, 1955). In spite of early statements to the contrary, there is no good evidence that the owls enlarge, line, or otherwise modify their nest sites in any way except to deepen the cup of the nest.

Females lay eggs at a rate of about one per day, although longer intervals may sometimes elapse, especially for the eggs laid later in a clutch. Among 241 European clutches the





range of clutch size was 1–9 eggs, with an average of 4.4 (Mikkola, 1983). Twenty-three Alberta nests ranged from 2 to 5 eggs, with an average of 3.2 (Oeming, 1955). Evidently European clutch sizes increase from south to north, and they are also apparently influenced by local food conditions. Replacement clutches have been reported, with renesting usually occurring 15–30 days after the loss of the first nest (Bull and Henjum, 1987). There are reports that in good vole years as many as three clutches may be laid, although of course only one brood per year is raised (Mikkola, 1983).

The female does all the incubation, which normally requires 28–29 days, while the male performs all the hunting duties, often in open areas only a few hundred meters from the nest. The female receives the prey from her mate with the bill and consumes it herself or, after the young have hatched, passes it on to them, after first tearing it to bits if the owlets are very small.

Hatching of the eggs typically occurs at intervals of from one to three days, with the young weighing about 37–38 grams at hatching. Within 5 days after hatching they will normally almost have doubled their hatching weights, and by two weeks old will have attained a weight of about 500 grams, which attests to the importance of an abundance of food at this time. There are cases of young increasing in weight from 40 to 225 grams in a single week. The owlets normally leave the nest at 20–29 days, when weighing 425–630 grams. By then they are surprisingly agile at climbing trees, even though they are incapable of flight. Actual fledging probably occurs before they are 55 days old, but even after this they are likely to remain near the nest. They stay within the nest-

ing territory for some months, watched over by the female. They probably become independent and begin dispersing at about 4–5 months (Cramp, 1985; Mikkola, 1983). Great horned owls are apparently serious predators on young birds (Bull and Henjum, 1987). There is seemingly a high mortality rate of young birds: Nero and Copland (1981) noted that 88 percent of 50 great gray owls found dead one winter in Manitoba were young of the year. Among 193 owls found dead over a 15-year period, 157 were killed by collision with motor vehicles, 26 had been shot, and 10 died from miscellaneous causes (Nero, Copland, and Mezibroski, 1984).

Although adult great gray owls may consume about 150–200 grams of feed per day on average, during a 50-day study period a young male and female averaged 76.4 and 80.6 grams of food respectively. This provides some idea of the enormous weight and number of prey that must be provided by a pair of birds (and primarily the male) if they are to raise a brood successfully (Mikkola, 1983).

Among a sample of 42 Finnish nests whose clutch sizes were known, 80.5 percent of the eggs hatched, and 72.1 percent of the chicks left the nest, for an overall reproductive success rate of 58 percent. The average number of fledged young per successful nest was 2.4, with humans being responsible for the largest number of egg and chick losses (Mikkola, 1983). Among a sample of 69 nesting attempts in Oregon, 75 percent of first nestings were successful, with northern ravens a major cause of egg losses. The average mortality of radio-tagged juveniles was 46 percent during their first year, as compared with 8–29 percent for adults (range of 3 years) (Bull and Henjum, 1987). Franklin (1987) reported a 71 percent

nesting success rate for 17 breeding attempts in the Grand Teton area, with an average of 2.5 fledged young per nest.

Evolutionary Relationships and Conservation Status

The great gray owl is a quite distinct form, and frequently has been given monotypic generic status by taxonomists. However, more recent classifications have placed it within the rather large genus *Strix*, albeit with no obvious close relatives. It seems possible that the Ural owl (*Strix uralensis*), and its southern counterpart the tawny owl, are the nearest living relatives to the great gray owl; the great gray and Ural owls are widely sympatric in Eurasia.

The status of the great gray owl in North America is difficult to judge, but Nero (1980) made an educated guess that the total popula-

tion may be in the neighborhood of 50,000 birds, most of which are certainly found in Canada. There have been recent reviews of the species's status in Manitoba (Nero, Copland, and Mezibroski, 1984) and Saskatchewan (Harris, 1984), as well as a California survey (Winter, 1980). Recent studies by Franklin (1985) have shown the species to be fairly common in northwestern Wyoming and adjacent Idaho, where he found evidence of 67 territories, while in Oregon Bull and Henjum (1985) located over 50 nests in three years. Breeding almost certainly occurs in Washington, but its occurrence in that state is virtually undocumented. There are several breeding records for Minnesota, one for northern Wisconsin (where a brood was seen in 1978), and one from Michigan, on Neebish Island, Chippewa County (Jensen, Robinson, and Heitman, 1982).

APPENDIX B

Key to the Vocalizations of Owls (Johnsgard, 1988)

Advertisement and Other Typical Calls of North American Owls

Group 1.

Screeching, croaking, and other nonhooting or nonwhistling calls.

A long, hoarse screech, *karr-r-r-r-ick* lasting about 2 seconds (Figure 53A), given at intervals of 1-20 seconds, and in series of up to 50 or more times while in flight (advertising song); also various snoring, croaking, and wheezing calls but never hoots. (Croaking, hissing, and screeching calls are uttered by many other owls, but not as primary advertising songs.)..... Common Barn-owl

Group 2.

Low-pitched hooting sounds, often in prolonged series of up to about 3 per second, but not rapidly pulsed or trilled, with variations in loudness and cadence but not pitch.

A. A rather definite and consistent number of up to 9 notes that are distinctly accented or cadenced. Arranged below by increasing number of syllables in phrase.

1. Double-noted *coo-hoooo*, similar to a cuckoo clock, the second note much prolonged and sometimes rising slightly in pitch; the doublets often monotonously repeated for an hour or more (advertisement call); also a mellow, fluty 3-noted *whea-woo-who-woo-who* in courtship, with the last four notes slurred together..... Burrowing Owl

2. Three or 4 low-pitched and cadenced notes, *who*; *who-who*; *who*; *who*, lasting nearly 2 seconds, the middle portion loudest and highest, the last prolonged and sometimes downslurred similar to Barred Owl (or "Who: who are youuuu?"); sometimes lacking the introductory note, and often with the last note distinctly emphasized (Figure 53G) (advertising call). Occasionally uttered as two long notes followed by two shorter ones; also diverse barking and sirenlike whistling noises..... Spotted Owl

3. A variable series of 4-5 (rarely 3-9) low-pitched hooting notes, with no pitch variation but usually a distinct cadence, often *who: hoo-hoo: hoo-hoo*, sounding rather like "DON'T kill owls! Save owls!", to which a preliminary "Please!" and one or two additional "Save owls!" are often added (Figure 53E) (advertising call) Great Horned Owl

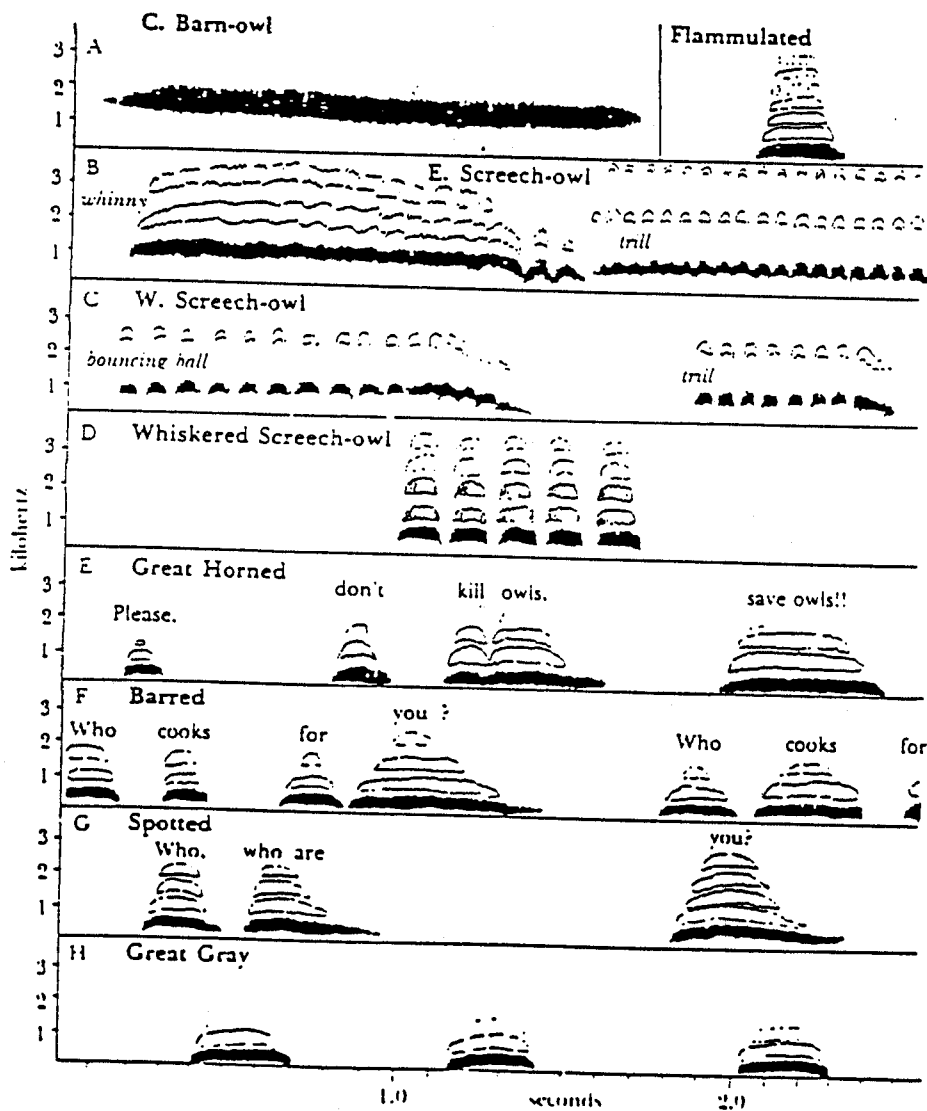


Figure 53. Diagrams of characteristic calls of nine North American owls, based on simplified sonographic representations of these calls. Major harmonics are indicated in lighter bands, minor ones are omitted.

Appendix 2

4. A syncopated series of 2 short and closely spaced notes followed by 2-5 (usually 3) longer and equally spaced notes ("dot, dot, dash, dash, dash"), the series lasting about 1-1.5 seconds. Often repeated several times without pause, and ending with an extra long note (syncopated duet song). Also a series of about 6 notes, sometimes with a pause before the last, or the penultimate one emphasized (male song) Whiskered Screech-owl; see also 2AA6
 5. Nine hooting notes in distinct two-phrase cadence, the whole sequence lasting nearly 3 seconds and sounding like, "Who cooks for you: who cooks for you-all?" (Figure 53F) (advertising call); also diverse barking, chuckling and screaming notes Barred Owl
- AA. A variable number of single or doublet hooting notes, not so distinctly accented (see also Group 3A). Arranged below by increasing pitch.
1. A series of up to 12 regularly spaced, very low-pitched (ca. 200 Hz) *boo* (sometimes double or triple) notes of equal duration (about 0.3 seconds) and uniform interval, the single units usually uttered at about 3 per 2 seconds (Figure 53H), but often becoming more rapid, lower, and softer toward the end of a calling sequence (advertising song). The female's notes are similar but harsher and are typically uttered in shorter series Great Gray Owl
 2. Loud, hollow, and booming *hoot-hoo* notes, usually given in groups of 2 (range 1-6 or more), with 1-2 second intervals between the doublet calls (advertising song); frequency low-pitched but still unmeasured Snowy Owl
 3. An indefinite series of prolonged, low (ca. 400 Hz), cooing *boo* sounds, each lasting about 0.5 seconds, the notes uttered at spaced intervals of about 2.5 seconds (range 2-8), the first usually lower in pitch and volume (Figure 54A). Sometimes uttered in flight (advertising song) Long-eared Owl
 4. A single very low-pitched (to ca. 500 Hz) hoot, uttered monotonously and regularly 8-60 times (average about 25) per minute (Figure 53A), each hoot often preceded by 1-2 preliminary softer notes of even lower pitch (advertising song); also a similar but double *boo-hoot*, uttered about 40 per minute, with the emphasis on the second syllable (courtship song) Flammulated Owl
 5. A low-pitched (ca. 500 Hz), indefinite series of spaced cooing or *boo* notes, each lasting about 0.1 seconds and recalling a distant steam engine, given at the rate of about 2-5 per second, with from 6 to 20 or more notes in each series (Figure 54B). The series may be repeated 5-6 times an hour; often uttered in flight (advertising song) Short-eared Owl

6. A series of about 6 (4-9, rarely to 16) rather evenly spaced *boo* notes (to ca. 800 Hz), the series usually lasting about 1 second or sometimes to 1.5 seconds (Figure 53D); often slowing toward the end, sometimes with the penultimate note emphasized (advertising song) Whiskered Screech-owl: see also 2A4

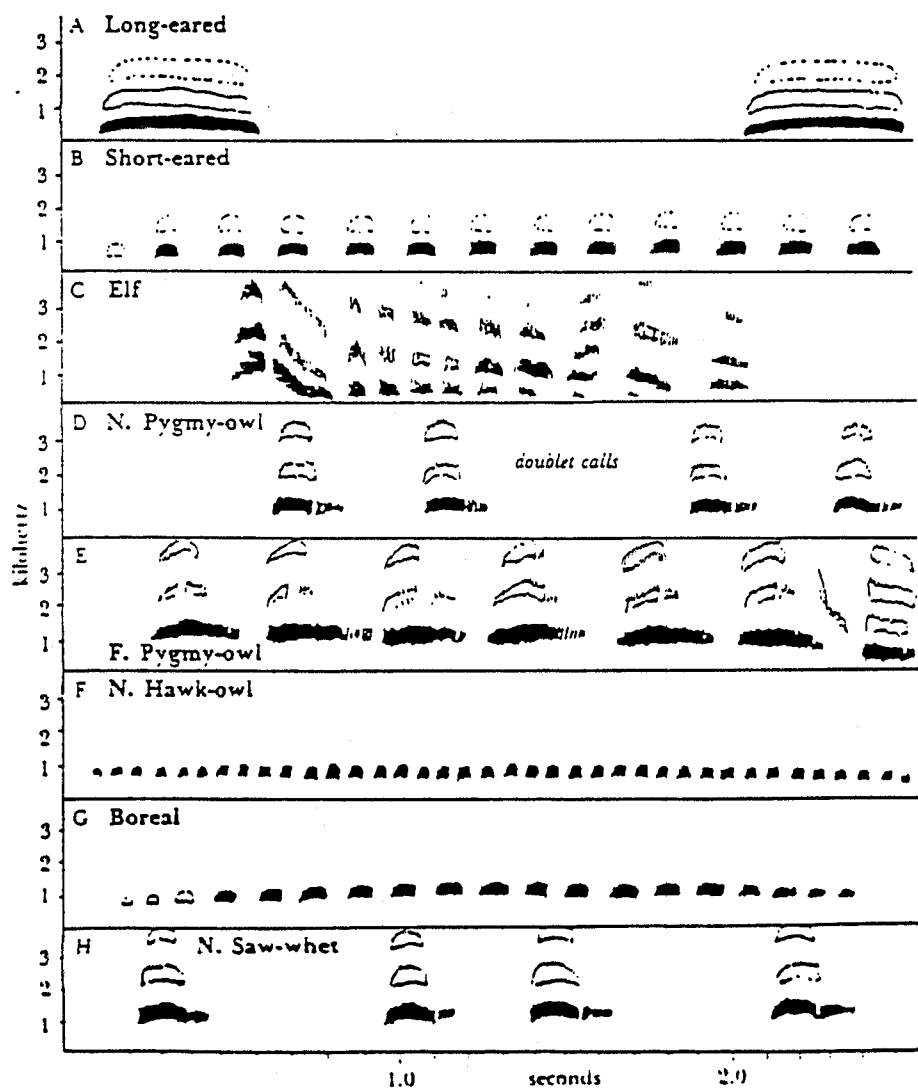


Figure 54. Diagrams of characteristic calls of eight North American owls, based on simplified sonographic representations of these calls. Harmonics shown as in Figure 53. From published sources and original sonagrams.

7. A variably long (6–30) series of short, mellow *took* notes, uttered at a uniform clocklike rate of about 5 every 2 seconds, each note lasting about 0.1 seconds, fairly high-pitched (ca. 1000 Hz) (advertising song)
 Ferruginous Pygmy-owl; see also 3A3

Group 3.

Calls given as a series of variably rapid (to about 10 per second), generally higher pitched and mellow notes that sometimes approach pure whistles; or as nearly continuous trills, the sequence often markedly rising in pitch and/or volume.

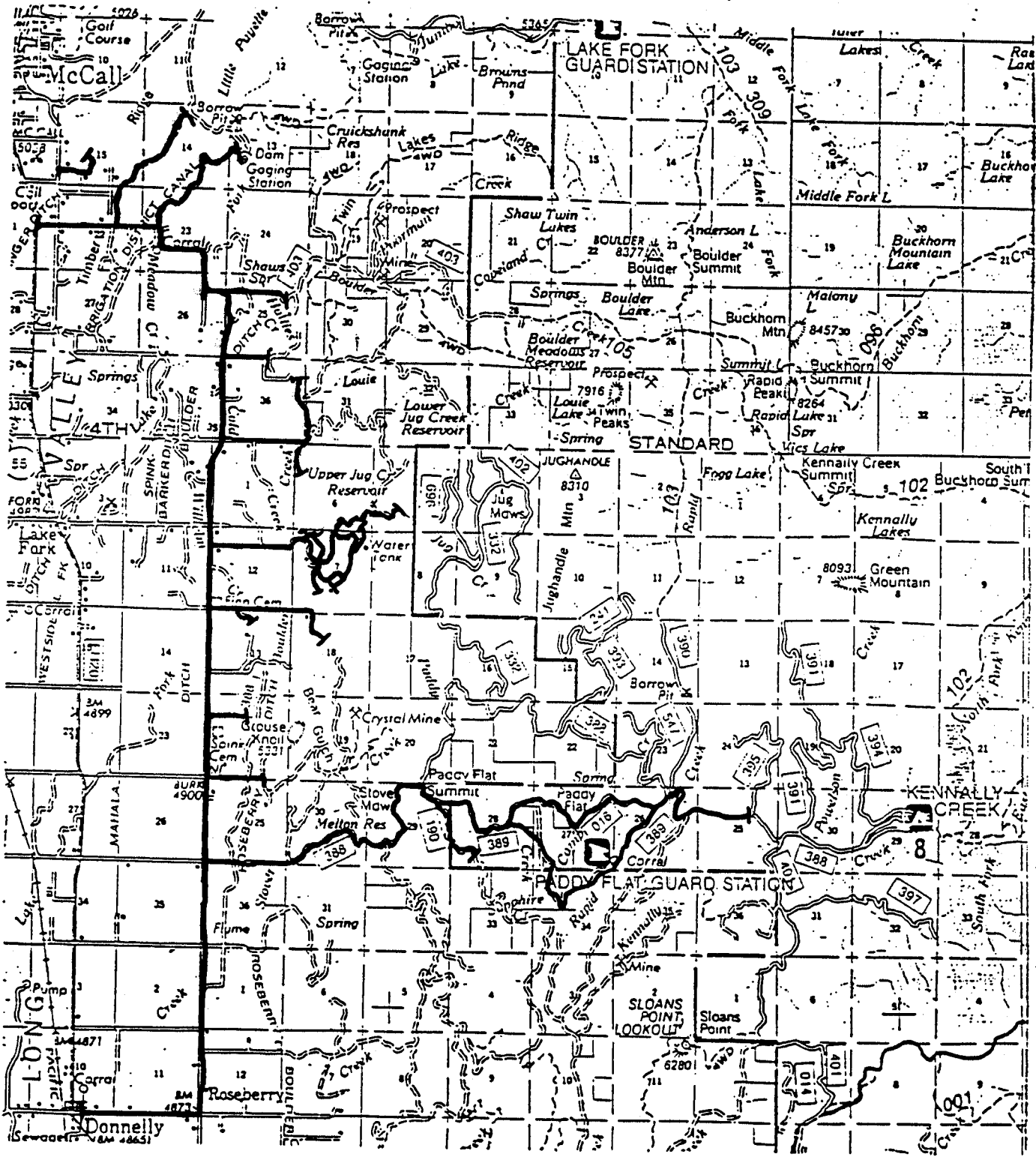
- A. A series of phrases of slower (up to about 5 per second), pulsed, single-noted (sometimes doublet) units separated at least in part by distinct intervals. (See Groups 3AA and 3AAA below for progressively faster note rates.) Pitch usually varied; arranged below by apparently increasing average pitch.

1. A series of 4–20 short (about 0.1 second) notes on same pitch (to 500–650 Hz) that begin slowly (to about 3.5 per second) but terminally accelerate (to about 11 per second) while declining in volume, recalling a bouncing ball coming to a stop (Figure 53C, left) (advertising song).
 Western Screech-owl; see also 3AAA1
2. A series of mellow *too* notes uttered independently in a long series, at intervals of about 2 seconds (advertising song), or less often as a series of 5–8 notes that increase in speed and pitch (scale song). A low, rolling trill of numerous mellow and uninflected *to* notes, followed by a pause and then about 3 widely spaced *hoo* notes (these sounding something like, "Look, look, look!"). In southern Arizona (*grioma*) the notes usually uttered as double *hoo-hoos* (Figure 54D), each doublet about a second apart, or in groups of three with interspersed single notes (advertising song)
 Northern Pygmy-owl
3. A long series of harsh, rapidly uttered and equally spaced "popping" or *poip* notes, each note with an upward inflection, uttered at the rate of about 2.5 notes per second and each lasting about 0.25 seconds (Figure 54E); sometimes interspersed with clear whistles.
 Ferruginous Pygmy-owl; see also 2AA7
4. A series of 4–15 or more rapidly repeated (6–8 per second), excited, and high-pitched *chuck* notes that descend in pitch and have a cackling or yipping quality (Figure 54C); the series often uttered 3–4 times in succession. Also various other whining and barking sounds suggestive of small dogs or puppies
 Elf Owl

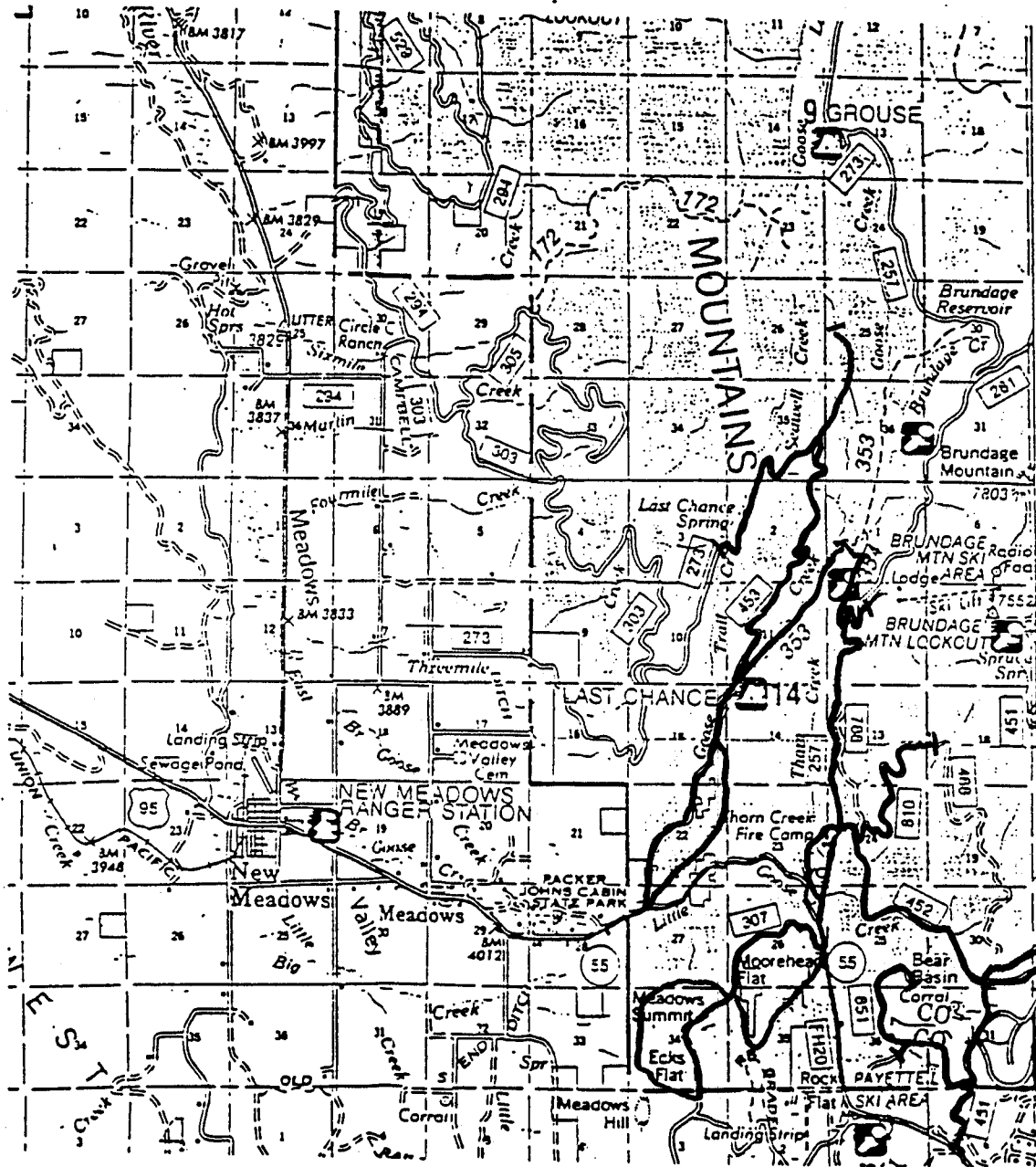
- A.A. A series of more rapid, usually monosyllabic toots, soft whistles, or metallic sounds uttered in extended phrases, sometimes in trilled or staccato fashion, at rates of about 1-8 notes per second. Arranged below by increasing rates of notes uttered per second.
1. An extended series of uniformly spaced and mellow *too* notes (about 1-2 per second), resembling dripping water (Figure 54H); the entire sequence lasting up to a minute or more, often becoming faster and ending quite rapidly (advertising song); also harsher *skreigh-aw* or *whurdle* notes, these often grouped in triplets, of varied pitch and cadence but recalling the filing of a saw Northern Saw-whet Owl
 2. A rapid series of whistled *hu* notes (about 5 per second), in long phrases lasting several seconds; 10-15 phrases per minute (advertising song) Northern Hawk-owl; variant of 3AAA3
 3. A very rapid series (about 8 per second) of mellow and hollow *po* notes (range 11-23, average 16 in N. America), in rising and falling phrases about 1-3 seconds long (Figure 54G), resembling snipe winnowing. About 2-3 seconds between successive phrases, which may go on indefinitely (advertising song) Boreal Owl
- A.A.A. A continuous or nearly continuous trill (at least 12 pulses per second) often lasting about 2 seconds or more and usually varying in pitch or loudness. Arranged below by increasing average phrase length.
1. A short burst of rapid notes (about 12 per second), lasting about 0.5 seconds, followed by a longer similar series, lasting about 1.0 seconds, forming a double trill (Figure 53C, right) (secondary and duetting song) Western Screech-owl; see also 3A1
 2. A prolonged, continuous, descending or uniformly pitched "whinny" of quavering trilled quality, lasting nearly 2 seconds (advertising song) (Figure 53B, left). Also a trilled series of very short notes (about 14 per second) on same pitch that slowly get louder and then may fade (Figure 53B, right); lasting 2-4.5 seconds (secondary and duetting song) Eastern Screech-owl
 3. A sonorous, trilling, vibrant, and rolling *hu-hu-hu-u-u-u* usually lasting 2-10 seconds (rarely to 14 seconds), with about 12 pulses per second (Figure 54F). Sometimes uttered as a bubbling, rising ripple of comparably pulsed notes; each phrase lasting 3-9 seconds, with a similar interval between phrases (advertising song) Northern Hawk-owl; variant of 3AA2

APPENDIX C

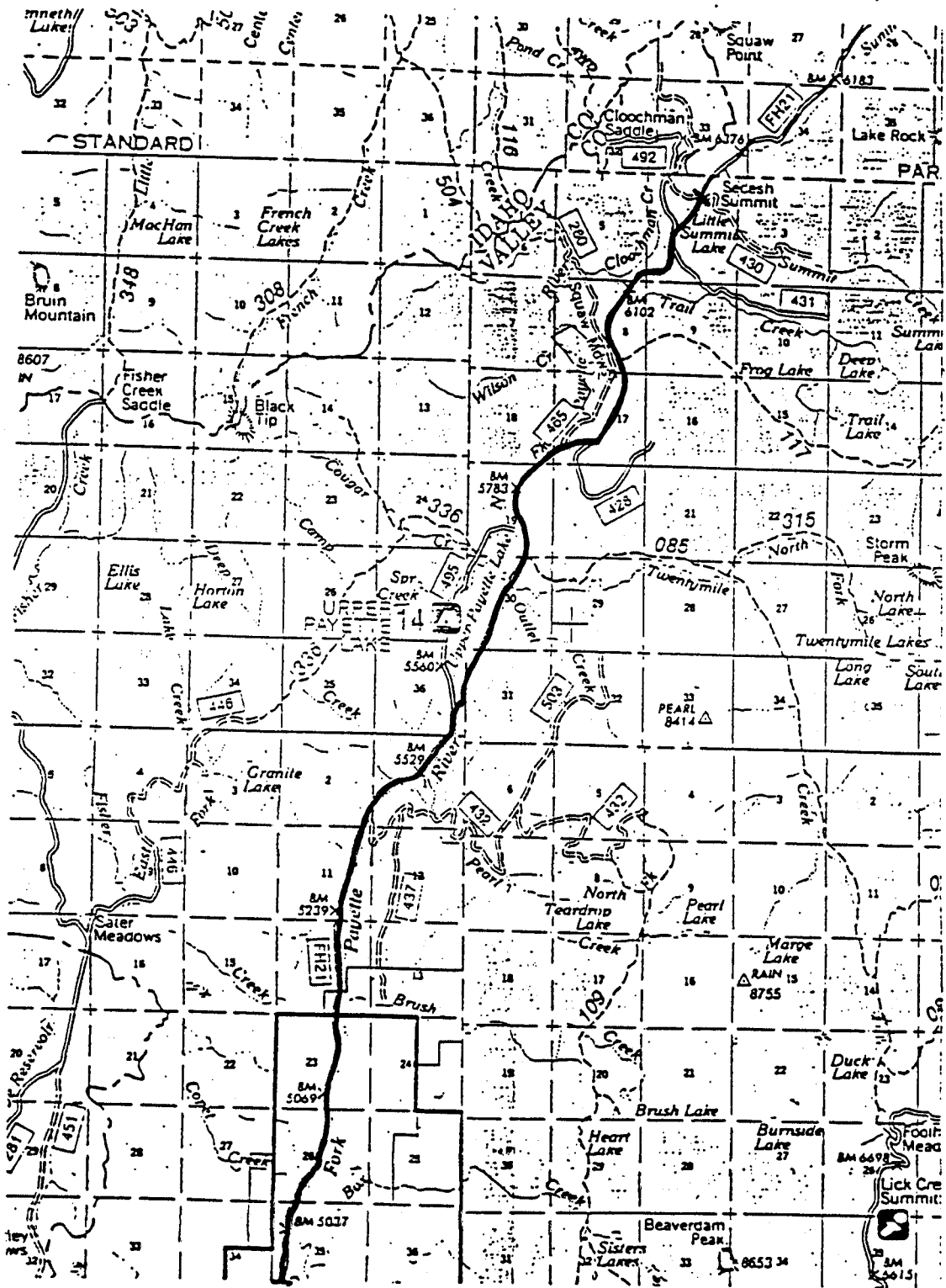
Mapped Locations of Owl Survey Routes



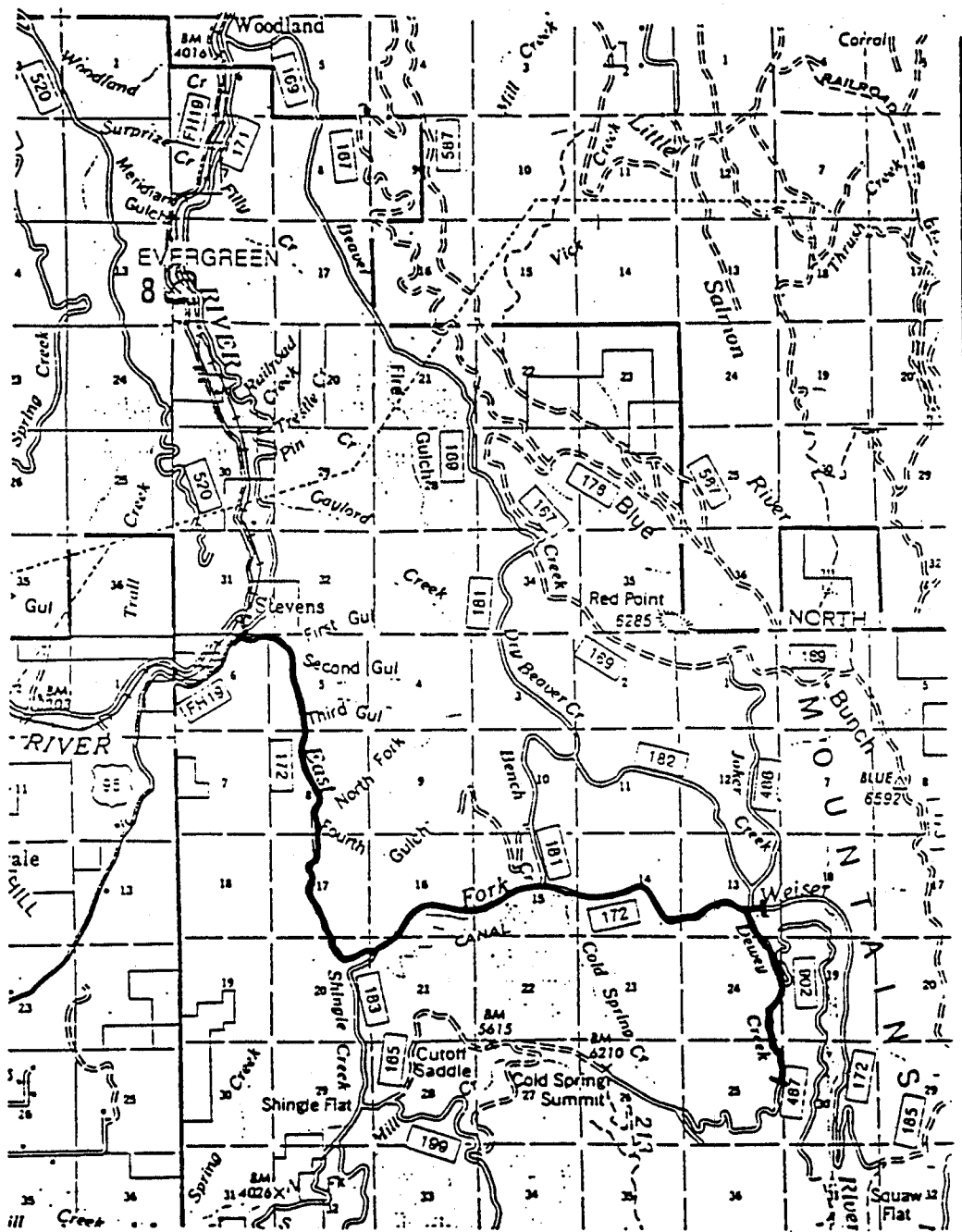
Farm to Market Road Route
 Forest Road 388 Route
 Paddy Flat Route
 Rural McCall Route



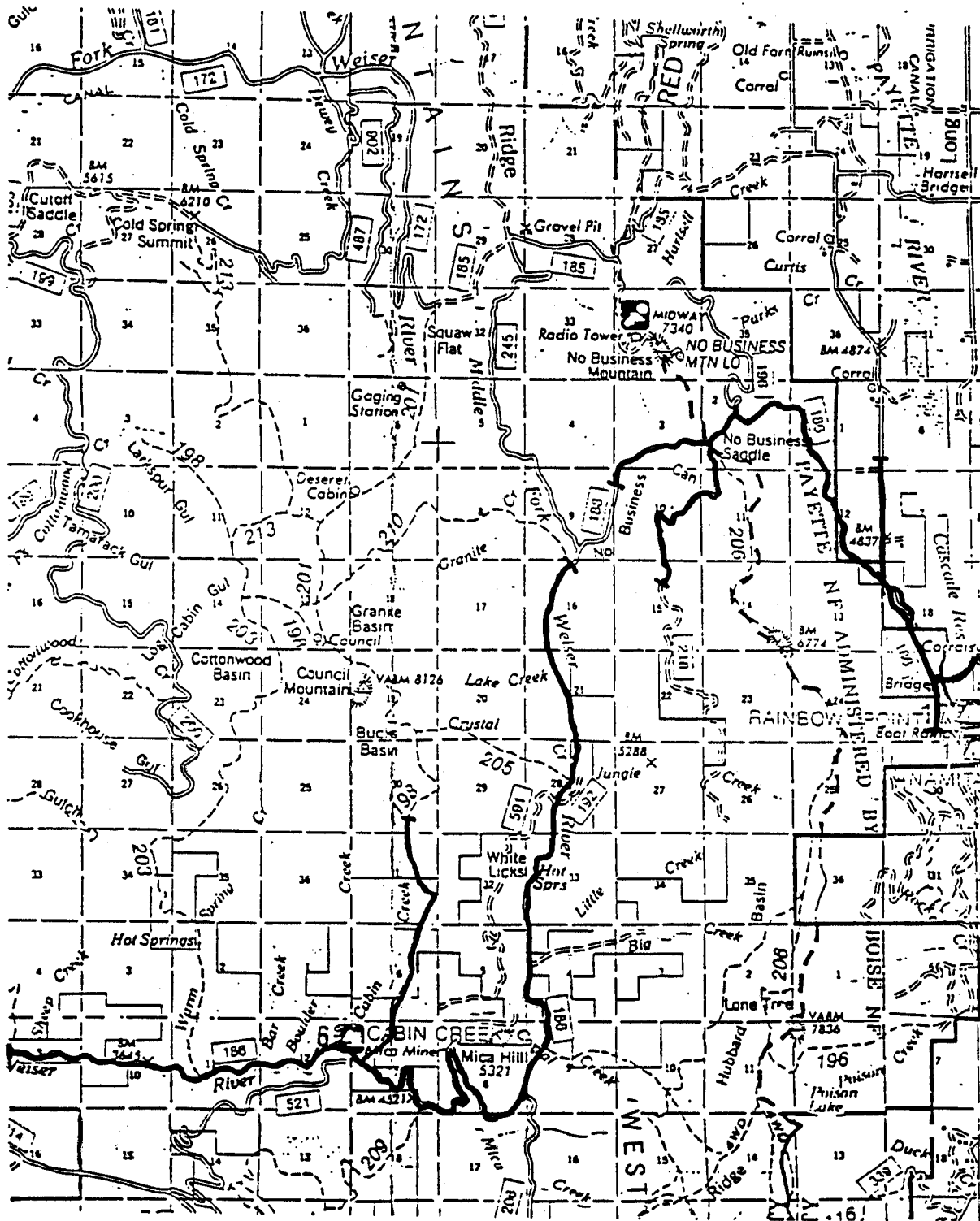
- Goose Creek Route
- Brundage Mountain Route
- Thorn Creek Route
- Bear Basin Route
- Rock Flat/Moorehead Flat/Ecks Flat Route



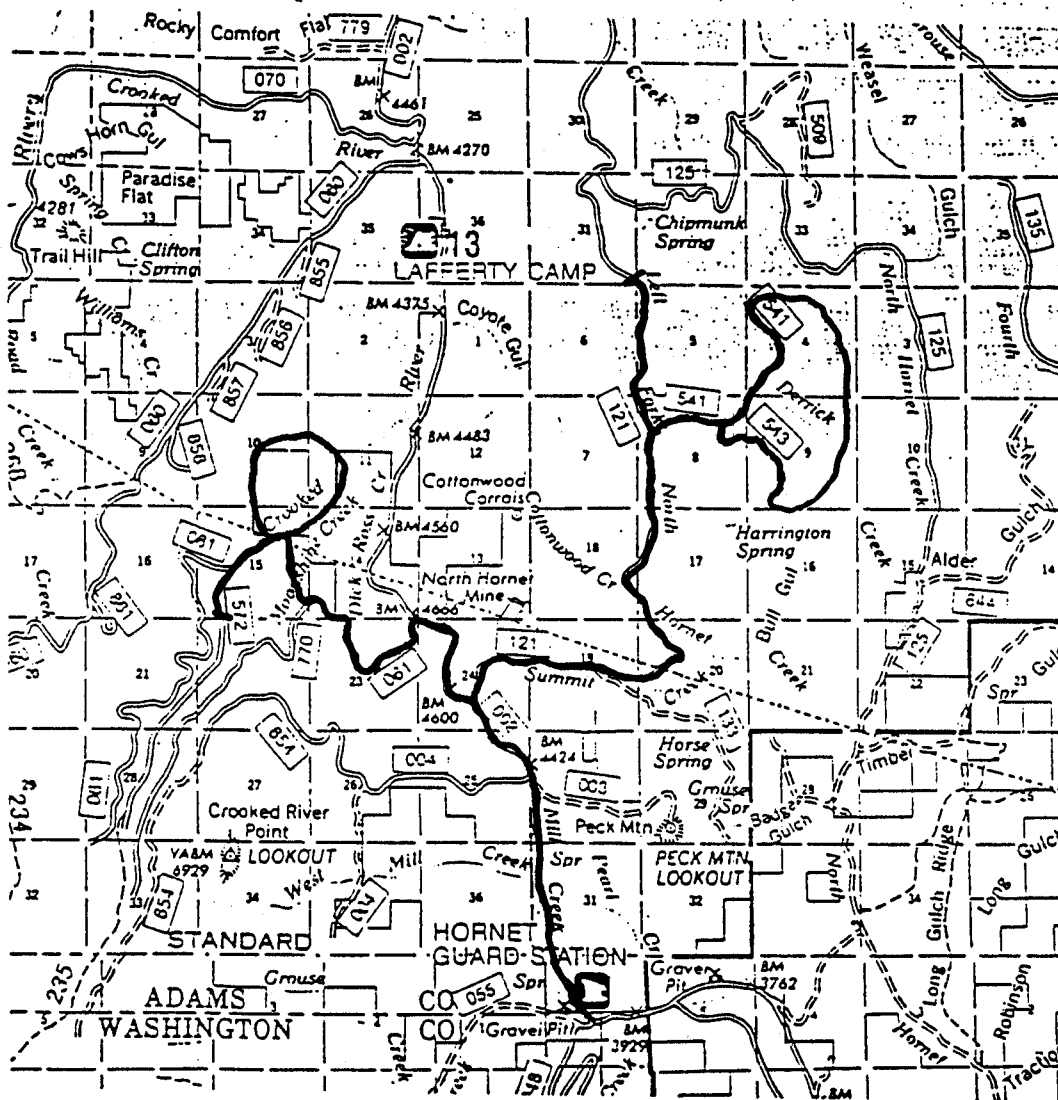
Upper Payette Lake Route



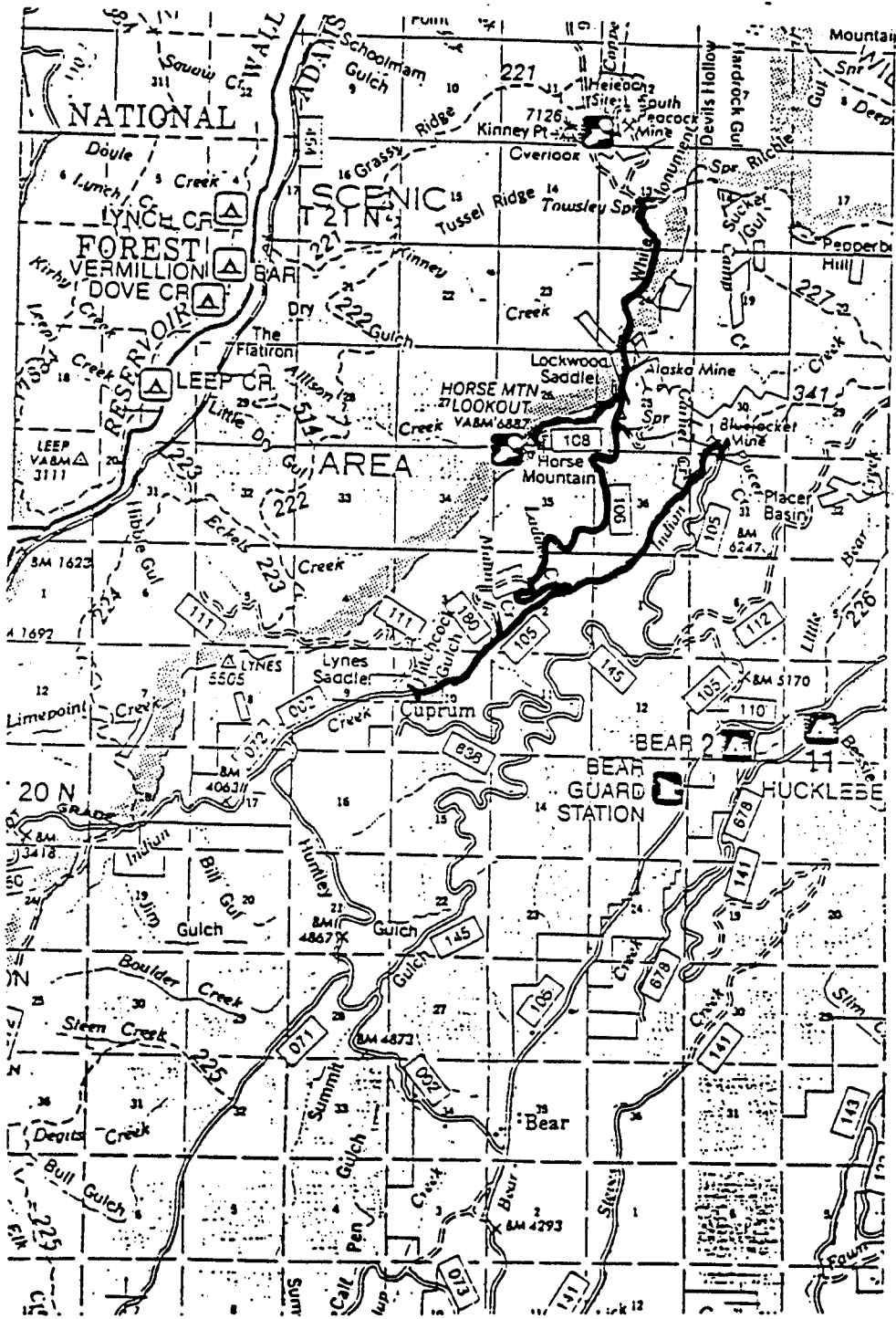
East Fork Weiser River Route



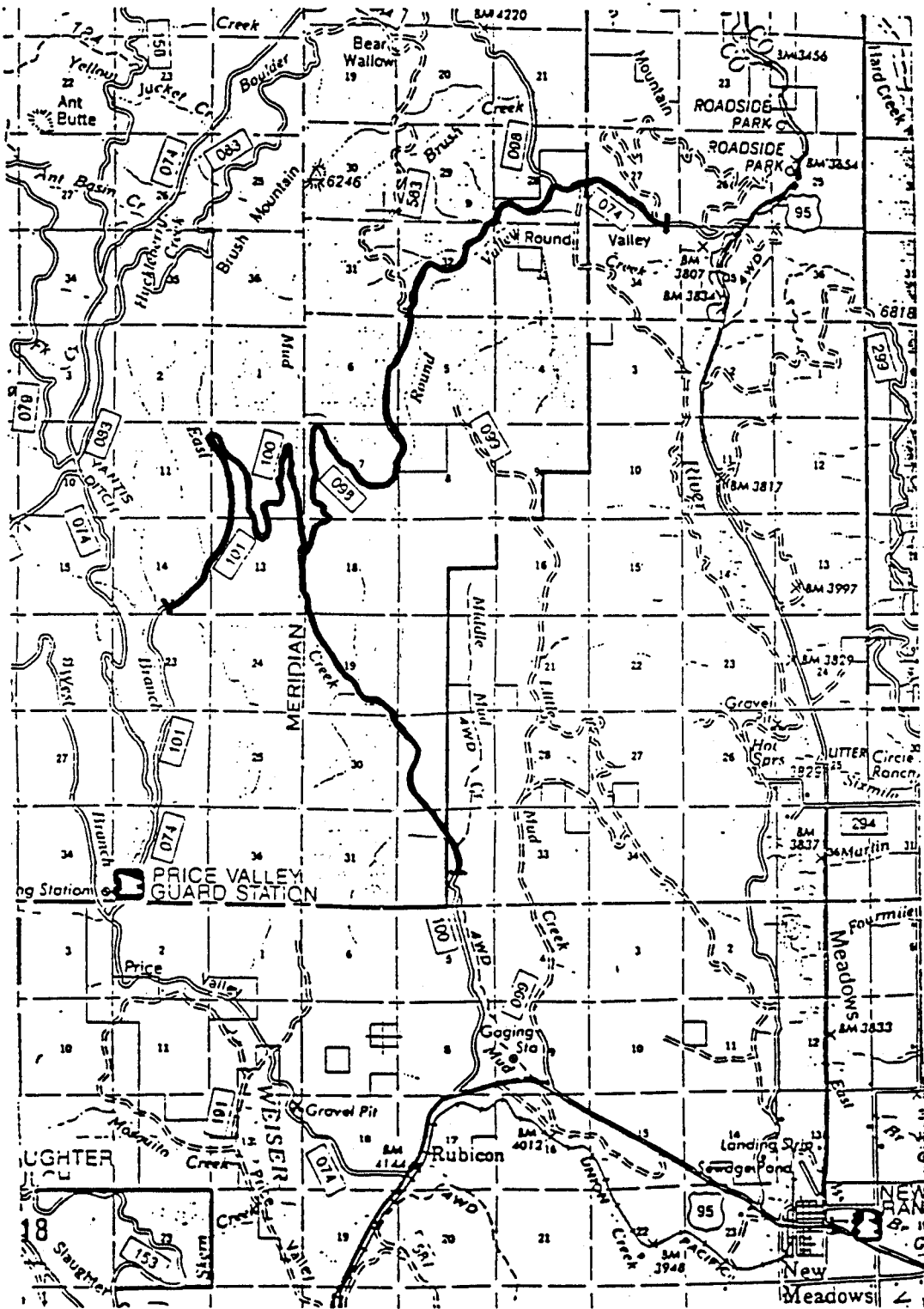
No Business L.O. Route
 Middle Fork Weiser River Route



Hornet Creek Route
Crooked River Route



Horse Mountain Route
Cuprum Route



Mud Creek-Round Valley Route

APPENDIX D

Great Gray Owl Poster

GREAT GRAY OWL SIGHTINGS WANTED

WE NEED YOUR HELP

The Idaho Department of Fish and Game is surveying national forests in Idaho for great gray owls—a Forest Service Sensitive Species and IDFG Species of Special Concern. We need your help in determining the status and distribution of these forest owls. Please turn in any sightings you make as soon as possible!

WHAT TO LOOK FOR

- largest owl in area
- 2-3 feet tall
- 4-5 foot wingspan
- distinct round facial ring
- gray coloration
- yellow eyes
- nests on top of snags or in old hawk nests

WHO TO CONTACT

Craig Groves – Nongame and
Endangered Wildlife Program
Idaho Dept. of Fish and Game
Box 25
Boise ID 83707
(208) 334-3402

or

Wildlife Biologist
Payette National Forest
Box 1026
McCall ID 83638
(208) 634-8151



APPENDIX E

Nest Platform Plans (Bull et al., 1987)

Nest Platforms for Great Gray Owls¹

Evelyn L. Bull,² Mark G. Henjum,³
and Ralph G. Anderson⁴

Abstract.—During 1983–1986, 12 great gray owl (*Syrinx nebulosa*) pairs nested on artificial platforms in northeastern Oregon. Platforms put up 15 m were preferred over those platforms put up 9 m. Nest platforms were preferred over nest boxes. Each platform cost \$40 to construct and mount.

The loss of natural nest sites has encouraged use of artificial nest structures for owls (*Syrinx* spp.) in northern Europe (Stafansson 1978, Lauhala 1980, Hilden and Helo 1981, Mikkola 1983, Helo 1984), and Canada (Zero 1980). In the Pacific Northwest, great gray owls (*S. nebulosa*) frequently nest in vacated hawk nests or on the broken tops of dead trees. Intensified timber management has reduced the number of available nest sites because many large diameter dead and live trees have been harvested.

At least 5 types of nest structures have been constructed for and used by great gray owls. Helo (1984) described an open nest structure 40 x 30 cm with a height of 10 cm that great gray owls have used. Nest structures used in Canada and Minnesota include wire frames with sticks inside (Zero et al. 1974, Zero 1982), wire baskets with sticks inside (Bohm 1985), and nests constructed of sticks alone (R. V. Zero, pers. comm.). Quinton (1984) described nests created by cutting the tops off trees and making a shallow depression inside the bole.

Great gray owls readily use artificial structures (fig. 1); we wanted to determine if the owls had a preference for height of nest (placed at 9 m or 15 m above the ground), type of nest (wooden platforms or nest boxes), and

distance of nest from a clearcut (adjacent to a clearcut or 100 to 200 m from the edge of a clearcut).

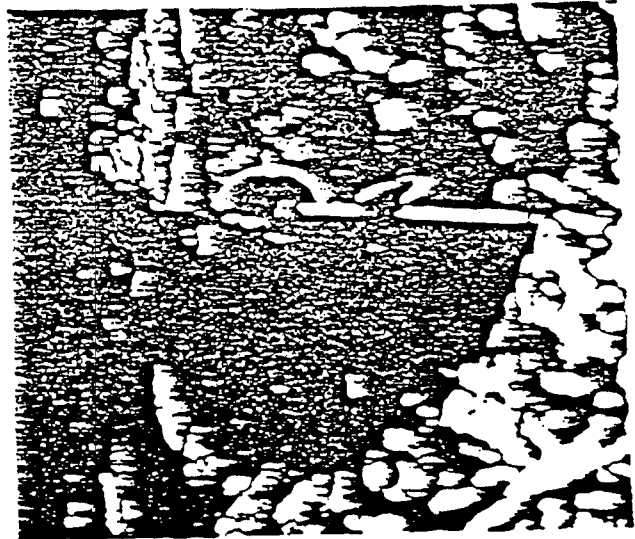


Figure 1. Female great gray owl nesting on wooden platform in northeastern Oregon, 1986.

METHODS

We established 3 study areas in the Blue and Wallowa Mountains in northeastern Oregon where mixed conifer forests were interspersed with openings. In study area A, we selected 26 sites and put 2 platforms (fig. 2) at each site, in separate trees but within 30 m of each other. One platform was 9 m and the other was 15 m above the ground.

In study area B, we selected 27 sites near clearcuts created 1 to 10 years ago. At each site, 1 platform was adjacent to the clearcut

¹Paper presented at the Northern Forest Owl Symposium, Winnipeg, Manitoba, February 3–7, 1987.

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⁴Biological Technician, Wallowa Valley Ranger Station, Joseph, OR.

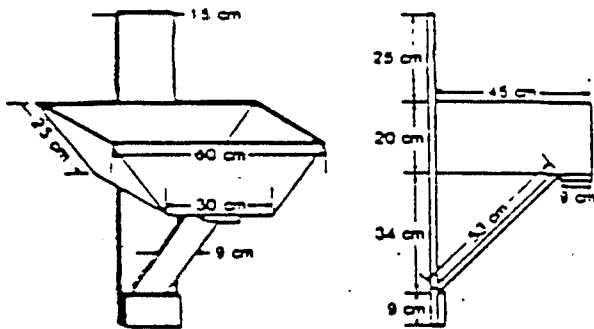


Figure 2.—Great gray owl nest platform constructed from 2-cm thick boards. Holes were drilled for 20-cm long ring-shank nails used with washers. Platforms were stained with 5 parts linseed oil and 1 part gray stain.

and 1 in a forest stand 100 to 200 m from the edge of the clearcut. Platforms were put 9 m above the ground.

In study area C, we selected 26 sites and put 1 wooden platform and 1 wooden nest box (fig. 3) at each site. Each platform was within 30 m of a box, and both were 9 m above the ground. An additional 28 wooden platforms were erected in study area C between 1975 and 1985 but were not part of this study. The platforms, 9 m above the ground in forested stands, were checked irregularly over the years.

Sites were at least 0.5 km apart—the minimum distance we found between active nests of great gray owls. Sites for platforms were selected based on historic use by great gray owls and the presence of mature trees.

Platforms were placed on the northeastern side of live trees ≥ 30 cm dbh (diameter at breast height) to reduce solar heat. Branches were removed along the bole from the ground to 1 m above the platform to allow access by the birds. An 8-cm layer of chips was placed in the bottom of platforms and boxes with twigs 1 cm in diameter placed on top. This chip layer permitted birds to dig depressions in which to lay eggs. Holes (1 cm in diameter) were drilled in the bottom of platforms and boxes for drainage.

The nest structures were put up in September 1984 in study areas A and B, and in summer 1982 in study area C. Each structure was checked annually in late April because great gray owls usually started incubating in late March. The female's tail was usually visible over the edge of the nest structure.

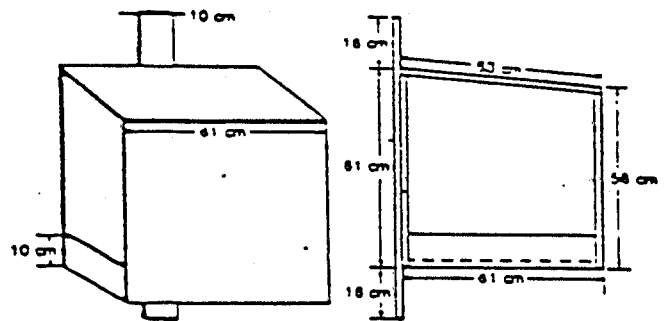


Figure 3.—Great gray owl nest box constructed of 1-cm thick plywood. The vertical support piece was a 2 x 10 cm board. Holes were drilled for 20-cm long ring-shank nails used with washers. Platforms were stained with 5 parts linseed oil and 1 part brown stain.

The cost of constructing and mounting the platforms was calculated using \$5 for materials/platform, \$7/hr for labor, and \$0.10/km for vehicular travel. Eight platforms could be erected in a 10-hr day. To construct and mount, each platform cost \$40.

RESULTS

From 1983 to 1986, 12 great gray owl pairs nested on these platforms (table 1). All 5 pairs that nested on platforms in study area A used the platforms 15 m above the ground. Two pairs nested in study area B, 1 on a platform adjacent to a clearcut and 1 on a platform 200 m from a clearcut. All 5 pairs that nested in study area C used wooden platforms. None used nest boxes. Ten of the 12 nesting pairs successfully fledged young. At least 5 of the additional 28 platforms in study area C were used by nesting great gray owls during 1980-1986.

Great horned owls (*Bubo virginianus*) nested on 1 platform in 1985 and on 5 platforms in 1986.

DISCUSSION

Great gray owls preferred the wooden platforms to the boxes and preferred the 15-m to the 9-m height, although the 9-m height was used when other suitable platforms were not available (as in study areas B and C). Platforms adjacent to and 200 m from a clearcut were used. Great gray owls sometimes used wooden platforms when natural nest sites were available nearby.

Table 1.—Number of artificial platforms used by great gray owls for nesting in northeastern Oregon, 1983-1986.

Study area	Year			
	1983	1984	1985	1986
A—Nest height (26 sites)				
9 m	NA ¹	NA	0	0
15 m	NA	NA	2	3
B—Proximity to clearcut (27 sites)				
Adjacent	NA	NA	0	1
100-200 m away	NA	NA	0	1
C—Nest structure type (27 sites)				
Platform	1	1	1	2
Box	0	0	0	0

¹ Platforms not put up until September 1984.

The number of pairs that fledged young was higher for those pairs that nested on wooden platforms (83%) than for pairs that nested on stick nests, mistletoe clumps, or broken-topped dead trees (70%) (unpublished data, E. L. Boll). This higher success was partly because the platforms are stable; eggs or nestlings sometimes fall through stick and mistletoe nests.

A potential problem exists with great horned owls using the platforms because great horned owls are a major predator of fledged great gray owls (Nero 1980). We did not anticipate this problem because the great horned owl nests we had observed before 1984 were in more concealed sites than the ones we offered. Because great horned owls nest 1 to 3 weeks earlier and are more aggressive, they could successfully compete with great gray owls for nest sites on platforms. The subsequent increase in great horned owls could take its toll on fledged great gray owls in the area.

Mikkola (1982, 1983) addressed a similar problem installing artificial nest structures for the tawny (*N. alumnus*) and ural owls (*N. uralensis*) in Europe. The tawny and ural owls prey on smaller owls, and in areas where artificial nest structures were used by tawny or ural owls, the smaller owls disappeared (Schonn 1980).

Thus, nest platforms can provide nest sites for great gray owls, but caution is needed because platforms could also increase populations of great horned owls, which could be detrimental to great gray owls. Given the rarity of great gray owls and the attraction the species has to segments of the public, the cost of providing artificial nest platforms is justified.

ACKNOWLEDGMENTS

R. A. Grove, J. S. Henderson, J. E. Hohmann, and M. E. Walker helped design, construct, mount, and check platforms. A. Franklin, V. I. Knight, E. Mikkola, R. W. Nero, Oregon Department of Fish and Wildlife, and personnel at the Wallowa Valley Ranger District provided additional assistance.

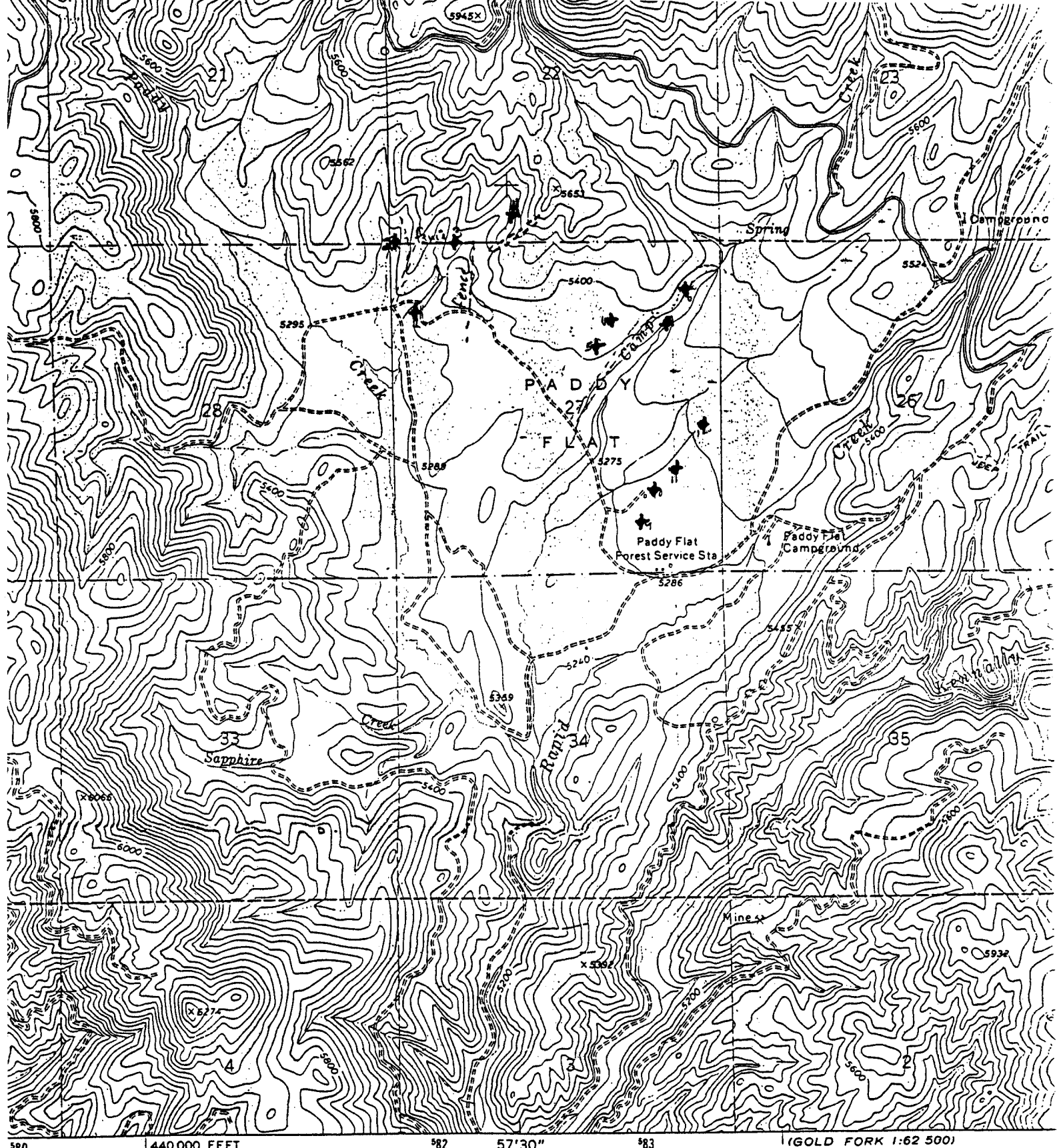
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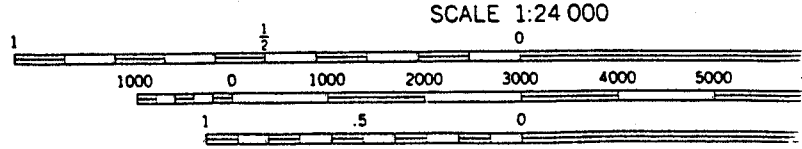
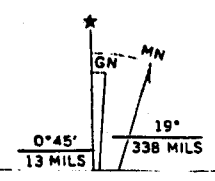
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APPENDIX F

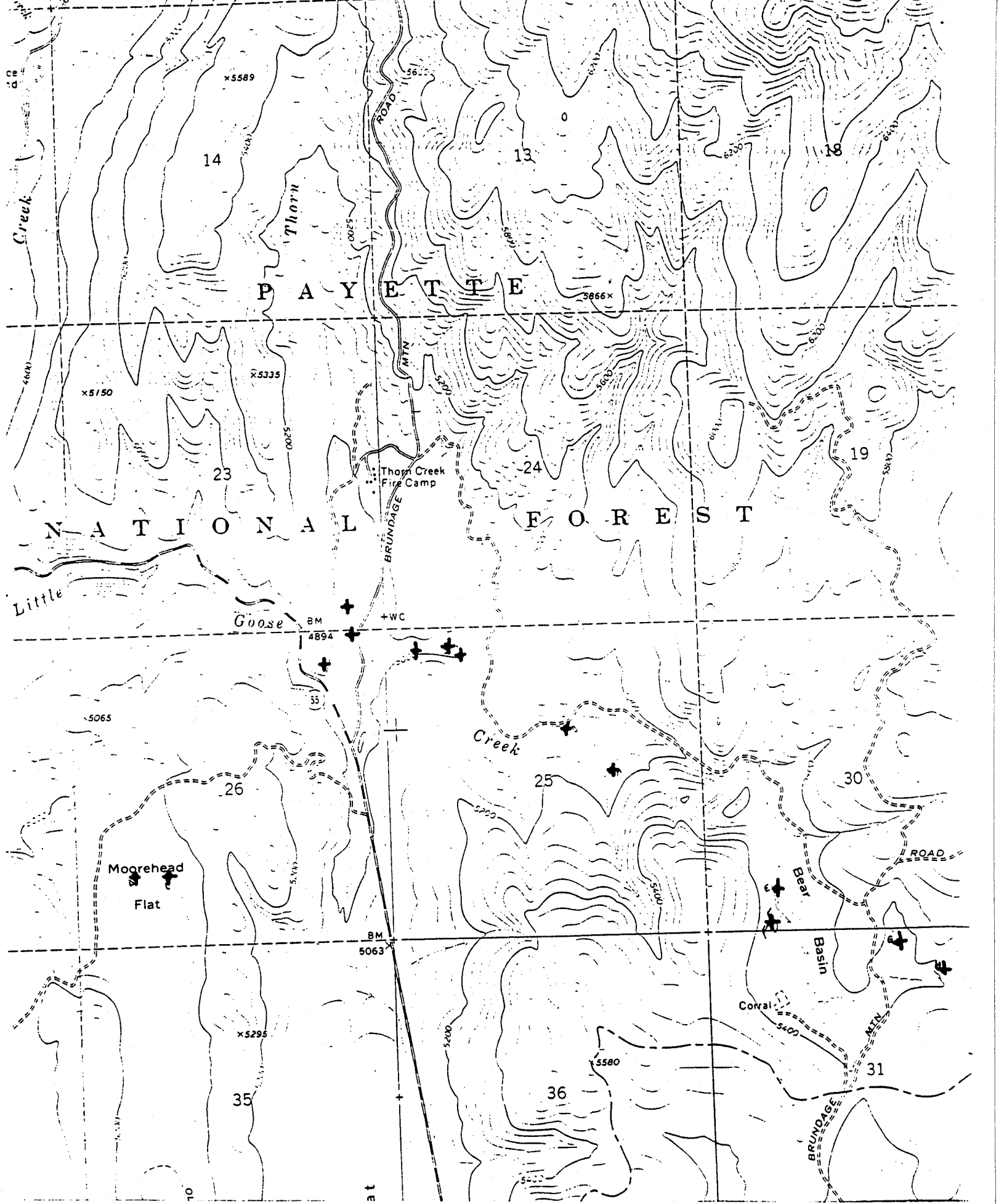
Locations of Nest Platforms Erected Fall 1989 by Raptor Research Center,
Boise State University.



Published by the Geological Survey
 U. S. Forest Service
 OAA, and USFS
 Metric methods from aerial
 and 1972. Field checked 1973
 Grid ticks: Idaho coordinate



CONTOUR INTERVAL 40 FEET



Submitted by:

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